

# Kenai Peninsula Borough

## All - Hazard Mitigation Plan



2014

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FEMA

July 23, 2014

Honorable Mike Navarre  
Mayor, Kenai Peninsula Borough  
144 N. Binkley  
Soldotna, Alaska 99669

Dear Mayor Navarre:

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) has approved the ***Kenai Peninsula Borough All-Hazard Mitigation Plan*** as a local plan as outlined in 44 CFR Part 201. With approval of this plan, the Kenai Peninsula Borough is now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through July 22, 2019.

The plan's approval provides eligibility to apply for hazard mitigation projects through your State. All requests for funding will be evaluated individually according to the specific eligibility and other requirements of the particular program under which the application is submitted. For example, a specific mitigation activity or project identified in the plan may not meet the eligibility requirements for FEMA funding, and even eligible mitigation activities are not automatically approved for FEMA funding under any of the aforementioned programs. Approved mitigation plans may be eligible for points under the National Flood Insurance Program's Community Rating System (CRS). Additional information regarding the CRS can be found at [www.fema.gov/business/nfip/crs.shtm](http://www.fema.gov/business/nfip/crs.shtm) or through your local floodplain manager.

Over the next five years, we encourage your community to follow the plan's schedule for its monitoring and updating, and to develop further mitigation actions. The plan must be reviewed, revised as appropriate, and resubmitted for approval within five years in order to continue project grant eligibility.

If you have questions regarding your plan's approval or FEMA's mitigation grant programs, please contact our State counterpart, Alaska Division of Homeland Security and Emergency Management, which coordinates and administers these efforts for local entities.

Sincerely,

  
for Mark Carey, Director  
Mitigation Division

cc: Ann Gravier, Alaska Division of Homeland Security and Emergency Management

Enclosure

BH:bb



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# EXECUTIVE SUMMARY

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Home to more than 56,000 people<sup>1</sup>, the Kenai Peninsula Borough (KPB) encompasses over 24,000 square miles. Due in part to the development of diverse key resources such as fishing, tourism, oil and gas development and timber, communities and facilities are distributed throughout the Borough. The large size and substantial regional variations in climate and geographic features contribute to the Borough's vulnerability to natural hazards such as flooding, earthquakes, tsunamis, winter storms and wildfire. As such, it is important to identify and implement strategies to lessen the effects of these and other potential hazards on infrastructure, critical facilities and communities. While it is not possible to prevent natural disasters from occurring, it is feasible to minimize their impacts to life and property with well-defined comprehensive hazard mitigation planning.

This document is a multi-jurisdictional All-Hazard Mitigation Plan developed by the Kenai Peninsula Borough (KPB) in coordination with the incorporated cities within the KPB, the Alaska Division of Homeland Security and Emergency Management (DHS&EM), and the Federal Emergency Management Agency (FEMA). This plan is designed to assist Borough residents, local and private organizations and other parties interested in hazard mitigation planning, as well as to coordinate planning efforts between government agencies. The plan is a living document, which will be updated on a five year cycle or reviewed within 90 days of a Presidential Disaster Declaration and updated as necessary within the following twelve months.

Eight hazard sections were completed: floods and erosion, wildfires, earthquakes, weather, tsunamis and seiches, volcanoes, avalanches and human-caused hazards.

The Introduction (Section 1.0) contains information about plan development and process, outreach, plan implementation and update processes, community profiles, critical facilities and risk assessments. Each of the eight hazard-specific sections (2.0 – 9.0) contain: 1) a history of hazard events in the KPB; 2) facilities and populations at risk; and 3) potential strategies and implementation ideas to reduce loss from future hazard events. Most sections also include a resource directory.

## **All-Hazard Mitigation Plan Goals, Objectives and Strategies**

Three overall goals were identified to mitigate the damaging effects of natural hazards that impact the Borough: ***protection, prevention and education.***

The following objectives were also identified to further define and direct the development of mitigation strategies. Strategies should:

- modify the impacts of hazard events by assisting individuals and communities to prepare for, respond to and recover from hazard events;
- reduce the susceptibility to damage and disruption by avoiding hazardous, uneconomic and unwise development in known hazard areas;

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<sup>1</sup> State of Alaska Department of Labor Vintage Place Estimates November 2013, the KPB estimated to be 56,756 by 2012. <http://labor.alaska.gov/research/pop/estimates/pub/popover.pdf>



## EXECUTIVE SUMMARY

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- protect the natural and beneficial values of floodplains, coastal areas and water resources; and
- reduce unnecessary economic losses and promote positive economic development by incorporating hazard assessment and mitigation into land use and development decisions.

For each hazard, strategies were further developed into implementation ideas and action items. The implementation ideas and action items are a detailed, though not exhaustive, list of suggestions to reduce threats to life and property from each hazard and ultimately accomplish the plan goals and objectives.

### Contributing Plans

Six incorporated cities are located within the KPB: Homer, Kachemak City, Kenai, Seldovia, Seward and Soldotna. Each jurisdiction participated in the 2004 Plan and the 2010 Plan Update. They have not participated in the 2013/2014 update, but will participate in the complete 2016 update. One additional service area, the Bear Creek/Seward Flood Service Area, created in 2003, was added to the 2010 plan. As an amendment to the 2010 KPB Plan, in January of 2014, the 2013 Seward/Bear Creek Flood Service Area Hazard Mitigation Plan replaced the existing 2010 Plan in Annex I of the 2013 KPB Plan.<sup>1</sup>

With the exception of Seldovia, each City has completed its own Hazard Mitigation Plan. They have identified their key hazards, examined their hazard history, identified critical facilities and structures at risk and identified potential mitigation measures to reduce damage to their communities from future events. The City plans are included as Annex Sections to this document and are also available from each City. Each city must update their plan before 2016. In addition, the Port Graham Flood Mitigation Plan<sup>2</sup> and the Interagency All Lands / All Hands [Wildfire] Action Plan are included as Annexes to this plan. The All Lands / All Hands Plan was developed by an interagency coordinating committee<sup>3</sup>, of which the KPB is a member. Recently renewed, the All Lands / All Hands Action Plan has been incorporated as the comprehensive Wildfire Hazard section of this plan.

The following table summarizes the implementation strategies developed for the eight completed natural hazard sections, including possible coordinating agencies, plan goals addressed, a timeline and the location of the strategy in the plan

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<sup>1</sup> KPB Assembly Ordinance 2014-03 was enacted on January 21, 2014.

<http://www.borough.kenai.ak.us/assembly-clerk/legislation/ordinances>

<sup>2</sup> Port Graham completed a Flood Mitigation Plan as a prerequisite for receiving Federal flood mitigation project funding. They do not currently intend to complete an all-hazard plan. Their Flood Mitigation Plan was included in this document to supplement the flood mitigation information for the Borough.

<sup>3</sup> Formally known as the "Kenai Forest, Wildland Fire and Fuels Management Coordinating Committee".



# EXECUTIVE SUMMARY

Mitigation Strategy	Potential Participants	Plan Goals			Timeline	Location in Plan
		Protection	Prevention	Education		
Floods and Erosion						
Complete a Borough-wide flood hazard risk assessment.	KPB, Incorporated Cities, Alaska Department of Transportation and Public Facilities (ADOT&PF), Permitting Agencies, Kachemak Bay Research Reserve (KBRR), Coastal Training Program Alaska (CTP Alaska).	X	X		In Progress	Section 2.0
Develop mechanisms to enhance floodplain permit compliance.	KPB Planning, Road Service Area, GIS, Assessing and Management Information Services Departments	X	X	X	In progress and ongoing	Section 2.0
Improve KPB floodplain mapping and identify other effective tools or methods to assist with flood hazard assessment.	KPB, U.S. Army Corps of Engineers (USACOE), FEMA, U.S. Geological Survey (USGS), Incorporated Cities, State of Alaska Dept. of Community and Economic Development (DCED), KBRR	X	X		In progress (as funding allows)	Section 2.0
Cooperate with the City of Seward and the Seward/Bear Creek Flood Service Area Board to identify, prioritize and implement cost effective strategies for controlling flood damage.	KPB, City of Seward, Seward/Bear Creek Flood Service Area Board, USACOE, USGS, FEMA, DCED	X	X		In progress (as funding allows)	Section 2.0
Review and appropriately revise floodplain development standards and requirements.	Affected KPB Departments, USACOE, FEMA, DCED, Incorporated Cities	X	X		In progress and ongoing	Section 2.0
Research and implement alternative floodplain management strategies.	KPB, Incorporated Cities, U.S. Army Corps of Engineers, FEMA, DCED, KBRR, CTP Alaska		X	X	Ongoing	Section 2.0
Evaluate Borough-maintained roads for floodplain hazards and potential flood reduction projects.	KPB, Private Non-Profit Organizations, FEMA, Alaska Division of Homeland Security and Emergency Management (DHS&EM)	X	X		Ongoing	Section 2.0
Protect and maintain beneficial floodplain natural values.	KPB, Private Non-Profit Organizations, Environmental Protection Agency (EPA), FEMA, Alaska Department of Environmental Conservation (ADEC), DNR/Parks, DNR/Office of Habitat Management and Permitting (OHMP), CTP Alaska	X		X	Ongoing	Section 2.0





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Promote positive economic development.	KPB, Private For-Profit and Non-Profit Organizations, EPA, FEMA, ADEC, DNR/Parks, DNR/OHMP		X	X	Ongoing	Section 2.0
Enhance existing emergency preparedness practices.	KPB, USGS, EPA, FEMA, USACOE, ADEC, DNR/Parks, DNR/OHMP	X		X	Both immediate and on-going	Section 2.0
Provide flood hazard and floodplain development education and information.	KPB, FEMA, Division of Community Advocacy, DCED, Cities of Homer and Seward			X	Ongoing	Section 2.0
Identify and develop partnership opportunities.	Local, State and Federal Agencies; Private For Profit and Non Profit Organizations and Other Interested Partners	X		X	Ongoing	Section 2.0
<b>Wildfires<sup>1</sup></b>						
<b>Goal 1: Improve Fire Prevention and Protection</b>						
Increase firefighting readiness and reduce the risks to homes and private property through prevention education.	USFS, State of Alaska Division of Forestry, USDI Fish and Wildlife Service, USDI BLM, USDI National Park Service, KPB, USDI Bureau of Indian Affairs, Cook Inlet Resources	X	X		Ongoing	Annex H
<b>Goal 2: Reduce Hazardous Fuels</b>						
Promote defensible space fuel reduction from “the back porch out” on 17,550 parcels of private land parcels containing structures.	USFS, State of Alaska Division of Forestry, USDI Fish and Wildlife Service, USDI BLM, USDI National Park Service, KPB, USDI Bureau of Indian Affairs, Cook Inlet Resources	X		X	Ongoing	Annex H
Conduct mechanical and prescribed fire fuel reduction in the Wildland Urban Interface (WUI) and outside the WUI on about 97,000 acres.	USFS, State of Alaska Division of Forestry, USDI Fish and Wildlife Service, USDI BLM, USDI National Park Service, KPB, USDI Bureau of Indian Affairs, Cook Inlet Resources	X	X		Ongoing (as funding allows)	Annex H
Conduct mechanical fuel reduction adjacent to 641 miles of power lines.	USFS, State of Alaska Division of Forestry, USDI Fish and Wildlife Service, USDI BLM, USDI National Park Service, KPB, USDI Bureau of Indian Affairs, Cook Inlet Resources	X	X		Ongoing (as funding allows)	Annex H
Conduct mechanical fuel reduction adjacent to 222 miles of highway/road evacuation routes.	USFS, State of Alaska Division of Forestry, USDI Fish and Wildlife Service, USDI BLM, USDI National Park Service, KPB, USDI Bureau of Indian Affairs, Cook Inlet Resources	X	X		Ongoing (as funding allows and situations require)	Annex H

<sup>1</sup> From the Interagency All Lands/All Hands Action Plan Executive Summary, July 2004 Final Draft, Warren Oja (Team Leader).



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<b>Goal 3: Restore Forest Health and Desired Ecosystems</b>						
Restore forest cover on about 199,000 acres.	USFS, State of Alaska Division of Forestry, USDI Fish and Wildlife Service, USDI BLM, USDI National Park Service, KPB, USDI Bureau of Indian Affairs, Cook Inlet Resources		X		5 years	Annex H
<b>Goal 4: Promote Community Assistance</b>						
Collaborative development of 20 Community Wildfire Protection Plans in the KPB as per direction from the Healthy Forests Restoration Act of 2003.	USFS, State of Alaska Division of Forestry, USDI Fish and Wildlife Service, USDI BLM, USDI National Park Service, KPB, USDI Bureau of Indian Affairs, Cook Inlet Resources	X		X	5 years	Annex H
<b>Earthquakes</b>						
Identify and prioritize studies and retrofit measures for KPB critical facilities and infrastructure that are seismically vulnerable.	KPB, Incorporated Cities, Local Emergency Planning Committee (LEPC), FEMA, DHS&EM	X	X		1-5 years (as funding allows)	Section 4.0
Encourage the reduction of non-structural and structural earthquake hazards in homes, businesses and government offices.	KPB Office of Emergency Management (OEM) and Capital Projects Departments, LEPC, Community Schools Program (KPB School District), DHS&EM, Local Realtors, Local Construction Companies, Incorporated Cities	X		X	Ongoing	Section 4.0
Encourage KPB residents to purchase earthquake hazard insurance.	KPB OEM and Capital Projects Departments, Local Insurance Companies	X		X	Ongoing	Section 4.0
Identify oil and gas producing facilities that pose a risk to the Kenai Peninsula Borough due to their proximity to active faults.	KPB OEM, Alaska Division of Geological & Geophysical Surveys (DNR), USGS, Local Oil and Gas Companies	X	X		Ongoing	Section 4.0
Perform earthquake hazard mapping for the Kenai Peninsula Borough and improve technical analysis of earthquake hazards.	KPB OEM and GIS Departments, Alaska Division of Geological & Geophysical Surveys (DNR), USGS, Incorporated Cities	X	X		Liquefaction-susceptibility maps (2-4 years)	Section 4.0
Augment KPB communications and facility support.	KPB OEM, Capital Projects and Road Service Area Departments, ADOT&PF, Local Utility Companies	X		X	Ongoing	Section 4.0
Conduct mock emergency exercises to identify response vulnerabilities.	KPB OEM, LEPC, Emergency Service Divisions, Incorporated Cities			X	Ongoing	Section 4.0
Minimize damage to residential structures in the unincorporated areas of the Kenai Peninsula Borough.	KPB; Incorporated Cities, Local Insurance Companies	X		X	Ongoing	Section 4.0



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<b>Weather</b>						
Increase public awareness of severe winter storm mitigation activities and emergency response.	National Weather Service (NWS), DHS&EM, KPB OEM, LEPC, Local Utility Companies, Incorporated Cities		X	X	Ongoing	Section 5.0
Enhance weather monitoring and warning systems.	NWS, DHS&EM, KPB OEM, LEPC, Incorporated Cities	X	X		Ongoing	Section 5.0
Expand local weather monitoring programs.	KPB OEM, NWS, DHS&EM, Police, Fire & Emergency Service Providers, Incorporated Cities	X	X		Ongoing	Section 5.0
Minimize damage to residential structures and private property in the Kenai Peninsula Borough.	NWS, KPB OEM, Capital Projects Division, LEPC, Community Schools Program (KPB School District), DHS&EM, FEMA, Local Realtors, Local Construction Companies, Incorporated Cities within the KPB	X	X	X	Ongoing	Section 5.0
<b>Tsunamis and Seiches</b>						
Increase public awareness of tsunami and seiche mitigation activities and emergency response.	Communities of Homer, Seward, Seldovia, Port Graham and Nanwalek, DHS&EM, KPB OEM, LEPC		X	X	Ongoing	Section 6.0
Conduct mock tsunami response exercises to identify response vulnerabilities.	KPB OEM, LEPC			X	Ongoing (2-4 years)	Section 6.0
Enhance tsunami-warning systems in KPB coastal communities.	NWS, DHS&EM, KPB OEM, LEPC, Incorporated Cities	X	X		Ongoing (2-4 years)	Section 6.0
Minimize tsunami damage to structures in the Kenai Peninsula Borough.	NWS, KPB OEM, Capital Projects Division, Planning, and Floodplain Programs, LEPC, Community Schools Program (KPB School District), DHS&EM, FEMA, Local Construction Companies, Incorporated Cities	X	X	X	Ongoing	Section 6.0
<b>Volcanoes</b>						
Conduct specific outreach to the Alaskan aviation community regarding the hazards posed by Alaskan and Russian volcanoes.	Alaska Volcano Observatory (AVO), DHS&EM, FAA, NWS, Alaska Air Carriers Association		X	X	Ongoing	Section 7.0
Ensure all Alaskan communities at risk from volcanic eruptions are aware of the hazard and what can be done to mitigate risk.	DHS&EM, AVO, USGS, DNR/DGGS, UAF/GI, ARC, DEC, Alaska Public Lands Information Center, KPB, Native corporations		X	X	Ongoing	
Ensure volcanic hazards are addressed in the ongoing revision of the State Emergency Response Plan.	DHS&EM, AVO, USGS, DNR/DGGS, UAF/GI	X			Ongoing	Section 7.0



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Expand real time seismic monitoring to high-priority western Aleutian volcanoes.	AVO, USFWS, DOD	X	X		Ongoing	Section 7.0
<b>Avalanches</b>						
Reduce number of structures in high-hazard areas	KPB	X	X		Ongoing	Section 8.0
Increase awareness among property owners of avalanche hazard zones	KPB	X	X	X	Ongoing	Section 8.0
Encourage communities to develop avalanche overlay districts	KPB, DHS&EM	X	X	X	Ongoing	Section 8.0
Improve avalanche warning	Chugach National Forest Avalanche Information Center, Alaska Avalanche Information Center, DOT&PF, NWS	X	X	X	Ongoing	Section 8.0
Promote avalanche education	Alaska Avalanche School, Alaska Avalanche Information Center, KPB, DNR State Parks, USFS (Chugach National Forest)		X	X	Ongoing	Section 8.0
Encourage artificial avalanche release and snow management	DPS, DHS&EM, DOT&PF, DNR	X	X		Ongoing	Section 8.0
<b>Human-Caused Hazards</b>						
Promote public awareness of potential hazards associated with handling of toxic and hazardous substances in the community.	DHS&EM, DEC, KPB		X	X	Ongoing	Section 9.0
Identify any potentially harmful substances used or disposed of within the Borough that are not adequately regulated by state and federal agencies to serve as the basis for future planning, monitoring or enforcement activity.	DHS&EM, DEC, KPB, DOT&PF		X		Ongoing	Section 9.0
Develop interim emergency response capabilities in the event of an accidental discharge of toxic or hazardous substances.	DHS&EM, DEC, KPB, DOT&PF	X	X		Ongoing	Section 9.0



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## 1.0 INTRODUCTION

### 1.1 Purpose and Scope of Plan

Natural events such as earthquakes, floods, wildfire and severe winter weather affect all segments of the communities they strike, including individuals, businesses and public services. While it is not possible to eliminate disasters, it is feasible to reduce their impacts. The development and implementation of a Hazard Mitigation Plan is intended to lessen or eliminate losses from natural hazards, as well as from human-caused hazards such as accidental chemical releases.

The Kenai Peninsula Borough (KPB or Borough) has produced this All-Hazard Mitigation Plan (Plan) as part of a statewide multi-jurisdictional document<sup>1</sup>. The Plan focuses on several key hazards that are of concern to the Borough: earthquakes, floods/coastal erosion, wildfires, weather, volcanic activity/ash fallout, avalanches, tsunamis and seiches and human-caused hazards such as levee failure and accidental chemical releases. KPB strategies have been coordinated with those from the incorporated cities within the Borough (see city annex sections) to develop mitigation strategies and actions appropriate for our region and to cooperatively adopt the Plan and Annexes.

#### ***1.1.1 All-Hazard Goals, Objectives and Strategies***

All hazard mitigation goals can be separated into three main categories: protection, prevention and education.

Protective measures can be structural or non-structural in nature. Examples of structural measures include seismic reinforcement of buildings and bridges and relocating or retrofitting hazard-prone structures. Non-structural mitigation measures include warning systems and emergency response programs.

Preventative measures are typically used to limit exposure to hazards, and may include the use of tools such as comprehensive land use plans, transportation plans, zoning, building codes or land subdivision regulations. Preventative actions might also include limiting development in known hazard areas, preserving open space, acquiring hazard-prone property and participating in outreach and education.

Outreach and education are important components of any hazard mitigation strategy. Community meetings, school activities, emergency preparedness outreach, ads in the media, workplace training, booths at fairs and home shows, brochures and video presentations all provide valuable outreach opportunities.

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<sup>1</sup> Alaska Division of Homeland Security and Emergency Management (ADHS&EM). 2002b. State Hazard Mitigation Plan. DMA 2000 Updated October 2013.



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Overall hazard mitigation planning objectives focus on saving lives and minimizing the direct and indirect costs of disaster damage<sup>1</sup>. Natural disasters affect all segments of the communities they strike, and their impacts, both measurable and immeasurable, produce long-lasting marks on the social and economic fabric of the community. The following objectives were identified to further define and assist with development of hazard mitigation strategies:

- modify impacts of hazard events by encouraging, assisting and training individuals and communities to prepare for, respond to and recover from hazard events;
- reduce susceptibility to damage and disruption by avoiding hazardous, uneconomic and unwise development in known hazard areas;
- protect natural and beneficial values of floodplains, coastal areas and water resources; and
- reduce unnecessary economic losses and promote positive economic development by incorporating hazard mitigation into land use and development decisions.

For each hazard, a number of mitigation strategies were developed and further expanded into implementation ideas and action items. The strategies and implementation ideas are a detailed, though not exhaustive, list of ideas and actions to reduce the threat to life and property from each hazard and ultimately accomplish the plan goals and objectives.

## **1.1.2 Overall Plan Development Guidelines**

The following basic guidelines supplied by the Alaska Division of Homeland Security and Emergency Management (ADHS&EM) and the Federal Emergency Management Agency (FEMA) Local Mitigation Plan Review Tool were used to guide the All-Hazard Mitigation Plan development (see Appendix H):

- implement a planning process that includes public involvement;
- conduct an assessment of hazard associated risks;
- determine the facilities or portions of infrastructure that are vulnerable to a disaster;
- develop mitigation strategies to reduce the loss of life and property damage;
- describe how the KPB will periodically evaluate, monitor, maintain and update the plan; and
- describe the process for implementing the plan after adoption by the KPB, and receiving ADHS&EM and FEMA approval.

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<sup>1</sup> These objectives are consistent with FEMA hazard mitigation planning process guidelines.





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## **1.1.3 Authority**

The purpose of this Plan is to fulfill FEMA local Hazard Mitigation Plan requirements under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Section 322 (a-d), Mitigation Planning, which were enacted by Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000) (Public Law 106-390). This initiative provides new and revitalized approaches to mitigation planning. Section 322 emphasizes the need for state, local and tribal entities to closely coordinate mitigation planning and implementation efforts. As part of the implementation process, FEMA prepared an Interim Final Rule that clearly establishes the mitigation planning criteria for states and local and tribal governments. This Rule was published in the Federal Register on February 26, 2002, at 44 CFR Part 201. The Final Rule was published in the Federal Register on September 16, 2009, at 44 CFR Parts 59, 61, 78, 79, 80, 201 and 206.

The DMA 2000, Section 322 (a-d), as implemented through 44 CFR Part 201.6, requires local governments, as a condition of receiving federal disaster mitigation funds, to complete and adopt a mitigation plan that identifies hazards, assesses risks and vulnerabilities and identifies mitigation actions. This Plan was completed to fulfill these requirements for the KPB, and in October of 2004 was passed by the KPB Assembly as Ordinance 2004-33 and enacted in the KPB Code as Chapter 2.80 Hazard Mitigation.

A review and revision process conducted in 2009 and 2010 included KPB and City adoptions of the Plan and Annexes as revised. The 2014 update includes an amendment to Annex I, replacing it with the newly adopted Seward/Bear Creek Flood Service Area (SBCFSA) Hazard Mitigation Plan. Annex J is the supporting GIS models for the SBCFSA flood study. The local jurisdictions did not participate in the 2014 plan update, but they will participate in the pending 2016 update.

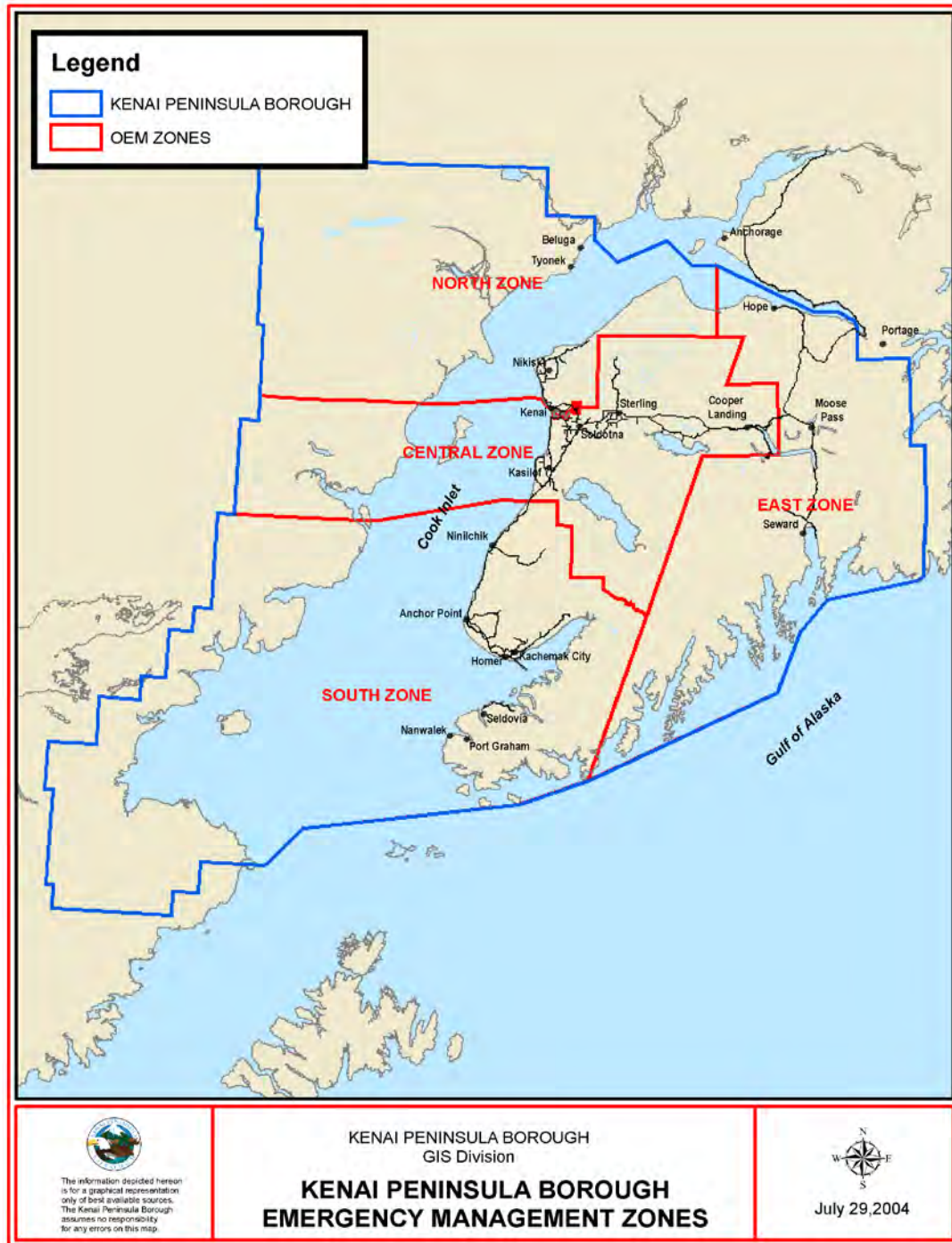
## **1.2 Plan Organization**

Information in the mitigation plan is organized into an introduction overview, hazard-specific sections, city plans located in annexes, and appendices. Because of the size and geographic diversity of the area, the Borough's emergency response zones were used as necessary to further organize and summarize information within each section (Figure 1-1).



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**Figure 1-1. Kenai Peninsula Borough Emergency Management Zones**





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## Section 1.0 – Introduction

The introduction describes the purpose and planning process used to develop and revise the mitigation plan for the KPB. It includes general information for Borough communities, including: population and demographics, geography, climate, culture, economy, transportation infrastructure, facilities and services, hazard risk assessment and critical and essential facilities.

## Section 2.0 – Flood and Coastal Erosion

The flood and coastal erosion hazard section contains information on historic floods, general types of flooding, zone-based risk assessments, a summary of existing programs, mitigation goals, strategies, current Floodplain Task Force recommendations and Assembly actions, implementation ideas and a resource directory.

## Section 3.0 – Wildfire

Concurrent with the All-Hazard Mitigation Plan, the Borough has completed an interagency wildfire protection plan (Interagency All Lands/All Hands Action Plan). This comprehensive, multi-year draft plan provides detailed assessments of Borough-wide wildfire risk, existing programs and resources, and mitigation goals and strategies. A summary of the AL/AH Plan is included as Section 3.0 and the full report is provided in Annex H. In conjunction with Section 3.0, this annex serves as our wildfire mitigation plan. Revision of the AL/AH Plan is not part of this revision process, though various Community Wildfire Protection Plans have been developed and completed through a public meeting process and are referenced as (Community Name) CWPP in this plan. The AL/AH Plan was recently extended. See Annex H. Updates to the All Lands / All Hands Plan are currently under development and review by the participating agencies.

## Section 4.0 – Earthquake

The earthquake hazard section contains information on earthquake history, types of earthquakes, Borough-wide risk assessment, existing programs, mitigation goals, strategies, implementation ideas and a resource directory.

## Section 5.0 – Weather

The weather hazard section contains information on historic KPB weather events, types of severe weather events that affect the Borough, a Borough-wide risk assessment, existing weather mitigation programs, mitigation goals, implementations ideas and a resource directory.



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A summary of Kenai River ice jam activity and ice dam failure occurrences between the 2004 Plan approval and 2013 is included in this section of the Plan update.

## Section 6.0 – Tsunamis & Seiches

The tsunami & seiche section describes tsunami & seiche events in the KPB, type of tsunamis, a Borough-wide risk assessment, an overview of coastal community All Hazard Alert Broadcast siren systems, existing mitigation programs, mitigation goals, implementation ideas and a resource directory. The City of Seward Annex includes a summary of that community's Tsunami Ready Program and Tsunami Surge Mapping information.

## Section 7.0 – Volcanoes

The volcano section is derived from the Alaska Division of Homeland Security and Emergency Management's Hazard Mitigation Plan (October 2013). Although the original Plan text was edited slightly to focus on volcanoes with the highest potential to impact KPB communities, most of the description is state rather than region-specific. A summary of actual KPB volcano activity and ash fallout occurrences between the 2004 Plan approval and February 2014 is included.

## Section 8.0 – Avalanches

The avalanche section is derived from the Alaska Division of Homeland Security and Emergency Management's Hazard Mitigation Plan (2013). Additional information and mitigation proposals specific to the Kenai Peninsula Borough have been added, including summaries of avalanche events affecting the power supply to the Seward and Hope/Sunrise areas and general avalanche activity affecting transportation.

## Section 9.0 – Human-Caused Hazards

Although much of the focus of hazard mitigation is on natural hazards such as earthquakes and floods, there are also hazards that are human-caused. For the purpose of this Plan, "human-caused hazards" are technological hazards. These are distinct from natural hazards primarily in that they originate from human activity. On the Kenai Peninsula, some of these human-created hazards include sudden flooding due to potential dam and water diversion breaches and hazards related to the storage, use and transportation of hazardous materials.

Sections 10.0 - 12.0 - Additional Hazard Sections that may be included as funding becomes available or during plan updates.

## Annexes



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Local hazard mitigation plans provided by the Cities of Homer, Kachemak, Kenai, Seward and Soldotna are included as Annex Sections A, B, C, E and F, respectively. Annex D is reserved for incorporation of the City of Seldovia's All-Hazard Mitigation Plan.

The Port Graham Flood Mitigation Plan, the All Lands/All Hands Action Plan, and the Seward Bear Creek Flood Service Area Flood Mitigation Plan were also included as Annexes G, H, and I respectively. The Port Graham Flood Mitigation Plan provides supplemental information to the flood mitigation section of the Borough's Plan.

The Interagency All Lands/All Hands Action Plan is a comprehensive, multi-year plan that provides a detailed assessment of wildfire issues facing the Borough and its residents. It addresses the wildfire situation within the Kenai Peninsula Borough facilities and populations at risk from fire, goals and action items to mitigate fire risk, and an implementation schedule for identified plan goals. In conjunction with Section 3.0 this annex serves as the KPB wildfire mitigation plan.

- Annex A: City of Homer All-Hazard Mitigation Plan
- Annex B: Kachemak City All-Hazard Mitigation Plan
- Annex C: City of Kenai All-Hazard Mitigation Plan
- Annex D: Placeholder: City of Seldovia All-Hazard Mitigation Plan
- Annex E: City of Seward All-Hazard Mitigation Plan
- Annex F: City of Soldotna All-Hazard Mitigation Plan
- Annex G: Port Graham Village Flood Mitigation Plan
- Annex H: All Lands/All Hands Action Plan
- Annex I: Seward Bear Creek Flood Service Area Flood Mitigation Plan
- Annex J: Seward Bear Creek Flood Service Area Flood Mitigation GIS

## Appendices

- Appendix A: Literature Cited
- Appendix B: Public Participation Process
- Appendix C: Glossary of Terms
- Appendix D: List of Acronyms
- Appendix E: KPB OEM Hazard Analysis Method
- Appendix F: Snow and Skilak Glacier-Dammed Lake Information
- Appendix G: Completed FEMA Plan Review Tool
- Appendix H: Plan Contributors
- Appendix I: Flood Forecasting and Stream Gauge Program
- Appendix J: Project Prioritization and Cost/Benefit Analysis Process
- Appendix K: Hazard Mitigation Plan Incorporations
- Appendix L: Revisions 2014 Update





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## 1.3 Methodology

To produce a plan that accurately reflects the needs and hazard risks of the KPB and its residents, information was solicited from a number of sources including the general public, local, state and federal agency personnel and professional researchers. This section details the approach used to produce a hazard mitigation plan and describes the process for implementing and updating the plan.

### 1.3.1 Planning Process

The plan revision was administered through the KPB Office of the Mayor, Office of Emergency Management (OEM) and KPB Planning Department (Planning). Per KPB Ordinance 2004-33, the steering committee, appointed by the Mayor and composed of department heads or their designees from the Mayor's Office, Planning, Donald E. Gilman River Center, OEM, Capitol Projects, Risk Management, Road Service Area, Solid Waste, Maintenance, Spruce Bark Beetle Mitigation Office and the Kenai Peninsula Borough School District, reviewed the Plan and submitted updates and suggested revisions. A list of contributors is located in Appendix H.

For the 2014 plan update, opportunity for public comment on revisions was provided at regular Planning Commission, Advisory Planning Commission, Road Service Area, Flood Service Area and Assembly meetings, as well as during other community meetings and outreach programs, including review by the Local Emergency Planning Committee. The Plan was posted on the KPB website for public comment. Each City is responsible for providing similar opportunities in its community as it reviews the City Plans as an annex to the KPB Plan.

The Alaska Division of Homeland Security and Emergency Management (ADHS&EM) provides initial review of the final draft and returns it with recommendations for additions and changes that may be necessary to satisfy FEMA plan requirements.

Throughout the project, information and draft plans are coordinated and shared with the ADHS&EM, KPB Departments and the Cities of Homer, Kachemak, Kenai, Seldovia, Seward and Soldotna.

### Tasks

The planning process consisted of the following steps:

- solicitation of public involvement;
- communication with agencies and organizations within the Borough;
- coordination with the incorporated Borough cities and the State of Alaska during the development of their associated hazard mitigation plans;
- assessment and inventory of Borough-wide hazards;
- review of existing mitigation activities;



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- formulation of mitigation strategies and implementation ideas; and
- establishment of a schedule for maintaining and updating the plan.

Following the completion of a substantially complete draft, the plan was:

- submitted to the State Hazard Mitigation Office and FEMA Region 10 for preliminary review and approval;
- also available on the KPB Hazard Mitigation Website;
- available for public review and hearings at the Planning Commission, RSA, Flood Service Area, Assembly and other community meetings; and
- reviewed for adoption by the KPB Planning Commission and Assembly (see Appendix M for adoption documentation).

## ***1.3.2 Public Participation and Outreach***

To ensure public awareness of the planning process and to provide ample opportunities to be involved in the 2010 update, the project was advertised in local newspapers and flyers, as well as on the OEM and KPB websites.

Community meeting presentations and public hearings were also held. For the 2014 update, the KPB solicited public participation for the Seward/Bear Creek Flood Service Area Flood Hazard Mitigation Plan, dated June 2013 and its adoption (Annexes I and J) of the KPB Hazard Mitigation Plan, enacted January 21, 2014 by the KPB Assembly as Ordinance 2014-03. Individual communities chose not to participate in the 2014 Borough update. Therefore the KPB will join the communities in completing a thorough plan update in 2016 for continuity. The KPB 2014 update draft resides on the KPB website asking for public comment. Full local, public and agency participation, implemented for the 2010 update, will also be the process for the 2016 update.

### **Website**

The 2014 HMP update public review draft is located at:

<http://www.borough.kenai.ak.us/planning-dept/planning-home>

KPB Office of Emergency Management posts the Hazard Mitigation Plan on its website: <http://www.borough.kenai.ak.us/emergency-mgmt/50-borough/emergency-management/506-ahmp> with additional contacts, agency links, and links to other important and useful hazard mitigation resources. Refer to Appendix B for a complete list of web links and documentation of public outreach.

For the 2016 update, the site will contain an on-line survey soliciting community input on hazards that have impacted residents in the past and possible strategies to help offset future damage. In addition, the site provided a means for transferring project information and materials between the cities, Borough and state agencies.





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## Online Hazard Survey for 2016 Update

The online survey will be posted allowing residents to provide input into revisions of the All-Hazard Mitigation Plan (see Appendix B5 for a copy of the survey questions). KPB received ten responses in 2010.

Survey respondents will rank their level of concern for 24 natural and technological hazards. Borough-wide, the 2010 top ten hazards of concern were: 1) earthquake; 2) wildfire; 3) extended power outage; 4) transportation infrastructure failure; 5) communication infrastructure failure; 6) energy emergency (fuel/resource shortage); 7) severe windstorm; 8) landslide; 9) winter storm and 10) hazardous material accident.

The 2016 survey will also ask people to indicate their level of support for nine types of hazard mitigation measures that could be used to reduce damage and loss of life. There will be five rating choices for each measure assigning values from 1 (“strongly disagree”) to 5 (“strongly agree”), with 3 being “no opinion”. On a Borough-wide basis, support in 2010 for the proposed mitigation measures varied from little support to strongly supportive (i.e. 1 to 5) and were ordered as follows: 1) encourage FireWise building practices; 2) clear spruce-bark beetle killed trees; 3) improve hazard education; 4) encourage the creation of firebreaks; 5) increase accuracy of floodplain mapping; 6) restrict construction in areas with a high risk for natural hazards; 7) make hazard mitigation part of every land use proposal; 8) increase accuracy of other hazard maps and 9) implement building code changes. A brief summary of the 2010 results Borough-wide and by zone is available in Appendix B5.

In 2010, ninety percent of survey respondents indicated they had an emergency plan in place, although most had not practiced the plan, and 50% were willing to spend their own money on structural measures to help hazard-proof their homes.

## Project Flyer for 2016 Update

Flyers will be mailed Borough-wide to agencies, libraries, advisory planning commissions and others to alert them to the revision process, direct them to the website and provide contact information for KPB and city plan coordinators. The flyers will also be posted at public locations around the peninsula and placed on the website for downloading and posting.

## Newspaper Public Notices for 2016 Update

Public notices for the project will be placed in the following peninsula newspapers: 1) The Peninsula Clarion (covering the Kenai Peninsula), 2) The Homer News (covering Homer, Anchor Point and surrounding communities) and 3) The Seward Phoenix Log (covering the communities of Seward, Moose Pass and Cooper Landing). The notices will contain contact information for the Borough as well as the participating local jurisdictions.



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## Agency Participation and Project Coordination for 2016 Update

The KPB has coordinated their efforts with the State of Alaska and the incorporated cities within the Borough to develop a multi-jurisdictional document in 2016.

## Meeting Presentations

Throughout the planning and drafting stages, meetings are held to facilitate communication, project coordination, and solicit information and feedback. Table 1-1 shows the outreach conducted for the 2010 and 2014 plan updates. The 2016 update will model the outreach conducted in 2010.

**Table 1-1.** Kenai Peninsula Borough All-Hazard Mitigation Plan Outreach, 2010 and 2014 update.

Date	Location	Outreach Activity
2-2-10	Anchor Point	Anchor Point Advisory Planning Commission meeting presentation and solicitation of feedback on plan introduction.
2-3-10	Cooper Landing	Cooper Landing Advisory Planning Commission meeting presentation and solicitation of feedback on plan introduction.
2-3-10	Moose Pass	Moose Pass Advisory Planning Commission meeting presentation and solicitation of feedback on plan introduction.
2-4-10	Hope	Hope/Sunrise Advisory Planning Commission meeting presentation and solicitation of feedback on plan introduction.
2-9-10	Soldotna	KPB Roads Service Area Board meeting presentation and solicitation of feedback on plan introduction.
2-16-10	Anchor Point	Anchor Point Advisory Planning Commission meeting presentation and solicitation feedback on plan introduction.
3-1-10	Seward	Seward-Bear Creek Flood Service Area Board Meeting presentation and solicitation of floods section feedback.
5-6-13	Seward	Seward-Bear Creek Flood Service Area Board meeting presentation and solicitation of feedback on the Seward/Bear Creek Flood Service Area Hazard Mitigation Plan review and update (Ordinance 2014-03).
3-2-10	Anchor Point	Anchor Point Advisory Planning Commission meeting presentation and solicitation of floods section feedback.
3-3-10	Cooper Landing	Cooper Landing Advisory Planning Commission meeting presentation and solicitation of floods section feedback.
3-3-10	Moose Pass	Moose Pass Advisory Planning Commission meeting presentation and solicitation of floods section feedback.
3-4-10	Hope	Hope/Sunrise Advisory Planning Commission meeting presentation and solicitation of floods section feedback.
3-8-10	Soldotna	KPB Planning Commission meeting presentation and



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		solicitation of floods section feedback.
3-9-10	Soldotna	KPB Roads Service Area Board meeting presentation and solicitation of floods section feedback.
4-5-10	Seward	Seward-Bear Creek Flood Service Area Board Meeting plan presentation and solicitation of feedback on remaining sections.
4-6-10	Anchor Point	Anchor Point Advisory Planning Commission presentation and solicitation of feedback on remaining sections.
4-7-10	Cooper Landing	Cooper Landing Advisory Planning Commission presentation and solicitation of feedback on remaining sections.
4-7-10	Moose Pass	Moose Pass Advisory Planning Commission presentation and solicitation of feedback on remaining sections.
4-8-10	Hope	Hope/Sunrise Advisory Planning Commission presentation and solicitation of feedback on remaining sections.
4-12-10	Soldotna	KPB Planning Commission meeting presentation and solicitation of feedback on remaining sections.
4-13-10	Soldotna	KPB Roads Service Area Board meeting presentation and solicitation of feedback on remaining sections.
5-4-10	Anchor Point	Anchor Point Advisory Planning Commission - review for adoption.
5-5-10	Cooper Landing	Cooper Landing Advisory Planning Commission - review for adoption.
5-5-10	Moose Pass	Moose Pass Advisory Planning Commission - review for adoption.
5-6-10	Hope	Hope/Sunrise Advisory Planning Commission - review for adoption.
6-8-10	Soldotna	KPB Assembly – Ordinance 2010-26 Introduction.
6-24-10	Soldotna	KPB Planning Commission – review Ordinance 2010-26; recommend adoption.
8-3-10	Soldotna	KPB Assembly – Ordinance 2010-26 Adoption.
5-6-13	Seward	Seward-Bear Creek Flood Service Area Board meeting presentation and solicitation of feedback on the Seward/Bear Creek Flood Service Area Hazard Mitigation Plan review and update (Ordinance 2014-03).
1-7-14	Soldotna	KPB Assembly – Ordinance 2014-03 Introduction
1-21-14	Soldotna	KPB Assembly – Ordinance 2014-03 Adoption
5-27-14	Soldotna	KPB Planning Commission – held a public meeting, reviewed the HMP, and recommended adoption of Ordinance 2014-03

## Plan Contacts

In addition to inviting agency participation via flyers and other notices (see Appendix B), direct input was sought with key individuals on hazard history, risk and mitigation strategies. Appendix H lists additional contributors to this plan.



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## Public Review and Adoption Process

The original Plan was adopted by Ordinance 2004-33 on October 26, 2004, with the revised Plan adopted by Ordinance 2010-26 on August 3, 2010. Following Seward/Bear Creek Flood Service Area Board review in May of 2013, Ordinance 2014-03, amended the plan by replacing Annex I with an updated Seward/Bear Creek Flood Service Area Hazard Mitigation Plan (SBC). The SBC plan was reviewed by the KPB Planning Commission on January 6, 2014 and adopted by the KPB Assembly on January 21, 2014. KPB Emergency Management updated their HMP the following spring. The KPB Planning Commission convened a public meeting and reviewed the HMP update on May 27, 2014 (Table 1-1).

Modifications were made to the plan through the aforementioned processes. Those modifications are summarized in Appendix L.

### **1.3.3 Contributing Reports**

A significant contribution of information for this plan was provided from the following reports:

FEMA. 1999. Flood Insurance Study: Kenai Peninsula Borough, Alaska. Community Number 020012.

FEMA. 1997. Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy.

FEMA. 2003. Developing the Mitigation Plan: Identifying mitigation actions and implementation strategies. FEMA 386-3.

FEMA. 2001. Understanding Your Risks: Identifying hazards and estimating losses. FEMA 386-2.

Kenai Peninsula Borough. 1992. Kenai Peninsula Borough Comprehensive Plan. Soldotna, Alaska.

Kenai Peninsula Borough. 1996. Flood Mitigation Plan. Soldotna, Alaska.

Kenai Peninsula Borough. 2002. Situations and Prospects of the Kenai Peninsula Borough. Soldotna, Alaska.

Kenai Peninsula Borough. 2003. 2003 Comprehensive Economic Development Strategy Update. Kenai Peninsula Economic Development District, Inc.

HDR Alaska, Inc. and Kittelson & Associates, Inc. 2003. Kenai Peninsula Borough Transportation Plan. Soldotna, Alaska.

Oja, Warren. 2004b. Interagency All Lands/All Hands Action Plan. September 5, 2004, Final Draft.



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Pinkston Enterprises. 2004. Kenai Peninsula Borough Emergency Response Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.

Alaska Division of Homeland Security and Emergency Management (ADHS&EM). State Hazard Mitigation Plan - DMA 2000 Updated October 2013. Available at <http://ready.alaska.gov/plans/mitigation.htm>.

Other citations are footnoted as they appear in the document and are also included in Appendix A (Literature Cited 2014).



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## **1.3.4 Implementation of Mitigation Strategies**

Mitigation strategies were developed to meet the overall Plan goals and objectives for each hazard. Implementation ideas and action items, potential participants and an estimate of the time required for implementation were identified for each mitigation strategy. With the exception of wildfire (see the Wildfire Mitigation Implementation section below), mitigation strategies and action items will be prioritized and implemented by an interdepartmental steering committee directed by the Mayor's office. As funding becomes available, mitigation projects will be prioritized based on the following criteria:

- a positive benefit/cost review to objectively determine which projects are cost-effective and provide maximum benefits;
- the extent to which a project can be coordinated with or integrated into scheduled maintenance, repair or capital improvement projects;
- the extent to which life, public infrastructure, property and historic areas will be protected;
- the extent to which repetitive losses will be reduced or eliminated;
- consistency with other plans, including the KPB Comprehensive Plan and Emergency Response Plan; and
- the extent to which areas with high natural mitigation value (e.g., floodplains, wetlands, riparian buffers) will be preserved or restored.

### **Coordination With Other Plans**

The All-Hazard Mitigation Plan will be implemented in concert with the Interagency All Lands/All Hands Action Plan (See Annex H), as well as the Kenai Peninsula Borough Comprehensive Plan and Emergency Response Plan. Specific goals, objectives and action items included in the All-Hazard Mitigation Plan are also included in the 2005 Kenai Peninsula Borough Comprehensive Plan. In the future, as plans are developed or updated, they will be cross-referenced and coordinated with the All-Hazard Mitigation Plan to highlight and foster implementation. See Appendix K for a list of locations in other plans where the All-Hazard Mitigation Plan has been integrated.

### **Wildfire Mitigation Implementation**

Mitigation strategies for wildfire were developed during a separate interagency planning process that overlapped development of the All-Hazard Mitigation Plan. Rather than duplicate the planning efforts, the All Lands/All Hands (AL/AH) Five-Year Action Plan was incorporated into the All-Hazard Mitigation Plan as Annex H. Wildfire mitigation strategies and action items were developed based on goals and guiding principles described in the AL/AH Action Plan. Additional



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implementation details are included in Section 3.0 and Appendix E of the AL/AH Action Plan (Annex H).

## FEMA Hazard Mitigation Grant Projects (HMGP)

In addition to the Borough's internal review, projects submitted for HMGP grant funding must meet FEMA's guidelines of being cost-effective, environmentally sound and technically feasible. HMGP projects compete on a statewide basis with projects submitted by other eligible local governments and are reviewed by the State Hazard Mitigation Advisory Committee (SHMAC) and prioritized according to whether they 1) protect life, 2) provide valuable planning or education or 3) serve other valuable mitigation purposes. A benefit/cost analysis (BCA) must be completed for each project. The BCA considers a number of factors, including total project costs, project life in years, effectiveness of the project, repair costs to pre-disaster conditions, annual maintenance costs, total past disaster costs, displacement costs and the frequency of disaster occurrence, annual maintenance costs, environmental impacts and permitting requirements. All projects submitted for FEMA funding must have a BCA ratio greater than 1.0 (see Appendix J for more detailed summaries of the State of Alaska's project review and prioritization process and FEMA's benefit/cost and cost-effectiveness analysis processes).

### ***1.3.5 Plan Update Process***

The All-Hazard Mitigation Plan will be evaluated annually and updated every five years. The Kenai Peninsula Borough Local Emergency Planning Committee (LEPC) will conduct a minimum of an annual review of the plan and associated issues. During the life cycle of the plan, the following issues will be evaluated by the LEPC during at least one of their regularly scheduled, quarterly meetings.

#### **Year 1:**

Summaries planned for the next two years will be presented by departments and organizations responsible for mitigation actions with the Kenai Peninsula Borough. Incorporated cities and other hazard mitigation service areas located in the Borough will be invited to participate.

Potential funding streams available will be discussed and recommendations of prioritized mitigation actions to be implemented within the next two fiscal years will be developed. These findings will be presented to the Borough and City Administrations and published on the All-Hazards Mitigation Plan web-site for public consumption.

#### **Year 2:**

The LEPC will review mitigation actions taken to date in fiscal year #1.





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The LEPC will review significant hazard events that occurred in the past year and determine if refining the Risk Assessment is warranted or if further study is required.

Public outreach efforts during the previous year will be reviewed and direction provided on future public outreach efforts.

## **Year 3:**

Summaries of actions taken during the previous two years and actions planned for the next two years will be presented by departments and organizations responsible for mitigation actions with the Kenai Peninsula Borough. Incorporated cities and other hazard mitigation service areas located in the Borough will be invited to participate.

Potential funding streams available will be discussed and recommendations of prioritized mitigation actions to be implemented within the next two fiscal years will be developed. These findings will be presented to the Borough and City Administrations and published on the All-Hazards Mitigation Plan web-site for public consumption.

## **Year 4:**

The LEPC will review mitigation actions taken to date in fiscal years # 2 and #3. The LEPC will review significant hazard events that occurred in the past year and determine if refining the Risk Assessment is warranted or if further study is required.

Public outreach efforts during the previous two years will be reviewed and direction provided on future public outreach efforts.

The KPB Office of Emergency Management will initiate the update planning process. Public outreach and plan writing tasks will be initiated a year before the end of the five year cycle. The Borough OEM Director will also coordinate revisions with the LEPC. The Planning Department will provide adequate public notice and opportunities for interested individuals and communities to participate in the plan update process.

The partial 2014 update was undertaken following amendment of the Kenai Peninsula Borough All-Hazard Mitigation Plan to replace Annex I with the June 2013 Seward/Bear Creek Flood Service Area Hazard Mitigation Plan. The partial update was a condition of the grant funding. The local communities chose to not participate in this update cycle; full community participation and updates in compliance with the update process will be completed for the 2016 plan update.



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## **Year 5:**

The LEPC will evaluate a draft All Hazards Mitigation Plan update and provide recommendations. The draft will then be reviewed and adopted using the normal Borough Planning Commission and Assembly public hearing processes which allow time for and encourage public review and input.

## **On-going:**

The plan will be reviewed within 90-days of any Presidential Disaster Declaration and updated as necessary within the following 12 months.

All-Hazard Mitigation Plan website

<http://www.borough.kenai.ak.us/emergency/hazmit/plan.htm>

## **Public involvement will be achieved by the following.**

1. The plan and updates will be provided on the Kenai Peninsula Borough Emergency Management web site open to the public.
2. The Local Emergency Planning Committee (LEPC) will be managing the annual review and updates of the plan. This committee has representatives of the public as standing members.
3. Notice of LEPC meetings where the All-Hazard Mitigation Plan will be discussed will be placed in the Borough's public meeting notice newspaper advertisement and on the KPB OEM website.
4. Minutes of the LEPC meetings will be placed on the KPB OEM website.
5. During year five, a series of public meetings with the Planning Commissions, Advisory Boards and Service Boards will be held to present the plan to the public. These meetings will be advertised in local newspapers.
6. The public also is afforded input during public hearings that are a part of the adoption process by the Kenai Peninsula Borough Assembly.

### ***1.3.6 All-Hazard Mitigation Action Status***

The status of the mitigation actions from the 2004 KPB All-Hazard Mitigation Plan are summarized in Appendix L. Some projects have been completed, some require continuous action and some have not been accomplished but remain goals of the 2010 All Hazard Mitigation Plan

## **1.4 Community Profile**

This section provides general background information for the entire KPB. Additional detailed description relating to a particular hazard, such as possible



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transportation disruption following an earthquake, may be found in the associated section.

## **1.4.1 Geography**

The Kenai Peninsula Borough lies directly south of Anchorage and is bordered by Prince William Sound on the east and the Gulf of Alaska to the south, and extends across Cook Inlet to the Chigmit Mountains of the Aleutian Range to the west (Figure 1-2). The Borough covers 24,737 total square miles<sup>1</sup>, of which 16,075 square miles is land<sup>2</sup>. Cook Inlet partitions the Borough into two landmasses. The peninsula proper, located on the east side of the Inlet, contains 99 percent of the Borough population as well as the vast majority of KPB development. The village of Tyonek, with 171 residents<sup>3</sup>, is the largest settlement on the west side of Cook Inlet.

The Borough owns less than 1% of land within its boundaries. Land division is approximately 66% federal, 10% Native, 2.5% private, 20% state, and the remaining land is municipal and Native allotment (Figure 1-3). Major holdings of public land within the Borough include portions of the Chugach National Forest, Kenai National Wildlife Refuge, Kenai Fjords National Park and portions of Lake Clark and Katmai National Parks. There are six incorporated cities within the Borough: Homer, Kachemak, Kenai, Seldovia, Seward and Soldotna.

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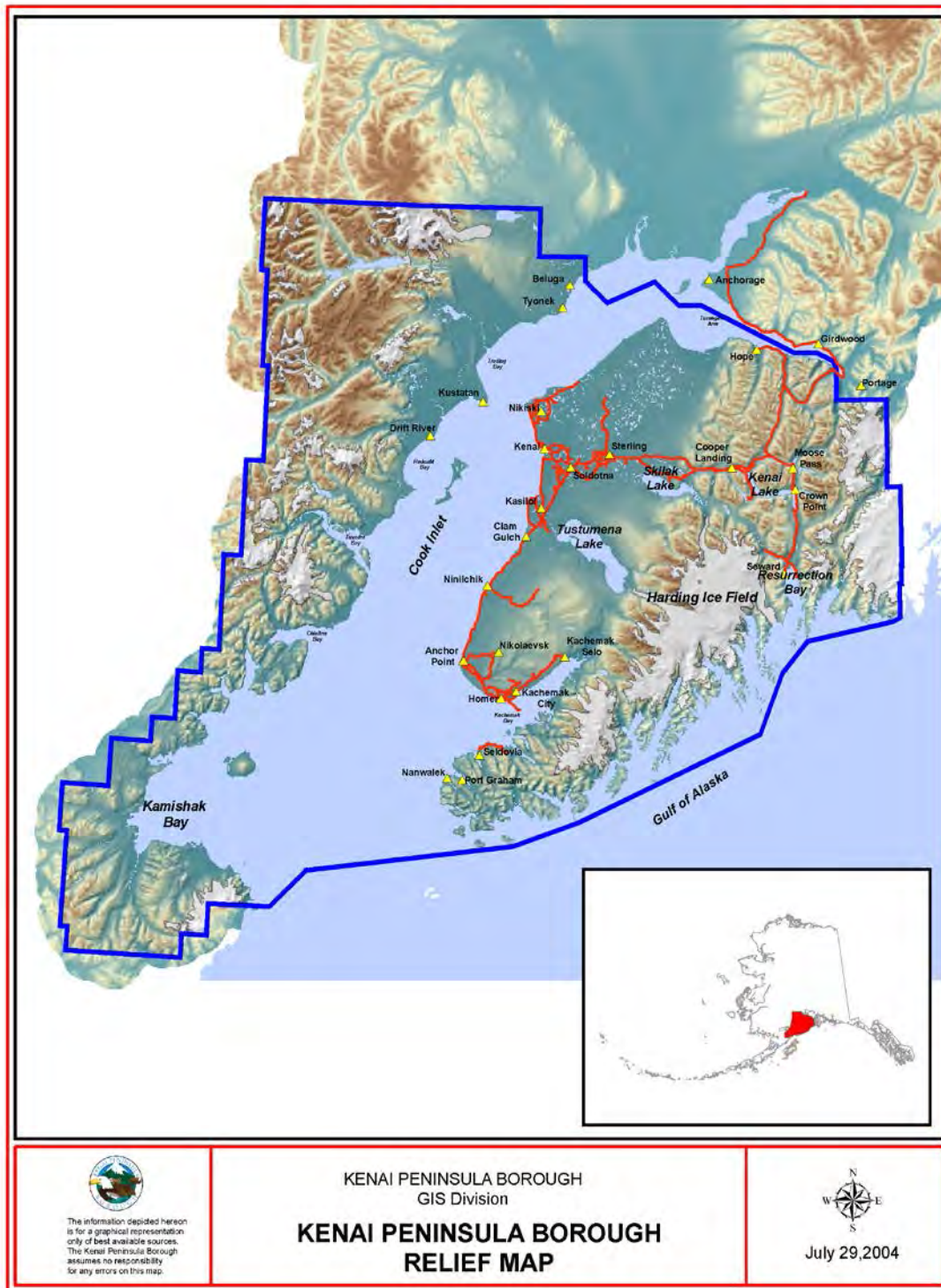
<sup>1</sup> Kenai Peninsula Borough 2002 Situations and Prospects.

<sup>2</sup> U.S. Census Bureau, Alaska: 2010 Population and Housing Unit Counts Issued June 2012 CPH-2-3.

<sup>3</sup> U.S. Census Bureau, Alaska: 2010 Population and Housing Unit Counts Issued June 2012 CPH-2-3.



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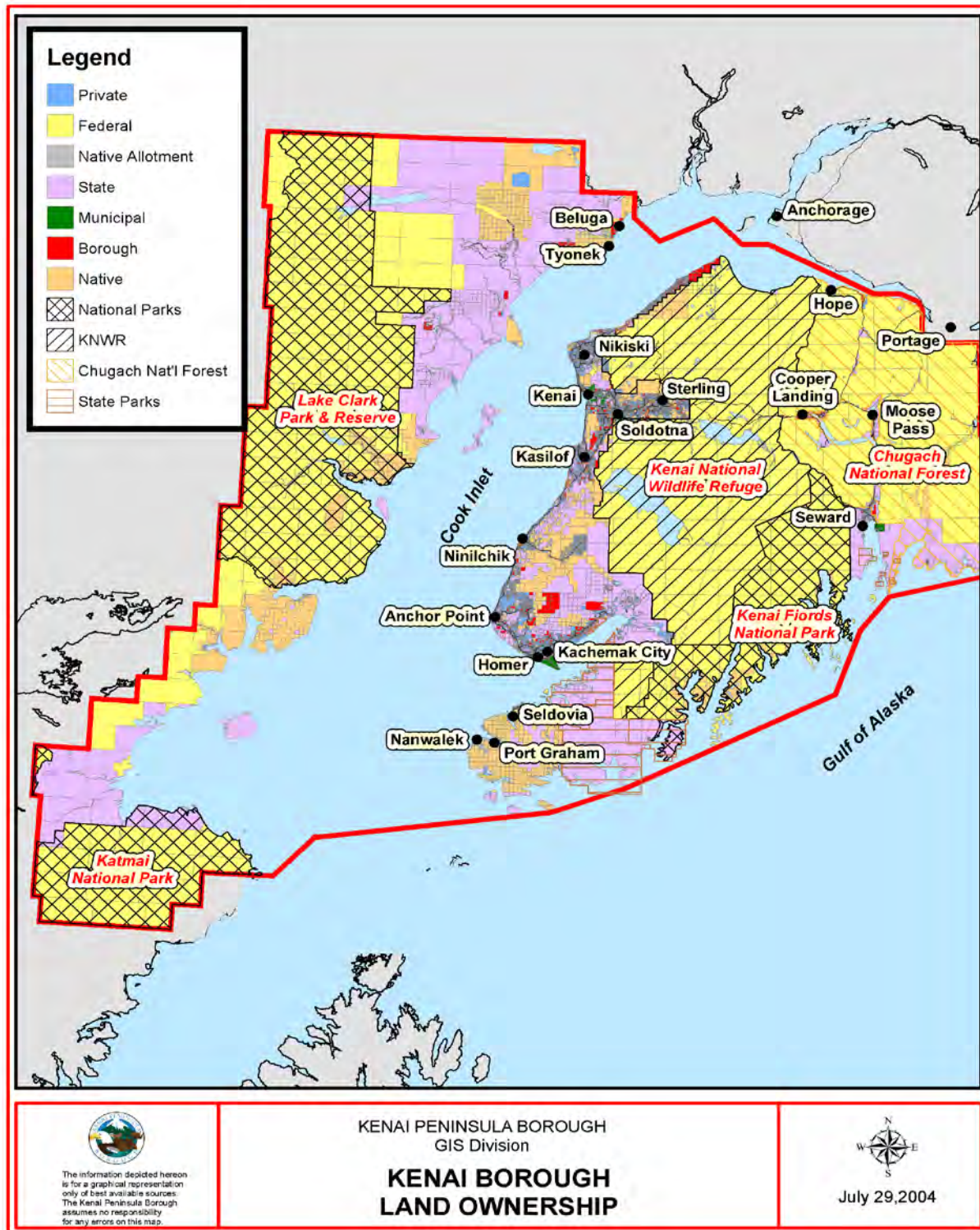


**Figure 1-2.** Kenai Peninsula Borough Boundaries.





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**Figure 1-3.** Kenai Peninsula Borough Land Ownership.



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## **1.4.2 Climate**

Although strong maritime influences from Cook Inlet, Prince William Sound and the Gulf of Alaska keep temperatures relatively mild in contrast with interior parts of the state, there is much local climate variability within the Borough due to weather influencing features such as the Harding Icefield, Chugach Mountains, Cook Inlet, and Skilak and Tustumena Lakes. To best describe these differences, climate information has been partitioned into emergency management zones and further separated by community (Table 1-2).

### **North Zone**

The transitional North Zone is influenced by both maritime and continental climatic factors and therefore exhibits some characteristics of both zones: the dry, cold continental climate of interior Alaska and the relatively wet mild maritime climate of the Gulf of Alaska coastal areas. Annual rainfall is approximately 16-19 inches but has high seasonal variation. The total average winter snowfall is 55-65 inches. The Kenai Lowlands fall within the precipitation shadow of the Kenai Mountains. Temperatures range from an average low of 11° F in the winter to an average high of 53° F in the summer, with a record high of 93°F and a record low of -50° F.

### **Central Zone**

The Kenai Mountains that run north-south on the peninsula divide the Central Zone into two distinct climatic regions. The Kenai lowlands to the west fall within the precipitation shadow of the Kenai Mountains and have a lower mean annual precipitation than the adjacent mountains to the east.

### **East Zone**

Heavy precipitation, cool summers and mild winters characterize the primarily maritime climate of the East Zone. Major storm and prevailing winds from the southeast generated in the Gulf of Alaska influence this region. The outer coast receives about 50 inches of precipitation a year, with some areas of the Kenai Mountains receiving annual precipitation amounts exceeding 100 inches (falling mostly as snow). Much of this area is heavily glaciated (Harding Ice Field) and receives approximately 400 inches of snow a year.

### **South Zone**

Climate within the South Zone is of two types. The southern end of the zone (including Homer) experiences a maritime climate characterized by heavy precipitation, cool summers and mild winters with major storm tracks and prevailing winds generated by the Gulf of Alaska. The rest of the South Zone experiences a transitional climate characterized by more extreme air temperatures with periods of extreme cold and/or high winds.



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**Table 1-2. Climate Data for Select Communities within the Kenai Peninsula Borough by Zone<sup>1</sup>.**

<b>North Zone</b>	
Kenai	Winter temperatures range from 4 to 22 F; summer temperatures typically vary from 46 to 65 F. Average annual precipitation is 19 inches. Average total annual snowfall is 61 inches.
Nikiski	Winter temperatures range from 5 to 27 F; summer temperatures vary from 44 to 65 F. Average annual precipitation is 18 inches. Average total annual snowfall is 18 inches.
Tyonek	Winter temperatures typically range 4 to 22 F; summer temperatures average from 46 to 65 F. Temperature extremes have been recorded from -27 to 91 F. Average annual precipitation is 23 inches.
<b>Central Zone</b>	
Cooper Landing	January temperatures range from 4 to 22 F; July temperatures vary from 46 to 65 F. Average annual precipitation is 20 inches.
Soldotna	Winter temperatures range from 6 to 24 F; summer temperatures range from 45 to 66 F. Average annual precipitation is 17.4 inches.
Sterling	Winter temperatures range from 4 to 22 F; Summer temperatures vary from 46 to 65 F. Average annual precipitation is 20 inches.
<b>East Zone</b>	
Seward	Winter temperatures average from 17 to 38 F; summer temperatures average 49 to 63 F. Annual precipitation includes 66 inches of rain and 83 inches of snowfall.
Moose Pass	Winter temperatures range from 14 to 27 F; summer temperatures vary from 45 to 65 F. Average annual precipitation is 28 inches. Average annual total snowfall is 83 inches.
Hope	Winter temperatures range from 5 to 30 F; summer temperatures vary from 45 to 65 F. Average annual precipitation is 22 inches. Average annual total snowfall is 39.5 inches.
<b>South Zone</b>	
Anchor Point	January temperatures range from 4 to 22 F; July temperatures vary from 46 to 65 F. Average annual precipitation is 20 inches.
Homer	During the winter, temperatures range from 16 to 33 F; summer temperatures vary from 45 to 65 F. Average annual precipitation is 25 inches. Average annual snowfall varies from 55 inches at the Homer Airport to 111 inches at higher elevations.
Nanwalek	Winter temperatures range from 14 to 27 F; summer temperatures vary from 45 to 60 F. Average annual precipitation is 24 inches.
Ninilchik	Winter temperatures range from 14 to 27 F; summer temperatures vary from 45 to 65 F. Average annual precipitation is 24 inches.
Port Graham	Winter temperatures range from 14 to 27 F; summer temperatures vary from 45 to 65 F. Average annual precipitation is 24 inches.
Seldovia	Winter temperatures in Seldovia average from 12 to 21 F; summer temperatures range from 48 to 65 F. Annual precipitation is 34.5 inches.

## 1.4.3 Culture

The Kenai Peninsula Borough has a rich and diverse cultural history that has been shaped by the abundant populations of fish, game and plant resources of the area. The Suqpiak Alutiiq and Dena'ina Athabaskan people are among the

<sup>1</sup> Pinkston Enterprises. 2004. Kenai Peninsula Borough Emergency Operations Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.



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first inhabitants of the area. Archaeological evidence of the First Peoples of the region, such as barabaras (semi-subterranean dwellings), is still found in many areas throughout the Borough.

Russian fur traders established settlements on the Kenai Peninsula in the late 1700s and harvested large quantities of sea otter pelts and other fur-bearing animals. As the demand for these pelts decreased, a new wave of settlers came to the peninsula to pursue fishing and mining. The healthy populations of fish and wildlife continue to attract people to the peninsula each year.

Today the Borough's diverse culture is reflected in the many community, non-profit and governmental organizations. There are over 17 Native for-profit and non-profit organizations in the KPB that help promote the cultural and economic interests of their members. There are also many sport fishing, outdoor adventure, hunting, environmental, arts and tourism groups that support the diverse interests of Borough residents.

## **1.4.4 Economy**

Commercial and sport fishing, oil and gas production and downstream industries, timber harvest, and recreation and tourism provide a diverse economic base for the KPB as well as one of the strongest regional economies in the state<sup>1</sup>.

Commercial fisheries in the area began in the 1880s and today include five species of salmon, halibut, sole, cod, herring, pollock, crab, shrimp, clams and scallops. Potential new markets for farmed oysters, mussels, seaweed, sea urchin and sea anemone are presenting themselves<sup>2</sup>.

The oil and gas industry, composed of exploration, extraction, storage, processing/manufacturing and transportation, accounts for approximately ten percent of private wage and salary employment on the Kenai Peninsula<sup>3</sup>. The North Zone contains a majority of the Borough's oil and gas development, including 14 offshore platforms and a number of pipelines and processing facilities centered in the North Kenai-Nikiski area (Figure 1-4). Processing facilities include the Tesoro Alaska fuel refinery, the Agrium ammonia and urea fertilizer plant (not currently in operation) and the ConocoPhillips Alaska petroleum liquid natural gas plant. Employment in the industry has declined in recent years with the closing of some manufacturing facilities. The importance of Cook Inlet natural gas is high, with Southcentral Alaska deriving almost all of its power generation and home and business heat from this region<sup>4</sup>.

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<sup>1</sup> Kenai Peninsula Borough (KPB). 1992. Kenai Peninsula Borough Comprehensive Plan. Soldotna, Alaska.

<sup>2</sup> Kenai Peninsula Borough (KPB). 2004b. Our Economy [[www.borough.kenai.ak.us/geo01.htm](http://www.borough.kenai.ak.us/geo01.htm)].

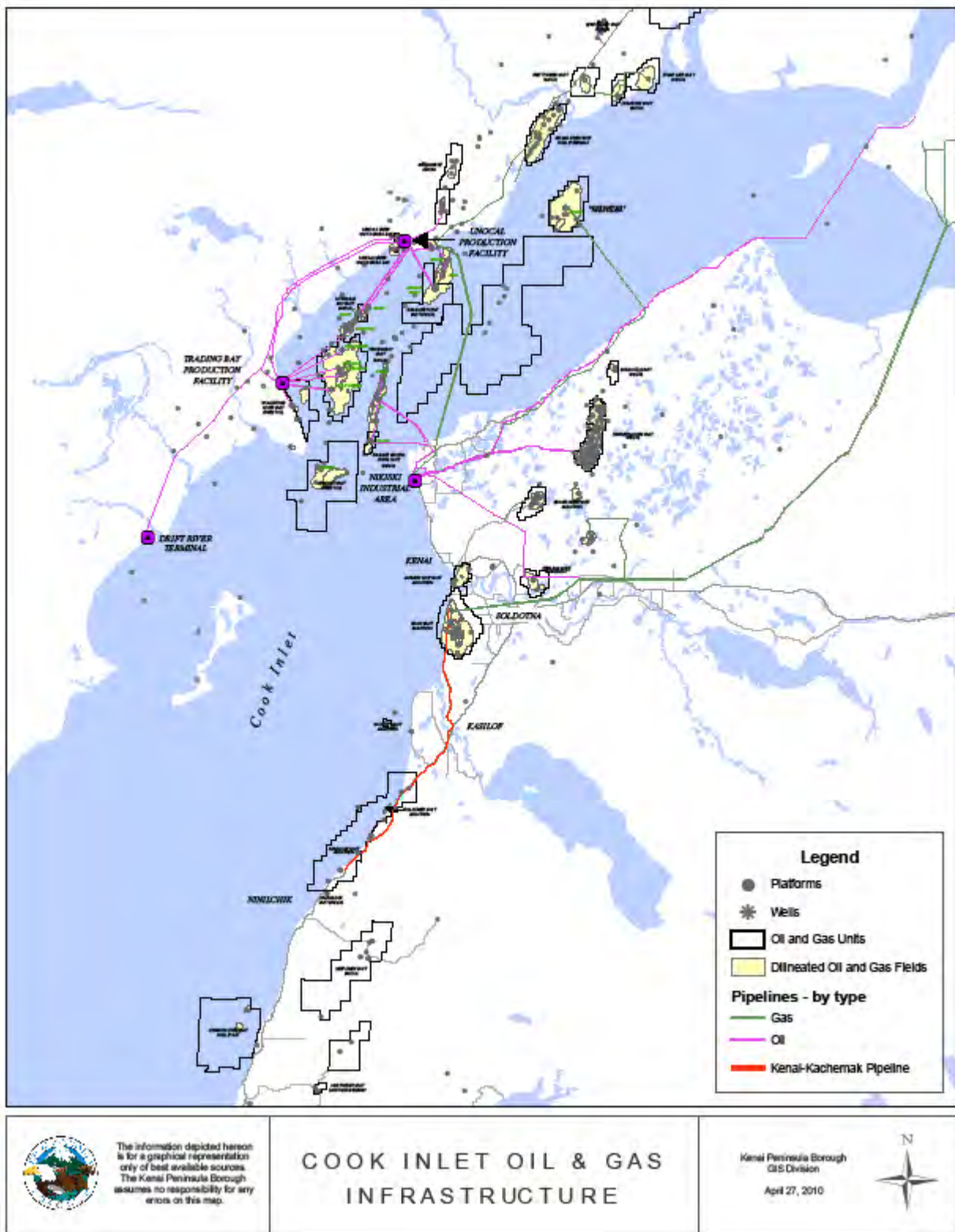
<sup>3</sup> Pers. Comm., Alyssa Shanks, State of Alaska, Department of Labor and Workforce Development, April 7, 2010

<sup>4</sup> Kenai Peninsula Borough (KPB). 2002. Situations and Prospects of the Kenai Peninsula Borough. Kenai Peninsula Borough, Community & Economic Development Division [[www.borough.kenai.ak.us](http://www.borough.kenai.ak.us)].





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**Figure 1-4.** Cook Inlet Oil and Gas Infrastructure.



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A network of petroleum and natural gas pipelines serves the Cook Inlet region within the North Zone. The Cook Inlet pipeline transports crude oil from production facilities at Granite Point to the Drift River Terminal on the west side of Cook Inlet. Oil is stored at the Drift River production facility and shipped by tankers to the Lower 48 states. Storage of oil in the Drift River Terminal storage tanks was discontinued during the 2009 eruption of Mt. Redoubt volcano and has not resumed as of April 2010. The Kenai Pipeline carries crude oil. One branch of this pipeline carries Swanson River crude oil to the Nikiski Marine terminal, and the other carries oil from the west side production facilities to Nikiski. The Tesoro Pipeline carries refined petroleum products, including gasoline, jet fuel, diesel fuel and fuel oil from the Nikiski refinery to the Port of Anchorage. The pipeline is approximately 70 miles long. Two natural gas pipelines, owned by Enstar, bring gas to the Anchorage area for domestic, industrial and commercial use. One pipeline connects Anchorage and the Kenai gas fields, and the other connects the Anchorage/Mat-Su region with the Beluga gas fields on the west side of the Cook Inlet. Both are approximately 95 miles long, and are buried along the entire route. Marathon and Union Oil own two natural gas pipelines. These pipelines, constructed in 1982, bring gas from Trading Bay and from the Kenai gas fields to the LNG plant in Nikiski. Beluga Pipe Line Company owns a natural gas pipeline that transports gas from the west side of Cook Inlet to the east side. The Kenai Kachemak pipeline (or KKPL), jointly owned by Marathon and Chevron, is the most recent and most southerly pipeline on the Kenai Peninsula. KKPL started shipping natural gas north from the Ninilchik field in 2003. A year later KKPL was extended inland 15 miles to the southeast to connect with Unocal's new Happy Valley gas field (Chevron later acquired Unocal).

Tourism is the fastest-growing industry in the Borough, and with railway and cruise ship access as well as the development of destination resorts, it is increasing. Tourist resources continue to develop to meet the demands of the growing interests and activities of visitors to the Borough. Subsistence and sport fishing have also gained momentum in recent years, and the KPB is a popular destination when the salmon and halibut seasons are open.

The timber industry has been severely affected by the spruce bark beetle infestation. The KPB responded with the development of the Spruce Bark Beetle Task Force in 1998 to develop an action plan to manage the impacts of the infestation on peninsula residents and to rehabilitate infested areas<sup>1</sup>. "While the abundance of available timber should have stimulated the economy, wood pulp and wood chips became the main marketable products from the diminished quality of beetle-killed spruce. In recent years, demand and prices for wood chips dropped to the extent that a major wood processor left the industry, leaving approximately 250 employees without work"<sup>2</sup>.

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<sup>1</sup> Spruce Bark Beetle Task Force (SSBTF). 2004. Program Narrative. Kenai Peninsula Borough, Planning Department.  
<sup>2</sup> (Page 185) Kenai Peninsula Borough (KPB). 2002. Situations and Prospects of the Kenai Peninsula Borough. Kenai Peninsula Borough, Community & Economic Development Division [[www.borough.kenai.ak.us](http://www.borough.kenai.ak.us)].



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## **1.4.5 Transportation**

KPB transportation facilities are constructed and maintained by a number of different entities including: the Alaska Department of Transportation and Public Facilities (ADOT&PF), the Alaska Railroad Corporation (ARRC), the Kenai Peninsula Borough, the incorporated Cities of Homer, Kenai, Seldovia, Seward, and Soldotna and Native village corporations, as well as the private sector<sup>1</sup>.

There are approximately 650 miles of state-maintained roads in the KPB and an additional 632 miles of Borough-maintained roads. The Seward, Sterling and Kenai Spur Highways provide the primary highway access. A number of secondary state and local roads provide access to communities and subdivisions along the highway corridor. Access to the west side of Cook Inlet and the southern tip of the Kenai Peninsula is limited to air and water. With the exception of roads that serve the communities of Tyonek and Beluga, most roads on the western side of Cook Inlet were constructed to support oil and gas facilities. A winter ice road provides access to the Beluga area from Point McKenzie.

Bridges are critical road infrastructure and are vulnerable to damage from natural events such as flooding and earthquake. There are approximately 60 significant bridges on the Borough's public road system, the majority of which are state-owned and maintained. The Borough owns and maintains 18 bridges (Figure 1-5, Table in Appendix J)<sup>2</sup>. By federal regulation, the ADOT&PF is required to physically inspect bridges that carry public traffic once every two years. The physical inspection includes measuring the depth across the streams and evaluating scour at the piers, abutments and banks. ADOT&PF also has a seismic retrofit prioritization program, which is based on a computer analysis of 1) seismic vulnerability (e.g. how earthquake prone is the region); 2) a review of each bridge's structural plans; and 3) the importance of the roadway in relation to the communities served, bridge length, available detours and proximity of other important infrastructure, such as pipelines<sup>3</sup>.

Three public ports, four small boat harbors, 14 public airports, and numerous private facilities provide air and water access to communities and developed areas within the Borough (Figures 1-6 and 1-7)<sup>4</sup>. In addition, the Alaska Marine Highway System provides ferry service between Homer, Seldovia, Kodiak, Prince William Sound and the Alaska Peninsula nine months of the year. Ferry service is important for transporting residents, visitors and freight, particularly for Seldovia where road access is not available. The Alaska Railroad, operated by the State of Alaska, provides passenger and freight rail service between Anchorage and Seward.

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<sup>1</sup> HDR Alaska, Inc. 2003. Kenai Peninsula Borough Transportation Plan Update.

<sup>2</sup> HDR Alaska, Inc. 2003. Kenai Peninsula Borough Transportation Plan Update.

<sup>3</sup> Pers. Comm. Richard Pratt, P.E, Chief Bridge Engineer, ADOT&PF. 7/2/04.

<sup>4</sup> HDR Alaska, Inc. 2003. Kenai Peninsula Borough Transportation Plan Update.





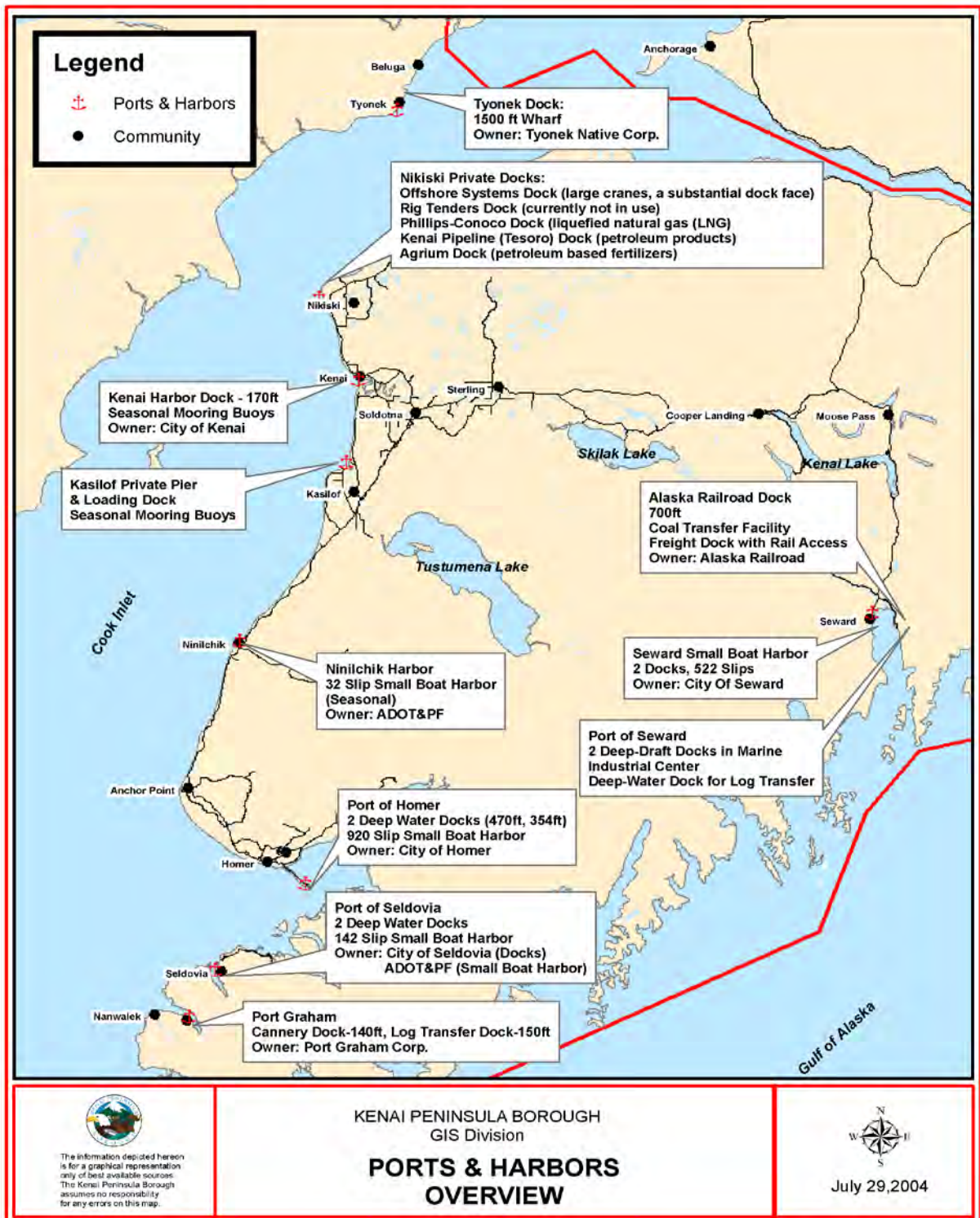
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**Figure 1-5.** State, Borough and City Bridges.



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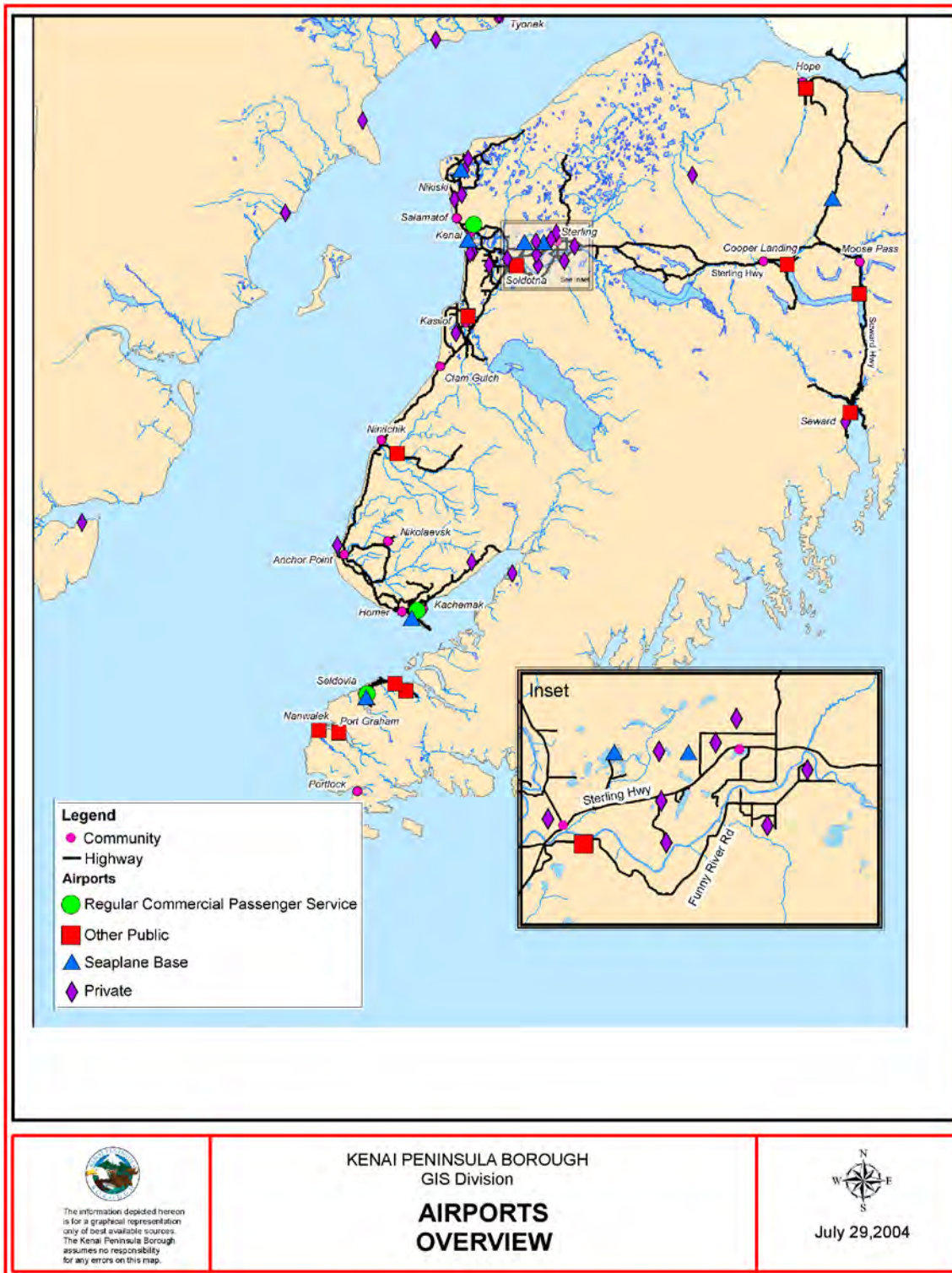


**Figure 1-6.** Overview of Kenai Peninsula Borough Ports and Harbors.





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**Figure 1-7.** Overview of Kenai Peninsula Borough Airports.



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## North Zone

The Kenai Spur Highway is the primary north-south road in the North Zone, traversing from the City of Kenai north to Nikiski, then northeasterly to its terminus at Captain Cook State Recreation Area. Numerous secondary state, city and Borough roads connect the outlying areas. In addition, a 4.5-mile gravel road between Lamplight Road in Nikiski and Marathon Road in Kenai serves as an evacuation route for the Nikiski area in the event the Kenai Spur Highway ever becomes impassable.

There is a municipal airport located at Kenai and a community-owned airport at Tyonek, as well as private airstrips, beaches, lakes and rivers scattered throughout the zone that provide landing sites for small aircraft. Service is by small and medium commuter-type aircraft.

There are three deep-draft piers and two shallow-draft wharves in the Nikiski area that serve the industrial facilities. The Kenai City Dock and boat ramp are located near the mouth of the Kenai River. In the Kenai River there are also several private commercial fish-processing docks and seasonally-placed vessel mooring buoys.

## Central Zone

The Kenai Spur Highway, Sterling Highway, Funny River Road and Kalifornsky Beach Road are the major state roads serving the Central Zone communities. Numerous secondary roads connect the communities and outlying areas. There are nine state-maintained highway bridges and one Borough-maintained bridge in the Central Zone (Appendix J).

There is a municipal airport in Soldotna, community airports at Kasilof and Quartz Creek and numerous private airstrips throughout the Central Zone. The Soldotna Municipal Airport provides aircraft maintenance and charter services.

## East Zone

Traveling south from Anchorage, the Seward Highway (Alaska State Highway 1) traverses the East Zone from the Borough boundary near Turnagain Arm to the junction at Tern Lake and the Sterling Highway. Alaska State Highway 9 continues south to its terminus at the City of Seward. The Hope Highway branches off the Seward Highway at Mile 56.4 and terminates at the community of Hope. There are 38 bridges in the East Zone (Appendix J). A majority of these are state-owned and maintained, although the Borough maintains nine of these bridges.

The Alaska Railroad Corporation (ARRC) provides service between Anchorage and Seward, and is important for the transport of freight, timber, coal and other resources. In the summer months, the railroad provides daily passenger service





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between Seward and Anchorage. The railroad closely parallels the Seward Highway through Moose Pass, Crown Point and the Seward area.

There are state-maintained airstrips located at Hope and Crown Point/Lawing, and a district airport with two paved runways in Seward, as well as local airstrips, beaches, lakes and rivers scattered throughout the zone that provide landing sites for small aircraft.

The Port of Seward is a deep-water, ice-free port and the only developed port in the eastern zone. Seward port facilities include the Municipal Pier, Seward Fisheries Wharf, the Alaska Railroad Dock and coal transfer facility, the City Dock, the Institute of Marine Science dock, the Marine Industrial Center and the Small Boat Harbor. The port facilities serve cruise ships, cargo barges and ocean freighters from Seattle and overseas. The Small Boat Harbor has two boat launch ramps and moorage for 700 boats.

### South Zone

The Sterling Highway (Alaska State Highway 1) traverses the South Zone from Clam Gulch to the end of the Homer Spit. The communities of Seldovia, Nanwalek and Port Graham, as well as other populated areas across Kachemak Bay from Homer, can only be reached by water or air transportation. There are thirteen bridges on South Zone roads (Appendix J), of which eight are state and five are Borough-maintained.

Homer has a state-owned district airport, with a 6,700 foot asphalt runway, a float plane basin and a seaplane base at Beluga Lake. The city is served by several scheduled and chartered aircraft services. There are four additional private landing strips in the vicinity. Seldovia, Port Graham, and Nanwalek have state-owned gravel airstrips with direct daily charter flights between the communities and Homer.

Homer is served by the Alaska Marine Highway ferry system as well as local ferry and water taxi services. There are two deep-water docks, a small boat harbor with moorage for 920 vessels, additional transient moorage, 48.7 acre boat basin, two tidal grids, a five-lane boat launch ramp and a 386-foot-long commercial fish plant dock. Seldovia and Ninilchik have small boat harbors, and docking facilities are available in Port Graham and Nanwalek.

### ***1.4.6 Population and Demographics***

During the early 1980s, the population of the Kenai Peninsula Borough grew by a remarkable 8% each year. After 1986, the growth rate slowed and the overall growth rate for the entire 1980-1990 period averaged about 5%. Since that time, population growth has continued but at a slower rate. From 1990 to 2000 the Borough gained almost 9,000 residents, which represents a growth rate of 2%



# INTRODUCTION

each year<sup>1</sup>. Between 2000 and 2012, Borough population grew by an estimated 10,065 people, representing a continued decline in the growth rate<sup>2</sup>.

There are six incorporated cities within the KPB: Homer, Kachemak City, Kenai, Seldovia, Seward and Soldotna<sup>3</sup>. Outside of the cities, there are thirty-two communities ranging in size from 19 individuals in Sunrise to 7,495 individuals in Kalifornsky (Table 1-3). Representation for the unincorporated communities includes local village councils, community councils, advisory planning commissions and chambers of commerce. However, some communities are not currently represented by local organizations.

**Table 1-3. Kenai Peninsula Borough 2012 Community Population Estimates<sup>4</sup>.**

North Zone			Total Population Estimate		13,087
Community	Population	Community	Population	Community	Population
Beluga	16	Nikiski	4,623	Tyonek	171
Kenai*	7,144	Salamatof	1,133		
Central Zone			Total Population Estimate		23,602
Community	Population	Community	Population	Community	Population
Clam Gulch	200	Funny River	928	Ridgeway	2,071
Cohoe	1,384	Kalifornsky	8,179	Soldotna*	4,299
Cooper Landing	293	Kasilof	558	Sterling	5,690
East Zone			Total Population Estimate		5,395
Community	Population	Community	Population	Community	Population
Bear Creek	1,997	Lowell Point	59	Seward*	2,754
Crown Point	60	Moose Pass	231	Sunrise	13
Hope	196	Primrose	85		
South Zone			Total Population Estimate		14,169
Community	Population	Community	Population	Community	Population
Anchor Point	2,007	Happy Valley	628	Ninilchik	842
Diamond Ridge	1,210	Homer*	5,153	Port Graham	168
Fox River	653	Kachemak*	467	Seldovia City*	242
Fritz Creek	1,953	Nanwalek	287	Seldovia Village	159
Halibut Cove	88	Nikolaevsk	312		
Entire KPB			Total Population Estimate		56,253

\* Indicates incorporated City.

## 1.4.7 Facilities and Services

A general overview of facilities and services available for KPB communities is organized by Zone and follows in Tables 1-4 through 1-7.

<sup>1</sup> 2005 KPB Comprehensive Plan Update – Chapter 2: Population

<sup>2</sup> Alaska Department of Labor 2012 Vintage Place Estimates

<sup>3</sup> An *All-Hazard Mitigation Plan* for each of these Cities is found in the Annexes

<sup>4</sup> Alaska Department of Labor 201 Vintage Place Estimates



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**Table 1-4. North Zone Facilities and Services.**

Facilities and Services	Kenai	Nikiski	Tyonek
01. Airport	X		
02. Airstrips	X	X	X
03. Fire	X	X	X
04. Law Enforcement	X	X (AST*)	X (VPSO** / AST*)
05. Hospital			
06. Health Clinics	X		X
07. Schools	X	X	X
08. Electric	X	X	X
09. Telephone	X	X	X
10. Natural Gas	X	X	
11. Landfill / Transfer Site	X	X	X
12. Library	X		
13. Roads	X	X	X
14. Community Hall			X
15. Parks	X	X	
16. Civic Center	X		
17. Sports Center	X	X	
18. Private Business	X	X	X
19. Government and Tribal Offices	X	X	
20. Sewage Treatment Facility	X		X
21. Individual Septic Systems	X	X	X
22. Stores	X	X	X
23. Bridge	X	X	
24. Post Office	X	X	X
25. Radio Communications	X	X	X
26. Water Supply	X		X
27. Senior Center	X	X	
28. Church	X	X	X

\*Alaska State Troopers

\*\*Village Public Safety Officer



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**Table 1-5.** Central Zone Facilities and Services.

Facilities and Services	Soldotna / Ridgeway / Kalifornsky	Sterling / Funny River	Cooper Landing	Kasilof / Cohoe
01. Airport	X			
02. Airstrips	X	X	X	X
03. Fire	X	X	X	X
04. Law Enforcement	X	X (AST*)	X (AST*)	X (AST*)
05. Hospital	X			
06. Health Clinics	X			
07. Schools	X	X	X	X
08. Electric	X	X	X	X
09. Telephone	X	X	X	X
10. Natural Gas	X	X		X
11. Landfill / Transfer Site	X	X	X	X
12. Library	X		X	
13. Roads	X	X	X	X
14. Community Hall			X	
15. Parks	X	X	X	X
16. Civic Center				
17. Sports Center	X			
18. Private Business	X	X	X	X
19. Government Offices	X			X
20. Sewage Treatment Facility	X			
21. Individual Septic Systems	X	X	X	X
22. Stores	X	X	X	X
23. Bridge	X	X	X	X
24. Post Office	X	X	X	X
25. Radio Communications	X	X	X	X
26. Water Supply	X			
27. Senior Center	X	X	X	
28. Church	X	X	X	X

\*Alaska State Troopers



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**Table 1-6. East Zone Facilities and Services.**

<b>Facilities and Services</b>	<b>Seward</b>	<b>Moose Pass</b>	<b>Hope</b>
01. Airport	X		
02. Airstrips		X	X
03. Fire	X	X	X
04. Law Enforcement	X	X (AST*)	X (AST*)
05. Hospital	X		
06. Health Clinics	X		
07. Schools	X	X	X
08. Electric	X	X	X
09. Telephone	X	X	X
10. Natural Gas			
11. Landfill / Transfer Site	X	X	X
12. Library	X	X	X
13. Roads	X	X	X
14. Community Hall	X	X	X
15. Parks	X		
16. Civic Center			
17. Sports Center			
18. Private Business	X	X	X
19. Government Offices	X		
20. Sewage Treatment Facility	X		
21. Individual Septic Systems	X	X	X
22. Stores	X	X	X
23. Bridge	X		
24. Post Office	X	X	X
25. Radio Communications	X	X	X
26. Water Supply	X		
27. Senior Center	X		
28. Church	X	X	

\*Alaska State Troopers



# INTRODUCTION

**Table 1-7. South Zone Facilities and Services.**

Facilities and Services	Anchor Point	Homer	Nanwalek	Ninilchik	Port Graham	Seldovia
01. Airport		X				
02. Airstrips	X		X	X	X	X
03. Fire	X	X	X	X	X	X
04. Law Enforcement	X (AST*)	X	X (VPSO** / AST*)	X (AST*)	X (AST*)	X
05. Hospital		X				
06. Health Clinics	X	X	X	X	X	X
07. Schools	X	X	X	X	X	X
08. Electric	X	X	X	X	X	X
09. Telephone	X	X	X	X	X	X
10. Natural Gas				X		
11. Landfill / Transfer Site	X	X	X	X	X	X
12. Library	X	X		X		X
13. Roads	X	X	X	X	X	X
14. Community Hall		X	X	X	X	X
15. Parks	X	X		X		
16. Civic Center						
17. Sports Center						
18. Private Business	X	X	X	X	X	X
19. Government and Tribal Offices		X	X	X	X	X
20. Sewage Treatment Facility		X	X		X	X
21. Individual Septic Systems	X	X		X		
22. Stores	X	X	X	X	X	X
23. Bridge	X			X		
24. Post Office	X	X	X	X	X	X
25. Radio Communications	X	X	X	X	X	X
26. Water Supply	X	X	X	X	X	X
27. Senior Center	X	X		X		
28. Church	X	X	X	X	X	X

\*Alaska State Troopers

\*\*Village Public Safety Officer



# INTRODUCTION

## 1.4.8 Capability Assessment

Tables 1-8 through 1-10 list the legal, technical, and fiscal capabilities of the KPB.

**Table 1-8** Legal and Regulatory Capability

Regulatory Tools (ordinances, codes, plans)	Local Authority (Y/N)	County/Regional Authority (Y/N)	Does State Prohibit? (Y/N)	Comments (Year of most recent update; problems administering it, etc)
Building code	Y	Y	N	
Zoning ordinance	Y	Y	N	
Subdivision ordinance or regulations	Y	Y	N	
Special purpose ordinances (floodplain management, stormwater management, hillside or steep slope ordinances, wildfire ordinances, hazard setback requirements)	Y	Y	N	Floodplain, avalanche and landslide, sand and gravel, streamside setbacks, hillside development, coastal management, wetlands, drainage and earth-moving requirements, habitat protection tax exemption & tax credit
Growth management ordinances (also called “smart growth” or anti- sprawl programs)	Y	Y	N	Urban Service Boundary, Mixed-Use zoning, planned unit developments
Site plan review requirements	Y	Y	N	
General or comprehensive plan	Y	Y		Published 1992
A capital improvements plan	Y	Y		KPB Comprehensive Economic Development Strategy, updated 2013
An economic development plan	Y	N	N	KPB Comprehensive Economic Development Strategy, updated 2013
An emergency response plan	Y	Y		Emergency Operations Plan updated in 2013
Community Wildfire Protection Plan	Y	Y	N	Interagency All Lands/All Hands Action Plan 2004
A Coastal Management Plan	Y	Y	N	Updated in 2008
A post-disaster recovery plan	N	N	N	
A post-disaster recovery ordinance	N	N	N	
Real estate disclosure requirements	N	N		Realtors are obliged to disclose hazards to the best of their knowledge





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**Table 1-9** Administrative and Technical Capability

Staff/Personnel Resources	Y/N	Department/Agency and Position
Planner(s) or engineer(s) with knowledge of land development and land management practices	Y	KPB Land Management, KPB Planning, KPB Emergency Management, KPB Coastal Program, & KPB Floodplain Management
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Y	CDD, Engineering Department, and Fire Department
Planners or Engineer(s) with an understanding of natural and/or human-caused hazards	Y	KPB Land Management, KPB Planning, KPB Emergency Management, KPB Coastal Program, & KPB Floodplain Management
Floodplain manager	Y	KPB Office of Emergency Management Program Coordinator & KPB Floodplain Management Program Floodplain Administrator
Surveyors	Y	KPB Land Management Division
Staff with education or expertise to assess the community's vulnerability to hazards	Y	KPB Office of Emergency Management Director and Staff
Personnel skilled in GIS and/or HAZUS	Y	KPB Geographic Information Office
Scientists familiar with the hazards of the community	N	KPB uses government agencies and private consultants
Emergency manager	Y	KPB Office of Emergency Management Director
Grant writers	N	Staff within departments write grants as a collateral duty
Environmental Advisory Council	Y	KPB Habitat Protection, KPB Coastal Program, KPB Floodplain Management, & Kenai Watershed Forum

**Table 1-10** Fiscal Capability

Financial Resources	Accessible or Eligible to Use (Yes/No/Don't Know)
Community Development Block Grants (CDBG)	Y
Capital improvements project funding	Y
Authority to levy taxes for specific purposes	Y
Fees for water, sewer, gas, or electric service	Y
Impact fees for homebuyers or developers for new developments/homes	N
Incur debt through general obligation bonds	Y
Incur debt through special tax and revenue bonds	Y
Incur debt through private activity bonds	N
Withhold spending in hazard-prone areas	Y



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## 1.5 Risk Assessment

### 1.5.1 What is a Risk Assessment?

A risk assessment provides a means to determine the possible loss of life and economic damage that could follow a disaster by evaluating community and infrastructure vulnerability. This phase of mitigation planning elicits critical information needed to appropriately develop mitigation strategies. FEMA identifies four important steps involved in a Risk Assessment (Table 1-11):

**Table 1-11. The Four Steps of a FEMA Hazard Risk Assessment**

<b>1. Hazard Identification</b>
Information is compiled on all hazards that may affect your community. This includes the geographic extent and intensity of the hazard, as well as possible recurrence intervals.
<b>Location in this plan:</b> Table 1-9 lists 12 hazards and the general probability of occurrence for each within the KPB. More detailed information is found in the appropriate hazard chapter.
<b>2. Profiling of Hazard Events</b>
Profiling hazard events involves describing the particular characteristics of hazards that have occurred in your area. The factors that contributed to a particular event, the affects of the event on population and infrastructure, and the geographic extent of the event are all unique and help to answer the question, How bad can it get?
<b>Location in this plan:</b> Found in the appropriate hazard chapter.
<b>3. Inventorying Assets</b>
Identification of the assets in a community that may be affected by a particular hazard event. This process combines information gathered about the extent and location of a hazard with the potential effects on community populations and infrastructure. Particular attention is paid to emergency and critical facilities that are critical following a hazard event.
<b>Location in this plan:</b> Section 1.5.3 and Tables 1-14 and 1-15 contain a review of critical and essential facilities within the Kenai Peninsula Borough. The threat to specific structures and populations from a hazard is found in the appropriate hazard chapter.
<b>4. Estimating Potential Losses</b>
This step examines possible injury, loss and damage of property from a hazard event in financial terms. This involves estimates of the value of existing structures, while taking into account future development trends in the region.
<b>Location in this plan:</b> Found in the appropriate hazard chapter.

The type and availability of information dictates the level of risk analysis that is possible for each hazard and for each community. Often, detailed hazard data is not available or is housed with different agencies and organizations, and is difficult to find and consolidate. If information deficits are serious, gathering information may be a prerequisite to developing useful mitigation strategies.

### 1.5.2 Probability of Hazard Occurrence

The overall probability of hazards occurring in the KPB was assessed for this Plan using 1) the State of Alaska's hazard rating matrix, 2) the KPB Emergency Management hazard risk assessment methodology and 3) the KPB Risk Management insurance risk rating table.



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## State of Alaska Hazard Plan Rating Matrix

The following matrix, developed for the State of Alaska Hazard Mitigation Plan<sup>1</sup>, assesses the probability of occurrence of twelve separate hazards in the KPB. Each hazard was identified with the probability of occurrence, if known, and rated low, moderate or high.

**Table 1-12.** 2014 Hazard Matrix for the Kenai Peninsula Borough

<b>Flood</b>	<b>Wildland Fire</b>	<b>Earthquake</b>	<b>Volcano</b>	<b>Snow Avalanche</b>	<b>Tsunami &amp; Seiche</b>
Y – H	Y – H	Y – H	Y – H	Y – M	Y – M
<b>Weather</b>	<b>Landslides</b>	<b>Erosion*</b>	<b>Drought</b>	<b>Technological</b>	<b>Economic</b>
Y – H	Y – L	Y – H	Y – H	Y – H	Y – M

\*coastline and riverine erosion

ECONOMIC Y – M (platform and Drift River short & long term effects of closures due to hazards including volcanic ash, lahars and mud flows)

- Y: Hazard is present in KPB but probability unknown  
Y – L: Hazard is present with a low probability of occurrence  
Y – M: Hazard is present with a moderate probability of occurrence  
Y – H: Hazard is present with a high probability of occurrence  
N: Hazard is not present  
U: Unknown if the hazard occurs in KPB

## KPB Emergency Management Hazard Assessment Method

The KPB Emergency Management Plan uses hazard-rating tables to provide a numeric aid for assessing relative risk (Tables 1-13, 1-14, 1-15). The calculations incorporate the probability of hazard occurrence, the maximum percentage of population and property that could be impacted, the history of occurrence and the vulnerability of lives and property to a hazard<sup>2</sup>. The highest possible hazard rating score is 240 (for a detailed explanation of calculation methods see Appendix E). This rating system was developed to compare hazard risk across KPB Emergency Response Zones for planning purposes<sup>3</sup>. For the purposes of the All Hazard Mitigation Plan, this information may be applied in much the same

<sup>1</sup> Alaska Division of Homeland Security and Emergency Services (ADHSES). State Hazard Mitigation Plan DMA 2000-Updated 2013.

<sup>2</sup> In this plan vulnerability was defined as: "the susceptibility of people, property, and the environment to death, injury or damage if a hazard manifests its potential."

<sup>3</sup> This rating system was developed by Pinkston Enterprises for the KPB Emergency Operations Plan (2004).



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way: to help assess the varying degrees of hazard risk faced by residents of the KPB.

**Table 1-13.** Hazard Rating for **Floods** in the Kenai Peninsula Borough by Emergency Management Zone<sup>1</sup>

Zone	History	Vulnerability	Maximum Threat	Probability	Total Points*
<b>North Zone</b> Severity Points	High 20	Low 5	Low 10	Moderate 35	70
<b>Central Zone</b> Severity Points	High 20	Moderate 25	Moderate 50	High 70	165
<b>East Zone</b> Severity Points	High 50	high 35	High 100	high 35	230
<b>South Zone</b> Severity Points	Moderate 10	Moderate 25	Low 10	Moderate 35	70

\*240 points possible

**Table 1-14.** Hazard Rating for **Wildfire** in the Kenai Peninsula Borough by Emergency Management Zone

Zone	History	Vulnerability	Maximum Threat	Probability	Total Points*
<b>North Zone</b> Severity Points	Moderate 10	Moderate 25	Moderate 50	Moderate 35	120
<b>Central Zone</b> Severity Points	High 40	High 50	high 100	high 50	240
<b>East Zone</b> Severity Points	Moderate 10	Moderate 25	Moderate 50	Moderate 35	120
<b>South Zone</b> Severity Points	High 40	High 50	high 100	high 50	240

\*240 points possible

**Table 1-15.** Hazard Rating for **Earthquakes** in the Kenai Peninsula Borough by Emergency Management Zone

Zone	History	Vulnerability	Maximum Threat	Probability	Total Points*
<b>North Zone</b> Severity Points	High 20	High 50	High 100	High 70	240
<b>Central Zone</b> Severity Points	High 20	High 50	High 100	High 70	240
<b>East Zone</b> Severity Points	High 20	High 50	High 100	High 70	240
<b>South Zone</b> Severity Points	High 20	High 50	High 100	High 70	240

\*240 points possible

<sup>1</sup> 2008 Kenai Peninsula Borough Emergency Operations Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.



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**Table 1-16.** Hazard Rating for **Weather**<sup>1</sup> in the Kenai Peninsula Borough by Emergency Management Zone

Zone	History	Vulnerability	Maximum Threat	Probability	Total Points*
<b>North Zone</b> Severity Points	Moderate 10	High 50	Moderate 50	Moderate 35	145
<b>Central Zone</b> Severity Points	Moderate 10	High 50	Moderate 50	Moderate 35	145
<b>East Zone</b> Severity Points	Moderate 10	High 50	Moderate 50	Moderate 35	145
<b>South Zone</b> Severity Points	Moderate 10	High 50	Moderate 50	Moderate 35	145

\*240 points possible

**Table 1-17.** Hazard Rating for **Tsunamis** in the Kenai Peninsula Borough by Emergency Management Zone

Zone	History	Vulnerability	Maximum Threat	Probability	Total Points*
<b>North Zone</b> Severity Points	Low 2	Moderate 25	Moderate 50	Low 7	84
<b>Central Zone</b> Severity Points	Low 2	Moderate 25	Low 10	Low 7	44
<b>East Zone</b> Severity Points	Moderate 10	High 50	High 100	Moderate 35	195
<b>South Zone</b> Severity Points	Moderate 10	High 50	High 100	Moderate 35	195

\*240 points possible

**Table 1-18.** Hazard Rating for **Volcanoes** in the Kenai Peninsula Borough by Emergency Management Zone

Zone	History	Vulnerability	Maximum Threat	Probability	Total Points*
<b>North Zone</b> Severity Points	High 20	High 50	High 100	High 70	240
<b>Central Zone</b> Severity Points	High 20	High 50	High 100	High 70	240
<b>East Zone</b> Severity Points	High 20	High 50	High 100	High 70	240
<b>South Zone</b> Severity Points	High 20	High 50	High 100	High 70	240

\*240 points possible

<sup>1</sup> This rating was performed for "weather extremes" which includes ice storms, blizzards, extreme heat or cold, drought and high winds.



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**Table 1-19.** Hazard Rating for **Avalanche** in the Kenai Peninsula Borough by Emergency Management Zone

Zone	History	Vulnerability	Maximum Threat	Probability	Total Points*
<b>North Zone</b> Severity Points	Not a significant hazard for the North Zone				
<b>Central Zone</b> Severity Points	Not a significant hazard for the Central Zone				
<b>East Zone</b> Severity Points	High 50	moderate 40	Moderate 50	High 70	210
<b>South Zone</b> Severity Points	High 20	Low 5	Moderate 50	High 70	145

\*240 points possible

## KPB Risk Management Insurance Rating Table

For insurance purposes, the KPB Risk Management Department has created a rating table that assesses the relative vulnerability of Borough assets from various hazards<sup>1</sup>. Table 1-13 is modified from the original table to highlight the potential affects of floods and earthquakes on identified property (and people) associated with Borough facilities.

**Table 1-20.** Assets at Risk from Earthquakes, Floods and Weather on the Kenai Peninsula According to the KPB Hazard Insurance Report.

Assets at Risk	Perceived Significant loss potential	Perceived Insignificant loss potential	No perceived risk
People	E	F, W, I	
Real property (Building)	E, F, I	W	
Personal property	E, F, I	W	
Transient property		E, I	F, W
Fuel tanks	E	F, W	I
Contractor's equipment			E, F, W, I
Boats	E	W	F, I
Vehicles	E	W	F, I
Computer systems/data processing	E, F	W	I
Roads/Bridges/Tunnels	E, F, W, I		

E = Earthquake; F = Flood; W = Wind/Storm/Hail; I = Ice/Freezing

### 1.5.3 Critical and Essential Facilities

Critical facilities allow for effective governmental response and recovery from a hazard event. They help in immediate assistance (e.g., fire, ambulance and police) and provide care and shelter for those in need (e.g., hospitals and

<sup>1</sup> This list is modified from KPB Hazard Insurance Report (in prep).





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schools). Other community infrastructure, such as communication, transportation and utility services, are also essential. A list of KPB critical facilities is provided in Table 1-14 and 1-15. Mitigation strategies in this plan are intended to minimize hazard effects on these facilities and support their continued function following a hazard event.

**Table 1-21. Emergency Response Facilities in the Kenai Peninsula Borough.**

<b>North Zone</b>		
<b>Emergency Services</b>	<b>Hospital and Medical Services</b>	<b>Law Enforcement Resources</b>
Cook Inlet Spill Prevention & Response, Inc. (Nikiski)	Central Peninsula Family Practice (Kenai)	Kenai Police Dept. (Kenai)
Nikiski Fire Dept. (Nikiski)	Indian Creek Health Dept. (Tyonek)	Tyonek Village Public Safety Officer (Tyonek)
Indian Creek Health Dept. (Tyonek)	Kenai Health Center (Kenai)	Wildwood Correctional Center (Kenai)
Kenai Composite Squadron (Kenai)	Medicenter (Kenai)	
Kenai Fire Dept. (Kenai)	Peninsula Insta Care Medical Clinic (Kenai)	
	State of Alaska Public Health (Kenai)	
<b>Central Zone</b>		
<b>Emergency Services</b>	<b>Hospital and Medical Services</b>	<b>Law Enforcement Resources</b>
ADNR Division of Forestry – Kenai Kodiak Area (Soldotna)	Central Peninsula Hospital (Soldotna)	ADNR Division of Parks – Kenai River District (Soldotna)
ADNR Division of Parks – Kenai River District (Soldotna)		Alaska DPS – Fish and Wildlife Protection (Soldotna)
Central Emergency Services (Soldotna, Kalifornsky Beach, Sterling, Funny River, Kasilof)		Alaska State Troopers (Soldotna)
Cooper Landing Volunteer Ambulance & Fire Dept. (Cooper Landing)		Soldotna Police Dept. (Soldotna)
		USFWS – Kenai National Wildlife Refuge (Soldotna)
<b>East Zone</b>		
<b>Emergency Services</b>	<b>Hospital and Medical Services</b>	<b>Law Enforcement Resources</b>
Bear Creek Fire Dept. (Seward)	Chugachmiut North Star Health Clinic (Seward)	Alaska DPS – Fish and Wildlife Protection Seward (Seward)
City of Seward Harbor Master (Seward)	Harbor Medical Clinic (Seward)	Alaska State Troopers (Seward)
Hope/Sunrise EMS (Hope)	Providence Seward Medical and Care Center (Seward)	City of Seward Police Dept. (Seward)
Lowell Point Emergency Service Area (Lowell Point)		Kenai Fjords National Park
Moose Pass Volunteer Fire Co. & EMS (Moose Pass)		Spring Creek Correctional Center (Seward)
Seward Bear Creek Flood Service Area		U.S. Forest Service – Seward Ranger District (Seward)



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Seward Civil Air Patrol (Seward)		
Seward Marine Service (Seward)		
Seward Volunteer Ambulance Corps (Seward)		
Seward Volunteer Fire Dept. (Seward)		
<b>South Zone</b>		
<b>Emergency Services</b>	<b>Hospital and Medical Services</b>	<b>Law Enforcement Resources</b>
ADNR Division of Forestry (Homer)	Kachemak Bay Medical Clinic (Homer)	ADNR Division of Parks – Kachemak Bay District (Homer)
ADNR Division of Parks – Kachemak Bay District (Homer)	Nanwalek (English Bay) Clinic (Nanwalek)	Alaska State Troopers (Homer)
Alaska DOT/PF Homer Airport & Homer Highways (Homer)	Ninilchik Community Clinic (Ninilchik)	Homer Police Dept. (Homer)
Anchor Point Volunteer Fire Dept. (Anchor Point)	Port Graham Clinic (Port Graham)	Nanwalek Village Public Safety Officer (Nanwalek)
City of Homer – Port & Harbor (Homer)	Seldovia Medical Clinic (Seldovia)	Port Graham Village Public Safety Officer (Port Graham)
Homer Volunteer Fire Dept. (Homer)	South Peninsula Hospital (Homer)	Seldovia Police Dept. (Seldovia)
Kachemak Emergency Services (Kachemak)		
Ninilchik Community Ambulance Assoc. (Soldotna)		
Ninilchik Volunteer Fire Dept. (Ninilchik)		



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**Table 1-22. Schools in the Kenai Peninsula Borough**

<b>North Zone</b>	
Nikiski North Star Elementary (PS-6)	Sears Elementary (K-3)
Nikiski High School (7-12)	Mountain View Elementary (PS-5)
Kenai Elementary (4-6)	Kenai Central High School
Kenai Middle School (6-8)	Tebughna (formerly Bartlett) (K-12)
River City Academy (7-12)	Kaleidoscope (K-6)
Aurora Borealis Charter (K-8)	Kenai Youth Facility (7-12)
Kenai Alternative High School (PS, 9-12)	
<b>Central Zone</b>	
Cooper Landing (K-12)	Kalifornsky Elementary (K-6)
Tustumena Elementary (K-6)	Sterling Elementary (K-6)
Redoubt Elementary (K-6)	Soldotna Elementary (K-6)
Soldotna Middle School (7-8)	Skyview High School (9-12)
Soldotna High School (9-12)	Soldotna Montessori (K-6)
<b>East Zone</b>	
Hope (K-12)	Moose Pass (K-8)
Seward Elementary (K-6)	Seward High School (9-12)
Seward Middle School (7-8)	Spring Creek (9-12)
<b>South Zone</b>	
Nikolaevsk (K-12)	Ninilchik (K-12)
Chapman (K-8)	Port Graham (K-12)
Paul Banks Elementary (PS-2)	Nanwalek (K-12)
West Homer Elementary (3-6)	Susan B. English (K-12)
Homer Middle School (7-8)	McNeil Canyon (K-6)
Homer High School (9-12)	Fireweed Academy (3-6)
Homer Flex (9-12)	Kachemak Selo (K-12)
Razdolna School (K-6)	Voznesenka (K-12)



# INTRODUCTION

## 1.5.4 Regional Overview of Structures at Risk

Some hazards, such as weather, earthquake and wildfire may threaten structures throughout an entire community or region. Table 1-20 was developed for the wildfire risk assessment and modified here to provide an overview of the number and assessed values of residential structures as well as the assessed values of industrial and commercial structures in 20 KPB communities. Specific information for community wildfire risk is provided in Table A-7, Appendix A of the Interagency All Lands/All Hands Action Plan (Annex H).

**Table 1-23.** Assessed Values of Residential, Industrial and Commercial Structures by Community

Communities	Number of Residential Structures	Residential Structures <sup>1</sup> Assessed Value	Industrial Structures <sup>2</sup> Assessed Value	Commercial Structures <sup>2</sup> Assessed Value	Total Structure <sup>3</sup> Values
Anchor Point/Happy Valley/Nikolaevsk	1,799	\$ 331,697,400	\$ -	\$ 12,164,600	\$ 343,862,000
Fritz Creek/Fox River (East End Rd.)	1,860	\$ 150,428,300	\$ -	\$ 929,200	\$ 151,357,500
Homer/Diamond Ridge/Kachemak	3,550	\$ 438,689,000	\$ 1,166,200	\$ 129,792,600	\$ 569,584,800
Kasilof/Cohoe	1,654	\$ 108,541,500	\$ -	\$ 5,216,600	\$ 113,758,100
Kenai/Kalifornsky	7,076	\$ 840,640,600	\$ 2,060,900	\$ 189,339,600	\$ 1,032,041,100
Moose Pass/Crown Point/Primrose	354	\$ 18,451,600	\$ -	\$ 4,465,500	\$ 22,917,100
Ninilchik/Clam Gulch	1,399	\$ 70,334,100	\$ -	\$ 12,903,700	\$ 83,237,800
Nikiski/Salamatof	3,399	\$ 241,710,700	\$ 230,583,700	\$ 95,747,400	\$ 702,877,100
Hope/Sunrise	369	\$ 13,012,800	\$ -	\$ 1,114,900	\$ 24,127,700
Cooper Landing	549	\$ 43,412,100	\$ -	\$ 5,668,300	\$ 49,080,400
Seldovia/Seldovia Village	549	\$ 32,277,000	\$ -	\$ 5,621,400	\$ 37,898,400
Soldotna/Ridgeway	3,443	\$ 379,458,400	\$ -	\$ 171,666,900	\$ 551,125,300
Sterling/Funny River	5,666	\$ 525,420,900	\$ 487,200	\$ 26,230,100	\$ 552,138,200
Halibut Cove/Bear Cove	304	\$ 12,590,600	\$ -	\$ 2,281,800	\$ 14,872,400
Grey Cliffs/Moose Point	204	\$ 1,523,800	\$ -	\$ -	\$ 1,523,800
Summit	17	\$ 211,200	\$ -	\$ 494,700	\$ 705,900
Seward/Bear Cr./Lowell Point	2,243	\$ 198,562,670	\$ 329,900	\$ 138,653,600	\$ 337,546,170
Tyonek/Beluga	86	\$ 1,889,400	\$ -	\$ 1,688,300	\$ 3,577,700
Port Graham/Nanwalek	130	\$ 8,102,500	\$ -	\$ 3,450,600	\$ 11,553,100
Remaining structures in Remote Areas	691	\$ 19,775,300	\$ 211,400	\$ 7,529,100	\$ 27,515,800
<b>Grand Total - Kenai Peninsula Borough</b>	<b>36,276</b>	<b>\$ 2,954,392,970</b>	<b>\$ 234,839,300</b>	<b>\$ 814,464,200</b>	<b>\$4,136,080,870</b>

\*Structure values are based on 2009 Kenai Peninsula Borough Property Tax Assessed Valuations and are considered conservative. These are not market values and land value is not included.



# FLOODS and EROSION

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## 2.0 FLOOD AND COASTAL EROSION

### 2.1 Why Focus on Flood Hazard Mitigation?

Flooding is a dynamic natural process. Along rivers, streams and coastal bluffs, a cycle of erosion and deposition is continuously rearranging and rejuvenating the aquatic and terrestrial systems. Although many plants, animals and insects have evolved to accommodate and take advantage of these ever-changing environments, damage to property and infrastructure often occurs when people develop coastal areas and floodplains and natural processes are altered or ignored.

Flooding can also threaten life, safety and health, and often results in substantial damage to infrastructure, homes and other property. The extent of damage caused by a flood depends on topography, soils and vegetation in an area, the depth and duration of flooding, velocity of flow, rate of rise and the amount and type of development in the floodplain.

With miles of coastline, and numerous rivers, streams and lakes, most Kenai Peninsula Borough communities are subject to several types of flood hazards. Although flood conditions eventually subside, damage to public and private property is often costly. Unfortunately, some losses suffered during disaster events are impossible to recover, making the actual financial and emotional costs even greater than what is recorded.



In 1986, 1989, 1995, 2002, 2006, 2007 and 2009, 2012 and 2013 major fall rainstorms swept the Kenai Peninsula, leaving widespread damage in their wake. The 1986, 1995, 2002, 2006, 2007, 2012 and 2013 events were substantial enough to be declared local, state and federal disasters. Though not officially declared a federal disaster, damage in the Seward area from the 1989 storm was sufficient to warrant a state disaster

declaration. In 1995, the combined public and private flood damage was estimated at over five million dollars<sup>1</sup>. The 2002 floods caused an estimated \$24.5 million dollars in damage to roads and other public facilities and an additional \$1.25 million in damage to private property<sup>2</sup>. The 2006 and 2007 flood events in the Seward area resulted in an estimated \$3 million - \$5 million in damages to public infrastructure and private property<sup>3</sup>.

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1 The 1995 damage estimates were provided by Alaska Division of Emergency Service (ADES) 1995 Damage Survey Reports, and Individual and Family Grant Program Summary, KPB Finance and Assessing Departments.

2 The 2002 flood damage estimates were compiled from summaries provided by the Alaska Division of Homeland Security and Emergency Management, Small Business Administration Loan Program and the FEMA- DR1445 Flood Summary.

3 Combined KPB, state and City of Seward preliminary damage assessments

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# FLOODS and EROSION

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Additionally, the 2007 Kenai River ice jams and related flooding resulted in an estimated \$2 million in public infrastructure damage and resulted in local, state and federal disaster declarations.

Although property location and value, availability of services and site development costs are normal considerations for residential, commercial and industrial development, the susceptibility of a particular site to naturally occurring events, such as flooding, may be overlooked or underestimated. When natural disasters do occur, such oversights can have tremendous social and monetary costs. As development continues to occur, even in areas susceptible to flooding, flood mitigation planning, including codifying permit/construction criteria for flood-prone areas, can help limit or prevent future loss of life and property.

Following a disaster, funding for damage repair is typically based on the concept of in-kind replacement, or “putting it back exactly as it was”, which helps the community in the short term, but also means that similar damage will occur during the next flood cycle. Evaluating problem areas and implementing measures to stop or control damage is a productive and proactive way to end the cycle of repetitive loss.

## ***2.1.1 Past Flood Hazard Mitigation Plans***

The Alaska Railroad Corporation, City of Seward, Seward/Bear Creek Flood Service Area Board, Kenai Peninsula Borough and Village of Port Graham have all completed flood mitigation plans in the past as a prerequisite for receiving federal flood mitigation project funding.

Alaska Railroad Corporation, Flood Hazard Mitigation Plan, Milepost 0.0 to Milepost 355.0, 1986.

Hazard Mitigation Plan for the Seward Area, Prepared by the KPB Planning Department, September, 1987.

City of Seward, Flood Hazards Mitigation Plan, Prepared by City of Seward Community Development Department with Hensley Consulting Services, 1996.

Kenai Peninsula Borough Flood Mitigation Plan, Phase I, Prepared by the KPB Planning Department, 1996.

Final Flood Mitigation Plan, Port Graham, Alaska, Kenai Peninsula Borough, Prepared by Montgomery Watson and Parker Horn Company, March 2001.

KPB and City of Seward Resurrection River Debris Removal and Maintenance Plan, 2006.

Seward/Bear Creek Flood Service Area Flood Hazard Mitigation Plan, 2013.





# FLOODS and EROSION

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## 2.1.2 Flood Terminology

A number of flood-related terms are frequently used in this plan and are defined below.

**Flood Insurance Study (FIS):** A *Flood Insurance Study* is the official report provided by the Federal Insurance Administration, which provides flood profiles, the flood boundary-floodway map, and the water surface elevation of the estimated 100-year base flood.

**Flood Insurance Rate Map (FIRM):** The Flood Insurance Rate Maps (FIRM) are the official maps on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

**Flood Insurance Zones (A, A2 through A10, V, B, C, D):** In order to set actuarial insurance rates, the Federal Insurance Administration established the following flood hazard map zones:

Zone	Definition
<b>A</b>	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.
<b>AO</b>	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no Flood Hazard Factors determined.
<b>Zone A2 through A5, and A10</b>	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
<b>Zone V</b>	Special flood hazard areas along coasts inundated by the 100-year flood, as determined by approximate methods, and that have additional hazards due to velocity (wave action); no base flood elevations shown or Flood Hazard Factors determined.
<b>Zone V1 through V9, V11, V12, V16, and V19</b>	Special flood hazard areas along coasts inundated by the 100-year flood, as determined by detailed methods and that have additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
<b>Zone B</b>	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year floodplain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than one square mile. Zone B is not subdivided.
<b>Zone C</b>	Areas of minimal flooding.
<b>Zone D</b>	Areas of undetermined, but possible, flood hazard.



# FLOODS and EROSION

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100-year Base Flood: Base Flood means the flood having a 1% chance of being equaled or exceeded in any given year. Also referred to as the “100-year flood”. Designation on the floodplain (FIRM) maps always includes the letters A or V.

Floodplain: A floodplain is land adjacent to a lake, river, stream, estuary or other water body that is subject to flooding. If left undisturbed, the floodplain serves to store and discharge excess floodwater. In riverine systems, the floodplain includes the floodway.

Floodway: “Floodway” means the channel of a river or other watercourse and the adjacent areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

## 2.2 Floodplain Information Sources

Between 1976 and 1983, FEMA and the United States Army Corps of Engineers (USACE) cooperated to produce the KPB Flood Insurance Study (FIS) and 100-year and 500-year Flood Insurance Rate Maps (FIRM). Additional information about the National Flood Insurance Program (NFIP) and FIRM maps follows in Section 2.5: Floodplain Management.

For the Seward area, the approximate boundaries of the 1986 and 1995 floods are also available as map overlays in the KPB GIS system. These maps provide historic flood information that is useful for land use decisions.

Following the 2006-2007 flood events in the Seward area, KPB coordinated state, local and federal interagency efforts to begin FEMA FIRM mapping updates. This process continued through 2008, with new maps expected to be available in late 2010, after this plan is revised and published. It is expected that other flood events will occur that could negate the effective information of the updated mapping.

As a contingency measure for this possibility, the KPB Assembly convened a task force through 2009 to determine best practices for permitting, property title/insurance identification of flood prone properties, and a public information process that was presented to and mostly enacted by the KPB Assembly in the fall of 2009.

## 2.3 Types of Flooding

Flooding can occur in a number of ways, and many times are not independent of each other and can occur simultaneously during a flood event: Flooding on the Kenai Peninsula can be broken into a number of categories including:

- heavy rainfall;
- urban stormwater overflow;
- rapid snowmelt;



## FLOODS and EROSION

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- rising groundwater (generally in conjunction with heavy prolonged rainfall and saturated conditions);
- chronic debris deposition in streambeds reducing effective stream depths, compounding saturation conditions and contributing to acute channel migration;
- riverine ice jams;
- flash floods;
- fluctuating lake levels;
- alluvial fan flooding;
- glacial lake outbursts (jökulhlaups);
- coastal storm surge run-up; and
- tsunami and seiche (see Section 6.0).

It is also important to note that the various types of flooding are not independent of each other and can occur simultaneously during flood events.

**Heavy Rainfall:** Based on normal weather patterns, it is not unusual for the Kenai Peninsula to receive heavy rain from mid to late summer through the fall. The rainfall intensity, duration, distribution and geomorphic characteristics, as well as the amount and type of development in each watershed, play a role in determining the magnitude of flood impacts. Runoff flooding is the most common type of flood and usually occurs in conjunction with intense, prolonged rainfall. In addition to surface flooding, saturated soils and rising groundwater can result in landslides and coastal bluff failures.

**Urban Stormwater Overflow:** As communities develop, natural vegetation is removed and replaced with buildings, streets and parking lots. Water that normally would be absorbed and slowly discharged into groundwater and stream systems rapidly runs off of hardened surfaces into ditches or stormwater systems. Stormwater systems can be overwhelmed by heavy rainfall, debris jams or icing, and it is not uncommon for water to temporarily back up on roads, parking lots and around buildings.

**Snow Melt Floods:** Floods from melting snow typically occur in the spring or early summer. Snowpack depth and spring and summer weather patterns influence the magnitude of flooding. Warm summer temperatures can rapidly melt mountain snowpack or glacier ice and raise the water level of streams and lakes.



## FLOODS and EROSION

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**Groundwater Floods:** Groundwater flooding occurs as water accumulates and saturates the soil. The water table rises and floods low-lying areas, including crawl spaces and basements, septic tanks and other facilities. It often happens in conjunction with heavy rains and rising surface waters. It is a significant problem for communities situated on alluvial fans, such as Seward, as well as in areas such as the Homer bench where clay layers concentrate the seasonal groundwater table close to the surface.

**Ice Jam Floods:** Ice jam floods occur when the ice cover on a river is disrupted by rapidly changing temperatures or by a sudden glacier-dammed lake (jökulhlaup) release. Ice jams can also occur when a slushy colloidal suspension, known as “frazil ice”, forms and is swept along until it becomes trapped and piles up beneath the surface ice. Ice jams also occur as the result of anchor ice formations or during spring breakup when the ice cover breaks into pieces and jams at bridges, bends or other natural constraints in the river.

Because of the unpredictable nature of ice jams, flooding can be worse than 100 or 500-year events<sup>1</sup>. Heavy damage can occur when ice jams give way, sending surges of ice and rapidly moving water downstream. Ice jams have the potential to significantly damage bridges, piers, levees, jetties and other structures along the riverbanks.

**Glacial Outburst Floods (Jökulhlaups):** A glacial outburst flood, also known as a jökulhlaup, occurs when water is suddenly released from a glacier-dammed lake. Releases occur when ice dams are overtopped, disrupted by earthquakes, melted by volcanic activity, or drained through sub-glacial conduits in the ice. Sub-glacial releases occur when enough hydrostatic pressure builds to float the ice dam. The Kenai Peninsula Borough has large expanses of ice fields and numerous glacier-dammed lakes. The two most notable for causing flood problems are the Snow and Skilak glacier-dammed lakes, which outlet into Kenai and Skilak Lakes respectively, and release every two to five years. Although Kenai and Skilak Lakes are large lakes and buffer the sudden influx of water, downstream flooding can be quite severe if the lakes or Kenai River are already high or frozen.

A jökulhlaup flood can occur at any time of the year, although in recent years it has occurred more frequently in the fall. One of the highest floods of record on the Kenai River happened in January 1969 when a sudden release from Skilak glacier-dammed lake lifted ice on the frozen river, severely scouring the banks as a surge of water and large ice chunks traveled downstream. At the Soldotna bridge, water levels were nine feet higher than any previous flood of record, including the 1995 100-year flood. In 2007 the water levels reached 20 feet at the Soldotna bridge, nearing the levels reached in 1969. *Maps and outburst history tables for the Skilak and Snow River Glacier-Dammed Lakes are available in Appendix F.*

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<sup>1</sup> FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.



## FLOODS and EROSION

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**Flash Floods:** Flash floods are characterized by a rapid rise in water level. They are often caused by heavy rain on small stream basins, ice jam formation or dam failure. They are usually swift-moving and debris-filled, causing them to be very powerful and destructive. Steep coastal areas in general are subject to flash floods. A number of steep alluvial streams in the Seward area are susceptible to flash flooding and debris slides. In October of 1986, after 15 inches of rain fell in a 24-hour period, widespread flood damage occurred as a result of debris avalanches and flash floods in Godwin, Lost, Box Canyon, Japanese and Spruce Creek basins<sup>1</sup>. Flash flooding and debris slides associated with steep alluvial streams also damaged property and roads in Homer and along the Homer bench.

**Fluctuating Lake Level Floods:** Although lakes can buffer downstream flooding due to their storage capacity, if inflow is excessive, flooding of the area around the lake can occur. The Kenai Lake area experiences periodic flooding due to rainfall, snowmelt and glacier-dammed lake releases.

**Alluvial Fan Floods:** Alluvial fans are areas of eroded rock and soil deposited by rivers. When various forms of debris fill an existing river channel on an alluvial fan, the river shifts to cut a new channel. Fast moving, debris filled water can cause erosion and flooding over large areas. Alluvial fan flooding in the Resurrection River, Lowell, Spruce, Box Canyon, Japanese Creek, Fourth of July and Salmon Creek drainages results in nearly annual road closures, as well as damage to property and infrastructure in the Seward area. Other eastern Peninsula alluvial streams that regularly damage road and railroad infrastructure include the Snow River, Trail Creek, Trail River, Victor Creek, Falls Creek and Ptarmigan Creek. Roads and property within the city of Homer and along the Homer bench have been damaged as a result of flash flooding and debris slides associated with steep alluvial streams.

**Coastal Storm Surge and Wave Run-Up:** Although the entire Borough coastline is susceptible to tidal storm surge, the coastal communities of Nanwalek, Port Graham, Homer, Ninilchik, Anchor Point, Hope, Seward and Seldovia are vulnerable to flooding from high tides, coastal erosion, storm surge wave run-up and storm water overflow as well as tsunamis and seiche waves.

**Tsunami and Seiche:** Tsunamis are sea waves of local or distant origin that typically are generated by earthquakes, volcanic activity or land or submarine slides. A seiche is an oscillating wave that occurs in a partially or totally enclosed body of water. Seiches can be generated by earthquakes, landslides, high winds or changes in atmospheric pressure. Because they are contained, seiche waves slosh repeatedly from side to side and continue to cause damage until the activity subsides. Tsunami and seiches are described in detail in Section 6.2.

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<sup>1</sup> Jones, S.H., and C. Zenone. 1988. Flood of October 1986 at Seward, Alaska. U.S. Geological Survey Water-Resources Investigations Report 87-4278.



# FLOODS and EROSION

## 2.4 Flood History

Peninsula-wide rivers, streams and coastal areas are a frequent source of flood and erosion damage. People are drawn to the natural beauty and resources available in these areas, and as development increases, so too do the costs associated with flooding.

The earliest flood records for peninsula streams date to the late 1940s. The Resurrection River near Seward inundated 400 acres near the airport in 1946<sup>1</sup>. Vulnerable due to its location on the Resurrection River alluvial fan, the airport has been damaged a number of times through the years. With the exception of a brief interval during the 1970s, flood records indicate the Resurrection River has flooded at least twice each decade since 1946<sup>2</sup> (summarized in Table 2-1).

**Table 2-1.** Floods of Record – Resurrection River, Salmon Creek, Kenai River and Anchor River<sup>3</sup>

Resurrection River	Salmon Creek	Kenai River	Anchor River
1946	1949	1947	1947
1951	1961	1964	1983
1957	1974	1967	1984
1960	1976	1969	1985
1961	1986	1974	1992
1962	1989	1977	2002
1986	1993	1986	2012
1989	1995	1989	
1993	2002	1993	
1995	2006	1995	
2002	2007	2002	
2006	2009	2007	
2007	2012	2009	
2009		2012	
2012			

In the Central Peninsula, one of the earliest recorded floods occurred in 1947 on the Kenai River when waters rose above the level of the Sterling Highway and flooded homes in Cooper Landing. In January of 1969, the Skilak glacier-dammed lake released into a frozen river system, causing serious ice-jam flooding along the Kenai River. In 1995, out of approximately 2,000 parcels of land in the Kenai River's 100-year floodplain, 1,248 were somehow affected by the flooding. Of those, 324 dwellings were surveyed and water damage was estimated at \$556,000<sup>4</sup>. Damage estimates did not include losses due to erosion or the wide array of fuel and septic tanks, steps, decks,

walkways and docks that were swept away. The 1995 flooding also involved the Kasilof River, where access to the Grant Fritz Subdivision was cut off for ten days due to the area being inundated with approximately six feet of water.

<sup>1</sup> FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

<sup>2</sup> FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

<sup>3</sup> Unless otherwise noted, information was excerpted from the 1999 KPB FEMA Flood Insurance Study and KPB/Office of Emergency Management files. 2002 Flood Summary was excerpted from USGS Fact Sheet 2004-3023, and email and memos from the National Weather Service.

<sup>4</sup> KPB Field Survey of Flood Damaged Homes, Oct. 1995.





# FLOODS and EROSION

As is typical of most of Alaska, detailed descriptions of historic floods on the Kenai Peninsula are rarely available. A summary of historic flood events follows in Table 2-2, and additional flood event information is included as appropriate within the subsequent Zone sections.

**Table 2-2. Kenai Peninsula Borough Floods of Record<sup>1</sup>**

Year	Location	Flooding Conditions
1883	English Bay	A debris slide into Cook Inlet during the 1883 eruption of Augustine Volcano, triggered a tsunami, which struck English Bay (Nanwalek) and Port Graham <sup>2</sup> . It was reported that the tsunami landed at low tide and caused only minor damage <sup>3</sup> .
1946	Resurrection River	First recorded flood in vicinity of the Seward airport; 400 acres inundated.
1947	Cooper Landing	A few basements flooded; water above Sterling Highway in places.
1947	Anchor Point	November rains caused river to top banks but there were no structures in the flooded area at that time.
1949	Salmon Creek	Salmon Creek overflowed at approximately River Mile 4; flooded railroad and threatened railroad bridge; floodwaters surrounded Metcalf Country Store.
1951	Resurrection River	Floodwaters rose unexpectedly at night from heavy snowmelt in the mountains due to warm weather; wells polluted by surface water; water rose five feet in the Clear Creek area.
1957	Resurrection River	River eroded easterly into the Clear Creek drainage and headwaters area; old car bodies were used to reinforce the bank in an attempt to halt the erosion.
1957	Moose Pass	Water reached the school and flooded the railroad tracks and station.
1960	Resurrection River	River overflowed; heavy flood flows caused bank erosion along the east bank above the highway.
1961	Salmon Creek	Flooded 8,000 feet of Nash Road.
1961	Resurrection River	Flooded 500 feet of the airport, eroded the runway and damaged private homes.
1962	Resurrection River	Heavy flood flows across the river's eastern floodplain; severe bank erosion above and below the highway; washed out Airport Road bridge.
1964	Kenai River	Ice-jam flooding caused five families to evacuate their homes on Ciechanski and Rebel Run Roads.
1964	Seward	After the catastrophic March 27, 1964 Good Friday earthquake, Seward was heavily damaged by quake-generated 30-40 foot tsunami waves and large

<sup>1</sup> Unless otherwise noted, information was excerpted from the 1999 KPB FEMA Flood Insurance Study and KPB/Office of Emergency Management files. 2002 Flood Summary was excerpted from USGS Fact Sheet 2004-3023, and email and memos from the National Weather Service.

<sup>2</sup> Waythomas, C.F. and R.B. Waitt. 1998. Preliminary Volcano-Hazard Assessment For Augustine Volcano, Alaska. U.S. Geological Survey, Open File Report 98-106 [[www.avo.alaska.edu/pdfs/augustine\\_ofr.pdf](http://www.avo.alaska.edu/pdfs/augustine_ofr.pdf)].

<sup>3</sup> For additional information see Tsunami and Seiche Section 6.3.



# FLOODS and EROSION

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seiche waves that occurred from landslides into Resurrection Bay<sup>1</sup>. According to the Army Corps of Engineers Waterways Experiment Station in Vicksburg, MS, the teleseismic tsunami waves that struck Seward exceeded a 500-year flood event<sup>2</sup>.

1964	South Peninsula	Ten- to thirty-foot tsunami waves generated by the Good Friday earthquake struck the communities of Homer, Seldovia, Nanwalek and Port Graham.
1964	Hope	The Good Friday earthquake caused the southern shoreline along Turnagain Arm to subside four to six feet, which caused spring tides to inundate areas five feet above the pre-earthquake tide levels. Homes in low-lying areas around town were flooded and the spring tides nearly reached the entrance to the General Store <sup>3</sup> . Similar tidal flooding occurred at the Homer Spit, where earthquake-induced subsidence lowered the Spit two to six feet and caused 70% inundation during the following autumn high tides.
1967	Kenai River	Ice-jam flooding caused 22 families (81 people) to evacuate their homes; docks, floatplanes, and many homes and businesses damaged; several trailer homes washed away.
1969	Kenai River	In the winter of 1969, a sudden surge release from the Skilak glacier-dammed lake caused a series of ice jams, serious flooding and ice scour damage from Sterling downstream to Soldotna's Rebel Run Subdivision.
1974	Kenai River	Ice-jam flooding washed out docks and boats and flooded several homes; an autumn jökulhlaup caused flooding and minor damage.
1974	Salmon Creek	Overbank flows and minor bank erosion; some minor property damage in the vicinity of the Nash Road bridge crossing.
1976	Cooper Landing	Floodwaters reached the top of the post office dock.
1976	Port Graham	Cannery flooded by coastal storm.
1976	English Bay	Airport runway partially flooded by coastal storm.
1976	Moose Pass	Water flooded sewer system, closing school.
1976	Salmon Creek	Over-bank flows and minor bank erosion. Some minor property damage in the vicinity of Nash Road crossing.
1977	Kenai River	Heavy snowmelt caused a 20-year flood in August; glacier lake dumping caused a 20-year flood in September; both resulted in moderate flooding at Salmon Run Acres (Big Eddy area).
1983	Anchor River	Flooding washed out two portions of the old Sterling Highway; erosion occurred along the south bank of the lower river, particularly along the Old Sterling Highway bridge and public campground.
1984	Anchor River	State Park flood damage included loss of a parking lot and a vaulted latrine, scouring of three other parking lots, and erosion of 500 linear feet of gabion-protected bank.
1985	Anchor River	High water in May and June washed away the bridge, flooded private property

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1 Fenner, K.D., Edwards, S.E., and T.M. Neely. 1987. Hazard Mitigation Plan for the Seward Area. 28pp.

2 FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.. For additional information see Earthquake (4.2) and Tsunami and Seiche (5.2) history sections in this plan.

3 Foster, H.L., and T.N.V. Karlstrom. 1967. The Alaska Earthquake. March 27, 1964. Regional Effects. Ground Breakage in the Cook Inlet Area. Geological Professional Paper 543-F.



# FLOODS and EROSION

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and caused significant erosion at the Anchor River State Recreation Area.

1986	South Peninsula	Heavy rains caused minor erosion in Homer, Anchor River and Ninilchik; damage at Bradley Lake, Homer and along the Anchor River. Other damage included mudslides at the Ninilchik boat harbor.
1986	Kenai River	Heavy rains on October 10-12 <sup>th</sup> damaged the Beaver Creek/Spur Highway culvert and caused major bank sloughing along the Kenai bluff.
1986	Seward	An intense storm from October 9-11 <sup>th</sup> deposited 15 inches of rain in 24 hours across broad areas of the lower Resurrection River and Salmon Creek watersheds. Flooding was widespread and catastrophic as torrential waters rushed down steep gradient mountain canyons. Massive landslides caused severe erosion and debris dams in the Godwin, Lost, Box Canyon, Japanese and Spruce Creek basins. Subsequent "surge-release" flooding occurred in numerous places as the water backed up and the dams failed. The debris dam failure on Spruce Creek resulted in a water surge of 13,600 cubic feet per second, four times greater than any previously known discharge from the basin <sup>1</sup> . Borough-wide damages to roads, bridges, and other public facilities were estimated at around \$2 million.
1989	Seward	Heavy rains on August 25-27 <sup>th</sup> caused over \$1 million in damage to homes, roads and bridges. Other areas of the Peninsula reported flooding, but sustained less damage.
1989	Kenai	In September flooding was observed along the south bank in the Riverside/Lane area (River Mile 15.5). Some homes and trailers affected; up to one foot of water on the ground. A half-dozen cabins inundated with 1 to 1.5 feet of water in the Castaway Cove area (River Mile 14.5 to 14.7).
1989-90	Drift River	Redoubt Volcano eruptions created a series of mudflows (lahars) that filled and shifted the Drift River watercourse and flooded the Drift River Oil Terminal, which is located 35 kilometers east of Mount Redoubt and 5 kilometers inland from the mouth of the Drift River. The Drift River facility and surrounding area was inundated by extensive lahars and personnel were evacuated three times. Although the facility was threatened by flooding and mudflows, no damage was reported to the oil storage tanks <sup>2</sup> .
1992	Anchor River	Flooding damage to one home was reported due to an ice jam on the north fork of the Anchor River.
1993	Seward	Heavy rains on August 26 <sup>th</sup> caused Salmon Creek, Clear Creek and the Resurrection River to flood. Three homes and one business were damaged. The railroad tracks at the upper end of Kenai Lake were damaged, and parts of Primrose Road were submerged.
1993	Cooper Landing	Jökulhlaup flooding from the Snow glacial-dammed lake submerged yards and docks along the Kenai River.
1994	Homer	Storm undercut 1/2 mile of newly paved Homer spit road.
1994	Seldovia & Nanwalek	Storm damaged a park in Seldovia and seriously damaged the Nanwalek runway.
1995	Peninsula-wide	Heavy rains caused extensive stream flooding across Southcentral Alaska.

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1 Jones, S.H., and C. Zenone. 1988. Flood of October 1986 at Seward, Alaska. U.S. Geological Survey Water-Resources Investigations Report 87-4278.

2 Waythomas, C.F., Dorava, J.M., Miller, T.P., Neal, C.A., and R.G. McGimsey. 1998 U.S. Geological Survey, Alaska Volcano Observatory, Alaska Open-File Report 97-857.

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Borough-wide damages to public facilities, commercial property and private residences exceeded \$5 million. Fisheries and watershed damage, as well as damage to recreational facilities, trails, and roads on the Chugach National Forest, was estimated at an additional \$3 million.

- |      |                |   |
|------|----------------|---|
| 1995 | Kenai River    | Heavy rains from a series of severe seasonal storms caused overbank flows that damaged homes, washed out roads, caused well and septic pollution, washed away decks, boardwalks, other improvements and property, and caused severe bank damage in River Quest, Castaway Cove, Big Eddy, Poacher's Cove, Morgan's Landing, Dow Island and Kenai Keys subdivisions. Although the total amount of private property damage can never be completely assessed, out of approximately 2,000 parcels of land located in the Kenai River's 100 year floodplain, 1,248 were affected by the flooding in 1995. Of those, 324 dwellings were surveyed and water damage was estimated at \$556,000 <sup>1</sup> .  |
| 1995 | Kasilof River  | Flooding occurred along the lower portion of the Kasilof River, east of the Sterling Highway (Mile 109), as well as on the south end of Pollard Loop Road. The river overflowed the embankment, destroyed the drainage crossing, a gravel levee, and inundated the Grant Fritz Subdivision. The area was under approximately six feet of water and road access was cut off for ten days.  |
| 1995 | Seward Area    | <p>Heavy rains associated with a series of storm fronts caused severe flooding in the Seward and outlying areas. Area roads, bridges, the airport, harbor and many homes and businesses were damaged. Road and utility repairs alone were estimated at \$3.5 million. Eastern Peninsula areas that flooded included Moose Pass, Falls Creek, Victor Creek, Primrose Creek, Snow River and Kenai Lake. In Moose Pass, rising water in Upper Trail Lake caused minor damage to a number of homes as well as to the first floor of the elementary school. South of Moose Pass, in the Victor Creek area, private lands were lost to erosion although no homes were damaged by the high water. Around the Primrose Area on Kenai Lake, homes were inundated and road access was blocked for approximately two weeks.</p> <p>In the outlying Seward area, flooding occurred along Lost Creek, Bear Creek, Glacier (Kwechak) Creek, Salmon Creek, Clear Creek, Box Canyon Creek and the Resurrection River. South of the city of Seward, substantial damage occurred to Lowell Creek Road due to high flows in both Lowell and Spruce Creeks<sup>2</sup>. Additional damage occurred within the Seward city limits from Japanese, Fourth of July, Godwin, Sawmill and Rudolph (Scheffler) Creeks<sup>3</sup>.</p> |
| 2002 | Peninsula-wide | Unusually warm temperatures, high winds and heavy rain lingered across the Kenai Peninsula from late September through the end of November 2002. Heavy rain during that time damaged areas from Portage (to the north), Cordova (to the east), Chignik (on the Alaskan Peninsula to the west) to Kodiak Island (to the south). The heaviest rains and most severe flooding occurred on the southwestern Kenai Peninsula between October 22-24 and November 23 <sup>4</sup> . The National Weather Service Doppler radar system was inoperable for a number of hours on October 20, 23 and 24. As a result, crucial information about the amount of rain falling in the Caribou Hills region was not reported and the flooding that began on the Seward side of the Peninsula struck southwestern Peninsula streams without much warning.  |

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1 Oct 1995, KPB Field Survey of Flood Damaged Homes.

2 Kenai Peninsula Borough. 1996. Flood Mitigation Plan.

3 City of Seward. 1996. Flood Hazard Mitigation Plan. City of Seward Community Development Department and Hensley Consulting Services.

4 Eash, J.D., Rickman, R.L., March 2004. Floods on the Kenai Peninsula, Alaska, October and November 2002. USGS Fact Sheet 2004-3023.



## FLOODS and EROSION

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All told, the fall floods directly affected ten communities and damage to public facilities (roads, railroad, parks, utilities, buildings and equipment) was estimated at over \$24.5 million dollars<sup>1</sup>. Of that, damage to 62 sites on the highway system was estimated at \$20.5 million, \$781,000 to State Park facilities, \$1.2 million to Borough roads and bridges and \$425,000 to power lines and underground distribution lines<sup>2</sup>. Damage to private property totaled more than \$1,225,000<sup>3</sup>.

2003	Pile Bay Road	In October of 2003, 15 inches of rain caused serious flooding on the west side of Cook Inlet between Lake Iliamna and Iliamna Bay. A State Disaster Declaration was issued and flood damage to the 14-mile (state-maintained) Pile Bay Road between Williamsport and Pile Bay Village cost nearly half a million dollars to repair. Damage to 22 sites along the first six miles of the road within the KPB accounted for \$176,800 of the total damage <sup>4</sup> .
2003	Nanwalek	Wind-driven waves in November of 2003 eroded away a 500-foot long by 40-foot wide section about halfway down the English Bay airstrip on the bay side and a 400-foot long by 40-foot wide section of runway on the lagoon side <sup>5</sup> .
2006	Seward area	On October 8, flooding, mudslides, heavy rains and extremely high winds occurred, threatening life and property in the Seward area. Seward was inaccessible by road due to flooding across the Seward Highway at mile 4. Lowell Point Bridge was heavily damaged, cutting off the Lowell Point community. Additional damage to bridge infrastructure required the replacement of the Forest Avenue and Lost Creek Bridges. Damage assessments included Old Mill Subdivision, Camelot Subdivision, Lowell Point and Old Exit Glacier Road. Initial Kenai Peninsula response costs approximated \$150,000. Recovery estimates for roads, bridges and other infrastructure were between \$3.1-\$3.5 million <sup>6</sup> .
2007	Old Mill (Seward area)	Beginning May 17 <sup>th</sup> , flooding occurred in the Old Mill Subdivision. Dredging was approved for 200 feet above and 100 feet below the Lost Creek Bridge. Approximately 100,000 cubic yards of gravel and silt were removed from Lost Creek. Flooding was a result of heavy deposits of gravel and silt from the headwaters of Lost Creek <sup>7</sup> .
2007	Kenai River Ice jams	Beginning on January 25, the Skilak Glacier-dammed lake breached, releasing a four foot high surge of water into the Kenai River. This flood dislodged rafts of ice up to four feet thick and weighing several tons. Ice jams formed and overtopped the riverbanks, with ice piling up to 15 feet high in some places. Ice jams threaten the Soldotna Bridge when water levels rose above 20 feet. Significant ice damage occurred from the community of Sterling through the City of Soldotna. Initial response and damage to both public and private facilities approximated \$5.5 million <sup>8</sup> .
2009	Drift River Lahar flows	Mount Redoubt began intermittently erupting on March 22. The largest eruption occurred on April 4. The resultant lahars caused extensive flooding at the Drift River Oil Terminal. The dike system and secondary tank containment systems held during these lahar flooding events. An incident command post

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1 Federal Emergency Management Agency (FEMA). 2002 Kenai Peninsula Flood Summary DR-1445.

2 Matthews, J. Planning and Project Management Coordinator, Homer Electric Assoc. Inc., (Email Memo).

3 Cowles, W. ADHS/ES, Private Assistance Grant Funding Summary, (email) and Jenkins, R., Small Business Administration, Private Homeowner and Business Loan Program (telephone communication).

4 Pers. Comm., Carol Sanner, Alaska Dept. of Transportation and Public Facilities, Central Region, Maintenance and Operations, Pile Bay Road Flooding Incident Spreadsheet, 3/30/04.

5 Trip Report: English Bay Runway Repairs, Nanwalek, Randel Jones, Homer Station Foreman, Alaska Dept. of Transportation and Public Facilities, 2/26/2004.

6 Seward Flood Situation Report 10/11/06 Media Release 10/13/06

7 OEM 2007 Seward Flooding File/ 6/15/07

8 Incident Fact Sheet/Claude Denver DMVA/DHS&EM/ 02/23/07

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was activated at the Sheraton Hotel in Anchorage on March 31. The primary response objectives included the safety of response personnel and protection of the environment. Prior to April 30, approximately 6.2 million gallons of crude oil were removed from the terminal. Subsequently, the remaining 13 percent, or another 841,000 gallons, of crude oil was transferred to a refinery in Hawaii<sup>1</sup>.

2009	Seward	In late July, Seward experienced flooding due to heavy rains. Lowell Point Road was closed at the bridge access and in danger of washing away. Landslides blocked Lowell Point Road. Seward airport was closed. The levee in Box Canyon Creek washed out, causing considerable flooding along Old Exit Glacier Road, Lois Way and Wilma Avenue. Initial emergency response was \$39,500. Recovery costs for road and bridge damage were approximately \$73,000 <sup>2</sup> .
2012	KPB	From September 15-30, the KPB as well as other major portions of the state experienced a severe storm with straight-line winds, flooding and landslides. The entire SBCFSA was affected with flooding September 19-30 from heavy rains, with 9 inches in one 24 hour period. The storm resulted in a federal disaster declaration <sup>3</sup> .
2013	K-Beach Road area	Beginning mid-September, heavy rains and apparently elevated groundwater resulted in flooding of many homes, properties and roads.
2013	Anchor Point area	Beginning in mid-September, heavy rains caused several roads to be impassable, cutting off numerous residents and businesses.
2013	Seward area	Beginning in mid-September, heavy rains caused the Seward Airport to be closed. Lowell Creek Bridge was not passable, cutting off residents. The City of Seward reported culvert and road damage. The Box Canyon water diversion structure was significantly compromised, threatening numerous subdivisions in the Bear Creek area.

A list of publications and additional flood hazard resources is provided in the Flood Resource Directory at the end of this chapter.

## 2.5 Floodplain Management

### 2.5.1 National Floodplain Insurance Program (NFIP)

The KPB first entered the NFIP in 1970 with passage of a resolution committing to adopt a floodplain development ordinance. In March of 1980, the Borough was suspended from the NFIP for failure to adopt the necessary regulations. A few years later, after severe fall storms caused widespread flood damage, the Borough reapplied for the NFIP. On November 18, 1986, after passage of Chapter 21.06 Floodplain Management (KPB Res. 87-13), FEMA accepted the Borough back into the NFIP.

In 1981, the U.S. Army Corps of Engineers (USACE) provided the Borough with Flood Insurance Rate Maps (FIRM), which were revised in 1983. Subsequent revisions to the original FIRM maps include a 1984 Letter of Map Revision (LOMR) for a portion of Kwechak/Glacier Creek, a 1996 LOMR for a portion of the Resurrection River above the Seward Highway and a 1999 re-map of the Big Eddy area along the lower Kenai River.

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<sup>1</sup> Drift River Terminal Coordination/Unified Command/Situation Report/04/22/09

<sup>2</sup> OEM Flood File/Seward Flooding 2009/07/30/2009

<sup>3</sup> Seward/Bear Creek Flood Service Area Hazard Mitigation Plan 2013





# FLOODS and EROSION

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Following the 2006-2007 flood events in the Seward area, KPB coordinated state, local and federal interagency efforts to begin FEMA FIRM mapping updates. This process continued through 2008; new maps for the Seward area, dated 9/27/2013, have been provided by FEMA. It is expected that other flood events will occur that could negate the effective information of the updated mapping.

As a contingency measure for this possibility, the KPB Assembly convened a task force through 2009 to determine best practices for permitting, property title/insurance identification of flood prone properties and a public information process that was presented to and mostly enacted by the KPB Assembly in the fall of 2009.

On September 16, 2008, Ordinance 2008-18-19 was enacted by the KPB Assembly, accepting and appropriating a grant of \$1,369,125 from the Natural Resources Conservation Service (NRCS) and \$228,187 from the Division of Homeland Security and Emergency Management and providing for a local match and in-kind services for conducting a voluntary buyout program in the Old Mill Subdivision, Seward. Total estimated project was \$1,825,500 and estimate for property acquisition was \$1,140,300. Properties tagged for buyout reflected recurring flood damage estimated at \$5 million with a near-term damage estimate of \$1 million<sup>1</sup>.

FEMA and the USACE prioritized stream and coastal areas for flood mapping based on the amount of at-risk existing development as well as the overall potential for future development. Areas with the most development were studied in detail, which provided floodway delineations and 100-year base flood elevations (BFEs) and wave run-up elevation predictions. Floodplain areas that have BFE information are referred to as **numbered** A and V Zones. Less-developed areas were studied by approximate methods, meaning the approximate boundaries of the 100-year flood were provided, but BFE information was not generated. Floodplain areas studied by approximate methods are referred to as **unnumbered** A and V zones<sup>2</sup>.

Detailed studies were completed for the Kenai and Kasilof Rivers, Salmon Creek, Salmon Creek Bypass and a limited portion of the Resurrection River. In addition, detailed studies to delineate coastal storm surge flood elevations were completed for several communities along Cook Inlet, Kachemak Bay and Resurrection Bay.

KPB Chapter 21.06 established floodplain management regulations for the FIRM mapped floodplains outside of the incorporated cities of Kenai, Soldotna, Seward and Homer. The Cities of Homer and Seward regulate floodplain development for FIRM areas within their incorporated boundaries<sup>3</sup>. Kenai and Soldotna do not currently regulate floodplain development in their FIRM areas and do not participate in the NFIP.

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<sup>1</sup> Kenai Peninsula Borough OEM Old Mill Buyout File/ 9/22/08

<sup>2</sup> FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

<sup>3</sup> Homer City Code – Chapter 12.12 Flood Damage Prevention; Seward City Code – Chapter 15.25 Floodplain Management.



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### 2.5.2 Flood Insurance

The NFIP is a source of reasonably-priced flood insurance for property owners that build to floodplain standards. Although insurance helps recover losses, it does not provide a complete solution, as it only pays for damage to improved land and buildings, therefore sometimes encouraging rebuilding in areas subject to repetitive flooding. According to FEMA's community insurance information system, there are currently 271 policies in the KPB (Table 2-3). Although the number of policies appears small compared to the total number of properties at potential risk, it actually is close to the national average of 12%<sup>1</sup>.

**Table 2-3.** Kenai Peninsula Borough  
Flood Insurance Summary<sup>2</sup>.

Number of Policies	340
Total Premiums	\$254,352
Insurance in Force	\$76,711,200
Number of Paid Losses	51
Value of Paid Losses	\$549,583

### 2.5.3 Repetitive Flood Losses

Although FEMA tracks repetitive insurance losses, it does not track uninsured losses, which have been significant in past flood events. A "repetitive loss property" is defined by FEMA as any property with two or more insurance claim losses in any ten-year period. If two losses occur within ten days of each other, only one loss is counted. In order for a property to be considered for repetitive loss status, the insurance claims must have occurred on or after January 1, 1978, be closed and involve at least \$1,000 in payments.

In addition to repetitive loss claims, the Borough also tracks "substantially damaged" improvements, defined as those that cost more than 50% of the improvement's market value to repair. If a substantially damaged structure is located within a mapped floodplain, repair or reconstruction must comply with floodplain building standards. After flood waters subsided in 2002, three floodplain properties in the Seward area were identified as substantially damaged<sup>3</sup>, and there were approximately five properties outside of mapped floodplains in the Anchor Point and Ninilchik areas that were identified with substantial damage<sup>4</sup>. Following the 2006/2007 flood events in the Seward area, properties in the Old Mill neighborhood were identified through the USDA Natural Resource Conservation Service (NRCS) Emergency Watershed Protection program as "buy-out" eligible to establish a conservation easement along

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1 Pers. Comm., Deborah Farmer, FM&I Branch Chief (Acting), FEMA Region 10/Mitigation, 3/13/2014

2 Pers. Comm., Taunnie Boothby, NFIP State Coordinator, Division of Community Advocacy, Department of Commerce, Community and Economic Development, 2-10-10.

3 Pers. Comm., Christy Miller, NFIP State Coordinator, Division of Community Advocacy, Department of Commerce, Community and Economic Development, 6-2-04.

4 Pers. Comm., Jane Gabler, KPB Floodplain Administrator, 6-2-04.



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the streams in that neighborhood. NRCS, KPB and residents of Old Mill are proceeding with that project as of December 2009.

## 2.5.4 Community Rating System Program

The KPB also participates in the NFIP Community Rating System, which is an incentive program that reduces premiums when communities exceed the minimum requirements of the NFIP. The KPB's Class 8 rating provides a 10% insurance premium reduction, which represents an average annual savings of \$60 per policy<sup>1</sup>.

## 2.5.5 Coastal Erosion

The western portion of the Kenai Peninsula is composed of poorly consolidated materials deposited by glaciers and rivers. This material is extremely susceptible to erosion. Until now there has been no effort to map these historical erosion rates. Several roads and houses have been lost to erosion since the 1950s. The erosion therefore impacts property values for homeowners and the Borough. This coastline also has a rapidly growing population base, with many people building near the bluff edge and then reinforcing their property once the effects of erosion become apparent. Often erosion control remedies result in increased erosion on adjacent properties.

Calculations of bluff recession over time were measured at approximately 100-meter intervals within an 86-mile study area from Homer to Nikiski. Based on these observations, the study concluded that, on average, during the period 1952-2004 the bluff has eroded one foot per year. This observation must be tempered with the understanding that some areas experience little erosion and other areas experience significant erosion. Within each of the defined areas of study, bluff erosion occurs at various rates. Areas experiencing high erosion rates are called "hot spots". These areas have been identified in the study. The area north of the Kenai River to the east Forelands has the greatest incidents of hot spot erosion. The area north of Anchor Point to the Kasilof River has the fewest such areas. The most significant hot spots experience erosion at the average rate of 2.3-5.7 feet per year. An important caveat in these observations is that erosion does not generally occur gradually. An area may not erode for many years and then suddenly slough a significant amount.

## 2.6 Flood Hazard Assessment Overview

The Kenai Peninsula Borough encompasses 24,737 square miles<sup>2</sup>, which includes Cook Inlet, and is approximately equivalent in size to the combined states of Vermont, New Hampshire and New Jersey. Within Borough boundaries there are 16,013<sup>3</sup> square miles of land, of which 9,050 are located on the Kenai Peninsula and 6,450 on the west side of Cook Inlet (Figure 1-2).

Given the Borough's large size and diversity of topography, geology, hydrology and

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1 Pers. Comm., Jeff Woodward, FEMA ISO/CRS Specialist

2 Kenai Peninsula Borough 2002 Situations and Prospects.

3 U.S. Census Bureau, County and City Data Book: 2000 (13<sup>th</sup> edition), Washington, DC, 2001, Library of Congress Card No. 52-4576.



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weather, the flood hazard risk assessment is organized into a general Borough-wide overview (which includes references to tables and figures included in Section 1). More detailed floodplain information is provided in the KPB Emergency Management Zone (North, Central, East, and South) sections which follow (see Figure 1-1).

## ***2.6.1 Risk and Vulnerability***

The extent of damage caused by any flood depends on topography, soils, vegetative cover, depth and duration of flooding, velocity of flow, rate of rise, amount of development in the floodplain and the effectiveness of flood prevention and flood fighting efforts. Critical elements of a flood hazard assessment involve:

- estimating the geographic areas at risk from flooding;
- the type and intensity of flooding;
- the probability of flood events; and
- the relative vulnerability of people and development.

Typically, communities use federally standardized Flood Insurance Studies and Flood Insurance Rate Maps (FIRMs) to identify risk and manage development in flood hazard areas.

## ***2.6.2 Floodplain Maps and Flood Risk Prediction***

The FEMA FIRM flood maps are currently the Borough's primary flood prediction and regulatory tool. It is important to realize that these maps represent the flood risk that was present at the time they were completed. As time goes by and significant natural and man-made changes occur within floodplains, the maps become less accurate for predicting flood risk. This is particularly true of the rapidly-changing alluvial streams in the Seward area. It is also true for south peninsula streams such as the Anchor and Ninilchik Rivers, where channel and floodplain characteristics were dramatically altered during the 2002, 2006, 2007, 2012 and 2013 floods.

Following the 2006-2007 flood events in the Seward area, KPB coordinated local, state and federal interagency efforts to begin FEMA FIRM mapping updates. This process continued through 2008; new maps for the Seward area have been provided (dated 9/27/2013). It is expected that other flood events will occur that could negate the effective information of the updated mapping.

In addition to the loss of predictive power that accompanies aging maps, some areas were only assessed for approximate flood boundaries (unnumbered A and V zones) or development is so recent that mapping is not yet available. Unmapped developing areas include locations next to streams, lakes, local drainages and coastal areas. In addition, as paving and other development has increased impervious surfaces, storm-



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water runoff flooding in some communities has become more problematic.

Adding a layer of complexity for flood risk assessment is the rate and amount of land subdivision and subsequent development, which has been increasing steadily in recent years in both developed and remote areas of the Borough. Another complicating factor involves the death and harvest of thousands of acres of spruce bark beetle-infested forest across the Borough (see wildfire hazard section). In recent years, accelerated timber harvest has opened access to large portions of the central and southern peninsula. Approximately 130,000 acres of infested timber on the Kenai Peninsula has been harvested, including lands in the Stariski Creek, Ninilchik River, Anchor River, North Fork Anchor River and Deep Creek watersheds. In addition to impacts from increased road building and other development, the death of millions of spruce trees is causing major ecological changes at a landscape scale, including changes to water retention and cycling processes. Concurrent with the harvest, the hydrologic cycle impacted by the mortality of mature spruce trees has increased runoff volumes significantly, affecting the flooding effects of our rivers and streams. The impact to the Borough's rivers, lakes, wetlands and other water systems from the removal (by death or harvesting) of millions of trees is still largely unknown.

Of the dozen FIRM floodplains in the KPB, nine have been entered into the KPB Geographic Information System (GIS) and linked to the Borough's tax assessment databases. GIS provides a powerful mapping and analysis tool that is useful for floodplain permitting and land management decisions. Tax parcel information provided by the GIS Department was also used for the floodplain risk analysis sections of this report.

Additional flood hazard risk assessment information specific to the communities of Seward, Kenai, Soldotna, Homer and Port Graham is included in the city annex sections at the end of this report.

As a contingency measure for this possibility, the KPB Assembly convened a task force through 2009 to determine best practices for permitting, property title/insurance identification of flood prone properties, and a public information process that was presented to and mostly enacted by the KPB Assembly in the fall of 2009.

### **2.6.3 Vulnerability Assessment**

A vulnerability assessment identifies the population, property and environment that may be exposed to flooding, and is important for understanding and reducing risk and preventing future losses. Consequences to people from flooding include the possibility of injury or death as well as the possible need for emergency sheltering due to loss of homes. Consequences to property include partial or total destruction of improvements, equipment and services. Serious flooding has the potential to disrupt vital services such as water, sewer, power and gas; can damage roadways, bridges, buildings, railroads, airport facilities, residential, commercial and recreational development; and can cause additional natural and environmental emergencies such as landslides.



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Because the data is not readily available to make site-specific predictions for 10-, 25-, 50-, 100-, or 500-year flood events, calculating each community's vulnerability to flooding is not straightforward. Although the Flood Insurance Rate Maps are somewhat dated and not predictive of all flood hazards, they currently represent the primary tool available to the Borough.

New FEMA FIRM mapping updated maps for the Seward area have been provided (dated 9/27/2013). Updated maps for the areas of Cooper Landing, Lowell Point, Kasilof, Ninilchik, Anchor Point to Homer, and mouth of the Kenai River are in the FEMA comment period; they may be available by late 2014, after this plan is revised and published. It is expected that other flood events will occur that could negate the effective information of the updated mapping.

In December 2013, the KPB Assembly adopted Resolution 2013-079, approving flood mitigation projects in the Seward/Bear Creek Flood Service Area. The mitigation projects are funded by a grant from the State of Alaska.

To assist with the vulnerability analysis section of this report, a GIS analysis of the 100-year FIRM floodplain overlays was used to calculate the number and value of parcels, improvements and acres that are within or intersect nine of the major KPB floodplains (Table 2-4). Unless otherwise noted, parcels that intersect the floodplain (and the associated structure and value estimates) were not differentiated from parcels that are completely within the floodplain. Total acreage was calculated in two ways: for parcels **intersecting** the floodplain and for total acres **within** the floodplain boundary (separate from parcel boundaries). Notes at the bottom of each summary table indicate which acreage calculation was used. Three of the KPB FIRM floodplains were not included in the GIS floodplain data analyses<sup>1</sup>.

An overview of the mapped floodplains is provided in Table 2-4. More detailed floodplain population and development assessments are included in the Zone sections, which follow. Spreadsheets used for the floodplain parcel analysis are provided in Appendix G.

**Table 2-4. Summary of Nine Mapped (FIRM) Floodplains<sup>2,3</sup>.**

Mapped Floodplains	Number of Parcels*	Total Value* (millions of \$)	Number of Parcels* with Improvements	Number of Improvements*	Value* of Improvements (millions of \$)	Total Acres**
Upper Kenai	157	\$146.7	107	323	\$23	652
Lower Kenai	2,612	\$673	1,546	3,000	\$274	5,589

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1 Due to technical problems with digitizing and geo-rectifying the FIRM maps, Nikiski, Nanwalek and Port Graham floodplains are not in the KPB GIS system and were not included in the mapped floodplain vulnerability summary.

2 Though not listed in this table, a floodplain parcel analysis was also completed for the lower 12.5 miles of the Kenai River that is within a FIRM area (see Appendix G). However the City of Kenai does not participate in the NFIP and this analysis only provides a brief overview and indication of the structures and parcels in the Kenai River floodplain.

3 Values provided by GIS search of 2013 Assessing data

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Kasilof River	243	\$49.2	109	236	\$17.4	1,330
Anchor River	36	\$3.7	19	34	\$2.1	167
Resurrection Ck	24	\$12.4	14	21	\$0.3	97
Ninilchik	75	\$3.3	20	31	\$1.8	66
Seldovia	197	\$29.3	93	146	\$12.0	136
Seward	593	\$138.5	268	527	\$58.5	2,434
Trail River	162	\$34.4	57	132	\$10.0	410
<b>TOTAL</b>	<b>4,099</b>	<b>\$1,091</b>	<b>2,233</b>	<b>4,450</b>	<b>\$399.1</b>	<b>10,881</b>

Data Source: 2013 KPB GIS System and Tax Assessment Database.

\* Value and number of parcels and improvements in the FIRM Flood Zone A includes properties that intersect but are not necessarily completely within the floodplain.

\*\* Represents an estimate of acres completely within the FIRM Flood Zone A.

### 2.6.4 Critical Facilities

Critical facilities provide essential services for public health and safety, emergency response and disaster recovery operations. They help in immediate assistance (e.g., fire, ambulance, and police) and provide care and shelter for those in need (e.g., hospitals and schools). The infrastructure that supports these services (e.g., roads, bridges, sewer and water facilities) is also essential. A list of KPB critical facilities is provided by Zone in Tables 1-18 and 1-19 in Section 1. Although a majority of the Borough's critical facility buildings and response equipment are located outside of mapped flood hazard areas, damage to roads, bridges or utility infrastructure can directly and indirectly impact the facilities and their response capabilities.

#### 2.6.4.1 Roads

Maintaining road connections is critical for providing emergency response and evacuation. Road systems in the KPB are maintained by multiple jurisdictions. Federal, state, borough, city and village governments all have a stake in managing and protecting roads from flood damage. Borough-owned roads are managed and maintained through the Kenai Peninsula Borough Road Service Area.

According to the Road Service Area Department, there are approximately ten Borough-maintained roads that are subject to repetitive flood damage<sup>1</sup>. Because flood-prone roads often create access or safety issues and are expensive to maintain and repair, new roads currently must be engineered and constructed to minimize flood impacts before they are accepted into the Borough road maintenance program. The 2003 KPB Transportation Plan identifies the lack of alternative routes for evacuation and emergency access and the need for more site-specific flood hazard mapping as key issues for Borough roads<sup>2</sup>.

An overview of KPB roads is available in Section 1.4.5 and more detailed information

<sup>1</sup> Pers. Comm., Jim Conner, Kenai Peninsula Borough Road Service Area Inspector, 4/07/2010.

<sup>2</sup> HDR Alaska, Inc. 2003. Kenai Peninsula Borough Transportation Plan Update, KPB Planning Dept.



# FLOODS and EROSION

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is available in the KPB Transportation Plan<sup>1</sup>.

Bridges and other water crossing structures, such as culverts, are vulnerable links in road networks. Depending on the design of the structure and the magnitude and type of event, bridges and culverts can fail, endangering lives, seriously impacting the stream and riparian areas and interfering with emergency response. There are approximately 60 bridges on public roads in the KPB, a majority of which are state-owned and maintained as part of the highway system. The Borough owns and maintains 14 of the 60 bridges (see Section 1.4.5, Figure 1-5).

## *2.6.4.2 Communities and Flood Risk*

Summary information for each community is included in Section 1 of this report and more detailed information specific to flood risk is provided for each zone in Sections 2.7, 2.8, 2.9 and 2.10.

## **2.6.5 Development Trends**

For areas within each zone where GIS FIRM floodplain information is available, a brief description is included of the number and size of vacant private parcels that are within or intersecting the mapped floodplains. This information is intended to provide a general sense of land that may be available for development. For the purposes of assessing development trends, three general assumptions were made:

- that one- to five-acre lots represent properties that have been subdivided and have some type of development potential;
- parcels larger than five acres have potential to be further subdivided for additional development; and
- large tracts of public land currently designated as state or national forest, park land, wilderness or critical habitat areas will not be subdivided into small lots and sold for private development.

No specific evaluation was done to determine whether vacant parcels contained factors such as steep slopes, poor soils or wetlands that could limit actual development potential. Time and resources were not available to evaluate flood hazards and development trends in other than a general way for unmapped floodplain areas.

## **2.7 North Zone**

### **2.7.1 North Zone Communities**

The North Zone covers approximately 5,469 square miles and includes the following localities and communities:

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<sup>1</sup> Ibid.



# FLOODS and EROSION

Kenai Lowlands, Cook Inlet and the west side of Cook Inlet, Beluga, Tyonek, Nikiski, Salamatof and the portions of the City of Kenai that lie north of the Kenai River.

The population of the zone is about 12,625 people, with an increase to about 20,000 during the summer tourist season. Communities with known flood hazard risks are described in Table 2-5 and shown in Figure 2-1.

**Table 2-5. North Zone Communities with Flood Hazard Risk<sup>1</sup>.**

Central Zone Community or Area	2013 Population Estimate <sup>2</sup>	Water Body	FEMA FIRM Maps	Type of Flooding
Salamatof Nikiski	5,761	Cook Inlet, Swanson River, Bishop Creek	<u>Nikiski</u> – Limited un-numbered A Zones <u>Cook Inlet</u> – limited Numbered V Zone. Note: Nikiski FIRM maps are not entered in the KPB GIS system.	Lake, riverine, coastal storm
West Side – Drift River Oil Terminal	N/A	Drift River, Rust Slough, Cook Inlet	No Flood Mapping	Riverine, volcanic debris-surge, ice-jam, coastal storm
Beluga/Tyonek	195	Three Mile Creek, Chuit River, Cook Inlet	No Flood Mapping	Riverine, coastal storm
Kenai City	7,247	Kenai River, Beaver Creek, Cook Inlet	Numbered A and V Zones – although City of Kenai does not regulate floodplain development or participate in the NFIP	Riverine, ice-jam, jökulhlaup, coastal storm
<b>Total North Zone Population</b>				<b>13,203</b>
<b>Approx. population at direct risk from flooding<sup>3</sup></b>				<b>600</b>

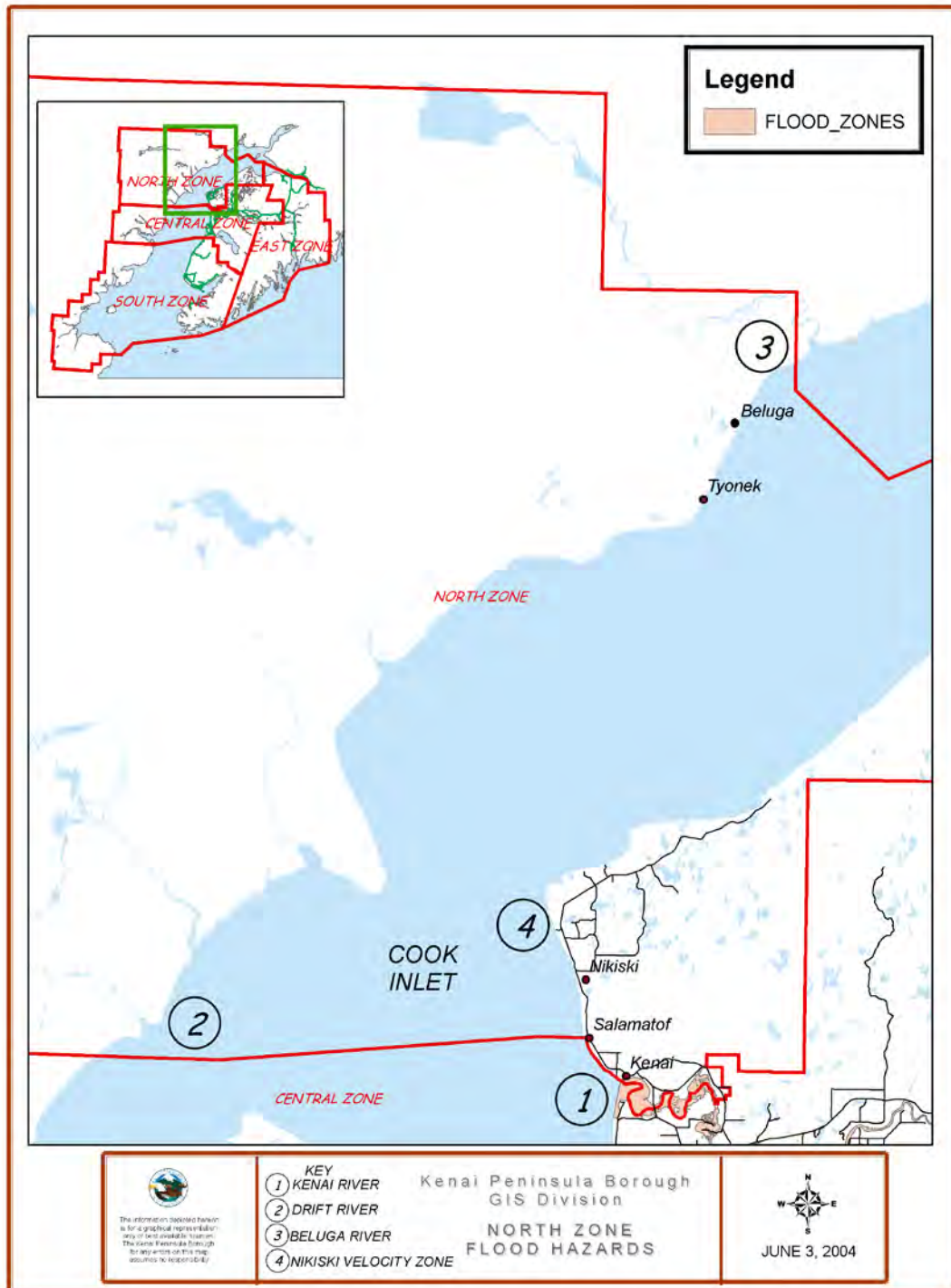
<sup>1</sup> Updated Feb 2014

<sup>2</sup> Source of Population Estimates: Alaska Department of Labor and Workforce Development, Research and Analysis, July 2013 CDP Estimates.

<sup>3</sup> Estimate of the at-risk population was generated by adding the 2007 KPB Emergency Response Plan estimate of 150 people at risk to the estimated number of people residing in the City of Kenai FIRM area. The FIRM area estimate was derived by multiplying the number of developed recreational and residential parcels within the City of Kenai FIRM area (6 recreational and 73 residential parcels) by three people per parcel.  $148 \times 3 = 444 + 150 = 590$ , which was rounded to 600.



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**Figure 2-1.** North Zone Communities and FEMA FIRM 100-Year Floodplains.



## FLOODS and EROSION

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The North Zone contains a majority of the Peninsula's oil and gas development, including 14 offshore platforms, and a number of processing facilities centered in the North Kenai-Nikiski area (Section 1.4.4, Figure 1-4). Air, land and water transportation networks are described in Section 1.4.5 and facilities and services are listed in Table 1-4. Additional information for the City of Kenai is included in Annex C.

### **2.7.2 Characteristics of Flooding**

Flooding in the North Zone could occur as the result of heavy precipitation, ice jams, rapid ice and snow melt, rapid release of glacial-dammed waters (jökulhlaup); urban storm-water runoff, tidal storm surge, coastal wave run-up, and tsunami and seiches (see also Section 6.0 Tsunami and Seiches). In addition, streams on the west side of Cook Inlet are subject to volcano lahar debris and surge release flooding.

The predominant risk of North Zone flooding involves the lower 12.5 miles of the Kenai River. With a mean tide range of nearly 20 feet on Cook Inlet, considerable backwater occurs at the mouth of the river during a high tide<sup>1</sup>. At the mouth, the bluffs to the north and the low-lying wetlands to the south are subject to periodic coastal storm-surge flooding and erosion, sometimes in combination with high river flows. High flows can occur during any season. Spring floods may occur as a result of above-normal snowfall during the preceding winter, followed by an unusually cold spring and then a rapid snowmelt. Summer and fall floods usually result from intense or prolonged rain storms.

The Kenai River is subject to glacial outburst (jökulhlaup) flooding from lakes formed in the Snow and Skilak glaciers. The Snow glacier-dammed lake releases into the Snow River, which outlets into Kenai Lake. The Skilak glacier-dammed lake releases into the Skilak River and Skilak Lake. Although the two large lakes help buffer the effect, jökulhlaup releases have caused flooding downstream on the Kenai River a number of times. A jökulhlaup can occur at any time of the year, although since 1953 the releases have generally occurred in the fall. The first recorded outburst of the Snow glacier-dammed lake was in December 1911 and the most recent occurred in November 2006 through January 2007 (*see outburst histories in Appendix F*). The highest river stage ever recorded at the Soldotna bridge occurred when the Skilak glacier-dammed lake released in January of 1969<sup>2</sup>. The ice jams and related flooding in 2007 reached similar levels and caused significant damage; however, flooding did not reach the mouth of the river, stopping near Big Eddy.

Although a number of glacier-dammed lakes exist in the vast ice fields on both the west and east sides of Cook Inlet, most drain into undeveloped areas and pose little flood risk to human populations. On the west side of Cook Inlet, the Beluga River is subject to periodic releases from a glacier-dammed lake high in the watershed. Prior to the 1989/1990 eruptions of Mount Redoubt Volcano, a glacier-dammed lake above

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<sup>1</sup> FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

<sup>2</sup> National Oceanic and Atmospheric Administration (NOAA). Snow and Skilak Glacier-Dammed Lakes Dump History.



## FLOODS and EROSION

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the Drift River Oil Tank Facility was monitored with monthly flyovers because of the perceived hazard to the facility<sup>1</sup>. After the eruptions the glacier receded enough that the lake no longer existed. During the eruptions, hot flowing lahars of mud, water and debris were carried down the Drift River Valley, surrounding and partially inundating the oil storage facility with hot mud and water. Fortunately, the oil storage tanks were not damaged. In 1990, to minimize future flood risk, a 2.5-mile, 20-foot high armored perimeter dike was built around the facility at a cost of \$20 million<sup>2</sup>. Following eruptive activity beginning in January 2009, though no significant volcanic impingement occurred, the Drift River terminal and associated pipeline and platform services were shut down, pumped off and closed in. During the summer and spring of 2009 some services returned to basic levels at Drift River. While these actions provided a sense of security related to environmental concerns, they also created a significant financial impact to the area.

In 1986, and again in 1995, heavy precipitation from seasonal storms caused severe flooding along the Kenai River as well as on the eastern side of the Peninsula. Damage to public facilities and infrastructure totaled approximately \$2 million in 1986 and around \$4 million in 1995<sup>3</sup>. During the 1995 flood, the City of Kenai spent several weeks and thousands of dollars intercepting and removing debris that was swept into the lower river, including docks, sheds, fuel tanks and damaged boats<sup>4</sup>. The 2007 ice jams and floods resulted in approximately \$2 million in public facility damages and an unknown dollar loss to private property.

In addition to riverine flood hazard, residential and commercial development adjacent to Cook Inlet is susceptible to high tides, erosion and storm surge wave run-up. In the fall of 2002, many of the Peninsula streams, including the Kenai River, were high due to extended heavy rain. Although overall property damage in the North Zone was minimal, high river water combined with high tides and wind to damage the Kenai City dock and two cannery dock bulkheads. High tides and wind also backed water up against the Bridge Access Road embankment, five miles upstream from the river mouth, at least twice during the fall storms. The City of Kenai is seeking funds to protect the bluff area of the city and associated infrastructure and private property.

The North Kenai lakes area consists of approximately 100 square miles of lakes and lowlands. The area is bounded by Cook Inlet to the north and west, Kenai to the south and the Kenai National Wildlife Refuge to the east. It is rapidly developing as a recreational and residential area. There are no major streams in the area, but interconnecting creeks between the numerous lakes constitute a possible flood threat<sup>5</sup>.

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1 Pers. Comm., David Strausser, Operations Supervisor, Drift River Oil Storage Facility, 4/29/04.

2 Pers. Comm., David Strausser, Operations Supervisor, Drift River Oil Storage Facility, 4/29/04.

3 1995 Alaska Department of Emergency Services Disaster Cost Index Report, Damage Survey Report Estimates; Individual and Family Grant Application Summary, and KPB Finance and Assessing Reports.

4 City of Kenai, Draft Local All Hazard Mitigation Plan (See Annex C).

5 FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

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## FLOODS and EROSION

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### **2.7.3 What is Susceptible to Damage During a Flood Event?**

#### **2.7.3.1 Critical Facilities**

North Zone critical facilities (fire and police stations, medical facilities and schools) are located in areas designated by the FEMA Flood Insurance Study as Zone C or D (areas of minimal or undetermined flood hazard). North Zone emergency and school facilities are described in Tables 1-14 and 1-15 of Section 1.5.3.

#### **2.7.3.2 Other Susceptible Areas or Facilities**

With the exception of their docking facilities, the North Kenai refineries are located on top of steep bluffs and are not in danger of flooding. A number of the facilities have installed sheet-pile bulkheads at the toe of the bluff to minimize coastal erosion around their dock and pipeline facilities.

There are barge landings or private docks at Tyonek, Beluga and other sites on the west side of Cook Inlet. North Zone industrial facilities are served by three deep draft piers and two shallow draft wharves. The Kenai City Dock and boat ramp are located near the mouth of the Kenai River. A number of private docks and mooring buoys on the lower Kenai River support fish processing activities.

#### **2.7.3.3 Bridges**

There are two state-maintained bridges in the North Zone, including the Warren Ames Bridge at Kenai River Mile 5 and the Swanson River Bridge at Mile 38.4 of the Kenai Spur Highway. The bridges are evaluated every two years by the Alaska Department of Transportation and Public Facilities for erosion and scour damage.

#### **2.7.3.4 FIRM Floodplain Analysis**

The KPB GIS system was used to provide an overview of floodplain development within the City of Kenai, which includes the lower 12.5 miles of the Kenai River FIRM floodplain (Table 2-6 and 2-7, and Appendix G-3). A parcel summary for the Nikiski FIRM area, which primarily covers the coastal area around the North Kenai industrial plants, is not currently available in the KPB GIS and was not included in this analysis.

**Table 2-6.** City of Kenai FIRM Area Parcel Summary (2013 Assessing data)

City of Kenai FIRM Area	
Total Parcels	296
Total Value	\$70,483,600
Total Acres	4,011
Number of Parcels with Improvements	137
Total # of Improvements	261
Total Improvement Value	\$33,250,800

*Note: Summary data is calculated for all parcels within or intersecting Flood Zone A.*

There are a total of 296 (tax) parcels valued at over \$70 million, which are within or



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intersect the lower 12.5 miles of the Kenai River's mapped 100-year floodplain. The total assessed value of homes and other improvements on the 137 developed parcels is over \$33 million. Parcel information by ownership category is summarized in Table 2-7.

**Table 2-7.** City of Kenai<sup>1</sup> FIRM Area Summary by Ownership Category (2013 Assessing data)

Parcel Summary	Private	City of Kenai	State	Native Corp.	Misc. <sup>2</sup>	Total
Total Parcels	221	55	16	1	2	295
Total Value (millions of \$)	\$56.3	\$8.3	\$4.9	\$0.1	\$0.9	\$70.5
Total Acres	331	1,458	784	73	4	2,650
# of Parcels with Improvements	128	3	2	0	0	133
Total number of Improvements	247	8	6	0	0	261
Total Improvement Value (millions of \$)	\$31.8	\$1.3	\$0.2	0	0	\$33.3

*Note: Summary data is calculated for all parcels within or intersecting Flood Zone.*

Of the 208 parcels which are within or intersect the Kenai River FIRM, 153 are privately owned with an estimated combined value of \$41.4 million. The City of Kenai owns 42 parcels (1,625 acres), which represents approximately 61% of the land (in acres) intersecting the FIRM Floodzone A.

Land use classification for floodplain parcels includes: 73 residential, 6 recreational, 2 mobile homes, 1 seafood processing plant, 3 accessory buildings, 1 parking lot and 7 commercial operations. There is also one city park (Cunningham) and two state parks (Pillars and Kenai River Flats), which provide recreational access to the Kenai River. Additional information on the City of Kenai's flood hazards is available in Annex C.

### **2.7.4 Development Trends**

The Kenai Spur Highway currently terminates approximately twelve miles north of Nikiski at Captain Cook State Recreation Area. Discussions continue on cost-effective ways to develop the road north to the Moose Point and Gray Cliff recreational subdivisions. Access to the area has primarily been by four-wheel drive or snow machines along an unimproved trail in the vicinity of the Tesoro pipeline right-of-way. Although the bluffs along Cook Inlet are high in the area, they are subject to wave run-up and coastal erosion. The area contains numerous streams, lakes and wetlands. Several of the streams provide salmon spawning and rearing habitat. Flood hazard for the recreational subdivisions is largely undetermined, although development is likely to substantially increase once improved road service is available.

### **2.7.5 Coastal Erosion North Zone**

Within the North Zone of the western Kenai Peninsula from Nikiski to the Kenai River, the range of bluff erosion is highly variable. At Nikiski the annual rate of erosion is 0.8

<sup>1</sup> Includes only the lower 12.5 river miles within Kenai City Limits.

<sup>2</sup> Miscellaneous parcels in tax foreclosure, lease, or Bureau of Indian Affairs restricted deed status.



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feet per year. From Nikiski to the Kenai River, the average rate of annual erosion is 2.2 feet per year, the highest rate on the Peninsula. The North Zone is characterized by many “hot-spots” of erosion in the range of 4.0 - 5.7 feet per year.

### **2.8 Central Zone**

#### **2.8.1 Central Zone Communities**

The Central Zone covers approximately 4,500 square miles and includes the following localities and communities:

The portion of the City of Kenai lying south of the Kenai River, Kenai Gas Fields, Kasilof, Clam Gulch, Tustumena Lake, the City of Soldotna, Kenai River and surroundings, Sterling, Funny River, Skilak Lake and Cooper Landing.

The overall population of the Central Zone is about 20,038 people, with an influx of approximately 100,000 visitors during the summer season. A large volume of tourists and other seasonal visitors utilize the rivers and coastal areas from May to August. The Kenai Visitor and Cultural Center receives more than 43,000 visitors and Soldotna Visitor Center recorded over 36,000 visitors in a summer. Much of the area outside the population centers is largely uninhabited.

Communities with known flood hazard risks are described in Table 2-8 and shown in Figure 2-2.



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**Table 2-8. Central Zone Communities with Flood Hazard Risk.**

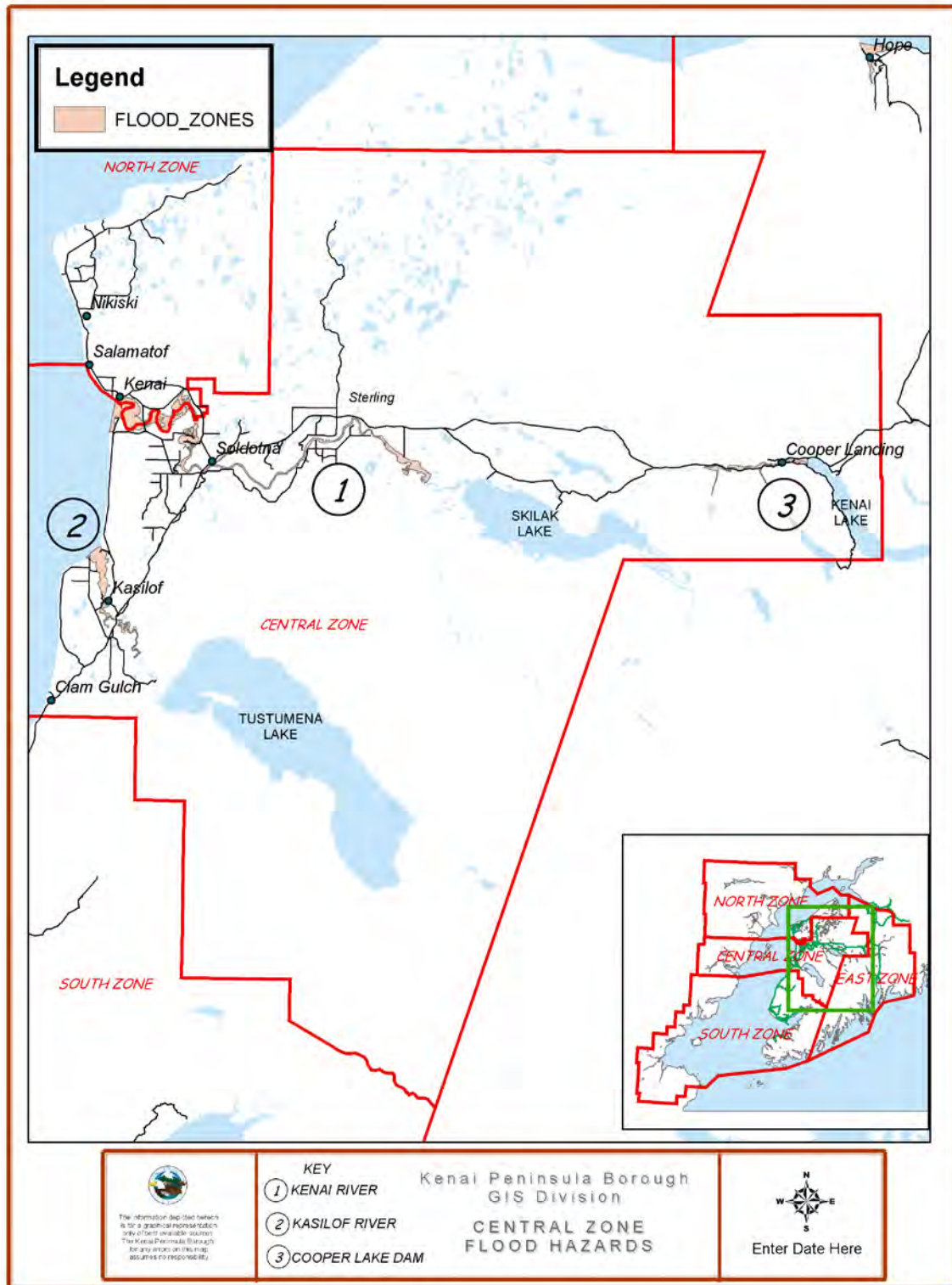
Central Zone Community or Area	2013 Pop Estimate <sup>1</sup>	Water Body	FEMA FIRM Maps	Type of Flooding
Clam Gulch	194	Cook Inlet	None	Coastal storm, riverine
Cohoe	1,383	Kasilof River, Crooked Creek, Cook Inlet	Numbered and un-numbered A and V	Coastal storm, riverine
Cooper Landing	279	Kenai River, Kenai Lake	Un-numbered A	Riverine, jökulhlaup, ice jam
Funny River	884	Kenai River, Funny River, Killey River	Numbered and Un-numbered A	Riverine, jökulhlaup, ice jam
Kalifornsky	8,337	Kenai River, Slikok Creek	Numbered A and V	Coastal storm, riverine
Kasilof	589	Kasilof River, Crooked Creek, Cook Inlet	Numbered and un-numbered A and V	Coastal storm, riverine
Soldotna City	4,284	Kenai River, Soldotna Creek	Numbered and un-numbered A	Riverine, jökulhlaup, ice jam
Sterling	5,795	Kenai River, Killey River, Moose River, Funny River	Numbered and un-numbered A	Riverine, jökulhlaup, ice jam
<b>Total Central Zone Population</b>				<b>21,745</b>
<b>Approx. Population at Direct Risk From Flooding<sup>2</sup></b>				<b>3,500</b>

<sup>1</sup> Source of Population Estimates: Source of Population Estimates: Alaska Department of Labor and Workforce Development, Research and Analysis, July 2013 CDP Estimates.

<sup>2</sup> According to the KPB GIS System, the Kenai River FIRM floodplain has 802 residential parcels and 293 recreational parcels; the Kasilof River FIRM floodplain has 63 residential and 8 recreational parcels. The total residential parcels (1166) were multiplied by 3 to generate an estimate of approximately 3,500 people.



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**Figure 2-2.** Central Zone Communities and FEMA FIRM 100-Year Floodplains.



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A description of Central Zone transportation infrastructure and facilities and services is available in Section 1.4.5 and Table 1-5. Facilities and services within the City of Soldotna are described in more detail in Annex F.

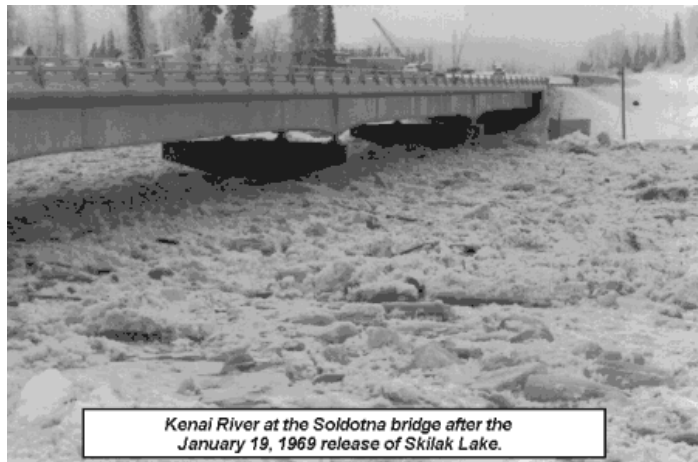
### **2.8.2 Characteristics of Flooding**

Flooding in the Central Zone is predominately associated with the Kenai and Kasilof Rivers and their tributaries. In addition, development along the Cook Inlet coastline is vulnerable to high tides, erosion, storm surge wave run-up and tsunami and seiches (See Section 6.0 Tsunami and Seiches).

Flooding associated with the Kenai and Kasilof River systems can occur as a result of heavy rainfall, ice jams, rapid snow melt or a combination of these factors. Flood hazards unique to the Kenai River system include the possible failure of the Cooper Lake dam and periodic releases of the Snow and Skilak Glacier-dammed Lakes.

High river flows can occur during any season. On the Kenai River, the highest river stage ever recorded was 22.62 feet at the Soldotna Bridge, which occurred on January 19, 1969 as a result of a rapid release of the Skilak glacier-dammed lake (see photo below)<sup>1</sup>. The resulting surge of water and ice nearly reached the bridge decking and caused severe flooding and ice scour damage along the river from Sterling to Soldotna. A similar event occurred in 2007 with ice and water levels nearing those experienced in 1969. The 2007 Kenai River ice jams and related flooding resulted in an estimated \$2 million in public infrastructure damage alone and resulted in local, state and federal disaster declarations.

In 1986, and again in 1995, heavy precipitation from seasonal storms caused severe flooding along the Kenai and Kasilof Rivers as well as on the eastern side of the Peninsula. Damage to Borough roads, bridges and other public facilities totaled approximately \$2 million in 1986 and \$4 million in 1995<sup>2</sup>.



In October and November of 2002, heavy rains caused serious flooding across the Borough, impacting a widespread area from Seward, on the east side of the Peninsula, to Chuitna across Cook Inlet to the west. Although most of the serious damage occurred on the Southern Peninsula, high water on the Kenai River at MP 48.9 and MP 55 of the

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<sup>1</sup> Snow and Skilak Glacier-Dammed Lake Discharge History.

<sup>2</sup> 1995 Alaska Department of Emergency Services Disaster Cost Index Report, Damage Survey Report Estimates, Individual and Family Grant Application Summary, and KPB Finance and Assessing Reports.





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Sterling Highway near Cooper Landing resulted in over \$1 million dollars in road embankment repairs. Crooked Creek washed out the Johnson Lake Road culverts and flooded the Crooked Creek Hatchery compound. The Killey River rose from its normal 1,000 cubic feet per second (cfs) flow to an estimated 9,000 cfs<sup>1</sup> and caused minor flooding along low lying areas of the Kenai River from Kenai Keys subdivision downstream to the city of Soldotna.

Flooding along smaller streams, such as Soldotna Creek, Slikok Creek and Crooked Creek has occurred in the past when undersized culverts jam with ice or are overwhelmed by water. In recent years, several culverts have been replaced with larger structures to help remedy flood and fish passage problems.

### ***2.8.3 What is Susceptible to Damage During a Flood Event?***

#### ***2.8.3.1 Critical Facilities***

Although it is always possible that a flood could affect public infrastructure, buildings and roads well outside of the mapped floodplain, the Central Zone's critical facilities (fire and police stations, hospital, and schools) are located in areas designated by the FEMA Flood Insurance Study as Zone C or D (areas of minimal or undetermined flood hazard).

Many of the Central Zone's critical facilities, including police and fire service, the Central Peninsula General Hospital, numerous medical clinics and a number of schools are located within the city of Soldotna. Although the Kenai River winds through the city, the banks are high and the 100-year floodplain is fairly confined. A majority of the developed property within the city was excluded from the FEMA Flood Insurance Study because it was believed to be at minimal flood risk. More information on Soldotna's flood hazards can be found in the City of Soldotna Hazard Plan (Annex F). A brief description of Central Zone critical facilities is available in Section 1.5.3 and Tables 1-14, 1-15 and Annex F.

#### ***2.8.3.2 Bridges***

There are 11 state-maintained highway bridges (Figure 1-5, Section 1.4.5 and Appendix J) in the Central Zone, including:

- Kenai Lake Outlet
- Schooner Bend (Kenai River)
- Soldotna (Kenai River)
- Moose River
- Funny River
- Cooper Creek
- Quartz Creek (Quartz Creek Road)
- Quartz Creek (Sterling Highway)

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<sup>1</sup> National Weather Service (NWS), Event Meteorology Summary of Kenai Peninsula Floods- October 22-31, 2002, internal NWS memo.



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- Daves Creek
- Kasilof River
- Crescent Creek

The Borough maintains one bridge across Crooked Creek at Running Water Road in Kasilof.

### 2.8.3.3 FIRM Floodplain Analysis

A summary of the number of parcels, improvements, acreage, and tax-assessed value within the Central Zone FIRM areas is provided in Table 2-9 and Appendices G-2 (Kasilof River), G-4 (Lower Kenai River) and G-5 (Upper Kenai River).

**Table 2-9.** Central Zone FIRM Areas Parcel Summary.

Parcel Summary	Upper Kenai	Lower Kenai	Kasilof	Total
Total Parcels*	157	2,612	243	3,012
Total Value* (millions of \$)	\$146.8	\$673.1	\$49.2	\$869.1
Total Acres**	652	5,589	1,330	7,571
Number of Parcels with Improvements*	107	1,546	109	1,762
Total Number of Improvements*	323	3,000	236	3,559
Total Improvement Value* (millions of \$)	\$23	\$274	\$17.4	\$314.40

Data Source: 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A.  
Kenai River

The Kenai River floodplain is divided into two units: the upper river, which begins at the Kenai Lake outlet and covers the Cooper Landing area, and the lower river, which covers the 47 river miles from Skilak Lake to Cook Inlet. A floodplain analysis follows for the upper and lower river floodplains.

### Upper Kenai River

A majority of the upper Kenai River watershed lies within the Chugach National Forest and the Kenai National Wildlife Refuge. Parcel information within the different ownership categories in the upper river FIRM area is summarized in Table 2-10.



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**Table 2-10.** Upper Kenai River FIRM Area Parcel Summary<sup>1</sup> by Ownership Category.

Parcel Summary	Private	Federal	State	Borough	Native	Total
Total Parcels*	119	11	21	5	1	157
Total Value* (millions of \$)	\$44.1	\$88.1	\$11.6	\$2.8	\$0	\$146.7
Total Acres **	40	510	88	0.4	13	652
Total Acres *	214	70,430	579	1,051	19	72,293
# of Parcels with Improvements*	101	3	3	0	0	107
Total # of Improvements *	308	10	5	0	0	323
Total Improvement Value* (millions of \$)	\$22.7	\$0.05	\$0.2	\$0	\$0	\$23

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A. Kenai River.

The upper river private floodplain development is centered around the community of Cooper Landing. Within or intersecting the FIRM there are 88 privately owned parcels with a total assessed value of \$35.6 million. (Table 2-10). Land use designations for all parcels intersecting the FIRM include: 38 residential, 21 recreational, 12 commercial, 3 institutional (public parks), 1 mobile home, 4 accessory buildings and 39 vacant lots. Of the 39 undeveloped parcels, 14 are private (10.23 acres), 15 are state (652 acres) and 11 are federal (71,593 acres). There are also a number of private developed parcels along Kenai Lake in the vicinity of the lake outlet, which are outside of the FIRM area.

### Lower Kenai River

Unlike the upper Kenai River where less than 1% of the mapped floodplain is in private ownership, over 27% of the land and 87% of the subdivided parcels within the lower river floodplain is privately owned. Parcel information for the major landownership categories in the lower river FIRM area is summarized in Table 2-11.

<sup>1</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.



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**Table 2-11. Lower Kenai River FIRM Area Parcel Summary<sup>1</sup> by Ownership Category.**

Parcel Summary	Private	Federal	State	Municipal	Borough	Native Corp.	Misc. <sup>2</sup>	Total
Total Parcels*	2,324	17	144	47	22	56	2	2,612
Total Value* (millions of \$)	\$531.4	\$13.7	\$78.5	\$18.6	\$6.8	\$22.2	\$1.9	\$673.1
Total Acres Within**	1,579	180	1,792	1,534	18	478	7	5,588
Total Acres Intersecting*	3,758	1,275	3,970	2,332	213	2,953	70	14,571
# of Parcels with Improvements*	1,519	2	20	4	1	0	0	1,546
Total # of Improvements*	2,934	2	48	14	2	0	0	3,000
Total Improvement Value* (millions of \$)	\$253.9	\$0.4	\$16.3	\$1.8	\$1.7	\$0	\$0	\$274

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents acreage completely within FIRM Flood Zone A.

A majority (77%) of the private parcels are subdivided into two acre or smaller lots, which are rapidly being developed for recreational, residential and commercial purposes. Within or intersecting the lower Kenai River mapped floodplain there are a total of 2,335 privately owned parcels, of which 1,623 have been developed (2,590 improvements) and have a total assessed value of \$563 million (Table 2-11). Of the private parcels, 1,380 parcels are one acre or less in size, and an additional 528 are one to two acres in size. Only 104 privately owned parcels in the lower Kenai River FIRM area remain in five-acre or larger tracts.

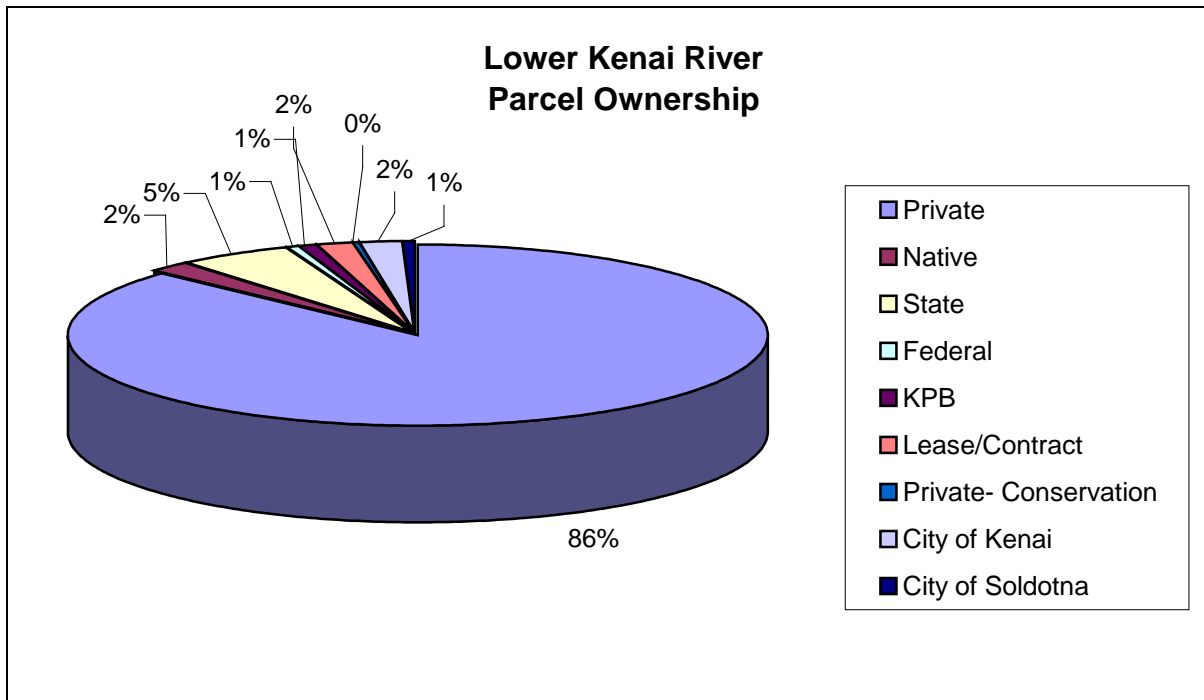
Figure 2-3 shows the number of parcels in different ownership categories, and Figure 2-4 illustrates the acres of land in the same ownership categories.

<sup>1</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.

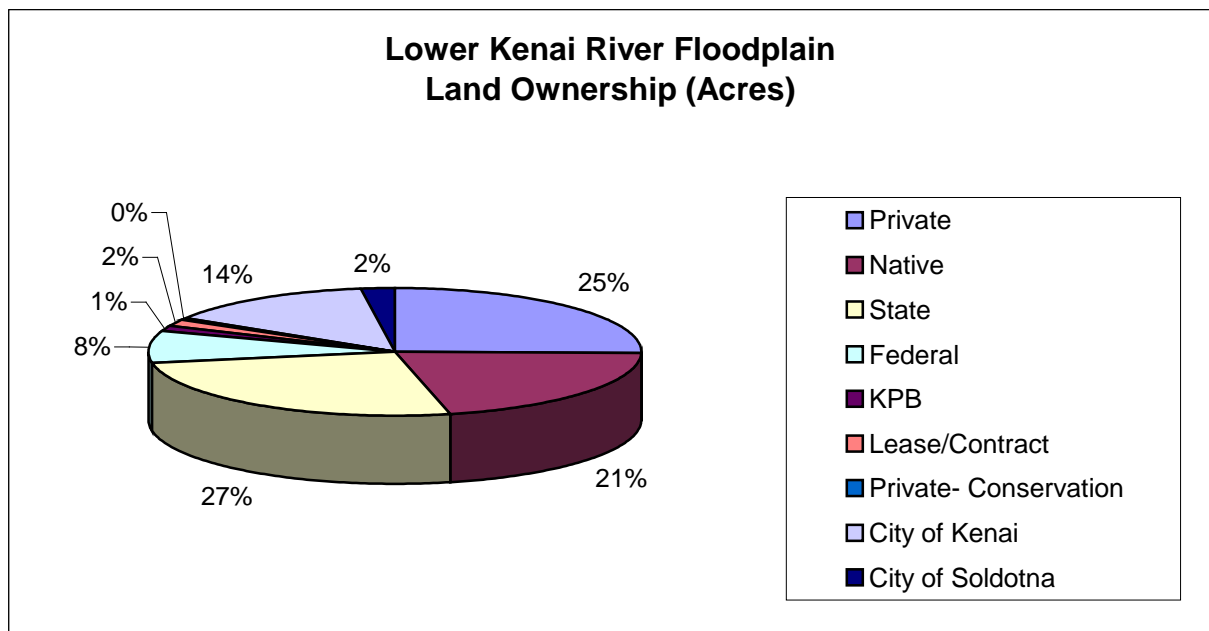
<sup>2</sup> Miscellaneous parcels in tax foreclosure, lease, or Bureau of Indian Affairs restricted deed status.



## FLOODS and EROSION



**Figure 2-3.** Comparison of Parcel Ownership in the Lower Kenai River FIRM Area.



**Figure 2-4.** Comparison of Acreage by Ownership Category in the Lower Kenai River FIRM Area.



# FLOODS and EROSION

## Kasilof River Floodplain

The Kasilof River, which originates at Tustumena Lake within the Kenai National Wildlife Refuge, meanders west for approximately 15 miles to its outlet at the community of Kasilof on Cook Inlet. The current population of the Kasilof area is estimated at 536.

**Table 2-12.** Kasilof River FIRM Area Summary by Ownership Category<sup>1</sup>.

Parcel Summary	Private	Federal	State	Borough	Native Corp.	Total
Total Parcels*	192	2	41	6	2	243
Total Value* (millions of \$)	\$36	\$4.7	\$7.6	\$0.5	\$0.5	\$49.3
Total Acres**	460	15	763	89	3	1,330
Total Acres *	1,764	7,373	1,846	151	75	11,209
# of Parcels with Improvements*	106	0	3	0	0	109
Total # of Improvements*	233	0	3	0	0	236
Total Improvement Value*(millions of \$)	\$17	\$0	\$0.4	\$0	\$0	\$17.4

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A.

Much of the terrain along the Kasilof River corridor is comprised of steep banks and a relatively narrow floodplain<sup>2</sup>. Parcel information for the FIRM mapped floodplain is summarized by ownership type in Table 2-13. Currently, within or intersecting the 100-year floodplain there are a total of 214 parcels of land with an assessed value of \$39.8 million. Of these, there are 160 private parcels, of which 105 have been developed (202 improvements) with a total assessed value of \$30.5 million.

Land use classifications for floodplain parcels include 97 residential vacant, 10 residential improved land, 71 residential, 7 residential cabins, 3 residential mobile homes, 6 residential accessory buildings, 2 lodges, 7 commercial fish processors, 3 general commercial, 1 leased vacant, 4 leased commercial, 1 gravel pit, 1 institutional, and 2 institutional accessory buildings. There are also two public boat launch facilities, and numerous private launches. The Sterling Highway Bridge provides the only road crossing for the Kasilof River.

## 2.8.4 Development Trends

### Kenai River

When the Borough incorporated in 1964, there were approximately 160 developed parcels in the lower Kenai River floodplain (Figure 2-5). By 2004, the same stretch of river had 1,392 improved parcels and an additional 853 subdivided but undeveloped parcels (Figures 2-6).

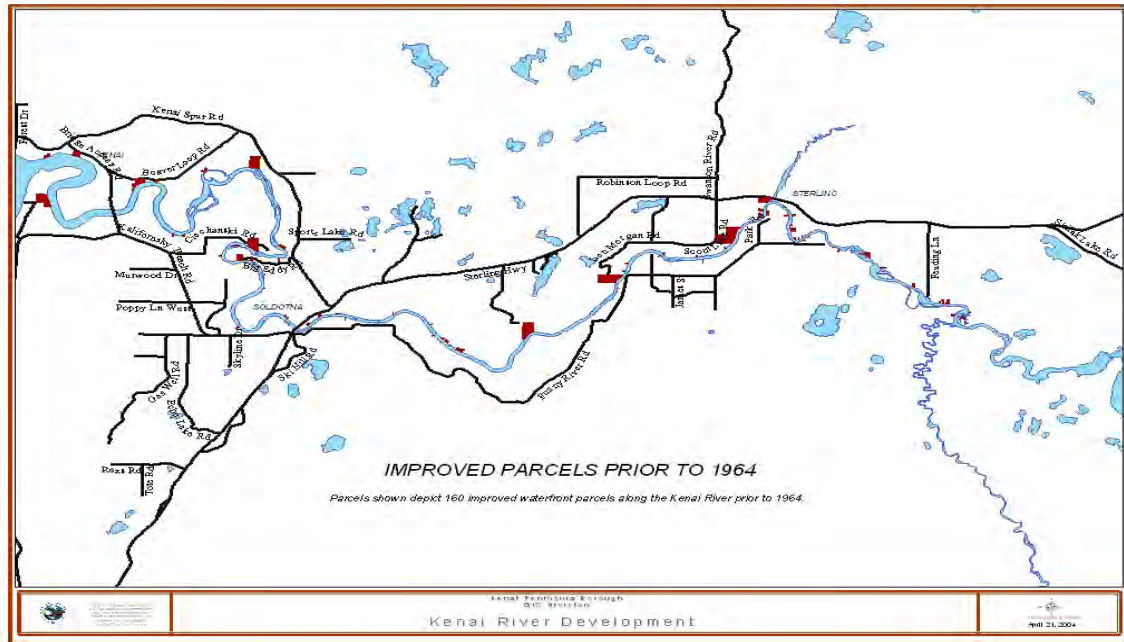
<sup>1</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.

<sup>2</sup> FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

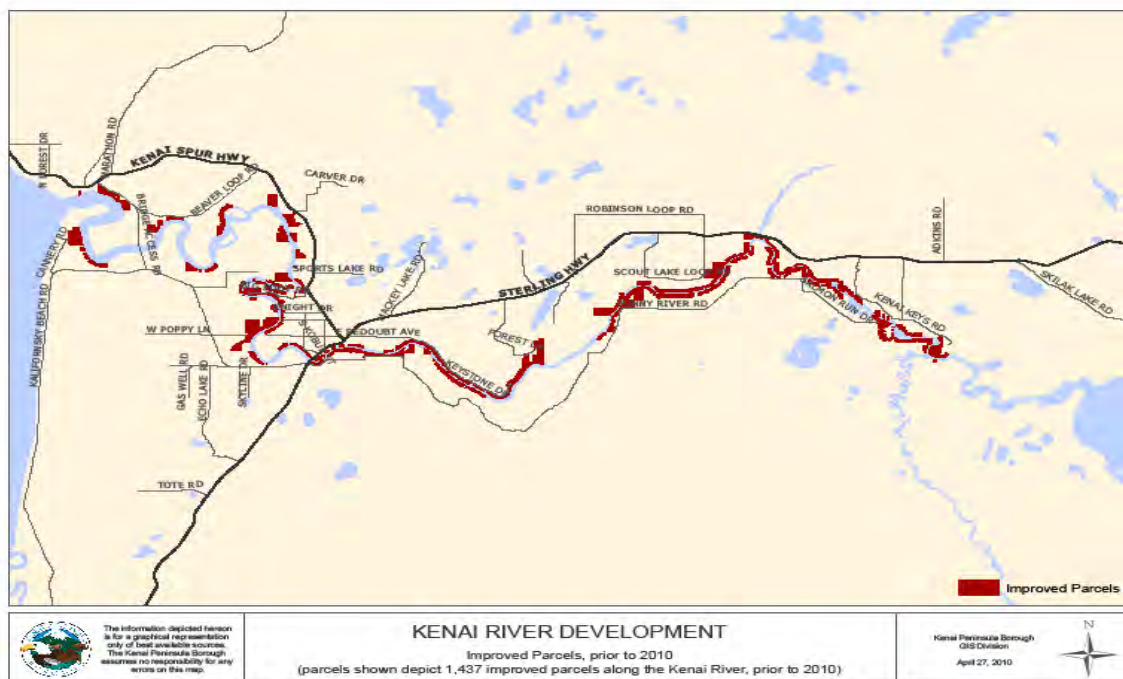




## FLOODS and EROSION



**Figure 2-5.** Location and Number of Improved Parcels Adjacent to the Kenai River Prior to 1964.



**Figure 2-6.** Location and Number of Improved Parcels Adjacent to the Kenai River in 2009.



## FLOODS and EROSION

A comparison between the 1996 *Flood Mitigation Plan* floodplain assessment <sup>1</sup> and the current 2009 GIS data, indicates a steady upward trend in private land subdivision, land value, and residential and recreational occupancy (Table 2-12).

**Table 2-13.** Floodplain Development Trends 1996 to 2009.

Year	# of Private Parcels	% Vacant	Estimated Value	Homes and Cabins	Estimated Population
1996	2,000	50 %	\$127,869,900	820	1,400
2004	2,240	38%	\$266,504,600	1,098	3,294
2009	2,335	40%	\$725,207,200	1,584	
<b>Difference</b>	<b>+ 335</b>	<b>- 10%</b>	<b>+\$597,337,300</b>	<b>+ 764</b>	<b>+</b>

Eighty-one percent or 2,140 parcels along the lower Kenai River are subdivided into two acre or smaller lots. Of these, 1,470 are developed with an estimated total assessed value of \$418,951,800. Another 760 parcels, valued at approximately \$39 million are vacant and (for the purposes of this analysis) are assumed to have some development potential. In addition, there are 242 private parcels (13,352 acres) remaining in five acre or larger tracts. These larger tracts represent potential for future subdivision. Development is also likely to occur on Cook Inlet Region, Inc. lands, which comprise 3,354 acres, or 22% of the total lower Kenai River floodplain.

Other large land tracts in the lower Kenai River floodplain are distributed between the state (4,021 acres in 69 parcels), Borough (229 acres in 5 parcels), City of Kenai (1,979 acres in 20 parcels), City of Soldotna (331 acres in 9 parcels) and the federal government (1,280 acres in 13 parcels). Although it is likely that a certain portion of lands owned by the Cities, Borough, and State University and Mental Health Trust systems will eventually be sold or developed, a majority of state land in the lower river floodplain was incorporated into the Kenai River Special Management Area and is currently being managed for habitat conservation, recreation and river access<sup>2</sup>.

### Kasilof River

Of the 160 private parcels within or intersecting the Kasilof River floodplain, only 49 are subdivided into two acre or smaller tracts, and 63 remain in parcels that are five acres or larger (Table 2-14). Depending on characteristics such as soils and topography, the potential for future land subdivision and development along the Kasilof River is substantial.

<sup>1</sup> Kenai Peninsula Borough. 1996. Flood Mitigation Plan.

<sup>2</sup> Alaska Department of Natural Resources, Division of Land, Division of Parks & Outdoor Recreation. Adopted Dec.1997. Kenai River Comprehensive Management Plan.



## FLOODS and EROSION

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**Table 2-14.** Kasilof River FIRM Area - Private Land Parcel Size Summary.

Parcel Size (Acres)	Number	Number with Improvements	Assessed Value	Improvement Value	Number of Improvements	Acres
1	6	3	\$653,100	\$351,500	5	5
>1-2 acres	43	29	\$5,720,100	\$3,403,600	49	63
>2-5	48	28	\$7,900,000	\$3,991,700	45	160
>5-10	30	24	\$7,801,200	\$4,235,700	30	209
>10-40	22	13	\$4,785,400	\$1,896,300	25	555
>40 & larger	11	8	\$3,532,500	\$1,124,800	19	738

### **2.8.5 Coastal Erosion Central Zone**

Within the Central Zone from the Kenai River to the Kasilof River, the rate of bluff erosion is 1.6 feet per year. From the Kasilof River to the Ninilchik River the erosion rate is 0.6 feet per year. The Central Zone is characterized by comparatively few “hot-spots” of erosion, but a number of areas are within the 2.3- 4.0 feet per year range.

## **2.9 East Zone**

### **2.9.1 East Zone Communities**

The East Zone covers approximately 4,960 square miles and includes the localities and communities of:

Hope, Sunrise, Moose Pass, Crown Point, Lawing, Primrose, Bear Creek, Lowell Point and the city of Seward.

The population of approximately 5,320 people increases to about 15,300 during the summer tourist season. Much of the area outside the population centers is largely uninhabited.

Communities and areas with known flood risk are described in Table 2-15. The City of Seward participates in the National Flood Insurance Program and issues permits for floodplain construction using Flood Insurance Rate Maps provided by FEMA. Additional information for is provided in the City of Seward (Annex E).



# FLOODS and EROSION

**Table 2-15. East Zone Communities with Flood Hazard Risk.**

Community	2013 Population Estimate <sup>1</sup>	Water Body	FEMA FIRM Maps	Type of Flooding
Hope/Sunrise	208	Resurrection Cr., Six Mile Cr, Cook Inlet	<i>Hope</i> – unnumbered A and V Zones	Riverine, coastal storm
Moose Pass, Crown Point, Primrose	398	Trail Lake, Trail River, Kenai Lake, Primrose, Grant, Ptarmigan, Falls, Victor Creeks	Limited Unnumbered A Zones	Riverine, lake
Seward and outlying Lowell Point, Bear Creek areas	4,573	Resurrection Bay, Resurrection River, Lowell Cr., Spruce Cr., Japanese Cr., Kwechak/Salmon Cr., Clear Cr., Lost Cr., Sawmill Cr., Grouse Cr., Godwin Cr., Fourth of July Cr.	Numbered and unnumbered A and V Zones - Although FIRM flood maps do not accurately predict flood hazards due to rapid, continual changes in the alluvial stream systems.	Riverine, alluvial fan, surge-release/debris slide, ice jam, coastal storm, tsunami
<b>Total East Zone Population</b>			<b>5,179</b>	
<b>Approx. Population at Direct Risk From Flooding</b>			<b>5,179</b>	

Because of the unpredictable nature of alluvial fan flooding, the FIRM maps were not used to estimate the population at risk of flooding. An assumption was made that nearly all East Zone residents are subject to direct or indirect impacts due to the dynamic nature of the area's flood hazards. East Zone communities and FIRM mapped floodplain areas are shown in Figure 2-7.

East Zone transportation infrastructure and facilities and services information is available in Section 1.4.5 and 1.4.7 and Table 1-6. Facilities and services within the City of Seward are described in more detail in Annex E.

## 2.9.2 Characteristics of Flooding

The East Zone is vulnerable to flooding from the following causes:

- heavy precipitation, which can occur at any time, but typically occurs from August through October;
- alluvial fan flooding;
- surge-release flooding from landslides and debris jams;
- spring ice jams and rapid snowmelt;
- tidal storm surges and coastal wave run-up;
- tsunami and seiches (See Section 6.0 Tsunami and Seiches Section);
- glacial damming and glacial outburst (jökulhlaup) flooding; and

<sup>1</sup> Source of Population Estimates: Alaska Department of Labor and Workforce Development, Research and Analysis, 2013 Estimates from CDP's.



## FLOODS and EROSION

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- failure of dikes, levees, or other diversion structures during high water events.

High stream flows can occur during any season but are most common as a result of rapid snowmelt in the spring or intense precipitation during late summer and fall. Many of the East Zone's steep-gradient mountain streams originate in unconsolidated glacial deposits, which over time have created the alluvial fans and deltas<sup>1</sup>. Flooding hazards associated with alluvial fans include<sup>2</sup>:

- high velocity (15 to 30 feet per second) floodwaters with tremendous potential for erosion, which can carry large amounts of sediment and debris, including boulders and trees; and
- the inability to confine floodwaters to a single channel. As channels fill and meander, they are capable of threatening development over a broad area.

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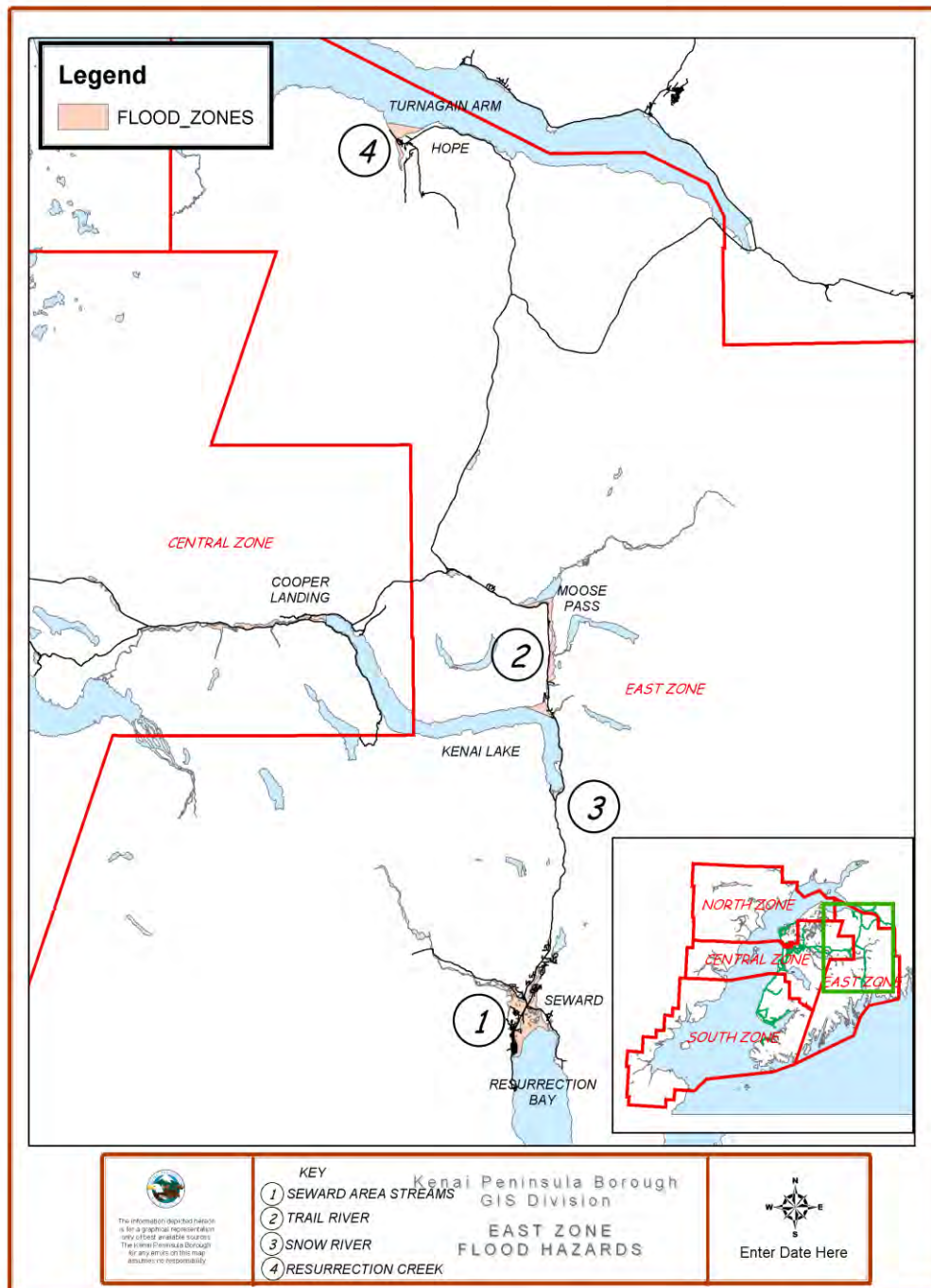
1 U.S. Army Corps of Engineers, Alaska District. 1994. Seward Area Rivers Flood Damage Prevention Interim Reconnaissance Report.

2 The Association of State Floodplain Managers. 1985. Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials.





# FLOODS and EROSION



**Figure 2-7.** East Zone Communities and FEMA FIRM 100-Year Floodplains.





## FLOODS and EROSION

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Although flooding occurs in many areas in the East Zone, a majority of the property and infrastructure damage occurs in the Seward area. The City of Seward and outlying developed areas are located primarily on alluvial fan deposits formed at the mouths of steep tributary valleys of Resurrection Bay. Streams that contribute to the alluvial fans include the Resurrection River, Box Canyon, Japanese, Lowell, Spruce, Fourth of July, Salmon, Glacier/Kwechak, Sawmill and Lost Creeks<sup>1</sup>. The fans have been built through time as large quantities of silt, sand and gravel were carried to the valley floor. Stream channels on the fans are highly unstable and regularly shift as material is deposited. Development on the fans is susceptible to flooding and erosion as the process of building and shifting continuously repeats.

Flooding problems are more pronounced during periods of heavy rainfall and rapid snowmelt. Saturated conditions contribute to slope failures, landslides, debris jams and surge-release flooding. As is typical of alluvial systems, streams frequently shift, and the corresponding changes in area, water depth and velocity contribute to unpredictable floods events.

The hazards associated with alluvial fan development have been repeatedly demonstrated in recent years. In October of 1986, the Seward area received over 15 inches of rain in a 24-hour period, saturating the steep slopes and causing severe erosion. In some areas, landslides and avalanches dammed stream channels, resulting in a surge of floodwater and debris when the dams failed. This material, which included boulders as large as eight feet in diameter, caused extensive damage to buildings and facilities located downstream on the alluvial fans<sup>2</sup>.

Three years later in 1989, a state disaster declaration was issued when heavy rains in the Seward area caused over \$1 million in damage to homes, roads and bridges. Again in September of 1995, flooding associated with Typhoon Oscar resulted in Borough, state, and federal disaster declarations and serious damage to roads, bridges, the airport, harbor and many homes and businesses. Road and utility repairs alone were estimated at \$3.5 million. Figure 2-8 shows the areas that flooded in 1986 and 1995 as well as the predicted 100-year FIRM floodplain.

Although damage was not nearly as severe as in 1986, 1989 and 1995, heavy rains that began on October 22, 2002 caused the Resurrection River to rise 5.5 feet overnight. By the morning of October 23<sup>rd</sup>, homes, buildings and roads began flooding as Bear, Kwechak/Glacier and Salmon Creek waters reached flood stage. The National Park Service closed the Exit Glacier Park road when the Resurrection River reached the bottom of the bridge. Minor flooding on the lower Resurrection River closed Runway 12-30 at the Seward Airport. An emergency effort to remove gravel at Lowell Creek occurred during the night of October 22<sup>nd</sup> when the City became

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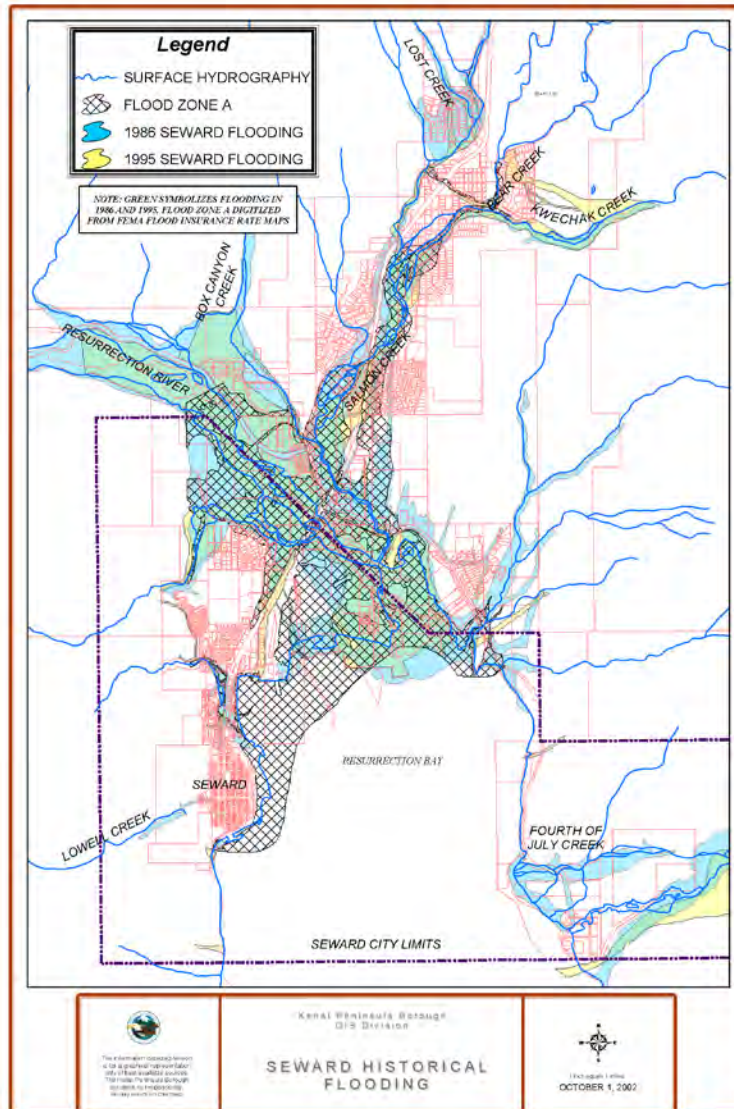
1 Kenai Peninsula Borough. 1996. Flood Mitigation Plan, and City of Seward. 1996. Flood Hazard Mitigation Plan.

2 Jones, S.H., and C. Zenone. 1988. Flood of October 1986 at Seward, Alaska. U.S. Geological Survey Water-Resources Investigations Report 87-4278.



# FLOODS and EROSION

concerned about water flow through the Lowell Creek tunnel<sup>1</sup>. Emergency in-stream gravel removal also occurred on Salmon Creek immediately downstream of the Mile 4.8 Alaska Railroad bridge to remedy water flowing down Nautical and Meridian Avenues in the Seward Park and Meridian Subdivisions.



**Figure 2-8.** Seward Area 1986 and 1995 Floods and FEMA FIRM 100-year Floodplain Boundaries

<sup>1</sup> National Weather Service (NWS), Event Meteorology Summary of Kenai Peninsula Floods- October 22-31, 2002, internal NWS memo.



## FLOODS and EROSION

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To the north, heavy rains in the Snow and Trail River drainages caused Kenai Lake to rise four feet between noon on October 22<sup>nd</sup> and noon on October 24<sup>th</sup><sup>1</sup>. Wind, waves and saturated conditions caused serious erosion to occur along the railroad embankment in more than a half-dozen locations along Kenai Lake. In addition, emergency repairs were needed at the Ptarmigan Creek railroad bridge as well as in several areas where the railroad tracks cross or closely parallel tributaries of Trail Creek and the Snow River. Minor flooding also occurred in the Primrose area along the southwestern shore of Kenai Lake.

In the last 30 years, as East Zone residential and commercial development has further encroached on riparian wetlands and alluvial streams, flooding has become more frequent and severe<sup>2</sup>. Roads, bridges, and culverts restrict stream movement and function as barriers to efficient water passage. Flood control structures require constant maintenance and have the potential for catastrophic failure or to divert flood problems to unprotected areas.

Although FIRM flood maps were generated for the Seward area, alluvial systems change rapidly and the base flood elevation and flood boundary predictions become less accurate each year. Although new maps would help, re-mapping is expensive and made less cost-effective by how quickly the maps become outdated. Unfortunately, even if funding can be found for new maps, the current flood prediction models are not capable of incorporating debris and gravel accumulation and movement, which are essential elements of alluvial fan flooding<sup>3</sup>.

For many years, area residents and agency representatives have struggled to find viable solutions to the area's volatile and chronic flood problems. During a community forum on flood issues in November of 2002, the concept of forming a Flood Service Area was discussed and in 2003 was brought forward as a ballot proposition. The proposition passed and the Seward/Bear Creek Flood Service Area was formed. A Flood Service Area Board was appointed by the Borough mayor in early 2004 and began meeting on a monthly basis. During a May 27, 2004 Flood Service Area Board community work session, a number of chronic problem areas were identified and possible mitigation solutions were discussed. A summary of information generated at the meeting follows in Table 2-16 and Figure 2-9.

In 2009, the Kenai Peninsula Borough Flood Plain Task Force was created as an alternative to a building moratorium in the Seward area. The first meeting was held on March 4, 2009 tasked through ordinance with creating a flood hazard district and a review of all effects of floodplain management. These options included the reclassifying of gravel fees, a buyout program for flood-sensitive private property and alternative ways of controlling stream flow. Starting in March of 2009, until its final

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1 National Weather Service (NWS), Event Meteorology Summary of Kenai Peninsula Floods- October 22-31, 2002, internal NWS memo.

2 City of Seward, 1996. Flood Hazard Mitigation Plan.

3 FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

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## FLOODS and EROSION

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meeting in March of 2010, the task force met eleven times, formalizing these changes to floodplain management. Task force objectives included the following:

- Stream navigability determinations,
- Resolution of gravel royalty fees,
- Soils and flood zone surveys,
- Determination of repetitive loss parcels within flood hazard zones for purchase.
- Complete a watershed master plan including channel mitigation zones.

As a result of efforts by the task force, public input and other governmental agencies, the Borough has a new set of criteria when determining risk factors, mitigation and incident recovery for flooding in the alluvial plain surrounding Seward. An ordinance has been adopted for the express purpose of developing a flood master plan. A buyout program has been established using approximately \$1.5 million dollars from grants to purchase 11 flood-sensitive properties in the Old Mill Subdivision. This is an ongoing project with more recommendations planned for introduction to the KPB Assembly.



# FLOODS and EROSION

**Table 2-16.** Flood Problem Areas and Possible Mitigation Measures<sup>1,2</sup>

Location	Map Reference (Figure 2-9)	Problem Areas	Possible Mitigation
<b>Lost Creek</b>	1	Old Mill Subdivision - area is flood-prone but not included in area floodplain mapping. Stream channels under bridges are filled with gravel and debris.	Obtain flood maps or otherwise regulate Lost Creek floodplain development; raise bridges or dredge gravel and debris to improve clearance and water conveyance.
<b>Lowell Creek</b>	13a and 13b	Potential for a tunnel blockage and diversion levee failure.	Construction of a second tunnel; continued monitoring and repair of existing tunnel.
<b>Scheffler Creek</b>	12	Culvert blockage in 1995 caused flooding across the Seward Highway and damage to a cannery and the harbor.	
<b>Resurrection River</b>	11a	ARRC pier supported bridges (situated downstream of the Seward Highway bridges) catch debris and contribute to back-water flooding above the Seward Highway.	Clear span bridges would help. In conjunction with ADOT&PF highway bridge upgrades, the ARRC plans to lengthen the span on the center bridge in the near future.
	11b	Airport runway- repetitive flood problems	ADOT/KPB/City of Seward – ongoing joint effort (which may not currently be funded?) to annually dredge the main stream channel and maintain water conveyance away from the airport.
	Not numbered	Exit Glacier Road- the river bed is filling and building and may soon overtop the armor reinforcement placed along the road embankment.	
<b>Salmon Creek</b>	7	ARRC Bridge- collects debris and fills with gravel.	Elevate, clear span or otherwise upgrade bridge to increase and maintain water conveyance.
	8	Nash Road Bridge- channel silting in with gravel and debris, clearance is no longer adequate. Also culverts in the vicinity are undersized or partially blocked and contribute to flood problems.	Raise bridge, remove gravel and debris. Oversize culverts or replace with bridges.
	9	Seriously floodprone private properties south of Nash Road.	Acquire and retain undeveloped land for floodplain conservation.
<b>Clear Creek</b>	6	The KPB is in the process of classifying, subdividing and selling part of a large parcel of land off of Old Exit Glacier	Clear Creek originates in springs on the parcel and the area historically floods from both the Resurrection River and Box Canyon Creek. Meeting participants

1 Seward/Bear Creek Flood Service Area Board Sponsored Work Session. 5/27/04

2 For 2013 update, see June 2013 SBCFSA Hazard Mitigation Plan (Tables 7-8, 7-9), adopted as Annex I of KPB Hazard Mitigation Plan <http://www.borough.kenai.ak.us/emergency-mgmt/50-borough/emergency-management/506-ahmp>



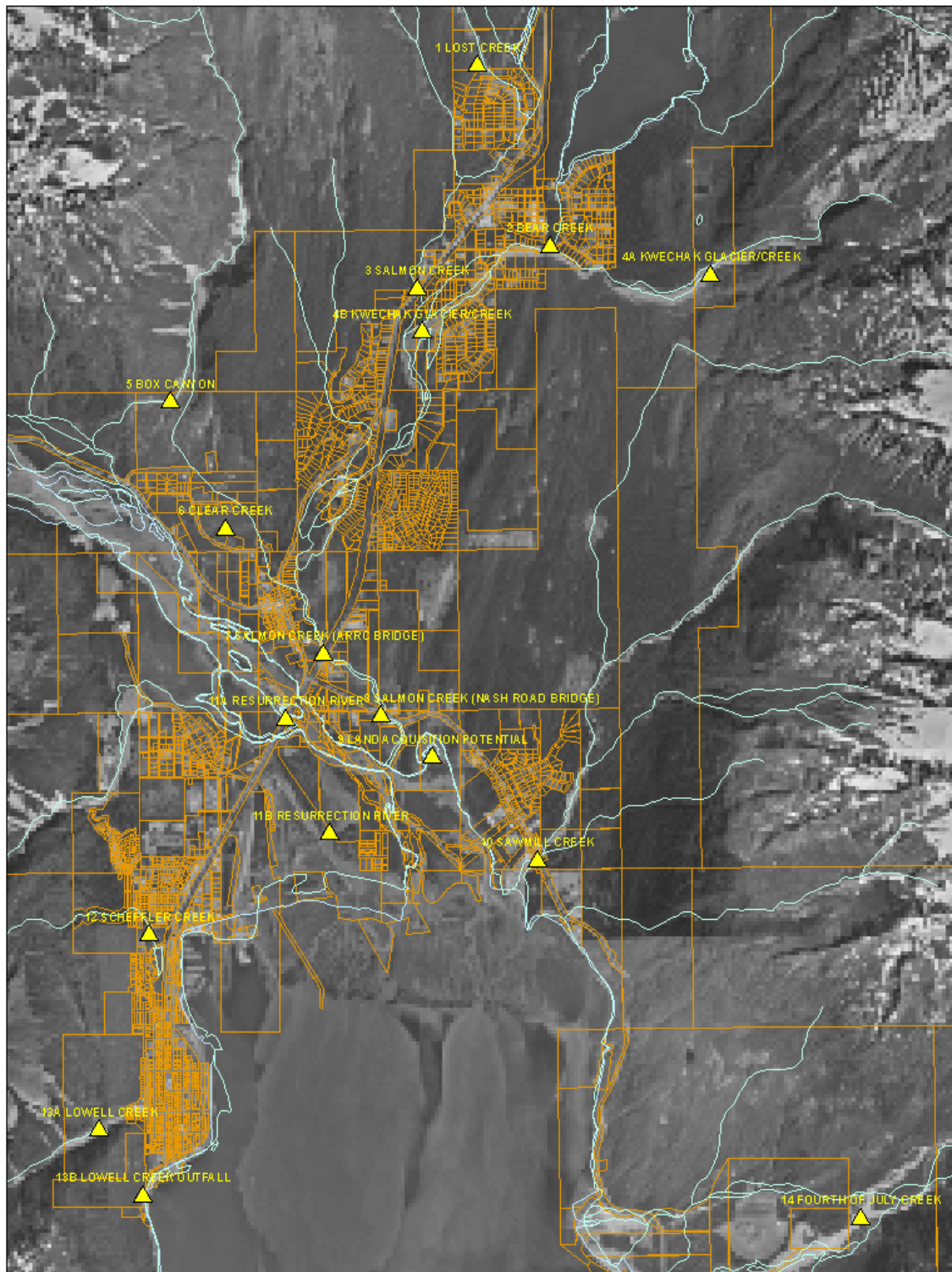
# FLOODS and EROSION

		Road. Selling these parcels will encourage more commercial development in a floodprone area.	recommended the KPB classify the entire parcel as preservation and keep it undeveloped to prevent future flood damage.
<b>Box Canyon Creek</b>	3	Debris slides/surge release flooding; stream makes a 90-degree bend as it comes out of the canyon. Past problems include overland surge flooding and problems at Exit Glacier Road.	
<b>Kwechak/ Glacier Creek</b>	4a & 4b	Floodplain is rapidly building at the canyon outlet, as well as in areas above and below Bruno bridge. The system is unstable system with a high probability that heavy rain or a debris jam in the upper watershed will cause major flood problems for down slope subdivisions (Meridian, Bear Creek, Woodrow, and Questa Woods).	Floodplain gravel extraction, particularly in the upper watershed at the canyon outlet.
	Not Numbered	Single road access into Questa Woods and Camelot-By-The-Sea, both of which are susceptible to flooding.	Identify alternative access routes. Possible alternatives include bridging Salmon Creek at a point north of Camelot-By-The-Sea and constructing a ridge road above the floodplain between Questa Woods and Camelot-By-The-Sea Subdivisions.
<b>Bear Creek</b>	2	During high water, Bear Creek causes localized flood damage as it tries to merge with Kwechak Creek.	
<b>Sawmill Creek</b>	10	Subject to debris jams and frequently causes localized damage in the vicinity of the Nash Road crossing.	





## FLOODS and EROSION



**Figure 2-9. Seward Area – Chronic Flood Problems<sup>1</sup>.**

<sup>1</sup> Seward/Bear Creek Flood Service Area Board Sponsored Work Session. 5/27/04.



## FLOODS and EROSION

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### ***2.9.3 What is Susceptible to Damage During a Flood Event?***

In recent years, the return cycle for flooding along Seward area alluvial streams appears to be on the order of two to ten years, and as development in the area has increased, so too has the potential for flood related damage. Because the Seward area is largely comprised of steep mountains and alluvial floodplains, there is very little developable property that is hazard-free. Unfortunately, development and subsequent flood protection actions taken in one location often change or worsen the severity of flooding somewhere else. The question of how to protect life and property inside and outside of the mapped floodplains is difficult, often contentious, and continues to be the focus of ongoing community and agency efforts.

Situated adjacent to Turnagain Arm and Resurrection Creek, the FIRM area for the small community of Hope includes properties in unnumbered A and V zones. Flooding occurs from Resurrection Creek as well as from high tides and wind-driven waves along Turnagain Arm. As a result of the 1964 earthquake, the southern shoreline of Turnagain Arm subsided four to six feet in places. High tides the following spring flooded areas that previously had been five feet above the pre-earthquake tide levels. Homes in low-lying areas around town were flooded and the spring tides nearly reached the entrance to the General Store<sup>1</sup>.

Past flood damage in and around the Trail River FIRM area, which includes the communities of Moose Pass, Crown Point and Primrose, has primarily affected road and railroad infrastructure.

#### ***2.9.3.1 Critical Facilities***

Most of the East Zone critical facilities (fire and police stations, hospital, schools, public sewer system) are located in areas designated by the FEMA Flood Insurance Study as Zone C or D (areas of minimal or undetermined flood hazard). Given the nature of the Seward area flood hazards, however, it is difficult to accurately assess risk. For example, many of Seward's critical facilities, such as the hospital and the police station, are located below the Lowell Creek diversion levee and tunnel. If the tunnel were to block with debris and the diversion dike fail, serious impacts to the city center and emergency response facilities are likely. Similarly, the Spring Creek Maximum Security Prison and the Seward Marine Industrial Center depend on flood protection from a diversion levee upstream on Fourth of July Creek, and residential neighborhoods and the high school depend on the Japanese Creek Levee.

Levees, including those built by the U.S. Army Corps of Engineers, have been installed over the years and are an integral part of Seward's flood mitigation. Unfortunately, they may also foster a false sense of security and encourage development in fairly high risk areas. At a minimum, they require constant

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<sup>1</sup> Foster, H.L., and T.N.V. Karlstrom. 1967. The Alaska Earthquake. March 27, 1964. Regional Effects. Ground Breakage in the Cook Inlet Area. Geological Professional Paper 543-F.



## FLOODS and EROSION

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maintenance and should be carefully monitored for function, longevity and behavior in a variety of flood scenarios. Many are on private or Native lands with landowners responsible for maintenance, which has been minimal.

More information on Seward area flood hazards is included in the City of Seward annex and in publications listed in the Flood Resource Section.

Although the Bear Creek Fire Station, which provides emergency services to the outlying Seward area, is located across the Seward Highway from the mapped Salmon Creek floodplain, it has flooded in recent years (2009/2012). This is mainly due to the fact that land subdivision and subsequent development in the area has restricted the stream to a limited portion of its fan. To address the rapid gravel deposition, the stream course and floodplain above and below the Bruno Road bridge has been subject to active dredging, bank armoring and levee maintenance activities for many years. Although gravel mining is also occurring in the Kwechak and Salmon Creek floodplains, it has not kept pace with the fan-building capacity of the streams.

The KPB Office of Emergency Management identifies schools as possible sources of emergency shelter. In Moose Pass, the elementary school floods when Trail Lake is high and the ground saturated from heavy rain. As the lake and ground water levels rise, water seeps into the concrete foundation of the school and must be pumped out. Although this situation has occurred several times and has not resulted in a threat to life or permanent damage to the structure, it may affect the use of the school as a source of emergency shelter<sup>1</sup>.

### *2.9.3.2 Transportation*

A majority of the air, land and water transportation infrastructure in the East Zone is subject to some degree of flood risk. The Seward Highway, Exit Glacier Road, Nash Road and many of the secondary subdivision roads in the Seward area have been closed by past flood events.

The Alaska Railroad closely parallels the Seward Highway through Moose Pass, Crown Point, and the Seward area. Flood damage to the railroad embankment and railroad bridges occurs regularly in places where the railroad crosses or parallels alluvial streams. Trail Creek and its tributaries, Snow River and its tributaries, the embankment along Kenai Lake and the Ptarmigan Creek bridge crossing are all areas that have experienced problems with flooding and erosion in recent years.

The Seward airport, an AKDOT&PF facility, is located on the terminus of the Resurrection River and Salmon Creek alluvial fans. In recent years, the Resurrection River has posed the most frequent and severe flood risk. A discussion of flood mitigation efforts for the airport is included in the City of Seward Annex E.

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<sup>1</sup> Pers. Comm., Nick Trudeau, Kenai Peninsula Borough Maintenance Department, 5/14/04.



# FLOODS and EROSION

The Seward Harbor was severely damaged by tsunamis after the 1964 earthquake (see Annex E). Damage also occurred at the harbor in 1995 when the lagoon outlet culverts jammed with debris, causing flooding and erosion in the harbor and serious damage to a cannery. The City of Seward is currently in the process of working to obtain permits to dredge the cruise and industrial ship areas of the harbor in order to accommodate vessels with a deeper draft.

In addition to the highly susceptible Seward area, the Trail River, Trail Creek, Kenai Lake, the Snow River and a number of tributary streams regularly flood and damage the road and railroad infrastructure. Railroad and highway bridges at Ptarmigan Creek, Victor Creek and Falls Creek have all been damaged in the past during high water events. Although the main highway embankment across the Snow River floodplain is well elevated, the road along Kenai Lake to Primrose is often subject to inundation and wave erosion from Kenai Lake.

## 2.9.3.3 Bridges

There are 41 bridges listed for the East Zone<sup>1</sup>, of which 8 are owned and maintained by the Borough (see Section 1.4.5, Figure 1-5, and Appendix J). The remaining 32 bridges are state- and city-maintained.

## 2.9.3.4 FIRM Floodplain Analysis

According to the KPB GIS database, there are a total of 778 parcels of land with a value of \$250.5 million within or intersecting the East Zone FIRM areas (Table 2-17). Of these, 373 parcels have 742 improvements valued at \$134.3 million. Additional parcel information is available for the East Zone FIRM areas in Appendices G-7, G-9 and G-10.

**Table 2-17. East Zone Overall FIRM Area Summary<sup>2</sup>.**

Mapped Floodplains	Resurrection Creek	Trail River	Seward	Total
Total Parcels*	24	162	593	779
Total Value* (millions of \$)	\$12.4	\$34.4	\$138.5	\$185.3
Total Acres**	97	410	2,433	2,940
Number of Parcels with Improvements*	14	57	268	339
Total Number of Improvements*	21	132	527	680
Total Improvement Value* (millions of \$)	\$0.3	\$10	\$58.5	\$68.9

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A.

1 HDR Alaska, Inc. 2003. Kenai Peninsula Borough Transportation Plan (Update). Prepared for the Kenai Peninsula Borough, Soldotna, Alaska [[www.kpbtransplan.net/](http://www.kpbtransplan.net/)]; Pers. comm., Gary Davis, Road Services Area Director, Kenai Peninsula Borough. Soldotna, Alaska 9/1/04.

2 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.



## FLOODS and EROSION

### Resurrection Creek FIRM Area

Resurrection Creek flows through the small town of Hope to outlet into Cook Inlet at Turnagain Arm. There are a total of 63 parcels within the Resurrection Creek FIRM area with a value of approximately \$16,503,600 (Table 2-18). Of these, 52 are privately owned with an assessed value of \$1,651,000 (Table 2-18). Twenty of the private parcels have improvements worth an estimated \$765,000 (Table 2-18).

**Table 2-18.** Parcel Summary<sup>1</sup> for the Resurrection Creek FIRM Area by Ownership Category.

Parcel Summary	Private	Federal	State	Borough	Total
Total Parcels*	19	3	2	0	24
Total Value* (millions of \$)	\$1.7	\$10.3	\$0.5	\$0	\$12.4
Total Acres Within**	19	76	2	0	97
Total Acres Intersecting*	146	22,322	78	0	22,545
# of Parcels with Improvements*	13	1	0	0	14
Total # of Improvements*	19	2	0	0	21
Total Improvement Value* (millions of \$)	\$0.3	\$0.04	\$0	\$0	\$0.34

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents acreage completely within FIRM Flood Zone A.

Land classifications for Resurrection Creek floodplain parcels include: 31 Residential Vacant, 3 Residential Improved Land, 10 Residential, 5 Residential Cabin, 3 General Commercial, 1 Institutional Accessory Building, and 10 Tidelands.

### Trail River FIRM Area

The Trail River Firm area includes the communities of Moose Pass, Crown Point, and Primrose and covers portions of Trail Lake, Trail River, Kenai Lake, Primrose Creek, Falls Creek, Grant Creek, Victor Creek and Ptarmigan Creek (Figure 2-7). There are a total of 104 parcels within the Resurrection Creek FIRM area, worth just over \$38 million (Table 2-19). Of these, 24 are privately owned with a total value of \$3,823,100. Twenty-two of the private parcels are improved and the assessed value of improvements is estimated at \$ \$2.67 million.

<sup>1</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.





# FLOODS and EROSION

**Table 2-19.** Parcel Summary<sup>1</sup> for the Trail River FIRM Area by Ownership Category.

Parcel Summary	Private	Federal	State	Borough	Total
Total Parcels*	73	9	79	1	162
Total Value* (millions of \$)	\$7.7	\$11.2	\$13.7	\$1.8	\$34.4
Total Acres Within **	25	106	276	3	410
Total Acres Intersecting*	109	27,982	5,265	3	33,359
# of Parcels with Improvements*	52	3	1	1	57
Total # of Improvements*	100	30	1	1	132
Total Improvement Value* (millions of \$)	\$5.2	\$3.2	\$0	\$1.7	\$10.1

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents acreage completely within FIRM Flood Zone A.

Land use classifications for the parcels within the Trail River FIRM area include: 73 Residential Vacant, 1 Residential Improved Land, 16 Residential Units, 3 Residential Cabins, 2 Residential Mobile Homes, 2 Residential Accessory Buildings, 1 Commercial Vacant, 3 General Commercial, 1 Institutional School, and 2 Institutional Accessory Buildings.

## Seward FIRM Area

The Seward Area FIRM analysis includes all parcels that lie within or intersect the A and V mapped zones both within the City and outlying areas. Flood mapped areas include portions of Resurrection Bay, the Resurrection River, Lowell Creek, Marathon Creek, Japanese Creek, Kwechak/Glacier Creek, and Salmon Creek. There are a total of 611 parcels within the Seward FIRM areas with an assessed value of approximately \$196 million (Table 2-20). Of these, 531 are privately owned with an approximate value of \$59 million. Of the private parcels, 303 have improvements (587 improvements) worth an estimated \$40 million. A parcel breakdown by ownership category is included in Table 2-20.

**Table 2-20.** Parcel Summary<sup>2</sup> for the Seward FIRM Area by Ownership Category.

Parcel Summary	Private	Federal	State	Borough	Native Corp	Native Allot	Municipal	Total
Total Parcels*	494	1	22	19	8	2	47	593
Total Value* (millions of \$)	\$54	\$0.03	\$40.4	\$5.8	\$0.3	\$0.4	\$37.7	\$138.6
Total Acres Within **	1,133	31	892	175	2	25	176	2,434
Total Acres Intersecting *	2,012	38	4,805	333	24	25	348	7,585
# of Parcels with Improvements*	257	0	2	2	0	1	6	268
Total # of Improvements*	497	0	17	3	0	1	9	527
Total Improvements Value* (millions of \$)	\$33	\$0	\$23.4	\$0.7	\$0	\$0.3	\$1.1	\$58.5

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents acreage completely within FIRM Flood Zone A.

<sup>1</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.

<sup>2</sup> Ibid.





## FLOODS and EROSION

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Land use classifications for the parcels within the Seward FIRM area include: 273 Residential Vacant, 28 Residential Improved Land, 177 Residential Units, 3 Residential Cabins, 26 Residential Mobile Home, 1 Condominium, 39 Residential Accessory Buildings, 6 Commercial Vacant, 1 Apartment Building, 2 Mobile Home Parks, 3 Lodges with Multiple Cabins, 1 Commercial Fish Processing, 26 General Commercial, 6 Commercial Parking Lots, 1 Commercial Accessory Building, 2 Leased Commercial, 1 Leased Industrial, 1 Leased Institutional, 2 Gravel Pits, 3 Institutional Vacant, 3 General Institutional, 3 Institutional Parking Lots, and 2 Institutional Accessory Buildings.

### **2.9.4 Development Trends** **Resurrection Creek**

Within or intersecting the mapped Resurrection Creek floodplain there are 52 privately owned parcels, of which 20 are developed and 32 are vacant (Table 2-18). Of the vacant parcels, 21 are one acre or less in size, and 6 are two to five acres in size. There are two private tracts that are greater than five acres in size. A majority of the surrounding land is Chugach National Forest, which is managed for multiple uses such as recreation, timber harvest and mining. Although there is some room for limited recreational and residential growth in the Hope area, much of area (including the floodplain) is federally owned and is unlikely to be developed in the near future.

### **Trail River**

Within or intersecting the Trail River FIRM area, there are 24 privately owned parcels, of which 22 are developed (Table 2-19). With a majority of land in public ownership, floodplain development should remain relatively limited. State and Chugach National Forest lands are currently managed for multiple uses, including recreation, timber harvest and mining. Parcel information for the different ownership categories within the Trail River FIRM area is summarized in Table 2-19.

### **Seward Area**

Within or intersecting the Seward FIRM area, there are 531 privately owned parcels of which 303 are developed and 228 are vacant (Table 2-20). Of the vacant parcels, 117 are one acre or less in size and 37 are two to five acres in size. The one- to five-acre lots typically represent properties that have already been subdivided for sale and development. There are 43 remaining privately owned parcels that are 5 acres or greater in size. A number of these may eventually be subdivided for future development. Although there may be some exceptions, it is highly probable that a majority of future development in the Seward area will have the same unpredictable flood hazard risk as existing development. Parcel information for the different ownership categories within the Seward Area FIRM is summarized in Table 2-20

## **2.10 South Zone**

### **2.10.1 South Zone Communities**

The South Zone covers approximately 8,386 square miles and includes the following communities and localities:



# FLOODS and EROSION

Ninilchik, Happy Valley, Anchor Point, Nikolaevsk, Diamond Ridge, Fritz Creek, Voznesenka, Razdolna, Kachemak Selo, Homer, Kachemak City, Seldovia, Port Graham and Nanwalek

The overall population of the zone is about 13,000 people, with an increase to about 22,000 during the summer tourist season. Much of the area outside the population centers is largely uninhabited.

Communities with known flood hazard risks are shown in Table 2-21 and Figure 2-10. The City of Homer participates in the National Flood Insurance Program and issues permits for floodplain construction using Flood Insurance Rate Maps provided by FEMA. More detailed flood hazard information for the Cities of Homer and Kachemak is included in their respective annex.

**Table 2-21. South Zone Communities and Known Flood Hazards.**

Community	2013 <sup>1</sup> Population Estimate	Water Body	FEMA FIRM Maps	Type of Flooding
Ninilchik	855	Ninilchik River, Deep Creek, Cook Inlet	Limited Unnumbered A & V Zones	Riverine, coastal Storm
Anchor Point, Nikolaevsk	2,320	Anchor and North Fork Anchor Rivers, Cook Inlet	<u>Anchor River</u> – Limited Unnumbered A & V Zones <u>North Fork Anchor River</u> - no flood mapping.	Riverine, ice jam, coastal storm
East End Road, Fritz Creek, Homer, Diamond Ridge, Kachemak City, Fox River	8,659	Numerous streams including Fritz, Beaver, Fox and Bridge Creeks, the Bradley River, Kachemak Bay	<u>Homer</u> – Numbered A and V zones.  <u>Outlying areas</u> – no flood mapping	Mud and debris slides, riverine, coastal storm
Nanwalek, Port Graham, Seldovia	810	Port Graham Bay, English Bay, Seldovia Bay, Fish Creek	Limited unnumbered A and V Zones	Coastal storm, tsunami, riverine
<b>Total South Zone Population<sup>2</sup></b>				<b>12,308</b>
<b>Approx. Population at Direct Risk From Flooding<sup>3</sup></b>				<b>357</b>

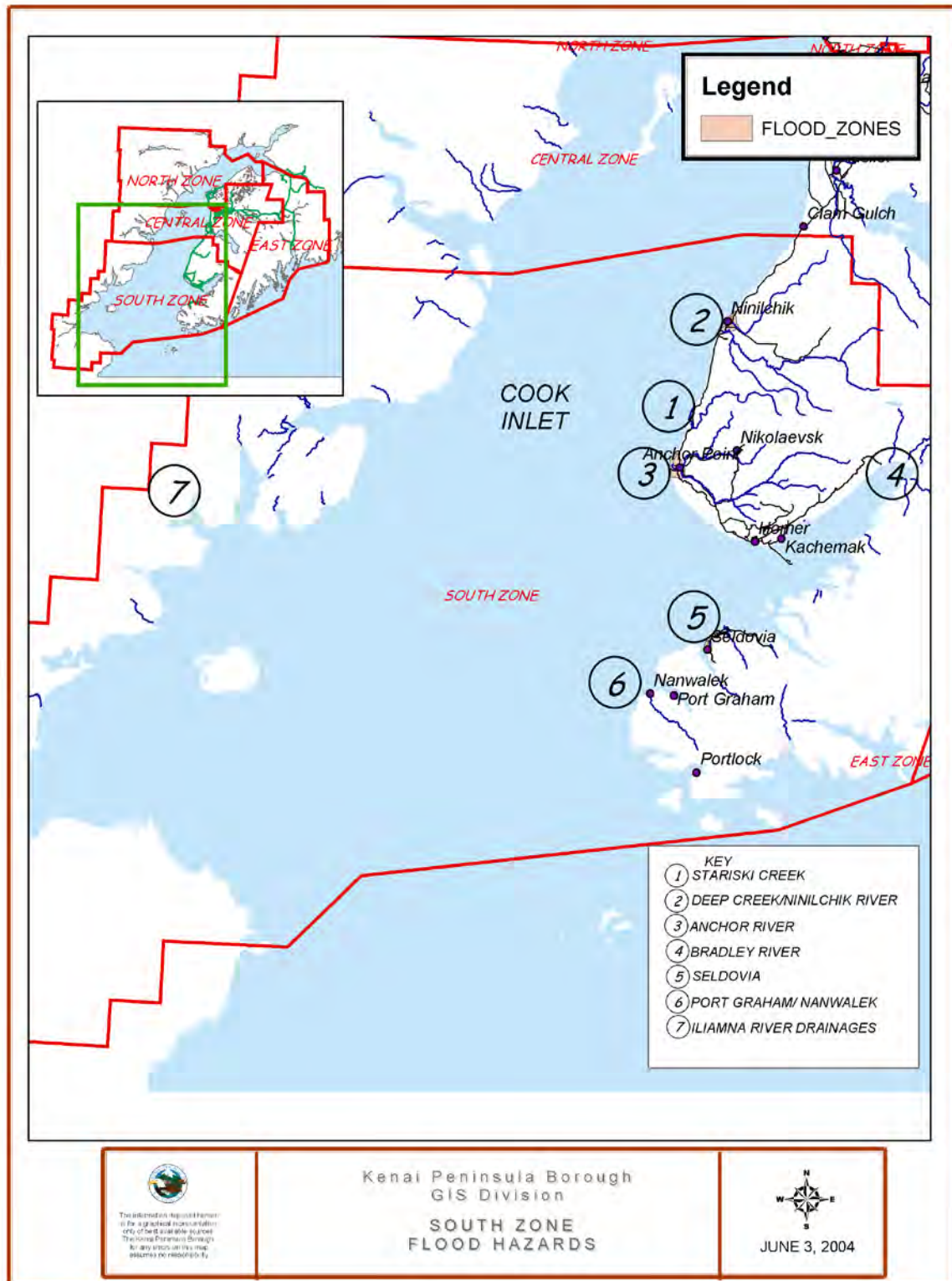
<sup>1</sup> Alaska Department of Labor and Workforce Development, Research and Analysis, 2013 CDPs.

<sup>2</sup> Alaska Department of Labor and Workforce Development, Research and Analysis, 2013 CDPs.

<sup>3</sup> According to the GIS database, the Anchor River FIRM floodplain has 17 residential parcels and 19 recreational parcels; the Ninilchik FIRM has 19 residential parcels and 2 recreational parcels; the Seldovia FIRM has 55 residential parcels and 7 recreational parcels. The total parcels (119) were multiplied by 3 to generate an estimate of approximately 357 people. The City of Homer FIRM areas were not included in this analysis.



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**Figure 2-10.** South Zone Communities and FEMA FIRM 100-Year Floodplains.



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A description of South Zone transportation infrastructure and facilities and services is available in Section 1.4.5 and 1.4.7 and Table 1-7. Facilities and services within the Cities of Homer and Kachemak are described in more detail in their annex.

### **2.10.2 Characteristics of Flooding**

Riverine system flood damage in the South Zone is predominately associated with the Anchor and North Fork Anchor Rivers, Deep Creek and Ninilchik River, as well as numerous smaller tributaries. Flooding on these river systems can occur as a result of heavy rainfall, ice jams, rapid snow melt or a combination of factors.

Along the Homer Bench on Kachemak Bay's north shore, heavy rains quickly saturate alluvial soils causing the water table to rise and liquefy the clay trapped soils. Seeps form and the coastal bluffs are susceptible to slumping and landslides.

The coastal communities of Nanwalek, Port Graham, Homer, Ninilchik, Anchor Point and Seldovia are subject to flooding from high tides, coastal erosion, storm surge wave run-up and stormwater overflow, as well as tsunamis and seiche waves (See Section 6.0: Tsunamis and Seiches). The Nanwalek airstrip, which is adjacent to English Bay, is particularly vulnerable to coastal wind and wave action. In November of 2003, a 500-foot long by 40-foot wide section of Nanwalek's airstrip on the bay side and a 400-foot long by 40-foot wide section of runway on the lagoon side were eroded away during a storm<sup>1</sup>.

Although flooding can happen during any season, the most serious floods of record for South Zone streams occurred in the fall of 2002. Starting in late September, unusually warm temperatures, high winds and heavy rain lingered across the Kenai Peninsula. The heaviest rains and most severe damage occurred between October 22-24 and November 23<sup>2</sup>.



The 2002 fall floods directly or indirectly affected a majority of South Zone communities and public facilities. Damage to roads, railroad, park facilities, utilities, buildings and equipment was estimated at over \$24.5 million dollars<sup>3</sup>. In addition to public infrastructure, private property damage totaled more than \$1,225,000<sup>4</sup>. Total damage to 62 sites on the highway system was estimated at \$20.5 million, with additional damages of \$781,000 to State Park facilities, \$1.2 million to Borough roads

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1 Trip Report: English Bay Runway Repairs, Nanwalek, Randel Jones, Homer Station Foreman, Alaska Dept. of Transportation and Public Facilities, 2/26/2004.

2 Eash, J.D., Rickman, R.L., March 2004. Floods on the Kenai Peninsula, Alaska, October and November 2002. USGS Fact Sheet 2004-3023.

3 FEMA 2002. 2002 Kenai Peninsula Flood – DR-1445 Damage Summary.

4 Cowles, W. ADHS/ES, Private Assistance Grant Funding Summary, (email) and Jenkins, R., Small Business Administration, Private Homeowner and Business Loan Program (telephone communication).





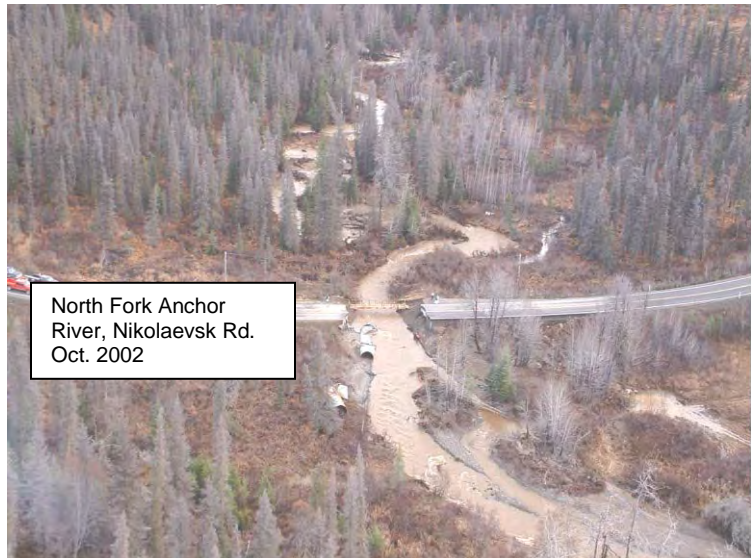
## FLOODS and EROSION

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and bridges and \$425,000 to power lines and underground distribution lines<sup>1</sup>. The culverts on Johnson Lake Road at Crooked Creek near the Sterling Highway were washed out by the 2002 floods, and rather than replace them, the stream was restored and a salmon-viewing area established.

During the flooding, eight streams exceeded previous record flows and many others reached near-record discharges<sup>2</sup>. Rainfall in the Bradley River Basin at the head of Kachemak Bay was 400% above average. Stariski Creek, Deep Creek, Anchor River and the Ninilchik River all surpassed previous recorded peak flows as well as predicted 100-year flows. Bridge approach and culvert washouts occurred at Deep Creek, the Anchor River and Stariski Creek, closing the Sterling and Old Sterling Highways between Ninilchik and Homer in several places for a number of days. Miraculously, no one was seriously injured when two cars traveled, one after the other, across a five-foot breach in the Deep Creek bridge approach that later widened to fifteen feet. In addition to major highway and bridge washouts, telephone and power lines were damaged and numerous secondary roads washed out or were closed for safety.

The Ninilchik beach access road as well as the Ninilchik Village bridge approach washed away, closing access to the Village, beach and harbor. Similarly, the village of Nikolaevsk was isolated when the culverts at the North Fork Anchor River crossing washed out. Steep terrain and overbank stream flows combined to deposit mud over a considerable portion of west Homer. Culverts plugged or were overwhelmed and minor roadbed damage occurred along the East End Road at Bear and Fritz



Creeks. A number of homes and driveways along the creeks were also damaged by erosion, water and mud<sup>3</sup>. In addition to major road and power outages, the Borough's Office of Emergency Management (OEM) received over 150 reports of private property damage, which included homes, driveways, septic systems, wells, businesses, and vehicles. Numerous Borough and private roads and bridges washed out, stranding at least 84 families in remote subdivisions.

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<sup>1</sup> Matthews, J. Planning and Project Management Coordinator, Homer Electric Assoc. Inc., (Email Memo).

<sup>2</sup> Eash, J.D., Rickman, R.L., March 2004. Floods on the Kenai Peninsula, Alaska, October and November 2002. USGS Fact Sheet 2004-3023.

<sup>3</sup> National Weather Service (NWS), Event Meteorology Summary of Kenai Peninsula Floods- October 22-31, 2002, internal NWS memo.



# FLOODS and EROSION

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A month later, while emergency repairs from October's flooding were still underway, heavy rain over the Caribou Hills caused a second round of flood damage along south Peninsula streams. East End Road near Homer was closed by mudslides, and before the stream gauge was destroyed, the Anchor River was running nearly three feet above minor flood stage. During the November flooding, 17 of the State highway repair sites damaged in October were re-damaged and 15 new sites were added to the repair list. A number of Borough roads were also re-damaged<sup>1</sup>. The Sterling Highway was temporarily closed due to inundation between Mile 160.5 and 162, and the Anchor River bridge approaches were severely damaged on the new and old Sterling Highways. The recently repaired Ninilchik Village bridge approach washed out and isolated the village for a second time. As a result of the two back to back flood events, the Ninilchik River, Deep Creek and Anchor River and many of their tributaries suffered severe channel scour, sediment deposition, bank erosion and land slides<sup>2</sup>.

## **2.10.3 What is Susceptible to Damage During a Flood Event?**

### *2.10.3.1 Critical Facilities*

South Zone critical facilities (fire and police stations, medical facilities and schools) are located in areas designated by the FEMA Flood Insurance Study as Zone C or D (areas of minimal or undetermined flood hazard). South Zone emergency and school facilities are described in Section 1.5.3, Tables 1-14 and 1-15. Information specific to critical facilities within the Cities of Homer and Kachemak are included in their annexes.

### *2.10.3.2 Bridges & Culverts*

As was vividly demonstrated during the floods of 2002, bridges and culverts are key points of concern during flood events. The number of sites and magnitude of damage that occurred at bridges and culverts was substantial and accounted for a majority of the damage to public infrastructure. Failures of the Deep Creek and Ninilchik Village bridge approaches, as well as culvert washouts on Stariski Creek, the North Fork Anchor River and Silver Salmon Creek, closed roads and isolated several South Zone communities for a number of days.

Post-flood damage repairs on Borough roads included riprap reinforcement of road embankments, installation of oversized culverts and overflow culverts, and improved ditch systems.

Bridges located in the South Zone include:

- South Fork Anchor River, MP 17.6, Sterling Highway
- South Fork Anchor River, MP 15.3, Anchor River/Pioneer
- Anchor River, MP 8.4, Old Sterling Highway

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1 The 2002 flood damage estimates were compiled from summaries provided by the Alaska Division of Homeland Security and Emergency Management, Small Business Administration Loan Program and the FEMA- DR1445 Damage Summary.  
2 Eash, J.D., Rickman, R.L., March 2004. Floods on the Kenai Peninsula, Alaska, October and November 2002. USGS Fact Sheet 2004-3023.





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- North Fork Anchor River, Chakok Rd (Borough)
- North Fork Anchor River, Cottonwood Lane (Borough)
- North Fork Anchor River, Dorothy Drive (Borough)
- North Fork Anchor River, MP 0.5, Anchor River/Pioneer
- Ninilchik River, MP 42.5, Sterling Highway
- Ninilchik River, MP 0.2, Ninilchik Road
- Ninilchik River, Brody Lane (Borough)
- Henry Creek, Lee Roy Ave. (Borough)
- Deep Creek, MP 40.9, Sterling Highway
- Seldovia Slough, MP 0.5 Seldovia Airport Rd.
- Barabara Creek, MP 4.8 Jakolof Bay Rd.

Five bridges are Borough-maintained (noted above in parenthesis), and the remaining nine are state-maintained. There are also two culverts at the Sterling Highway crossing of Stariski Creek (MP 27.0) and four culverts at the Anchor River (MP 21.0). After washing out during the 2002 floods, the Stariski Creek culverts were replaced. Unfortunately, severe scour and erosion caused the pipe outlets to perch above the stream, creating a waterfall that now poses a serious barrier to fish passage. ADOT&PF plans to replace the culvert pipes with a bridge in the near future.

### 2.10.3.3 FIRM Floodplain Analysis

According to the KPB assessing database, there are 422 parcels of land with a total value of \$42.8 million within or intersecting South Zone FIRM areas (Table 2-22).

**Table 2-22.** South Zone Overall FIRM Parcel Summary<sup>1</sup>.

Mapped Floodplains	Anchor River	Ninilchik	Seldovia	Total
Total Parcels*	36	75	197	308
Total Value* (millions of \$)	\$3.7	\$3.3	\$29.3	\$36.3
Total Acres**	167	94	136	397
Number of Parcels with Improvements*	19	20	93	132
Total Number of Improvements *	34	31	146	211
Total Improvement Value* (millions of \$)	\$2.1	\$1.8	\$12.0	\$15.9

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A and V.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A.

The assessed value of homes and other improvements on the 167 developed parcels is approximately \$19.5 million. Additional parcel information is included in Appendices G-1, G-6, and G-8.

### Anchor River FIRM Area

The Anchor River FIRM area encompasses the portions of the North and South Forks of the Anchor River around the community of Anchor Point as well as the coastal area at the river mouth. There are a total of 107 total parcels within the Anchor River FIRM area with an assessed value of approximately \$9.7 million (Table 2-23). Of these, 85

<sup>1</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.



## FLOODS and EROSION

(79%) are privately owned with an approximate value of \$8.4 million. Of the 85 private parcels, 51 are improved and the improvements are assessed at around \$4.9 million. A parcel summary by ownership category is included in Table 2-23

**Table 2-23.** Anchor River FIRM Area Parcel Summary<sup>1</sup> by Ownership Category.

Parcel Summary	Private	Federal	State	Borough	Total
Total Parcels*	30	0	6	0	36
Total Value* (millions of \$)	#3.4	\$0	\$0.4	\$0	\$3.8
Total Acres **	136	0	31	0	167
Total Acres *	340	0	71	0	411
# of Parcels with Improvements*	19	0	0	0	19
Total # of Improvements *	34	0	0	0	34
Total Improvement Value* (millions of \$)	\$2.1	\$0	\$0	\$0	\$2.1

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A.

Land use classifications for the Anchor River FIRM parcels include: 5 commercial, 19 recreational, 17 residential, 12 institutional (State Parks), 4 mobile homes and 48 vacant.

### Ninilchik River FIRM Area

The Ninilchik River FIRM area encompasses the lower Ninilchik River, the lower portion of Deep Creek as well as the coastal area at the mouth of both streams. There are 109 total parcels intersecting the Ninilchik River FIRM area, with an assessed value of approximately \$20.75 million (Table 2-24). Of these, 71 (66%) are privately owned with an approximate value of \$6.85 million. Of the 71 private parcels, 41 have improvements assessed at around \$4.3 million. The two Borough parcels are included in the FIRM summary because they have Cook Inlet frontage. The vacant parcel adjacent to the Ninilchik School is classified for future school use. The Ninilchik School is located on the other Borough parcel and has an assessed value of \$7.7 million. Although the school parcel frontage is within the coastal velocity zone, the school itself is located on a high bluff above Cook Inlet and is outside of the mapped floodplain.

A parcel breakdown by ownership category is included in Table 2-24.

<sup>1</sup> Ibid.



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**Table 2-24.** Ninilchik River FIRM Area Parcel Summary<sup>1</sup> by Ownership Category.

Parcel Summary	Private	Borough	State	Native Corp	Total
Total Parcels*	45	9	20	1	75
Total Value* (millions of \$)	\$2.5	\$0.02	\$0.8	\$0	\$3.3
Total Acres **	24	1	69	0	94
Total Acres *	141	2	250	.7	393.4
# of Parcels with Improvements*	19	0	1	0	20
Total # of Improvements*	28	0	3	0	31
Total Improvement Value* (millions of \$)	\$1.5	\$0	\$0.3	\$0	\$17.8

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A.

Land use classifications for the Ninilchik River FIRM parcels include: 5 commercial, 2 institutional (State Parks), 1 school (see explanation above), 2 mobile homes, 2 recreational, 19 residential, 4 accessory buildings, 9 tidelands and 63 vacant.

### Seldovia FIRM Area

Seldovia is a fishing village near the southern end of the Kenai Peninsula across Kachemak Bay from Homer. The FIRM area includes most of the eastern shore of Seldovia Bay (including the lagoon), which constitutes the primary flood threat to the city. There are 204 parcels intersecting the Seldovia FIRM area with a total assessed value of approximately \$27.5 million (Table 2-25). Of these, 155 (75%) are privately owned with an approximate value of \$21.2 million. Of the 155 private parcels, 92 are improved and have improvements assessed at around \$11.2 million.

**Table 2-25.** Seldovia FIRM Area Parcel Summary<sup>2</sup> by Ownership Category.

Parcel Summary	Private	City	Borough	State	Native Corp	Total
Total Parcels*	146	35	3	11	2	197
Total Value* (millions of \$)	\$22.1	\$3.5	\$0.3	\$3.1	\$0.3	\$29.3
Total Acres **	79	11	7	22	17	136
Total Acres *	209	16	12	61	17	315
# of Parcels with Improvements*	86	6	0	1	0	93
Total # of Improvements*	134	11	0	1	0	146
Total Improvement Value* (millions of \$)	\$10.7	\$1.3	\$0	\$0.02	\$0	\$12.02

\* Represents information for parcels that are within or intersect the FIRM Flood Zone A.

\*\* Represents an estimate in acres of land that is completely within the FIRM Flood Zone A.

Land use classifications for the Seldovia FIRM parcels include: 13 commercial, 4 institutional (3 city, 1 state airport) 2 mobile homes, 7 recreational, 55 residential, 10 accessory buildings, 1 parking lot and 112 vacant.

<sup>1</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.

<sup>2</sup> 2013 KPB GIS System and Tax Assessment Database. Value estimates are rounded to nearest \$100,000.



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### **2.10.4 Development Trends**

#### **Anchor River FIRM Area**

Of the 85 privately owned parcels in the mapped floodplain, 51 have some type of development and 33 are vacant (Table 2-23). Of the vacant parcels, 16 are an acre or less in size, 12 are one to five acres, 6 are five to ten acres and the remaining 6 parcels are ten acres or greater in size. There is also a sizeable quantity of private and Native Corporation land in the North and South Fork Anchor River floodplains that has not been assessed for flood hazard, but is accessible due to road building associated with timber harvest and land subdivision. Given the availability of vacant land and slow but steady population growth in the area, new development is likely to continue to occur in the mapped and unmapped floodplains of the North and South Fork Anchor Rivers.

#### **Ninilchik River**

There are 71 privately owned parcels in the mapped floodplain, of which 41 are improved and 30 are vacant (Table 2-24). Of the 39 vacant parcels, 9 are one acre or smaller, 21 are one to five acres and 9 are five acres or larger. Although development in the lower river floodplain is fairly minimal, there is a sizeable quantity of Native Corporation land in the upper Ninilchik River watershed. Much of the Native Corporation land has been subject to timber harvest and future use and development will depend on the Corporation's land management goals and objectives.

#### **Seldovia**

Within or intersecting the Seldovia FIRM area, there are 155 privately owned parcels, of which 92 are developed and 63 are vacant (Table 2-25). Of the 75 vacant parcels, 59 are subdivided into one acre or smaller lots, 12 are one to five acres and 4 are five acres or larger in size. Parcel information for the Seldovia FIRM area is summarized in Table 2-25. Development trends for the City of Seldovia will be discussed in more detail in the future when the City completes their All Hazard Plan annex.

### **2.10.5 Coastal Erosion South Zone**

Within the Southern Zone from Ninilchik to Stariski Creek, the annual rate of erosion is 0.6 feet per year. From Stariski Creek to the Anchor River, the rate is 1.0 feet per year. From Anchor point to Homer, the rate is 0.7 feet per year. This zone is characterized by many erosion "hot-spots" ranging from 2.3 – 5.7 feet per year.

## **2.11 Flood/Erosion Mitigation Goals**

All hazard mitigation goals can be separated into three main categories:

- protection;
- prevention; and
- education.

For the purposes of flood mitigation, protective measures can be structural or non-structural in nature. Structural projects include the creation of debris retention basins, diversion structures, dikes and levees, channel modification, and bridge, road, and



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culvert alteration or replacement. These measures are often expensive, involve engineering and construction work and must be maintained to keep their effectiveness through time. They need to be carefully evaluated for the potential consequences of failure and the possibility that over time they may cost more than the development they are put in place to protect.

Non-structural flood mitigation measures include mechanisms such as flood warning systems, emergency response programs, relocation of flood prone structures or use of flood proofing techniques. Retrofitting or rehabilitating structures and facilities can be quite expensive, but in some cases can be done incrementally or as part of routine maintenance, thereby reducing upfront costs.

Protective measures associated with erosion mitigation can also be described as structural or non-structural. Adverse impacts to adjacent properties is of particular concern since some shore protection options change the natural coastal processes in ways that extend beyond the protected property. The responses to bluff and shore protection fall into two general categories: structural and non-structural measures, though some measures may include both types. In all cases, appropriate technical engineering by professionals in coastal processes should be utilized for both types of measures.

**Non-structural measures:** Non-structural shore protection includes vegetation, slope reduction, drainage control and beach nourishment. Vegetation of eroding slopes can be an affordable and effective measure, if not directly exposed to wave action and the slope is gradual.

**Structural shore protection:** Rigidly constructed erosion control methods are common and familiar to most coastal residents. Revetments protect slopes from erosion by waves and currents. Rocks or concrete shapes resist wave and current energy while holding down a permeable gravel layer or synthetic membrane that keeps native sediments in place. Seawalls are impermeable vertical structures built along the shore to protect property behind from wave attack. Seawalls may be built as bulkheads (earth retaining walls) or as free-standing walls. As with revetments, a seawall surrounding a single piece of coastal property will eventually extend its effect beyond adjacent unprotected property, ultimately blocking some longshore sediment supply. Seawalls are typically subjects of controversy among adjacent property owners when used in isolated circumstances solely for shore protection.

In 2007 the Borough installed an all-hazard alert broadcast system, which includes 14 outdoor warning sirens and three control centers. Sirens are concentrated in coastal communities, with six sirens in Seward, five in Homer and one siren each in the villages of Part Graham, Nanwalek and Seldovia. There are control centers in Seward and Homer, as well as an overall control center in Soldotna. The warning sirens are capable of automated activation via the National Weather Service Emergency Alert



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System and can play pre-recorded messages. The sirens also have a live public address function that can be used for any purpose.

Preventative measures are typically used to limit people's exposure to hazards, and may include the use of tools such as comprehensive land use plans, transportation plans, zoning, building codes, or land subdivision regulations. In areas that suffer repetitive flooding, preventative measures may also include preserving open space, acquiring property and relocating structures to safer areas.

Outreach and education are important components of any hazard mitigation strategy. Community meetings, school activities, emergency preparedness outreach, ads in the media, workplace training, booths at fairs and home shows, brochures and video presentations all provide valuable outreach opportunities.

### ***2.11.1 Accomplishing the KPB Flood/Erosion Mitigation Goals***

The following are suggested as objectives or approaches to further define and accomplish the Borough's long-term flood/erosion mitigation goals:

- modify impacts of hazard events by assisting individuals and communities to prepare for, respond to and recover from hazard events;
- reduce susceptibility to damage and disruption by avoiding hazardous, uneconomic and unwise development in known hazard areas;
- protect natural and beneficial values of floodplains, coastal areas and water resources; and
- reduce unnecessary economic losses and promote positive economic development by incorporating hazard mitigation into land use and development decisions.

### ***2.11.2 Existing Flood Mitigation Programs and Activities***

To obtain hazard mitigation grant funding in the aftermath of the 1995 floods, the Borough developed a flood hazard mitigation plan that focused on the communities that flooded in the eastern and central zones. This Plan expands the planning effort to include flood susceptible communities Borough-wide. In addition, the incorporated Cities of Seward, Kenai, Soldotna, Homer and Kachemak have included their Hazard Plans as annexes at the end of this document. Annex D has been reserved for future inclusion of the City of Seldovia's Hazard Mitigation Plan.

Within the Borough, an intricate mix of public and private facilities, infrastructure and landownership governs the possible blend of flood mitigation activities. Local, state, and federal planning and regulatory authorities must also be considered in the mix. This complexity necessitates a broad management perspective for flood mitigation





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planning. It also offers a wider array of resources and mitigation opportunities through cooperative partnerships.

### *2.11.2.1 Floodplain Development Standards and Education*

The Borough participates in the National Flood Insurance Program and the Community Rating System (CRS) Program with the following floodplain regulations, programs and activities:

- implementation of the Chapter 21.06 *Floodplain Management* code, which regulates land subdivision, residential and commercial construction, dredging, filling, mining, excavation and placement of manufactured homes within the FEMA FIRM-mapped Flood Zone A;
- implementation of Chapter 21.18 *Anadromous Streams Habitat Protection*. Although primarily enacted to protect salmon spawning and rearing habitat, the 50-foot habitat protection area also helps maintain stable well-vegetated banks and minimizes new development within 50 feet along 25 Peninsula streams. Section 21.18.050 also establishes permit requirements for fuel storage and logging activities within mapped floodplains;
- creation and maintenance of a floodplain permit database including name, tax parcel number, location, project description, permit date, and base flood elevation information;
- annual mail-out notices to floodplain property owners advising them of their compliance status as well as their responsibility to apply for floodplain development permits;
- mail notices to property owners in areas of historic flooding outside the FIRM floodplain areas;
- participation in the Community Rating System (CRS) program to help lower insurance rates for Borough property owners;
- development of a Borough-wide Multi-Hazard Mitigation Plan, including a section specifically for Flood Hazard Mitigation;
- continuing floodplain education and outreach through workshops and community meetings;
- providing a local source of information on proper floodplain building techniques;
- an in-progress review and revision of the KPB Floodplain Management



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Ordinance to improve the clarity, implementation and enforceability of the floodplain code.

## *2.11.2.2 Emergency Response and Preparedness*

The KPB's Office of Emergency Management (OEM) coordinates emergency response efforts during disaster events. Since 1995, the Borough has implemented the following measures to improve flood warning and response:

- created a website ([www.borough.kenai.ak.us/emergency](http://www.borough.kenai.ak.us/emergency)), which provides current weather watch and advisory information as well as links to the National Weather Service, FEMA educational materials, the Local Emergency Planning Committee, and other web resources such as The Weather Channel ([www.weather.com](http://www.weather.com));
- partnered with USGS for installation and maintenance of real-time stream and precipitation gages (see Appendix K);
- partnered with the National Weather Service to improve weather radio and emergency broadcast capabilities in the Central Peninsula by installing an additional NOAA weather radio station in Ninilchik;
- Developed two mobile sirens that can be moved to areas not served by the Borough's emergency siren warning system;
- Acquired, equipped and programmed a mobile strategic command vehicle (MCV) to facilitate Borough-wide communication and emergency response;
- coordinated with local and state emergency planning committees to develop, refine and implement cross-jurisdictional emergency response plans; and
- implemented a Reverse 911 system (aka Rapid Notify System) to telephone property owners with a recorded alert message in the event of flooding or emergency evacuation.
- Digital elevation mapping (DEM) data using LIDAR has been acquired for the Kenai Peninsula and is currently being processed. LIDAR (Light Detection And Ranging) is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target. The Seward area was flown in January 2006 during a snow-free period, and the western Kenai lowlands were flown in the summer of 2008. The data acquired has a resolution of one pixel per four foot square and a vertical accuracy of plus or minus 20 centimeters. No data was acquired for the ice fields or for communities across Kachemak Bay/Cook Inlet.



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## 2.12 Flood/Erosion Mitigation Strategies and Implementation Ideas

The flood events in recent years illustrate that the potential for loss of life and property increases where development intersects active floodplains. In addition to the major flooding events described in these pages, floods of lesser magnitude occur almost yearly. The dynamic and varied nature of the Peninsula's climate, geography, topography, geology and waterways suggest that flooding should be considered the norm and not the exception. Thus, as the Borough's population grows, so too does the importance of implementing measures to ensure growth proceeds in the *safest possible* manner.

Although restricting unwise development in floodplains is the most cost-effective way to limit long-term losses and liability, the Borough also needs strategies to protect existing development in vulnerable areas as well as plan for future growth. Because of the complexity of this task, a combination of strategies and implementation ideas are outlined to assist with formulating future flood mitigation actions.

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### ***Flood Mitigation Strategies***

***Strategy 1: Complete a Borough-wide flood and coastal erosion hazard risk assessment.***

#### **Implementation Ideas and Action Items**

- Assemble a detailed inventory of problem areas and flood susceptible structures and infrastructure (e.g., buildings, critical facilities, roads, bridges, culverts, etc.).
- Identify potential retrofit or rehabilitation measures or activities.
- Seek grants and technical partnerships to complete comprehensive studies of the Homer bench to identify areas of slope instability. Studies would incorporate soil surveys, slope and drainage assessments and an evaluation of the effect of existing and proposed new development on slope stability.
- Use information gathered in the comprehensive studies to formulate mitigation strategies to minimize the risk of catastrophic slope failures in developing areas on the Homer Bench.
- Seek grants and technical partnerships to complete comprehensive coastal erosion studies. Studies would include identifying existing storm wave protection structures, establishing erosion rates,



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completing a comprehensive digital elevation model and researching the oceanographic and coastal processes that affect the Kenai Peninsula coastlines.

- Develop a modeling tool to help predict bluff and coastal erosion.
- Use information gathered in the comprehensive studies to formulate mitigation strategies to develop cost-effective solutions to protect life, property and coastal resources.
- Coordinate with other agencies and organizations to identify permit requirements, partnership interests, funding sources.
- Review and update information on a periodic basis.

<b>Potential Participants:</b>	KPB Road Maintenance, Public Works, and Planning Departments, ADOT&PF, Permitting Agencies, DCED, Incorporated Cities, Kachemak Bay Research Reserve, Coastal Training Program, Alaska.
<b>Potential Funding:</b>	NOAA, USACE, NRCS, USGS, FEMA RiskMap, FMA, PDM, HMGP, AKDHS&EM
<b>Time Frame:</b>	Ongoing as part of the Hazard Mitigation Plan Implementation.

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### ***Strategy 2: Develop mechanisms to enhance floodplain permit compliance.***

#### **Implementation Ideas and Action Items**

Develop a project notification process to connect property owners with the appropriate floodplain, utility, and right-of-way construction permit information. This could be accomplished using a simple one page form that would be available on the Borough website as well as from the Planning, Assessing and Road Service Area Departments and the Donald E. Gilman River Center. The form could be given to property owners when they first contact the Borough for floodplain development, street addressing, KPB right-of-way, driveway or utility installation permit information.

- The notification form would provide an effective means to coordinate permitting between the various Borough departments and lessen permit confusion for the public. It would also help the Borough identify more projects prior to construction, reduce the number of non-compliant floodplain improvements, and result in fewer costly and complicated “after-the-fact” enforcement actions.



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More importantly, it would proactively insure that improvements, roads and utilities are built to proper standards and less susceptible to flood damage and will not induce or worsen flood damage to other properties.

- Complete and verify the Floodplain Permit Database. Using the database and Borough GIS capabilities, complete an audit of existing floodplain development within regulated floodplains for permit compliance. Work with property owners to bring their improvements into compliance with floodplain development standards.

**Potential Participants:** KPB Planning, Road Service Area, GIS, Assessing and MIS Departments.

**Potential Funding:** KPB, AKDHS&EM, Rasmussen, Lindberg, FEMA, USACE

**Time Frame:** Implementation of Permit Notification Form: 3-6 months  
Completion of Floodplain Permit Database: 1-2 years (ongoing)  
Completion of Floodplain Development Audit: 1-2 years (ongoing.)

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### ***Strategy 3: Improve KPB floodplain mapping and identify other effective tools or methods to assist with flood hazard assessment.***

With a few exceptions, the Borough's official Flood Insurance Rate Maps (FIRM) were completed in the early 1980's<sup>1</sup>. In many less populated communities, stream floodplains, seeping bluffs and coastal run-up zones were not studied or only studied by approximate methods. For these areas, base flood elevation (BFE) predictions were not generated, resulting in unnumbered A and V Zone maps. Although unnumbered zones roughly delineate the probable boundary of the 100-year flood event, they do not predict the BFE. In addition, natural stream processes, recent flood events or floodplain development have significantly altered the systems and the original BFE elevation modeling is no longer accurate.

#### **Implementation Ideas and Action Items**

- Perform detailed flood studies for FIRM Unnumbered A and V Zones to provide base flood and wave run-up elevations and floodway delineations.

Areas that currently would benefit from more detailed maps include:

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<sup>1</sup> FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.



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- the upper Kenai River (Cooper Landing - 7 miles);
  - Ninilchik River (lower 16 miles);
  - main-stem Anchor River (lower 17 miles);
  - North Fork Anchor River (lower 19 miles);
  - Deep Creek (lower 22 miles);
  - Trail River (Moose Pass);
  - Seldovia;
  - Port Graham;
  - Nanwalek;
  - Seward (Bear Lake to Resurrection Bay – Alluvial Streams);
  - Resurrection River (lower 6 miles);
  - Resurrection Creek and Hope coastline; and
  - North Kachemak Bay coastline.
- In addition to 100-year BFE and coastal storm surge predictions, generate detailed flood boundaries and predicted base flood elevations for 10-, 25-, and 50-year events in areas such as the Kenai River with significant floodplain growth and development.
  - Correct geo-referencing problems with the Nikiski, Port Graham and Nanwalek FIRM maps so they can be entered into the KPB GIS System.
  - Digitize, geo-rectify and enter floodway boundary lines into the KPB GIS System for all numbered A zones.
  - Verify existing and install additional vertical elevation benchmarks in developing floodplains to facilitate accurate base flood elevation surveys for homeowners.
  - Map actual flood boundaries after major flood events.
  - Identify and map areas of active and severe riverine erosion along streams and rivers.
  - Identify and map areas of active and severe coastal erosion.
  - Install visible shoreline markers to collect erosion rate information in areas vulnerable to coastal storm run-up. Coastal processes, including sediment transport and erosion, are little-understood along KPB coastlines. Installing markers is a cost effective way to gather erosion information, which can be used by communities to help formulate and prioritize erosion mitigation solutions. To date, Port Graham is the only coastal community that has identified specific





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sites for installing erosion markers (see the Port Graham Flood Mitigation Plan<sup>1</sup> in Annex G).

**Potential Participants:** KPB Planning, GIS, and Public Works Departments in cooperation with U.S. Army Corps of Engineers, FEMA, USGS, KPB communities, Alaska Dept. of Community and Economic Development, Kachemak Bay Research Reserve.

**Potential Funding:** FEMA, USACE, NRCS, NOAA, AKDHS&EM, USGS, KPB

**Time Frame:** 1-5 Years (as funding can be generated)

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**Strategy 4:** *Cooperate with the City of Seward and the Seward/Bear Creek Flood Service Area Board to identify, prioritize and implement cost effective strategies for controlling flood damage.*

### *Implementation Ideas and Action Items*

- Seek grants and technical partnerships to complete comprehensive hydrologic studies of the Seward area alluvial streams from their headwaters to Resurrection Bay. The analysis should identify repetitive flood problems, evaluate channel morphology and stability, bed load transport and the location and effectiveness of existing flood control structures. In addition, important riparian, wetland and aquatic functions, such as water storage, filtering, changes in water quality or quantity and identification of salmon spawning and rearing habitat, should be evaluated and factored into decisions.
- Apply for grants and technical partnerships to obtain two-foot interval digital surface elevation data to assist with alluvial fan flood hazard evaluation as well as future FIRM map revisions.
- Investigate the feasibility of implementing an array of alluvial fan floodplain management alternatives, including: land use planning and zoning, stream channel migration zones, floodplain conservation areas, moving and elevating structures, acquiring properties subject to repetitive flooding, identifying areas, methods and markets for annual gravel and debris removal.

**Potential Participants:** Seward/Bear Creek Flood Service Area Board, KPB Public Works, Planning, Road Service Area Departments, City of Seward, U.S. Army Corps of Engineers, USGS, FEMA, Alaska Dept. of Community and Economic Development.

**Potential Funding:** FEMA FMA, RiskMap, PDM, HMGP, USACE, USGS, USF&W,

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<sup>1</sup> Montgomery Watson and Parker Horn Company, Flood Hazard Mitigation Plan, Port Graham, Alaska, Kenai Peninsula Borough, March 2001.



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**Time Frame:**

AKDHS&EM, AKDNR, AKF&G, KPB  
1-5 Years (as funding allows)

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**Strategy 5: *Review and appropriately revise KPB floodplain development standards and requirements.***

**Implementation Ideas and Action Items**

**Note:** A number of the revisions to **Chapter 21.06 Floodplain Management** discussed below may also require other KPB Code sections to be reviewed and revised as appropriate.

- Review the definition section and add and clarify definitions as needed.
- In areas where base flood elevation (BFE) information is available, require the lowest floor of residential and commercial buildings to be elevated at least one foot above the BFE.
- Add emergency response permit provisions, including guidelines for issuing verbal and written permits during emergencies.
- Add regulations governing permanent and temporary storage of home heating oil, gasoline, diesel, and other hazardous materials. Minimum requirements might include setbacks from waterbodies, wells, and wetlands, proper anchoring of tanks or other storage containers, use of double-walled tanks or appropriate secondary containment, and insuring vents and openings are a minimum of one to two feet above BFE.
- Evaluate changing Chapter 21.06 *Floodplain Management* and Chapter 20.12.060 *Subdivisions* to limit or prohibit (with the exception of properly engineered and permitted stream crossings) the platting of new roads in floodways.
- Require all new subdivision lots to be of adequate size, orientation and elevation to insure there is developable space that is not unduly constrained by floodway, tideland, steep terrain, poor soils, wetlands or unmapped surface water drainages. Chapter 20.12.060 *Subdivisions* would also need to be revised as appropriate.
- Require new subdivision plats to show FIRM floodplain and floodway boundaries and carry appropriate plat notes. Chapter



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20.12.060 *Subdivisions* may also need to be revised as appropriate.

- At the time of preliminary plat submittal, require an engineer-stamped drainage plan<sup>1</sup> that evaluates the surface water flow across the landscape and describes the methods that will be used to reduce flood damage exposure for all subdivisions that contain mapped floodway or are greater than five acres or five lots in the mapped floodplain. Chapter 20.12.060 *Subdivisions* and 14.06.150 *Road Construction Standards* may also need to be revised as appropriate.
- Develop a long-term (two to five year) permit exclusively for alluvial floodplain gravel extraction projects that will improve flood-water conveyance and reduce flood hazard. Permit applications would require submittal of a gravel removal plan describing the location, dimensions of the extraction area, a detailed analysis of anticipated changes to the hydrologic characteristics in the area, the dimensions and location of material and equipment storage areas and a description of associated floodplain/floodway road development or stream crossings. Plans should also show how activities will be conducted to minimize damage to stream banks (from mining activities or site access) and describe any necessary reclamation or restoration activities. Chapter 21.26 Material Site Permits would also need to be revised as appropriate.
- Review and revise Chapters 14.06.150 Road Construction Standards and 14.08 Utility Right-of-Way Permits as appropriate to ensure drainage plans and proper floodplain standards are incorporated into new road development as well as upgrades to existing road and utility services.
- Review all proposed code changes for consistency with KPB Coastal Management Program enforceable policies, and specifically include language in KPB 21.06, Floodplain Management, KPB 21.18, Anadromous Streams Habitat Protection, KPB 20.20, Subdivisions, KPB 14.06 Road Standards, KPB 14.08 Permits for Utility Right-Of-Ways, and Chapter 21.26 Material Site Permits,

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<sup>1</sup> Drainage plans typically address road and lot orientation, installation of ditches, water passage structures such as bridges or culverts, water retention swales, and set aside preservation areas such as wetlands and riparian vegetation, which store and filter runoff. Ideally, drainage plans would be submitted with the preliminary plat and include drawings or written descriptions of the location and construction plans for utility improvements such as water, sewer, natural gas, telephone and electrical facilities.



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which specifies floodplain related development decisions must comply with the enforceable policies of the KPB Coastal Management Program.

<b>Potential Participants:</b>	Affected KPB Departments, U.S. Army Corps of Engineers, FEMA, Alaska Dept. of Community and Economic Development, the Incorporated Cities.
<b>Potential Funding:</b>	FEMA, USACE, NRCS, NOAA, AKDHS&EM, USGS, KPB
<b>Time Frame:</b>	1-5 Years (as staff and funding permit)

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## ***Strategy 6: Research and implement alternative floodplain management strategies.***

### **Implementation Ideas and Action Items**

- Create or encourage establishment of a revolving low-interest loan fund to help private property owners elevate or appropriately retrofit their improvements to meet floodplain standards. After the floodplain permit database and audit are complete, develop a list of residential properties that need retrofitting to qualify for permits and improved floodplain insurance rates. Establish procedures and implement the loan fund through private financial institutions or the KPB with the guidance of a community advisory group.
- Investigate use of waterway setbacks and special zoning overlay areas, including riparian and coastal bluff buffers and channel migration zones.
- Provide tax credits to people willing to institute non-development easements in mapped floodplains and floodways.
- Encourage the use of "flood service areas" for places and projects that require annual maintenance to control flooding hazards.
- Periodically meet with the Cities of Homer and Seward to share information and brainstorm ways to improve National Flood Insurance Program implementation.
- Encourage the Cities of Soldotna, Kenai, Kachemak and Seldovia to adopt their own floodplain regulations and join the NFIP.



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- Acquire property or relocate structures in areas subject to severe flooding or erosion.

**Potential Participants:** Kenai Peninsula Borough, incorporated Cities within the KPB, U.S. Army Corps of Engineers, FEMA, Alaska Dept. of Commerce, Community and Economic Development, Kachemak Bay Research Reserve, Coastal Training Program Alaska.

**Potential Funding:** KPB, AKDHS&EM, FEMA mitigation

**Time Frame:** On-going (as staff, funding and interest are generated).

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### ***Strategy 7: Evaluate Borough-maintained roads for floodplain hazards and potential flood reduction projects.***

#### **Implementation Ideas and Action Items**

- Institute a revolving flood mitigation budget fund to assist with Borough maintained road and capital projects.
- Conduct joint site visits with key permitting agencies to evaluate repetitively damaged roads and formulate plans for flood mitigation upgrades.
- Identify and investigate the possibility of vacating existing platted but not yet constructed **floodway** roads.
- Evaluate the feasibility of constructing additional alternate road access to areas currently served by a single flood prone road.
- Identify and upgrade existing stream crossings to maximize flood-water conveyance, maintain fish passage, and reduce negative impacts to wetlands, rivers, and streams. According to the KPB Road Service Area Department, there are approximately 30 Borough-maintained culvert crossings that would be better served by clear span bridges<sup>1</sup>.
- Identify and stabilize erosion prone cut-banks to decrease damage to KPB roads. There are approximately five locations where KPB roads would benefit from this type of structural mitigation<sup>2</sup>.
- Clean, resize or relocate overflow ditches to facilitate water movement and minimize debris jam flooding.

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<sup>1</sup> Pers. Comm., Gary Davis, Kenai Peninsula Borough Road Service Area Director, 4/22/2004.

<sup>2</sup> Pers. Comm., Gary Davis, Kenai Peninsula Borough Road Service Area Director, 4/22/2004



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- Install, upgrade or maintain protective dikes, dams, levees and as appropriate, conduct ongoing maintenance activities such as emergency gravel/debris removal or stream re-channelization. An important caveat for all structural projects is that they should be carefully evaluated for long-term consequences, including costly maintenance, the shifting of problems from one location to another, and adverse hydrological or environmental impacts. Structural protection can also create a false sense of security and encourage development in areas that could be catastrophically affected if the structure failures.

<b>Potential Participants:</b>	KPB, Private Non Profit Organizations, FEMA, Alaska Division of Homeland Security and Emergency Management
<b>Potential Funding:</b>	Local Cities, KPB, AKDOT, USDOT, AKDNR, AK Public Safety, USACE, NRCS, AKDHS&EM, FEMA
<b>Time Frame:</b>	Ongoing (Funding Dependent)

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### ***Strategy 8: Protect and maintain beneficial floodplain and shore zone natural values.***

Floodplains often serve important functions in protecting the physical, biological, and chemical integrity of water resources. Important floodplain functions include the ability to store and convey flood water, maintain water quality, perpetuate groundwater recharge, and support large and diverse populations of aquatic and terrestrial organisms (plants, animals, fish, amphibians, and insects). Similarly, the natural accretion and erosion processes of shore zones play an essential role in sustaining sandy beaches and sub-tidal and intertidal habitats. Structures and control measures such as seawalls and bulkheads that are designed to protect individual properties can impact other property owners as well as the natural resources in these zones by changing erosion and accretion rates along the shoreline.

Land owners and managers of the Borough's rich and diverse rivers, streams and coastal areas have the additional responsibility of maintaining critical fish and wildlife habitats despite pressures from increasing use and development. In years to come, the health of the wild salmon runs will largely depend on whether the streams remain connected to unique and productive biological floodplain features such as wetlands, cutoff oxbows, sandbars, backwaters, undercut banks, floodplain pools and extensive high water tables.

In addition to their fisheries, wildlife and hydrologic values, the riverine and coastal floodplains and bluff zones are often of unique scientific interest as





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geological, archeological or historical sites and have extraordinary community value as open space resources<sup>1</sup>.

Unfortunately, development that proceeds without considering the dynamic and beneficial functions unique to floodplains often increase flooding potential, and diminish the values that originally attracted people to these areas. Long-term floodplain management strategies should do the following:

## Implementation Ideas and Action Items

- Work with other interested agencies to identify degraded floodplains and investigate the potential for restoring or improving water passage, removing repetitively damaged improvements and/or acquiring land to restore or preserve floodplain function.
- Work with other interested agencies and non-profit organizations to develop watershed and coastal bluff management plans that identify important natural water storage and flow features and recommend land management and development techniques to preserve critical floodplain function. General floodplain management recommendations include avoiding development in floodways, old meander channels and wetlands; identifying less hazard prone areas for development and encouraging proper construction techniques, including elevating structures and utilities; engineering proper road and drainage crossings, minimizing impervious surfaces and using vegetated swales and storm water basins to slow water run-off.
- Provide best management practices (BMP) education and information to landowners and contractors to help minimize floodplain project impacts. BMPs include scheduling projects during low water, using silt fences and other sediment control techniques to stabilize fill or disturbed areas and scheduling in-water work to periods less likely to impact salmon migration, spawning, incubation and rearing.
- Provide incentives to encourage proper stewardship and limit impacts from residential and recreational development adjacent to lakes, streams, coastal shoreline and bluffs (e.g., habitat protection tax credits and restoration project cost share programs).

**Potential Participants:** KPB Planning Dept., Donald E. Gilman River Center, private

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<sup>1</sup> FEMA, 1986. Interagency Task Force on Floodplain Management. A Unified National Program for Floodplain Management. FEMA 100 March 1986.



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nonprofit organizations, EPA, FEMA, ADEC, DNR/Parks, ADF&G/Division of Habitat, Kachemak Bay Research Reserve, Coastal Training Program Alaska and Kachemak Heritage Land Trust.

**Potential Funding:** Local Cities, KPB, EPA, FEMA, ADEC, AKDNR/Parks, USACE  
**Time Frame:** Ongoing(Funding Dependent)

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## ***Strategy 9: Promote positive economic development.***

It may appear difficult to balance the loss of economic opportunities when proposing that communities restrict growth in hazard-prone areas. However, when development proceeds unplanned in areas subject to flooding and erosion, there are always serious social and financial costs. Preventing unwise floodplain and floodway development can minimize disaster damage, increase property values and maintain many of the natural features that originally attracted people to an area. To achieve positive long-term economic growth, it is important to include floodplain and coastal development considerations in the comprehensive and long-range planning goals for each community.

### **Implementation Ideas and Action Items**

- Incorporate floodplain, coastal bluffs and watershed planning in appropriate KPB planning documents such as the Comprehensive Plan, Transportation Plan and Coastal Management Program Plan.
- Require written disclosure of hazard prone areas (such as floodplain, tsunami run-up zones, coastal bluffs and other areas with high erosion potential) when property ownership is transferred.
- Enforce development standards to reduce or avoid flood vulnerability.
- Encourage planning concepts such as cluster development, floodplain open space, and riparian zone conservation easements.
- Develop incentive programs to encourage growth and development in less hazard prone areas outside of floodplains.

**Potential Participants:** KPB Assembly, Planning, Economic Development and other appropriate departments, private nonprofit organizations, EPA, FEMA, ADEC, DNR/Parks, ADF&G/Division of Habitat, Kachemak Bay Research Reserve.

**Potential Funding:** Local Communities, KPB, AKDNR, FEMA

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# FLOODS and EROSION

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**Timeline:** Ongoing (Funding Dependent)

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## ***Strategy 10: Enhance existing emergency preparedness practices.***

Currently, the Office of Emergency Management (OEM) coordinates disaster response and participates in ongoing hazard assessments, emergency preparedness education and outreach. In addition to existing program activities, the following implementation ideas and activities could be used to assist with flood warning and response efforts:

### **Implementation Ideas and Action Items**

- In cooperation with the USGS, upgraded the Anchor River gage to a continuous real time system (additional cost share KPB: \$14,113/USGS \$8,348), and found funding to return the Ninilchik River gage system to service (cost share KPB \$21,135/USGS \$12,522) <sup>1</sup>.
- Seek funding for digital elevation mapping (DEM). Digital elevation data can be used for hazard assessments as diverse as flooding, tsunami run-up, avalanche and wildfire behavior. Acquiring DEM data and maps for the major river systems and coastal areas would provide a multi-faceted tool for hazard assessment and emergency response planning.
- Add a permit liaison position to the KPB Incident Command Structure to coordinate emergency permitting with the appropriate regulatory agencies.
- Identify debris management sites.
- Maintain a revolving flood mitigation fund for the purpose of delivering clean water, sand and sand bags and other critical services to communities during flood emergencies.

**Potential Participants:** KPB, USGS, EPA, FEMA, US Army Corps of Engineers, ADEC, DNR/Parks, ADF&G/Division of Habitat  
**Potential Funding:** KPB, EPA, USGS, FEMA, USACE, ADEC, DNR/Parks, ADF&G  
**Time Frame:** KPB Emergency – Incident Command Permit Liaison Position- Immediately

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<sup>1</sup> Pers. comm., Jeff Conaway, Hydrologic Data Program Chief, Water Resources Office, USGS Alaska Science Center, 3/5/14.



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KPB Revolving Flood Budget - Immediately  
DEM Mapping, Stream Gauges - Ongoing (Funding Dependent)

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## ***Strategy 11: Provide flood hazard and floodplain development education and information.***

An informed public is crucial to achieving the Borough's flood mitigation goals. Providing education and outreach is an ongoing process and can always be improved or expanded.

### **Implementation Ideas and Action Items**

- Continue to send annual letters to all floodplain property owners notifying them of floodplain regulatory requirements.
- Expand the annual property owner mail-out to include homeowners in areas that are floodprone but are not currently within a KPB flood-mapped (FIRM) area.
- Continue to sponsor regular educational seminars with lending institutions, title companies, realtors, building contractors, surveyors, architects and engineers;
- Continue to provide "self-help" flood protection and structural retrofit information from FEMA as well as participate in area trade shows, and public meetings; and,
- Continue to provide information and individual permit assistance to property owners.

**Potential Participants:** KPB; FEMA, Division of Community Advocacy, Department of Commerce, Community and Economic Development; Cities of Homer and Seward.

**Potential Funding:** KPB, ADEC, FEMA, AKDHS&EM, AKDCCED

**Time Frame:** Ongoing

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## ***Strategy 12: Identify and develop partnership opportunities.***

By seeking and participating in partnerships, the KPB can capitalize on resources available in the public and private sectors, providing more benefit for less overall cost. Ideally, long-range hazard mitigation planning will involve everyone with interest, resources and ideas to share. In many cases, projects and management strategies that protect vital floodplain and water quality values simultaneously



## FLOODS and EROSION

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provide economic and protective benefits for property and infrastructure.

In the past, the Borough has cooperated on mitigation planning and projects with the Alaska Division of Emergency Services, Federal Emergency Management Agency, City of Seward, Alaska Railroad Corporation, U.S. Geological Survey, National Weather Service, U.S. Army Corps of Engineers, Alaska Department of Fish and Game, Alaska Division of Parks and Outdoor Recreation, Natural Resource Conservation Service, Alaska Department of Transportation and Public Facilities, Alaska Department of Environmental Conservation, U.S. Environmental Protection Agency and the U.S. Forest Service.

<b>Potential Participants:</b>	Other potential partners include local nonprofit research, education, conservation and land trust groups, such as the ADF&G Kachemak Bay National Estuarine Reserve, Homer Soil and Water Conservation District, Cook Inlet Keeper, The Nature Conservancy, Kachemak Bay Research Reserve, Coastal Training Program Alaska, Kenai Watershed Forum, Kachemak Heritage Land Trust, and the Resurrection Bay Conservation Alliance.
<b>Potential Funding</b>	ADF&G, KPB, AKDNR, USGS, AKDHS&EM, FEMA, USACE, AKDOT, ADEC, USGS, USF&W, AKF&G, AKDCCED, Lindberg, Rasmussen
<b>Time Frame:</b>	Ongoing

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### ***Strategy 13: Encourage all incorporated Borough communities to participate in the National Flood Insurance Program.***

Currently the Cities of Seward and Homer administer the National Flood Insurance Program for properties within their respective city limits. The Kenai Peninsula Borough administers the program for all other properties except those within the Cities of Kenai and Soldotna, which have chosen not to participate. Because flood insurance is only available to property owners in areas that participate in NFIP, this leaves residents in some areas of the Borough ineligible to purchase flood insurance.

By encouraging all incorporated communities to participate in NFIP, the number of property owners eligible for flood insurance can be increased, and building standards that reduce potential flood damage can be put in place.

<b>Potential Participants:</b>	Kenai Peninsula Borough, City of Seward, City of Soldotna, City of Kenai, City of Homer, City of Seldovia, Kachemak City.
<b>Potential Funding:</b>	FEMA
<b>Time Frame:</b>	Ongoing



# FLOODS and EROSION

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## ***Erosion Mitigation Strategies***

### ***Strategy 1: Survey Borough shorelines to project rates of erosion and identify littoral zones***

#### **Implementation Ideas and Action Items**

- Determine the longshore sediment drift.
- Determine rates of bluff and shoreline retreat.

**Potential Participants:** KPB, DHS&EM, DCCED, USACE, USGS, NRCS, AKDOT, DNR

**Potential Funding:** USACE, FEMA, AKDOT, USGS, NRCS

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### ***Strategy 2: Determine the areas of highest hazard and implement appropriate development standards in those areas***

#### **Implementation Ideas and Action Items**

- Standards may be in the form of guidance or setback requirements for high-hazard areas

**Potential Participants:** KPB, DHS&EM, DCCED, USACE, USGS, NRCS, AKDOT, DNR

**Potential Funding:** USACE, FEMA, AKDOT, USGS, NRCS

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### ***Strategy 3: Provide best available coastal process and hazard information to Borough residents***

#### **Implementation Ideas and Action Items**

- Use GIS and Coastal Management websites as repositories of information
- Publications

**Potential Participants:** KPB, DHS&EM, DCCED, USACE, USGS, NRCS, AKDOT, DNR

**Potential Funding:** USACE, FEMA, AKDOT, USGS, NRCS

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## 2.13 Flood Resource Directory

### Local Resources

#### Kenai Peninsula Borough (KPB)

##### Office of Emergency Management (OEM)

The KPB OEM has the primary responsibility for disaster management programs and activities. The overall objectives for OEM are disaster mitigation, preparedness, response, and recovery to all disaster incidents, whether natural or man-made. Flood information, including FEMA and American Red Cross brochures, checklists, and fact sheets are available online or by contacting the OEM office. The OEM website also provides links to the National Weather Service Alaska River Forecast Center and the USGS Real-time Stream Flow Data.

**Contact:** KPB/ Office of Emergency Management  
**Address:** 253 Wilson Lane, Soldotna, AK 99669  
**Phone:** (907) 262-4910  
**Website:** [www.borough.kenai.ak.us/emergency](http://www.borough.kenai.ak.us/emergency)

##### Local Emergency Planning Committee (LEPC)

The 27-member KPB Local Emergency Planning Committee (LEPC) meets quarterly, and is comprised of: firefighters, community groups, media, hospital representatives, local & state law enforcement officials, industry representation, transportation, environmental groups, elected officials, Alaska State Defense Force representatives and interested members of the public. Anyone interested in emergency response planning is encouraged to attend. The mission of the LEPC is to prepare emergency response plans for all hazards, whether natural or manmade, and to establish procedures for receiving and processing requests from the public for information generated by SARA Title III reporting requirements.

**Contact:** KPB/Office of Emergency Management  
Local Emergency Planning Committee (LEPC)  
**Address:** 253 Wilson Lane, Soldotna, AK 99669  
**Phone:** (907) 262-4910  
**Website:** [www.borough.kenai.ak.us/emergency/LEPC/lepchome.htm](http://www.borough.kenai.ak.us/emergency/LEPC/lepchome.htm)

##### Seward/Bear Creek Flood Service Area Board

The KPB Seward/Bear Creek Flood Service Area Board was established to provide flood protection, planning and mitigation services for the City Seward and outlying Bear Creek areas.

**Contact:** KPB/ Seward/Bear Creek Flood Service Area Board  
**Address:** 302 Railway Suite #123, P.O. Box 1554, Seward, Alaska 99664  
**Phone:** (907) 224-3340  
**Website:** [sewardbearcreekfloodservicearea.org/index.html](http://sewardbearcreekfloodservicearea.org/index.html)

##### Donald E. Gilman River Center (RC)

The Donald E. Gilman River Center is a multi-agency permitting, information and education center. Three agencies and one non-profit organization are housed at the Center and work cooperatively to protect the rivers, watersheds and fish and wildlife resources of the Kenai Peninsula.

- **Kenai Peninsula Borough Resource Planning Department-** Programs administered by Borough staff include:



# FLOODS and EROSION

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**Floodplain Management Program** - The Borough participates in the National Flood Insurance Program (NFIP) by providing floodplain building information and standards, assisting with floodplain determinations, and issuing floodplain construction permits.

**50-foot Habitat Protection Area Conditional Use Area** – Staff provide information and permit assistance for activities that occur within the 50-foot Habitat Protection Area setback along 25 salmon streams.

**Kenai Peninsula Borough Coastal Management Program** - The borough provides local input and guidance to state and federal agencies involved in issuing permits or managing land and coastal resources. The program also provides an information base and policies to assist the borough in managing borough land and resource use decisions.

- ***Alaska Department of Fish and Game***

**Division of Habitat** - Issues permits for activities and projects that occur below ordinary high water in anadromous waters (e.g., salmon streams). Also permit projects or activities that could affect fish passage in non-anadromous streams.

- ***Alaska Department of Natural Resources***

**Division of Parks and Outdoor Recreation** - Issues permits for projects that occur below ordinary high water in the Kenai River Special Management Area, as well as for all commercial activity that takes place in State Parks on the Kenai Peninsula, including Kachemak Bay, Resurrection Bay and Prince William Sound.

- ***U.S. Environmental Protection Agency (EPA)*** – EPA staff at the KRC provide technical assistance for wetlands and other aquatic ecosystem conservation planning, oversee watershed research grants, and conduct waste and storm water inspections.
- ***The Kenai Watershed Forum*** - A local nonprofit citizens' group that provides the RC's school-based outreach and education programs.

**Contact:** For All Agencies at the Donald E. Gilman River Center  
**Address:** 514 Funny River Road, Soldotna, AK 99669  
**Phone:** (907) 260-4882  
**Website:** [www.borough.kenai.ak.us/KenaiRiverCenter](http://www.borough.kenai.ak.us/KenaiRiverCenter)

## State Resources

### Alaska Department of Fish and Game

For Central Kenai Peninsula Area Fishery and Wildlife Information

**Address:** 43961 Kalifornsky Beach Road, Soldotna, AK 99669  
**Phone:** (907) 262-9368

For South Kenai Peninsula Area Fishery and Wildlife Information

**Address:** 3298 Douglas St., Homer, AK 99603  
**Phone:** (907) 235-8191

### Alaska Department of Natural Resources

#### Division of Parks and Outdoor Recreation

For Park Use Permits



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**Contact:** Donald E. Gilman River Center  
**Address:** 514 Funny River Road, Soldotna, AK 99669  
**Phone:** (907) 260-4882

For Other Park Information or Business

**Contact:** Kenai/Prince William Sound Area, Morgan's Landing Office  
**Address:** 35850 Lou Morgan Rd., Sterling, AK 99672  
**Phone:** (907) 262-5581 (open year round)

## Alaska Department of Environmental Conservation (ADEC)

**Contact:** ADEC  
**Address:** Red Diamond Center, 43335 Kalifornsky Beach Rd., Suite 11, Soldotna, AK 99669  
**Phone:** (907) 262-5210

## Federal Resources

### FEMA

FEMA's mission is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery. FEMA provides flood hazard maps, publications related to flood mitigation, funding for flood mitigation projects and technical assistance. FEMA also operates the National Flood Insurance Program. FEMA's Region X office serves the northwestern states of Alaska, Idaho, Oregon and Washington.

**Contact:** FEMA, Federal Regional Center, Region 10  
**Address:** 130 228<sup>th</sup> St. SW, Bothell, WA 98021-9796  
**Phone:** (425) 487-4600  
**Website:** [www.fema.gov](http://www.fema.gov)

**To obtain FEMA publications:**  
**Phone:** (800) 480-2520

**To obtain FEMA maps:**  
**Contact:** Map Service Center  
**Address:** P.O. Box 1038, Jessup, Maryland 20794-1038  
**Phone:** (800) 358-9616

**To obtain National Flood Insurance Program (NFIP) and Community Rating System (CRS) Program information:**

**Contact:** National flood Insurance Program  
**Website:** [www.fema.gov/nfip](http://www.fema.gov/nfip)

## Natural Resource Conservation Service (NRCS), U.S. Department of Agriculture

The NRCS provides a number of federal programs that assist state and local governments and landowners to mitigate the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners willing to set land aside that is either a wetland resource or experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clear debris from clogged waterways, restore vegetation, and stabilize riverbanks. The measures taken under EWP must be environmentally and economically sound and generally benefit more than one property. Program assistance may also be available through the three Soil and Water Conservation District Offices that serve the Kenai Peninsula.



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**Contact:** NRCS, District Conservationist, Kenai Field Office  
**Address:** 110 Trading Bay, Suite 160, P.O. Box 800, Kenai, AK 99611-0800  
**Phone:** (907) 283-8732  
**Website:** [www.nrcs.usda.gov](http://www.nrcs.usda.gov)  
[www.ak.nrcs.usda.gov](http://www.ak.nrcs.usda.gov)

**Contact:** Kenai Soil and Water Conservation District, District Manager  
**Address:** 110 Trading Bay, Suite 160, P.O. Box 800, Kenai, AK 99611-0800  
**Phone:** (907) 283-8732

**Contact:** Homer Soil and Water Conservation District, District Manager  
**Address:** 4014 Lake Street, Suite 201, P.O. Box 4014, Homer, AK 99603  
**Phone:** (907) 283-8732

**Contact:** Alaska Soil and Water Conservation, District, District Manager  
**Address:** 510 "L" Street, Suite 280, Anchorage, AK 99501  
**Phone:** (907) 271-2424

## National Weather Service (NWS), Alaska Region Headquarters

The NWS provides flood watches, warnings and informational statements for rivers in Alaska. The website offers river, lake, marine, aviation and weather forecasts and warnings, and climate reports.

**Contact:** Alaska Region Headquarters  
**Address:** 222 West 7th Ave, #23, Anchorage, AK 99513-7575  
**Phone:** 907-271-5088  
**Fax:** 907-271-3711  
**Website:** [www.arh.noaa.gov/sitemap.php](http://www.arh.noaa.gov/sitemap.php)

## U. S. Geological Survey (USGS)

The USGS investigates the occurrence, quantity, quality, distribution and movement of surface and underground waters and disseminates the data to the public, state and local governments, public and private utilities, and other federal agencies involved with managing water resources. The USGS website also provides current stream flow information for 14 USGS gauging stations distributed across the Kenai Peninsula.

**Contact:** USGS Alaska Science Center  
**Address:** 4210 University Dr., Anchorage, AK 99508-4664  
**Phone:** (907) 786-7011  
**Email:** [dc\\_ak@usgs.gov](mailto:dc_ak@usgs.gov)  
**Website:** [waterdata.usgs.gov/ak/nwis](http://waterdata.usgs.gov/ak/nwis)  
Stream gage information: [waterdata.usgs.gov/ak/nwis/current/?type=flow](http://waterdata.usgs.gov/ak/nwis/current/?type=flow)

## U.S. Fish and Wildlife Service (USFWS)

The USFWS provide financial and technical resources through the Partners for Fish and Wildlife and Fish Passage Programs to assist private landowners and the Cities of Kenai and Soldotna to restore and protect riverbanks and riparian habitat in the Kenai, Kasilof and Anchor River watersheds.

**Contact:** U.S. Fish and Wildlife Service  
**Address:** Kenai Fishery Resource Office  
43665 Kalifornsky Beach Rd., Soldotna, AK 99669  
**Phone:** (907) 262-9863  
**Email:** [ak\\_fisheries@fws.gov](mailto:ak_fisheries@fws.gov)  
**Website:** <http://www.fws.gov/alaska/fisheries/fieldoffice/kenai/index.htm>

## The Floodplain Management Association (FMA)

The FMA website provides full-text management articles, a calendar of events, a list of available job



# FLOODS and EROSION

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positions, an index of publications, a floodplain management consultant list, newsletters, information on the basics of floodplain management and a catalog of web links.

**Contact:** Floodplain Managers Association  
**Address:** P.O. Box 712080, Santee, CA 92072-2080  
**Phone:** 619-204-4380  
**Website:** [www.floodplain.org](http://www.floodplain.org)

## **The Association of State Floodplain Managers (ASFPM)**

The association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recovery. ASFPM provides technical advice to governments and other entities for actions or policies that will affect flood hazards, and encourages research, education and training. The ASFPM website includes information on how to become a member, information on upcoming conferences, a publication list and other useful information and web links.

**Contact:** The Association of State Floodplain Managers  
**Address:** 2809 Fish Hatchery Road, Madison, WI 53713  
**Phone:** (608) 274-0123  
**Website:** [www.floods.org](http://www.floods.org)

## **Northwest Regional Floodplain Managers Association (NORFMA)**

This site provides technical information, articles, and web links in the field of floodplain, fisheries and river engineering management.

**Contact:** Northwest Regional Floodplain Managers Association  
**Website:** [www.norfma.org/](http://www.norfma.org/)

## **Additional Resources**

### **Kachemak Bay Research Reserve**

The Kachemak Bay Research Reserve (KBRR) performs and coordinates research and education related to estuarine, oceanic and watershed interests of the Kenai Peninsula and Gulf of Alaska. The KBRR is a partnership between the National Oceanic and Atmospheric Administration (NOAA) and the State of Alaska and is administered through the Alaska Department of Fish and Game.

**Contact:** Kachemak Bay Research Reserve  
**Address:** 95 Sterling Highway, Suite 2, Homer, AK 99603  
**Phone:** (907) 235-6377  
**Email:** [dfg.dsf.kachemak-bay@alaska.gov](mailto:dfg.dsf.kachemak-bay@alaska.gov)  
**Website:** [www.habitat.adfg.state.ak.us/geninfo/kbrr/index.html](http://www.habitat.adfg.state.ak.us/geninfo/kbrr/index.html)

### **Coastal Training Program Alaska**

The Coastal Training Program Alaska (CTP Alaska) provides science-based training and education services to assist policy makers and land managers make better decisions about coastal issues. CTP Alaska is a NOAA national initiative operated in conjunction with National Estuarine Research Reserves.

**Contact:** Kachemak Bay Research Reserve  
**Address:** 95 Sterling Highway, Suite 2, Homer, AK 99603  
**Phone:** (907) 235-6377  
**Email:** [Megan.Murphy@alaska.gov](mailto:Megan.Murphy@alaska.gov)  
**Website:** [www.habitat.adfg.state.ak.us/index.cfm/FA/educationCoastal.home](http://www.habitat.adfg.state.ak.us/index.cfm/FA/educationCoastal.home)

### **Kachemak Heritage Land Trust (KHLT)**

KHLT is a non-profit organization established in 1989 to preserve for public benefit land with significant



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natural, recreational or cultural values by working with willing landowners on the Kenai Peninsula.

**Contact:** Kachemak Heritage Land Trust  
**Address:** 315 Klondike Avenue, Homer, AK 99603  
**Phone:** (907) 235-5263  
**Fax:** (907) 235-1503  
**Website:** [www.kachemaklandtrust.org](http://www.kachemaklandtrust.org)

## American Red Cross

The American Red Cross is a volunteer humanitarian organization, which provides relief to disaster victims and helps people prevent, prepare for, and respond to emergencies.

**Contact:** American Red Cross  
**Address:** 235 E. 8<sup>th</sup> Avenue, Anchorage, AK 99501  
**Phone:** (907) 646-5401  
**Website:** [alaska.redcross.org](http://alaska.redcross.org)

## Kenai Watershed Forum

The Kenai Watershed Forum is a local non-profit citizens' group, which focuses on issues and activities that promote the health of Kenai Peninsula watersheds.

**Contact:** Kenai Watershed Forum  
**Address:** P.O. Box 2937, Soldotna, AK 99669  
**Phone:** (907) 260-5449  
**Website:** [www.kenaiwatershed.org](http://www.kenaiwatershed.org)

## Cook Inletkeeper

Cook Inlet Keeper is a private nonprofit organization, which conducts water quality monitoring, environmental education, and advocacy activities that promote clean water in the 47,000 square mile Cook Inlet watershed.

**Contact:** Cook Inletkeeper  
**Address:** PO Box 3269, 3734 Ben Walters Lane, Homer, AK 99603  
**Phone:** 907-235-4068  
**Website:** [www.inletkeeper.org](http://www.inletkeeper.org)

## Resurrection Bay Conservation Alliance

RCBA is a non-profit organization that promotes quality of life and tracks environmental issues on the eastern Kenai, from Seward to Portage, Cooper Landing to Hope.

**Contact:** Resurrection Bay Conservation Alliance  
**Address:** P.O. Box 1092, Seward, AK 99664  
**Phone:** (907) 224-4621  
**Email:** [info@rcba-alaska.org](mailto:info@rcba-alaska.org)  
**Website:** [www.rcba-alaska.org](http://www.rcba-alaska.org)

## Publications

City of Seward. 1996. *Flood Hazards Mitigation Plan*.

Dearborn, L.L., Anderson, G.S., and Zenone, Chester. 1979. *Water-resources data of the Seward area, Alaska: U.S. Geological Survey Water-Resources Investigations 79-11*.

Federal Emergency Management Agency. Revised Dec. 6, 1999. *Flood Insurance Study - Kenai Peninsula Borough, Alaska*.

U.S. Army Corps of Engineers, Alaska District. 1973. *Flood Plain Information, Kenai River, Phase I, Kenai Peninsula Borough, Alaska*.

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# FLOODS and EROSION

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*Kenai Peninsula Borough, Alaska.*

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Jones, S.H. and C. Zenone. 1988. *Flood of October 1986 at Seward, Alaska*, United States Geological Survey, Water Resources Investigations Report 87-4278, Anchorage, Alaska.

Larson, L., Klitze, M.J., and D.A. Brown. 2003. *No Adverse Impact: A Toolkit for Common Sense Floodplain Management*. Association of State Floodplain Managers, Madison, WI.

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Nelson, G.L. 1981. *Hydrologic Reconnaissance near Fourth of July Creek, Seward, Alaska*: U.S. Geological Survey Water-Resources Investigations 81-21.

Nibler, G.J. 1986. *Report on the October 10-12, 1986, Heavy Rain and Flooding in Southcentral Alaska*. Alaska River Forecast Center Report.

Sloan, C.E. 1985. *Water Resources and Hydrologic Hazards of the Exit Glacier Area near Seward, Alaska*: U.S. Geological Survey Water-Resources Investigations 81-21.

U.S. Army Corps of Engineers, Alaska District. 1975. *Flood Plain Information, Resurrection River and Salmon Creek, Seward, Alaska*.

U.S. Corps of Engineers. 1994. *Seward Area Rivers Flood Damage Prevention Interim Reconnaissance Report*.



# WILDFIRE

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## 3.0 Wildfires

A detailed interagency<sup>1</sup> action plan for fire prevention and protection, hazardous fuel reduction, forest health, restoration, and rehabilitation and community assistance has been developed for the Kenai Peninsula Borough.

The *All Lands/All Hands Action Plan* is a working document designed to implement the National Fire Plan (NFP) 10-Year Comprehensive Strategy and Healthy Forest Reforestation Act (HFRA) on Borough lands. This plan also facilitates the development of 20 Community Wildfire Protection Plans for Borough communities.

Currently, the Kenai Peninsula Borough is updating the All Lands/All Hands Action Plan for the year 2016. Upon adoption, the updated plan will be incorporated into the Borough's Hazard Mitigation Plan update scheduled for completion that year. All participating local jurisdictions will also incorporate the wildfire action plan into their 2016 Hazard Mitigation Plan updates.

This comprehensive, multi-year plan provides a detailed assessment of wildfire issues facing the Kenai Peninsula Borough and its residents. It addresses the wildfire situation within the Kenai Peninsula Borough facilities and populations at risk from fire, goals and action items to mitigate fire risk and an implementation schedule for identified plan goals. For the Hazard Mitigation Plan 2014 Update, all goals and actions referenced in the All Lands/All Hands Action Plan are still valid as the implementation schedule is contingent upon available funds and not legally binding.

The All Lands/All Hands Action Plan is arranged into three primary sections with five appendices:

- 1.0 **Introduction.** This section includes the background and purpose of the plan, document organization and the relationship of this plan to others.
- 2.0 **Action Plan Goals, Principles, Actions, Outcomes, Performance Measures & Implementation Tasks.** This section describes in detail the four main goals of the plan, associated implementation tasks and as a schedule for monitoring and evaluating the plan strategy.
- 3.0 **All Lands/ All Hands Multi-Year Project Implementation Schedule, Outputs and Costs.**

Appendix A – Fuel Hazard and Wildfire Risk Assessment

Appendix B – Wildland Fire Protection Capability

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<sup>1</sup> Participating agencies include: The Kenai Peninsula Borough, The USDA Forest Service (Alaska Region), State of Alaska Division of Forestry, USDI Fish and Wildlife Service (Alaska Regional Office), USDI Bureau of Land Management (Anchorage Field Office), USDI National Park Service (Kenai Fjords National Park), USDI Bureau of Indian Affairs, Cook Inlet Resources (Alaska Regional Office).



# WILDFIRE

Appendix C – Community Wildfire Protection Plans

Appendix D – Literature Cited

Appendix E – Individual Agency/Landowner 5-Year Project Implementation Plans

The entire *All Lands/All Hands Action Plan* is located in Annex H.

## 3.1 Wildfire History

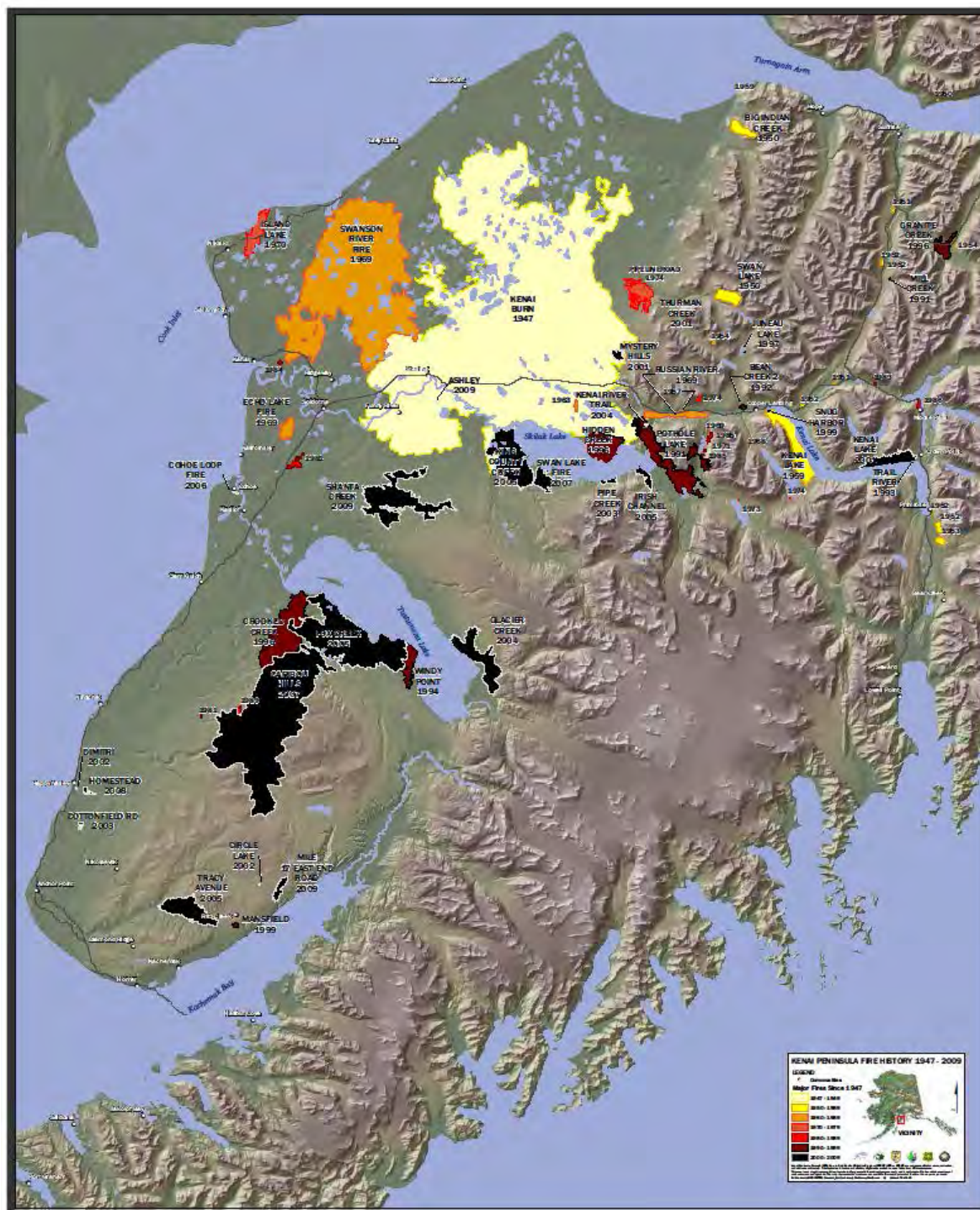
The Kenai Peninsula Borough has an active wildfire history, with an average of 66 fires a year in the past 22 years. Many of these fires have been confined to a relatively small area, but active response plans are critical for fire control. The most recent large fire on the Kenai Peninsula occurred at Shanta Creek (2009) and burned a reported 13,200 acres (Table 3-1). In 2007, a fire in the Caribou Hills burned 56,000 acres and destroyed 88 homes and cabins, as well as 109 outbuildings. Other recent fires burning large areas have taken place at Glacier Creek (2004) and Fox Creek (2005) near Tustumena Lake, Tracy Avenue (2005) fire near Homer and the King County Creek fire near Skilak Lake on the central peninsula (2005).

**Table 3-1.** Select Historical Fires on the Kenai Peninsula.

Year	Location	Number of acres affected
1947	Skilak Lake	310,000
1969	Swanson River	79,000
1974	Pipeline Road	3,780
May-June 1991	Pothole Lake*	7,900
1994	Windy Point	2,700
June 1996	Crooked Creek	17,500
May 1996	Hidden Creek and Voznesenka Village	5,200
July 1997	Kasilof	90
June 1999	Mansfield-Hutler Road	75
June-July 2001	Kenai Lake, Mystery Hills & Thurman	3,912 <sup>1</sup>
2003	Pipe Creek	513
2004	Glacier Creek Fire	8,600
2005	Fox Creek	26,300
2005	Tracy Avenue	5,400
2005	King County Creek	10,100
2007	Caribou Hills	56,000
2007	Swan Lake	2,000
2009	Shanta Creek	13,200
2009	Mile 17 East End Road	1,100

\* Disaster Declaration

<sup>1</sup> This was actually three fires: Kenai Lake (3,200 acres), Mystery Hills (697 acres) and Thurman (15 acres).



<sup>1</sup> No large fires since 2009, map will be revised for 2016 plan update



# WILDFIRE

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For additional information on fire history on the Kenai Peninsula see the *All Lands/All Hands Action Plan*:

- 1) Map A9: Historical Fire Start Locations and Ignition Cause on the Kenai Peninsula from 1980-2002.

## **3.2 All Lands / All Hands Executive Summary**

The All Lands / All Hands Executive Summary provides an overview of the project including goals and estimated implementation costs and outputs. Refer to Annex H for the complete All Lands / All Hands Action Plan.

The All Lands / All Hands plan has been extended and is currently under review for update by the participating agencies.



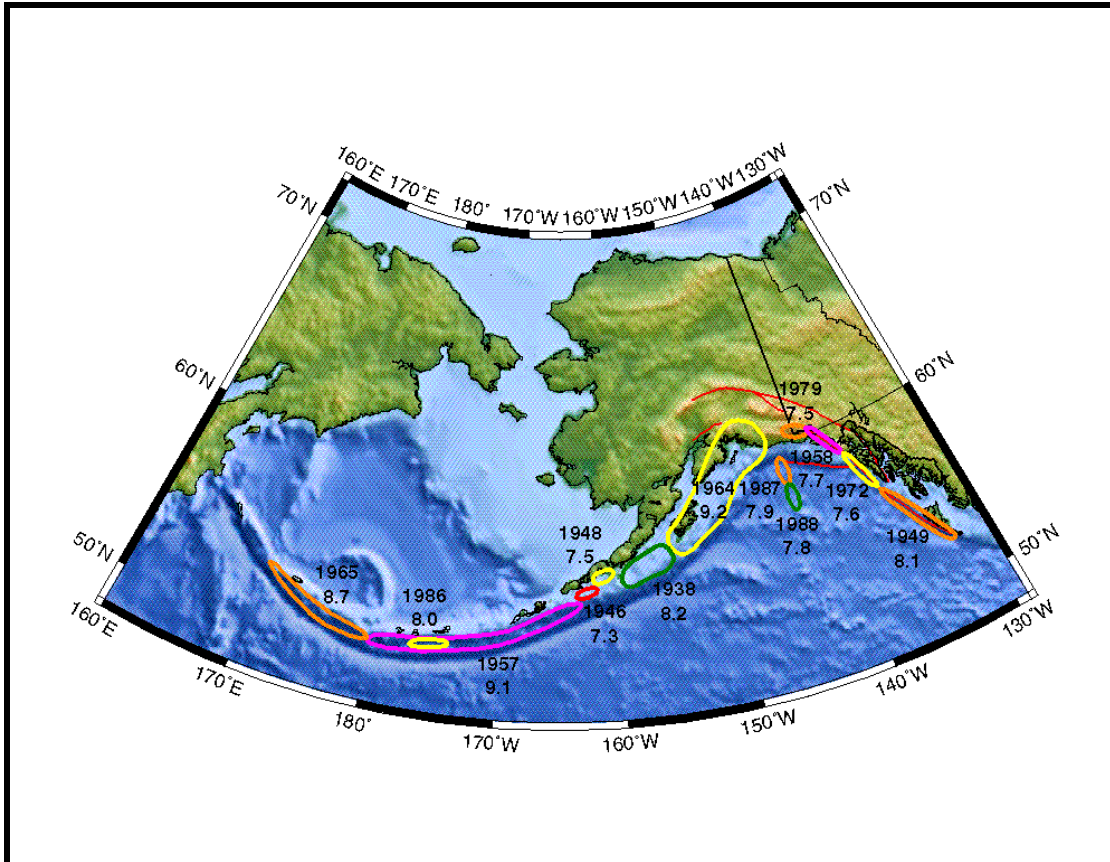


# EARTHQUAKES

## 4.0 Earthquakes

### 4.1 Why Focus on Earthquake Hazard Mitigation?

Approximately 11% of the world's earthquakes occur in Alaska and since 1904, Alaska has experienced three of the ten largest earthquakes anywhere on the globe<sup>1</sup>. High magnitude earthquakes in Alaska most commonly occur along the Aleutian Islands, the Alaska Peninsula and the Kenai Peninsula - an area referred to as the Alaska-Aleutian megathrust (Figure 4-1)<sup>2</sup>.



**Figure 4-1.** Rupture Areas and Dates of Large Earthquakes in the Alaska-Aleutian Region During This Century. Note that, with a few exceptions, virtually the entire boundary between the Pacific and North American Plates (*the Alaska-Aleutian Megathrust*) has ruptured during this period<sup>3</sup>.

As crustal plates move past each other pressure is accumulated. The release of this stress is felt as an earthquake. Seismic events that are generated in the area between two plates are referred to as interplate events. Earthquakes may also be

<sup>1</sup> Haeussler, P. and G. Plafker. 2003. Earthquakes in Alaska (map). U.S. Geological Survey, Open File Report 95-624.

<sup>2</sup> Wesson, R., A. Frankel, C. Mueller and S. Harmsen. 1999. Probabilistic Seismic Hazard Maps of Alaska. U.S. Geological Survey, Open File Report 99-36.

<sup>3</sup> Plafker, G. J.C. Moore, and G.R. Winkler. 1994. Geology of the Southern Alaska Margin in Plafker, G. and H.C. Berg (editors). The Geology of North America, Vol G-1, The Geology of Alaska. The Geological Society of America, 1994, Boulder, Colorado.





# EARTHQUAKES

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generated in areas within a tectonic plate, such as along fault zones, and are then termed intraplate events. Both earthquakes generated within and between plates may produce significant ground shaking events.

The vast majority of the quakes on the Kenai Peninsula are subduction zone earthquakes that result from the oceanic northwestward-moving Pacific Plate colliding and then descending beneath the continental North American Plate (an interplate event). The release of built up stress in the subduction zone usually leads to very large earthquakes, such as the one that occurred on March 27, 1964. These may be very deep forces and typically cause strong shaking that may last several minutes. They can also cause significant permanent uplift or subsidence over great areas, large seismic sea waves (tsunamis), landslides and snow avalanches. Subduction zone earthquakes in this region have a recurrence interval of 300-800 years<sup>1</sup>. Despite the estimated interval between these seismic events, they are an on-going threat and continue to have the potential to produce large magnitude earthquakes in the Kenai Peninsula region.

Earthquakes may also occur on the Kenai Peninsula as a result of the movement of active faults (Figure 4-2). These intraplate earthquakes may occur at great distance from the plate boundaries. There is evidence that some young shallow intraplate faults that trap oil and gas in Cook Inlet may be seismically active and have the ability to produce large magnitude earthquakes on an infrequent basis<sup>2</sup> (Figure 4-3). The active Castle Mountain Fault and possibly the Bruin Bay Fault, both on the west side of Cook Inlet, are two sources of potentially damaging earthquakes. In fact, geologists exploring possible seismic hazards in upper Cook Inlet found that shallow intraplate earthquakes may present a greater short-term threat than subduction-zone earthquakes, which have a longer recurrence interval<sup>3</sup>. The connection of these faults with oil and gas facilities further underscores the importance of mitigation strategies to reduce the damage from a major earthquake event.

In addition, many of the small to moderate magnitude earthquakes felt in the Kenai Peninsula region occur in an area referred to as the Wadati-Benioff Zone, which is the portion of the Pacific Ocean crust that is being subducted beneath the North American Plate. Rather than occurring on the interface between the plates (subduction zone/interplate events), these deep intraplate earthquakes occur within the down-moving slab as the oceanic plate deforms<sup>4</sup>.

More infrequently, Alaska may experience transform fault earthquakes, a special type of interplate strike-slip fault formed when crustal blocks slide by each other.

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<sup>1</sup> Haeussler, P., R. Bruhn, and T. Pratt, 2000. Potential seismic hazards and tectonics of the upper Cook Inlet basin, Alaska, based on analysis of Pliocene and younger deformation. GSA Bulletin 112(9): 1414-1429.

<sup>2</sup> Pers. comm., Peter Haeussler, Geologist, U.S. Geological Survey. Anchorage, Alaska, 2004.

<sup>3</sup> Haeussler, P., R. Bruhn, and T. Pratt, 2000. Potential seismic hazards and tectonics of the upper Cook Inlet basin, Alaska, based on analysis of Pliocene and younger deformation. GSA Bulletin 112(9): 1414-1429.

<sup>4</sup> Pers. comm., Rod Combellick, Acting Director, Alaska Division of Geological and Geophysical Surveys. Fairbanks, Alaska, 2004.



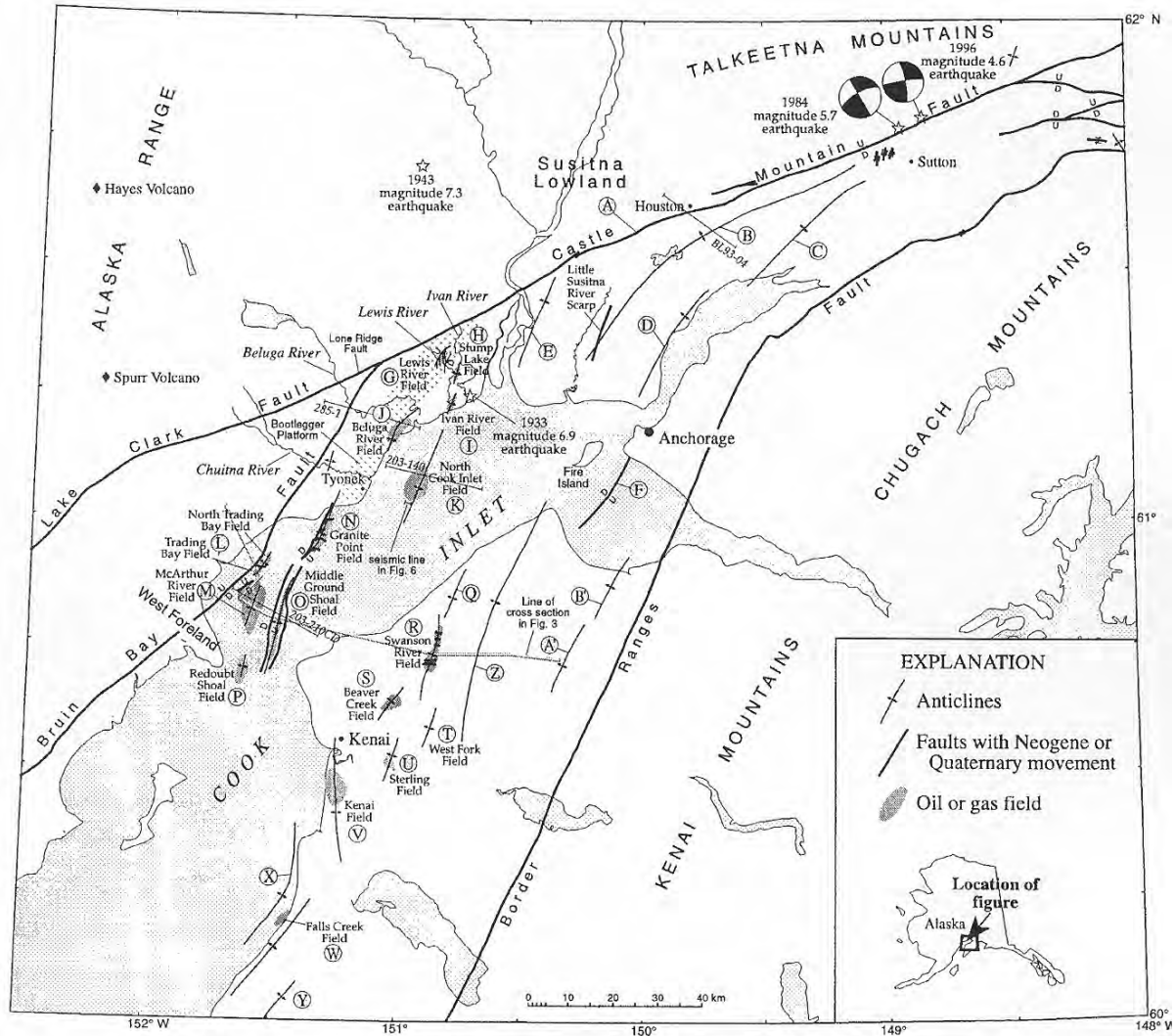
# EARTHQUAKES



**Figure 4-2.** Major Faults in the Kenai Peninsula Borough.



# EARTHQUAKES



**Figure 4-3.** Tertiary Structures in Cook Inlet Basin. Approximate basin boundaries are the Castle Mountain Fault, Bruin Bay Fault, and Border Ranges Fault. Details of significant structures, demarcated by letters, are found in Table 4-1. Used with permission from Haeussler et al. 2000.



# EARTHQUAKES

**Table 4-1.** Name of Structures and Labels in Figure 4-3<sup>1</sup>.

Name of structure and label in Figure 4-3	Length (km)	Data sources
(A) Castle Mountain Fault	52	Magoon et al. 1976
(B) Big Lake - Pittman	76	Magoon et al. 1976
(C) Wasilla St. 1- Needham	~15	Magoon et al. 1976
(D) Lorraine-Alaska Gulf	~25	Magoon et al. 1976
(E) Bell Island	~22	Magoon et al. 1976
(F) Turnagain Arm	~22	ARCO data/well data
(G) Lewis River	8	AOGCC 1994
(H) Stump Lake	7	AOGCC 1994
(I) Ivan River	6	AOGCC 1994
(J) Beluga River	15	AOGCC 1994; ARCO data
(K) North Cook Inlet	23	Magoon et al. 1976
(L) Trading Bay (and NTB)	26	ARCO data
(M) McArthur River	17	AOGCC 1994
(N) Granite Point	11	Magoon et al. 1976, AOGCC 1994
(O) Middle Ground Shoal	17	Magoon et al. 1976
MGS + Granite Point	44	ARCO data
(P) Redoubt Shoal	11	Magoon et al. 1976
Redoubt Shoal + McArthur River	26	Magoon et al. 1976
(Q) Birch Hill	12	Magoon et al. 1976
(R) Swanson River	20	Magoon et al. 1976
(S) Beaver Creek	9	Magoon et al. 1976
(T) West Fork	9	Magoon et al. 1976
(U) Sterling	9	Magoon et al. 1976
(V) Kenai	12	AOGCC 1994
(W) Falls Creek	27	Magoon et al. 1976
(X) Kasilof	32	Magoon et al. 1976
(Y) Deep Creek	12	Magoon et al. 1976
(Z) Naptown - Sunrise Lake – Beaver Ck	55	Magoon et al. 1976
(A') Swan Lake	17	Magoon et al. 1976
(B') Pincher Creek	14	Magoon et al. 1976

As one of the fastest-growing boroughs in Alaska, the Kenai Peninsula Borough has a rapidly developing urban and transportation infrastructure that is vulnerable to a high level of earthquake hazard<sup>2</sup>. Only through increased hazard awareness and implementation of loss/reduction measures can potential risks be mitigated.

<sup>1</sup> Used with permission from Haeussler, P., R. Bruhn, and T. Pratt, 2000. Potential seismic hazards and tectonics of the upper Cook Inlet basin, Alaska, based on analysis of Pliocene and younger deformation. GSA Bulletin 112(9): 1414-1429.

<sup>2</sup> Pinkston Enterprises. 2004. Kenai Peninsula Borough Emergency Response Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.





# EARTHQUAKES

## 4.2 Earthquake History

The Kenai Peninsula Borough frequently experiences small earthquakes (below magnitude 4), which usually go unnoticed by area residents - only information collected at seismic stations detect the activity. Earthquakes are commonly noticed when they reach the 4 to 4.5-magnitude range, though property damage or injury is minimal at this level. However, once earthquakes exceed the 4.5 level, the possibility of damage and injury increases significantly. Over 82 earthquakes with a magnitude of 6.0 or greater have been recorded in the Cook Inlet region<sup>1</sup> since 1898, with 30 of these triggered directly within the KPB boundaries<sup>2</sup> (Table 4-2; Figure 4-4).

**Table 4-2.** Earthquakes with Their Epicenter Located in the Kenai Peninsula Borough with a Magnitude of 6.0 or Greater from 01/1898 Through 02/2/2014<sup>3</sup>.

Date	Magnitude	Date	Magnitude
07/14/1899	7.2	10/03/1954	6.8
09/22/1911	6.9	01/24/1958	6.4
06/07/1912	6.4	12/26/1959	6.2
06/10/1912	6.9	09/05/1961	6.1
12/24/1931	6.2	06/24/1963	6.8
04/27/1933	7.1	03/28/1964	6.1*
06/13/1933	6.2	03/28/1964	6.1*
06/19/1933	6.0	03/28/1964	6.2*
06/18/1934	6.7	04/23/1968	6.5
10/11/1940	6.0	12/17/1968	6.2
07/30/1941	6.2	01/16/1970	6.1
12/05/1942	6.5	11/20/1993	6.0
01/12/1946	7.2	02/12/1995	6.1
09/27/1949	7.0	07/09/1998	6.3
06/25/1951	6.2	07/28/2001	6.3

\* The three earthquakes listed for March 28, 1964 are associated with one major earthquake that had its epicenter north of Prince William Sound (61.04 N, 147.73 W) and a calculated moment magnitude of 9.2<sup>4</sup>.

<sup>1</sup> Pinkston Enterprises. 2004. Kenai Peninsula Borough Emergency Response Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.

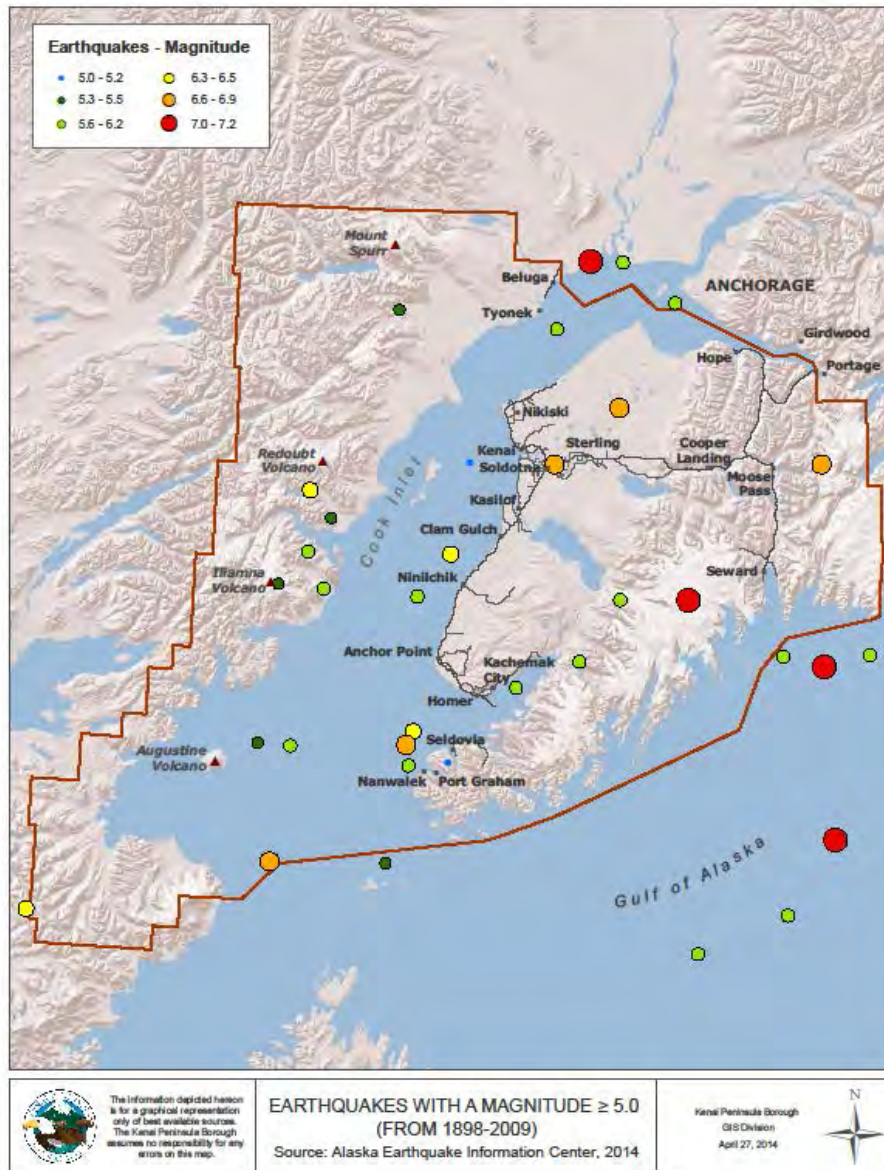
<sup>2</sup> Alaska Earthquake Information Center (AEIC). 2004. AEIC Earthquake Database, Geophysical Institute, University of Alaska, Fairbanks.

<sup>3</sup> ibid.

<sup>4</sup> U.S. Department of Commerce, National Science Services Administration, U.S. Coast and Geodetic Survey. 1964. United States Earthquakes



# EARTHQUAKES



**Figure 4-4.** Location of Earthquakes Generated Within the Kenai Peninsula Borough Boundaries From 1898 Through April 2010 with a Magnitude  $\geq 5.0$  (Data source: Alaska Earthquake Information Center 2010).





# EARTHQUAKES

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## ***March 27, 1964 (Good Friday) Earthquake***

The second largest earthquake ever recorded, measuring 9.2<sup>1</sup> at its epicenter, occurred on March 27, 1964 in the northern part of Prince William Sound. The rupture was calculated to a depth of approximately 25 km and lasted four minutes<sup>2</sup>. It caused considerable ground breakage, loss of lives and significant economic and infrastructure destruction. Notable damage was documented for over 50,000 square miles of land and developed areas, and recorded for over 100,000 square miles of cracked river and lake ice<sup>3</sup>. In addition, at least 10,000 miles of shoreline experienced subsidence or uplift in south-central Alaska<sup>4</sup>.

The Good Friday earthquake triggered landslides, avalanches, tsunamis and seiches<sup>5</sup> that caused extensive property damage and killed 115 people in Alaska, 106 of them as a direct result of tsunamis<sup>6</sup> (see Section 6.0). The death count could have been much higher if students had not been out of school for the Good Friday holiday, if the tide were high at the time of the quake or if building techniques (small, cross-braced houses) were not as resilient to earthquake related effects<sup>7</sup>.

Two local slide-generated tsunamis occurred on the Kenai Peninsula: one at Seward and another in Kachemak Bay. According to Thomas Sokolowski with the West Coast & Alaska Tsunami Warning Center, following the 1964 earthquake, a 1070-meter section of the Seward water front slid into Resurrection Bay. This produced a large seiche wave, which was followed 20 minutes later by the first main tsunami wave. The 11-13 fatalities in Seward were due to the local and the main tsunamis (see Section 6.0).

Major structural damage occurred on parts of the Kenai Peninsula as a result of the earthquake: houses collapsed, fires were triggered that destroyed industrial and port facilities, and schools were damaged beyond use (Figure 4-5). In Seward alone, the estimated cost to replace and repair facilities affected from the earthquake was \$22 million<sup>8</sup> (in 1967 dollars).

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<sup>1</sup> An original measurement of magnitude 8.3-8.4 calculated surface wave magnitude. A moment magnitude of 9.2 was later recalculated for this earthquake. Moment magnitude is a better measurement of energy release for large earthquakes.

<sup>2</sup> Christensen, D. 2004. The Great Alaska Earthquake of 1964. Geophysical Institute, University of Alaska, Fairbanks.

<sup>3</sup> Lageson, D. 1988. Tectonics of the Kenai Peninsula and Seward Region, Alaska. *In* D. Reichmuth, D. Findorff and M. Leaverton. Hazard Mitigation in the Seward, Alaska Area. Geomax, P.C., Bozeman, Montana.

<sup>4</sup> Stanley, K.W. 1968. Effects of the Alaska Earthquake of March 27, 1964: On Shore Processes and Beach Morphology. Geological Survey Professional Paper 543-J. United States Department of the Interior, Washington, D.C.

<sup>5</sup> A seiche is the back and forth movement of a closed body of water. Earthquakes, strong winds or a change in barometric pressure, can trigger seiches.

<sup>6</sup> A tsunami is large ocean wave caused by sea-floor displacement associated with earthquakes, landslides and volcanic eruptions.

<sup>7</sup> Lageson, D. 1988. Tectonics of the Kenai Peninsula and Seward Region, Alaska. *In* D. Reichmuth, D. Findorff and M. Leaverton. Hazard Mitigation in the Seward, Alaska Area. Geomax, P.C., Bozeman, Montana.

<sup>8</sup> Lemke, R. 1967. The Alaska Earthquake, March 27, 1964: Effects on Communities. Effects of the Earthquake of March 27, 1964, at Seward, Alaska. Geological Survey Professional Paper 542-E. United States Department of the Interior, Washington, D.C.



# EARTHQUAKES



**Figure 4-5.** Earthquake-triggered Tsunami Damage in Seward at the North End of Resurrection Bay Following the Good Friday Earthquake. The photo depicts a grounded ship and a destroyed Texaco chemical truck (Photo courtesy of U.S. Department of the Interior).

Earthquakes often trigger a number of secondary events. Unconsolidated material, such as those found in alluvial fans, may become unstable as seismic shaking causes ground material to lose strength and act like a liquid (called liquefaction)<sup>1</sup>. Earthquakes can also cause land to subside or sink, which may be associated with liquefaction. As a result of the Good Friday earthquake, Seward subsided about 3.5 feet, flooding several areas along the margin of Resurrection Bay<sup>2</sup>. Subsidence in the Homer Spit shoreline in Kachemak Bay ranged from two to six feet, causing 70 percent of the spit to be inundated by the high fall tides<sup>3</sup>. Similarly, the southern shoreline along Turnagain Arm at the town of Hope Hope dropped four to six feet and spring high tides inundated areas five feet above the pre-quake tide levels<sup>4</sup>. The Seldovia area subsided with a vertical drop of 6 ft (1.8 m), which completely changed its waterfront.<sup>5</sup>

<sup>1</sup> Lageson, D. 1988. Tectonics of the Kenai Peninsula and Seward Region, Alaska. *In* D. Reichmuth, D. Findorff and M. Leaverton. Hazard Mitigation in the Seward, Alaska Area. Geomax, P.C., Bozeman, Montana.

<sup>2</sup> Ibid.

<sup>3</sup> Alaska Department of Fish and Game. Homer Spit Pictorial History.

<sup>4</sup> Foster, H.L., and T.N.V. Karlstrom. 1967. The Alaska Earthquake. March 27, 1964. Regional Effects. Ground Breakage in the Cook Inlet Area. Geological Professional Paper 543-F.

<sup>5</sup> Suleimani, E.N., et al., Tsunami Hazard Maps of the Homer and Seldovia Areas, Alaska. State of Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, 2005



# EARTHQUAKES

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To a large extent, ground breakage associated with the 1964 earthquake occurred on thick deposits of unconsolidated sediments and consisted of: 1) fracturing or cracking, and 2) slumping and lateral extensions of unconfined faces<sup>1</sup>. Within the KPB, the majority of ground breakage occurred in the northern portion of the Kenai Lowlands (west of the Kenai National Wildlife Refuge and north of Kachemak Bay). Cracks were found as large as 30 feet across and 25 feet deep<sup>2</sup>. For additional information about the damage to the Seward area, see the City of Seward All-Hazard Plan (Annex E) and Tsunamis & Seiches Section 6.0.

As the population and infrastructure of the Kenai Peninsula grows, so does the need to prepare for other earthquakes of this magnitude. Predicting when another large earthquake may occur is difficult. Geologic evidence of prehistoric earthquakes, combined with historic records and seismologic monitoring, suggests an average recurrence interval of 600-800 years<sup>3</sup>. However, it would be misleading to interpret this to mean that another high magnitude earthquake is not due on the Kenai Peninsula for another 600-800 years; indeed, one could occur anytime.

## ***Other Earthquakes on the Kenai Peninsula***

Though earthquakes are frequently occurring on the Kenai Peninsula, very little damage to facilities or private homes has been recorded. Two classrooms in Chapman School in Anchor Point had cracked walls as a result of an earthquake in 1994<sup>4</sup>. Fortunately, the damage was cosmetic rather than structural. In 2002 a 7.9 magnitude earthquake along the Denali fault in the Alaska Range damaged several wells in Moose Pass and Sterling. In addition, a concrete subfloor in the Cooper Landing elementary school gym developed a crack that is suspected to be a result of the earthquake<sup>5</sup>. While earthquake damage has been minimal in the past few decades on the Kenai Peninsula, many structures are potentially at risk should a significantly large earthquake occur near developed areas. For additional information about earthquakes affecting the KPB, see the All-Hazard Plan annexes for the incorporated cities.

## **4.3 Earthquake Risk Assessment**

The extent of damage from an earthquake is dependent on several factors, such as the magnitude of the quake, the geology of the area, distance from the epicenter, population concentration and structure design and construction. An earthquake greater than 6.0 on the Richter scale has a possibility of triggering potentially damaging events such as floods and landslides, and greater than 7.0

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<sup>1</sup> Foster, H. and T. Karlstrom. 1967. The Alaska Earthquake, March 27, 1964: Region Effects. Ground Breakage and Associated Effects in the Cook Inlet, Alaska, Resulting from the March 27, 1964, Earthquake. Geological Survey Professional Paper 543-F. United State Department of the Interior, Washington, D.C.

<sup>2</sup> Ibid.

<sup>3</sup> Combellick, R. 1997. Evidence of Prehistoric Great Earthquakes in the Cook Inlet Region, Alaska. In Karl, S., N. Vaughn and T. Hyherd (editors), Guide to the Geology of the Kenai Peninsula, Alaska. Alaska Geological Society, Anchorage, Alaska.

<sup>4</sup> Pers. comm., Rob Robson, Director, Capital Projects Division, Kenai Peninsula Borough. Soldotna, Alaska, 2004.

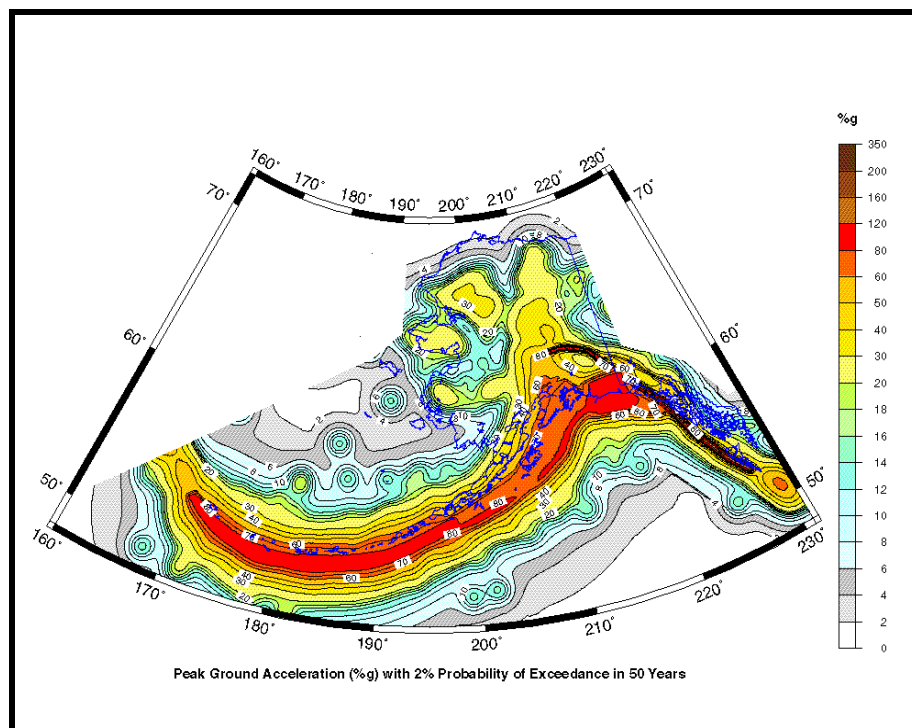
<sup>5</sup> Pers. comm., Dave Tressler, Director of Maintenance, Kenai Peninsula Borough. Soldotna, Alaska, 2004.



# EARTHQUAKES

may trigger a tsunami<sup>1</sup>. It can also cause industrial and technological emergencies such as fires, explosions, and hazardous material spills or a disruption of vital services such as water, sewer, power, gas and transportation. An event of this scale can also damage or disrupt emergency response facilities, resources and systems. Clearly, it is important to develop and implement mitigation strategies to offset the damage to life and property in earthquake prone areas such as south-central Alaska.

The entire KPB lies within Zone 4 (highest earthquake hazard potential) of the former Uniform Building Code<sup>2</sup>. Zone 4 is susceptible to earthquakes of magnitude of greater than 6.0 in which major structural damage could occur. Current building codes rarely use numbered zones to identify at-risk areas; rather, they use probabilistic ground motion to show high-probability ground accelerations for an area<sup>3</sup> (Figure 4-6). Both building code models for predicting earthquake vulnerability place the Kenai Peninsula in a highly susceptible area.



**Figure 4-6.** Peak Ground Acceleration (%g) with 2% Probability of Exceedance in 50 Years<sup>4</sup>.

- <sup>1</sup> Oregon Department of Geology and Mineral Industries. 2001. Tsunami Warning Systems and Procedures: Guidance of Local Officials. Special Paper 35 prepared for the National Tsunami Hazard Mitigation Program.
- <sup>2</sup> Pers. comm., Rod Combellick, Acting Director, Alaska Division of Geological and Geophysical Surveys. Fairbanks, Alaska, 2004.
- <sup>3</sup> Maps in the current building code do not take into account additional potential hazards associated with areas that are subject to landsliding during earthquakes or are otherwise unstable due to soft, saturated ground (R. Combellick pers. comm., 2004).
- <sup>4</sup> Wesson, R., A. Frankel, C. Mueller and S. Harmsen. 1999. Probabilistic Seismic Hazard Maps of Alaska. U.S. Geological Survey, Open File Report 99-36.



# EARTHQUAKES

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## **4.3.1 Populations and Facilities at Risk**

Because the entire Kenai Peninsula Borough is vulnerable to earthquakes, it is critical that particularly vulnerable facilities and populations be identified and prioritized so that appropriate mitigation strategies can be developed. Factors that should be considered when assessing earthquake risk include population and property distribution, location of housing and facilities relative to potential secondary hazards, building design and construction, and disaster readiness for the region. Refer to Table 1-20 in Section 1.5.4 for a summary of the tax assessed value of residential, industrial and commercial structures in KPB communities.

Major damage may be caused by secondary earthquake hazards. Landslides, floods, avalanches, tsunamis, uplift, subsidence, infrastructure failures and soil liquefaction are all powerful events. The severity of the damage is a result of several factors: soil and slope conditions, proximity to the epicenter, earthquake magnitude, and the type of earthquake<sup>1</sup>. Many of these earthquake-associated hazards will be addressed in detail in their own chapters in subsequent additions of this plan.

Maintaining or rapidly repairing infrastructure and communication systems is critical following a hazard event. Disruption to facilities and services such as roads, rail service, businesses, lifelines and critical services can seriously affect a community's ability to respond to a large-scale earthquake. Fires, debris buildup, death and injury are all potential emergencies that require the infrastructure and communication that may be damaged during an earthquake.

### **4.3.1.1 Transportation**

As was clearly demonstrated in 1964, large earthquakes have the potential to disrupt important transportation infrastructure. Of the three main types on the Peninsula (land, water, air), land-based transportation is likely to be the most seriously affected by a large earthquake<sup>2</sup>. However, runways (for air travel) and docks and harbors (for water travel) are also at risk. There are approximately 630 miles of Borough-maintained roads and 650 miles of state (ADOT&PF) maintained roads in the Kenai Peninsula Borough<sup>3</sup> (see Figure 1-5).

The central region of the ADOT&PF is, in part, responsible for the maintenance and construction of the Seward Highway from Anchorage to Seward, and the Sterling Highway from the Seward "Y" to Homer. The earthquake readiness of state-owned bridges is analyzed using a three-part computer seismic retrofit

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<sup>1</sup> Combellick, R., R. Reger and C. Nye. 1995. Geologic Hazards in and near Proposed State of Alaska Oil and Gas Lease Sale 85A (Cook Inlet). Department of Natural Resources, Division of Geological & Geophysical Surveys, Public-Data File 95-36; Oregon Natural Hazards Workgroup (ONHW). 2002. Clackamas County Natural Hazards Mitigation Plan. *Report for Clackamas County Emergency Management prepared by* Resource Assistance for Rural Environments/Oregon Natural Hazards Workgroup. Eugene, Oregon.

<sup>2</sup> HDR Alaska, Inc. 2003. Kenai Peninsula Borough Transportation Plan (Update). Prepared for the Kenai Peninsula Borough, Soldotna, Alaska.

<sup>3</sup> Ibid.; Pers. comm., Gary Davis, Road Service Areas Director, Kenai Peninsula Borough. Soldotna, Alaska, 2004.





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analysis program: 1) seismic vulnerability (e.g., how earthquake prone is the region?); 2) structural vulnerability (based on bridge plans and structural factors such as length and vulnerability of piers and abutments); 3) route importance (evaluation and prioritization based on factors such as importance of the highway connection, communities served, bridge length, available detours and proximity to other important infrastructure, such as pipelines)<sup>1</sup>. All of the Kenai River bridges have been seismically retrofitted. The Cooper Creek Bridge is seismically vulnerable and will eventually need to be replaced<sup>2</sup>. The timing and priority for replacement depends in large part on which route is selected for the Cooper Landing Highway improvement project, which is pending.

Although outside of the Kenai Peninsula Borough, the bridges on the Seward Highway along Turnagain Arm at Ingram and Portage Creeks and the Placer and Twenty-mile Rivers have the potential to disrupt access to the Peninsula. These bridges are older and possibly in need of replacement or retrofiting<sup>3</sup>. Continuing south along the Seward Highway, the Canyon Creek bridge was recently replaced and many of the bridges between MP 18-25 (Snow River to Crown Point) are slated for upgrade (two bridges at Snow River) or replacement (Falls, Victor and Ptarmigan Creeks) in conjunction with an upcoming highway improvement project. The three highway bridges crossing the Resurrection River at the city of Seward were recently replaced and meet current seismic standards<sup>4</sup>. The upgrade of at least one of the Resurrection River railroad bridges is planned for the near future.

The KPB has 14 bridges in the road maintenance program with a total value of approximately \$3,000,000. Seward has nine bridges, Anchor Point has four, and Kasilof and Ninilchik each have one. The three newest bridges are the Cottonwood Bridge in Anchor Point, the Brody Bridge in Ninilchik and the Tinker Lane Bridge in Seward. The other bridges are older but sturdy. In terms of maintenance priority, the Henry Creek Bridge in Anchor Point is first<sup>5</sup>. Other points of concern involve locations where the failure of roads or culverted stream crossings could isolate residents in remote or even urban areas.

## 4.3.1.2 Other Facilities

Of the 56 borough buildings, only the five most recently built are known to meet Zone 4 International Building Code requirements. Although all new structures are now mandated to meet this standard, the majority of KPB buildings were constructed before this requirement was established<sup>6</sup>. The necessary seismic studies to determine whether older Borough buildings meet current earthquake standards would cost \$25,000 - \$60,000 per building, totaling approximately \$2.0 -3.0 million dollars for an examination of all KPB buildings. Although it is

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<sup>1</sup> Pers. comm., Richard Pratt, Alaska Department of Transportation and Public Facilities. Alaska, 2004.

<sup>2</sup> Ibid.

<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

<sup>5</sup> Pers. comm., Gary Davis, Road Service Areas Director, Kenai Peninsula Borough. Soldotna, Alaska, 2004.

<sup>6</sup> Ibid; Pers. comm., Rob Robson, Director, Capital Projects Division, Kenai Peninsula Borough. Soldotna, Alaska. 2004





# EARTHQUAKES

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important that vulnerable facilities in each community be identified and prioritized for seismic retrofitting, funding to complete the necessary structural upgrades would need to be obtained.

The KPB does own some state-of-the art earthquake “ready” buildings. The new Seward Middle School and the addition to Central Peninsula Hospital are recently-completed projects that are built to current earthquake standards. The new Nikiski Fire Station Number Two was also designed and constructed utilizing the current building code earthquake loading requirements (IBC 2006). The Baler Building at the Soldotna Landfill has rigid moment design and is one out of only two buildings in the state of Alaska constructed with this design<sup>1</sup>.

Additional key resources that are vulnerable to earthquake-related damage include: wells, water and sewer lines, oil and gas pipelines, electric, gas and phone utilities, schools, prisons, airports, hospitals, police, fire and evacuation support. For a complete listing of facilities, structures and populations at risk, see Tables 1-4, 1-5, 1-6, 1-7, 1-14 and 1-15.

Because the entire KPB lies within Zone 4 (highest earthquake hazard potential)<sup>2</sup> of the former Uniform Building Code, all structures, facilities and populations listed above are vulnerable to earthquake related hazards. The KPB Hazard Insurance Report (in prep.) analyzed the risk to Borough-owned assets from earthquake and flood hazards into categories of *significant*, *insignificant* or *no perceived risk*. (Table 1-13). Hazard prediction tools, such as FEMA’s HAZUS model and liquefaction-susceptibility mapping as well as additional active fault research<sup>3</sup> could help identify particularly vulnerable locations on the Peninsula.

## **4.3.2. Emergency Communications**

During design development of the All Hazard Alert Broadcast System (AHAB), KPB coastal communities were evaluated utilizing tsunami inundation maps (among other considerations). AHAB sirens are located in Homer, Seward, Seldovia, Port Graham and Nanwalek.

The warning sirens operate on DC power and are capable of generating their own power through a wind turbine, reducing their reliance on commercially provided power distribution systems. The AHAB siren system can operate independently and activate automatically via radio frequency NWS Emergency Alert System alerts.

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<sup>1</sup> Pers. comm., Gary Davis, Road Service Areas Director, Kenai Peninsula Borough. Soldotna, Alaska, 2004; Pers. comm., Rob Robson, Director, Capital Projects Division, Kenai Peninsula Borough. Soldotna, Alaska, 2004.

<sup>2</sup> Zone 4 it is susceptible to earthquakes of Richter magnitude 6.0 to 8.8; a level at which major structural damage is probable.

<sup>3</sup> Pers. comm., Peter Haeussler, Geologist, U.S. Geological Survey. Anchorage, Alaska, 2004.



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## **4.3.3. Community Preparedness**

### **4.3.3.1 Community Emergency Response Teams**

The Citizen Corps program, coordinated through the Kenai Peninsula Borough Office of Emergency Management, has implemented the Community Emergency Response Team (CERT) program. As of March 2014 approximately 100 CERT volunteers in communities throughout the Peninsula have received training in emergency preparedness and response, including light search and rescue, triage and emergency first aid, suppression of small fires and incident command systems. These teams are trained to act as first responders in an emergency until professional rescuers and responders can arrive.

### **4.3.3.2 TsunamiReady Program**

Based on the NWS StormReady model, the TsunamiReady Program is a National Weather Service (NWS) initiative that promotes public safety and tsunami hazard preparedness. It is a collaborative program that combines the efforts of federal, state and local emergency management agencies, the public, and the NWS tsunami warning system.

In 2002, Seward and Homer became Alaska's first TsunamiReady communities (Figure 6-5). Before a community can be declared tsunami ready, it must meet five guidelines under the categories of communications and coordination, tsunami warning reception, warning dissemination, awareness and program administration<sup>1</sup>.

## **4.4 Earthquake Mitigation Goals and Objectives**

Although it is not possible to eliminate the threat that earthquakes pose to Borough residents, it is possible to identify ways to reduce vulnerability. Three primary goals were identified to mitigate the damaging effects of earthquakes: *protection, prevention and education*. These goals encompass both agency and individual responsibilities.

Protective earthquake measures could include such activities as safeguarding life and property by minimizing development on unstable soil and encouraging earthquake-ready building design. Increasing knowledge of areas vulnerable to landslide and liquefaction would also be beneficial for preventing loss of life and damage from earthquake activity. In addition, promoting public awareness and individual preparedness helps to increase the capacity of Borough residents to safeguard their homes and families.

Hazard mitigation planning objectives focus on saving lives and minimizing the direct and indirect costs of disaster damage. Earthquakes have the potential to affect all segments of the communities they strike and the following objectives

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<sup>1</sup> Guidelines detailed online at [www.tsunamiready.noaa.gov/guidelines.htm](http://www.tsunamiready.noaa.gov/guidelines.htm)



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were identified to further define and guide the development of mitigation strategies:

- modify potential impacts by assisting individuals and communities to prepare for, respond to, and recover from earthquake events;
- reduce susceptibility to damage and disruption by avoiding hazardous, uneconomic and unwise development in known hazard areas (such as landslide, avalanche, or liquefaction zones);
- protect the natural and beneficial values of floodplains, coastal areas and water resources; and
- reduce unnecessary economic losses and promote positive economic development by incorporating earthquake hazard mitigation into land use and development decisions.

## 4.5 Earthquake Mitigation Strategies and Implementation Ideas

Following an assessment of facilities and populations at risk, identifying strategies that minimize or eliminate those risks provides long-term direction for planning purposes. The regional, on-going nature of earthquake risk in the Kenai Peninsula Borough necessitates the implementation of short and long-term strategies that protect both existing and future structures and communities. The following mitigation strategies are intended to augment existing activities, such as public education, as well as identify potential new activities, such as soil-liquefaction mapping. Various stakeholders' ideas and concerns were taken into consideration in the development of the mitigation strategies for the KPB. City specific mitigation strategies may be found in the incorporated city annexes.

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### ***Strategy 1: Identify and prioritize studies and retrofit measures for KPB critical facilities and infrastructure that are seismically vulnerable.***

The Borough owns and maintains a number of structures that provide both critical and non-critical services for area residents. While it is important to reduce earthquake vulnerability of all Borough structures, protecting critical facilities will help promote effective and efficient response when events occur. To be best prepared and able to respond to a hazard event, it is key to reduce the vulnerability of these facilities from hazard damage and keep them functionally operative.

### **Implementation Ideas and Action Items**

- Assemble prioritized lists of Borough structures needing seismic studies to identify necessary changes or retrofits to meet current



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earthquake building standards. Seismic studies should be prioritized as follows:

1. Emergency response facilities. These buildings are highest priority following a hazard as they provide fire protection, police, and emergency medical response and rescue.
  2. Hospitals. Available medical treatment is critical in an emergency situation.
  3. Schools. Schools provide a source of temporary shelter, and central location for the distribution and dissemination of necessary supplies and information.
  4. Other Borough facilities such as support buildings and storage facilities.
- Identify potential retrofit and rehabilitation measures and activities.

**Long term:** Once seismic vulnerabilities have been identified for KPB facilities, it is possible to outline steps required to retrofit them. The cost and time associated with this action will depend on the findings from the seismic study.

**Short term:** Perform economical retrofit projects for schools and other critical facilities. Such projects could include:

- securing ceiling tiles with clips
- seismic bracing of loose equipment; bolting bookcases.

A list of additional actions for work spaces and homes may be found on the KPB Office of Emergency Management website: [www.borough.kenai.ak.us/emergency](http://www.borough.kenai.ak.us/emergency).

- Analyze benefits/costs and prioritize seismic studies and retrofit projects.
- Coordinate with other agencies and organizations to identify permit requirements, partnership interests and possible funding sources.
- Review and update project priorities on an annual basis.

**Potential Participants:** Capital Projects Division (KPB), Maintenance Department (KPB), Office of Emergency Management (KPB), Solid Waste Department (KPB) Risk Management (KPB), School District (KPB), Hospitals (KPB), Incorporated Cities within the KPB.



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<b>Potential Funding:</b>	KPB, Local Communities, AKDHS&EM, FEMA mitigation grants, State Capital Improvement, Private Granting Agencies, NEHRP, USGS
<b>Time Frame:</b>	For seismic study: 18 weeks per building - includes plan development and approval For retrofit activities and projects: Ongoing (1-5 years as funding permits)
<b>Estimated Cost:</b>	For seismic study: \$25,000-60,000 per building

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**Strategy 2:** *Encourage the reduction of non-structural and structural earthquake hazards in homes, businesses and government offices.*

## Implementation Ideas and Action Items

- Augment existing homeowner earthquake safety programs. This should include distribution of information on safe building design and retrofitting techniques.
- Explore partnerships to provide retrofitting classes for homeowners, renters, building professionals and contractors.
- Target development located in potential fault zones or in unstable soils for intensive education and retrofitting resources.

<b>Potential Participants:</b>	Office of Emergency Management (KPB), Capital Projects Division (KPB), Local Emergency Planning Committee, Community Schools Program (KPB School District), AK State Division of Homeland Security and Emergency Management, FEMA, Local Realtors, Local Construction Companies, Incorporated Cities within the KPB
<b>Potential Funding:</b>	KPB, Local Communities, FEMA, USACE, AKDHS&EM, NEHRP
<b>Time Frame:</b>	Ongoing (1-5 years as funding permits)

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**Strategy 3:** *Encourage KPB residents to purchase earthquake hazard insurance.*

A very low number of Kenai Peninsula Borough residents have earthquake insurance<sup>1</sup>. This is due in part to the high cost of the insurance (roughly \$300-\$700 dollars a year). However, some combined hazard insurance plans are available, which would group earthquake, flood and landslide hazards together and may make the insurance more affordable.

## Implementation Idea and Action Item

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<sup>1</sup> Pers. comm., Sherri Jackson, Insurance Agent, Acordia of Alaska. Soldotna, Alaska, 2004.



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- Coordinate with insurance companies and organizations such as the Alaska Division of Insurance to produce and distribute earthquake insurance information.

**Potential Participants:** Office of Emergency Management (KPB) Capital Projects Division (KPB), Local Insurance Companies  
**Potential Funding:** Local Communities, KPB, AK Insurance Division  
**Time Frame:** Ongoing (1-5 years as funding and time permits)

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## ***Strategy 4: Identify oil and gas producing facilities that pose a risk to the Kenai Peninsula Borough due to their proximity to active faults.***

Although a few active faults, such as the Castle Mountain Fault and Bruin Bay Fault (Figure 4-3), have been identified, the extent and subsurface trends of many associated faults are speculative<sup>1</sup> and the determination of truly active structures in the Cook Inlet Region remains difficult. As some of the oil and gas infrastructure appears to be associated with active shallow faults<sup>2</sup>, potential earthquake events at or near the location of onshore and offshore oil and gas facilities pose a significant risk for the Kenai Peninsula Borough.

Presently, most of the existing seismic data is closely-held proprietary property of oil and gas companies and is not generally available to government agencies. According to Peter Haeussler, geologist with the U.S. Geological Survey, the seismic reflection data held by the oil and gas companies would be extremely useful for identifying the best locations for boreholes to reveal the age of folded subsurface layers. With this information, seismic structure activity, deformation rates, activity occurrence intervals and potential quake magnitude could be determined. Unfortunately, the cost of commissioning new seismic surveys for the region is prohibitive to governmental agencies and organizations.

### **Implementation Ideas and Action Items**

- Contact the oil and gas companies to encourage cooperation and data sharing with state and federal geoscientists to enable them to better predict areas vulnerable to seismic damage. Prioritize data

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<sup>1</sup> Combellick, R., R. Reger and C. Nye. 1995. Geologic Hazards in and near Proposed State of Alaska Oil and Gas Lease Sale 85A (Cook Inlet). Department of Natural Resources, Division of Geological & Geophysical Surveys, Public-Data File 95-36.

<sup>2</sup> Haeussler, P., R. Bruhn, and T. Pratt, 2000. Potential seismic hazards and tectonics of the upper Cook Inlet basin, Alaska, based on analysis of Pliocene and younger deformation. GSA Bulletin 112(9): 1414-1429.





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acquisition for areas with larger oil and gas producing structures in the Cook Inlet region.

- After this information is obtained, cooperate with researchers at the U.S. Geological Survey and the Alaska Department of Geophysical and Geological Survey to develop projects that determine fault activity and generate earthquake risk information. This data could then be used in mitigation planning for high-risk areas.

**Potential Participants:** Office of Emergency Management (KPB), Alaska Division of Geological & Geophysical Surveys (DNR), U.S. Geological Survey, Oil and Gas Companies (ConocoPhillips, Cook Inlet Pipeline, Forest Oil, Pelican Hill, XTO Energy, Marathon Oil Company, Tesoro Alaska, Unocal, Aurora Gas, British Petroleum), Incorporated Cities within the KPB

**Potential Funding:** KPB, AKDHS&EM, USGS, USF&W, USACE, NRCS

**Time Frame:** Ongoing (longer term 3-5 years as funding and time permits)

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## ***Strategy 5: Perform earthquake hazard mapping for the Kenai Peninsula Borough and improve technical analysis of earthquake hazards.***

The Kenai Peninsula Borough presently has little site-specific information to assist with identifying areas at particularly high risk to earthquakes. The Federal Emergency Management Agency (FEMA) has produced a model (HAZUS-MH) that has the capacity to integrate national, regional and local hazard information to estimate potential loss from earthquakes (as well as floods and hurricanes). This model generates hazard maps, compiles potential damage and economic loss information for buildings and infrastructure and predicts the effects of different earthquake scenarios on populations.

Although time and resources were not available to accomplish the task, the possibility of conducting HAZUS-MH modeling for this mitigation plan was explored. Rod Combellick<sup>1</sup> with the Alaska Division of Geological and Geophysical Surveys recommended assembling a group of knowledgeable geoscientists to develop a credible and scientifically defensible earthquake event to run through the model. In addition, the model requires an up-to-date structure inventory and recent population census data.

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<sup>1</sup> Rod Combellick was one of a group of scientists involved in a HAZUS analysis sponsored by the Army Corps of Engineers in the Anchorage area and has had two levels of training in this program.



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variations in soil and rock types, and therefore will not identify areas vulnerable to landslides or liquefaction. Unfortunately, these earthquake associated hazards often cause the most damage<sup>1</sup>.

Available seismic maps for the Kenai Peninsula indicate a high probability of ground acceleration for the region, indicating possible change in ground velocity during an earthquake. Increased ground velocity (or ground speed) means amplified ground movement and therefore a greater possibility of damage to above ground structures. However, the maps do not factor in variations in local geologic conditions, which would help identify areas particularly susceptible to landslides, liquefaction and other severe earthquake damage. Liquefaction-susceptibility maps would address these conditions and provide more site-specific information.

## Implementation Ideas and Action Items

- Conduct HAZUS-MH modeling for the Borough.
- Develop liquefaction-susceptibility maps for the urban and industrial areas at the scale of 1:25,000. It is possible to derive liquefaction susceptibility from existing geologic maps (available for much of the Borough); however, this effort requires particular expertise.

**Potential Participants:** Office of Emergency Management (KPB), Alaska Division of Geological & Geophysical Surveys (DNR), U.S. Geological Survey, GIS Department (KPB), Incorporated Cities within the KPB

**Potential Funding:** KPB, AKDHS&EM, FEMA, USGS, USACE

**Time Frame:** HAZUS modeling (shorter term 1-2 years)  
Liquefaction-susceptibility maps (longer term 2-4 years)

**Estimated Cost:** Liquefaction-susceptibility maps (\$300,000 per year)

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## ***Strategy 6: Augment KPB communications and facility support.***

### Implementation Ideas and Action Items

- Perform a Peninsula-wide assessment of communication system vulnerability. This information could be obtained through HAZUS-MH modeling.
- Promote interagency scenario planning to anticipate unique seasonal problems (i.e., transportation or long-term power outages)

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<sup>1</sup> Pers. comm., Rod Combellick, Acting Director, Alaska Division of Geological and Geophysical Surveys. Fairbanks, Alaska, 2004.



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during winter or the availability of useful construction equipment during off seasons<sup>1</sup>).

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<sup>1</sup> Montgomery & Assoc. 2000. Catastrophic Earthquake Damage Workshop. Review Draft, December 2000. Produced for the U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska.



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<b>Potential Participants:</b>	Office of Emergency Management (KPB), Capital Projects Division (KPB), Road Maintenance (KPB), Alaska Department of Transportation and Public Facilities, Utility Companies (ACS, Chugach Electric Association Inc., Enstar Natural Gas, GCI, HEA)
<b>Potential Funding:</b>	KPB, Local communities, ADEC, AKDHS&EM, AKDOT, Utility companies, DCCED, FEMA
<b>Time Frame:</b>	Ongoing (shorter term 1-3 years; performed in conjunction with HAZUS modeling, Strategy 5)

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## ***Strategy 7: Conduct mock emergency exercises to identify response vulnerabilities.***

### **Implementation Ideas and Action Items**

- Conduct simulated exercises to determine vulnerabilities in emergency response and facilities. This will help identify areas that need further attention, resources and training.

<b>Potential Participants:</b>	Office of Emergency Management (KPB), Local Emergency Planning Committee, Incorporated Cities within the KPB
<b>Potential Funding:</b>	Local Communities, KPB, AKDHS&EM, FEMA, USACE, US Homeland Security, NSA
<b>Time Frame:</b>	Ongoing (longer term 2-4 years)

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## ***Strategy 8: Minimize damage to residential structures in the unincorporated area of the Kenai Peninsula Borough.***

Currently, there are no enforced residential building codes within the unincorporated areas of the Kenai Peninsula Borough for structures smaller than a four-plex. The State Fire Marshall's Office in Anchorage permits residential structures that are equal to or larger than a four-plex, as well as commercial structures (regardless of size). Permitting regulations currently follow the 2006 edition of the International Building Code. The Fire Marshall's Office expects to adopt the 2009 edition in the early fall of 2010.

Building code certification is a mechanism employed by many communities to insure structures are built to a reasonably safe standard. Homebuyers can be more confident in their investment if the home meets international building standards. It may also increase the value of a home, protect against damage and lawsuits, and provide a measure of safety to residents.

Although the Borough does not currently enforce building codes, homeowners who wish to obtain financing from the Alaska Housing Finance

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Corporation (AHFC), must present verification that demonstrates structures built after July 1, 1992 meet the Uniform Building Code and International Residential Code standard. Currently there are twelve private inspectors listed through a link to the State of Alaska Professional Licensing Division shown by AHFC with International Code Council (ICC) certification on the Kenai Peninsula who provide this service<sup>1</sup>. Implementation of building codes would require this structural review process Borough-wide.

Building codes are usually administered through a permit application process. There are two common approaches to determine the permitting cost for a structure: 1) based on the total square footage or 2) based on a estimated home value. In the City of Kenai, permit fees are calculated using 28 cents per square foot for a house and 14 cents per square foot for a garage. In addition to the permit fee, there is a plan review fee that is typically about 50% of the permit fee<sup>2</sup>.

The City of Kenai's program information was used to estimate the cost of implementing a residential building permit program for the Borough. Roughly 4,178 new structures were built outside of city limits in the KPB between 1998 and May 2004<sup>3</sup>.

The total square footage of new structures was estimated at 6,118,297, which was multiplied by 28 cents per square foot to arrive at an estimated \$1,713,123 in funds accrued from permitting fees. By adding an estimated \$856,562 in plan review fees (50% of permit fees), \$2,569,685 in possible revenue may be generated.

The City of Kenai, which has one full time permitter and one support staff, reviews an average of 100 permits a year<sup>4</sup>. If there are an estimated 700 new home starts each year in the Borough, then roughly seven full time permitters and at least one support staff may be required to implement plan review and issue building permits. For the City of Kenai, the permitting fees roughly cover the cost of running the program<sup>5</sup>. The same should be possible for the Borough.

## Implementation Ideas and Action Items

- Implement building codes for residential structures (smaller than 4-plexes) outside of city limits.

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<sup>1</sup> Alaska Housing Finance Corporation (AHFC) site refers to inspectors listed by State of Alaska DCEED, Division of Corporations, Business and Professional Licensing. Number is current as of 2/2014 license search.

<sup>2</sup> <http://www.ci.kenai.ak.us/publicworks/buildingdeptment.htm> (2014)

<sup>3</sup> Figure derived from KPB Assessing Department data. Structures coded as 3 or 4 family residences (R3) are included. Because some of these structures may be 4-plexes, these numbers may be slightly high.

<sup>4</sup> Pers. Comm., Nancy Carver, City of Kenai Building Official. Kenai, Alaska, February 2010

<sup>5</sup> Pers. Comm., Robert Springer, City of Kenai Building Official. Kenai, Alaska, July 2004.



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**Potential Participants:** KPB, Incorporated Cities within the KPB, Local Insurance Companies  
**Potential Funding:** Local Communities, KPB  
**Time Frame:** Ongoing (longer term 3-5 + years)

## 4.6 Earthquake Resource Directory

### Local Resources

#### Kenai Peninsula Borough (KPB)

##### Office of Emergency Management (OEM)

OEM was established to coordinate disaster management response between the Kenai Peninsula Borough, the State of Alaska, FEMA, other municipalities, as well as other response and recovery organizations. OEM has the primary responsibility for overseeing disaster management programs and activities, including mitigation, planning, response and public education.

**Contact:** Office of Emergency Management  
**Address:** 253 Wilson Lane, Soldotna, AK 99669  
**Phone:** (907) 262-4910  
**Website:** [www.borough.kenai.ak.us/emergency](http://www.borough.kenai.ak.us/emergency)

### State Resources

#### Alaska Earthquake Information Center

AEIC serves as an integration center for all seismic networks within Alaska and archives and processes data from the [Alaska Tsunami Warning Center](#) in Palmer, Alaska and the [Alaska Volcano Observatory](#) in Fairbanks and Anchorage. The center operates with a real-time data acquisition system at the Geophysical Institute.

**Contact:** Geophysical Institute, University of Alaska Fairbanks  
**Address:** 903 Koyukuk Drive, P.O. Box 757320, Fairbanks, Alaska 99775-7320  
**Phone:** (907) 474-7558  
**Website:** [www.giseis.alaska.edu/](http://www.giseis.alaska.edu/)

#### State of Alaska, Department of Natural Resources

##### Division of Geological and Geophysical Surveys (DGGS)

DGGS collects, analyzes, interprets, and publishes data on Alaska's geologic resources for use in state land management as well as private sector development and exploration. DGGS is divided into five sections that address different aspects of geology, they are: minerals, energy, engineering geology, geological communications and the geological materials center.

**Contact:** DGGS Information  
**Address:** 3354 College Road, Fairbanks, AK 99709  
**Phone:** (907) 451-5020  
**Website:** [www.dggs.dnr.state.ak.us/index.html#](http://www.dggs.dnr.state.ak.us/index.html#)

#### State of Alaska, Division of Homeland Security and Emergency Management

This agency in part conducts hazard preparedness and mitigation workshops. They also coordinate the State of Alaska's All-Hazard Mitigation Plan. Their community response program works with communities during a crisis as well in recovery and planning phases.

**Contact:** AK Division of Homeland Security and Emergency Management





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**Address:** P.O. Box 5750, Fort Richardson, AK 99505-5750  
**Phone:** (907) 428-7000 OR (800) 478-2337  
**Website:** [www.ak-prepared.com/](http://www.ak-prepared.com/)

## Federal Resources

### US Geological Survey (USGS)

#### Earthquake Hazards Program

The USGS maintains an active earthquake hazards program website that catalogues information on worldwide earthquake activity, the mitigation of earthquake related damage and earthquake science research. They also have seismic hazard maps for the United States.

**Contact:** USGS/Earthquake Hazards Program  
**Address:** 4210 University Dr., Suite 201, Anchorage, AK 99508-4626  
**Phone:** (907) 786-7447  
**Website:** [earthquake.usgs.gov](http://earthquake.usgs.gov)

### Building Seismic Safety Council (BSSC)

The Building Seismic Safety Council develops and promotes structural earthquake risk mitigation regulatory provisions for the nation. They manage complex regulatory, technical, social, and economic issues involved in developing and disseminating building earthquake mitigation regulatory requirements.

**Contact:** Building Seismic Safety Council; National Institute of Building Sciences  
**Address:** 1090 Vermont Avenue, N.W., Suite 700, Washington, D.C. 20005  
**Phone:** (202) 289-7800  
**Website:** [www.nibs.org/index.php/bssc/](http://www.nibs.org/index.php/bssc/)

## Additional Resources

### GSC Pacific-Sidney; Pacific Geoscience Centre (PGC)

Research conducted at the PGC involves the geology and geophysics within the region of Western Canada known as the "Canadian Cordillera", as well as along the continental margin that is Canada's West Coast. Specific research foci include earthquake seismology, geodynamics, Cordilleran and Continental margin tectonics and marine geoscience.

**Contact:** GSC Pacific-Sidney; Pacific Geoscience Centre  
**Address:** 9860 West Saanich Rd.; North Saanich, BC, Canada V8L 3S1  
**Phone:** (250) 363-6500  
**Website:** <http://www.nrcan.gc.ca/earth-sciences/>

### Natural Hazards Center (NHC)

The NHC is an international center cataloging and disseminating information about the social science and policy aspects of disasters, including earthquakes. The mission encompasses hazard preparedness, response and mitigation. A primary goal of the NHC is to foster communication among researchers, individuals, organizations and agencies concerned with minimizing damage from hazards. They maintain an active searchable literature database, publish papers and reports and host an annual hazard workshop.

**Contact:** NHC  
**Address:** University of Colorado, 482 UCB, Boulder, CO 80309-0482  
**Phone:** (303) 492-6818  
**Website:** [www.colorado.edu/hazards/](http://www.colorado.edu/hazards/)



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## **Benfield Hazard Research Centre (BHRC)**

The Benfield Hazard Research Centre, based in London, UK gathers and transmits information on natural hazard and risk research among the academic, government and various international agencies. They maintain links to much current hazard research, provide education and training and catalogue an extensive list of publications.

**Contact:** BHRC  
**Address:** Aon Benfield UCL Hazard Research Centre  
Department of Earth Sciences, University College London  
136 Gower Street (Lewis Building)  
London, WC1E 6BT, UK  
**Phone:** +44 (0)20 7679 3449/3637  
**Website:** <http://www.ucl.ac.uk/abuhc/home-link>

## **Applied Technology Council**

Produces technical documents to inform those interested in design details to reduce structural and content damage due to earthquakes.

**Contact:** Applied Technology Council  
**Address:** 201 Redwood Shores Parkway, Suite 240, Redwood City, CA 94065  
**Phone:** (650) 595-1542  
**Website:** [www.atcouncil.org](http://www.atcouncil.org)

## **Earthquake Engineering Research Institute (EERI)**

With an international focus, this agency strives to produce the most current technical information on earthquake hazard mitigation and response. It is a technical, non-profit agency with a membership comprised of engineers, researchers, planners and architects.

**Contact:** EERI  
**Address:** 499 14<sup>th</sup> St., Suite 320, Oakland, CA 94612-1934  
**Phone:** (510) 451-0905  
**Website:** [www.eeri.org](http://www.eeri.org)

## **The Global Earthquake Response Center**

This web page is a source for information and supplies about earthquake preparedness. Links to many online services (e.g., insurance information, engineering resources and emergency supply kits) are provided. No contact information is provided.

**Website:** [www.earthquake.com](http://www.earthquake.com)

## **American Red Cross**

The American Red Cross is a volunteer humanitarian organization, which provides relief to disaster victims and helps people prevent, prepare for, and respond to emergencies.

**Contact:** American Red Cross  
**Address:** 235 E 8<sup>th</sup> Avenue, Anchorage, AK 99501  
**Phone:** (907) 646--5401  
**Website:** [alaska.redcross.org](http://alaska.redcross.org)



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## **Publications**

Bolton, P., S. Heikkala, M. Greene, P. May. 1986. Land Use Planning for Earthquake Hazard Mitigation: A Handbook for Planners. University of Colorado, Institute of Behavioral Science, Natural Hazards Research and Applications Information Center, Special Publication No. 14. Boulder, Colorado.

Combellick, R.A. 1985. Geologic-hazards mitigation in Alaska: A review of federal, state, and local policies. Alaska Division of Geological and Geophysical Surveys. Special Report 35.

Combellick, R., R. Head, and R. Updike. 1994. Earthquake Alaska; Are we prepared? U.S.G.S. Open File Report 94-218.

Haeussler, P. 2004. The Next Big Earthquake in Alaska May Come Sooner Than You Think! Website developed from booklet prepared for the USGS.



## 5.0 Weather

### 5.1 Why Focus on Mitigation for Weather Events?

According to the National Weather Service StormReady website<sup>1</sup>, 90% of federally declared disasters are weather related, leading to approximately 500 deaths per year and nearly \$14 billion in damage. Severe weather events often impact large geographic areas and pose a significant threat to life and property by creating conditions that disrupt utilities, transportation and telecommunication systems. It is critical that communities have appropriate warning of severe weather events and have undertaken realistic mitigation planning. Since 2000, the KPB has been included in seven weather-related presidential disaster declarations (DR 1316, DR 1445, DR 1461, DR 1669, DR 4054, DR 4094 and DR 4161)<sup>2</sup>.

The KPB regularly experiences winter storms, high winds, seasonal heavy rainfall, coastal storm and storm surge events. Severe winter weather is often accompanied by high wind, freezing rain, icing conditions, heavy snowfall and extended periods of cold temperatures. Winter storms can make driving and walking extremely hazardous, damage structures and utilities, and result in substantial repair and snow removal costs.

Prolonged extreme cold (-20 to -50 degrees Fahrenheit) coupled with little or no snow cover may lower the ground frost level, rupture underground water and sewer utilities, congeal fuel in storage tanks and supply lines and interfere with vehicle and equipment operation. Extended periods of severe cold can form ice in Cook Inlet, which when disrupted by the tides creates hazards for ship traffic. It also increases the likelihood of ice jams and associated flooding along rivers and streams.

### 5.2 Types of Weather Events

Weather hazards on the Kenai Peninsula can be broken into a number of categories including:

- winter storm
- heavy snow
- extreme cold
- ice storms
- high winds
- thunderstorms and lightning
- coastal storm
- storm surge

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<sup>1</sup> [www.stormready.noaa.gov](http://www.stormready.noaa.gov).

<sup>2</sup> DR1316 – 2000 Snow storms, avalanches; DR1445 – Oct/Nov 2002 Floods; DR1461 – 2003 Wind Storm; DR 1669 - 2006 Severe Flooding; DR4054 – 2011 Storm; DR 4094 – 2012 Wind storm, flooding; DR 4161 – 2013 Flood



# WEATHER

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It is important to note that weather hazards can occur in combination or in rapid succession, which can significantly increase the potential for damage.

## ***Winter Storms***

Winter storms originate as mid-latitude depressions or cyclonic weather systems. High winds, heavy snow, and cold temperatures usually accompany them. To develop, they require:

- *cold air* - subfreezing temperatures in the clouds and/or near the ground to make snow and/or ice;
- *moisture* - the air must contain moisture in order to form clouds and precipitation; and
- *lift* - the mechanism that raises moist air to form clouds and cause precipitation. Lift may be provided by any or all of the following: 1) the flow of air up a mountainside, 2) fronts where warm air meets cold air and rises over the dome of cold air, and 3) upper-level low pressure troughs.

## ***Heavy Snow***

Heavy snow, generally more than 12 inches of accumulation in less than 24 hours, can immobilize a community by compromising or halting the use of airports and major roadways, which in turn stops the flow of supplies and disrupts emergency and medical services. Accumulations of snow can collapse roofs, fell trees and power lines, damage light aircraft and sink small boats. In the mountains, avalanche risk increases with fast large accumulations of snow. A quick thaw after a heavy snow can cause substantial flooding, especially along small streams and in urban areas. The cost of snow removal, damage repair and the loss of business can have serious economic impact on cities and towns.

Injuries and deaths related to heavy snow usually occur as a result of vehicle accidents. Casualties also occur due to overexertion while clearing snow and hypothermia caused by overexposure to the cold weather.

During the winter, Alaska's weather is greatly influenced by large areas of high pressure that can persist for weeks at a time over Siberia, interior Alaska and northwestern Canada. While a well-developed mass of cold air dominates the interior, storms crossing the North Pacific often move into the Gulf of Alaska depositing large amounts of precipitation over the southern coastal region, affecting the KPB.



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## **Extreme Cold**

What is considered an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures may be considered "extreme cold." In the Cook Inlet region of Alaska, extreme cold usually involves temperatures below -40 degrees Fahrenheit (F). Excessive cold may accompany winter storms, be left in their wake, or occur without storm activity.

Low temperatures and ice fog conditions can ground aircraft, shutting down commuter flights and airfreight shipments. Extended periods of -20 to -40 degrees F causes ice in Cook Inlet, which can close or disrupt shipping in the upper inlet. Extended cold also increases the likelihood of riverine ice jams and associated flooding. The lowering of ground surface temperatures affects frost levels and break underground utility lines.

The greatest danger from extreme cold is to people. Prolonged exposure to the cold can cause frostbite or hypothermia and become life threatening, particularly for the very young and elderly. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, and carbon monoxide poisoning is possible as people use supplemental heating devices.

**Frostbite** occurs when tissue exposed to extreme cold freezes. Frostbite causes a loss of feeling and exposed skin turns white or pale in color. As frostbite progresses it can lead to serious infections or the loss of extremities.

**Hypothermia** occurs when the internal body temperature drops below 98.6° F. Internal temperatures below 95°F can be life threatening. Hypothermia can occur from a short period of exposure to extreme cold or prolonged exposure to temperatures above freezing.

## **Ice Storms**

Ice storms are instances when damaging accumulations of ice develop during freezing rain (rain that becomes super-cooled and freezes on impact with cold surfaces). Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations. Ice storms are among the most devastating of winter weather phenomena and often cause airplane and automobile accidents, power outages and personal injury.

Freezing rain develops as falling snow encounters a layer of warm air in the atmosphere deep enough for the snow to completely melt and become rain. As the rain continues to fall, it passes through a thin layer of cold air just above the earth's surface and cools to a temperature below freezing. The drops themselves do not freeze, but rather they become super-cooled. When these super-cooled drops strike surfaces such as frozen ground, power lines and tree branches, they instantly freeze. Within the state, atmospheric conditions that can lead to ice





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storms most frequently occur in southwestern Alaska, along the Alaska Peninsula and around Cook Inlet, affecting the KPB.

## ***High Winds***

Winds in excess of 60 mph occur frequently over coastal areas along the Gulf of Alaska due to coastal storms. High winds can also combine with loose snow to produce blinding blizzard conditions and dangerous wind chill temperatures. Winds can reach hurricane force and have the potential to seriously damage port facilities, the fishing industry and community infrastructure (especially above ground utility lines).

In mountainous areas, down-slope windstorms created by temperature and pressure differences across the terrain can produce winds in excess of 100 mph. These windstorms can be particularly damaging as they are gusty in character and may seem to come from several directions.

Localized downdrafts, downbursts and microbursts, are also important hazards in Alaska. Downbursts and microbursts can be generated by thunderstorms. Downburst winds are strong concentrated straight-line winds created by falling rain and sinking air that can reach speeds of 125 mph. The combination induces strong wind downdrafts due to aerodynamic drag forces or evaporation processes. Microburst winds are more concentrated than downbursts and can reach speeds up to 150 mph. They can last five to seven minutes and cause significant damage. Because of wind shear and detection difficulties, they can create a severe hazard for aircraft landings and departures.

## ***Thunderstorms & Lightning***

Thunderstorms are caused by the turbulence and atmospheric imbalance that arise when rising warm air, lift, and moisture combine. The result is unstable



Lightning. Image courtesy of NOAA Photo Library, NOAA Central Library; OAR/ERL/National Severe Storms Laboratory (NSSL)

weather that includes lightning and heavy rainfall, which can quickly intensify into severe damaging hail, high winds, and flash flooding. A thunderstorm is considered severe if winds reach or exceed 58 mph, a tornado develops, or it drops surface hail at least 0.75 inches in diameter.

Thunderstorms affect relatively small areas. The average thunderstorm is about 15 miles in diameter and lasts less than 30 minutes in any given location. Lightning exists in all thunderstorms. It is caused by a buildup of

charged ions within the thundercloud. When lightning connects with a grounded object, electricity is released which can be harmful to humans and can start fires. Lightning induced wildfires are fairly rare in the Borough, although they do occur.



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Between 1980 and 2002, two percent or 27 of the 1,454 recorded wildfire ignitions were caused by lightning<sup>1</sup>.

## ***Coastal Storms***

From fall through spring, low pressure cyclones develop in the Bering Sea and Gulf of Alaska or are brought to the region by wind systems in the upper atmosphere that steer storms in the north Pacific Ocean toward Alaska. When these storms impact the shoreline, they often bring wide swathes of high winds and occasionally cause coastal flooding and erosion. The intensity, location and local topography influence storm impacts.

Along Cook Inlet, shoreline erosion occurs from a number of natural processes, including tides, wind, storms, ice, and the freezing and thawing of bluff soils and ground water seeps. With increased development of waterfront properties, coastal erosion is of high concern to KPB coastal communities.

In addition to accelerating coastal erosion, the north shore bench above Kachemak Bay is susceptible to slope slippage and landslides when seasonal heavy rains saturate and liquefy unstable soil and clay layers. The heavy rain in 2002 resulted in slope failures and debris slides in numerous places in Homer and along East End Road. The risk of slope failures has become more serious as vegetation removal, road construction and development has increased along the steep north shore bench.

The Seward area is also susceptible to damage from coastal storms. A December 2009 weather event paired an extreme 12.6 foot high tide with a heavy winter storm. Significant damage to infrastructure resulted in a local and state disaster declaration.

Homer and Halibut Cove, on Kachemak Bay, also received some damage as a result of the December 2009 storm event.

## ***Storm Surge***

Storm surges, or coastal floods, occur when the sea is driven inland above the high-tide level onto normally dry land. Often, heavy surf conditions driven by high winds accompany a storm surge adding to the destructive force of the flooding waters. The conditions that cause coastal floods may also cause significant shoreline erosion as the floodwaters undercut roads and other structures.

The meteorological parameters conducive to coastal flooding include low atmospheric pressure, strong winds (blowing directly onshore or along the shore

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<sup>1</sup> Table A5; Appendix A – Interagency All Lands/All Hands Action Plan, 9-5-04.



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with the shoreline to the right of the direction of the flow), and winds maintained from roughly the same direction over a long distance across the open ocean.

Communities that are situated on low-lying coastal lands with gradually sloping bathymetry near the shore and exposure to strong winds with a long fetch over the water are particularly susceptible to coastal flooding. The five-mile-long Homer Spit has a moderate exposure to coastal flooding due to the consistent effects of erosion and the extraordinary tidal range in the region. In November of 2002, a storm surge that followed the heavy rains in October and November resulted in flooding on the Homer Spit. The English Bay airstrip in Nanwalek is also vulnerable to coastal storms. Situated on a gravel spit at the entrance to the bay, it is subject to the dynamics of the beach on the northern boundary and the lagoon on the southern boundary. The runway was significantly damaged by wind driven tides in November of 2003.

## **5.3 Historical Severe Weather Events**

Borough history details significant damage to life and property due to such severe weather events as heavy snowfall, ice storms, avalanches and high winds. As a direct result of severe weather events within the Borough, highway closures, power outages, structural damage and loss of life have occurred. Some weather occurrences may both produce benefits and create problems. For example, heavy snowfall may replenish reservoir waters above the Cooper Lake Hydroelectric Facility, while simultaneously increasing avalanche risk, snow load damage and flooding concerns for area residents. Though it may not be possible to alter the occurrence of extreme weather events on the Kenai Peninsula, it is important (both economically and socially) to mitigate their potential negative effects. Additional information about flooding in the KPB (often caused by extreme weather occurrences) may be found in Section 2.0: Floods and Section 7.0: Tsunamis.

### ***1951 – Seward Area Flooding***

In the Resurrection River in the eastern Kenai Peninsula, floodwaters rose unexpectedly at night from heavy snowmelt in the mountains due to warm weather. As a result, surface water run-off polluted local wells.

### ***1986 – Seward Area Flooding***

A severe storm in Seward occurred between October 10<sup>th</sup> and 12<sup>th</sup> and deposited 15 inches of rain in 24 hours across large areas of the Resurrection River and Salmon Creek watersheds. Flooding was widespread and catastrophic as torrential waters rushed down steep gradient mountain canyons. Borough-wide damages to roads, bridges, and other public facilities were estimated at around \$2 million.



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## **1989 – Extreme Cold**

The cold snap in January 1989 affected a large geographic area of the state of Alaska, including the Kenai Peninsula. Extreme, prolonged low temperatures caused pipes to freeze, obstructed motor operations and damaged sewer and water utilities. Homer experienced five days of new record low temperatures including the lowest temperature (-24 degrees F) for the area<sup>1</sup>.

## **1999-2000 - Winter Storms and Avalanches**

A series of severe winter storms struck the Kenai Peninsula Borough between December 21, 1999 and February 23, 2000, triggering avalanches and flooding in southcentral Alaska. Power lines were downed by high winds causing outages in schools and homes. A series of avalanches struck the Peninsula during these months. The Seward Highway was closed from Jan. 30 – Feb. 4, 2000<sup>2</sup> as debris from avalanches was removed and the continued threat of additional avalanches loomed. Road closures directly affected the communities of Hope, Sunrise, Moose Pass, Crown Point and Seward, as well as temporarily interrupting transportation and supply services to the rest of the Peninsula. Avalanche locations along the Seward Highway included MP 97.8, MP 62.5, MP 50 and 49, MP 45.5, MP 44, MP 23.7, MP 20.5 and between MP 18 and 18.5<sup>3</sup> (Figures 5-1 and 5-2). A slide also occurred on the Sterling Highway just west of Quartz Creek Road. The Alaska Department of Transportation and Public Facilities (ADOT&PF) spent a considerable amount of money on mitigation activities, such as controlled avalanche activation requiring the use of explosives and extended helicopter time. There was also a large ADOT&PF work force focused on snow and debris removal and guardrail repair.

A generator and fuel was delivered to the community of Hope, which was without power for an extended period of time. Over 2,000 homes in Seward, Moose Pass, and Cooper Landing also lost power for several days due to the storm<sup>4</sup>. The Alaska Railroad suspended Peninsula service for about one week and accrued approximately \$1 million dollars in unrecoverable lost revenue<sup>5</sup>. A heavy equipment operator was swept into Cook Inlet and killed by a second avalanche while clearing debris from an earlier slide along Turnagain Arm<sup>6</sup>.

The Borough mayor declared the avalanche damage a disaster on Feb. 3, 2000; the State of Alaska followed suit on Feb. 4, 2000 and a presidential disaster declaration was issued on February 17, 2000<sup>7</sup> (DR 1316). The Municipality of

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<sup>1</sup> Wendler, G. 1989. Alaska's Cold Spell of January, 1989. Alaska Science Forum, Article No. 912.

<sup>2</sup> Ibid.

<sup>3</sup> Pers. comm. Terry Onslow, Safety and Emergency Supply Specialist, Alaska Department of Transportation and Public Facilities (email), 9/3/04.

<sup>4</sup> Clark, M. 2000. Disaster Emergency Declared on Peninsula. Peninsula Clarion, Feb. 4, 2000.

<sup>5</sup> Pers. comm. Alaska Railroad Corporation representative. 9/2/04.

<sup>6</sup> Since 1995, 9 people have been killed on the Kenai Peninsula due to avalanches.

([www.avalanche.org/accidents.php](http://www.avalanche.org/accidents.php))

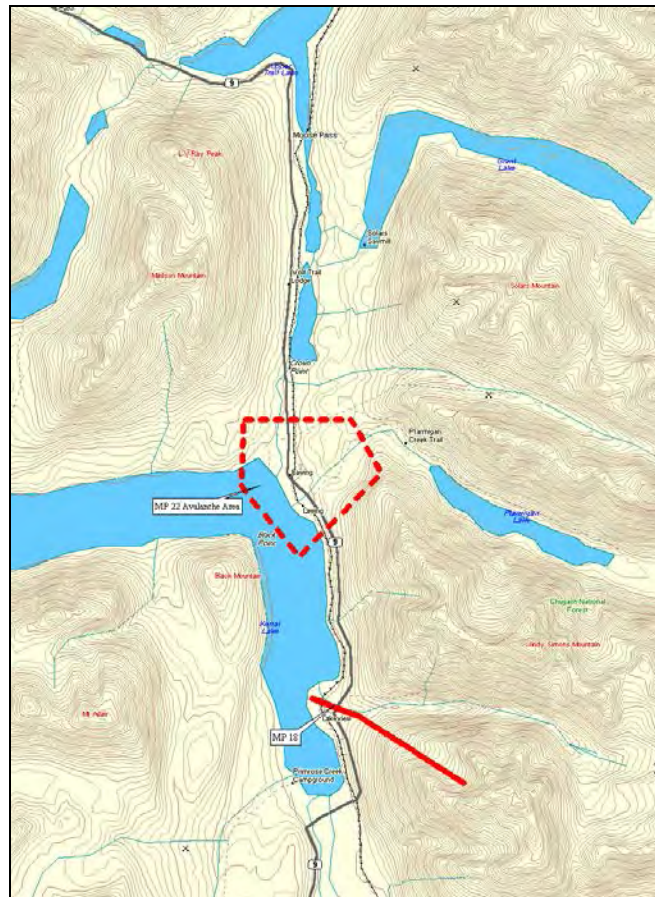
<sup>7</sup> Kenai Peninsula Borough (KPB). 2000. Kenai Peninsula Borough Ordinance 2000-26. Soldotna, Alaska.



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Anchorage, the Kenai Peninsula Borough, the Matanuska-Susitna Borough and the Valdez-Cordova Census Area subsequently received disaster funding to help pay for snow and debris removal, emergency services and repair of public facilities damaged by the weather and avalanche events.

The Borough incurred in excess of \$618,500 in storm damage to facilities and structures<sup>1</sup>. The incorporated cities within the Borough together experienced over \$590,000 in damage. Combined with damages incurred by Providence Hospital in Seward, Chugach Electric Association, Homer Electric Association and the Spring Creek Correctional Facility, there was over 3.3 million dollars of damage to public facilities on the Kenai Peninsula<sup>2</sup>.



**Figure 5-1.** Location of Avalanche Between Mileposts 22 and 23 of the Seward Highway Resulting from the 2000 Winter Storm.

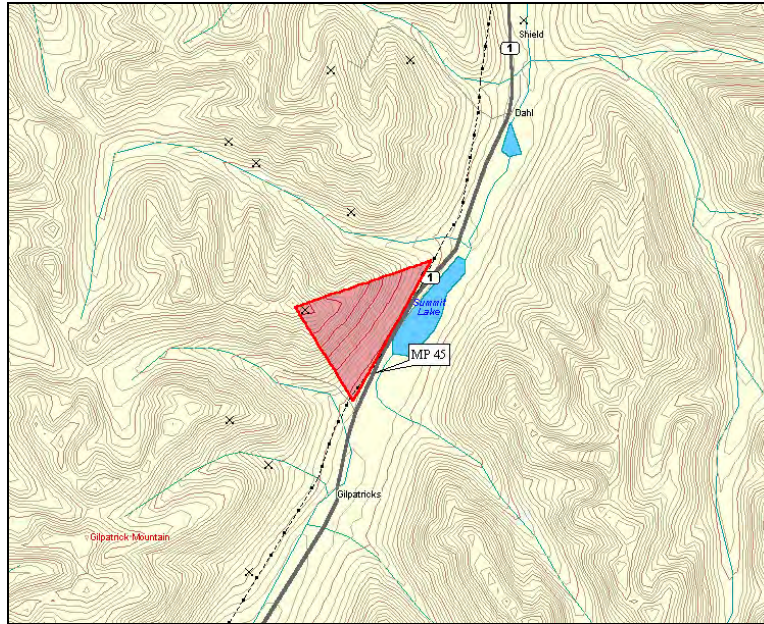
<sup>1</sup> Pers. comm. Cowles, W. ADHS&EM, FEMA report from computerized tracking system. 09/02/04. This is the portion of damages that FEMA and the State of Alaska agreed to cover.

<sup>2</sup> Ibid.





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**Figure 5-2.** Location of Avalanche at Milepost 45 of the Seward Highway Resulting from the 2000 Winter Storm.

### **2001 - Christmas Storm**

A National Weather Service winter storm warning was issued on December 25, 2001 covering the area from the Kenai Mountains east to Prince William Sound. Heavy snow and strong winds hit the entire region. Homer Electric Association reported power outages throughout the Peninsula with a total of \$866,294 in emergency costs and \$367,711 in permanent rebuild costs<sup>1</sup>.

### **2002 - October/November Flooding**

In October and November of 2002, unseasonably warm temperatures coupled with heavy rain contributed to flooding and coastal storm surge on the Kenai Peninsula that resulted in a presidential disaster declaration (DR 1445). For more information on the location and extent of flood damage see Flood Section 2.10.2 and Table 2.2.

Unusually warm temperatures, high winds and heavy rain lingered across the Kenai Peninsula from late September through the end of November 2002. The storm damaged areas from Portage (to the north), Cordova (to the east), Chignik (on the Alaskan Peninsula to the west) to Kodiak Island (to the south). The heaviest rains and most severe flooding occurred on the southwestern Kenai Peninsula between October 22-24 and November 23<sup>2</sup>. The National Weather

<sup>1</sup> Pers. Comm., J. Matthews, Homer Electric Association, Inc. Homer, Alaska. March 2004.

<sup>2</sup> Eash, J.D., Rickman, R.L., March 2004. Floods on the Kenai Peninsula, Alaska, October and November 2002. USGS Fact Sheet 2004-3023.





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Service Doppler radar system was inoperable for a number of hours on October 20, 23, and 24. As a result, crucial information about the intensity of the storm over the Caribou Hills region was unrecorded and flooding that began on the Seward side of the Peninsula struck southwestern Peninsula streams with little warning.

The 2002 floods directly affected 10 communities and damage to public facilities was estimated at over \$24.5 million dollars<sup>1</sup>. Total damage included: 62 sites on the Peninsula highway system (\$20.5 million), State Park facilities (\$781,000), Borough roads and bridges (\$1.2 million) and power line and underground distribution line damage (\$425,000<sup>2</sup>). Reported damage to private property totaled more than \$1,225,000<sup>3</sup>. In the city of Homer, flooding was followed by a November storm surge, which partially inundated the Homer Spit<sup>4</sup>.

### ***2002 - Winter Snow Storm***

Record heavy snow occurred just north of the Kenai Peninsula in Anchorage on March 17, 2002 when two to three feet of snow fell in less than 24 hours over portions of the city. Fortunately, the storm began on Sunday morning when very few businesses were open. Military bases, universities, and many businesses remained closed the following day; Anchorage schools remained closed for two days. It took four days for snowplows to reach all areas of the city. The snowfall also impacted the Kenai Peninsula, causing airport closures, travel delays and disrupting the flow of goods to local communities.

### ***2003 - Spring Wind Storm***

In the spring of 2003, a presidential disaster declaration (DR 1461) was issued when strong winds swept the Kenai Peninsula uprooted trees, causing widespread power outages, damaging structures and fanning the flames of a 150-acre wildfire in Anchor Point. Temperatures around 12 degrees F and winds up to 60 miles per hour were measured in Anchor Point in the vicinity of the fire.

Borough-wide the windstorm caused over \$895,000 in damage to federal, state, borough, city and private property<sup>5</sup>. The high winds and freezing temperatures between March 6 and March 14, 2003 resulted in approximately 48 power outages to 4,000 Peninsula homes. Temporary power was restored to homes through contractors hired by Homer Electric Association. Emergency electrical supplies cost over \$51,000 and permanent repairs cost nearly \$206,000<sup>6</sup>.

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<sup>1</sup> FEMA 2002 Kenai Peninsula Flood Summary DR-1445.

<sup>2</sup> Matthews, J. Planning and Project Management Coordinator, Homer Electric Assoc. Inc., (Email Memo).

<sup>3</sup> Cowles, W. ADHS/ES, Private Assistance Grant Funding Summary, (email) and Jenkins, R., Small Business Administration, Private Homeowner and Business Loan Program (telephone communication).

<sup>4</sup> Annex A: 2004 Draft City of Homer All-Hazard Mitigation Plan.

<sup>5</sup> Kenai Peninsula Borough (KPB). 2003. Resolution 2003-050: A Resolution Authoring Application for Public Assistance from State of Alaska Department of Military and Veterans Affairs, Division of Emergency Services, for the 2002 Flooding and Winter Storm Disaster.

<sup>6</sup> Pers. Comm., J. Matthews, Homer Electric Association, Inc. Kenai, Alaska. March 2004.



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### ***2003 - Pile Bay Road Flooding***

In October of 2003, 15 inches of rain fell over a short period of time causing serious flooding on the west side of Cook Inlet between Lake Iliamna and Iliamna Bay. A state disaster declaration was issued and flood damage to the 14 mile (state-maintained) Pile Bay Road between Williamsport and Pile Bay Village cost nearly half a million dollars to repair. Damage to 22 sites along the first six miles of the road within the KPB accounted for \$179,800 of the total damage<sup>1</sup>.

### ***2003 - English Bay Airport Runway Washout, Nanwalek***

The English Bay Airport runway was significantly damaged by wind driven waves during a storm in November of 2003. Situated on a gravel spit at the entrance to English Bay, the airstrip is vulnerable to the dynamics of the beach on the northern boundary and the lagoon on the southern boundary. During the November 2003 storm, a section of runway measuring approximately 500 feet by 40 feet was eroded away on the bay side and an area 400 feet by 40 feet was also damaged on the lagoon side.

### ***2006 - Fall Flooding, Seward***

On October 8, 2006, flooding, mudslides, heavy rains and extremely high winds occurred, threatening life and property in the Seward area. Seward was inaccessible by road due to flooding across the Seward Highway at mile 4. Lowell Point Bridge was heavily damaged, cutting off the Lowell Point community. Additional damage to bridge infrastructure required the replacement of the Forest Avenue and Lost Creek Bridges. Damage assessments included Old Mill Subdivision, Camelot Subdivision, Lowell Point and Old Exist Glacier Road. Initial Kenai Peninsula response costs approximated \$150,000. Recovery estimates for roads, bridges and other infrastructure were between \$3.1-\$3.5 million<sup>2</sup>. This event was declared a local, state and federal disaster.

### ***2007 - Flooding in Old Mill Subdivision, Seward***

Beginning May 17<sup>th</sup>, 2007, flooding occurred in the Old Mill Subdivision as result of heavy deposits of gravel and silt from the headwaters of Lost Creek<sup>3</sup>. Dredging was approved for 200 feet above and 100 feet below the Lost Creek Bridge. Approximately 100,000 cubic yards of gravel and silt were removed from Lost Creek.

### ***2007 – Kenai River Ice Jam Flooding, Sterling and Soldotna***

In January and February of 2007, the Kenai River experienced an ice jam flood event triggered by the release of the Skilak Glacier-Dammed Lake. The lake began releasing around the 16th of January 2007, eventually raising the level of

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<sup>1</sup> Pers. Comm., Carol Sanner, Alaska Department of Transportation and Public Facilities, Central Region, Maintenance and Operations, Pile Bay Road Flooding Incident Spreadsheet, 3/30/04.

<sup>2</sup> Seward Flood Situation Report 10/11/06 Media Release 10/13/06

<sup>3</sup> Kenai Peninsula Borough OEM 2007 Seward Flooding File/ 6/15/07



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the Kenai River at Skilak Lake by about 3.8 feet. The river below Skilak Lake experienced a broad crest on January 27<sup>th</sup>, measuring 20 feet above flood stage at the Soldotna bridge. The rise in water levels caused the ice cover to break up and form ice jams and localized flooding in the Soldotna vicinity. Rapid water level increases and moving ice caused significant property damage.

## ***2009 – Sea Storm and Tidal Surge, Seward***

A Dec 1, 2009 weather event paired an extreme 12.6 foot high tide with a heavy winter storm that included strong southeast winds blowing toward the north. T 2 ½ mile Lowell Point Road, the protective seawall at Alaska SeaLife Center and the paved bike/ foot path adjacent to the city campgrounds at Resurrection Bay received significant damage. This event was declared a local and state disaster.

## **5.4 Weather Risk Assessment**

The extent of damage caused by severe weather depends on a number of factors including temperature, type and amount of precipitation, wind speed and event duration. Strong maritime influences from Cook Inlet, Prince William Sound and the Gulf of Alaska combine with geographical features such as the Harding Ice Field and Chugach Mountains to create diverse climactic differences across the Kenai Peninsula (see Section 1.4.2 and Table 1-2 for community-specific climate information).

Severe weather events have the potential to damage or disrupt water, sewer, power, gas, transportation and communication infrastructure as well as emergency response facilities and systems. Heavy rains, high wind, extreme cold and winter storms have all directly affected the KPB in recent years. Storm events that closely follow each other, or occur in combination with other hazards have the potential to directly or indirectly affect all Borough residents. There is a moderate to strong probability in any given year that some type of severe weather event will occur<sup>1</sup>.

### ***5.4.1 Populations and Facilities at Risk***

KPB communities, critical facilities and transportation infrastructure are described in Sections 1.4.5, 1.4.6, 1.4.7, and 1.5.3. Depending on the event, damage to critical infrastructure up to and including the complete abandonment of key facilities may result. Indirect effects may include road closures that isolate residents, impact public safety (access and response capabilities) and limit availability of perishable commodities. Refer to Table 1-20 in Section 1.5.4 for a summary of the tax-assessed value of residential, industrial and commercial structures in KPB communities.

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<sup>1</sup> Pinkston Enterprises. 2004. Kenai Peninsula Borough Emergency Operations Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.



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## 5.5 Weather Mitigation Goals

Although it is not possible to completely eliminate the threat that weather hazards pose to Borough residents, it is possible to identify ways to reduce vulnerability and minimize adverse impacts. To this end, three goals have been identified to guide mitigation planning and ultimately help protect KPB residents. These goals, objectives and mitigation strategies that follow encompass both agency and individual responsibilities. Although the goals broadly apply to all hazards, the mitigation strategies in this section are tailored for severe weather events.

All-hazard mitigation goals:

- protection;
- prevention; and
- education.

Protective measures could include minimizing development in high hazard areas, such as along steep eroding bluffs, floodplains, avalanche zones and landslide prone areas. Likewise, using proper building design and construction can reduce susceptibility to hazards such as heavy snow loads, flooding, or wind damage.

Risk can often be mitigated by timely weather warnings, particularly when flooding, glacier dammed lake outbursts or severe winter storms are forecast. Ongoing educational efforts promote public awareness and individual preparedness and increase the capacity of residents to safeguard their homes and families.

### 5.5.1 Accomplishing KPB Weather Mitigation Goals

The following are suggested as objectives to further define, guide and help achieve the Borough's weather mitigation goals:

- modify the impacts of weather by assisting individuals and communities to prepare for, respond to, and recover from these events;
- reduce susceptibility to damage and disruption by avoiding hazardous, uneconomic and unwise development in high-risk areas;
- protect the natural and beneficial values of Peninsula floodplains, coastal areas and water resources; and
- promote positive economic development.

### 5.5.2 Existing Weather Mitigation Programs and Activities *Emergency Response and Preparedness*

The KPB Office of Emergency Management (OEM) was established to coordinate disaster management response between the Kenai Peninsula Borough, the State of Alaska, FEMA and other municipalities as well as other response and recovery



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organizations. OEM has the primary responsibility for overseeing Peninsula disaster management programs and activities that include mitigation, planning, response and public education.

Since 1995, the Borough has taken the following steps to improve weather warning and response:

- created a website ([www.borough.kenai.ak.us/emergency](http://www.borough.kenai.ak.us/emergency)) that provides current weather watch and advisory information as well as links to the National Weather Service, FEMA educational materials, the Local Emergency Planning Committee, and other web resources such as The Weather Channel ([www.weather.com](http://www.weather.com));
- engaged in cost-share partnerships with USGS to install and maintain additional real-time stream and precipitation gages (see Appendix K);
- partnered with the National Weather Service to improve weather radio and emergency broadcast capabilities in the Central Peninsula by installing an additional NOAA weather radio station in Ninilchik;
- purchased two mobile sirens that can be moved to areas not served by the Borough's emergency siren warning system;
- acquired a mobile strategic command vehicle to facilitate Borough-wide communication and emergency response;
- participated with local and state emergency planning committees to develop, refine and implement cross-jurisdictional emergency response plans; and
- implemented a reverse 911 (Rapid Notify) system to telephone property owners with a recorded alert message in the event of flooding or emergency evacuation; and
- promoted individual use of weather radios, obtained grants to procure and distribute small quantities of same; and
- initiated partnership with NWS for Storm Ready Community programs to be provided in schools by NWS; and
- participated in tests of Emergency Alert System and national Emergency Alert Network; and



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- installed All Hazard Alert Broadcast System (AHAB) warning sirens in the communities of Homer (five sirens), Seward (six sirens), Seldovia, Port Graham and Nanwalek (one siren per community). The AHAB siren system can operate independently and is programmed to activate automatically via radio frequency NWS Emergency Alert System alerts.

### ***StormReady Program***

StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with explicit guidelines for improving their hazardous weather operations.

To be officially StormReady, a community must:

- establish a 24-hour warning point and emergency operation center;
- have more than one way to receive and pass along severe weather forecasts and warnings;
- have a system for monitoring local weather conditions;
- promote the importance of public readiness through community seminars;
- develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises; and
- demonstrate a capability to disseminate warnings.

Currently, the Cities of Homer and Seward are the only KPB communities that participate in the StormReady program. StormReady provides different guidelines for different sized communities. More information on the StormReady program is available by contacting the National Weather Service Office in Anchorage<sup>1</sup>. The National Weather Service and Kenai Peninsula Borough have initiated discussions about bringing the StormReady program to the rest of tPeninsula as NWS resources permit.

### ***Digital Elevation Mapping for Kenai Peninsula***

Digital elevation mapping (DEM) data using LIDAR has been acquired for the Kenai Peninsula and is currently being processed. LIDAR (Light Detection And Ranging) is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target. The Seward area was flown in January 2006 during a snow-free period, and the western Kenai lowlands were flown in the summer of 2008. The data acquired

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<sup>1</sup> National Weather Service, Anchorage Forecast Office, 6930 Sand Lake Road, Anchorage, AK 99502, (907) 266-5117, <http://www.stormready.noaa.gov/>.





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has a resolution of one pixel per four foot square and a vertical accuracy of plus or minus 20 centimeters. No data was acquired for the ice fields or for communities across Kachemak Bay/Cook Inlet.

## 5.6 Weather Mitigation Strategies and Implementation Ideas

After experiencing three presidentially-declared weather-related disasters in the past four years, it is clear that severe weather poses a significant risk to the Borough. The dynamic and varied nature of the Peninsula's climatic patterns and geographic features suggest that winter storms and other severe weather events are likely an ongoing threat. As the Borough's population grows, so does the importance of improving emergency response and warning, and implementing measures to insure development proceeds in the safest possible manner as well as in the safest places. The strategies in this section, as well as those developed for the Flood Section (2.12), are intended to augment existing activities and identify potential new measures to minimize damage and prevent loss of life from future severe weather events. Specific mitigation strategies for borough cities may be found in their respective Annex Sections.

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### ***Strategy 1: Increase public awareness of severe winter storm mitigation activities and emergency response.***

#### **Implementation Ideas and Action Items**

- Participate in statewide outreach and awareness activities such as Winter Weather Awareness Week and Flood Awareness Week.
- Continue weather preparedness outreach and education activities for Borough residents.
- Coordinate with local utility organizations to increase homeowner education about potential storm effects and possible mitigation activities.
- Expand public awareness about the NOAA Weather Radio service continuous weather broadcasts and warning tone alert services.

**Potential Participants:** National Weather Service, Alaska Division of Homeland Security and Emergency Management, Office of Emergency Management (KPB), Local Emergency Planning Committee, Local Utility Companies, Incorporated Cities within the KPB

**Potential Funding:** AKDHS&EM, FEMA, NOAA, KPB, local communities

**Time Frame:** Ongoing



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## ***Strategy 2: Enhance weather monitoring and warning systems.***

### **Implementation Ideas and Action Items**

- Evaluate the need for additional weather stations and/or weather instrumentation across the Kenai Peninsula Borough.
- Evaluate current weather warning systems and explore the need to employ redundant methods of receiving and distributing weather warnings to Borough residents.
- Support ongoing coordination between the incorporated cities, KPB, local utilities and state and federal agencies to promote disaster warning and preparedness planning.
- Add a permit liaison position to the KPB Incident Command Structure to coordinate emergency permitting with regulatory agencies during disaster events.
- Maintain the revolving flood mitigation fund for the purpose of delivering clean water, sand bags and other critical services or supplies to communities during flood emergencies.

**Potential Participants:** National Weather Service, Alaska Division of Homeland Security and Emergency Management, Office of Emergency Management (KPB), Local Emergency Planning Committee, Incorporated Cities within the KPB  
**Potential Funding:** AKDHS&EM, KPB, FMA, FEMA, NOAA,  
**Time Frame:** Ongoing

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## ***Strategy 3: Expand local weather monitoring programs.***

The Borough currently participates in the Alaska Warning System (AKWAS)<sup>1</sup> and can receive weather warning information from the National Weather Service; additional site-specific information could augment the Borough and state weather warning systems.

### **Implementation Ideas and Action Items**

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<sup>1</sup> National Warning System (NAWAS) website: [www.fas.org/nuke/guide/usa/c3i/nawas.htm](http://www.fas.org/nuke/guide/usa/c3i/nawas.htm).



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- Investigate participation in the National Weather Service all-season storm spotter network.
- Partner with the National Weather Service to use their all-hazard warning system (weather radio) to initiate alerts and provide Borough specific hazard warnings.

**Potential Participants:** Office of Emergency Management (KPB), National Weather Service, Division of Homeland Security and Emergency Management, Local Police and Fire Departments, Incorporated Cities within the KPB  
**Potential Funding:** KPB, AKDHS&EM, NOAA  
**Time Frame:** Ongoing

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## ***Strategy 4: Minimize damage to residential structures and private property in the Kenai Peninsula Borough.***

Weather resistant materials and building practices can help structures withstand weather events with minimal damage. For example, bracing and strapping roofs can prevent damage during high winds, grounding buildings will reduce or eliminate lightning damage, and constructing sloped rather than flat roofs will prevent or reduce snow damage.

### **Implementation Ideas and Action Items**

- Encourage use of weather resistant materials and construction practices by implementing Uniform International Building Code Standards for residential structures smaller than four-plexes outside of city limits (see Section 4.5, Strategy 8).
- Require written disclosure of hazard prone areas (such as floodplain, tsunami run-up zones, and areas with high erosion potential) when property ownership is transferred.
- Augment existing homeowner winter storm safety programs. This should include distribution of information on safe building design and retrofitting techniques.
- Explore partnerships to provide retrofitting classes for homeowners, renters, building professionals and contractors.



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- Encourage non-participating local communities to join the StormReady program to help prepare for weather events.

**Potential Participants:** National Weather Service, Office of Emergency Management (KPB), Capital Projects Division (KPB), Local Emergency Planning Committee, Community Schools Program (KPB School District), AK State Division of Homeland Security and Emergency Management, FEMA, Local Realtors, Local Construction Companies, Incorporated Cities within the KPB

**Potential Funding:** KPB, AKDHS&EM, NOAA

**Time Frame:** Ongoing

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## 5.7 Weather Resource Directory

### Local Resources

#### Kenai Peninsula Borough Office of Emergency Management (OEM)

KPB/OEM was established to coordinate disaster management response between the Kenai Peninsula Borough, the State of Alaska, FEMA and other municipalities, as well as other response and recovery organizations. OEM has the primary responsibility for overseeing disaster management programs and activities, including mitigation, planning, response and public education.

**Contact:** Office of Emergency Management  
**Address:** 253 Wilson Lane, Soldotna, AK 99669  
**Phone:** (907) 262-4910  
**Website:** [www.borough.kenai.ak.us/emergency](http://www.borough.kenai.ak.us/emergency)

### State Resources

#### State of Alaska, Division of Homeland Security and Emergency Management

This agency in part conducts hazard preparedness and mitigation workshops. They also coordinate the State of Alaska's All-Hazard Mitigation Plan. Their community response program works with communities during a crisis as well in recovery and planning phases.

**Contact:** AK Division of Homeland Security and Emergency Management  
**Address:** P.O. Box 5750, Fort Richardson, AK 99505-5750  
**Phone:** (907) 428-7000 OR (800) 478-2337  
**Website:** [www.ak-prepared.com](http://www.ak-prepared.com)

#### University of Alaska, Fairbanks, Geophysical Institute

The mission of the Geophysical Institute is to promote understanding of basic geophysical processes, especially as they pertain to Alaska; train graduates and undergraduates to play leading scientific roles in society; solve applied geophysical problems and develop related technologies of importance to the state and the nation; and satisfy the intellectual and technological needs of fellow Alaskans through public service.

**Contact:** Geophysical Institute  
**Address:** 903 Koyukuk Drive, Univ. of Alaska, Fairbanks, AK 99775-7320  
**Websites:** Main University: [www.uaf.edu](http://www.uaf.edu)  
Geophysical Institute: [www.gi.alaska.edu](http://www.gi.alaska.edu)

#### University of Alaska, Fairbanks, Alaska Climate Research Center

The primary mission of the Center is to respond to meteorology and climatologic inquiries concerning Alaska from public, private, and government agencies, as well as researchers around the world. The Center archives digital climate records, develops climate statistics, and writes monthly weather summaries (published in several newspapers around the state as well as in *Weatherwise* magazine). Services are provided free of charge for small requests. The Center also conducts research on a number of high latitude meteorological and climatological topics and provides useful links for related data.

**Contact:** Alaska Climate Research Center  
**Address:** 903 Koyukuk Drive, P.O. Box 757320, Fairbanks, AK 99775-7320  
**Phone:** (907) 474-7885  
**Website:** [climate.gi.alaska.edu](http://climate.gi.alaska.edu)



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## Federal Resources

### FEMA: Mitigation Division

FEMA's Mitigation Division manages the National Flood Insurance Program and oversees a number of mitigation programs and activities, which provide protection (with flood insurance), prevention and partnerships to communities throughout the country.

**Contact:** FEMA/Region X  
**Address:** 130 228<sup>th</sup> Street, SW, Bothell, WA 98021  
**Phone:** (425) 487-4600  
**Website:** <http://www.fema.gov/region-x-mitigation-division>

### National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

**Contact:** National Oceanic and Atmospheric Administration  
**Address:** 1401 Constitution Avenue NW, Room 5128, Washington, DC 20230  
**Phone:** (202) 482-6090  
**Fax:** (202) 482-3154  
**Website:** [www.noaa.gov](http://www.noaa.gov)

### National Weather Service (NWS), Alaska Region Headquarters

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

**Contact:** National Weather Service/ Alaska Region Headquarters  
**Address:** 222 West 7<sup>th</sup> Avenue #23, Anchorage, AK 99513-7575  
**Phone:** (907) 271-5088 OR 1-800-472-0391 (Alaska Weather Line)  
**Fax:** (907) 271-3711  
**Website:** Alaska: [www.arh.noaa.gov](http://www.arh.noaa.gov)  
National: [www.nws.noaa.gov](http://www.nws.noaa.gov)

### Federal Aviation Administration (FAA)

The FAA's mission is to provide a safe, secure and efficient global aerospace system that contributes to national security and the promotion of aviation safety. As the leading authority in the international aerospace community, FAA is responsive to the dynamic nature of customer needs, economic conditions, and environmental concerns. Local flight service stations provide aviation weather briefings, in-flight advisories and pilot reports as well as other aviation related services.

**Contact:** FAA/Alaska Region  
Kenai Flight Service Center  
**Address:** 470 North Willow Street  
Kenai, AK 99611-7707  
**Website:** [www.faa.gov/about/office\\_org/headquarters\\_offices/ato/service\\_units/systemops/fs/alaskan/alaska/ena](http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/fs/alaskan/alaska/ena)





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## Additional Resources

### Public Assistance Debris Management Guide

Federal Emergency Management Agency (July 2000).

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The *Public Assistance Debris Management Guide* is available in hard copy or on the FEMA website.

**Contact:** FEMA Distribution Center  
**Address:** 130 228th Street, SW, Bothell, WA 98021-9796  
**Phone:** (800) 480-2520  
**Fax:** (425) 487-4622  
**Website:** [www.fema.gov/government/grant/pa/demagde.shtm](http://www.fema.gov/government/grant/pa/demagde.shtm)

### Alaska Science Forum

Information and articles provided as a public service by the Geophysical Institute, University of Alaska Fairbanks, in cooperation with the UAF research community:

**Contact:** Geophysical Institute  
**Address:** 903 Koyukuk Drive, University of AK, Fairbanks, AK 99775-7320  
**Website:** Geophysical Institute: [www.gi.alaska.edu](http://www.gi.alaska.edu) OR  
[www.gi.alaska.edu/ScienceForum/weather.html](http://www.gi.alaska.edu/ScienceForum/weather.html)

### National Weather Radio (NWR)

#### NOAA National Weather Service Weather Radio

NWR is a nationwide network of radio stations broadcasting continuous 24-hour weather information direct from a nearby National Weather Service office. NWR is an “all hazards” radio network, making it a comprehensive weather and emergency information source. NWR also broadcasts warning and post-event information for all types of hazards.

**Contact:** NOAA, National Weather Service  
Office of Climate, Water and Weather Services  
**Address:** 1325 East West Highway, Silver Spring, MD 20910  
**Website:** National: [www.nws.noaa.gov/nwr](http://www.nws.noaa.gov/nwr)

**Contact:** NOAA/NWR Anchorage Forecast Office  
**Address:** 6930 Sand Lake Road, Anchorage, AK 99502  
**Websites:** Alaska NWR Locations: [www.nws.noaa.gov/nwr/stations.php?State=AK](http://www.nws.noaa.gov/nwr/stations.php?State=AK)  
Anchorage Forecast Office: [pafc.arh.noaa.gov](http://pafc.arh.noaa.gov)  
**Phone:** 1-800-472-0391 (Alaska Weather Line)



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## **NWS/StormReady Program**

StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. StormReady guidelines, examples, and applications also may be found on the Internet or by contacting the National Weather Service, Anchorage Forecast Office.

**Contact:** National Weather Service, Anchorage Forecast Office  
**Address:** 6930 Sand Lake Road, Anchorage, AK 99502  
**Phone:** (907) 266-5117  
**Website:** [www.stormready.noaa.gov](http://www.stormready.noaa.gov)

## **NWS/TsunamiReady Program**

Based on the NWS StormReady model, the Tsunami Ready Program is a National Weather Service (NWS) initiative that promotes tsunami hazard preparedness to provide consistent and location specific mitigation activities for communities at risk. This is a collaborative program that combines the efforts of Federal, state and local emergency management agencies, the public, and the NWS tsunami warning system. TsunamiReady guidelines, examples, and applications also may be found on the Internet or by contacting the West Coast and Alaska Tsunami Warning Center.

**Contact:** West Coast & Alaska Tsunami Warning Center  
**Address:** 910 S. Felton St., Palmer, AK 99645  
**Phone:** (907) 745-4212  
**Website:** [wcatwc.arh.noaa.gov](http://wcatwc.arh.noaa.gov)

## **American Red Cross**

The American Red Cross is a volunteer humanitarian organization, which provides relief to disaster victims and helps people prevent, prepare for and respond to emergencies.

**Contact:** American Red Cross  
**Address:** 235 E. 8<sup>th</sup> Avenue, Anchorage, AK 99501  
**Phone:** (907) 646-5401  
**Website:** [alaska.redcross.org](http://alaska.redcross.org)

## **Western Regional Climate Center**

The Western Regional Climate Center (WRCC) is one of six regional climate centers in the United States. The Regional Climate Centers Program is administered by the National Oceanic and Atmospheric Administration and funded through the NOAA Cooperative Institute for Atmospheric Sciences and Terrestrial Applications (CIASTA). They have several key objectives: 1) to coordinate applied climate activities in the western United States, 2) to conduct applied climate related research in the west, 3) to maintain a historic climate database for the west, and 4) to respond to climate data requests.

**Contact:** Western Regional Climate Center  
**Address:** 2215 Raggio Parkway, Reno, Nevada 89512  
**Phone:** (775) 674-7010  
**Website:** <http://www.wrcc.dri.edu/>

## **Kachemak Bay Research Reserve**

The Kachemak Bay Research Reserve (KBRR) performs and coordinates research and education related to estuarine, oceanic and watershed interests of the Kenai Peninsula and Gulf



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of Alaska. The KBRR is a partnership between the National Oceanic and Atmospheric Administration (NOAA) and the State of Alaska and is administered through the Alaska Department of Fish and Game.

**Contact:** Kachemak Bay Research Reserve  
**Address:** 95 Sterling Highway, Suite 2, Homer, AK 99603  
**Phone:** (907) 235-6377  
**Website:** <http://www.adfg.alaska.gov/index.cfm?adfg=kbr.home>

## Coastal Training Program Alaska

The Coastal Training Program Alaska (CTP Alaska) provides science-based training and education services to assist policy makers and land managers make better decisions about coastal issues. CTP Alaska is a NOAA national initiative operated in conjunction with National Estuarine Research Reserves.

**Contact:** Kachemak Bay Research Reserve  
**Address:** 95 Sterling Highway, Suite 2, Homer, AK 99603  
**Phone:** (907) 235-6377  
**Website:** [http://www.adfg.alaska.gov/index.cfm?adfg=kbr\\_educationcoastal.home](http://www.adfg.alaska.gov/index.cfm?adfg=kbr_educationcoastal.home)

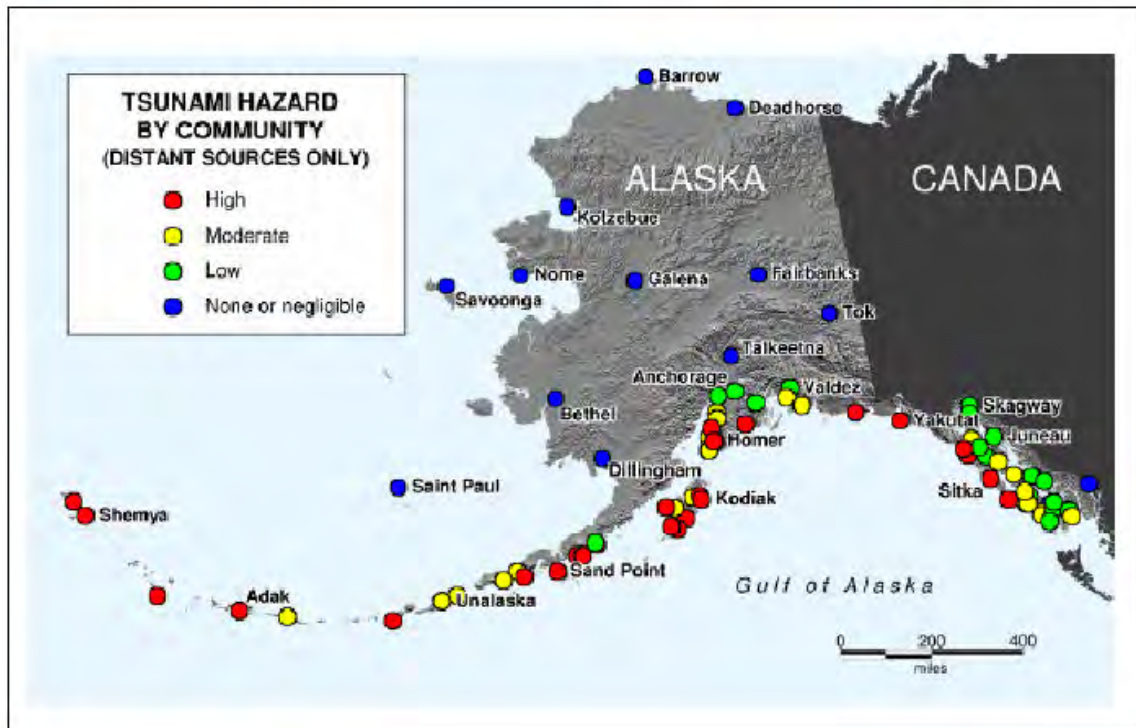


# TSUNAMIS & SEICHES

## 6.0 Tsunamis & Seiches

### 6.1 Why Focus on Tsunami & Seiche Hazard Mitigation?

Tsunamis are sea waves (sometimes referred to as tidal waves) of local or distant origin that occur as a result of large-scale seafloor displacement.



**Figure 6-1.** Alaska Tsunami Hazard by Community.

Typically, seismic activity, volcanic activity or landslides (above or below sea in origin) generate the uplift or drop in the ocean floor. Within Alaska, the most tsunami-vulnerable regions are the low-lying coastal zones along the Gulf of Alaska and the Pacific Ocean, including much of the Kenai Peninsula Borough shoreline.

The potential for tsunamis to cause tremendous damage to the KPB is well documented. On March 27<sup>th</sup>, 1964, the city of Seward was devastated by a series of waves generated by a 9.2<sup>1</sup> magnitude earthquake. With four active volcanoes and a high potential for earthquakes of magnitude 6.0 or greater, Borough coastal communities (tsunamis are generated by earthquakes with a magnitude of 7.0 or greater<sup>2</sup>).

<sup>1</sup> U.S. Department of Commerce, National Science Services Administration, U.S. Coast and Geodetic Survey. 1964. United States Earthquakes.

<sup>2</sup> Oregon Department of Geology and Mineral Industries. 2001. Tsunami Warning Systems and Procedures: Guidance of Local Officials. Special Paper 35 prepared for the National Tsunami Hazard Mitigation Program.



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Coastal areas with the greatest tsunami risk are generally less than 50 feet above sea level and within one mile of the shoreline<sup>1</sup>. There are three primary sources of damage from tsunamis: inundation (the extent the water goes over the land), wave impact (both incoming and receding currents) and coastal erosion.

The direction or path, the wave energy, the coastal configuration and the offshore topography influence the terminal height (or run-up) of the wave and therefore the potential for damage<sup>2</sup>. As tsunamis reach the coastal shoals wave velocity decreases but wave height increases. Waves can reach heights of more than 100 feet and strike coastal areas with extraordinary force.

A seiche is a wave that oscillates in partially or totally enclosed bodies of water and can last from a few minutes to a few hours. The resulting effect is similar to bathtub water sloshing repeatedly from side to side. The reverberating water can continue to cause damage until the activity subsides. Events such as earthquakes, landslides, avalanches, high winds or changes in atmospheric pressure may trigger seiches. Similar to locally-generated tsunamis, the onset of the first wave from the causal event may take only a few minutes, giving virtually no warning.

## 6.2 Types of Tsunamis

The four primary types of tsunamis that could impact the KPB include:

- tele-tsunami
- volcanic tsunami
- seismically generated tsunami
- landslide-generated tsunami

### ***Tele-Tsunami***

Tele-tsunami is the term used when a tsunami travels 1,000 kilometers or more from its source. In many cases, tele-tsunamis allow for sufficient warning time and evacuation.

According to the State All-Hazard Mitigation Plan, Alaska's coastal areas are believed to be at relatively low risk of experiencing high magnitude tele-tsunamis<sup>3</sup>. To date, no damage from tele-tsunamis has been recorded within the Kenai Peninsula Borough.

<b><i>Magnitude</i></b>	<b><i>Height (ft)</i></b>
-2 to -1	<1.0 to 2.5
-1 to 0	2.5 to 4.9
0 to 1	4.9 to 9.9
1 to 2	9.9 to 19.7
2 to 3	19.7 to 34.2
3 to 4	34.2 to 79.0
4 to 5	79.0 to >105.0

**Table 6-1.** Tsunami Magnitude and Height Relationships.

<sup>1</sup> Federal Emergency Management Agency. 2004. Fact Sheet: Tsunamis

<sup>2</sup> Pararas-Carayannis, G. 2004. The Tsunami Page. [www.drgeorgepc.com/TsunamiFAQ.html](http://www.drgeorgepc.com/TsunamiFAQ.html).

<sup>3</sup> Alaska Division of Homeland Security and Emergency Management (DHS&EM). State Hazard Mitigation Plan. DMA 2000 - Updated September 2004.



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### ***Volcanic Tsunamis***

Volcanoes that are situated in the sea or near the coast can initiate tsunamis by generating earthquakes, pyroclastic flows, submarine explosions, debris avalanches, caldera collapse, pyroclastic surges, lahars and airwaves from explosions, and lava avalanches into the sea<sup>1</sup>. Factors governing tsunami magnitude include the volume of debris that enters the sea, the velocity of the avalanche and the water depth in the run-out zone<sup>2</sup>.

There are five active volcanoes within the KPB on the west side of Cook Inlet: Fourpeaked, Augustine, Iliamna, Redoubt and Mount Spurr (Figure 6-2).



**Figure 6-2.** Volcanoes in the Cook Inlet Region<sup>3</sup>.

Located at the southern end of Cook Inlet approximately 90 kilometers west of Nanwalek, Augustine Volcano has the potential to generate tsunamis. A number of anecdotal records indicate that an 1883 eruption of Mt. Augustine caused a

<sup>1</sup> Waythomas, C.F. and R.B. Waitt. 1998. Preliminary Volcano-Hazard Assessment For Augustine Volcano, Alaska. U.S. Geological Survey, Open File Report 98-106.

<sup>2</sup> Ibid.

<sup>3</sup> Modified from Ray Sterner, Johns Hopkins University, Applied Physics Laboratory (Copyright 1998).





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series of tsunami waves to strike the villages of Nanwalek and Port Graham<sup>1</sup>. Information suggests wave heights of 20 to 30 feet hit the communities within 30 minutes of the eruption. Low tide at the time of the tsunami was reported as the reason for minimal damage.

## ***Seismically-Generated Local Tsunamis***

Although in recent years most of the seismically-generated local tsunamis have occurred along the Aleutian Arc, seismic activity is common in the KPB (see Section 4.0 Earthquakes) and is often associated with the active volcanoes. An island in Cook Inlet, Augustine has high probability of generating tsunami waves that could impact communities in lower Cook Inlet.

## ***Landslide-Generated Tsunamis***

Submarine and surface landslides can generate large waves. Surface landslides have greater associated kinetic energy than submarine landslides so they typically trigger larger tsunamis. Earthquakes often trigger multiple landslides and landslide-generated tsunamis. Submarine landslides occur more readily at low tide when water-saturated sediments are exposed and lack the support of the water. Additional loading from human activities, such as warehouses, canneries and freight yards can increase a delta's instability. In Alaska, landslide events usually occur in heavily glaciated areas such as Resurrection Bay, Kachemak Bay and Prince William Sound.

Landslide-generated tsunamis are often the deadliest, because they quickly follow the triggering event with little to no warning. The Seward harbor was seriously damaged in 1964 when a large section of waterfront slid into Resurrection Bay during the Good Friday earthquake. The landslide-generated waves were followed a short time later by quake-generated tsunami waves. The city of Homer was impacted by a landslide-generated tsunami when a large debris slide near the Grewingk Glacier sent a wave of water across Kachemak Bay<sup>2</sup>.

## ***Seiches***

A seiche is a wave that oscillates in partially or totally enclosed bodies of water. Seiches can last from a few minutes to a few hours as a result of an earthquake, surface or submarine landslide or atmospheric disturbance. The resulting effect is similar to bathtub water sloshing repeatedly from side to side. The reverberating water will continue to cause damage until the activity subsides. Similar to a local tsunami, the onset of the first wave may happen in only minutes, giving virtually no time for evacuation or warnings.

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<sup>1</sup> Montgomery Watson and Parker Horn Company. 2001. Flood Hazard Mitigation Plan, Port Graham, Alaska, Kenai Peninsula Borough, Feb. 2001. Waythomas, C.F. and R.B. Waitt. 1998. Preliminary Volcano-Hazard Assessment For Augustine Volcano, Alaska. U.S. Geological Survey, Open File Report 98-106.

<sup>2</sup> City of Homer All-Hazard Mitigation Plan (Annex A).



# TSUNAMIS & SEICHES

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In Alaska, seiches are commonly generated by the collapse of deltas into deep glacial lakes. They may also be associated with deltas built through time by alluvial streams, which typically consist of unconsolidated gravel, rock and debris. Within the Kenai Peninsula Borough, slide-induced waves have occurred on Kenai, Tustumena and Skilak Lakes<sup>1</sup>.

## 6.3 Historical Tsunami Events

### ***1883 Tsunami***

Records indicate that Augustine erupted in 1883, and a large debris avalanche slid into Cook Inlet, causing a series of four 15- to 30-foot waves to strike the village of English Bay (now known as Nanwalek)<sup>2</sup>. An entry in the Alaska Commercial Company trading post daily log (University of Alaska Archives), indicated that wave heights were six meters above the “usual” level<sup>3</sup>. Nearby, Port Graham residents also reported several 15-foot waves striking within a half-hour of the eruption. Because the tide was low at the time, damage was minor but boats were swept into the harbor and several residences were flooded<sup>4</sup>. If a similar event occurred during high tide, damage to low-lying areas in the communities of Seldovia, Port Graham, Nanwalek and Homer could be substantial<sup>5</sup>.

### ***1964 Tsunami***

The 1964 earthquake triggered several tsunamis: one major tectonic tsunami and about 20 local submarine and surface landslide tsunamis. The major tsunami hit south-central Alaska between 20 and 45 minutes after the earthquake. The local tsunamis struck between two and five minutes after the quake and caused a majority of the fatalities. Overall, the tsunamis were responsible for more than 90% of the earthquake related deaths, killing 106 Alaskans as well as 17 people in California and Oregon<sup>6</sup>.

In Seward, the earthquake caused a 1,070 meter section of the Seward waterfront to collapse into Resurrection Bay (Figure 6-3). The landslide generated a 30-foot local tsunami that destroyed most of the facilities near the waterfront, including a fuel tank farm, which started the first of many fires.

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- <sup>1</sup> Foster, H. and T. Karlstrom. 1967. The Alaska Earthquake, March 27, 1964: Region Effects. Ground Breakage and Associated Effects in the Cook Inlet, Alaska, Resulting from the March 27, 1964, Earthquake. Geological Survey Professional Paper 543-F. United State Department of the Interior, Washington, D.C.; McCulloch, D. 1966. Slide-Induced Waves, Seiching and Ground Fracturing Caused by the Earthquake of March 27, 1964, at Kenai Lake, Alaska. Geological Survey Professional Paper 543-A. United State Department of the Interior, Washington, D. C.
- <sup>2</sup> Waythomas, C.F. and R.B. Waitt. 1998. Preliminary Volcano-Hazard Assessment For Augustine Volcano, Alaska. U.S. Geological Survey, Open File Report 98-106.
- <sup>3</sup> Ibid.
- <sup>4</sup> Montgomery Watson and Parker Horn Company. 2001. Flood Hazard Mitigation Plan, Port Graham, Alaska, Kenai Peninsula Borough. March 2001.
- <sup>5</sup> Troshina, E.N., 1996. Tsunami waves generated by Mt. St. Augustine Volcano, Alaska: Fairbanks, University of Alaska, M.S.thesis, 84pp in Waythomas, C.F. and R.B. Waitt. 1998. Preliminary Volcano-Hazard Assessment For Augustine Volcano, Alaska. U.S. Geological Survey, Open File Report 98-106.
- <sup>6</sup> Sokolowski, T. 2004. The Great Alaskan Earthquake & Tsunamis of 1964. West Coast & Alaska Tsunami Warning Center, Palmer, Alaska.
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## TSUNAMIS & SEICHES

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Smaller tsunamis then spread the burning fuel floating on the water surface and started another fire at the Texaco Petroleum tank farm further inland<sup>1</sup>.

In the small boat harbor, landslide-induced waves collapsed the dock and sank 30 fishing boats and 40 pleasure craft. The railroad yards were also heavily damaged, as were freight cars in the marshalling yards. The waves struck with sufficient force to move a 120-ton locomotive 100 feet and sweep a 75-ton locomotive 300 feet inland.

About twenty minutes after the first local tsunami hit the Seward waterfront, a 40-foot earthquake-generated wave struck. This wave carried a wall of flaming oil into Seward, destroying and setting fire to a large section of town. All told, about 95% of Seward's industrial base was lost and 15% of the town's residential properties were totally destroyed or heavily damaged. There were 12 fatalities, 200 injuries<sup>2</sup> and approximately \$14 million in damage<sup>3</sup>.

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<sup>1</sup> KPB All-Hazard Plan, Annex E: City of Seward. 2010. All-Hazard Mitigation Plan.

<sup>2</sup> Alaska Division of Homeland Security and Emergency Management (DHS&EM). State Hazard Mitigation Plan. DMA 2000 - Updated 2013.

<sup>3</sup> Sokolowski, T. 2004. The Great Alaskan Earthquake & Tsunamis of 1964. West Coast & Alaska Tsunami Warning Center, Palmer, Alaska.



## TSUNAMIS & SEICHES



**Figure 6-3.** Tsunami Damage to the City of Seward Waterfront Following the March 27, 1964 Earthquake<sup>1</sup>.

Although 10- to 30-foot quake generated tsunami waves were also reported in Homer, Seldovia, Port Graham and Nanwalek<sup>2</sup>, there were no fatalities and much less damage. The primary damage in Homer involved two to six feet of earthquake-induced subsidence along the five-mile-long Homer Spit road. As a result, 70 percent of the Spit flooded during the following autumn high tides. In Seldovia as well as other coastal areas, many boats and some waterfronts were damaged<sup>3</sup>. The land in much of Seldovia subsided four feet, necessitating the rebuilding and relocation of much of the village.<sup>4</sup>

### 6.4 Tsunami & Seiche Risk Assessment

Tsunami vulnerability is greater when coastal communities have beaches that open to the ocean or are located near bay entrances, tidal flats and shores of

<sup>1</sup> Source: John Combs Seward Part 2 website: [www.alaskarails.org/historical/earthquake/earthquake-seward2.html](http://www.alaskarails.org/historical/earthquake/earthquake-seward2.html).

<sup>2</sup> United States Army Corps of Engineers, May 1968. Coastal Engineering Research Center, Technical Memorandum No. 25, *The Tsunami of the Alaskan Earthquake, 1964, Engineering Evaluation* in FEMA. 1999. Flood Insurance Study, Kenai Peninsula Borough, Alaska (revised). Community Number 020012.

<sup>3</sup> Sokolowski, T. 2004. The Great Alaskan Earthquake & Tsunamis of 1964. West Coast & Alaska Tsunami Warning Center, Palmer, Alaska <http://wcatwc.arh.noaa.gov/about/64quake.htm>.

<sup>4</sup> Suleimani, E.N., et al., Tsunami Hazard Maps of the Homer and Seldovia Areas, Alaska. State of Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, 2005





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coastal rivers. Within the KPB, the most significant threat is from local tsunamis generated in Resurrection Bay, Alaska Pacific waters and Cook Inlet. Communities at primary risk include Seward, Homer, Seldovia, Port Graham and Nanwalek.

The entire KPB lies within Zone 4 (highest earthquake hazard potential) of the former Uniform Building Code<sup>1</sup>. Zone 4 is susceptible to earthquakes of magnitude greater than 6.0 in which major structural damage could occur. A strong earthquake that lasts more than 20 seconds can also generate a tsunami<sup>2</sup>. See Section 4.0 for additional KPB earthquake information.

According to the KPB Emergency Response Plan<sup>3</sup>, coastal communities in the East and South Zones are highly vulnerable to tsunami events, which have a moderate probability of occurring. Residents of North and Central Zone coastal communities are moderately vulnerable to tsunamis, although the probability of occurrence is low due to the shallow depth of upper Cook Inlet and the lack of substantial submarine structures.

**Table 6-2.** Population and Facility Tsunami Hazard Vulnerabilities for the Kenai Peninsula Borough<sup>4</sup>.

Zone	Population within vulnerability zone*	Property that may be damaged	Probability of occurrence
North	2,000	Structures, vehicles and equipment, port and harbor facilities, transportation facilities, airports	Low
Central	2,000		Low
East	7,000		Moderate
South	7,500		Moderate

\* Numbers are for "worst case" occurrence in summer.

Tsunamis have the potential to damage structures, vehicles, boats, equipment, harbor and transportation facilities. The probability of simultaneous emergencies following a tsunami is rated as high in the KPB Emergency Response Plan<sup>5</sup>. Associated events include industrial/technological emergencies (resulting from fire, explosions and hazardous materials incidents), disruption of vital services (such as water, sewer, power, gas and transportation) and damage and disturbance to emergency response facilities and resources.

<sup>1</sup> Pers. comm., Rod Combellick, Acting Director, Alaska Division of Geological and Geophysical Surveys. Fairbanks, Alaska, 2004.

<sup>2</sup> National Disaster Education Coalition. 1999. Tsunami. In: *Talking About Disaster: Guide for Standard Messages*. Washington, D.C. Available at <http://www.fema.gov/pdf/rrr/talkdiz/tsunami.pdf>.

<sup>3</sup> Pinkston Enterprises. 2004. Kenai Peninsula Borough Emergency Operations Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.

<sup>4</sup> Pinkston Enterprises. 2004. Kenai Peninsula Borough Emergency Operations Plan. Prepared for the Office of Emergency Management, Kenai Peninsula Borough, Soldotna, Alaska.

<sup>5</sup> Ibid.



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### **6.4.1 Populations and Facilities at Risk**

#### *Overall*

Depending on the epicenter and magnitude, an earthquake-generated tsunami could result in significant damage to KPB coastal communities. The tsunami inundation maps for the communities of Homer, Seldovia and Seward provide a tool to more accurately assess the number of people and development that is at risk in those communities. Risk assessments for the other unmapped communities, at least in the near term, will be based on available historical or estimated information.

The DHS&EM, with input from an interagency committee, established a statewide priority list for tsunami inundation mapping. As part of this effort, maps for Homer and Seldovia have been finalized<sup>1</sup> and Seward received maps in 2010<sup>2</sup>. The tsunami maps can be used to more accurately predict the number of people and development at risk, as well as assist with land use and emergency response planning.

Due to resource limitations, the smaller KPB coastal communities are currently not scheduled for tsunami mapping. Without inundation maps, communities must rely on historical or estimated information for land use and evacuation route planning.

#### *North Zone*

Coastal areas with potential tsunami risk in the North Zone begin at the north side of the mouth of the Kenai River and continue north up the coast, including the west side of Cook Inlet. Due to the relatively shallow depth of upper Cook Inlet and the substantial distance from areas to the south with significantly higher risk, the upper Inlet is believed to have low tsunami risk<sup>3</sup>.

#### *Central Zone*

The areas of concern in the Central Zone begin at the south side of the mouth of the Kenai River and continue south to Clam Gulch. Due to the relatively shallow depth of upper Cook Inlet and the substantial distance from the lower end of Cook Inlet, the Central Zone is believed to have a low tsunami risk.

#### *East Zone*

Surface and submarine landslides could hit both the east and west shores of Resurrection Bay, which increases Seward's vulnerability to both local seiche waves and earthquake generated waves (see Section 6.3 Historical Tsunami Events).

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<sup>1</sup> Available at: <http://www.dggs.alaska.gov/pubs/pubs?regtype=citation&ID=14474>

<sup>2</sup> [http://137.229.113.30/webpubs/dggs/ri/text/ri2010\\_001.pdf](http://137.229.113.30/webpubs/dggs/ri/text/ri2010_001.pdf)

<sup>3</sup> Pers. comm., Rod Combellick, Acting Director, Alaska Division of Geological and Geophysical Surveys. Fairbanks, Alaska, 2004; For project status visit <http://www.aeic.alaska.edu/tsunami/intro.html>





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### *South Zone*

The South Zone communities are vulnerable to earthquake, volcano and surface and submarine landslide induced tsunamis that originate in Prince William Sound, the Gulf of Alaska and Cook Inlet. Typical peak wave heights from large tsunamis in the Pacific Ocean over the last 80 years have been between 21 and 45 feet at the shoreline. A few waves, however, have been higher locally - as much as 100 feet in a few isolated locations<sup>1</sup>.

Tsunamis could impact both the east and west shores of Cook Inlet. Potentially vulnerable communities include Port Graham, Nanwalek, Seldovia, Homer, Anchor Point, Ninilchik and other small communities along the water.

Both Port Graham and Nanwalek are at risk from tsunami damage. As part of their Flood Hazard Mitigation Plan<sup>2</sup> (Annex G), the community of Port Graham used the 100-foot elevation contour to map their potential tsunami hazard zone (Figure 6-4). This map did not take into account site-specific shoaling effects or wave diffraction that may impact water run-up – factors that are included in the interagency-produced inundation maps (described above). According to the Port Graham Flood Mitigation Plan:

*Current development is concentrated in the coastal areas, making the community vulnerable to flooding from tsunamis and extreme events. Much of the available land is owned by the Port Graham Village, allowing them to a certain extent to control the development of the community. Future development could occur along existing roads, preventing the need for costly road construction. Duncan Heights Road, Second Street, and A Street could all accommodate additional development. Structures along these roads, while still in the Tsunami Hazard Zone, would be out of immediate danger from storms or coastal erosion. (Annex G, p. 6-1)*

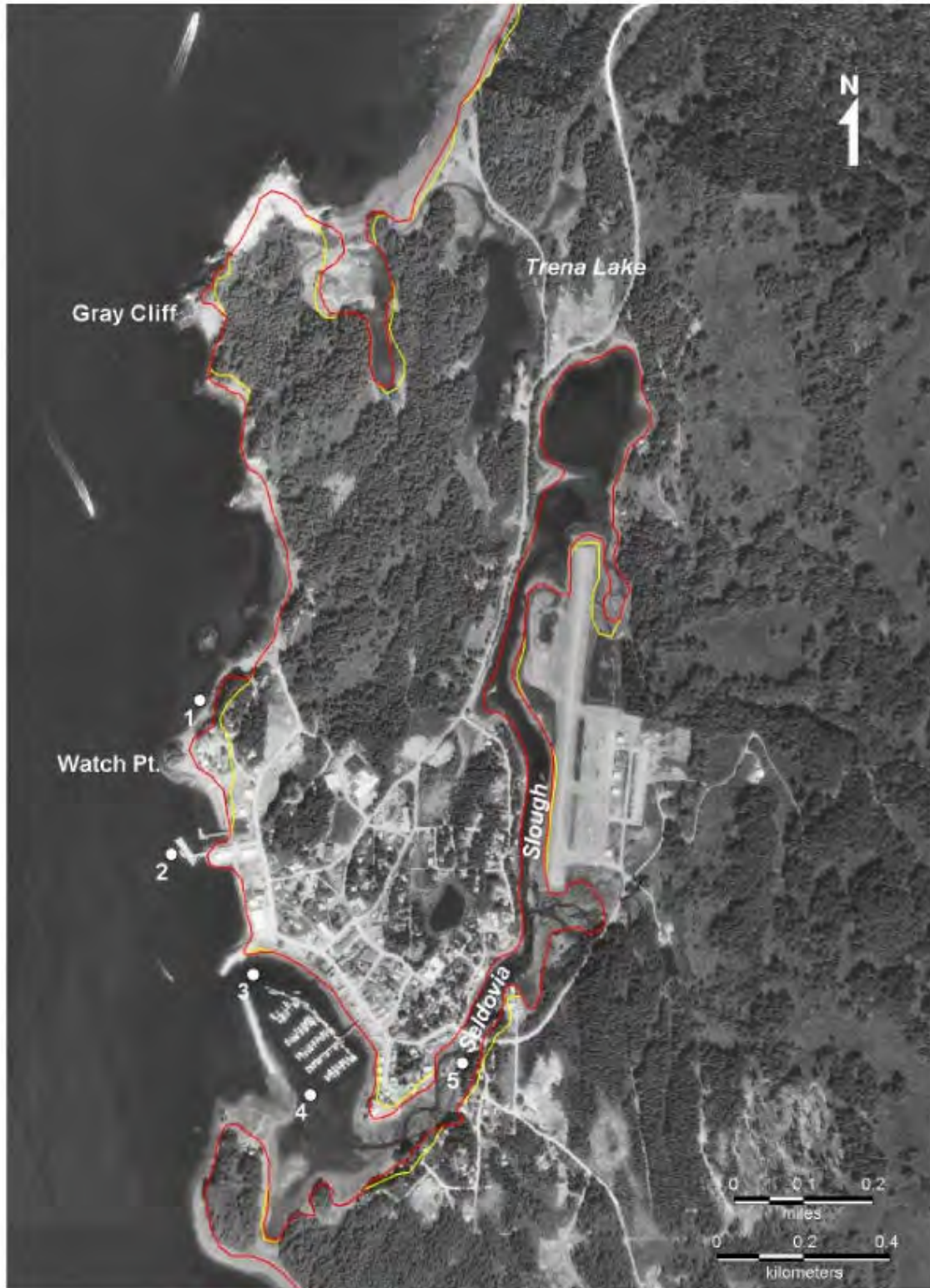
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<sup>1</sup> Earthquake Education Center. 1996. *Tsunami! How to Survive the Hazard on California's Coast*. Humboldt State University. [http://www.wsspc.org/tsunami/CA/CA\\_survive.html](http://www.wsspc.org/tsunami/CA/CA_survive.html).

<sup>2</sup> Montgomery Watson and Parker Horn Company. 2001. Flood Hazard Mitigation Plan, Port Graham, Alaska, Kenai Peninsula Borough, Feb. 2001.



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**Figure 6-4.** Tsunami Hazard Map for Seldovia, Alaska



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**Figure 6-5. Port Graham Tsunami Hazard Zone<sup>1</sup>.**

<sup>1</sup> Montgomery Watson and Parker Horn Company. 2001. Flood Hazard Mitigation Plan, Port Graham, Alaska, Kenai Peninsula Borough, Feb. 2001.



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**Figure 6-6. Homer Tsunami Hazard Zone<sup>1</sup>.**

<sup>1</sup> Montgomery Watson and Parker Horn Company. 2001. Flood Hazard Mitigation Plan, Port Graham, Alaska, Kenai Peninsula Borough, Feb. 2001.





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## 6.5 Tsunami & Seiche Mitigation Goals

Although it is not possible to eliminate the threat that tsunami hazards pose to Borough residents, it is possible to identify ways to reduce vulnerability. To this end, three goals were identified to best serve and protect the Kenai Peninsula Borough from tsunami and seiche related hazards. These goals encompass both agency and individual responsibilities and are the same for all hazards, although mitigation strategies are tailored to the specific nature of each hazard.

All-hazard mitigation goals include:

- protection;
- prevention; and
- education.

### 6.5.1 Accomplishing KPB Tsunami and Seiche Mitigation Goals

The following are suggested as approaches to further define and accomplish the Borough's long-term tsunami mitigation goals.

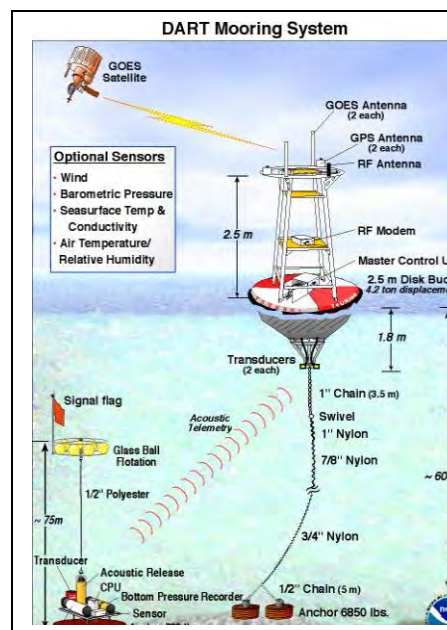
- modify the impacts of tsunamis and seiches by assisting individuals and communities to prepare for, respond to and recover from these events;
- Reduce susceptibility to damage and disruption by avoiding hazardous, uneconomic and unwise development in tsunami hazard areas.
- protect the natural and beneficial values of Peninsula floodplains, coastal areas and water resources;
- Promote positive economic development.

### 6.5.2 Existing Tsunami & Seiche Mitigation Programs and Activities

#### 6.5.2.1 Deep-Ocean Assessment and Reporting of Tsunamis (DART)

The DART project is a component of the larger U.S. National Tsunami Hazard Mitigation Program (NTHMP). The NTHMP is a comprehensive Federal and State effort to reduce loss of life and property due to tsunami inundation along U.S. coastlines. Cooperating U.S. agencies include NOAA, FEMA, USGS, and the Emergency Management agencies of the five Pacific States: Alaska, California, Hawaii, Oregon and Washington.

The DART project is an ongoing effort to develop





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and implement early detection and real-time reporting of tsunamis in the open ocean. Project goals are designed to:

- reduce the loss of life and property in U.S. coastal communities; and
- eliminate false alarms and the high economic cost of unnecessary evacuations.

To ensure early detection and acquire information critical to real-time tsunami forecasting, DART stations were sited in regions where destructive tsunamis have been generated in the past. A DART system consists of a seafloor bottom pressure-recording device (BPR) capable of detecting sea surface elevation changes as small as one centimeter, and a moored surface buoy for real-time communication. An acoustic link is used to transmit data from the BPR on the seafloor to the surface buoy. The data are then relayed via a GOES satellite link to ground stations, which modulate and transfer the signals to NOAA Tsunami Warning Centers and the Pacific Marine Environmental Laboratory (PMEL). Tele-tsunami warnings generated by the DART systems are expected to provide more accurate tsunami wave predictions for coastal communities in the Pacific Northwest and Alaska. Several DART stations are located in the central and western Gulf of Alaska and extend westward to the end of the Aleutian Chain.

### *6.5.2.2 TsunamiReady Program*

Based on the NWS StormReady model, the TsunamiReady Program is a National Weather Service (NWS) initiative that promotes public safety and tsunami hazard preparedness. It is a collaborative program that combines the efforts of federal, state and local emergency management agencies, the public, and the NWS tsunami warning system.

In 2002, Seward and Homer became Alaska's first TsunamiReady communities (Figure 6-5). Before a community can be declared tsunami ready, it must meet five guidelines under the categories of communications and coordination, tsunami warning reception, warning dissemination, awareness and program administration<sup>1</sup>.

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<sup>1</sup> Guidelines detailed online at [www.tsunamiready.noaa.gov/guidelines.htm](http://www.tsunamiready.noaa.gov/guidelines.htm)





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**Figure 6-7.** Communities in Alaska that Participate in the TsunamiReady Program<sup>1</sup>.

### 6.5.2.3 Tsunami Inundation Mapping Program

As part of a larger federal program, Alaska is generating tsunami inundation maps for communities along the Gulf of Alaska. The DHS&EM, in cooperation with the University of Alaska Fairbanks, the Division of Geological and Geophysical Survey, the West Coast and Alaska Tsunami Warning Center, the National Weather Service and NOAA have completed detailed studies to predict tsunami threats for the cities of Homer and Seldovia. The study for Seward was completed in 2010<sup>2</sup>. With data from these studies, detailed tsunami inundation maps can be generated. The studies and resulting maps will greatly assist the cities with future emergency planning efforts such as delineating evacuation routes. The maps will also be useful for land-use planning and development decisions. These maps will require maintenance and upgrades as new data becomes available and coastal changes occur.

### 6.5.2.4 West Coast/Alaska Tsunami Warning Center (WC&ATWC)

The WC&ATWC was established in Palmer, Alaska in 1967 as a direct result of the Good Friday earthquake that occurred in Prince William Sound on March 27, 1964. The earthquake alerted state and federal officials to the need for a facility to provide timely and effective tsunami warnings and information for Alaska's coastal areas.

In 1982, the WC&ATWC's area of responsibility (AOR) was enlarged to include California, Oregon, Washington, and British Columbia. In 1996, the responsibility

<sup>1</sup> Image Source: [www.tsunamiready.noaa.gov/ts-com/ak-ts.htm](http://www.tsunamiready.noaa.gov/ts-com/ak-ts.htm).

<sup>2</sup> Available at: [http://137.229.113.30/webpubs/dggs/ri/text/ri2010\\_001.pdf](http://137.229.113.30/webpubs/dggs/ri/text/ri2010_001.pdf)



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was again expanded to include all Pacific-wide tsunamigenic sources that could affect the California, Oregon, Washington, British Columbia and Alaska coasts.

Tsunami warnings are of two types: regional warnings for tsunamis produced in or near the AOR and warnings for tsunamis generated outside the AOR. Regional warnings are issued within 15 minutes of earthquake origin time and are based solely on seismic data. Warnings are issued for any earthquake in the WC&ATWC's AOR over magnitude 7. Warnings outside the WC&ATWC's AOR are issued after coordination with the Pacific Tsunami Warning Center in Ewa Beach, Hawaii. The warnings are based on seismic data, along with historical tsunami records and recorded tsunami amplitudes from tide gauges.

In addition to evacuation warning messages, the WC&ATWC also provides informational messages for earthquakes that may be felt strongly by local citizens but are not large enough to generate a tsunami. Each year, the WC&ATWC staff responds to more than 250 alarms (an average of five per week). The informational messages are important for preventing needless evacuations since citizens near coastal areas are taught to move to higher ground when earthquakes occur. The WC&ATWC provides the public with critical, correct and timely tsunami information.

### *6.5.2.5 Tsunami Warning and Environmental Observatory for Alaska (TWEAK)*

TWEAK is a program to collect tsunami information and biological and oceanographic data. Its efforts are focused on the following areas:

- tsunami research
- water quality
- ocean productivity
- weather prediction
- education and outreach

The information generated by TWEAK is expected to enhance the productivity and improve utilization of the ocean resources available in Kachemak Bay, Cook Inlet and the Gulf of Alaska.

### *6.5.2.6 Digital Elevation Mapping for Kenai Peninsula*

Digital elevation mapping (DEM) data using LIDAR has been acquired for the Kenai Peninsula and is currently being processed. LIDAR (LIght Detection And Ranging) is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target. The Seward area was flown in January 2006 during a snow-free period, and the western Kenai lowlands were flown in the summer of 2008. The data acquired has a resolution of one pixel per four foot square and a vertical accuracy of plus or minus 20 centimeters. No data was acquired for the ice fields or for communities across Kachemak Bay/Cook Inlet.



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## 6.6 Tsunami & Seiche Mitigation Strategies and Implementation Ideas

Tsunami damage associated with the 1883 volcanic eruption and the 1964 earthquake (see 6.3 Historical Tsunami Events) highlight the ongoing vulnerability of KPB coastal communities to this hazard. Though it is not possible to prevent tsunamis and seiches from occurring, both agencies and individuals can participate in mitigation activities to greatly lessen or eliminate damage. Potentially cost-effective ways to offset losses include increasing public awareness of tsunami prone areas, improving and practicing emergency warning and response measures, minimizing non-water dependent development in tsunami runup zones, and implementing measures to help water-based facilities withstand or deflect tsunami wave forces. The mitigation strategies that follow were developed to reduce tsunami-associated loss of life and property while simultaneously fulfilling the overall hazard mitigation plan goals of protection, prevention and education. Additional tsunami mitigation recommendations can be found in the Homer and Seward City Annex Sections.

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***Strategy 1: Increase public awareness of tsunami and seiche mitigation activities and emergency response.***

### Implementation Ideas and Action Items

- Continue tsunami education activities for coastal residents (such as development of personal disaster preparedness kits for resident's homes and vehicles).
- Increase public awareness of the All-Hazard Alert and Broadcast (AHAB) siren system and the reverse 911 community notification system (Rapid Notify).
- Maintain the number and visibility of warning signs to alert visitors and residents when entering tsunami hazard areas.
- Continue to ensure that evacuation routes and assembly areas are clearly marked in the event of emergency.
- Coordinate with coastal communities to develop additional evacuation routes.



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- Work with local health services, emergency services and American Red Cross officials to identify people with mobility impairments who live or work in tsunami vulnerable areas and develop plans for providing evacuation assistance.

**Potential Participants:** Communities of Homer, Seward, Seldovia, Port Graham and Nanwalek, Alaska Division of Homeland Security and Emergency Management, Office of Emergency Management (KPB), Local Emergency Planning Committee

**Potential Funding:** Local communities, KPB, AKDHS&EM, AKDCCED, NOAA

**Time Frame:** Ongoing

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### ***Strategy 2: Conduct mock tsunami hazard response exercises to identify response vulnerabilities.***

#### **Implementation Ideas and Action Items**

- Conduct simulated exercises to determine vulnerabilities in emergency response and facilities. This will help identify areas that need further attention, resources and training.

**Potential Participants:** Office of Emergency Management (KPB), Local Emergency Planning Committee, Tsunami Vulnerable Communities

**Potential Funding:** KPB, AKDHS&EM, AKDCCED, NOAA

**Time Frame:** Ongoing (longer term 2-4 years)

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### ***Strategy 3: Enhance tsunami-warning systems in KPB coastal communities.***

#### **Implementation Ideas and Action Items**

- Evaluate the need for additional tsunami warning systems in coastal communities across the Kenai Peninsula Borough.
- Continue to partner with the NWS to use their all-hazard warning system (weather radio) to initiate alerts and provide KPB area-specific hazard warnings.



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- Seek funding to complete tsunami run-up maps for Port Graham and Nanwalek.
- Support ongoing coordination between the incorporated cities, KPB, local utilities and state and federal agencies to promote disaster warning and preparedness planning and training.
- Add a permit liaison position to the KPB Incident Command Structure to coordinate emergency permitting with regulatory agencies during and immediately following disaster events.
- Maintain the revolving flood mitigation fund for the purpose of delivering clean water, sand bags or other critical services or supplies to communities during disaster emergencies.

**Potential Participants:** National Weather Service, Alaska Division of Homeland Security and Emergency Management, Office of Emergency Management (KPB), Local Emergency Planning Committee, Incorporated Cities within the KPB

**Potential Funding:** KPB, AKDHS&EM, NOAA, FEMA, USACE  
**Time Frame:** Ongoing (longer term 2-4 years)

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### ***Strategy 4: Minimize tsunami damage to structures in the Kenai Peninsula Borough.***

Land use planning and regulatory steps such as zoning can help limit tsunami damage by reducing or preventing certain types of “non-water-dependent” development in high-risk areas. Risks to coastal development can be minimized in many ways, including: encouraging elevation and bracing of buildings, positioning structures on the highest available ground, using the lower floors as non occupied spaces and encouraging the development of site planning regulations requiring streets and structures to be perpendicular to potential waves so there is less resistance and erosive force. Water-based facilities like ferry terminals and shipping docks should be built to withstand tsunami wave forces.

#### **Implementation Ideas and Action Items**

- Use tsunami inundation maps (when available) to assist with land use planning, zoning and permitting decisions and processes.



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- Support the development of tsunami inundation maps for all vulnerable KPB coastal communities that haven't yet been mapped.
- Encourage residents to explore building options to make property and structures more resistant to tsunami damage. Options may include such activities as elevating coastal homes, identifying ways to possibly divert water away from coastal structures and implementing sound site planning, building design and construction.
- Require written disclosure of hazard prone areas (such as coastal storm surge - FIRM V Zones, tsunami run-up zones and areas with high erosion potential) when property ownership is transferred.
- Encourage non-participating local communities to join the TsunamiReady program to help them prepare for tsunami events.
- Explore partnerships to provide retrofitting information or classes to homeowners, renters, building professionals and contractors who work or live in tsunami vulnerable locations.

**Potential Participants:** National Weather Service, Office of Emergency Management (KPB), Capital Projects Division (KPB), KPB Planning and Floodplain Programs, Local Emergency Planning Commission, Community Schools Program (KPB School District), AK State Division of Homeland Security and Emergency Management, FEMA, Local Construction Companies, Incorporated Cities within the KPB

**Potential Funding:** KPB, AKDHS&EM, NOAA, FEMA, Community improvement grants.

**Time Frame:** Ongoing

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### 6.7 Tsunami & Seiche Resource Directory

#### Local Resources

##### **Kenai Peninsula Borough Office of Emergency Management (OEM)**

KPB/OEM was established to coordinate disaster management response between the Kenai Peninsula Borough, the State of Alaska, FEMA and other municipalities, as well as other response and recovery organizations. OEM has the primary responsibility for overseeing disaster management programs and activities, including mitigation, planning, response and public education.





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**Contact:** Office of Emergency Management  
**Address:** 253 Wilson Lane, Soldotna, AK 99669  
**Phone:** (907) 262-4910  
**Website:** [www.borough.kenai.ak.us/emergency](http://www.borough.kenai.ak.us/emergency)

## State Resources

### State of Alaska, Division of Homeland Security and Emergency Management

This agency in part conducts hazard preparedness and mitigation workshops. They also coordinate the State of Alaska's All-Hazard Mitigation Plan. Their community response program works with communities during a crisis as well in recovery and planning phases.

**Contact:** AK Division of Homeland Security and Emergency Management  
**Address:** P.O. Box 5750, Fort Richardson, AK 99505-5750  
**Phone:** (907) 428-7000 OR (800) 478-2337  
**Website:** [www.ak-prepared.com](http://www.ak-prepared.com)

### Alaska Earthquake Information Center

AEIC serves as an integration center for all seismic networks within Alaska and archives and processes data from the [Alaska Tsunami Warning Center](#) in Palmer, Alaska and the [Alaska Volcano Observatory](#) in Fairbanks and Anchorage.

**Contact:** Geophysical Institute, University of Alaska Fairbanks  
**Address:** 903 Koyukuk Drive, P.O. Box 757320, Fairbanks, Alaska 99775-7320  
**Phone:** (907) 474-7320  
**Website:** [www.aeic.alaska.edu/](http://www.aeic.alaska.edu/)



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## Federal Resources

### FEMA: Mitigation Division

FEMA's Mitigation Division manages the National Flood Insurance Program and oversees a number of mitigation programs and activities, which provide protection (flood insurance), prevention and partnerships to communities throughout the country.

**Contact:** FEMA/Region X  
**Address:** 130 228<sup>th</sup> Street, SW, Bothell, WA 98021  
**Phone:** (425) 487-4600  
**Website:** <http://www.fema.gov/region-x-ak-id-or-wa>

### National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship. NOAA supports the West Coast and Alaska Tsunami Warning Center.

**Contact:** National Oceanic and Atmospheric Administration  
**Address:** 1401 Constitution Avenue, NW, Room 5128, Washington, DC 20230  
**Phone:** (202) 482-6090  
**Fax:** (202) 482-3154  
**Website:** [www.noaa.gov](http://www.noaa.gov)

### National Weather Service, Alaska Region Headquarters

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

**Contact:** National Weather Service/ Alaska Region Headquarters  
**Address:** 222 West 7<sup>th</sup> Avenue #23, Anchorage, AK 99513-7575  
**Phone:** (907) 271-5088 OR 1-800-472-0391 (Alaska Weather Line)  
**Fax:** (907) 271-3711  
**Website:** Alaska: [www.arh.noaa.gov/](http://www.arh.noaa.gov/)  
National: [www.nws.noaa.gov/](http://www.nws.noaa.gov/)

### The National Tsunami Hazard Mitigation Program

The program is designed to reduce the impacts of tsunamis through warning, mitigation and hazard assessment.

**Contact:** National Tsunami Hazard Mitigation Program  
**Address:** Box 50027, Honolulu, Hawaii 96850-4993  
**Phone:** (808) 541-1657 or 1658  
**Fax:** (808) 541-1678  
**Website:** [www.pmel.noaa.gov/tsunami-hazard/](http://www.pmel.noaa.gov/tsunami-hazard/)



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## Additional Resources

### International Tsunami Information Center (ITIC)

The ITIC is maintained by the U.S. National Oceanic and Atmospheric Administration for the Intergovernmental Oceanographic Commission to mitigate the effects of tsunamis throughout the Pacific.

**Contact:** International Tsunami Information Center  
**Address:** Box 50027, Honolulu, Hawaii 96850-4993  
**Phone:** (808) 541-1657 or 1658  
**Fax:** (808) 541-1678  
**Website:** [www.geophys.washington.edu/tsunami/general/mitigation/itic.html](http://www.geophys.washington.edu/tsunami/general/mitigation/itic.html)

### Public Assistance Debris Management Guide

Federal Emergency Management Agency (July 2000).

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris removal and disposal operations. Debris management is generally associated with post-disaster recovery. The *Public Assistance Debris Management Guide* is available in hard copy or on the FEMA website.

**Contact:** FEMA Distribution Center  
**Address:** 130 228th Street, SW, Bothell, WA 98021-9796  
**Phone:** (800) 480-2520  
**Fax:** (425) 487-4622  
**Website:** [www.fema.gov/government/grant/pa/demagde.shtml](http://www.fema.gov/government/grant/pa/demagde.shtml)

### Alaska Science Forum

The Alaska Science Forum provides information and articles as a public service of the Geophysical Institute, University of Alaska Fairbanks (UAF) in cooperation with the UAF research community.

**Contact:** Geophysical Institute  
**Address:** 903 Koyukuk Drive, University of AK, Fairbanks, AK 99775-7320  
**Website:** Geophysical Institute: [www.gi.alaska.edu/](http://www.gi.alaska.edu/) OR  
[www.gi.alaska.edu/ScienceForum/weather.html](http://www.gi.alaska.edu/ScienceForum/weather.html)

### National Weather Radio (NWR)

#### NOAA National Weather Service Weather Radio

NWR is a nationwide network of radio stations broadcasting continuous 24-hour weather information directly from a nearby National Weather Service office. NWR is an “all hazards” radio network, making it a comprehensive weather and emergency information source. NWR also broadcasts warning and post-event information for all types of hazards.

**Contact:** NOAA, National Weather Service  
Office of Climate, Water and Weather Services  
**Address:** 1325 East West Highway, Silver Spring, MD 20910  
**Website:** National: [www.nws.noaa.gov/nwr](http://www.nws.noaa.gov/nwr)

**Contact:** NOAA/NWR Anchorage Forecast Office  
**Address:** 6930 Sand Lake Road, Anchorage, AK 99502  
**Websites:** Alaska NWR Locations: [www.nws.noaa.gov/nwr/stations.php?State=AK](http://www.nws.noaa.gov/nwr/stations.php?State=AK)  
Anchorage Forecast Office: [pafo.arh.noaa.gov/](http://pafo.arh.noaa.gov/)  
**Phone:** 1-800-472-0391 (Alaska Weather Line)



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## **NWS/TsunamiReady Program**

Based on the NWS StormReady model, the TsunamiReady Program is a National Weather Service (NWS) initiative that promotes tsunami hazard preparedness to provide consistent and location specific mitigation activities for at-risk communities. This is a collaborative program that combines the efforts of federal, state and local emergency management agencies, the public, and the NWS tsunami warning system.

TsunamiReady guidelines, examples, and applications also may be found on the Internet or by contacting the West Coast and Alaska Tsunami Warning Center.

**Contact:** West Coast & Alaska Tsunami Warning Center  
**Address:** 910 S. Felton St., Palmer, AK 99645  
**Phone:** (907) 745-4212  
**Website:** [www.tsunamiready.noaa.gov/](http://www.tsunamiready.noaa.gov/)

## **American Red Cross**

The American Red Cross is a volunteer humanitarian organization that provides relief to disaster victims and helps people prevent, prepare for, and respond to emergencies.

**Contact:** American Red Cross  
**Address:** 235 E. 8<sup>th</sup> Avenue, Anchorage, AK 99501  
**Phone:** (907) 646-5401  
**Website:** [alaska.redcross.org](http://alaska.redcross.org)

## **Publications**

Oregon Department of Geology and Mineral Industries. 2001. Tsunami Warning Systems and Procedures: Guidance for Local Officials. Special Paper 35. Available at [www.preventionweb.net/english/professional/publications/v.php?id=1474](http://www.preventionweb.net/english/professional/publications/v.php?id=1474)



# VOLCANOES

## 7.0 Volcanoes<sup>1</sup>

The following hazard description is derived from the Alaska Division of Homeland Security and Emergency Management's All-Hazard Mitigation Plan (October 2007). Although the text was edited slightly to focus on volcanoes with the highest potential to impact KPB communities, most of the description is state rather than region-specific. The State Plan is available at <http://ready.alaska.gov/plans/documents/Alaska%20HMP%202013%20sm.pdf>.

The term volcano is used to describe both the vent at the Earth's surface through which magma (molten rock) and associated gases erupt, and the landform built by effusive and explosive eruptions. Alaska is home to 52 historically active volcanoes stretching across the entire southern portion of the state from the Wrangell Mountains to the far western Aleutians<sup>2</sup>. An average of one to two eruptions per year occurs in Alaska. Volcanoes display a wide variety of shapes, sizes, and behavior; however, they are commonly classified among three main types: cinder cone, composite and shield.

Volcanoes are also categorized according to the age of their eruptive activity. Active volcanoes are those that are currently erupting or showing signs of unrest, such as unusual earthquake activity or significant new gas emissions. Dormant volcanoes are those that are not currently active, but could become restless or erupt again. Extinct volcanoes are those that are considered unlikely to erupt again. This can be difficult to determine as a volcano could go tens of thousands of years, or longer, between eruptions. There are over 80 volcanic centers in Alaska but only 52 are considered active.

There are five active volcanoes within the KPB on the west side of Cook Inlet: Fourpeaked, Augustine, Iliamna, Redoubt and Mount Spurr.



Redoubt Volcano – a composite volcano - is one of the active volcanoes of the Cook Inlet region. Steam and volcanic gas rise above the summit crater of the volcano during the 2009 eruption. Photograph courtesy of G. McGimsey, USGS/Alaska Volcano Observatory.

<sup>1</sup> Alaska Division of Homeland Security and Emergency Management (ADHS&EM). 2013 State Hazard Mitigation Plan.

<sup>2</sup> Alaska Volcano Observatory, February 2014.



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## 7.1 Types of Volcanoes

### *Cinder cones*

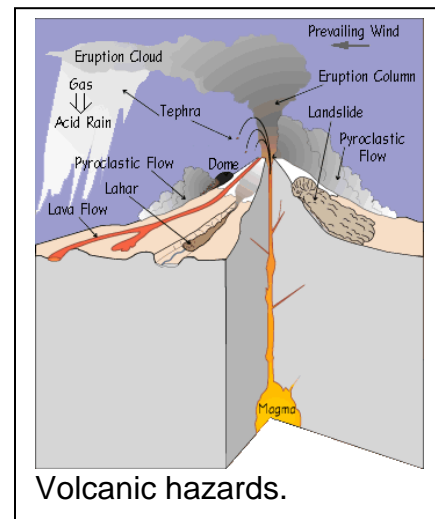
Cinder cone volcanoes are built from particles and blobs of congealed lava ejected from a single vent. As the lava is blown into the air, it breaks into small fragments that solidify and fall as cinders and bombs around the vent to form a circular or oval cone. Most cinder cones have a bowl-shaped crater or craters at the summit and are rarely more than a thousand feet above their surroundings. Cinder cones may form as flank vents on the sides of larger composite or shield volcanoes. They often occur in clusters and produce lava flows. Cinder cones are common in western North America.

### *Composite volcanoes*

Composite volcanoes, sometimes called stratovolcanoes, are typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, blocks and bombs and may rise as much as 8,000 feet above their bases.

Composite volcanoes have a principal conduit system through which magma from a reservoir deep in the earth's crust rises to the surface repeatedly to cause eruptions. The volcano is built up by the accumulation of material erupted through the conduit and increases in size as lava, ash, etc., are added to its slopes.

Stratovolcanoes tend to erupt explosively because of the silica-based nature of magmas associated with these volcanoes. Some stratovolcanoes produce enormous explosive eruptions that destroy a large part of the volcano itself, leaving a wide, roughly circular depression called a caldera. Eruptions that produce calderas are among the most explosive and largest eruptions known. Most Alaskan volcanoes are stratovolcanoes, including Fourpeaked, Redoubt, Spurr and Iliamna in the Cook Inlet Region.



Volcanic hazards.

### *Shield volcanoes*

Shield volcanoes are formed by lava flowing in all directions from a central summit vent, or group of vents, or rift zones building a broad, gently sloping cone with a dome shape. They are built up slowly by the accretion of thousands of highly fluid lava flows that spread widely over great distances, and then cool in thin layers.





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## 7.2 Volcanic Hazards

### *Lava Flows*

Lava flows are streams of molten rock that flow from a volcano. The distance traveled by a flow (typically 6-30 miles) is dependant on several variables including viscosity, volume, slope steepness and obstructions in the flow path. Lava flows cause damage by burning, crushing, or burying people and objects. The high flow temperatures may trigger wildfires or cause flooding by melting ice and snow.

### *Pyroclastic Flows*

Pyroclastic flows are high-density mixtures of hot gasses and dry rock that are usually released explosively from a volcano. The flows travel at speeds of 30 to 90 miles per hour (or greater) and the debris or associated high winds can destroy or move objects.

### *Pyroclastic Surges*

Pyroclastic surges are turbulent low-density clouds of rock debris, air, and other gases that move over the ground at speeds similar to pyroclastic flows. There are two types: hot surges consisting of dry materials over 212°F and cold surges consisting of cooler rock debris and water or steam.



A pyroclastic flow sweeping down the north flank of 1,282-m (4,206 ft) high Augustine Volcano. Image courtesy M.E. Yount, USGS.



Cleaning up ash from the 1992 Mt. Spurr eruption. Photographer Bill Roth, Anchorage Daily News (file 920917).

### *Lava Domes*

Volcanic or lava domes are formed when viscous lava erupts slowly from a vent. This causes it to solidify near the vent forming the dome instead of flowing away from the vent. A dome grows largely by expansion from within. As it grows its outer surface cools and hardens, then shatters, spilling loose fragments down its sides. Volcanic domes commonly occur within the craters or on the flanks of large composite volcanoes.

### *Volcanic Ash and Bombs*

Volcanic ash, also called tephra, consists of fine fragments of solidified lava ejected into the air by an explosion or rising hot air. The fragments range in size, with the larger falling nearer the source. Ash is a problem near the source



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because of its high temperatures (may cause fires), burial (the weight can cause structural collapses), and impact of falling fragments. Further away from the source the primary hazard to humans is decreased visibility and lowered air quality. Ash also interferes with mechanical equipment operation.

## *Volcanic Gases*

Volcanic gases consist mostly of steam, carbon dioxide, sulfur dioxide, hydrogen sulfide and chlorine compounds, but may include other substances. The gases can damage eyes, respiratory systems and cause suffocation in high concentration (usually near the vent). They can also be very corrosive.

## *Lateral Blasts*

Lateral blasts are inflated mixtures of gases, ash and hot rock debris. They may be hundreds of feet thick and travel at speeds up to 370 miles per hour. They cause damage through abrasion, impact, burial, and heat. They may also trigger pyroclastic flows or surges.

## *Debris Avalanches*

A debris avalanche is a sudden downward movement of unconsolidated material (mostly rock and soil). They occur without warning and travel quickly. Debris avalanches can extend over 300 square miles causing damage from impact or burial.

## *Debris Flows*

Debris flows, also known as lahars, are rapidly flowing mixtures of rock debris and water that originate on the slopes of a volcano. They form in a variety of ways including the rapid melting of snow and ice by pyroclastic flows, the intense rainfall on loose volcanic rock deposits, the breakout of a lake dammed by volcanic deposits, or as a consequence of debris avalanches. They generally have the consistency of wet cement and have the ability to destroy or bury anything in their path.



Lahars from the 1989 to 1990 eruptions of Redoubt Volcano inundated this structure near the mouth of Drift River. Photograph courtesy of C. Gardner, USGS.

## **7.3 Historic Volcanic Activity**

The largest volcanic eruption of the 20<sup>th</sup> century occurred at Novarupta Volcano in June 1912. It started by generating an ash cloud that grew to become thousands of miles wide during the three-day event. Within four hours of the eruption, ash started falling on Kodiak, darkening the city. It became hard to breathe because of the ash and sulfur dioxide gas. The water became



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undrinkable and unable to support aquatic life. Roofs collapsed under the weight of the ash. Some buildings were destroyed by ash avalanches while others burned after being struck by lightning from the ash cloud. Similar conditions could be found all over the area. Some villages ended up being abandoned, including Katmai and Savonoski villages. The ash and acid rain also negatively affected animal and plant life. Large animals were blinded and many starved because their food was eliminated.

The ash fall from this eruption was significantly greater than the recent eruptions of Fourpeaked, Redoubt, Spurr and Augustine Volcanoes. Fourteen earthquakes of magnitude 6 to 7 were associated with this event. At least ten Alaskan volcanoes are capable of this type of event.

A more recent eruption occurred on Augustine Volcano in 2006. An ash plume disrupted air traffic and deposited ash in Homer, Nanwalek, Port Graham, Seldovia, Iliamna and Kodiak. A dome formed in the crater, and caused some to fear it would subsequently collapse and trigger a tsunami along the east shore of Cook Inlet, as happened in 1883.

Redoubt Volcano erupted in 1989-1990 and again in 2009. Both events resulted in debris flows. This caused the temporary closing of the Drift River Oil Terminal in 1989/90, and more extensive closures of the terminal and associated Cook Inlet platforms in 2009. In 1990, a KLM 747 jet aircraft, Flight 867, temporarily lost power in all four engines when it entered the volcanic ash plume. It would have crashed into the mountains had they not been able to restart their engines about 4,000 feet (1,219 meters) above ground.

## 7.4 Volcano Risk Assessment

The responsibility for hazard identification and assessment for the active volcanic centers of Alaska falls to the Alaska Volcano Observatory (AVO) and its constituent organizations (USGS, DNR/DGGS, and UAF/GI). AVO is in the process of publishing individual hazard assessments for each active volcano in the State. As of January 2010, published or in-press hazard assessments cover the following volcanoes: Hayes, Spurr, Okmok, Great Sitkin, Kanaga, Redoubt, Iliamna, Augustine, the Katmai Group, Aniakchak, Shishaldin, Akutan, and Makushin<sup>1</sup>. Each report contains a description of the eruptive history of the volcano, the hazards they pose and the likely effects of future eruptions on populations, facilities and ecosystems.

AVO has the primary responsibility to monitor all of Alaska's potentially active volcanoes and to issue timely warnings of activity to authorities and the public. During episodes of volcanic unrest or eruption, AVO is also the agency responsible for characterizing the immediate hazards and describing likely

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<sup>1</sup> Alaska Volcano Observatory 2010



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scenarios for an evolving volcanic crisis. AVO uses a four-color Level of Concern Color Code to succinctly portray its interpretations of the state of activity and likely course of unrest at a given volcano.

Basic information about vulnerable assets and populations are identified in these assessments. However, DCCED and other state agencies could work with AVO map data to integrate quantitative, current information regarding communities and other at-risk elements to improve our analysis of vulnerability. The NWS participates in producing weather models to assist in producing ash travel and possible fall at various elevations. NWS is able to provide this information in approximately six-hour increments, greatly enhancing ability to notify the public and to minimize impact on community health.

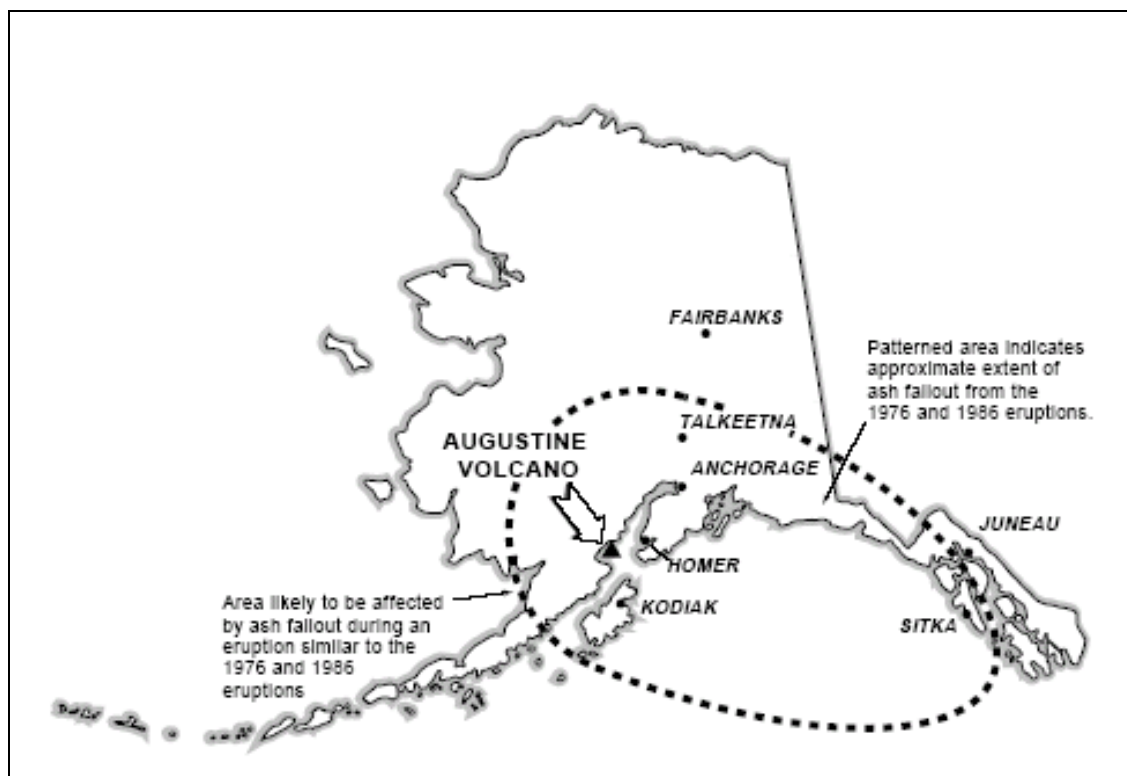
One of the most vulnerable sectors is the aviation industry, which is at risk from the effects of airborne volcanic ash. The significant trans-Pacific and intrastate air traffic in Alaska, directly over or near 52 potentially active volcanoes, has necessitated development of a strong communication and warning link between AVO, other government agencies with responsibility in aviation management, and the airline and air cargo industry.

The following maps depict approximate extent of ash fallout for eruptions of four of the five volcanoes within the KPB. These maps are from four U.S. Geological Survey Open-File reports:

- Waythomas, C.F., J.M. Dorava, T.P. Miller, C.A. Neal and R.G. McGimsey. 1998. Preliminary Volcano-Hazard Assessment for Redoubt Volcano, Alaska. U.S. Geological Survey, Open File Report 97-857 [[www.avo.alaska.edu/pdfs/redoubt.hazards.ofr.pdf](http://www.avo.alaska.edu/pdfs/redoubt.hazards.ofr.pdf)].
- Waythomas, C.F. and R.B. Waitt. 1998. Preliminary Volcano-Hazard Assessment for Augustine Volcano, Alaska. U.S. Geological Survey, Open File Report 98-106 [[www.avo.alaska.edu/pdfs/augustine\\_ofr.pdf](http://www.avo.alaska.edu/pdfs/augustine_ofr.pdf)].
- Waythomas, C.F. and T.P. Miller. 1999. Preliminary Volcano-Hazard Assessment for Iliamna Volcano, Alaska. U.S. Geological Survey, Open File Report 99-373 [[www.avo.alaska.edu/pdfs/Iliamna.Haz.OFR.99.373.pdf](http://www.avo.alaska.edu/pdfs/Iliamna.Haz.OFR.99.373.pdf)].
- Waythomas, C.F. and C.J. Nye. 2002. Preliminary Volcano-Hazard Assessment for Mount Spurr Volcano, Alaska. U.S. Geological Survey, Open File Report 01-482 [[www.avo.alaska.edu/pdfs/of01-482.pdf](http://www.avo.alaska.edu/pdfs/of01-482.pdf)].



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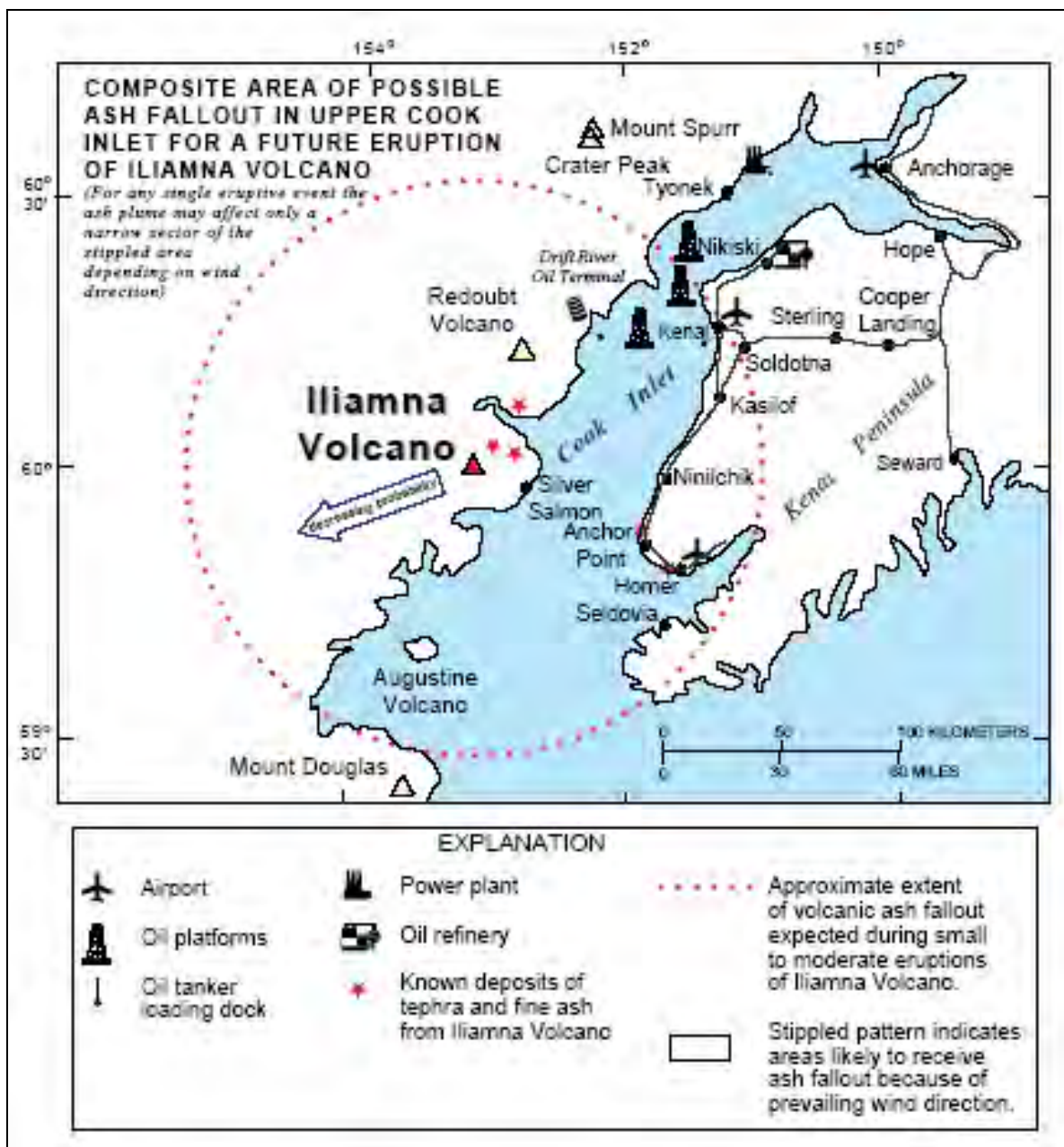
**Figure 7-1.** Area likely to be affected by ash fallout during a typical eruption of Augustine Volcano. Specific area of ash fallout depends on wind direction<sup>1</sup>.

<sup>1</sup> Waythomas, C.F. and R.B. Waitt. 1998. Preliminary Volcano-Hazard Assessment For Augustine Volcano, Alaska. U.S. Geological Survey, Open File Report 98-106 [[http://www.avo.alaska.edu/pdfs/augustine\\_ofr.pdf](http://www.avo.alaska.edu/pdfs/augustine_ofr.pdf)].





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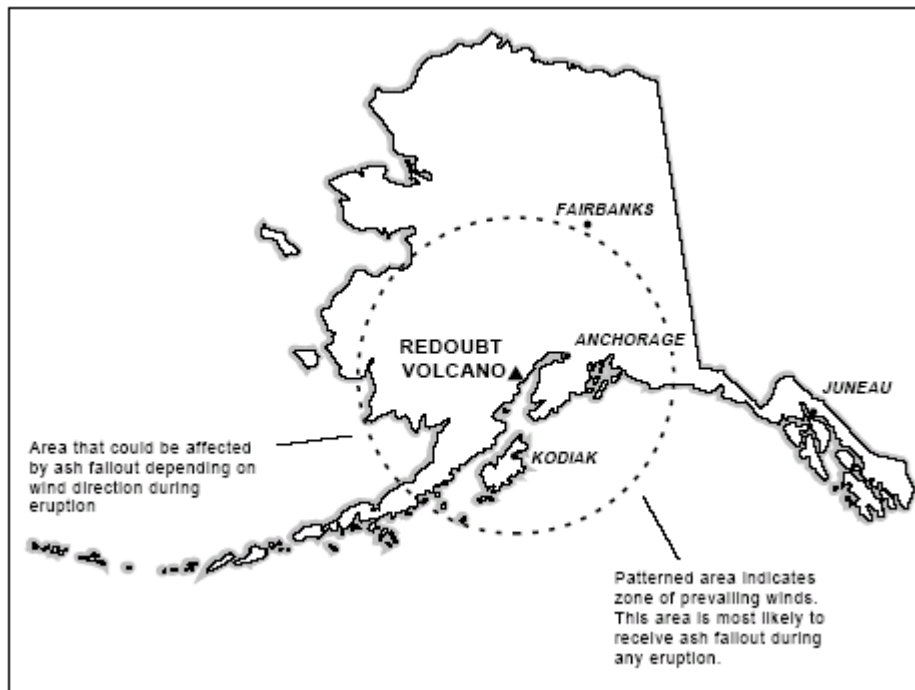
**Figure 7-2.** Approximate extent of volcanic ash fallout for small to moderate eruptions of Iliamna Volcano<sup>1</sup>.

<sup>1</sup> Waythomas, C.F. and T.P. Miller. 1999. Preliminary Volcano-Hazard Assessment For Iliamna Volcano, Alaska. U.S. Geological Survey, Open File Report 99-373 [[www.avo.alaska.edu/pdfs/Iliamna.Haz.OFR.99.373.pdf](http://www.avo.alaska.edu/pdfs/Iliamna.Haz.OFR.99.373.pdf)].

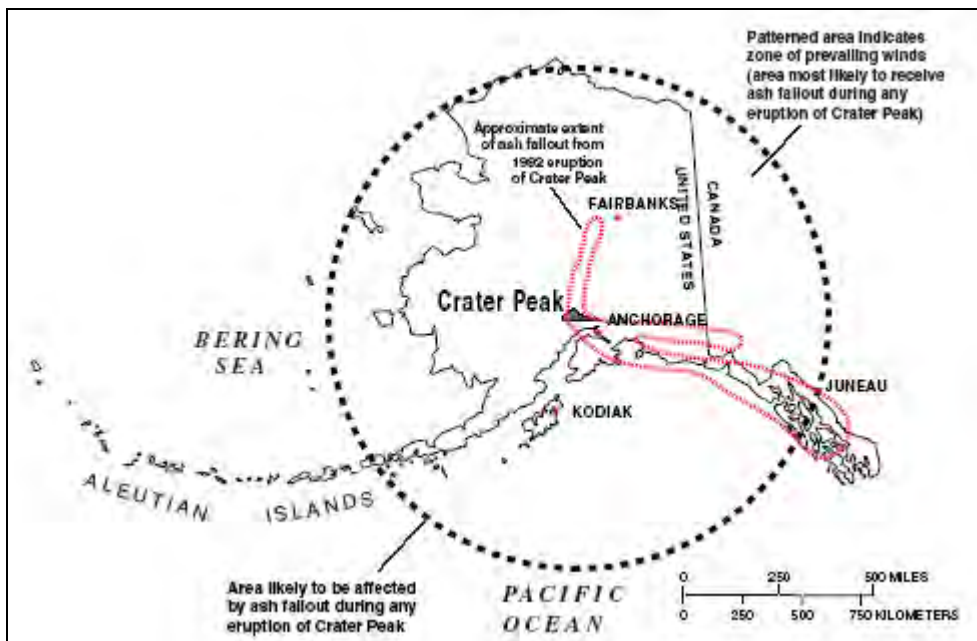




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**Figure 7-3.** Area likely to be affected by volcanic ash fallout from eruptions similar to 1989-90 eruption of Redoubt Volcano<sup>1</sup>.



**Figure 7-4.** Areas most likely to receive ash fallout from future eruption of Crater Peak [a vent associated with Mount Spurr Volcano], given prevailing winds<sup>1</sup>.

<sup>1</sup> Waythomas, C.F., J.M. Dorava, T.P. Miller, C.A. Neal and R.G. McGimsey. 1998. Preliminary Volcano-Hazard Assessment for Redoubt Volcano, Alaska. U.S. Geological Survey, Open File Report 97-857 [[www.avo.alaska.edu/pdfs/redoubt.hazards.ofr.pdf](http://www.avo.alaska.edu/pdfs/redoubt.hazards.ofr.pdf)].



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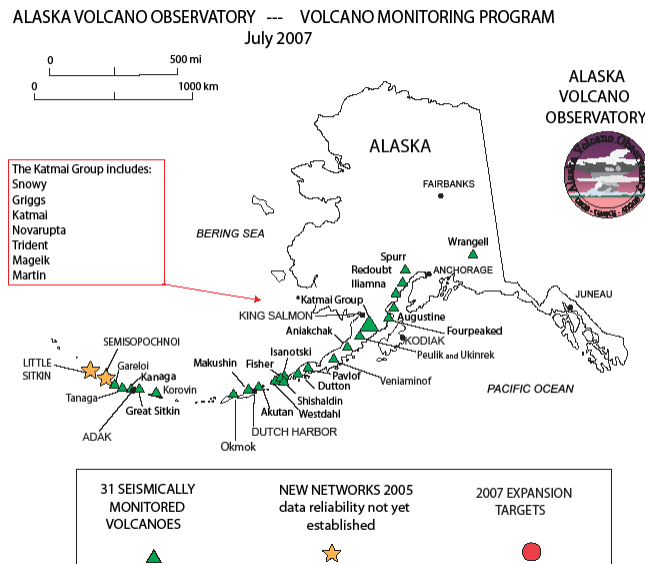
## 7.5 Existing Programs

### *Alaska Volcano Observatory<sup>2</sup>*

The Alaska Volcano Observatory, a joint program of USGS, DNR/DGGS, and UAF/GI, is the State's principal agency with responsibility to assess, monitor, and issue early warning of volcanic activity and hazards in Alaska. AVO was formed in 1988, and uses federal, state and university resources to monitor and study Alaska's hazardous volcanoes, to predict and record eruptive activity, and to mitigate volcanic hazards to life and property.

As of February 2010, AVO maintains seismic monitoring networks on 27 of Alaska's 52 active volcanoes. Data from these networks are recorded 24 hours a day and examined for precursory signs of eruptive activity. Several times a day, AVO also examines satellite images of Alaskan, Kamchatkan and northern Kuril volcanoes for signs of eruptive activity or possible precursory heating of the ground. These two primary data streams are used routinely to assess the likelihood and character of volcanic activity. Additional monitoring methods such as space-based satellite radar interferometry, are under development.

AVO regularly disseminates information about the status of volcanoes in Alaska and neighboring Kamchatka. Each week, AVO distributes a written status report to federal, state and local agencies, the media and the public. Volcanic crises, or if precursors to eruptive activity are noted, AVO follows a rigid emergency call-down protocol, as well as using Internet and fax outlets to notify authorities, the media, the aviation industry, and the public.



<sup>1</sup> Waythomas, C.F. and C.J. Nye. 2002. Preliminary Volcano-Hazard Assessment for Mount Spurr Volcano, Alaska. U.S. Geological Survey, Open File Report 01-482 [[www.avo.alaska.edu/pdfs/of01-482.pdf](http://www.avo.alaska.edu/pdfs/of01-482.pdf)].

<sup>2</sup> Alaska Volcano Observatory website [[www.avo.alaska.edu](http://www.avo.alaska.edu)].



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## 7.6 Hazard Mitigation Successes

### Alaska Volcano Observatory

Since its formation 1988, AVO scientists have responded to numerous volcanic crises in Alaska, providing early warning for such explosive eruptive events at Redoubt (1989-90/2009) and Mt. Spurr (1992) and Augustine (2006). Advanced warning of eruptions and accurate analysis of data from seismic monitoring networks and satellite platforms prevents needless evacuations and economic impacts to the aviation industry. AVO staff works closely with Russian colleagues in Kamchatka to monitor, track and disseminate warnings of eruptions and ash clouds from volcanoes in the Russian Far East that may threaten Alaskan air space.

### Interagency Plan for Volcanic Ash Episodes

In December 1989, a KLM flight 867 that encountered an ash cloud from Redoubt Volcano highlighted a serious weakness in the aviation and volcanic ash warning system. Following this incident, a consortia of federal, state and private sector parties worked to develop an improved early warning system and ash avoidance protocols for the heavily traveled North Pacific airways. In Alaska, this effort resulted in the growth and increased capacity of the AVO and formal adoption of a Alaska Interagency Plan for Volcanic Ash Episodes (signatories include USGS, NOAA/NWS, Federal Aviation Administration (FAA), Department of Defense (DOD) /United States Air Force (USAF), and DHS&EM. An updated plan was adopted in April 2004, with the United State Coast Guard and the Alaska Volcano Observatory as additional participants. The plan documents specific responsibilities and protocols for each agency before, during, and after a volcanic event. Since the 1989 KLM ash encounter, no serious ash-aircraft incidents have been reported in Alaska, despite dozens of additional eruptions. This multi-agency early warning and response program is a model endorsed by the International Civil Aviation Organization and emulated in many volcanically active regions around the world.

## 7.7 Volcano Mitigation Goals

Below are hazard mitigation goals and objectives taken from the State of Alaska October 2013 All-Hazard Mitigation Plan<sup>1</sup>. KPB-specific volcano mitigation goals will be developed in the next KPB All-Hazard Mitigation Plan update.

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### **Goal 1: Public Education**

Mitigation Measures: Educational

Priority: Medium

**Objective: 1.1** Conduct specific outreach to the Alaskan aviation community regarding the hazards posed by volcanoes.

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<sup>1</sup> Alaska Division of Homeland Security and Emergency Management (ADHSEM). 2007 State Hazard Mitigation Plan.



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Lead Agency: AVO  
Support Agencies: DHS&EM, FAA, NWS, Alaska Air Carriers Association  
Time Frame: Ongoing

**Action 1.1.1:** Revise the fact sheet on Volcano Hazards and Aviation Safety.

Lead Agency: AVO  
Support Agencies: DHS&EM, FAA, NWS, Alaska Air Carriers Association

**Action 1.1.2:** Develop a fact sheet about mitigating the risk to aviation from Kamchatkan volcanoes.

Lead Agency: AVO  
Support Agencies: DHS&EM, FAA, NWS, Alaska Air Carriers Association

**Objective 1.2:** Ensure all Alaskan communities at risk from volcanic eruptions are aware of the hazard and what can be done to mitigate risk.

Lead Agency: DHS&EM, AVO  
Support Agencies: USGS, DNR/DGGS, UAF/GI, ARC, DEC, Alaska Public Lands Information Center, local jurisdictions, Native corporations  
Time Frame: Ongoing

**Action 1.2.1:** Distribute free USGS literature on volcano hazards.

Lead Agency: AVO  
Support Agencies: USGS  
Time Frame: Ongoing

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## **Goal 2: Increase planning for volcanic hazards**

Mitigation Measures: Educational; Preventative

Priority: Medium

**Objective 2.1:** Ensure volcanic hazards are addressed in the ongoing revision of the State Emergency Response Plan.

Lead Agency: DHS&EM  
Support Agencies: AVO, USGS, DNR/DGGS, UAF/GI  
Time Frame: Ongoing

**Action 2.1.1:** Revise State ERP<sup>1</sup> - this action completed in 2011

Lead Agency: DHS&EM  
Support Agencies: All Agencies

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<sup>1</sup>

<http://ready.alaska.gov/plans/documents/2013%20Updated%20FINAL%20State%20of%20Alaska%20Emergency%20Operations%20Plan%20January%202011.docx>



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## **Goal 3: Improve monitoring**

Mitigation Measures: Educational; Preventative

Priority: Medium

**Objective 3.1:** Expand real time seismic monitoring to high-priority western Aleutian volcanoes.

Lead Agency: AVO  
Support Agencies: USFWS, DOD  
Time Frame: Ongoing (in progress)

**Action 3.1.1:** Install monitoring equipment on selected volcanoes

**Lead:** AVO

**Timeline:** Ongoing

## **7.8 Volcano Resource Directory**

### **Alaska Department of Environmental Conservation, Division of Air Quality**

The Division of Air Quality, Air Monitoring & Quality Assurance Program operates and oversees air quality monitoring networks throughout Alaska.

**Contact:** Division of Air Quality, Alaska Dept. of Environmental Quality  
**Address:** 619 E. Ship Creek, Ste. 249, Anchorage, AK 99501  
**Phone:** (907) 269-6249  
**Website:** [www.dec.state.ak.us/air/am/aq\\_sr.htm](http://www.dec.state.ak.us/air/am/aq_sr.htm)

### **Alaska Volcano Observatory**

The Alaska Volcano Observatory (AVO) is a joint program of the United States Geological Survey (USGS), the Geophysical Institute of the University of Alaska Fairbanks (UAFGI), and the State of Alaska Division of Geological and Geophysical Surveys (ADGGS).

**Contact:** Alaska Volcano Observatory  
**Address:** 4200 University Drive, Anchorage, AK 99508  
**Phone:** (907) 786-7497  
**Email:** [avo\\_sci@usgs.gov](mailto:avo_sci@usgs.gov)  
**Website:** [www.avo.alaska.edu](http://www.avo.alaska.edu)

### **American Red Cross**

The American Red Cross is a volunteer humanitarian organization, which provides relief to disaster victims and helps people prevent, prepare for, and respond to emergencies.

**Contact:** American Red Cross  
**Address:** 235 E. 8<sup>th</sup> Avenue, Anchorage, AK 99501  
**Phone:** (907) 646-5401  
**Website:** [alaska.redcross.org](http://alaska.redcross.org)



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## **National Weather Service, Alaska Region Headquarters**

The National Weather Service provides information on wind and weather patterns and ashfall predictions in the event of an eruption.

**Contact:** Alaska Region Headquarters  
**Address:** 222 West 7th Ave, #23, Anchorage, AK 99513-7575  
**Phone:** 907-271-5088  
**Fax:** 907-271-3711  
**Website:** [pafc.arh.noaa.gov/volcano.php](http://pafc.arh.noaa.gov/volcano.php)

## **National Weather Service, Anchorage Center Weather Service Unit**

The Anchorage CWSU supports Air Traffic Managers at the Anchorage Center through verbal briefings and written warnings. Center Weather Advisories (CWA) are short-term warnings, valid for zero to 2 hours, of hazardous weather conditions provided to all aviation interests including private pilots, towers, flight service stations, and commercial airlines.

**Contact:** CenterWeather Service Unit  
**Address:** 700 North Boniface Parkway, Anchorage, AK 99506  
**Phone:** 907- 338-1010  
**Fax:** 907- 338-1510  
**Website:** [cwsu.arh.noaa.gov](http://cwsu.arh.noaa.gov)

## **NOAA Air Resource Laboratory**

The National Oceanic and Atmospheric Administration Air Resource Laboratory provides ashfall trajectory forecasts for several Alaska volcanoes.

**Contact:** NOAA Air Resource Laboratory  
**Address:** Silver Spring Metro Center #3, Rm. 3316, 1315 East West Highway,  
Silver Spring, Maryland 20910  
**Phone:** (301) 713-0295  
**Website:** [ready.arl.noaa.gov/READY\\_traj\\_alaska.php](http://ready.arl.noaa.gov/READY_traj_alaska.php)





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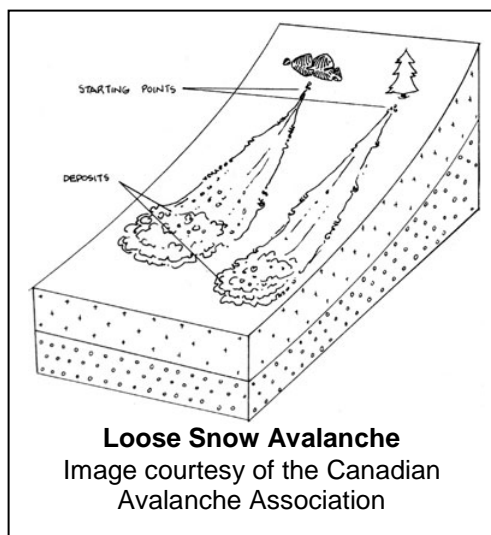
## 8.0 Snow Avalanches

The following hazard description is derived from the Alaska Division of Homeland Security and Emergency Management's All-Hazard Mitigation Plan (October 2007), although the text was edited slightly to focus on avalanche potential to impact KPB communities. The 2013 State Plan is available at <http://ready.alaska.gov/plans/documents/Alaska%20HMP%202013%20sm.pdf>.

Many snow avalanches occur in Alaska every year. The exact number is undeterminable, as most occur in isolated areas and are unreported. Avalanches tend to occur repeatedly in localized areas and can shear off trees, cover communities and transportation routes, destroy buildings and cause death. Alaska leads the nation in avalanche accidents per capita.

Avalanches cause two primary hazards: road blocks and death or significant injury. Fatalities are the best-documented impact related to avalanches and are significant simply because of the nature of the hazard. Furthermore, there are costs associated with search and rescue efforts and removal of the injured or deceased.

Road blocks are another major concern where roads intersect an avalanche path. The major costs associated with road blocks are snow removal and traffic diversion, which both necessitate personnel and equipment. Another less frequent issue is the costs associated with rescuing motorists if they were involved in the avalanche. Because the Kenai Peninsula is connected to Anchorage and the rest of the state by a single highway and rail line, avalanches blocking either can effectively isolate the Peninsula



### 8.1 Hazard Analysis/Characterization

A snow avalanche is a swift, downhill-moving snow mass. Damage extent is related to avalanche type, composition and consistency of the material in the avalanche, the volume of snow and debris involved, force and velocity of the flow, and the avalanche path.

#### 8.1.1. Avalanche Types

There are two main types of snow avalanches: loose snow and slab. Other types that occur in Alaska include cornice collapse, ice and slush avalanches.



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## Loose snow avalanches

Loose snow avalanches, sometimes called point releases, generally occur when a small amount of non-cohesive snow slips and causes more non-cohesive snow to go downhill. They occur frequently as small local cold dry 'sloughs' which remove excess snow (involving just the upper layers of snow) keeping the upper slopes relatively safe. However they can also be large and destructive. For example, wet loose snow avalanches occur in the spring and are very damaging. Loose snow avalanches can also trigger slab avalanches.

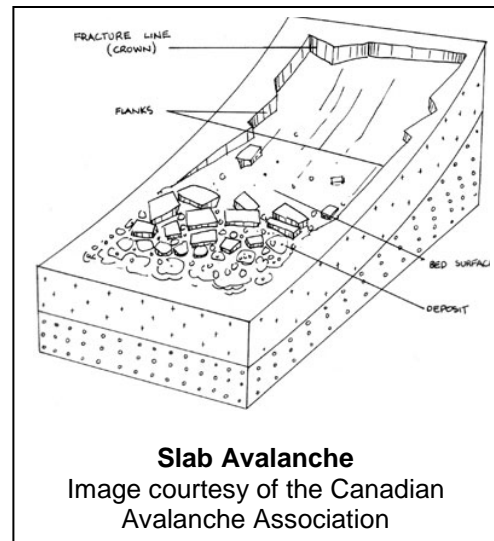
Loose snow avalanches typically occur on slopes greater than 35 degrees, leaving behind an inverted V-shaped scar. They are often caused by snow overloading (common during or just after a snowstorm), vibration or warming (triggered by rain, rising temperatures or solar radiation).

## Slab Avalanches

Slab avalanches are the most dangerous types of avalanches. They happen when a mass of snow breaks away from and travels down the mountainside. As it moves, the slab breaks up into smaller cohesive blocks.

Slab avalanches usually require structural weaknesses within interfacing layers of the snowpack. The weakness exists when a relatively strong, cohesive snow layer overlies weaker snow or is not well bonded to the underlying layer. The weaknesses are caused by changes in the thickness and type of snow covers due to changes in temperature or multiple snowfalls. The interface fails for several reasons. It can fail naturally by earthquakes, blizzards, temperature changes or other seismic and climatic causes, or artificially by human activity. Slab releases accelerate, gaining speed and mass as they travel downhill.

The slab margin is defined by fractures. The uppermost fracture delineating the top line of the slab is termed the "crown surface", the area above that is called the crown. The slab sides are called the flanks. The lower fracture indicating the base of the slab is called the "stauchwall". The surface the slab slides over is called the "bed surface". Slabs can range in thickness from less than an inch to 35 feet or greater.





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## **Cornice Collapse**

A cornice is an overhanging snow mass formed by wind blowing snow over a ridge crest or the sides of a gulley. The cornice can break off and trigger bigger snow avalanches when it hits the wind-loaded snow pillow.

## **Ice Fall Avalanche**

Ice fall avalanches result from the sudden falling of broken glacier ice down a steep slope. They can be unpredictable as it is hard to know when ice falls are imminent. Despite what some people think, they are unrelated to temperature, time of day or other typical avalanche factors.

## **Slush Avalanches**

Slush avalanches occur mostly in high latitudes such as in the Brooks Range of Alaska. They have also occurred in the mountain areas of the Seward Peninsula and occasionally in the Talkeetna Mountains near Anchorage. They are more common in high latitudes because of rapid snowmelt in the spring. Slush avalanches can start on slopes from 5 to 40 degrees but usually not on slopes greater than 25 to 30 degrees. The snowpack is totally or partially water saturated. The release bed surface is nearly impermeable to water. It is also commonly associated with heavy rainfall or sudden intense snowmelt. Additionally, depth hoar is usually present at the base of the snow cover. Slush avalanches can travel slowly or reach speeds over 40 miles per hour. Their depth is variable as well, ranging from one foot to over 50 feet deep.

### **8.1.2. Avalanche Terrain Factors**

There are several factors that influence avalanche conditions, with the main ones being slope angle, slope aspect and terrain roughness. Other factors include slope shape, vegetation cover, elevation, and path history. Avalanches usually occur on slopes greater than 25 degrees. There usually is not enough stress on the snowpack to get it to slide when the slope angle is less than 25 degrees. The snow tends to slough off and does not have the opportunity to accumulate when greater than 60 degrees. Avalanches can occur outside this slope angle range, but are not as common.

Slope aspect, also termed orientation, describes the direction a slope faces with respect to the wind and sun. Leeward slopes loaded by wind-transported snow are problematic because the wind-deposited snow increases the stress and enhances slab formation. Intense direct sunlight, primarily during the spring months, can weaken and lubricate the bonds between the snow grains, weakening the snowpack. Shaded slopes are potentially more unstable because the weak layers are held for a longer time in an unstable state.

Terrain and vegetation influence snow avalanches because trees, rocks, and general roughness act as anchors, holding snow in place. However, once an anchor is buried by snow, it loses its effectiveness. Anchors make avalanches less likely but do not prevent them unless the anchors are so close together that a person could not travel between them.



# AVALANCHES

## Avalanche Path

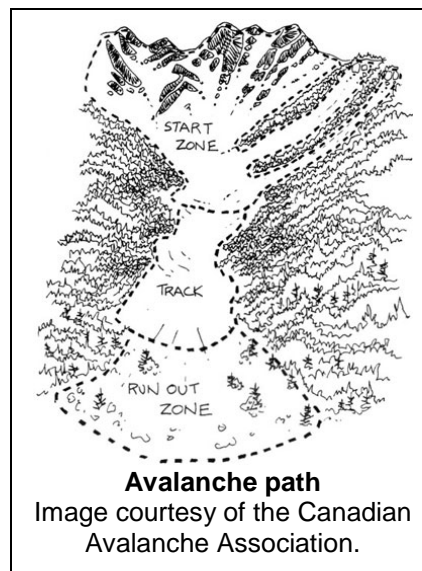
The local terrain features determine an avalanche's path. The path has three parts: the starting zone, the track and the run-out zone.

The starting zone is where the snow breaks loose and starts sliding. It is generally near the top of a canyon, bowl, ridge, etc., with steep slopes between 25 and 50 degrees. Snowfall is usually significant in this area.

The track is the path taken or created by an avalanche. The track has milder slopes, between 15 and 30 degrees, but this is where the snow avalanche will reach maximum velocity and mass. Tracks can branch, creating successive runs that increase the threat, especially when multiple releases share a run-out zone.

The run-out zone is a flatter area (around 5 to 15 degrees) at the path base where the avalanche slows down, resulting in snow and debris deposition.

The impact pressure determines the amount of damage caused by a snow avalanche. The impact pressure is related to the density, volume (mass) and velocity of the avalanche.



## 8.2 Historical Avalanche Events

Alaska has a long history of snow avalanches. It has been estimated that there have been over 4,500 avalanche disaster events in the past 200 years. The Palm Sunday avalanche of April 3, 1898, is considered to be the deadliest event of the Klondike gold rush. Multiple slides occurred that day along the Chilkoot Trail near Skagway, including three with multiple fatalities. The first fatal slide killed three people. The second one killed the entire Chilkoot Railroad and Transportation Company crew who were trying to evacuate an avalanche-prone area further up the trail. The third slide occurred in about the same location as the second, killing approximately 70 people who were following the trail left by the construction crew. The exact death toll is unknown because of the transient nature of those involved and inefficiencies in the identification process.

In late 1999 and early 2000, avalanches occurred in Cordova, Valdez, Anchorage, Whittier, Cooper Landing, Moose Pass, Summit, Matanuska Susitna Valley, and Eklutna from the Central Gulf Coast Storm. The most damaging avalanche occurred in Cordova, near milepost 5.5 of the Copper River Highway, and was approximately ½ mile wide. It resulted in one death, at least ten damaged structures and about one million dollars in damage. Avalanches had struck in that spot before, including one in 1971.



# AVALANCHES

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Snow avalanches can occur in many area of the State. All major highways, railroads, and several towns face an avalanche danger. The following map shows the areas that face a snow avalanche threat.

## 8.3 Avalanche Hazard Areas on the Kenai Peninsula

Avalanches that can affect infrastructure are a hazard primarily in the East Zone of the Kenai Peninsula Borough. Although the Central and South Zones also have terrain where avalanches are possible, these slopes are generally away from roads and developed areas. One exception is the Sterling Highway near Cooper Landing.

Between March of 1999 and February of 2014, 14 people were killed in avalanches on the Kenai Peninsula, most commonly in the area around Turnagain Pass. Most were engaged in off-road recreation, but one was a railroad worker, working to clear the Seward Highway from an earlier avalanche, whose D6 Caterpillar was swept 400 feet off the road by a second avalanche.

Areas of high avalanche hazard along major roadways<sup>1</sup> include:

Mile 18 – 23 Seward Highway (Crown Point)

Mile 61 – 67 Seward Highway (Turnagain Pass)

Mile 28 – 39 Seward Highway (Moose Pass to just north of Tern Lake)

Mile 38 – 39 Sterling Highway (just west of Tern Lake)

Mile 1 – 4 Hope Highway

Mile 9 – 15 Hope Highway

Several areas of the Alaska Railroad tracks also run through avalanche terrain and are frequently impacted.

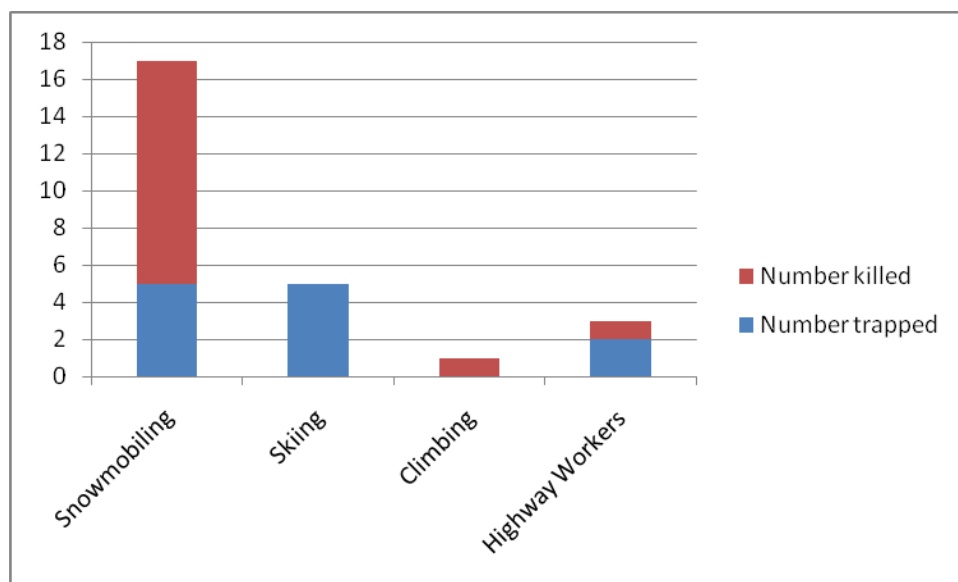
Although the eastern Kenai Peninsula is the most avalanche-prone, other areas have avalanche terrain as well. In December 2001, an avalanche in the Kenai National Wildlife Refuge near Skilak Glacier, approximately 30 miles south of Skilak Lake, killed at least 143 caribou. Although there is little infrastructure in the south-central part of the peninsula, the area is extremely popular for outdoor recreation, particularly snowmobiling.

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<sup>1</sup> Kenai Peninsula Borough Coastal Management Plan 2008



# AVALANCHES



**Figure 8-1.** Number of People Killed and/or Trapped in Avalanches on the Kenai Peninsula Since 1999<sup>1</sup>

### **8.3.1. Significant Recent Avalanches on the Kenai Peninsula**

A prolonged winter storm in late January and early February 2000 resulted in a series of avalanches that cut off the Kenai Peninsula for five days. On February 1, a snow slide killed a highway worker and the state closed mountainous areas of the Seward and Sterling Highway. Significant avalanches blocked the Seward Highway at Mile 23 and Mile 44. Power lines were damaged, resulting in the communities of Hope and Sunrise being without power, and the city of Seward operating on generator power, for several days. Hope, Sunrise, Moose Pass, Crown Point and Seward were cut off from road, rail and air access, and faced shortages of groceries and other supplies.

On February 9<sup>th</sup>, 2006, three avalanches closed the Seward Highway at Mile 21, Mile 33 and Mile 84. The road was reopened Feb. 10. The avalanche at Mile 21 trapped a car with two occupants (both were rescued) and buried the road under 18 feet of snow. On the same day, an avalanche near Hope cut off the town's power supply. The City of Seward was also cut off from its regular power supply and forced to operate on generator power. On February 11, another avalanche destroyed 2000 feet of power transmission and distribution line serving Seward and surrounding areas. The City of Seward estimated costs from the event at \$1.06 million<sup>2</sup>.

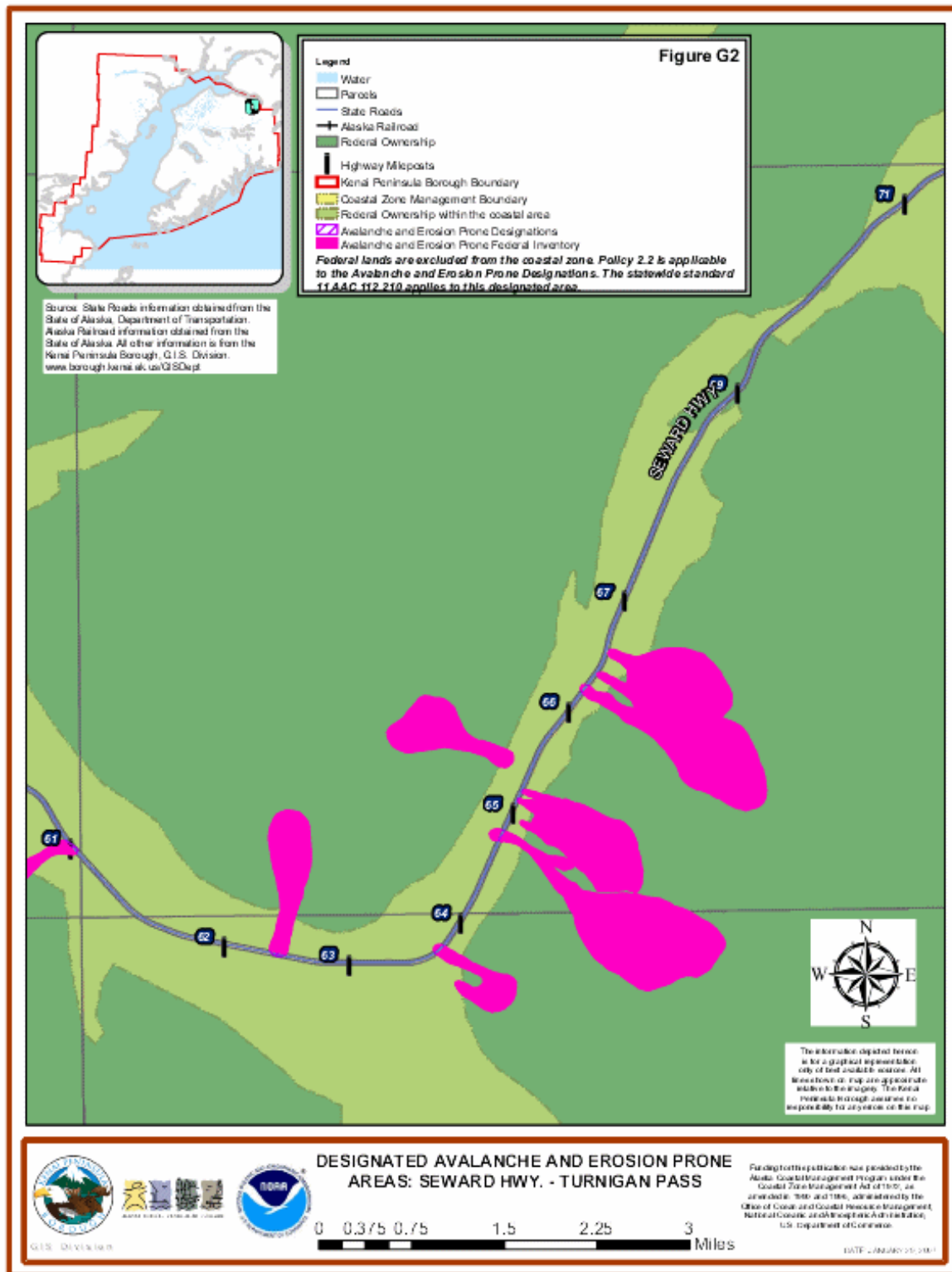
<sup>1</sup> Chugach National Forest Avalanche Information Center, 2010.

<sup>2</sup> City of Seward, Declaration of Local Emergency Disaster Addendum Two, 3/6/2006





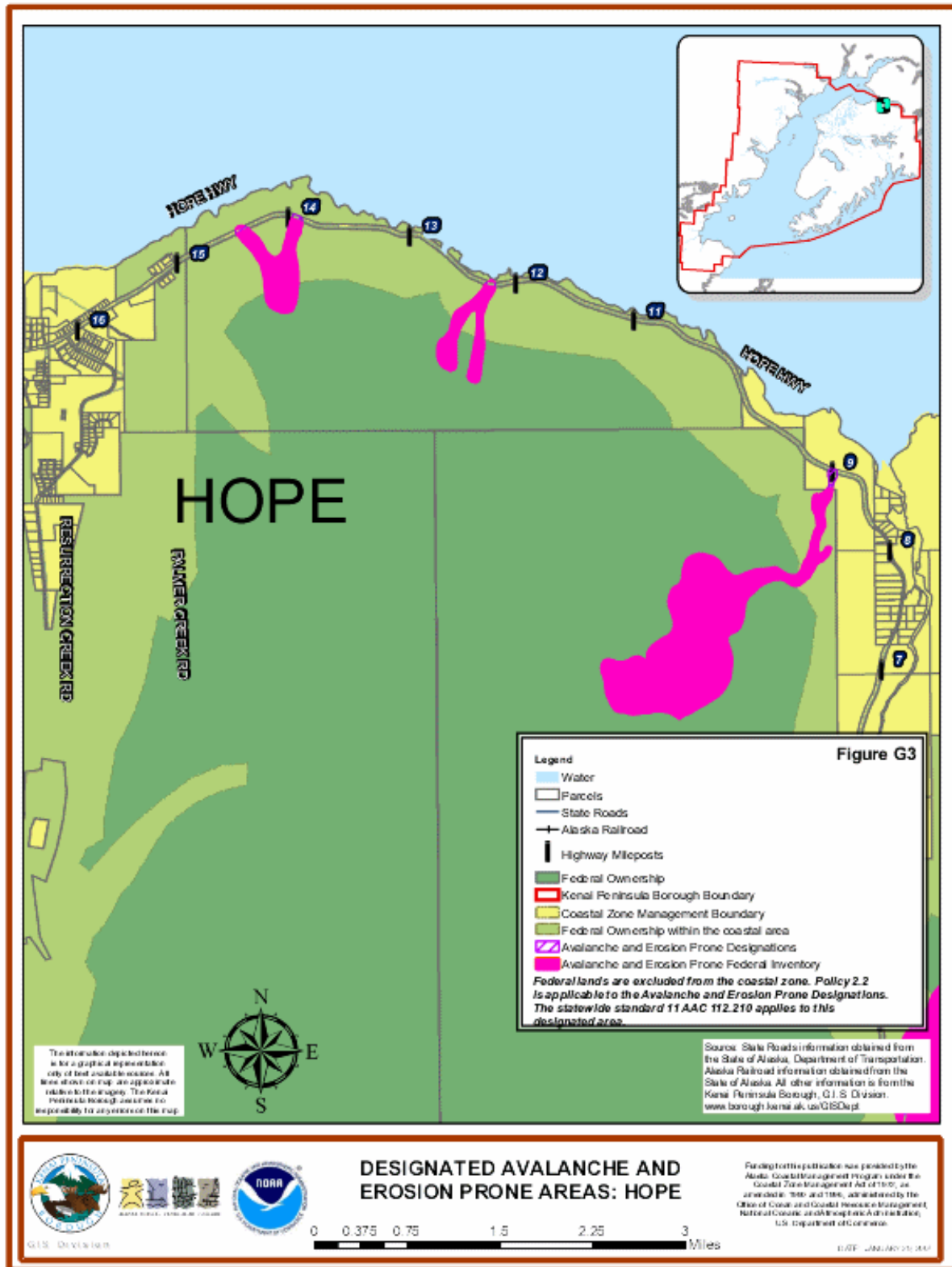
# AVALANCHES



**Figure 8-2. Avalanche Zones in Turnagain Pass, Seward Highway, Alaska**



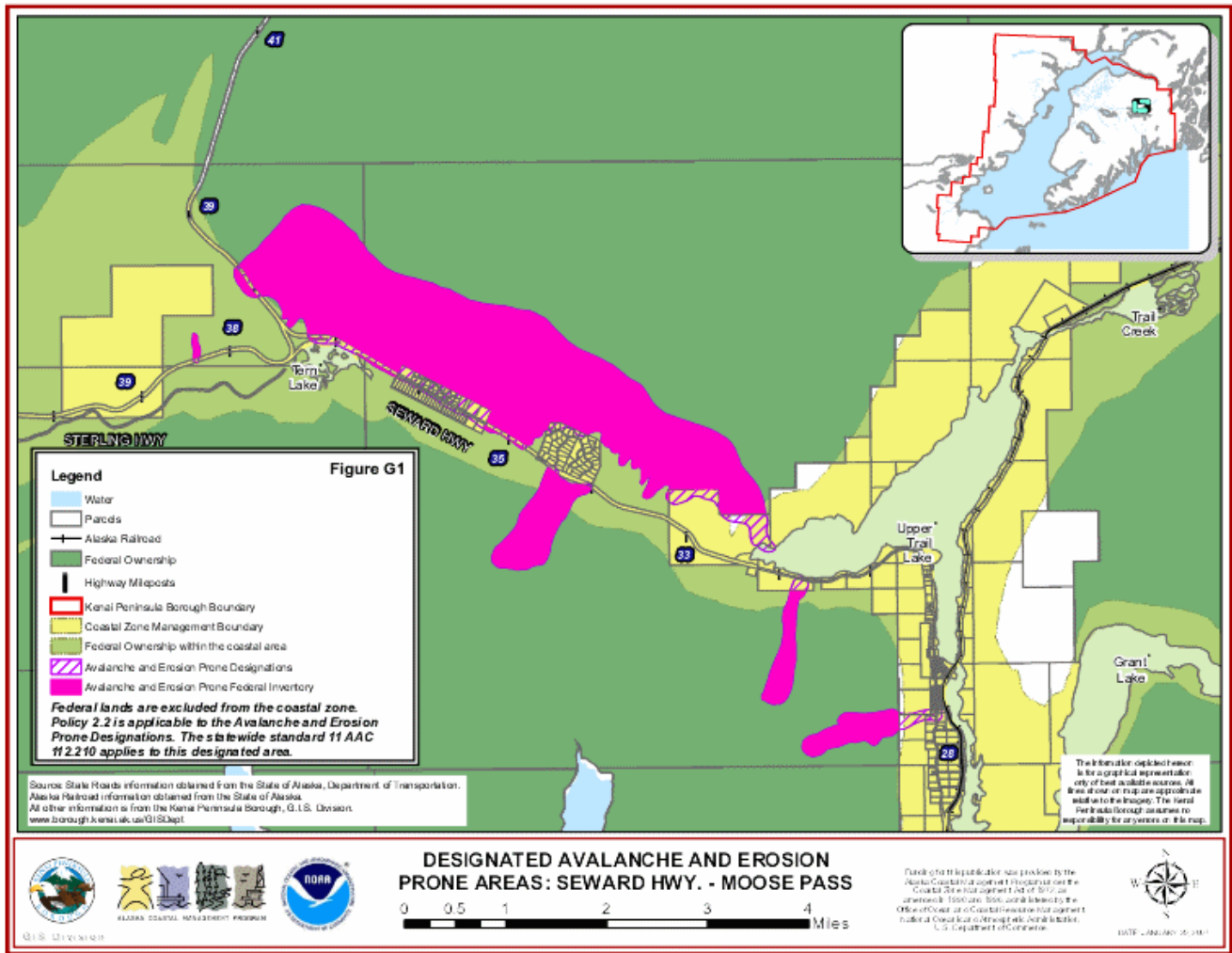
# AVALANCHES



**Figure 8-3. Avalanche Zones near Hope, Alaska**



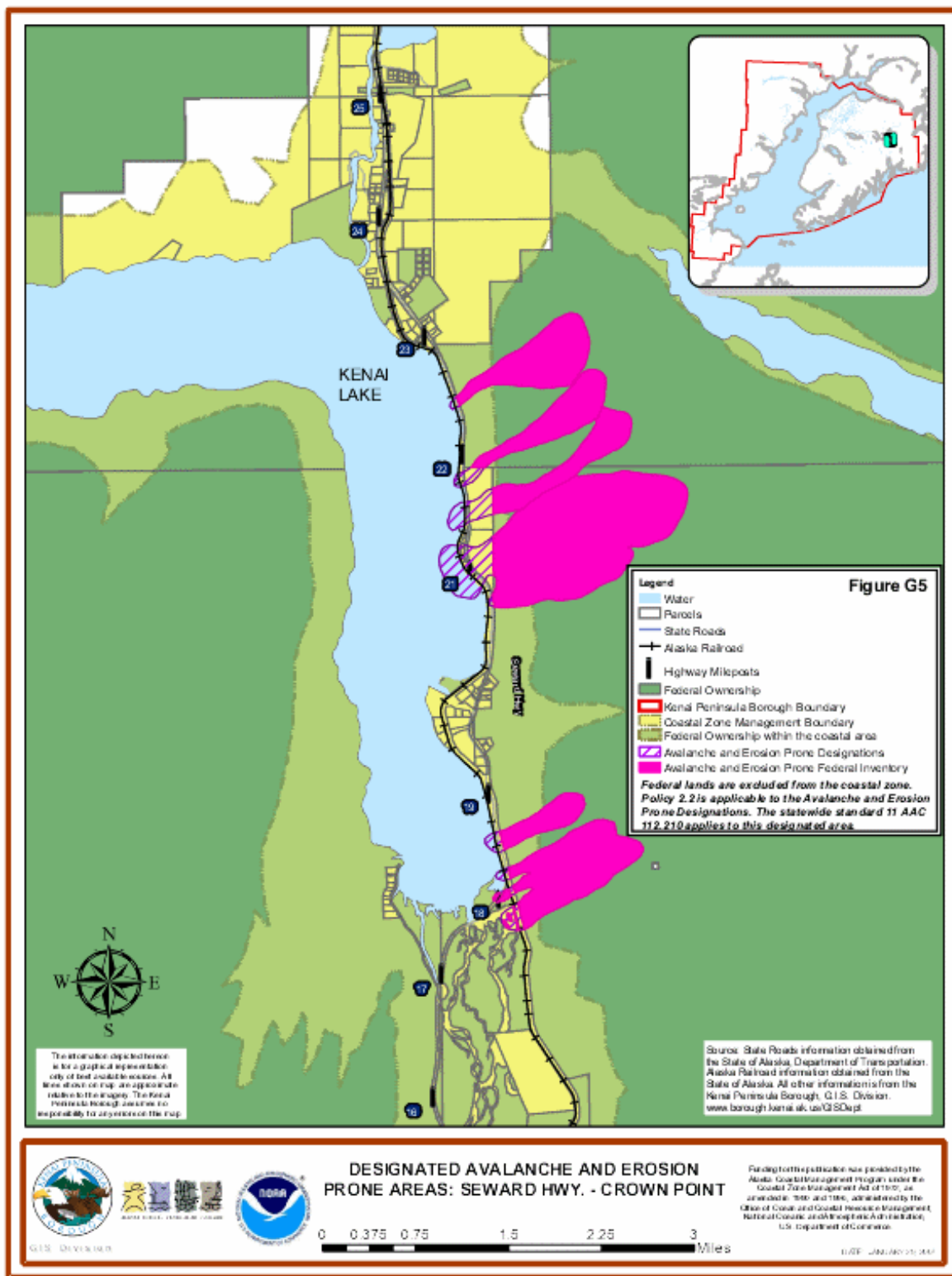
# AVALANCHES



**Figure 8-5. Avalanche Zones along the Seward Highway near Moose Pass, Alaska**



# AVALANCHES



**Figure 8-6.** Avalanche Zones along the Seward Highway near Crown Point, Alaska



# AVALANCHES

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## 8.4. Existing Programs and Strategies

### **Avalanche Awareness Month**

The Alaska State Legislature adopted, and the Governor signed, Senate Concurrent Resolution (SCR) 16 proclaiming the month of November as Avalanche Awareness Month. It urges further education on recognizing avalanche risks, response to avalanches, and using appropriate equipment in avalanche areas. It also urges schools, community groups, and other public and private agencies to increase public awareness.

### **Alaska Mountain Safety Center (AMSC)**

The AMSC is a non-profit organization specializing in avalanche hazard evaluation, mitigation, forecasting, and education. The AMSC also operates the Alaska Avalanche School, which offers field-oriented classes on mountain safety training and avalanche hazard evaluation.

#### **8.4.1. Hazard Mitigation Successes**

### **Alaska Railroad Avalanche Program**

The Alaska Railroad Avalanche Program is a three-year program to improve existing avalanche risk management tools and create new control systems. The program involves improving data acquisition and management, improving explosive delivery support, upgrading snow clearing and explosives-control equipment, constructing a central avalanche office and a secure gun storage facility in Girdwood.

### **Chugach Electric**

Before Chugach Electric sends any of its maintenance crews to do work in a known avalanche area in the winter, it requires an avalanche assessment to ensure worker safety.

### **Alaska Department of Transportation and Public Facilities**

ADOT&PF has identified and signposted stretches of the Seward and Sterling Highways that are in avalanche hazard zones. Signs mark both the beginning and end of each section, warning motorists not to stop within the zones in winter. There are also gates that can be lowered to block off sections of highway when danger is extreme and/or avalanche-clearing work is underway.

#### **8.4.2. Avalanche Policies**

### **Kenai Peninsula Borough 2008 Coastal Management Plan**

In section G-2.4 of the “Enforceable Policies” section, the 2008 Coastal Management Plan reads, “Unless there are no practicable alternatives, new development should avoid designated natural hazard areas subject to landslide, mass wasting and avalanche hazards.”





# AVALANCHES

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## Summary of local capabilities, goals and actions

### Kenai Peninsula Borough

**Capabilities:** Using GIS technology, ordinance adoption for snow load and avalanche control measures.

**Goals:** Reducing vulnerability to avalanche hazards by prohibiting new construction in avalanche zones, buyout and relocation, harden existing structures for increased snow load capabilities, public education activities, and increase warning and forecasting capabilities.

### Seward

**Capabilities:** Rescue capabilities for homes and automobiles. Heavy equipment for removal of snow and debris and access to avalanche probes from neighboring fire departments.

**Goals:** Public education, develop avalanche GIS mapping layers, develop avalanche program at Lowell Canyon that includes signs, designating safe parking zones, retaining wall and renovate tunnel access.

## 8.5 Snow Avalanche Mitigation Strategies and Implementation Ideas

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### *Strategy 1: Reduce number of structures in high-hazard areas*

#### Implementation Ideas and Action Items

Encourage relocating existing development from known avalanche areas. It is not a question of if an avalanche will strike these areas. It is only a question of when and whether people will be injured or killed and how much damage will result.

- Foreclosed property within high & moderate hazard areas should be kept in borough land base rather than re-sold.
- When possible, acquire private properties located in high-hazard areas
- Do not allow repairs/rebuilding of homes in high hazard areas if damage to home (from any cause) is more than 50% of the home's assessed value
- Do not allow expansion of homes in high hazard areas if expansion would allow for an increase in occupancy. In moderate hazard zones, develop building requirements designed to increase resistance to avalanche damage for all structures undergoing structural renovation/expansion.
- Limit development of property within high-hazard areas to uses/structures suitable for summer and shoulder-season use only, with grandfathered



# AVALANCHES

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- development rights for current property owners. Development ban would take effect when the property is sold. For properties where development is limited to prevent avalanche-season occupancy, re-assess property values to reflect limitations on use.

**Potential Participants:** KPB

**Potential Funding:** FEMA, AKDHS&EM, USACE

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## ***Strategy 2: Increase awareness among property owners of avalanche hazard zones***

### **Implementation Ideas and Action Items**

- Add Geologic Hazard Layer to Kenai Peninsula Borough's on-line GIS mapping system  
Lead: KPB
- Send annual/semiannual mailers to property owners with high and moderate hazard areas, reminding them of the property classification, relevant borough codes and ordinances and giving suggested mitigation measures.
- Require all property sales disclosure documents to include notice of high avalanche hazard.

**Potential Participants:** KPB

**Potential Funding:** KPB, AKDHS&EM, FEMA, Private grant agencies

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## ***Strategy 3: Encourage communities to develop avalanche overlay zones.***

Development of these zones would provide several benefits, for example: communities could require building to a more stringent standard to ensure structures would be able to withstand potential avalanches or to allow recreational or building use during non-avalanche season.

### **Implementation Ideas and Action Items**

- Complete avalanche area GIS mapping



# AVALANCHES

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**Potential Participants:** KPB, DHS&EM

**Potential Funding:** KPB, DHS&EM, FEMA, USGS, USACE, AKDOT, AKDNR, AK Public Safety

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## ***Strategy 4: Improve avalanche warning.***

### **Implementation Ideas and Action Items**

- Add avalanche conditions and warnings to the ADOT&PF 511 road condition phone recording and website. This activity would provide travelers with information about avalanche risks and avalanche forecasts along major travel routes.

**Potential Participants:** Chugach National Forest Avalanche Information Center, Alaska Avalanche Information Center, DOT&PF, NWS

**Potential Funding:** KPB, DHS&EM, FEMA, USGS, AKDOT, AKDNR, AK Public Safety

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## ***Strategy 5: Promote avalanche education.***

Education is the best way to reduce fatalities, injuries, and property damage from avalanches. Residents, recreational enthusiasts, elected officials and others need to be aware of the dangers associated with avalanches and how to avoid them.

### **Implementation Ideas and Action Items**

- Host workshops in communities and schools to teach avalanche awareness.
- Encourage avalanche safety training for snow machine riders. Snow machines frequently trigger avalanches with deadly consequences. Training programs to teach people how to identify high-risk conditions and what to do if they are caught in an avalanche could save numerous lives annually.
- Conduct voluntary avalanche safety courses and encourage manufacturers and vendors to distribute avalanche awareness videos with their products.

**Potential Participants:** Alaska Avalanche School, Alaska Avalanche Information Center, Kenai Peninsula Borough, Alaska State Parks, DNR, USFS Chugach National Forest

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# AVALANCHES

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**Potential Funding:** KPB, DHS&EM, AKDNR, USFS, FEMA,

**Time Frame:** on-going

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## ***Strategy 6: Encourage artificial avalanche release and snow management.***

### **Implementation Ideas and Action Items**

- Promote using artificial release and avalanche control measures to include: pre-positioning avalanche release equipment and deflection structures in existing developed avalanche prone areas.
  - Identify avalanche areas for artificial release.
    - Lead: DPS
    - Support: DHS&EM, DOT&PF, DNR
    - Potential Funding: DPS, DHS&EM, DOT&PF, DNR
    - Timeline: on-going
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# AVALANCHES

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## 8.6 Snow Avalanche Resource Directory

### Alaska Avalanche Information Center

The mission of the Alaska Avalanche Information Center is to provide public avalanche forecasts, education and the exchange of snow stability observations for Alaska.

**Contact:** Alaska Avalanche Information Center  
**Address:** PO Box 2988, Valdez, AK 99686  
**Phone:** (907) 835-4488  
**Website:** [www.alaskasnow.org/home](http://www.alaskasnow.org/home)

### Alaska Avalanche Specialists

Alaska Avalanche Specialists is a Juneau, Alaska-based firm that specializes in all phases of avalanche work, including consulting, planning, training, artificial release and structural mitigation, research, risk analysis, mapping, and management.

**Contact:** Alaska Avalanche Specialists  
**Address:** PO Box 22316, Juneau, AK 99802-2316  
**Phone:** (907) 523-8900  
**Website:** [akavalanches.com/index.html](http://akavalanches.com/index.html)

### Alaska Avalanche School

The mission of the Alaska Avalanche School is to promote safety in and around the mountain environment through education, research, publishing, and consulting.

**Contact:** Alaska Avalanche School, Inc.  
**Address:** PO Box 100145, Anchorage, AK 99510-0145  
**Phone:** (907) 345-0878  
**Website:** [www.alaskaavalanche.com/Site/Homepage.html](http://www.alaskaavalanche.com/Site/Homepage.html)

### American Red Cross

The American Red Cross is a volunteer humanitarian organization, which provides relief to disaster victims and helps people prevent, prepare for, and respond to emergencies.

**Contact:** American Red Cross  
**Address:** 235 E. 8<sup>th</sup> Avenue, Anchorage, AK 99501  
**Phone:** (907) 646-5401  
**Website:** [alaska.redcross.org](http://alaska.redcross.org)

### Chugach National Forest Avalanche Information Center

The mission of the Chugach National Forest Avalanche Information Center is to increase public awareness in the Turnagain area through advisories and public education. Forecasts are updated seven days a week.

**Contact:** CNFAIC  
**Address:** PO Box 129, Girdwood, AK 99587  
**Phone:** (907) 754-2346  
**Website:** [www.cnfaic.org](http://www.cnfaic.org)



# AVALANCHES

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# HUMAN-CAUSED HAZARDS

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## 9.0 Human-Caused Hazards

Although much of the focus of hazard mitigation is on natural hazards such as earthquakes and floods, there are also hazards that are human-caused. For the purpose of this Plan, “human-caused hazards” are technological hazards. These are distinct from natural hazards primarily in that they originate from human activity. In contrast, while the risks presented by natural hazards may be increased or decreased as a result of human activity, they are not inherently human-induced.

The term “technological hazards” refers to the origins of incidents that can arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. For the sake of simplicity, this Plan assumes that technological emergencies are accidental and that their consequences are unintended. On the Kenai Peninsula, some of these human-created hazards include sudden flooding due to potential dam and water diversion breaches and hazards related to the storage, use and transportation of hazardous materials.

### 9.1 Hazards By Zone

**Table 9-1.** Examples of Facilities Posing Potential Hazards – North Zone

Facility	Operator	Hazard Type
Fertilizer Plant*	Agrium Kenai Nitrogen Operations	chemical
Natural Gas Liquefaction	ConocoPhillips Alaska, Inc.	chemical
Refinery	Tesoro Alaska Co.	chemical
Gas Fields, Production Facility	Marathon Alaska Production LLC	chemical
Oil Platforms and Storage	Union Oil Co. of California (Chevron)	chemical
Gas To Liquids Plant*	BP Exploration	chemical
Municipal Airport	City of Kenai	aviation fuel

\* Currently being decommissioned

**Table 9-2.** Examples of Facilities Posing Potential Hazards – Central Zone

Facility	Operator	Hazard Type
Sterling Gas Field	Marathon Alaska Production LLC	chemical
Swanson River Oil Field	Union Oil Co. of California (Chevron)	chemical
Municipal Airport	City of Soldotna	aviation fuel
Cooper Lake Dam	Chugach Electric Association	flooding



# HUMAN-CAUSED HAZARDS

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**Table 9-3.** Examples of Facilities Posing Potential Hazards – East Zone

Facility	Operator	Hazard Type
Seafood Plants	Polar Seafoods, Icicle Seafoods	chemical
Coal Loading Facility	Alaska Railroad Corporation	air quality
Ship Repair Facility	Seward Ship's DryDock	air quality
Chemical Transfer Area	ConocoPhillips Alaska, Inc.	chemical
Diversion Levees and Tunnel	City of Seward	flooding
Municipal Airport	City of Seward	aviation fuel

**Table 9-4.** Examples of Facilities Posing Potential Hazards – South Zone

Facility	Operator	Hazard Type
Ninilchik Gas Fields	Marathon Alaska Production LLC	chemical
Seafood Plant	Icicle Seafoods	chemical
Municipal Airport	City of Homer	aviation fuel

## 9.2 SUDDEN FLOODING

### 9.2.1. Sudden Flooding Hazards

Although there are few dams on the Kenai Peninsula, there are a few structures that could pose a threat to human safety and infrastructure in the case of failure.

#### **Cooper Lake Dam – Central Zone**

Cooper Lake Dam is located near Cooper Landing. This rock-and-fill structure at the outlet of 3000-acre Cooper Creek is a hydroelectric dam owned by Chugach Electric Association. The dam was originally licensed in 1957, completed in 1959 and relicensed in 2007 (to expire in 2057). The dam has a storage capacity of approximately 127,000 acre-feet of water from the dam base to the dam crest.<sup>1</sup> Cooper Creek joins the Kenai River at approximately mile 50.5 of the Sterling Highway, just west of the outlet of Kenai Lake. This means that any outburst from Cooper Lake would generally follow the Kenai River, adjacent to the Sterling Highway, until Mile 58 where the Kenai turns south of the highway and flows toward Skilak Lake. Skilak Lake would act as a buffer to slow the release of floodwaters. Nonetheless, flooding would be expected downstream all the way to the mouth of the Kenai River, as well as upstream to the mouth of Kenai Lake. The first approximately five miles of the Kenai downstream from the mouth of Skilak Lake are part of the Kenai National Wildlife Refuge and are thus undeveloped. From the refuge boundary downstream, however, development is fairly heavy, with both seasonal and year-round residences and commercial development. Flood levels from a dam failure could surpass the 1% flood event level.

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<sup>1</sup> Chugach Electric Association, Cooper Lake Hydroelectric Project Emergency Action Plan, December 2009



## HUMAN-CAUSED HAZARDS

**Table 9-5. Possible Flood Levels from a Failure of Cooper Lake Dam<sup>1</sup>**

Location	Estimated Time to Wave Front	Max. Elevation Above Normal
Kenai RM 0	3 hours 6 minutes	12.5'
Kenai RM 3.0	2 hours 36 minutes	25.7'
Kenai RM 7 (Russian River)	3 hours 6 minutes	29.7'
Kenai RM 12	5 hours 36 minutes	34.5'
RM 13.25	5 hours 36 minutes	47.3

### ***Lowell Creek Diversion Tunnel and Dam – East Zone***

Lowell Creek is a glacier-fed stream that runs three miles through a talus strewn canyon above Seward and then used to flow over an alluvial fan on which Seward's original town site was built. The stream channel through the canyon is prone to landslides and avalanches that dam the stream and can lead to surge-release type flooding. The volume and velocity of Lowell Creek is powerful enough during flood events to pick up large boulders and huge amounts of sediment and carry them downstream.

Much of Seward's critical infrastructure, including the hospital, police station, fire station and city hall, is located within this alluvial fan area, as well as businesses, homes and a senior citizen housing structure. The creek currently is diverted from its original path by a dam and diversion tunnel built by the US Army Corps of Engineers. The dam is located just inside the mouth of Lowell Canyon and is 400 feet long and 25 feet high. The uncontrolled spillway is about 400 feet long with a sharp drop at the tunnel entrance to increase the velocity of the water enough to ensure that all debris will pass into and through the tunnel. From the dam, the waters of Lowell Creek are funneled through a diversion tunnel 2,068 feet long and 10 feet in diameter through Bear Mountain and into Resurrection Bay via a spillway above Lowell Point Bridge at the southern edge of the city. A 40-foot-long emergency spillway was originally designed to direct flood waters into the old creek bed through the center of town but that outlet no longer exists as this area has been fully developed.

The history of Lowell Creek flooding since 1940 has been one of repeated and expensive repairs to the tunnel and intake system and near disaster in 1966 and 1986 due to blockage of the tunnel during major flood events. The tunnel has deteriorated due to debris abrasion. The railroad rails armoring the tunnel's floor have been torn out through the years and the floor has periodically eroded to bedrock.

<sup>1</sup> Chugach Electric Association, Cooper Lake Hydroelectric Project Emergency Action Plan, December 2009



# HUMAN-CAUSED HAZARDS

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## ***Japanese Creek Levee – East Zone***

Following several flood events, Japanese Creek Levee was constructed in 1986, rebuilt in 2001 and underwent a major renovation in 2007. Infrastructure at risk on the Japanese Creek alluvial fan includes all three Seward schools, Seward Sanitary Landfill, major businesses, the Seward Military Resort and several highly developed subdivisions. In 2007 the City of Seward chose a tract of land also in the risk area on which to build the future Seward Long Term Care Facility. Currently there is only one access and evacuation route to this highly populated area.

## ***Fourth of July Creek Levee – East Zone***

Fourth of July Creek is located on the east side of Resurrection Bay and is known for continuously shifting its channels. Fourth of July Creek and its tributaries have created a segmented alluvial fan on which has been constructed commercial and industrial facilities and the \$80 million dollar Spring Creek Correctional Facility, a maximum security state prison. In 2007, further development of the Seward Marine Industrial Complex was approved by the Seward City Council as well as a project to add on to Spring Creek Correctional Institution.

Flood control levees were constructed in 1982 to protect the infrastructure and development on the alluvial fan. However, flood events in 1982, 1986 and 1989 caused extensive damage to these levees. Failure of the Fourth of July Creek dike would result in considerable damage to public and private infrastructure, including the Spring Creek Correctional Center, the City of Seward's water supply and the Seward Marine Industrial Center.

## ***9.2.2. Levee and Dam Failure Mitigation Strategies***

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***Strategy 1: Promote public awareness of potential hazards associated with dam and levee failure.***

### **Implementation Actions**

- Cooperate with residents, industry and state and federal agencies through the Office of Emergency Management and the Local Emergency Planning Committee to develop and disseminate information about areas in danger of flooding from levee or dam failure.



# HUMAN-CAUSED HAZARDS

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## ***Strategy 2: Decrease possibility of levee or dam failure***

### **Implementation Actions**

- Support efforts by City of Seward and other responsible parties to procure funding for ongoing maintenance of water retention and diversion structures.
- 

## ***Strategy 3: Limit hazards to health and safety in case of dam or levee failure***

### **Implementation Actions**

- Prepare contingency plans for sudden flood events, including public notification plans, evacuation routes and emergency shelters
- 

## **9.3. HAZARDOUS MATERIAL RELEASE**

### ***9.3.1. Nature of the Hazard***

Because of their chemical, physical, or biological nature, hazardous materials can pose a potential risk to health and safety, property, and the environment. In addition, many chemicals that are not categorized as hazardous can adversely affect human health and safety and the environment if spilled or otherwise released in sufficient quantities. Precautions against spills and releases, plus quick response, containment, and cleanup, are key to limiting the hazardous materials and chemical hazard.

Given its vast acreage and potential resources, the Borough is still relatively lightly developed and populated. Large parts of the Borough remain largely free from the environmental contamination associated with urban and industrial areas. However, there are sites in the Borough with contamination from waste spills or unsafe disposal.

### ***Sources of Pollution and Impacts***

Even though it is lightly populated, the Kenai Peninsula Borough ranks as one of the most industrialized parts of Alaska, with many onshore and offshore oil and gas fields, a petroleum refinery, liquid natural gas plant and numerous seafood processing plants. These industries, as well as various activities of private individuals, generate or use an assortment of toxic and hazardous substances, which are sometimes released into the environment through emissions, spills or unsafe disposal.



# HUMAN-CAUSED HAZARDS

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## ***Characteristics of the Hazard***

Hazardous materials are chemical substances that, if released or misused, can pose a threat to human health and safety and the environment. These chemicals are used in industry, agriculture, medicine, research, consumer goods, and in the home. Hazardous materials may be in the form of explosives, flammable and combustible substances, poisons, and reactive materials. Hazardous materials are routinely transported through the Peninsula via truck, railroad and pipelines. Hazardous materials also travel in and out of Kenai by air transport. The majority of chemical accidents occur in the home from misuse of flammable or combustible materials; however, these are typically small-scale accidents affecting individuals. Larger incidents involving hazardous materials typically occur because of accidents at an industrial facility or during transportation.

The presence of a hazardous material may or may not be readily evident. Some hazardous materials do not have an odor or taste. Some hazardous materials can cause immediate physical reactions such as nausea or watering eyes.

## ***Hazard Categories***

Regulatory requirements establish four categories of hazard for chemicals and materials:

- 1) Reactivity
- 2) Ignitability/flammability
- 3) Corrosivity
- 4) EP toxicity

Reactivity refers to a material's characteristics when mixed with water. A solid waste is categorized as a hazardous waste if, when mixed with water, it: (1) reacts violently; (2) forms potentially explosive mixtures; or (3) generates toxic gases, vapors, or fumes in a quantity sufficient to be harmful to human health of the environment.

The DOT system defines flammable materials as those with a flashpoint of 100°F or less; combustible materials as those with a flashpoint between 100°F and 200°F; and those with a flashpoint of <200°F as nonflammable. EPA designates those wastes with a flashpoint of less than 140°F as ignitable hazardous wastes.

The corrosive hazard relates to acids and bases, and is defined in terms of pH (i.e., wastes are considered hazardous if they have a pH < 2 or > 12.5). Acids and bases are typically highly soluble in water. Concentrated solutions will attack skin and other materials; bases are generally worse than acids as they will penetrate the skin.

EP toxicity is a measure of a material's toxicity to humans.





# HUMAN-CAUSED HAZARDS

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## ***Hazard Identification***

An accident involving hazardous materials could occur anywhere. Communities located near industrial facilities that use or store large quantities of hazardous chemicals are particularly at risk. However, given that hazardous materials are routinely and frequently transported on local roadways and railways, all communities on the Kenai Peninsula are potentially exposed. Because of the limited highway infrastructure on the Kenai Peninsula, an accident that blocked the highway at nearly any point would cut communities off from each other. Only between Kenai and Soldotna is an alternate route available.

**Table 9-6.** Some Hazardous Materials Transported on Kenai Peninsula Highways<sup>1</sup>

<b>Material</b>	<b>Classification</b>	<b>Communities</b>
Anhydrous Ammonia	Extremely Hazardous	Kenai, Homer, Seward
Formaldehyde	Extremely Hazardous	Kenai, Homer
Sulfuric Acid	Extremely Hazardous	Kenai, Homer, Seward
Chlorine	Extremely Hazardous	Kenai
Nitric Acid	Extremely Hazardous	Kenai, Seward
Acetylene	Hazardous	Kenai, Homer, Seward
Oxygen	Hazardous	Kenai, Homer, Seward
Nitrogen	Hazardous	Kenai, Seward
Argon	Hazardous	Kenai, Homer, Seward
Aviation Fuel	Oil	Kenai, Homer
Gasoline	Oil	Kenai, Homer, Seward, Nikiski
Diesel, Heating Oil	Oil	Kenai, Homer, Seward, Nikiski

## ***Pipelines***

Natural gas supplies are transported by pipelines from Cook Inlet drilling platforms and other fields on the Kenai Peninsula and the west side of Cook Inlet to facilities located in Trading Bay, Granite Point and Nikiski. Twelve- and sixteen-inch pipelines run from the Kenai Peninsula, with a sub-marine portion at Turnagain Arm, to Anchorage and the Matanuska-Susitna Valley. Tesoro Alaska ten-inch pipeline transports Jet A fuel, gasoline and diesel #2 from Nikiski to the Anchorage Terminal.

## ***Railroad***

The Alaska Railroad Corporation (ARRC) transports nine classes of hazardous materials on its system. Hazardous materials enter the state at the ports of Seward, Anchorage and Whittier and then switch to rail systems. The majority of materials moved on ARRC's main track are comprised of Class 3 flammable liquids and gases, with fuel being the greatest tonnage of any single commodity moved. The majority of

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<sup>1</sup> ADEC HazMat Community Flow (2).doc-6/28/2005



## HUMAN-CAUSED HAZARDS

these hazardous materials shipments have Seward as a destination, although ethylene refrigerant gas and liquefied petroleum are transported to the siding at Crown Point.<sup>1</sup>

**Table 9.7.** Examples of Hazardous Material Events on the Kenai Peninsula Through 2013

Date	Location	Substance/Amt	Source	Injuries
4/1986	Crown Point	Formaldehyde, trimethylamine	Leaking railcar	
1/1992	Soldotna	Chlorine gas	Wastewater Treatment Plant	
4/1994	Kenai	Explosives	Halliburton – explosion and fire	1 killed, 4 injured
5/1997	Nikiski	12,000 lbs. ammonia	Unocal Chemical Plant	
9/1997	Ninilchik	Sulfur, 17 tons	Overtaken container	
10/1997	Nikiski	17,946 lbs. Ammonia	Unocal valve failure	
4/1998	Nikiski	49,605 lbs. Ammonia	Unocal valve failure	
7/1998	Homer Spit	35,000 lbs. Ammonia	Icicle Seafood Plant fire	
8/1999	Nikiski	9000 lbs. MDEA, 500 lbs. Ammonia	Unocal tank explosion	3 injured
10/2001	Cooper Landing	Fuel - 8800 gallons	Overtaken tanker	1 injured
7/2004	Nikiski	13,200 lbs. Ammonia	Agrium – human error	
7/2005	Nikiski	324 gallons Hydrochloric Acid	Corrosion – OSK Dock	
5/2009	Nikiski	20,000 lbs. Sulfur Dioxide	Tesoro Refinery	

### 9.3.2. Regulations, Planning and Monitoring Programs

#### **Borough**

The Borough has no specific ordinance regulating toxic and hazardous substances.

The Kenai Peninsula Borough Emergency Operations Plan (EOP) does incorporate response checklists for oil/hazardous material releases. The EOP response checklist for transportation accidents also includes steps to be taken in the event that hazardous materials are involved.<sup>2</sup>

#### **State**

The State Emergency Response Commission (SERC) oversees regional and local government contingency planning for releases of oil and hazardous substances through

<sup>1</sup> ADEC HazMat Community Flow (2).doc-6/28/2005

<sup>2</sup> Kenai Peninsula Borough Emergency Operations Plan, August 2008



# HUMAN-CAUSED HAZARDS

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the formation of LEPCs. ADEC's Division of Spill Prevention and Response is in charge of oil spill prevention, preparedness, and response. The State has prepared Geographic Response Strategies (GRS) for the Cook Inlet and nine other regions.

The Cook Inlet region is divided into seven geographic response zones, five of which are wholly or partially within the Borough. Response strategies are prepared for specific sites within each response zone by a workgroup consisting of natural resource agency representatives, oil spill response professionals, and tribal organization representatives. The objective of these strategies is to improve response time and efficiency in the event of future oil spill incidents.

In accordance with ADEC criteria, ten petrochemical operators also have jointly sponsored a nonprofit response unit (Cook Inlet Spill Prevention and Response, Inc.) to respond to emergency spills. This organization is also a primary participant in the Cook Inlet Geographic Response Strategies program.

## ***Federal***

The Resource Conservation and Recovery Act of 1976 (RCRA) and subsequent federal acts give the EPA the authority to regulate the generation, transportation, treatment, storage, and disposal of hazardous waste. The EPA's Office of Solid Waste manages the RCRAInfo system, an online database that contains many types of information about hazardous wastes and disposal practices regulated by the EPA.

### **9.3.3. Resources**

#### ***Borough Resources***

The Kenai Peninsula Borough maintains three decontamination trailers. One is based in Kenai/ Soldotna, one in Seward and a third in Homer.

The Kenai Peninsula Borough contracts with RapidNotify, an emergency notification service that, in the event of an emergency, can be used to alert affected residents of the emergency and provide instructions to evacuate or shelter in place. This system can be activated by the KPB Office of Emergency Management or any of the four emergency dispatch centers located on the Peninsula (Soldotna, Kenai, Seward and Homer).

As of February 2014, none of the firefighting and emergency medical response services within the Borough has HazMat capabilities, although some individual members of the services do have training in HazMat response. Formal response capability is limited to establishing safety zones and basic spill containment.



# HUMAN-CAUSED HAZARDS

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## **State Resources**

### ***Alaska Statewide Hazardous Materials Response Team***

The Statewide Hazmat Team is composed of several teams capable of deploying to any location in the state to respond to a hazardous materials release. The team is 'Level A' capable (i.e. the highest level of capability for response). Teams are based in Anchorage, Fairbanks, Kodiak and Valdez and are available for callout through the Alaska Department of Environmental Conservation. The teams are available for emergency response only, and not for cleanup and recovery operations. Once the emergency phase is terminated, the teams will be returned to their location of origin.

As of February, 2010, The Alaska Department of Environmental Conservation (ADEC), Tesoro Alaska Co. and Cook Inlet Spill Prevention & Response, Inc. (CISPRI) have Kenai Peninsula-based gas monitors capable of detecting dangerous gases including hydrogen sulfide, benzene, ammonia, chlorine and volatile organics. ADEC also has a radiation detector located on the Peninsula.<sup>1</sup>

ADEC also maintains containers with spill response equipment in Kenai and Seldovia. The communities of Kenai, Homer and Seldovia have Community Spill Response Agreements.<sup>2</sup>

## **Federal Resources**

U.S. Department of Transportation  
U.S. Coast Guard  
U.S. Environmental Protection Agency

### **9.3.4. Ongoing Mitigation**

#### ***The Emergency Planning and Community Right to Know Act (EPCRA) of 1986***

In response to the disaster in Bhopal and other hazardous materials releases, on October 17, 1986, the Superfund Amendments and Reauthorization Act of 1986 (SARA) was signed into law. Title III: The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986, within SARA, establishes requirements for federal, state, and local governments, and industry regarding emergency response planning and community right-to-know on hazardous chemicals. Title III requires state and local governments and industries to take action to inform citizens about chemical hazards in their communities and to develop emergency plans. Title III also requires each community to establish a Local Emergency Planning Committee (LEPC) to be responsible for developing an emergency plan for responding to chemical emergencies in the community.

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<sup>1</sup> Alaska Department of Environmental Conservation, February 24, 2010

<sup>2</sup> Alaska Department of Environmental Conservation, January 27, 2010



# HUMAN-CAUSED HAZARDS

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The U.S. Department of Transportation employs a labeling and placard system for identifying the types and characteristics of hazardous materials being carried by truck, rail, and barge or shipping. The placard system allows local emergency officials to identify the nature and potential health threat of chemicals under transport, and to determine the proper response procedures in the event of an accident involving hazardous materials.

In Alaska, the State Emergency Response Commission (SERC) is the leading entity in the implementation of SARA at the state level to mitigate the effects of an accidental release or spill of hazardous materials. The SERC establishes Local Emergency Planning Districts within Alaska and manages the State's Local Emergency Planning Committees (LEPC). Alaska statute also directs the SERC to be an all-hazard SERC. This means that the Alaska SERC is tasked to address hazardous materials issues and all other hazards and threats that might create an emergency situation in Alaskan communities. Select the SERC Home link for SERC information. Alaska Statute 26.23.071 establishes the Alaska SERC and specifies its duties.

Each Local Emergency Planning District (LEPD) has its own LEPC. LEPC members are volunteers who live in the LEPD. The SERC approves LEPC members. The LEPC implements EPCRA at the local level. The Kenai Peninsula Borough LEPC compiles information on hazardous materials stored and transported on the Kenai Peninsula.

The responsibility to coordinate SERC and LEPC activities in Alaska resides with the Department of Military and Veterans Affairs, Division of Homeland Security and Emergency Management.

## ***9.3.5. Hazardous Material Release Mitigation Strategies and Implementation Ideas***

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***Strategy 1: Promote public awareness of potential hazards associated with handling of toxic and hazardous substances in the community.***

### **Implementation Actions**

- Cooperate with residents, industry and state and federal agencies through the Office of Emergency Management and the Local Emergency Planning Committee to develop and disseminate information about the location, types and amounts of toxic or hazardous substances within the Borough.

**Potential Funding:** Local Industry, Local Communities, KPB, DHS&EM, AK Public Safety



# HUMAN-CAUSED HAZARDS

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- Request that responsible parties and regulatory agencies give adequate public notice and conduct a public hearing, if appropriate, prior to approval of new permits for use or disposal of toxic or hazardous substances.

**Potential Funding:** Local Industry, Local Communities, KPB, DHS&EM, AK Public Safety, EPA, NTSB

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***Strategy 2. Identify any potentially harmful substances used or disposed of within the Borough that are not adequately regulated by state and federal agencies to serve as the basis for future planning, monitoring or enforcement activity.***

## **Implementation Action**

Coordinate with state and federal agencies to evaluate the materials identified by LEPC, identify any regulatory deficiencies and work towards solving any problems.

**Potential Funding:** Local Industry, Local Communities, KPB, DHS&EM, AK Public Safety, EPA, NTSB

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***Strategy 3. Promote public knowledge of how to react to chemical release***

## **Implementation Actions**

- Develop public education program to teach residents about sheltering in place and developing emergency preparedness plans and kits.
- Develop evacuation plans for all areas on the Kenai Peninsula road system, and provide public education about where to find evacuation information.

**Potential Funding:** Local Industry, Local Communities, KPB, DHS&EM, AK Public Safety, AKDOT, NTSB

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***Strategy 4. Develop interim emergency response capabilities in the event of an accidental discharge of toxic or hazardous substances.***

## **Implementation Actions**

- Support training programs for local first responders, including borough, municipal and volunteer fire departments and law enforcement officials, in hazardous material response.





## HUMAN-CAUSED HAZARDS

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- Support efforts by local responders to obtain appropriate equipment for responding to hazardous material releases.
- Support the formation and efforts of a Kenai Peninsula Hazardous Materials Team to coordinate training and response efforts among fire departments, law enforcement and other emergency response personnel located on the Kenai Peninsula. This team should be capable of responding at the technician level, with support from additional responders trained to operations level.
- Support efforts to conduct a hazardous materials risk analysis specific to the materials used and transported in the Kenai Peninsula Borough.

**Potential Funding:** Local Industry, Local Communities, KPB, DHS&EM, AK Public Safety, EPA

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# HUMAN-CAUSED HAZARDS

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## 9.4 Human-Caused Hazards Resource Directory

### **Alaska West Training Center**

A division of Alaska West Express, inc., the Alaska West Training Center specializes in competency based, "hands-on" experience for hazardous materials training in transportation, emergency response, work place safety and hazardous waste operations.

**Contact:** Alaska West Training Center  
**Address:** 1095 Sanduri Street, Fairbanks, AK 99701  
**Phone:** (907) 456-2223  
**Website:** <http://www.lynden.com/awtc/index.html>

### **Alaska DEC Division of Spill Prevention and Emergency Response**

The Division of Spill Prevention and Response (SPAR) prevents spills of oil and hazardous substances, prepares for when a spill occurs and responds rapidly to protect human health and the environment.

**Contact:** AKDEC Division of Spill Prevention and Response  
**Address:** 410 Willoughby Avenue, Ste. 303, PO Box 111800,  
Juneau, AK 99811-1800  
**Phone:** (907) 465-5250  
**Website:** <http://www.lynden.com/awtc/index.html>



# **City of Homer Local All-Hazard Mitigation Plan**

## ***Draft 2010 Update***

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## **Chapter I – Introduction**

### **A. Purpose of the Plan:**

The purpose of the All-Hazard Mitigation Plan is to fulfill the FEMA requirement under The Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Act), Section 322, Mitigation Planning enacted by Section 104 of the Disaster Mitigation Act of 2000 (DMA) (P.L. 106-390). In accordance with FEMA directives, the City of Homer All-Hazard Mitigation Plan originally adopted in July of 2004 must be updated and revised to reflect the current situation as determined by a review of the mitigation efforts completed under the existing plan and a review of events that have occurred since adoption of the first plan. This plan will identify hazards; establish community goals and objectives and develop mitigation strategies and activities that are appropriate for the City of Homer.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d), as implemented through 44 CFR Part 201.6 requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identifying and prioritizing mitigation actions, encouraging development of local mitigation and providing technical support for those efforts.

The purpose of this plan is to produce a program of activities through actions and projects that will best deal with the City of Homer's hazard problems, while meeting other community needs. This plan will accomplish the following objectives consistent with FEMA planning process guidelines:

- Describe the planning process to include public involvement;
- Conduct an assessment of the risks;
- Determine what facilities, or portions of infrastructure, are vulnerable to a disaster;
- Develop a mitigation strategy to reduce potential losses and target resources;
- Describe how each entity will periodically evaluate, monitor maintain and update the plan; and,
- Describe the process for implementing the plan after adoption by the local governing body of the community and receiving FEMA approval.

## **B. Methodology**

The approach used for the review and update of the City of Homer All-Hazard Mitigation Plan consisted of the following tasks:

1. Coordinate with other agencies and organizations
2. Solicit public involvement
3. Conduct hazard area inventory
4. Review and analyze previous and future mitigation activities
5. Describe the update and review process and schedule for plan maintenance
6. Coordinating the Plan with the Kenai Peninsula Borough and State Hazard Mitigation Plan
7. Submitting to the State Hazard Mitigation Officer for Review
8. Submitting to FEMA Region 10 for Review and Approval
9. Adoption of the Plan following the public hearing process

This All Hazard Local Mitigation Plan Revision contains a list of potential goals and activities with a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan.

This plan summarizes the activities outlined above to assess the effects of hazards in the City of Homer: flooding, earthquake, wildfire and etc. and recommends mitigation strategies and activities.

The mitigation plan will be evaluated and updated every five years. In addition, the plan will be updated, as appropriate when a declared disaster occurs that significantly affects the City of Homer, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than 12 months following the date the disaster declaration occurs.

Routine maintenance of the plan will include updating historical hazard information, completing hazard analysis and adding projects, as new funding sources become available or taking projects off the list when they are accomplished.



## **C. Homer – Background**

The following information was obtained from the DCED Alaska Community Database at this website: [http://www.commerce.state.ak.us/dca/commdb/CF\\_BLOCK.cfm](http://www.commerce.state.ak.us/dca/commdb/CF_BLOCK.cfm)

### **General Location**

Homer is located on the north shore of Kachemak Bay on the southwestern edge of the Kenai Peninsula. The Homer Spit, a 4.5-mile long gravel bar, extends from the Homer shoreline into Kachemak Bay. Homer is 227 road miles south of Anchorage, at the southern-most point of the Sterling Highway. It lies approximately 59.6425<sup>o</sup> North Latitude and -151.54833<sup>o</sup> West Longitude. (Section 19, Township 6 South, Range 13 West, Seward Meridian.) Homer is located in the Homer Recording District. The area encompasses 10.6 square miles of land and 14.9 square miles of water.

### **Climate**

Homer lies in the maritime climate zone. During the winter, temperatures range from 14<sup>o</sup> F to 27<sup>o</sup> F; summer temperatures vary from 45<sup>o</sup> F to 65<sup>o</sup> F. Average annual precipitation is 24 inches, including 55 inches of snow.

### **History**

The Homer area has been home to Kenaitze Indians for thousands of years. In 1895, the U.S. Geological Survey arrived to study coal and gold resources. Prospectors bound for Hope and Sunrise disembarked at the Homer Spit. The community was named for Homer Pennock, a gold mining company promoter, who arrived in 1896 and built living quarters for his crew of 50 on the Spit. Their plans were to mine the beach sands along Cook Inlet, from Homer to Ninilchik. The Homer post office opened shortly thereafter. In 1899, Cook Inlet Coal Fields Company built a town and dock on the Spit, a coal mine at Homer's Bluff Point, and a 7-mile long railroad, which carried the coal to the end of the Homer Spit. Various coal mining operations continued until World War I, and settlers continued to trickle into the area, some to homestead in the 1930s and 1940s, other to work in the canneries built to process Cook Inlet fish. Coal provided fuel for homes, and there is still an estimated 400 million tons of coal deposits near Homer. The City government was incorporated in March 1964. After the Good Friday earthquake in 1964, the Homer Spit subsided approximately 4 to 6 feet, and several buildings had to be relocated.

### **Culture**

While commercial fishing has long been the mainstay of the Homer economy, tourism has become increasingly important. Homer is known as an arts community and is also a gateway community in relation to more remote destinations, such as Kachemak Bay State Park and Lake Clark National Park and Preserve. Activities and events, such as the

Homer Jackpot Halibut Derby and Kachemak Bay Shorebird Festival, draw many participants.

## Population and Economy

The Department of Community and Economic Development certified Homer's population at 5,551 in 2009 (estimated).

Homer is incorporated as a first-class city. It is primarily a fishing, fish processing, trade and service center, and enjoys a considerable seasonal visitor industry. The Homer Spit has two deep water docking facilities: the Deep Water Dock and the newer Pioneer Dock which is home to the U.S. Coast Guard Cutter Hickory and is the home berth of the Alaska Marine Highways Ferry Tustumena. Homer is home of the \$13 million U.S. Fish & Wildlife Visitors Center for the Alaska Maritime National Wildlife Refuge named the Islands and Ocean Visitor Center.

### Employment by Occupation and Industry in Homer (2000 Census)

OCCUPATION		INDUSTRY	
Management/ Professional	585	Agriculture/ Forestry/ Fishing/Mining	115
Sales & Office	327	Construction	116
Farming/ Fishing/ Forestry	55	Manufacturing	54
Construction/Extraction/ Maintenance	169	Wholesale Trade	28
Production/Transportation	234	Retail Trade	198
		Transportation/warehousing/utilities	171
		Information	35
		Finance/Insurance/Real Estate/Rental/Leasing	95
		Professional/Scientific/Management, Administration/Waste Management Services	82
		Education/Health/Social Services	411
		Arts/Recreation/Food & Lodging	256
		Other	110
		Public Administration	90
<b>2000 Totals</b>	<b>1,761</b>		<b>1,761</b>

The annual average unemployment rate from 1990 to 2002 for the Kenai Peninsula Borough has fluctuated between a low of 9.7% in 2001, to a high of 15.5% in 1992 (reported by the State Department of Labor Research and Analysis website).

## **Facilities**

Over 90% of homes are fully plumbed. Water is supplied by a dam and 35-acre reservoir at Bridge Creek, is treated, and stored in a 500,000-gallon tank and a newly constructed 1,000,000-gallon tank, and piped to the majority of homes in the City. The newly completed Water Treatment Plant can treat 2.0 million gallons of water per day, with the potential for another 1.0 million gallons per day when needed due to population growth. Other residents use individual wells or have water delivered to home tanks. City sewage is piped to a deep-shaft sewer treatment plant; capacity is 880,000 gallons per day. Refuse is collected by one of two private trash collection services, and hauled to the Borough operated Class 2 landfill and bale-fill in Homer, at mile 169.3 Sterling Highway. Homer Electric Association operates the Bradley Lake Hydroelectric Plant and is part owner of the Alaska Electric Generation & Transmission Cooperative, which operates a gas turbine plant in Soldotna. It also purchases electricity from Chugach Electric.

## **Transportation**

Homer is accessible by the Sterling Highway to Anchorage, Fairbanks, Canada and the lower 48 states. It is often referred to as “The End of the Road”, because it lies at the terminus of the Sterling Highway. The State owns and operates the Homer Airport, with a 6,700’ asphalt runway, and a seaplane base at Beluga Lake. The City is served by several scheduled and chartered aircraft services. There are four additional private landing strips in the Homer vicinity. The Alaska Marine Highway and local ferry services provide water transportation. The Deep Water Dock was constructed in 1990 and can accommodate vessels up to 800’, displacing 65,000 tons. The Pioneer Dock, constructed in 2001/2002 can accept vessels up to 750’ and displacing 80,000 tons. The Small Boat Harbor has 920 reserved boat slips (up to 85’ boats); 6,000+ linear feet of transient moorage; 48.7 acre boat basin; 2 tidal grids; and a 5 lane load and launch ramp.

## **Chapter II – Adoption Process and Documentation**

The City of Homer All-Hazards Mitigation Plan Update/Revision was developed as a multi-jurisdictional plan in cooperation with the Kenai Peninsula Borough; therefore, the plan was adopted by Resolution (pending approval by the State Hazard Mitigation Officer) by the local governing body as well as the Kenai Peninsula Borough, as incorporated into the Kenai Peninsula Borough All-Hazard Mitigation Plan as an Annex.

## **Chapter III – Planning Process**

### **A. Planning Process**

The City of Homer Fire Chief/Director of Emergency Services along with the City of Homer Planning, Port and Harbor, Library, Police Department, City Council, Public Works Departments and Administrative Staff developed the City of Homer All-Hazard Mitigation Plan 2010 Update/Revision. Various City departments coordinated with agencies to include; the Alaska Division of Homeland Security & Emergency Management and the Kenai Peninsula Borough Office of Emergency Management. These agencies provided information from existing plans including; Alaska State All Hazard Mitigation Plan and the Kenai Peninsula Borough All-Hazard Mitigation Plan. A committee was formed specifically to review the existing All Hazard Mitigation Plan and to formulate changes for the 2010 Update. This committee included: Homer City Manager, Walt Wrede; Police Chief, Mark Robl; Police Lieutenant, Randy Rosencrans; Public Works Director, Carey Meyer; Library Director, Helen Hill, Fire Chief, Bob Painter; Planning and Zoning Technician I and Code Compliance, Officer Dotti Harness; City Planner, Rick Abboud; Port and Harbor Director, Bryan Hawkins; and Homer City Council Member, Barbara Howard. Other city staff and employees provided support and review services of the draft documents and provided helpful feedback to the committee.

The All-Hazard Mitigation Plan Update/Revision Final Draft was then reviewed by the Homer City Council and public comment was sought regarding the drafted plan. The Final Draft was also posted on the City of Homer Web-site to solicit public comment and copies were provide key Stakeholders within the City of Homer requesting review and comment. The City of Homer also relied on information provided by the Kenai Peninsula Borough, U.S. Census, and State of Alaska.

### **B. Contributors**

The City of Homer Volunteer Fire Department, Planning and Zoning, Public Works Department, Library, Police Department, Homer Port and Harbor, Alaska Department of Transportation, Kenai Peninsula Office of Emergency Management, Alaska Division of Homeland Security and Emergency Management, Homer City Council and Mayor, Public, and private sector businesses and non-profit organizations contributed to the development, review, and submission of this document.

### **C. Public Opportunity for Involvement**

In order to enlist public comment on the development of the City of Homer All-Hazard Mitigation Plan 2010 Update/Revision, the Mayor and City Council added the item to the City Council Agenda beginning with the April 12, 2010 meeting. Having the item on the agenda permitted the public to comment on the process and development. Drafts of the 2010 Update were posted on the front page of the City of Homer Website with a feedback form provided for public comment. Input for the plan was also solicited from local stakeholders including: South Peninsula Hospital, Homer Electric Association, local

telecommunications companies (ACS, ATT and GCI). Comments were forwarded to the Review Committee for possible action. *Insert number* comments were submitted.

On April 12, 2010, during the regularly scheduled City Council meeting, public comment was sought on the Draft All-Hazard Plan Update. This meeting was advertised pursuant to Homer City Code and State of Alaska Open Meeting laws. There were *insert number* people that commented.

## Chapter IV– Hazard Identification & Risk Assessment

### A. Hazard Identification

**\*Hazard Matrix – City of Homer**

<b>Flood</b>	<b>Wildland Fire</b>	<b>Earthquake</b>	<b>Volcano</b>	<b>Snow Avalanche</b>	<b>Tsunami &amp; Seiche</b>
Y-M	Y-H	Y-M	Y-M	Y-M	Y-M
<b>Weather</b>	<b>Landslides</b>	<b>Erosion</b>	<b>Drought</b>	<b>Technological</b>	<b>Economic</b>
Y-H	Y-M	Y-H	N	Y-L	Y-M
<b>Biologic</b>	<b>Man-Made</b>				
Y-M	Y-L				

Hazard Identification:

- Y: Hazard is present in jurisdiction but probability unknown
- N: Hazard is not present
- U: Unknown if the hazard occurs in the jurisdiction

Risk:

- L : Hazard is present with a low probability of occurrence
- M : Hazard is present with a moderate probability of occurrence
- H: Hazard is present with a high probability of occurrence

## **B. Profile of Hazard Events**

### **Flood**

Flooding is a natural event and damages occur when humans interfere with the natural process by altering the waterway, developing watersheds, and/or building inappropriately within the floodplain. This flooding threatens life, safety and health; causes extensive property loss; and results in substantial damage. Nationally, on average floods kill about 140 people each year and cause \$6 billion in property damage.

Flooding in Homer can be broken into a number of categories including rainfall-runoff floods, snowmelt floods, ground-water flooding, and stream/creek flash floods. Homer also experiences coastal flooding from storm surge but this will be discussed in the Weather section. These are not exclusive categories as a flood event could have elements of more than one type.

Homer has experienced floods on several occasions in the last 10 years. Major events occurred in 2002 resulting in numerous bridges being washed out on the Kenai Peninsula effectively the peninsula and isolating Homer for several weeks while temporary repairs were made. Two of these

events were declared disasters and resulted in disruptions to the economy by preventing the flow of goods and materials south of Ninilchik except by barge or airplane.

There continue to be local events caused by ground water saturation, snow-melt, water runoff and local topography.

#### **Rainfall-Runoff Floods**

A typical rainfall event occurs in mid to late summer and early fall. The rainfall intensity, duration, distribution and geomorphic characteristics of the watershed all play a role in determining the magnitude of the flood. Runoff flooding is the most common type of flood. They usually result from weather systems that have prolonged rainfall associated with them such as the 2002 events.

#### **Snowmelt Floods**

Snowmelt floods usually occur in the spring or early summer. The depths of the snowpack and spring weather patterns influence the magnitude of river and stream flooding. The Sterling Highway between Homer and Anchor Point is subject to snowmelt flooding each spring.



*Photo shows damage to East End Road following the 2002 flooding event.*



### **Ground-water Floods**

Ground-water flooding occurs when water accumulates and saturates the soil. The water-table rises and floods low-lying areas, including homes, septic tanks, and other facilities. Ground-water flooding can also occur in basements of structures along streams or in low-lying areas. Areas along Kachemak Drive are subject to ground water flooding.

### **Flash Floods**

These floods are characterized by a rapid rise in water. They are often caused by heavy rain on small stream basins, ice jam formation or by dam failure. They are usually swift moving and debris filled, causing them to be very powerful and destructive. Steep coastal areas in general are subject to flash floods. Debris slides are often associated with heavy rains. The 2002 events resulted in several flash floods which closed roads and washed away bridges. Several small creeks and streams in the Homer area produced substantial debris laden flows during this time.

### **Wildland Fires**

Wildland fires occur in every state in the country and Alaska is no exception. Each year, between 600 and 800 wildland fires, mostly between March and October, burn across Alaska causing extensive damage.

Fire is recognized as a critical feature of the natural history of many ecosystems. It is essential to maintain the biodiversity and long-term ecological health of the land. In Alaska, the natural fire regime is characterized by a return interval of 50 to 200 years, depending on the vegetation type, topography and location. The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the fire management planning process and the full range of fire management activities is exercised in Alaska to help achieve ecosystem sustainability, including its interrelated ecological, economic, and social consequences on firefighter and public safety and welfare, natural and cultural resources threatened, and the other values to be protected dictate the appropriate management response to the fire. Firefighter and public safety is always the first and overriding priority for all fire management activities.

#### **Hazard Analysis/Characteristics**

Fires can be divided into the following categories:

**Structure fires** – originate in and burn a building, shelter or other structure. These may subsequently spread to adjacent wildlands.

**Prescribed fires** - ignited under predetermined conditions to meet specific objectives, to mitigate risks to people and their communities, and/or to restore and maintain healthy, diverse ecological systems.

**Wildland fire** - any non-structure fire, other than prescribed fire, that occurs in the wildland.

**Wildland Fire Use** - a wildland fire functioning in its natural ecological role and fulfilling land management objectives.

**Wildland-Urban Interface Fires** - fires that burn within the line, area, or zone where structures and other human development meet or intermingle with

undeveloped wildland or vegetative fuels. The potential exists in areas of wildland-urban interface for extremely dangerous and complex fire burning conditions which pose a tremendous threat to public and firefighter safety.

Fuel, weather, and topography influence wildland fire behavior. Wildland fire behavior can be erratic and extreme causing fire-whirls and firestorms that can endanger the lives of the firefighters trying to suppress the blaze. Fuel determines how much energy the fire releases, how quickly the fire spreads and how much effort is needed to contain the fire. Weather is the most variable factor. Temperature and humidity also affect fire behavior. High temperatures and low humidity encourage fire activity while low temperatures and high humidity help retard fire behavior. Wind affects the speed and direction of a fire. Topography directs the movement of air, which can also affect fire behavior. When the terrain funnels air, like what happens in a canyon, it can lead to faster spreading. Fire can also travel up slope quicker than it goes down.

Wildland fire risk is increasing in Alaska due to the spruce bark beetle infestation. The beetles lay eggs under the bark of a tree. When the larvae emerge, they eat the tree's phloem, which is what the tree uses to transport nutrients from its roots to its needles. If enough phloem is lost, the tree will die. The dead trees dry out and become highly flammable.

Homer like other areas of the Kenai Peninsula has been dramatically affected by the beetle-kill. The vast majority of wildland fires on the Kenai Peninsula are the result of human activities: open burning the most prevalent. Lightning caused fire, though they do occur, are infrequent, especially on the south Kenai Peninsula. Most recent fires in the Homer area: Tracy Avenue Fire, and 17 Mile East End Road Fire were especially threatening to property and potential loss of life. Though located outside Homer City Limits, both recent fires demonstrate the potential for rapid fire spread given the weather conditions, topography and the availability of local and state wildfire fighting crews.

### **Wildland Fire Management in Alaska**

In Homer, wildland fire management is the responsibility of two agencies: Division of Forestry and the City of Homer, Homer Volunteer Fire Department.

The Alaska Division of Forestry has statutory authority of all wildlands within the state of Alaska. The City of Homer provides wildland fire protection under terms of a Cooperative Agreement and Annual Operating Plan with the Division of Forestry (DOF).

These two agencies, along with other mutual-aid fire departments, work together to fight wildfires in and around Homer.

### **Weather**

Weather is the result of four main features: the sun, the planet's atmosphere, moisture, and the structure of the planet. Certain combinations can result in severe weather events that have the potential to become a disaster.

In Homer, there is potential for weather disasters. Wind-driven waves from intense storms produce coastal flooding and erosion. High winds, common on the Kenai Peninsula can topple trees, damage roofs, and result in power outages across vast areas of Homer and the surrounding communities. Heavy snow contributes to the availability of water for the Bradley Lake Hydroelectric Plant, and for keeping the Bridge Creek watershed supplied, but can also cause avalanches or collapse roofs of buildings throughout the area when accumulations are too heavy. A quick thaw can lead to erosion and flooding along creeks and area streams.

## **Winter Storms**

Winter storms originate as mid-latitude depressions or cyclonic weather systems. High winds, heavy snow, and cold temperatures usually accompany them. To develop, they require:

- Cold air - Subfreezing temperatures (below 32°F, 0°C) in the clouds and/or near the ground to make snow and/or ice.
- Moisture - The air must contain moisture in order to form clouds and precipitation.
- Lift - A mechanism to raise the moist air to form the clouds and cause precipitation. Lift may be provided by any or all of the following:
  - The flow of air up a mountainside.
  - Fronts, where warm air collides with cold air and rises over the dome of cold air.
  - Upper-level low pressure troughs.

Each year the Seward Highway between Anchorage and the Kenai Peninsula is closed for intervals due to either avalanche or avalanche control efforts. The longest period the roadway was closed was a two-week period which resulted in local stores running low on perishable commodities and the hospital running low of some supplies and medications.

## **Heavy Snow**

Heavy snow, generally more than 12 inches of accumulation in less than 24 hours, can immobilize a community by bringing transportation to a halt. Until the snow can be removed, airports and major roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage light aircraft and sink small boats. In the mountains, heavy snow can lead to avalanches. A quick thaw after a heavy snow can cause substantial flooding, especially along small streams and in urban areas. The cost of snow removal, repairing damages, and the loss of business can have severe economic impacts on cities and towns.

Injuries and deaths related to heavy snow usually occur as a result of vehicle accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Record heavy snow occurred in Anchorage on March 17, 2002 when two to three feet of snow fell in less than 24 hours over portions of the city. Ted Stevens International Airport recorded a storm total of 28.7 inches, and an observer near Lake Hood measured over 33 inches. The city of Anchorage was essentially shut down during the storm, which fortunately occurred on a Sunday morning when a minimal number of businesses

were open. Both military bases, universities, and many businesses remained closed the following day, and Anchorage schools remained closed for two days. It took four days for snow plows to reach all areas of the city. This snowfall also impacted Homer and the Kenai Peninsula and resulted in airport closures, travel delays, and delays of transportation of foodstuffs and other commodities.

## **Ice Storms**

The term ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. They can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power outages and personal injury. Ice storms result from the accumulation of freezing rain, which is rain that becomes super-cooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations.

Freezing rain develops as falling snow encounters a layer of warm air in the atmosphere deep enough for the snow to completely melt and become rain. As the rain continues to fall, it passes through a thin layer of cold air just above the earth's surface and cools to a temperature below freezing. The drops themselves do not freeze, but rather they become super-cooled. When these super-cooled drops strike the frozen ground, power lines, tree branches, etc., they instantly freeze.

The atmospheric conditions that can lead to ice storms occur most frequently in Southwestern Alaska along the Alaska Peninsula and around Cook Inlet. Brief instances of freezing rain occur frequently along the southern coast of Alaska, but these events generally produce very light precipitation with less than ¼ inch of ice accumulation.

## **High Winds**

In Alaska, high winds (winds in excess of 60 mph) occur rather frequently over the coastal areas along the Bering Sea and the Gulf of Alaska because of coastal storms. High winds, especially across the coast, can also combine with loose snow to produce blinding blizzard conditions and dangerous wind chill temperatures.

They can reach hurricane force and have the potential to seriously damage port facilities, the fishing industry and community infrastructure (especially above ground utility lines).

In the spring of 2003 strong winds across the Kenai Peninsula resulted in wide-spread power outages, downed trees, and structural damage and fanned the flames of a 150 acre wildfire in Anchor Point.

## **Coastal Storms**

From the fall through the spring, low pressure cyclones either develop in the Bering Sea or Gulf of Alaska or are brought to the region by wind systems in the upper atmosphere that tend to steer storms in the north Pacific Ocean toward Alaska. When these storms impact the shoreline, they often bring wide swathes of high winds and occasionally cause coastal flooding and erosion.

Homer has an extensive history of storm damage, especially in the coastal areas along the Homer Spit and adjacent properties. In August of 1989 the U.S. Army Corp of Engineers

published a Storm Damage Reduction Draft Interim Feasibility Report with Engineering Design And Environmental Assessment for the Homer Spit. Over the years attempts have been made to reduce the impacts of coastal storms and subsequent erosion with varying degrees of success and some notable failures. In 1982 significant damage to the sheet pile reinforcement along the Spit prompted the installation of a concrete slab revetment. In a storm in 1984 those repairs were mostly washed away, again resulting in significant damage to the State Highway leading to the end of the Homer Spit. In the 1990's a major project along the western edge of the Spit Road involving the placement of significant large rock revetments along the Spit corridor lessening, but not completely eliminating damage to the roadway during severe storms.

## **Storm Surge**

Storm surges, or coastal floods, occur when the sea is driven inland above the high-tide level onto land that is normally dry. Often, heavy surf conditions driven by high winds accompany a storm surge adding to the destructive force of the flooding waters. The conditions that cause coastal floods also can cause significant shoreline erosion as the flood waters undercut roads and other structures. Storm surge is a leading cause of property damage in Alaska.

Communities that are situated on low-lying coastal lands with gradually sloping bathymetry near the shore and exposure to strong winds with a long fetch over the water are particularly susceptible to coastal flooding.

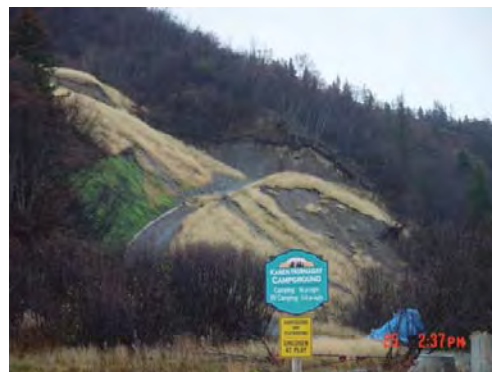
The Homer Spit has a moderate exposure to coastal flooding due to the consistent effects of erosion and the extraordinary tidal range in the region. A storm surge and high water levels resulted in flooding on the Homer Spit in November of 2002.

## **Landslides**

Ground failure can occur in many ways. Types of ground failure in Alaska include landslides, land subsidence, and failures related to seasonally frozen ground and permafrost.

Landslide is a generic term for a variety of downslope movements of earth material under the influence of gravity. Some landslides occur rapidly, in mere seconds, while others might take weeks or longer to develop.

Landslides usually occur in steep areas but not always. They can occur as ground failure of river bluffs, cut-and-fill failures associated with road and building excavations, collapse of mine-waste piles, and slope failures associated with open-pit mines and quarries. Underwater landslides



Homer Landslide 11-02

usually involve areas of low relief and slope gradients in lakes and reservoirs or in offshore marine setting.

Landslides can occur naturally or be triggered by human activities. They occur naturally when inherent weaknesses in the rock or soil combine with one or more triggering events such as heavy rain, snowmelt, changes in groundwater level, and seismic or volcanic activity. They can be caused by long-term climate change that results in increased precipitation, ground saturation and a rise in groundwater level, which reduces the shear strength and increases the weight of the soil. Erosion that removes material from the base of a slope can also cause naturally triggered landslides.

Human activities that trigger landslides are usually associated with construction such as grading that removes material from the base, loads material at the top, or otherwise alters a slope. Changing drainage patterns, groundwater level, slope and surface water, for example the addition of water to a slope from agricultural or landscape irrigation, roof downspouts, septic-tank effluent, or broken water or sewer lines can also cause landslides.

Though the risk of landslide in Homer is low, the majority of town rest on a bench of land bordered on the north with steep slopes and gullies that have historical evidence of slides and sloughing. South Peninsula Hospital is situated immediately below such a steep slope and is subject to landslide damage should one occur. Homer is currently addressing steep slope development to mitigate future impacts from construction in these potentially unstable areas.

The secondary effects of landslides can also be very destructive. Landslide dams cause damage upstream due to flooding and downstream due to a flood which may develop as a result of a sudden dam break. Landslides can also trigger tsunamis and seiches.

## **Land Subsidence**

Land subsidence is any sinking or downward settling of the earth's surface. Underground mining for minerals, ground water or petroleum, and drainage of organic materials are typical causes of subsidence. However, these are rare in Alaska. More common causes of land subsidence in Alaska are sediment compaction and seismic or volcanic activity. The Homer Spit subsided 5 – 6 ft. during the 1964 Good Friday Earthquake.

## **Coastal Erosion in Homer**

Erosion is a process that involves the wearing away and movement of land. Coastal erosion along Kachemak Bay is a natural phenomenon which includes four principal processes that include wave action, rain and wind, high tides, and the freeze-thaw liquefaction of soils.

In 2005 the Kachemak Bay Research Reserve completed a study of erosion rates in Homer. The study provided an estimate of coastal bluff erosion rates based on a series of aerial surveys from 1951 to 2003. The result, the average erosion rates along Homer's shoreline is approximately 0.3-1.2 meters per year.



Homer confronts coastal erosion seasonally, usually with winter storms, especially along the Spit and along Ocean Drive Loop, a residential housing area. A seawall has been constructed in an attempt to protect residential structures from continued erosion. Even before the seawall was completed it was damaged by a moderate storm. Following storms have also damaged the seawall leading the engineering firm to bring lawsuit against the manufacturer of the seawall materials. Portions of the Sterling Highway along the Spit had to be reconstructed when undercut by several strong winter storms in 1998-1999.

West of the Homer Spit, erosion threatens the Sterling Highway where steep bluffs are creeping close to the Sterling Highway. Redirecting portions of the Sterling Highway inland is a project that the State of Alaska, DOT and FEMA are considering.

Protective measures such as seawalls, or revetments, can actually lead to increased erosion. This is because shoreline structures eliminate the natural wave run-up and sand deposition and can increase reflected wave action. The increased wave action can scour in front of and behind structures and prevent the settlement of suspended sediment.

### **Factors Influencing the Erosion Process**

When undeveloped coastlines undergo erosion, it does not present a problem because there is nothing to be damaged. However, pressure to develop and protect properties along the Kachemak Bay is increasing. There are a variety of natural and human-induced factors that influence the erosion process. For example, shoreline orientation, beach composition and exposure to prevailing winds, open ocean swells, and waves all influence erosion rates. Natural factors may include:

- Shoreline type
- Geomorphology of the coast
- Nature of the coastal topography
- Elevation of coastal dunes and bluffs
- Shoreline exposure to wind and waves

Human-induced factors include: Information from *Erosion Responses for Property Owners*, pg 2, 12.

- Shoreline stabilization structures that change the power and direction of waves and of sediment transport.
- Density of development
- Development encroaching into the high hazard zones.
- Altered drainages
- Added water to soil
- Cleared lands
- Change of absorption rate of land surface

## **Earthquake**

Seismic hazards in Alaska come from several sources. The largest earthquakes in the state are caused by subduction of the Pacific plate beneath Alaska. Three of the seven largest earthquakes in the 20th century occurred in Alaska (1957 Aleutian, 1964 Prince William Sound, and 1965 Rat Islands). Although it is generally believed that these great earthquakes are rare, with recurrence times on the order of hundreds of years for an individual segment, five great underthrusting events have occurred in Alaska since 1938. In addition, both the 1986 Andreanof Islands and the 1996 Delarof Islands magnitude 8-class earthquakes reruptured sections of the 1957 zone, even though only 29 and 39 years, respectively, had passed since that great event. In a recent evaluation of the seismic potential in Alaska, researchers indicated that several subduction zone segments may be ready to rupture soon. The Yakataga gap and the region between Kodiak Island and the Shumagin Islands are areas where magnitude 8+ events are expected. A second type of hazard comes from the smaller magnitude 6.8 to 8.0 earthquakes, which occur in many regions of central and southcentral Alaska. These events, while smaller, occur at more frequent intervals, and in locations that cannot always be predicted. On average, Alaska has a magnitude 7.0 or larger earthquake about every two years. Similar in size to recent California earthquakes, these events could cause major damage if they occurred in a populated or strategically sensitive area. A third hazard exists from the many smaller events that often occur near populated areas. While these events are too small to cause widespread damage, they are relatively common and thus pose a continuous threat to urban areas. Alaska Earthquake Information Center personnel locate and report about 22,000 earthquakes each year, and advise federal and state officials of each major earthquake's location and size within 30 minutes. (Alaska Earthquake Information Center, 2010)

### **Hazard Analysis/Characterization**

Most large earthquakes are caused by a sudden release of accumulated stresses between crustal plates that move against each other on the earth's surface. Some earthquakes occur along faults that lie within these plates. The dangers associated with earthquakes include ground shaking, surface faulting, ground failures, snow avalanches, seiches and tsunamis. The extent of damage is dependent on the magnitude of the quake, the geology of the area, distance from the epicenter and structure design and construction. A main goal of an earthquake hazard reduction program is to preserve lives through economical rehabilitation of existing structures and constructing safe new structures.

Earthquakes are usually measured in terms of their magnitude and intensity. Magnitude is related to the amount of energy released during an event while intensity refers to the effects on people and structures at a particular place. Earthquake magnitude is usually reported according to the standard Richter scale for small to moderate earthquakes. Large earthquakes, like those that commonly occur in Alaska are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by these large events. Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from not felt to total destruction. Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building

construction practices. Soil conditions are a major factor in determining an earthquake's intensity, as unconsolidated fill areas will have more damage than an area with shallow bedrock.

Earthquake-induced ground failure is often the result of liquefaction, which occurs when soil (usually sand and coarse silt with high water content) loses strength as a result of the shaking and acts like a viscous fluid. Liquefaction causes three types of ground failures: lateral spreads, flow failures, and loss of bearing strength. In the 1964 earthquake, over 200 bridges were destroyed or damaged due to lateral spreads. Flow failures damaged the port facilities in Seward, Valdez and Whittier. Similar ground failures can result from loss of strength in saturated clay soils, as occurred in several major landslides that were responsible for most of the earthquake damage in Anchorage in 1964.

## **Tsunamis**

Tsunamis are traveling gravity waves in water, generated by a sudden vertical displacement of the water surface. They are typically generated by uplift or drop in the ocean floor, seismic activity, volcanic activity, meteor impact, or landslides (above or under sea in origin).

Most tsunamis are small and are only detected by instruments. Tsunami damage is a direct result of three factors: inundation (extent the water goes over the land), wave impact on structures and coastal erosion.

In 2003, Homer became the first community in Alaska to receive both a Tsunami and Storm Ready Community Designation from the National Weather Service and ADHSEM.

## **Types of Tsunamis**

### **Tele-tsunami**

Tele-tsunami is the term for a tsunami observed at places 1,000 kilometers from their source. In many cases, tele-tsunamis can allow for sufficient warning time and evacuation. No part of Alaska is expected to have significant damage due to a tele-tsunami. There is a slight risk in the western Aleutians and some parts of Southeast Alaska.

Most tele-tsunamis that have reached Alaska have not caused damage. In fact, most tele-tsunamis have had their largest recorded amplitude (in Alaska) at Massacre Bay, Attu Island. The amplitude is usually under 1 foot.

Risk is even less for communities within Kachemak Bay including Homer.

<b><i>Magnitude</i></b>	<b><i>Height (ft)</i></b>
-2 to -1	<1.0 to 2.5
-1 to 0	2.5 to 4.9
0 to 1	4.9 to 9.9
1 to 2	9.9 to 19.7
2 to 3	19.7 to 34.2
3 to 4	34.2 to 79.0
4 to 5	79 to >105.0

Tsunami Magnitude and Height relationships.

## **Volcanic tsunamis**

There has been at least 1 confirmed volcanically triggered tsunami in Alaska. In 1883, a debris flow from the Saint Augustine volcano reportedly triggered a tsunami that inundated Port Graham (across Kachemak Bay from Homer) with waves 30 feet high, although geologic evidence is inconclusive to substantiate the wave height claim. Other volcanic events may have caused tsunamis but there is not enough evidence to report that conclusively. Many volcanoes have the potential to generate tsunamis.

## **Seismically-generated local tsunamis**

Most seismically-generated local tsunamis have occurred along the Aleutian Arc. Other locations include the back arc area in the Bering Sea and the eastern boundary of the Aleutian Arc plate. They generally reach land 20 to 45 minutes after starting.

## **Landslide-generated tsunamis**

Submarine and subaerial landslides can generate large tsunamis. Subaerial landslides have more kinetic energy associated with them so they trigger larger tsunamis. An earthquake usually, but not always, triggers this type of landslide and they are usually confined to the bay or lake of origin. One earthquake can trigger multiple landslides and landslide-generated tsunamis. Low tide is a factor for submarine landslides because low tide leaves part of the water-saturated sediments exposed without the support of the water.

Landslide –generated tsunamis are responsible for most of the tsunami deaths in Alaska because they allow virtually no warning time.

There is some historical evidence of a landslide generated tsunami impacting the Homer area when a large landslide near the Grewingk Glacier across from Homer impacted the glacier lake sending large quantities of water across Kachemak Bay.

Tsunamis generated by landslides in lakes occur more in Alaska than any other part of the U.S. They are associated with the collapse of deltas in glacial lakes having great depths. They may also be associated with delta deposits from rapidly flowing streams and rivers carrying glacial debris.

## **Historical Tsunamis**

### **1964 Earthquake Tsunami**

The 1964 earthquake triggered several tsunamis, one major tectonic tsunami and about 20 local submarine and sub aerial landslide tsunamis. The major tsunami hit between 20 and 45 minutes after the earthquake. The locally generated tsunamis struck between two and five minutes after being created and caused most of the deaths and damage. Tsunamis caused more than 90% of the deaths – 106 Alaskans and 16 Californian and Oregonian residents were killed.

## **Volcanoes**

Alaska is home to 41 historically active volcanoes stretching across the entire southern portion of the State from the Wrangell Mountains to the far Western Aleutians. An average of 1-2 eruptions per year occurs in Alaska. In 1912, the largest eruption of the 20<sup>th</sup> century occurred at Novarupta and Mount Katmai, located in what is now Katmai National Park and Preserve on the Alaska Peninsula.

A volcano is a vent at the Earth's surface through which magma (molten rock) and associated gases erupt, and also the landform built by effusive and explosive eruptions.

Volcanoes display a wide variety of shapes, sizes, and behavior, however they are commonly classified among three main types: cinder cone, composite, and shield.

Homer has been recently impacted by volcanic ash events, the only local volcanic hazard, twice in as many years with the eruptions of Mt. Augustine and Redoubt volcano's.

## **Volcanic Hazards**

As stated, other than the disruption of air traffic into and out of Alaska, the only danger from Cook Inlet Volcano in Homer is ash fall:

## **Volcanic Ash**

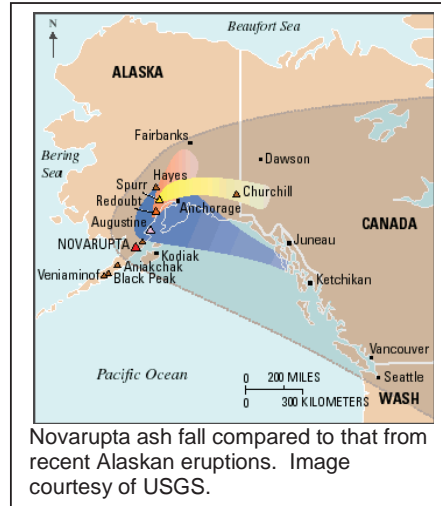
Volcanic ash, also called tephra, is fine fragments of solidified lava ejected into the air by an explosion or rising hot air. The fragments range in size, with the larger falling nearer the source. Ash is a problem near the source because of its high temperatures (may cause fires), burial (the weight can cause structural collapses), and impact of falling

fragments. Further away, the primary hazard to humans is decreased visibility and inhaling the fine ash. Ash will also interfere with the operation of mechanical equipment including aircraft. In Alaska, this is a major problem as many of the major flight routes are near historically active volcanoes. Ash accumulation may also interfere with the distribution of electricity due to shorting of transformers and other electrically components (ash is an excellent conductor of electricity).



### Historic Volcanic Activity

The largest volcanic eruption of the 20<sup>th</sup> century occurred at Novarupta Volcano in June 1912. It started by generating an ash cloud that grew to thousands of miles wide during the three-day event. Within four hours of the eruption, ash started falling on Kodiak, darkening the city. It became hard to breathe because of the ash and sulfur dioxide gas. The water became undrinkable and unable to support aquatic life. Roofs collapsed under the weight of the ash. Some buildings were destroyed by ash avalanches while others burned after being struck by lightning from the ash cloud. Similar conditions could be found all over the area. Some villages ended up being abandoned, including Katmai and Savonoski villages. The ash and acid rain also negatively affected animal and plant life. Large animals were blinded and many starved because their food was eliminated.



The ash fall from this eruption was significantly greater than the recent eruptions of Redoubt, Spurr and Augustine Volcanoes. Fourteen earthquakes of magnitude 6 to 7 were associated with this event. At least 10 Alaskan volcanoes are capable of this type of event.

### Hazard Identification and Assessment

The responsibility for hazard identification and assessment for the active volcanic centers of Alaska falls to the Alaska Volcano Observatory (AVO) and its constituent organizations (USGS, DNR/DGGS, and UAF/GI). AVO is in the process of publishing individual hazard assessments for each active volcano in the State. As of 2002, published or in-press hazard assessments cover the following volcanoes: Hayes, Spurr, Redoubt, Iliamna, Augustine, the Katmai Group, Aniakchak, Shishaldin, Akutan, and Makushin. Additional reports for Shishaldin, Kanaga, Great Sitkin, Westdahl, Dutton, Okmok are expected within the next year or two. Each report contains a description of the eruptive history of the volcano, the hazards they pose and the likely effects of future eruptions on populations, facilities, and ecosystems.

AVO has the primary responsibility to monitor all of Alaska's potentially active volcanoes and to issue timely warnings of activity to authorities and the public. During episodes of volcanic unrest or eruption, AVO is also the agency responsible for characterizing the immediate hazards and describing likely scenarios for an evolving volcanic crisis. AVO uses a 4-color Level of Concern Color Code to succinctly portray its interpretations of the state of activity and likely course of unrest at a given volcano.

Basic information about vulnerable assets and populations are identified in these assessments. However, DCED and other State agencies could work with AVO map data to integrate quantitative, current information regarding communities and other at-risk elements to improve our analysis of vulnerability.



## **C. Vulnerability Assessments**

### **Identification of Assets -**

The Hazard Matrix below includes a list of facilities and/or structures that have been determined to be critical in nature, structures or facilities that would seriously impact not only the quality of life in Homer but also the sustainability and survivability of Homer residents.

Critical Facilities include:

- Essential facilities, which are necessary for the health and welfare of an area and are essential during the response and recovery phase of a disaster such as: public safety facilities, hospital, schools.
- Transportation systems such as: airport, port and harbor, highway and roads.
- Lifeline utility systems such as: potable and waste water treatment plants, electrical generation facilities and power grid and communications systems.

# HAZARD MATRIX FOR THE CITY OF HOMER

City Homer	Flood	Wildfire	Earthquake	Volcano	Man made	Tsunami	Weather	Landslide	Erosion	Tech	Economy	Biologic
Airport		X	X	X	X		X			X	X	X
Banking			X	X	X		X			X	X	X
Churches			X	X	X		X			X	X	X
City Hall			X	X	X		X			X	X	X
Fire Dept			X	X	X		X			X	X	X
Fuel System	X	X	X	X	X	X	X		X	X	X	X
Groceries	X		X	X	X		X			X	X	X
HEA	X	X	X	X	X	X	X	X	X	X	X	X
Landfill		X	X	X	X		X			X	X	X
Library			X	X	X		X			X	X	X
Police Dept			X	X	X		X			X	X	X
Port & Harbor	X		X	X	X	X	X		X	X	X	X
Post Office			X	X	X		X			X	X	X
Public Works	X	X	X	X	X	X	X	X	X	X	X	X
Radio Rpts	X		X	X	X	X	X			X		
Reservoir	X	X	X	X	X		X		X	X		X
Roads	X	X	X	X	X	X	X	X	X	X		
Schools		X	X	X	X		X			X	X	X
Senior Center			X	X	X		X			X	X	X
Sewer System	X	X	X	X	X	X	X			X	X	X
SPH			X	X	X		X	X		X	X	X
Telephone	X	X	X	X	X	X	X	X		X	X	X
Water System	X	X	X	X	X	X	X	X	X	X	X	X

## **Homer's Vulnerability to Identified Hazard:**

In summary, most identified hazards are area wide. The principal hazards of flood, earthquake and wildfire could potentially impact any part of Homer. Flooding events, even for those properties unaffected directly, will suffer due to road closures, impacts to public safety (access and response capabilities), limited availability of perishable commodities, and isolation. Earthquake damage would be area-wide with potential damage to critical infrastructure up to and including the complete abandonment of key facilities. Some critical infrastructure has been seismically upgraded (Fire Station) to protect occupants long enough to exit the building, but no facilities have been hardened sufficiently to remain functional following a high magnitude event. Limited building damage assessors are available in Homer to determine a structures integrity following earthquake damage. Priority would have to be given critical infrastructure to include: public safety facilities, health care facilities, shelters and potential shelters, and finally public utilities. The entire South Zone of the Kenai Peninsula is subject to wildfire conflagration. Perhaps with the exception of portions of the Homer Spit, the entire Homer community could be considered an "interface" zone. History has demonstrated that fire brands can be carried by local winds up to ½ mile, jumping man-made fire lines and spreading fire across large areas. Most areas of homer are immediately adjacent to wildland areas and could be threatened by uncontrolled fire.

Based on tsunami inundation mapping provided by the Alaska Division of Homeland Security and Emergency Management very limited areas of the Homer coast line would be potentially damaged by tsunami, with no critical infrastructure immediately threatened.

Other assessed hazards not affecting the entire area would be landslides and erosion. With limited exceptions due to flooding, landslide danger would impact only those portions of Homer located near the base or top of the inland bluffs which create the "Homer bench" and those properties near the coast (due to storm erosion).

## **Development Trends**

The City has several zoning districts ranging from Conservation to Commercial-Industrial zones. In 2003 the City received the right to regulate development in the Bridge Creek Watershed Protection District (BCWPD) which surrounds the City's water supply. In 2010 the City should complete and adopt the Homer's Comprehensive Plan update.

In 2008 to present, Homer is experiencing downturns in both residential and commercial construction starts, which is similar to development trends in other parts of Alaska.

**Residential:** In the past five years Homer developers have created several urban residential subdivisions with water, sewer, paved streets, some sidewalks and stormwater management. These higher density areas are characterized by single family residents and one development consists of "cluster housing" with eight (8) detached units on one acre.

**Commercial:** In 2007 and 2008 two phone companies built facilities on the Sterling Highway which host their customer service retail needs and their switch terminals. Funding for public

1 projects includes Homer’s Public Library, Homer Water Treatment Plant and expansion for the  
2 hospital, courthouse and college.

### 4 Development Trends

	2004	2005	2006	2007	2008	2009
Number of Zoning Permits Issued	107	103	83	87	62	55
Value of Zoning Permits in millions	\$23.8	\$21.6	\$20.2	\$14.1	\$23.18*	\$8.0
*Water Treatment Plan \$8.5 M.						

## 10 Chapter V– Mitigation Goals, Objectives, & Strategies

### 12 A. Public Education Goals

14 **Objective 1.1:** Provide public education on the prioritized and identified local hazards.  
15 An informed public is crucial to achieving the City’s mitigation goals.

16 *Action 1.1.1: Distribute, display and educate about hazards, flood insurance and*  
17 *the benefits of various protective measures in public outreach programs.*  
18 *Outreach maybe information in a newsletter, on utility bills, in newspapers,*  
19 *public workshops, kiosk at the fire/police hall, and the library. (from CRS Appl.*  
20 *Pg 16)*

21 *Action 1.1.2: Provide the public library with documents about hazards, flood*  
22 *insurance and the benefits of various protective measures.*

23 *Action 1.1.3: Provide on the city’s website information about hazards and*  
24 *include links to relevant pages that have local conditions, protective measures,*  
25 *permit requirements and maps.*

26 **Responsible Parties:** City of Homer; ADHSEM, KPBOEM, West Coast/Alaska  
27 Tsunami Warning Center.

### 29 B. Tsunami Goals

#### 31 1. Tsunami Ready Community Designation (Priority-High)

32 Objective 1.1: Continue to meet the requirements for a Tsunami Ready Community  
33 Certification.

35 *Action 1.1.1: Continue to participate in the NWS/WC&ATWC Tsunami Ready*  
36 *Program.*

37 *Action 1.1.2: Maintain regular tsunami warning siren drills that citizens can*  
38 *learn to recognize and expect.*

**Responsible Parties:** City of Homer, ADHSEM, West Coast/Alaska Tsunami Warning Center, KPBOEM.

## 2. *Tsunami Evacuation Route Signage (Priority-High)*

**Objective 2.1:** Maintain evacuation route signs and Tsunami Warning System.

*Action 2.1.1: Continue to monitor the tsunami evacuation signs on the Homer Spit to Kachemak Drive, East to the junction with East End Road. This route directs people away from the Beluga Slough crossing which is located in the projected tsunami inundation zone.*

**Responsible Parties:** City of Homer, Department of Transportation, ADHSEM, KPBOEM.

## 3. *Encourage City of Homer, Planning & Zoning Office to incorporate high risk areas in land use planning and zoning. (Priority-Medium)*

In 2005 the City of Homer adopted the Tsunami Hazard Map. In 2009 the City adopted updated Flood Insurance Rate Maps. The flood maps are based on a 100 year chance event and do not include tsunamis because the relatively short period of record. Local tsunamis should always be considered before beginning any construction in the coastal areas.

**Objective 3.1:** Reduce the vulnerability of infrastructure and improvements in high risk areas.

*Action 3.1.1: Reduce susceptibility to damage and disruption by incorporating the Tsunami Hazard and the Flood Insurance Rate Maps into the City Planning and Zoning process.*

*Action 3.1.2: New development in tsunami hazard areas to meet the same standards required in the Coastal High Hazard areas per HCC 21.41.CRS Tsunami Credits pg 18.*

*Action 3.1.2: Require the anchoring of fuel tanks, manufactured home, accessory structures and recreational vehicles to be anchored to resist flotation, collapse and lateral movement due to the effects of wind and water loads per HCC 21.41.*

**Responsible Parties:** City of Homer, KPBM, FEMA, NFIP.

## C. Wildfire Goals

There are two phases to addressing the wildfire issue in Homer. The first and foremost revolves around public education (Item A). The second phase focuses on specific mitigation strategies found within the International Urban-Wildland Interface Code™. This code utilizes three mitigation strategies: creation and management of defensible

spaces around threatened structures; wildfire fuel management; and encouraging fire-resistive construction techniques.

### ***1. Create Defensible space.***

**Objective 1.1:** Cooperate with the Division of Forestry in the “Fire Wise” campaign. One of the most useful methods developed for wildfire mitigation has been the concept of “defensible space” thus limiting fuels immediately adjacent to at-risk structures. This strategy was proven during the Mansfield/Hutler Road Fires in which only one structure was lost. The Mansfield Road neighborhood had worked with the fire department in the development of defensible space in the year preceding the fire event. Additional lessons were learned as fire crews and home owners were able to immediately return to the fire area once the fire front had passed and were able to extinguish any remaining fires around their buildings.

**Action 1.1.1:** *Encourage home owners and property owners to remove dead or diseased trees to create “defensible space”.*

**Action 1.1.2:** *Encourage home and business owners to complete a Fire Wise assessment of their home and/or business.*

**Action 1.1.3** *Educate home owners in wildfire resistive construction techniques and strategies to limit their exposure to wildfire.*

**Action 1.1.4** *Provide interested residents with Fire Wise informational packets and brochures.*

**Responsible Parties:** City of Homer, Alaska Division of Forestry, KPB.

### ***2. Control and direct open burning within the City limits of Homer. (Priority-High)***

**Objective 2.1** Limit the number, size and location of burn piles within City Limits. Homer City Code requires that residents obtain an Open Burning Permit anytime during the year for all fires other than “warming fires” (those less than 2 feet in diameter used for cooking or warming). State regulations require residents outside of Homer to have a Burn Permit during the “fire season” of May 1 through the end of September each year.

**Action 2.1.1:** *Issue burn permits to Homer residents who wish to dispose of organic materials. Direct non-residents to the Division of Forestry Website to obtain an open burning permit during the statutory fire season.*

**Responsible Parties:** Homer Volunteer Fire Department, City of Homer, Alaska Division of Forestry.

### ***3. Establish alternative methods of disposal for slash, brush, and organic debris so that residents do not have to use open burning. (Priority-High)***



**Objective 3.1:** Explore alternative methods of debris disposal other than open burning.

*Action 3.1.1 Encourage use of composting, chipping, or grinding as an alternative to burning of woody debris.*

**Responsible Parties:** City of Homer, KPB.

#### **4. Prohibit open burning during high-risk periods. (Priority-High)**

**Objective 4.1:** In cooperation with the Division of Forestry, suspend burn permits and open burning during high fire danger conditions or when other factors will contribute to high fire danger.

*Action 4.1.1 Maintain open lines of communication between the Division of Forestry, National Weather Service, and the Homer Volunteer Fire Department to determine when fire conditions warrant suspension of burn permits or open burning in general.*

*Action 4.1.2 When conditions warrant suspension of burn permits or open burning in Homer, disseminate that information in the form of press-releases to the local radio and print media.*

*Action 4.1.3 When open burning is prohibited, or burn permits are suspended ensure that the Homer Police Department Dispatch center is notified so that they can advise persons that call in to activate their individual permit that a temporary suspension has been placed on open burning.*

*Action 4.1.4 Complete a daily assessment of fire danger during closures or suspensions by 10:00 AM each day to determine the need to continue the closure or resend the closure.*

**Responsible Parties:** Homer Volunteer Fire Department, Alaska Division of Forestry, National Weather Service, KPB-OEM.

#### **5. Develop wildfire fuel load reduction projects such limbing and thinning, especially around critical infrastructure and identified “safe zone” and potential emergency shelters. (Priority-High, Funding Dependent).**

**Objective 5.1:** Review current fuel loads surrounding infrastructure and safety zone/shelter locations identified in the Community Wildfire Protection Plan.

*Action 5.1.1 Develop list of known shelters (from Emergency Plan), safe zones, and critical infrastructure.*

*Action 5.1.2 Review wildfire fuel load and develop mapping of area in need of fuels management activities.*

*Action 5.1.3 Develop and implement fuel reduction plan.*

**Responsible Parties:** Homer Volunteer Fire Department, Alaska Division of Forestry, Kachemak City, KPB.

**Objective 5.2:** Continue collaborative effort between the Community Wildfire Protection Plan and the City of Homer.

*Action 5.2.1 Attend local planning meetings when conducted.*

*Action 5.2.2 Review drafts of the CWPP when available and provide feedback to DOF as appropriate.*

**Responsible Parties:** Homer Volunteer Fire Department, CWPP Stakeholders.

## **D. Earthquake Goals**

### **1. Protect existing critical infrastructure from earthquake damage. (Priority-Medium, Funding Dependent)**

**Objective 1.1:** Perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Homer.

*Action 1.1.1 Identify buildings and facilities that must be able to remain operable during and following a hazard event.*

*Action 1.1.2 Contract a structural engineering firm to assess the identified buildings and facilities to determine their structural integrity and strategy to improve their earthquake resistance.*

**Objective 1.2** Perform those steps identified above to protect critical infrastructure from earthquake damage and to preserve functionality.

*Action 1.2.1 Identify priorities and budget to retrofit existing infrastructure to existing earthquake resistive construction standards.*

*Action 1.2.2 Develop a Request for Proposals to submit for design and construction of the retrofitting requirements.*

**Responsible Parties:** City of Homer, KPB, FEMA Mitigation Programs.

### **2. Building Code Adoption-Seismic Requirement-New Construction (Priority-Low)**

While the State of Alaska has adopted the International Building, Fire and Mechanical Codes that include seismic requirements, there is no State-wide building code for single family, duplex and triplex residential construction. There are no adopted seismic codes for these most vulnerable occupancies.

**Objective 2.1:** Encourage practices of the International Residential Building code, including all 1 and 2 family residential occupancies (State of Alaska adopted Building Code covers residential occupancies greater than 3-plex).

*Action 2.1.1 Reference the International Residential Code (Current Edition) for seismic and wind load requirements.*

**Responsible Parties:** City of Homer, Planning Department, Public Works Department, Homer Volunteer Fire Department.

**3. Existing Buildings – Non-Structural Mitigation Program (Priority-Medium, Funding Dependent)**

Experience demonstrates (Nisqually Earthquake, February 28, 2001) that mitigation programs which emphasizing tie-downs and strapping of book shelves and computers is an effective and economical way to reduce property damage and loss of life during earthquake events.

**Objective 3.1:** Provide technical advice and information to those individuals, businesses and institutions requesting non-structural mitigation program guidance.

*Action 3.1.1 Compile list of available non-structural mitigation resources available to the public.*

**Responsible Parties:** City of Homer, KPBOEM, FEMA.

**E. Flood Goals**

City of Homer updated the Flood Prone Areas section of the Homer City Code 21.41 on September 15, 2009. (Ord. 09-38).

**1. Participation in National Flood Insurance Program (NFIP)(Priority-High).**

Homer participates in the NFIP which is a source of reasonably priced flood insurance for property owners that build to floodplain standards.

**Objective 1.1:** Maintain the City of Homer's participation in the NFIP so that low cost flood insurance is available to residents.

*Action 1.1.1 Annually review the requirements of the National Flood Insurance Program to conform to enrollment objectives and criteria.*

**Responsible Parties:** City of Homer, Planning Department, NFIP, FEMA, KPB.

**2. Update the Flood Hazard Maps and map the City's watershed and drainage patterns. (Priority-High, Funding Dependent)**

The existing flood plain maps were updated and adopted by the City of Homer in 2009. A thorough flood restudy is needed to resolve inconsistent elevations with emphasis on the Homer Spit, Beluga Slough and Beluga Lake. Consider a comprehensive watershed and drainage study that includes future hazards.

**Objective 2.1:** Obtain updated flood plain maps to include all current city limits, the Bridge Creek Watershed, the Homer Spit, Beluga Slough and Beluga Lake.

*Action 2.1.1 Encourage FEMA to restudy and remap the city with emphasis on the Homer Spit, Beluga Slough and Beluga Lake.*

**Objective 2.2: Map the watershed and drainage patterns.**

*Action 2.2.1 Acquire funds to develop a watershed and drainage management plan that identifies important natural water storage, low features critical to flood function and predicts future flood hazards.*

**Responsible Parties:** City of Homer, Alaska Department of Community and Economic Development, FEMA, Federal Insurance and Mitigation Administration, KPB.

### **3. Review flood events to determine mitigation strategies. (Priority-Medium)**

**Objective 3.1:** Coordinate fact finding between Zoning and Planning and Public Works, Kenai Peninsula Borough and the State of Alaska DOT to map areas that experienced flooding.

**Objective 3.2:** Identify and evaluate high risk facilities and infrastructure to determine if changes need to be made to mitigate for future flood conditions.

*Action 3.2.1 Develop overlay map of existing infrastructure (drainages, culvert size, storm drains).*

*Action 3.2.2 Identify high risk city structures.*

*Action 3.2.3 Establish an annual inspection of all stormwater management (public and private) and order maintenance as needed. CRS Credit for Stormwater pg 14).*

*Action 3.2.4 Require maintenance logs on private and public stormwater plans.*

**Responsible Parties:** City of Homer, Alaska Department of Transportation, KPB-OEM.

### **4. Manage development in flood hazard areas (Priority-Medium)**

1  
2 Ensure, through adequate planning and zoning oversight that all development meets the  
3 intent of Chapter 21.41, Flood Prone Areas. In the future, the City may participate in the  
4 Community Rating System(CRS) which is a part of the National Flood Insurance  
5 Program (NFIP). The CRS reduces flood insurance premiums to reflect what a  
6 community does above and beyond the minimum flood standards.  
7

8 **Objective 4.1:** Review Chapter 21.41 to ensure up-to-date requirements are being  
9 addressed.  
10

11 ***Action 4.1.1** Require developers/land owners to provide documentation of*  
12 *compliance with existing Flood Damage Prevention requirements if the project is*  
13 *located within a flood hazard area as defined by City Code.*  
14

15 **Responsible Parties:** City of Homer, Planning and Zoning Office.  
16

17 **Objective 4.2:** Assure that flood loss reduction measures minimize the need for rescue  
18 and relief efforts associated with flooding, and to assure that flood loss reduction  
19 measures are consistent with retaining natural flood function.  
20

21 ***Action 4.2.1** Acquire land in high hazard area to restore or retain flood functions.*  
22 *Aligns with the 1999 Homer Comp. Plan pg 4. CRS 420. KPB Mit. Plan pg 2-71.*  
23

24 ***Action 4.2.2** Identify less hazard prone areas for development. Suitability study*  
25 *and map 2008.*  
26

27 ***Action 4.2.3** Create and maintain buffers and building setbacks from wetlands,*  
28 *creeks, shorelines and drainages. KPB Hazard Mit. Plan p2-68. Landscape*  
29 *Suitability Map pg 49. Floodplain Management Higher Regulatory Standards, p3.*  
30

31 ***Action 4.2.4** In the flood hazard areas and along the bluff, consider “relocatable*  
32 *structures” on skids or pilings versus permanent foundation structures. Coastal*  
33 *Bluff Erosion Study, pg 11, 19.*  
34

35 ***Action 4.2.5.** Require the anchoring of fuel tanks, manufactured homes, and*  
36 *accessory structures to resist flotation, collapse and lateral movement due to the*  
37 *effects of wind and water loads per HCC 21.41*  
38

39 ***Action 4.2.6** Preserve open space and/or relocate structures out of high risk*  
40 *areas. 1999 Comp. Plan. CRS 420. Landscape Suitability Map pg 51.*  
41

42 ***Action 4.2.7** Provide a means to regulate clearing, filling, grading, dredging, and*  
43 *other development which may impact flood, drainage and erosion damage.*  
44 *Floodplain Management Higher Regulatory Standards p31, 59. Landscape*  
45 *Suitability Map pg 31, 33. HMP pg 18.*  
46

**Action 4.2.8** Minimize adverse impacts of alterations of ground and surface waters and natural flow patterns. KPB HMP p 2-71. Landscape Suitability Map 45. Floodplain Management Higher Regulatory Standards p 13, 31 & 59.

**Action 4.2.9** Maintain requirements for stormwater control and mitigation through the enforcement of HCC 21.74 Development Activity Plan and HCC 21.75 Stormwater Plan. Landscape Suitability Map pg 16 & 52.

**Action 4.2.10** Integrate hazard identification, ecosystem protection, protection of community infrastructure and shoreline management into zoning and subdivision ordinances. Coastal Bluff Erosion Study, . Floodplain Management Higher Regulatory Standards p 4 & 5.

**Responsible Parties:** City of Homer

## **F. Ash**

Fresh volcanic ash may be harsh, acidic, gritty and smell like sulfur. Heavy ash-fall may reduce sunlight, causing a sudden demand and possibly brownout of electrical power. Ash can clog watercourses, sewage plants, and all kinds of machinery.

**Objective 1.1:** Protect equipment and personnel from the effects of ash.

**Action 1.1.1** Do not operate non-essential equipment.

**Action 1.1.2** Protect office equipment such as copiers, fax machines, and personal computers.

**Action 1.1.3** Allow employees to get home before an ash-fall occurs.

**Action 1.1.4** Limit outdoor activity.

**Action 1.1.5** Close doors, windows and vents.

**Action 1.1.6** Do not run exhaust-circulating fans.

**Action 1.1.7** Check and change (when needed) oil, oil filter and air filters.

**Action 1.1.8** Wear respirator and eye protection during ash cleanup.

**Action 1.1.9** Establish a communication system to alert employees

**Action 1.1.10** Establish an email alert or a call-in voice recording.

## **G. Technological Hazards**

Technological hazards are manmade activities such as the manufacture, transportation, storage. the use of hazardous materials and our reliance on technology.

**Objective 1.1:** Reduce the community's risk of exposure to hazardous materials.

**Action 1.1.1** Install security systems where hazard materials are stored and/or transferred.

**Objective 1.2:** Protect the community's water supply.



*Action 1.2.1 Install security measure at the city water treatment plant.*

*Action 1.2.2 Secure all remote pump facilities.*

**Objective 1.3:** Ensure that the city has reliable communication:

*Action 1.3.1 Create redundant/back-up capability for landline telephone system.*

*Action 1.3.2 Develop off-site backup information technology system.*

*From: Tab 1, pg 3-2.*

*Action 1.3.3 Prepare for utility disruption.*

*Action 1.3.4 Secure vital records and other important document.*

**Objective 1.4:** Protect the communities ability to operate in case of technological disruptions.

*Action 1.4.1 Encourage local businesses to have adequate cash on hand for emergencies.*

*Action 1.4.2 Encourage local businesses to establish a regular, off-site, computer back-up system.*

*Action 1.4.3 Encourage local businesses to participate in the State's Continuity of Business program through the Department of Homeland Security and Emergency Management.*

**Responsible Parties:** City of Homer, local businesses, ADHSEM, KPBOEM.

## **H. Biological, Chemical and Hazardous Materials**

Liquid or solid contaminants may pose a threat to the community and can easily spread. Biological hazards include both man-made threats (bio-terrorism) and naturally occurring diseases (pandemics).

**Objective 1.1:** Limit the community's vulnerability to biological, chemical and hazardous material incidents.

*Action 1.1.1: Safely store biological, chemical and hazardous materials.*

*Action 1.1.2: Continue to require Fire Marshal certification for all commercial buildings.*

*Action 1.1.3: Monitor, in cooperation with the Department of Health, Public Health Center, spikes in illness that may indicate the spread of a natural or man-made pathogen among the population.*

*Action 1.1.3: Continue participation and leadership in the Community Based Emergency Planning Committee established by Public Health.*

**Responsible Parties:** City of Homer. Alaska Department of Public Health, KPBOEM, State Fire Marshal's Office and South Peninsula Hospital.

## **I. Economic**

Economic disasters can result from uncontrollable natural events that have large effects on a region's economic base. Unfortunately, economic disasters also result from poor business practices, poor risk management and public policies.

### **Assessing Risk**

The first step to long-term mitigation is understanding which economies are at risk and how to reduce those risks through public and private investments. Ways to quantify economic risks include:

- Monitor long-term supply and demand trends,
- Measure the diversity of end-product markets,
- Measure the size and diversity of base industries,
- Measure the growth rates in employment, income and gross sales,
- Monitor the relative dependence on imports,
- Assess the skill levels in the workforce,
- Reduce the cost and dependency of transportation and energy.

### **Objectives and strategies**

Public infrastructure, sensible regulations, public-private partnerships, efficient and coordinated service delivery, industry advocacy, marketing, economic analysis, and the dissemination of timely information all represent legitimate venues for government to promote economic development.

The following objectives define and direct the development of mitigation strategies: KPB Hazard Mitigation Plan.

**Objective 1.1:** Reduce the susceptibility to damage and disruption by avoiding hazardous, uneconomic and unwise development in known hazard areas.

**Objective 1.2:** Reduce unnecessary economic losses and promote positive economic development by incorporating hazard assessment and mitigation into land use and development decisions.

## **Chapter VI – Implementation & Maintenance Procedures**

### **A. Implementation**

The City of Homer will implement this plan by using mitigation actions within our Comprehensive Plan, the Capital Improvement Plan, and other plans to pursue our mitigation goals. Our various community plans will consider best mitigation practices to maximize the benefit to the community. We will consider projects that show they are cost effective by ensuring that for every dollar spent we will reduce loss of life or property damage.

We will use the following criteria to prioritize all community projects:

1           The Planning Commission will analyze and prioritize projects based on:  
2           1. Life saving or personal safety issues  
3           2. Projects will be coordinated with all community plans. For example: the Homer  
4           Comprehensive Plan, the Homer Capital Improvement Plan, the City of Homer All-  
5           Hazard Mitigation Plan, etc.  
6

7           **B. Maintenance**  
8

9           The City of Homer All-Hazard Mitigation Plan will be reviewed annually and will be updated at  
10          a minimum of every five years or 90 days after a Presidential declared disaster. The Director of  
11          Planning will be responsible for ensuring that reviews are completed, the planning commission  
12          and the general public will be notified of opportunities to review the plan by written invitation,  
13          use of newspaper, radio, television, brochures or flyers to advertise this opportunity and solicit  
14          involvement. Public involvement is essential to ensure that the mitigation goals, objectives and  
15          action items are addressing the community's need  
16  
17

## Appendix A

### Glossary of Terms

**Base Flood Elevation (BFE)** - the level of a flood having a 1% chance of occurring in any given year; also referred to as a 100-year flood. Designated on the Floodplain (FIRM) maps.

**Community Rating System (CRS)** – The Community Rating System is a voluntary program that each municipality or county government can choose to participate in. The activities that are undertaken through CRS are awarded point. A community's points can earn people in their community a discount on their flood insurance premiums.

**Critical Infrastructure** – Facilities that are deemed highly important to the health and welfare of the population and that are especially crucial during and after a hazard event. Critical facilities include, but are not limited to: shelters, hospitals, and fire stations.

**Development** – Any man-made change to improved or unimproved real estate, including but not limited to: buildings or other structures, mining, dredging, filling, grading, paving, excavation of drilling operations or any other activity which results in the removal of substantial amounts of vegetation or in the alteration of natural site characteristics located within the area of special flood or coastal high hazard per HCC 21.41.030.

**Digitize** – To convert electronically points, lines and area shown on maps into X and Y coordinates (e.g., latitude and longitude, Universal Transverse Mercator (UTM), for use in computer applications.

**Disaster Mitigation Act** – DMA 2000 (Public Law 106-390) is the latest legislation of 2000 (DMA 2000) to improve the planning process. It was signed into law on October 10, 2000. This legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.

**Earthquake Swarm** – A collection of earthquakes that is frequent in time. There is no identifiable main shock.

**Emergency Operations Plan** – A document that describes: how people and property will be protected in disaster and disaster threat situations; details who is responsible for carrying out specific actions; identifies the personnel, equipment, facilities, supplies, and other resources for use in the disaster; and outlines how all actions will be coordinated.

**Federal Disaster Declaration** – The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended. Same meaning as a Presidential Disaster Declaration.

**Federal Emergency Management Agency (FEMA)** – A federal agency created in 1979 to provide a single point of accountability for all federal activities related to hazard mitigation, preparedness, response, and recovery.

1 **Flood Disaster Assistance** – Flood disaster assistance includes development of comprehensive  
2 preparedness and recovery plans, program capabilities, and organization of federal agencies and  
3 of state and local governments to mitigate the adverse effects of disastrous floods. It may include  
4 maximum hazard reduction, avoidance, and mitigation measures, as well as policies, procedures  
5 and eligibility criteria for federal grant or loan assistance to state and local governments, private  
6 organizations, or individuals as the result of major disaster.

7  
8 **Flood Hazard Area** – The land covered by a flood having a 1% chance of occurring in any  
9 given year. See 100-Year Flood.

10  
11 **Flood Insurance Rate Map (FIRM)** – The official map on which the Federal Insurance  
12 Administration has delineated the 100-Year Flood, the water surface elevation of the base flood  
13 and the flood insurance rate zones.

14  
15 **Flood Insurance Study** – Flood Insurance Study (FIS) is the official report provided by the  
16 Federal Insurance Administration that includes the flood profiles and the water surface elevations  
17 for the estimated 100-Year Base Flood.

18  
19 **Flood Zones** – Zones on the FIRM in which a Flood Insurance Study has established the risk  
20 premium insurance rates.

21  
22 **Hydrology** – The science of the behavior of water in the atmosphere, on the earth's surface, and  
23 underground.

24  
25 **Infrastructure** – The public services of a community that have a direct impact to the quality of  
26 life. Infrastructure refers to communications technology such as phone lines or internet access,  
27 vital services such as public water supply and sewer treatment facilities, and includes an area's  
28 transportation system, regional dams or bridges, etc..

29  
30 **Inundation** – The maximum horizontal distance covered by flood waters, including those  
31 generated by Tsunami.

32  
33 **Katabatic Wind** – Any wind blowing down an incline; the opposite of anabatic wind.

34  
35 **Liquefaction** – The phenomenon that occurs when ground shaking causes loose soils to lose  
36 strength and act like a thick or viscous fluid. Liquefaction causes two types of ground failure:  
37 lateral spread and loss of bearing strength.

38  
39 **Mitigation Plan** – A systematic evaluation of the nature and extent of vulnerability to the effects  
40 of natural or man-made hazards typically present in the area and includes a description of actions  
41 to minimize future vulnerability to those hazards.

42  
43 **One Hundred (100) Year Flood** – The flood elevation that has a 1% chance of occurring in any  
44 given year. See Base Flood Elevation.

1 **Preparedness** – The steps taken to decide what to do if essential services break down,  
2 developing a plan for contingencies, and practicing the plan. Preparedness ensures that people  
3 are ready for a disaster and will respond to it effectively. Actions that strengthen the capabilities  
4 of government, citizens, and communities to respond to disasters.

5  
6 **Riverine Flooding** – Flooding related to or caused by a river, stream, or tributary overflowing its  
7 banks due to excessive rainfall, snowmelt or ice.

8  
9 **Run-Up** – The maximum vertical height of a tsunami in relation to sea level.

10  
11 **Seiche** – An oscillating wave (also referred to as a seismic wave) in partially or fully enclosed  
12 bodies of water. May be initiated by landslide, undersea landslide, long-period seismic waves,  
13 wind and water waves, or a tsunami.

14  
15 **Seismicity** – Describes the likelihood of an area being subject to earthquake.

16  
17 **State Disaster Declaration** – A disaster emergency shall be declared by executive order or  
18 proclamation of the Governor upon finding that a disaster has occurred or that the occurrence or  
19 threat of a disaster is imminent. Along with other provisions, this declaration allows the  
20 Governor to utilize all available resources of the State as reasonably necessary, direct and  
21 compel the evacuation of all or part of the population from any stricken or threatened area if  
22 necessary, prescribe routes, modes of transportation and destinations in connection with  
23 evacuation and control ingress and egress from disaster areas. It is required before a Presidential  
24 Disaster Declaration can be requested.

25  
26 **Storm Surge** – Rise in the water surface above normal water level on open coast due to the  
27 action of wind stress and atmospheric pressure on the water surface.

28  
29 **Subsidence** – Sinking of the land surface, usually due to withdrawals of underground water, oil,  
30 or minerals.

31  
32 **Substantial Damage** – Damage of any origin sustained by a structure whereby the cost of  
33 restoring the structure to its “before-damaged” condition would equal or exceed 50% of the  
34 recent market value of the structure.

35  
36 **Substantial Improvement** – Substantial improvement means any reconstruction, rehabilitation,  
37 addition, or other improvement of a structure, the cost of which equals or exceeds 50% of the  
38 market value of the structure prior to the “start of construction” of the improvement. See HCC  
39 21.41.030.

40  
41 **Vulnerability** – Describes how exposed or susceptible to damage an asset is. Vulnerability  
42 depends on an asset's construction, contents, and the economic value of its functions. The  
43 vulnerability of one element of the community is often related to the vulnerability of another. For  
44 example, many businesses depend on uninterrupted electrical power – if an electrical substation  
45 is flooded, it will affect not only the substation itself, but a number of businesses as well. Other,  
46 indirect effects can be much more widespread and damaging than direct ones.



1 **Vulnerability Assessment** – The extent of injury and damage that may result from a hazard  
2 event of a given intensity in a given area. The vulnerability assessment should address impacts of  
3 hazard events on the existing and future built environment.  
4

5 **Watershed** – An area that drains to a single point. In natural basin, this is the area contributing  
6 flow to a given place or stream.  
7

8 **Wetlands** – Areas that are inundated or saturated frequently and for long enough to support  
9 vegetative or aquatic life requiring saturated or seasonally saturated soil conditions for growth  
10 and reproduction.  
11  
12

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**CITY OF HOMER  
HOMER, ALASKA**

Howard

**RESOLUTION 10-31**

A RESOLUTION OF THE CITY COUNCIL OF HOMER, ALASKA, ADOPTING THE CITY OF HOMER ALL HAZARDS MITIGATION PLAN 2010 UPDATE AND REVISION AND AUTHORIZING THE CITY MANAGER TO FORWARD THE DOCUMENT TO THE KENAI PENINSULA BOROUGH, THE FEDERAL EMERGENCY MANAGEMENT AGENCY, THE ALASKA DIVISION OF HOMELAND SECURITY, AND OTHER ORGANIZATIONS AS APPROPRIATE.

WHEREAS, The Homer City Council recognizes the threat that natural and human generated hazards pose to its residents, their property, public infrastructure, and the health and safety of the community at large; and

WHEREAS, Planning for and implementing actions that avoid or mitigate the impacts of hazards before disasters occur reduces the potential for harm to people and property and saves taxpayer dollars; and

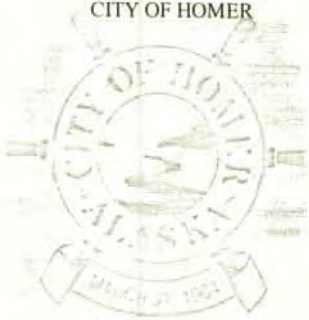
WHEREAS, An adopted All Hazards Mitigation Plan is required as a condition for future grant funding to the City for hazard mitigation projects; and

WHEREAS, The City has provided notice of the draft plan revision and opportunities to comment to its local partners in disaster mitigation, has participated jointly in the planning process with the Borough and other units of government, and held a hearing to solicit comments from the public.

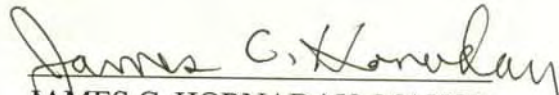
NOW, THEREFORE, BE IT RESOLVED that the Homer City Council hereby approves and adopts the All Hazards Mitigation Plan 2010 Update / Revision.

BE IT FURTHER RESOLVED that the Council authorizes the City Manager to forward the Plan to the Kenai Peninsula Borough, the Federal Emergency Management Agency, the State Division of Emergency Management, and other organizations as appropriate.

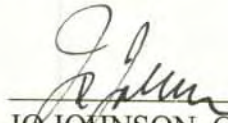
PASSED AND ADOPTED by the Homer City Council this 12<sup>th</sup> day of April, 2010.



CITY OF HOMER

  
JAMES C. HORNADAY, MAYOR

ATTEST:

  
JO JOHNSON, CMC, CITY CLERK

Fiscal Note: N/A

**CITY OF KACHEMAK**

**HAZARD MITIGATION PLAN**

**APRIL 2004**

P.O. Box 958  
Homer, AK 99603  
907-235-8897  
907-235-8854  
[kachemak@xyz.net](mailto:kachemak@xyz.net)





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## Chapter 1 - Introduction

### Purpose of Plan

The purpose of this plan is to fulfill local Hazard Mitigation Plan requirements. The plan will identify hazards; establish community goals and objectives and select mitigation activities that are appropriate for The City of Kachemak.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d) requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identify and prioritize mitigation actions, encourage the development of local mitigation and provide technical support for those efforts.

The purpose of this plan is produce a program of activities that will best address The City of Kachemak's identified hazards and meet other community needs. Consistent with FEMA planning process guidelines, the purpose of this plan is to accomplish the following objectives:

- Ensure that all possible activities are reviewed and implemented so that disaster related hazards are addressed by the most appropriate and efficient solution;
- Link hazard management policies to specific activities;
- Educate residents about potential hazards that threaten the community, including but not limited to flood and debris flow hazards, extreme weather conditions, hazard materials releases, volcanic eruptions and earthquakes;
- Build public and political support for projects that prevent new problems from known hazards and reduce future losses;
- Fulfill planning requirements for future hazard mitigation project grants.
- Facilitate implementation of hazard mitigation management activities through an action plan.

# Hazard Mitigation Plan

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## Methodology

The methodology used for the development and updating of The City of Kachemak Hazard Mitigation Plan, consisted of the following tasks:

1. Public involvement
2. Coordination with other agencies or organizations
3. Hazard identification
4. Problem identification
5. Review and analysis of possible mitigation activities
6. Local adoption following a public hearing
7. Periodic review and update

This hazard mitigation plan contains a list of potential projects and a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan.

This plan summarizes the activities outlined above to assess the effects of hazards in Kachemak City and recommends mitigation activities.

This Hazard Mitigation Plan was formally adopted by the City of Kachemak Council by resolution after conducting a public hearing. The resolution is included in the Appendix.

The Hazard Mitigation Plan will be evaluated and updated every five years. In addition, the plan will be updated as appropriate when a disaster occurs that significantly affects Kachemak, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than the 12 months following the date the disaster occurs.

Routine maintenance of the plan will include adding projects, as new funding sources become available or taking projects off the list when they are accomplished.

## Organization of Plan

The plan is organized as follows:

### **Chapter 1**

Chapter 1 presents sections on the purpose and goals of the plan, methodology used, organization of plan and a background study of the City of Kachemak.

### **Chapter 2**

Chapter 2 identifies and analyses known hazards the City of Kachemak, such as flooding, landslides, fires and earthquake potential, including probability of each event.

### **Chapter 3**

Chapter 3 addresses mitigation measures for the identified natural hazards.

### **Chapter 4**

Chapter 5 outlines the public participation process undertaken during the planning process and for the purpose of prioritizing projects and updating the plan.

### **Chapter 5**

Chapter 6 addresses implementation procedures and a process for updating the plan.

### **Chapter 6**

Chapter 6 contains the references used in this plan.

### **Chapter 7**

Chapter 7 contains appendix materials.

# Hazard Mitigation Plan

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## The City of Kachemak – Background

### General Location

The City of Kachemak is on the East Road, adjacent to Homer, on the Kenai Peninsula. It is on the northern shore of Kachemak Bay. It lies at approximately 59.67° North Latitude and 151.43417° West Longitude (Sec. 23, T006S, R013W, Seward Meridian.). The City of Kachemak is located in the Homer Recording District. The area encompasses 1.6 sq. miles of land and 0.0 sq. miles of water.

### Climate

Winter temperatures average 14° to 27°; summer temperatures typically range from 45° to 65°. Average annual precipitation is 24 inches.

### History

The city was incorporated in 1961 as a city of the second class.

### Economy

Nearby Homer offers a variety of employment opportunities. There are few businesses within the City boundaries; most supplies and services are provided by Homer.

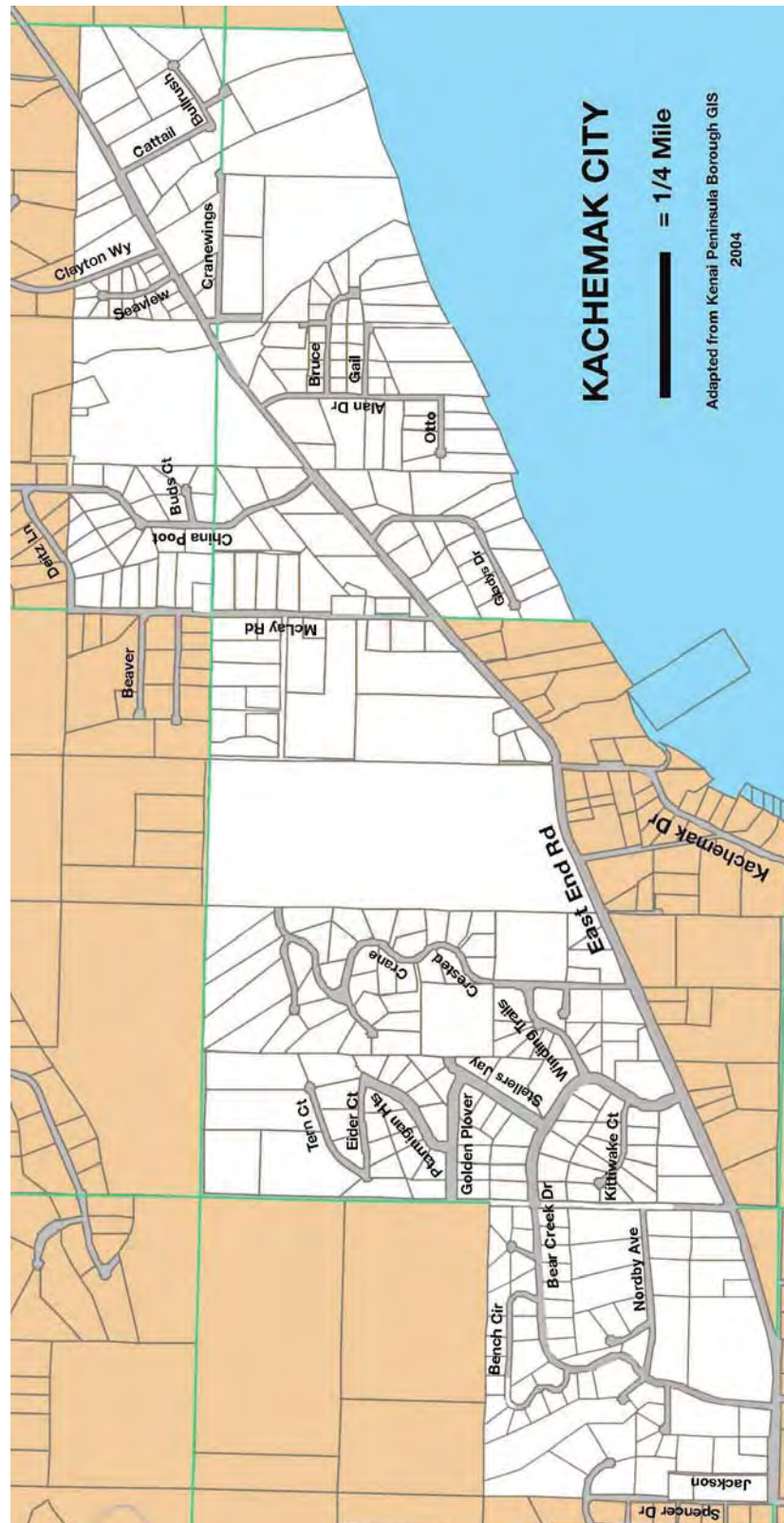
### Facilities

Residents haul water, have water delivered to home storage tanks, or have individual wells and/or cisterns. The City of Homer provides some homes with piped sewer, and the remainder use individual septic tank systems or privies. Approximately 75% of households are fully plumbed. Some homes in this area are used only seasonally. Homer Electric Assoc. purchases electricity from Chugach Electric in Anchorage and distributes it to communities on the west side of the Kenai Peninsula. The Borough operates a refuse collection site off East End Road, or the landfill in Homer is used.

### Transportation

The Sterling Highway provides access to Anchorage and beyond. Homer offers an airport, harbor/dock, and State Ferry access.





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## Chapter 2 – Hazard Analysis

### DISCUSSION

The development of an all hazard mitigation plan for The City of Kachemak requires the analysis of hazards, both natural and technological, that threaten the people, property, and environment within the City. The hazard analysis is the foundation for mitigation strategies, planning and preparedness activities, response capabilities, and recovery and restoration. There are several concepts involved in analyzing the dangers posed by natural and technological hazards. Hazard, vulnerability, and risk have different meanings and are sometimes used interchangeably. This document adopts the following definitions:

#### **Hazard**

Any situation that has the potential for causing personal injury or death, or damage to property and the environment.

#### **Vulnerability**

The susceptibility of people, property, and the environment to death, injury or damage if a hazard manifests its potential.

#### **Risk**

The probability that death, injury, or damage to property and the environment will occur.

The Kenai Peninsula Borough's South Zone Emergency Response Plan hazard information was incorporated and utilized to develop the hazard information in this plan.

Twenty-one hazards believed to have a major impact on local jurisdictions were analyzed. Eleven were identified that pose the most serious threat for causing injury to life or damage to property and the environment within The City of Kachemak.

# Hazard Mitigation Plan

---

The following steps were employed:

## **1. Hazard Identification**

Twenty-one hazards believed to have a major impact on local jurisdictions were analyzed. Eleven were identified that pose the most serious threat for causing injury to life or damage to property and the environment

## **2. Vulnerability Analysis**

The vulnerability analysis identifies what in the community is susceptible to damage should an identified incident occur. The vulnerability analysis provides information on the extent of the affected area, population that could expect to be affected, property that may be damaged, and the environment that may be affected

## **3. Risk Analysis**

The risk analysis assesses the probability of damage or injury taking place in the zone due to an incident occurring and the actual damage that might occur in light of the vulnerability analysis. A “worst case scenario” was chosen for this analysis. The risk analysis provides information on the probability that an incident will occur, the type of harm to people, the type of damage to property, and the type of damage to the environment

As important as knowing the methodology of performing a hazard analysis is, deciding how detailed an analysis to conduct is a major consideration. While a complete analysis of all hazards would be informative, it may not be feasible or practical given resource and time constraints. The value of a limited hazard analysis should not be underestimated. The zone hazard analysis was performed by using qualitative methods and only the major hazards were studied

The method that follows provides the zone with a sense of hazard priorities or relative risk. It doesn't predict the occurrence of a particular hazard but does “quantify” the risk of one hazard compared with another. By doing this, planning can first be focused where the risk is greatest.

## Hazard Identification

<b>HAZARD</b>	<b>COULD THIS HAZARD AFFECT THE CITY OF KACHEMAK</b>	<b>IS THIS HAZARD A SIGNIFICANT THREAT TO THE CITY OF KACHEMAK?</b>
<b>Avalanche</b>  Mass of sliding snow, occurs in mountainous terrain where snow is deposited on slopes of 20 degrees or more.	<b>YES</b>	<b>NO</b>
<b>Civil Disorder</b>  Terrorist attack, riot, violent protest, demonstration, illegal assembly. Certain types of facilities are more vulnerable than others such as government buildings, universities, military bases, nuclear power facilities, correctional facilities.	<b>YES</b>	<b>YES</b>
<b>Dam Failure</b>  Downstream flooding due to the collapse or failure of an impoundment. Risk area is the downstream inundation area as mapped by the Corps of Engineers or state/local agencies.	<b>NO</b>	<b>NO</b>
<b>Drought</b>  Prolonged period without rain.	<b>YES</b>	<b>NO</b>

# Hazard Mitigation Plan

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HAZARD	COULD THIS HAZARD AFFECT THE CITY OF KACHEMAK?	IS THIS HAZARD A SIGNIFICANT THREAT TO THE CITY OF KACHEMAK?
<b>Enemy Attack</b>  Hostile action taken against the U.S. by foreign forces resulting in the destruction of military targets or civilian targets or both. Areas around the country have been designated as high risk areas, host areas, or both.	YES	NO
<b>Earthquake</b>  Sudden motion of the earth's surface, faulting, and ground failure.	YES	YES
<b>Flood</b>  <b>Flash:</b> quickly rising small streams after heavy rain or rapid snowmelt. <b>Urban:</b> overflow of storm sewer system usually due to poor drainage following heavy rain or rapid snowmelt. <b>Tidal Storm:</b> Surge and wave run-up higher than normal tidal range and higher inshore wave run-up due to storm effects in coastal areas.	YES	YES
<b>Hazardous Materials Incident (stationary)</b>  Uncontrolled release of hazardous materials from a fixed site. Areas with hazardous materials fabrication, processing, or storage sites or hazardous waste treatment, storage, or disposal sites are at risk.	YES	YES



## Hazard Analysis

<b>HAZARD</b>	<b>COULD THIS HAZARD AFFECT THE CITY OF KACHEMAK?</b>	<b>IS THIS HAZARD A SIGNIFICANT THREAT TO THE CITY OF KACHEMAK?</b>
<b>Hazardous Materials Incident</b> (transportation)  Uncontrolled release of hazardous materials during transport. Areas at risk would be along highways, rail lines, pipelines, rivers, and port areas.	<b>YES</b>	<b>YES</b>
<b>Hurricane ~ Tropical Storm</b>  Large cyclonic storm accompanied by high winds, extreme rainfall, and storm surge.	<b>NO</b>	<b>NO</b>
<b>Landslide</b>  A mass of sliding mud or rocks.	<b>YES</b>	<b>YES</b>
<b>Nuclear Facility Incident</b> (fixed)  Uncontrolled release of radioactive material at a commercial power plant or other reactor facility. Areas at risk are designated as within the emergency planning zone of such facilities.	<b>NO</b>	<b>NO</b>
<b>Power Failure</b>  Interruption or loss of electrical service for an extended period of time. (An extended period of time would be long enough to require emergency management organization response to needs for food, water, heating, etc., caused by loss of power.)	<b>YES</b>	<b>YES</b>

# Hazard Mitigation Plan

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<b>HAZARD</b>	<b>COULD THIS HAZARD AFFECT THE CITY OF KACHEMAK?</b>	<b>IS THIS HAZARD A SIGNIFICANT THREAT TO THE CITY OF KACHEMAK?</b>
<b>Subsidence</b>  Depressions, cracks, and sinkholes in the ground surface. Areas of high vulnerability are active or abandoned underground mining sites, areas subject to other hazards which could trigger subsidence (i.e. earthquake) or areas of extensive groundwater withdrawal.	<b>YES</b>	<b>NO</b>
<b>Tornado</b>  A small radius cyclonic windstorm.	<b>YES</b>	<b>NO</b>
<b>Transportation Accident</b>  An incident involving passenger air or rail travel resulting in death or injury. Risk areas would be around airports with FAA control towers or with traffic flow heavy enough to pose a hazard and passenger rail lines.	<b>YES</b>	<b>NO</b>
<b>Tsunami</b>  Seismic sea wave usually generated by submarine geophysical displacement.	<b>YES</b>	<b>NO</b>

## Hazard Analysis

---

HAZARD	COULD THIS HAZARD AFFECT THE CITY OF KACHEMAK?	IS THIS HAZARD A SIGNIFICANT THREAT TO THE CITY OF KACHEMAK?
<b>Urban Fire</b>  Uncontrolled burning in residential, commercial, industrial, or other properties in developed areas. All urban areas are at risk to personal injury or property damage due to fire.	YES	YES
<b>Volcanic Eruption</b>  An eruption from the earth's interior producing severe blast effects, turbulent clouds of ash and gases, lighting discharges, volcanic mudflows, pyroclastic flows, corrosive rain, flash floods, outburst floods, earthquakes and tsunamis.	YES	YES
<b>Wildfire</b>  Any instance of uncontrolled burning in grasslands, brush or woodlands.	YES	YES
<b>Winter Storm (severe)</b>  Includes ice storm, blizzard, and extreme cold. Vulnerable areas would be subject to heavy snowfall, combined snow and high winds, or ice storms.	YES	YES

# Hazard Mitigation Plan

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## Hazard Assessment

The following are explanations of hazards that threaten The City of Kachemak.

### CIVIL DISORDER

**Definition: Domestic terrorist attack, riot, violent protest, demonstration, illegal assembly. Certain types of facilities are more vulnerable than others such as government buildings, universities, military bases, nuclear power facilities, correctional facilities.**

Civil disturbance and terrorism may be seen as the two extremes of a continuum of activity ranging from lawful protest, such as strikes against a particular employer, through sabotage of governmental facilities, to the taking of hostages and assassinations. At the various seats of local government, the employees and facilities may become targets for acts of terrorism or civil disturbance. In addition, facilities of City, Borough, State, and Federal agencies exist within the area which may also become the focus for violent activity. Finally, persons or organizations determined to disrupt normal activities may attempt to damage or destroy such vital services as phone, electricity, water, and others. Results of these and other actions may precipitate other emergencies such as fire, flood, transportation, hazardous materials incidents, and others. Persons and property at risk depends on the nature and extent of the incident.

In conclusion, pre-planning and “worst case scenario” analysis are ways to begin mitigation for civil disturbance and acts of terrorism.

## 1. HAZARD

Civil Disorder

## 2. VULNERABILITY ANALYSIS

- |           |   |   |
|-----------|---|---|
| <b>a.</b> | <b>Vulnerability Zone</b>                   | Area specific.  |
| <b>b.</b> | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.  |
| <b>c.</b> | <b>Property that may be damaged</b>         | Damage to, buildings, facilities, utilities and communications systems; disruption of vital services such as water, sewer, power, gas and transportation; damage to and disruption of emergency response facilities, resources and systems. |
| <b>d.</b> | <b>Environment that may be affected</b>     | All flora and fauna.  |

## 3. RISK ANALYSIS

- |           |  |  |
|-----------|--|--|
| <b>a.</b> | <b>Probability of Occurrence</b>               | Low  |
| <b>b.</b> | <b>Consequences to People</b>                  | Injuries and deaths; hardship due to the disruption of vital services such as water, sewer, power, gas and transportation; disruption of emergency response facilities, resources and systems. |
| <b>c.</b> | <b>Consequences to Property</b>                | Loss of service systems such as water, sewer, power, property government, gas and transportation; damage to emergency response facilities, resources and systems.                              |
| <b>d.</b> | <b>Consequences to Environment</b>             | Gross destruction to all types of property; environmental degradation.   |
| <b>e.</b> | <b>Probability of Simultaneous Emergencies</b> | High   |
| <b>f.</b> | <b>Unusual Conditions</b>                      | N/A  |

# Hazard Mitigation Plan

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## EARTHQUAKE

**Definition:** Sudden motion of the earth's surface, faulting, and ground failure.

Approximately 11 percent of the world's earthquakes occur in Alaska. Of the six largest earthquakes in the world, three occurred in Alaska. The vast majority of the large earthquakes in Alaska occur along the Aleutian Islands, the Alaska Peninsula, and the Kenai Peninsula. This belt is known as the Alaska-Aleutian subduction zone. The earthquakes result from slipping along the contact zone of the Pacific and Alaska plates. These earthquakes typically cause very strong shaking which last several minutes; significant, permanent uplift or subsidence over very large areas; very large seismic sea waves or tsunamis; extremely high wave runup of a few to more than 90 feet locally; and many landslides, snow avalanches, and submarine slumps at distances out to 160 miles from the epicenter.

The general effects of these events include structural damage to bridges, buildings, port and harbor facilities, airport facilities, utilities, and communications systems. In addition, an earthquake of between 6.0 to 8.0 on the Richter scale may be expected to result in additional natural/environmental emergencies such as tsunamis, floods and landslides; industrial/technological emergencies such as fires, explosions, and hazardous materials incidents; disruption of vital services such as water, sewer, power, gas and transportation; damage to and disruption of emergency response facilities, resources and systems; civil and political emergencies such as looting, and damage to water impoundment structures.

The South Zone experiences frequent earthquakes below the 6.0 level. Since 1899, at least 82 earthquakes of Richter magnitude 6.0 or greater have been recorded in the Cook Inlet area, and 26 of these were actually triggered within the area.

Persons and property at risk in the South Zone are dependent on the severity of the earthquake. The severity in part can be expressed in terms of both intensity and magnitude. Intensity is based on the observed effects of ground shaking on people, buildings, and natural features. This is measured with the Modified Mercalli Intensity Scale. Magnitude is related to the amount of seismic energy released at the hypocenter of the earthquake. This is measured with the Richter Magnitude Scale. The maximum threat would be the "worst case scenario" with the above mentioned effects impacting the entire South Zone.

In conclusion, the South Zone has a rapidly developing urban and transportation infrastructure which is vulnerable to an extremely high level of earthquake hazard. Only through increased knowledge of the hazard and the carrying out of loss/reduction measures can we begin to mitigate this potential hazard.



## 1. HAZARD

Earthquake

## 2. VULNERABILITY ANALYSIS

- |           |   |  |
|-----------|---|--|
| <b>a.</b> | <b>Vulnerability Zone</b>                   | Entire City.   |
| <b>b.</b> | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.   |
| <b>c.</b> | <b>Property that may be damaged</b>         | Structural damage to bridges, buildings, facilities, utilities and communications systems; disruption of vital services such as water, sewer, power, gas and transportation; damage to and disruption of emergency response facilities, resources and systems. |
| <b>d.</b> | <b>Environment that may be affected</b>     | Land subsidence and deformation, earth fissures, landslides, mass wasting, forest "blow down", damage due to flooding, and environmental degradation.  |

## 3. RISK ANALYSIS

- |           |  |  |
|-----------|--|--|
| <b>a.</b> | <b>Probability of Occurrence</b>               | High   |
| <b>b.</b> | <b>Consequences to People</b>                  | Injuries and deaths from structure collapse, land deformation, mass casualties.                |
| <b>c.</b> | <b>Consequences to Property</b>                | Gross destruction to all types of property.  |
| <b>d.</b> | <b>Consequences to Environment</b>             | Gross alterations to natural landforms and environmental degradation from hazardous materials. |
| <b>e.</b> | <b>Probability of Simultaneous Emergencies</b> | High   |
| <b>f.</b> | <b>Unusual Conditions</b>                      | Civil and political emergencies such as looting.   |

# Hazard Mitigation Plan

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## ENERGY SHORTAGES

**Definition:** The shortage, interruption or loss of vehicle fuel, heating oil, natural gas and electrical service for an extended period of time that would require emergency management organizations to respond.

Energy shortages would include the shortage or interruption of vehicle fuel, heating oil, LP gas or disruptions of electrical power. The area's supply of fuel, heating oil, LP gas, and production of electrical power may be affected by international, national or Alaska conditions, or as a result of major natural or technological emergencies such as earthquakes or periods of unusually cold weather. The moment at which a reduction in supply becomes an emergency, or requires specific action is difficult to pinpoint. Conditions may be exacerbated by panic buying, hoarding, or the time of year in which the crisis occurs. Short of declarations of emergency by either the Governor of the State of Alaska, or by the President of the United States, the fuel supply of the United States is designed to respond to market conditions. People and property at risk are dependent on the extent of shortages or outages. It may involve small segments of the population in isolated instances or can be zone wide.

In conclusion, mitigation depends again on public education and awareness for individuals to be prepared to function without normal sources and supplies of energy and for entities such as hospitals, administrations, emergency services, and other vital agencies to have in place alternate and/or backup supplies and capabilities for energy use.

## 1. HAZARD

Energy Shortages

## 2. VULNERABILITY ANALYSIS

- |    |   |  |
|----|---|--|
| a. | <b>Vulnerability Zone</b>                   | Entire City.   |
| b. | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.   |
| c. | <b>Property that may be damaged</b>         | Shortage or interruption of vehicle fuel, heating oil, gas or disruptions of electrical power. |
| d. | <b>Environment that may be affected</b>     | None anticipated.  |

## 3. RISK ANALYSIS

- |    |  |   |
|----|--|---|
| a. | <b>Probability of Occurrence</b>               | Moderate  |
| b. | <b>Consequences to People</b>                  | Hardship due to the disruption of vital services such as water, sewer, power, gas and transportation; disruption of emergency response facilities, resources and systems. |
| c. | <b>Consequences to Property</b>                | Loss of service systems such as water, sewer, power, gas and transportation; damage to emergency response facilities, resources and systems.                              |
| d. | <b>Consequences to Environment</b>             | N/A   |
| e. | <b>Probability of Simultaneous Emergencies</b> | Low   |
| f. | <b>Unusual Conditions</b>                      | N/A   |

# Hazard Mitigation Plan

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## FIRE

**Definition:** Wildland fire: Any instance of uncontrolled burning in grasslands, brush or woodlands

Urban fire: Uncontrolled burning in residential, commercial, industrial or other properties in developed areas.

Wildland/Urban The wildland/urban interface is defined as Interface: the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation. It is synonymous with the term "intermix."

The City of Kachemak has the potential to experience both large structural and urban/wildland interface fires. Large wildland fires within the South Zone also have the potential to affect the City from secondary effects such as air space and road closures due to smoke. Fires may arise as isolated incidents, or be caused by other emergencies such as earthquakes.

In addition, they may be complicated by the presence of hazardous materials, and extreme weather conditions. There is a history of large wildland fires in the South Zone. The increasing numbers of beetle killed forest within the South Zone coupled with the beetle kill corridor down the peninsula may have the potential for a large wildfire, given the right mix of fire weather and fire behavior. Under certain conditions, the increased beetle kill forest may increase the potential for fire starts of urban/wildland fires in formerly low risk areas. The potential risk to property and people can be great given the correct mix of extreme fire weather and increased fuel loading.

In conclusion, mutual aid and cooperative fire agreements are a must for long term mitigation along with hazardous fuel reduction, public education and awareness, and evacuation planning.

## 1. HAZARD

Fire

## 2. VULNERABILITY ANALYSIS

- |    |   |   |
|----|---|---|
| a. | <b>Vulnerability Zone</b>                   | The entire City where there is wildland/urban interface and/or wildlands. |
| b. | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.  |
| c. | <b>Property that may be damaged</b>         | Equipment, vehicles, and structures.                                      |
| d. | <b>Environment that may be affected</b>     | Flora, fauna, air quality and watersheds.                                 |

## 3. RISK ANALYSIS

- |    |  |   |
|----|--|---|
| a. | <b>Probability of Occurrence</b>               | Moderate  |
| b. | <b>Consequences to People</b>                  | Displacement, loss of life, injury, respiratory distress.   |
| c. | <b>Consequences to Property</b>                | Destruction of structures, equipment, facilities, powerlines, vehicles and property. Disruption to transportation modes due to smoke and ash. |
| d. | <b>Consequences to Environment</b>             | Destruction of current flora and fauna; vegetation type change; short-term degradation of air quality.  |
| e. | <b>Probability of Simultaneous Emergencies</b> | Low   |
| f. | <b>Unusual Conditions</b>                      | Extended drought and/or wind conditions elevate potential for a significant fire event.   |

# Hazard Mitigation Plan

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## FLOOD

**Definition:** Flash: Quickly rising small streams after heavy rain or rapid snowmelt.

Urban: Overflow of storm sewer system usually due to poor drainage following heavy rain or rapid snowmelt.

Tidal/Storm: Surge and wave run-up, higher than normal tidal range and higher inshore wave run-up due to storm effects in coastal areas.

The City of Kachemak is at risk to flooding from heavy rains and rapid snow melt; tidal storm surges and wave runup. The effects of flooding would most likely be a disruption of vital services such as water, sewer, power, transportation; damage to bridges, buildings, facilities, utilities and communications systems and additional natural/environmental emergencies such as landslides.

Populations at risk depends on the extent of the scope of flooding, "worst case scenario" would affect the entire South Zone to some degree.

Again, mitigation depends heavily on public awareness and individual preparation along with the restoration of services, public sheltering capabilities, and adequate warning systems to reduce the loss of life and property.



## 1. HAZARD

Flood

## 2. VULNERABILITY ANALYSIS

- |           |   |   |
|-----------|---|---|
| <b>a.</b> | <b>Vulnerability Zone</b>                   | All drainages within the City boundaries.   |
| <b>b.</b> | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.  |
| <b>c.</b> | <b>Property that may be damaged</b>         | Structural damage to roads, bridges, buildings, facilities, utilities and communications systems; disruption of vital services such as water, sewer, power, gas and transportation; damage to and disruption of emergency response facilities, resources and systems. |
| <b>d.</b> | <b>Environment that may be affected</b>     | Destruction of flora and fauna.   |

## 3. RISK ANALYSIS

- |           |  |   |
|-----------|--|---|
| <b>a.</b> | <b>Probability of Occurrence</b>               | Moderate  |
| <b>b.</b> | <b>Consequences to People</b>                  | Injuries and deaths from being trapped by flood waters; need for sheltering due to loss of homes.   |
| <b>c.</b> | <b>Consequences to Property</b>                | Destruction to structures, equipment, and vehicles; disruption of transportation modes and services due to destruction of infrastructure. |
| <b>d.</b> | <b>Consequences to Environment</b>             | Destruction of flora and fauna; degradation of water quality.   |
| <b>e.</b> | <b>Probability of Simultaneous Emergencies</b> | High  |
| <b>f.</b> | <b>Unusual Conditions</b>                      | N/A   |

# Hazard Mitigation Plan

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## HAZARDOUS MATERIALS

**Definition: Stationary Releases:** The uncontrolled release of hazardous materials from a fixed site; such as hazardous materials fabrication, processing or storage sites, or hazardous waste treatment, storage or disposal sites.

**Transportation Releases:** The uncontrolled release of hazardous materials being transported via highways, railway, pipelines, waterways or by air.

Hazardous materials refers generally to hazardous substances, petroleum, natural gas, synthetic gas, acutely toxic chemicals and other toxic chemicals. Hazardous material incidents addressed include both fixed facilities (manufacturing, processing, storage, and disposal) and during transportation (highway, waterway, rail, and air).

The main east/west road corridor between the City of Homer and the outlying areas along Kachemak Bay transects through The City of Kachemak, over which hazardous materials may be transported. All classes of hazardous materials may be expected on this route with the most frequent materials being petroleum products (eg. fuel and heating oil) and propane gas.

In addition, there are a number of fixed sites where hazardous materials are stored. Currently there is a bulk fuel facility and a bulk propane facility located within The City of Kachemak.

Historically, the hazardous material incidents in the area have involved petroleum products. Numerous small incidents from fixed sites have occurred. Major incidents have impacted the City but occurred outside the City.

## 1. HAZARD

Hazardous Materials

## 2. VULNERABILITY ANALYSIS

- |    |   |   |
|----|---|---|
| a. | <b>Vulnerability Zone</b>                   | Transportation corridors and fixed sites as identified within the City.   |
| b. | <b>Population within Vulnerability Zone</b> | Approximately 500 residents given “worst case scenario”.  |
| c. | <b>Property that may be damaged</b>         | Dependent on type of material, quantity, location, and prevailing environmental conditions (i.e. state of the weather and sea). |
| d. | <b>Environment that may be affected</b>     | Flora, fauna, ecosystems, air and water quality.  |

## 3. RISK ANALYSIS

- |    |  |   |
|----|--|---|
| a. | <b>Probability of Occurrence</b>               | Moderate  |
| b. | <b>Consequences to People</b>                  | Full spectrum from no effect to mass casualties and fatalities.                                   |
| c. | <b>Consequences to Property</b>                | Physical damage to inhabitable, non-usable.   |
| d. | <b>Consequences to Environment</b>             | Damage, loss, destruction of flora, fauna, air and water quality to entire ecosystem destruction. |
| e. | <b>Probability of Simultaneous Emergencies</b> | High  |
| f. | <b>Unusual Conditions</b>                      | N/A   |

# Hazard Mitigation Plan

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## Landslide

**Definition:** A mass of sliding mud or rocks.

Landslide is a generic term for a variety of downslope movements of earth material under the influence of gravity. They can occur as ground failure of river bluffs, cut and fill failures associated with road and building excavations and slope failures associated with open pit mines and quarries. Landslides can occur naturally or be triggered by human activities. They occur naturally when inherent weakness in the rock or soil combine with one or more triggering events such as heavy rain, snowmelt, changes in groundwater level, and seismic or volcanic activity. Erosion that removes material from the base of a slope can also cause naturally triggered landslides.

Three main factors that influence landslides are topography, geology, and precipitation. Topography and geology are associated with each other, the steeper the slope, the greater the influence from gravity. Rock strength is important as certain bedrock formation or rock types appear to more prone than others to landsliding. Precipitation may erode and undermine slope surfaces. If precipitation is absorbed into the ground, it increases the pore water pressure and lubricates weak zones of rock or soil.

The City of Kachemak is at risk from the following types of landslides:

### **Falls**

Falls occur when masses of rock or other materials detach from a cliff or other steep slope and move downhill by free fall, rolling or bouncing. The movement is very quick. The typical slope angle involved is 45 to 90 degrees. Debris falls are a type of fall that involves a mixture of soil, regolith (unconsolidated weathered rock and soil material), vegetation and rocks.

### **Slides**

Slides are characterized by shear displacement along one or several surfaces.

## Flows

In general, a flow is a moving mass that differential internal movements that are distributed throughout the mass. They differ from slides by their higher water content and the distribution of velocities that resemble a viscous fluid. Flows in debris include soil creep, solifluction, block stream, debris flows and debris avalanche.

Soil creep is an imperceptibly slow steady movement of slope forming soil or rock due to gravity. Creep can occur due to alternate wetting and drying which expands and contracts the ground. Creep is more of a problem where the ground freezes and thaws or where clay minerals are present because many of them expand considerably when they contact water. Evidence of soil creep includes bent fences or retaining walls, curved tree trunks and tilted poles.

A debris flow is a rapid movement of loose soil, rock and organic matter combined with water and air to form a downward-moving slurry. The slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way. Debris flows tend to occur on slopes in the 20-45 degree range. They are usually associated with unusually heavy precipitation or with rapid snowmelt. They can also occur following the bursting of a natural dam formed by landslide debris.

Mudflows are flows of fine-grained material such as silt or clay, with a high water content. They differ from debris flows only in the size of their component materials (over 50% sand, silt and clay sized particles).

Landslides are often associated with other hazards. For example, a landslide may occur during floods because both involve precipitation, runoff and ground saturation. Landslides are often associated with seismic events. Some of the costliest landslides were associated with the 1964 Good Friday earthquake. It has been estimated that ground failure caused 60% of the damage.

Again, mitigation depends heavily on public awareness and individual preparation along with the restoration of services, public sheltering capabilities, and adequate warning systems to reduce the loss of life and property.

# Hazard Mitigation Plan

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## 1. HAZARD

Landslide

## 2. VULNERABILITY ANALYSIS

- |           |   |   |
|-----------|---|---|
| <b>a.</b> | <b>Vulnerability Zone</b>                   | All sloped areas and drainages within the City boundaries.  |
| <b>b.</b> | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.  |
| <b>c.</b> | <b>Property that may be damaged</b>         | Structural damage to roads, bridges, buildings, facilities, utilities and communications systems; disruption of vital services such as water, sewer, power, gas and transportation; damage to and disruption of emergency response facilities, resources and systems. |
| <b>d.</b> | <b>Environment that may be affected</b>     | Destruction of flora and fauna.   |

## 3. RISK ANALYSIS

- |           |  |   |
|-----------|--|---|
| <b>a.</b> | <b>Probability of Occurrence</b>               | High  |
| <b>b.</b> | <b>Consequences to People</b>                  | Injuries and deaths from being trapped by flood waters and debris flows, need for sheltering due to loss of homes.                        |
| <b>c.</b> | <b>Consequences to Property</b>                | Destruction to structures, equipment, and vehicles; disruption of transportation modes and services due to destruction of infrastructure. |
| <b>d.</b> | <b>Consequences to Environment</b>             | Destruction of flora and fauna; degradation of water quality.   |
| <b>e.</b> | <b>Probability of Simultaneous Emergencies</b> | Moderate  |
| <b>f.</b> | <b>Unusual Conditions</b>                      | N/A   |



## VOLCANIC ERUPTION

**Definition:** An eruption from the earth's interior producing severe blast effects, turbulent clouds of ash and gases, lighting discharges, volcanic mudflows, pyroclastic flows, corrosive rain, flash floods, outburst floods, earthquakes and tsunamis.

The Kenai Peninsula is the start of the famed "Pacific Rim of Fire". Six volcanoes are located along the west side of Cook Inlet that can impact the City: Mt. Hayes, Mt. Spurr, Mt. Redoubt, Mt. Iliamna, Mt. Augustine, and Mt. Douglas. These volcanoes are classified as strombolian type, with their main characteristic being mildly explosive, and have been active for some time, as indicated by numerous buried ash layers in surrounding soils. There have been four eruptive episodes in the recent past. Three of these, Mt. Augustine, Mt. Redoubt and Mt. Spurr have been "active and eruptive" in the last two decades.<sup>\*</sup> The effects associated with volcanism include severe blast effects, turbulent clouds of ash and gases, lighting discharge, volcanic mudflows, pyroclastic flows, corrosive rain, flash flood, outburst floods, earthquakes, and tsunamis. Some of the results of these activities have been ash fallout in various communities, disruption of air traffic, road transportation and maritime activities. Vulnerability is dependent on the type of activity and current weather, especially wind patterns.

In conclusion, hazards from volcanic eruption in the City are from secondary results, and actions needed are to be able to cope with potential long term effects and continual activity from the volcanoes. The ability to function and carry out services in airborne ash environments is a way to mitigate these effects as well as a public information to inform the public during an event along with public education and individual awareness.

\* Recent eruptions include Redoubt 1989 and 2009, Spurr 1992, Augustine 1986, 2005.

# Hazard Mitigation Plan

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## 1. HAZARD

Volcanic Eruption

## 2. VULNERABILITY ANALYSIS

- |           |   |  |
|-----------|---|--|
| <b>a.</b> | <b>Vulnerability Zone</b>                   | Entire City.   |
| <b>b.</b> | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.   |
| <b>c.</b> | <b>Property that may be damaged</b>         | Buildings subject to heavy loading due to ash fallout; ash take up in ventilation systems (eg. schools, hospitals, etc.); ash damage to vehicles operating in ash (eg. emergency vehicles, aircraft, etc.); property in the path of mudflows and at risk for generated tsunamis. |
| <b>d.</b> | <b>Environment that may be affected</b>     | Lowlands due to tsunamis, water supply quality due to ash fall.  |

## 3. RISK ANALYSIS

- |           |  |   |
|-----------|--|---|
| <b>a.</b> | <b>Probability of Occurrence</b>               | High  |
| <b>b.</b> | <b>Potential effects on People</b>             | Respiratory distress to people exposed to ashfall, persons required to work in ash environments, loss of life to people exposed to effects of local tsunami.  |
| <b>c.</b> | <b>Potential effects on Property</b>           | Heavy damage to structures due to high loading effects of ashfall; increased maintenance and/or heavy damage to equipment and vehicles operating in high ash environments; heavy damage to structures in tsunami zones; electric utility failure. |
| <b>d.</b> | <b>Other Consequences</b>                      | Farm and stock animals could suffer health effects from breathing and ingesting ash; degradation of water quality; destruction of flora and fauna.  |
| <b>e.</b> | <b>Probability of Simultaneous Emergencies</b> | Moderate  |
| <b>f.</b> | <b>Unusual Conditions</b>                      | N/A   |

## WEATHER EXTREMES

**Definition:** Severe weather includes ice storms, blizzards, extreme heat or cold, drought and high winds.

There are no regular occurrences of severe weather such as hurricanes, tornadoes, or large hail on the Kenai Peninsula. High winds in excess of 50 miles/hour occur occasionally in some locations. Freezing rain and drifting snow are the dominate winter weather hazards that affect the City. Periods of extreme cold occur on a less than frequent basis. The effects of extreme weather would most likely be a disruption of vital services such as electric power, water, sewer, transportation; damage to and disruption of emergency response facilities, resources and systems. Populations at risk depends on the extent of the scope of weather system, “worst case scenario” would affect the entire South Zone to some degree.

In conclusion, mitigation depends heavily on public education and individual preparedness and shelter planning on the borough’s part.

# Hazard Mitigation Plan

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## 1. HAZARD

Weather Extremes

## 2. VULNERABILITY ANALYSIS

- |    |   |  |
|----|---|--|
| a. | <b>Vulnerability Zone</b>                   | Entire City  |
| b. | <b>Population within Vulnerability Zone</b> | Approximately 500 residents.   |
| c. | <b>Property that may be damaged</b>         | Damage to service systems such as water, sewer, power, gas and transportation; damage to and disruption of emergency response facilities, resources and systems. |
| d. | <b>Environment that may be affected</b>     | Standing timber, moose, other large mammals.   |

## 3. RISK ANALYSIS

- |    |  |   |
|----|--|---|
| a. | <b>Probability of Occurrence</b>               | Moderate  |
| b. | <b>Consequences to People</b>                  | Injuries and deaths, hardships from loss of vital services.   |
| c. | <b>Consequences to Property</b>                | A disruption of vital services such as water, sewer, power, gas and transportation; disruption of emergency response facilities, resources and systems.                 |
| d. | <b>Consequences to Environment</b>             | Degradation of woodland habitat from high wind and extreme cold; degradation to moose and other large mammals from loss of feed; degradation to farm and stock animals. |
| e. | <b>Probability of Simultaneous Emergencies</b> | Moderate  |
| f. | <b>Unusual Conditions</b>                      | N/A   |

## Chapter 3 - Mitigation Measures

### Earthquake Mitigation

#### Goal 1 – Reduce earthquake damage

Mitigate damage to structures, facilities, roads, and utilities by requiring that construction practices be adequate for the anticipated earthquake events.

#### Goal 2 - Increase public awareness

Property protection focuses resources on activities involving individual property owners. The goal stresses measures that landowners can take to protect their homes, structures or property from the effects of earthquakes.

The risk from earthquakes can be reduced indirectly through increased public awareness. If residents and property owners are knowledgeable about mitigation opportunities, emergency service procedures, and potential hazards, there will be more support for risk reduction efforts. Public information activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards. A variety of organizations and agencies can implement public information activities.

#### General Mitigation Strategies

In order to mitigate damage from an earthquake, protective measures should be implemented to protect a structure or facility from damage during a hazard event. They might not be able to completely eliminate damage but they can help minimize it.

#### Protective mitigation measures:

- Reduce exposure to hazards
- Facilitate restoration of facilities
- Preserve functionality of facilities

An example of a protective mitigation measure is to seismically upgrade a structure to withstand an earthquake.

# Hazard Mitigation Plan

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## Retrofitting or Rehabilitation:

Retrofitting or rehabilitating existing structures and facilities can protect against future damage. The costs associated with these activities can be quite high and not be cost effective.

### Potential Projects

- Establishing minimum seismic standards for new construction will reduce structural damage and make recovery efforts easier and less costly.
- Evaluate and revise if necessary building codes for single family, duplex, and tri-plex residential construction, and seek state resources and incentives to ensure compliance.
- Encourage non-structural mitigation and preparedness activities.
- Encourage the development of earthquake structural performance standards and incorporate earthquake overlay zones in the community land use ordinances.
- Encourage the development of siting requirements based on soil type, slope, and other considerations. Before this can happen, information about where the various risks are located must be developed.
- Promote incorporation of new methods to improve building performance. New materials and construction techniques might be more effective or feasible than what is currently available.
- Evaluate the need for development of large-scale earthquake-hazard maps of The City of Kachemak areas. Seismic hazard area maps need to be created for the area. The maps should depict site amplification, liquefaction susceptibility, and ground failure at a minimum scale of 1 inch = 1 mile.
- Continued enforcement of the International Building Code which requires that new construction be built with adequate standards that reduces the structural damage in the community should an earthquake occur.



## Fire Mitigation

### Goal 1 – Reduce and eliminate fire damage

Mitigate damage to personal property, structures and infrastructure, roads, utilities by requiring measures that would be adequate for the anticipated fire events

### Goal 2 - Increase public awareness

Property protection focuses resources on activities involving individual property owners. The goal stresses measures that landowners can take to protect their homes, structures or property from the effects of fire.

The risk from fires can be reduced indirectly through increased public awareness. If residents and property owners are knowledgeable about mitigation opportunities, emergency service procedures, and potential hazards, there will be more support for risk reduction efforts. Public information activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards. A variety of organizations and agencies can implement public information activities.

#### Potential Projects:

- Evaluate FireWise building design, siting, and materials for construction. FireWise building design, siting, and materials for construction are a way to reduce a structure's vulnerability to fires.
- Building codes should be evaluated to promote using nonflammable building material where appropriate, and adopting a residential fire code, an urban interface code, and support or promote Firewise communities.
- Identify buildings or locations vital to the emergency response effort and buildings or locations that, if damaged, would create secondary disasters.

# Hazard Mitigation Plan

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## Flood Mitigation

### Goal 1 – Reduce and eliminate flood damage

Mitigate damage to roads, drainage and utilities by requiring that reconstruction be adequate for the anticipated flood events

### Goal 2 – Increase public awareness

The risk of flooding can be reduced indirectly through increased public awareness. If residents and property owners are knowledgeable about mitigation opportunities, floodplain functions, emergency service procedures, and potential hazards, there will be more support for risk reduction efforts. Public information activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards. A variety of organizations and agencies can implement public information activities. Public information activities include:

#### Information Dissemination

The purpose of information dissemination is to provide community residents with knowledge about the flood hazard in their area and possible activities for mitigation. A variety of agencies can participate in information dissemination.

#### Potential Projects:

- Brochure containing information on the City of Kachemak flood dangers could be developed that is distributed to the community
- Historic and potential flooding information

#### Outreach projects

A valuable exchange of information can occur when agencies and organizations reach out to provide technical assistance to those affected by flooding. Some opportunities for such assistance might include the following.

### Potential Projects:

- Finding available resources for mitigation projects
- Erosion and sediment control project assistance
- Real estate disclosure
- Current homeowners and potential homebuyers are notified about flood hazard risk. Requirements for disclosing hazard risk in real estate transactions are made with the idea that the more knowledgeable homeowners and homebuyers are about flood risk, the more risk reduction efforts will occur.
- Provide local realtors and lending institutions with flood potential information.
- Evaluate the need for development of large-scale flood-hazard maps of City areas.

# Hazard Mitigation Plan

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## Landslide Mitigation

### Goal 1 – Reduce and eliminate landslide damage

Mitigate damage to structures, facilities, roads, drainage and utilities by requiring that reconstruction be adequate for the anticipated landslide events

### Goal 2 – Increase public awareness

Property protection focuses resources on activities involving individual property owners. The goal stresses measures that landowners can take to protect their homes, structures or property from the effects of landslides.

The risk from landslides can be reduced indirectly through increased public awareness. If residents and property owners are knowledgeable about mitigation opportunities, emergency service procedures, and potential hazards, there will be more support for risk reduction efforts. Public information activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards. A variety of organizations and agencies can implement public information activities. Public information activities include:

#### Information Dissemination

The purpose of information dissemination is to provide community residents with knowledge about the landslides hazard in their area and possible activities for mitigation. A variety of agencies can participate in information dissemination.

#### Potential Projects:

- Brochure containing information on the City of Kachemak landslide dangers could be developed that is distributed to the community
- Historic and potential landslide information

#### Outreach projects

A valuable exchange of information can occur when agencies and organizations reach out to provide technical assistance to those affected by landslides. Some opportunities for such assistance might include the following.

### Potential Projects:

- Finding available resources for mitigation projects
- Erosion and sediment control project assistance
- Real estate disclosure
- Current homeowners and potential homebuyers are notified about landslide hazard risk. Requirements for disclosing hazard risk in real estate transactions are made with the idea that the more knowledgeable homeowners and homebuyers are about landslide risk, the more risk reduction efforts will occur.
- Provide local realtors and lending institutions with landslide potential information.
- Encourage the development of siting requirements based on soil type, slope, and other considerations. Before this can happen, information about where the various risks are located must be developed.
- Evaluate the need for development of large-scale landslide-hazard maps of City areas.

# Hazard Mitigation Plan

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## Volcanic Eruption Mitigation

**Goal 1: - Mitigate the effects of extreme weather by instituting programs that provide early warning and preparation.**

Mitigate damage to structures, facilities, drainage and utilities by requiring that construction preparedness measures be adequate for the anticipated volcanic eruption events

**Goal 2: - Educate people about the dangers of extreme weather and how to prepare.**

Property protection focuses resources on activities involving individual property owners. The goal stresses measures that landowners can take to protect their homes, structures or property from the effects of volcanic eruptions.

The risk from volcanic eruptions can be reduced indirectly through increased public awareness. If residents and property owners are knowledgeable about mitigation opportunities, emergency service procedures, and potential hazards, there will be more support for risk reduction efforts. Public information activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards. A variety of organizations and agencies can implement public information activities.

### **Potential Projects:**

- Conduct special outreach/awareness activities concerning the hazards associated with volcanic eruptions.
- Expand public awareness about NOAA Weather Radio for continuous broadcasts and warning tone alert capability.
- Encourage ashfall resistant building construction materials and practices.



## Weather Extremes Mitigation

**Goal 1: - Mitigate the effects of extreme weather by instituting programs that provide early warning and preparation.**

**Goal 2: - Educate people about the dangers of extreme weather and how to prepare.**

Property protection focuses resources on activities involving individual property owners. The goal stresses measures that landowners can take to protect their homes, structures or property from the effects of extreme weather.

The risk from extreme weather can be reduced indirectly through increased public awareness. If residents and property owners are knowledgeable about mitigation opportunities, emergency service procedures, and potential hazards, there will be more support for risk reduction efforts. Public information activities advise property owners, potential property owners, and visitors about the hazards, ways to protect people and property from the hazards. A variety of organizations and agencies can implement public information activities. Public information activities include:

### **Potential Projects:**

- Conduct special outreach/awareness activities, such as Winter Weather Awareness Week, etc.
- Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability.
- Encourage weather resistant building construction materials and practices.

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## Chapter 5 – Public Participation

The City of Kachemak Council is the lead agency for planning issues. All City Council meetings are open to the public and noticed.

The City of Kachemak Council is comprised of seven members. Council members that were involved in the development of this plan are as follows:

Therese Bennett  
June Engstrom  
Tamara Farrow  
C. Neil McArthur, Vice Mayor  
Philemon Morris, Mayor  
Edna Morris  
Jeanne Walker

City Mayor Philemon Morris and City Clerk Helyn Schoepke were City staff involved in the plan development. Pinkston Enterprises, LLC assisted in the plan development, which was revised and ultimately approved by the City of Kachemak Council. The public was invited to public hearings and invited to each of the City of Kachemak Council meetings.

The City Council at this time has not selected any of the suggested projects to be submitted for funding.

During the preparation of this plan, the City of Kachemak Council held the following meetings:

1. March 10, 2004 – City Council Meeting

The City of Kachemak Council was advised of the plan project schedule and process that would be undertaken.

2. March 10, 2004

A public hearing meeting was held at the Kachemak Community Center during the scheduled City Council meeting from 7 p.m. to 8 p.m. The Federal Mitigation Assistance program was presented to the public and input was solicited concerning hazard identification and mitigation project identification and priorities.

# Hazard Mitigation Plan

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3. April 14, 2004

A public hearing meeting was held at the Kachemak Community Center during the scheduled City Council meeting from 7 p.m. to 8 p.m. The purpose of the public hearing was to solicit input concerning completion of the draft Hazard Mitigation Plan.

In conjunction with the City, the Kenai Peninsula Borough produced public service announcements and established a Web site to inform the public at large of the development of the Borough's Hazard Mitigation Plan. This method was utilized by The City of Kachemak to gather input and comments from the public who did not participate in the public meetings.

## **Update to Plan April, 2010**

In April, 2010 this plan was reviewed. No major changes were incorporated into the plan.

Copies of the plan were available to the public and the Kachemak City Council passed a resolution accepting the plan and recommending adoption by the Kenai Peninsula Borough.

### Chapter 6 – Implementation

The City of Kachemak will implement this plan by the methods outlined in this chapter. In addition to a positive cost/benefit ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns and public support. The City Mayor is responsible for implementing the plan as resources allow. Projects selected for funding will follow a public process with the City Council making recommendations to the City Mayor.

The City Council will review the projects for a recommendation on which projects should receive the highest priority. The City Council is responsible for making the final decision on which projects are submitted for funding. The City Mayor is responsible for administration of the projects.

This plan will be incorporated into the Kenai Peninsula Borough Hazard Mitigation Plan.

The Hazard Mitigation Plan will be updated when a disaster occurs that significantly affects The City of Kachemak, whether or not it receives a Presidential Declaration, assuming funding is available to update the plan. The update will be completed as soon as possible, but by no later than the 12 months following the date the disaster occurs.

The City Mayor will start the updating of this plan two years before the end of the five-year cycle. Securing grant monies and developing a project plan will occur the two years before the end of the five year requirement. Public participating and writing of the update will happen one year before the end of the five year cycle.

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### Chapter 7 – References

1. Kenai Peninsula Borough, South Zone Emergency Response Plan

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### Chapter 8 – Appendices

1. Resolution adopting the City of Kachemak Hazard Mitigation Plan
2. Newspaper ads were published in the Homer Tribune and Homer News on February 21, 2004 and April 21, 2004.

# Hazard Mitigation Plan

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*We will have this resolution on the June 2<sup>nd</sup>, 2004 Agenda*

**Resolution Number:** \_\_\_\_\_

## **Adopting the City of Kachemak Hazard Mitigation Plan**

**Whereas**, the City of Kachemak recognizes the threat that all hazards pose to people and property, and

**Whereas**, undertaking hazard mitigation actions before disasters occur will reduce the potential for harm to people and property and save taxpayer dollars, and

**Whereas**, an adopted hazard mitigation plan is required as a condition of future grant funding for mitigation projects, and

**Whereas**, the City of Kachemak participated jointly in the planning process with the Kenai Peninsula Borough to prepare a Hazard Mitigation Plan;

**Now, therefore, be it resolved**, that the City of Kachemak, hereby adopts the City of Kachemak Hazards Mitigation Plan as an official plan.

**Passed:** \_\_\_\_\_

\_\_\_\_\_  
**Certifying Official**

### CITY OF KACHEMAK, ALASKA

#### NOTICE OF PUBLIC HEARING

Notice is hereby given that on the 14<sup>th</sup> April, 2004 a public hearing will be held on the City of Kachemak Hazard Mitigation Plan at 7:00 p.m. at the Kachemak Community Center:

Copies of the plan are available at the Kachemak City Clerk's Office in the Kachemak Community Center. Regular office hours are Mondays, 9am-3pm--other hours by appointment. Please call 235-8897 for more information.

Helyn I. Schoepke  
City Clerk

Publish: 4/08/04 Homer News

# Hazard Mitigation Plan

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CITY OF KACHEMAK, ALASKA

## NOTICE OF PUBLIC HEARING

Notice is hereby given that on the 10th March, 2004 a public hearing will be held on the following ordinance at 7:00 p.m. at the Kachemak Community Center:

ORDINANCE 04-01: AN ORDINANCE FOR THE CITY OF KACHEMAK, ALASKA PROVIDING FOR THE INVESTMENT OF FUNDS IN COLLATERALIZED CDS AND A VANGUARD ACCOUNT.

Copies of the ordinance are available at the Kachemak City Clerk's Office in the Kachemak Community Center. Regular office hours are Mondays, 9am-3pm--other hours by appointment. Please call 235-8897 for more information.

Also, a public hearing will be held on the All-Hazard Mitigation plan being developed for the City of Kachemak at the same meeting

Helyn I. Schoepke  
City Clerk

Publish: 2/26, 3/4/2004 Homer News

Posted: 2/23/04



### PUBLIC NOTICE

The Kenai Peninsula Borough (KPB) and the Cities of Homer, Kenai, Kachemak, Seward, Soldotna and Seldovia are working on an All-Hazard Mitigation Plan to identify strategies for minimizing damage from floods, wildfires, earthquakes, and other major disasters.

Your input is valuable. For additional information and access to an online survey, we invite you to visit the Hazard Mitigation Plan website: [www.borough.kenai.ak.us/emergency/hazmit/plan.htm](http://www.borough.kenai.ak.us/emergency/hazmit/plan.htm)

For more information, please contact:

**KPB** - Glenda Landua, 144 N. Binkley, Soldotna, AK 99669, (907) 714-2218, [glandua@borough.kenai.ak.us](mailto:glandua@borough.kenai.ak.us).

**Homer** - Robert L. Painter, Fire Chief, 604 East Pioneer Ave., Homer, AK 99603, (907) 235-3155, [fire@ci.homer.ak.us](mailto:fire@ci.homer.ak.us).

**Kenai** - Scott Walden, Fire Chief, 105 S. Willow, Kenai, AK 99611, (907) 283-7666, [swalden@ci.kenai.ak.us](mailto:swalden@ci.kenai.ak.us).

**Kachemak** - Helyn Schoepke, Box 958, Homer, AK 99603, (907) 235-8897, [kachemak@xyz.net](mailto:kachemak@xyz.net).

**Seward** - David Squires, Fire Chief, Box 167, Seward, AK 99664, (907) 224-3445, [dsquires@cityofseward.net](mailto:dsquires@cityofseward.net).

**Soldotna** – Kathy Dawson, 177 N. Birch St., Soldotna, AK 99669, (907) 262-9107, [kdawson@ci.soldotna.ak.us](mailto:kdawson@ci.soldotna.ak.us).

**Seldovia**, Box 13, Seldovia, AK 99663, (907) 234-7639, [seldcity@xyz.net](mailto:seldcity@xyz.net).



# Hazard Mitigation Plan

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## CITY OF KACHEMAK MINUTES MARCH 10, 2004 REGULAR MEETING

The regular meeting of the Kachemak City Council was called to order by Mayor Phil Morris in the Kachemak Council Chambers, March 10, 2004 at 7:03 PM. Pledge of Allegiance.

Council members present: Edna Morris, Therese Bennett, Phil Morris, June Engstrom, Neil McArthur. Floyd Gonzales resigned at the February 11, 2004 meeting.  
Council members absent: Tammy Farrow—no motion made to excuse.  
Also present: Helyn Schoepke, City Clerk.

### AGENDA:

Motion: June Engstrom/Neil McArthur moved to approve the agenda as written.

Vote: Motion passed. Unanimous.

### ANNOUNCEMENTS/VISITORS:

Bill “Pinky” Morse, All Hazard Mitigation Plan: Hazards that should be in the plan discussed. The Federal Government is requiring this plan to reduce and eliminate hazards. If the plan is in place and there was a federal disaster there may be money available for mitigation projects.

### PUBLIC HEARING:

At 7:22 the regular meeting was closed and the public hearing on the All Hazard Mitigation Plan was opened.

At 7:23 the public hearing on mitigation was closed with no public comment offered and the public hearing on Ordinance 04-01 was opened.

ORDINANCE 04-01: AN ORDINANCE FOR THE CITY OF KACHEMAK, ALASKA PROVIDING FOR THE INVESTMENT OF FUNDS IN COLLATERALIZED CDS AND A VANGUARD ACCOUNT.

No public was in attendance and the public hearing was closed and the regular meeting reopened at 7:26 pm.

### *Excerpt from City of Kachemak Minutes, approved April 12, 2004*

#### CITY OF KACHEMAK MINUTES APRIL 14, 2004 REGULAR MEETING

The regular meeting of the Kachemak City Council was called to order by Mayor Phil Morris in the Kachemak Council Chambers, April 14, 2004 at 7:00 PM. Pledge of Allegiance.

Council members present: Edna Morris, June Engstrom, Therese Bennett, Neil McArthur, Jeanne Walker, Phil Morris. Tammy Farrow arrived shortly after meeting was called to order.

Council members absent: None

Also present: Helyn Schoepke, City Clerk.

#### AGENDA:

Motion: Neil McArthur/Therese Bennett moved to approve the agenda as written.

Vote: Motion passed. Unanimous.

#### PUBLIC HEARING:

The regular meeting was closed at 7:40 PM and the public hearing on the Hazard Mitigation Plan. Mayor explained that the plan is for public infrastructure.

Bob Turkington, a resident of Kachemak City, said that his property was being threatened by the diversion of water from above. He would like to see regulations against diverting water. He said this fit the criteria of a hazard as it met all three criteria of the hazard analysis in Chapter 2. Other points Mr. Turkington made is that he thought hurricanes and tropical storms could affect the City of Kachemak and could be a significant hazard; during the 64 Earthquake subsidence was a problem, and today there are many old buried automobiles that could be a hazard; and tsunamis could be a significant threat.

Council asked Clerk to check with Pinky Morse and clarify whether this hazard plan applies to all property in the City or just City property.

The public hearing was closed at 8:10 and the regular meeting reopened.

# Hazard Mitigation Plan

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*Excerpt from April 14, 2004 Council Meeting Minutes*

*Minutes approved May 5, 2004*

## **KACHEMAK CITY, ALASKA**

P.O. BOX 958, (VIA) HOMER, ALASKA 99603

PH. (907) 235-8897 FAX (907) 235-8854

E-mail: kachemak@xyz.net

May 21, 2010

**TO:** Kachemak City Council

**FROM:** Helyn Schoepke

**RE:** Hazard Mitigation Plan Clarification and Questions.

At the April 14, 2004 Public Hearing on the Hazard Mitigation Plan some questions were raised that Council wanted me to clarify with Bill Morse.

1. The plan was written to encompass all property in the City of Kachemak.
2. Hurricane and Tropical Storm Hazard: This would more likely be a severe winter storm or weather extremes and is addressed under that in the plan.
3. Subsidence: The main hazard is covered under earthquakes.
4. Tsunami: While this is identified as a possible hazard affecting the City of Kachemak, it is not thought of as a significant hazard as most of the coastal land is above 50 feet.

# City of Kenai ANNEX to the Kenai Peninsula Borough Local All Hazard Mitigation Plan

(References to “the Plan” in this Annex refer to the 2010  
Kenai Peninsula Borough All Hazard Mitigation Plan)

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## **Chapter I - Introduction**

### **A. Purpose of the Plan:**

The purpose of the All-Hazard Mitigation Plan is to fulfill the FEMA requirement under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Act), Section 322, Mitigation Planning enacted by Section 104 of the Disaster Mitigation Act of 2000 (DMA) (P.L. 106-390). This initiative provides new and revitalized approaches to mitigation planning. Section 322 emphasizes the need for State, local and tribal entities to closely coordinate mitigation planning and implementation efforts. As part of the process of implementing the DMA, FEMA prepared an Interim Final Rule (the Rule) to clearly establish the mitigation planning criteria for State, local and tribal governments. This Rule was published in the Federal Register on February 26, 2002, at 44 CFR Part 201. This plan will identify hazards, establish community goals and objectives, and develop mitigation strategies and activities that are appropriate for the City of Kenai.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d), as implemented through 44 CFR Part 201.6 requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identifying and prioritizing mitigation actions, encouraging development of local mitigation and providing technical support for those efforts.

The purpose of this plan is to produce a program of activities through actions and projects that will best deal with the City of Kenai's hazard problems, while meeting other community needs. This plan will accomplish the following objectives consistent with FEMA planning process guidelines:

- Describe the planning process to include public involvement and conduct an assessment of the risks
- Determine what facilities, or portions of infrastructure, are vulnerable to a disaster
- Develop a mitigation strategy to reduce potential losses and target resources
- Describe how each entity will periodically evaluate, monitor maintain and update the plan
- Describe the process for implementing the plan after adoption by the local governing body of the community and receiving FEMA approval

### **B. Methodology**

The approach used for the development and updating of the City of Kenai Annex to the Kenai Peninsula Borough All-Hazard Mitigation Plan consisted of the following tasks:

1. Coordinate with other agencies and organizations
2. Solicit public involvement
3. Conduct hazard area inventory
4. Review and analysis of possible mitigation activities
5. Describe the update and review process and schedule for plan maintenance

6. Coordinating the Plan with the State Hazard Mitigation Plan
7. Submitting to the State Hazard Mitigation Officer for Review
8. Submitting to FEMA Region 10 for Review and Approval
9. Adoption of the Plan following a public hearing

This All Hazard Local Mitigation Plan contains a list of potential projects and a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan.

This plan summarizes the activities outlined above to assess the effects of hazards in the City of Kenai such as: flooding, earthquake, wildfire, volcanic eruption and fallout and bluff erosion etc. and recommends mitigation strategies and activities. The City of Kenai annexes to the plan describe specific hazards experienced by the City: floods, wild-land fires, erosion, tsunami, earthquakes and volcanoes.

The mitigation plan will be evaluated and updated every five-years. In addition, the plan will be updated, as appropriate when a disaster occurs that significantly affects the City of Kenai, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than 12 months following the date the disaster occurs.

Routine maintenance of the plan will include updating historical hazard information, completing hazard analysis and adding projects, as new funding sources become available or taking projects off the list when they are accomplished.

## **C. City of Kenai - Background**

### **Location**

The City of Kenai is located on the western coast of the Kenai Peninsula, fronting Cook Inlet. It lies on the western boundary of the Kenai National Wildlife Refuge, on the Kenai Spur Highway, from mile post 4 to 15. It is approximately 65 air miles and 155 highway miles southwest of Anchorage via the Sterling Highway. It lies at approximately 60.55444° N and -151.25833° W. (Sec. 05, T005N, R011W, Seward Meridian.)

The City of Kenai is located in the Kenai Recording District. The city limits area encompasses 29.9 square miles of land and 5.6 square miles of water.

### **Climate**

Winter temperatures range from 4F to 22F; summer temperatures vary from 46F to 65F. Average annual precipitation is 20 inches.

### **History**

Prior to Russian settlement by fur traders in 1741, Kenai was a Dena'ina Athabascan Indian village. At that time, about 1,000 Dena'ina lived in the village of Shk'ituk't, near the River. These traders called the people "Kenaitze," or "Kenai people." In 1791, a fortified Russian trading post, Fort St. Nicholas, was constructed for fur and fish trading. It was the second permanent Russian settlement in Alaska. In 1849, the Holy Assumption Russian Orthodox Church was established by Egumen Nicholai. In 1869, the U.S. military established a post for the Dena'ina Indians in the area, called Fort



Kenai, which was abandoned in 1870 after Alaska was purchased by the U.S. A post office was established in 1899. Through the 1920s, commercial fishing was the primary activity. In 1940, homesteading enabled the area to develop.

The first dirt road from Anchorage was constructed in 1951. In 1957, oil was discovered at Swanson River, 20 miles northeast of Kenai - the first major Alaska oil strike.

The City was incorporated in 1960. In 1965, offshore oil discoveries in Cook Inlet fueled a period of rapid growth. Kenai has been a growing center for oil exploration, production and services since that time.

### **Culture**

The Kenai River is a major sport fishing location for Anchorage residents and tourist from all over the world. The river is world renown for trophy King as well as plentiful Silver salmon and Sockeye Salmon runs. Thousands of Alaska residents flock to the mouth of the Kenai River every July to harvest hundreds of thousands of Sockeye salmon for subsistence purposes. The Kenaitze and Salamatof Indians live throughout the Kenai Peninsula Borough (KPB) and utilize the rich resources of Cook Inlet.

### **Population and Economy**

In January of 2010 The Department of Commerce, Community and Economic Development (DCCED) certified Kenai's population at 7,115 people. Kenai is incorporated as a home rule city.

The City is the center of the oil and gas industry, providing services and supplies for Cook Inlet's oil and natural gas drilling and exploration. Tesoro Alaska's oil refining operation is located in North Kenai. Both in-state and out-of-state visitors provide a significant industry on the Peninsula.

Other important economic sectors include sport, subsistence and commercial fishing, fish processing, timber and lumber, agriculture, transportation services, construction and retail trade.

The largest employers are the Borough School District, the State of Alaska, Arctic Slope Regional Corporation (ASRC Energy), Central Peninsula Hospital (CPH), and Peak Oilfields.

### **Facilities**

Domestic water is supplied by three deep wells and is piped to 75% of households with the remaining 25% of households utilizing individual water wells and septic systems . During the Fall of 2010 and Spring 2011, a fourth and fifth well will be drilled in the area of Well House 2, which is served from the Beaver Creek aquifer, located at approximately mile 6 of the Kenai Spur Highway. A Water Treatment facility will be built at the Well House 2 site and operational by December 31, 2011. These upgrades are the result of the City of Kenai meeting mandated Environmental Protection Agency (EPA) arsenic standards for public water supplies. Sewage is piped and treated to a sewage treatment facility located at S. Spruce Street. Predominately, residential & commercial use for heating is supplied by the Enstar Natural Gas company. Electricity for the communities is supplied by Homer Electric Association, which operates the Bradley Lake Hydroelectric Project and is part owner of the Alaska Electric Generation & Transmission Cooperative. It also purchases electricity from Chugach Electric. A Borough refuse transfer station is located on Redoubt Ave. The Borough

landfill is located in nearby Soldotna, at mile 110.4 Sterling Hwy.

### **Transportation**

Kenai is accessible by the Sterling Highway to Anchorage, Fairbanks, Canada and the lower 48 states. The City-owned Kenai Municipal Airport provides a 7,575-foot asphalt runway, a 2,000-foot gravel strip, a float plane strip, and helicopter service. A fully staffed Flight Service Station is also located in the City. Float plane facilities are also available at Island Lake and Arness Lake. There are five additional privately-owned airstrips in the vicinity. The Kenai City Dock and boat ramp are located near the mouth of the Kenai River. There are also a number of private commercial fish processing docks. Moorage is by buoys anchored in the Kenai River.

## **Chapter II - Adoption Process and Documentation**

The City of Kenai Annex to the Kenai Peninsula Borough All-Hazards Mitigation Plan was developed as part of a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 the plan was adopted by the City as well as the Borough.

The local process included discussion and public comment periods during the development phase. The Planning & Zoning Commission advertised, and then heard presentations on the Annex draft on April 28, 2004. A public comment period was advertised beginning May 4, 2004, and a public hearing for public comment on the Annex draft was opened at the May 12, 2004 meeting. At that meeting, the Commission passed a resolution supporting the Annex and the Plan, and recommended adoption to the Kenai City Council. Simultaneously, the Kenai Peninsula Borough publicly advertised that comments were being sought on the Plan, and listed contacts for each community developing a Plan Annex. The Borough also expanded their website to include Plan and Annex information, with the City of Kenai linking to the site. The adoption process included notices of consideration for, and adoption of the Annex and Plan, for the City Council meeting of June 2, 2004.

In April 2010, the City of Kenai administration made revisions to the plan and submitted the updated version for review to the Planning & Zoning Commission who; advertised, and discussed updates to the plan. Based on this public discussion and review the plan was further updated. Kenai Municipal Code requires that public hearings must be advertised in the local newspaper a minimum of seven days prior to the public hearing. The City's code also requires that the notices be posted in three public places a minimum of ten days prior to the hearing. Notices were posted at the U.S. Post Office, State Courthouse, and Kenai City Hall public bulletin boards. Meeting agendas, resolutions and ordinances are posted on the City of Kenai and Kenai Peninsula Borough web pages prior to the scheduled meetings. Public hearing notices for the Hazard Mitigation Plan were advertised in the Peninsula Clarion on April 7, 9, 21, and 23, 2010 for the Planning Commission meetings that were held on April 14 and 28, 2010. The public hearing process was the primary method of encouraging outside coordination/involvement from neighboring communities, agencies, businesses, academia, non-profits, and other interested parties.

It is worth mentioning that a Kenai Borough Planning Commission representative is also a member of the City's Planning Commission. This inherently facilitated coordination with the Kenai Peninsula Borough in their planning process. It is also noteworthy to this collaborative process that the City of Kenai Planner is a member of the City of Soldotna Planning Commission and collaborated with the City of Soldotna's Planner and their Commission updating the All Hazard Mitigation Plan.

The City of Kenai Planning and Zoning Commission approved the updated plan by Resolution PZ10-06 on April 28, 2010. The Kenai City Council held a public hearing on June 16, 2010 and adopted Resolution 2010-34 adopting the updated "All Hazard Mitigation Plan." Related resolutions are available for review in the office of the Kenai City Clerk at 210 Fidalgo Street, Kenai, Alaska 99611.

City administration referenced in this document includes the following:

- City Planner
- Police Chief
- Fire Chief
- Fire and Planning Department Assistants
- Public Works Director
- Capital Projects Manager
- City Manager
- Planning & Zoning Commission
- Kenai City Council

# SAMPLE

## Sample All Hazard Mitigation Plan Adoption Resolution

Resolution # \_\_\_\_\_

### **Adopting the City of Kenai All Hazards Mitigation Plan**

**Whereas,** the City of Kenai recognizes the threat that all hazards pose to people and property; and

**Whereas,** undertaking hazard mitigation actions before disasters occur will reduce the potential for harm to people and property and save taxpayer dollars; and

**Whereas,** an adopted all hazards mitigation plan is required as a condition of future grant funding for mitigation projects; and

**Whereas,** the City of Kenai participated jointly in the planning process with the other local units of government with the Borough to prepare an updated All Hazards Mitigation Plan;

**Now, therefore, be it resolved,** that the City of Kenai **City Council**, hereby adopts the updated City of Kenai All Hazards Mitigation Plan as an official plan; and

**Be it further resolved,** that the Kenai Peninsula Borough will submit on behalf of the participating municipalities the adopted All Hazards Mitigation Plan to the Alaska Division of Emergency Services and the Federal Emergency Management Agency officials for final review and approval.

Passed: \_\_\_\_\_

\_\_\_\_\_  
Certifying Official

## **Chapter III - Planning Process**

### **A. How was it Done**

In 2010 the City of Kenai administration updated the 2004 City of Kenai All Hazard Mitigation Plan. The existing 2004 plan was a thorough enough platform that monumental changes were not necessary. The 2010 review resulted in an update of outdated or inaccurate information. The city administration compiled all pertinent data and completed a draft plan with subsequent review and input by the City of Kenai Planning Commission. After review and input by the Planning Commission, the Commission's recommendation was forwarded to the Kenai City Council for public hearing and formal adoption by resolution. (See Chapter II, Adoption Process and Documentation)

### **B. Who were the Contributors**

The following groups contributed to the 2010 All Hazard Mitigation Plan;

- The City of Kenai Public Works and Planning Department
- The City of Kenai Planning and Zoning Commission
- Public and private sectors
- The City of Kenai Public Safety departments
- The Kenai Peninsula Borough Office of Emergency Management.

### **C. Public Opportunity for Involvement**

The following methods were used to provide opportunities for public involvement;

- Public meetings
- The City of Kenai and KPB websites
- Newspaper notices
- Public hearing notices
- Public meeting agendas

See page 7 of this report for full details on public opportunities for involvement.

## Chapter IV- Hazard Identification & Risk Assessment

Historically, all of the identified natural hazards that could affect the City of Kenai are relatively rare in occurrence and have low impact when they do occur. As a result there have been no significant mitigation actions taken since the 2004 plan. However, the City is proud of ongoing maintenance actions such as the Spruce Bark Beetle Mitigation, FireWise education programs and the continuing pursuit of funding to complete the bluff erosion project.

### A. Hazard Identification

#### Hazard Matrix - CITY OF KENAI

Flood	Wildland Fire	Earthquake	Volcano	Snow Avalanche	Tsunami & Seiche
Y/H	Y/H	Y/H	Y/M	N	Y/L
Weather	Landslides	Erosion	Drought	Technological	Economic
Y/H	N/L	Y/H	U/L	U/L	U/L

#### Hazard Identification:

Y: Hazard is present in jurisdiction but probability unknown

N: Hazard is not present

U: Unknown if the hazard occurs in the jurisdiction

#### Risk:

L: Hazard is present with a low probability of occurrence

M: Hazard is present with a moderate probability of occurrence

H: Hazard is present with a high probability of occurrence

### B. Hazard Profile (NOTE: References to “the Plan” refer to the KPB All Hazard Mitigation Plan)

#### Flood

Please reference the Plan for detailed flood events affecting the City of Kenai and Kenai Peninsula.

Kenai is at the mouth of the Kenai River, on the shores of Cook Inlet. The summary of historical flood events shows clearly that the City is adversely affected by nearly all significant events.

For example, in 1995, as referenced in the Plan, flood events resulted in tremendous debris flowing downstream into the City limits. There have been no floods since 1995 that have affected the City of Kenai. City service including police, fire, public works and the administration were mobilized using City boats, vehicles, and safety equipment to intercept and extract huge quantities of debris such as docks, sheds, large Liquefied Petroleum Gas (LPG) tanks, fuels storage tanks and damaged boats from the Kenai River before this debris caused further property damage and before it could flow into



Cook Inlet shipping lanes.

Collected debris was extracted using City Dock resources and cranes, then stockpiled on approximately two acres of Dock property for safe keeping, identification, pollution prevention, retrieval by owners and eventual disposal.

City personnel patrolling the Kenai River for debris also assisted many private and commercial property owners in securing loose docks, boats and other debris before it could be swept downstream, and before this debris caused additional property and ecological damage.

This process within City limits was conducted entirely with City incident management teams. Coordinated records, reports and financial records were physically delivered to the Borough offices by a runner on a daily basis.

The City public safety building served as the incident command site for the duration of this event, coordinating efforts with the Boroughs temporary command site in Soldotna by phone and periodic face-to face meetings.

City staff remained on-duty for several days, incurring tens of thousands of dollars in personnel costs. Resources such as cars, trucks, loaders, fire engines, ambulances, survival equipment and ropes, buildings and fuel were committed to this event. Damage to equipment was experienced and was later reimbursed through FEMA.

The City of Kenai is not currently participating in the National Flood Insurance Policy (NFIP) program. The City of Kenai has no repetitive loss properties.

See “Flood” map in appendix for areas most likely to receive negative impact from flooding.

## **Wildland Fires**

Dead and dying spruce trees pose the greatest risk of wild fire on the entire Kenai Peninsula. Within the City, trees infested by the spruce bark beetle became a mitigation priority in the late 1990’s, with firefighters conducting door-to-door educational campaigns in high-risk neighborhoods delivering information packets to homeowners on how to develop a defensible space around their properties.

The City proactively pursued a fire mitigation plan that resulted in the clearing of dead and dying spruce from approximately 700 acres of public and private land. Funding for these projects are facilitated through the Kenai Peninsula Borough Spruce Bark Beetle Mitigation program. The Kenai Peninsula Borough and the City of Kenai work cooperatively to identify high hazard areas. Local contractors continue to provide hazard mitigation under the Borough funded program. Logistically, the reduction in fuels within the City has enabled State Forestry resources to free themselves to patrol other nearby communities, and has reduced wildfire activity within the City. Damage from fallen trees during heavy wind storms has dropped drastically within the City. Homer Electric Association has attributed this reduction directly to the City’s pro fire wise actions.

The City continues to promote the FireWise Project, and promotes the use of a “slash drop point” on a large parcel of Borough property off of Redoubt Avenue in the City of Kenai. The present drop

point was established on Redoubt Avenue in 2008. This site is designated as a location for residents to dispose of land clearing debris as an alternative to burning.

This drop point, along with the original drop point at Mile 13 of the Kenai Spur Highway, has been heavily used since being established in the year 2000. The Kenai Peninsula Borough Spruce Bark Beetle Mitigation Office has worked closely with the City in funding a contracted, clean-burning incinerator to clear slash from the drop point.

This partnership has resulted in the Borough exploring the possibility of expanding the drop point method to other parts of the Peninsula.

Historically significant fires within the City included the 1969 Swanson River Fire and the Swires Road fire in the mid-1980's.

The City does experience small wildland fires throughout the summer months, with the most recent being a 10 acre fire during the summer of 2009 which the City of Kenai Fire Department and State Forestry responded to cooperatively.

The City continues to educate the public on the dangers of wildfire in the City, and efforts to identify and remove wildland fire hazards continue as well.

All areas within the City of Kenai have equal risk of Wildland fires.

### **Coastal Storms**

From the fall through the spring, low pressure cyclones either develop in the Bering Sea or Gulf of Alaska or are brought to the region by wind systems in the upper atmosphere that tend to steer storms in the north Pacific Ocean toward Alaska. When these storms impact the shoreline, they often bring wide swathes of high winds and occasionally cause coastal flooding and erosion.

The intensity, location and the land's topography influence the storm's impact. Another factor that influences the damage done to the shoreline by coastal storms is whether or not the shore-fast ice is solid enough to protect against erosion and physical damage to community infrastructure.

Fierce storm conditions do not have to be present to cause damage. The City of Kenai community suffers from "Silent Storms" where high-water storm surges erode and undercut the banks melting the permafrost.

Erosion is a process that involves the wearing away, transportation, and movement of land. Erosion rates can vary significantly as erosion can occur quite quickly as the result of a flash flood, coastal storm or other event. It can also occur slowly as the result of long-term environmental changes. Erosion is a natural process but its effects can be exacerbated by human activity.

Erosion rarely causes death or injury. However, erosion causes the destruction of property, development or infrastructure. In Alaska, coastal erosion is the most destructive. Riverine erosion is a close second and wind erosion is a distant third.

Classifying erosion can be confusing, as there are multiple terms to refer to the same type of erosion. For example, riverine erosion may be called stream erosion, stream bank erosion, or riverbank erosion, among other terms. Coastal erosion is sometimes referred to as tidal land forming gullies. It is also caused by erosion. For heavy snow or rainfall, this annex, coastal erosion encompasses bluff and beach erosion while riverine erosion will be considered synonymous for stream erosion, stream bank erosion and riverbank erosion.

See “Flood” and “Erosion” maps in appendix for areas most likely to receive negative impact from flooding.

## **Erosion**

The Kenai River meanders through the City of Kenai. There is about a mile of 55 to 70 foot high eroding river bluff in the downtown center of the City. A comparison of aerial photos over 50 years reveals approximately 150 feet of horizontal distance of erosion. This equals an average of three feet of erosion per year. There is a similar erosion problem along the Cook Inlet where the bluff even gets higher.

Major erosion occurs when there is a high tide and large storm waves that carry away the base material of the bluff making the slopes steeper. These steeper slopes are more susceptible to erosion by wind and surface or ground water.

The City of Kenai has lost land and structures due to the erosion. Roads have been abandoned and sewer mains relocated. In 2000, a sewer line was relocated due to the erosion on Mission Street. The relocation of the line and subsequent roadwork was in excess of \$300,000 (Funded through State of Alaska Capital Improvements funding).

After years of studies, the City of Kenai is planning a Bluff Stabilization Project that will stop the erosion process along the Kenai River in the Downtown Area. The US Army Corps of Engineers is completing a two million dollar study and the engineering for this project. The City of Kenai continues to seek funding for construction of this project.

### Definitions:

**Groin** - A narrow, elongated coastal-engineering structure built on the beach perpendicular to the trend of the beach. Its purpose is to trap long shore drift to build up a section of beach

**Jetty** - A narrow, elongated coastal-engineering structure built perpendicular to the shoreline at inlets to stabilize the position of a navigation channel, to shield vessels from wave forces, and to control the movement of sand along adjacent beaches to minimize the movement of sand into a channel.

**Seawall** - A vertical, wall-like coastal-engineering structure built parallel to the beach or dune line and usually located at the back of the beach or the seaward edge of the dune. They are designed to halt shoreline erosion by absorbing the impact of waves.

**Revetment** - An apron-like, sloped, coastal engineering structure built on a dune face or fronting a seawall. Designed to dissipate the force of storm waves and prevent undermining of a seawall, dune or placed fill.

See “Erosion” map in appendix for areas most likely to receive negative impact from flooding.

## Coastal Erosion

Coastal erosion is the wearing away of land resulting in loss of beach, shoreline, or dune material from natural activity or human influences. Coastal erosion occurs over the area roughly from the top of the bluff out into the near-shore region to about the 30 foot water depth. It is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time. Bluff recession is the most visible aspect of coastal erosion because of the dramatic change it causes in the landscape. As a result, this aspect of coastal erosion usually receives the most attention. On the coast, the forces of erosion are embodied in waves, currents, and wind. Surface and ground water flow, and freeze-thaw cycles may also play a role. Not all of these forces may be present any particular location.

Coastal erosion can occur from rapid, short-term daily, seasonal, or annual natural events such as waves, storm surge, wind, coastal storms, and flooding or from human activities including boat wakes and dredging. The most dramatic erosion often occurs during storms, particularly because the highest energy waves are generated under storm conditions.

Coastal erosion also may be from multi-year impacts and long-term climatic change such as sea-level rise, lack of sediment supply, subsidence or long-term human factors such as the construction of shore protection structures and dams or aquifer depletion. Studies are underway to determine the effects generated from global warming. Ironically, attempts to control erosion through shoreline protective measures such as groins, jetties, seawalls, or revetments, can actually lead to increased erosion activity.

This is because shoreline structures eliminate the natural wave run-up and sand deposition processes and can increase reflected wave action and currents at the waterline. The increased wave action can cause localized scour both in front of and behind structures and prevent the settlement of suspended sediment.

Fortunately in Alaska, erosion is hindered by bottomfast ice, which is present on much of the Arctic coastline during the winter. These areas are fairly vulnerable while the ice is forming. The winds from a fall storm can push sea ice into the shorefast ice, driving it onto the beach. The ice will then gouge the beach and cause other damage.

Erosional and depositional processes:

Degradation: Lowering of the channel bed on a substantial reach length occurring over a relatively long period of time in response to disturbances that affect general watershed conditions, such as sediment supply, runoff volume, and artificial channel controls.

Aggradation: Rising of the channel bed as a result of disturbances in watershed conditions that produce the opposite effect to those leading to degradation.

General Scour: Lowering of the streambed in a general area as consequences of a short duration event such as the passage of a flood. Examples are the erosion zones near bridge abutments and those in the vicinity of gravel pits.

Local Scour: Lowering of the bed due to localized phenomena such as vortex formation around bridge piers.

Deposition: Rising of the streambed due to specific episode. An example is the formation of a sand bar after a flood event. Deposition is used in this document as the counterpart of general scour.

Lateral Migration: Shifting of the stream bank alignment due to a combination of the above vertical erosional and depositional processes. The most common example is meander migration in the floodplain. Bank retreat due to mass failure is another example.

In 2009, the City of Kenai added permanent fencing to the north beach dunes to help ensure this

natural barrier will adequately prevent bluff erosion. The fencing will help ensure that man-made destruction of vegetation does not compromise the integrity of the dunes. A similar fencing project was completed in the summer of 2010 on the south beach. The dunes were at risk of destruction from the annual personal use dipnet fishery if the fencing was not installed.

## **Factors Influencing the Erosion Process**

There are a variety of natural and human-induced factors that influence the erosion process. For example, shoreline orientation and exposure to prevailing winds, open ocean swells, and waves all influence erosion rates. Beach composition influences erosion rates as well. For example, a beach composed of sand and silt, such as those near Shishmaref, are easily eroded whereas beaches primarily consisting of boulders or large rocks are more resistant to erosion. Other factors may include:

- Shoreline type
- Geomorphology of the coast
- Structure types along the shoreline
- Density of development
- Amount of encroachment into the high hazard zone
- Proximity to erosion inducing coastal structures
- Nature of the coastal topography
- Elevation of coastal dunes and bluffs
- Shoreline exposure to wind and waves

## **Coastal Erosion in Alaska**

Coastal erosion is a problem in all 30 coastal states, including Alaska. A 1971 U.S. Army Corps of Engineers (USACE) study showed that just less than 11% of Alaska's coastline was undergoing "significant" erosion. This may not sound like much but it means that approximately 5,100 miles of Alaska's coast is experiencing "significant" erosion. That's more than most states have in coastline.

When undeveloped coastlines undergo erosion, it does not present a problem because there is nothing to be damaged. However, in developed areas, primarily along the western and northern coasts of Alaska and the Cook Inlet, erosion is a significant threat. In extreme cases, an entire community can be threatened in these areas such as the City of Kenai, Shishmaref and Point Hope. Usually, only part of a community is at risk. For example, most of Kenai is unaffected by erosion; however, large sections of the City's coast, including the Historic District, and residential areas are.

## **Riverine Erosion**

Rivers constantly alter their course, changing shape and depth, trying to find a balance between the sediment transport capacity of the water and the sediment supply. This process, called riverine erosion, is usually seen as the wearing away of riverbanks and riverbeds over a long period of time.

Riverine erosion is often initiated by failure of a riverbank causing high sediment loads or heavy rainfall. This generates high volume and velocity run-off which will concentrate in the lower drainages within the river's catchment area. When the stress applied by these river flows exceeds the resistance of the riverbank material, erosion will occur. As the sediment load increases, fast-flowing rivers will erode their banks downstream. Eventually, the river becomes overloaded or Velocity is reduced, leading to the deposition of sediment further downstream or in dams and reservoirs. The deposition may eventually lead to the river developing a new channel. While all rivers change in the long-term, short-term rates of change vary significantly. In less stable braided channel reaches, erosion and deposition of material are a constant issue. In more stable meandering channels, episodes of erosion may only occur occasionally. The erosion rate depends on the sediment supply and amount of run-off reaching the river. These variables are affected by many things including earthquakes, floods, climatic changes, loss of bank vegetation, urbanization, and the construction of civil works in the waterway. Riverine erosion has many consequences including the loss of land and any development on that land. It can cause increased sedimentation of harbors and river deltas. It can hinder channel navigation and affect marine transportation source.

Other problems include reduction in water quality due to high sediment loads, loss of native aquatic habitats, damage to public utilities (roads, bridges, and dams) and maintenance costs associated with trying to prevent or control erosion sites.

## **Riverine Erosion in Alaska Input Research Data**

Examples of riverine erosion are found throughout Alaska that threatens both public and private property. Riverine erosion on the meandering Matanuska River, near Palmer, has already destroyed several homes and is threatening more. Attempts to control erosion have met with very limited success. For example, armored dikes helped control erosion for a while but eventually failed.



Presently tracking the permitting process for bank stabilization, there is no riverine erosion within the City of Kenai requiring mitigation.

Riverine erosion problems also exist on other rivers including the Kuskokwim, Yukon, and Kenai Rivers. Erosion on the Kenai River, predominantly outside the City of Kenai, is of great concern to resource management agencies because the increased sedimentation and loss of streamside cover associated with accelerated erosion rates may threaten salmon returns to the river. Salmon fishing on the Kenai can generate as much as \$78 million annually in direct benefits.

## **Wind Erosion**

Wind erosion is when wind is responsible for the removal, movement and redeposition of land. It occurs when soils are exposed to high-velocity wind. The wind will pick up the soil and carry it away. The wind moves soil particles 0.1-0.5 mm in size in a hopping or bouncing fashion (known as saltation) and those greater than 0.5 mm by rolling (known as soil creep). The finest particles (less than 0.1 mm) are carried in suspension. Wind erosion can increase during periods of drought.

Wind erosion can cause a loss of topsoil, which can hinder agricultural production. The dust can reduce visibility causing automobile accidents, hinder machinery, and have a negative effect on air and water quality creating animal and human health concerns. Wind erosion also causes damage to public utilities and infrastructure.

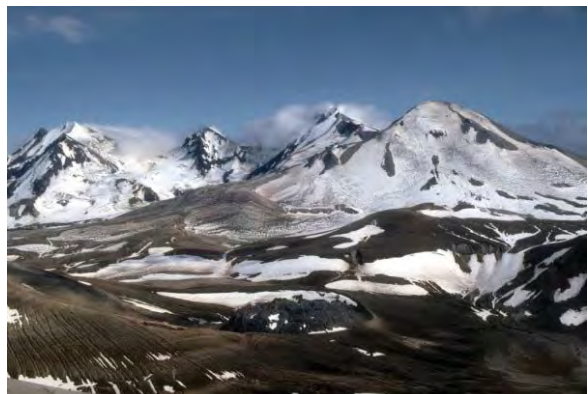
## **Volcanoes**

### **Historic Volcanic Activity**

The largest volcanic eruption of the 20th century occurred at Novarupta Volcano in June 1912. It started by generating an ash cloud that grew to thousands of miles wide during the three-day event. Within four hours of the eruption, ash started falling on Kodiak, which is located approximately 250 miles southwest of the City of Kenai, darkening the city. It became hard to breathe because of the ash and sulfur dioxide gas. The water became undrinkable and unable to support aquatic life. Roofs collapsed under the weight of the ash. Some buildings were destroyed by ash avalanches, while others burned after being struck by lightning from the ash cloud. Similar conditions could be found all over the area. Some villages ended up being abandoned, including Katmai and Savonoski villages located across the Shelikof Straights from Kodiak Island. The ash and acid rain also negatively affected animal and plant life. Large animals were blinded and many starved because their food was eliminated.

The ash fall from this eruption was significantly greater than the recent eruptions of Redoubt, Spur and Augustine Volcanoes. Fourteen earthquakes of magnitude 6 to 7 were associated with this event. At least 10 Alaskan volcanoes are capable of this type of event.

A more recent eruption occurred on Augustine





Volcano in 1986. An ash plume disrupted air traffic and deposited ash in Anchorage. A dome formed in the crater, and caused some to fear it would subsequently collapse and trigger a tsunami along the east shore of Cook Inlet, as happened in 1883.

Redoubt Volcano erupted in 1989-1990 and debris flows caused temporary closing of the Drift River Oil Terminal. A similar eruption event occurred again in 2009 effecting the offloading of 3.7 million gallons of crude oil from the oil terminal. Media reports, the Kenai Peninsula Borough OEM website, and the Kenai communications center, located in and operated by the Kenai Police Department, adequately informed citizens of volcano precautions. The City government took steps to minimize damage to vehicles, buildings, and computer equipment. The City of Kenai administration feels the above actions were more than adequate to help mitigate potential damage from volcanic ash fallout to residential and commercial assets.

During the 1990 event, a KLM 747 jet aircraft, flight 867, temporarily lost power in all four engines when it entered the volcanic ash plume. It would have crashed into the mountains had they not be able to restart their engines about 4,000 feet (1,219 meters) above ground.

All areas within the City of Kenai have equal risk of effects from volcanic activity.

## *Earthquake*

Approximately 11% of the world's earthquakes occur in Alaska, making it one of the most seismically active regions in the world. Three of the ten largest quakes in the world since 1990 have occurred here.

Earthquakes of magnitude 7 or greater occur in Alaska on average of about once a year; magnitude 8 earthquakes average about 14 years between events. According to the USGS Earthquake Density maps, the City of Kenai experiences less than one earthquake of magnitude 5.0 or greater per year.

### Hazard Analysis/Characterization

Most large earthquakes are caused by a sudden release of accumulated stresses between crustal plates that move against each other on the earth's surface. Some earthquakes occur along faults that lie within these plates. The dangers associated with earthquakes include ground shaking, surface faulting, ground failures, snow avalanches, seiches and tsunamis. The extent of damage is dependent on the magnitude of the quake, the geology of the area, distance from the epicenter and structure design and construction. A main goal of an earthquake hazard reduction program is to preserve lives through economical rehabilitation of existing structures and construction of safe new structures.

Ground shaking is due to the three main classes of seismic waves generated by an earthquake. P (primary) waves are the first ones felt, often as a sharp jolt. S (shear or secondary) waves are slower and usually have a side to side movement. They can be very damaging because structures are more vulnerable to horizontal than vertical motion. Surface waves are the slowest, although they can carry the bulk of the energy in a large earthquake. The damage to buildings depends on how the specific characteristics of each incoming wave interact with the buildings' height, shape, and construction materials.

Earthquakes are usually measured in terms of their magnitude and intensity. Magnitude is related to the amount of energy released during an event while intensity refers to the effects on people and structures at a particular place. Earthquake magnitude is usually reported according to the standard Richter scale for small to moderate earthquakes. Large earthquakes, like those that commonly occur in Alaska are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by these large events.

Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from not felt to total destruction. Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building construction practices. Soil conditions are a major factor in determining an earthquake's intensity, as unconsolidated fill areas will have more damage than an area with shallow bedrock.

Surface faulting is the differential movement of the two sides of a fault. There are three general types of faulting. Strike-slip faults are where each side of the fault moves horizontally. Normal faults have one side dropping down relative to the other side. Thrust (reverse) faults have one side moving up and over the fault relative to the other side.

Earthquake-induced ground failure is often the result of liquefaction, which occurs when soil (usually sand and coarse silt with high water content) loses strength as a result of the shaking and acts like a viscous fluid. Liquefaction causes three types of ground failures: lateral spreads, flow failures, and loss of bearing strength. In the 1964 earthquake, over 200 bridges were destroyed or damaged due to lateral spreads. Flow failures damaged the port facilities of Seward, Valdez, and Whittier. Similar ground failures can result from loss of strength in saturated clay soils, as occurred in several major landslides that were responsible for most of the earthquake damage in Anchorage in 1964. Other types of earthquake-induced ground failure include slumps and debris slides on steep slopes.

All areas within the City of Kenai have equal risk of Earthquake effects.

## **Tsunamis**

As defined by the Kenai Peninsula Borough, areas of concern for tsunami impacts within the Borough are divided into geographical zones. Due to resource limitations, smaller KPB coastal communities are currently not scheduled for tsunami mapping. Without these maps, communities must rely on historical or estimated information for land use and evacuation route planning.

Coastal areas with potential tsunami risk in the North Zone begin at the north side of the mouth of the Kenai River and continue north up the coast, including the west side of Cook Inlet. Due to the relatively shallow depth of upper Cook Inlet and the substantial distance from areas to the south with significantly higher risk, the upper Inlet is believed to have low tsunami risk.

### **Central Zone**

The areas of concern in the Central Zone begin at the south side of the mouth of the Kenai River and continue south to Clam Gulch. Due to the relatively shallow depth of upper Cook Inlet and the

substantial distance from the lower end of Cook Inlet, the Central Zone is believed to have a low tsunami risk.

Earthquakes are a natural occurrence that can occur anywhere in Alaska and are a common cause of tsunamis. The City of Kenai is located adjacent to Cook Inlet between the North and Central zones. It is unknown if a tsunami has ever had a significant destructive effect on the land mass where the coastal city of Kenai lies. Given the high coastal bluffs protecting much of Kenai, and a lack of historical documentation of a destructive tsunami in Kenai, the City administration feels tsunami's pose a low threat to the City's people and property.

## **Economic**

### **Hazard Analysis/Characterization**

Economic disasters can result from uncontrollable natural events that have large negative effects on a region's economic base. Unfortunately, economic disasters also result from poor business practices and public policies that inhibit competition. An economic disaster declaration does not trigger the availability of disaster assistance in the manner of a natural or technological disaster, but it can provide the basis for seeking and receiving financial assistance. For example, the declaration of an economic disaster for fisheries led to the availability of assistance through provisions of the Magnusen-Stevens Fisheries Conservation and Management Act and the Interjurisdictional Fisheries Act in 1998, 1999 and 2000. In other instances, a disaster declaration has been unnecessary to secure Assistance. For example, when Southeast Alaska pulp mills closed, extensive worker assistance was provided through the Job Training Partnership Act and the Trade Adjustment Act; funds were made available for projects through the Economic Development Administration, the U.S. Forest Service (USFS) and U.S. Department of Agriculture (USDA)-Rural Development.

Economic disaster mitigation is not usually done by emergency management agencies, as these agencies are oriented to natural and technological disasters. Instead, it is essentially performed by economic development agencies. These agencies or any segment of Government cannot create private economies even though they have an historic and legitimate role in fostering opportunities for economic development. Government's role cannot be to create or replace the marketplace, but to recognize and understand it, and help its citizens capitalize on the opportunities. Economic development agencies have programs designed to build, broaden and diversify the economic base by fostering economic development, and/or creating an environment in which economic development can flourish.

Public infrastructure, sensible regulations, public-private partnerships, efficient and coordinated service delivery, industry advocacy, marketing, economic analysis, and the dissemination of timely information all represent legitimate venues for government to promote economic development.

### **Approaches to Economic Development**

Economic development can be promoted in a variety of ways, using a variety of approaches. These approaches can overlap with one another and are not meant to represent distinctly separate strategies, but to be illustrative. These approaches are also dynamic, state strategies evolve accordingly. Economic development approaches include:

- Industrial recruitment - competing for the siting of large industrial or manufacturing companies by promoting advantages such as tax abatement, transportation access or developed industrial locations.
- Targeted incentives analysis - using regional economic and workforce to match the most suitable type of industry for particular areas.

- Quality of life - promoting recreation and leisure opportunities, quality schools, cultural entities, low crime rates, a skilled workforce and clean air and water, to attract new business.
- Tax abatement - offering property tax abatement and other forms of tax relief as a development incentive.
- Workforce development - training the resident workforce for existing and anticipated jobs created through policy-based development initiatives, evolving technology, etc. For example, showcasing well-educated workforces, where higher than average percentages of workers have high school degrees or college diplomas.
- Resource endowments - promoting the existence of natural resource endowments to attract extractive industries. Alaska, particularly, is known as the nation's resource treasure chest with its huge oil and mineral reserves
- The new economy - promoting an adaptable, consumer-friendly, technology savvy, innovative, performance-driven and accountable environment to attract technology-based and knowledge-based industries.
- Web-based economic information systems - developing web sites, often using boroughs or sub-state regions as portals, to display and link to comprehensive economic information providing users with easy access.
- Regional partnerships - promoting regional organizations to implement community and regional economic development priorities. These organizations are like a two-way door, with local and regional issues, problems and priorities passing upward to the agencies, and agency programs, funding and technical assistance passing downward to the benefiting populations.

## **Assessing Risk**

The first step to long-term mitigation is understanding which economies are at risk and which economies have the best chance to reduce risks through public and private investments. Ways to quantify economic risks include:

- Identifying comparative advantages in order to produce goods or services better than a competitor
- Monitoring long-term supply and demand trends
- Measuring the diversity of end-product markets
- Measuring the size and diversity of base industries
- Measuring the growth rates in employment, income and gross sales

- Monitoring the relative dependence on imports
- Assessing the skill levels in the workforce
- Assessing the infrastructure needs to reduce transportation and energy costs

Risk can then be used to evaluate and rank economies on their potential resilience during an economic downturn. Perhaps more importantly, when risks are regularly monitored, economic information is more freely shared, creating fewer uncertainties.

### **C. Vulnerability Assessments**

**Earthquake & Volcanic:** All City facilities are vulnerable to volcanic ash fallout and seismic activity. Protective measures are in place to minimize damage such as housing emergency generators inside and meeting construction standards for the seismic zone.

**Erosion:** The Senior Center, Congregate Housing (Vintage Pointe Manor) and Wastewater Treatment Plant are more vulnerable to erosion damage than the remainder of City facilities. The City has taken steps to preserve the integrity of protective dunes by installing permanent fencing.

**Flood:** City Dock facilities are somewhat vulnerable to flood conditions, but were constructed with those events in mind, and generally remain usable in a flood event.

**Fire:** The City maintains a defensible space around all City facilities as a preventative measure for wildland fires.

**Emergency Planning:** An emergency plan is in place for critical infrastructure, evacuation districts, emergency notification and housing. The Kenai Police and Fire Departments work closely with local school administrators in planning to be self-sufficient during disasters which may isolate schools for three or more days. The following table describes the critical facilities for the City of Kenai. Without these facilities loss of life and human suffering is certain.

Hazard Matrix for CITY OF KENAI		Flood	Wildfire	Earthquake	Volcano	Tsunami	Weather	Landslides	Erosion	Technological	Economic
00.	Airport			X	X		X			X	X
01.	Fire			X	X		X			X	
02.	Police			X	X		X			X	
04.	Health Clinic			X	X		X				
05.	School			X	X		X				
07.	Electric	X	X	X	X		X			X	
08.	Telephone	X	X	X			X			X	
10.	Washeteria			X	X		X				
11.	Harbor/Dock/Port	X		X	X	X	X		X	X	X
12.	Landfill/Incinerator			X	X		X				
13.	Museum			X	X		X				X
14.	Library			X	X		X				X
15.	Road	X	X	X	X		X		X		
16.	Community Hall			X	X		X				
17.	Park		X	X	X			X	X		
19.	Cemetery			X			X		X		
20.	Offices										
22.	WWTP			X		X	X	X	X		
23.	Teachers Quarters				X						
25.	Service/Maintenance			X	X						
26.	Bridge	X		X		X	X		X		
27.	Post Office			X	X		X				
28.	Radio Transmitter			X	X		X				
29.	Reservoir/Supply (water)			X	X		X				
30.	Senior Center/Congregate Housing		X	X	X		X		X		
31.	Church	X	X	X	X		X				
33.	Generator		X	X							
34.	Guard		X	X							
36.	Boardwalk								X		





## City of Kenai Flood & Erosion Maps



#### **D. Development Trends**

The City has been a deferred code enforcement entity since the late 1970's enforcing local building, fire and life safety codes in plan reviews for new construction. This provides local access and oversight in new construction without requiring plans being sent through the State Fire Marshal's office in Anchorage.

Zoning changes are needed to comply with Comprehensive Plan and to prevent infrastructure loss near eroding bluff. Public Works has been addressing this for several years, and the City has restricted new construction near hazardous areas and infrastructure has been relocated to prevent added loss or damage (water and sewer lines, utilities, etc.).

Commercial, industrial and residential development is continuing at slow but steady pace, as is the population. The population is aging and the need for senior housing and assisted living is increasing. This has been addressed in the Comprehensive Plan. Health care facilities, physicians, dentists and family care offices are increasing within the City, and government offices are beginning an entralizing trend in Kenai.

Use of the beach for recreation and personal use fisheries increases each year. Increased use of City services is taxing resources in public works, public safety and the sewer treatment plant (STP). The STP will require expansion in the near future so evaluation and planning for the facility is ongoing.

The Municipal water system is being enhanced and expanded annually, with a risk analysis plan already in place.

In 2007, the City of Kenai completed a comprehensive Emergency Operations Plan (EOP). The plan describes the system that will be used to manage the mitigation of, preparation for, response to, and recovery from natural and man-caused disaster emergencies. It is an all-hazard, all-risk plan based on the National Incident Management System (NIMS) for comprehensive management of disaster emergency relief forces and disaster emergency operations. The EOP consists of 14 sections, each considering a different element of emergency response.

This EOP is intended to meet disaster emergency planning requirements of all federal, state, borough, and city agencies and departments having jurisdiction over such matters. It is further intended that this document be used as a reference and training aid for municipal, regional, industry, and other emergency response personnel to ensure efficient and effective response to and management of disaster emergencies. This EOP will be activated whenever there is a disaster emergency that could significantly threaten human health, property or the environment. Upon declaration of a disaster emergency, the designated person responsible for disaster emergency management is authorized to commit the resources necessary to carry out the provisions of the Emergency Operations Plan.

Section 2 of the City of Kenai Emergency Operations Plan references the Kenai Peninsula Borough All-Hazard Mitigation Plan, and states that the City of Kenai All-Hazard Mitigation Plan is Annex C of the KPB plan.

## Chapter V- Mitigation Goals, Objectives, & Strategies

### A: Floods:

Goal: Reduce or eliminate property damage and influx of debris into waterways due to floods by raising public awareness, and through zoning changes

Objective: Raise public awareness of probable magnitude of flood damage and debris based on historical events using on site visits and meetings during permit issuance. Encourage securing of docks, vehicles, trash and utilities (LPG tanks, fuel tanks, etc) to reduce loss of same to owners, and reduce influx of debris into waterways during floods.

Action Item: Continue cooperative efforts of the Kenai Peninsula Borough, City of Kenai Planning & Zoning Commission, City Council and land owners/developers to enact and enforce a 50-foot setback of items on property adjacent to waterways.

Source of Funds: State and Federal Grants, Corps. Of Engineers

Agency Lead: City

Timeline: Ongoing

Goal Completion: Kenai River Overlay mandates a 50 foot building setback from the mean high water line of the Kenai River. Borough regulations for development in this area meet the objective to minimize damage in the event of a flood.

### B: Wildland Fires:

Goal: Reduce or eliminate loss of homes and property due to wildland fires.

Objective: Promote the development of FireWise neighborhoods.  
To include the removal of fuels and increase awareness of wildland/urban fire hazards in the community.

Action Item: Continue to promote FireWise programs including public education programs in schools and neighborhoods. Promote the development of defensible space and landscaping techniques to community and home construction contractor participation. Encourage the reduction of fuels in hazardous areas and egress routes in coordination with the Kenai Peninsula Spruce Bark Beetle Mitigation Office, State Forestry and land owners.

Source of Funds: State and Federal Grants

Agency Lead: Kenai Peninsula Borough

Timeline: Ongoing

Goal Completion: 100% of identified areas have been mitigated. Continued re-evaluation and determination of future projects is ongoing.

### **C. Erosion:**

Goal: Reduce or eliminate the erosion of the bluff at the mouth of the Kenai River.

Objective: Construct a retaining wall to protect the bluff, adjacent structures, and city infrastructure in area.

Action Item: Continue seeking funding for bluff protection, establish zoning and building restrictions for that area, and develop a plan to move infrastructure back from bluff to protect from catastrophic failure and potential pollution of inlet.

Source of Funds: City, State and Federal Funds

Agency Lead: City

Timeline: Ongoing

Goal Completion: TBD – Pending Funding Sources and Construction

### **D. Volcanoes:**

Goal: Help prepare citizens to adequately protect themselves and property from hazards of volcanic ash.

Objective: Help facilitate the public to prepare for the harmful effects of volcanic ash fallout to life and property.

Action Item: Continue cooperative effort with Borough OEM, local media, and City of Kenai websites to provide the public with preparedness information prior to and during periods of increased volcano seismic activity.

Source of Funds: City, State and Federal Funding

Agency Lead: City, Kenai Peninsula Borough, Alaska Volcano Observatory (AVO)

Timeline: Ongoing

Goal Completion: During recent (2009) volcanic activity the public was adequately informed for preparedness via Kenai Peninsula Borough and AVO Websites as well as collaboration of City Government and local media.

## **E. Earthquakes:**

Goal: Prepare our citizens and the built environment to better survive the hazards associated with earthquakes.

Objective: Raise public awareness of potential threats and necessary preparations to increase survivability of citizens and structures.

Action: In an effort to reduce property damage, the City of Kenai will continue to adopt and enforce current building codes and construction standards that address the seismic concerns for our area. Prepare our citizens and the built environment to better survive the hazards associated with earthquakes through the promotion of public education, promote the practice of sheltering in place, and encourage the preparation of our citizens for self sufficiency on a post earthquake scenario.

Source of Funds: City and Kenai Peninsula Borough

Agency Lead: City of Kenai and Kenai Peninsula Borough

Timeline: Ongoing

Goal Completion: Building codes are in effect. Public awareness is ongoing via education in the schools and disaster preparedness through Community Emergency Response Team (CERT) drills

## **F: Tsunami:**

Goal: Lessen loss of life through adequate notification and evacuation of identified high hazard areas.

Objective: Public awareness of publically recognized hazard zones needing evacuation in the event of a tsunami.

Action Item: Continue cooperative advisements to public via Borough OEM, local media, and local emergency responders to collectively evacuate the public.

Source of Funds: City and Kenai Peninsula Borough

Agency Lead: City of Kenai and Kenai Peninsula Borough

Timeline: Ongoing

Goal Completion: Public awareness is ongoing via disaster preparedness through Community Emergency Response Team (CERT) drills

## Chapter VI - Implementation & Maintenance Procedures

### A. Implementation

The City of Kenai will implement this plan by using the Comprehensive Plan, the Capital Improvement Plan, the City of Kenai Emergency Operations Plan, and other plans. The various community plans will consider the best mitigation practices to maximize the benefit to the community. The City of Kenai will consider projects that are cost effective to ensure that for every dollar spent there is a minimum of one dollar savings by eliminating or reducing future disaster losses.

All Hazard Mitigation Strategies considered by the City of Kenai will utilize a Benefit Cost Analysis calculation which takes into consideration lives saved, property saved and preventing the functional loss of critical infrastructure. For future FEMA mitigation grant requests, the City of Kenai will use the FEMA Benefit Cost Analysis (BCA) as outlined on the FEMA web site. [www.fema.gov/government/grant/bca.shtm](http://www.fema.gov/government/grant/bca.shtm)

The City of Kenai Bluff Erosion project is the only current mitigation project that has significant mitigation costs (present & future). In February 2011, the City of Kenai received the *Kenai River Bluff Limited Economic, Cultural and Historic Property Evaluation*, published by the U.S. Army Corps of Engineers, Alaska District. This report outlines the existing conditions, causes and possible solutions to the erosion along a one mile portion of the Kenai bluff at the mouth of the Kenai River. The report evaluated possible lost income and diminished opportunities as well as potential loss of historical and cultural sites.

The City of Kenai will use the following criteria to prioritize mitigation projects based on:

1. Life saving or personal safety issues
2. Protection of infrastructure (water, sewer, utility systems)
3. Protection of private property
4. Protection and preservation of the bluff and river
5. Protection and preservation of historical areas
6. Coordination with all community plans. For example: the Community Comprehensive Plan, the Community Capital Improvement Plan, the All-Hazard Mitigation Plan, etc.

### B. Maintenance

The All-Hazard Mitigation Plan will be reviewed annually and will be updated at a minimum of every five years or 90 days after a presidentially declared disaster. The City Planner will be responsible for ensuring that reviews are completed. The general public will be notified of opportunities to review the plan and public involvement will be solicited. Public involvement is essential to ensure that the mitigation goals, objectives and action items are addressing the community's needs.



## **Appendix A**

### **Glossary of Terms**

<b>Asset</b>	Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.
<b>Avalanche</b>	Mass of snow and ice falling suddenly down a mountain slope and often taking with it earth, rocks, trees, and rubble of every description.
<b>Base Flood</b>	A term used in the National Flood Insurance Program to indicate the minimum size of a flood. This information is used by a community as a basis for its floodplain management regulations. It is the level of a flood which has a one-percent chance of occurring in any given year. Also known as a 100-year flood elevation or one-percent chance flood.
<b>Borough</b>	The basic unit of local government in Alaska.
<b>Building</b>	Any structure used or intended for supporting or sheltering any use or occupancy.
<b>Building Code</b>	The regulations adopted by a local governing body principally setting forth standards for the construction, addition, modification, and repair of buildings and other structures for the purpose of protecting the health, safety, and general welfare of the public.
<b>Community</b>	Any state, area or political subdivision thereof, or any Indian tribe or tribal entity that has the authority to adopt and enforce statutes for areas within its jurisdiction.
<b>Dam</b>	A structure built across a waterway to impound water.
<b>Development</b>	Any man-made change to improved or unimproved real estate, including but not limited to buildings other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or of equipment or materials.
<b>Disaster Mitigation Act</b>	DMA 2000 (public Law 106-390) is the latest



legislation of 2000 (DMA 2000) to improve the planning process. It was signed into law on October 10, 2000. This new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.

**Earthquake**

A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the earth's tectonic plates.

**Elevation**

The raising of a structure to place it above flood waters on an extended support structure.

**Emergency Operations Plan**

A document that: describes how people and property will be protected in disaster and disaster threat situations; details who is responsible for carrying out specific actions; identifies the personnel, equipment, facilities, supplies, and other resources available for use in the disaster; and outlines how all actions will be coordinated.

**Erosion**

The wearing away of the land surface by running water, wind, ice, or other geological agents.

**Federal Disaster Declaration**

The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended. Same meaning as a Presidential Disaster Declaration

**Federal Emergency Management Agency (FEMA)**

A federal agency created in 1979 to provide a single point of accountability for all federal activities related to hazard mitigation preparedness response and to hazard mitigation, preparedness, response, and recovery.

**Flash Flood**

A flood event occurring with little or no warning where water levels rise at an extremely fast rate. It is often the result of heavy rainfall in a localized area.

**Flood**

A general and temporary condition of partial or complete inundation of water over normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.

<b>Flood Control</b>	Keeping flood waters away from specific developed or populated areas by the construction of flood storage reservoirs, channel alterations, dikes and levees, bypass channels, or other engineered structures
<b>Flood Elevation</b>	Elevation of the water surface above an establish datum (reference mark), e.g. National Geodetic Vertical Datum of 1929, North American Datum of 1988, or Mean Sea Level
<b>Flood Hazard</b>	Flood Hazard is the potential for inundation and involves the risk of life, health, property, and natural value. Two reference base are commonly used: (1) For most situations, the Base Flood is that flood which has a one-percent chance of being exceeded in any given year (also known as the 100-year flood); (2) for critical actions, an activity for which a one-percent chance of flooding would be too great, at a minimum the base flood is that flood which has a 0.2 percent chance of being exceeded in any given year (also known as the 500-year flood).
<b>Flood Hazard Boundary Map</b>	Flood Hazard Boundary Map (FHBM) means an Official (FHBM) map of a community, issued by the Administrator, where the boundaries of the flood, mudslides (i.e., mudflow) related erosion areas having special hazards have been designated as Zones A, M, and/or E.
<b>Flood Insurance Rate Map</b>	Flood Insurance Rate Map (FIRM) means an official map of a community, on which the Administrator has delineated both the special hazard areas and the risk premium zones applicable to the community.
<b>Flood Insurance Study</b>	Flood Insurance Study or Flood Elevation Study means an examination, evaluation and determination of flood hazards and, if appropriate, corresponding water surface elevations, or an examination, evaluations and determination of mudslide (i.e., mudflow) and/or flood-related erosion hazards.
<b>Floodplain</b>	A "floodplain" is the lowland adjacent to a river, lake or ocean. Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood. The 100-year floodplain by the 100-year flood.

<b>Floodplain Management</b>	Thee operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.
<b>Floodplain Management Regulations</b>	Floodplain Management Regulations means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as floodplain ordinance, grading ordinance and erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.
<b>Flood Proofing</b>	Any combination of structural and nonstructural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved property, water and sanitary facilities, structures and their contents
<b>Floodway</b>	Floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.
<b>Geographic Information System</b>	A computer software application that relates physical features of the earth to a database that can be used for mapping and analysis.
<b>Governing Body</b>	The legislative body of a municipality that is the assembly of a borough or the council of a city.
<b>Hazard</b>	A source of potential danger or adverse condition. Hazards in the context of this plan will include naturally occurring events such as floods, earthquakes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.
<b>Hazard Event</b>	A specific occurrence of a particular type of hazard.
<b>Hazard Identification</b>	The process of identifying hazards that threaten an area.

<b>Hazard Mitigation</b>	Any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. (44 CFR Subpart M 206.401)
<b>Hazard Profile</b>	A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.
<b>Hydrology</b>	The science of the behavior of water in the atmosphere, on the earth's surface, and underground.
<b>Infrastructure</b>	The public services of a community that have a direct impact to the quality of life. Infrastructure refers to communication technology such as phone lines or Internet access, vital services such as public water supply and sewer treatment facilities, and includes an area's transportation system, regional dams or bridges, etc.
<b>Intensity</b>	A measure of the effects of a hazard event at a particular place.
<b>Inundation</b>	The maximum horizontal distance covered by flood water, a seiche or a tsunami.
<b>Landslide</b>	Downward movement of a slope, soil, and other materials or debris under the force of gravity.
<b>Liquefaction</b>	The phenomenon that occurs when ground shaking cause's loose soils to lose strength and act like a thick or viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.
<b>Local Emergency Planning Committee (LEPC)</b>	LEPCs consist of community representatives and are appointed by the State Emergency Response Commissions (SERCs), as required by Superfund Amendments and Reauthorization Act (SARA), Title III. They develop an emergency plan to prepare for and respond to a chemical emergency. They are also responsible for coordinating with local facilities to find out what they are doing to reduce hazards, prepare for accidents, and reduce hazardous inventories and

releases. The LEPC serves as a focal point in the community for information and discussion about hazardous substances, emergency planning, and health and environmental risks

**Local Government**

Any county, borough, municipality, city, township, public authority, school district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency, or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity, for which an application for assistance is made by a State or political subdivision of state.

**Magma**

Molten rock originating from the Earth's interior.

**Magnitude**

A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.

**Mitigate**

To cause something to become less harsh or hostile, to make less severe or painful

**Mitigation Plan**

A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the State and includes a description of actions to minimize future vulnerability to hazards.

**Municipality**

A political subdivision incorporated under the laws of the State that is a home rule or general law city, a home rule or general law borough, or a unified municipality.

**National Flood Insurance**

The Federal program, created by an act of Congress in Program (NFIP) 1968 that makes flood insurance available in communities that enact satisfactory floodplain management regulations.

**National Weather Service**

Prepares and issues flood, severe weather, and coastal (NWS) storm warnings and can provide technical assistance to federal and State entities in preparing weather and flood warning plans.

<b>Natural Disaster</b>	Any natural catastrophe, including any hurricane, tornado, storm, high water, wind, driven water... tsunami, earthquake, volcanic eruption, landslide, snowstorm, fire, or drought. (44 CFR Subpart M 206.401)
<b>New Construction</b>	New construction means structures for which the “start of construction” on or after the effective date of a floodplain management regulation adopted by a community and includes any subsequent improvement to such structures.
<b>One Hundred (100)-Year</b>	The flood elevation that has a one-percent chance of occurring in any given year. It is also known as the Base Flood.
<b>Period</b>	The length of time between two successive peaks or troughs of a wave. The Period may vary due to complex interferences of waves. Tsunami wave periods generally range from 5 to 60 minutes apart.
<b>Planning</b>	The act or process of making or carrying out plans; the establishment of goals, policies, and procedures for a social or economic unit.
<b>Preparedness</b>	The steps taken to decide what to do if essential services break down, developing a plan for contingencies, and practicing the plan. Preparedness ensures that people are ready for a disaster and will respond to it effectively. Actions that strengthen the capabilities of government, citizens, and communities to respond to disasters.
<b>Presidential Disaster Declaration</b>	The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended.
<b>Probability</b>	A statistical measure of the likelihood that a hazard event will occur.
<b>Recovery</b>	The actions taken by an individual or community after a catastrophic event to restore order and lifelines in a community.

<b>Relocation</b>	The moving of a structure from a flood area to a new location, normally to one where there is no threat of flooding.
<b>Response</b>	Those activities and programs designed to address the immediate and short-term effects of the onset of an emergency or disaster.
<b>Richter Scale</b>	A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.
<b>Risk</b>	The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It can also be expressed in terms of potential monetary losses associated with the intensity of the hazard.
<b>Riverine</b>	Relating to, formed by, or resembling rivers (including tributaries), streams, creeks, brooks, etc.
<b>Riverine Flooding</b>	Flooding related to or caused by a river, stream, or tributary overflowing its banks due to excessive rainfall, snowmelt or ice.
<b>Runoff</b>	That portion of precipitation that is not intercepted by vegetation, absorbed by land surface, or evaporated, and thus flows overland into a depression, stream, lake, or ocean (runoff, called immediate subsurface runoff, also takes place in the upper layers of soil).
<b>Run-up</b>	The maximum vertical height of a tsunami in relation to sea level.
<b>Scale</b>	A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.
<b>Seiche</b>	An oscillating wave (also referred to as a seismic sea wave) in a partially or fully enclosed body of water. May be initiated by landslides, undersea landslides, long period seismic waves, wind and water waves, or a tsunami.



<b>Special Flood Hazard</b>	An area within a floodplain having a 1 percent or greater Area (SFHA) chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designation that include the latter A or V.
<b>Special Hazard Area</b>	Special Hazard Area means an area having special flood, mudslide (i.e., mudflow) and/or flood-related erosion hazards, as shown on a FHBM or FIRM as Zone A, AOA, A1-30, AE, A99, AH, VO, V1-30, VE, V, M, or E.
<b>Stafford Act</b>	1) The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended. 2) The Stafford Act provides an orderly and continuing means of assistance by the Federal Government to State, local and tribal governments in carrying out their responsibilities to alleviate the suffering and damage which result from disaster.
<b>State Hazard Mitigation Officer (SHMO)</b>	The SHMO is the representative of State government who is the primary point of contact with FEMA, other State and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.
<b>Stile</b>	A set of stairs to allow access over an obstruction, such as a floodwall
<b>Storm Surge</b>	Rise in the water surface above normal water level on open coast due to the action of wind stress and atmospheric pressure on the water surface.
<b>Stream</b>	A body of water flowing in a natural surface channel. Flow may be continuous or only during wet periods. Streams that flow only during wet periods are termed “intermittent streams.”
<b>Structure</b>	That which is constructed above or below ground in some definite manner for any use or purpose.
<b>Subdivision Regulations</b>	Ordinances or regulations governing the subdivision of land with respect to things such as adequacy and suitability of building sites and utilities and public facilities.

<b>Subsidence</b>	Sinking of the land surface, usually due to withdrawals of underground water, oil, or minerals.
<b>Substantial Damage</b>	Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceeds 50 percent of the market value of the structure before the damage.
<b>Tectonic Plate</b>	Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.
<b>Topography</b>	The contour of the land surface. The technique of graphically representing the exact physical features of a place or region on a map.
<b>Tribal Government</b>	A Federally recognized governing body of an Indian or Alaska Native Tribe, band, nation, pueblo, village or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Tribe List Act of 1994, 25 U.S.C. 479a. This does not include Alaska Native corporations, the ownership of which is vested in private individuals.
<b>Tsunami</b>	A sea wave produced by submarine earth movement or volcanic eruption with a sudden rise or fall of a section of the earth's crust under or near the ocean. A seismic disturbance or land slide can displace the water column, creating a rise or fall in the level of the ocean above. This rise or fall in sea level is the initial formation of a tsunami wave.
<b>Volcano</b>	A volcano is an opening, or rupture, in a planet's surface or crust, which allows hot magma, ash and gases to escape from below the surface. Volcanoes are generally found where tectonic plates are diverging or converging. A mid-oceanic ridge, for example the Mid-Atlantic Ridge, has examples of volcanoes caused by divergent tectonic plates pulling apart; the Pacific Ring of Fire has examples of volcanoes caused by convergent tectonic plates coming together.
<b>Vulnerability</b>	Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's

construction, contents, and the economic value of its functions. The vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power - if an electrical substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Other, indirect effects can be much more widespread and damaging than direct ones.

**Vulnerability Assessment**

The extent of injury and damage that may result from hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.

**Watercourse**

A natural or artificial channel in which a flow of water occurs either continually or intermittently.

**Watershed**

An area that drains to a single point. In a natural basin, this is the area contributing flow to a given place or stream.

**Water Surface Elevation**

Water surface elevation means the height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929, (or other datum, where specified) of floods of various magnitudes and frequencies in the floodplains of coastal riverine areas.

**Water Table**

The uppermost zone of water saturation in the ground.

**Wetlands**

Areas that are inundated or saturated frequently and for long enough to support vegetative or aquatic life requiring saturated or seasonally saturated soil conditions for growth and reproduction.

**Wildfire**

An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.

## **Appendix B Acronyms**

AEIC	Alaska Earthquake Information Center
ARC	American Red Cross
AVO	Alaska Volcanic Observatory
DC	Department of Corrections
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
KPB	Kenai Peninsula Borough
LEPC	Local Emergency Planning Committee
NFIP	National Flood Insurance Program
NOS	National Ocean Service
NPS	National Park Service
NWS	National Weather Service
SERC	State Emergency Response Commission
SHMO	State Hazard Mitigation Officer
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USGS	United States Geological Survey

# **City of Seward**



## **All Hazard Mitigation Plan**

**Final Plan  
April 12, 2010**

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# Chapter 1 - Introduction

## I. Purpose of Plan

The purpose of this plan is to fulfill local Hazard Mitigation Plan requirements. The plan will identify hazards; establish community goals and objectives and select mitigation activities that are appropriate for the City of Seward.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d) requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identify and prioritize mitigation actions, encourage the development of local mitigation and provide technical support for those efforts.

In addition, this plan has fulfilled the requirements of the National Flood Insurance Reform Act of 1994 (NFIRA). With this act, Congress authorized the establishment of a Federal grant program to provide financial assistance to States and communities for flood mitigation planning and activities. The Federal Emergency Management Agency (FEMA) has designated this Flood Mitigation Assistance (FMA).

Under the FMA, FEMA provides assistance to States and communities for activities that will reduce the risk of flood damages to structures insurable under the National Flood Insurance Program (NFIP). FMA is a state-administered, cost-share program through which states and communities can receive grants for flood mitigation planning, technical assistance and mitigation projects.

The purpose of this plan is to produce a program of activities that will best tackle Seward's hazard and flood problems and meet other community needs. Consistent with FEMA planning process guidelines, the purpose of this plan is to accomplish the following objectives:

- Ensure that all possible activities are reviewed and implemented so that disaster related hazards are addressed by the most appropriate and efficient solution;
- Link hazard management policies to specific activities;
- Educate residents about potential hazards that threaten the community, including but not limited to flood and wildfire hazards, extreme weather conditions, earthquakes and tsunami;
- Build public and political support for projects that prevent new problems from known hazards and reduce future losses;
- Fulfill planning requirements for future hazard mitigation project grants; and,
- Facilitate implementation of hazard mitigation management activities through an action plan.



## **II. Methodology**

The methodology used for the development and updating of the Seward Hazard Mitigation Plan, consisted of the following tasks:

1. Public involvement
2. Coordination with other agencies or organizations
3. Hazard area inventory
4. Problem identification
5. Review and analysis of possible mitigation activities
6. Local adoption following a public hearing
7. Periodic review and update

This hazard mitigation plan contains a list of potential projects and a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan.

The Mitigation Plan will be evaluated and updated every five years. In addition, the plan will be updated as appropriate when a disaster occurs that significantly affects Seward, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than the 12 months following the date the disaster occurs.

Routine maintenance of the plan will include adding projects, as new funding sources become available or taking projects off the list when they are accomplished.

## **The Plan is organized as follows:**

### Chapter 1

Chapter 1 presents sections on the purpose and goals of the plan, methodology used, and a background study of the City of Seward.

### Chapter 2

Chapter 2 identifies known hazards in Seward, such as flooding, tsunami and earthquake potential, and beach erosion, including probability of each event.

### Chapter 3

Chapter 3 addresses historical floods and other hazards that have occurred within the City of Seward.

### Chapter 4

Chapter 4 includes annexes of hazards affecting the City of Seward with hazard assessment vulnerability and potential mitigation measures.

### Chapter 5

Chapter 5 outlines the public participation process undertaken during the planning process and for the purpose of prioritizing projects and updating the plan.

### Chapter 6

Chapter 6 addresses implementation procedures and a process for updating the plan.

### References

References are included in this section.

## **IV. City of Seward – Background**

### **General Location**

Seward is situated on Resurrection Bay on the east coast of the Kenai Peninsula, 125 highway miles south of Anchorage. It lies at the foot of Mount Marathon, and is the gateway to the Kenai Fjords National Park. The communities of Bear Creek and Lowell Point are adjacent to Seward. The city lies at approximately 60.10417° North Latitude and 149.44222° West Longitude (Sec. 10, T001S, R001W, Seward Meridian). The City of Seward is located in the Seward Recording District. The incorporated area encompasses 14.4 sq. miles of land and 7.1 sq. miles of water.

### **Climate**

Seward experiences a maritime climate. Winter temperatures average from 17 to 38 degrees F; summer temperatures average 49 to 63 degrees F. The average annual precipitation includes 66 inches of rain and 80 inches of snowfall. Due to the proximity of the Gulf of Alaska and the topography of the land, large low pressure systems often bring heavy rains and strong winds during the fall storm season.

### **History of Seward**

Resurrection Bay was named in 1792 by Russian fur trader and explorer Alexander Baranof. While sailing from Kodiak to Yakutat, he found unexpected shelter in this bay from a storm. He named the bay Resurrection because it was the Russian Sunday of the Resurrection. Seward was named for U.S. Secretary of State William Seward, who negotiated the purchase of Alaska from Russia during the Lincoln administration. In the 1890's, Capt. Frank Lowell arrived with his family and established a settlement. In 1903 John and Frank Ballaine and a group of settlers arrived to begin construction of a railroad. Later, this settlement became a town. Seward became an incorporated city in 1912. The Alaska Railroad was constructed between 1915 and 1923, and Seward was developed as the ocean terminus and supply center for interior Alaska. By 1960, Seward was the largest community on the Peninsula. Tsunamis generated after the 1964 earthquake destroyed the railroad terminal and killed several residents. As an ice-free harbor, Seward has become an important supply center for interior Alaska. 2003 was the 100<sup>th</sup> anniversary of the founding of Seward.

### **Culture**

Seward is primarily a non-Native community, although the Qutekcak Tribe is very active within the community. Seward's annual Fourth of July celebration and its grueling Mount Marathon race attract participants and visitors worldwide. Other annual events include the Seward Silver Salmon Derby in August and the Polar Bear Jump-Off Festival in January.

## **Population and Economy**

In 2009, the Department of Community and Economic Development certified Seward's population at 2,619 people. Seward is incorporated as a home rule city.

As the southern terminus for the Alaska Railroad and road link to Anchorage and the Interior, Seward has long been a transportation center. The economy has diversified with tourism, commercial fishing and processing, ship services and repairs, oil and gas development, a coal export facility for Usibelli Mine, Alaska Vocational Technical Center (AVTEC), the Spring Creek Correctional Center, and the University of Alaska's Institute of Marine Sciences. The Alaska SeaLife Center, the Kenai Fjords National Park and the Mt. Marathon Race during the Fourth of July festivities attract visitors. Over 320,000 cruise ship passengers visit Seward annually. Approximately seventy-five residents of Seward hold commercial fishing permits.

## **Facilities**

Water is supplied by nine wells, is treated and distributed throughout Seward. Sewer is collected via pipes to a secondary treatment lagoon. Almost all homes are connected to the city systems. Refuse collection is provided by the city under contract; the Borough provides solid waste disposal. The Kenai Peninsula Borough refuse transfer facility is located on Dimond Boulevard.

Seward Public Utility purchases power from Chugach Electric Association for day to day operations, and owns six emergency standby diesel generators.

Harbor facilities include approximately 4000 linear feet of moorage and space for up to 650 vessels.

Seward Providence Medical Care Center is licensed to admit and care for up to six in-patients. The Long Term Care Facility, Seward Mountain Haven, is licensed to admit and care for up to forty patients.

Fire/rescue resources include Seward's primary facility, Seward Fire Department located at 316 4<sup>th</sup> Avenue in downtown Seward and one satellite station located at mile 6.5 Nash Road in the Seward Marine Industrial Center basin area.

## **Transportation**

Seward is connected to the Alaska Highway system by the Seward Highway. Bus and commercial trucking services to and from Anchorage are available daily. Air services and charters are available at the State-owned airport. Two paved runways are utilized, at 4,240 and 2,300 feet. The port serves cruise ships, cargo barges and ocean freighters from Seattle and overseas. The small boat harbor has two launch ramps, slips for 650 vessels and approximately 4,000 linear feet of moorage for transient vessels. The Alaska Railroad provides over 1.4 billion pounds of cargo transit each year, importing cargo for the Alaskan Interior and exporting coal to the Pacific Rim. Seasonal passenger transportation is available by rail and highway.

## Chapter 2 – Hazard Identification

The Alaska Division of Homeland Security and Emergency Management is in the process of preparing a Hazard Mitigation Plan for the state. The following hazard matrix was modified from that plan for the Seward area.

Hazard Matrix – Seward Census Area

	Flood	Wildfire	Earthquake	Volcano	Ash Fall	Snow Avalanche	Tsunami	Weather	Land Slides	Erosion	Drought	Tech	Economic
Probability	Y-H	Y-L	Y-H	U	Y	Y	Y	Y	Y	Y	N	Y	Y
Extent	L	L	T	Z	T	L	L	T	L	T	Z	T	T
Previous Occurrence	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y

### Probability:

Y = Hazard is present in jurisdiction but probability unknown

Y – L = Hazard is present with a low probability of occurrence

Y – H = Hazard is present with a high probability of occurrence

N = Hazard is not present

U = Unknown if the hazard occurs in the jurisdiction

### Extent:

Z = Zero

L = Limited

T = Total or extensive

### Previous Occurrence

Y = Yes

N = No



The following sections are explanations of hazards that are present in the City of Seward.

## **Flood**

### **Definition**

- Riverine: Periodic over bank flow of rivers and streams.  
Flash: Quickly rising small streams after heavy rain or rapid snow melt.  
Urban: Overflow of storm sewer system usually due to poor drainage following heavy rain or rapid snowmelt.  
Tidal/Storm: Surge and wave run-up, higher than normal tidal range and higher inshore wave run-up due to storm effects in coastal areas.

The East Zone of the Kenai Peninsula Borough is at risk to flooding from heavy rains; spring ice jams and rapid snow melt; tidal storm surges and coastal wave run-up; glacial damming and glacial outburst flooding, and special geologic conditions. High flows can occur during any season, but are most common as a result of rapid snowmelt in the spring or intense precipitation during the summer and fall. In the East Zone, flooding hazards are compounded by steeply sloped, unstable mountain streams.

In Seward, development is occurring on alluvial fans and deltas which have been deposited by these steep drainages. The hazards associated within the area were demonstrated in major flood occurrences in October of 1986, August 1989, September 1995, October and November 2001, October 2006 and December 2009. Flooding in Seward and the surrounding area has resulted in repeated disruption of vital services such as water, sewer, power, and transportation routes; damage to roadways, bridges, flood control structures (dikes, weirs), buildings, port and harbor facilities, airport facilities, railroad facilities, utilities and communications systems and in addition natural/environmental emergencies such as landslides.

### **Seward Area Drainages:**

<b>Spruce Creek</b>	surge-release/debris
<b>Lowell Creek</b>	surge-release/debris
<b>Japanese Creek</b>	surge-release/debris
<b>Resurrection River</b>	seasonal
<b>Glacier/Salmon Creek</b>	seasonal
<b>Sawmill Creek</b>	surge-release/debris
<b>Godwin Creek</b>	surge-release/debris
<b>4th of July Creek</b>	surge-release/debris
<b>Lost Creek</b>	surge-release/debris

Debris and surge-release flooding will continue to be a problem in the Seward area. According to the 1994 Resurrection River Reconnaissance Report, the US Army Corps of Engineers stated that the 1986 and 1995 storms left the steep drainages even less stable and more prone to landslides and avalanches in future storms. In addition, stream channels tend to migrate unpredictably across the alluvial fans as deposition occurs. Consequently, mapping flood hazard areas on these fans is difficult and unreliable.

In 2003, residents of Seward, Bear Creek and Lowell Point established a flood-service area board, the Seward/Bear Creek Flood Service Area (SBCFA). This board's duties are to provide flood protection, planning and mitigation services, as well as developing, implementing and updating a development plan for furnishing flood protection services. The board will develop criteria for determining service area involvement in future flood control projects, and coordinate with the City of Seward to ensure there is neither duplication nor contradiction in the flood control projects or services provided.

The SBCFSA Flood Hazard Mitigation Plan was originally published July 2005 and updated November 2007.

The October 2006 flood event resulted in federal disaster declaration as residents were evacuated, highways and roads flooded, levees damaged and critical infrastructure damaged. The December 2009 high water event and storm surge resulted in a state disaster declaration as critical waterfront infrastructure was damaged including the wave barrier along Lowell Point Road, the Seward Green belt area and the seawall at the Alaska SeaLife Center.

### **Earthquake**

**Definition:** Sudden motion of the earth's surface, faulting, and ground failure.

Coastal Alaska is within the Pacific subduction zone. Subduction zones are areas where one tectonic plate plunges beneath another. Earthquakes cluster at the edge of the plunging plate, and its path into the mantle can be traced by the location of the earthquakes. The "ring of fire" around the Pacific is a giant earthquake zone, and coincides with a ring of subduction zones that produces the world's deepest trenches, such as the 36,000 foot deep Marianas Trench. It is striking evidence for the existence of these zones. An example of a subduction-zone plate boundary is found along the northwest coast of the United States, western Canada, and southern Alaska and the Aleutian Islands. Subduction zones are characterized by deep-ocean trenches, shallow to deep earthquakes, and mountain ranges containing active volcanoes. Seward is located on this subduction zone.

Seward's earthquake risk may be better explained by using the matrix prepared by the Alaska Division of Homeland Security and Emergency Management (ADHS&EM) designates Seward as a jurisdiction that has a high probability of an earthquake. Seward is designated as having a zone 4 risk. Earthquakes can trigger secondary hazards including fires, fuel spills, landslides, avalanches, tsunamis, uplift, subsidence, infrastructure failures and soil liquefaction.

### **Tsunami Hazard**

Tsunamis are ocean waves that are generally triggered by vertical motion of the sea floor during major earthquakes. Near ocean or undersea landslides or volcanic eruptions can also generate tsunamis. They can be generated locally or a great distance from where they landfall. Tsunamis have historically caused significant damage to coastal communities



throughout the world. As the tsunami crosses the deep ocean, its length from crest to crest may be a hundred miles or more, and its height from crest to trough will only be a few feet or less. They can not be felt aboard ships nor can they be seen from the air in the open ocean. In the deepest oceans, the waves will reach speeds exceeding 600 miles per hour (970 km/hr). When the tsunami enters the shoaling water of coastlines in its path, the velocity of its waves diminishes and the wave height increases. It is in these shallow waters that a large tsunami can crest to heights exceeding 100 feet (30 m) and strike with devastating force.

As a tsunami leaves the deep water of the open sea and travels into the more shallow waters near the coast, it undergoes a transformation. Since the speed of the tsunami is related to the water depth, as the depth of the water decreases, the speed of the tsunami diminishes. The change of total energy of the tsunami remains constant. Therefore, the speed of the tsunami decreases as it enters shallower water, and the height of the wave grows. Because of this "shoaling" effect, a tsunami that was imperceptible in deep water may grow to be several feet or more in height. When a tsunami finally reaches the shore, it may appear as a rapidly rising or falling tide, a series of breaking waves, or even a bore. Reefs, bays, entrances to rivers, undersea features and the slope of the beach all help to modify the tsunami as it approaches the shore.

Earthquake or other seismic activities near Seward can cause a tsunami to occur in Resurrection Bay as was the case in 1964. Due to the frequency of earthquakes within Alaska and the ocean topography of Resurrection Bay, there is a significant threat that a tsunami will occur again.

### **Shoreline Erosion**

**Definition:** Storm induced waves and flooding cause the destructive erosion of the coastal areas.

From the fall through the spring, large low pressure systems that develop in the Gulf of Alaska and systems that are brought to the region by winds in the upper atmosphere steer massive storms in the North Pacific Ocean toward Alaska. When these storms impact the shoreline, they often bring wide swathes of high winds and rain, occasionally causing coastal flooding and erosion.

The intensity, location and the land's topography influence the storm's impact. Another factor that influences the damage done to the shoreline by coastal storms is the amount of rain associated with the system. Fierce storm conditions do not have to be present to cause damage.

Coastal shoreline erosion is a continuing problem within the City of Seward along the waterfront campground and near the Seward Marine Industrial Center. Weather conditions make shoreline erosion an ongoing threat to the city.

Erosion to the beaches caused by storms or high winds are an ongoing hazard in the City of Seward. The December 2008 storm surge with high water event caused extensive damage to the wave barrier along Lowell Point Road, the Seward Green belt area and the seawall at the Alaska SeaLife Center. Lowell Point Road is the only access for Kenai Peninsula Borough Citizens living in that community, access for State and Federal Parks and a key sewer and electric utility corridor for Seward. Other wave action and coastal flooding also causes damage to the shoreline. Use of Resurrection Bay by recreational boaters, is a source of wave action which will continue to be a problem even without significant storms. City of Seward has taken steps to minimize the impacts of erosion on the beaches with the addition of rock walls, culverts and channels, but additional measures are necessary.

Coastal erosion regularly threatens significant assets including the City owned bike path, Playgrounds, park, RV sights landmarks and the Alaska Sea Life Center.

### **Wildfire**

#### **Wildfires that were reviewed are:**

- Wildland fire
- Urban Interface fire
- Firestorms

Wildfires do not present a major threat to people or property because of the coastal weather conditions in the Seward area. Urban Interface Fire risk changes, as more development occurs, placing people and property at a higher risk due to accidental and man made fires.

The fire risk has also been increasing in recent years due to the spruce bark beetle infestation. The dead trees are very dry and therefore highly combustible. This will present an even bigger problem in the coming years as the trees start to fall, littering the forest floor with flammable material.

### **Volcanoes**

Alaska is the home to more than 80 major volcanic centers. In general, there are one or two eruptions a year. Over half of the state's population lives within 100 miles of an active volcano.

The single greatest hazard from an explosive volcanic eruption is ash, fine fragments of rock blown into the atmosphere during volcanic eruption.

Lahars, lava and tsunami generating landslides are also potential hazards during a volcanic eruption.

## **Avalanches**

An avalanche is a slope failure consisting of a mass of fluidized snow sliding down a hillside. The damage caused by an avalanche varies based on the avalanche type, the consistency and composition of the avalanche flow, the flow's force and velocity, as well as the avalanche path. Avalanches usually occur on slopes between 25 and 50 degrees, with most starting between 30 and 40 degrees. They can be triggered by both natural and human factors.

There is growing exposure to this hazard as development continues to occur in avalanche prone areas and participation in winter recreational activities increases.

## **Winter Weather**

Winter weather includes heavy snows such as blizzards, ice storms and extreme cold. Heavy snows can bring the community to a standstill by inhibiting transportation, knocking down trees and utility lines, and by causing structural collapses in buildings not designed to withstand the weight of the snow. The cost of repairs and snow removal can be significant.

Ice buildup can bring down utility and communication lines as well as making transportation difficult.

Extreme cold causes fuel to congeal in storage tanks and supply lines stopping fuel flow to residential furnaces. Without heat water and sewer pipes can freeze and pipes can rupture. Alternate heating sources can cause their own set of problems, from accidental fires and illness from carbon monoxide in the home. Extreme cold can also increase the likelihood of ice jams and flooding.

## **Landslide**

Landslide refers to "the downward and outward movement of slope forming materials reacting under the force of gravity." The materials are usually natural soil, rock, artificial fill or a combination of those items. The term covers a range of events including mudflows, mudslides, rock flows, rockslides, debris flows, debris avalanches, debris slides and earth flows.

Geology, precipitation, topography and cut and fill construction practices all influence landslide activity. They are often the result of heavy precipitation, coastal storms, flooding, volcanic eruption, construction work or seismic activity.

One of the costliest landslide events ever experienced in the United States was associated with the 1964 Good Friday earthquake. Approximately 60 percent of the total damage caused by the earthquake was due to landslides. This was part of the equation for the tsunami damage in Seward.

### **Drought**

Droughts are fairly rare in Seward. A drought is commonly defined as a period of time of very low precipitation. Drought severity depends on duration, intensity and geographic extent as well as the demand on the water supply.

Seward experiences periods without rain, and the forests and grasslands become extremely dry, increasing the probability of Urban Interface fires.

### **Economic**

A large section of the Alaskan economy is resource based. When the resources generate insufficient revenue, due to lack of the resource availability, poor prices or other conditions, an economic disaster may be the result. Economic disaster consequences usually affect a wide geographic area. Some of the resources that could lead to disasters if their availability becomes limited include fish, lumber and coal. Seward is a tourist destination for cruise ships, road and rail. The visitor decline would have a major impact on the economic wellbeing of Seward.

### **Interactive Nature of Hazards**

A hazard cannot be treated in isolation, as there are inter-relation between the hazard agents. Frequently one hazard event triggers another. For example, a coastal storm will often trigger flood and landslides. Or a wildfire could increase erosions and flooding risks. As a result, all possible consequences of a hazard need to be considered when deciding the most appropriate mitigation actions. It is also important to consider all the hazards that could occur in an area when decided which mitigation activities to undertake. Some mitigation measures could worsen the effects from the hazards such as allowing economic development in areas susceptible to tsunamis or landslides.



## Chapter 3 – Historical Hazards in Seward

### History of Flooding in Seward

In 1986, over 15 inches of rain fell in a 36 hour period; saturating the steep slopes and causing severe erosion. In some areas, landslides and avalanches dammed stream channels, eventually causing a "surge-release" of floodwaters and debris when the dam failed. This material, which included boulders as large as 8-feet in diameter, caused extensive damage to buildings and facilities located downstream on the alluvial fans.

In August 1989 and September 1995, only active channel work kept Japanese Creek from changing course and charging through the western edge of Forest Acres Subdivision. Workers kept it within the channel. Creek waters joined Resurrection River to flood southerly along the Seward Highway embankment into the undeveloped Forest Acres and Fort Raymond area. Water moved across the highway and moved toward the Port Avenue section of the small boat harbor. Part of the Seward Fisheries Meal Plant and the north boat launch facility in the harbor were destroyed by the rapid water movement. The City of Seward has worked with the Kenai Peninsula Borough to implement the Resurrection River/Japanese Creek flood mitigation work. The work in the Resurrection River delta was completed in 1999 and some maintenance work was done in July 2000. The construction for the initial phase of the Japanese Creek Levee was completed during the summer of 2001.

Currently, the City of Seward has completed the permitting process for the second phase of the project. has completed the Japanese Creek relocation and, by the time of this plan's approval, will have completed all the property acquisitions. The second phase of the project will extend the levee/road to the Seward Highway. Construction of the levee and relocation of utilities is planned to begin in 2010. (Please see maps below and attached)



A major area of flood concern in the city involves the Lowell Creek Flood Control Project. This project, built in 1940, diverts Lowell Creek away from the city through a tunnel in Bear Mountain and into Resurrection Bay. During floods, Lowell Creek can reach high velocities and carry boulders and debris weighing several tons. Blockage of the tunnel would cause flood flow to go over the spillway and flow through the middle of the city. Due to the age of the tunnel and the potential for catastrophic failure from debris blockage, the tunnel has been determined to be inadequate and unsafe. Many repairs of the tunnel have taken place throughout the years beginning in 1945, with additional emergency repairs in 1984, 1988, and 1991. More recently an overhaul of the tunnel occurred in the winter of 2002-2003. The US Army Corps of Engineers and subcontractors were responsible for tunnel work including a lining of high strength concrete on the floor and replacement of some railroad ties at the entrance for protection. Voids were found beneath the tunnel and were filled during this project period.

During the 1995 and 2001 flood event, sediment and rock that flowed out of Lowell Creek washed away riprap and a portion of the bridge at the waterfall which eroded the water main and sewer line.

The flooding event in October 2006 was caused by the combination of high tides, warm temperatures and the remnants of a typhoon stalled over south central Alaska caused 9 to 15 inches of rain to fall on the Seward area. The heavy rains contributed to the closing of the Seward Highway at Mile 4, portions of the airport were flooded and residents from outlying areas were evacuated from their homes. The outflow from the Lowell Creek diversion tunnel dumped a 25 foot pile of debris and gravel on the bridge, severed the only road to residents living at Lowell Point and threatened water main and sewer lines. Several levees were damaged and approximately 200,000 cubic yards of bed load was deposited in Japanese Creek severely constraining the levee's ability to contain flood waters.

The Alaska District of the U.S. Army Corps of Engineers assumed long-term maintenance and repair responsibility of the tunnel, inlet and outlet structures, until completion of construction of an alternative method of flood diversion or until November 8, 2022. The City of Seward continues to work with our congressional delegation to insure this project is funded.

### **History of Earthquake and Tsunami Events in Seward**

On Good Friday, March 27, 1964, North America's strongest recorded earthquake, with a moment magnitude of 9.2, rocked central Alaska. Large areas were lifted up or dropped by several feet, landslides were extensive, ground failure led to large fissures in the ground, landslides into bays caused huge seiche waves locally and a tsunami caused damage thousands of miles away. The result in Seward was disastrous to the town, waterfront, boats and railroad. An estimated \$14 million in damage occurred. An entire section of the waterfront slid into Resurrection Bay.

During the 1964 earthquake, landslides into bays near Valdez and Seward sent 35 foot waves sloshing back and forth like water in a bathtub. In Seward, an oil tanker was wrenched loose from a pipeline, which erupted in flames, spreading to the nearby oil tanks. Burning oil on the water washed inland. Ships were battered against piers and washed ashore. Warning time can be limited when the tsunami is triggered close to the impacted coastline. In Seward, a 1070 meter section of the waterfront slid into the Resurrection Bay due to the earthquake shaking. This generated a local tsunami causing much damage. Oil from storage tanks was spread on to the water and ignited. About 20 minutes later, the first wave of the main tsunami hit. The 11-13 fatalities in Seward were due to the local and the main tsunamis.

### **History of Erosion in Seward**

Coastal erosion is an ongoing problem for the City of Seward. Areas most seriously affected by shoreline erosion include Lowell Point Road, Alaska SeaLife Center Lease site, Waterfront Park south to the waterfall and the Seward Marine Industrial Center (SMIC). Emergency erosion control efforts by the City of Seward include the shoreline at the waterfront camping area and within the Seward Marine Industrial Center. In recent years, the city has replaced riprap along Lowell Point Road in a number of different locations to maintain the protection of the city sewer line.

The December 2009 storm surge event with high water caused extensive erosion and damage to the wave barrier along Lowell Point Road, the Seward Green belt or water front park area and the seawall at the Alaska SeaLife Center.



## **Chapter 4 – Hazards in Seward**

The goal of mitigation is to reduce the future impacts of a hazard including property damage, disruption to local and regional economies, and the amount of public and private funds spent to assist with recovery. However, mitigation should be based on risk assessment.

A risk assessment predicts the potential loss from a hazard event by assessing the vulnerability of buildings, infrastructure and people. It identifies the characteristics and potential consequences of hazards, how much of the community could be affected by a hazard, and the impact on community assets.

A risk assessment consists of three components: hazard identification, vulnerability analysis and risk analysis. Hazard identification will attempt to identify known hazards within the community. Vulnerability analysis will show how each hazard may have an impact on the community. Risk analysis will show what frequency and what damage from identified hazard may impact the community.

The following annexes describe hazards that may occur in the City of Seward. The hazards are broken into annex sections, which when appropriate, identify the hazard, assess vulnerability, risk, mitigation goals and potential projects. Due to time constraints, hazards that are not identified as a significant risk to the City of Seward are included but given less comprehensive attention.

### **Annex A - Floods**

#### **A. Hazard Assessment**

Step one is to identify the hazard. As outlined in Chapter 2 of this plan, flooding in the City of Seward occurs primarily as a result of heavy rains and the effects of being built on the alluvial fans of Resurrection River and Lowell Creek.

#### **B. Vulnerability Assessment and Impacts**

Step two is to identify the jurisdiction's vulnerability (the people and property that are likely to be affected). Inventorying the jurisdiction's assets to determine the number of buildings, their value, and population in hazard areas can also help determine vulnerability. Identifying hazard prone critical facilities is vital because they are necessary during the response and recovery activities.

Major rain events in the past have shown that the Seward area is prone to flooding by many factors, including swelling of water ways, surge-debris release and the damming effects caused by erosion of the steep banks of the surrounding mountains, rapid snow melt and to some degree, storm surge. The City of Seward remains vulnerable due to its being built on an alluvial fan. The Lowell Creek Tunnel Project is an example of mitigation

planning for the City of Seward. In 1992, a report on flood damage reduction was created by the US Army Corps of Engineers. In this report, the Corps determined that the tunnel has deteriorated due to debris abrasion. The rails used to armor the tunnels floor had been torn out and floor has eroded to the bedrock. The report states the tunnel has been determined to be vulnerable to blockage and possible collapse. They also determined that the tunnel is deteriorating faster than it could be repaired. Blockage of the tunnel by lining failure, debris and/or landslides would cause flood flow to go over the spillway. Water and debris would flow through the heart of the city. Homes, senior citizen apartments, medical and dental clinics, and the hospital are situated in the Lowell Creek Canyon just below the diversion dike. According to the 1992 US Army Corps of Engineers report, the flood control project is considered unsafe and inadequate. The most recent repair work was done during the winter of 2002-2003, in which the Corps replaced the floor, rails and part of the eroded bedrock voids. These repairs should control the erosion problem for a number of years but this will be an ongoing project. The 2008 Water Resources and Development Act (WRDA) returned the Lowell Creek diversion tunnel to the US Army Corps of Engineers management and authorized a project to correct current deficiencies.

Resurrection River is another area prone to flood damage. In 1994, the US Army Corps of Engineers did a reconnaissance report on prevention of flood damage for the Seward Area Rivers. In this report, all the watersheds entering the upper Resurrection River were examined and it was determined that rapid sedimentation in the Resurrection River channel places much of the development adjacent to the river in danger of flood damage. A significant concern of possible flood damage is the Seward Highway bridge crossings. During the 1995 flood event, water crossed the highway at or near these crossings. In 1999, 150,000 cubic yards of debris, woody material, gravel, sand and silt was removed from Resurrection River approximately 2000 feet downstream from the center Seward Highway Bridge. The desired effect of the work was to alleviate backwater conditions eliminating potential flooding. Along with this project, the city replaced the culverts of the lagoon outflow at 4<sup>th</sup> Avenue. Recent improvements to the Seward Highway and Alaska Railroad bridges include the installation of clear span bridges across the Resurrection River.

In 1996, the City of Seward developed a mitigation plan for flood hazards in the city. Flooding mitigation and recommendations have been done for Spruce Creek, Lowell Creek, Rudolph Creek, Japanese Creek, Resurrection River Basin, Sawmill Creek and Fourth of July Creek. That plan is available at the City of Seward Community Development office. The Kenai Peninsula Borough Flood Mitigation Plan also includes Seward and areas north of the city and is available through the borough office. In 2003 the Kenai Borough adopted Ordinance 2003-30 establishing the Seward/Bear Creek Flood Service Area (SBCFA). Section 16.50.090 of the Kenai Peninsula Code defines the SBCFSA Board of Directors powers and duties, which include responsibility for developing, implementing and updating a plan for furnishing flood protection, planning and mitigation services. The SBCFSA Flood Hazard Mitigation Plan was originally published July 2005 and updated November 2007.

Risk analysis is the final level of hazard assessment. It involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result (defined through

the vulnerability assessment); and (2) the likelihood or probability of the harm occurring (multiple flooding scenarios).

The magnitude of the flooding in Seward has been historically high. Debris and surge-release flooding will continue to be a problem due to the topography and traditional weather patterns of the area. Risk depends on the degree of flooding and can include disruption of services, transportation routes, and communication systems. According to the FEMA FIRM maps, if there was a 100 year flood event, the estimated borough assessed values of structures within the flood affected area is in excess of \$21,000,000. These structures include residential buildings, commercial buildings and public facilities. In 1986, estimated recovery costs for the City of Seward were projected at \$2.2 million. The 1995 flood had estimated repairs to just city property was \$147,700.

In Seward, there are flood warning systems which give community residents' an organized notification of impending flood danger. The National Weather Service (NWS) provides flood forecast and warning data utilized by many communities that have local warning systems.

### **National Flood Insurance Programs (NFIP)**

The function of NFIP is to provide flood insurance to homes and businesses located in floodplains at a reasonable cost, and to encourage the location of new development away from the floodplain. The program is based upon mapping areas of flood risk, and requiring local implementation to reduce that risk, primarily through guidance of new development in floodplains.

The City of Seward uses Flood Insurance Rate Maps (FIRM), effective May 19, 1981, and codified the Flood Plain Mitigation Plan in October 1999, to depict areas of flooding within the city limits. The FIRM depicts the flood plain as determined by FEMA.

Details of the NFIP can be found at <http://www.fema.gov/doc/library/nfipdescrip.doc>.

The 1981 Flood Insurance Rate Maps are outdated and are in need of updating to address the following items.

- 1981 maps need to be reevaluated with the 29 years of additional data.
- Corrections may need to be made for areas where fill or naturally high ground is now shown as flood prone but may not be in jeopardy of flooding.

In 2010, FEMA will update its FIRM maps for the City of Seward. The estimated date for release of the draft maps is March 30, 2010. Draft hard copy maps will be released for public review, and once public meetings are held by FEMA, and public comment is obtained, final maps and digital shapefiles will be available in 2011.

The City of Seward Community Development Office is available for estimates of the number and assessed values of structures located within the areas identified on the FIRM.

To deal with problems of flooding at the Seward Airport, the State of Alaska Department of Transportation and Public Facilities published the Seward Airport Master Plan and environmental assessment in July 2008.

The City of Seward and the US Army Corps of Engineers have made substantial progress in prevention of flooding in Seward. The Lowell Creek Tunnel Project completed in 1940, diverts the waters of Lowell Creek away from the city through Bear Mountain and into Resurrection Bay. The Japanese Creek Levee Project completed in 2001, keeps flood waters from entering the Forest Acres Subdivision and crossing the highway. These projects, as well as the Resurrection River dredging project, currently reduce the risk of major flooding within the city.

### **C. Mitigation Measures**

This section of Annex A addresses flood mitigation goals for the City of Seward with potential projects to achieve these goals.

- Goal 1: Identify hazard areas and select mitigation measures for those areas
- Goal 2: Increase public awareness of hazards
- Goal 3: Enact mitigation measures

This first goal is to identify the flood hazard areas and mitigation measures that will better protect individual and commercial property owners within the City of Seward. On going mitigation measures include:

- Floodplain development permits to include elevation certificates and data
- Request base sea level and flood elevations from builders on proposed projects
- Provide maps of flood hazard areas, in digital and hard copy
- Update as required city code floodplain management ordinance
- Update the Seward Flood Hazard Mitigation Plan, 1996; this was subsequently replaced by the Seward/Bear Creek Flood Service Area Flood Hazard Mitigation Plan, Originally published July 2005 and updated in November 2007.
- Integrating Flood Hazard Mitigation strategies into the Seward 2010 Comprehensive Plan, 1990
- Include flood issues in the Seward Strategic Plan, 1999
- Provide FEMA Public Outreach Floodplain Information booklets
- Staff coordination with SBCFSA, KPB, State of Alaska, and Federal Floodplain managers on flood issues within the City of Seward.
- Building Permits; insuring the adopted building codes address flood issues
- Continue working with the Seward Bear Creek Flood Service Area Advisory Board to update the working mitigation plan.
- Advising the US Army Corps of Engineers of conditions concerning the Lowell Creek Tunnel Project including renovating the tunnel and developing a new outfall.
- Maintain and extend the Japanese Creek Levee.
- Remove excess bed load accumulation in Seward's rivers and creeks.



- Ditch, drainage, sea wall and culvert construction, coordinated to help ensure the safe, flood free drainage even during potential storm events.

#### ***Potential Projects:***

- Acquire land within the city to develop a usable secondary evacuation route that bypasses the Seward lagoon and boat harbor areas. Provide barriers to this route and designate it as a recreational trail for use outside of emergency access. (Planning and Zoning Commission, May 6, 2004)
- Complete the Two Lakes Park Replat and the joint use access agreements providing the secondary evacuation route.
- Update Flood Insurance Rate Maps: the 1981 maps need to be reevaluated with 29 years of additional data. Evaluate additional programs that address Seward's unique alluvial fan flood problem.
- The City of Seward should continue improving its NFIP Community Rating System, under the Federal Insurance Administration's Community Rating System (CRS) by exceeding the required standards to obtain further flood insurance premium reductions for policyholders within communities while simultaneously reducing flood losses.
- North Forest Acres Levee and Access Road Project: Phase 2 of this project has begun to protect the North Forest Acres Subdivision and other areas of the City of Seward from recurrent flood damage by constructing a levee along the lower portion of Japanese Creek. Flood-proofing existing structures: Improving existing structures to make them less susceptible to flood damage could be a viable project for many of the historic buildings or non-elevated structures.
- Dairy Hill Drainage Improvements: Upsize culverts and improve haphazard drainage in the Dairy Hill Area. During heavy rainfall events, the flows in the drainages can become severe and cause washouts of roadways, culverts and building improvements. An HMGP grant application was submitted in 2010 in the amount of \$339,387.00.
- Replace the Dairy Hill Road/ Seward Lagoon culverts with larger culverts. During flood events, the existing culverts cannot divert enough water to prevent flooding of the road.
- Conduct a structural assessment of the 4<sup>th</sup> of July Creek dike. A failure of the existing dike would cause damage to infrastructure of the city water supply and Spring Creek Correctional Center.
- Coordinate with the US Army Corps of Engineers as they develop a project to upgrade, replace or find an alternative to the Lowell Creek diversion tunnel and it's resulting out-flow sediment build up
- Japp Creek investigation to evaluate the flow capacity of the existing flood control corridor, to determine sedimentation trends/rates, and to utilize this information to develop a long term maintenance strategy and funding plan to preserve the system.
- Fourth of July Creek investigation to evaluate the flow capacity of the existing flood control corridor, to determine sedimentation trends/rates, and to utilize this information to develop a long term maintenance strategy and funding plan to preserve the system.

- Spruce Creek evaluate the flow capacity of the flood control corridor and determine sedimentation rates. Use this information to develop a plan to preserve the flood control corridor and to create a long term maintenance strategy and funding plan.
- A geomorphic investigation should be conducted of Scheffler Creek to determine the size, frequency, and potential deposition characteristics of future debris flows.
- Consider land use code regulation changes to more effectively guide development and floodplain use. Evaluate certain areas for additional preventative measures. The city subdivision regulations which govern the division of land for sale or development should include floodplain regulations. The floodplain regulations should be incorporated into the Alaska Coastal Management Program (ACMP) and the Seward Comprehensive Plan.
- Support a U.S. Army Engineer District, Alaska needs Assessment this fall to consider needs throughout the greater Seward watershed area. Alternative, the City could proceed ahead to request our Congressional delegation to establish earmarks of \$100K for our preliminary assessments.

Goal two is to increase public awareness. This could be accomplished by the following measures.

- Information Dissemination: The purpose of information dissemination is to provide the community residents with knowledge about the flood hazards in their neighborhoods and possible activities for mitigation. A variety of agencies can participate in information dissemination. Manuals are available through the City of Seward Clerks Office, Community Development Office and at the Seward Community Library.

Outreach Projects: The City continues to provide flood information and technical assistance to current and prospective residents and business owners. The City will schedule training/info sessions for local realtors, contactors and lending institutions. Real estate disclosure: Alaska State Statute 34-70 requires a seller to disclose flood hazard on residential properties.

- Risk Analysis: With advances made in Geographic Information System (GIS) technology, it is becoming increasingly easy to analyze the risk of various flood events. This analysis, of course, depends on the availability of data relating to building location and value and flood recurrence. Performing multiple risk analyses helps to increase public understanding of a coastal or river flood potential. Often, risk is understood only at the "100-year" level, because this forms the basis for Flood Insurance Rate Maps. The "100-year" flood means a flood level having a 1% chance of being equaled or exceed annually. If information is collected and reviewed, the possibility of predicting what areas may be impacted during a 5, 10, 15 year cycle.

### ***Potential Projects:***

- Continue distributing the brochure describing the City of Seward flood dangers and floodplain building regulations.
- Continue working with FEMA and other Federal and State Agencies as the Flood Insurance Rate Maps (FIRMs) are updated and researching other tools for accurately forecasting and mitigating Seward's complex alluvial fan flood problem.
- Continue working with FEMA to obtain the latest National Flood Insurance Program information and scheduling workshops.
- Provide floodplain regulations information, updates or revisions to the citizens of Seward.
- Continue coordination with FEMA to conduct flood proofing or elevating workshops for the City and public.
- Continue the City's efforts working with potential partners or agencies while capitalizing on multiple funding sources for mitigation projects, including erosion and sediment control projects.
- Continue refining the education and outreach programs to notify current homeowners and potential homebuyers about flood hazard risks in identified areas.
- Provide local realtors and lending institutions with GIS copies of FIRM as they are updated.
- Complete North Forest Acres Levee and Access Road Project.
- Complete Dairy Hill Road/ Seward Lagoon culvert replacement.
- Conduct a structural assessment of the 4<sup>th</sup> of July Creek dike.
- Obtain ongoing permits for the Lowell Creek outfall sediment and erosion control program.
- Continue public education concentrating on the SAWS (Siren Alert and Warning System), what it means and what to do in the event of an emergency. Educate the public on the Emergency Alert Network. (Planning and Zoning Commission May 6, 2004)
- Continue providing new homeowners, builders or renovators a brochure detailing the fuel tank stand codes helping to insure they're more *flood/earthquake prepared* (Planning and Zoning Commission May 6, 2004)

The third goal in the process is to enact mitigation solutions. The City working closely with the SBCFSA has identified flood mitigation problems and recommended solutions within their capabilities, which have been through the public process and approved by the City Council, with some funded and others competing for state or federal funding. Mitigation problems exceeding the City and SBCFSA capabilities and expertise have been forwarded to FEMA, US Army Corps of Engineers and other federal and state organizations for their assistance. The City and SBCFSA have agreed on those projects that can be funded by each and included in their budget. Grant requests and other financial sources are being sought on those that exceed either's capacity. Completion of any project will depend on the availability of funds and any changes of priority.



## **Annex B - Earthquake**

### **A. Hazard Assessment**

Earthquakes are common occurrences in Seward. The threat of a tsunami is dependent on the magnitude and location of the tectonic activity.

Most large earthquakes are caused by a sudden release of accumulated stresses between crustal plates that move against each other on the earth's surface. Some earthquakes occur along faults that lie within these plates. The dangers associated with earthquakes include ground shaking; surface faulting; ground failures; snow avalanches, seiches and tsunamis. The extent of damage is dependent on the magnitude of the quake, the geology of the area, distance from the epicenter and structure design and construction. A main goal of an earthquake hazard reduction program is to preserve lives through economical rehabilitation of existing structures and constructing safe new structures.

Ground shaking is due to the three main classes of seismic waves generated by an earthquake. P (primary) waves are the first ones felt, often as a sharp jolt. S (shear or secondary) waves are slower and usually have a side to side movement. They can be very damaging because structures are more vulnerable to horizontal than vertical motion. Surface waves are the slowest, although they can carry the bulk of the energy in a large earthquake. The damage to buildings depends on how the specific characteristics of each incoming wave interact with the buildings' height, shape, and construction materials.

Earthquakes are usually measured in terms of their magnitude and intensity. Magnitude is related to the amount of energy released during an event while intensity refers to the effects on people and structures at a particular place. Earthquake magnitude is usually reported according to the standard Richter scale for small to moderate earthquakes. Large earthquakes, like those that commonly occur in Alaska are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by large events.

Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from not felt to total destruction. Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building construction practices. Soil conditions are a major factor in determining an earthquake's intensity, as unconsolidated fill areas will have more damage than an area with shallow bedrock.

On the Richter scale, magnitude is expressed in whole numbers and decimals. A 5.0 earthquake is a moderate event, 6.0 characterize a strong event, 7.0 is a major earthquake and a great earthquake exceeds 8.0. The scale is logarithmic and open-ended.

Surface faulting is the differential movement of the two sides of a fault. There are three general types of faulting. Strike-slip faults are where each side of the fault moves horizontally. Normal faults have one side dropping down relative to the other side. Thrust (reverse) faults have one side moving up and over the fault relative to the other side.

Earthquake-induced ground failure is often the result of liquefaction, which occurs when soil (usually sand and coarse silt with high water content) loses strength as a result of the shaking and acts like a viscous fluid. Liquefaction causes three types of ground failures: lateral spreads, flow failures, and loss of bearing strength.

On Sunday, November 3, 2002 magnitude 7.9 Denali Fault Earthquake, one of the largest ever recorded on U.S. soil according to the U.S. Geologic Survey, resulted in no damage in Seward. On a global level, three of the ten strongest earthquakes ever recorded occurred in Alaska.

## **B. Vulnerability Assessment and Impacts**

Seward, Alaska is located in the Pacific Subduction Zone in which Oceanic-continental convergence is taking place. This area is also known as the Ring of Fire or the Pacific Rim of Fire. It is the place where two tectonic plates are in a very slow collision. The buildup of pressure between the tectonic plates determines the degree of earth movement. Such destruction (recycling) of crust takes place along convergent boundaries where plates are moving toward each other, and sometimes one plate sinks (is *subducted*) under another. The location where sinking of a plate occurs is called a *subduction zone* (USGS). Volcanic activity is also high along subduction zones.

The City of Seward is very vulnerable to such earth movements. A risk analysis for the City of Seward shows significant impact to priority infrastructures and the economy. If the right conditions occur during an earthquake, a tsunami is also a potential hazard.



This photo was taken after the 1964 earthquake. It shows the waterfront area where major devastation occurred from both the earthquake and the resulting tsunamis.

Photos from the *Earth Science Photographs from the U.S. Geological Survey Library*, by Joseph K. McGregor and Carl Abston, U.S. Geological Survey Digital Data Series DDS-21, 1995.

Impact to the city would be substantial if a major earthquake occurred. The history of Seward during the 1964 earthquake shows that many major problems were eminent. Depending on the magnitude of the quake, a number of different outcomes could take place. Transportation, infrastructure, emergency services, commerce and individual property as well as lives would be affected by a large quake. In the 2004 plan edition, mitigation measures Goal 1; had an objective to obtain land for a secondary evacuation route that bypasses the Seward Lagoon and boat harbor areas.

In January 2010, the Seward Planning & Zoning Commission approved a replat of land owned by the City to designate it as a park. A sixty foot wide Right-of-Way was included in the request to allow for access to a private landholder. The landholder agreed to allow for a secondary access route across their property for consideration of the right of way. Details on the exact location of the secondary route and its width will be determined in the spring of 2010. Construction of the route will not start until funds are available to complete it.

Goal 2 in the Plan mitigation measures had an objective to develop a brochure to educate homeowners on fuel tank stands. That objective was included in the information packet given to anyone applying for a Building Permit. During the plan review phase of a project items that are of concern for earthquake mitigation are pointed out to the developer and where possible required for the project.

### **C. Mitigation Measures**

*Goal 1:* Identify hazard areas and select mitigation measures for those areas

- Update building codes to stay current with state requirements and industry concerning earthquake protection.
- Identify non-buildable sites through the city's land use plan and city zoning maps.
- Earthquake proof priority structures (schools, city buildings, public safety offices, etc.) This project requires the involvement of many government entities and assessments of various structures. Where possible employ Earthquake resistant building technology to mitigate damage.
- Acquire land within the city to develop a secondary evacuation route that bypasses the Seward lagoon and boat harbor areas. Provide barriers to this route and designate it as a recreational trail for use outside of emergency access. (Planning and Zoning Commission, May 6, 2004) (Land has been designated in January of 2010. The survey of the route is scheduled to be accomplished in the spring of 2010.)

*Goal 2:* Increase public awareness of hazards

- Conduct community mock emergency exercises and evaluate response.
- Develop public education to concentrate on the SAWS (Siren Alert and Warning System), what it means and what to do in the event of an emergency. Educate the public on EAN (Emergency Alert Network). (Planning and Zoning Commission May 6, 2004) Possibly make public announcements using the utility billing memo and the scanner announcement page with GCI cable TV and radio.

Continue to update brochures and handouts to educate homeowners on fuel tank stand codes and earthquake mitigation measures so they will be more flood/earthquake prepared.

*Goal 3:* Enact mitigation measures



The third goal in the process is to enact mitigation solutions. Once the potential problems and solutions have been addressed along with input from the public process and approval of the City Council, the mitigation can go forward. The process of funding each project can be addressed during the normal budget process and/or with grant funding. Completion of any project will depend on the availability of funds and any changes of priority.

## **Annex C -Tsunami**

### **A. Hazard Assessment**

Tsunamis are ocean waves that are generally triggered by vertical motion of the sea floor during major earthquakes. Near ocean or undersea landslides or volcanic eruptions can also generate tsunamis. They can be generated locally or a great distance from where they landfall. Warning time can be limited when the tsunami is triggered close to the impacted coastline.

#### *Seismically-generated local tsunamis*

Seismically-generated local tsunamis were produced during the 1964 earthquake. Earthquakes generate tsunamis when the sea floor abruptly deforms and displaces the overlying water from its equilibrium position. Waves are formed as the displaced water mass, which acts under the influence of gravity, attempts to regain its equilibrium. The main factor which determines the initial size of a tsunami is the amount of vertical sea floor deformation. This is controlled by the earthquake's magnitude, depth, fault characteristics and coincident slumping of sediments or secondary faulting. Other features which influence the size of a tsunami along the coast are the shoreline and bathymetric configuration, the velocity of the sea floor deformation, the water depth near the earthquake source, and the efficiency which energy is transferred from the earth's crust to the water column.

#### *Landslide-generated tsunamis*

Submarine and sub-aerial landslides can generate large tsunamis. Sub-aerial landslides have more kinetic energy associated with them so they trigger larger tsunamis. An earthquake usually, but not always, triggers this type of landslide and they are usually confined to the bay or lake of origin. During the 1964 earthquake, landslides into bays near Valdez and Seward sent 35 foot waves sloshing back and forth like water in a bathtub. Warning time can be limited when the tsunami is triggered close to the impacted coastline. In Seward, a 1070 meter section of the waterfront slid into Resurrection Bay due to the earthquake shaking. This created a local tsunami causing much damage. Landslides usually occur in the heavily glaciated areas of Prince William Sound and parts of Southeast Alaska. One earthquake can trigger multiple landslides and landslide-generated tsunamis. Low tide is a factor for submarine landslides because low tide leaves part of the water-saturated sediments exposed without the support of the water. Loading on the delta from added weight such as trains or a warehouse or added fill can add to an area's instability.

Resurrection Bay borders the Gulf of Alaska and it is vulnerable to tsunamis generated by landslides, underwater landslides, crustal plate movement, and volcanic activity in the North Pacific Ocean. The Gulf of Alaska could receive a tsunami from several possible sources.

## B. Vulnerability Assessment and Impacts

The map below is from the State of Alaska Hazard Mitigation Plan which designates Seward as having a high tsunami hazard.



This truck at Lowell Point, 2 miles from Seward, was bent around a tree by the surge waves generated by the underwater landslides along the Seward waterfront. The truck was about 32 feet above water level at the time of the earthquake.

Source US Geological Survey.



## **C. Mitigation Measures**

Seward was one of the first cities in the U.S. to be considered Tsunami Ready. The city has put together evacuation maps, pamphlets and signs designated to help people in our community escape potential risk. Due to the history of tsunamis in Seward, the city has cooperated with the State of Alaska and the Kenai Peninsula Borough in the development of tsunami warning signals. The city has developed response plans to deal with the effects of tsunamis. In the 2004 version of this plan, in Goal 1 we identified two potential projects that benefit the community. With the assistance of The State of Alaska DHS/EM, USGS, UAF Geological Department and NOAA we have finalized a new inundation map for the community. This map shows the effects of different size waves and effects from waves generated inside and outside of Resurrection Bay. The final version of the map went to the publishers in January 2010. The second project was to acquire land to develop a secondary evacuation route. An agreement has been reached with the private landowner who will allow for this route over their property. Survey of the route has been completed and we are currently looking into any engineering studies that may be required.

*Goal 1: Identify earthquake and tsunami hazards within the City of Seward and evaluate and prioritize potential mitigation measures.*

### ***Potential Projects:***

- Revise tsunami inundation hazard prediction maps as needed after an event or disaster.
- Develop a secondary evacuation route that bypasses the Seward lagoon and boat harbor areas. Provide barriers to this route and designate it as a recreational trail for use outside of emergency access. (Planning and Zoning Commission, May 6, 2004)
- Drill or dry run practice community evacuations of above and existing evacuation routes.
- Place one electrical supply circuit underground across the Lagoon in an old waterline.
- Complete an underground electrical supply circuit over Dairy Hill and through Two Lakes Park.
- Complete an underground circuit from the South Harbor expansion to Jefferson along Ballaine Blvd.
- Complete the SMIC electrical loop along Sorrel Rd.
- Complete the electrical loop along Alameda St. To Leirer Rd.
- Complete the underground electrical loop on Lowell Pt. from Beach Drive to Lowell Pt. Rd., and the loop from Shady Ln. to Beach Dr.

*Goal 2: Protect lives and properties in the event of a tsunami through public education and emergency response exercises.*

- Install AWS (Alaska Weather System) radios in public buildings. These radios will also broadcast tsunami watches and warnings.
- Install EMWIN (Emergency Managers Weather Information Network), from the National Weather Service into the police dispatch area.

- Conduct community mock tsunami exercises and review responses to correct deficiencies.
- Develop public education to concentrate on the SAWS (Siren Alert and Warning System), what it means and what to do in the event of an emergency. Educate the public on EAN (Emergency Alert Network).

## **Annex D – Coastal Erosion**

### **A. Hazard Assessment**

Erosion to the beaches caused from storms or high winds are an ongoing hazard in the City of Seward. Other wave action and coastal flooding also causes damage to the shoreline. South facing shorelines within the city are more susceptible to wave erosion. These shorelines are mainly public property.

### **B. Vulnerability Assessment and Impacts**

Erosion in the form of wave action in Resurrection Bay is caused by a number of different scenarios. The most damaging wave action is the result of storm surge. These storm-induced waves cause the destructive erosion of coastal areas. Use of Resurrection Bay by recreational boaters, is a source of wave action which will continue to be a problem even without significant storms.

The City of Seward has taken steps to minimize the impacts of erosion on beaches with the addition of rock walls, culverts and channels. In 2002, the City of Seward did some emergency erosion control work south of the ship lift located in Seward Marine Industrial Center. The project was designed to reduce the ongoing erosion in that area. Over \$38,000 was spent on that repair effort. The U.S. Army Corps of Engineers is looking into more extensive erosion work at the SMIC.

After the 2006 flood event, the City of Seward evaluated options for additional erosion control within the Seward Small Boat Harbor basin. A new Travelift dock was built in 2008, connecting the existing sheet-piling dock forming the foundation for the Best Western Hotel. Additional rock was placed in the north-west corner to help alleviate the erosion problem in this quadrant of the harbor.

The north-east corner of the harbor requires additional mitigation efforts to prevent future damage from future flooding events. A stormwater drain is currently in place in this area; however shore bank erosion will continue to be a problem unless rock, sheetpile or other substrate is placed in the area to prevent further erosion. This area of the harbor has been subject to damage from wave action because the east breakwater was not originally designed or built long enough to protect this area from wave events originating from



Resurrection Bay. In 2010 the US ARMY Corps of Engineers awarded a contract to extend the east breakwater 215 feet to mitigate this problem.

An additional consequence of the flooding events in Seward is the accumulation of debris (soil, rocks, vegetative matter, trash) that is deposited in the harbor basin. This requires additional dredging to maintain proper depth in the harbor. The US Army Corps of Engineers maintains responsibility for a portion of the harbor dredging, but most flood prone areas are the City of Seward's responsibility. Dredging is scheduled to occur in 2011 based on funding availability.

Lowell Point Road on the south end of the City of Seward has suffered repetitive erosion and flood damage problems from both weather and coastal erosion. Lowell Point Road serves as the infrastructure access to the sewage treatment facility. This access must be maintained. Erosion to the access road south of the waterfall has been a major economic and safety concern. The city estimates it would cost approximately \$5 million dollars to replace and erosion proof the existing access, electric and sewer lines.

In December of 2009 a storm surge caused severe damage to Lowell Point Road, Alaska SeaLife Center, the south camping area, camping area along Ballaine Blvd and the south beach of SMIC. The State of Alaska made a declaration of disaster for this event.

The likelihood of coastal erosion becoming more problematic and occurring more often in Resurrection Bay also increases with possible global climate change and associated rising of sea levels.

### **C. Mitigation Measures**

**GOAL:** Reduce the amount of shoreline erosion within allowable practices and monetary constraints.

#### ***Potential Projects:***

- Build a protective barrier south of the Seward Marine Industrial Center (SMIC) for erosion control.
- Complete wave barrier at the ship lift located in SMIC.
- Maintain the rock barrier located in the Waterfront Park area.
- Create a baseline assessment on Lowell Point Road, existing infrastructures and the feasibility of culvert/ditch line installation.
- Maintain or redesign rip-rap barriers along Lowell Point Road.
- Dredging operations to remove debris and fill at the head of Resurrection Bay near the airport.
- Cover the underground electric line to Lowell Pt. with concrete.
- Current Mitigation measures required at Waterfront Park includes 1) repairing, maintaining and redesigning the rock barrier located in the Waterfront Park area and 2) implementing a regenerative program of our native Beach Rye Grass (*Elymus arenarius*) by aggressively replanting, relocating city campground fire pits, implementing educational signage to redirect foot and recreational vehicle traffic and

installing boulders and other barriers to prohibit vehicles from damaging the coastal vegetation.

- Install a protective "spit" near the waterfront in cooperation with the state, to protect from coastal erosion, storm surge tides and tsunami inundation. Similar to the south harbor upland, but smaller.
- Install sheet-piling or a rock barrier along the north-east edge of the harbor to prevent further erosion.
- Dredging operations to remove debris and sediment accumulation within the harbor from flooding events and to maintain necessary depth.

## **Annex E – Wildland Fire**

### **A. Hazard Assessment**

The City of Seward has a low probability of direct wildland fire hazard but there have been instances of wildland/urban interface fire situations in May of 2000 and 2001.

Seward is subject to the effects of a wildland fire in the East Zone of the Kenai Peninsula. Primarily, transportation to the city would be disrupted if a major wildland fire event would take place in the East Zone.

### **B. Vulnerability Assessment and Impacts**

The City of Seward has a low risk of wildland fire and secondary effects of a fire from the East Zone are covered in the KPB Hazard Mitigation Plan.

The communities of the East Zone have the potential to experience both large structural and urban/wildland interface fires. Large wildland fires also have the potential to affect Seward from secondary effects such as air space and road closures due to smoke. Fires may arise as isolated incidents, or be caused by other emergencies such as earthquakes. In addition, they may be complicated by the presence of hazardous materials, and extreme weather conditions.

There is a history of large wildland fires in the East Zone such as the Moose Pass fire of 1985 or the Crown Point fire of 2001. The increasing amount of spruce-bark beetle killed forest coupled with the right mix of weather and fire behavior could result in a large wildfire that would impact people, property, air quality and the transportation corridor. Under certain conditions, the increased beetle kill forest may increase the potential for fire starts of urban/wildland fires in formerly low risk areas. The potential risk to property and people can be great given the correct mix of extreme fire weather and increased fuel loading.

Although the City of Seward has a low probability of wildland fire, the East Zone wildland fire potential has been problematic for Seward and continues to pose a threat to the city. In the case of the wildland fire that affected the Kenai Lake/Trail River campground in 2001, the City of Seward gave mutual aid to the US Forest Service. The Seward Fire Department crew was on the fire from June 26 through June 29, 2001.

### ***Potential projects:***

- Acquire permission to clear hazard, and potential hazard trees beyond the permit area for the transmission line from Dave's Creek to Grouse Lake from the State and the USFS.
- Clear the trees from the newly acquired permission areas and the brush within the permitted area.

### **Urban Fires**

As with many communities, the City of Seward has a greater probability of urban fire situations than wildland fires. Urban fires continue to dominate the city's fire prevention/protection efforts within the City of Seward. Structural, vehicle, marine and small brush fires are common occurrences within the city.

### **C. Mitigation Measures**

The Kenai Peninsula Borough offered a course on urban interface fire fighting in May of 2004 to better prepare firefighters for wildland/urban fire situations. The three day course was sponsored by the Borough Office of Emergency Management and Central Emergency Services in Soldotna. It was designed to address the issues of wildland/urban fires on the peninsula. The City of Seward has participated in the Alaska Firewise Program, which identifies hazards to homeowners and offers solutions to protect residents in or near forested areas. Relocating the Seward Building Department into the Fire Department has helped streamline this part of the process for builders by consolidating review of potential response to a structure, operational needs of the builder and City department's requirements in one location. During this plan review structures that are in an area that has risk/exposure to a wildland/urban fire, have been required to incorporate protective measures.

KPB is tracking the spread of the spruce bark beetle throughout the peninsula. The KPB Spruce Bark Beetle Office offers assistance and advice to businesses and homeowners.

## **Annex F- Weather**

### **A. Hazard Assessment**

The City of Seward has a high probability of weather related hazards. Winter storms can include heavy snowfall, ice storms, blizzards and extreme cold. Heavy spring or fall precipitation can lead to flooding in the Seward area.

## **B. Vulnerability Assessments and Impacts**

The probability of weather related hazards in Seward is high. Weather can disrupt communications; power, transportation, emergency services, and can pose a risk to individuals. Heavy snow has secondary effects as well, such as avalanches that close the highway and rail access into the city. A major winter storm in 2000 caused numerous avalanches that closed the Seward Highway in several places between Anchorage, Girdwood and Seward. This storm also caused power outages that affected the city and outlying areas. People rushed to the local grocery stores and most of the perishable foods were cleaned out as soon as the town was notified that the road would be closed. Medical supplies had to be flown in and the state ferry Tustumena was given deliveries from other communities to bring into Seward. Many people were stranded for up to seven days in one of the several communities that were affected.

Other major weather events include flooding, wind and extreme cold. Flooding of the past was a direct result of major downpours and already saturated ground. Extended dry periods and wind have affected the city by hampering efforts of controlling fire. In May 2000, a wildland fire in the Japanese Creek region quickly spread due to high winds and dry conditions. The City of Seward evacuated the Gateway Subdivision due to the speed at which the fire was traveling.

## **C. Mitigation Measures**

*Goal:* Increase public awareness of hazards related to severe weather

- Coordinate responses of private contractors during a severe event as indicated in the City's Emergency Plan.
- Public education on the effects of severe weather.
- Inform public of availability of AWS radios, in preparation of potential weather advisories.
- Activate the City's EOC to coordinate planning and logistical efforts in dealing with the emergency.

### ***Potential projects:***

- Rebuild the old transmission line sections in Lawing, Boulder Ck, and Lakeview to current distribution standards (its current use) so that it will withstand known weather conditions.
- Rebuild the double Circuit line from Dimond Blvd. to Dairy Hill Rd to withstand known weather conditions.



## **Annex G – Snow Avalanches/Landslides**

### **A. Hazard Assessment**

Both snow avalanches and landslides are common occurrences within the City of Seward. Lowell Point Road is commonly closed during the winter from snow avalanches. Landslides occur along that same road during heavy rains. Lowell Canyon is also prone to landslides during heavy rain. If a landslide were to block the Lowell Creek Tunnel entrance, serious flooding could affect homes, businesses, the hospital, and the senior center. Monitoring of Lowell Creek during major weather events is a high priority for the City of Seward.

### **B. Vulnerability Assessment and Impacts**

There is a moderate probability of snow avalanches/landslides within the City of Seward. Infrastructure disruption in Lowell Canyon can be a result of an avalanche or landslide event. Many of the secondary effects of avalanche are road closures on the Seward Highway which have greater impact to the community as a whole.

### **C. Mitigation Measures**

*Goal:* Increase public awareness of hazards of avalanche/landslides in the community

- Identify avalanche areas within the city and generate GIS Hazard Maps. Coordinate with Community Development on locations of areas for any zoning issues.
- Create safe parking areas along Lowell Point Road for vehicles.
- Develop and install signs designating avalanche danger zone.
- Renovate Lowell Canyon Tunnel access.
- Establish a retaining structure in Lowell Canyon to prevent avalanches from disrupting city water storage system.

#### ***Potential Projects:***

- Design and develop a new generation of diversion structures and flexible transmission poles to bend with the snow impact.
- Underground more of the distribution lines in avalanche areas, ex. Mile 22.

## **Annex H – Volcano**

### **A. Hazard Assessment**

The City of Seward, in the East Zone of the Kenai Peninsula Borough, would see secondary effects from a volcanic eruption. Actions needed are to be able to cope with potential long term effects and continual activity from the volcanoes. Infrastructure, facilities

and priority buildings will need to be secured from volcanic ash fallout. Citizens with respiratory conditions would need to be protected or evacuated.

## **B. Vulnerability Assessment and Impacts**

The vulnerability assessment is covered in the Kenai Peninsula Borough Hazard Mitigation Plan for the East Zone. In the Borough's Emergency Plan is a checklist that covers volcanic activity. The City has adopted the checklist for activities to be performed for warning, response and recovery phases (Vol. 2 KPB Emergency Plan Hazard Specific Checklist).

## **C. Mitigation Measures**

*Goal:* Increase public awareness of hazards

- Refer to KPB Hazard Mitigation Plan for guidance on mitigation plans
- Identify critical facility risk and need from ash fallout

# **Annex I – Technical**

## **A. Hazard Assessment**

There are various technical hazards within the City of Seward. One of the most prevalent is the anhydrous ammonia that is used in chilling facilities at the local fish processing plants. Facilities are located at the SMIC, the boat harbor and the south end of town. Other potential technical hazards within the city include; fuel storage facilities, explosive storage and hazardous materials shipped into the city by marine vessel and truck or train cargo.

## **B. Vulnerability Assessment and Impacts**

The probability of a technical hazard incident in the City of Seward is low, although there have been incidents in the past. Anhydrous ammonia is the most significant hazard that affects the community. Anhydrous ammonia is a corrosive and toxic gas that is an eye, nose and throat irritant. It is highly toxic if inhaled and may be an explosive hazard in a confined space. An example of this is the anhydrous ammonia leak and explosion at the Icicle Seafood's processing plant in Homer, Alaska, On July 1, 1998. The fire/explosion destroyed the Homer Plant. A broken ammonia line, under repair at the plant, was the source of the explosion. An estimated 34,000 lbs was in the system at the time of the explosion. It is not clear how much anhydrous ammonia escaped out of the system before the incidents. The plant was located on the Homer Spit, which is away from the heavily populated portion of the city but within close proximity of many businesses, campgrounds and the boat harbor. During the fire, the Spit had to be evacuated which took approximately one hour to complete.

Icicle Seafood's Seward Plant, located in the Seward boat harbor and within 1 mile of downtown Seward, holds 23,000 lbs. of anhydrous ammonia in their system with an additional 300 lb external cylinder. Resurrection Bay Seafoods, located at the southern end of town has 650 lbs. in the system. Polar Seafoods, located in the SMIC area has 4500 lbs. Due to the proximity of two of these processing plants to populated areas, the city has a high risk from the effects of an anhydrous ammonia release.

Icicle Seafoods currently has an Emergency Response Plan in place for potential release of anhydrous ammonia. In coordination with the Seward Fire Department, Icicle Seafoods conducts a simulated leak exercises. Icicle also does an in-house monthly exercise as part of their ERP. The plan is designed to meet the requirements of the Process Safety Management of Highly Hazardous Chemicals, the Hazardous Waste Operations and Emergency Response regulation, and Part 68 of Risk Management Plan regulations. The plan is available at the Icicle Seafoods Seward Fisheries Plant.

Another potential technical hazard incident is the fuel storage tanks located north of the small boat harbor. These include gasoline, heating oil, motor oil, and diesel and propane storage facilities. All of which have the ability cause extreme environmental disasters and/or fire/explosion incidents. In the event of a failure of any of these tank systems, the risk to the City of Seward is high. The probability however of such failures is low. The largest threat from a fuel spill would be environmental contamination. The petroleum tank facility is located within a few hundred yards of the shoreline. A major spill or rupture of any tank would have far reaching impacts.

All of these technical hazards can also occur as secondary affects of other identified hazards such as earthquakes, tsunamis and flooding. During the 1964 earthquake, ruptured fuel lines and ignition of the fuel caused additional problems for the City of Seward. Other technical hazards that could affect the City of Seward by secondary effects are listed in the KPB Hazard Mitigation Plan.

### **C. Mitigation Measures**

*Goal:* Increase public awareness of hazards of potential spills/accidents.

- Work with industry operators to educate the public on potential hazards and develop strategies for response, evacuation, and containment.
- Develop spill/clean up plans with industry.
- Encourage sites to meet standards/regulations for all reportable quantity hazard materials.
- During large renovation, repairs or after a disaster, encourage the use of utilidors for future pipelines.



## **Annex J – Economic**

### **A. Hazard Assessment**

An economic hazard for the City of Seward would primarily result as a secondary effect of other potential hazards such as earthquakes, tsunamis and flooding. Because of the diversified economy of Seward, the probability of an economic hazard is low.

### **B. Vulnerability Assessment and Impacts**

The economic impact of increased natural gas prices is currently being felt through the Fuel Adjustment Charge in our electric bills. This increase is expected to increase dramatically in the next few years.

The City of Seward has a low probability of other economic hazards. There are a number of scenarios that could cause a hazard to the economy if they were to occur. A few of these would be the closure of one or many of the government/private industry that has significant influence to the local economy. A few of the local industries that could affect the City of Seward would be the loss of the tourism industry or the closure of the Alaska Vocational Technical Center.

Tourism in Seward is an industry that has far reaching impact on Seward businesses and residents. There are many different industries that stem from the influx of the travel industry. There are approximately 28 hotels, motels, and bed and breakfasts, 27 restaurants, 4 seasonal water tour companies, 66 charter boats, 2 grocery stores, 22 art/gift shops, the Alaska SeaLife Center, hardware businesses and charter booking agencies, 2 fuel companies, campgrounds, and other related industries throughout the area could all be impacted by the reduction or elimination of tourism. A potential cause of reduction would be a terrorist threat or action based in the city or within the US. If one cruise ship was destroyed or taken by a terrorist organization in the US the reduction of tourist coming to Seward could be 100%.

Another major industry that has far reaching impacts on the City of Seward is the Alaska Vocational Technical Center (AVTEC). AVTEC is a state entity. AVTEC owns and operates 12 buildings, leases 1 building, has 69 full time employees with a payroll of \$4.4 million, and spend approximately \$530,000 in local businesses. AVTEC offers its employees good wages, benefits and a retirement system. The employees in return live in the community using the various businesses and services. A possible scenario that could affect the role of AVTEC in our community would be the reduction of the State budget.

An impact to the commercial fishing industry could also affect the City of Seward by the reduction of services, employment and the decrease in vessels and crews who support many businesses throughout the city. These include the 3 local fish processing facilities, fuel companies, grocery stores, restaurants and hardware/fishing supply stores.

Government agencies would also be impacted such as the City of Seward for port fees, business license fees, and other research/enforcement agencies.

The probability of any of these events to occur is very low but the impact to the economy of the community would be high.

### **C. Mitigation Measures**

*Goal 1:* Increase public awareness of potential hazards

- Make concise information available to the public about local industry concerning any government control.
- Make sure that accurate information is given to agencies that are responsible for dissemination of information concerning the City of Seward or other government agencies.
- Public groups (Chamber of Commerce, Lions, and Rotary Clubs, etc.) with business interests have accurate and timely information available to dispel rumors.

*Goal 2:* Support and encourage planned economic development that will be beneficial to the City of Seward.

- Develop and find existing programs that insure that the City of Seward is a safe and clean place for visitors to come.

*Goal 3:* Support and encourage the permitting and construction of an in state gas line to the states vast gas reserves.

## **Chapter 5 – Public Participation on Plan**

In 2010 Fire Chief David Squires led the revision of the Hazard Mitigation Plan for the City of Seward under the direction of the City Manager, Phillip Oates.

Working with the following people within City of Seward departments Executive Liaison to the City Manager, Suzi Towsley collected information.

Departments from the City of Seward that assisted in compiling information include:

Fire Department – David Squires, Fire Chief

Engineering / Building Department– Stefan Nilsson

Public Works – W.C. Casey and Kirsten Vesel

Community Development- Christy Terry and Donna Glenz

Electrical Department- John Foutz and Jeff Estes

Small Boat Harbor- Karl Anderson

Seward Parks and Recreation- Karin Sturdy

Upon completion of the first draft, copies were distributed to the Fire Station, the Public Library and the City Clerks office for public review.

The first public hearing for the draft proposal was held at the Planning and Zoning Commission meeting of April 6, 2010.

An additional public hearing on The All Hazard Mitigation Plan was conducted at City Council meeting on April 12, 2010.

Comments from the public from the meetings will be incorporated into the plan before submission to the KPB, State of Alaska, and Federal Governments.

The Kenai Peninsula Borough has put together a public notice bulletin with contacts for the City of Seward as well as Borough contacts for individuals interested in the process of hazard mitigation. This is available on the internet at <http://www.borough.kenai.ak.us/emergency/hazmit/plan.htm>

Public input into The All Hazard Mitigation Plan planning process was solicited in a Public Notice published in the Seward Phoenix Log on April 1 and 8, and 15, 2010.

Interagency coordination was received from the following agencies:

Kenai Peninsula Borough

State of Alaska

US Army Corps of Engineers

The State of Alaska gave direction on how to formulate the plan, identify the hazards and mitigation measures. The State of Alaska reviews the plan for compliance and completeness and recommends changes that need to be made.

The Corp of Engineers provided information on past mitigation efforts and estimations on proposed mitigation measures and including the permitting process.

In the revision of this plan under the direction of City Manager, Phillip Oates, each of the City departments were contacted for input for completed mitigation measures, new proposed mitigation measures and other hazards that may effect the City of Seward. Any agency contacted to review the original plan was given the opportunity to review the revised document.

## Chapter 6 – Implementation

The City of Seward will implement this plan by the methods outlined in this chapter. In addition to a positive cost/benefit ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns and public support. The City Manager is responsible for implementing the plan as resources allow. Projects selected for funding will follow a public process with the Planning Commission making recommendations to the Seward City Council for further public input and approval of projects. Completion of any project will depend on the availability of funds, changes in priority and will need to be individually approved and adopted by the City Council prior to the start of that project.

The Planning and Zoning Commission will review the potential projects list for recommendations to the Council on which projects should receive the highest priority. The Council is responsible for making the final decision on which projects are submitted for funding.

Because flooding from severe storms presents the greatest probability of occurrence to Seward it is anticipated that projects mitigating damage from floods will receive the highest priority. In subsequent updates of the plan, continued evaluation of danger from other hazards will be undertaken.

Determining which projects should be submitted for funding will be based on a FEMA approved cost/benefit method. A publication by FEMA explains how to determine cost-effectiveness of mitigation projects and how to calculate the benefit-cost ratio. In addition to a positive cost/benefit ratio, projects will be prioritized and selected for implementation based on community goals, planning objectives, funding availability, environmental concerns and public support.

The Plan will be monitored and it will be updated when a disaster occurs that significantly affects Seward, whether or not it receives a Presidential Declaration, assuming funding is available to update The Plan. The update will be completed as soon as possible, but by no later than the 12 months following the date the disaster occurs. The normal review cycle will be five years.

The City Manager will direct staff to start the updating of this Plan two years before the end of the five-year cycle. Securing grant monies and developing a project plan will occur the two years before the end of the five year requirement. Writing of the update will happen one year before the end of the five year cycle, to allow for adequate time for public participation. The public will be advised of the revision process through announcements the paper for public review and comment at regular Planning and Zoning Commission meetings and City Council Meetings. Plans will be available at various public sites (example: Library, City Hall). Advertisements will run in the Seward Phoenix Log, our weekly local newspaper, requesting public comment.



The All Hazard Mitigation Plan will be updated as necessary as required by State of Alaska law, Title 29.40.030. At a minimum however The Plan will be evaluated and updated every five years.

## **6A – Potential Projects**

The following list is based upon city staff analysis of vulnerabilities and mitigation measures for known hazards in the Seward area. Prioritizing the list will depend on future disasters and the needs of the community. Inclusion of short and long term projects is consistent with the state hazard plan.

- Short-term projects are those, which could be accomplished within a two year time period.
- Long-term projects will take longer than two years and/or depend on other projects being accomplished first or substantial funding resources.

### *Project Listing: (not prioritized)*

1. Identify additional hazards not covered previously and do a risk analysis within a two year time period. (Short Term)
2. The current Flood Insurance Rate Maps are very outdated and are in need of updating to address the following items. (Long Term)
  - 1981 maps need to be reevaluated with 23 years of additional data.
  - Corrections may need to be made for areas where fill or naturally high ground is now shown as flood prone but may not be in jeopardy of flooding.
  - U.S. Corps of Engineers needs to analyze new flood boundaries as part of the harbor/port improvement project.
  - Investigate better flood programs, especially ones specific to alluvial fan flooding.
3. City of Seward should evaluate the benefits of applying to FEMA to join the Community Rating System. (Short Term)
4. City staff should work with adjustors on the Community Rating System to reduce interest rates. (Long Term)
5. Information on how to obtain insurance from the NFIP should be provided to private property owners. (Short Term)
6. Publish a brochure containing information on the City of Seward flood dangers to be distributed to the community. (Short Term)
7. Require that realtors disclose hazard risk in real estate transactions. (Short Term)
8. Bring a flood-proofing workshop to Seward to assist the City and private property owners. (Short Term)

9. Reevaluate land use codes and subdivision regulations that are specific to development within the flood prone areas. (Short Term)
10. Mitigate damage to roads, drainage and utilities by requiring that reconstruction be to a higher standard after a storm. (Long Term)
11. Revise the flood plain ordinance to include a provision for cumulative substantial improvement or damage. (Short Term)
12. Properties should be identified that would be appropriate for protection because of flood risks, and after public input, acquisition, conservation, or flood hazard protection regulations by the government should be pursued. (Long Term)
13. Require buildings to be built with the lowest floor one foot above base flood elevation. (Short Term)
14. Improve enforcement of floodplain regulations, including requiring certificates for all structures within the flood plain. (Short Term)
15. Continued maintenance of the Resurrection River drainage. In conjunction with KPB, conduct an engineering study to determine the most effective use of the dredge materials from the maintenance dredging. (Long Term)
16. Continue Lowell Creek Tunnel outflow maintenance. (Short Term)
17. Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability. (Short Term)
18. Identify buildings or locations vital to the emergency response effort and buildings or locations that, if damaged, would create secondary disasters. (Short Term)
19. Encourage real-time availability and use of satellite data to evaluate fire, spruce bark beetle killed forest, and flood or tsunami potential. i.e. EMWINS, KPB Spruce Bark Beetle. (Long Term)
20. Encourage KPB school mitigation efforts. This measure will increase help to protect children and retain a school's functionality as an emergency shelter. (Long Term)
21. Encourage non-structural mitigation and preparedness activities. Encourage activities at the household level. (Short Term)
22. Conduct city-wide earthquake/tsunami drills. Citywide earthquake/tsunami drills will educate people on what to do when an earthquake/tsunami occurs and reinforce interagency and individual expectations. (Long Term)

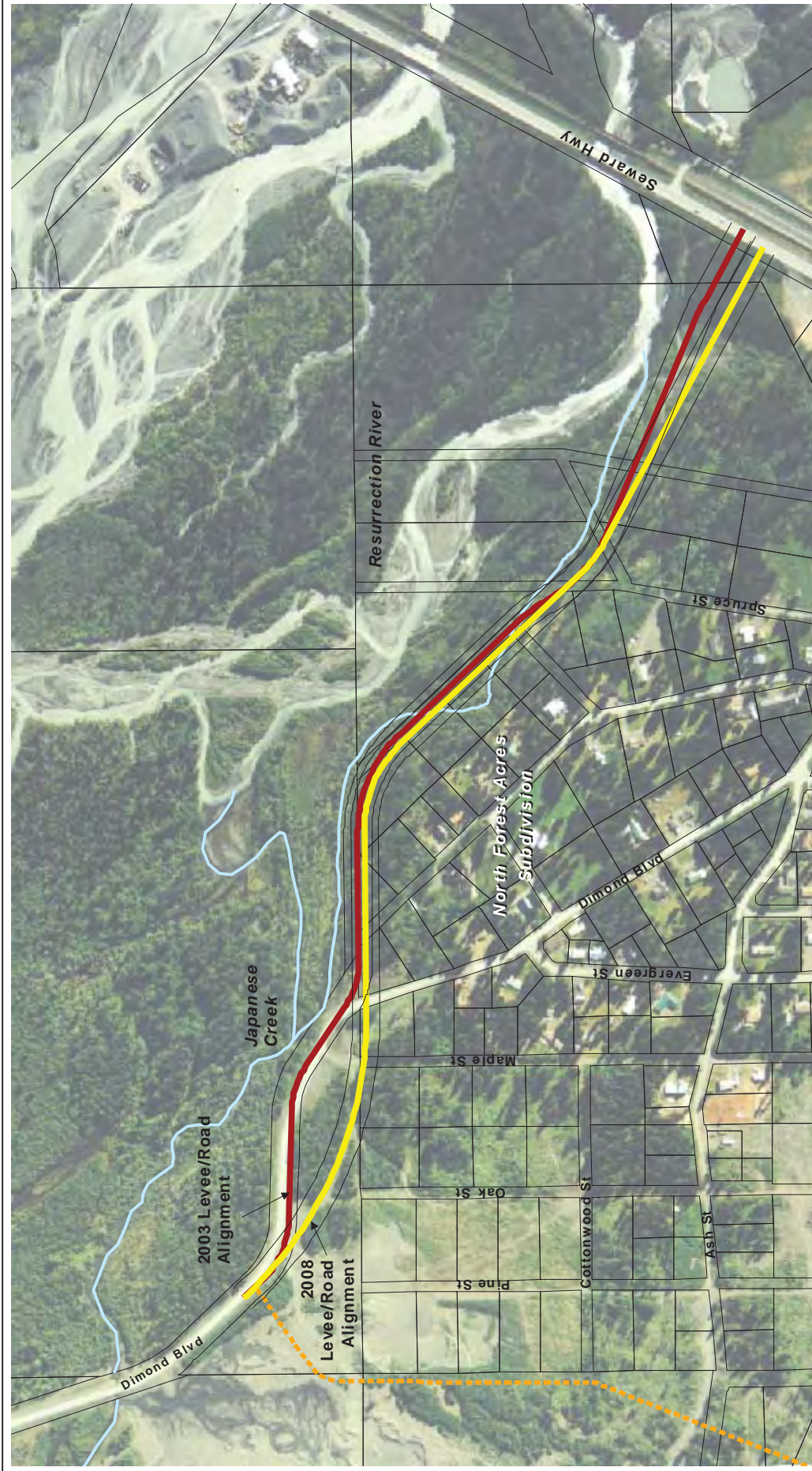


23. Encourage the development of earthquake structural performance standards and incorporate earthquake overlay zones in the community land use ordinances. Encourage the development of citing requirements based on soil type, slope, and other considerations. Before this can happen, information about where the various risks are located must be developed. (Long Term)
24. Promote incorporation of new methods to improve building performance. New materials and construction techniques might be more effective or feasible than what is currently available. (Long Term)
25. Evaluate the need for development of large-scale earthquake-hazard maps of the Seward areas. Seismic hazard area maps need to be created for the area. The maps should depict site amplification, liquefaction susceptibility, and ground failure at a minimum scale of 1 inch = 1 mile. (Long Term)
26. Publish Tsunami Inundation Maps. Revise maps after a significant event or natural disaster. (Long Term)
27. Improve the Lowell Creek diversion project by reassessing the best route for creek diversion, renovation of the tunnel and development of a new outfall. (Long Term)
28. Identify and advise of avalanche/landslide areas within the City of Seward for potential community development. (Short Term)
29. Encourage the Kenai Peninsula Borough to include service areas outside of City of Seward city limits in this plan.

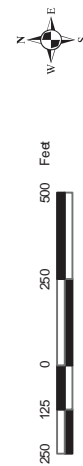
## References and Addendum

- 1 City of Seward: Flood Hazards Mitigation Plan. City of Seward Community Development Department and Hensley Consulting Services, 1996.
- 2 Draft State Hazard Mitigation Plan. Alaska Division of Emergency Services (ADES), March 2002.
- 3 Flood Damage Reduction Revised Reconnaissance Report Seward, Alaska, Lowell Creek. United States Army Corps of Engineers (USCOE), August 1992.
- 4 Flood Mitigation Assistance Guidance. Federal Emergency Management Agency (FEMA) FEMA 299, August 1997.
- 5 Kenai Peninsula Borough All-Hazard Mitigation Plan First Draft 2003. Bechtol Planning and Development, November 2003.
- 6 Kenai Peninsula Borough Flood Mitigation Plan. KPB, March 1996.
- 7 Seward Area Rivers: Flood Damage Prevention Interim Reconnaissance Report. United States Army Corps of Engineers, February 1994.
- 8 Subduction Zones. Alan Feuerbacher  
<http://www.geocities.com/Athens/Academy/6040/Flood09.htm>
- 9 U.S. Geological Survey web sites: <http://nied.usgs.gov/>  
<http://pubs.usgs.gov/publications/text/understanding.html>
- 10 FEMA publications: How to Determine Cost-Effectiveness of Mitigation Projects and Calculating the Benefit-Cost Ratio. <http://www.fema.gov/fema/pdml.shtml>
- 11 The Water Resources Development Act of 2007, Section 5032 Lowell Creek Tunnel, United States Army Corps of Engineers, 2007
- 12 Proposed North Forest Acres Levee/Road map, HDR, Wm. J. Nelson & Associates, AeroMetric, April 2008]

## Addendum of Revisions/Updates



## Proposed North Forest Acres Levee/Road



- Legend**
- 2008 Alignment
  - 2003 Alignment
  - - - Existing Levee
  - Parcel Boundary



**SEC. 5032. LOWELL CREEK TUNNEL, SEWARD, ALASKA.**

**(a) LONG-TERM MAINTENANCE AND REPAIR.—**

**(1) MAINTENANCE AND REPAIR.**—The Secretary shall assume responsibility for the long-term maintenance and repair of the Lowell Creek tunnel, Seward, Alaska.

**(2) DURATION OF RESPONSIBILITIES.**—The responsibility of the Secretary for long-term maintenance and repair of the tunnel shall continue until an alternative method of flood diversion is constructed and operational under this section, or 15 years after the date of enactment of this Act, whichever is earlier.

**(b) STUDY.**—The Secretary shall conduct a study to determine whether an alternative method of flood diversion in Lowell Canyon is feasible.

**(c) CONSTRUCTION.—**

**(1) ALTERNATIVE METHODS.**—If the Secretary determines under the study conducted under subsection (b) that an alternative method of flood diversion in Lowell Canyon is feasible, the Secretary shall carry out the alternative method.

**(2) FEDERAL SHARE.**—The Federal share of the cost of carrying out an alternative method under paragraph (1) shall be the same as the Federal share of the cost of the construction of the Lowell Creek tunnel.



DEPARTMENT OF THE ARMY  
U.S. ARMY CORPS OF ENGINEERS  
WASHINGTON, D.C. 20314-1000

CEMP-POD

JUN 29 2009

MEMORANDUM FOR COMMANDER, Pacific Ocean Division (CEPOD-PDC)

SUBJECT: Implementation Guidance for Section 5032 of the Water Resources Development Act of 2007 (WRDA 2007) – Lowell Creek Tunnel, Seward, Alaska

1. Section 5032 directs the Secretary to assume responsibility for the long-term maintenance and repair of the Lowell Creek tunnel, Seward, Alaska until an alternative method of flood diversion is constructed and operational, or 15 years after the date of enactment of WRDA 2007 (8 November 2007), whichever is earlier. In addition, the Secretary is authorized to conduct a study to determine whether an alternative method of flood diversion in Lowell Canyon is feasible. Further, if the Secretary determines an alternative method of flood diversion in Lowell Canyon is feasible, the alternative method shall be constructed and the Federal share of the cost of carrying out such alternative method will be the same as the Federal share of the cost of the construction of the Lowell Creek tunnel. A copy of Section 5032 is enclosed for information.
2. Construction was completed in 1940 of the existing Lowell Creek project to protect the city of Seward from the floodwaters of Lowell Creek. The project consists of a diversion dam and a concrete lined tunnel 10 feet in diameter and 2,070 feet long through Bear Mountain. The construction was performed at Federal expense and the City of Seward provided, at no cost to the Government, all lands, easements, and rights-of-way necessary for construction. The City of Seward assumed responsibility for operation and maintenance of the existing project upon completion of construction.
3. The Alaska District will assume long-term maintenance and repair responsibility of the concrete lined tunnel (and tunnel inlet and outlet structures) until completion of construction of an alternative method of flood diversion or until 8 November 2022 (15 years after the date of enactment of WRDA 2007), whichever is earlier. Funding to accomplish the long-term maintenance and repair will be budgeted in the O&M account in accordance with existing budgetary policies and procedures. In advance of the budget request, a letter report that details the extent and cost of the operations and maintenance must be submitted for review and approval by the ASA(CW). Long-term maintenance and repair activities of the concrete lined tunnel (and tunnel inlet and outlet structures) will be limited to those that meet the definitions for "replacement" and "rehabilitation" in Section 12 of ER 1110-2-401, "Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors" such as replacement of worn out portions of the concrete lined tunnel (and



CEMP-POD

SUBJECT: Implementation Guidance for Section 5032 of the Water Resources Development Act of 2007 – Lowell Creek Tunnel, Seward, Alaska

tunnel inlet and outlet structures) or returning a deteriorated feature of the concrete lined tunnel (and tunnel inlet and outlet structures) back to its original condition. The need to rehabilitate the concrete lined tunnel (and tunnel inlet and outlet structures) also could result from unusual damage incurred during a flood event. Long-term maintenance and repair activities typically require multiple seasons to plan, design, and execute. If no alternative method of flood diversion is constructed before 8 November 2022, the responsibility for long-term maintenance and repair of the concrete lined tunnel (and tunnel inlet and outlet structures) shall revert back to the City of Seward.

4. Annual maintenance and repair of the concrete lined tunnel (and tunnel inlet and outlet structures) will remain the responsibility of the City of Seward. Annual maintenance and repair is defined in Section 12 of ER 1110-2-401 as “those activities of a routine nature that maintain the project in a well kept condition.” Examples of such activities include annual removal of sediments and debris from the stilling basin at the outfall of the tunnel and repairs necessary to fences and ladders. Inspections are also part of the annual operations and maintenance responsibilities of the City of Seward and should continue in accordance with state regulatory authority. The District may accompany the city or state on the inspections and should obtain a copy of the final inspection reports.

5. Operation, maintenance, repair, replacement, and rehabilitation of the diversion dam will remain the responsibility of the City of Seward.

6. At such time as funds are appropriated for such work, the District should conduct a reconnaissance study to determine whether an alternative method of flood diversion in Lowell Canyon is feasible in accordance with procedural guidance contained in ER 1105-2-100. If the reconnaissance study determines that there is at least one feasible solution, once funds are appropriated for such work, the District should conduct a feasibility study in accordance with current budgetary policy and procedural guidance contained in ER 1105-2-100 for projects authorized without a report. The costs of the feasibility study will be shared 50 percent Federal and 50 percent non-Federal pursuant to a Feasibility Cost Sharing Agreement. The feasibility report will be submitted to the POD RIT for policy compliance review by HQUSACE and approval by the Secretary.

7. Upon approval of a report that documents a feasible alternative to flood diversion in Lowell Canyon and receipt of Federal funding for construction of such alternative, a project partnership agreement (PPA) addressing design and construction of the approved plan may be executed in accordance with the current guidance on preparation of, approval, and execution of PPAs. The design and construction of the approved plan shall be accomplished at Federal expense and the non-Federal sponsor shall provide, at no cost to the Government, all lands, easements, and rights-

CEMP-POD

SUBJECT: Implementation Guidance for Section 5032 of the Water Resources Development Act of 2007 – Lowell Creek Tunnel, Seward, Alaska

of-way necessary for the construction. Further, upon completion of construction the non-Federal sponsor shall operate, maintain, repair, replace, and rehabilitate the new project. Contact the POD RIT for direction on drafting the PPA.

FOR THE COMMANDER:

Encl



LLOYD D. PIKE

Chief, Pacific Ocean Division  
Regional Integration Team  
Directorate of Military Programs



Sponsored by: Administration

**CITY OF SEWARD, ALASKA  
PORT AND COMMERCE ADVISORY BOARD  
RESOLUTION 2010-02**

**A RESOLUTION OF THE PORT AND COMMERCE ADVISORY BOARD  
OF THE CITY OF SEWARD, ALASKA, RECOMMENDING CITY  
COUNCIL ADOPTION OF THE ALL-HAZARD MITIGATION PLAN FOR  
THE CITY OF SEWARD**

**WHEREAS**, the Federal Emergency Management Agency (FEMA) requires all States to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

**WHEREAS**, the Kenai Peninsula Borough incorporates into their plan the City of Seward's All-Hazard Mitigation Plan as an annex; and

**WHEREAS**, FEMA disaster recovery funding requires regular updates to the Plan; and

**WHEREAS**, the Kenai Peninsula Borough (KPB) is working with Peninsula cities to update the All-Hazard Mitigation Plan; and

**WHEREAS**, the City of Seward's All-Hazard Mitigation Plan is scheduled for adoption by the Council on April 12, 2010; and

**WHEREAS**, the Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward annex, is scheduled for introduction on May 4, 2010 and final adoption on June 8, 2010; and

**WHEREAS**, the All-Hazard Mitigation Plan will then continue on to the State and Federal level for adoption.

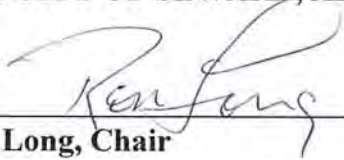
**NOW, THEREFORE, BE IT RESOLVED BY THE PORT AND COMMERCE  
ADVISORY BOARD OF THE CITY OF SEWARD, ALASKA that:**

**Section 1.** The Board recommends Council approval of the Seward All-Hazard Mitigation Plan and consider changes based upon PACAB's comments attached.

**Section 2.** This resolution shall take effect immediately upon its adoption.

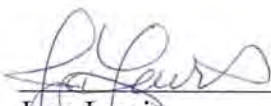
**PASSED AND APPROVED** by the Port and Commerce Advisory Board of the City of Seward, Alaska, this 7<sup>th</sup> day of April, 2010.

**THE CITY OF SEWARD, ALASKA**

  
\_\_\_\_\_  
**Ron Long, Chair**

AYES:  
NOES:  
ABSENT:  
ABSTAIN:  
VACANT:

**ATTEST:**

  
\_\_\_\_\_  
Jean Lewis  
City Clerk

(City Seal)



Sponsored by: Administration

**CITY OF SEWARD, ALASKA  
PLANNING AND ZONING COMMISSION  
RESOLUTION 2010-04**

**A RESOLUTION OF THE PLANNING AND ZONING COMMISSION OF  
THE CITY OF SEWARD, ALASKA, RECOMMENDING CITY COUNCIL  
ADOPTION OF THE ALL-HAZARD MITIGATION PLAN FOR THE CITY  
OF SEWARD**

**WHEREAS**, the Federal Emergency Management Agency (FEMA) requires all States to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

**WHEREAS**, the Kenai Peninsula Borough incorporates into their plan the City of Seward's All-Hazard Mitigation Plan as an annex; and

**WHEREAS**, FEMA disaster recovery funding requires regular updates to the Plan; and

**WHEREAS**, the Kenai Peninsula Borough (KPB) is working with Peninsula cities to update the All-Hazard Mitigation Plan; and

**WHEREAS**, the City of Seward's All-Hazard Mitigation Plan is scheduled for adoption by the Council on April 12, 2010; and

**WHEREAS**, the Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward annex, is scheduled for introduction on May 4, 2010 and final adoption on June 8, 2010; and

**WHEREAS**, the All-Hazard Mitigation Plan will then continue on to the State and Federal level for adoption.

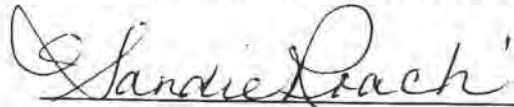
**NOW, THEREFORE, BE IT RESOLVED BY THE PLANNING AND ZONING COMMISSION OF THE CITY OF SEWARD, ALASKA that:**

**Section 1.** The Commission recommends Council approval of the Seward All-Hazard Mitigation Plan as attached.

**Section 2.** This resolution shall take effect immediately upon its adoption.

**PASSED AND APPROVED** by the Planning and Zoning Commission of the City of Seward, Alaska, this 6<sup>th</sup> day of April, 2010.

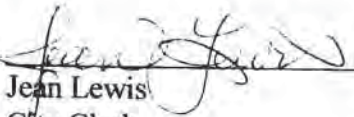
**THE CITY OF SEWARD, ALASKA**



**Sandie Roach', Chair**

AYES: Heinrich, Ecklund, Morgan, DeMarco, Roach'  
NOES: None  
ABSENT: None  
ABSTAIN: None  
VACANT: Two

**ATTEST:**



Jean Lewis  
City Clerk

(City Seal)





**CITY OF SEWARD, ALASKA  
RESOLUTION 2010-030**

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SEWARD,  
ALASKA, TO APPROVE REVISIONS TO THE ALL HAZARD  
MITIGATION PLAN FOR THE CITY OF SEWARD FOR SUBMISSION TO  
THE KENAI PENINSULA BOROUGH**

**WHEREAS**, the Federal Emergency Management Agency (FEMA) requires all States to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

**WHEREAS**, the Kenai Peninsula Borough incorporates into their plan the City of Seward's All-Hazard Mitigation Plan as an annex; and

**WHEREAS**, FEMA disaster recovery funding requires regular updates to the Plan; and

**WHEREAS**, the Kenai Peninsula Borough (KPB) is working with Peninsula cities to update the All-Hazard Mitigation Plan; and

**WHEREAS**, the City of Seward's All-Hazard Mitigation Plan is scheduled for adoption by the Council on April 12, 2010; and

**WHEREAS**, the Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward annex, is scheduled for introduction on May 4, 2010 and final adoption on June 8, 2010; and

**WHEREAS**, the All-Hazard Mitigation Plan will then continue on to the State and Federal level for adoption.

**NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SEWARD, ALASKA that:**

**Section 1.** The City Council approves the Seward All-Hazard Mitigation Plan as attached.

**Section 2.** This resolution shall take affect immediately upon its adoption.

**PASSED AND APPROVED** by the City Council of the City of Seward, Alaska, this 12<sup>th</sup> day of April, 2010.

**CITY OF SEWARD, ALASKA  
RESOLUTION 2010-030**

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**THE CITY OF SEWARD, ALASKA**

*Jean Bardarson*  
**Jean Bardarson, Vice-Mayor**

AYES: Valdatta, Smith, Keil, Shafer, Amberg, Bardarson  
NOES: None  
ABSENT: Dunham  
ABSTAIN: None

**ATTEST:**

*Jean Lewis*  
Jean Lewis  
City Clerk

(City Seal)







**CITY OF SOLDOTNA  
PLANNING AND ZONING COMMISSION  
RESOLUTION NO. PZ 2010-012**

**A RESOLUTION OF THE PLANNING AND ZONING COMMISSION OF THE CITY OF SOLDOTNA  
RECOMMENDING APPROVAL OF THE 2010 SOLDOTNA ALL HAZARD MITIGATION PLAN  
UPDATE**

---

WHEREAS, the City of Soldotna recognizes that all hazards pose a threat to people and property; and

WHEREAS, undertaking hazard mitigation actions before disasters occur reduces the potential for harm to people and property and saves taxpayer dollars; and

WHEREAS, an adopted all hazards mitigation plan is required as a condition of future grant funding for mitigation projects; and

WHEREAS, the City of Soldotna participated jointly in the planning process with the Kenai Peninsula Borough in 2004 to prepare and adopt an All Hazards Mitigation Plan; and

WHEREAS, the attached plan is an update to the 2004 plan.

NOW, THEREFORE, BE IT RESOLVED BY THE PLANNING AND ZONING COMMISSION OF THE CITY OF SOLDOTNA, ALASKA:

- Section 1. The Commission recommends approval of the attached 2010 Soldotna All Hazard Mitigation Plan.
- Section 2. The plan shall be forwarded on to the Soldotna City Council for their consideration.
- Section 3. This resolution shall become effective immediately upon its adoption.

PASSED by the Planning and Zoning Commission this \_\_\_\_\_ day of \_\_\_\_\_, 2010.

\_\_\_\_\_  
Chair

\_\_\_\_\_  
Attest



**City of Soldotna**

177 North Birch Street ▶ Soldotna, Alaska ▶ Phone (907) 262-9107

**MEMORANDUM**

**To:** Planning and Zoning Commission

**Cc:**

**From:** Stephanie Queen, City Planner *Stephanie*

**Date:** Friday, May 14, 2010

**Subject:** All Hazard Mitigation Plan

Attached is a draft City of Soldotna All Hazard Mitigation Plan for your review and recommendation. The City of Soldotna, in conjunction with the Kenai Peninsula Borough (KPB), adopted a plan in August 2005, which was approved by the State of Alaska and the Federal Emergency Management Agency (FEMA). FEMA regulations require local jurisdictions to complete a full update of their plans every five years (44 CFR 201.6(d)(3)). The update process requires community involvement, State and FEMA review, and finally community adoption. The Soldotna City plan, in conjunction with the Kenai Peninsula Borough and other incorporated communities, will need to be updated and approved by FEMA no later than August 17, 2010.

The attached plan provides a vulnerability analysis for twelve possible hazards, and focuses on five which are considered to be the greatest risk to our community including: floods, wildland fire, earthquake, volcano, and weather.

Resolution PZ 2010-012 is attached for your consideration. Following review at the Planning and Zoning Commission, the plan will be sent to the Soldotna City Council for their recommendation. Finally, it will be incorporated into KPB's plan as an attachment, and adopted by the Borough Assembly.

I have also forwarded a copy of the draft plan to the State of Alaska so they can do a preliminary review. Following the state review, they will forward the draft to FEMA for preapproval. It is possible the state or FEMA will request changes to the plan, but in order to meet our goal of delivering the plan to the KPB by the end of May, we will move forward with the plan adoption concurrent to the State and FEMA's initial review.



**City of Soldotna**  
**All Hazard Mitigation Plan Update**  
**\*\* DRAFT \*\***  
**May 2010**

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# Chapter I – Introduction

## Purpose of the Plan

The purpose of the All-Hazard Mitigation Plan is to fulfill the FEMA requirement under The Robert T. Stafford Disaster Relief and Emergency Assistance Act (the Act), Section 322, Mitigation Planning enacted by Section 104 of the Disaster Mitigation Act of 2000 (DMA) (P.L. 106-390). This initiative provides new and revitalized approaches to mitigation planning. Section 322 emphasizes the need for State, local, and tribal entities to closely coordinate mitigation planning and implementation efforts. As part of the process of implementing the DMA, FEMA prepared an Interim Final Rule (the Rule) to clearly establish the mitigation planning criteria for States and local and tribal governments. This Rule was published in the Federal Register on February 26, 2002, at 44 CFR Part 201. This plan will identify hazards; establish community goals and objectives and develop mitigation strategies and activities that are appropriate for the City of Soldotna.

The Disaster Mitigation Act of 2000 (DMA 2000), Section 322 (a-d), as implemented through 44 CFR Part 201.6 requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identifying and prioritizing mitigation actions, encouraging development of local mitigation and providing technical support for those efforts.

The purpose of this plan is to produce a program of activities through actions and projects that reduce the City of Soldotna's vulnerability to natural hazards, while meeting other community needs. This plan will accomplish the following objectives consistent with FEMA planning process guidelines:

- Describe the planning process to include public involvement;
- Conduct an assessment of the risks;
- Determine what facilities, or portions of infrastructure, are vulnerable to a disaster;
- Develop a mitigation strategy to reduce potential losses and target resources;
- Describe how each entity will periodically evaluate, monitor maintain and update the plan; and,
- Describe the process for implementing the plan after adoption by the local governing body of the community and receiving FEMA approval.

## Methodology

This plan is an update to the City of Soldotna Hazard Mitigation Plan adopted by the Soldotna City Council on June 23, 2004 (Resolution 2004-38). It is a supplement to the Kenai Peninsula Borough All-Hazard Mitigation Plan, and therefore information relevant to the City of Soldotna may be found in this annex, as well as in the Borough's adopted plan. The approach used for the development of the plan consisted of the following tasks:



- Coordinate with other agencies and organizations
- Solicit public involvement
- Conduct hazard area inventory
- Review and analysis of possible mitigation activities
- Describe the update and review process and schedule for plan maintenance
- Coordinate the Plan with the State Hazard Mitigation Plan
- Submit to the State Hazard Mitigation Officer for Review
- Submit to FEMA Region 10 for Review and Approval
- Adopt the Plan following a public hearing

The mitigation plan is intended to be evaluated and updated every five years. In addition, the plan will be updated, as appropriate when a disaster occurs that significantly affects the City of Soldotna, whether or not it receives a Presidential Declaration. The update will be completed as soon as possible, but no later than 12 months following the date the disaster occurs.

In early 2010, the City of Soldotna began the process of revising the plan to update historical hazard information, review the hazard analysis, and adding new mitigation projects as new funding opportunities are identified.

This All Hazard Local Mitigation Plan contains a list of potential projects and a brief rationale or explanation of how each project or group of projects contributes to the overall mitigation strategy outlined in the plan. The plan summarizes the activities outlined above to assess the effects of hazards in the City of Soldotna such as: flood, wildfire, earthquake, and volcanoes, and recommends mitigation strategies and activities for each.

## City of Soldotna– Background

### **Location**

The City of Soldotna is located along the Kenai River in Southcentral Alaska at the junction of the Sterling and Kenai Spur Highways. By road, Soldotna is 150 miles from Anchorage, 11 miles from Kenai, 78 miles from Homer and 93 miles from Seward. Soldotna's municipal airport is 58 air miles from Anchorage International Airport.

### **History**

The history of the City of Soldotna begins with homesteading that occurred in the late 1940's, although Native Alaska Athabaskan peoples had lived and used the area around the Kenai River for many thousands of years prior to the City's establishment. After World War II, veterans were given priority in homesteading in this area and settlement began to grow. The construction of the Sterling Highway from Anchorage and the Kenai Spur Highway occurred in the late 1940s and early 1950s, which resulted in increased settlement in the area. A post office for Soldotna was established in 1949. Oil was discovered at the nearby Swanson River area in 1957, giving the population and economy of the area another major boost. Soldotna's location at the junction of the Sterling and

Kenai Spur highways resulted in the area becoming a major location for retail trade, services and government on the Kenai Peninsula.

The City of Soldotna incorporated in 1960 with 332 residents and an area of 7.4 square miles. Most of Soldotna was still unsettled at this time, with few residents in the surrounding territory. Soldotna was mostly built up and already near its current population by the end of the early 1980s building boom. By then, most still-vacant land in the City was parklands, wetlands, or tracts with some development limitations.

Since incorporation in 1960, Soldotna's population has grown a dozen times over to 4,000 residents in 2008.

## **Economy**

Soldotna serves as an economic hub of the Kenai Peninsula. Its location at the intersection of two major highways in the most rapidly growing portion of the borough has helped Soldotna emerge as a retail and administrative center for the Kenai Peninsula Borough (KPB). Half of the top ten employers in the KPB are located in Soldotna including: the KPB School District, Central Peninsula Hospital, the KPB administrative offices, and Fred Meyers.

Soldotna's economy is solidly based in industries that have shown strong growth over the last decade and which are projected to continue to grow in the near future. The Education, Health & Social Services Industry accounted for over 20% of the City's employment in 2000, with Retail making up another 17.5% and Arts, Entertainment, Recreation, Accommodation & Food Services making up almost 16%. The State projects that Health Care and Social Services will be the industry with the highest growth in the number of jobs in the state between 2006 and 2016, with Retail trade the second highest. Accommodations and Food Service come in third and Education Services comes in fourth. These top four employment generators are the top industries in Soldotna, providing a good opportunity for growing employment in the area.

The emergence of the health care industry as a primary industry for the Soldotna area provides the City with significant opportunities for the future. The industry provides high-paying jobs and draws an educated work force. It also contributes to the attraction of retirees who want to live outside the "urban Southcentral Alaska" area but still want high quality medical care similar to that found in Anchorage.

Soldotna's strong economy is evidenced by the City's low poverty rate (6.6%), the lowest in the KPB in 2000. The 2000 median family income in Soldotna was \$52,372, slightly lower than the \$54,106 for the KPB and the \$59,036 for the state (2000 census). The City's median household income was the highest on the KPB at \$48,420 (2000 census). The per capita income for the City (\$21,740) was higher than for the borough (\$20,949) but lower than the state (\$22,660) (2000 census).

## **Geology and Soils**

Soldotna is based on unconsolidated glacial deposits which range in depth from 300 to 700 feet deep. This material is unsorted and varies in size from silt to boulders. Thick alluvial deposits of silt, sand and gravel are found along the Kenai River.

The Soil Conservation Service classifies three broad series of soils in the Soldotna area; the Soldotna, Tustumena and Kenai. The Soldotna series are found in the developed area of town from the "Y" west to the Kenai River. The Kenai series dominate the hilly region north of Soldotna and the Tustumena series is found south of the Kenai River. Both the Soldotna and Tustumena series are well-drained silt loam underlain by gravely sand or sand at a depth of 15 to 25 inches. These soils include a silty clay loam and are slightly less suited for development because of drainage problems. Significant areas of peat are found both north and east of the "Y" between Soldotna Creek and the Kenai River, and south of the Kenai River, downstream from the bridge. These soils are generally unsuited for development, except with special precautions.

## **Topography**

The community is located just five miles from Cook Inlet, and the elevation at the airport is 107 feet above sea level. Broad level plains characterize the landscape and rolling hills, which are the result of repeated episodes of glacial advances and retreats. Small lakes, peat bogs and wetlands are common.

## **Climate**

Soldotna lies within a transitional climatic zone influenced by both the maritime Gulf of Alaska and Prince William Sound regions, and the continental climate of Interior Alaska. Average annual precipitation is about 20 inches, with the greatest rainfall occurring in August and September. Average annual snowfall in Soldotna is about 64 inches. Average mid-winter temperatures range from -10 degrees Fahrenheit to -41 degrees F. Average mid-summer temperatures range from 40 degrees to 65 degrees. Extremes of -47 degrees to +90 degrees have been recorded in the area. The maritime effects commonly cause some days of above-freezing temperatures in the winter.

## **Flora and Fauna**

Soldotna is surrounded on three sides by the Kenai National Wildlife Refuge, which supports extensive populations of moose, brown and black bear, upland game animals and waterfowl. Important species of birds include grouse, ducks, geese, eagles, and ptarmigan. Small animals include fox, lynx, coyote, rabbits and squirrels. According to the US Soil Conservation Service, the Kenai River corridor is home to 32 different types of mammals, not counting humans.

Major trees found in the Soldotna area include white spruce, Kenai paper birch and quaking aspen. Cottonwood willows and alders are found in wetter areas. Black Spruce is found in muskeg areas, and also in previously burned upland areas. Open muskegs support a thick mat of low scrubs and sphagnum moss.

The Kenai River drainage is considered to be the major sockeye salmon producing system in Cook Inlet. Two salmon runs occur annually, the first in late May and the second in late June. King, Pink, and Coho salmon also spawn in the Kenai River system. Other sport fish supported by the Kenai River and its tributaries include Rainbow Trout, Lake Trout, Steelhead, Dolly Varden and Arctic Char.

## **Wetlands and Drainage**

There are approximately 200 acres of mapped wetlands within the City boundaries. The majority of the wetlands lie in the vicinity of Soldotna Creek between the Sterling Highway and the Kenai River. Wetlands are also found along Slikok Creek on the west side of the City. These wetlands provide for water recharge, water quality improvement, habitat for waterfowl and wildlife. Other wetlands are located between the Sterling and Kenai Spur highways at the north end of the City and along the river at the west end of the City.

Placement of fill and other "structures" in wetlands are regulated by the U.S. Army Corps of Engineers under the Clean Water Act. Depending on the type of activity and function and value of wetland, development may be subject to nation-wide or individual state and federal permits, and mitigation may be required as a condition of development. Maintenance of drainage patterns, whether involving surface runoff or identified creeks is an additional development consideration. Disruption or diversion of drainage can cause flooding, erosion, and damage to roads and structures.

## **Steep Slopes**

Areas of excessively steep slopes are found in specific areas of the City, and can present limitations to development. Such limitations include location and grade of access and internal subdivision roads, drainage, and structure foundation considerations. Improper road and foundation cuts on hillsides, or disturbances to drainage patterns can create slope instability and accelerated runoff and erosion, damaging roads, drainage structures, and buildings.

## **The Kenai River**

The Kenai River is a major community asset as well as a viable economic engine. The superior natural setting of Soldotna is due in large part to the Kenai River, which runs through the center of town, providing ample economic and recreational opportunities for the community and visitors as well as valuable habitat for wildlife.

The land along the banks of the river is owned and managed by a variety of public and private owners. Property within one hundred feet of the ordinary high water mark for the Kenai River is designated as the Kenai River Overlay District and has special permitting requirements under Title 17 (Zoning Code) of the Soldotna Municipal Code. The City is incorporating habitat protection into management of city lands and parks, and is currently involved in a habitat enhancement project at Soldotna Creek Park.

The Alaska Department of Natural Resources manages activities on the river and adjacent state land through the Kenai River Management Plan. The Kenai Peninsula Borough

Code of Ordinances contains Chapter 21.18, Anadromous Streams Habitat Protection Ordinance, which was created to ensure measures for the protection of salmon spawning and rearing habitat within the Kenai Peninsula Borough.

As use of the river, utilization of its fishery stocks, and development along its banks have grown, so have concerns over the effects of increasing use. Of particular concern are the impacts of individual activities and the cumulative effects of use and development along the river. A number of local, state, federal, and private organizations have initiated studies and programs to address specific and regional problems along the Kenai River. There are strong desires to protect the river and provide sound and increased access for residents and visitors alike.

## Chapter II – Adoption Process and Documentation

The City of Soldotna All-Hazards Mitigation Plan was developed as a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 the local municipalities as well as the borough adopted the plan. This section documents the adoption process of the city in order to demonstrate compliance with this requirement. Additional information is available in Appendix A.

- February-May 2010, City of Soldotna administrative review and department comment period
- May 5, 2010, City of Soldotna Planning and Zoning Commission work session
- May 19, 2010 City of Soldotna Planning and Zoning Commission public hearing
- May 26, 2010, City of Soldotna City Council public hearing
- May 27, 2010, Delivery of Soldotna plan to the Kenai Peninsula Borough for adoption by the Borough Assembly



## Chapter III – Planning Process

The 2010 City of Soldotna All-Hazard Mitigation Plan Update was developed by the city planning department with input from other city departments. The plan was reviewed at regular meetings of the Planning and Zoning Commission and City Council, where comments were solicited from members of the public. The City's public outreach is intended to supplement the larger planning effort of the Kenai Peninsula Borough. More information on the Borough's planning effort is provided in Chapter 1, Introduction, of the Borough's All-Hazard Mitigation Plan.

### Supporting Planning Documents

1995 City of Soldotna Comprehensive Plan  
2001 COS Roads and Trails Master Plan and Traffic Study  
2001 COS Wastewater Facilities Master Plan  
2004 Kenai Peninsula Borough All-Hazard Mitigation Plan  
2004 Soldotna Municipal Airport Master Plan Update  
2007 COS Emergency Operations Plan  
2009 Soldotna/Ridgeway Area Community Wildfire Protection Plan

### Contributors

The City of Soldotna planning department took the lead in updating this plan, with comments from other city departments. The Planning and Zoning Commission and City Council held public meetings on the draft, and solicited comments from members of the community. The City's plan update is a coordinated effort with the Kenai Peninsula Borough including the Borough planning department and office of emergency management.

### Opportunities for Public Involvement

The KPB maintained a project web site to provide drafts and information about the plan update. The City of Soldotna held meetings open to the public at both the Planning and Zoning Commission and City Council, that were advertised in the local newspaper and on the city's web site.

## Chapter IV– Hazard Identification & Risk Assessment

### Hazard Identification

\*Hazard Matrix – City of Soldotna

Flood	Wildland Fire	Earthquake	Volcano	Snow Avalanche	Tsunami & Seiche
Y/H	Y/M	Y/M	Y/M	N	N

Weather	Landslides	Erosion	Drought	Technological	Economic
Y/M	N	N	N	U/L	U/L

#### Hazard Identification:

- Y: Hazard is present in jurisdiction
- N: Hazard is not present
- U: Unknown if the hazard occurs in the jurisdiction

#### Risk:

- L: Low probability of occurrence
- M: Moderate probability of occurrence
- H: High probability of occurrence

### Hazard Profile

The City of Soldotna has identified five hazards which are present in our community and determined to pose a threat to property, infrastructure, and lives. The plan focuses on these five hazards which include: floods, wildland fires, earthquakes, volcano eruptions, and weather.

#### **Flood**

The City of Soldotna is subject to flooding along the Kenai River, Soldotna Creek, and Slikok Creek. Flooding can threaten life, safety and health, and result in substantial damage to infrastructure, homes and other property. Although the City of Soldotna regulates development within 100 feet of the Kenai River (known as the Kenai River Overlay District under the Soldotna Municipal Code), the city has no special development review or permitting process for construction specifically related to location within a flood zone.

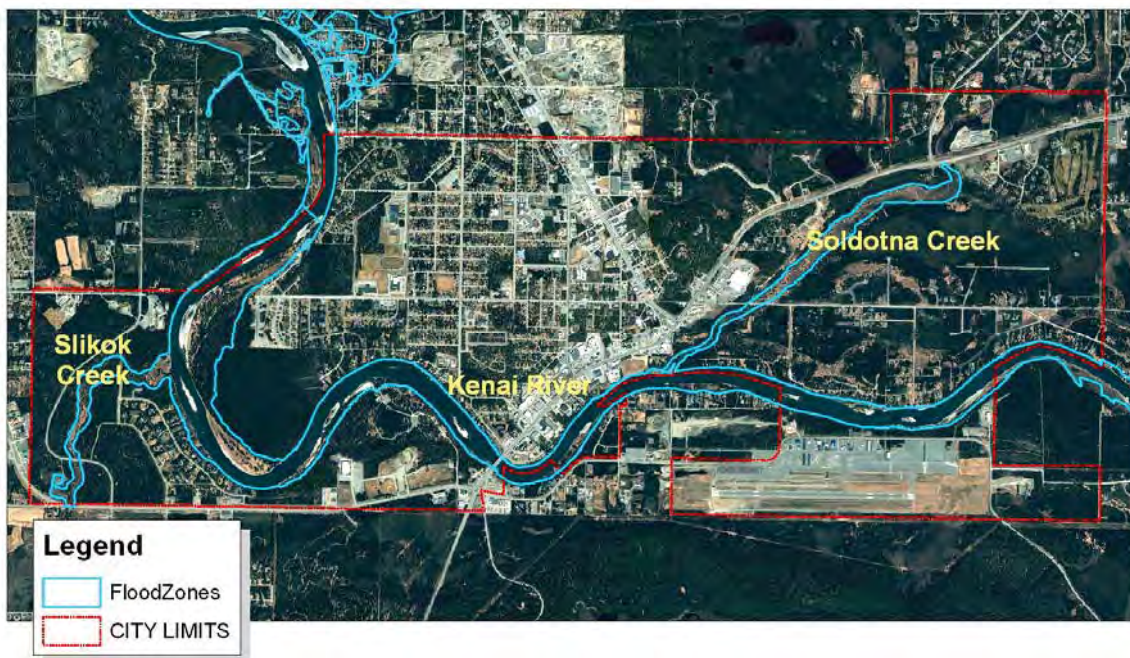
Flooding can occur in a number of ways as described in Chapter 2, Flooding, of the KPB All-Hazard Mitigation Plan. Chapter 2 also includes information about historic flood events along the Kenai River dating from 1964 to the ice-jams of 2007. Soldotna is a Central Zone Community (Section 2.8.1, KPB All Hazard Mitigation Plan) and is susceptible to riverine, jokulhlaup, and ice jam flooding.

Flooding is a natural event and damages occur when humans interfere with the natural process by altering the waterway, developing watersheds, and/or building inappropriately within the floodplain. Most of Alaska's communities and transportation facilities are located along large rivers and are subject to flooding. This flooding threatens life, safety and health; causes extensive property loss; and results in damage in excess of three-quarters of a million dollars annually.



**Image 1: The Kenai River at Soldotna Creek Park. Stairways are raised during the winter months to prevent damage due to flooding and ice flows.**

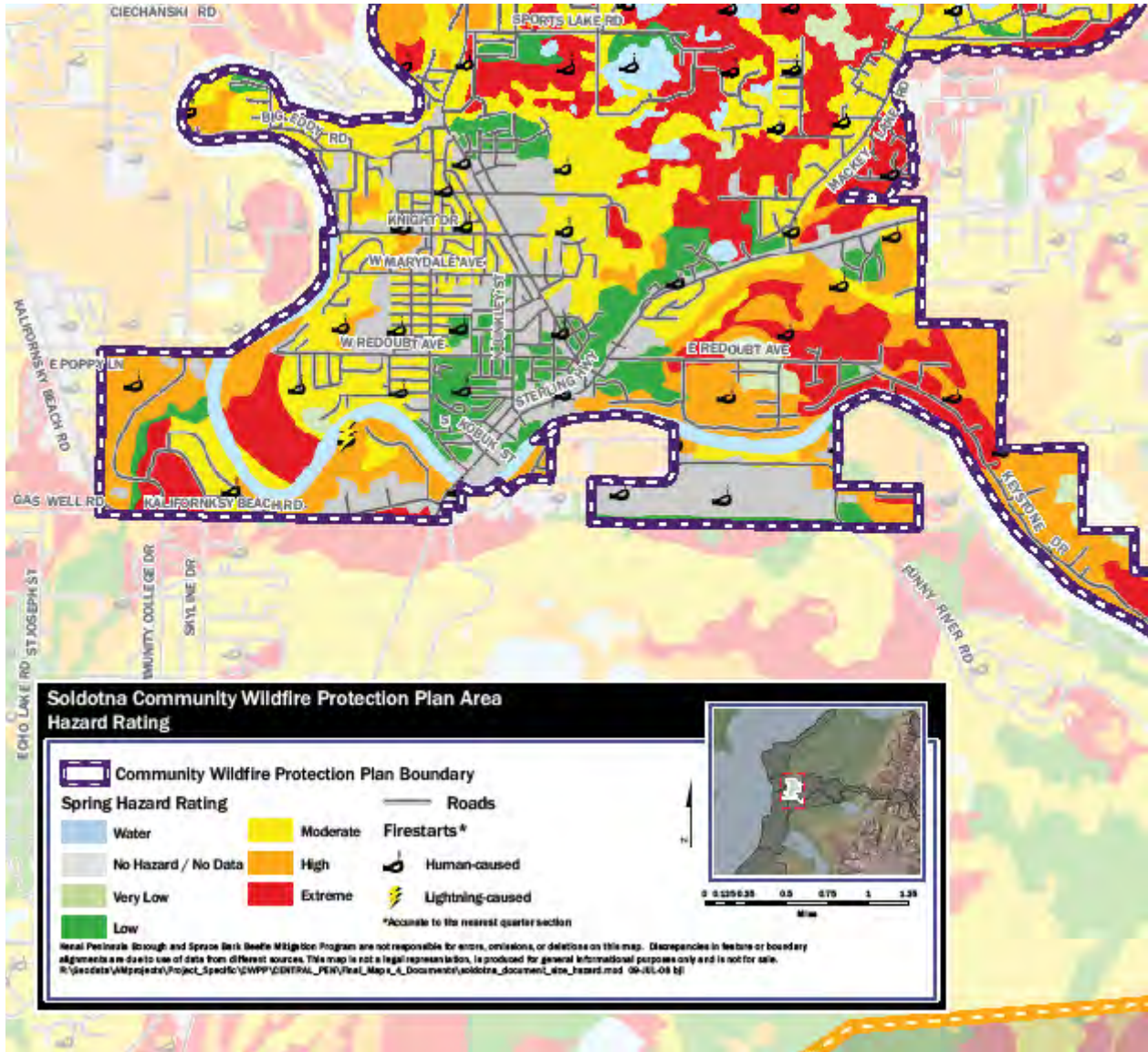
Flooding in Alaska can be broken into a number of categories including rainfall-runoff floods, snowmelt floods, ground-water flooding, ice jam floods, flash floods, fluctuating lake levels, alluvial fan floods and glacial outburst floods. Alaska also experiences coastal flooding from storm surge but this will be discussed in the Weather section. These are not exclusive categories as a flood event could have elements of more than one type.





## Wildland Fires

In 2009 the *Soldotna/Ridgeway Community Wildfire Protection Plan* (CWPP) was developed to identify wildfire hazards, and propose ways to mitigate the risk. The plan identifies fuel hazards, values at risk from wildfire, and the fire history for the area. The graphic below is an excerpt of the hazard rating map for the plan which shows the relative hazard ratings for the Soldotna area.



Wildland fires on the Kenai Peninsula central corridor, including the Soldotna/Ridgeway area, are usually human-caused. Human-caused wildland fires account for 98% of fire ignitions on the Kenai Peninsula over a recent fifteen year period. However, lightning strikes have increased in frequency in recent years, with numerous strikes recorded in 2005, resulting in 22 detected fires<sup>1</sup>.

<sup>1</sup> Soldotna/Ridgeway Community Wildfire Protection Plan, December 2009, Pg. 18.

Wildland fires occur in every state in the country and Alaska is no exception. Each year, between 600 and 800 wildland fires, mostly between March and October, burn across Alaska causing extensive damage.

Fire is recognized as a critical feature of the natural history of many ecosystems. It is essential to maintain the biodiversity and long-term ecological health of the land. In Alaska, the natural fire regime is characterized by a return interval of 50 to 200 years, depending on the vegetation type, topography and location. The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the fire management planning process and the full range of fire management activities is exercised in Alaska to help achieve ecosystem sustainability, including its interrelated ecological, economic, and social consequences on firefighter and public safety and welfare, natural and cultural resources threatened, and the other values to be protected dictate the appropriate management response to the fire. Firefighter and public safety is always the first and overriding priority for all fire management activities.

Fires can be divided into the following categories:

- Structure fires – originate in and burn a building, shelter or other structure.
- Prescribed fires - ignited under predetermined conditions to meet specific objectives, to mitigate risks to people and their communities, and/or to restore and maintain healthy, diverse ecological systems.
- Wildland fire - any non-structure fire, other than prescribed fire, that occurs in the wildland.
- Wildland Fire Use - a wildland fire functioning in its natural ecological role and fulfilling land management objectives.
- Wildland-Urban Interface Fires - fires that burn within the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. The potential exists in areas of wildland-urban interface for extremely dangerous and complex fire burning conditions which pose a tremendous threat to public and firefighter safety.

Fuel, weather, and topography influence wildland fire behavior. Wildland fire behavior can be erratic and extreme causing firewhirls and firestorms that can endanger the lives of the firefighters trying to suppress the blaze. Fuel determines how much energy the fire releases, how quickly the fire spreads and how much effort is needed to contain the fire. Weather is the most variable factor. Temperature and humidity also affect fire behavior. High temperatures and low humidity encourage fire activity while low temperatures and high humidity help retard fire behavior. Wind affects the speed and direction of a fire. Topography directs the movement of air, which can also affect fire behavior. When the terrain funnels air, like what happens in a canyon, it can lead to faster spreading. Fire can also travel up slope quicker than it goes down.

Wildland fire risk is increasing in Alaska due to the spruce bark beetle infestation. The beetles lay eggs under the bark of a tree. When the larvae emerge, they eat the tree's phloem, which is what the tree uses to transport nutrients from its roots to its needles. If

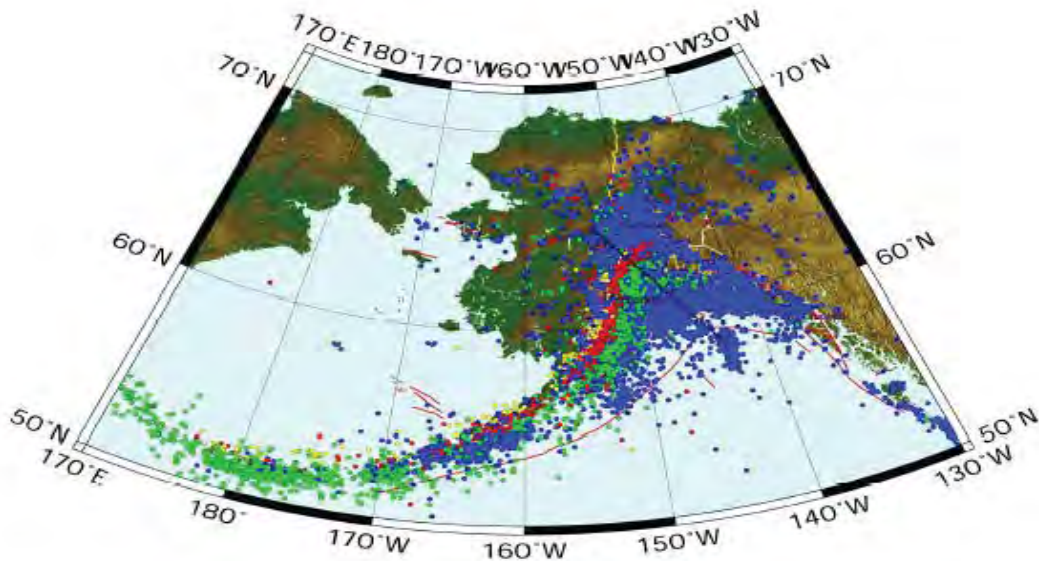
enough phloem is lost, the tree will die. The dead trees dry out and become highly flammable.

Wildland Fire Management in Alaska is the responsibility of three agencies: Division of Forestry, Bureau of Land Management (BLM) (through the Alaska Fire Service (AFS)) and U.S. Forest Service (USFS). Each agency provides fire-fighting coverage for a portion of the State regardless of land ownership. These agencies have cooperated to develop a state-wide interagency wildland fire management plan.

These three agencies and others, work together to fight fires. The 1996 Miller's Reach Fire was one of the worst wildland fires in State history. It involved 37 fire departments, and over 100 different agencies and organizations. In addition, 1,800 fire-fighting and support personnel had responded within the first 48 hours. It took almost two weeks for the fire to be contained and during this time it burned 37,336 acres and destroyed 344 structures.

## Earthquake

Approximately 11% of the world's earthquakes occur in Alaska, making it one of the most seismically active regions in the world. Three of the ten largest quakes in the world since 1900 have occurred here. Earthquakes of magnitude 7 or greater occur in Alaska on average of about once a year; magnitude 8 earthquakes average about 14 years between events.



Most large earthquakes are caused by a sudden release of accumulated stresses between crustal plates that move against each other on the earth's surface. Some earthquakes occur along faults that lie within these plates. The dangers associated with earthquakes include ground shaking, surface faulting, ground failures, snow avalanches, seiches and



tsunamis. The extent of damage is dependent on the magnitude of the quake, the geology of the area, distance from the epicenter and structure design and construction. A main goal of an earthquake hazard reduction program is to preserve lives through economical rehabilitation of existing structures and constructing safe new structures.

Ground shaking is due to the three main classes of seismic waves generated by an earthquake. P (primary) waves are the first ones felt, often as a sharp jolt. S (shear or secondary) waves are slower and usually have a side to side movement. They can be very damaging because structures are more vulnerable to horizontal than vertical motion. Surface waves are the slowest, although they can carry the bulk of the energy in a large earthquake. The damage to buildings depends on how the specific characteristics of each incoming wave interact with the buildings' height, shape, and construction materials.

Earthquakes are usually measured in terms of their magnitude and intensity. Magnitude is related to the amount of energy released during an event while intensity refers to the effects on people and structures at a particular place. Earthquake magnitude is usually reported according to the standard Richter scale for small to moderate earthquakes. Large earthquakes, like those that commonly occur in Alaska are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by these large events.

Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from not felt to total destruction. Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building construction practices. Soil conditions are a major factor in determining an earthquake's intensity, as unconsolidated fill areas will have more damage than an area with shallow bedrock.

Surface faulting is the differential movement of the two sides of a fault. There are three general types of faulting. Strike-slip faults are where each side of the fault moves horizontally. Normal faults have one side dropping down relative to the other side. Thrust (reverse) faults have one side moving up and over the fault relative to the other side.

Earthquake-induced ground failure is often the result of liquefaction, which occurs when soil (usually sand and coarse silt with high water content) loses strength as a result of the shaking and acts like a viscous fluid. Liquefaction causes three types of ground failures: lateral spreads, flow failures, and loss of bearing strength. In the 1964 earthquake, over 200 bridges were destroyed or damaged due to lateral spreads. Flow failures damaged the port facilities in Seward, Valdez and Whittier. Similar ground failures can result from loss of strength in saturated clay soils, as occurred in several major landslides that were responsible for most of the earthquake damage in Anchorage in 1964. Other types of earthquake-induced ground failures includes slumps and debris slides on steep slopes.

## Volcano

Volcanic ash, also called tephra, is fine fragments of solidified lava ejected into the air by an explosion or rising hot air. The fragments range in size, with the larger falling nearer the source. Ash is a problem near the source because of its high temperatures (may cause fires), burial (the weight can cause structural collapses), and impact of falling fragments. Further away, the primary hazard to humans are decreased



visibility and inhaling the fine ash. Ash will also interfere with the operation of mechanical equipment including aircraft. In Alaska, this is a major problem as many of the major flight routes are near historically active volcanoes.

Image 2: Redoubt Volcano is one of the active volcanoes of the Cook Inlet region. Steam and volcanic gas rise above the summit crater of the volcano.

## Weather

Weather is the result of four main features: the sun, the planet's atmosphere, moisture, and the structure of the planet. Certain combinations can result in severe weather events that have the potential to become a disaster.

In Alaska, there is great potential for weather disasters. Wind-driven waves from intense storms crossing the Bering Sea produce coastal flooding and can drive large chunks of sea ice inland destroying buildings near the shore. High winds, especially across Alaska's Arctic coast, can combine with loose snow to produce a blinding blizzard and wind chill temperatures to 75°F below zero! Extreme cold (-40°F to -60°F) and ice fog may last a week at a time. Heavy snow can impact the interior and is common along the southern coast. Heavy snow accumulations in the mountains builds glaciers, but can also cause avalanches or collapse roofs of buildings throughout the State. A quick thaw means certain flooding.

### *Winter Storms*

Winter storms originate as mid-latitude depressions or cyclonic weather systems. High winds, heavy snow, and cold temperatures usually accompany them. To develop, they require:

- Cold air - Subfreezing temperatures (below 32°F, 0°C) in the clouds and/or near the ground to make snow and/or ice.
- Moisture - The air must contain moisture in order to form clouds and precipitation.
- Lift - A mechanism to raise the moist air to form the clouds and cause precipitation. Lift may be provided by any or all of the following:
  - The flow of air up a mountainside.
  - Fronts, where warm air collides with cold air and rises over the dome of cold air.
  - Upper-level low pressure troughs.

#### Snow Terminology

Snow is defined as a steady fall of snow for several hours or more.

Heavy Snow generally means:

- Snowfall accumulating to 4 inches or more in depth in 12 hours or less
- Snowfall accumulating to 6 inches or more in depth in 24 hours or less

Snow Squalls are periods of moderate to heavy snowfall, intense, but of limited duration, accompanied by strong, gusty surface winds and possibly lightning.

A Snow Shower is a short duration of moderate snowfall.

Snow Flurries are an intermittent light snowfall of short duration with no measurable accumulation.

Blowing Snow is wind-driven snow that reduces surface visibility. Blowing snow can be falling snow or snow that already has accumulated but is picked up and blown by strong winds.

Drifting Snow is an uneven distribution of snowfall and snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.

A Blizzard means that the following conditions are expected to prevail for a period of 3 hours or longer:

- Sustained wind or frequent gusts to 35 miles/hour or greater
- Considerable falling and/or blowing snow reducing visibility to less than 1/4 mile
- Freezing Rain or Drizzle occurs when rain or drizzle freezes on surfaces such as the ground, trees, power lines, motor vehicles, streets, highways, etc.

A series of severe winter storms in December 1999 and January 2000 triggered avalanches and flooding in Southcentral Alaska and resulted in a Federal Disaster Declaration. The Municipality of Anchorage, the Kenai Peninsula Borough, the Matanuska-Susitna Borough, and the Valdez-Cordova census area received funding to supplement the recovery needs of the local governments to pay for debris removal, emergency services, and repair and replacement costs for damaged public facilities related to the storms.

### **Heavy Snow**

Heavy snow, generally more than 12 inches of accumulation in less than 24 hours, can immobilize a community by bringing transportation to a halt. Until the snow can be removed, airports and major roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage light aircraft and sink small boats. In the mountains, heavy snow can lead to avalanches. A quick thaw after a heavy snow can cause substantial flooding, especially along small streams and in urban areas. The cost of snow removal, repairing damages, and the loss of business can have severe economic impacts on cities and towns.

Injuries and deaths related to heavy snow usually occur as a result of vehicle accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Heavy snow can impact interior Alaska, but it is most common along the southern coasts. During the winter, Alaska's weather is greatly influenced by large areas of high pressure that can persist for weeks at a time over Siberia, interior Alaska, and northwestern Canada. While a well-developed mass of cold air dominates the interior, storms crossing the North Pacific often move into the Gulf of Alaska dumping large amounts of precipitation over the southern coastal region. The most frequent heavy snowfalls occur along the north Gulf coast from Prince William Sound to the southeastern Panhandle. Snowfalls of one to two feet are common in coastal communities such as Valdez and Yakutat, and these same events can bring up to six feet of snow in the mountains nearby. For example, the mountain ranges near Glacier Bay and Thompson Pass are considered two of the snowiest places in the nation.

High winds, especially across the Arctic coast, can combine with loose snow to produce blinding blizzard conditions and dangerous wind chill temperatures.



Record heavy snow occurred in Anchorage on March 17, 2002 when two to three feet of snow fell in less than 24 hours over portions of the city. Ted Stevens International Airport recorded a storm total of 28.7 inches, and an

observer near Lake Hood measured over 33 inches. The city of Anchorage was essentially shut down during the storm, which fortunately occurred on a Sunday morning when a minimal number of businesses were open. Both military bases, universities, and many businesses remained closed the following day, and Anchorage schools remained closed for two days. It took four days for snow plows to reach all areas of the city.

It doesn't take several feet of snow to cause considerable risk to residents of the Anchorage area. On March 20, 2001, more than 100 vehicle accidents occurred in the Anchorage-Eagle River area when 8 to 12 inches of snow fell.

### ***Extreme cold***

What is considered an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." In Alaska, extreme cold usually involves temperatures below -40 degrees Fahrenheit. Excessive cold may accompany winter storms, be left in their wake, or can occur without storm activity.

Extreme cold, can bring transportation to a halt across interior Alaska for days or sometimes weeks at a time. Aircraft may be grounded due to extreme cold and ice fog conditions, cutting off access as well as the flow of supplies to northern villages. Long cold spells can cause rivers to freeze, disrupting shipping and increasing the likelihood of ice jams and associated flooding.

Extreme cold also interferes with a community's infrastructure. It causes fuel to congeal in storage tanks and supply lines, stopping electric generation. Without electricity, heaters do not work, causing water and sewer pipes to freeze or rupture. If extreme cold conditions are combined with low or no snow cover, the ground's frost depth can increase disturbing buried pipes.

The greatest danger from extreme cold is to people. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible.

**Frostbite** is damage to body tissue caused by that tissue being frozen. Frostbite causes a loss of feeling and a white or pale appearance in the extremities.

**Hypothermia** is low body temperature. Normal body temperature is 98.6°F. When body temperature drops to 95°F, however, immediate medical help is needed. Hypothermia also can occur with prolonged exposure to temperatures above freezing.

The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, and carbon monoxide poisoning is possible as people use supplemental heating devices.

Generally the risk of extreme cold is restricted to the interior region of Alaska, bounded by the Alaska Range to the south and the Brooks Range to the north.

During January of 1989, a fairly widespread extreme cold event occurred across the interior part of the state. The city of Fairbanks came to a virtual halt for fourteen days when bitter cold and ice fog gripped the area. During the cold spell, Tanana recorded a low temperature of -76°F, McGrath followed closely with -75°F, and the record for the highest barometric pressure reading ever recorded in North America occurred in Northway at 31.85 inches of mercury. Aircraft were grounded for more than 6 days during the event.

### ***Ice Storms***

The term ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. They can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power outages and personal injury. Ice storms result from the accumulation of freezing rain, which is rain that becomes supercooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations.

Freezing rain develops as falling snow encounters a layer of warm air in the atmosphere deep enough for the snow to completely melt and become rain. As the rain continues to fall, it passes through a thin layer of cold air just above the earth's surface and cools to a temperature below freezing. The drops themselves do not freeze, but rather they become



supercooled. When these supercooled drops strike the frozen ground, power lines, tree branches, etc., they instantly freeze.

The atmospheric conditions that can lead to ice storms occur most frequently in Southwestern Alaska along the Alaska Peninsula and around Cook Inlet. Brief instances of freezing rain occur frequently along the southern coast of Alaska, but these events generally produce very light precipitation with less than ¼ inch of ice accumulation.

## ***Hail***

Hailstorms are an outgrowth of thunderstorms in which ball or irregular shaped lumps of ice greater than 0.75 inches in diameter fall with rain. The size and severity of the storm determine the size of the hailstones. In Alaska, hailstorms are fairly rare and cause little damage, unlike the hailstorms in Mid-western states. The extreme conditions of atmospheric instability needed to generate hail of a damaging size (greater than ¾ inch diameter) are highly unusual in Alaska. Small hail of pea-size has been observed periodically.



Hail collecting during a thunderstorm.  
Image courtesy of NOAA Photo Library,  
NOAA Central Library; OAR/ERL/National  
Severe Storms Laboratory (NSSL)

In August of 2000, an intense thunderstorm moved across the community of Sitka, dumping pea- to dime-sized hail over the downtown area. The hail covered the ground and plugged up storm drains causing minor street flooding until it melted.

## **Critical Facilities**

The following table describes the critical facilities for City of Soldotna. Without these facilities loss of life and human suffering is certain.



	Flood	Wildfire	Earthquake	Volcano	Snow Avalanche	Tsunami & Seiche	Weather	Landslides	Erosion	Drought	Technological	Economic
00. Airport		X	X	X			X					
01. Fire		X	X	X			X					
02. Police		X	X	X			X					
03. Hospital		X	X	X			X					
04. Health Clinic												
05. School		X	X	X			X					
06. Tank (fuel) Farm												
07. Electric		X	X	X			X					
08. Telephone		X	X	X			X					
09. Satellite												
10. Washeteria												
11. Harbor/Dock/Port												
12. Landfill/Incinerator												
13. Museum		X	X	X			X					
14. Library		X	X	X			X					
15. Road		X	X	X			X					
16. City Hall		X	X	X			X					
17. Park	X	X	X	X			X					
18. Civic Center												
19. Cemetery		X	X	X			X					
20. Offices												
21. Tannery												
22. Sewage Lagoon												
23. Teachers Quarters												
24. Store												
25. Service/Maintenance		X	X	X			X					
26. Bridge	X	X	X	X			X					
27. Post Office		X	X	X			X					
28. Radio Transmitter												
29. Reservoir / Supply (water)		X	X	X			X					
30. Senior Center		X	X	X			X					
31. Church												
32. Community Freezer												
33. Generator												
34. Guard												
35. Comm. Storage Shed												
36. Boardwalk	X	X	X	X			X					
99. Other												

## Chapter V– Mitigation Goals, Objectives, & Strategies

### Mitigation Goals

A *goal* is a general statement of a future condition which is considered desirable for the community; it is an end towards which actions are aimed. An *objective* is a statement of a measurable activity to be accomplished in pursuit of the goal; it refers to some specific aspiration which is reasonably attainable. A *strategy* is a specific proposal to do something that relates directly to accomplishing the objective; it identifies the how, where, who, and amount to be done. Through the process of writing and adopting the COS hazard mitigation plan, the City has identified the following goals (in bold), objectives (italicized), and strategies (lowercase roman numerals).

**1. Goal: Reduce the vulnerability of properties and infrastructure along the Kenai River to flooding and ice damage.**

- a. Continue to review development proposals within the Kenai River Overlay District and consider possible revisions to the Zoning Code regarding building within the 100-foot overlay district.*
  - i. Review the existing KROD code to determine whether it adequately addresses building standards near the Kenai River.
- b. Investigate whether the City of Soldotna should participate in the National Flood Insurance Program*
  - i. Learn more about the program and how it would affect property owners and the City of Soldotna;
  - ii. Open a dialogue between the City and agencies at the Gilman River Center about the program and its benefits;
  - iii. Identify the necessary next steps toward joining the program;
  - iv. Determine which additional City resources would be required to adopt and adequately manage a floodplain management ordinance.

**2. Goal: Reduce Soldotna’s vulnerability to wildfires.**

- a. Reduce the risk of structural ignitions.*
  - i. Encourage homeowners to educate themselves about defensible space and other Firewise principals.
- b. Reduce the amount of hazardous fuels in and around Soldotna.*
  - i. Provide fire breaks in and around the City of Soldotna (including the wildlife refuge);
  - ii. Work with the Spruce Bark Beetle office of the Kenai Peninsula Borough to identify projects within and around the city.
- c. Promote education and awareness about the risks of wildfires and mitigation steps individual homeowners can implement.*
  - i. Collaborate with partner agencies and communities including the KPB Spruce Bark Beetle Office, Firewise program, individual homeowners, area fire departments, and fire management personnel in natural resource agencies;
  - ii. Review and implement action items from the Soldotna/Ridgeway CWPP Action Plan;

- iii. Prioritized fuel reduction to reduce the amount of fuels in the interface area, and fragment or break up continuous wildland fuels;
- iv. Public education and outreach of firewise program and practices;
- v. Encourage homeowners to participate in firewise program;
- vi. Ensure defensible areas surrounding vital public facilities.

**3. Goal: Reduce the City's vulnerability to damage from earthquakes**

- a. *Identify retrofit measures for City of Soldotna facilities which may be vulnerable to earthquake damage, and which provide critical services for area residents.*
  - i. Prepare a list of all City facilities and identify those which are critical to area residents;
  - ii. Determine whether retrofits or backup systems are needed to protect the structures in the event of an earthquake.
- b. *Strengthen the City's response capabilities to a large earthquake event.*
  - i. Prepare disaster supplies kits for all City public buildings and vehicles;
  - ii. Establish water supply facilities at artesian flow well houses;
  - iii. Purchase generators to run water well pumps at well B (near hospital) and E on Funny River Road;
  - iv. Utilize the water reservoir tank on the south side of the Kenai River in case of disruption of main lines under Sterling Highway Bridge;
  - v. Provide standby generators to operate vital facilities;
  - vi. Provide road maintenance equipment on both sides of the Kenai River in case of bridge damage;
  - vii. Investigate alternate water/sewer utility lines crossing the Kenai River other than the those under on the Sterling Highway Bridge;
  - viii. Provide public education and awareness about earthquake preparedness and response;
  - ix. Provide information and location of shelter facilities.

**4. Increase the City's preparedness to volcanic eruptions to reduce the impact of possible future events.**

- a. *Provide response kits in City of Soldotna buildings and vehicles which include instructions for how to operate City equipment in the event of a volcanic eruption.*

**5. Goal: Reduce the City's risk to extreme weather events.**

- a. *Increase public awareness of severe weather events and potential mitigation activities.*
  - i. Engage citizens in existing educational programs such as Winter Weather Awareness Week and Flood Awareness Week;
  - ii. Coordinate with the Kenai Peninsula Borough, State of Alaska, and local utility providers about potential storm effects and possible mitigation activities;

- iii.** Promote awareness of [www.511.alaska.gov](http://www.511.alaska.gov), and encourage drivers to use this service to check road conditions before taking road trips in winter months.

## Chapter VI – Implementation & Maintenance Procedures

### Implementation

The City of Soldotna will implement this plan by using mitigation actions within our Community Comprehensive Plan, the Capital Improvement Plan, and other plans to pursue our mitigation goals. Our various community plans will consider best mitigation practices to maximize the benefit to the community. We will consider projects that show they are cost effective by ensuring that for every dollar spent we will get a minimum of one dollar savings from eliminating or reducing future disaster losses.

### Maintenance

The All-Hazard Mitigation Plan will be reviewed annually and will be updated at a minimum of every five years or 90 days after a Presidentially declared disaster. The City Planner will be responsible for ensuring that reviews are completed, the planning commission and the general public will be notified of opportunities to review the plan by written invitation, use of newspaper, radio, television, brochures or flyers to advertise this opportunity and solicit involvement. Public involvement is essential to ensure that the mitigation goals, objectives and action items are addressing the community's needs.

Ongoing public input regarding community planning and community threats to natural hazards is critical. The City will continue to provide opportunities for public comment at Planning and Zoning Commission and City Council meetings.



Port Graham

# Flood Hazard Mitigation Plan



February 2001



MONTGOMERY WATSON



**Final Flood Hazard Mitigation Plan  
Port Graham, Alaska  
Kenai Peninsula Borough**

Montgomery Watson Job No. 1850717.010101

March 2001

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Conditional Letter of Map Revision  
Kenai Peninsula Borough Assembly Resolution

## Acronyms and Abbreviations

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ADES	State of Alaska Division of Emergency Services
CLOMR	Conditional Letter of Map Revision
FEMA	Federal Emergency Management Administration
FIRM	Flood Insurance Rate Map
LOMR	Letter of Map Revision
MLLW	mean lower low water
NGVD	National Geodetic Vertical Datum

## 1.0 INTRODUCTION

---

The community of Port Graham has experienced an ongoing and worsening problem with coastal erosion and continued susceptibility to storm flooding in the coastal areas. A recent threat to the community's school and erosion concerns at several coastal properties have prompted public officials to scrutinize the long-term effects of coastal erosion and storm flooding to assess possible solutions, and to make recommendations for actions to mitigate future damage. This plan summarizes these findings and recommendations.

## 2.0 A SHORT HISTORY OF PORT GRAHAM'S FLOODING AND COASTAL EROSION PROBLEM

---

### 2.1 BRIEF DESCRIPTION AND HISTORY OF PORT GRAHAM

Port Graham is located in the Kenai Peninsula Borough on the southern tip of the Kenai Peninsula, approximately 24 miles southwest of Homer, and 125 miles southwest of Anchorage. The community sits on relatively low-lying coastal ground between the waters of Port Graham Bay and Cook Inlet. Figure 1 shows Port Graham and vicinity. Virtually all development in the community is concentrated in the coastal area adjacent to Port Graham Bay. The area encompasses approximately six square miles of land and 1 square mile of water. Port Graham's 178 residents (1999 Alaska Department of Labor estimate) are of primarily Alaska Native (Sugpiaq) descent. The village is accessible only by air and water, although a foot trail leads to the neighboring village of Nanwalek (English Bay), approximately four miles away.

The earliest settlers of Port Graham were Russians who arrived in the early 1800s in search of furs. Coal mining and trapping served as the region's primary economic activities during the 1800s. Ancestors of the majority of today's population settled the area in the early 1900s, arriving from neighboring villages. Cultural traditions passed down from these early settlers remain important today. Most of the community's residents continue to lead a subsistence lifestyle, although reliant on the area's cash economy. In 1912, the Fidalgo Canning Co. built a salmon cannery, which provided the economic base for the community for many years. The cannery was destroyed by fire in 1960 and rebuilt in 1968. Economic activity for residents from Port Graham and the nearby village of Nanwalek (English Bay) centered either directly or indirectly around the cannery. In 1991, a pink salmon hatchery became operational. In 1998, the hatchery and cannery were destroyed by fire, reopening in June of 1999. Workforce data shows that the hatchery and cannery employ about 70 residents seasonally, while 15 residents hold commercial fishing permits.

The population in Port Graham has slowly, but steadily increased over the last century. A population of 47 was recorded in 1920. The 1990 census reported a population of 166, while the most recent Alaska Department of Labor estimates show the population at 178.

### 2.2 DESCRIPTION OF FLOODING AND COASTAL EROSION EVENTS

In recent history, coastal flooding has been a concern for Port Graham residents since a 1976 flood deluged the cannery. Severe storms and teleseismic or local tsunamis have the potential to cause serious flooding as well as worsening the coastline's active erosion. Regular wave activity continues to erode areas of the shoreline near critical public facilities and infrastructure, adding to the concern that a storm or tsunami event could destroy public or private property.

The eruption of the volcano on Augustine Island in 1883 illustrates the severity of potential tsunami events in Port Graham. The eruption generated several waves over fifteen feet, which reached the Port Graham area within a half-hour of the eruption. Since tides were low at the

**Figure 2-1    Port Graham Vicinity Map**



time, the waves posed no safety concern for the community's residents. Waves did, however, flood several residences and carried fishing boats out into the harbor. In addition to the risk from a tsunami event, storm tides pose a flooding hazard. Storm tides have caused flooding in the coastal areas on numerous occasions. Harlow (1972) reported flood water depths of 21 inches above the floor of the old cannery, flooding the carpenter shop and destroying supplies. Harlow reported other estimates of an additional 24 to 48 inches of flooding during severe storms.

Coastal erosion due to storm activity and regular wave action has increasingly become a concern for public officials and area residents. Erosion at the site of Port Graham's community school poses the most immediate threat, but other sites along the Port Graham coastline are also vulnerable to continuing erosion. An old cemetery, the cannery and hatchery, the main road to the cannery and hatchery, and a road to the log transfer facility are all threatened by coastal erosion. Rates of erosion along the different sections of coastline are unknown, adding an element of uncertainty to future planning efforts.

### 3.0 HOW THIS PLAN WAS PREPARED

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In 1998, residents of Port Graham informed the Kenai Peninsula Borough of a serious erosion problem at the village school. The coastal bank had eroded to such an extent that it threatened the school gymnasium and a fuel tank farm that supplies the fuel to heat the building.

After the Kenai Peninsula Borough became aware of the severity of the coastal erosion problem in Port Graham, the borough applied for a remediation grant through the Federal Emergency Management Administration (FEMA). The borough received \$275,000 from FEMA to address the immediate problem at the village school. The State of Alaska, Department of Community and Economic Development, Division of Municipal and Regional Assistance administered the grant funds. As part of the grant, the state requested that the Kenai Peninsula Borough prepare a flood hazard mitigation plan for the community, to address the problem over the long-term and mitigate future damage from flooding or erosion.

To deal with the urgent problem, coastal erosion threatening the school gymnasium and fuel tank farm, the borough installed riprap to shore up the embankment and prevent further erosion at the site. This effort provided an effective temporary solution. Other structures in the community are likewise in danger, and will require action to ensure that eroding banks do not continue to undermine them, threatening their structural stability.

On December 4, 2000, the contractor for the flood hazard mitigation plan met with residents of Port Graham to discuss their concerns about flooding and erosion, and to obtain feedback on possible mitigation measures. Residents expressed concern about the erosion problem. They specifically expressed fears about four sites: 1) the old cemetery, 2) the cannery/hatchery complex, 3) the public school, and 4) the road to the log transfer facility. It is important to note the cultural importance of the cemetery to the residents of Port Graham and their hesitance to relocate gravesites. Mitigation measures should take into consideration these concerns and should reflect the community's values.

## 4.0 FLOOD AND EROSION DATA

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Relatively little data has been collected on Port Graham's flood and erosion problems, but the 1883 eruption of Mt. Augustine demonstrates the potential flooding danger from a tsunami event. Estimations at the time of the eruption placed tsunami wave heights at 25 to 30 feet. Several of these large waves hit the village within a half-hour. Damage was minimal because tides were low at the time. The 1964 earthquake in Southcentral Alaska also caused a tsunami event. Information from the Kenai Peninsula Borough Flood Insurance Study (FEMA 1980) shows that 10 to 20-foot tsunami waves were reported in Port Graham as a result of the 1964 earthquake.

A local tsunami caused by an earthquake or volcanic eruption poses the greatest threat to Port Graham. Such a catastrophic event could damage property and take lives because of the short period of time between the earthquake or eruption and the subsequent tsunami. The State of Alaska Division of Emergency Services (ADES) has estimated that a tsunami wave of up to 100 feet, reaching one-mile inland, could result from an earthquake or volcanic event. A wave of this magnitude could engulf virtually the entire community of Port Graham. Thus, the State of Alaska Division of Emergency Services (ADES) has recommended that all residents retreat inland to higher ground upon feeling a strong earthquake lasting over 30 seconds (Figure 2). ADES established the 100-foot elevation as the upper limit of the Tsunami Hazard Zone for much of lower Cook Inlet. They did not take into account site-specific effects of shoaling or wave diffraction which may temper the actual peak run up of a tsunami at Port Graham.

According to ADES, Port Graham also faces a moderate risk from distant source tsunamis, which originate from a source so far away from the community that the earthquake is not felt. The waves from such an event could reach  $\frac{3}{4}$ -mile inland and could be up to 35 feet. Usually, the distance of the community from the earthquake's epicenter allows sufficient time for warning.

Storm tides pose a less-threatening, but significant risk to the community. In 1976, storm tides reached an elevation of 21 feet above mean lower low water (MLLW) and flooded portions of the cannery. Coastal erosion adds to the flooding concerns in Port Graham. As the shoreline gradually erodes away, structures become exposed and unstable. Recent analysis performed by Pacific International Engineering (1999) study showed that islands and shoals at the head of Port Graham Bay provide considerable tempering of the wave climate from Cook Inlet. The maximum 100-year significant wave height of 24 feet for Cook Inlet is attenuated to something less than 3 feet in height near the cannery area. The 3-foot waves in open water become even larger breakers on the beach and can be particularly damaging to the toe of slopes along the shoreline at high tides. Unfortunately, little data exists on the rate of coastal erosion in Port Graham, making analysis of the potential risk to specific structures difficult. Residents have noted ongoing, active erosion at several sites, including the school, the cemetery, the road to the cannery, and the road to the log transfer facility.

## **Figure 4-1    Tsunami Hazard Zone**

## 5.0 FLOODPLAIN DEVELOPMENT

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Floods cause little damage under natural conditions. In undeveloped coastal areas near Port Graham, nature ensures that floodplain flora and fauna can endure occasional inundation. Only when flooding damages human development is high water truly a problem. FEMA has identified several zones of differing coastal flood hazard in its mapping of the Port Graham area. Zonation includes the following classifications:

- Zone V: Areas of coastal flooding having a 1% chance of occurrence in any year, with wave action (the 100-year flood)
- Zone VE: Areas of 100-year coastal flood with velocity (wave action), base flood elevation determined
- Zone C: Areas of minimal flooding
- Zone D: Areas of undetermined, but possible, flood hazards
- Zone X: A designation that replaces zones C and D

The existing FEMA Flood Insurance Rate Map (FIRM Panel 5410), was published in 1981. This map identifies a narrow strip of coastline as Zone V, with coastal flood elevations shown as either 31 or 33 feet above the National Geodetic Vertical Datum of 1929 (NGVD). The difference in elevation is due to the aspect of the coast in relation to the head of Port Graham Bay. NGVD 29 is 9.3 feet above MLLW; therefore, this elevation would be equivalent to 40.3 to 42.3 feet above MLLW. Recently, FEMA concluded that these elevations were calculated incorrectly, and that the elevations shown on the FIRM should be 12 and 14 feet NGVD (21.3 and 23.3 feet MLLW), respectively (FEMA, letter from Max H. Yuan, P.E., to The Honorable Dale Bagley, Mayor, Kenai Peninsula Borough, January 24, 2000). Figure 3 shows the zonation as outlined on the original FIRM, with the adjusted base flood elevations shown. Figure 3 Also identifies locations of concern for coastal erosion. Figure 4 shows the relationship between the erroneous NGVD 29 assumed in the 1981 FIRM, MLLW, and the 100-year flood.

Additionally, in the area near the cannery, Pacific International Engineering has identified portions of the peninsula where incident waves are not likely to be greater than 3.0 feet and run up of breaking waves will be less than 3 feet. In these areas, flood zonation is to be limited to flooding due to the still water flood elevation, or 12.4 feet NGVD (21.7 feet MLLW).

Four structures in the village of Port Graham fall within the V-zones identified on the FIRM. Most of the developed area in the village lies in Zone C, above the elevation of the base flood and wave action identified as part of Zone V. Structures in Zone C include:

- Seventy-seven structures classified as “residential.”
- Twelve structures classified as “community buildings.” These include the school complex, the fire station, the ambulance storage building, the airport maintenance building, the community center and council offices, the Russian Orthodox Church, the water treatment plant, and a storage building.
- Fourteen structures classified as “commercial.” These include the Port Graham Corporation clinic and laundry, the cannery/hatchery complex, and several private businesses.

Property ownership in Port Graham is diverse in the coastal areas. Most of the land is in native ownership or is owned by individuals. There are several large parcels of private land, including the cannery/hatchery complex. The Borough owns one sizable parcel, the site of the village

school, while the state owns a large parcel running through the middle of the community, the airstrip.



**Figure 5-1     Federal Emergency Management Administration Flood Insurance Rate Map**

**Figure 5-2      Federal Emergency Management Administration 1981 Datum and National  
Geodetic Vertical Datum 29**

## 6.0 FUTURE DEVELOPMENT

---

Current development is concentrated in the coastal areas, making the community vulnerable to flooding from tsunamis and extreme events. Much of the available land is owned by the Port Graham Village, allowing them to a certain extent to control the development of the community. Future development could occur along existing roads, preventing the need for costly road construction. Duncan Heights Road, Second Street, and A Street could all accommodate additional development. Structures along these roads, while still in the Tsunami Hazard Zone, would be out of immediate danger from storms or coastal erosion.

## 7.0 PLANNING GOALS

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In 1995, a flood destroyed property in the Resurrection River, Kenai River, and Kasilof River watersheds within the Kenai Peninsula Borough. In the aftermath of the event, the Kenai Peninsula Borough developed a flood mitigation plan to assess flood hazards specific to areas that suffer repetitive flooding losses, to establish overall goals and mitigation alternatives, to reduce the long-term flooding risk, and to guide future growth and development. The plan recognizes that because of the variety of land ownership in the borough, many agencies and individuals have an interest in flood mitigation activities, necessitating a broad management perspective for mitigation planning. The plan also recognizes the necessity for working through cooperative partnerships to achieve mitigation goals. This value will prove important in Port Graham, with its geographic isolation. The Port Graham Flood Hazard Mitigation Plan fits within the overall borough plan. Through the planning process, the borough identified the following goals to guide the development of flood hazard mitigation efforts within the borough:

- *Modify the impact of flooding* by assisting individuals and communities to prepare for, respond to, and recover from floods.
- *Reduce susceptibility* to flood damage and disruption by avoiding hazardous, uneconomic, or unwise use of floodplains.
- *Protect the natural and beneficial values* of Peninsula floodplains and water resources.
- *Promote positive economic development.*

Recommended activities in Port Graham should reflect the principles expressed in the goals listed above. The borough also outlined specific approaches to accomplish flood mitigation goals. They are as follows:

- **Enhance Emergency Preparedness** – Through coordination with the Kenai Peninsula Borough's Office of Emergency Management.
- **Comply with Federal Requirements** – To insure ongoing participation in the National Flood Insurance Program through enforcement of the Borough's floodplain development ordinance.
- **Provide Education and Information** – To educate the public about the Borough's floodplain ordinance and building permit requirements.
- **Identify Partnership Opportunities** – To maximize resources available from the government and private sector.
- **Reduce Vulnerability to Flooding Hazards** – To protect existing structures in floodplains and gather further information on potential risks to property in floodplains.
- **Protect or Maintain Beneficial Floodplain Natural Values** – To protect the beneficial functions floodplains serve in safeguarding the physical, biological, and chemical integrity of water resources.
- **Promote Positive Economic Development** – To balance the loss of economic opportunity when development is restricted in a floodplain area.

While not all of these approaches will prove appropriate in Port Graham, recommended activities should fall under one of the above categories.

## 8.0 RECOMMENDED ACTIVITIES

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Numerous alternatives to mitigate against loss and repetitive loss are available to Port Graham. They include measures intended to provide more data on the rate of coastal erosion, measures to combat active erosion, and suggestions meant to mitigate the damage of future flooding events. A prospective timeline for these recommended activities is provided as Table 8-1. Each activity is described in greater detail below.

**Table 8-1      Timeline for Potential Mitigation Activities**

<b>Project</b>	<b>Responsible Party</b>	<b>Timetable</b>
Installation of Erosion Markers	Kenai Peninsula Borough	1 year
Revegetation of Eroding Banks	Kenai Peninsula Borough Port Graham Village Council	Ongoing
Location of New Development	Kenai Peninsula Borough	Ongoing
Public Education	Kenai Peninsula Borough	18 months
Completion of Base Flood Elevation Map	Kenai Peninsula Borough	6 months

### 8.1 INSTALLATION OF EROSION MARKERS

A relative dearth of data exists on the rate of coastal erosion at vulnerable sites in Port Graham. Evaluating the costs and benefits of potential mitigation action without further information on the rate of erosion will prove difficult. Before prioritizing which areas to concentrate mitigation activities upon, planners must know which sites are the most vulnerable. To remedy this lack of data, Port Graham, in cooperation with the Kenai Peninsula Borough, should identify critical sites and place clearly visible markers at a specified distance away from the embankment. The erosion rate should be measured periodically, and charted against the erosion rates at other sites. Recommended sites for these markers are listed below.

- Top of erosion gully near the school
- Top of erosion gully near the propane tanks by the school
- North road to cannery/hatchery
- Erosion area south of the cannery/hatchery
- Gully adjacent to the road to the log transfer facility
- Beach below the cemetery

### 8.2 REVEGETATION OF ERODING BANKS

Revegetation of eroding banks in the coastal areas of Port Graham would provide a natural and effective method of controlling coastal erosion, in addition to moderating the effects of stormwater runoff and water level fluctuations. Efforts in Port Graham to look at revegetation as a solution to the current coastal erosion problem should include the input of landowners, the community, the State of Alaska, the federal government, and the Kenai Peninsula Borough. Through the Kenai River Center, a one-stop facility which houses federal, state, and local government agencies charged with permitting aquatic projects and providing education materials, Port Graham can access needed technical assistance to initiate restoration projects. The Kenai River Center, located in Soldotna, houses staff from the Kenai Peninsula Borough Planning Department, the Alaska Department of Fish and Game, the Environmental Protection Agency, and the Alaska Department of Natural Resources Division of Parks and Outdoor Recreation. In addition to the Kenai River Center, other programs exist that could help Port Graham in its revegetation efforts. The Youth Restoration Corps, a non-profit organization that

employs and trains area youth to complete restoration projects could provide assistance in Port Graham. The program relies on grant funding, and has primarily completed projects on the Kenai River. However, the model of training local youth to do habitat restoration could be used effectively in Port Graham.

Numerous revegetation and bank protection techniques have been studied and used in Alaska. A specific technique should be selected only after evaluating site specific factors, including the erosion potential, water velocities, the slope, soil characteristics, and the type and condition of vegetation. The project's intended goal and the project's cost should also factor into the decision. These decisions can be made in Port Graham on a site by site basis in consultation with the landowner and the permitting agencies.

Several specific sites in Port Graham are of special concern because of the rapid nature of bank erosion. Erosion control measures, including revegetation, should be implemented at these sites first in order to avoid further damage to property. These sites include:

- Village school
- Road to the log transfer facility
- Cemetery
- Cannery/hatchery facilities
- Road to the cannery/hatchery facilities
- Erosion area south of the cannery/hatchery

### **8.3 LOCATION OF NEW DEVELOPMENT**

The Port Graham/Nanwalek vicinity has been named an "Area Which Merits Special Attention" under the Kenai Peninsula Borough's Coastal Management Program. In the Area Which Merits Special Attention Plan, authored by the Kenai Peninsula Borough Resource Planning Department, the plan mandates that a development buffer of at least 100 feet be maintained along rivers, lakes and shorelines to ensure water quality. A 1972 "Port Graham Comprehensive Development Plan" also prepared by the Kenai Peninsula Borough Planning Department notes the flood hazard in Port Graham, and recommends that any new structures be placed "as high as possible and well back from beach or bluff areas." The same plan recommends that a greenbelt be established along all available coastal land to provide for subsistence and recreational access for Port Graham residents, and to serve as a buffer zone to protect structures from flooding. In accordance with these recommendations and mandates, and to prevent further damage to property from coastal erosion or tsunamis, it is recommended that new development be located well away from coastal areas. As mentioned previously, development could occur along Duncan Heights Road, A Street, or Second Street, eliminating the need for new road construction to support development.

### **8.4 PUBLIC EDUCATION**

Public education is a critical component of any disaster mitigation plan, empowering people to protect their lives and property. Efforts to promote public education in Port Graham should include Port Graham Corporation, the ANCSA recognized village corporation, and the Native Village of Port Graham, the Bureau of Indian Affairs recognized traditional council. The Kenai Peninsula Borough in cooperation with the village corporation and the traditional council has at its disposal numerous ways to educate the residents of Port Graham about their vulnerability to flooding and erosion problems and ways they can work together to combat these problems. Specific suggestions include:

- Meeting with coastal property owners to discuss their participation in bank rehabilitation projects or other erosion control measures.



- Public meetings to discuss disaster preparedness, including warning signs for a tsunami event.
- Assistance in planning the locations of future community facilities.
- Public or private meetings with borough planning department staff to discuss the Borough's floodplain ordinance and its application in Port Graham.

## **8.5 COMPLETION OF UPDATED FLOOD INSURANCE RATE MAP**

The cannery that marked the major industrial facility in Port Graham was destroyed by fire in January, 1998, and was rebuilt by the Port Graham Corporation in 1999. In redevelopment of the cannery area, additional improvements were made to minimize potential for flooding due to storm tides and waves. A variance to the Kenai Peninsula Borough Flood Hazard Ordinance was granted to allow placement of fill on the site. The variance was granted subject to certain conditions, including the securing of a Letter of Map Revision (LOMR) from FEMA, which would provide appropriate documentation of new flood hazard zoning as a result of the improvements.

Based on engineering reports (Pacific International Engineering, 1999a and b) that have addressed changes in flood hazard conditions specific to the cannery and the proposed developments, FEMA issued a Conditional Letter of Map Revision (CLOMR). The CLOMR, dated January 24, 2000, corrects the still water flood elevation discrepancy identified in Figure 4 and provides a list of conditions that must be addressed prior to release of a final LOMR. The CLOMR and drawings showing prospective boundaries of revised flood hazard zones are provided in an Appendix to this Flood Hazard Mitigation Plan.

The LOMR will stand as an independent modification of the FIRM for the cannery area. The findings will be included in any future publications of the FIRM for the community.

## 9.0 REFERENCES

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## APPENDIX

### *Conditional Letter of Map Revision*

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## APPENDIX

*Kenai Peninsula Borough Assembly  
Resolution*

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Photo by AeroMap US, 1966 - Hazard Zone by State of Alaska, Division of Emergency Services.

FIGURE 2

PORT GRAHAM  
FLOOD HAZARD MITIGATION PLAN

TSUNAMI HAZARD ZONE



MONTGOMERY WATSON

Anchorage, Alaska





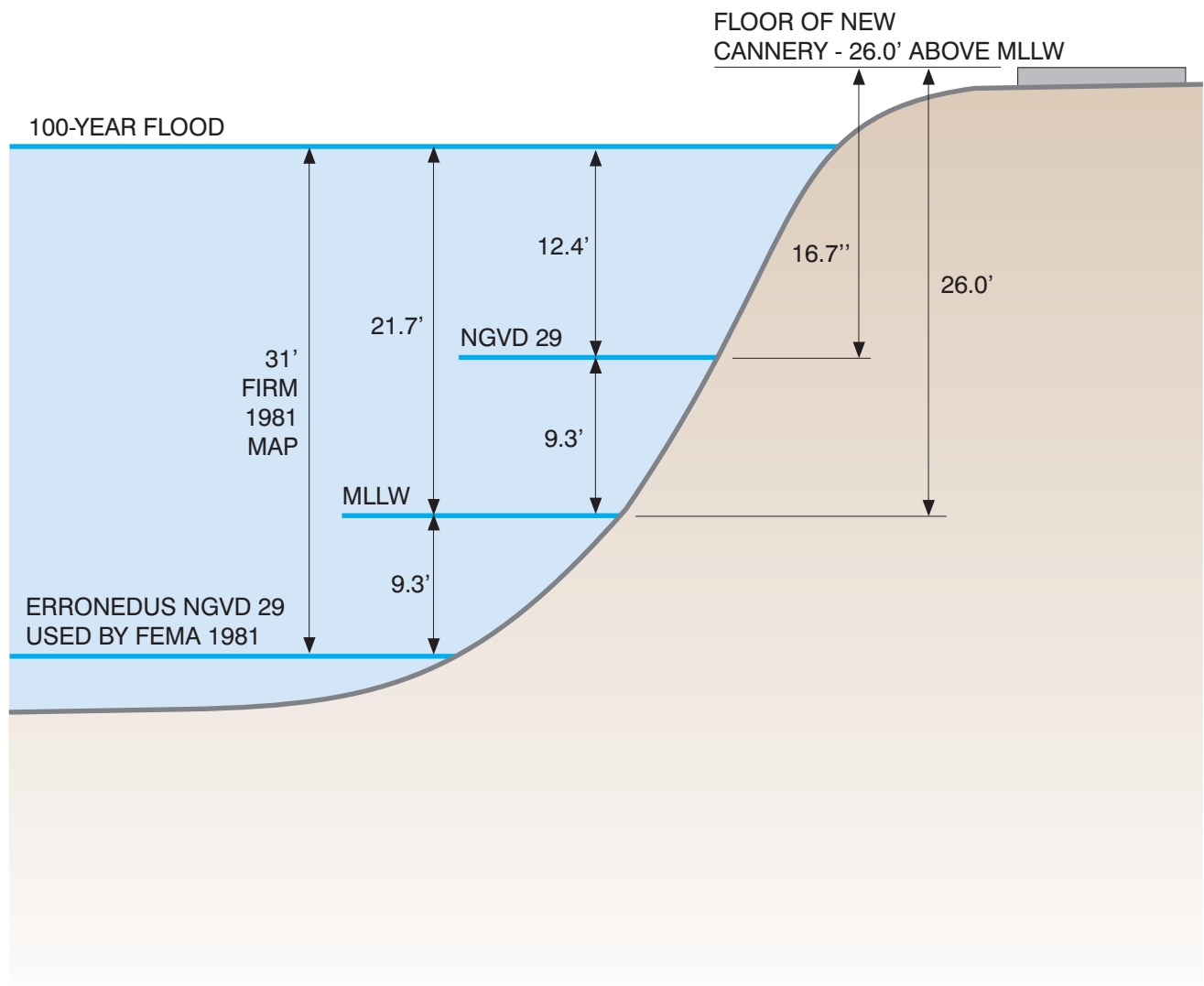


FIGURE 4

PORT GRAHAM  
FLOOD HAZARD MITIGATION PLAN

FEMA 1981 DATUM AND NGVD 29



MONTGOMERY WATSON

Anchorage, Alaska

# Port Graham Vicinity



0.3 0 0.3 0.6 Miles

## Parcel Ownership

- Private
- Federal
- Native Allotment
- University
- State
- Mental Health
- Municipal
- Borough
- Native







Interagency  
**ALL LANDS/ALL HANDS**  
**ACTION PLAN**

for

**Fire Prevention & Protection**  
**Hazardous Fuel Reduction**  
**Forest Health & Ecosystem Restoration**  
**Community Assistance**

in

**Alaska's Kenai Peninsula Borough**

**September 5, 2004**

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As Administrator of a Land Management Agency or Land Owner Organization represented on the Kenai Forest, Wildland Fire, and Fuels Management Coordinating Committee, I concur with the Coordinating Committee recommendation to implement the Interagency All Lands/All Hands Action Plan within the Kenai Peninsula Borough.

**USDA FOREST SERVICE  
ALASKA REGION**

/s/ Dennis E. Bschor      11/2/04  
**Dennis E. Bschor**      Date  
Regional Forester

**STATE OF ALASKA  
DIVISION OF FORESTRY**

/s/ Jeff Jahnke      4/23/04  
**Jeff Jahnke**      Date  
State Forester

**USDI FISH & WILDLIFE SERVICE  
ALASKA REGIONAL OFFICE**

/s/ Tye J. Long (for)      9/16/04  
**Rowan Gould**      Date  
Regional Director

**USDI BUREAU OF LAND MGMT.  
ANCHORAGE FIELD OFFICE**

/s/ June Bailey      7/28/04  
**June Bailey**      Date  
Manager

**USDI NATIONAL PARK SERVICE  
KENAI FJORDS NATIONAL PARK**

/s/ Peter J. Armato      10/26/04  
**Peter J. Armato**      Date  
Acting Superintendent

**KENAI PENINSULA BOROUGH**

/s/ Dale L. Bagley      6/24/04  
**Dale Bagley**      Date  
Mayor

**USDI BUREAU OF INDIAN  
AFFAIRS**

/s/ Niles Cesar      10/5/04  
**Niles Cesar**      Date  
Regional Director



## Preface

The interagency “All Lands/All Hands Action Plan” is a wildfire hazard mitigation plan intended to reduce community and individual vulnerability to wildfire hazards before they occur. The plan is designed to be a working document that will implement the National Fire Plan (NFP) 10-Year Comprehensive Strategy and Healthy Forest Restoration Act (HFRA) within Alaska's 10.25 million acre Kenai Peninsula Borough (KPB).

All Lands/All Hands is a multi-year plan which displays a 5-year implementation schedule for all participating landowners for fiscal years 2005 through 2009. Recognizing that full implementation of the plan is contingent on available funding; the 5-year schedule provides a basis for identifying what landowners in the KPB could accomplish individually and/or cumulatively on an annual basis over a 5-year period under each NFP/HFRA Goal at full funding.

The plan will be periodically updated with 20 Community Wildfire Protection Plans (CWPPs) as they are completed in 2005 and 2006, as new information becomes available, and as planned tasks and projects are accomplished by participating agencies/landowners.

## List of Interagency Planning Team Members

This plan was prepared by the following Interagency Planning Team:

Warren Oja, Team Leader	USFS Chugach National Forest, SO
Doug Newbould	USFWS, Kenai National Wildlife Refuge
Dianne Maclean	USFWS, Kenai National Wildlife Refuge
John See	State of Alaska, Division of Forestry
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Roberta Wilfong	Kenai Peninsula Borough, SBB Mitigation Office
Marvin Rude	Kenai Peninsula Borough, SBB Mitigation Office
Gary Greenberg	Kenai Peninsula Borough, SBB Mitigation Office
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Mike Stubbs	USFS Chugach National Forest, SO
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Brian Sines	USFS Chugach National Forest, SRD
Steve Heppner	Bureau of Indian Affairs
Charlie Sink	Chugachmiut

## Executive Summary

Alaska's 10.25 million acre Kenai Peninsula Borough (KPB) is in the midst of a regional spruce bark-beetle (SBB) outbreak that has resulted in extensive white (Lutz) spruce mortality on approximately 1.06 million acres. This outbreak extends beyond the KPB and over the last two decades an estimated 4 million acres of spruce in south-central Alaska have been infested. While spruce bark-beetle outbreaks are natural events and periodically occur throughout south-central Alaska, the magnitude of spruce mortality during historic episodes was typically much less (20% to 30%) than the current infestation in which mortality rates exceed 90%.

Within the Borough, 24% (253,000 acres) of the spruce mortality is located on the sparsely populated west-side of Cook Inlet, while 76% (804,500 acres) is located on the east-side of Cook Inlet on the Kenai Peninsula (KP) where most Borough residents live. This SBB outbreak has resulted in hazardous forest fuel accumulations throughout the 5 million acre Kenai Peninsula (KP). The prevalence of hazardous fuel beds along the road system where urban and rural development is concentrated is of special concern to KP residents. With an annual average of **66 wildfires** over the last 22 years, public safety concerns are justified by the KP's active wildfire history. The western half of the KP has experienced many large wildfires over the past century, including the 1947 Skilak Lake Fire (310,000 acres), 1969 Swanson River Fire (79,000 acres), 1991 Pothole Lake Fire (7,900 acres), 1996 Crooked Creek Fire (17,500 acres), 1996 Hidden Creek Fire (5,200 acres) and the 2004 Glacier Creek Fire (8,600 acres).

The risk of catastrophic wildfire is at a historic high on the Kenai Peninsula. Increasing development of residential subdivisions in rural areas adjacent to, and within beetle-killed forests, is significantly expanding the Wildland-Urban Interface (WUI) on the KP. Egress from many of these rural areas is marginal, with one and two lane, low-standard roads winding through thousands of acres of dead spruce fuels.

Most of the Borough's 51,187<sup>1</sup> residents live on the KP in approximately 26,000 residential structures. Borough tax assessments value these residential structures at \$1.7 billion dollars. When industrial and commercial structures are added, the cumulative private property valuation in the KPB is \$2.7 billion dollars. **Eighty-nine percent** of the Borough private property valuation is located in 15 community census areas with either an EXTREME or HIGH Wildfire Risk Rating.

Within the KPB, 20 community wildfire protection plan (CWPP) areas covering 1.1 million acres have been identified. There are an estimated 300,700 acres of dead spruce fuel within these CWPP areas. Cumulatively to-date, commercial and noncommercial biomass fuel reduction has reduced the dead spruce acreage on the KP by approximately 100,000 acres. Unfortunately, in January 2004, commercial biomass fuel reduction on the Kenai Peninsula ceased due to lost markets.

Recognizing that this landscape is ready for one or more significant stand replacement fires which could put many of these CWPP areas at risk, an interagency policy committee of Federal, State, local and Native land managers, called the "Kenai Forest, Wildland Fire and Fuels Management Coordinating Committee" was established in 2003.

In November 2003, the Coordinating Committee chartered the development of a collaborative, interagency, action plan to identify and prioritize fire prevention and protection, hazardous fuels,

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<sup>1</sup> KPB population was certified by the Alaska Dept. Community & Economic Development in 2002 to be 51,187 people. The 2000 U.S. Census listed the population at 49,691.

forest health and ecosystem restoration, and community assistance projects on the KP. Funding to implement these projects will be required under the National Fire Plan (NFP), the Healthy Forests Restoration Act of 2003 (HFRA), and a variety of other Federal, State, KPB, and private funding sources.

This plan, called the “All Lands/All Hands Action Plan” puts forth a bold, collaborative interagency strategy of compelling on-the-ground actions that emphasizes treatments in CWPP areas and WUI areas that lie outside CWPP area boundaries. The focus of the plan is to employ a “from the back porch out” philosophy of fuel reduction and restoration in the defensible space zone around structures and work outward from there.

Plan implementation by NFP/HFRA Goal would result in the following:

### **Goal 1 - Fire Prevention & Protection**

- Increased interagency capability for fire prevention and protection within the KPB.

### **Goal 2- Hazardous Fuel Reduction**

- Defensible space fuel reduction from “the back porch out” on 17,550 private land parcels containing structures;
- Mechanical and prescribed fire fuel reduction in the Wildland/urban interface (WUI) and outside the WUI on about 97,000 acres;
- Mechanical fuel reduction adjacent to 641 miles of power lines;
- Mechanical fuel reduction adjacent to 222 miles of highway/road evacuation routes.
- Construction of 2 strategic fuel breaks on the west side of the Kenai Peninsula. The Tustumena West Fuel Break would be designed to prevent a wildland fire from getting around the west end of Tustumena Lake and the Crooked Creek-Caribou Hills Fuel Break would be designed to create a buffer between the south end of the Kenai Wildlife Refuge and the adjacent WUI.

### **Goal 3 - Forest Ecosystem Restoration**

- Restoration of forest cover on about 199,000 acres

### **Goal 4 - Community Assistance**

- Collaborative development of 20 Community Wildfire Protection Plans (CWPPs) in the KPB as per direction from the HFRA.

Total estimated cost of plan implementation is about **\$247.3 million dollars** or about **\$49.5 million dollars per year** over a 5-year implementation schedule.

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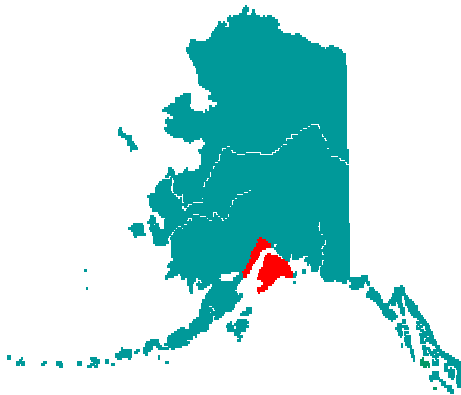
# All Lands/All Hands Action Plan for Alaska's Kenai Peninsula Borough

## 1.0 INTRODUCTION

### 1.1. Background

Alaska's 10.25 million acre Kenai Peninsula Borough (**KPB**) (Map 1.1) is in the midst of a regional spruce bark-beetle, *Dendroctonus rufipennis*, (**SBB**) infestation that has resulted in extensive spruce tree mortality on approximately 1.06 million acres. The **KPB** is home to several species of spruce trees including white spruce (*Picea glauca*), Sitka spruce (*P. sitchensis*), the hybrid Lutz spruce (*P. x lutzii*), and black spruce (*P. mariana*), all of which have been affected by the SBB infestation. This insect outbreak extends beyond the **KPB** and over the last two decades an estimated 4 million acres of spruce in south-central Alaska (Map 1.2) have been infested.

**Map 1.1 – KPB Location Map**



**Map 1.2 – Alaska Regions Map**



While spruce bark-beetle outbreaks are natural events and periodically occur throughout south-central Alaska, the magnitude of spruce mortality during historic episodes was typically much less (20% to 30%) than the current infestation in which mortality rates exceed 90%. Although SBB populations peaked in 1996 and then began to decline, active pockets of SBB activity within the KPB continue to kill thousands of additional spruce trees every year.

Within the KPB, 24% (253,000 acres) of the spruce mortality is located on the 5.0 million acre, sparsely populated land mass on the west-side of Cook Inlet, while 76% (804,500 acres) is located east of Cook Inlet on the 5.0 million acre Kenai Peninsula (**KP**) where most of the KPB's 51,187<sup>2</sup> residents live in approximately 26,000 residential structures. KPB tax assessments value these residential structures at \$1.7 billion dollars. When industrial and commercial structures are added, the cumulative private property valuation in the KPB is \$2.7 billion dollars. **Eighty-nine**

<sup>2</sup> KPB population was certified by the Alaska Dept. Community & Economic Development in 2002 to be 51,187 people. The 2000 U.S. Census listed the population at 49,691.

**percent** of the KPB private property valuation is located in 15 community census areas with either an EXTREME or HIGH Wildfire Risk Rating.

The risk of catastrophic wildfire is at a historic high in South-central Alaska, and especially the Kenai Peninsula. The intensive development of residential subdivisions in rural areas adjacent to, and within beetle-killed forests, is expanding the wildland-urban interface (WUI). Egress from many of these rural areas is marginal, with one and two lane, low-standard roads winding through thousands of acres of spruce mortality. With an annual average of **66 wildland fires** over the last 22 years, public safety concerns are justified by the KP's active wildfire history. The western half of the KP has experienced many large wildfires over the past century, including the:

1947 Skilak Lake Fire	310,000 acres,
1969 Swanson River Fire	79,000 acres,
1991 Pothole Lake Fire	7,900 acres,
1996 Crooked Creek Fire	17,500 acres,
1996 Hidden Creek Fire	5,200 acres,
2004 Glacier Creek Fire	8,600 acres.

Recognizing that the Kenai Peninsula landscape is ready for one or more significant stand replacement fires which could put many of the Borough's 41 communities at risk, an interagency policy committee of Federal, State, local and Native land managers, called the "Kenai Forest, Wildland Fire and Fuels Management Coordinating Committee"<sup>3</sup> was established in 2003. In November 2003, the Coordinating Committee chartered the development of a collaborative, interagency, multi-year action plan that will focus implementation of the National Fire Plan in the KPB and utilize the new authorities of the Healthy Forest Restoration Act. This collaborative plan is called the "All Lands/All Hands Action Plan".

## **1.2 Purpose of the "All Lands/All Hands" Action Plan**

The All Lands/All Hands Action Plan is a collaboratively developed, interagency multi-year action plan that will implement mitigation tasks and/or projects under the National Fire Plan (NFP) and Healthy Forest Restoration Act (HFRA) within Alaska's 10.25 million acre Kenai Peninsula Borough.

This action plan is based on the most current fuel hazard and wildfire risk assessment (see Appendix A) and Wildland Fire Protection Capability (see Appendix B) within the Borough. The purpose of the action plan is to mitigate community and individual vulnerability to wildfire hazards before they occur and restore forest health and ecosystems within the 1.06 million acres of spruce forest killed by SBB over the last two decades in the Borough.

The plan puts forth a bold, collaborative interagency strategy of first developing community wildfire protection plans (CWPPs) for 20 community census areas<sup>4</sup> in the KPB (see Appendix C)

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<sup>3</sup> In FY 2003, an interagency committee called the "Kenai Forest, Wildland Fire and Fuels Management Coordinating Committee" was established. This group is made up of Federal, State, local and Native entities. Its purpose is to collaborate and coordinate on both strategic and project level planning with respect to forest, wildland fire, fuels management, and community assistance activities by all landowners on the Kenai Peninsula. An interagency Memorandum of Understanding (MOU) formally establishing the committee and its charter is scheduled for completion by March 2004.

<sup>4</sup> For Community Wildfire Protection Plan purposes, the Borough's 41 communities have been consolidated into 20 CWPP areas based on the 2000 U.S. Census Area boundaries. This was based on National direction contained in the June 27, 2003, National Association of State Foresters, Field Guidance for Identifying and Prioritizing Communities at Risk.

and then implementing compelling on-the-ground, prioritized actions/projects (see Appendix E) within the KPB in:

1. fire prevention and protection,
2. hazardous fuels reduction,
3. forest health & ecosystem restoration, and
4. community assistance.

The underlying focus of the plan is to employ a “from the back porch out” philosophy of fuel reduction and restoration in the defensible space zone around structures and communities in the wildland-urban interface (WUI) and work outward from there into areas outside the WUI.

### **1.3 Plan Organization**

Information in the All Lands/All Hands Action Plan is organized into the following sections:

	Executive Summary
	List of Maps
	List of Tables
	List of Figures
	List of Photos
1.0	Introduction
2.0	Action Plan Goals, Principles, Actions, Outcomes, Performance Measures, & Implementation Tasks
3.0	All Lands/All Hands Multi-Year Project Implementation Schedule, Outputs, and Costs
Appendix A	Fuel Hazard and Wildfire Risk Assessment
Appendix B	Wildland Fire Protection Capability
Appendix C	Community Wildfire Protection Plans
Appendix D	Literature Cited
Appendix E	Individual Agency/Landowner 5-Year Project Implementation Plans

### **1.4 Collaboration**

Collaborating participants involved in development of the “All Lands/All Hands” plan include the following land management agencies and/or land owners:

- USDI, Fish & Wildlife Service, Kenai Wildlife Refuge
- USDI, National Park Service, Kenai Fjords National Park
- USDI, Bureau of Land Management (BLM)
- USDI, Bureau of Indian Affairs (BIA)
- USDA, Forest Service, State & Private Forestry
- USDA, Forest Service, Chugach National Forest
- State of Alaska, Division of Forestry
- State of Alaska, Division of State Parks, Kenai Area
- State of Alaska, Alaska Mental Health Trust Authority
- Kenai Peninsula Borough, SBB Mitigation Office
- Chugachmiut



## 1.5 Relationship to Other Plans

The “All Lands/All Hands” plan builds on the implementation successes of the June 30, 1998 KPB SBB task force action plan titled, "*An Action Plan for Rehabilitation in response to Alaska's Spruce Bark Beetle Infestation.*"; the USDA-Forest Service Chugach National Forest Kenai Peninsula SBB Management Strategies & Five Year Action Plan (1999-2004), and the State of Alaska, Division of Forestry's Western Kenai Peninsula Strategic Forest Health Plan.

The “All Lands/All Hands” plan tiers to the USDA-Forest Service Chugach National Forest Land Management Plan (2002), the USDI-Fish & Wildlife Service Kenai Wildlife Refuge Management Plan and FEMA's<sup>5</sup> All-Hazard Mitigation Plan for the KPB.

The Interagency All Lands/All Hands Action Plan is designed to be a working document that will implement the National Fire Plan (NFP) and the Healthy Forest Restoration Act (HFRA) within Alaska's KPB.

### 1.5.1 National Fire Plan (NFP)

The National Fire Plan was developed in August 2000, following a landmark wildland fire season, with the intent of actively responding to severe wildland fires and their impacts to communities while ensuring sufficient firefighting capacity for the future.

The All Lands/All Hands Planning Team incorporated the NFP 10-Year Comprehensive Strategy titled “A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment” dated August 2001 and its associated Implementation Plan dated May 2002, for use by all participating landowners in addressing wildland fire risks on all lands on the KP and within the KPB.

#### 1.5.1.1 Goals and Guiding Principals of the NFP 10-Year Comprehensive Strategy

The four goals of the NFP 10-Year Comprehensive Strategy are:

1. Improve Fire Prevention and Protection
2. Reduce Hazardous Fuels from the “back porch out”.
3. Restore Desired Ecosystems
4. Promote Community Assistance

Its three guiding principles are:

1. Emphasize community and watershed protection.
2. Collaborate with governments and broadly representative stakeholders.
3. Establish performance measures and monitor results.

The 10-Year Strategy identifies a number of actions for each goal. The Implementation Plan establishes a collaborative, performance-based framework for achieving these goals and actions with performance measures and tasks to identify key benchmarks and track progress over time.

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<sup>5</sup> Federal Emergency Management Agency

### **1.5.1.2 Communities and the Wildland-Urban Interface (WUI)**

The wildland-urban interface (WUI) is commonly described as the zone where structures and other human development meet and intermingle with undeveloped wildland or vegetative fuels.

The WUI zone poses tremendous risks to life, property and infrastructure and is one of the most dangerous and complicated situations faced by firefighters.

Both the National Fire Plan 10-Year Comprehensive Strategy for Reducing Wildland Fire Risks to Communities and the Environment and HFRA place a priority on working collaboratively with communities in the WUI to reduce their risk from large-scale wildfire.

### **1.5.2 Healthy Forest Restoration Act of 2003 (HFRA)**

The Healthy Forest Restoration Act of 2003 provides government agencies, organizations and communities with new tools and a fresh opportunity to address the fuels issue. The HFRA represents the legislative component of the Healthy Forests Initiative, introduced by President Bush in January 2003.<sup>6</sup> Congress passed the HFRA on November 21, 2003 and the President signed the bill into law on December 3<sup>rd</sup>.

Title I of the HFRA authorizes the Secretaries of Agriculture and Interior to expedite the development and implementation of hazardous fuel reduction projects on federal land managed by the U.S. Forest Service or Bureau of Land Management when certain conditions are met.

Priority areas for use of expedited authorities include the wildland-urban interface, municipal watersheds, areas impacted by wind throw or insect and disease epidemics, and critical wildlife habitat that would be negatively impacted by catastrophic wildfire.

The Act emphasizes the need for federal agencies to work collaboratively with communities in developing hazardous fuel reduction projects and places priority on treatment areas identified by communities themselves in a Community Wildfire Protection Plan.

## **1.6 Scheduled Plan Updates**

The Interagency All Lands/All Hands Action Plan is designed to be a working document covering the Federal Fiscal Years<sup>7</sup> of 2005 through 2009. Scheduled plan updates would occur every 5 years.

Initially, the plan will be updated with each of the 20 Community Wildfire Protection Plans (CWPPs) as they are completed during 2005 and 2006. The plan may also be updated as new information becomes available and as planned tasks and projects are accomplished by participating agencies/landowners.

Each updated version of the plan will have the version date at the bottom of each page in the plan. The most current version of the All Lands/All Hands Action Plan will be posted on the Kenai Peninsula Borough's web site at: [www.borough.kenai.ak.us/SBB/all-lands/](http://www.borough.kenai.ak.us/SBB/all-lands/)

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<sup>6</sup> The full text of the Act is available at <http://thomas.loc.gov/>. Type HR 1904 in the Bill Number box and then select the *enrolled* bill from the list of options.

<sup>7</sup> A Federal Fiscal Year is October 1 to September 30

## 2.0 ACTION PLAN GOALS, PRINCIPLES, ACTIONS, OUTCOMES, PERFORMANCE MEASURES, & IMPLEMENTATION TASKS



Photo 2.1 – Mansfield Fire, Kenai Peninsula, June 1999.

### 2.1 GOAL 1 – Improve Fire Prevention and Protection

#### 2.1.1 Guiding Principles:

1. **Firefighting Readiness** – Public and firefighter safety is the first priority in all fire management.
2. **Prevention Through Education** – Reduce the risks to homes and private property through prevention education.

#### 2.1.2. Actions:

1. Improve Federal State, and local firefighting resource capability and readiness to protect communities and the environment from wildland fires.
2. Reduce the incidence of injury to life and property resulting from catastrophic wildland fires.
3. Expand outreach and education to homeowners and communities about fire prevention through use of programs such as “Firewise.”
4. Develop a consistent preparedness planning model, among the Federal agencies and others, that analyzes cost-effective fire protection across all

administrative boundaries. In developing the model, consider State and local protection needs and resources in the wildland-urban interface.

**2.1.3 Implementation Outcome:** Firefighter injuries and loss of life is minimized or eliminated and damage to communities and the environment from severe, unplanned and unwanted wildland fire is reduced.

**2.1.4. Performance Measures:**

1. Amount of time lost from firefighter injury in proportion to number of days worked across all agencies;
2. Number of acres burned by unplanned and unwanted wildland fire;
3. Percent of unplanned and unwanted wildland fires controlled during initial attack;
4. Number of homes and significant structures lost as a result of wildland fire;
5. Average gross cost per acre for suppression and emergency stabilization and rehabilitation by size class and fire regime for fires:
  1. Contained within initial attack
  2. Escaping initial attack
  3. Within WUI areas
  4. Outside WUI areas
  5. In areas with compliant fire management plans
  6. In areas without compliant fire management plans

**2.1.5. Implementation Tasks:**

1. Update and implement the Alaska Wildland Fire Management Plan with an emphasis on cost-effective fire protection across all administrative boundaries. The update should focus on local protection needs and resources in Community Wildfire Protection Plan (CWPP) areas and the Wildland Urban Interface (WUI) and be based on the most current wildfire risk assessment.

**Collaboration Level:** All levels

**Lead Collaborator:** AWFCG<sup>8</sup>

**Implementation Timeframe:** March 1, annually

2. Improve fire suppression decision-making training for line officers, fire suppression managers, and responsible officials (including communication with local jurisdictional agency representatives regarding the outcomes of their decisions, risks, and placement of firefighter resources, suppression strategies, and costs).

**Collaboration Level:** All levels

**Lead Collaborator:** JFSP, NWCG, AWFCG<sup>4</sup>

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<sup>8</sup>

AWFCG – Alaska Wildland Fire Coordinating Group

JFSP – Joint Fire Sciences Program

NWCG – National Wildfire Coordinating Group

USFS – U.S. Forest Service

KPB – Kenai Peninsula Borough

DOF – State Division of Forestry

KPB SPP Mitigation Office – Kenai Peninsula Borough Spruce Bark Beetle Mitigation Office

BLM – Bureau of Land Management

BIA – Bureau of Indian Affairs

USFWS – U.S. Fish & Wildlife Service

USFS-S&PF – U.S. Forest Service State & Private Forestry

**Implementation Timeframe:** Annually

3. During annual updates of cooperative fire protection agreements, assess the training, equipment, safety awareness, and services provided by rural, volunteer, and other firefighters that work in the Wildland Urban Interface and report those findings to agency administrators and the Borough.

**Collaboration Level:** All levels

**Lead Collaborator:** USFS, DOF, KPB

**Implementation Timeframe:** Annually prior to May 1

4. Implement assessment report findings by providing training in wildfire suppression and safety in the Wildland Urban Interface and address identified equipment shortages as funds become available.

**Collaboration Level:** All levels

**Lead Collaborator:** USFS, DOF, KPB

**Implementation Timeframe:** Annually prior to November 1

5. Identify appropriate agency and land management representatives and prepare training information on the use of minimum impact suppression activities and deliver through standard firefighting training programs.

**Collaboration Level:** All levels

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** Annually prior to May 1

6. Develop and distribute an interagency fire prevention plan detailing prevention messages and materials for Wildland Urban Interface communities that includes strategies for training and technology transfer.

**Collaboration Level:** All levels

**Lead Collaborator:** USFS, DOF, USFWS

**Implementation Timeframe:** 2004

7. Compile reports of communities in the Wildland Urban Interface (WUI) protected as a direct result of suppressed wildland fire.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** Annually





**Photo 2.2 - Fuller Mechanical Fuel Reduction (Mastication) Project (north of the Russian River Ferry in Cooper Landing, Alaska, October 2003)**

## **2.2 GOAL 2 – Reduce Hazardous Fuels**

### **2.2.1 Guiding Principles:**

1. **Hazardous Fuels Reduction** – Prioritize hazardous fuels reduction where the negative impacts of wildland fire are greatest.

### **2.2.2. Actions:**

1. Reduce the total number of acres at risk to severe wildland fire.
2. Evaluate community risk factors to ensure communities most at risk in the wildland-urban interface receive priority for hazardous fuels treatment.
3. Expand and improve integration of the hazardous fuels management program to reduce severe wildland fires to protect communities and the environment.
4. Incorporate public health and environmental/ecological considerations in fire management activities undertaken for the hazardous fuels management program.
5. Develop smoke management plans in conjunction with prescribed fire planning and implementation.



6. Develop strategies to address fire-prone ecosystems like black spruce that increases fire risk or threatens sustainability of these areas.
7. Assure maintenance of areas improved by fuels treatment by managing activities permitted on the restored lands to maintain their resiliency.
8. Conduct and utilize research to support the reduction of hazardous fuels in wildland-urban interface communities and environments.
9. Ensure local environmental conditions (e.g., stream crossings, riparian buffers, wetlands, soils, etc.) are factored into hazardous fuels treatment planning.

**2.2.3 Implementation Outcome:** Hazardous fuels are treated, using appropriate tools and with an interagency priority of focusing treatments **“from the back porch out”** near structures susceptible to wildland fire, to reduce the risk of unplanned and unwanted wildland fire to communities and to the environment.

#### **2.2.4. Performance Measures:**

Number of acres treated that are:

1. In the wildland urban interface (WUI) or
2. Outside the WUI and are identified as high priority through collaboration consistent with the Implementation Plan, in total, and as a percent of all acres treated.

#### **2.2.5. Implementation Tasks**

1. Develop a collaborative, interagency action plan that incorporates the objectives and priorities established through the 10-Year Strategy and determine a schedule for implementation.

**Collaboration Level:** All

**Lead Collaborator:** USFS

**Implementation Timeframe:** April 2004

2. Create complete vegetation type, fuel hazard, infrastructure (roads, bridges, gas wells, power lines, etc.), fire occurrence, fire history, watershed, stream, and structures polygon and/or point GIS map layers for all lands within the Kenai Peninsula Borough.

**Collaboration Level:** All

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** Initiate 2004, ongoing after that.

3. Create and maintain an “All Lands/All Hands” digital GIS “treatment” map coverage in ARC-INFO format for all planned and accomplished projects with related project attribute data for all participating landowners within the KPB.

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** Initiate 2004, ongoing after that.

4. Utilize the National Fire Plan Operations & Reporting System (NFPORS) data base to enter, track and report planned and accomplished projects in the KPB. This is currently a federal data base and non-federal agencies do not have access to it. Obtain access for the State of Alaska and the KPB.

**Collaboration Level:** All

**Lead Collaborator:** USFS- S&PF

**Implementation Timeframe:** Obtain access for State, KPB by June 2004  
Update NFPORS Quarterly

5. Prepare material and establish an Internet-based information system, identifying Federal, State, local, and private, and funding opportunities through grants, cooperative agreements, and other assistance mechanisms. The web site should include information for non-federal landowners about programs that provide assistance and incentives to maintain low-risk fuel conditions. Utilize the KPB website with appropriate links.

**Collaboration Level:** All

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** June 2004

6. Develop and implement a process for Federal, State, Borough, Tribal, and local governments to collaborate on the annual selection of fuel treatment projects within their respective jurisdictions.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** annually through the Kenai Forest,  
Wildland Fire and Fuels Management Coordinating Committee

7. Develop and train an interagency prescribed burn team that will function as an interagency resource for conducting prescribed burns and/or explore the use of contracting prescribe burn teams..

**Collaboration Level:** All

**Lead Collaborator:** USFS-S&PF

**Implementation Timeframe:** Establish in 2004; provide annual training

8. As communities complete their wildfire protection plans, incorporate their identified treatment and funding needs into the All Lands/All Hands Action Plan for the Kenai Peninsula Borough, update the KPB GIS and the NPORS data bases.

**Collaboration Level:** All

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** Initiate in 2005, ongoing after that.

9. Focus cost effective fuel management treatments in specific areas to minimize the risk of wildland fire occurrence and/or intensity, particularly in critical and full protection level areas identified in the Alaska Wildland Fire Management Plan. **Priorities for treatment include:**

1. the immediate 100 foot defensible space around structures (**back porch out**) WUI;
2. an additional 100 foot to 300 foot defensible space buffer in the WUI;
3. adjacent to infrastructure facilities:
  1. within 100 feet of utilities including substations, power lines, etc.;
  2. within 100 feet on either side of roads in the WUI;
  3. within 100 feet on either side of trails in the WUI;
  4. within 300 feet of school boundaries;
  5. within 300 feet of public use areas, i.e., campgrounds, river access points, waysides, trailheads, etc. that in the WUI;
4. legally required fuels management (timber sales) and activity fuel generating management activities (WUI and Non-WUI);

5. maintain effectiveness of existing or newly created fuel breaks and fuel reduction areas. Eliminate slash piles in fuel treatment areas as soon as possible after treatment operations cease (WUI and Non-WUI);
6. dead spruce in the census community WUI;
7. Key areas of known historical fire ignitions (WUI and Non-WUI) such as adjacent to roads;
8. Other high risk areas (WUI and Non-WUI).

**Collaboration Level:** All

**Lead Collaborator:** DOF, KPB-SBB Mitigation Office

**Implementation Timeframe:** Initiate in 2004, ongoing after that.

10. Break up large scale fuel continuity by creating two strategically important fuel breaks on the lower Kenai Peninsula. Both fuel breaks need to be about ¼ of mile wide and maintained annually as strategic fuel breaks.

1. Fuel break one, called the Tustumena West Fuel break, would extend from the west end of Tustumena Lake to Cook Inlet. The objective of this fuel break is to prevent a wildland fire from getting around the west end of Tustumena Lake and burning either north or south.
2. Fuel break two, called the Crooked Creek-Caribou Hills Fuel Break would connect the south end of the Crooked Creek Fire to State DOF fuel reduction areas and natural fire resistant vegetation types (alder stand) and extend to alpine vegetation in the Caribou Hills. The objective of this fuel break is to create a buffer between the south end of the Kenai Wildlife Refuge, which is in the process of changing the southern KWR fire protection level to limited, and the WUI.

**Collaboration Level:** All

**Lead Collaborator:** DOF, KPB-SBB Mitigation Office, CIRI

**Implementation Timeframe:** Initiate in 2005 according to funding availability and maintain effectiveness annually.

11. Develop spruce biomass volume and weight estimators. Total tree volume and weight tables based on tree diameter and total tree height for both green and dead black and white/Lutz spruce. Tables would provide green and dead cubic volume and weight (lbs) of tree boles (from a 1 foot stump to 4-inch top (diameter outside bark), stump and roots (from a 1 foot stump to and including the tree root system), tree branches, twigs, and needles (from 4 inch top (diameter outside bark) to tip of tree, and branches, twigs, and needles).

**Collaboration Level:** All

**Lead Collaborator:** USFS, PNW Research Station

**Implementation Timeframe:** October 2005



Photo 2.3 – Spruce Regeneration, Chugach National Forest

Photo 2.4 – Post fuel reduction treatment in a mixed spruce-birch stand leaving a birch overstory, Cooper Landing, June 1993

## 2.3 GOAL 3 – Restore Forest Health and Desired Ecosystems

### 2.3.1. Guiding Principles:

1. **Rehabilitation** – Prevent invasive species and restore watershed function and biological communities through short-term rehabilitation.
2. .
3. **Restoration** – Restore healthy, diverse, and resilient ecological systems to minimize uncharacteristically severe fires on a priority watershed basis through long-term restoration.
4. **Using Science and Information** – Promote the development and use of the best available science along with local and indigenous knowledge.
5. .
6. **Monitoring** – Monitor restoration and rehabilitation projects for effectiveness and share the results in order to facilitate adaptive implementation.

### 2.3.2. Actions:

1. In the short-term, perform burned area emergency stabilization and rehabilitation work to protect life and property, protect municipal watersheds, and prevent further degradation of critical cultural and natural resources.
2. In the long-term, restore burned areas and repair and improve lands unlikely to recover naturally from severe fire damage.
3. Place priority on at risk watersheds that have been damaged by wildland fire.
4. Promote the establishment of sources of native seed and other plant material.

5. Promote awareness and training in the use of minimum impact suppression activities.
6. Promote research and effective use of restoration and rehabilitation treatments.
7. Eradicate or minimize the rate of spread of invasive species that negatively impact natural fire cycles and fire-adapted ecosystems.
8. Improve the capability to decrease invasive species in burned areas through research and development.
9. Research interactions between fire, land management actions, and other disturbances, and apply lessons learned to future management decisions.

**2.3.3 Implementation Outcome:** Desired ecosystems are restored, rehabilitated and maintained, using appropriate tools, in a manner that will provide sustainable environmental, social, and economic benefits.

**2.3.4. Performance Measures:**

1. Number of acres moved to a better condition class, that were identified as high priority through collaboration consistent with the Implementation Plan, in total, and as a percent of total acres treated.
2. Percent of acres with treatments underway, completed, and monitored.
3. Number of acres in a) moved to a better condition class per million of dollars of gross investment.

**2.3.5. Implementation Tasks:**

1. Provide guidance for Federal, State, Borough, Tribal and private land managers/owners to enable rapid assessments of lands and the implementation of appropriate collaborative treatments.

**Collaboration Level:** All

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** annually

2. Provide research and develop products for restoration and rehabilitation treatments, including addressing invasive species considerations and promoting the establishment of native seed and plant material to meet needs identified at the State/regional and Tribal level.

**Collaboration Level:** All

**Lead Collaborator:** USFS, USFWS, BLM

**Implementation Timeframe:** annually

3. Develop and implement a process for Federal, State, Borough, Tribal, and local governments to collaborate on the annual selection of ecosystem restoration projects within their respective jurisdictions.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** annually through the Kenai Forest, Wildland Fire and Fuels Management Coordinating Committee

4. Focus cost effective silvicultural treatments in high human use areas to minimize public safety hazards (i.e., hazard trees), prevent or control additional SBB impacts in non-infested or lightly infested spruce stands and/or restore forest cover in those stands already moderately to heavily infested or dead. Priorities for treatment include areas meeting the following criteria:

1. WUI areas with sensitive soils;

2. anadromous stream riparian zones or public watersheds;
3. non-anadromous stream riparian zones;
4. lake riparian zones;
5. within 100 feet of roads;
6. within 100 feet of facilities;
7. within 100 feet on either side of trails;
8. WUI spruce stands;
9. important wildlife habitat;
10. spruce stands outside the WUI.

**Collaboration Level:** All

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** Initiate in 2004, ongoing after that.





**Photo 2.5 – Mansfield Fire, Kenai Peninsula, June 1999.**

## **2.4 GOAL 4 – Promote Community Assistance**

### **2.4.1. Guiding Principles:**

1. **Increase Local Capacity** – Where appropriate, stimulate local capacity to accomplish hazardous fuels reduction and rehabilitation work.
2. **Incentives** – Promote better fire prevention planning and actions in local communities through technical assistance and cost-sharing incentives.
3. **Biomass Utilization** – Employ all appropriate means to stimulate industries that can utilize small-diameter, woody material resulting from hazardous fuel reduction activities, such as for biomass electric power, pulp and paper making, and composite structural building materials.

### **2.4.2. Actions:**

1. Reduce the losses to communities and individuals from wildland fire.
2. Promote markets for traditionally underutilized wood as a value-added outlet for by-products of hazardous fuel reduction and ecosystem restoration.
3. Increase incentives for private landowners to address defensible space and fuels management needs on private property through local land use policies.

4. Promote local government initiatives to implement fire-sensitive land use planning.
5. Promote public knowledge and understanding of wildland fire, including risks and the role of fire in natural ecosystem processes.

**2.4.3 Implementation Outcome:** Communities at risk have increased capacity to prevent losses from wildland fire and the potential to seek economic opportunities resulting from treatments and services.

#### **2.4.4. Performance Measures:**

1. Percentage of at risk communities with completed and current wildfire protection plans.
2. Percentage of at risk communities that initiate volunteer and community funded efforts to reduce hazardous fuels resulting in removal of the community from the at risk list.
3. Percentage of acres treated to reduce hazardous fuels by mechanical means with by-products utilized.

#### **2.4.5. Implementation Tasks**

1. Collaboratively develop and implement Community Wildfire Protection Plans (CWPPs) for the 20 Census area communities identified in Appendix B, page B-9. The USFS will take the lead in developing CWPPs for the 5 census area communities within the boundary of the Chugach National Forest. The KPB-SBB Mitigation Office will take the lead in developing the remaining 15 census area community CWPP's.

**Collaboration Level:** All

**Lead Collaborator:** USFS – Cooper Landing, Hope/Sunrise, Summit,  
Moose Pass/Primrose, Seward  
KPB-SBB Mitigation Office – 15 remaining CWPP's

**Implementation Timeframe:** 2005, 2006

2. Develop and implement consistent and effective procedures for procurement, contracting, grants, and agreements to support interagency projects.

Explore development of one or more interagency ID/IQ (Indefinite Delivery/Indefinite Quantity) task order contracts for fire prevention, fuel reduction, restoration, and community assistance projects with supporting cost collection agreements. Federal Public Law 106-291 in the FY 2001 DOI and Related Agencies Appropriations Act authorized the use of contracts, grants, and cooperative agreements to accomplish fuels reduction, rehabilitation, etc. A model for consideration is: The State of Oregon Dept. of Forestry, the State of Washington Dept of Natural Resources, and the five federal land management agencies in the Pacific Northwest have established "A Master Cooperative Fire Protection Agreement". Each of the participating agencies can place orders with any other participating agency for emergency fire preparedness, fire prevention, fuels management, fire suppression, and related services. The terms of the agreement call for reimbursement of costs, and the state cannot earn a profit. Consequently, prices are lower than commercial contract prices, where profit and risk for fixed-price work push prices up.

**Collaboration Level:** All

**Lead Collaborator:** USFS, USFWS, DOF, KPB-SBB Mitigation Office

**Implementation Timeframe:** October 2004

3. Provide Public Education and Assistance.

**Collaboration Level:** All

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** Ongoing

4. Create an Internet-based information system to provide technical assistance and identify programs that improve and increase utilization of by-products from hazardous fuel treatments and ecosystem restoration activities.

**Collaboration Level:** All

**Lead Collaborator:** KPB-SBB Mitigation Office

**Implementation Timeframe:** Establish 2004, update annually

5. Promote FIREWISE programs in more wildland urban interface communities.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF, KPB

**Implementation Timeframe:** annually

6. Develop and adopt local land use plans and ordinances that provide for the maintenance of defensible space and fuel management on municipal and public property.

**Collaboration Level:** All

**Lead Collaborator:** KPB

**Implementation Timeframe:** annually

7. Develop and maintain an accurate prioritized list of all communities designated by the State of Alaska as being at-risk of wildland fire, including contact information.

**Collaboration Level:** All

**Lead Collaborator:** DOF

**Implementation Timeframe:** annually

8. Develop an improved technical assistance program to promote commercial uses for fuel reduction materials, such as biomass utilization for bio-energy projects.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** annually

## 2.5 MONITORING AND EVALUATION

A formal review process will be established to monitor and evaluate performance and effectiveness, suggest revisions, and make necessary adaptations to the strategy at all levels on a regular basis. Revisions will also integrate new information obtained from scientific research as well as third party review and analysis of findings.

### 2.5.1. Implementation Tasks:

1. Meet annually to discuss ALL LANDS/ALL HANDS progress and effectiveness and recommend changes as needed.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** annually

2. Develop cost effective monitoring plans to provide annual feedback on the progress and effectiveness of ALL LANDS/ALL HANDS projects and activities.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** annually

3. Monitor selected collaboratively developed ALL LANDS/ALL HANDS projects and activities to assess progress and effectiveness of planning and implementation.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** annually

4. Evaluate the effectiveness of the performance measures, 1e, 2b, and 3c under Goals 1, 2, and 3 respectively for gross investment to determine how well they capture value and adjust accordingly.

**Collaboration Level:** All

**Lead Collaborator:** USFS, DOF

**Implementation Timeframe:** annually

**Photo 2.6 – Natural Regeneration Evaluation, Bean Creek Fuel Break, Cooper Landing, Alaska June 1993**



### **3.0 ALL LANDS/ALL HANDS MULTI-YEAR PROJECT IMPLEMENTATION SCHEDULE, OUTPUTS, AND COSTS**

The All Lands/All Hands Action Plan is a multi-year plan which contains a 5-year implementation schedule for all participating agencies/landowners. Since plan implementation is dependent on federal funding under the National Fire Plan, HFRA, and/or normal federal appropriations, estimated project outputs and costs are displayed by Federal Fiscal Years 2005 through 2009. The 5-year project implementation schedule provides a basis for identifying projects that each participating agency/landowner in the KPB could accomplish individually and/or cumulatively on an annual basis over a 5-year period under each NFP/HFRA Goal at full funding. Obviously, if proposed projects are not fully funded, the individual and cumulative project outputs and costs will be less than planned.

Almost all of the proposed interagency project work over the next five years is focused in the wildland-urban interface (WUI) on the Kenai Peninsula.

#### **3.1 Individual Agency/Landowner 5-Year (FY 2005-2009) Project Implementation Schedules, Outputs, and Costs**

Section 2.0 of the Action Plan identifies Implementation Tasks that need to be completed to achieve NFP/HFRA Goals. Representatives of the participating individual agencies/landowners on the All Lands/All Hands Planning Team developed a set of projects for their respective agency/landowner that responded to each of the implementation tasks that were applicable to their organization or lands.

Each participating agency/landowner's proposed 5-year project implementation schedule is listed by NFP/HFRA Goal and includes the project name and the estimated activity/project outputs and costs by fiscal year. While projects designed to achieve fire prevention & protection and/or community assistance goals may have project costs displayed, they do not have associated acreage outputs. Individual agency/landowner 5-year project implementation schedules are located in Appendix E.

Annual and 5-Year Total Cost information for each individual agency/landowner is displayed by NFP/HFRA Goal and Fiscal Year in Table 3.1.1. Annual and 5-Year Total Fuel Reduction Outputs and Costs for each individual agency/landowner are displayed by NFP/HFRA Goal and Fiscal Year in Table 3.1.2. Annual and 5-Year Total Forest Health & Ecosystem Restoration Outputs and Costs for each individual agency/landowner are displayed by NFP/HFRA Goal 3 and Fiscal Year in Table 3.1.3.

##### **3.1.1 Individual Agency/Landowner Project Cost Assumptions for Mechanical Fuel Reduction Projects**

Prior to January 2004, the log and/or wood chip market facilitated most of the cumulative 100,000 acres in mechanical fuel reduction that has occurred in the Kenai Peninsula

**Table 3.1.1 – Estimated ALL LANDS/ALL HANDS Implementation Cost in Dollars by National Fire Plan (NFP)/Healthy Forest Restoration Act (HFRA) Goals 1-4, Fiscal Year (2005-2009), and Primary Landowner in the Kenai Peninsula Borough**

Fiscal Year	Primary Landowner	NFP GOAL 1 Improve Fire Prevention & Protection Estimated Cost	NFP/HFRA GOAL 2 Reduce Hazardous Fuels Estimated Cost	NFP/HFRA GOAL 3 Restore Forest Health & Ecosystems Estimated Cost	NFP/HFRA GOAL 4 Promote Community Assistance Estimated Cost	Implement NFP & HFRA TOTAL Estimated Cost	
2005	PVT LANDS	\$ -	\$ 3,623,400	\$ 12,776,000	\$ -	\$ 16,399,400	
	DOF	\$ 3,066,500	\$ 7,297,800	\$ 710,000	\$ 160,000	\$ 11,234,300	
	KPB	\$ 144,000	\$ 7,794,000	\$ 456,600	\$ 234,500	\$ 8,629,100	
	USFS	\$ 847,000	\$ 1,421,000	\$ 385,500	\$ 30,000	\$ 2,683,500	
	USFWS	\$ 378,000	\$ 586,500			\$ 964,500	
2005	<b>TOTAL</b>	<b>\$ 4,435,500</b>	<b>\$ 20,722,700</b>	<b>\$ 14,328,100</b>	<b>\$ 424,500</b>	<b>\$ 39,910,800</b>	
2006	PVT LANDS	\$ -	\$ 15,598,050	\$ 16,876,000	\$ -	\$ 32,474,050	
	DOF	\$ 4,351,500	\$ 9,233,000	\$ 2,794,667	\$ 480,000	\$ 16,859,167	
	KPB	\$ 144,000	\$ 3,413,350	\$ 137,560	\$ 225,000	\$ 3,919,910	
	USFS	\$ 815,100	\$ 1,480,400	\$ 1,078,500	\$ 30,000	\$ 3,404,000	
	USFWS	\$ 378,000	\$ 503,500			\$ 881,500	
2006	<b>TOTAL</b>	<b>\$ 5,688,600</b>	<b>\$ 30,228,300</b>	<b>\$ 20,886,727</b>	<b>\$ 735,000</b>	<b>\$ 57,538,627</b>	
2007	PVT LANDS	\$ -	\$ 15,598,050	\$ 16,876,000	\$ -	\$ 32,474,050	
	DOF	\$ 2,071,500	\$ 6,904,000	\$ 700,667	\$ 150,000	\$ 9,826,167	
	KPB	\$ 144,000	\$ 3,061,750	\$ 350,480	\$ 50,000	\$ 3,606,230	
	USFS	\$ 847,900	\$ 1,240,900	\$ 1,243,300	\$ 30,000	\$ 3,362,100	
	USFWS	\$ 378,000	\$ 409,000	\$ -	\$ -	\$ 787,000	
2007	<b>TOTAL</b>	<b>\$ 3,441,400</b>	<b>\$ 27,213,700</b>	<b>\$ 19,170,447</b>	<b>\$ 230,000</b>	<b>\$ 50,055,547</b>	
2008	PVT LANDS	\$ -	\$ 15,598,050	\$ 16,876,000	\$ -	\$ 32,474,050	
	DOF	\$ 2,071,500	\$ 6,904,000	\$ 94,000	\$ 70,000	\$ 9,139,500	
	KPB	\$ 144,000	\$ 3,198,950	\$ 202,400	\$ 50,000	\$ 3,595,350	
	USFS	\$ 881,700	\$ 1,510,900	\$ 1,262,310	\$ 30,000	\$ 3,684,910	
	USFWS	\$ 878,000	\$ 575,000	\$ -	\$ -	\$ 1,453,000	
2008	<b>TOTAL</b>	<b>\$ 3,975,200</b>	<b>\$ 27,786,900</b>	<b>\$ 18,434,710</b>	<b>\$ 150,000</b>	<b>\$ 50,346,810</b>	
2009	PVT LANDS	\$ -	\$ 15,598,050	\$ 16,876,000	\$ -	\$ 32,474,050	
	DOF	\$ 2,071,500	\$ 6,530,000	\$ 116,000	\$ 70,000	\$ 8,787,500	
	KPB	\$ 144,000	\$ 3,054,950	\$ 288,000	\$ 50,000	\$ 3,536,950	
	USFS	\$ 917,200	\$ 1,500,300	\$ 912,800	\$ -	\$ 3,330,300	
	USFWS	\$ 378,000	\$ 889,000	\$ -	\$ -	\$ 1,267,000	
2009	<b>TOTAL</b>	<b>\$ 3,510,700</b>	<b>\$ 27,572,300</b>	<b>\$ 18,192,800</b>	<b>\$ 120,000</b>	<b>\$ 49,395,800</b>	
2005-2009	PVT LANDS	\$ -	\$ 66,015,600	\$ 80,280,000	\$ -	\$ 146,295,600	59%
	DOF	\$ 13,632,500	\$ 36,868,800	\$ 4,415,334	\$ 930,000	\$ 55,846,634	23%
	KPB	\$ 720,000	\$ 20,523,000	\$ 1,435,040	\$ 609,500	\$ 23,287,540	9%
	USFS	\$ 4,308,900	\$ 7,153,500	\$ 4,882,410	\$ 120,000	\$ 16,464,810	7%
	USFWS	\$ 2,390,000	\$ 2,963,000	\$ -	\$ -	\$ 5,353,000	2%
2005-2009	<b>TOTAL</b>	<b>\$ 21,051,400</b>	<b>\$ 133,523,900</b>	<b>\$ 91,012,784</b>	<b>\$ 1,659,500</b>	<b>\$ 247,247,584</b>	100%
% of Total		9%	54%	37%	1%	100%	% of Total

**Landowner Key**

PVT LANDS -	Private Lands
DOF -	State of Alaska Division of Forestry & State Park Lands
KPB -	Kenai Peninsula Borough Lands
USFS -	Chugach National Forest Lands
USFWS -	Kenai National Wildlife Refuge Lands



**Table 3.1.2 – Estimated ALL LANDS/ALL HANDS Implementation Outputs in Number of Structures Protected, Acres, and Power Line and Highway Miles for NFP/HFRA Goal 2 (Hazardous Fuel Reduction) by Fiscal Year (2005-2009) and Primary Landowner in the Kenai Peninsula Borough**

Fiscal Year	Primary Landowner	Goal 2 Provide Defensible Space # of Parcels with Structures	Mechanical Fuel Reduction Acres	Mechanical Fuel Break Construction Acres	Goal 2 Total Mechanical Fuel Reduction Acres	Goal 2 Prescribe Burn Fuel Reduction Acres	GOAL 2 TOTAL Mechanical & Prescribed Burn Acres	Power Line Fuel Reduction Miles	Hwy Corridor Fuel Reduction Miles	GOAL 2 TOTAL HWY & Power Line Miles
2005	PVT LANDS	3,510	-	-	-	-	-	-	-	-
	DOF	-	4,332	-	4,332	-	4,332	3	2	5
	KPB	-	3,047	2,560	5,607	-	5,607	-	40	40
	USFS	-	550	-	550	300	850	-	-	-
	USFWS	-	150	-	150	4,853	5,003	-	-	-
2005	TOTAL	3,510	8,079	2,560	10,639	5,153	15,792	3	42	45
2006	PVT LANDS	3,510	10,000	-	10,000	-	10,000	-	-	-
	DOF	-	6,055	800	6,855	-	6,855	2	5	7
	KPB	-	1,422	-	1,422	-	1,422	160	40	200
	USFS	-	613	-	613	200	813	-	-	-
	USFWS	-	-	185	185	2,700	2,885	-	-	-
2006	TOTAL	3,510	18,090	985	19,075	2,900	21,975	162	45	207
2007	PVT LANDS	3,510	10,000	-	10,000	-	10,000	-	-	-
	DOF	-	4,475	-	4,475	-	4,475	2	5	7
	KPB	-	1,139	-	1,139	-	1,139	160	40	200
	USFS	-	400	-	400	200	600	-	-	-
	USFWS	-	-	10	10	4,375	4,385	-	-	-
2007	TOTAL	3,510	16,014	10	16,024	4,575	20,599	162	45	207
2008	PVT LANDS	3,510	10,000	-	10,000	-	10,000	-	-	-
	DOF	-	4,348	-	4,348	-	4,348	4	10	14
	KPB	-	1,250	-	1,250	-	1,250	160	40	200
	USFS	-	810	-	810	200	1,010	-	-	-
	USFWS	-	-	260	260	3,400	3,660	-	-	-
2008	TOTAL	3,510	16,408	260	16,668	3,600	20,268	164	50	214
2009	PVT LANDS	3,510	10,000	-	10,000	-	10,000	-	-	-
	DOF	-	4,275	-	4,275	-	4,275	-	-	-
	KPB	-	1,250	-	1,250	-	1,250	150	40	190
	USFS	-	810	-	810	-	810	-	-	-
	USFWS	-	150	710	860	900	1,760	-	-	-
2009	TOTAL	3,510	16,485	710	17,195	900	18,095	150	40	190
2005-2009	PVT LANDS	17,550	40,000	-	40,000	-	40,000	41%	-	-
	DOF	-	23,485	800	24,285	-	24,285	25%	11	22
	KPB	-	8,108	2,560	10,668	-	10,668	11%	630	200
	USFS	-	3,183	-	3,183	900	4,083	4%	-	-
	USFWS	-	300	1,165	1,465	16,228	17,693	18%	-	-
2005-2009	TOTAL	17,550	75,076	4,525	79,601	17,128	96,729	100%	641	222
% of Total					82%	18%	100%	% of Total	74%	26%
% of Total			94%	6%	100%					100%

**Landowner Key**

PVT LANDS -	Private Lands
DOF -	State of Alaska Division of Forestry & State Park Lands
KPB -	Kenai Peninsula Borough Lands
USFS -	Chugach National Forest Lands
USFWS -	Kenai National Wildlife Refuge Lands

**Table 3.1.3 – Estimated ALL LANDS/ALL HANDS Implementation Outputs in Acres for NFP/HFRA Goal 3 (Forest Health & Desired Ecosystem Restoration) by Fiscal Year (2005-2009) and Primary Landowner in the Kenai Peninsula Borough**

Fiscal Year	Primary Landowner	GOAL 3 Mechanical Site Preparation Regen/Habitat Improvement Acres	GOAL 3 Prescribe Burn Site Preparation Regen/Habitat Improvement Acres	GOAL 3 Forest Health Insect Suppression Acres	GOAL 3 Reforestation Aerial Seeding Acres	GOAL 3 Reforestation Contract Planting Acres	GOAL 3 Total Ecosystem Restoration Acres	
2005	PVT LANDS	-	-	-	-	17,180	17,180	
	DOF	-	-	-	-	1,000	1,000	
	KPB	710	-	-	-	1,799	2,509	
	USFS	100	-	-	-	66	166	
	USFWS	-	-	-	-	-	-	
	<b>2005 TOTAL</b>	<b>810</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>20,045</b>	<b>20,855</b>	
2006	PVT LANDS	-	-	-	-	32,180	32,180	
	DOF	-	5,800	-	-	3,486	9,286	
	KPB	102	-	-	-	477	579	
	USFS	300	2,500	-	2,700	734	6,234	
	USFWS	-	-	-	-	-	-	
	<b>2006 TOTAL</b>	<b>402</b>	<b>8,300</b>	<b>-</b>	<b>2,700</b>	<b>36,877</b>	<b>48,279</b>	
2007	PVT LANDS	-	-	-	-	32,180	32,180	
	DOF	-	-	-	-	1,845	1,859	
	KPB	381	-	-	-	2,680	3,461	
	USFS	570	2,650	-	2,700	913	6,833	
	USFWS	-	-	-	-	-	-	
	<b>2007 TOTAL</b>	<b>951</b>	<b>2,650</b>	<b>-</b>	<b>2,700</b>	<b>37,618</b>	<b>44,333</b>	
2008	PVT LANDS	-	-	-	-	32,180	32,180	
	DOF	-	-	-	-	-	-	
	KPB	-	-	-	-	812	812	
	USFS	-	4,233	-	4,803	850	9,886	
	USFWS	-	-	-	-	-	-	
	<b>2008 TOTAL</b>	<b>-</b>	<b>4,233</b>	<b>-</b>	<b>4,803</b>	<b>33,842</b>	<b>42,878</b>	
2009	PVT LANDS	-	-	-	-	32,180	32,180	
	DOF	-	-	-	-	112	112	
	KPB	800	-	-	-	920	1,720	
	USFS	-	3,900	300	3,900	600	8,700	
	USFWS	-	-	-	-	-	-	
	<b>2009 TOTAL</b>	<b>800</b>	<b>3,900</b>	<b>300</b>	<b>3,900</b>	<b>33,812</b>	<b>42,712</b>	
2005-2009	PVT LANDS	-	-	-	-	145,900	145,900	73%
	DOF	-	5,800	-	-	6,443	12,243	6%
	KPB	1,993	-	-	-	6,688	8,681	4%
	USFS	970	13,283	300	14,103	3,163	31,819	16%
	USFWS	-	-	-	-	-	-	0%
	<b>2005-2009 TOTAL</b>	<b>2,963</b>	<b>19,083</b>	<b>300</b>	<b>14,103</b>	<b>162,194</b>	<b>198,643</b>	<b>100%</b>
% of Total		<b>1%</b>	<b>10%</b>	<b>0%</b>	<b>7%</b>	<b>82%</b>	<b>100%</b>	% of Total

**Landowner Key**

PVT LANDS - Private Lands  
DOF - State of Alaska Division of Forestry & State Park Lands  
KPB - Kenai Peninsula Borough Lands  
USFS - Chugach National Forest Lands  
USFWS - Kenai National Wildlife Refuge Lands

Borough between 1992 and January 2004. An example is the Kenai Peninsula Borough which was able to reduce hazardous fuels on approximately 6,000 acres of Borough land while generating gross revenues of approximately \$700,000 (approximately \$117 per acre) by selling Borough hazardous fuels to contractors who harvested the dead spruce trees for the log and/or chip markets. As discussed in Appendix A, the wood chip market in the Kenai Peninsula Borough disappeared in January 2004 and the woodchip storage and ship loading facilities on the Homer Spit have been sold and dismantled.

Until such time as a new market for SBB killed spruce emerges in the Borough that can pay for or offset the cost of mechanical fuel reduction, hazardous fuel reduction treatments by mechanical methods is estimated to cost from \$500 to \$1800 per acre depending on the project requirements. These cost estimates have been built into the 5-Year Project Implementation Schedules.

### **3.2 Cumulative Agency/Landowner 5-Year (FY 2005-2009) Project Implementation Schedule, Outputs, and Costs**

The cumulative All Lands/All Hands 5-year project implementation schedule was built by combining all of the participating agency/landowner 5-year project implementation schedules into one schedule.

Annual and 5-Year Total Cost information for each individual agency/landowner is displayed by NFP/HFRA Goal and Fiscal Year in Table 3.1.1. Annual and 5-Year Total Fuel Reduction Outputs and Costs for each individual agency/landowner are displayed by NFP/HFRA Goal and Fiscal Year in Table 3.1.2. Annual and 5-Year Total Forest Health & Ecosystem Restoration Outputs and Costs for each individual agency/landowner are displayed by NFP/HFRA Goal 3 and Fiscal Year in Table 3.1.3.

By NFP/HFRA Goal, All Lands/All Hands Action Plan implementation over FY 2005-2009 would result in the following outputs:

#### **Goal 1 - Fire Prevention & Protection**

- Increased interagency capability for fire prevention and protection within the KPB.

#### **Goal 2- Hazardous Fuel Reduction**

- Defensible space fuel reduction from “the back porch out” on 17,550 private land parcels containing structures;
- Mechanical and prescribed fire fuel reduction in the Wildland/urban interface (WUI) and outside the WUI on about 97,000 acres;
- Mechanical fuel reduction adjacent to 641 miles of power lines;
- Mechanical fuel reduction adjacent to 222 miles of highway/road evacuation routes.

- Construction of 2 strategic fuel breaks on the west side of the Kenai Peninsula. The Tustumena West Fuel Break would be designed to prevent a wildland fire from getting around the west end of Tustumena Lake and the Crooked Creek-Caribou Hills Fuel Break would be designed to create a buffer between the south end of the Kenai Wildlife Refuge and the adjacent WUI.

### **Goal 3 - Forest Health and Ecosystem Restoration**

- Forest Health and Ecosystem restoration on about 199,000 acres.

### **Goal 4 - Community Assistance**

- Collaborative development of 20 Community Wildfire Protection Plans (CWPPs) in the KPB as per direction from the HFRA.

Total 5-year estimated cost of plan implementation is about **\$247.3 million dollars** or about **\$49.5 million dollars per year** over the 5-year implementation schedule. The five year implementation cost is 9.2 percent of the total tax assessed value (\$2.7 billion) of the residential, industrial, and commercial structures in the Kenai Peninsula Borough.

# APPENDIX A

## FUEL HAZARD & WILDFIRE RISK ASSESSMENT

for the

KENAI PENINSULA BOROUGH  
ALASKA

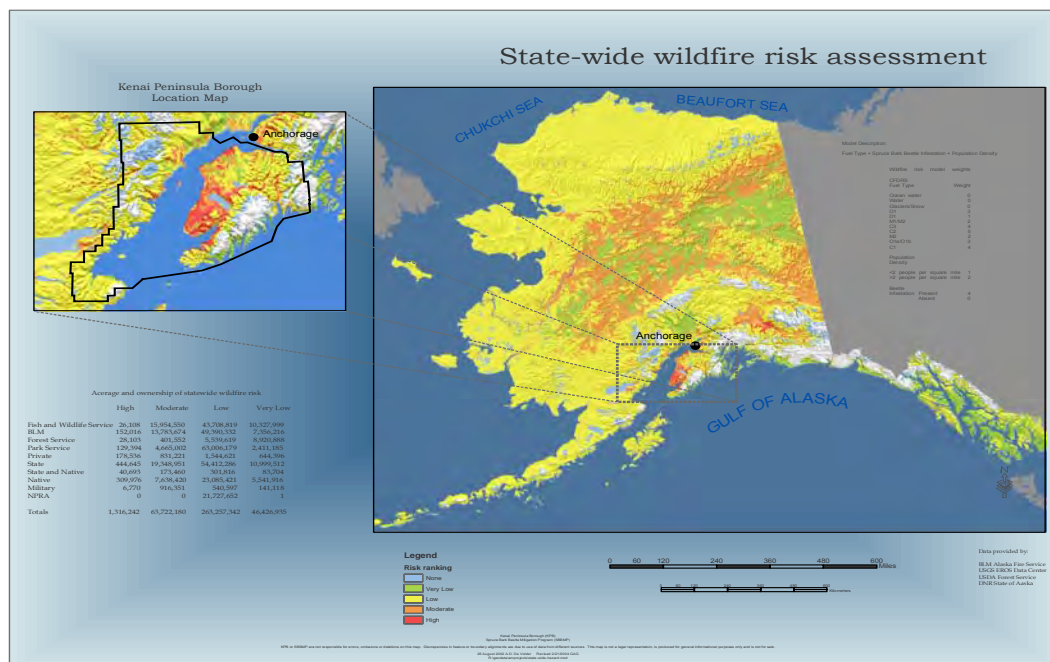
## Appendix A – Fuel Hazard and Wildfire Risk Assessment

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Alaska's 10.25 million acre Kenai Peninsula Borough (**KPB**) (Map A1) is in the midst of a regional spruce bark-beetle, *Dendroctonus rufipennis*, (**SBB**) infestation that has resulted in extensive spruce tree mortality on approximately 1.06 million acres. The **KPB** is home to several species of spruce trees including white spruce (*Picea glauca*), Sitka spruce (*P. sitchensis*), the hybrid Lutz spruce (*P. x lutzii*), and black spruce (*P. mariana*), all of which have been affected by the SBB infestation. This insect outbreak extends beyond the **KPB** and over the last two decades an estimated 4 million acres of spruce in south-central Alaska (Map A1) have been infested.

## Map A1 – State-wide Wildfire Risk Assessment Map



While spruce bark-beetle outbreaks are natural events and periodically occur throughout south-central Alaska, the magnitude of spruce mortality during historic episodes was typically much less (20% to 30%) than the current infestation in which mortality rates exceed 90%. This event has resulted in hazardous forest fuel accumulations throughout the Kenai Peninsula, but the prevalence of these hazardous fuelbeds along the road system where urban and rural development is concentrated, is of special concern to Peninsula residents.

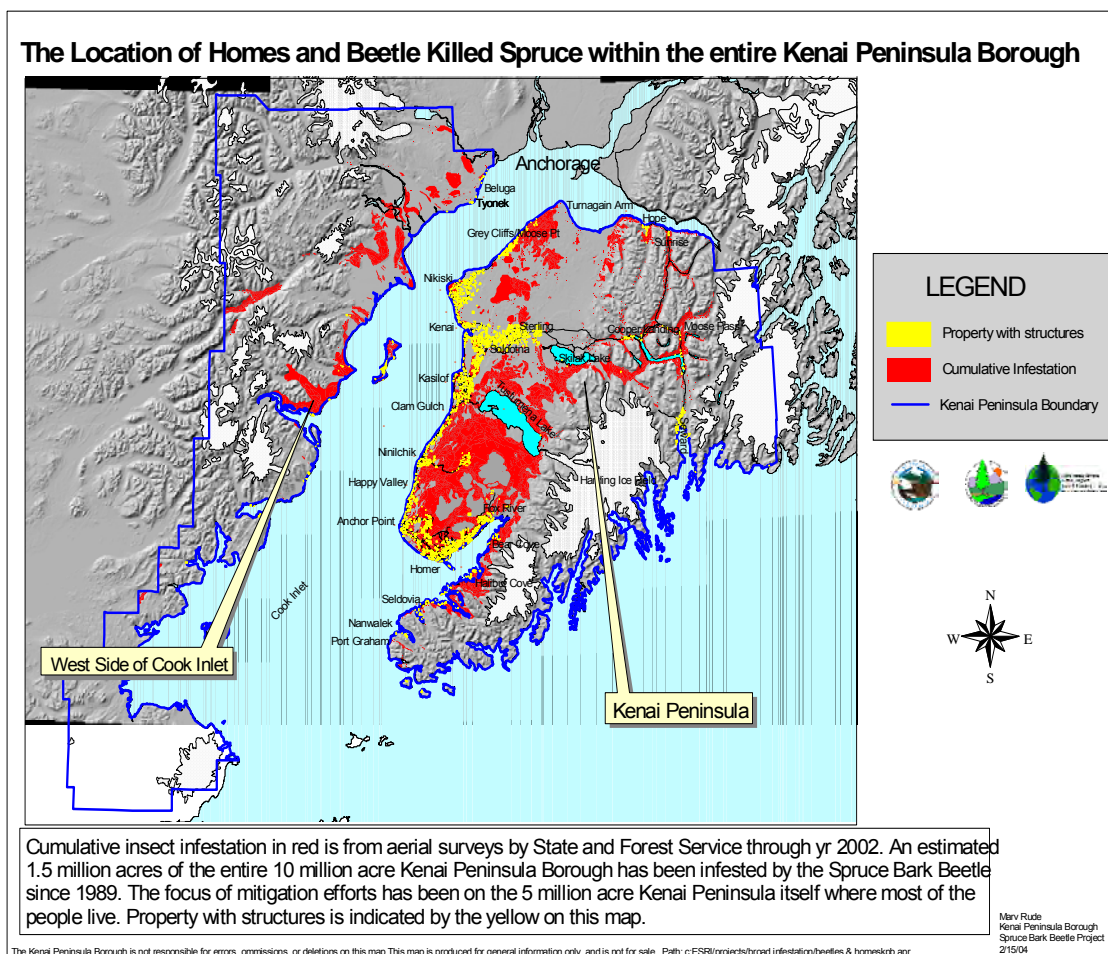
In an effort to respond to the loss of spruce forest resources and the threat of catastrophic wildfires in south-central Alaska and on the Kenai Peninsula, Congress directed the USDA Forest Service “to establish a multi-party task force to prepare an action plan to manage Spruce Beetle infestations in Alaska and rehabilitate the infested areas.” The Kenai Peninsula Borough was designated the lead agency in the Spruce Bark Beetle Task Force, and given \$500,000 to develop the action plan. On June 30, 1998, the SBB Task Force published, *An Action Plan for Rehabilitation in response to Alaska’s Spruce Bark Beetle Infestation*. With additional funding from Congress, the Borough hired a team of professionals to implement the recommended actions of the Plan. This Spruce Bark Beetle Office team, working with state and federal land managers, has subsequently completed many tasks including: development of emergency response and evacuation plans; hosting a regional Firewise (wildland fire mitigation/community action planning) workshop; completion of an urban interface wildfire hazard/risk assessment; conducting interagency emergency response training and field exercises; reducing/removing fuel hazards near public buildings, roads, power-lines and residential areas; and developing a geographic information system (GIS) database for mapping specific features of the Peninsula.

Using satellite imagery, the KPB SBB Mitigation Office has completed maps that display spruce mortality (see Map A2), fuel hazard, wildfire hazard-risk assessment, wildland-urban interface and previous treatment areas. A vegetation layer (database) that will provide a basis for a Peninsula-wide fuel type map is close to completion. These datasets cover federal, state, private and borough lands and provide a foundation on which to develop more accurate relationships between fuels, fire behavior, consumption and vegetative response. With these new tools, local land/fire managers will provide more accurate information to the Alaska Interagency Fire Control Center for regional/statewide decisions regarding the pre-positioning of suppression resources. Fire managers will be better able to verify or adjust assumptions made in risk assessments and crown fire analyses and existing public escape routes and safety zones can be evaluated more effectively.

### **VEGETATION CLASSIFICATION AND MAPPING**

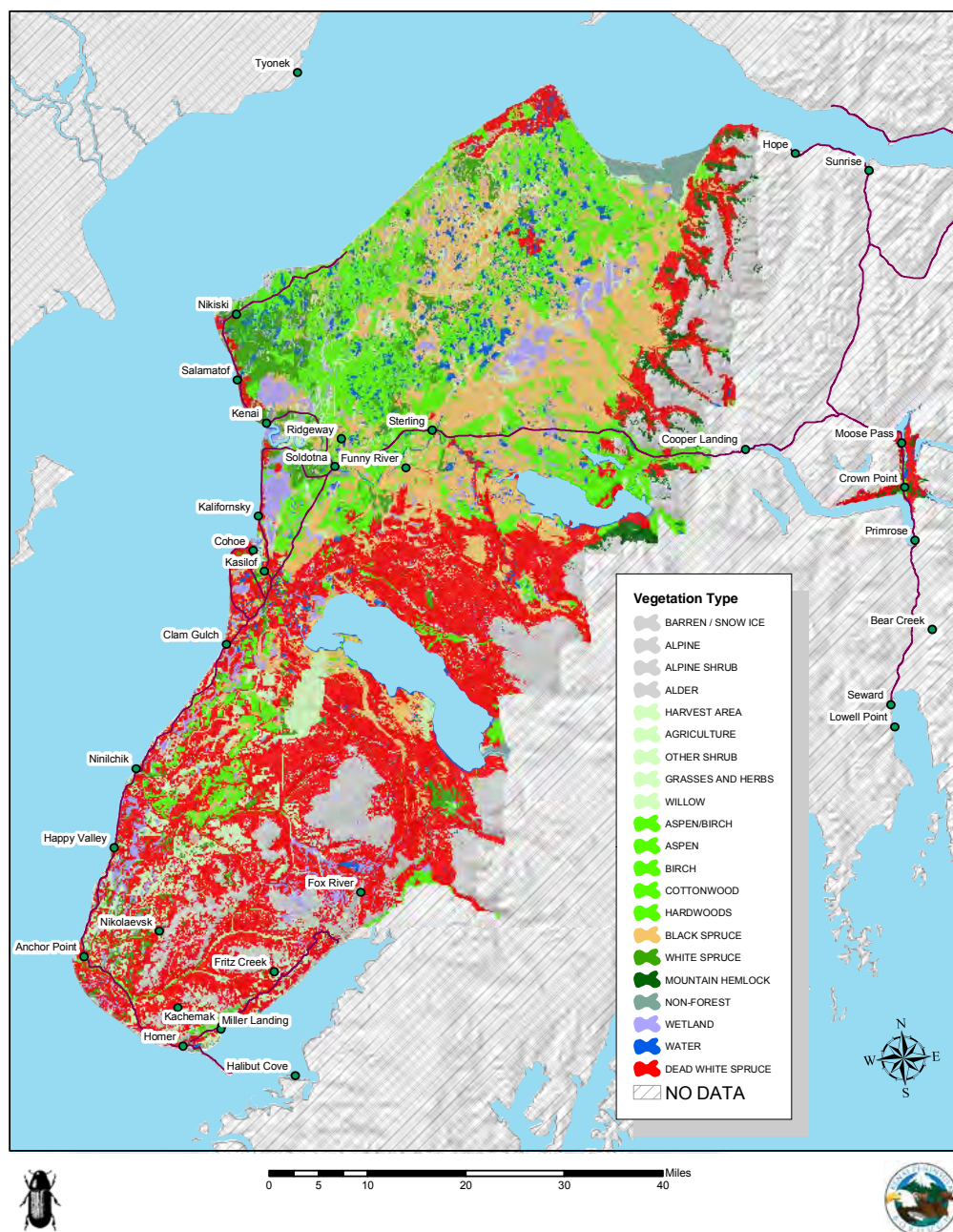
The KPB contains an estimated 1.5 million acres (see Map A2, page A5) of an estimated 4.0 million acres of spruce bark beetle (SBB) infestation mortality in the State of Alaska. These estimates are based on annual, aerial surveys conducted by the U.S. Forest Service and Alaska State Division of Forestry. Since 1999, the KPB SBB Mitigation Office in Soldotna has classified and mapped detailed stand specific vegetation and fuels down to stand sizes as small as 10 acres on 2.2 million acres of the 5.0 million acres of the KP (see Map A3, page A6). By combining the detailed stand specific mapping on 2.2 million acres of the KP with the less precise aerial survey data for the remaining 7.8 million acres in the KPB that have not yet been mapped to a stand level, the KPB SBB Mitigation Office has reduced the total estimate of SBB mortality in the KPB to 1,057,485 acres.

**Map A2 – The Location of Homes and Beetle Killed Spruce within the entire Kenai Peninsula Borough.**



**Map A3 – Stand Level Vegetation Map for 2.2 million acres on the Kenai Peninsula as of January 1, 2004**

## Vegetation Mapping January 1st 2004

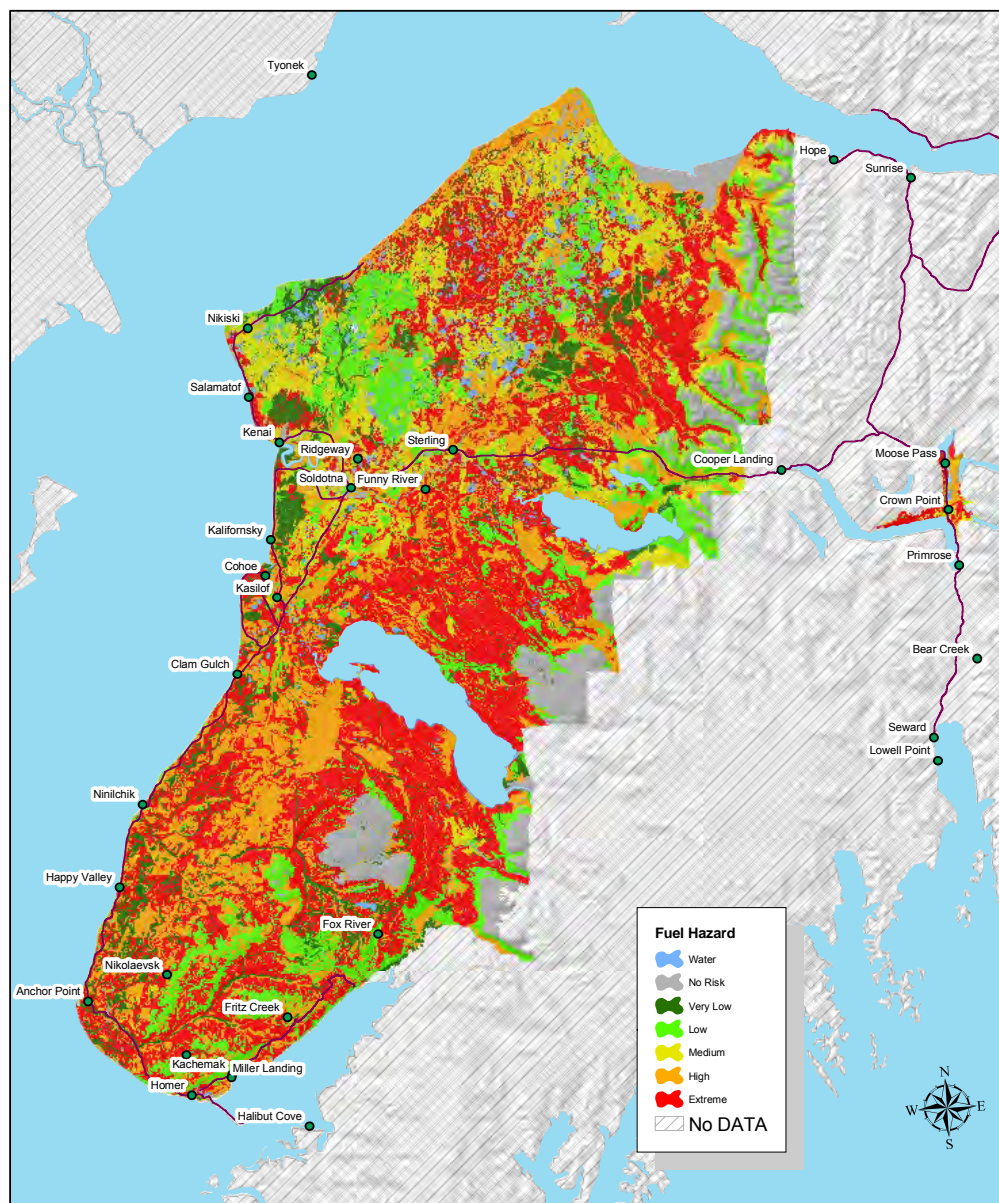




## Appendix A – Fuel Hazard and Wildfire Risk Assessment

**Map A4 – Stand Level Fuel Hazard Map for 2.2 million acres on the Kenai Peninsula as of January 1, 2004**

### Fuel Hazard January 1st 2004



## THE FIRE MANAGEMENT SITUATION

### 1. Changing Forest Fuel Hazards

The spruce beetle infestation during the 1990's resulted in the most significant ecological impact of any natural agent of change in Alaska (USDA 1996). The changes occurring in forests on the Kenai Peninsula are significant. Spruce beetles are greatly influencing the composition of forests by killing almost all spruce trees over 6 inches in diameter. In forest stands composed almost entirely of spruce trees, the effects to the forest structure caused by the bark beetle epidemic are evident. The almost total loss of mature seed bearing trees over large landscapes will have very long term and profound affects on the Kenai Peninsula.

Spruce beetle impacts begin with the attack of individual spruce trees. Although there is variation, typically, new emerging adult bark beetles infest host trees during the early summer season. The larva life cycle stage of the beetle destroys the inner bark or phloem of the tree that is vital for providing nutrients necessary for the tree's survival. By the second summer after bark beetle attack, spruce trees can no longer sustain life.

After bark beetle caused mortality, dead spruce trees begin a physiological change that occurs over time. The moisture content of the dead tree changes significantly. Foliage supported by moisture from root systems in live trees usually contains from 200 percent water content during the early summer to 120 percent during drought conditions. Tree boles of live trees usually range from 70% to 40% moisture content. This water content significantly decreases after tree mortality. Based on previous sampling of large dead tree material, it has been determined that dead spruce will reach equilibrium with environmental conditions within approximately 60 days following mortality. This material will typically have a moisture content of approximately 10%.

The loss of nutrient availability causes trees to shed needles during late winter and the remaining foliage turns red during the second summer after beetle attack. Smaller twig size branch material usually breaks off trees within a couple years after death. However, observation indicates this volume of fine size fuel material is often replaced with lichen material. *Bryoria fuscescens* (Old Man's Beard) favors dead spruce trees as a platform for lichen growth. Over time, additional branch material breaks off the tree.

As trees lose their needles and smaller branch material, an increase of direct sunlight reaches the forest floor. Surface vegetation changes with this event. Most noticeably, native blue joint reedgrass begins to dominate surface vegetation.

The boles of dead spruce trees are subject to natural decay processes such as "sap rot". The wood fiber structure changes so that tree boles loose elasticity and are not as flexible during windy conditions. A study of vegetative survey plots on the Kenai Peninsula (Holsten et. al. 1995) indicates that tree stem breakage begins to accelerate between 5-10 years after bark beetles attack forest stands.

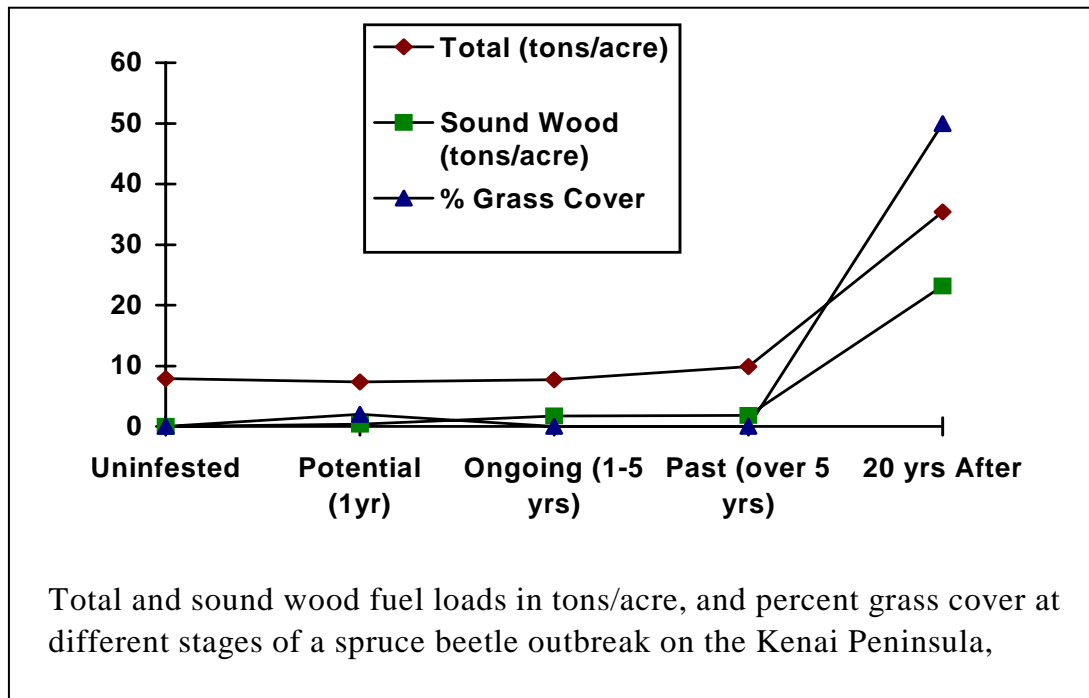
As time progresses, standing trees begin to break off and fall into one another becoming



jack-strawed as displayed in Photos A1, A2 and A3. This provides a means for surface fires to accelerate the transition to crown fires in the remaining canopy. Over time trees begin to fall to the ground where they become part of the surface fuel matrix and as years progress the regenerating forests develop over heavy concentrations of fuels. The heavy concentration of fuel mixed with this regeneration will be available for combustion for many years. In some cases in the Yukon, it has been reported that the material will be readily combustible for 50 years after it has fallen to the ground (Beaver 1997). This period will likely be shorter on the Kenai Peninsula, especially when wood is in direct contact with the ground.

Downed trees create additional surface fuel loading, which combines with the heavy grass mat to create a serious wildfire hazard. As beetle killed stands unravel, grass cover increases from near zero to over 50 percent of the ground cover (Schulz 1995) (Photo A4). Fires in this fuel type can be intense, rapidly moving, and difficult to control (See 1997). A 1994 study of a past beetle infestation showed a general tendency for increasing surface fuel loads in later stages of an infestation (Schulz 1995). This study showed an increase in woody surface fuel loading from approximately 9 tons per acre in 1987 to over 35 tons per acre in 1994; nearly a 400 percent increase (see Figure A1 below).

**Figure A1: Total and Sound Wood Fuel Loads in Tons/Acre, and Percent Grass Cover at different stages of a Spruce Beetle Outbreak on the Kenai Peninsula.**



Another case study of fire in beetle-impacted forests was conducted in 1997 (Beaver 1997). An important product generated from this study is a comparison of fire "critical

## Appendix A – Fuel Hazard and Wildfire Risk Assessment

surface intensity" (CSI). CSI is the term used to describe the amount of surface fire heat production that is necessary to generate full crown fire involvement of tree canopies. In the case of spruce forests that are alive and unaffected by bark beetles, Beaver determined that 1,704 kilowatts/meter (KW/M) of surface heat intensity is required to ignite green trees whose crown begins an average of four feet above the ground. In dead beetle kill spruce with the same crown height ratio, only 192 KW/M is required to generate crown fires.

The moisture content in live trees is supported by root systems. By comparison, the moisture content of dead trees is subject to daily changes due to changing weather conditions and long term drying in drought periods. In an average year, it is estimated that environmental conditions necessary to allow for full crown fire involvement of live spruce forests only occurs about 2 to 3 days each year. The number of days where environmental conditions are reached that will allow for crown fire in dead trees occurs with much greater frequency. It is estimated that dead spruce forests can reach crown fire involvement about 30 days/year on the average.

The spread of fire is greatly enhanced in beetle-killed spruce. The amount of dead and dry fine material, such as Old Mans Beard lichen, that is contained in standing dead trees aids spot fire occurrence. Dead material down wind of a fire creates a condition where hot embers initiate new fire starts with much greater frequency when compared to green live forests (personal observation W. Wahrenbrock, DOF).

### Fuel Hazard Classification and Mapping

Map A4 on page A7 displays the fuel hazard classification for 2.2 million acres of KP that is conducted as part of the vegetation classification and mapping program.



**Photo A1: Jack-strawed, spruce bark beetle killed trees on the Kenai Peninsula.**



**Photo A2: Fuel loads from stem breakage on State Mental Health Trust lands in Moose Pass, Alaska, June 2002.**





## Appendix A – Fuel Hazard and Wildfire Risk Assessment

**Photo A3: Fuel load from stem breakage on Chugach National Forest (north of Russian River Ferry), October 2003.**



**Photo A4: SBB killed trees mixed with dead blue-joint grass along Homer's East End Road on the Kenai Peninsula.**



**Photo taken along Homer's East End Road, April 2004**

### Ownership of Dead Spruce Fuels Location by Broad Geographic Area

Maps A5, A6, and A7 on pages A-14, A-15, and A-16 display by color code the individual land owners of dead spruce acreage in each of the three geographic areas within the KPB. Table A1 below summarizes the dead spruce acreage from all three geographic areas. The estimate of dead spruce acres in the KPB is 1,057,458 acres. Seventy six percent (804,709 acres) is found on the KP where most of the population is located while twenty-four percent (252,776 acres) is found on the sparsely populated west-side of Cook Inlet.

On the KP, about 9 percent of the total dead spruce acreage in the KPB is located on the east-side within the boundary of the Chugach National Forest and while 67 percent is located on the west-side which includes the Kenai National Wildlife Refuge.

Within the KPB, the largest percentage of dead spruce acres is on federal land (41%) followed by State land (31%). These two landowner groups account for 72 percent of the dead spruce acreage.

**Table A1 – Estimated Acres and Percentages of Dead Spruce by Geographic Area and Land Owner Group within the Kenai Peninsula Borough.**

<b>Geographic Area</b>	<b>All Federal</b>	<b>All State</b>	<b>All KPB</b>	<b>All Native</b>	<b>All Private</b>	<b>Total</b>	<b>Percent of Total Dead</b>
Eastside-Kenai Peninsula	70,953	17,440	1,369	-	3,788	93,550	9%
Westside-Kenai Peninsula	324,000	187,000	19,000	75,159	106,000	711,159	67%
<b>Subtotal Kenai Peninsula</b>	<b>394,953</b>	<b>204,440</b>	<b>20,369</b>	<b>75,159</b>	<b>109,788</b>	<b>804,709</b>	<b>76%</b>
West Side-Cook Inlet	39,981	123,250	3,788	73,420	12,337	252,776	24%
<b>Total</b>	<b>434,934</b>	<b>327,690</b>	<b>24,157</b>	<b>148,579</b>	<b>122,125</b>	<b>1,057,485</b>	<b>100%</b>
<b>Percentage of Total Dead</b>	<b>41%</b>	<b>31%</b>	<b>2%</b>	<b>14%</b>	<b>12%</b>	<b>100%</b>	

### Ownership of Dead Spruce Fuels in the WUI on the Kenai Peninsula

Map A8 on page A-17 displays who owns the 208,185 acres of dead spruce fuels that are located in the wildland-urban interface (WUI)<sup>1</sup> on the Kenai Peninsula. Table A2 displays the acres and percentages of ownership of dead spruce in the WUI-KP. The largest landowner of dead spruce in the KP-WUI is private (41%) followed by the State at (31%).

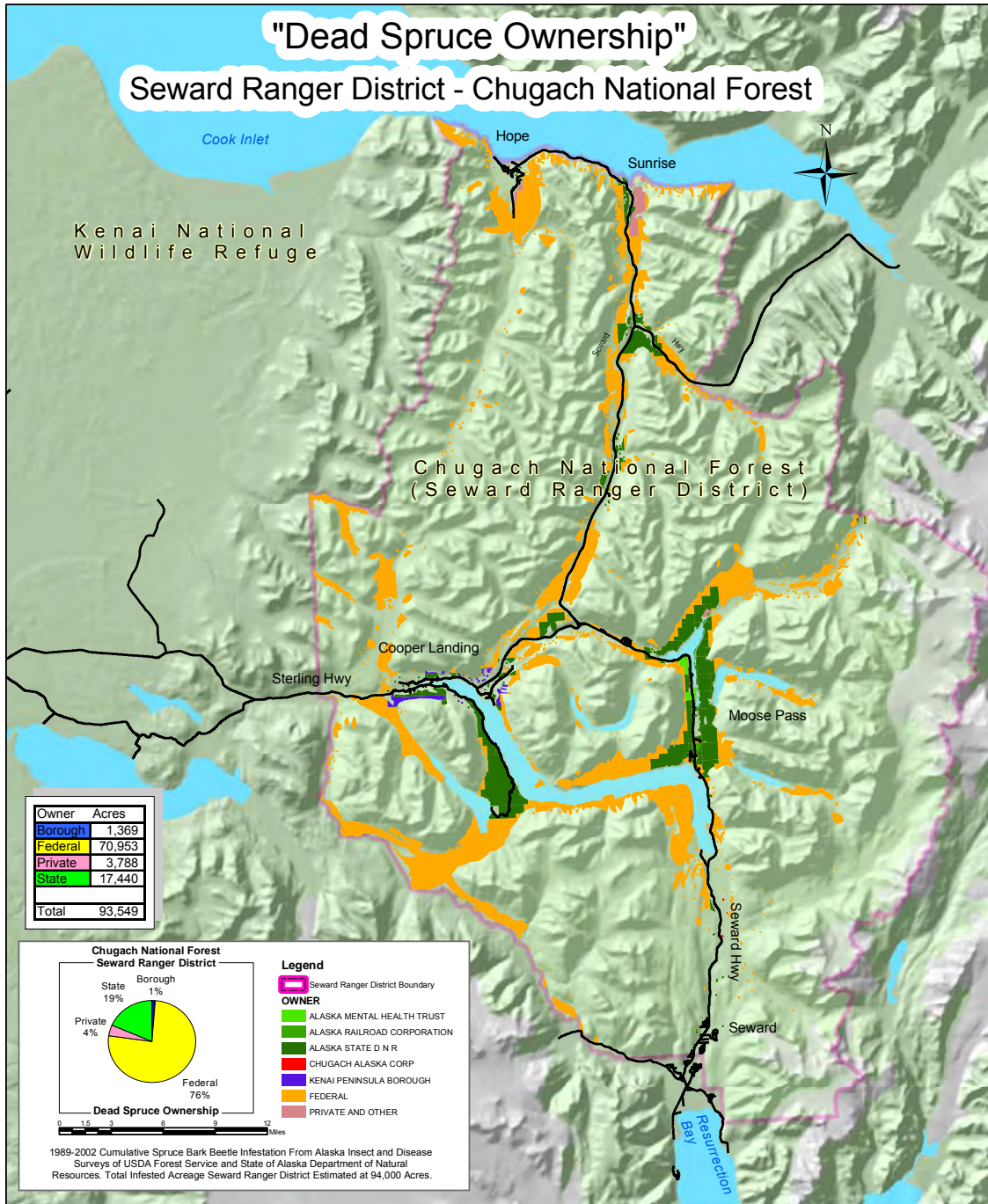
**Table A2 – Estimated Acres and Percentages of Dead Spruce in the WUI on the Kenai Peninsula by Land Owner Group.**

<b>Kenai Peninsula Wildland Urban Interface (WUI)</b>	<b>All Federal</b>	<b>All State</b>	<b>All KPB</b>	<b>All Private</b>	<b>All Native</b>	<b>Total</b>
<b>Total</b>	<b>15,964</b>	<b>64,477</b>	<b>11,201</b>	<b>86,123</b>	<b>30,420</b>	<b>208,185</b>
<b>Percentage of Total Dead</b>	<b>8%</b>	<b>31%</b>	<b>5%</b>	<b>41%</b>	<b>15%</b>	<b>100%</b>

<sup>1</sup> - The WUI on Map A8 is defined according to criteria in the Healthy Forest Restoration Act of 2003.



**Map A5 – Dead Spruce Ownership on the East Side of the Kenai Peninsula**



Kenai Peninsula Borough (KPB) - Spruce Bark Beetle Mitigation Program (SBBMP)

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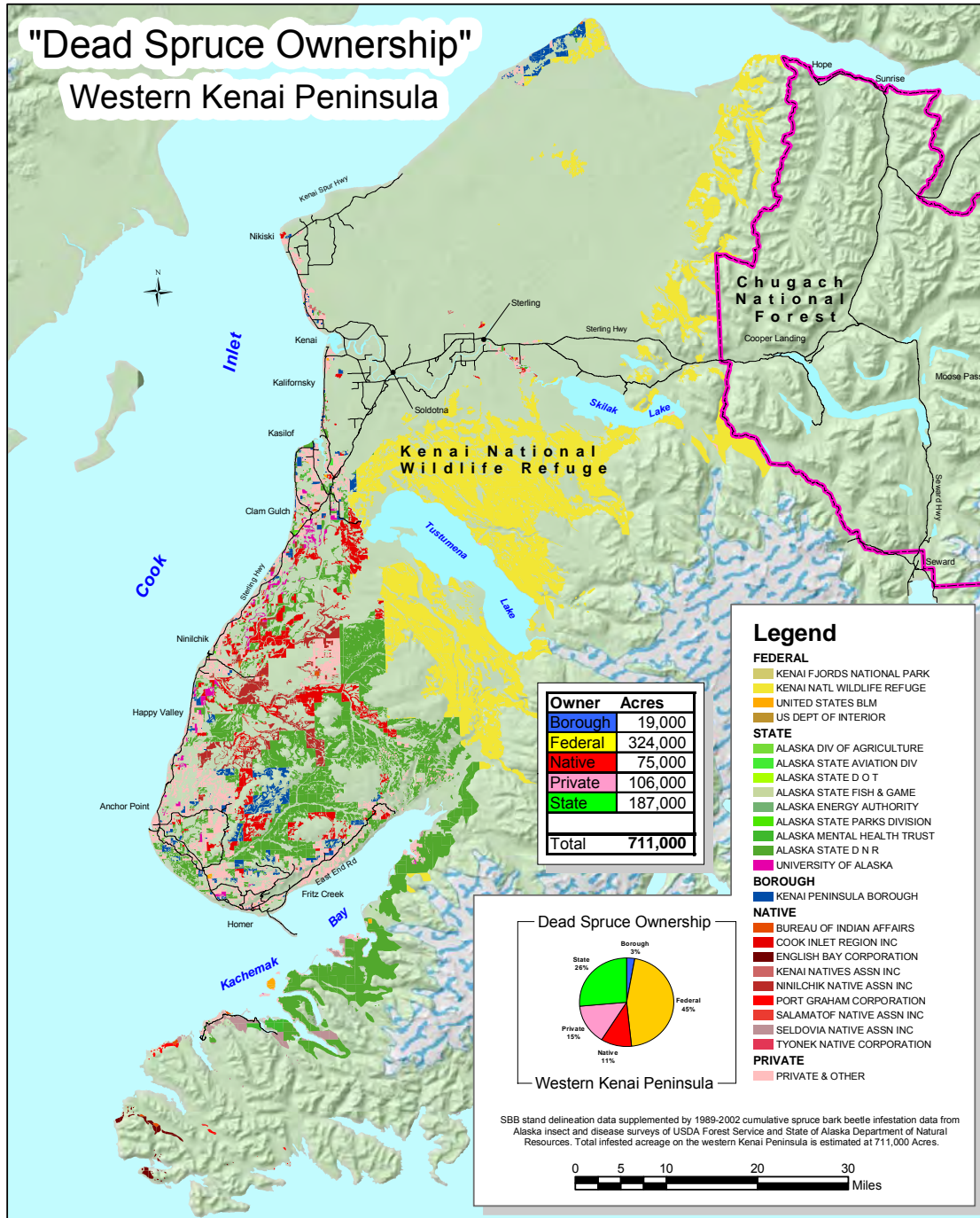
Path: M:\projects\vegetation\srld\_ownership.mxd Revision Date: 2/29/04 Revised By: Gary Greenberg & Marvin Rude



State Road Centerline information is derived from Alaska DOT GPS Centerline Survey



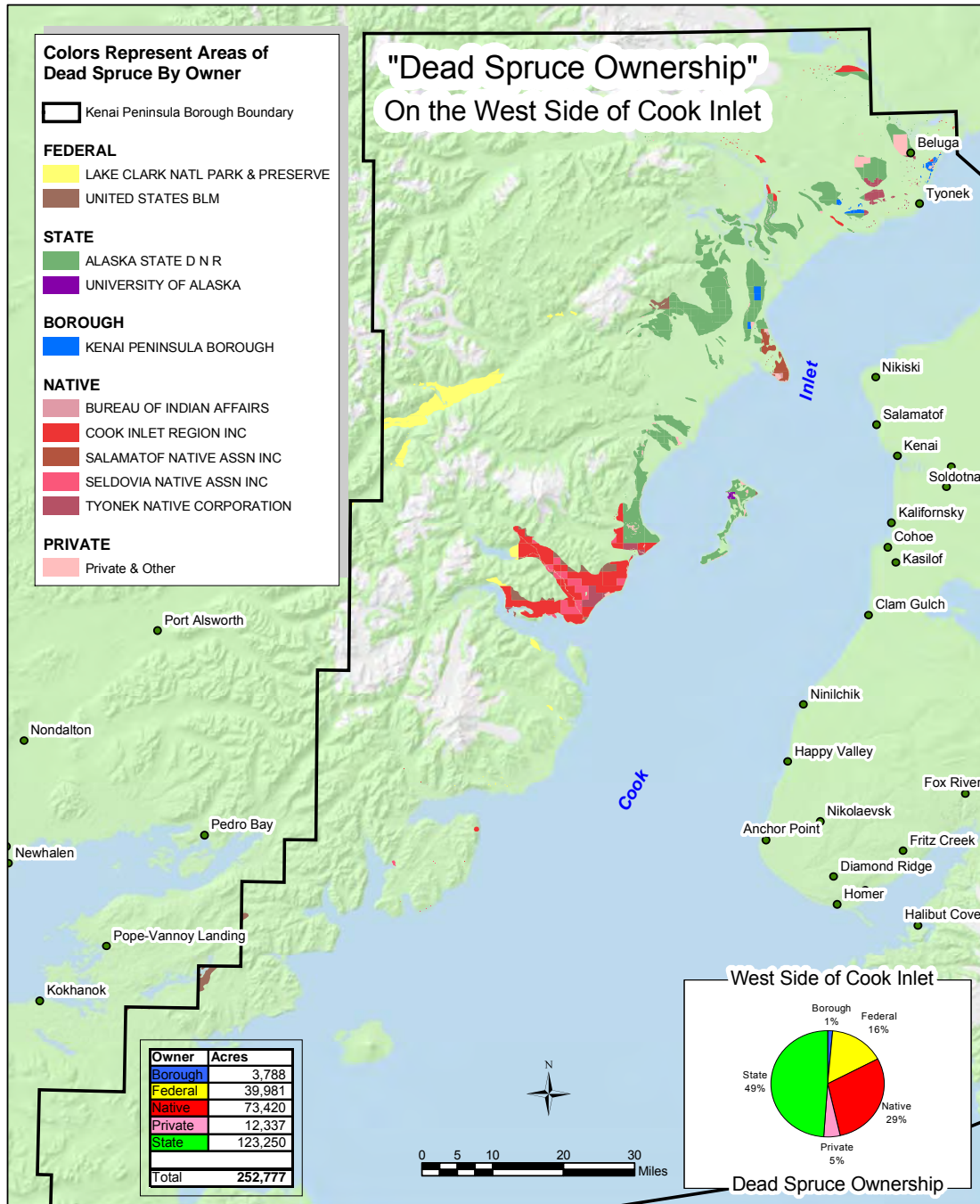
Map A6 – Dead Spruce Ownership on the West Side of the Kenai Peninsula



Kenai Peninsula Borough (KPB) - Spruce Bark Beetle Mitigation Program (SBBMP)  
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Path: M:\projects\vegetation\infest\_owner\_west.mxd Created: 6/24/03 Author: Gary Greenberg  
Revision Date: 3/2/04 Revised By: Gary Greenberg & Marvin Rude



**Map A7 – Dead Spruce Ownership on the West Side of Cook Inlet**







## Appendix A – Fuel Hazard and Wildfire Risk Assessment

Individual Land Ownership of Dead Spruce Acres in the Kenai Peninsula Borough  
Tables A1 and A2 displayed ownership of dead spruce fuels by land owner group. Table A3 displays the same ownership, but by individual land owner.

**Table A3: Acres and Percentages of Dead Spruce in WUI and Other (Non-WUI) Areas by Land Owner within the Kenai Peninsula Borough**

Kenai Peninsula Borough Landowners	Landowner WUI Dead Spruce Acres	Landowner Non-WUI Dead Spruce Acres	Landowner TOTAL DEAD SPRUCE Acres	PERCENT OF TOTAL
<b>FEDERAL</b>				
Lake Clark National Park And Preserve	0	30,000	30,000	3%
Kenai National Wildlife Refuge	3,354	322,759	326,113	31%
USDI - Bureau of Land Management	442	11,093	11,535	1%
USDA- Forest Service, Chugach National Forest	12,168	55,019	67,187	6%
SubTotal Federal	<b>15,964</b>	<b>418,871</b>	<b>434,835</b>	<b>41%</b>
<b>STATE</b>				
Alaska State Aviation Division	196	-	196	0%
Alaska State Dept of Transportation	21	-	21	0%
Alaska Dept of Fish & Game	98	-	98	0%
Alaska Energy Authority	-	707	707	0%
Alaska State Parks Division	178	-	178	0%
Alaska Mental Health Trust	1,745	724	2,469	0%
Alaska State Division of Natural Resources	56,984	261,049	318,033	30%
University of Alaska	5,255	804	6,059	1%
SubTotal State	<b>64,477</b>	<b>263,284</b>	<b>327,761</b>	<b>31%</b>
<b>BOROUGH</b>				
Kenai Peninsula Borough	11,201	12,739	23,940	2%
SubTotal Borough	<b>11,201</b>	<b>12,739</b>	<b>23,940</b>	<b>2%</b>
<b>NATIVE</b>				
USDI - Bureau of Indian Affairs	468	548	1,016	0%
Cook Inlet Region, Inc.	15,412	75,031	90,443	9%
English Bay Corporation	-	2,344	2,344	0%
Kenai Natives Assn, Inc.	317	68	385	0%
Ninilchik Native Assn., Inc.	10,676	11,492	22,168	2%
Port Graham Corporation	-	872	872	0%
Salamatof Native Assn. Inc.	119	5,168	5,287	0%
Seldovia Native Assn., Ince	3,420	13,069	16,489	2%
Tyonek Native Corporation	8	9,895	9,903	1%
SubTotal Native	<b>30,420</b>	<b>118,487</b>	<b>148,907</b>	<b>14%</b>
<b>PRIVATE</b>				
Private & Other	86,123	35,919	122,042	12%
SubTotal Private & Other	<b>86,123</b>	<b>35,919</b>	<b>122,042</b>	<b>12%</b>
<b>Total All</b>	<b>208,185</b>	<b>849,300</b>	<b>1,057,485</b>	<b>100%</b>

## Appendix A – Fuel Hazard and Wildfire Risk Assessment

### Individual Ownership of Estimated Tons of Dead Spruce Fuels in the Kenai Peninsula Borough

Table A4 displays the estimated tons of dead spruce fuel represented in spruce tree boles from a 1-foot stump to a 4-inch top. Estimates in tons have also been calculated for land owners for the amount of fuel represented in tops, limbs, foliage, stumps, and tree roots. Based on using average values for each acre, it is estimated that there are over 37 million tons of dead spruce tree boles on 1 million plus acres of dead spruce in the KPB. The amount of fuel contributed by the other parts of these trees is estimated to be another 7.4 million tons bringing the total tonnage of dead spruce fuels in the KPB to 44.4 million tons.

**Table A4 – Estimated Tons of Dead Spruce Fuel by Land Owner within the Kenai Peninsula Borough**

Kenai Peninsula Borough Landowners	Landowner TOTAL DEAD SPRUCE Acres	1/ -AVG Bole TONS/ ACRE	TOTAL Bole TONS FUEL	2/ - AVG Slash TONS ACRE	TOTAL Slash TONS FUEL	TOTAL ALL TONS FUEL	PERCENT OF TOTAL
<b>FEDERAL</b>							
Lake Clark National Park And Preserve	30,000	35	1,050,000	7	210,000	1,260,000	3%
Kenai National Wildlife Refuge	326,113	35	11,413,955	7	2,282,791	13,696,746	31%
USDI - Bureau of Land Management	11,535	35	403,725	7	80,745	484,470	1%
USDA- Forest Service, Chugach National Forest	67,187	35	2,351,545	7	470,309	2,821,854	6%
SubTotal Federal	<b>434,835</b>	<b>35</b>	<b>15,219,225</b>	<b>7</b>	<b>3,043,845</b>	<b>18,263,070</b>	<b>41%</b>
<b>STATE</b>							
Alaska State Aviation Division	196	35	6,860	7	1,372	8,232	0%
Alaska State Dept of Transportation	21	35	735	7	147	882	0%
Alaska Dept of Fish & Game	98	35	3,430	7	686	4,116	0%
Alaska Energy Authority	707	35	24,745	7	4,949	29,694	0%
Alaska State Parks Division	178	35	6,230	7	1,246	7,476	0%
Alaska Mental Health Trust	2,469	35	86,415	7	17,283	103,698	0%
Alaska State Division of Natural Resources	318,033	35	11,131,155	7	2,226,231	13,357,386	30%
University of Alaska	6,059	35	212,065	7	42,413	254,478	1%
SubTotal State	<b>327,761</b>	<b>35</b>	<b>11,471,635</b>	<b>7</b>	<b>2,294,327</b>	<b>13,765,962</b>	<b>31%</b>
<b>BOROUGH</b>							
Kenai Peninsula Borough	23,940	35	837,900	7	167,580	1,005,480	2%
SubTotal Borough	<b>23,940</b>	<b>35</b>	<b>837,900</b>	<b>7</b>	<b>167,580</b>	<b>1,005,480</b>	<b>2%</b>
<b>NATIVE</b>							
USDI - Bureau of Indian Affairs	1,016	35	35,560	7	7,112	42,672	0%
Cook Inlet Region, Inc.	90,443	35	3,165,505	7	633,101	3,798,606	9%
English Bay Corporation	2,344	35	82,040	7	16,408	98,448	0%
Kenai Natives Assn, Inc.	385	35	13,475	7	2,695	16,170	0%
Ninilchik Native Assn., Inc.	22,168	35	775,880	7	155,176	931,056	2%
Port Graham Corporation	872	35	30,520	7	6,104	36,624	0%
Salamatof Native Assn. Inc.	5,287	35	185,045	7	37,009	222,054	0%
Seldovia Native Assn., Ince	16,489	35	577,115	7	115,423	692,538	2%
Tyonek Native Corporation	9,903	35	346,605	7	69,321	415,926	1%
SubTotal Native	<b>148,907</b>	<b>35</b>	<b>5,211,745</b>	<b>7</b>	<b>1,042,349</b>	<b>6,254,094</b>	<b>14%</b>
<b>PRIVATE</b>							
Private & Other	122,042	35	4,271,470	7	854,294	5,125,764	12%
SubTotal Private & Other	<b>122,042</b>	<b>35</b>	<b>4,271,470</b>	<b>7</b>	<b>854,294</b>	<b>5,125,764</b>	<b>12%</b>
<b>Total All</b>	<b>1,057,485</b>	<b>35</b>	<b>37,011,975</b>	<b>7</b>	<b>7,402,395</b>	<b>44,414,370</b>	<b>100%</b>

1/ - Assumes the average dead spruce tree is 12 inches in diameter at breast height, 60 feet in total height, gross cubic foot volume is 19.3 cubic feet between a 1-foot stump and a 4-inch diameter inside bark top. (USDA-FS, Research Note NOR-5, Table 1.)

Assuming the average number of dead spruce per acre is 120 trees, then 19.3 cubic feet per tree X 120 trees per acre = 2316 CF/Acre

Assuming the weight of dead spruce with 12 % moisture content = 30 lbs/CF, then the

Total tons per acre of dead spruce = (2316 cf/ac X 30 lbs/cf )/2000 lbs/ton = 34.74

The Kenai Peninsula Borough indicates the average weight per acre of harvested trees in their fuel reduction timber sales has been 35 tons per acre.

(Personal communication - Mike Fastabend, KPB-SBB)

2/ - Assumes the average weight of stumps, roots, branchwood, twigs, and foliage on a per acre basis is equal to 20% of the average weight of dead spruce tree boles (35 tons/ac X 0.20 = 7.0 tons per acre)

## **2. Weather**

Major weather patterns during fire season normally move onto the Kenai Peninsula from the Southwest. Unobstructed by significant terrain features, they move to the Northeast, abruptly hit the Kenai Mountains on the Kenai National Wildlife refuge, and lift. The one exception to this is the break in terrain caused by the Kenai River flowing out of the mountains into Skilak Lake, which allows weather patterns to move unobstructed into the interior of the mountains, maintaining increased temperatures and drier conditions sometimes as far east as the Tern Lake Wye. Within this area is the urban interface community of Cooper Landing, as well as some of the highest recreational use areas within Forest Service protection. Weather patterns and risk from human activity are the two main reasons why the western half of the Peninsula and Cooper Landing may have a daily fire danger classification of high and extreme during fire season, while the rest of the Kenai Peninsula is classified as low or moderate. This is also the reason behind the forest closure order for campfires outside of designated campgrounds within 1/2 mile of the section of Sterling Highway under Forest Service protection.

## **3. Fire Season**

The designated fire season on the Kenai Peninsula can be described as having the following four distinct periods for fire suppression and fire effects purposes:

- a) From the annual April 15th declaration of fire season on the Kenai Peninsula by the State Forester, fires carry predominantly in a combination of Calamagrostis grass (bluejoint reedgrass), a fine fuel growing in dense continuous clumps found in most areas of the Kenai Peninsula, and black or white spruce. Calamagrostis grass, frost killed the previous winter, and matted down by snow, can dry rapidly in direct sunlight to carry a fire within 1 hour of having been too wet to burn. At that time of year, the lower duff layer is saturated. Large dead and down woody debris is saturated. Fire spread can be rapid, involve major crowning of tree canopies, and attain large acreage's. Fire suppression containment efforts are difficult to achieve. However, while fire acreage's may be large, there is little consumption of the large dead and down woody debris and little mineral soil exposure due to their high moisture content.
- b) By June, Calamagrostis grass greens up and holds moisture, making it fire resistant. Fires slow down in these fuels, provided the fires don't have an aerial component driven by wind. By this time, dead and down woody debris have dried considerably, and the soil moisture is lower. Fires are not usually as large after green-up, but consumption of the large dead and down woody debris takes place, as well as increased exposure of mineral soil. This is the time of year when prescribed fires are more likely to meet their management objectives. These conditions exist until mid July when the peninsula is usually hit by periodic rains.
- c) Once the mid July rains occur, the Alaska Interagency Fire Group declares that Modified Suppression Zones convert to Limited Suppression Zones. Open areas are saturated. The lower duff layer and large dead and down woody debris start accumulating moisture again. Fires still occur, but generally spread slowly, and



do not present much of a containment problem. It is interesting to note that at the beginning of the rainy period, the duff layer under timbered canopies is dry. Rain hangs up on the tree canopies but does not always penetrate the canopy to make it the ground. It evaporates directly into the atmosphere. Surrounding grass and brush fields are saturated. Fire within these stands at this time will spread so slowly it presents no containment problem. It will burn slowly straight down through the duff layer with minimal lateral spread and expose mineral soil, killing the stand. This is a stand regenerating fire seldom identified. It is also an opportunity for prescribed burning that has little risk of escape.

- d) In September or October, after continuous periodic rains, the Calamagrostis grass is frost killed. During late fall there are often warm days when the sun is shining, and when Calamagrostis grass becomes cured and dry, or even freeze dried, and can carry fire similarly to the beginning period of fire season. Sometimes at this time of year, timber understories are dry. Fire in the understory will burn straight down through the lower duff layer to mineral soil with minimal lateral spread. In 1995, a fire at Gull Rock which started in a Limited suppression zone in August on the Kenai National Wildlife Refuge was allowed to burn. It continued to burn through mid December, in full view of the city of Anchorage, before going out naturally. All trees within the stand were killed, creating a 14 acre stand regenerating fire with mineral soil exposure.

There are fire seasons on the Kenai Peninsula where the risk from wildland fire lasts from April 15th to the end of August. Within every 12-14 year period, there are usually 2 years in a row where these conditions exist. These conditions existed last in 1993 and 1994. There are occasionally fire seasons on the Eastern half of the Kenai Peninsula where the conditions are so wet that wildland fire numbers are low, will not spread when they do occur, and prescribed fires would not meet management objectives if ignited. This condition last existed in 1995.

#### **4. Terrain**

##### **a. Kenai Peninsula – East-Side**

The terrain on the east-side of the Kenai Peninsula within Forest Service protection is higher elevation mountainous terrain which provides many natural fuel breaks, including valley bottom rivers and streams, upper side slope alpine, rockfields, avalanche chutes, hanging glaciers, and snowfields which last much longer into fire season. Steep slopes and narrow valleys provide more shade, lower average temperatures and higher average relative humidity than terrain on the west-side of the peninsula. On the east-side of the peninsula, wildland fires are driven mostly by slope and aspect rather than by wind.

##### **b. Kenai Peninsula – West-Side**

The west-side of the Kenai Peninsula is also subject to occasional dry Northerly winds during fire season. These winds insignificantly affect the eastern half of the Kenai Peninsula under Forest Service protection due to the protection afforded by the Kenai Mountains, but cause an accelerated drying of dead and down fuels

on the western half of the Peninsula. Wind driven fires have a higher potential to become large where there are no breaks in terrain or fuel type. The terrain of the western half of the Kenai Peninsula is more conducive to wind driven wildland fires, and winds there are a daily occurrence.

The normal daily movement of air, which is onshore in the morning, and offshore at night, has a much greater impact on the drying of wildland fuels on the western half of the Peninsula than it does in the Kenai Mountains. There, the daily movement of air reacts more like rivers, channeling airflow upstream in the morning and downstream at night.

Unobstructed winds from frontal passages tend to dry the western half of the Peninsula, lift and become high elevation transport winds over the eastern half of the Peninsula. This lifting action cools the air to generate high clouds over the interior mountains which partially shades the landscape from direct sunlight. Shading reduces average temperatures and maintains higher relative humidity in mountainous broken terrain, which because of its multitude of aspects, dries fuels at slower rates than the flat terrain on the western half of the Peninsula. The eastern half of the Peninsula is higher in elevation than the western half, and therefore will have lower average daily temperatures and higher relative humidity. Snow accumulates deeper in the mountains, and stays longer before melting than on the west-side of the Peninsula. Therefore, dead and down fuels have a longer period in which to dry on the west-side.

The western half of the Kenai Peninsula has more private land and a more widely distributed population than the eastern half. The population is also increasing at a higher rate there. Lightning fires on the Kenai Peninsula are rare, but some occur every decade on the western half. On the eastern half, lightning fires are considered an anomaly. There have been only 3 documented lightning fires there since 1910. The western half of the Kenai Peninsula has continuous fuels of beetle killed spruce, as well as large areas of black spruce, a more volatile fuel type. The western half of the Kenai Peninsula has more wildland fires annually. The fires that do occur are larger, and are a greater threat to life and property on the average.

### **5. Risk of Ignition**

Another factor affecting the fire risk of forests is the probability of ignition. Probability of ignition is an expression of how easily a fire will ignite. Dead spruce with low moisture content will ignite far more readily than green spruce. There is an average of 66.1 fire ignitions per year on the Kenai Peninsula over the last 22 years. Map A9 (page A-28) displays these ignitions by cause for the 1,454 wildland fires on the Kenai Peninsula over the last 22 years. Lightning has historically been an infrequent cause of fire ignition on the Kenai Peninsula accounting for only 2 percent of ignitions over the last 22 years (Table A5) (See 1998); however, wildland fire research scientists have declared the potential for lightning fire starts will increase as a result of the "sea of snags"

that has been created (Alexander and Stocks 1997). During the same period, humans have been responsible for 98 percent of the fire starts.

The probability of crown fire events is greatly enhanced as a result of the spruce beetle infestation. Once fires reach crown fire stage, they are difficult to suppress and are often uncontrollable. Higher crown fire risk will be sustained for about 10 years until such time as dead timber stands begin to break apart and unravel. This reduction of vertical fuel load continuity does not diminish the fire risk problem. To the contrary, as trees break off and fall, increased fuel loading on the ground surface extends the fire problem in fuel types that are known to be of short season duration. Specifically, grass that evolves with increased exposure to sunlight usually only creates fire control problems during the early summer season before "green-up". The addition of large woody material from downed beetle killed trees will create fuel conditions that will support fire occurrence throughout the summer season. These fuel types have been observed to burn with high intensity levels (M. Kromery, USFS, personal communication). Fires in this fuel type burn 20 times faster and 6 times more intensely than the fuel type associated with healthy white spruce stands, particularly in the spring and early fall (See 1997). Fires in downed spruce trees in grass fuels exhibit a high resistance to control by firefighters as downed timber impedes access into a fire area and severely limits the use of tactical ground forces such as engines, dozers and hand crews (See 1998). Even when suppressing fires during moderate environmental conditions, placing crews in this type of fuel poses a significant personal safety risk should winds begin to rapidly increase, change direction, or if sudden slope changes are encountered.

**Table A5 – Number of Wildland Fires on the Kenai Peninsula by Cause, 1980-2002.**

Ignition Cause	Total Number of Fires	Percent of Total Fires	Avg Fires Per Year
Lighting	27	2%	1.2
Human Caused	1,427	98%	64.9
<b>Total</b>	<b>1,454</b>	<b>100%</b>	<b>66.1</b>
Years (1980-2002)	22		

## 6. Fire Behavior

Observations from recent fires on the Kenai Peninsula have shown an increase in crown fires. This fire behavior is caused by fire traveling up the dead spruce trees and spotting into the crowns of adjacent beetle killed trees. In some areas, there may be an increase in the lower level winds because of a "reduction" of the wind-break characteristics of a green forest, thus augmenting fire crowning behavior. It should be noted, however, that although current levels of infestation have declined, the spruce beetle has cumulatively impacted over 1 million acres of forested land in the Kenai Peninsula Borough over the last 17 years. The challenges stemming from past beetle activity, such as fuel-loading, habitat changes, hydrological changes and liability issues remain for forest managers and private landowners alike".

Spotting is also a common characteristic of larger fires on the Kenai Peninsula as displayed in Photo A5 (page A-24) on the 2001 Kenai Lake Fire. Spot fires were starting

one mile ahead of this fire which was initially a fuel reduction prescribed burn that escaped.

**Photo A5: 2001 Kenai Lake Fire Spotting**



## **7. Western Kenai Peninsula Worst Case Fire Behavior<sup>2</sup>**

**Overview:** A modeling analysis utilizing weather data, historical fire occurrence and fire behavior would ordinarily be the recommended procedure for establishing the “worst case” fire behavior scenario. Unfortunately, there are some flaws in the existing data that prevent a state-of-the-art evaluation of this issue. First of all, the weather database for the western Kenai Peninsula goes back to 1995, when the Ninilchik remote automated weather station (RAWS) was installed. RAWS stations catalogue ten-minute averages for winds, hourly temperature and relative humidity (RH) readings and precipitation amounts and duration of rain events. Meteorologists consider thirty years of continuous data to be a “reasonable” amount of data to complete an analysis. Additionally, RAWS stations should represent conditions over about 100,000 acres. The two RAWS stations on the west side of the Kenai Peninsula cover millions of acres, so more stations would be needed before accurate fire modeling could occur.

**Procedures:** If a reliable database were available, FireFamily Plus software could be utilized to define season ending events, common and rare-event fire spread and then RERAP software could present probabilities of the different events occurring prior to a season ending event. When it was discovered that the Ninilchik RAWS had been operational during the Crooked Creek Fire in June of 1996, we were hopeful data could be “pulled” from this period. Although the event occurred during a historical “high” energy release component (ERC) period, the actual weather conditions on the fire differed significantly (refer to attached ERC chart). This reinforces the earlier statement regarding representative acreages for RAWS stations.

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<sup>2</sup> - John See, Alaska Division of Forestry, March 1, 2004  
All Lands/All Hands Action Plan  
Kenai Peninsula Borough, Alaska  
September 5, 2004

If we assume that weather conditions and fire behavior potential were approaching a “worst case” fire behavior scenario, we can fall back on the data and fire spread for the Crooked Creek Fire to represent the “rare event” fire behavior potential. Wade Wahrenbrock, forester and fire behavior analyst with the Division of Forestry, Kenai-Kodiak Area Office, worked on a re-creation of the Crooked Creek Fire, assisted by the Kenai Peninsula Borough’s Geographic Information Systems (GIS) unit. He was able to produce a perimeter growth map, based upon the fuel and topography in the area and estimate the fire behavior conditions.

We were also able to refer to previous fire behavior analyses completed for the Cooper Landing area in 1991. While the earlier study was completed without the assistance of more advanced analysis software, the custom fuel models help to define the spruce bark beetle killed fuel complexes that are emerging.<sup>3</sup>

Findings: The Crooked Creek Fire was pushed by winds that descended over the land area that were heated and dried as the air mass subsided. Initial attack failed on this incident in the late evening/early morning hours, which was very uncharacteristic for the area. Normally, nighttime recovery provides firefighters with an opportunity to gain the upper hand. This would help qualify the weather event and resulting fire spread as a “rare event”. The fire covered over eight miles in less than twenty-four hours, including a good percentage of downslope spread. Lake Tustumena offered a substantial barrier that proved impenetrable, even by this rapidly moving fire, that had all the characteristics of a fully accelerated wildland running crown fire, where slope and crown spacing of the dead trees permitted the maximum spread rate.

Although spotting was observed well over ¼ mile, much of the area downwind of the fire was covered by dense smoke and precise spotting distances can only be speculated upon. Another factor to consider was that the Miller’s Reach Fire had burned aggressively during the preceding three days, covering approximately 37,000 acres of wildland-urban interface. There is no doubt that the Crooked Creek Fire would have covered many times the 17,000 plus acres that burned before running into Lake Tustumena. A repeat of the Crooked Creek Fire is certainly a very likely possibility, given a similar weather event.

### **8. Wildland Fire Size**

Large wildland fires have occurred on the Kenai Peninsula at least since the beginning of recorded history. Large intense fires may become stand replacement fires because the burned areas regenerate with even aged trees that form young successional forests. The intensity of the spruce beetle attack has created a circumstance where spruce seed will not be readily available to regenerate burned areas. The advent of large landscapes of dead trees has also created a condition where fires will burn at high intensity but may not produce seedbeds that are receptive to forest regeneration. Several early season fires such as the Pot Hole Lake, Hidden Creek, and Crooked Creek fires, which resulted in

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<sup>3</sup> - Cooper Landing Spruce Beetle Fire Behavior Analysis by John W. See, February 23, 1990.

suppression costs of \$6.6 million dollars, demonstrate this problem. Even though the dead spruce canopy of these fires burned with high intensity, surface vegetation consumption was low due to high moisture content. Surveys of the Crooked Creek Fire revealed that the fire consumed only 2 to 3 centimeters (cm) of duff material and less than 2% of the surface area had exposed mineral soils (Berg 1996). To compound the problem of regenerating this area, virtually all birch, and the sapling size spruce that had not succumbed to the earlier bark beetle epidemic, was killed as a result of fire intensity. The lack of a seed source within and adjoining this burned area will compound the problem of reforesting this 17,500-acre area.

Had these large fires occurred closer to towns or improvements, structures could have been lost. The risk factors for a catastrophic wildland fire are starting to stack up on the Kenai Peninsula. With the right weather conditions, the scenario for a catastrophic urban-wildland interface fire with property loss and loss of life is a definite possibility. Studies in Alaska and Canada show that a large percentage of beetle-killed trees will fall to the ground in five to ten years. This downed fuel loading will add to the problem fire potential (See 1998). Of the three main factors affecting fire behavior (fuel, weather, and topography), fuel is the only component over which some measure of management may be exerted. Extensive fuel management is the only option for mitigating potential losses (Beaver 1997).

Reference Map A10 on page A-29 which displays the Fire History for Major Wildland Fires on the Kenai Peninsula since 1947.

### a. Kenai Peninsula – East-Side

The majority of wildfires within Forest Service protection are less than 1/10th acre in size, occur within 1/4-1/2 mile of the transportation system, and are human caused. Since 1910, there have been 8 documented lightning fires within Forest Service protection. The last two occurred in 2003 in the vicinity of Hope and burned ½ acre. In 1996, it was determined that for the previous 10 years, 58% of the fires occurring within Forest Service protection began on private lands, or lands that are now under State ownership.

### b. Kenai Peninsula – West-Side

The western half of the Peninsula has experienced many large wildfires over the past century, including the 1947 Skilak Lake Fire (310,000 acres), the 1969 Swanson River Fire (79,000 acres), the 1991 Pothole Lake Fire (7,900 acres) and the 1996 Crooked Creek Fire (17,500 acres).

Since the 1990's, the western half of the Kenai Peninsula has had the Pothole Lake Fire at 7,900 acres and a \$3,654,000 approximate suppression cost, the Crooked Creek Fire at 17,510 acres with a \$2,187,000 approximate suppression cost, and the Hidden Creek fire at 5,200 acres with a \$913,000 approximate suppression cost, and the Kenai Lake Fire with a \$1,800,000 approximate suppression cost. These fires were all in bark beetle killed stands.



## **9. Wildland Fire Risk**

There is a management concern that fire hazard in spruce beetle impacted stands will increase over time. After a spruce beetle outbreak, grass or other fine vegetation ground cover increases: fire spreads rapidly through these vegetation types. As the dead trees break or blow down (5-10 years after an outbreak), large woody debris begins to accumulate on the forest floor. This wood is the heaviest component of the fuels complex. Heavy fuels do not readily ignite, but once ignited they burn at higher temperatures for a longer period. The combination of fine, flashy fuels and abundant large woody debris results in a dangerous fuels situation.

The spruce bark beetle has impacted both areas of the Kenai Peninsula extensively, and has increased fuel loading in both areas, but the hazard and risk of wildland fire differs greatly between the two areas. The Kenai Peninsula is a transitional zone between boreal forest merging with the coastal rainforest. The key to the differences in fire behavior and risk between the two areas is the Kenai Mountains, which separates the Kenai Peninsula into east and west halves.

### a. Kenai Peninsula – East-Side

The eastern half of the Peninsula is similar to the fire cycles of the maritime ecosystem, with disturbance between 300-500 years. Here, some evidence does exist for natural fire cycles in some areas. Fire cycles are considered natural processes, but were sometimes influenced by human presence in prehistoric periods, which is difficult to prove at present. It must be remembered that even where natural fire cycles existed, they seldom exist in a pure state anywhere anymore due to the ability of humans to interrupt them by fire suppression.

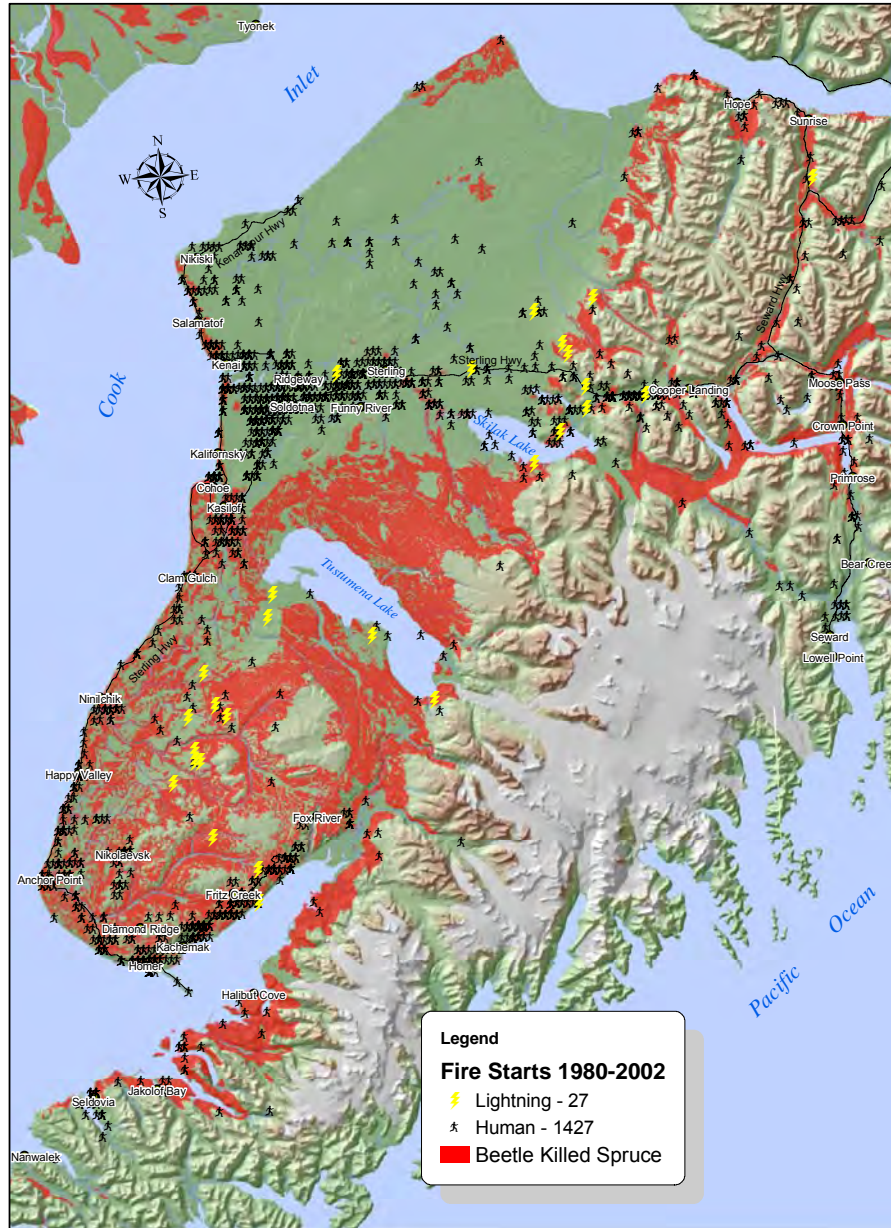
### b. Kenai Peninsula – West-Side

The western half of the Kenai Peninsula is similar to the natural fire cycles of the boreal forest, which burn every 75-150 years. What is interesting to note, is that the historical and current fire situation there may be caused by human presence. To date, studies have shown little physical evidence of a natural fire cycle.

Map A11 (page A-30) provides a Wildland Fire Risk Classification for the Kenai Peninsula. Note that most of the southern Kenai Peninsula is classified as either extreme or high risk.

**Map A9 – Historical Fire Start Locations and Ignition Cause on the Kenai Peninsula from 1980 - 2002**

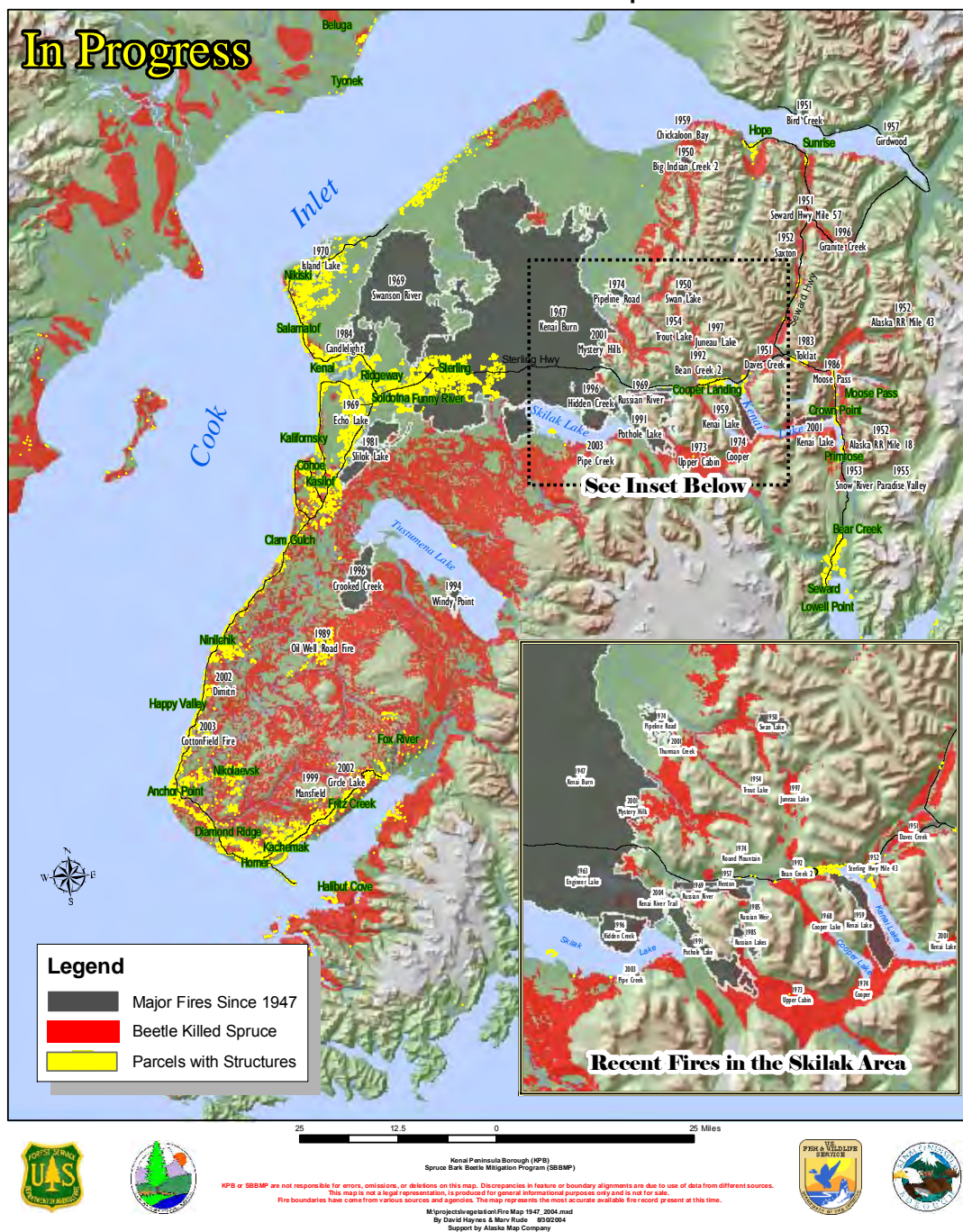
## Kenai Peninsula Fire Starts



Kenai Peninsula Borough (KPB)  
Spruce Bark Beetle Mitigation Program (SBBMP)  
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Map projective: gisnorline\_start.mxd  
By Gary Greenberg & Mary Rude 3/2/2004

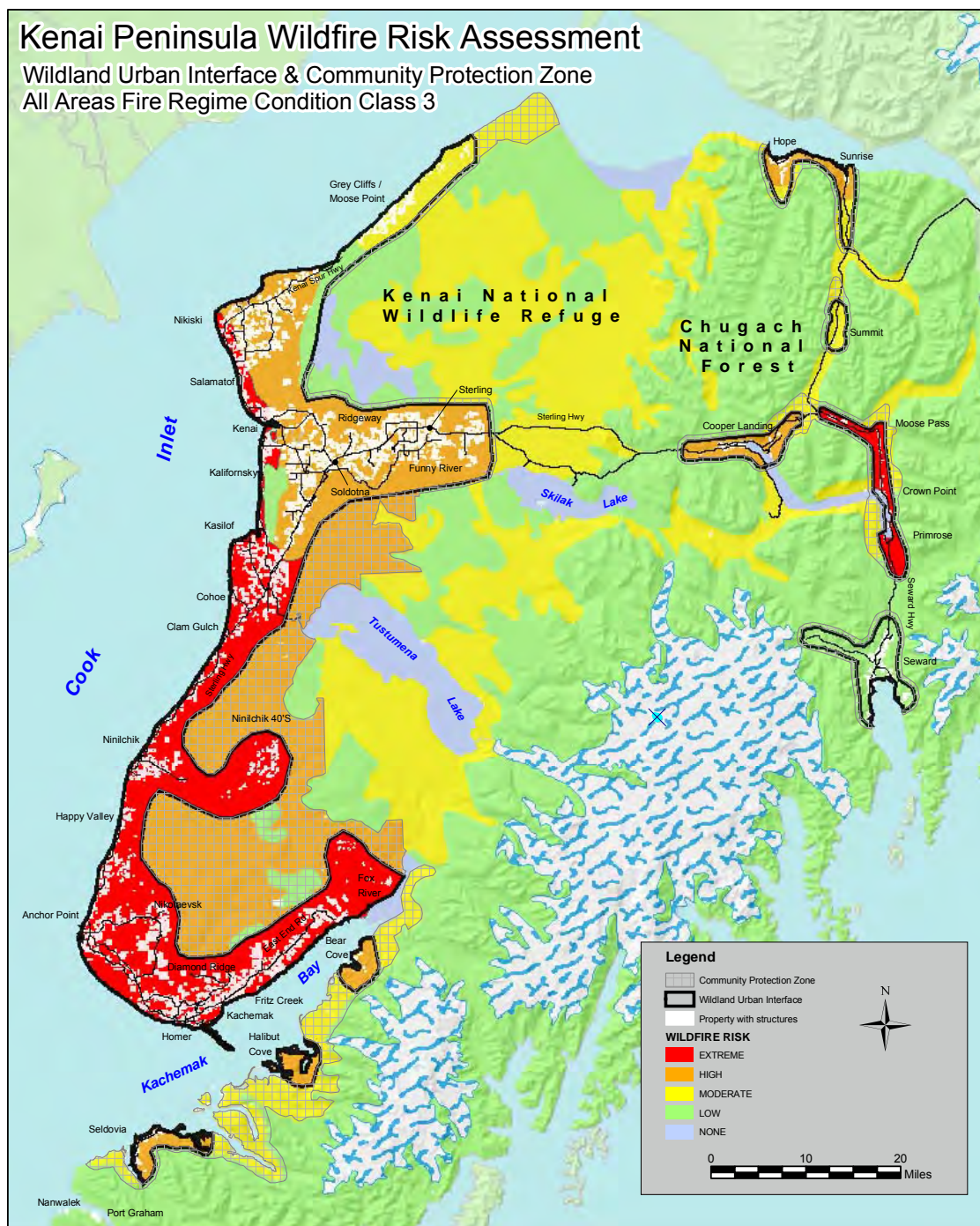
**Map A10 – Fire History Map for Major Wildland Fires on the Kenai Peninsula since 1947**

## Kenai Peninsula Fire Map 1947+





**Map A11 – Kenai Peninsula Wildfire Risk Assessment Map**



Kenai Peninsula Borough (KPB) - Spruce Bark Beetle Mitigation Program (SBMP)  
KPB or SBMP are not responsible for errors, omissions, or deletions on this map. Discrepancies in feature or boundary alignments are due to use of data from different sources. This map is not a legal representation, is produced for general informational purposes only and is not for sale.  
Path: M:\projects\vegetation\risk\_kp.mxd Created 7/17/03 Author: Gary Greenberg  
Revision Date: 12/23/03 Revised By: Gary Greenberg & Marvin Rude

1989 land delineation data supplemented by 1995-2002 cumulative spruce bark beetle infestation data from Alaska Forest and Game Survey of 2004 Forest Service and State of Alaska Department of Natural Resources.  
State Road Centerline information is derived from Alaska DOT GPS Centerline Survey

## 10. Populations and Facilities at Risk

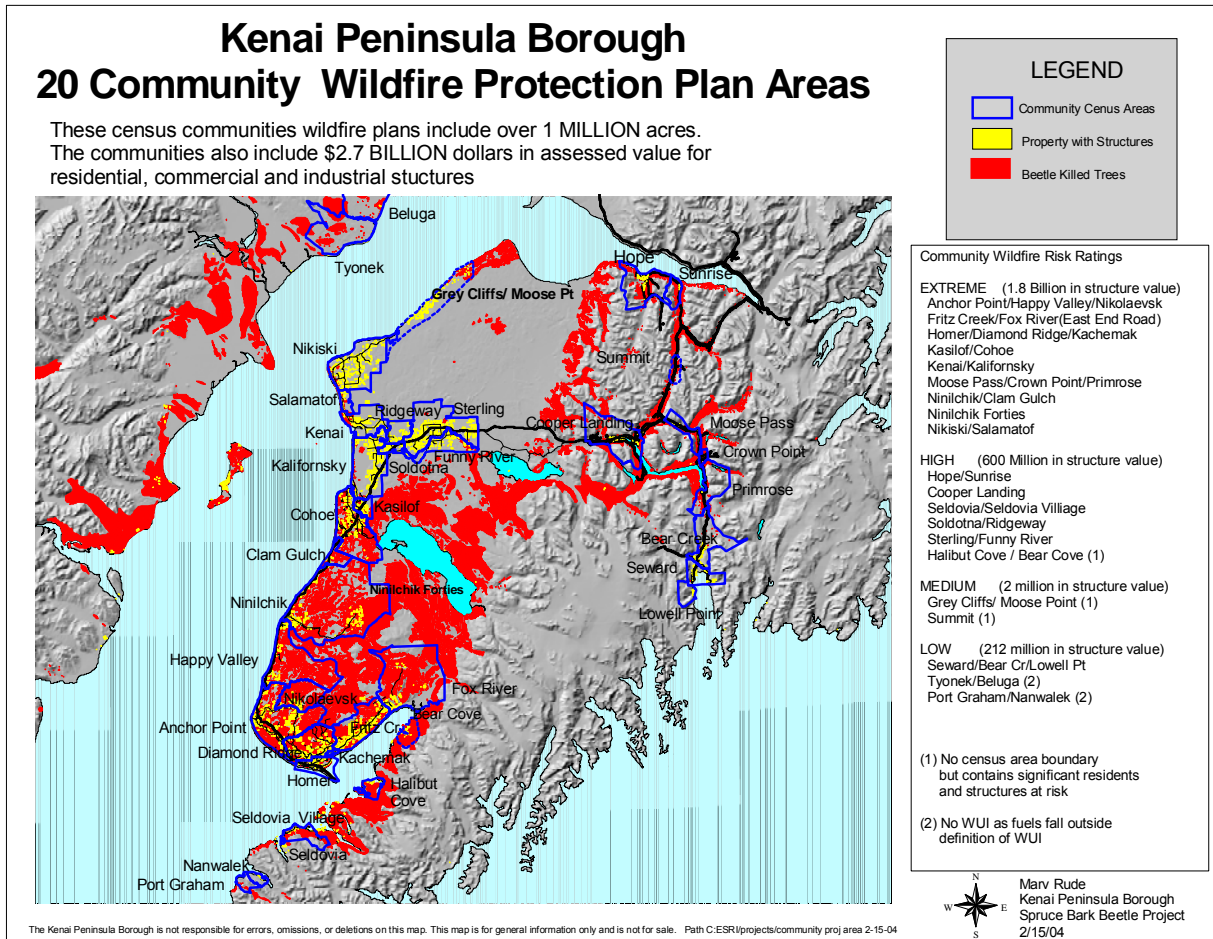
Communities within the KPB have been grouped into 20 Community Wildfire Protection Plan (CWPP) areas as displayed on Map A12 on page A-32. The 2000 census area boundaries were used to define the boundaries of these 20 CWPP areas. These CWPP areas were then assigned a Community Wildfire Risk Rating ranging from Extreme Risk to Low Risk.<sup>4</sup> Nine of the twenty CWPPs (45%) have an Extreme Wildfire Risk rating, six (30%) have a High rating, two (10%) have a Medium rating, and three (15%) have a Low rating. Fifteen CWPPs (75%) have an Extreme or High Wildfire Risk rating.

Table A6 (page A-33) displays the number of acres in each CWPP that are in the WUI or Other (Non-WUI), acres of dead spruce within the CWPP, and the CWPP population. Table A7 (page A-34) displays the number of residential structures in each CWPP and the tax assess dollar value of residential, industrial, and commercial structures within each CWPP.

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<sup>4</sup> - June 27, 2003 National Association of State Foresters Field Guidance for Identifying and Prioritizing Communities at Risk

**Map A12 – 20 Community Wildfire Protection Plan Areas**





## Appendix A – Fuel Hazard and Wildfire Risk Assessment

**Table A6 – CWPP Area Acres and Population by Wildfire Risk Rating**

Community Wildfire Protection Plan Areas	Community WUI Acres	Community Non-WUI Acres	Community Total Acres	Community <sup>1</sup> Dead Spruce Acres	Community Total Population
<b>EXTREME – Communities with Extreme Wildfire Risk Ratings</b>					
1. Anchor Point/Happy Valley/Nikolaevsk	86,866	51,149	138,015	65,746	2,679
2. Fritz Creek/Fox River (East End Road)	67,380	50,215	117,595	53,219	2,219
3. Homer/Diamond Ridge/Kachemak	37,596	8,267	45,862	18,018	6,179
4. Kasilof/Cohoe	39,629	13,588	53,218	25,893	1,639
5. Kenai/Kalifornsky	64,583	3,008	67,590	4,806	12,788
6. Moose Pass/Crown Point/Primrose	14,782	23,633	38,415	7,139	374
7. Ninilchik/Clam Gulch	73,961	67,622	141,583	65,228	945
8. Ninilchik Forties (Undefined By Census included in Ninilchik)	-	-	-	-	-
9. Nikiski/Salamatof	53,874	145	54,019	3,228	5,281
<b>SubTotal Extreme RiskCommunity Protection Plan Areas</b>	<b>438,671</b>	<b>217,627</b>	<b>656,298</b>	<b>243,277</b>	<b>32,104</b>
<b>HIGH – Communities with High Wildfire Risk Ratings</b>					
10. Hope/Sunrise	12,651	28,821	41,472	9,229	155
11. Cooper Landing	14,220	30,517	44,737	6,997	369
12. Seldovia/Seldovia Village	7,970	5,714	13,684	4,970	430
13. Soldotna/Ridgeway	15,997	-	15,997	-	5,691
14. Sterling/Funny River	58,499	11,038	69,537	2,142	5,341
15. Halibut Cover/Bear Cove (No Census Area for Bear Cove)	17,156	2,388	19,544	13,401	35
<b>SubTotal High RiskCommunity Protection Plan Areas</b>	<b>126,494</b>	<b>78,477</b>	<b>204,971</b>	<b>36,739</b>	<b>12,021</b>
<b>MEDIUM – Communities with Medium Wildfire Risk Ratings</b>					
16. Grey Cliffs/Moose Point (No Census Area)	31,630	-	31,630	1,961	-
17. Summit (No Census Area)	5,613	-	5,613	1,463	-
<b>SubTotal Low RiskCommunity Protection Plan Areas</b>	<b>37,243</b>	<b>-</b>	<b>37,243</b>	<b>3,424</b>	<b>-</b>
<b>LOW – Communities with Low Wildfire Risk Ratings</b>					
18. Seward/Bear Cr./Lowell Point	19,054	29,652	48,706	188	4,670
19. Tyonek/Beluga (Not in WUI)	-	110,117	110,117	16,773	225
20. Port Graham/Nanwalek (Not in WUI)	-	9,232	9,232	303	348
<b>SubTotal Low RiskCommunity Protection Plan Areas</b>	<b>19,054</b>	<b>149,001</b>	<b>168,055</b>	<b>17,264</b>	<b>5,243</b>
<b>Total All 20 Community Protection Plan Areas</b>	<b>621,462</b>	<b>445,105</b>	<b>1,066,566</b>	<b>300,705<sup>2</sup></b>	<b>49,368</b>
Remaining WUI area outside census Communities	101,457			19,585	
Total WUI and Communities	722,918			320,290	
<b>Remaining Outside WUI and Communities</b>				<b>737,195</b>	
<b>Grand Total entire Kenai Peninsula Borough</b>				<b>1,057,485</b>	

1) Dead Spruce acres based on a combination of site specific stand delineation and data supplemented by cumulative spruce bark beetle infestation data from Alaska state insect and disease surveys of USDA forest service and state of Alaska.

## Appendix A – Fuel Hazard and Wildfire Risk Assessment

**Table A7 – Total Number of Residential & Other Structures, Structure Class Tax Assessed Dollar Value by CWPP Area and Wildfire Risk Rating.**

Community Wildfire Protection Plan Areas	Residential & other Structures	Residential Structures <sup>3</sup> Assessed Value	Industrial Structures <sup>3</sup> Assessed Value	Commercial Structures <sup>3</sup> Assessed Value	Total Structure <sup>3</sup> Values
<b>EXTREME – Communities with Extreme Wildfire Risk Ratings</b>					
1. Anchor Point/Happy Valley/Nikolaevsk	1,799	\$ 76,912,600	\$ 1,500	\$ 6,870,000	
2. Fritz Creek/Fox River (East End Road)	1,235	\$ 65,558,700	\$ -	\$ 668,700	
3. Homer/Diamond Ridge/Kachemak	2,708	\$ 248,703,700	\$ 861,200	\$ 71,947,900	
4. Kasilof/Cohoe	1,182	\$ 51,482,800	\$ 231,800	\$ 2,285,000	
5. Kenai/Kalifornsky	5,130	\$ 435,711,500	\$ 2,808,600	\$ 119,967,400	
6. Moose Pass/Crown Point/Primrose	232	\$ 11,090,100	\$ -	\$ 2,767,600	
7. Ninilchik/Clam Gulch	970	\$ 32,619,500	\$ -	\$ 7,679,900	
8. Ninilchik Forties (Undefined By Census included in Ninilchik)	-	\$ -	\$ -	\$ -	
9. Nikiski/Salamatof	2,229	\$ 139,619,200	\$ 447,674,300	\$ 104,589,300	
<b>SubTotal Extreme RiskCommunity Protection Plan Areas</b>	<b>15,485</b>	<b>\$ 1,061,698,100</b>	<b>\$ 451,577,400</b>	<b>\$ 316,775,800</b>	<b>\$ 1,830,051,300</b>
<b>HIGH – Communities with High Wildfire Risk Ratings</b>					
10. Hope/Sunrise	232	\$ 6,197,200	\$ -	\$ 787,200	
11. Cooper Landing	374	\$ 20,411,800	\$ -	\$ 9,824,300	
12. Seldovia/Seldovia Village	374	\$ 14,712,000	\$ -	\$ 7,899,400	
13. Soldotna/Ridgeway	2,463	\$ 208,165,600	\$ 109,400	\$ 92,471,300	
14. Sterling/Funny River	3,862	\$ 239,625,400	\$ 258,900	\$ 14,932,700	
15. Halibut Cover/Bear Cove (No Census Area for Bear Cove)	163	\$ 5,851,600	\$ -	\$ 1,984,000	
<b>SubTotal High RiskCommunity Protection Plan Areas</b>	<b>7,468</b>	<b>\$ 494,963,600</b>	<b>\$ 368,300</b>	<b>\$ 127,898,900</b>	<b>\$ 623,230,800</b>
<b>MEDIUM – Communities with Medium Wildfire Risk Ratings</b>					
16. Grey Cliffs/Moose Point (No Census Area)	187	\$ 906,000	\$ -	\$ -	
17. Summit (No Census Area)	17	\$ 211,200	\$ -	\$ 494,700	
<b>SubTotal Low RiskCommunity Protection Plan Areas</b>	<b>204</b>	<b>\$ 1,117,200</b>	<b>\$ -</b>	<b>\$ 494,700</b>	<b>\$ 1,611,900</b>
<b>LOW – Communities with Low Wildfire Risk Ratings</b>					
18. Seward/Bear Cr./Lowell Point	1,567	\$ 118,873,000	\$ 24,046,000	\$ 56,635,600	
19. Tyonek/Beluga (Not in WUI)	112	\$ 797,900	\$ 269,800	\$ 1,061,100	
20. Port Graham/Nanwalek (Not in WUI)	123	\$ 5,916,300	\$ -	\$ 4,860,700	
<b>SubTotal Low RiskCommunity Protection Plan Areas</b>	<b>1,802</b>	<b>\$ 125,587,200</b>	<b>\$ 24,315,800</b>	<b>\$ 62,557,400</b>	<b>\$ 212,460,400</b>
<b>Total All 20 Community Protection Plan Areas</b>	<b>24959</b>	<b>\$ 1,683,366,100</b>	<b>\$ 476,261,500</b>	<b>\$ 507,726,800</b>	<b>\$ 2,667,354,400</b>
Remaining WUI area outside census Communities					
Total WUI and Communities					
<b>Remaining Outside WUI and Communities</b>	<b>992</b>	<b>\$ 18,142,300</b>	<b>\$ 195,300</b>	<b>\$ 12,501,500</b>	
<b>Grand Total entire Kenai Peninsula Borough</b>	<b>25,951</b>	<b>\$ 1,701,508,400</b>	<b>\$ 476,456,800</b>	<b>\$ 520,228,300</b>	<b>\$ 2,698,193,500</b>

2) Total census community acres exceeds those acres within the WUI. Census Communities contain 300,000 acres of dead spruce. The WUI contains 200,000 acres of dead spruce.

3) Structure values are based on the Kenai Peninsula Borough Property Tax Assessed Valuations and are considered conservative. These are not market values and land value is not included.

## General Management Considerations

### Legal, Policy, Political, and Economic Constraints

Legal, policy, political, and/or economic constraints for many land owners in the KPB preclude fuels and/or restoration treatments thereby reducing the estimated 1.06 million acres of dead spruce that is potentially available for fuels and/or restoration treatments.

On Federal land, congressionally designated wilderness status on about 80 percent of the Kenai Wildlife Refuge, which is estimated to contain 31 percent (326,000 acres) of the total dead spruce acreage in the KPB, precludes treatment by law. The Lake Clark National Park and Preserve in the northwest corner of the KPB contains about 3 percent (30,000 acres) and is precluded from treatment by policy. Approximately 5 percent of State Lands (53,000 acres) are in State Parks where most of the dead acreage will probably not be treated because of policy, political, and/or economic considerations.

Table A8 below displays the total estimated acreage in the KPB that is probably not going to ever receive fuel reduction treatments unless it burns in a wildfire.

**Table A8 – Dead Spruce Acres Precluded from Treatment by Legal, Policy, Political, or Economic Constraints within the KPB**

Landowner	Dead Spruce Acres Precluded from Treatment by Legal, Policy, Political, or Economic Constraints	Percent of Total Dead Spruce Acres in the KPB
<b>Federal</b>		
Lake Clark National Park and Preserve	30,000	3%
Kenai National Wildlife Refuge Wilderness	261,000	25%
<b>Subtotal Federal</b>	<b>291,000</b>	<b>28%</b>
<b>State</b>		
Alaska State Parks	53,000	5%
<b>Subtotal State</b>	<b>53,000</b>	<b>5%</b>
<b>Grand Total in the KPB</b>	<b>344,000</b>	<b>33%</b>

### Loss of the Wood Chip Market on the Kenai Peninsula

To-date, it is estimated that approximately 100,000 acres of the potentially treatable 250,000 acres of SBB infested property in the KPB have been treated by: private landowners, private industry, Native Corporations, State agencies, Federal agencies and the KPB. The best available data for cumulative harvest from the KPB-SBB Mitigation GIS database is displayed on Map A13 on page A36. Map A13 displays 77,500 acres of cumulative harvest but not all treated areas are currently in the Borough database. Based on a manual check of harvest records against the acreage in the Borough database, it is estimated that another 22,500 acres have been harvested which are not currently mapped in the Borough's database.

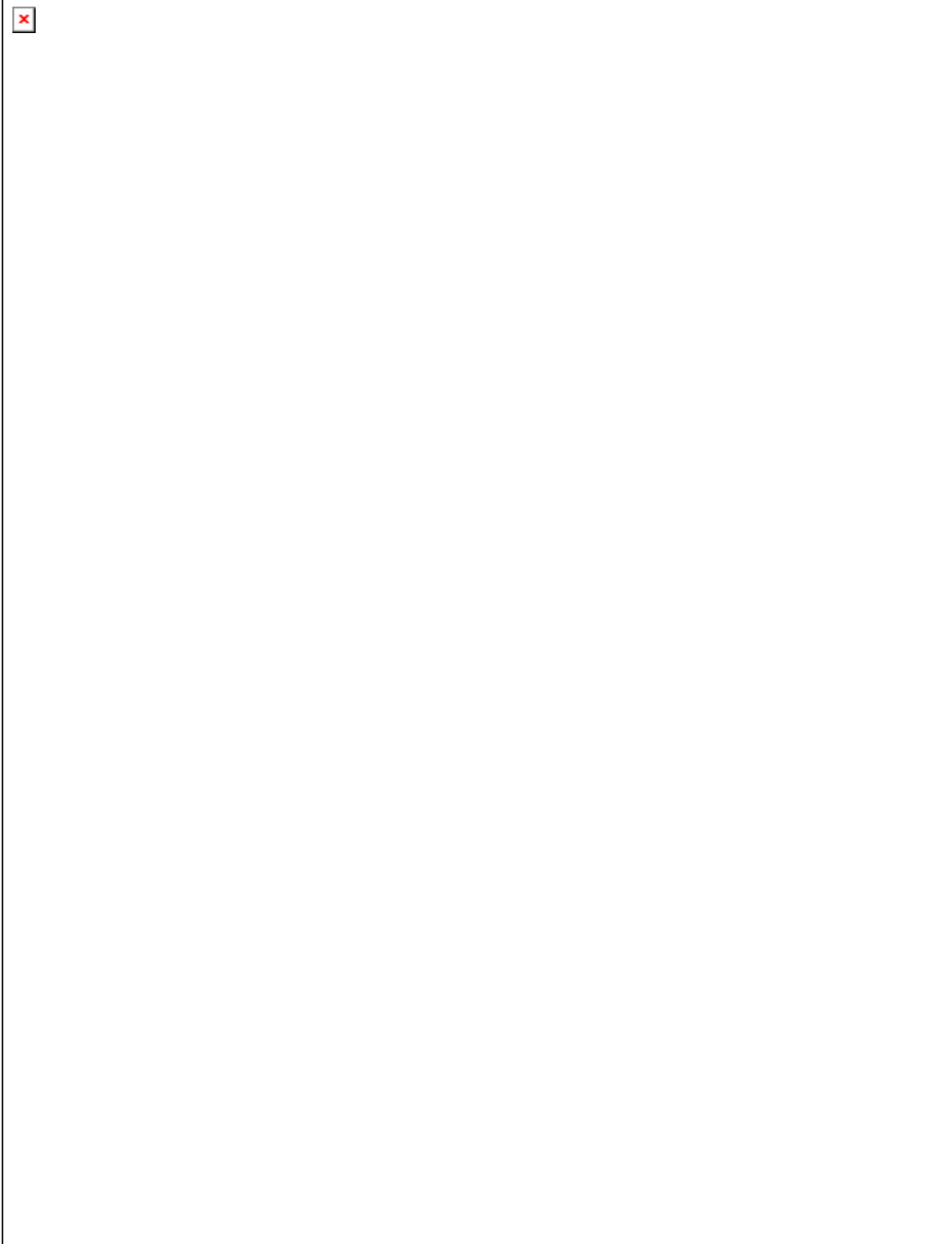
Although the SBB infestation, which peaked in 1996, has slowed and an estimated 100,000 acres have been harvested, approximately 100,000 to 150,000 acres of potentially treatable hazardous fuels within the KPB remain untreated.

Since 1991, biomass utilization projects designed to reduce fuels on the Kenai Peninsula have depended upon the sale of wood fiber to international wood chip and pulp log markets to offset the costs of fuel removal. With the exception of KPB, DOF, and small private landowner biomass sales in the last few years, the majority of harvested acres have been Native owned lands. However, the January 2004 loss of the wood chip and pulp log market, and subsequent removal of the wood chip loading facility from the port in Homer, has caused all large biomass utilization projects to cease. Although an industry capable of removing hazardous fuels remains on the KP, without markets for the product, this wood fiber has no value. Until a new market for wood fiber on the Kenai Peninsula develops, fuel reduction will be a direct expense to landowners with no off-setting revenues to cover or reduce the cost of treatment.

### Biomass Energy

In January 2004, a biomass-energy grant pre-proposal titled, “Biomass for community heating, economic development, and reduced wildfire risk on Alaska’s Kenai Peninsula”, was submitted to the U.S. Dept. of Energy by USFS-S&PF, PNW-Research Station, and the Alaska Energy Authority. If the project makes it through this first step, a full grant application will be submitted by March 30, 2004. If accepted, the grant would fund one or more bio-energy projects on the Kenai Peninsula. At this time, it is unclear if and when, a small market for dead spruce biomass may materialize. With relatively cheap natural gas available on most of the Kenai Peninsula, it is doubtful that enough bio-energy projects would come on line to create a substantial demand for surplus wood fiber on the Kenai Peninsula.

**Map A13 – Cumulative Mechanical Fuel Reduction Harvest with By-product Utilization on the Kenai Peninsula.**



# APPENDIX B

## WILDLAND FIRE PROTECTION CAPABILITY

for

## ALASKA'S KENAI PENINSULA BOROUGH



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## WILDLAND FIRE PROTECTION CAPABILITY

### Fire Protection Land Designations

The Alaska Interagency Fire Management Plan (AIFMP) has classified and mapped all lands within Alaska into one of four fire protection designations or levels. The protection designations determine the fire suppression response, and are used to set priorities for fire fighting resources when Alaska has multiple fires. The Plan also divides the responsibility for wildland fire suppression in Alaska between 3 agencies: the USDI-Bureau of Land Management, the State Division of Forestry, and the USDA-Forest Service.

Within the Kenai Peninsula Borough, the Alaska State Division of Forestry (DOF) is responsible for wildland fire suppression on the west side of Cook Inlet. The Kenai Peninsula is divided into two distinct zones for fire protection purposes. The western half, which includes a portion of the Kenai Mountains on the Kenai National Wildlife Refuge, is protected by DOF. The eastern half, which is entirely within the Kenai Mountains, is protected by the USDA-Forest Service. Each agency protects the lands within its jurisdiction, regardless of actual land ownership. The Community of Cooper Landing and surrounding area is under a joint protection agreement by both agencies.

The current AIFMP Fire Protection Levels for all lands within the 10.25 million acre Kenai Peninsula Borough is currently being updated and was not available for this assessment.

The fire protection designations or levels within the Kenai Peninsula Borough are:

- a. **Critical Protection:** Areas where human life or habitation is present have priority over all others. Immediate and continuous suppression actions are made to minimize loss of life and damage to property (AIWFMP, 10/1999).
- b. **Full Protection:** Valuable resources, such as commercial timber stands and historic structures exist, but human life or habitations are minimal in these areas. Immediate and aggressive suppression actions are taken to limit the numbers of acres burned (AIWFMP, 10/1999).
- c. **Modified Protection:** Uninhabited; with resources of lesser value. Land managers consider trade-off of acres burned versus suppression expenses. Fires during critical burning months are attacked, but a lower level of protection is provided when the risks of large damaging fires are less. Lands classified as "modified" may convert to "limited" after July 15th during a "normal" fire season (AIWFMP, 10/1999).
- d. **Limited Protection:** Areas where natural fires are beneficial, or where the costs of fighting the fire are greater than the fire damage. Suppression

efforts are limited to keeping a fire within a designated area, or protecting critical sites within the areas (AIWFMP, 10/1999).

## Appropriate Wildland Fire Suppression Response

There are three appropriate suppression responses that can be used on wildland fires within the designated protection areas. They are based on tactics, economics, and risk:

- a. **Confine:** Use of tactical actions to manage a fire within a predetermined area or perimeter, usually defined by geographic features. This term no longer has a strategic meaning in Federal Wildland fire policy.
- b. **Contain:** A tactical point at which a fire's spread is stopped by and within specific features, constructed or natural; also, the result of stopping a fire's spread so that no further spread is expected under foreseeable conditions. For reporting purposes, the time and date of containment. This term no longer has a strategic meaning in Federal Wildland fire policy.
- c. **Control:** To construct fireline, or use natural features to surround a fire and any spot fires therefrom and reduce its burning potential to a point that it no longer threatens further spread or resource damage under foreseeable conditions. For reporting purposes, the time and date of control. This term no longer has a strategic meaning in Federal Wildland fire policy.



**Photo B1 – Air Tanker Retardant Drop on a Interior Alaska Wildland Fire**

### Wildland Fire Suppression Responsibilities & Capabilities

Regardless of the fire protection jurisdiction, or the selected appropriate management response (such as full suppression or monitoring/surveillance), protection of life and property will always be the first priority for wildland and structural fire suppression agencies. Should weather or fire situations change or multiple incidents occur simultaneously, any new threat to life and/or property will take precedence over a wildland incident where life safety is not threatened.

With limited availability of wildland fire suppression personnel and equipment on the Kenai Peninsula, this could mean that during the initial attack phase of a wildland fire incident, firefighters would be delayed from responding promptly, due to the need for evacuation or structure protection. Wildfire suppression would have to wait. The wildland fire would grow and spread until additional resources arrived. Once a fire has exceeded the capabilities of the initial attack fire crews, full transition to a Type 1 or 2 Incident Management Team could take 24-72 hours, depending on availability, with full implementation of a large fire suppression strategy taking an additional 24 hours.

Current initial attack fire suppression capabilities on the Kenai Peninsula have been adequate to date. They have often been called upon to deal with more than one fire per day, or several fires concurrently. Fires in the western half of the Kenai Peninsula have historically been larger, because ignition occurred in, or spread into black spruce, which is a more volatile fuel type than those found at higher elevations in the eastern half. Black spruce can exhibit extreme fire behavior similar to California chaparral. The western half of the Kenai Peninsula also has a history of periodic lightning fires.

## **1. State**

During fire season, the State of Alaska, Division of Forestry fields two-250 gallon engines at Soldotna staffed by 3 people each, an additional 500 gallon slip on unit at Soldotna staffed during periods of high fire danger, one-250 gallon engine at Homer staffed by 1 person, an additional 500 gallon slip on unit at Homer staffed with 2 people, and an initial attack helicopter and 3 person crew also stationed at Soldotna. Units at Homer would be unlikely to be used in the Moose Pass area, but could be used to cover the State protection areas while Soldotna forces are moved.

State initial attack resources and budgets are not projected to increase on the Peninsula at this time. An initial attack fire cache is available at Soldotna. The Division of Forestry can also field up to 50 Emergency Firefighters on the Kenai Peninsula within 24 hours. Wildfire Dispatch for both the State Division of Forestry and the Seward Ranger District are coordinated at the Division of Forestry office in Soldotna. Airtankers with retardant are available at Palmer and Fairbanks and can be pre-positioned at Kenai during high fire danger. A retardant mixing base exists in Palmer and Kenai.

## **2. Federal**

### **A. Chugach National Forest**

The Seward Ranger District of the Chugach National Forest has a comprehensive wildland fire management program (prevention, suppression, mitigation, prescribed fire, training, and monitoring), with a full-time Fire Management Officer (FMO), an Assistant FMO and 3 WAE positions and 3 temporary initial attack firefighters dedicated specifically to fire suppression during the average 60-day annual fire season. Each initial attack firefighter works 5, eight-hour days per week, due to extended Alaska daylight, and staff one 200-gallon engine with a (WEPS) Water Expansion Foam System and one 75-gallon engine with a slip-on unit. These personnel provide seven day coverage of staggered work schedules to give best I/A coverage for the entire week. A 50-person fire cache (fire support equipment) is available at Kenai Lake Work Center. Under normal fire weather conditions, 3-4 firefighters are on duty on any given day, and additional people are brought on when the fire danger climbs.

Funding for the Fire Crew is based on the National Fire Management Analysis System (NFMAS), programmed for the Seward RD. NFMAS is a National fire suppression budgeting system approved by Congress separate from other federal budgets, and is based on the District's most efficient level of initial attack. It is designed to allow Congressional approval of Fire budgets 2 years in advance. It is unlikely that Seward's normal fire budget will allow increased personnel beyond its present capabilities unless the District has significant increased numbers of fires and acres burned on Federal land. In fact, Federal staffing is projected to decrease. A fire analysis of the North Kenai assessment area in 1995 for the previous 10 years indicated that 58% of all fires within Forest Service protection were on State and private lands. This may well result in an increase in State protection in the area. Severity funding is available to hire more

firefighters if the fire season becomes unusually severe. Additional trained firefighters are available from the Seward and Glacier Ranger Districts within 1-3 hours, and from the Cordova Ranger District within 3-5 hours. The Forest Service also partially funds the Alaska Division of Forestry initial attack fire helicopter at Soldotna, and an air tanker stationed at Palmer.

#### **B. Kenai Fjords National Park**

Kenai Fjords National Park has no fire suppression equipment, and no designated firefighters. A limited number of people are available for wildfire suppression by request only. Responsibility for fire suppression within the Park resides (by Inter-agency agreement) with the Chugach National Forest.

#### **C. Kenai National Wildlife Refuge**

The Kenai National Wildlife Refuge has a comprehensive wildland fire management program (prevention, suppression, mitigation, prescribed fire, training, research and monitoring), with a full-time Fire Management Officer (FMO), an Assistant FMO and three permanent-seasonal firefighters.

During the wildland fire season, the Refuge can field from 10-20 qualified firefighters within two hours of dispatch. Refuge wildland fire equipment includes: one Type-4 Engine (AWD), two Type-6 Engines, one Type-6 ATV (Bombardier), one Type-2 Dozer, one Type-5 Dozer, one Hydro-axe, one 6WD ATV, one 4WD ATV, two 250-gpm diesel trash (volume) pump trailers, one portable 500-gpm trash pump, and numerous other portable pumps, hoses and hardware. The Refuge also owns a Premo Mark III sphere dispenser and has recently purchased a new heli-torch. There are two fixed-wing aircraft on the Refuge, available for fire reconnaissance or patrol: a Cessna 185 and a Piper PA 18-150 Super Cub (both on floats during the fire season).

The Refuge also maintains a 20-person fire cache to support Refuge fire operations. Refuge firefighters routinely respond to local, regional and national fire emergencies. Through the Alaska Interagency Wildland Fire Management Plan and Agreement, the Alaska Division of Forestry – Kenai/Kodiak Area Office in Soldotna provides initial attack and fire suppression support to the Refuge as needed.

### **3. Community Fire Departments**

Several local communities have developed Volunteer Fire Departments for structural fire protection. All listed departments are currently under agreement with the Chugach National Forest, Seward Ranger District, to provide additional initial attack resources for wildland fires on State, Private and Federal lands within their response areas. All listed departments are potentially available for response to wildland fire incidents, upon request by the Forest Service. Due to the need to provide structural fire protection for their respective communities, not all equipment and personnel could be made available at any given time. Response times vary. Many volunteers work in areas outside their local community and commute over long distances.



The community fire departments are a mix of volunteer fire departments in the smaller communities and funded employees in the larger communities.

A. City and Borough Fire Departments

a. Central Emergency Services (Soldotna)

The Kenai Peninsula Borough Central Emergency Services could field on request:

Hydrant Areas – three structural engines

Outside Hydrant Area – three tankers, ten support vehicles, a boat

Firefighters – six full time and thirty-two on call temporary employees

b. Kenai City

The Kenai City Fire Department could field on request:

Hydrant Areas - three structural engines and six support vehicles

c. Nikiski Fire Department

The Kenai Peninsula Borough Nikiski Fire Department is set up to provide structural as well as industrial firefighting. Within this industrial area is an active infestation with live and dead spruce trees. The area includes several oil refineries, a liquid natural gas facility and a fertilizer plant.

Apparatus includes: two 4,000 gallon tankers, two 2,500 gallon tankers, one 4,000 gallon foam tanker, two 2,000 gpm structural pumpers, two 1000 gpm structural pumpers, five support vehicles, one boat, twenty full time firefighters and twenty on call firefighters.

d. Girdwood Fire Department

The Girdwood Fire Department could potentially field on request, three-1,750 gallon engines, and 12 firefighters.

B. Volunteer Fire Departments

a. Anchor Point Volunteer Fire Department

Engine 1 - 1,000 gal

Tanker 1 - 2,000 gal

Rescue 1 250 gal

Old Tanker - 3,000 gal

Brush Truck with Foam Unit

30-35 Volunteers

b. Bear Creek Volunteer Fire Department

The Bear Creek Volunteer Fire Department could potentially field on request, one-250 gallon engine, one-300 gallon engine, one-500 gallon engine, three-2,000 gallon engines, one-3,000 gallon engine, and 20 firefighters.

c. Cooper Landing Volunteer Fire Department

The Cooper Landing Volunteer Fire Department could potentially field on request, one-250 gallon engine, two-2,500 gallon engines, two support vehicles and 12 firefighters.

d. Funny River Volunteer Fire Department

The following is a list of apparatus, both current and pending...

- 1 Brush Truck, 200 gal.
- 1 Tanker/tender, 1,250 gal.
- 1 Ambulance
- 1 Support truck, (pick-up)
- 1 Structure apparatus, 1,000 gal. Pending, by means of a FEMA grant.
- 1 Structure apparatus, 850 gal. ladder truck. Pending, by means of donation.
  
- 1 firefighter/engineer
- 1 firefighter/emt 2
- 1 fft 2/ firefighter/emt 1

e. Homer Volunteer Fire Department

The Homer Volunteer Fire Department could potentially field on request, two 2,000 gallon engines, one 750 gallon engine, one 300 gallon engine, two support vehicles and 24 volunteer fire fighters.

f. Moose Pass Volunteer Fire Department

The Moose Pass Volunteer Fire Department could potentially field on request, one-250 gallon engine, one-500 gallon engine, one-1,000 gallon engine, one-2,000 gallon engine and 13 firefighters.

g. Ninilchik Volunteer Fire Department

The Ninilchik Volunteer Fire Department could potentially field on request:

- Pumper Tanker 1,000 gal
- Tanker 2,000 gal
- 1 Ton Utility Truck

At the moment they also have, on loan from CES, a Tanker 3,000 gal & 16 Volunteer Fire Fighters

h. Port Graham Volunteer Fire Department

The Port Graham Volunteer Fire Department is not located on a main road system. It is accessible only by boat or by air and has locally. Port Graham has a 500 gallon pumper tanker and a conex with large Trimax extinguishers and 10 firefighters.

i. Tyonek Volunteer Fire Department

The Tyonek Volunteer Fire Department is not located on a main road system. It is accessible only by boat or by air and has locally one 1,000 gallon engine, two class A Foam extinguishers and 15 volunteers.

j. Seldovia Volunteer Fire Department

The Seldovia Volunteer Fire Department could potentially field on request, one small engine of unknown size and 13 volunteer firefighters.

k. Seward Volunteer Fire Department

The Seward Volunteer Fire Department could potentially field on request one 1000 gallon engine, one 750 gallon engine, two 500 gallon engines, three support vehicles and 22 volunteer firefighters.

# APPENDIX C

COMMUNITY WILDFIRE

PROTECTION PLANS

(CWPPs)

for

Alaska's Kenai Peninsula Borough

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# COMMUNITY WILDFIRE PROTECTION PLANS (CWPPs)

## INTRODUCTION

The idea for community-based forest planning and prioritization is neither novel nor new. However, the incentive for communities to engage in comprehensive forest planning and prioritization was given new and unprecedented impetus with the enactment of the Healthy Forests Restoration Act (HFRA) in 2003.

This landmark legislation includes the first meaningful statutory incentives for the US Forest Service (USFS) and the Bureau of Land Management (BLM) to give consideration to the priorities of local communities as they develop and implement forest management and hazardous fuel reduction projects.

In order for a community to take full advantage of this new opportunity, it must first prepare a Community Wildfire Protection Plan (CWPP). Local wildfire protection plans can take a variety of forms, based on the needs of the people involved in their development. Community Wildfire Protection Plans may address issues such as wildfire response, hazard mitigation, community preparedness, or structure protection—or all of the above.

The process of developing a CWPP can help a community clarify and refine its priorities for the protection of life, property, and critical infrastructure in the wildland–urban interface. It also can lead community members through valuable discussions regarding management options and implications for the surrounding watershed.

The language in the HFRA provides maximum flexibility for communities to determine the substance and detail of their plans and the procedures they use to develop them. Because the legislation is general in nature, some communities may benefit from assistance on how to prepare such a plan.

This *Handbook* is intended to provide communities with a concise, step-by-step guide to use in developing a CWPP. It addresses, in a straightforward manner, issues such as who to involve in developing a plan, how to convene other interested parties, what elements to consider in assessing community risks and priorities, and how to develop a mitigation or protection plan to address those risks.

This guide is not a legal document, although the recommendations contained here carefully conform to both the spirit and the letter of the HFRA. The outline provided offers one of several possible approaches to planning. We hope it will prove useful in helping at-risk communities establish recommendations and priorities that protect their citizens, homes, and essential infrastructure and resources from the destruction of catastrophic wildfire.

## DISCUSSION

### **Communities and the Wildland–Urban Interface**

The wildland–urban interface (WUI) is commonly described as the zone where structures and other human development meet and intermingle with undeveloped wildland or vegetative fuels. This WUI zone poses tremendous risks to life, property, and infrastructure in associated communities and is one of the most dangerous and complicated situations firefighters face.



Both the National Fire Plan and the Ten-Year Comprehensive Strategy for Reducing Wildland Fire Risks to Communities and the Environment place a priority on working collaboratively within communities in the WUI to reduce their risk from large-scale wildfire.

The HFRA builds on existing efforts to restore healthy forest conditions near communities and essential community infrastructure by authorizing expedited environmental assessment, administrative appeals, and legal review for hazardous fuels projects on federal land.

The Act emphasizes the need for federal agencies to work collaboratively with communities in developing hazardous fuel reduction projects, and it places priority on treatment areas identified by communities themselves in a CWPP.

### **Role of Community Wildfire Protection Plans**

The HFRA provides communities with a tremendous opportunity to influence where and how federal agencies implement fuel reduction projects on federal lands and how additional federal funds may be distributed for projects on nonfederal lands. A CWPP is the most effective way to take advantage of this opportunity.

Local wildfire protection plans can take a variety of forms, based on the needs of those involved in their development. They can be as simple or complex as a community desires.

The *minimum requirements* for a CWPP as described in the HFRA are:

- (1) Collaboration:** A CWPP must be collaboratively developed by local and state government representatives, in consultation with federal agencies and other interested parties.
- (2) Prioritized Fuel Reduction:** A CWPP must identify and prioritize areas for hazardous fuel reduction treatments and recommend the types and methods of treatment that will protect one or more at-risk communities and essential infrastructure.
- (3) Treatment of Structural Ignitability:** A CWPP must recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area addressed by the plan.

The HFRA requires that three entities must mutually agree to the final contents of a CWPP:

- The applicable local government (i.e., counties or cities);
- The local fire department(s); and
- The state entity responsible for forest management.

In addition, these entities are directed to consult with and involve local representatives of the USFS and BLM and other interested parties or persons in the development of the plan. The process is intended to be open and collaborative, as described in the Ten-Year Strategy, involving local and state officials, federal land managers, and the broad range of interested stakeholders.

If a community already has a plan that meets these requirements, the community need not develop an additional plan for the purposes of the HFRA.

### **Benefits to Communities**

In the context of the HFRA, a CWPP offers a variety of benefits to communities at risk from wildland fire. Among those benefits is the opportunity to establish a localized definition and boundary for the wildland–urban interface.

In the absence of a CWPP, the HFRA limits the WUI to within 1/2 mile of a community’s boundary or within 1 1/2 miles when mitigating circumstances exist, such as sustained steep slopes or geographic features aiding in creating a fire break. Fuels treatments can occur along evacuation routes regardless of their distance from the community. At least 50 percent of all funds appropriated for projects under the HFRA must be used within the WUI as defined by either a CWPP or by the limited definition provided in the HFRA when no CWPP exists.<sup>1</sup>

In addition to giving communities the flexibility to define their own WUI, the HFRA also gives priority to projects and treatment areas identified in a CWPP by directing federal agencies to give specific consideration to fuel reduction projects that implement those plans. If a federal agency proposes a fuel treatment project in an area addressed by a community plan but identifies a different treatment method, the agency must also evaluate the community’s recommendation as part of the project’s environmental assessment process.

## PREPARING A COMMUNITY WILDFIRE PROTECTION PLAN

- ~ These step-by-step recommendations are intended to help communities develop a wildfire protection plan that addresses the core elements of community protection. Items required under the HFRA are addressed, as are some additional issues that often are incorporated into wildfire protection planning. Actions beyond those listed in the legislation are not required for the purposes of the HFRA.
- ~ Community fire planning need not be a complex process. A community can use this outline to develop a fire plan that is as extensive or as basic as is appropriate and desired by the community.
- ~ A key element in community fire planning should be the meaningful discussion it promotes among community members regarding their priorities for local fire protection and forest management. This handbook should help to facilitate these local discussions.

### ✍ STEP ONE: Convene Decisionmakers

The initial step in developing a CWPP should be formation of an operating group with representation from local government, local fire authorities, and the state agency responsible for forest management.

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<sup>1</sup> 1. In the absence of a CWPP, Section 101 (16) of the HFRA defines the wildland–urban interface as “ (i) an area extending 1/2 mile from the boundary of an at-risk community; (ii) an area within 1 1/2 miles of the boundary of an at-risk community, including any land that (I) has a sustained steep slope that creates the potential for wildfire behavior endangering the at-risk community; (II) has a geographic feature that aids in creating an effective fire break, such as a road or ridge top; or (III) is in condition class 3, as documented by the Secretary in the project-specific environmental analysis; (iii) an area that is adjacent to an evacuation route for an at-risk community that the Secretary determines, in cooperation with the at-risk community, requires hazardous fuels reduction to provide safer evacuation form the at-risk community.”

Together, these three entities form the core decision-making team responsible for the development of a CWPP as described in the HFRA. The core team members must mutually agree on the plan's final contents.

In communities where several local governments and fire departments are within the planning area, each level of government/authority may need to convene ahead of time and identify a single representative to participate, on its behalf, as a core team member.

#### ✍ **STEP TWO: Involve Federal Agencies**<sup>2</sup>

Once convened, members of the core team should engage local representatives of the USFS and BLM to begin sharing perspectives, priorities, and other information relevant to the planning process.<sup>3</sup>

Because of their on-the-ground experience, mapping capabilities, and knowledge of natural resource planning, these local land management professionals will be key partners for the core team. In some landscapes, they will also be largely responsible for implementing the priorities established in the resulting CWPP.

#### ✍ **STEP THREE: Engage Interested Parties**

The success of a CWPP also hinges on the ability of the core team to effectively involve a broad range of local stakeholders, particularly when the landscape includes active and organized neighborhood associations, community forestry organizations that work in forest management, and other stakeholder groups that display a commitment to fire protection and fuels management.

Substantive input from a diversity of interests will ensure that the final document reflects the highest priorities of the community. It will also help to facilitate timely implementation of recommended projects. In some circumstances, the core team may wish to invite local community leaders or stakeholder representatives to work along with them in final decision making.

As early as possible, core team members should contact and seek active involvement from key stakeholders and constituencies such as:

- Existing collaborative forest management groups
- City Council members
- Resource Advisory Committees
- Homeowners Associations—particularly those representing subdivisions in the WUI
- Division of Wildlife/Fish and Game—to identify locally significant habitats
- Department of Transportation—to identify key escape corridors
- Local and/or state emergency management agencies
- Water districts—to identify key water infrastructure

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<sup>2</sup> Sec. 103 (b)(2) of the Act states that “the Federal Advisory Committee Act (5 U.S.C. App.) shall not apply to the planning process and recommendations concerning community wildfire protection plans.”

<sup>3</sup> A CWPP is legally applicable to federal lands only if they are managed by the USFS or the BLM. Nothing in the Act requires a community to exclude other federal agencies—such as the Fish and Wildlife Service or the National Park Service—from planning efforts, but those agencies are not bound by the provisions of the HFRA.

- Utilities
- Recreation organizations
- Environmental organizations
- Forest products interests
- Local Chambers of Commerce
- Watershed councils

This list provides a starting point and is by no means exhaustive.

In addition to directly contacting key individuals and organizations, core team members may want to consider using a public notice or public meeting process to acquire additional, more generalized input as the plan is developed.

#### ✍ **STEP FOUR: Establish a Community Base Map**

Using available technology and local expertise, the core team and key partners should develop a base map of the community and adjacent landscapes of interest within the WUI. This map will provide a visual information baseline from which community members can assess and make recommendations regarding protection and risk-reduction priorities.

To the extent practicable, the map should identify:

- • Inhabited areas at potential risk to wildland fire;
- • Areas containing critical human infrastructure—such as escape routes, municipal water supply structures, and major power or communication lines—that are at risk from fire disturbance events; and
- • A preliminary designation of the community's WUI zone.

#### ✍ **STEP FIVE: Develop a Community Risk Assessment**

The development of a community risk assessment will help the core team and community members more effectively prioritize areas for treatment and identify the highest priority uses for available financial and human resources.

A meaningful community assessment can be developed by considering the risk factors identified below. Choose an appropriate adjective rating (such as high, medium, and low) that best represents the risk to the community posed by each factor. Display the results on the base map to develop a useful tool for the final decision-making process.

State and federal land managers will be a valuable resource in helping communities locate the best available data and in producing quality maps that display and aid assessment of that data. Engaging key stakeholders in the rating process will be essential to a successful outcome.

#### **A. Fuel Hazards**

To the extent practicable, evaluate the vegetative fuels on federal and nonfederal land within or near the community. Identify specific areas where the condition of vegetative fuels is such that, if ignited, they would pose a significant threat to the community or essential community infrastructure. Consider how the local topography (such as slope, aspect, and elevation) may affect potential fire behavior.

Identify areas affected by windthrow, ice storms, or insect and disease epidemics where fuels treatment would reduce wildfire risks to communities and/or their essential infrastructure.

State and federal resource planning documents can be a valuable source of information on local forest and rangeland conditions.

Rate each area of identified hazardous fuels and show each on the base map as a high, medium, or low threat to the community.

#### **B. Risk of Wildfire Occurrence**

Using historical data and local knowledge, determine the common causes and relative frequency of wildfires in the vicinity of the community. Consider the range of factors, including critical weather patterns, that may contribute to the probability of fire ignitions and/or extreme fire behavior.

Use relative ratings such as high, medium, and low to show areas of concern for fire starts on the base map.

#### **C. Homes, Businesses, and Essential Infrastructure at Risk**

Assess the vulnerability of structures within the community to ignition from firebrands, radiation, and convection. Document areas of concern.

Identify specific human improvements within or adjacent to the community, such as homes, businesses, and essential infrastructure (e.g., escape routes, municipal water supply structures, and major power and communication lines) that would be adversely impacted by wildfire.

Categorize all identified areas needing protection using ratings of high, medium, or low, and show them on the base map.

#### **D. Other Community Values at Risk**

At the community's option, the risk assessment may also consider other areas of community importance, such as critical wildlife habitat; significant recreation and scenic areas; and landscapes of historical, economic, or cultural value that would benefit from treatment to reduce wildfire risks. Additional recommendations from local stakeholders should be incorporated as appropriate.

Categorize all identified areas that warrant protection using the ratings of high, medium, or low, and show them on the base map.

#### **E. Local Preparedness and Firefighting Capability**

Assess the level of the community's emergency preparedness, including evacuation planning, safety zones, and fire assistance agreements, as well as the response capability of community and cooperator fire protection forces. Consider the insurance industry ISO rating, if available and applicable. Use the knowledge and experience of local officials to identify areas in need of improvement.

Incorporate local preparedness information into the base map as appropriate.

### **✍ STEP SIX: Establish Community Hazard Reduction Priorities and Recommendations to Reduce Structural Ignitability**

Once the community assessment and base map are completed, the core team should convene all interested parties to discuss the results and their implications for local protection and hazard mitigation needs. A key objective of these discussions is to

develop the community’s prioritized recommendations for fuel treatment projects on federal and nonfederal lands in the WUI, along with the preferred treatment methods for those projects.

Recommendations should also be developed regarding actions that individuals and the community can take to reduce the ignitability of homes and other structures in the community’s WUI zone.

While local interests are gathered, communities may also want to take this opportunity to identify and develop strategies to improve their emergency preparedness and fire response capability.

The discussion and identification of community priorities should be as open and collaborative as possible. Diverse community involvement at this stage is critical to the ultimate success of the CWPP.

Recommendations included in the final CWPP should clearly indicate whether priority projects directly relate to protection of the community and its essential infrastructure or are geared toward reducing risks to other community values. Under the provisions of the HFRA, only projects that directly protect communities and essential infrastructure are eligible for the minimum 50 percent WUI funding specified in the legislation.

#### ✍ **STEP SEVEN: Develop an Action Plan and Assessment Strategy**

Before finalizing the CWPP, core team members and key community partners should consider developing an action plan that identifies roles and responsibilities, funding needs, and timetables for carrying out the highest priority projects.

Additional consideration should be given to establishing an assessment strategy for the CWPP to ensure that the document maintains its relevance and effectiveness over the long term.<sup>4</sup>

#### ✍ **STEP EIGHT : Finalize the Community Wildfire Protection Plan<sup>5</sup>**

The final step in developing a CWPP is for the core team to reconvene and mutually agree on the fuels treatment priorities, preferred methods for fuels treatment projects, the location of the wildland-urban interface, structural ignitability recommendations, and other information and actions to be contained in the final document.

If an associated action plan has not been developed, the core team should identify a strategy for communicating the results of the planning process to community members and key land management partners in a timely manner.

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<sup>4</sup> Community planning participants may also want to participate in multiparty monitoring of USFS and BLM projects developed under the HFRA as provided for in Sec.102 (g)(5) of the legislation: “In an area where significant interest is expressed in multiparty monitoring, the Secretary shall establish a multiparty monitoring, evaluation, and accountability process in order to assess the positive or negative ecological and social effects of authorized hazardous fuels reductions projects.”

<sup>5</sup> 5 Some states have statutes that may require an environmental analysis for plans adopted by local or state agencies. In such states, core team members should determine whether formal environmental analysis is required before finalizing their plans.



## Summary and Checklist

### ✍ Step One: **Convene Decisionmakers**

- Form a core team made up of representatives from the appropriate local governments, local fire authority, and state agency responsible for forest management.

### ✍ Step Two: **Involve Federal Agencies**

- Identify and engage local representatives of the USFS and BLM.
- Contact and involve other land management agencies as appropriate.

### ✍ Step Three: **Engage Interested Parties**

- Contact and encourage active involvement in plan development from a broad range of interested organizations and stakeholders.

### ✍ Step Four: **Establish a Community Base Map**

- Work with partners to establish a baseline map of the community that defines the community's WUI and displays inhabited areas at risk, forested areas that contain critical human infrastructure, and forest areas at risk for large-scale fire disturbance.

### ✍ Step Five: **Develop a Community Risk Assessment**

- Work with partners to develop a community risk assessment that considers fuel hazards; risk of wildfire occurrence; homes, businesses, and essential infrastructure at risk; other community values at risk; and local preparedness capability.
- Rate the level of risk for each factor and incorporate into the base map as appropriate.

### ✍ Step Six: **Establish Community Priorities and Recommendations**

- Use the base map and community risk assessment to facilitate a collaborative community discussion that leads to the identification of local priorities for fuel treatment, reducing structural ignitability, and other issues of interest, such as improving fire response capability.
- Clearly indicate whether priority projects are directly related to protection of communities and essential infrastructure or to reducing wildfire risks to other community values.

### ✍ Step Seven: **Develop an Action Plan and Assessment Strategy**

- Consider developing a detailed implementation strategy to accompany the CWPP, as well as a monitoring plan that will ensure its long-term success.

### ✍ Step Eight: **Finalize Community Wildfire Protection Plan**

- Finalize the CWPP and communicate the results to community and key partners.

## **Sponsor Organizations**

### **Communities Committee of the Seventh American Forest Congress**

[www.communitiescommittee.org](http://www.communitiescommittee.org)  
919 Elk Park Rd.  
Columbia Falls, MT 59912  
Phone: 406-892-8155  
Fax: 406-892-8161

### **Society of American Foresters**

[www.safnet.org](http://www.safnet.org)  
5400 Grosvenor Lane  
Bethesda, MD 20814-2198  
Phone: (301) 897-3690  
Fax: (301) 897-3690

### **National Association of Counties**

[www.naco.org](http://www.naco.org)  
440 First Street, NW  
Washington, DC 20001  
Phone: (202) 393-6226  
Fax: (202) 393-2630

### **National Association of State Foresters**

[www.stateforesters.org](http://www.stateforesters.org)  
444 N. Capitol St., NW Suite 540  
Washington, DC 20001  
Phone: (202) 624-5415  
Fax: (202) 624-5407

For an electronic version of this Handbook and the latest information visit:  
**[www.safnet.org/policyandpress/cwpp.cfm](http://www.safnet.org/policyandpress/cwpp.cfm)**

### **Additional Resources on the Web:**

- Federal Agency Implementation Guidance for the Healthy Forest Initiative and the Healthy Forest Restoration Act: [www.fs.fed.us/projects/hfi/field-guide/](http://www.fs.fed.us/projects/hfi/field-guide/)
- Field Guidance for Identifying and Prioritizing Communities at Risk: [www.stateforesters.org/reports/COMMUNITIESATRISKFG.pdf](http://www.stateforesters.org/reports/COMMUNITIESATRISKFG.pdf)
- The National Fire Plan: [www.fireplan.gov](http://www.fireplan.gov)
- Fire Safe Councils: [www.firesafecouncil.org](http://www.firesafecouncil.org)
- Western Governors Association: [www.westgov.org](http://www.westgov.org)
- Collaboration:  
[www.redlodgeclearinghouse.org](http://www.redlodgeclearinghouse.org)  
[www.snre.umich.edu/emi/lessons/index.htm](http://www.snre.umich.edu/emi/lessons/index.htm)

### **Examples of Community Fire Plans**

*(Note: these plans may not meet the requirements of HFRA, because they were created prior to its enactment)*

Josephine County, Oregon: [www.co.josephine.or.us/wildfire/index.htm](http://www.co.josephine.or.us/wildfire/index.htm)  
Applegate Fire Plan: [www.grayback.com/applegate-valley/fireplan/index.asp](http://www.grayback.com/applegate-valley/fireplan/index.asp)  
Colorado Springs, CO: [csfd.springsgov.com/wildfiremitigation.pdf](http://csfd.springsgov.com/wildfiremitigation.pdf)  
Jefferson County, Colorado:  
[www.co.jefferson.co.us/ext/dpt/admin\\_svcs/emergmgmt/index.htm](http://www.co.jefferson.co.us/ext/dpt/admin_svcs/emergmgmt/index.htm)  
Lower Mattole Fire Plan: [www.mattole.org/html/publications\\_publication\\_2.html](http://www.mattole.org/html/publications_publication_2.html)  
Trinity County Fire Management Plan: [users.snowcrest.net/tcrd/](http://users.snowcrest.net/tcrd/)

## **LOCAL ASSISTANCE FOR KPB COMMUNITIES IN PREPARING A CWPP**

For assistance in preparing a CWPP community leaders may contact the KPB SBB Mitigation Office in Soldotna or their nearest state forestry agency or a federal land management agency.

Local Contacts are:

Roberta Wilfong  
Spruce Bark Beetle Mitigation Office  
**Kenai Peninsula Borough**  
Soldotna, Alaska  
907-260-6202 office phone

Jim Peterson  
Area Forester - Kenai-Kodiak Area  
**Alaska State Division of Forestry,**  
Soldotna, Alaska  
907-262-4124 office phone  
907-260-4263 fax

Doug Newbould  
Kenai Wildlife Refuge  
**U.S. Fish & Wildlife Service**  
Soldotna, Alaska  
907-260-5994 office phone  
907-262-3566 fax

Warren Oja  
Chugach National Forest, Supervisor's Office  
**U.S. Forest Service**  
Anchorage, Alaska  
907-743-9438 office phone  
907-743-9480 fax

## **COMMUNITY BASE MAPS AND FUEL OWNERSHIP MAPS**

Map A12 on page A-32 displays all twenty community wildfire protection plan areas in the Kenai Peninsula Borough by Wildfire Risk Ratings and cumulative assessed structure values. The boundaries of these protection plan areas are based on the 2000 census area boundaries and are starting points for the development of Community Wildfire Protection Plans (CWPPs).

Maps C1.1 on page C-16 through C15.2 on page C-44 are Community Base Maps (BM) and Fuel Ownership Maps (FO) for the first 15 communities identified on Map A12. The BM and FO Map correspond to Steps 4 and 5 respectively of the CWPP development process for a community.

These maps are the initial starting point for local communities in preparing their individual Community Wildfire Protection Plan for their community.

As communities initiate development of their protection plans, they should plan to work closely with the SBB Mitigation Office of the Kenai Peninsula in Soldotna to address their map, photo, and satellite imaging needs for the area to be covered by the protection plan.

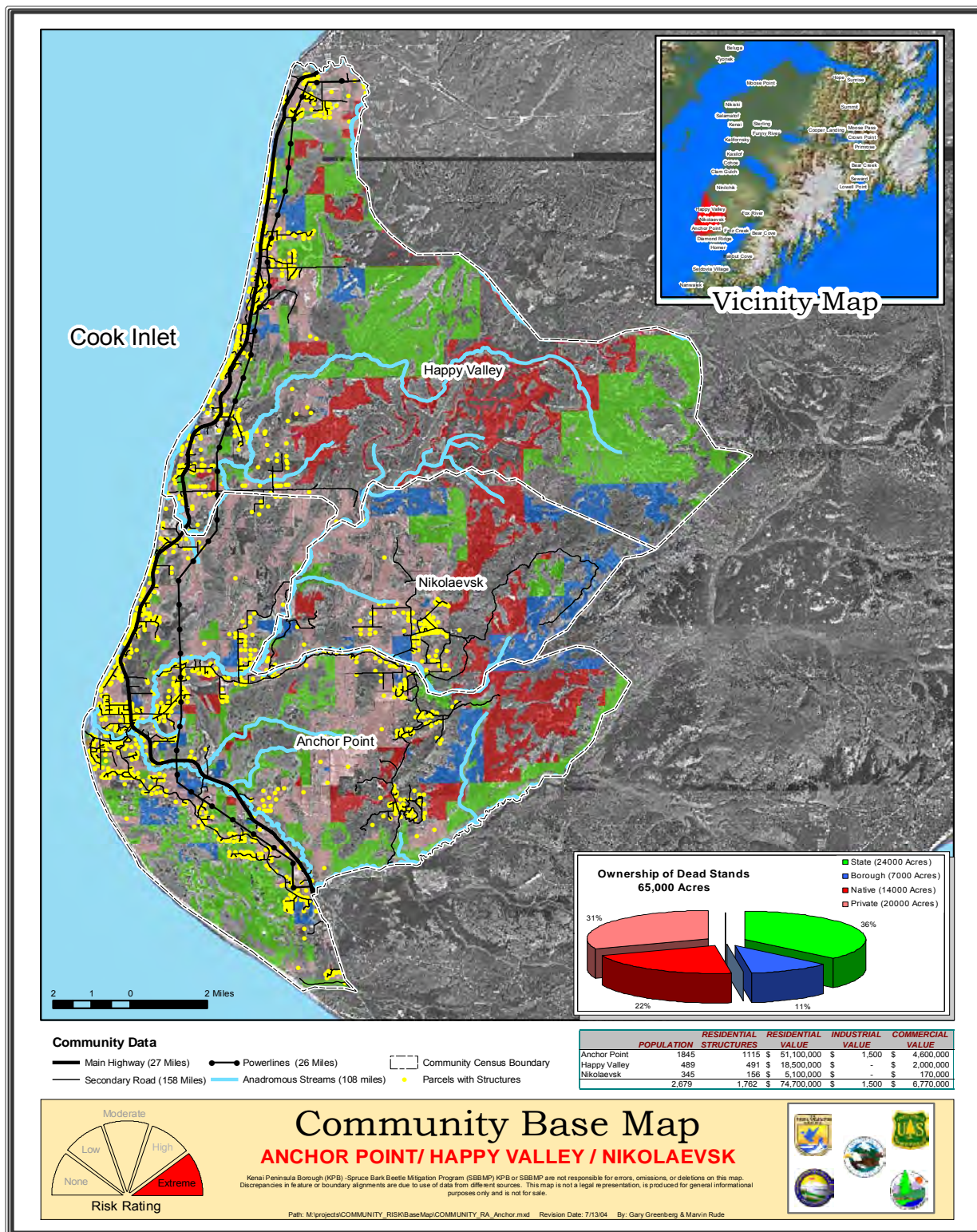
Upon completion of a CWPP, the All Lands/All Hands Action Plan will be updated to reflect consensus recommendations for treatments within a CWPP area.

**Community Base Maps & Fuel Ownership Maps**  
for  
**Kenai Peninsula Communities**  
with an  
**Extreme Wildfire Risk Rating**  
(Cumulative Structure Value = \$1.8 Billion Dollars)

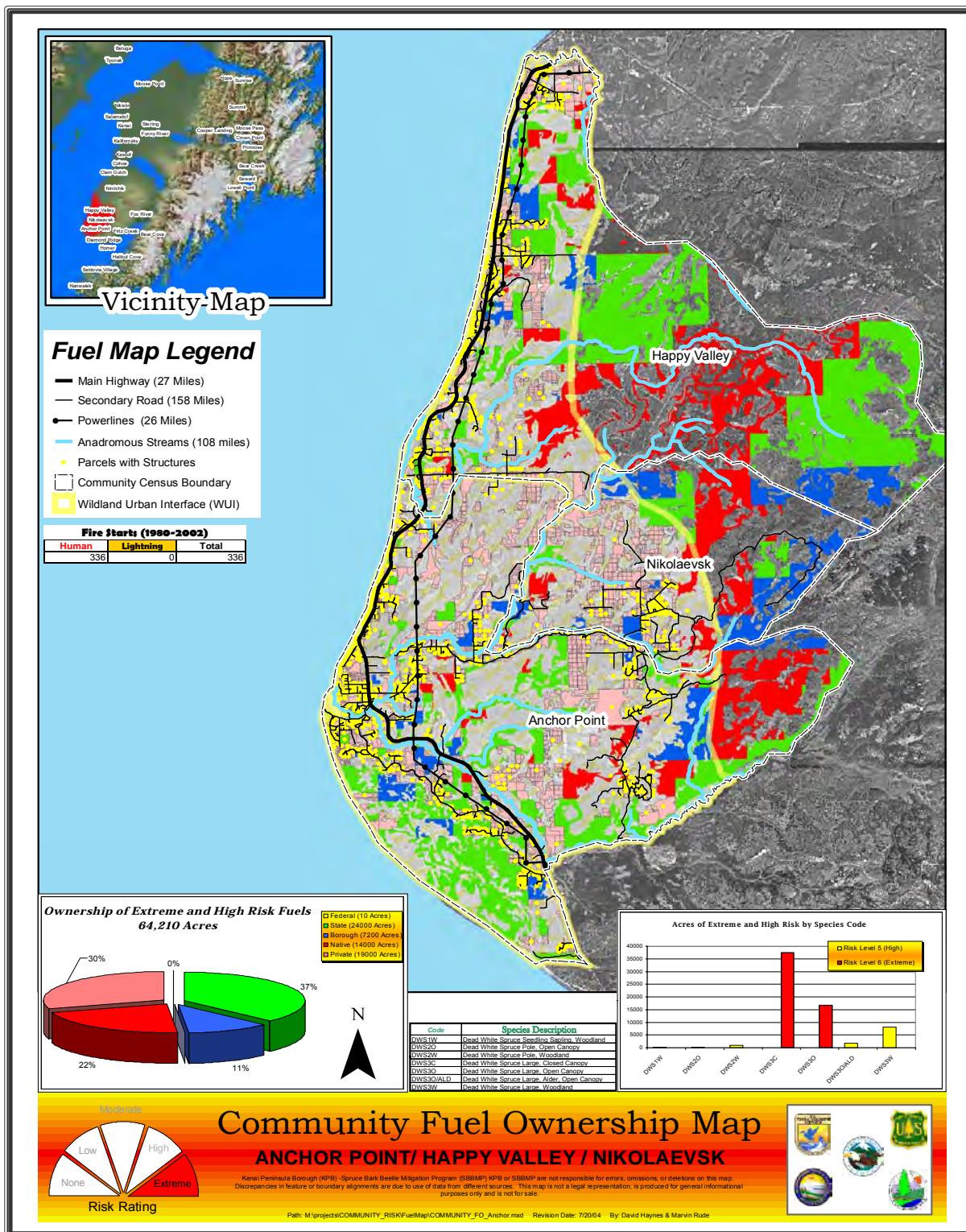
Map C-1.0	Anchor Point/Happy Valley/Nikolaevsk
Map C-2.0	Fritz Creek/Fox River (East End Road)
Map C-3.0	Homer/Diamond Ridge/Kachemak
Map C-4.0	Kasilof/Cohoe
Map C-5.0	Kenai/Kalifornsky
Map C-6.0	Moose Pass/Crown Point/Primrose
Map C-7.0	Ninilchik/Clam Gulch
Map C-8.0	Ninilchik Forties (Note – Included on the Ninilchik/Clam Gulch Maps)
Map C-9.0	Nikiski/Salamatof



Map C-1.1

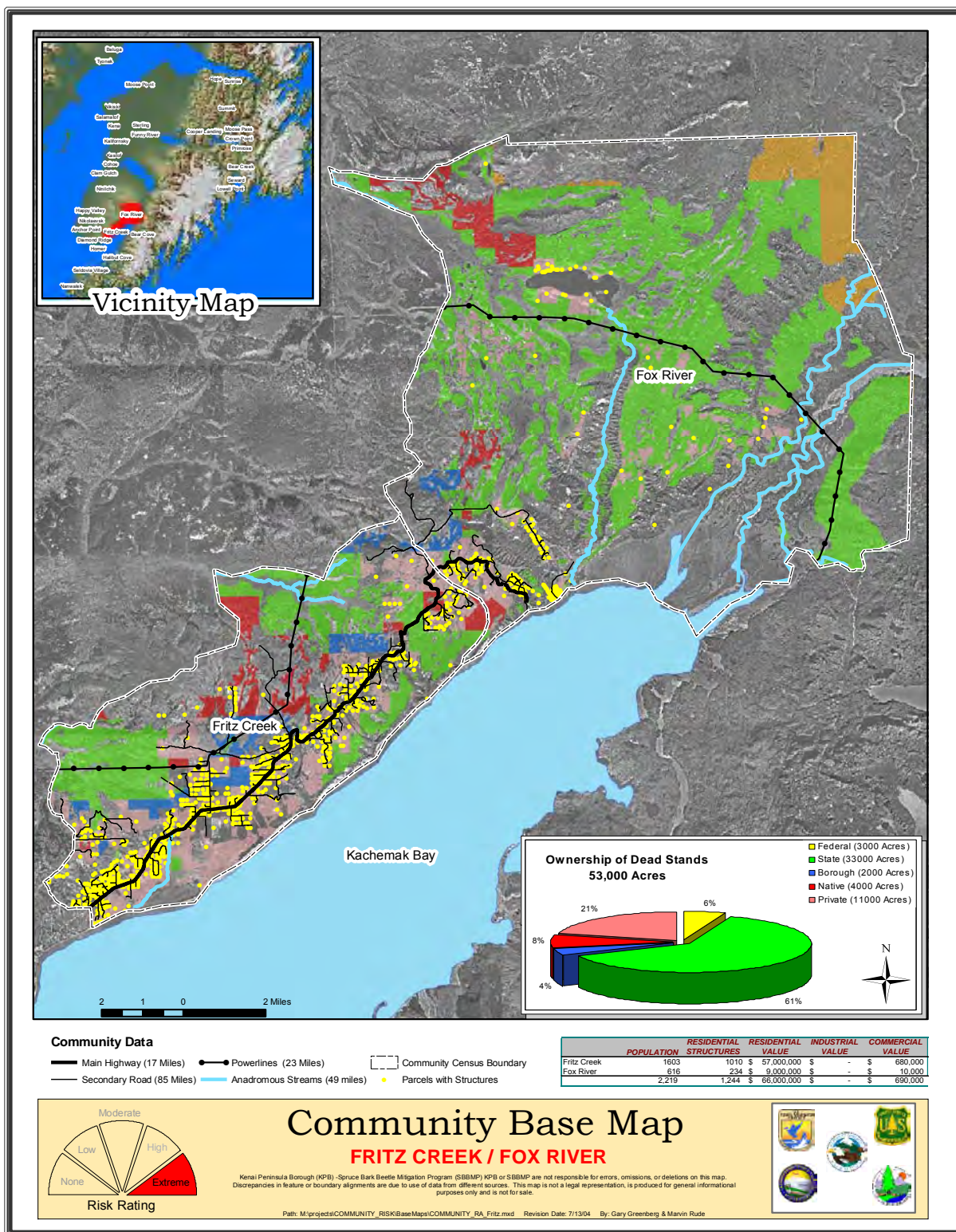


Map C-1.2



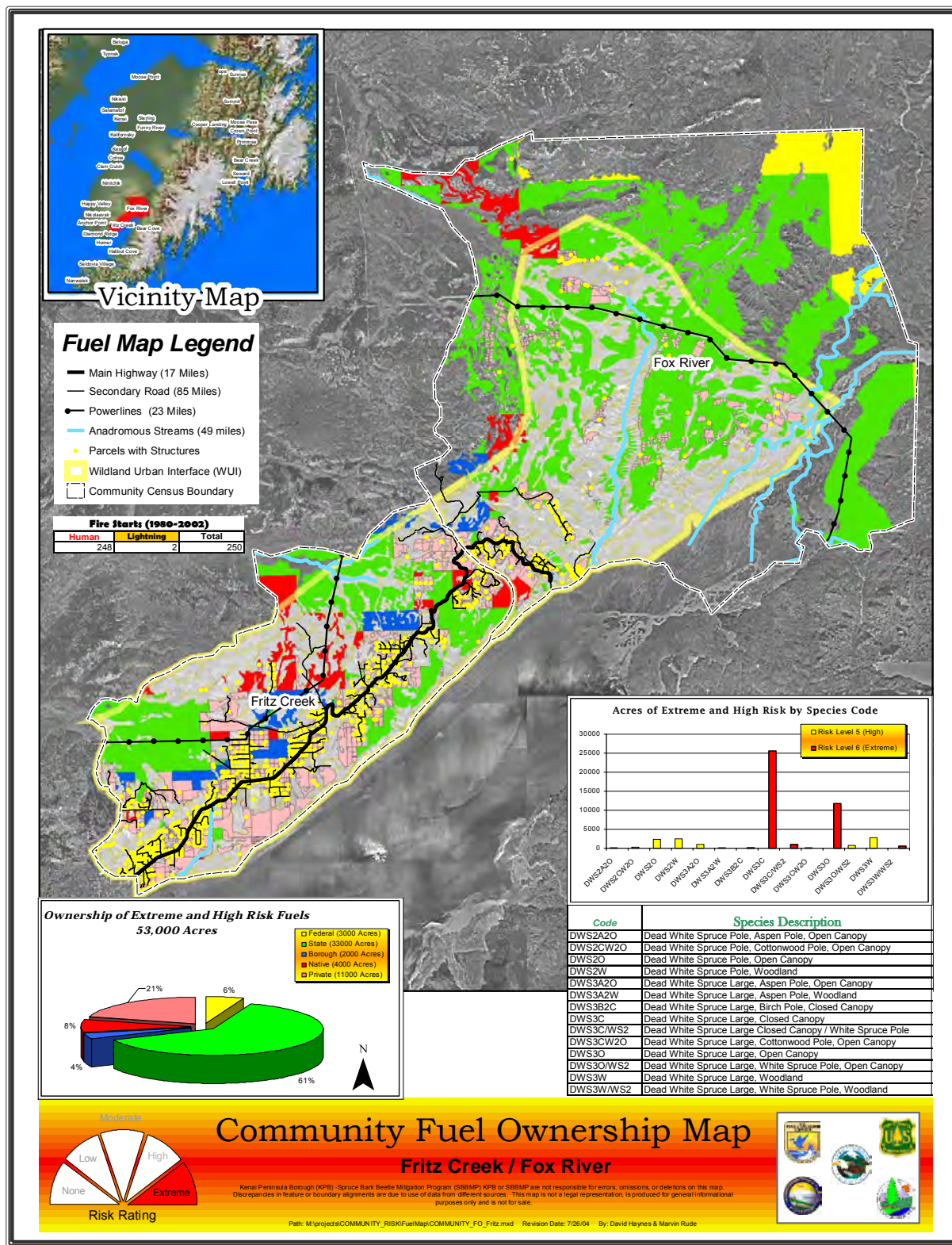


Map C-2.1

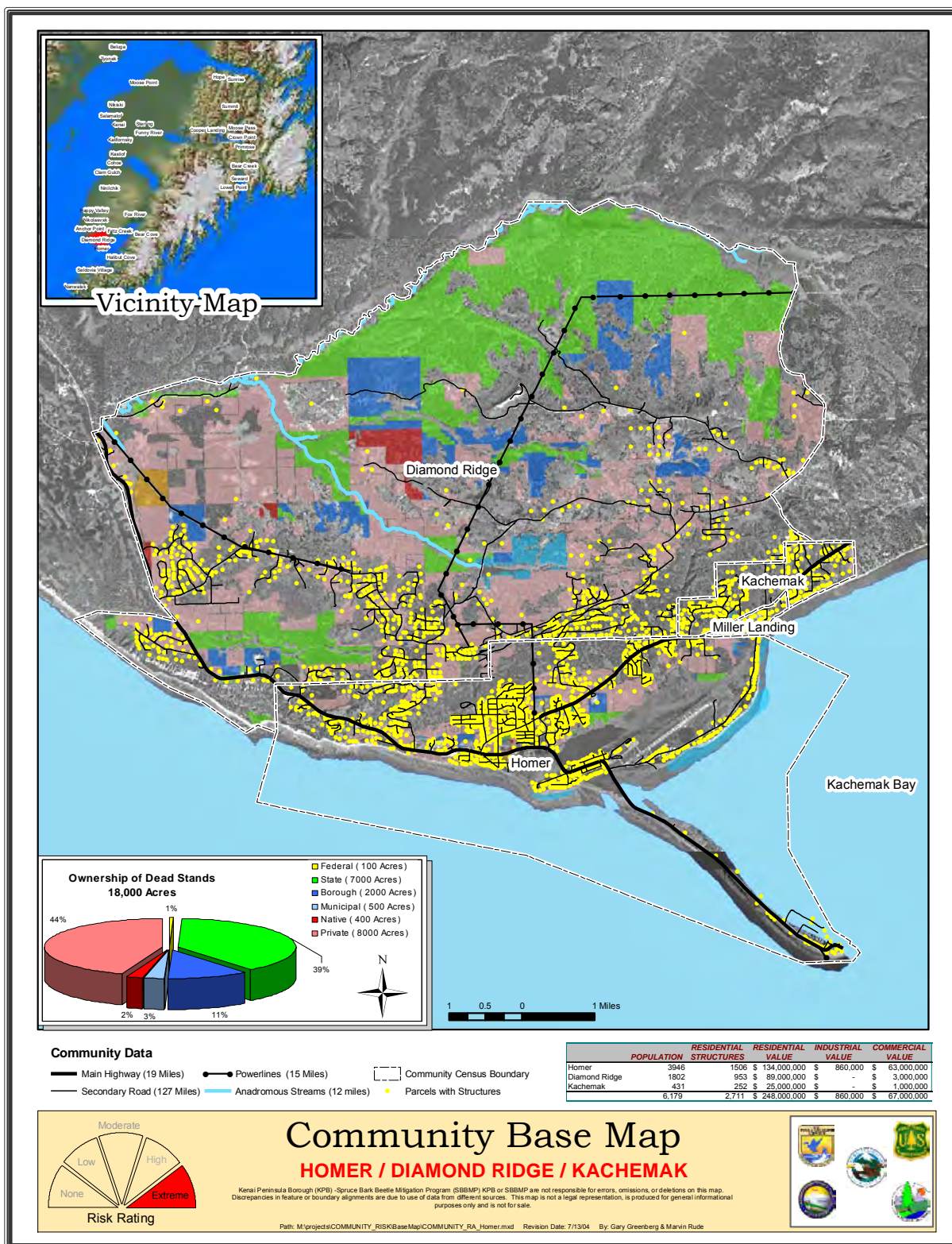




Map C-2.2

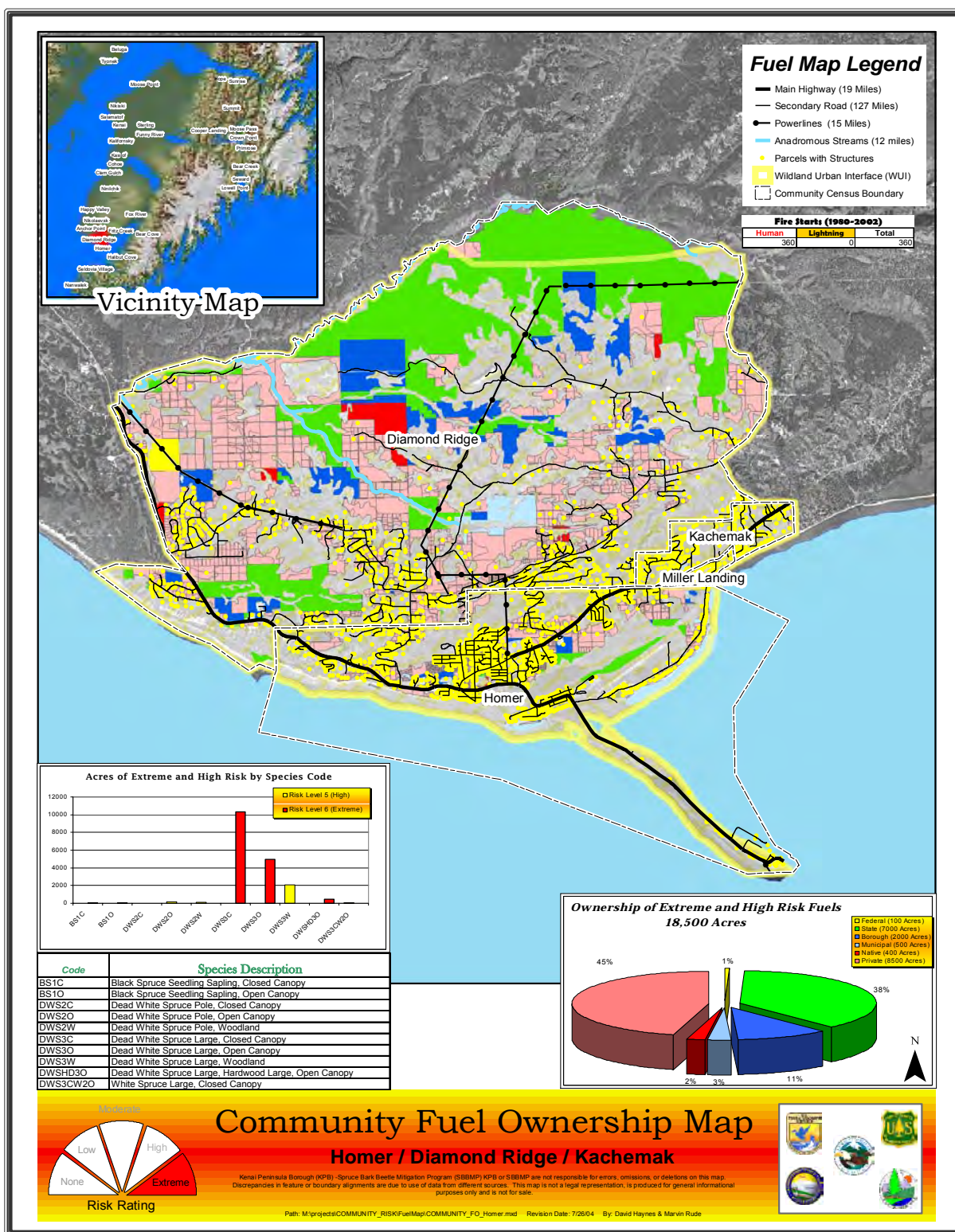


Map C-3.1



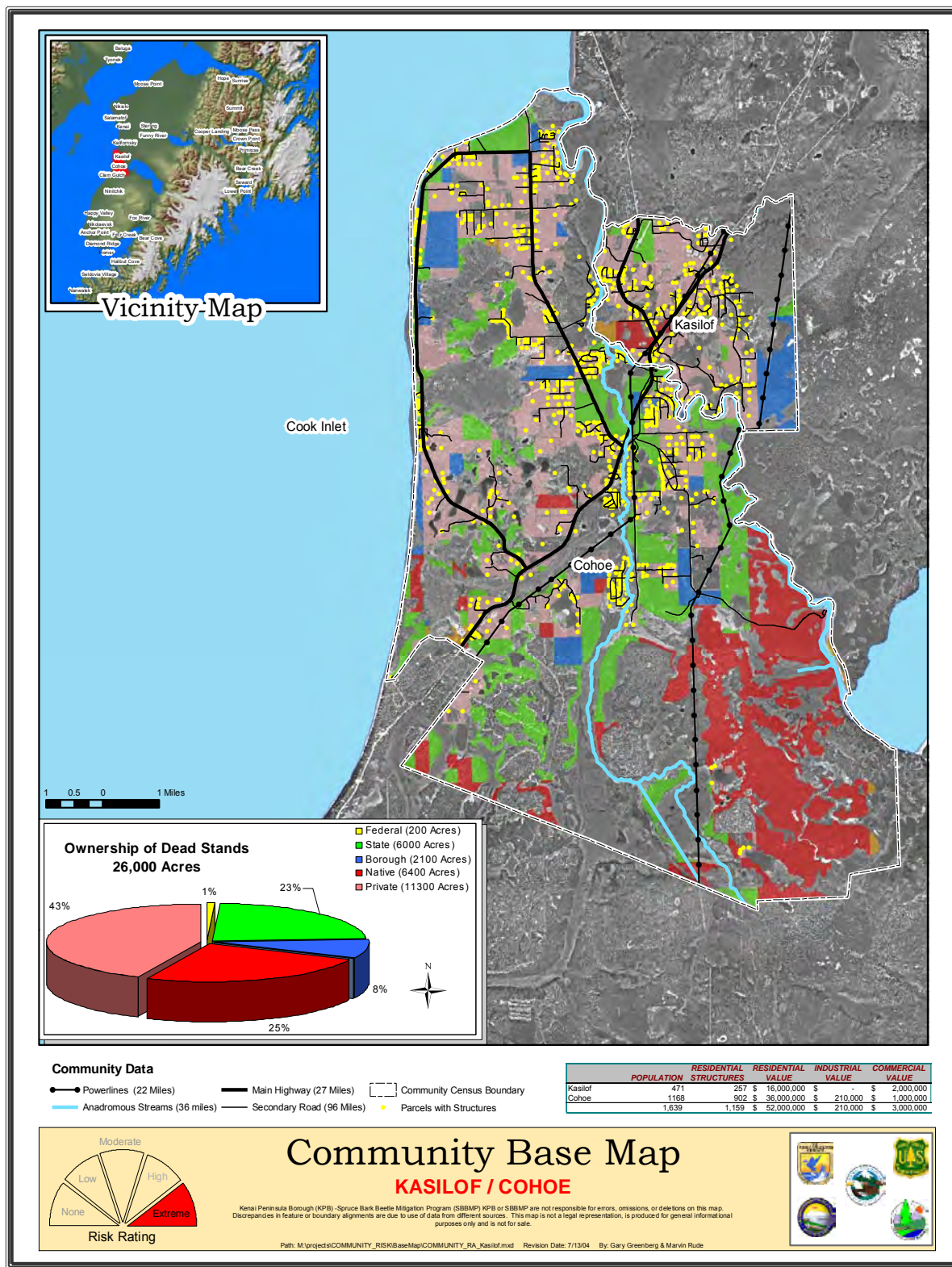


Map C-3.2





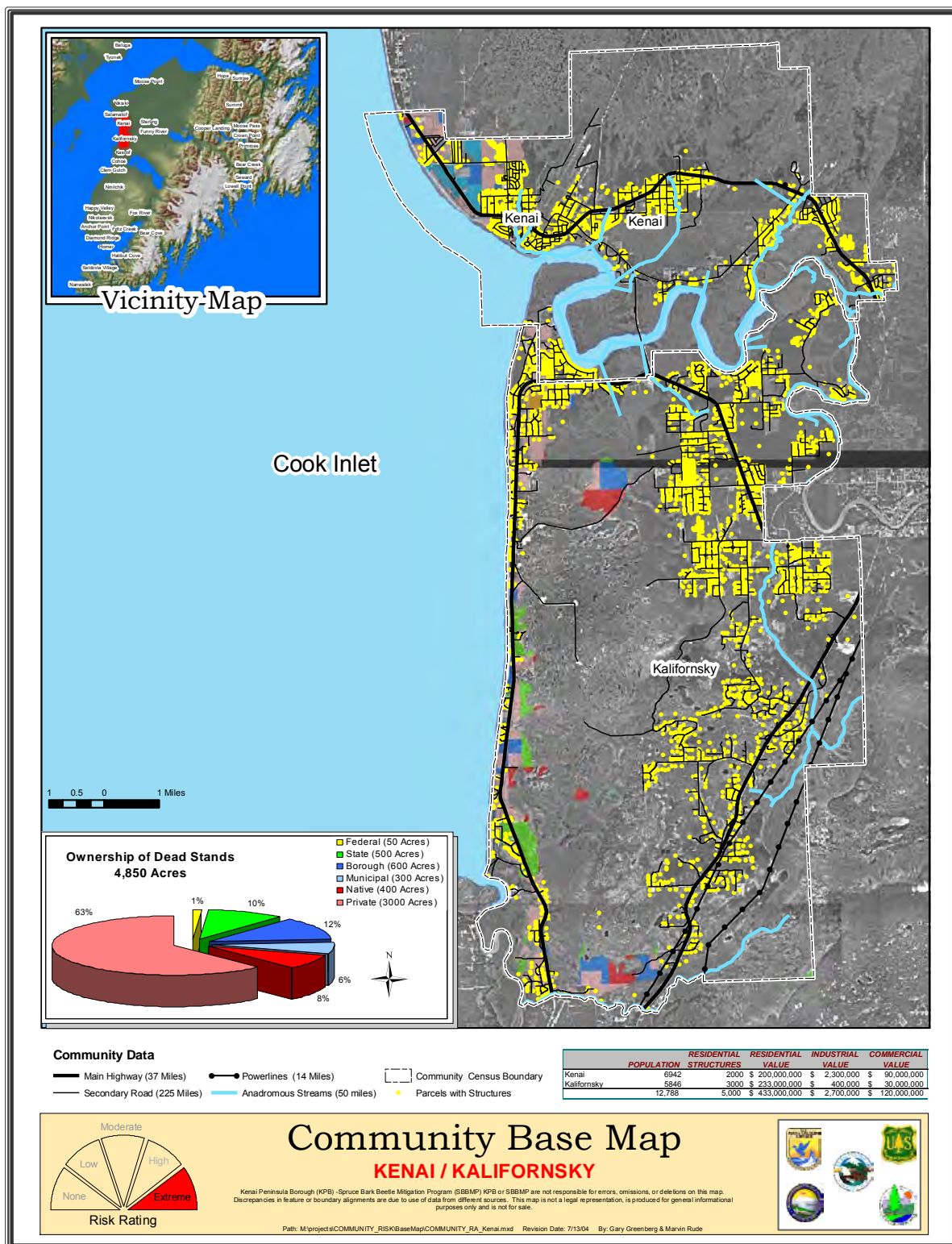
Map C-4.1







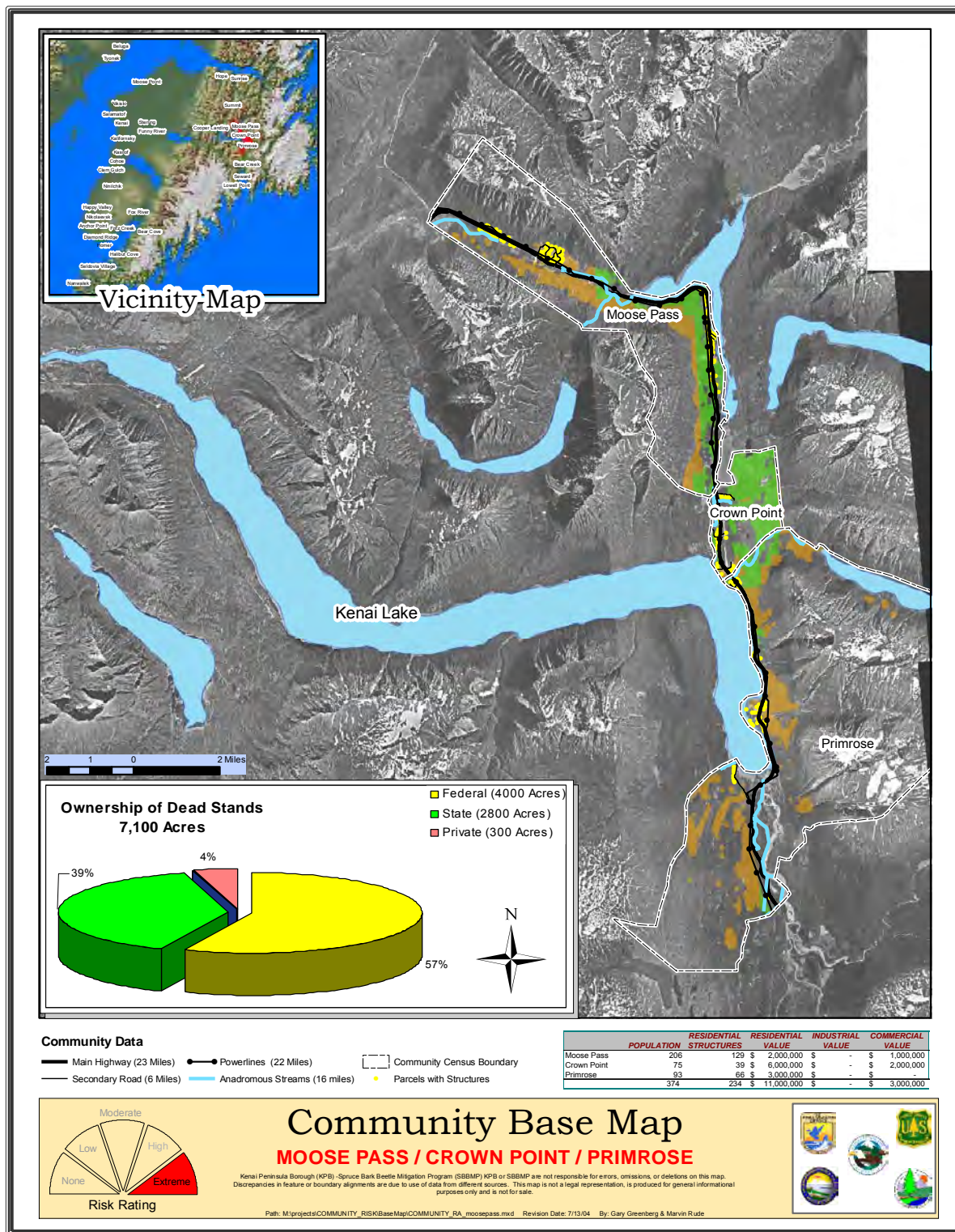
Map C-5.1



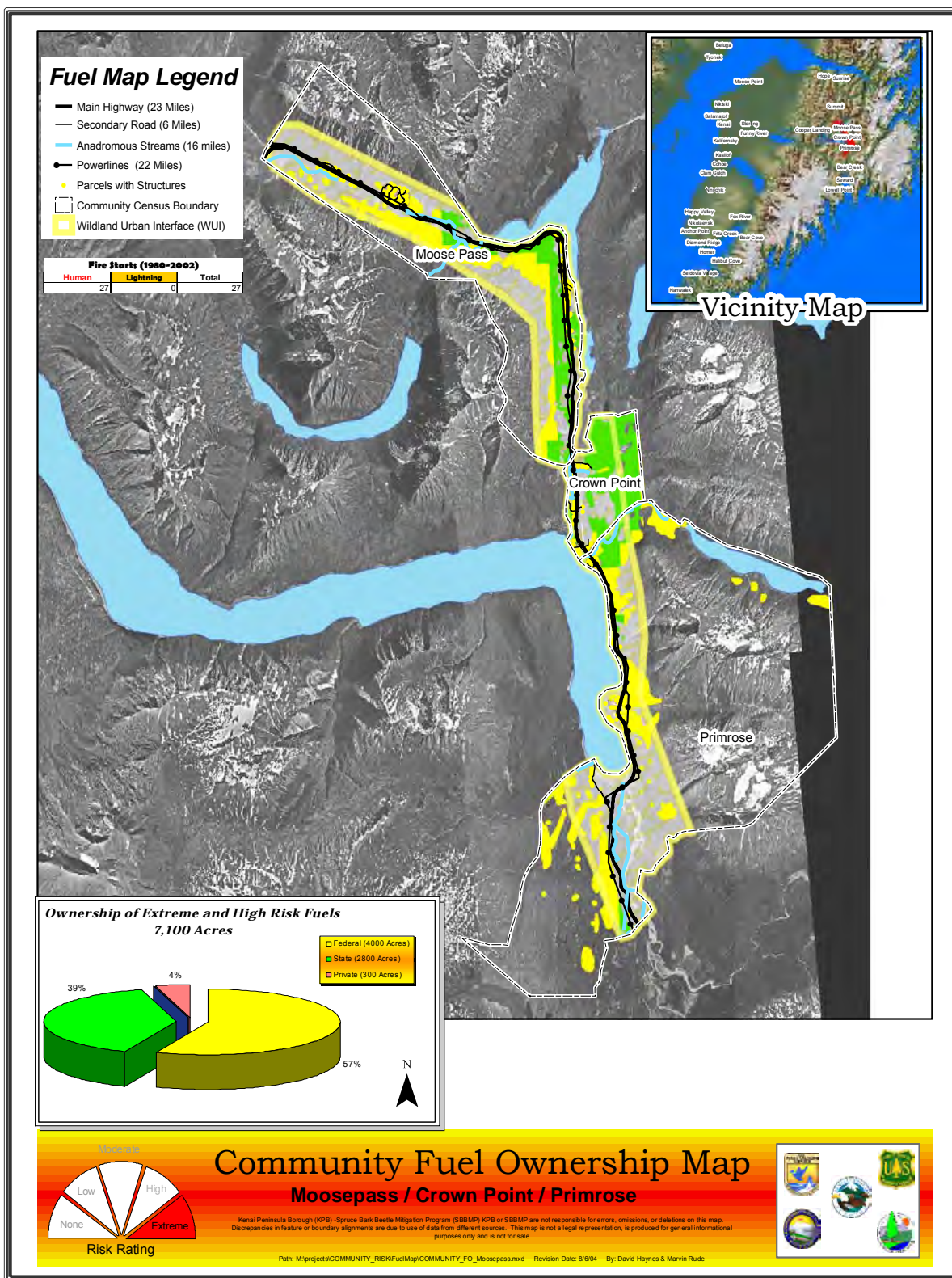




Map C-6.1

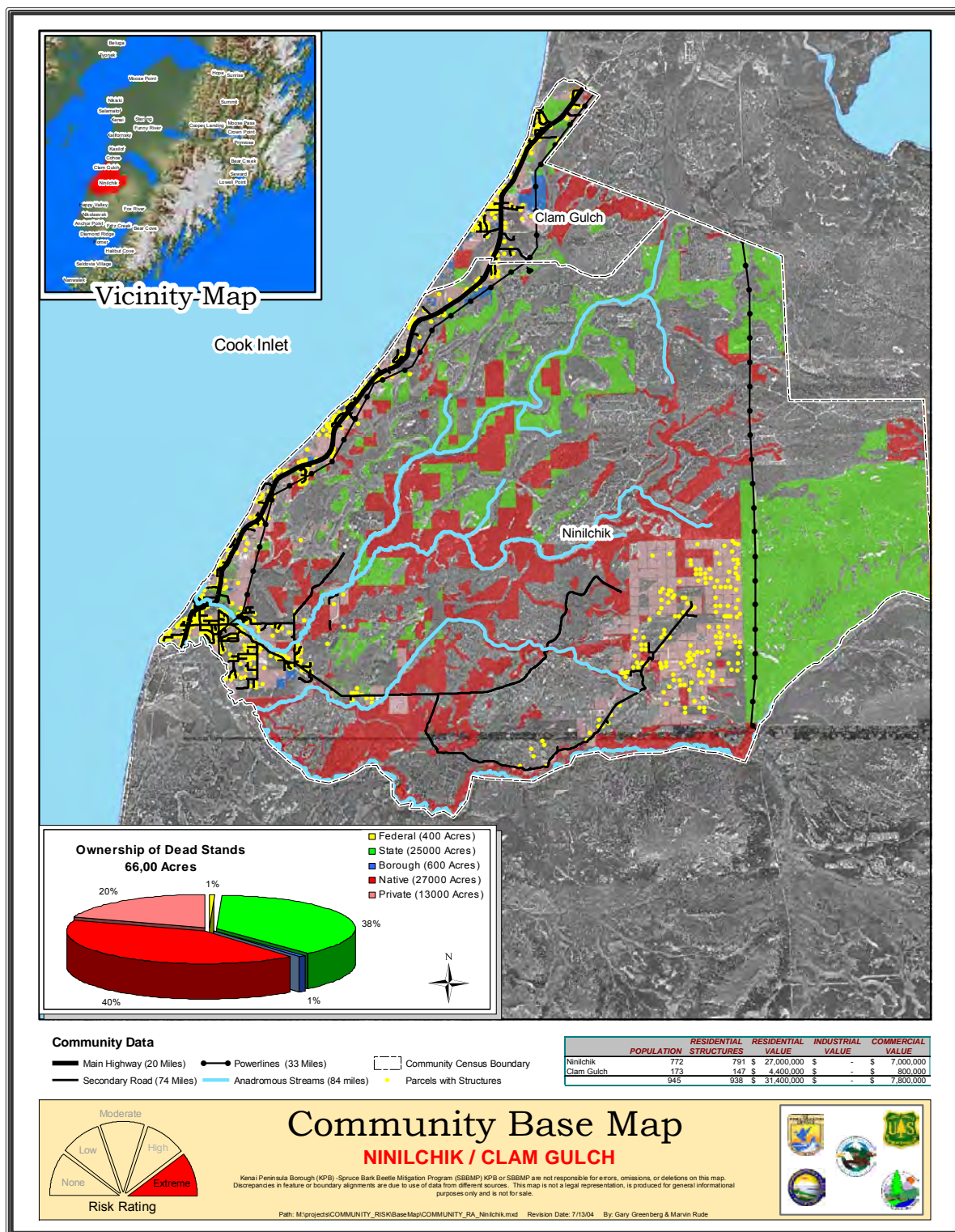


Map C-6.2

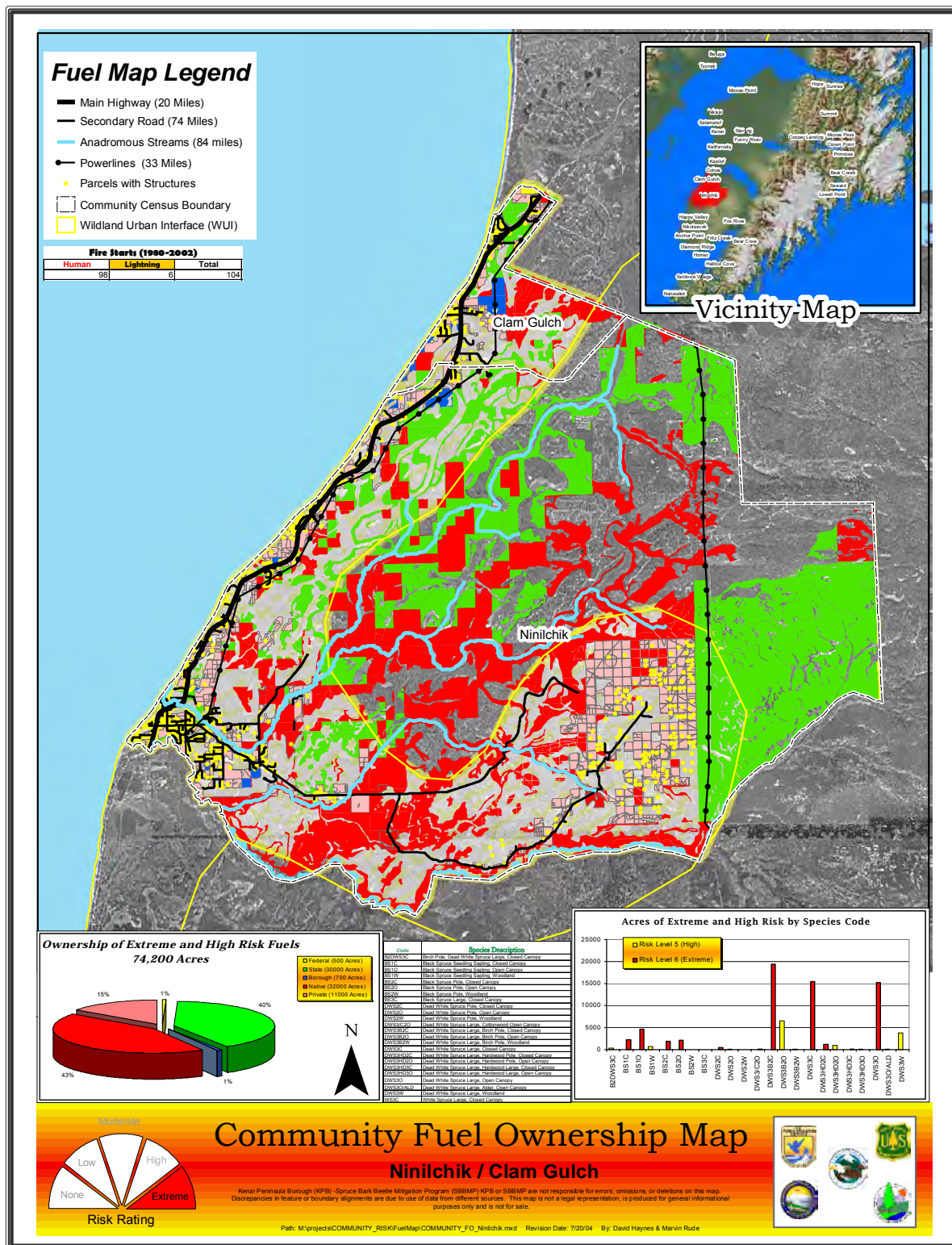




Map C-7/8.1

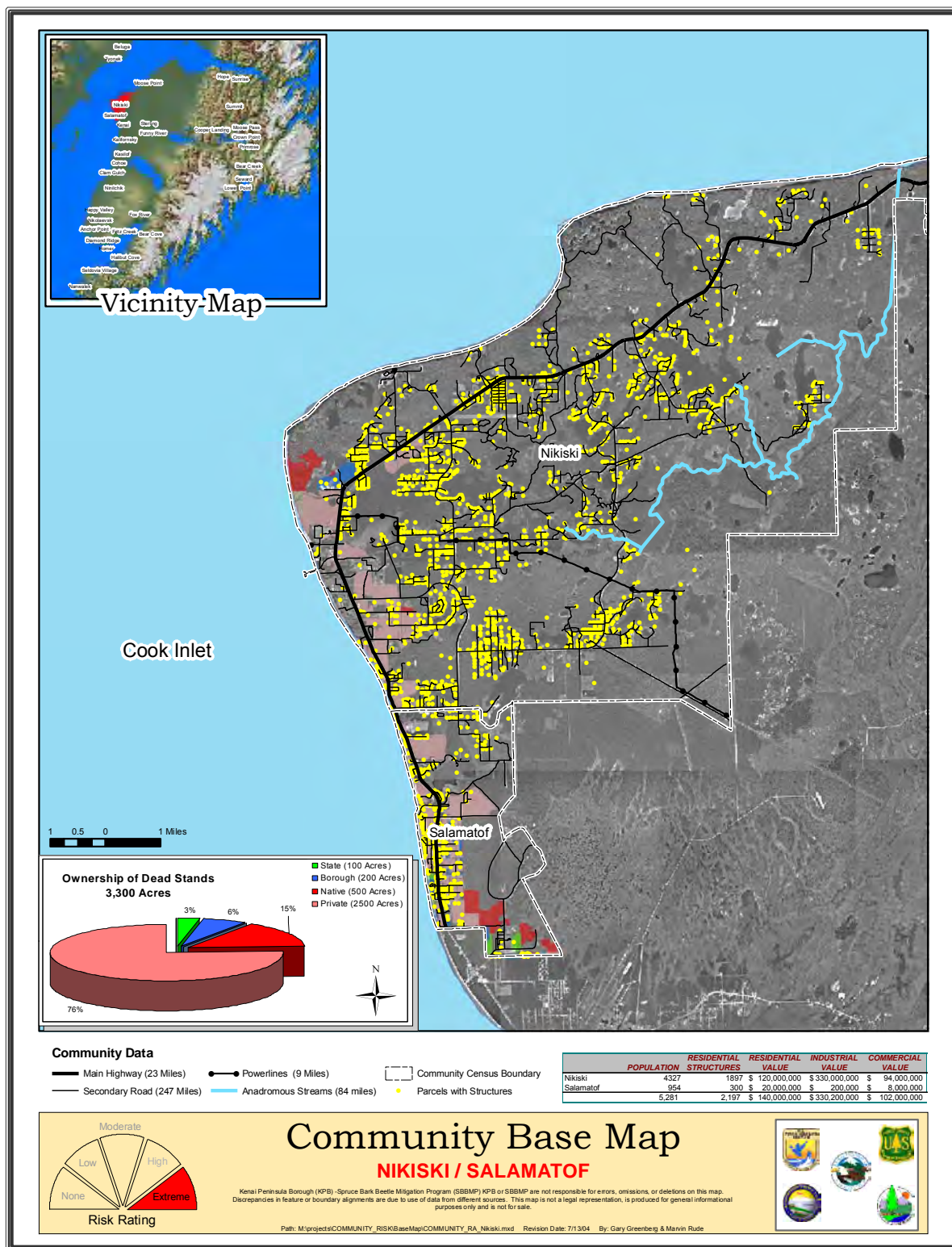


Map C-7/8.2

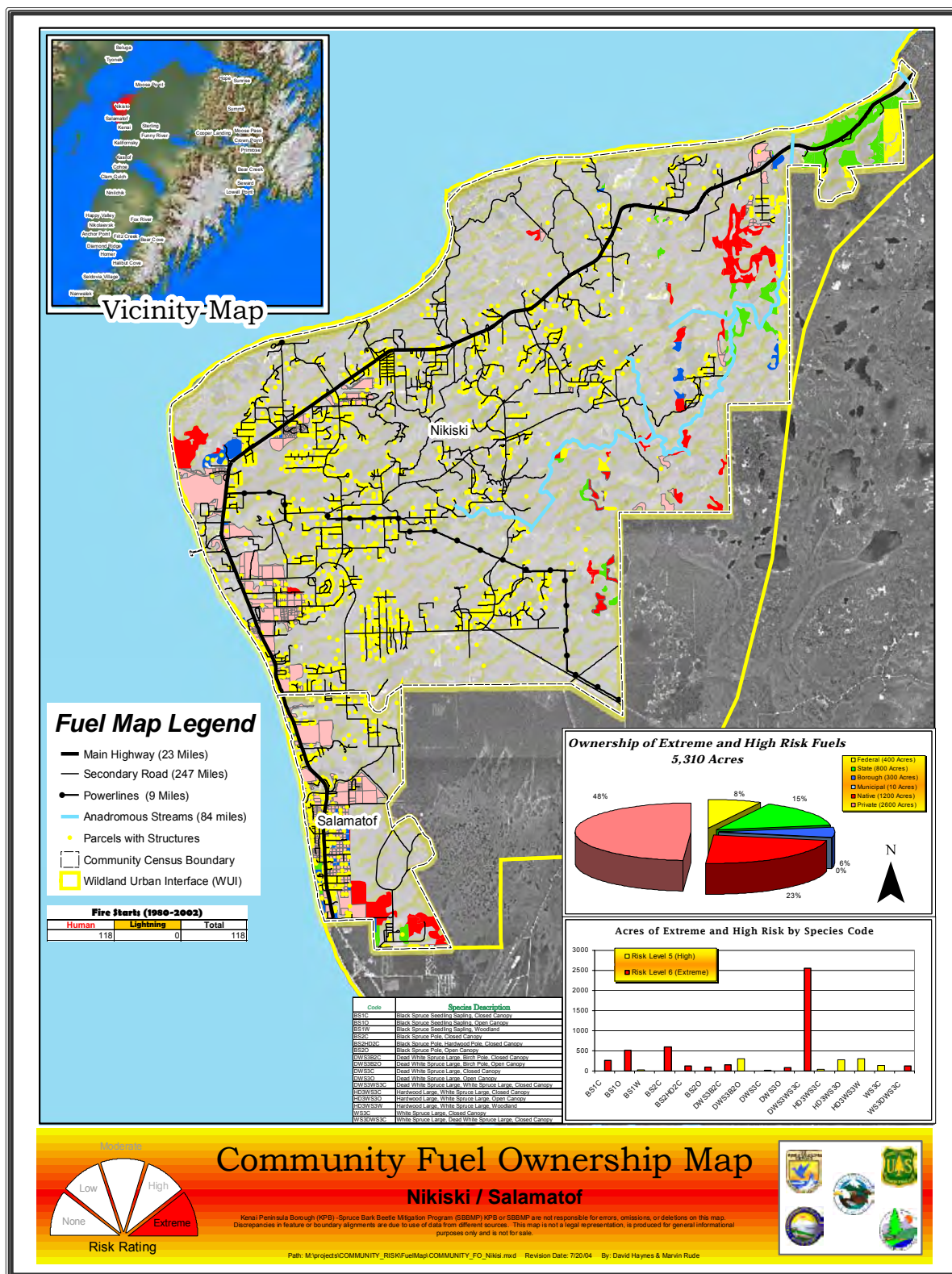




Map C-9.1



Map C-9.2

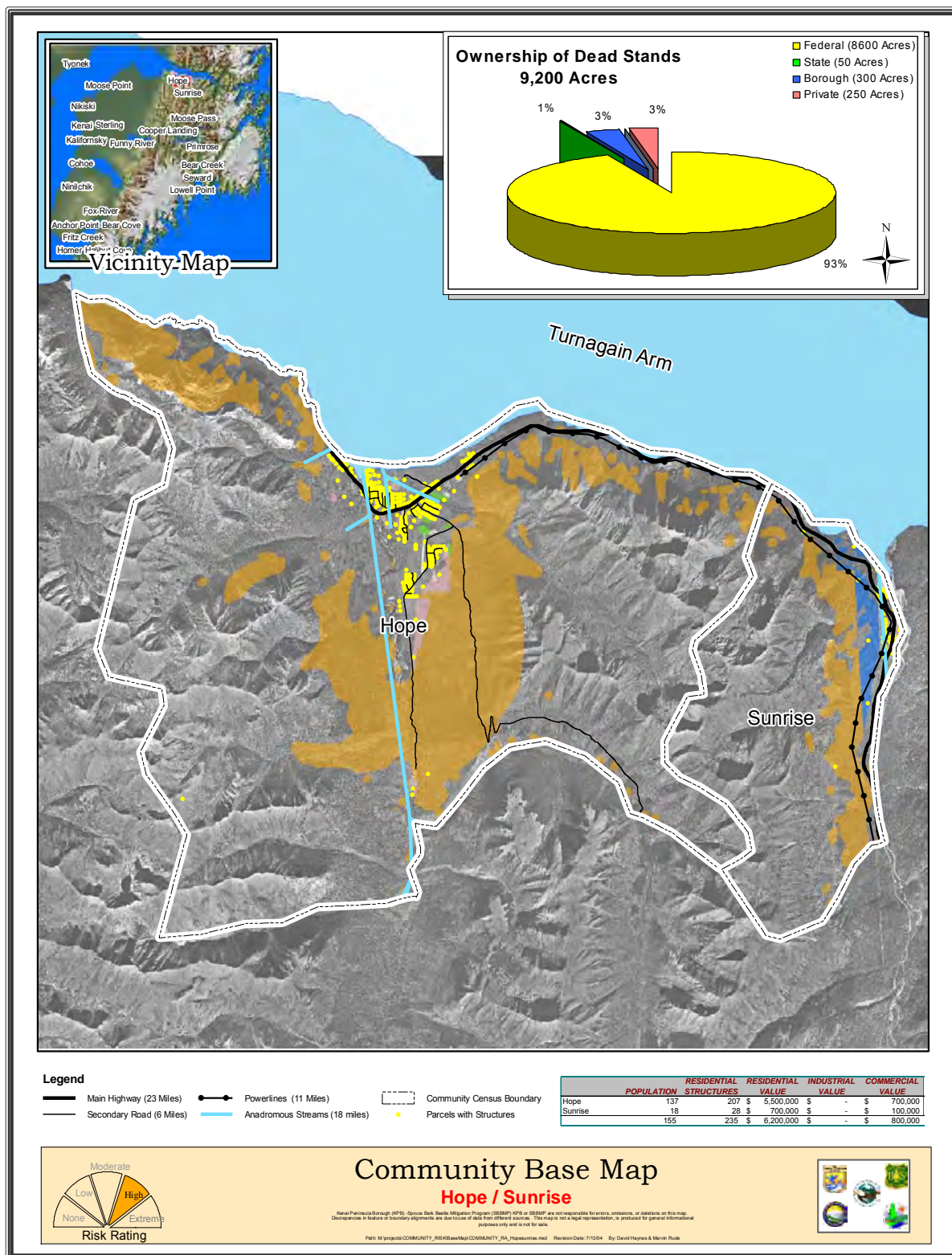


**Community Base Maps & Fuel Ownership Maps**  
for  
**Kenai Peninsula Communities**  
with a  
**High Wildfire Risk Rating**  
(Cumulative Structure Value = \$600 Million Dollars)

- Map C-10.0 Hope/Sunrise
- Map C-11.0 Cooper Landing
- Map C-12.0 Seldovia/Seldovia Village
- Map C-13.0 Soldotna/Ridgeway
- Map C-14.0 Sterling/Funny River
- Map C-15.0 Halibut Cover/Bear Cove

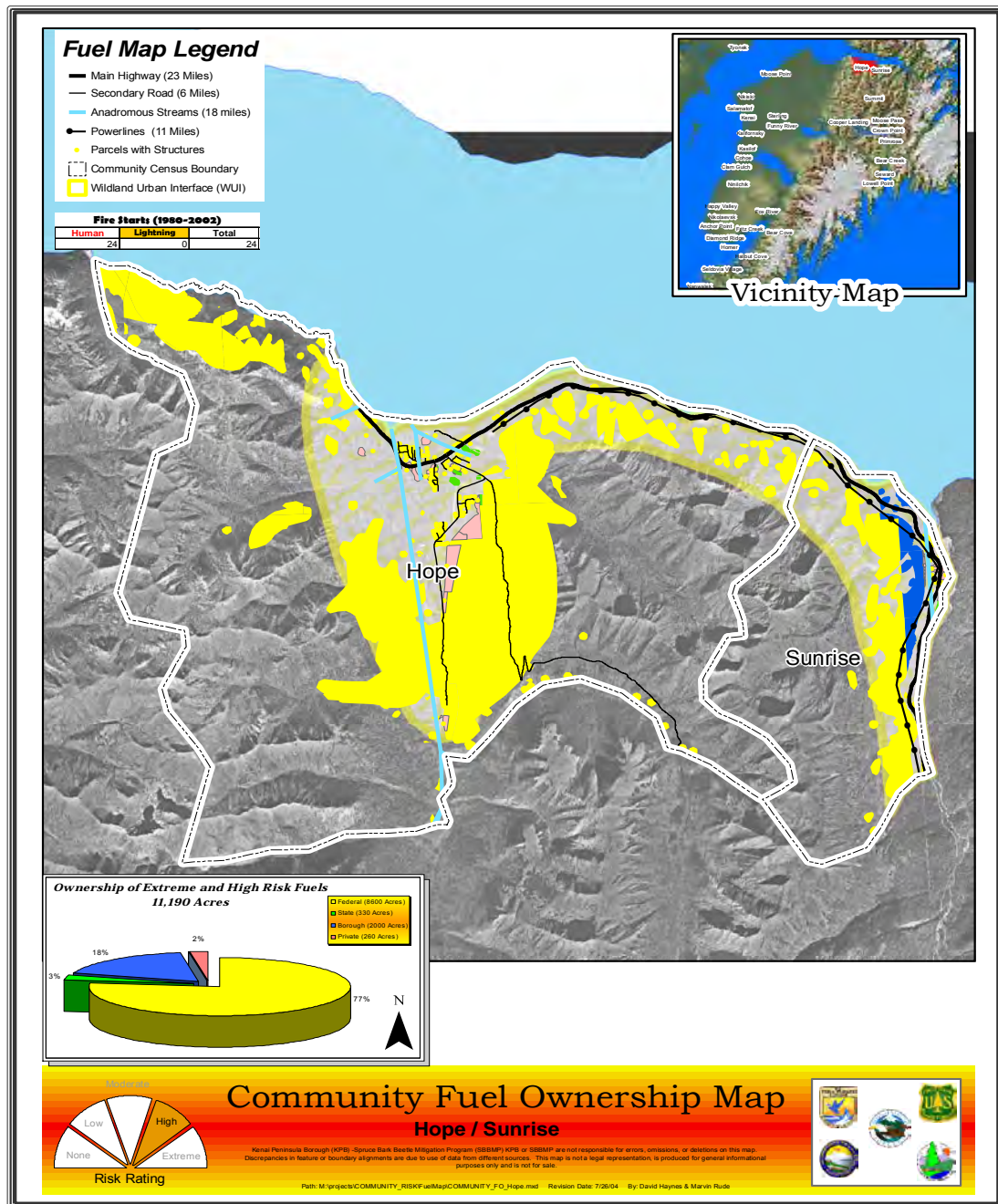


Map C-10.1

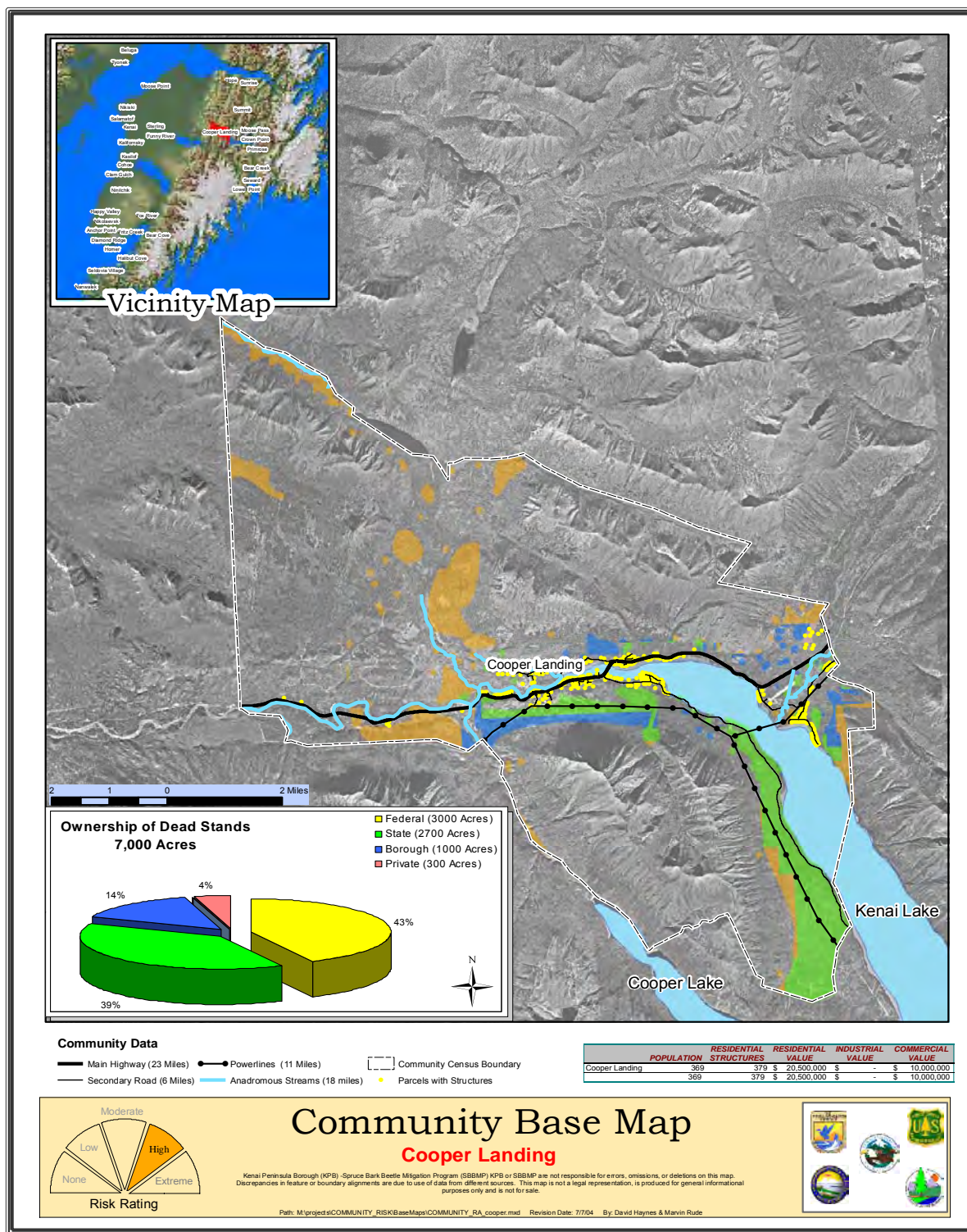




Map C-10.2

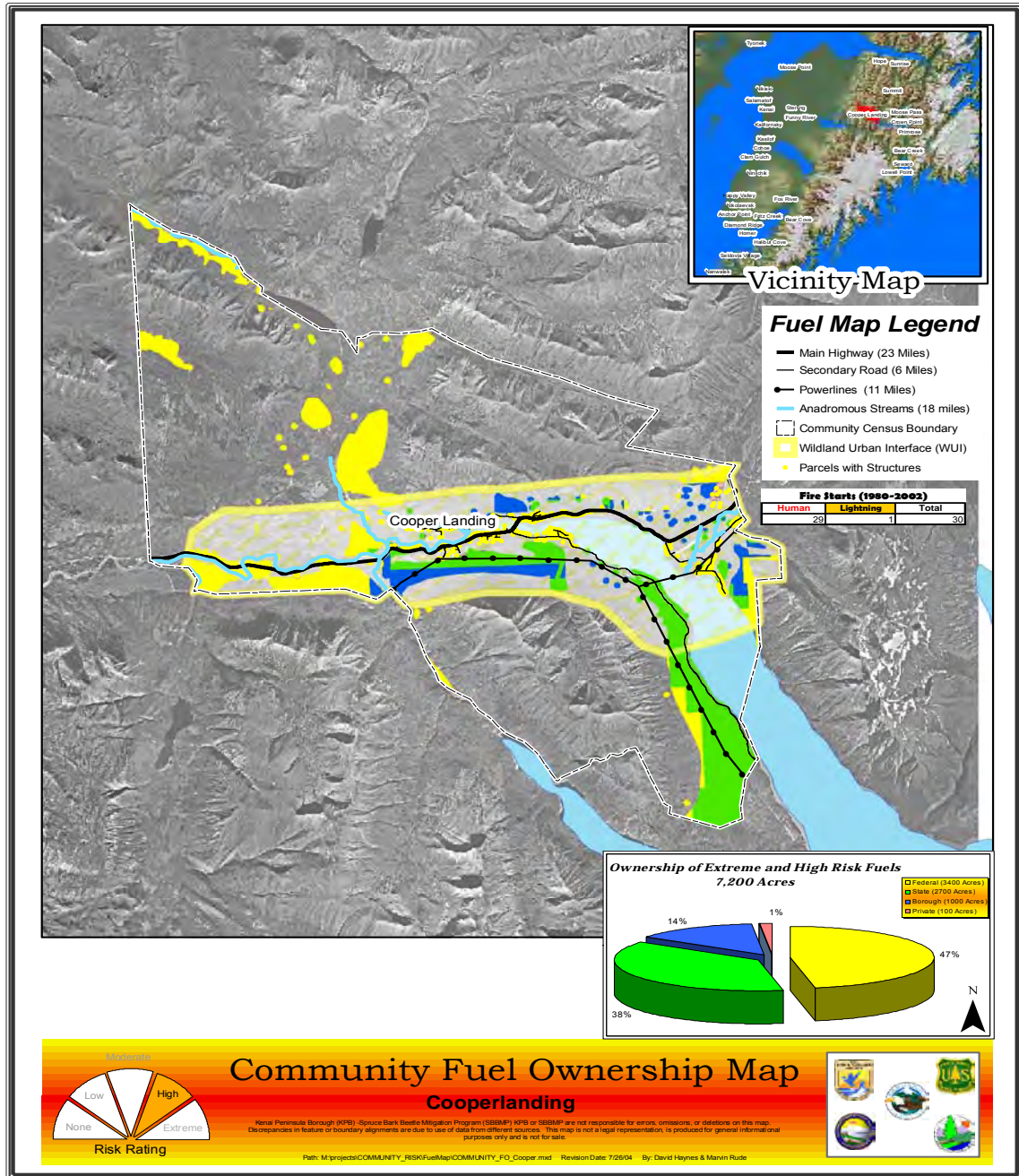


Map C-11.1

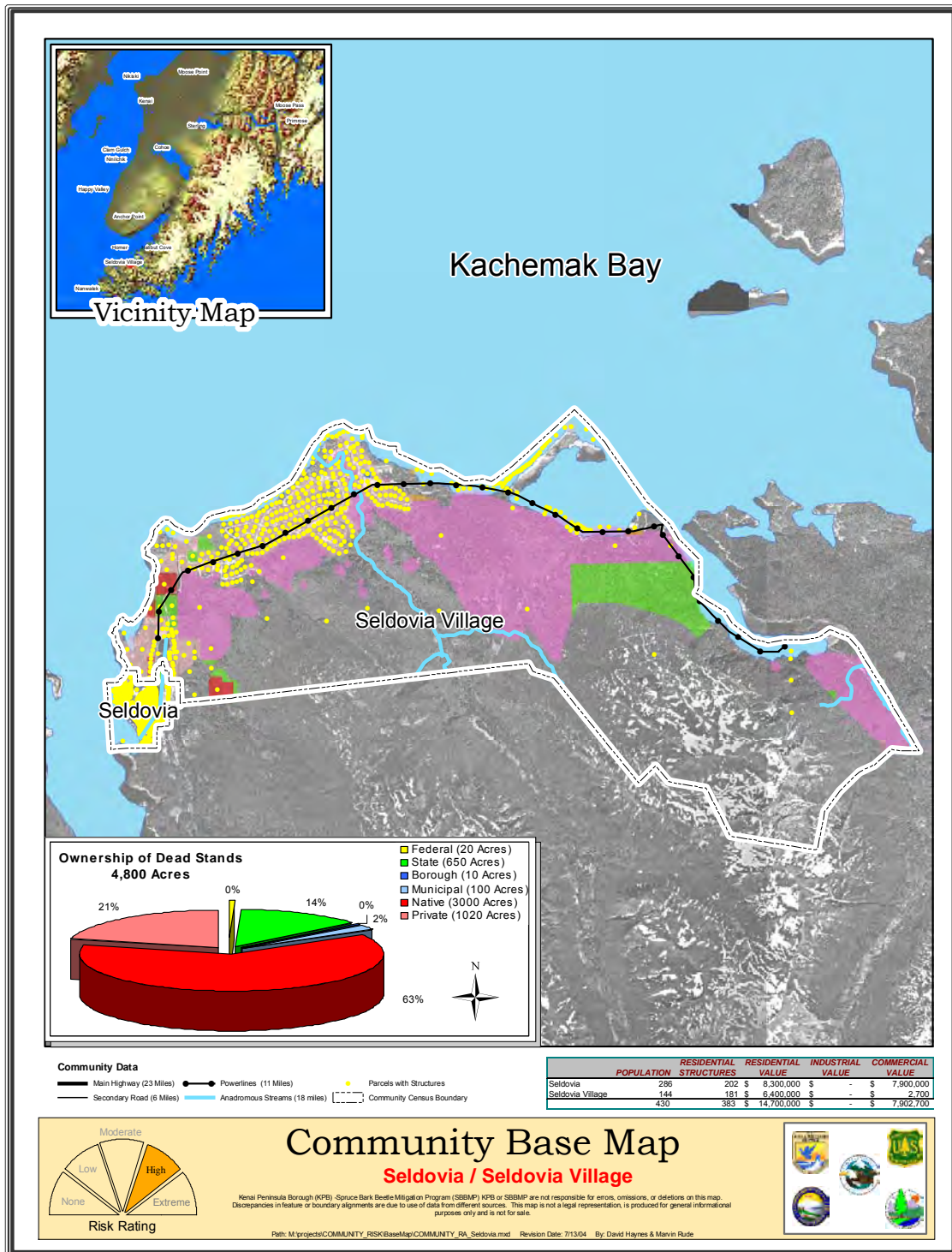




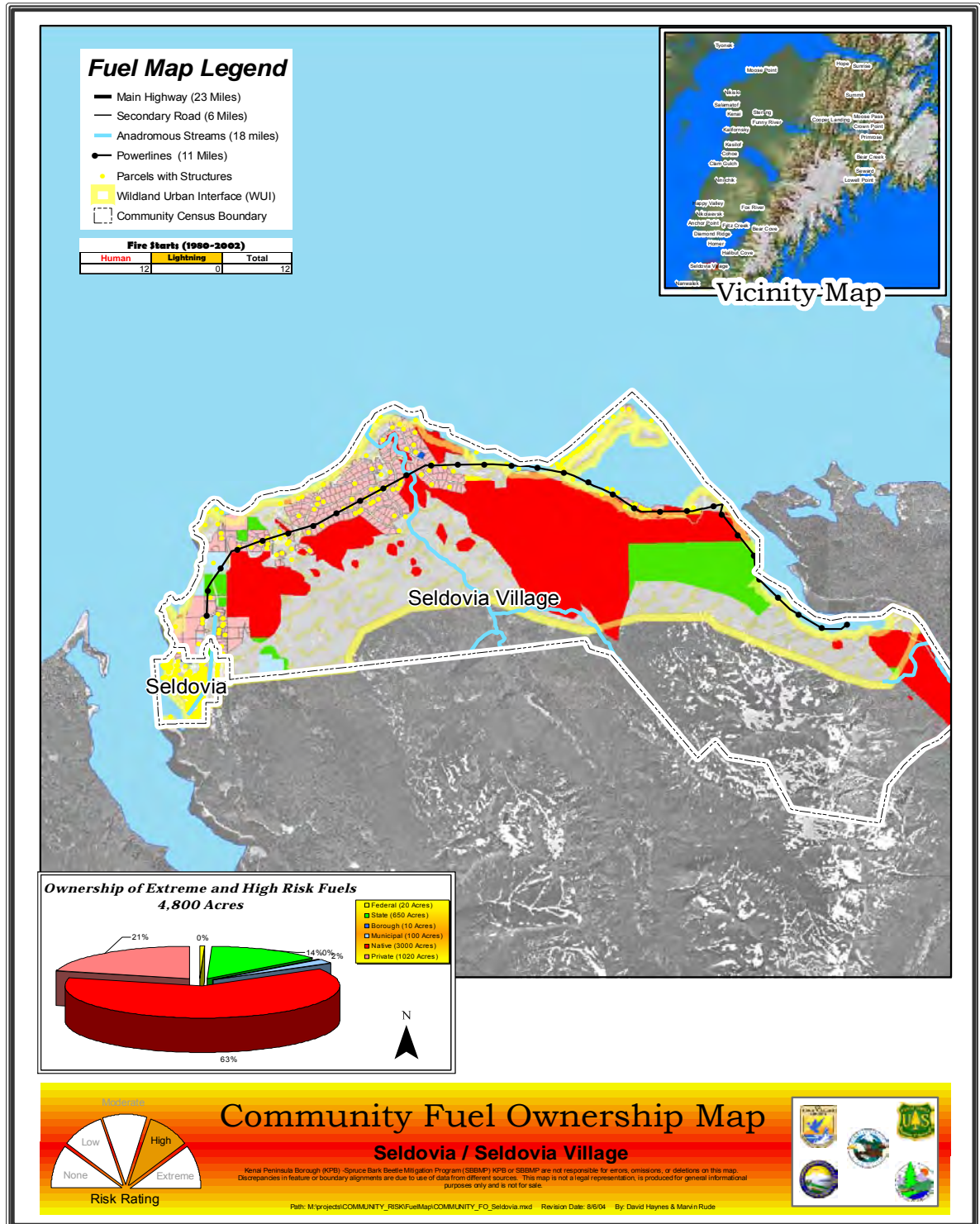
Map C-11.2



Map C-12.1

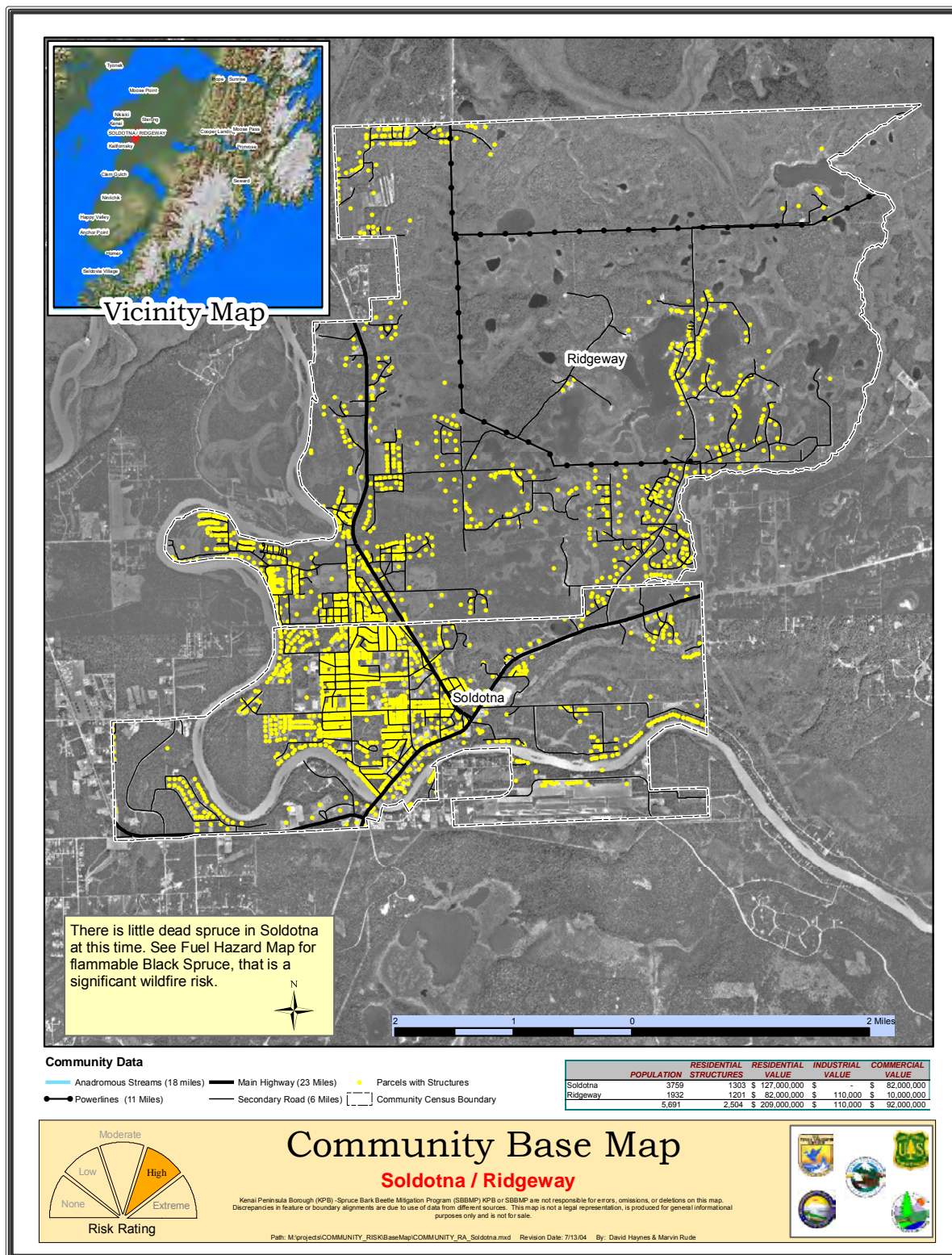


Map C-12.2



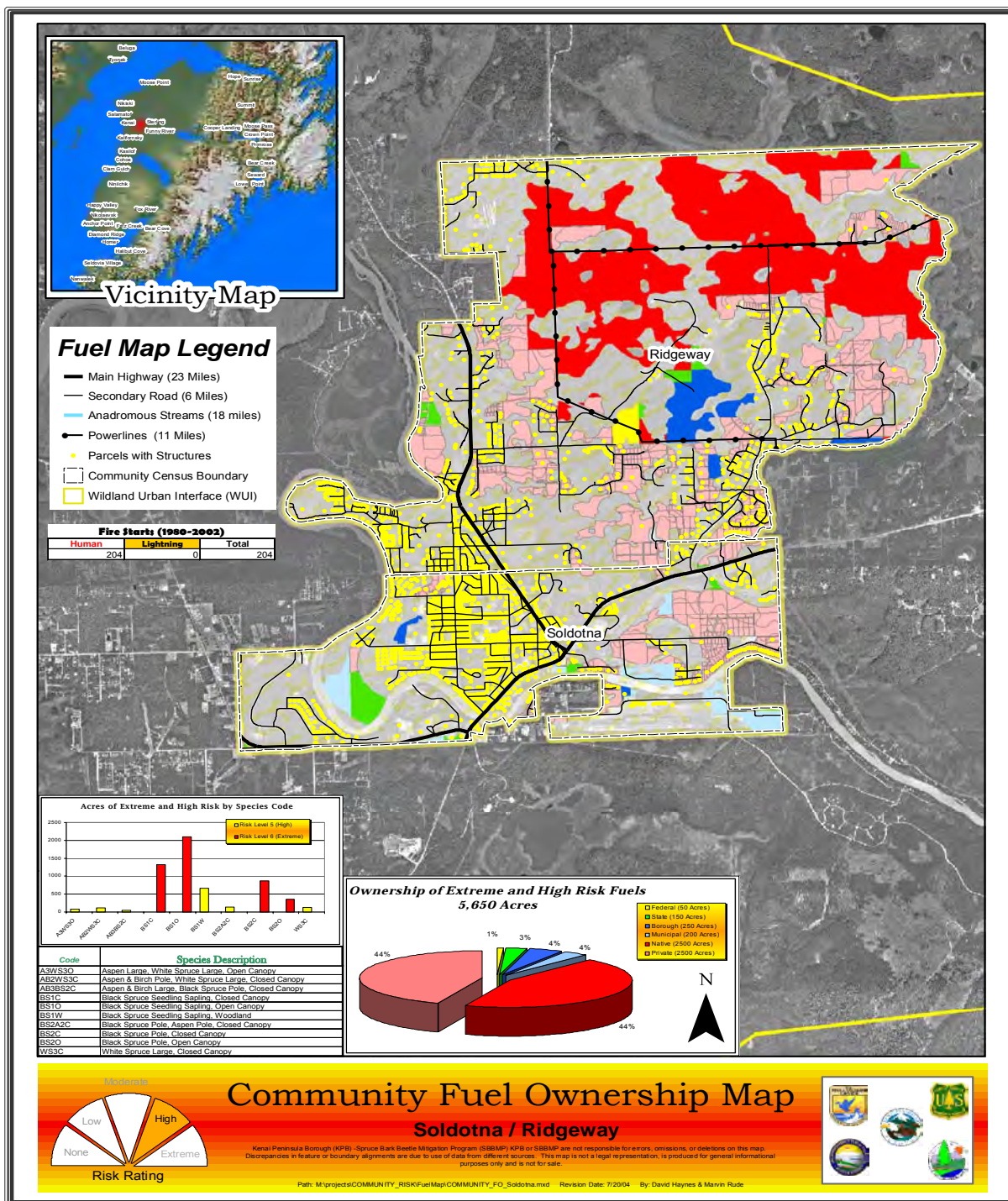


Map C-13.1

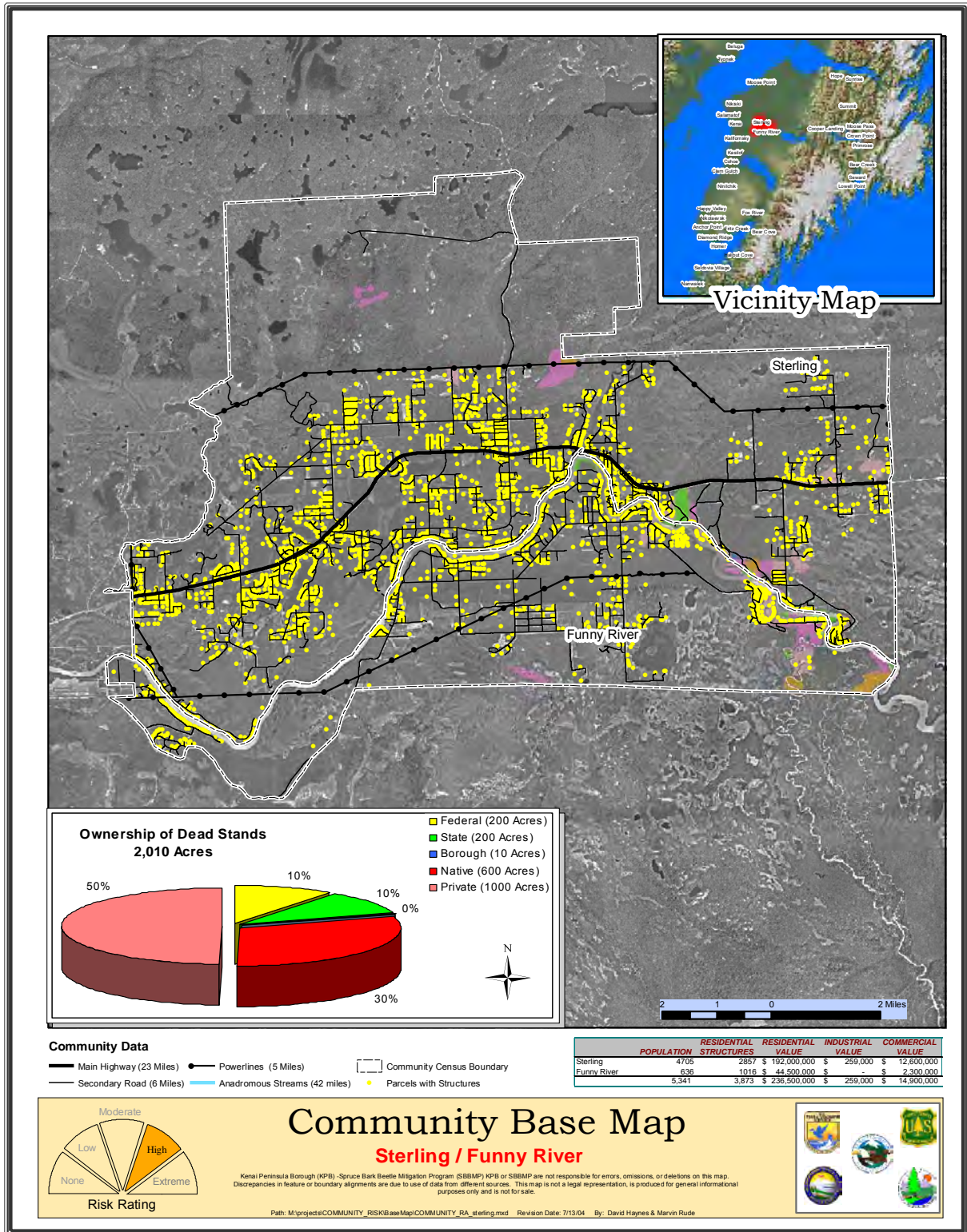




Map C-13.2

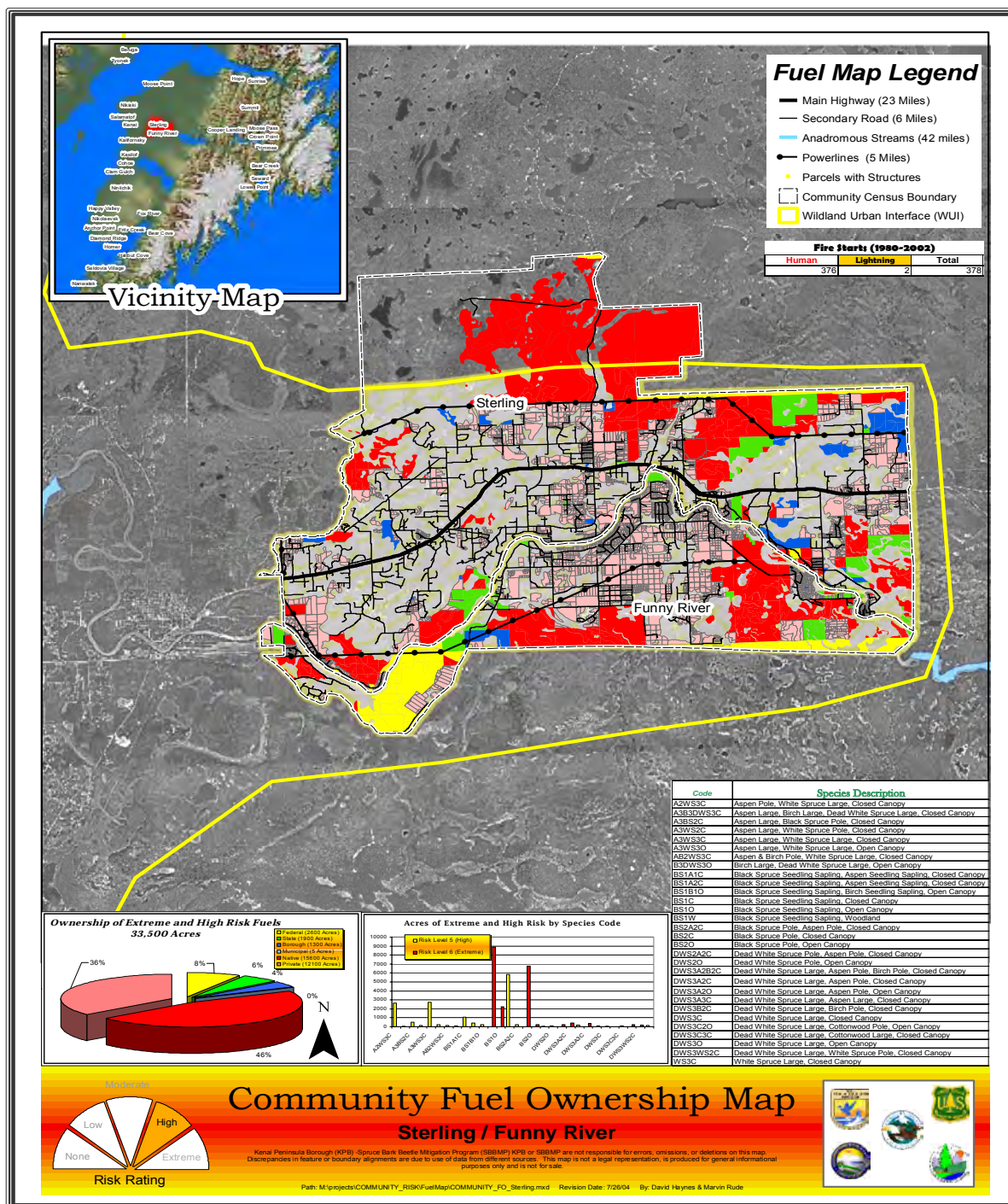


Map C-14.1

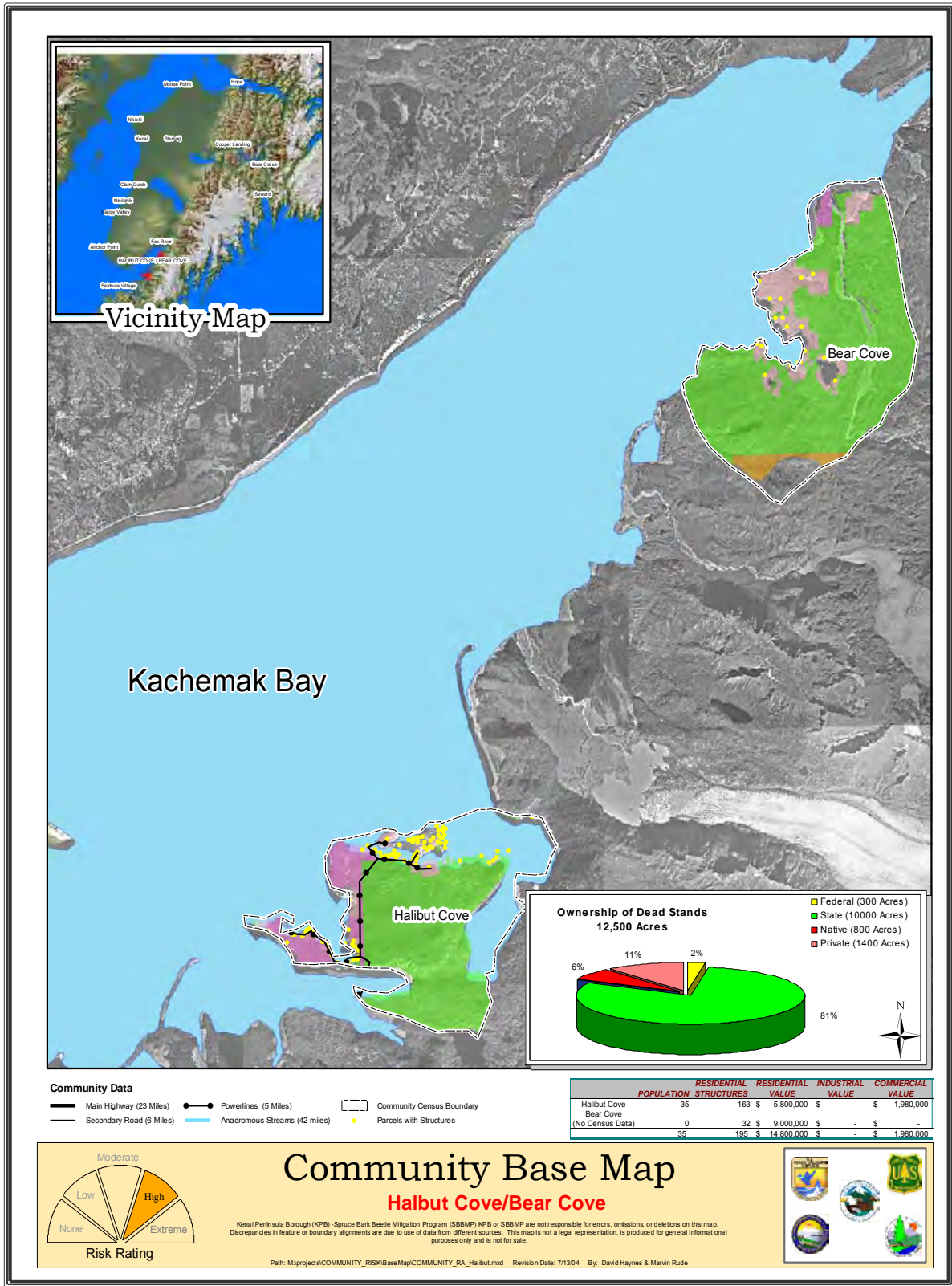




Map C-14.2

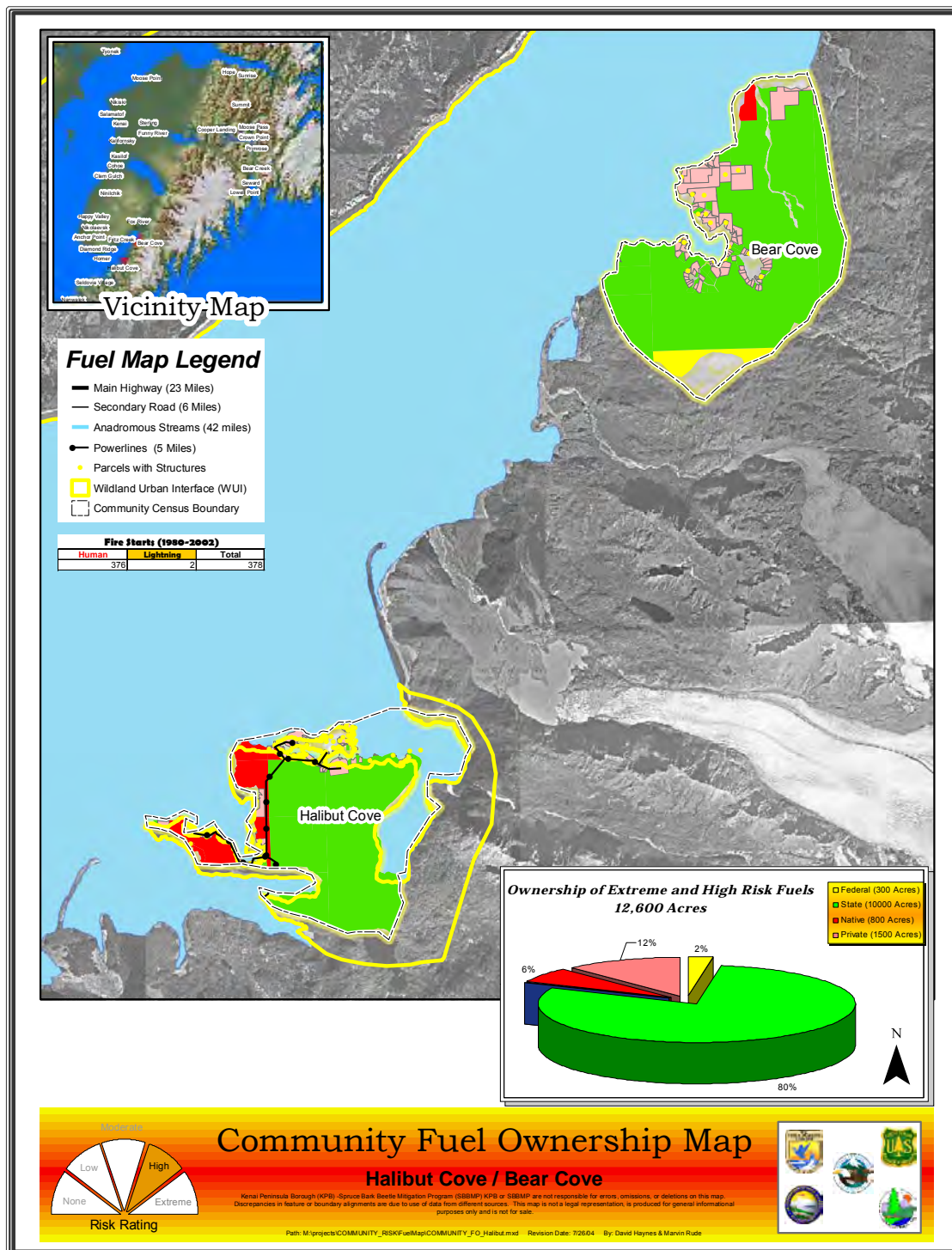


Map C-15.1





Map C-15.2



**Community Base Maps & Fuel Ownership Maps**  
for  
**Kenai Peninsula Communities**  
with a  
**Medium Wildfire Risk Rating**  
(Cumulative Structure Value = \$2 Million Dollars)

Map C-16.0 Grey Cliffs/Moose Point (Not currently available)

Map C-17.0 Summit (Not currently available)



**Community Base Maps & Fuel Ownership Maps**  
for  
**Kenai Peninsula Communities**  
with a  
**Low Wildfire Risk Rating**  
(Cumulative Structure Value = \$212 Million Dollars)

Map C-18.0 Seward/Bear Cr./Lowell Point (Not currently available)

Map C-19.0 Tyonek/Beluga Community (Not currently available)

Map C-20.0 Port Graham/Nanwalek (Not currently available)

# APPENDIX D

## LITERATURE

## CITED

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## LITERATURE CITED

**Alexander, Martin E. and Brian J. Stocks. 1997** Letter to Joe Stam, Fire Operations Forester, DNR regarding spruce beetle effects on wildland fuels and fire suppression dated August 15, 1997.

**Beaver, Al, 1997.** Haines Junction Fire HJ-03-97, Fire Behavior Case Study. Yukon Forest Protection Program

**Berg, Ed, 1996.** Final Report of Crooked Creek Post Fire Vegetation Survey, Kenai Wildlife Refuge.

**Holsten E. H., Richard A. Werner, and Rob Develice. 1995.** Effects of a Spruce Bark Beetle (Coleoptera: Scolytidae) Outbreak and Fire on Lutz Spruce in Alaska. Environ. Entomol. 24(6): 1539-1547 (1995).

**Kromery, Mark, 1998.** Forestry Technician, Seward Ranger District-United States Forest Service, personal conversation.

**Schulz, Bethany. 1995.** Changes Over Time in Fuel-loading Associated with Spruce Beetle-Impacted Stands of the Kenai Peninsula, Alaska. Forest Health Management Report. U.S. Dep. Of Ag. Forest Service. Technical Report R10-TP-53, January 1995.

**See, John W. 1997.** Spruce Beetle Activity & Potential Wildland Fire Hazards in Southcentral Alaska. Prepared by the Department Of Natural Resources, Division of Forestry. March 1997.

**See, John W. 1998.** Kenai Peninsula Spruce Beetle Epidemic Fire Danger/Behavior Status Report. Prepared by the Dept. of Natural Resources, Division of Forestry, January 1998.

**USDA 1996.** Forest Insect and Disease Conditions in Alaska – 1996, USDA Forest Service, State & Private Forestry, General Technical Report R10-TP-67, April, 1997.

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# APPENDIX E

## INDIVIDUAL AGENCY/LANDOWNER 5-YEAR PROJECT IMPLEMENTATION PLANS



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# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

## TABLE E1.0 - PRIVATE LAND OWNERS 5-YEAR PROJECT IMPLEMENTATION SCHEDULE

Goal # 1 - Fire Prevention & Protection - Private Land								
Project Name	Project	Output Units of Measure/Cost C	2005	2006	2007	2008	2009	TOTAL
<b>Total Fire Prevention &amp; Protection - Private Land</b>	<b>TOTAL</b>	<b>Annual Estimated Program Cost</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>
Goal # 2 - Hazardous Fuel Reduction - Private Land Projects								
Project Name	Project	Output Units of Measure/Cost C	2005	2006	2007	2008	2009	TOTAL
<b>WUI Forest Stewardship Program - Private</b>	FR-4	Number of Parcels	1660	1660	1660	1660	1660	8,300
- WUI Fuel Reduction on Private Land less than 1/2 acre in size and containing structures	FR-4	Mechanical Acres	0	0	0	0	0	-
	FR-4	Fuel Break Acres	0	0	0	0	0	-
Goal - Reduce fuel loading within 75 feet of structures. Project would involve properties 1/2 acres in size and larger with structures. Within the KPB, approximately 8,300 parcels are expected to participate in the program. Participation will be on a cost-share basis of 70%. Average cost per parcel is \$1,600. Support costs of \$193,000 per year for staff and operating supplies.	FR-4	Prescribe Burn Acres	0	0	0	0	0	-
	FR-4	Power Line Miles	0	0	0	0	0	-
	FR-4	Hwy Miles	0	0	0	0	0	-
	FR-4	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	FR-4	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Note: Project Funding is normally administered by the State DOF</b>	FR-4	Contract & Administration	\$ 2,022,000	\$ 2,022,000	\$ 2,022,000	\$ 2,022,000	\$ 2,022,000	\$ 10,110,000
	FR-4	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: KPB, PVT	FR-4	<b>Estimated Annual Total Project Cost</b>	<b>\$ 2,022,000</b>	<b>\$ 2,022,000</b>	<b>\$ 2,022,000</b>	<b>\$ 2,022,000</b>	<b>\$ 2,022,000</b>	<b>\$ 10,110,000</b>
<b>Fuel Reduction Project - 300' defensible space</b>	FR-7	Number of Parcels	1600	1600	1600	1600	1600	8,000
	FR-7	Mechanical Acres	0	0	0	0	0	-
Goal - Reduce fuel loading around structures within WUI.	FR-7	Fuel Break Acres	0	0	0	0	0	-
30 weeks Kenai Crew work funds provided for support to clear defensible space.	FR-7	Prescribe Burn Acres	0	0	0	0	0	-
	FR-7	Power Line Miles	0	0	0	0	0	-
	FR-7	Hwy Miles	0	0	0	0	0	-
	FR-7	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	FR-7	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Note: Project Funding is normally administered by the KPB</b>	FR-7	Contract & Administration	\$ 1,225,350	\$ 1,225,350	\$ 1,225,350	\$ 1,225,350	\$ 1,225,350	\$ 6,126,750
	FR-7	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: AKDOF, USFS, PVT	FR-7	<b>Estimated Annual Total Project Cost</b>	<b>\$ 1,225,350</b>	<b>\$ 1,225,350</b>	<b>\$ 1,225,350</b>	<b>\$ 1,225,350</b>	<b>\$ 1,225,350</b>	<b>\$ 6,126,750</b>
<b>WUI Treatment (creating 300' defensible space)</b>	FR-8	Number of Parcels	250	250	250	250	250	1,250
- WUI Fuel Reduction on KPB & public use parcels that are within high/moderate hazard areas.	FR-8	Mechanical Acres	0	0	0	0	0	-
Goal - Reduce fuel loading on small KPB & public use parcels	FR-8	Fuel Break Acres	0	0	0	0	0	-
Approximately 1250 parcels needing treatment	FR-8	Prescribe Burn Acres	0	0	0	0	0	-
	FR-8	Power Line Miles	0	0	0	0	0	-
	FR-8	Hwy Miles	0	0	0	0	0	-
	FR-8	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	FR-8	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Note: Project Funding is normally administered by the KPB</b>	FR-8	Contract & Administration	\$ 350,700	\$ 350,700	\$ 350,700	\$ 350,700	\$ 350,700	\$ 1,753,500
	FR-8	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: KPB, State	FR-8	<b>Estimated Annual Total Project Cost</b>	<b>\$ 350,700</b>	<b>\$ 350,700</b>	<b>\$ 350,700</b>	<b>\$ 350,700</b>	<b>\$ 350,700</b>	<b>\$ 1,753,500</b>
<b>Fuel Reduction Project - 300' to WUI boundary</b>	FR-9	Number of Parcels	0	0	0	0	0	-
	FR-9	Mechanical Acres	0	10000	10000	10000	10000	40,000
Goal - Reduce fuels in the zone from 300 feet from structures/communities out to the WUI boundary.	FR-9	Fuel Break Acres	0	0	0	0	0	-
	FR-9	Prescribe Burn Acres	0	0	0	0	0	-
	FR-9	Power Line Miles	0	0	0	0	0	-
	FR-9	Hwy Miles	0	0	0	0	0	-
	FR-9	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	FR-9	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Note: Project Funding is normally administered by the KPB</b>	FR-9	Contract & Administration	\$ 25,350	\$ 11,500,000	\$ 11,500,000	\$ 11,500,000	\$ 11,500,000	\$ 46,025,350
	FR-9	Cleanup & Monitoring	\$ -	\$ 500,000	\$ 500,000	\$ 500,000	\$ 500,000	\$ 2,000,000
Project Partners: State/PVT/Native	FR-9	<b>Estimated Annual Total Project Cost</b>	<b>\$ 25,350</b>	<b>\$ 12,000,000</b>	<b>\$ 12,000,000</b>	<b>\$ 12,000,000</b>	<b>\$ 12,000,000</b>	<b>\$ 48,025,350</b>
Total Hazardous Fuel Reduction - Private Land Projects								
	ALL	Total Number of Parcels	3,510	3,510	3,510	3,510	3,510	17,550
	ALL	Total Mechanical Acres	-	10,000	10,000	10,000	10,000	40,000
	ALL	Total Fuel Break Acres	-	-	-	-	-	-
	ALL	Total Prescribe Burn Acres	-	-	-	-	-	-
	ALL	Total Power Line Miles	-	-	-	-	-	-
	ALL	Total Hwy Miles	-	-	-	-	-	-
	ALL	Program Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Contract & Administration	\$ 3,623,400	\$ 15,098,050	\$ 15,098,050	\$ 15,098,050	\$ 15,098,050	\$ 64,015,600
	ALL	Cleanup & Monitoring	\$ -	\$ 500,000	\$ 500,000	\$ 500,000	\$ 500,000	\$ 2,000,000
	ALL	<b>Estimated Annual Total Program Cost</b>	<b>\$ 3,623,400</b>	<b>\$ 15,598,050</b>	<b>\$ 15,598,050</b>	<b>\$ 15,598,050</b>	<b>\$ 15,598,050</b>	<b>\$ 66,015,600</b>
Goal # 3 - Forest Health & Ecosystem Restoration - Private Land Projects								
Project Name	Project	Output Units of Measure/Cost C	2005	2006	2007	2008	2009	TOTAL
<b>Stewardship Forestry - Private</b>	RS-2	Mechanical Site Prep Acres	-	-	-	-	-	-
<b>Restoration of Small Private Land parcels under 7 acres in size</b>	RS-2	Reforestation Acres	4,900	4,900	4,900	4,900	4,900	24,500
Goal - Restore small private parcels by reforesting non-commercial forest lands between 1-7 acres in size. Estimate participation of approximately 24,500 acres. Assistance at a 70% cost-share basis. Assistance provided by Stewardship Foresters.	RS-2	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-2	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-2	Number of Seedlings	-	-	-	-	-	-
	RS-2	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-2	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-2	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Note: Project Funding is normally administered by the State DOF</b>	RS-2	Contract & Administration	\$ 4,123,000	\$ 4,123,000	\$ 4,123,000	\$ 4,123,000	\$ 4,123,000	\$ 20,615,000
	RS-2	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: Pvt	RS-2	<b>Estimated Annual Total Project Cost</b>	<b>\$ 4,123,000</b>	<b>\$ 4,123,000</b>	<b>\$ 4,123,000</b>	<b>\$ 4,123,000</b>	<b>\$ 4,123,000</b>	<b>\$ 20,615,000</b>
<b>Stewardship Forestry-Restoration of Small Private Land over 7 Acres in Size</b>	RS-6	Mechanical Site Prep Acres	-	-	-	-	-	-
	RS-6	Reforestation Acres	12,280	12,280	12,280	12,280	12,280	61,440
Goal - Restore Private Land by removing dead trees, site preparation, & tree planting. Estimate participation of approximately 64,400 acres. Average costs have been \$881 per acre. Assistance would be on a cost-share basis of 70%.	RS-6	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-6	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-6	Number of Seedlings	-	-	-	-	-	-
	RS-6	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-6	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-6	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Note: Project Funding is normally administered by the State DOF</b>	RS-6	Contract & Administration	\$ 8,093,000	\$ 8,093,000	\$ 8,093,000	\$ 8,093,000	\$ 8,093,000	\$ 40,465,000
	RS-6	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: Pvt	RS-6	<b>Estimated Annual Total Project Cost</b>	<b>\$ 8,093,000</b>	<b>\$ 8,093,000</b>	<b>\$ 8,093,000</b>	<b>\$ 8,093,000</b>	<b>\$ 8,093,000</b>	<b>\$ 40,465,000</b>
<b>Exempt Private Land Reforestation</b>	RS-9	Mechanical Site Prep Acres	-	-	-	-	-	-
	RS-9	Reforestation Acres	-	15,000	15,000	15,000	15,000	60,000
Goal - Determine Private Land exempt from reforestation that need site preparation and plan. Implement reforestation plan. Approximately 85,000 acres have been exempted from reforestation requirements.	RS-9	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-9	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-9	Number of Seedlings	-	-	-	-	-	-
	RS-9	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-9	Assessment and Planning	\$ 500,000	\$ -	\$ -	\$ -	\$ -	\$ 500,000
	RS-9	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Note: Project Funding is normally administered by the State DOF</b>	RS-9	Contract & Administration	\$ -	\$ 4,600,000	\$ 4,600,000	\$ 4,600,000	\$ 4,600,000	\$ 18,400,000
	RS-9	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: CIRI, NNAL, Pvt.	RS-9	<b>Estimated Annual Total Project Cost</b>	<b>\$ 500,000</b>	<b>\$ 4,600,000</b>	<b>\$ 4,600,000</b>	<b>\$ 4,600,000</b>	<b>\$ 4,600,000</b>	<b>\$ 18,900,000</b>

## Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

Stewardship Forestry-Restoration of Small Private Lands over 7 Acres in Size  Goal - Restore small private parcels by reforesting non-commercial forest lands between 1-7 acres in size. Estimate participation of approximately 24,500 acres. Assistance at a 70% cost-share basis. Assistance provided by Stewardship Foresters.	RS-2	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-2	Reforestation Acres	-	-	-	-	-	-	-
	RS-2	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-2	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-2	Number of Seedlings	-	-	-	-	-	-	-
	RS-2	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-2	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-2	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-2	Contract & Administration	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	300,000
	RS-2	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Note: Project Funding is normally administered by the KPB									
Project Partners: State/Pvt		RS-2	Estimated Annual Total Project Cost	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	300,000

Total Forest Health & Ecosystem Restoration - Private Land	ALL	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	ALL	Reforestation Acres	17,180	32,180	32,180	32,180	32,180	32,180	145,900
	ALL	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	ALL	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	ALL	Number of Seedlings	-	-	-	-	-	-	-
	ALL	Program Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Assessment and Planning	\$ 500,000	\$ -	\$ -	\$ -	\$ -	\$ -	500,000
	ALL	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Contract & Administration	\$ 12,276,000	\$ 16,876,000	\$ 16,876,000	\$ 16,876,000	\$ 16,876,000	\$ 16,876,000	79,780,000
	ALL	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Estimated Annual Total Program Cost	\$ 12,776,000	\$ 16,876,000	\$ 16,876,000	\$ 16,876,000	\$ 16,876,000	\$ 16,876,000	80,280,000

Goal # 4 - Community Assistance - Private Land Projects									
Project Name	Project		2005	2006	2007	2008	2009		TOTAL
Total Community Assistance - Private Land Projects	TOTAL	Estimated Annual Total Program Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-

GRAND TOTAL ALL - Private Land									\$ 146,295,600
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# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

## TABLE E2.0-STATE DIVISION OF FORESTRY 5-YEAR PROJECT IMPLEMENTATION SCHEDULE

Goal # 1 - Fire Prevention & Protection - State Division of Forestry									
Project Name	Project		2005	2006	2007	2008	2009	TOTAL	
Program Administration	FP-0	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Fire Prevention &amp; Suppression</b> - Current program funding level for the Kenai-Kodiak Area (KKA) (Needs to be maintained) Goal - To provide cost effective fire protection to state, private, municipal, and federal lands in accordance with interagency agreements and the Alaska Interagency Fire Management Plan. Project Partners: DOF, USFS, RFD's, BLM, KPB	FP-1	Annual Estimated Cost	\$ 891,500	\$ 891,500	\$ 891,500	\$ 891,500	\$ 891,500	\$ 4,457,500	
<b>Increased Strength of Force for Preparedness &amp; Suppression</b> Increase agency infrastructure to adequately protect state, private, municipal, and federal lands. Goal - To provide cost effect fire management to protect WUI resources. Project Partners: DOF, USFS, RFD's, BLM, KPB	FP-2	Annual Estimated Cost	\$ 790,000	\$ 470,000	\$ 470,000	\$ 470,000	\$ 470,000	\$ 2,670,000	
<b>Firewise Program</b> - Workshops, Materials,Administration. Goal - Provide Firewise workshops for homeowners within the KPB. Project Partners: DOF, KPB, USFS, USFWS, RFD's	FP-3	Annual Estimated Cost	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 250,000	
<b>Air Tanker Contract (90 days)</b> Air tankers are essential to protection of WUI resources during initial attack. Goal - Ensure 90 day contract for a Type 1 airtanker to support initial attack operations. Project Partners: DOF, USFS, BLM	FP-4	Annual Estimated Cost	\$ 450,000	\$ 450,000	\$ 450,000	\$ 450,000	\$ 450,000	\$ 2,250,000	
<b>Weather Stations &amp; Improved Data Collection</b> - 10 RAWS Stations Goal - Provide sufficient RAWS stations to obtain accurate weather predictions in support of fire preparedness. Project Partners: DOF, USFS, BLM, USFWS, KPB, RFD's	FP-5	Annual Estimated Cost	\$ 130,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 170,000	
<b>Communications Upgrades</b> Radio systems are all going to narrow band and require conversion. Project would purchase 30 trunking handhelds & 30 trunking mobile radios. Goal - Provide critical communications with incident personnel. Project Partners: DOF, USFS, KPB, RFD's, BLM	FP-6	Annual Estimated Cost	\$ 215,000	\$ -	\$ -	\$ -	\$ -	\$ 215,000	
<b>Cooperative Protection Agreements Improvements</b> Goal - Improve fire protection agreements & assess training needs, equipment, and services provided by local fire departments. Project Partners: DOF, KPB, Local Fire Departments	FP-7	Annual Estimated Cost	\$ 30,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 110,000	
<b>Interagency Fire Prevention Plan</b> Goal - Develop, distribute & annually update an interagency plan for wildland interface communities that includes strategies for training & technology transfer. Project Partners: DOF, KPB, USFS, USFWS, local fire departments.	FP-8	Annual Estimated Cost	\$ 30,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 110,000	
<b>Fire Training Improvement</b> Goal - Improve fire suppression decision making for line officers, fire managers, and local agency representatives. Provide training on minimum impact suppression activities. Project Partners: DOF, KPB, USFS, USFWS, local fire departments.	FP-9	Annual Estimated Cost	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 100,000	
<b>Facilities</b> - Retardant Base (Kenai Airport)/KKA Office Improvements - 2005-Planning/Contract & Design; 2006-Contract & Construction - 2007-2009- Facility Administration Goal - Provide a fully functional air tanker retardant base at the Kenai Airport Project Partners: DOF, City of Kenai	FP-10	Annual Estimated Cost	\$ 400,000	\$ 1,880,000	\$ 80,000	\$ 80,000	\$ 80,000	\$ 2,520,000	
<b>Interagency Fire Dispatch Center - KKA</b> - 2005-Planning/Contract & Design; 2006-Contract & Construction - 2007-2009- Facility Administration Goal - Provide an interagency incident dispatch center that will coordinate incident operations. Project Partners: DOF, USFS, USFWS	FP-11	Annual Estimated Cost	\$ 60,000	\$ 540,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 780,000	
TOTAL			Annual Estimated Program Cost	\$ 3,066,500	\$ 4,351,500	\$ 2,071,500	\$ 2,071,500	\$ 2,071,500	\$ 13,632,500

Total Fire Prevention & Protection - State Division of Forestry								
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Goal # 2 - Hazardous Fuel Reduction - State Division of Forestry Projects								
Project Name	Project	Output Units of Measure/Cost C	2005	2006	2007	2008	2009	TOTAL
Program Administration	FR-0	Estimated Annual Program Admin Cost	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 300,000
<b>WUI Fuel Reduction on State Land Near 421 Structures</b>	FR-1	Number of Parcels	0	0	0	0	0	-
	FR-1	Mechanical Acres	0	1080	0	0	0	1,080
Goal - Reduce fuel loading within 300 feet of structures & regenerate treated areas.	FR-1	Fuel Break Acres	0	0	0	0	0	-
Estimate 1,800 acres to be treated and protects approximately 421 structures.	FR-1	Prescribe Burn Acres	0	0	0	0	0	-
	FR-1	Power Line Miles	0	0	0	0	0	-
	FR-1	Hwy Miles	0	0	0	0	0	-
	FR-1	Assessment and Planning	\$ 100,000	\$ -	\$ -	\$ -	\$ -	100,000
	FR-1	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-1	Contract & Administration	\$ -	\$ 1,600,000	\$ -	\$ -	\$ -	1,600,000
	FR-1	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-1	Estimated Annual Total Project Cost	\$ 100,000	\$ 1,600,000	\$ -	\$ -	\$ -	\$ 1,700,000
<b>WUI Moose Pass Fuel Reduction Project Phase 2</b>	FR-2	Number of Parcels	0	0	0	0	0	-
	FR-2	Mechanical Acres	57	0	0	0	0	57
Goal - Reduce fuel loading near the community of Moose Pass on 57 treatment acres, 1.9 miles of highway right-of-way, and 2.7 miles of powerline right-of-way.	FR-2	Fuel Break Acres	0	0	0	0	0	-
	FR-2	Prescribe Burn Acres	0	0	0	0	0	-
	FR-2	Power Line Miles	2.7	0	0	0	0	3
	FR-2	Hwy Miles	1.9	0	0	0	0	2
	FR-2	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-2	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-2	Contract & Administration	\$ 237,800	\$ -	\$ -	\$ -	\$ -	237,800
	FR-2	Cleanup & Monitoring	\$ -	\$ 5,000	\$ 1,000	\$ 1,000	\$ -	7,000
Project Partners: KPB	FR-2	Estimated Annual Total Project Cost	\$ 237,800	\$ 5,000	\$ 1,000	\$ 1,000	\$ -	\$ 244,800
<b>WUI Hope/Sunrise Fuel Reduction Project</b>	FR-3	Number of Parcels	0	0	0	0	0	-
	FR-3	Mechanical Acres	0	200	200	73	0	473
Goal - Reduce fuel loading near the communities of Hope and Sunrise on 473 treatment acres, 20.0 miles of highway right-of-way, and 8.0 miles of powerline right-of-way.	FR-3	Fuel Break Acres	0	0	0	0	0	-
	FR-3	Prescribe Burn Acres	0	0	0	0	0	-
	FR-3	Power Line Miles	0	2	2	4	0	8
	FR-3	Hwy Miles	0	5	5	10	0	20
	FR-3	Assessment and Planning	\$ 50,000	\$ -	\$ -	\$ -	\$ -	50,000
	FR-3	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-3	Contract & Administration	\$ -	\$ 373,000	\$ 373,000	\$ 373,000	\$ -	1,119,000
	FR-3	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners: KPB, USFS, PVT	FR-3	Estimated Annual Total Project Cost	\$ 50,000	\$ 373,000	\$ 373,000	\$ 373,000	\$ -	\$ 1,169,000

# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

Kenai Peninsula State Parks	FR-5	Number of Parcels	0	0	0	0	0	0	-	
	FR-5	Mechanical Acres	0	250	0	0	0	0	250	
	FR-5	Fuel Break Acres	0	0	0	0	0	0	-	
	FR-5	Prescribe Burn Acres	0	0	0	0	0	0	-	
	FR-5	Power Line Miles	0	0	0	0	0	0	-	
	FR-5	Hwy Miles	0	0	0	0	0	0	-	
	FR-5	Assessment and Planning	\$ 200,000	\$ -	\$ -	\$ -	\$ -	\$ -	200,000	
	FR-5	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	FR-5	Contract & Administration	\$ -	\$ 300,000	\$ -	\$ -	\$ -	\$ -	300,000	
	FR-5	Cleanup & Monitoring	\$ -	\$ -	\$ 20,000	\$ 20,000	\$ 20,000	\$ -	60,000	
Project Partners: DPOR	FR-5	Estimated Annual Total Project Cost	\$ 200,000	\$ 300,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 560,000		
Restoration of State Lands within WUI	FR-6	Number of Parcels	0	0	0	0	0	0	-	
	FR-6	Mechanical Acres	1860	1860	1860	1860	1860	1860	9,300	
	FR-6	Fuel Break Acres	0	0	0	0	0	0	-	
	FR-6	Prescribe Burn Acres	0	0	0	0	0	0	-	
	FR-6	Power Line Miles	0	0	0	0	0	0	-	
	FR-6	Hwy Miles	0	0	0	0	0	0	-	
	FR-6	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	FR-6	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	FR-6	Contract & Administration	\$ 2,700,000	\$ 2,700,000	\$ 2,700,000	\$ 2,700,000	\$ 2,700,000	\$ -	13,500,000	
	FR-6	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
Project Partners:	FR-6	Estimated Annual Total Project Cost	\$ 2,700,000	\$ 2,700,000	\$ 2,700,000	\$ 2,700,000	\$ 2,700,000	\$ 13,500,000		
Kachemak Bay State Park	FR-7	Number of Parcels	0	0	0	0	0	0	-	
	FR-7	Mechanical Acres	0	250	0	0	0	0	250	
	FR-7	Fuel Break Acres	0	0	0	0	0	0	-	
	FR-7	Prescribe Burn Acres	0	0	0	0	0	0	-	
	FR-7	Power Line Miles	0	0	0	0	0	0	-	
	FR-7	Hwy Miles	0	0	0	0	0	0	-	
	FR-7	Assessment and Planning	\$ 200,000	\$ -	\$ -	\$ -	\$ -	\$ -	200,000	
	FR-7	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	FR-7	Contract & Administration	\$ -	\$ 300,000	\$ -	\$ -	\$ -	\$ -	300,000	
	FR-7	Cleanup & Monitoring	\$ -	\$ -	\$ 20,000	\$ 20,000	\$ 20,000	\$ -	60,000	
Project Partners: DPOR	FR-7	Estimated Annual Total Project Cost	\$ 200,000	\$ 300,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 560,000		
Upper Trail Lake Prescribed Burn	FR-8	Number of Parcels	0	0	0	0	0	0	-	
	FR-8	Mechanical Acres	0	0	0	0	0	0	-	
	FR-8	Fuel Break Acres	0	0	0	0	0	0	-	
	FR-8	Prescribe Burn Acres	0	800	0	0	0	0	800	
	FR-8	Power Line Miles	0	0	0	0	0	0	-	
	FR-8	Hwy Miles	0	0	0	0	0	0	-	
	FR-8	Assessment and Planning	\$ 30,000	\$ -	\$ -	\$ -	\$ -	\$ -	30,000	
	FR-8	Force Account Implementation	\$ -	\$ 175,000	\$ -	\$ -	\$ -	\$ -	175,000	
	FR-8	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	FR-8	Cleanup & Monitoring	\$ -	\$ -	\$ 10,000	\$ 10,000	\$ 10,000	\$ -	30,000	
Project Partners: KPB, USFS	FR-8	Estimated Annual Total Project Cost	\$ 30,000	\$ 175,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 235,000		
Restoration of State Lands Outside the WUI	FR-9	Number of Parcels	0	0	0	0	0	0	-	
	FR-9	Mechanical Acres	2415	2415	2415	2415	2415	2415	12,075	
	FR-9	Fuel Break Acres	0	0	0	0	0	0	-	
	FR-9	Prescribe Burn Acres	0	0	0	0	0	0	-	
	FR-9	Power Line Miles	0	0	0	0	0	0	-	
	FR-9	Hwy Miles	0	0	0	0	0	0	-	
	FR-9	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	FR-9	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	FR-9	Contract & Administration	\$ 3,720,000	\$ 3,720,000	\$ 3,720,000	\$ 3,720,000	\$ 3,720,000	\$ -	18,600,000	
	FR-9	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
Project Partners:	FR-9	Estimated Annual Total Project Cost	\$ 3,720,000	\$ 3,720,000	\$ 3,720,000	\$ 3,720,000	\$ 3,720,000	\$ 18,600,000		
Total Hazardous Fuel Reduction - State Division of Forestry										
ALL	Total Number of Parcels	-	-	-	-	-	-	-	-	
ALL	Total Mechanical Acres	4,332	6,055	4,475	4,348	4,275	-	-	23,485	
ALL	Total Fuel Break Acres	-	-	-	-	-	-	-	-	
ALL	Total Prescribe Burn Acres	-	800	-	-	-	-	-	800	
ALL	Total Power Line Miles	3	2	2	4	-	-	-	11	
ALL	Total Hwy Miles	2	5	5	10	-	-	-	22	
ALL	Program Administration	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ 60,000	\$ -	-	300,000	
ALL	Assessment and Planning	\$ 580,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	580,000	
ALL	Force Account Implementation	\$ -	\$ 175,000	\$ -	\$ -	\$ -	\$ -	\$ -	175,000	
ALL	Contract & Administration	\$ 6,657,800	\$ 8,993,000	\$ 6,793,000	\$ 6,793,000	\$ 6,420,000	\$ -	-	35,656,800	
ALL	Cleanup & Monitoring	\$ -	\$ 5,000	\$ 51,000	\$ 51,000	\$ 50,000	\$ -	-	157,000	
ALL	Estimated Annual Total Program Cost	\$ 7,297,800	\$ 9,233,000	\$ 6,904,000	\$ 6,904,000	\$ 6,530,000	\$ -	-	36,868,800	

Goal # 3 - Forest Health & Ecosystem Restoration - State Division of Forestry Projects										
Project Name	Project		2005	2006	2007	2008	2009	TOTAL		
Program Administration	FR-0	Estimated Annual Program Admin Co	\$ 12,000	\$ 12,000	\$ 12,000	\$ 12,000	\$ 12,000	\$	60,000	
Riparian Habitat Assessment & Restoration Goal - Determine riparian habitats negatively impacted by the SBB infestation & develop a restoration plan.	RS-1	Mechanical Site Prep Acres	-	-	-	-	-	-	-	
	RS-1	Reforestation Acres	-	665	665	-	-	-	1,330	
	RS-1	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-	
	RS-1	Project Implementation Monitoring Acres	-	-	-	-	-	-	-	
	RS-1	Number of Seedlings	-	-	-	-	-	-	-	
	RS-1	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-1	Assessment and Planning	\$ 100,000	\$ -	\$ -	\$ -	\$ -	\$ -	100,000	
	RS-1	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-1	Contract & Administration	\$ -	\$ 200,000	\$ 200,000	\$ -	\$ -	\$ -	400,000	
	RS-1	Monitoring	\$ -	\$ -	\$ -	\$ 20,000	\$ -	\$ -	20,000	
Project Partners: DF&G	RS-1	Estimated Annual Total Project Cost	\$ 100,000	\$ 200,000	\$ 200,000	\$ 20,000	\$ -	\$	520,000	
Reforestation of WUI Fuel Reduction on State Land near 421 Structures Goal - Restore fuel reduction areas in the WUI.	RS-3	Mechanical Site Prep Acres	-	-	-	-	-	-	-	
	RS-3	Reforestation Acres	-	-	1,080	-	-	-	1,080	
	RS-3	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-	
	RS-3	Project Implementation Monitoring Acres	-	-	-	-	-	-	-	
	RS-3	Number of Seedlings	-	-	-	-	-	-	-	
	RS-3	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-3	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-3	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-3	Contract & Administration	\$ -	\$ -	\$ 390,000	\$ -	\$ -	\$ -	390,000	
	RS-3	Monitoring	\$ -	\$ -	\$ -	\$ 12,000	\$ -	\$ -	12,000	
Project Partners:	RS-3	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 390,000	\$ 12,000	\$ -	\$	402,000	
Restoration of State Fuel Treatment Areas within the WUI Goal - Restore fuel reduction areas in the WUI.	RS-4	Mechanical Site Prep Acres	-	-	-	-	-	-	-	
	RS-4	Reforestation Acres	-	1,000	-	-	-	-	1,000	
	RS-4	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-	
	RS-4	Project Implementation Monitoring Acres	-	-	-	-	-	-	-	
	RS-4	Number of Seedlings	-	-	-	-	-	-	-	
	RS-4	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-4	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-4	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-	
	RS-4	Contract & Administration	\$ 300,000	\$ -	\$ -	\$ -	\$ -	\$ -	300,000	
	RS-4	Monitoring	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	5,000	
Project Partners:	RS-4	Estimated Annual Total Project Cost	\$ 300,000	\$ -	\$ -	\$ 5,000	\$ -	\$	305,000	

# **Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

<b>Kenai Peninsula State Parks</b> - Restoration of State Park site, trails, and trailheads Goal - Restore park sites, trails & trailheads by removal of stumps & planting of sapling sites	RS-5	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-5	Reforestation Acres	-	100	100	-	-	112	312
	RS-5	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-5	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-5	Number of Seedlings	-	-	-	-	-	-	-
	RS-5	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-5	Assessment and Planning	\$ 50,000	\$ -	\$ -	\$ -	\$ -	\$ -	50,000
	RS-5	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-5	Contract & Administration	\$ -	\$ 66,667	\$ 66,667	\$ -	\$ 75,000	\$ -	208,334
	RS-5	Monitoring	\$ -	\$ -	\$ -	\$ 20,000	\$ -	\$ -	20,000
Project Partners: DPOR	RS-5	<b>Estimated Annual Total Project Cost</b>	<b>\$ 50,000</b>	<b>\$ 66,667</b>	<b>\$ 66,667</b>	<b>\$ 20,000</b>	<b>\$ 75,000</b>	<b>\$ -</b>	<b>278,334</b>
<b>Homer Public Watershed Assessment &amp; Restoration</b> Goal - Determine the impact of the SBB infestation on the Homer public watershed and develop a restoration plan.	RS-7	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-7	Reforestation Acres	-	300	-	-	-	-	300
	RS-7	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-7	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-7	Number of Seedlings	-	-	-	-	-	-	-
	RS-7	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-7	Assessment and Planning	\$ 30,000	\$ -	\$ -	\$ -	\$ -	\$ -	30,000
	RS-7	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-7	Contract & Administration	\$ -	\$ 100,000	\$ -	\$ -	\$ -	\$ -	100,000
	RS-7	Monitoring	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	5,000
Project Partners: KPB, City of Homer	RS-7	<b>Estimated Annual Total Project Cost</b>	<b>\$ 30,000</b>	<b>\$ 100,000</b>	<b>\$ 5,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>135,000</b>
<b>Crooked Creek Fire Restoration</b> Goal - Restore State lands impacted by the Crooked Creek Fire.	RS-8	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-8	Reforestation Acres	-	821	-	-	-	-	821
	RS-8	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-8	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-8	Number of Seedlings	271,000	-	-	-	-	-	271,000
	RS-8	Purchase Tree Seedlings/Collect Tree Seedlings	\$ 68,000	\$ -	\$ -	\$ -	\$ -	\$ -	68,000
	RS-8	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-8	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-8	Contract & Administration	\$ -	\$ 158,000	\$ -	\$ -	\$ -	\$ -	158,000
	RS-8	Monitoring	\$ -	\$ -	\$ 6,000	\$ 4,000	\$ 4,000	\$ -	14,000
Project Partners:	RS-8	<b>Estimated Annual Total Project Cost</b>	<b>\$ 68,000</b>	<b>\$ 158,000</b>	<b>\$ 6,000</b>	<b>\$ 4,000</b>	<b>\$ 4,000</b>	<b>\$ -</b>	<b>240,000</b>
<b>Road Corridor Restoration</b> Goal - Determine road corridors on state and private lands that need restoration to enhance visual appeal and provide wildlife cover. Implement restoration plan.	RS-10	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-10	Reforestation Acres	-	1,600	-	-	-	-	1,600
	RS-10	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-10	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-10	Number of Seedlings	-	-	-	-	-	-	-
	RS-10	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-10	Assessment and Planning	\$ 30,000	\$ -	\$ -	\$ -	\$ -	\$ -	30,000
	RS-10	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-10	Contract & Administration	\$ -	\$ 500,000	\$ -	\$ -	\$ -	\$ -	500,000
	RS-10	Monitoring	\$ -	\$ -	\$ 5,000	\$ 5,000	\$ 5,000	\$ -	15,000
Project Partners: DOT&PF, DF&G, KPB, USFS, USFWS, CIRI, NNAI, Pvt.	RS-10	<b>Estimated Annual Total Project Cost</b>	<b>\$ 30,000</b>	<b>\$ 500,000</b>	<b>\$ 5,000</b>	<b>\$ 5,000</b>	<b>\$ 5,000</b>	<b>\$ -</b>	<b>545,000</b>
<b>Dome View Prescribed Burn</b> Goal - Ecosystem restoration.	RS-11	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-11	Reforestation Acres	-	-	-	-	-	-	-
	RS-11	Prescribe Burn Site Prep Acres	-	800	-	-	-	-	800
	RS-11	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-11	Number of Seedlings	-	-	-	-	-	-	-
	RS-11	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-11	Assessment and Planning	\$ 30,000	\$ -	\$ -	\$ -	\$ -	\$ -	30,000
	RS-11	Force Account Implementation	\$ -	\$ 318,000	\$ -	\$ -	\$ -	\$ -	318,000
	RS-11	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-11	Monitoring	\$ -	\$ -	\$ 5,000	\$ 5,000	\$ 5,000	\$ -	15,000
Project Partners: KPB, USFS, USFWS, CIRI, NNAI	RS-11	<b>Estimated Annual Total Project Cost</b>	<b>\$ 30,000</b>	<b>\$ 318,000</b>	<b>\$ 5,000</b>	<b>\$ 5,000</b>	<b>\$ 5,000</b>	<b>\$ -</b>	<b>363,000</b>
<b>South Ninilchik Prescribed Burn</b> Goal - Ecosystem restoration.	RS-12	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-12	Reforestation Acres	-	-	-	-	-	-	-
	RS-12	Prescribe Burn Site Prep Acres	-	2,000	-	-	-	-	2,000
	RS-12	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-12	Number of Seedlings	-	-	-	-	-	-	-
	RS-12	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-12	Assessment and Planning	\$ 30,000	\$ -	\$ -	\$ -	\$ -	\$ -	30,000
	RS-12	Force Account Implementation	\$ -	\$ 640,000	\$ -	\$ -	\$ -	\$ -	640,000
	RS-12	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-12	Monitoring	\$ -	\$ -	\$ 5,000	\$ 5,000	\$ 5,000	\$ -	15,000
Project Partners: KPB, USFS, USFWS, CIRI, NNAI	RS-12	<b>Estimated Annual Total Project Cost</b>	<b>\$ 30,000</b>	<b>\$ 640,000</b>	<b>\$ 5,000</b>	<b>\$ 5,000</b>	<b>\$ 5,000</b>	<b>\$ -</b>	<b>685,000</b>
<b>Anchor River-Fritz Creek Critical Habitat Area Prescribed Burn</b> Goal - Ecosystem restoration in 3,000 acres of the Anchor River-Fritz Creek Critical Habitat Area	RS-13	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-13	Reforestation Acres	-	-	-	-	-	-	-
	RS-13	Prescribe Burn Site Prep Acres	-	3,000	-	-	-	-	3,000
	RS-13	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-13	Number of Seedlings	-	-	-	-	-	-	-
	RS-13	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-13	Assessment and Planning	\$ 60,000	\$ -	\$ -	\$ -	\$ -	\$ -	60,000
	RS-13	Force Account Implementation	\$ -	\$ 800,000	\$ -	\$ -	\$ -	\$ -	800,000
	RS-13	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-13	Monitoring	\$ -	\$ -	\$ 6,000	\$ 6,000	\$ 10,000	\$ -	22,000
Project Partners: DF&G	RS-13	<b>Estimated Annual Total Project Cost</b>	<b>\$ 60,000</b>	<b>\$ 800,000</b>	<b>\$ 6,000</b>	<b>\$ 6,000</b>	<b>\$ 10,000</b>	<b>\$ -</b>	<b>882,000</b>
<b>Total Forest Health &amp; Ecosystem Restoration - State Division</b>									
	ALL	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	ALL	Reforestation Acres	1,000	3,486	1,845	-	-	112	6,443
	ALL	Prescribe Burn Site Prep Acres	-	5,800	-	-	-	-	5,800
	ALL	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	ALL	Number of Seedlings	271,000	-	-	-	-	-	271,000
	ALL	Program Administration	\$ 12,000	\$ 12,000	\$ 12,000	\$ 12,000	\$ 12,000	\$ -	60,000
	ALL	Purchase Tree Seedlings/Collect Tree Seedlings	\$ 68,000	\$ -	\$ -	\$ -	\$ -	\$ -	68,000
	ALL	Assessment and Planning	\$ 330,000	\$ -	\$ -	\$ -	\$ -	\$ -	330,000
	ALL	Force Account Implementation	\$ -	\$ 1,758,000	\$ -	\$ -	\$ -	\$ -	1,758,000
	ALL	Contract & Administration	\$ 300,000	\$ 1,024,667	\$ 656,667	\$ -	\$ 75,000	\$ -	2,056,334
	ALL	Monitoring	\$ -	\$ -	\$ 32,000	\$ 82,000	\$ 29,000	\$ -	143,000
	ALL	<b>Estimated Annual Total Program Cost</b>	<b>\$ 710,000</b>	<b>\$ 2,794,667</b>	<b>\$ 700,667</b>	<b>\$ 94,000</b>	<b>\$ 116,000</b>	<b>\$ -</b>	<b>4,415,334</b>



# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

Goal # 4 - Community Assistance - State Division of Forestry Projects										
Project Name	Project		2005	2006	2007	2008	2009	TOTAL		
Program Administration	CA-0	Estimated Annual Total Program Admin Cost						\$ -		
Community Wildfire Protection Plan (CWPP) Grant Applications for Funding	CA-1	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
Goal - Develop and submit grant applications to fund the development of 15 Community Wildfire Protection Plans (CWPPs) within the KPB according to guidelines contained in the Healthy Forest Restoration Act (HFRA) of 2003. The KPB has the lead for submitting grant applications for 15 of the 20 CWPPs.										
Project Partners:										
Community Wildfire Protection Plan (CWPP) Development Contracts Goal - Develop Community Wildfire Protection Plans for 20 census communities within the KPB according to guidelines contained in the Healthy Forest Restoration Act (HFRA) of 2003. The KPB will take the lead in developing 15 of the 20 by contracting for CWPPs. The Forest Service will take the lead in developing CWPP's for five community census areas within the Chugach National Forest (Highlighted in Yellow).	CA-2-1	1. Anchor Point/Happy Valley/Nikolaev	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-2	2. Fritz Creek/Fox River (East End Road)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-3	3. Homer/Diamond Ridge/Kachemak	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-4	4. Kasloff/Cohoe	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-5	5. Kenai/Kalifornsky	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-6	6. Moose Pass/Crown Point/Primrose	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-7	7. Nimulchik/Clam Gulch	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-8	8. Nimulchik/Forbes	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-9	9. Nikiski/Salamatof	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-10	10. Hope/Sunrise	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-11	11. Cooper Landing	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-12	12. Seldovia/Seldovia Village	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-13	13. Soldotna/Ridgeway	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-14	14. Sterling/Funny River	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-15	15. Halibut Cover/Bear Cove	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-16	16. Grey Cliffs/Moose Point	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-17	17. Summit (No Census Area)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-18	18. Seward/Bear Cr./Lowell Point	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-19	19. Tyonek/Beluga (Not in WUI)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
	CA-2-20	20. Port Graham/Nauyaslek (Not in WUI)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
Project Partners:										
Community Wildfire Protection Plan (CWPP) Development Support	CA-2	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
Goal - Provide fire behavior, home ignition, Firewise and other staff support to the development of CWPP's.	CA-3-1	1. Anchor Point/Happy Valley/Nikolaev	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-2	2. Fritz Creek/Fox River (East End Road)	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-3	3. Homer/Diamond Ridge/Kachemak	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-4	4. Kasloff/Cohoe	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-5	5. Kenai/Kalifornsky	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-6	6. Moose Pass/Crown Point/Primrose	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-7	7. Nimulchik/Clam Gulch	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-8	8. Nimulchik/Forbes	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-9	9. Nikiski/Salamatof	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-10	10. Hope/Sunrise	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-11	11. Cooper Landing	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-12	12. Seldovia/Seldovia Village	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-13	13. Soldotna/Ridgeway	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-14	14. Sterling/Funny River	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-15	15. Halibut Cover/Bear Cove	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-16	16. Grey Cliffs/Moose Point	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-17	17. Summit (No Census Area)	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-18	18. Seward/Bear Cr./Lowell Point	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-19	19. Tyonek/Beluga (Not in WUI)	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
	CA-3-20	20. Port Graham/Nauyaslek (Not in WUI)	\$ 4,000	\$ 4,000	\$ 4,000	\$ -	\$ -	\$ 12,000		
Project Partners: KPB, USFS, USFWS, RFD's, Census Communities										
Community Risk Assessment & Database	CA-3	Estimated Annual Total Project Cost	\$ 80,000	\$ 80,000	\$ 80,000	\$ -	\$ -	\$ 240,000		
Goal - Assess, inventory, & develop database on risk to structures from wildfire, access & egress, etc. to enhance tactical decisions, evacuations, and safety considerations.	CA-4	Estimated Annual Total Project Cost	\$ 30,000	\$ 350,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 440,000		
Project Partners: KPB, RFD's, Census Communities										
Public Education & Assistance	CA-5	Estimated Annual Total Project Cost	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000	\$ 440,000		
Goal - Provide the public with information and conduct field reviews regarding insect infestation, identification, prevention methods, suppression options, Firewise recommendations, etc. Provide for a seasonal position to provide public assistance.										
Project Partners: Pvt.										
Bio-Energy Project Development	CA-6	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -		
Project Partners:										
Total Community Assistance - State Division of Forestry Proj			TOTAL	Estimated Annual Total Program Cost	\$ 160,000	\$ 480,000	\$ 150,000	\$ 70,000	\$ 70,000	\$ 930,000
GRAND TOTAL ALL - STATE DIVISION OF FORESTRY										\$ 55,846,634

**Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

**TABLE E3.0 - KENAI PENINSULA BOROUGH 5-YEAR PROJECT IMPLEMENTATION SCHEDULE**

<b>Goal # 1 - Fire Prevention &amp; Protection - Kenai Peninsula Borough Spruce Bark Beetle Mitigation Program</b>									
<b>Project Name</b>	<b>Project</b>	<b>Output Units of Measure/Cost</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>TOTAL</b>	
Program Administration	FP-0	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Increased Strength of Force for Preparedness &amp; Suppression</b> cooperative agreement with State DOF for additional weeks, Kenai Crew Goal - increase local initial attack coverage during high fire danger Project Partners: State DOF	FP-1	Annual Estimated Cost	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 720,000	720,000
<b>TOTAL</b>	<b>TOTAL</b>	<b>Annual Estimated Program Cost</b>	<b>\$ 144,000</b>	<b>\$ 144,000</b>	<b>\$ 144,000</b>	<b>\$ 144,000</b>	<b>\$ 144,000</b>	<b>\$ 720,000</b>	<b>720,000</b>
<b>Total Fire Prevention &amp; Protection - KPB-Spruce Bark Beetle Mitigation Program</b>									
<b>Goal # 2 - Hazardous Fuel Reduction - Kenai Peninsula Borough Spruce Bark Beetle Mitigation Program</b>									
<b>Project Name</b>	<b>Project</b>	<b>Output Units of Measure/Cost</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>TOTAL</b>	
Program Administration	FR-0	Estimated Annual Program Admin Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Create data information layers for KPB	FR-1	Number of Parcels	0	0	0	0	0	0	-
	FR-1	Mechanical Acres	0	0	0	0	0	0	-
Goal - Complete vegetation type, fuel hazard, infrastructure (roads, bridges, gas wells, power lines, etc) fire occurrence, fire history, watershed, stream, and structures polygon and/or point GIS map layers for all lands within the Kenai Peninsula Borough.	FR-1	Fuel Break Acres	0	0	0	0	0	0	-
	FR-1	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-1	Power Line Miles	0	0	0	0	0	0	-
	FR-1	Hwy Miles	0	0	0	0	0	0	-
	FR-1	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-1	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-1	Contract & Administration	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 1,000,000	1,000,000
	FR-1	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-1	Estimated Annual Total Project Cost	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 200,000	\$ 1,000,000	1,000,000
Create treatment map layers for KPB	FR-2	Number of Parcels	0	0	0	0	0	0	-
	FR-2	Mechanical Acres	0	0	0	0	0	0	-
Goal - Create and maintain an "All Lands/All Hands" digital GIS "treatment" map layer for planned and accomplished project with related project attribute data for all landowners within KPB.	FR-2	Fuel Break Acres	0	0	0	0	0	0	-
	FR-2	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-2	Power Line Miles	0	0	0	0	0	0	-
	FR-2	Hwy Miles	0	0	0	0	0	0	-
	FR-2	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-2	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-2	Contract & Administration	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 500,000	500,000
	FR-2	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-2	Estimated Annual Total Project Cost	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 100,000	\$ 500,000	500,000
Establish an Internet-based information system for funding	FR-3	Number of Parcels	0	0	0	0	0	0	-
	FR-3	Mechanical Acres	0	0	0	0	0	0	-
Goal - prepare and maintain an information system relating to funding opportunities, cooperative agreements, other assistance mechanisms relative to project funding for all landowners in the KPB that provide assistance, information, and incentives to maintain low-risk fuel conditions.	FR-3	Fuel Break Acres	0	0	0	0	0	0	-
	FR-3	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-3	Power Line Miles	0	0	0	0	0	0	-
	FR-3	Hwy Miles	0	0	0	0	0	0	-
	FR-3	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-3	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-3	Contract & Administration	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 125,000	125,000
	FR-3	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-3	Estimated Annual Total Project Cost	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 125,000	125,000
Establish an information system for projects and accomplishments	FR-4	Number of Parcels	0	0	0	0	0	0	-
	FR-4	Mechanical Acres	0	0	0	0	0	0	-
Goal - compile information from CWPPs for specific treatment and funding needs, enter data into the KPB GIS data layers and the NFPORS data base.	FR-4	Fuel Break Acres	0	0	0	0	0	0	-
	FR-4	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-4	Power Line Miles	0	0	0	0	0	0	-
	FR-4	Hwy Miles	0	0	0	0	0	0	-
	FR-4	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-4	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-4	Contract & Administration	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 125,000	125,000
	FR-4	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-4	Estimated Annual Total Project Cost	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ 125,000	125,000
WUI Fuel Reduction on KPB parcels - timber sales	FR-5	Number of Parcels	0	0	0	0	0	0	-
	FR-5	Mechanical Acres	2597	972	689	800	800	5,858	5,858
Goal - Reduce fuel loading within WUI & regenerate treated areas. Estimate 6,000 acres to be treated.	FR-5	Fuel Break Acres	0	0	0	0	0	0	-
	FR-5	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-5	Power Line Miles	0	0	0	0	0	0	-
	FR-5	Hwy Miles	0	0	0	0	0	0	-
	FR-5	Assessment and Planning	\$ 40,000	\$ 16,000	\$ 4,000	\$ 8,000	\$ 8,000	\$ 76,000	76,000
	FR-5	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-5	Contract & Administration	\$ 3,369,900	\$ 1,419,900	\$ 1,080,300	\$ 1,213,500	\$ 1,213,500	\$ 8,297,100	8,297,100
	FR-5	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-5	Estimated Annual Total Project Cost	\$ 3,409,900	\$ 1,435,900	\$ 1,084,300	\$ 1,221,500	\$ 1,221,500	\$ 8,373,100	8,373,100
Fuel reduction project - ROW corridor	FR-6	Number of Parcels	0	0	0	0	0	0	-
	FR-6	Mechanical Acres	450	450	450	450	450	2,250	2,250
Goal - Reduce fuel loading near evacuation routes within high/moderate hazard areas 200 miles of highway right-of-way needs to be treated.	FR-6	Fuel Break Acres	0	0	0	0	0	0	-
	FR-6	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-6	Power Line Miles	0	0	0	0	0	0	-
	FR-6	Hwy Miles	40	40	40	40	40	200	200
	FR-6	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-6	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-6	Contract & Administration	\$ 886,050	\$ 886,050	\$ 886,050	\$ 886,050	\$ 886,050	\$ 4,430,250	4,430,250
	FR-6	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-6	Estimated Annual Total Project Cost	\$ 886,050	\$ 886,050	\$ 886,050	\$ 886,050	\$ 886,050	\$ 4,430,250	4,430,250
Tustumena Fuel Break WUI	FR-10	Number of Parcels	0	0	0	0	0	0	-
	FR-10	Mechanical Acres	0	0	0	0	0	0	-
Goal - Create 1/4 mile fuel break from natural landscape features through high hazard areas from Tustumena Lake to Cook Inlet to prevent a wildland fire from getting around the west end of Tustumena Lake and burning either north or south. Conduct fuels treatment as appropriate.	FR-10	Fuel Break Acres	1120	0	0	0	0	1,120	1,120
	FR-10	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-10	Power Line Miles	0	0	0	0	0	0	-
	FR-10	Hwy Miles	0	0	0	0	0	0	-
	FR-10	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-10	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-10	Contract & Administration	\$ 1,369,350	\$ 25,350	\$ 25,350	\$ 25,350	\$ 25,350	\$ 1,470,750	1,470,750
	FR-10	Cleanup & Monitoring	\$ -	\$ 112,000	\$ 112,000	\$ 112,000	\$ 112,000	\$ 448,000	448,000
Project Partners: State/PVT/Native	FR-10	Estimated Annual Total Project Cost	\$ 1,369,350	\$ 137,350	\$ 137,350	\$ 137,350	\$ 137,350	\$ 1,918,750	1,918,750
Tustumena Fuel Break NON-WUI	FR-11	Number of Parcels	0	0	0	0	0	0	-
	FR-11	Mechanical Acres	0	0	0	0	0	0	-
Goal - Create 1/4 mile fuel break from natural landscape features through high hazard areas from Tustumena Lake to Cook Inlet to prevent a wildland fire from getting around the west end of Tustumena Lake and burning either north or south. Conduct fuels treatment as appropriate.	FR-11	Fuel Break Acres	320	0	0	0	0	320	320
	FR-11	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-11	Power Line Miles	0	0	0	0	0	0	-
	FR-11	Hwy Miles	0	0	0	0	0	0	-
	FR-11	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-11	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-11	Contract & Administration	\$ 409,350	\$ 25,350	\$ 25,350	\$ 25,350	\$ 25,350	\$ 510,750	510,750
	FR-11	Cleanup & Monitoring	\$ -	\$ 32,000	\$ 32,000	\$ 32,000	\$ 32,000	\$ 128,000	128,000
Project Partners: State/PVT/Native	FR-11	Estimated Annual Total Project Cost	\$ 409,350	\$ 57,350	\$ 57,350	\$ 57,350	\$ 57,350	\$ 638,750	638,750

# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

<b>Crooked Creek-Caribou Hills Fuel Break</b>	FR-12	Number of Parcels	0	0	0	0	0	0	-
	FR-12	Mechanical Acres	0	0	0	0	0	0	-
	FR-12	Fuel Break Acres	1120	0	0	0	0	0	1,120
	FR-12	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-12	Power Line Miles	0	0	0	0	0	0	-
	FR-12	Hwy Miles	0	0	0	0	0	0	-
	FR-12	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-12	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-12	Contract & Administration	\$ 1,369,350	\$ 25,350	\$ 25,350	\$ 25,350	\$ 25,350	\$ 25,350	1,470,750
	FR-12	Cleanup & Monitoring	\$ -	\$ 112,000	\$ 112,000	\$ 112,000	\$ 112,000	\$ 112,000	448,000
Project Partners: State	FR-12	<b>Estimated Annual Total Project Cost</b>	<b>\$ 1,369,350</b>	<b>\$ 137,350</b>	<b>\$ 137,350</b>	<b>\$ 137,350</b>	<b>\$ 137,350</b>	<b>\$ 137,350</b>	<b>1,918,750</b>
<b>Fuel Reduction Project - Power lines (Chugach, HEA, Seward Electric)</b>	FR-13	Number of Parcels	0	0	0	0	0	0	-
	FR-13	Mechanical Acres	0	0	0	0	0	0	-
	FR-13	Fuel Break Acres	0	0	0	0	0	0	-
	FR-13	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-13	Power Line Miles	0	150	150	150	150	150	600
	FR-13	Hwy Miles	0	0	0	0	0	0	-
	FR-13	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-13	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-13	Contract & Administration	\$ -	\$ 252,675	\$ 252,675	\$ 252,675	\$ 265,350	\$ -	1,023,375
	FR-13	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners: KPB, USFS, State, PVT, Native	FR-13	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 252,675</b>	<b>\$ 252,675</b>	<b>\$ 252,675</b>	<b>\$ 265,350</b>	<b>\$ -</b>	<b>1,023,375</b>
<b>Fuel Reduction Project - Major Utility Lines</b>	FR-14	Number of Parcels	0	0	0	0	0	0	-
	FR-14	Mechanical Acres	0	0	0	0	0	0	-
	FR-14	Fuel Break Acres	0	0	0	0	0	0	-
	FR-14	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-14	Power Line Miles	0	10	10	10	10	10	30
	FR-14	Hwy Miles	0	0	0	0	0	0	-
	FR-14	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-14	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-14	Contract & Administration	\$ -	\$ 156,675	\$ 156,675	\$ 156,675	\$ -	\$ -	470,025
	FR-14	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners: State	FR-14	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 156,675</b>	<b>\$ 156,675</b>	<b>\$ 156,675</b>	<b>\$ -</b>	<b>\$ -</b>	<b>470,025</b>
<b>Total Hazardous Fuel Reduction - KPB- Spruce Bark Beetle Mitigation Program</b>									
ALL	Total Number of Parcels	0	0	0	0	0	0	0	-
ALL	Total Mechanical Acres	3047	1422	1139	1250	1250	1250	1250	8,108
ALL	Total Fuel Break Acres	2560	0	0	0	0	0	0	2,560
ALL	Total Prescribe Burn Acres	0	0	0	0	0	0	0	-
ALL	Total Power Line Miles	0	160	160	160	160	150	150	630
ALL	Total Hwy Miles	40	40	40	40	40	40	40	200
ALL	Program Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
ALL	Assessment and Planning	\$ 40,000	\$ 16,000	\$ 4,000	\$ 8,000	\$ 8,000	\$ 8,000	\$ 8,000	76,000
ALL	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
ALL	Contract & Administration	\$ 7,754,000	\$ 3,141,350	\$ 2,801,750	\$ 2,934,950	\$ 2,790,950	\$ -	\$ -	19,423,000
ALL	Cleanup & Monitoring	\$ -	\$ 256,000	\$ 256,000	\$ 256,000	\$ 256,000	\$ 256,000	\$ 256,000	1,024,000
ALL	<b>Estimated Annual Total Program Cost</b>	<b>\$ 7,794,000</b>	<b>\$ 3,413,350</b>	<b>\$ 3,061,750</b>	<b>\$ 3,198,950</b>	<b>\$ 3,054,950</b>	<b>\$ -</b>	<b>\$ -</b>	<b>20,523,000</b>

## Goal # 3 - Forest Health & Ecosystem Restoration - KPB-Spruce Bark Beetle Mitigation Program

Project Name	Project	2005	2006	2007	2008	2009	TOTAL	
Program Administration								
KPB Timber Sale parcels- Restoration Goal - Reforestation on parcels where fuels have been removed.	FR-0	Estimated Annual Program Admin Cost	\$ -	\$ -	\$ -	\$ -	\$ -	
	RS-1	Mechanical Site Prep Acres	710	102	381	-	800	1,993
	RS-1	Reforestation Acres	1,799	477	-	692	800	3,768
	RS-1	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-1	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-1	Number of Seedlings	-	-	-	-	-	-
	RS-1	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-1	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-1	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-1	Contract & Administration	\$ 456,600	\$ 137,560	\$ 70,480	\$ 178,400	\$ 264,000	1,107,040
RS-1	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Project Partners:	RS-1	Estimated Annual Total Project Cost	\$ 456,600	\$ 137,560	\$ 70,480	\$ 178,400	\$ 264,000	1,107,040
Reforestation of WUI Tustumena Fuel Reduction Goal - Restore fuel reduction areas in the WUI.	RS-3	Mechanical Site Prep Acres	-	-	-	-	-	-
	RS-3	Reforestation Acres	-	-	1,120	-	-	1,120
	RS-3	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-3	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-3	Number of Seedlings	-	-	-	-	-	-
	RS-3	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-3	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-3	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-3	Contract & Administration	\$ -	\$ -	\$ 112,000	\$ -	\$ -	112,000
	RS-3	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-3	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 112,000	\$ -	\$ -	112,000
Reforestation of NON-WUI Tustumena Fuel Reduction Goal - Restore fuel reduction areas in theNON- WUI.	RS-4	Mechanical Site Prep Acres	-	-	-	-	-	-
	RS-4	Reforestation Acres	-	-	320	-	-	320
	RS-4	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-4	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-4	Number of Seedlings	-	-	-	-	-	-
	RS-4	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-4	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-4	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-4	Contract & Administration	\$ -	\$ -	\$ 32,000	\$ -	\$ -	32,000
	RS-4	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-4	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 32,000	\$ -	\$ -	32,000
Restoration of Crooked Creek-Caribou Hills Fuel Break - Restoration of fuel removal area around power lines Goal - Restore cleared area around power lines with more fire resistant vegetation.	RS-5	Mechanical Site Prep Acres	-	-	-	-	-	-
	RS-5	Reforestation Acres	-	-	1,120	-	-	1,120
	RS-5	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-5	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-5	Number of Seedlings	-	-	-	-	-	-
	RS-5	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-5	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-5	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-5	Contract & Administration	\$ -	\$ -	\$ 112,000	\$ -	\$ -	112,000
	RS-5	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: State	RS-5	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 112,000	\$ -	\$ -	112,000
Restoration in area of Fuel Reduction Project - Major Utility Lines Goal - Create a fire resistant vegetation buffer along cleared areas near transmission lines.	RS-6	Mechanical Site Prep Acres	-	-	-	-	-	-
	RS-6	Reforestation Acres	-	-	120	120	120	360
	RS-6	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	RS-6	Project Implementation Monitoring Acres	-	-	-	-	-	-
	RS-6	Number of Seedlings	-	-	-	-	-	-
	RS-6	Purchase Tree Seedlings/Collect Tree Seedlings	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-6	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-6	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-6	Contract & Administration	\$ -	\$ -	\$ 24,000	\$ 24,000	\$ 24,000	72,000
	RS-6	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners: Pvt	RS-6	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 24,000	\$ 24,000	\$ 24,000	72,000

# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

<b>Total Forest Health &amp; Ecosystem Restoration - KPB-Spruce Bark Beetle Program</b>	ALL	Mechanical Site Prep Acres	710	102	381	-	800	1,993
	ALL	Reforestation Acres	1,799	477	2,680	812	920	6,688
	ALL	Prescribe Burn Site Prep Acres	-	-	-	-	-	-
	ALL	Project Implementation Monitoring Acres	-	-	-	-	-	-
	ALL	Number of Seedlings	-	-	-	-	-	-
	ALL	Program Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Contract & Administration	\$ 456,600	\$ 137,560	\$ 350,480	\$ 202,400	\$ 288,000	\$ 1,435,040
	ALL	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	<b>Estimated Annual Total Project Cost</b>	<b>\$ 456,600</b>	<b>\$ 137,560</b>	<b>\$ 350,480</b>	<b>\$ 202,400</b>	<b>\$ 288,000</b>	<b>\$ 1,435,040</b>

<b>Goal # 4 - Community Assistance - KPB-Spruce Bark Beetle Mitigation Program</b>								
Project Name	Project		2005	2006	2007	2008	2009	TOTAL
<b>Program Administration</b>	CA-0	<b>Estimated Annual Total Program Admin</b>	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Community Wildfire Protection Plan (CWPP) Grant Applications for Funding</b>	CA-1	<b>Estimated Annual Total Project Cost</b>	\$ 2,000	\$ -	\$ -	\$ -	\$ -	\$ 2,000
Goal - Develop and submit grant applications to fund the development of 15 Community Wildfire Protection Plans (CWPPs) within the KPB according to guidelines contained in the Healthy Forest Restoration Act (HFRA) of 2003. The KPB has the lead for submitting grant applications for 15 of the 20 CWPPs.								
Project Partners:								
<b>Community Wildfire Protection Plan (CWPP)</b>	CA-2-1	1. Anchor Point/Happy Valley/Nikolaev	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
<b>Development Contracts</b>	CA-2-2	2. Fritz Creek/Fox River (East End Road)	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
Goal - Develop Community Wildfire Protection Plans for 20 census communities within the KPB according to guidelines contained in the Healthy Forest Restoration Act (HFRA) of 2003. The KPB will take the lead in developing 15 of the 20 by contracting for CWPPs. The Forest Service will take the lead in developing CWPPs for five community census areas within the boundaries of the Chugach National Forest (Highlighted in Yellow).	CA-2-3	3. Homer/Diamond Ridge/Kachemak	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-4	4. Kaslof/Cohoe	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-5	5. Kenai/Kalifornsky	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-6	6. Moose Pass/Crown Point/Primrose	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	CA-2-7	7. Nintchik/Clam Gulch	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-8	8. Nintchik Forties	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-9	9. Nikiski/Salamatof	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-10	10. Hope/Sunrise	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	CA-2-11	11. Cooper Landing	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	CA-2-12	12. Seldovia/Seldovia Village	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-13	13. Soldotna/Ridgeway	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-14	14. Sterling/Punny River	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-15	15. Halibut Cover/Bear Cove	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-16	16. Grey Cliffs/Moose Point	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-17	17. Summit (No Census Area)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	CA-2-18	18. Seward/Bear Cr./Lowell Point	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	CA-2-19	19. Tyonek/Beluga (Not in WUI)	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ 25,000
	CA-2-20	20. Port Graham/Narwahl (Not in WUI)	\$ -	\$ 25,000	\$ -	\$ -	\$ -	\$ 25,000
Project Partners:								
<b>Community Wildfire Protection Plan (CWPP) Development Support</b>	CA-2	<b>Estimated Annual Total Project Cost</b>	<b>\$ 200,000</b>	<b>\$ 175,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 375,000</b>
Goal - Provide fire behavior, home ignition, Firewise and other staff support to the development of CWPPs.	CA-3-1	1. Anchor Point/Happy Valley/Nikolaev	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-2	2. Fritz Creek/Fox River (East End Road)	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-3	3. Homer/Diamond Ridge/Kachemak	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-4	4. Kaslof/Cohoe	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-5	5. Kenai/Kalifornsky	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-6	6. Moose Pass/Crown Point/Primrose	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-7	7. Nintchik/Clam Gulch	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-8	8. Nintchik Forties	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-9	9. Nikiski/Salamatof	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-10	10. Hope/Sunrise	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-11	11. Cooper Landing	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-12	12. Seldovia/Seldovia Village	\$ -	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 10,000
	CA-3-13	13. Soldotna/Ridgeway	\$ -	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 10,000
	CA-3-14	14. Sterling/Punny River	\$ -	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 10,000
	CA-3-15	15. Halibut Cover/Bear Cove	\$ -	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 10,000
	CA-3-16	16. Grey Cliffs/Moose Point	\$ -	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 10,000
	CA-3-17	17. Summit (No Census Area)	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-18	18. Seward/Bear Cr./Lowell Point	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 12,500
	CA-3-19	19. Tyonek/Beluga (Not in WUI)	\$ -	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 10,000
	CA-3-20	20. Port Graham/Narwahl (Not in WUI)	\$ -	\$ 2,500	\$ 2,500	\$ 2,500	\$ 2,500	\$ 10,000
Project Partners: KPB, USFS, USFWS, RFD's, Census Communities								
	CA-3	<b>Estimated Annual Total Project Cost</b>	<b>\$ 32,500</b>	<b>\$ 50,000</b>	<b>\$ 50,000</b>	<b>\$ 50,000</b>	<b>\$ 50,000</b>	<b>\$ 232,500</b>

<b>Total Community Assistance - KPB-Spruce Bark Beetle Mitigation Program</b>	<b>TOTAL</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 234,500</b>	<b>\$ 225,000</b>	<b>\$ 50,000</b>	<b>\$ 50,000</b>	<b>\$ 50,000</b>	<b>\$ 609,500</b>
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<b>GRAND TOTAL ALL - KPB-SPRUCE BARK BEETLE MITIGATION PROGRAM</b>								<b>\$ 23,287,540</b>
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**Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

**TABLE E4.0-CHUGACH NATIONAL FOREST 5-YEAR PROJECT IMPLEMENTATION SCHEDULE**

<b>Goal # 1 - Improve Fire Prevention &amp; Protection - USFS Chugach National Forest</b>									
<b>Project Name</b>	<b>Project</b>		<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>TOTAL</b>	
Program Administration	FP-0	Annual Estimated Cost	\$ 285,000	\$ 234,000	\$ 243,400	\$ 253,100	\$ 263,300	\$ 1,278,800	
<b>Fire Prevention &amp; Suppression</b> - Current program funding level for the Kenai-Kodiak Area (KKA) (Needs to be maintained) Goal - To provide cost effective fire protection to state, private, municipal, and federal lands in accordance with interagency agreements and the Alaska Interagency Fire Management Plan. Project Partners: DOF, USFS, RFD's, BLM, KPB	FP-1	Annual Estimated Cost	\$ 562,000	\$ 581,100	\$ 604,500	\$ 628,600	\$ 653,900	\$ 3,030,100	
<b>Increased Strength of Force for Preparedness &amp; Suppression</b> Increase agency infrastructure to adequately protect state, private, municipal, and federal lands. Goal - To provide cost effect fire management to protect WUI resources. Project Partners: DOF, USFS, RFD's, BLM, KPB	FP-2	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Firewise Program</b> - Workshops, Materials,Administration. Goal - Provide Firewise workshops for homeowners within the KPB. Project Partners: DOF, KPB, USFS, USFWS, RFD's	FP-3	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Air Tanker Contract (90 days)</b> Air tankers are essential to protection of WUI resources during initial attack. Goal - Ensure 90 day contract for a Type 1 airtanker to support initial attack operations. Project Partners: DOF, USFS, BLM	FP-4	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Weather Stations &amp; Improved Data Collection</b> - 10 RAWs Stations Goal - Provide sufficient RAWs stations to obtain accurate weather predictions in support of fire preparedness. Project Partners: DOF, USFS, BLM, USFWS, KPB, RFD's	FP-5	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Communications Upgrades</b> Radio systems are all going to narrow band and require conversion. Project would purchase 30 trunking handhelds & 30 trunking mobile radios. Goal - Provide critical communications with incident personnel. Project Partners: DOF, USFS, KPB, RFD's, BLM	FP-6	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Cooperative Protection Agreements Improvements</b> Goal - Project Partners:	FP-7	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Interagency Fire Prevention Plan</b> Goal - Develop, distribute & annually update an interagency plan for wildland interface communities that includes strategies for training & technology transfer. Project Partners: DOF, KPB, USFS, USFWS, local fire departments.	FP-8	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Fire Training Improvement</b> Goal - Improve fire suppression decision making for line officers, fire managers, and local agency representatives. Provide training on minimum impact suppression activities. Project Partners: DOF, KPB, USFS, USFWS, local fire departments.	FP-9	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Facilities</b> Project Partners:	FP-10	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>Interagency Fire Dispatch Center - KKA</b> Goal - Provide an interagency incident dispatch center that will coordinate incident operations. Project Partners: DOF, USFS, USFWS	FP-11	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
<b>TOTAL</b>	<b>Annual Estimated Program Cost</b>		<b>\$ 847,000</b>	<b>\$ 815,100</b>	<b>\$ 847,900</b>	<b>\$ 881,700</b>	<b>\$ 917,200</b>	<b>\$ 4,308,900</b>	
<b>Total Fire Prevention &amp; Protection - USFS Chugach National Forest</b>									
<b>Goal # 2 - Reduce Hazardous Fuel Reduction - USFS Chugach National Forest</b>									
<b>Project Name</b>	<b>Project</b>	<b>Output Units of Measure/Cost Category</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>TOTAL</b>	
Program Administration	FR-0	Estimated Annual Program Admin Cost	\$ 606,500	\$ 625,100	\$ 669,900	\$ 699,900	\$ 709,300	\$ 3,310,700	
<b>All Lands/All Hands &amp; Community Wildfire Protection Plan Technical Assistance</b>	FR-1	Number of Parcels	0	0	0	0	0	-	
Goal -	FR-1	Mechanical Acres	0	0	0	0	0	-	
	FR-1	Fuel Break Acres	0	0	0	0	0	-	
	FR-1	Prescribe Burn Acres	0	0	0	0	0	-	
	FR-1	Power Line Miles	0	0	0	0	0	-	
	FR-1	Hwy Miles	0	0	0	0	0	-	
	FR-1	Assessment and Planning	\$ 18,000	\$ 18,000	\$ 18,000	\$ 18,000	\$ 18,000	\$ 90,000	
	FR-1	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-1	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-1	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Project Partners:	FR-1	Estimated Annual Total Project Cost	\$ 18,000	\$ 18,000	\$ 18,000	\$ 18,000	\$ 18,000	\$ 90,000	
<b>Fire Regime &amp; Fuels Map</b>	FR-2	Number of Parcels	0	0	0	0	0	-	
Goal - Develop a Fire Regime & Fuels Map of for the Chugach National Forest	FR-2	Mechanical Acres	0	0	0	0	0	-	
	FR-2	Fuel Break Acres	0	0	0	0	0	-	
	FR-2	Prescribe Burn Acres	0	0	0	0	0	-	
	FR-2	Power Line Miles	0	0	0	0	0	-	
	FR-2	Hwy Miles	0	0	0	0	0	-	
	FR-2	Assessment and Planning	\$ 32,000	\$ 19,000	\$ 19,000	\$ -	\$ -	\$ 70,000	
	FR-2	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-2	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-2	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Project Partners: KPB	FR-2	Estimated Annual Total Project Cost	\$ 32,000	\$ 19,000	\$ 19,000	\$ -	\$ -	\$ 70,000	
<b>Primrose Mechanical Fuel Reduction Project</b>	FR-3	Number of Parcels	0	0	0	0	0	-	
Goal - WUI mechanical fuel reduction on 1100 acres and stewardship contract.	FR-3	Mechanical Acres	400	400	200	0	0	1,000	
	FR-3	Fuel Break Acres	0	0	0	0	0	-	
	FR-3	Prescribe Burn Acres	0	0	0	0	0	-	
	FR-3	Power Line Miles	0	0	0	0	0	-	
	FR-3	Hwy Miles	0	0	0	0	0	-	
	FR-3	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-3	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-3	Contract & Administration	\$ 441,000	\$ 520,000	\$ 220,000	\$ -	\$ -	\$ 1,181,000	
	FR-3	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Project Partners:	FR-3	Estimated Annual Total Project Cost	\$ 441,000	\$ 520,000	\$ 220,000	\$ -	\$ -	\$ 1,181,000	
<b>Hope Highway Mechanical Fuel Reduction Project</b>	FR-4	Number of Parcels	0	0	0	0	0	-	
	FR-4	Mechanical Acres	100	0	0	0	0	100	
	FR-4	Fuel Break Acres	0	0	0	0	0	-	
	FR-4	Prescribe Burn Acres	0	0	0	0	0	-	
	FR-4	Power Line Miles	0	0	0	0	0	-	
	FR-4	Hwy Miles	0	0	0	0	0	-	
	FR-4	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-4	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
	FR-4	Contract & Administration	\$ 110,000	\$ -	\$ -	\$ -	\$ -	\$ 110,000	
	FR-4	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Project Partners:	FR-4	Estimated Annual Total Project Cost	\$ 110,000	\$ -	\$ -	\$ -	\$ -	\$ 110,000	

**Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

<b>Juneau Creek Mechanical Fuel Reduction Project</b>	FR-5	Number of Parcels	0	0	0	0	0	0	-
	FR-5	Mechanical Acres	50	0	0	0	0	0	50
	FR-5	Fuel Break Acres	0	0	0	0	0	0	-
	FR-5	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-5	Power Line Miles	0	0	0	0	0	0	-
	FR-5	Hwy Miles	0	0	0	0	0	0	-
	FR-5	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-5	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-5	Contract & Administration	\$ 55,000	\$ -	\$ -	\$ -	\$ -	\$ -	55,000
	FR-5	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners: DPOR</b>			<b>FR-5</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 55,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 55,000</b>
<b>Gull Rock Unit 1 - Mechanical Fuel Reduction Project</b>	FR-6	Number of Parcels	0	0	0	0	0	0	-
	FR-6	Mechanical Acres	0	13	0	0	0	0	13
	FR-6	Fuel Break Acres	0	0	0	0	0	0	-
	FR-6	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-6	Power Line Miles	0	0	0	0	0	0	-
	FR-6	Hwy Miles	0	0	0	0	0	0	-
	FR-6	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-6	Force Account Implementation	\$ 6,000	\$ -	\$ -	\$ -	\$ -	\$ -	6,000
	FR-6	Contract & Administration	\$ -	\$ 14,300	\$ -	\$ -	\$ -	\$ -	14,300
	FR-6	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners:</b>			<b>FR-6</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 6,000</b>	<b>\$ 14,300</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 20,300</b>
<b>Silver Tip Mechanical Fuel Reduction Project</b>	FR-7	Number of Parcels	0	0	0	0	0	0	-
	FR-7	Mechanical Acres	0	200	200	300	300	0	1,000
	FR-7	Fuel Break Acres	0	0	0	0	0	0	-
	FR-7	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-7	Power Line Miles	0	0	0	0	0	0	-
	FR-7	Hwy Miles	0	0	0	0	0	0	-
	FR-7	Assessment and Planning	\$ 37,500	\$ -	\$ -	\$ -	\$ -	\$ -	37,500
	FR-7	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-7	Contract & Administration	\$ -	\$ 190,000	\$ 190,000	\$ 285,000	\$ 285,000	\$ -	950,000
	FR-7	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners: DPOR</b>			<b>FR-7</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 37,500</b>	<b>\$ 190,000</b>	<b>\$ 190,000</b>	<b>\$ 285,000</b>	<b>\$ 987,500</b>
<b>Prescribed Fire (Slash Pile Burning) of Fuel Reduction Treatment Slash Piles</b>	FR-8	Number of Parcels	0	0	0	0	0	0	-
	FR-8	Mechanical Acres	0	0	0	0	0	0	-
	FR-8	Fuel Break Acres	0	0	0	0	0	0	-
	FR-8	Prescribe Burn Acres	300	200	200	200	0	0	900
	FR-8	Power Line Miles	0	0	0	0	0	0	-
	FR-8	Hwy Miles	0	0	0	0	0	0	-
	FR-8	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-8	Force Account Implementation	\$ 90,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ -	\$ -	150,000
	FR-8	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-8	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners: KPB, DOF</b>			<b>FR-8</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 90,000</b>	<b>\$ 20,000</b>	<b>\$ 20,000</b>	<b>\$ 20,000</b>	<b>\$ 150,000</b>
<b>Granite Creek Mechanical Fuel Reduction Project (Other)</b>	FR-9	Number of Parcels	0	0	0	0	0	0	-
	FR-9	Mechanical Acres	0	0	0	500	500	0	1,000
	FR-9	Fuel Break Acres	0	0	0	0	0	0	-
	FR-9	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-9	Power Line Miles	0	0	0	0	0	0	-
	FR-9	Hwy Miles	0	0	0	0	0	0	-
	FR-9	Assessment and Planning	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ -	25,000
	FR-9	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-9	Contract & Administration	\$ -	\$ -	\$ -	\$ 475,000	\$ 475,000	\$ -	950,000
	FR-9	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners:</b>			<b>FR-9</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 25,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 475,000</b>	<b>\$ 975,000</b>
<b>Spruce Biomass Incinerators Study</b>	FR-10	Number of Parcels	0	0	0	0	0	0	-
	FR-10	Mechanical Acres	0	0	0	0	0	0	-
	FR-10	Fuel Break Acres	0	0	0	0	0	0	-
	FR-10	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-10	Power Line Miles	0	0	0	0	0	0	-
	FR-10	Hwy Miles	0	0	0	0	0	0	-
	FR-10	Assessment and Planning	\$ -	\$ 74,000	\$ 74,000	\$ -	\$ -	\$ -	148,000
	FR-10	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-10	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-10	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners:</b>			<b>FR-10</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 74,000</b>	<b>\$ 74,000</b>	<b>\$ -</b>	<b>\$ 148,000</b>
<b>12 Mile Mechanical Fuel Reduction Project</b>	FR-11	Number of Parcels	0	0	0	0	0	0	-
	FR-11	Mechanical Acres	0	0	0	10	10	0	20
	FR-11	Fuel Break Acres	0	0	0	0	0	0	-
	FR-11	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-11	Power Line Miles	0	0	0	0	0	0	-
	FR-11	Hwy Miles	0	0	0	0	0	0	-
	FR-11	Assessment and Planning	\$ -	\$ -	\$ 20,000	\$ -	\$ -	\$ -	20,000
	FR-11	Force Account Implementation	\$ -	\$ -	\$ 10,000	\$ -	\$ -	\$ -	10,000
	FR-11	Contract & Administration	\$ -	\$ -	\$ -	\$ 13,000	\$ 13,000	\$ -	26,000
	FR-11	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners: DPOR</b>			<b>FR-11</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 30,000</b>	<b>\$ 13,000</b>	<b>\$ 56,000</b>
<b>Total Hazardous Fuel Reduction - USFS CHUGACH NATIONAL FOREST</b>	ALL	Total Number of Parcels	0	0	0	0	0	0	-
	ALL	Total Mechanical Acres	550	613	400	810	810	0	3,183
	ALL	Total Fuel Break Acres	0	0	0	0	0	0	-
	ALL	Total Prescribe Burn Acres	300	200	200	200	0	0	900
	ALL	Total Power Line Miles	0	0	0	0	0	0	-
	ALL	Total Hwy Miles	0	0	0	0	0	0	-
	ALL	Assessment and Planning	\$ 112,500	\$ 111,000	\$ 131,000	\$ 18,000	\$ 18,000	\$ -	390,500
	ALL	Force Account Implementation	\$ 96,000	\$ 20,000	\$ 30,000	\$ 20,000	\$ -	\$ -	166,000
	ALL	Contract & Administration	\$ 606,000	\$ 724,300	\$ 410,000	\$ 773,000	\$ 773,000	\$ -	3,286,300
	ALL	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>ALL</b>			<b>Estimated Annual Total Project Cost</b>	<b>\$ 814,500</b>	<b>\$ 855,300</b>	<b>\$ 571,000</b>	<b>\$ 811,000</b>	<b>\$ 791,000</b>	<b>\$ 3,842,800</b>
<b>ALL</b>			<b>Estimated Annual Total Program Cost</b>	<b>\$ 1,421,000</b>	<b>\$ 1,480,400</b>	<b>\$ 1,240,900</b>	<b>\$ 1,510,900</b>	<b>\$ 1,500,300</b>	<b>\$ 7,153,500</b>

<b>Goal # 3 - Restore Forest Health &amp; Desired Ecosystems -USFS Chugach National Forest</b>									
Project Name	Project	2005	2006	2007	2008	2009	TOTAL		
Program Administration	FR-0	Estimated Annual Program Admin Co	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Paper Birch Seed Collection</b>	RS-1	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-1	Reforestation Acres	-	-	-	-	-	-	-
	RS-1	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-1	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-1	Number of Seedlings/Pounds of Seed	1,000	-	1,000	-	1,000	-	3,000
	RS-1	Purchase Tree Seedlings/Collect Tree Seed	\$ 25,000	\$ -	\$ 25,000	\$ -	\$ 25,000	\$ -	75,000
	RS-1	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-1	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-1	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-1	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Project Partners:</b>		<b>RS-1</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 25,000</b>	<b>\$ -</b>	<b>\$ 25,000</b>	<b>\$ -</b>	<b>\$ 25,000</b>	<b>\$ 75,000</b>



**Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

<b>Palmer Creek Project Reforestation</b>	RS-2	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-2	Reforestation Acres	66	190	-	-	-	-	256
	RS-2	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-2	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-2	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-2	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-2	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-2	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-2	Contract & Administration	\$ 35,600	\$ 95,000	\$ -	\$ -	\$ -	\$ -	130,600
	RS-2	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-2	<b>Estimated Annual Total Project Cost</b>	<b>\$ 35,600</b>	<b>\$ 95,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>130,600</b>
<b>Grant Lake Prescribed Burn Site Prep for Regeneration &amp; Habitat Improvement</b>	RS-3	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-3	Reforestation Acres	-	-	-	-	-	-	-
	RS-3	Prescribe Burn Site Prep Acres	-	-	2,650	-	-	-	2,650
	RS-3	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-3	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-3	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-3	Assessment and Planning	\$ 42,400	\$ -	\$ -	\$ -	\$ -	\$ -	42,400
	RS-3	Force Account Implementation	\$ 10,000	\$ -	\$ -	\$ -	\$ -	\$ -	10,000
	RS-3	Contract & Administration	\$ 80,000	\$ -	\$ 159,000	\$ -	\$ -	\$ -	239,000
	RS-3	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-3	<b>Estimated Annual Total Project Cost</b>	<b>\$ 132,400</b>	<b>\$ -</b>	<b>\$ 159,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>291,400</b>
<b>Juneau Creek Mechanical Site Prep for Regeneration &amp; Habitat Improvement</b>	RS-4	Mechanical Site Prep Acres	-	-	570	-	-	-	570
	RS-4	Reforestation Acres	-	-	-	-	-	-	-
	RS-4	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-4	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-4	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-4	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-4	Assessment and Planning	\$ 28,500	\$ -	\$ -	\$ -	\$ -	\$ -	28,500
	RS-4	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-4	Contract & Administration	\$ -	\$ -	\$ 427,500	\$ -	\$ -	\$ -	427,500
	RS-4	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-4	<b>Estimated Annual Total Project Cost</b>	<b>\$ 28,500</b>	<b>\$ -</b>	<b>\$ 427,500</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>456,000</b>
<b>Ptarmagin Lake Prescribed Burn Site Prep for Regeneration &amp; Habitat Improvement</b>	RS-5	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-5	Reforestation Acres	-	-	-	-	-	-	-
	RS-5	Prescribe Burn Site Prep Acres	-	2,500	-	-	-	-	2,500
	RS-5	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-5	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-5	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-5	Assessment and Planning	\$ 50,000	\$ -	\$ -	\$ -	\$ -	\$ -	50,000
	RS-5	Force Account Implementation	\$ 13,500	\$ -	\$ -	\$ -	\$ -	\$ -	13,500
	RS-5	Contract & Administration	\$ 65,500	\$ 200,000	\$ -	\$ -	\$ -	\$ -	265,500
	RS-5	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-5	<b>Estimated Annual Total Project Cost</b>	<b>\$ 129,000</b>	<b>\$ 200,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>329,000</b>
<b>Quartz East Project Reforestation</b>	RS-6	Mechanical Site Prep Acres	100	-	-	-	-	-	100
	RS-6	Reforestation Acres	-	300	-	-	-	-	300
	RS-6	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-6	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-6	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-6	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-6	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-6	Force Account Implementation	\$ -	\$ 4,500	\$ -	\$ -	\$ -	\$ -	4,500
	RS-6	Contract & Administration	\$ 35,000	\$ 75,000	\$ -	\$ -	\$ -	\$ -	110,000
	RS-6	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-6	<b>Estimated Annual Total Project Cost</b>	<b>\$ 35,000</b>	<b>\$ 79,500</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>114,500</b>
<b>Hope Highway Project Reforestation</b>	RS-7	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-7	Reforestation Acres	-	110	50	483	-	-	643
	RS-7	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-7	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-7	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-7	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-7	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-7	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-7	Contract & Administration	\$ -	\$ 55,000	\$ 25,000	\$ 33,660	\$ -	\$ -	113,660
	RS-7	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-7	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 55,000</b>	<b>\$ 25,000</b>	<b>\$ 33,660</b>	<b>\$ -</b>	<b>\$ -</b>	<b>113,660</b>
<b>Birch Seeding District Slash Piles that were Prescribe Burned</b>	RS-8	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-8	Reforestation Acres	-	50	50	-	-	-	100
	RS-8	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-8	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-8	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-8	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-8	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-8	Force Account Implementation	\$ -	\$ 500	\$ 500	\$ -	\$ -	\$ -	1,000
	RS-8	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-8	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-8	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 500</b>	<b>\$ 500</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>1,000</b>
<b>Fuller Project Reforestation</b>	RS-9	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-9	Reforestation Acres	-	180	-	-	-	-	180
	RS-9	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-9	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-9	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-9	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-9	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-9	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-9	Contract & Administration	\$ -	\$ 90,000	\$ -	\$ -	\$ -	\$ -	90,000
	RS-9	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-9	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 90,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>90,000</b>
<b>Quartz East Mechanical Site Prep for Regeneration &amp; Habitat Improvement</b>	RS-10	Mechanical Site Prep Acres	-	300	-	-	-	-	300
	RS-10	Reforestation Acres	-	-	-	-	-	-	-
	RS-10	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-10	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-10	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-10	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-10	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-10	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-10	Contract & Administration	\$ -	\$ 285,000	\$ -	\$ -	\$ -	\$ -	285,000
	RS-10	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	RS-10	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 285,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>285,000</b>
<b>Gull Rock Prescribed Burn Site Prep for Regeneration &amp; Habitat Improvement</b>	RS-11	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-11	Reforestation Acres	-	-	-	-	-	-	-
	RS-11	Prescribe Burn Site Prep Acres	-	-	-	1,000	-	-	1,000
	RS-11	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-11	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-11	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	RS-11	Assessment and Planning	\$ -	\$ 40,000	\$ -	\$ -	\$ -	\$ -	40,000
	RS-11	Force Account Implementation	\$ -	\$ 6,000	\$ -	\$ -	\$ -	\$ -	6,000
	RS-11	Contract & Administration	\$ -	\$ 65,500	\$ -	\$ 90,000	\$ -	\$ -	155,500
	RS-11	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners: USFWS	RS-11	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 111,500</b>	<b>\$ -</b>	<b>\$ 90,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>201,500</b>

# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

Ptarmagin Lake Prescribed Burn Aerial Seeding (Birch) Reforestation	RS-12	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-12	Reforestation Acres	-	2,500	-	-	-	-	2,500
	RS-12	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-12	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-12	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-12	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-12	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-12	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-12	Contract & Administration	\$ -	\$ 50,000	\$ -	\$ -	\$ -	\$ -	50,000
	RS-12	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-12	Estimated Annual Total Project Cost	\$ -	\$ 50,000	\$ -	\$ -	\$ -	\$ -	50,000
Project Partners:									
Victor Creek Planting (Spruce) Reforestation	RS-13	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-13	Reforestation Acres	-	104	-	-	-	-	104
	RS-13	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-13	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-13	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-13	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-13	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-13	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-13	Contract & Administration	\$ -	\$ 52,000	\$ -	\$ -	\$ -	\$ -	52,000
	RS-13	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-13	Estimated Annual Total Project Cost	\$ -	\$ 52,000	\$ -	\$ -	\$ -	\$ -	52,000
Project Partners:									
Hopw Highway Prescribed Burn Site Prep for Regeneration & Habitat Improvement	RS-14	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-14	Reforestation Acres	-	-	-	-	-	-	-
	RS-14	Prescribe Burn Site Prep Acres	-	-	-	433	-	-	433
	RS-14	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-14	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-14	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-14	Assessment and Planning	\$ -	\$ 12,000	\$ -	\$ -	\$ -	\$ -	12,000
	RS-14	Force Account Implementation	\$ -	\$ 48,000	\$ -	\$ 64,950	\$ -	\$ -	112,950
	RS-14	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-14	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-14	Estimated Annual Total Project Cost	\$ -	\$ 60,000	\$ -	\$ 64,950	\$ -	\$ -	124,950
Project Partners:									
Primrose Project Reforestation	RS-15	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-15	Reforestation Acres	-	-	400	400	200	-	1,000
	RS-15	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-15	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-15	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-15	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-15	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-15	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-15	Contract & Administration	\$ -	\$ -	\$ 160,000	\$ 160,000	\$ 80,000	\$ -	400,000
	RS-15	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-15	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 160,000	\$ 160,000	\$ 80,000	\$ -	400,000
Project Partners:									
Juneau Creek Project Reforestation	RS-16	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-16	Reforestation Acres	-	-	50	-	-	-	50
	RS-16	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-16	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-16	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-16	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-16	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-16	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-16	Contract & Administration	\$ -	\$ -	\$ 25,000	\$ -	\$ -	\$ -	25,000
	RS-16	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-16	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 25,000	\$ -	\$ -	\$ -	25,000
Project Partners:									
Gull Rock Unit 1 Planting (Spruce) Reforestation	RS-17	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-17	Reforestation Acres	-	-	13	-	-	-	13
	RS-17	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-17	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-17	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-17	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-17	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-17	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-17	Contract & Administration	\$ -	\$ -	\$ 6,500	\$ -	\$ -	\$ -	6,500
	RS-17	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-17	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 6,500	\$ -	\$ -	\$ -	6,500
Project Partners:									
Upper Russian Lake Prescribed Burn Site Prep for Regeneration & Habitat Improvement	RS-18	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-18	Reforestation Acres	-	-	-	-	-	-	-
	RS-18	Prescribe Burn Site Prep Acres	-	-	-	1,500	-	-	1,500
	RS-18	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-18	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-18	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-18	Assessment and Planning	\$ -	\$ -	\$ 30,000	\$ -	\$ -	\$ -	30,000
	RS-18	Force Account Implementation	\$ -	\$ -	\$ 12,000	\$ -	\$ -	\$ -	12,000
	RS-18	Contract & Administration	\$ -	\$ -	\$ 67,500	\$ 135,000	\$ -	\$ -	202,500
	RS-18	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-18	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 109,500	\$ 135,000	\$ -	\$ -	244,500
Project Partners:									
Moose Pass 7A Prescribed Burn Site Prep for Regeneration & Habitat Improvement	RS-19	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-19	Reforestation Acres	-	-	-	-	-	-	-
	RS-19	Prescribe Burn Site Prep Acres	-	-	-	1,300	-	-	1,300
	RS-19	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-19	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-19	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-19	Assessment and Planning	\$ -	\$ -	\$ 26,000	\$ -	\$ -	\$ -	26,000
	RS-19	Force Account Implementation	\$ -	\$ -	\$ 7,800	\$ -	\$ -	\$ -	7,800
	RS-19	Contract & Administration	\$ -	\$ -	\$ 5,000	\$ 117,000	\$ -	\$ -	122,000
	RS-19	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-19	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 38,800	\$ 117,000	\$ -	\$ -	155,800
Project Partners:									
Silver Tip Planting (Spruce) Reforestation	RS-20	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-20	Reforestation Acres	-	-	200	200	200	-	600
	RS-20	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-20	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-20	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-20	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-20	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-20	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-20	Contract & Administration	\$ -	\$ -	\$ 100,000	\$ 100,000	\$ 100,000	\$ -	300,000
	RS-20	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-20	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 100,000	\$ 100,000	\$ 100,000	\$ -	300,000
Project Partners:									
Granite Creek Planting (Spruce) Reforestation	RS-21	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-21	Reforestation Acres	-	-	200	200	200	-	600
	RS-21	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-21	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-21	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-21	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-21	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-21	Force Account Implementation	\$ -	\$ -	\$ 100,000	\$ 100,000	\$ 100,000	\$ -	300,000
	RS-21	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-21	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-21	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 100,000	\$ 100,000	\$ 100,000	\$ -	300,000
Project Partners:									

# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

Snow River North Insect (SBB) Suppression Thinning	RS-22	Insect (SBB) Suppression	-	-	-	-	-	300	300
	RS-22	Reforestation Acres	-	-	-	-	-	-	-
	RS-22	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-22	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-22	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-22	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-22	Assessment and Planning	\$ -	\$ -	\$ -	\$ 13,500	\$ -	\$ -	\$ 13,500
	RS-22	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ 9,000	\$ -	\$ 9,000
	RS-22	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 150,000	\$ 150,000
	RS-22	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-22	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 13,500	\$ 9,000	\$ 150,000	\$ 172,500
Grant Lake Prescribed Burn Aerial Seeding (Birch) Reforestation	RS-23	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-23	Reforestation Acres	-	-	-	2,650	-	-	2,650
	RS-23	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-23	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-23	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-23	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-23	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-23	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-23	Contract & Administration	\$ -	\$ -	\$ -	\$ 53,000	\$ -	\$ -	\$ 53,000
	RS-23	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-23	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 53,000	\$ -	\$ -	\$ 53,000
Cooper Creek Prescribed Burn Site Prep for Regeneration & Habitat Improvement	RS-24	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-24	Reforestation Acres	-	-	-	-	-	-	-
	RS-24	Prescribe Burn Site Prep Acres	-	-	-	-	1,300	-	1,300
	RS-24	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-24	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-24	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-24	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ 45,500	\$ -	\$ 45,500
	RS-24	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ 7,800	\$ -	\$ 7,800
	RS-24	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 80,000	\$ 117,000	\$ 197,000
	RS-24	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-24	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 133,300	\$ 117,000	\$ -	\$ 250,300
Upper Resurrection Creek Prescribed Burn Site Prep for Regeneration & Habitat Improvement	RS-25	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-25	Reforestation Acres	-	-	-	-	-	-	-
	RS-25	Prescribe Burn Site Prep Acres	-	-	-	-	2,000	-	2,000
	RS-25	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-25	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-25	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-25	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ 40,000	\$ -	\$ 40,000
	RS-25	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ 12,000	\$ -	\$ 12,000
	RS-25	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 78,000	\$ 140,000	\$ 218,000
	RS-25	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-25	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 130,000	\$ 140,000	\$ -	\$ 270,000
Kenai Lake South Prescribed Burn Site Prep for Regeneration & Habitat Improvement	RS-26	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-26	Reforestation Acres	-	-	-	-	-	-	-
	RS-26	Prescribe Burn Site Prep Acres	-	-	-	-	600	-	600
	RS-26	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-26	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-26	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-26	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ 21,000	\$ -	\$ 21,000
	RS-26	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ 3,600	\$ -	\$ 3,600
	RS-26	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 46,800	\$ 54,000	\$ 100,800
	RS-26	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-26	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 71,400	\$ 54,000	\$ -	\$ 125,400
Stetson Creek South Prescribed Burn Site Prep for Regeneration & Habitat Improvement	RS-27	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-27	Reforestation Acres	-	-	-	-	-	-	-
	RS-27	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-27	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-27	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-27	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-27	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ 30,600	\$ -	\$ 30,600
	RS-27	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ 5,400	\$ -	\$ 5,400
	RS-27	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 63,400	\$ -	\$ 63,400
	RS-27	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-27	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 30,600	\$ 68,800	\$ -	\$ 99,400
Moose Pass 7A Prescribed Burn Aerial Seeding (Birch) Reforestation	RS-28	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-28	Reforestation Acres	-	-	-	1,300	-	-	1,300
	RS-28	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-28	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-28	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-28	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-28	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-28	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-28	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 26,000	\$ -	\$ 26,000
	RS-28	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-28	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 26,000	\$ -	\$ -	\$ 26,000
Gull Rock Prescribed Burn Aerial Seeding (Birch) Reforestation	RS-29	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-29	Reforestation Acres	-	-	-	1,000	-	-	1,000
	RS-29	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-29	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-29	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-29	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-29	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-29	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-29	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 20,000	\$ -	\$ 20,000
	RS-29	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-29	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 20,000	\$ -	\$ -	\$ 20,000
Juneau Creek Aerial Seeding (Birch) Reforestation	RS-30	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-30	Reforestation Acres	-	-	-	570	-	-	570
	RS-30	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-30	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-30	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-30	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-30	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-30	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-30	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 11,400	\$ -	\$ 11,400
	RS-30	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-30	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 11,400	\$ -	\$ -	\$ 11,400
Upper Russian Lake Prescribed Burn Aerial Seeding (Birch) Reforestation	RS-31	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-31	Reforestation Acres	-	-	-	1,500	-	-	1,500
	RS-31	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-31	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-31	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-31	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-31	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-31	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-31	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 30,000	\$ -	\$ 30,000
	RS-31	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-31	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 30,000	\$ -	\$ -	\$ 30,000

# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

<b>Kenai Lake South Prescribed Burn Aerial Seeding (Birch) Reforestation</b>	RS-32	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-32	Reforestation Acres	-	-	-	-	600	-	600
	RS-32	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-32	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-32	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-32	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-32	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-32	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-32	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	12,000	12,000
	RS-32	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-32	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 12,000	\$ 12,000
<b>Upper Rensselaire Creek Prescribed Burn Aerial Seeding (Birch) Reforestation</b>	RS-33	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-33	Reforestation Acres	-	-	-	-	2,000	-	2,000
	RS-33	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-33	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-33	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-33	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-33	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-33	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-33	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	40,000	40,000
	RS-33	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-33	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 40,000	\$ 40,000
<b>Cooper Creek Prescribed Burn Aerial Seeding (Birch) Reforestation</b>	RS-34	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	RS-34	Reforestation Acres	-	-	-	-	1,300	-	1,300
	RS-34	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	RS-34	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	RS-34	Number of Seedlings/Pounds of Seed	-	-	-	-	-	-	-
	RS-34	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-34	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-34	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	RS-34	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	26,000	26,000
	RS-34	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Project Partners:	RS-34	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 26,000	\$ 26,000
<b>Total Forest Health &amp; Ecosystem Restoration - USFS Chugach National Forest</b>	ALL	Mechanical Site Prep Acres	100	300	570	-	300	-	1,270
	ALL	Reforestation Acres	66	3,434	3,613	5,653	4,500	-	17,266
	ALL	Prescribe Burn Site Prep Acres	-	2,500	2,650	4,233	3,900	-	13,283
	ALL	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	ALL	Number of Seedlings/Pounds of Seed	1,000	-	1,000	-	1,000	-	3,000
	ALL	Purchase Tree Seedlings/Collect Tree Seed	\$ 25,000	\$ -	\$ 25,000	\$ -	\$ 25,000	\$ -	75,000
	ALL	Assessment and Planning	\$ 120,900	\$ 52,000	\$ 69,500	\$ 137,100	\$ -	\$ -	379,500
	ALL	Force Account Implementation	\$ 23,500	\$ 59,000	\$ 120,300	\$ 197,350	\$ 105,400	\$ -	505,550
	ALL	Contract & Administration	\$ 216,100	\$ 967,500	\$ 1,028,500	\$ 927,860	\$ 782,400	\$ -	3,922,360
	ALL	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	ALL	Estimated Annual Total Project Cost	\$ 385,500	\$ 1,078,500	\$ 1,243,300	\$ 1,262,310	\$ 912,800	\$ -	4,882,410
	ALL	Estimated Annual Total Program Cost	\$ 385,500	\$ 1,078,500	\$ 1,243,300	\$ 1,262,310	\$ 912,800	\$ -	4,882,410
<b>Goal # 4 - Promote Community Assistance - USFS Chugach National Forest</b>									
<b>Project Name</b>	<b>Project</b>		<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>TOTAL</b>	
<b>Program Administration</b>	CA-0	Estimated Annual Total Program Admin Cost	-	-	-	-	-	\$ -	-
<b>Community Wildfire Protection Plan (CWPP) Grant Applications for Funding</b>	CA-1	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Goal - Develop and submit grant applications to fund the development of 15 Community Wildfire Protection Plans (CWPPs) within the KPB according to guidelines contained in the Healthy Forest Restoration Act (HFRA) of 2003. The KPB has the lead for submitting grant applications for 15 of the 20 CWPPs.									
Project Partners:									
<b>Community Wildfire Protection Plan (CWPP) Development Contracts</b>  Goal - Develop Community Wildfire Protection Plans for 20 census communities within the KPB according to guidelines contained in the Healthy Forest Restoration Act (HFRA) of 2003. The KPB will take the lead in developing 15 of the 20 by contracting for CWPPs. The Forest Service will within the take the lead in developing CWPPs for five community census areas the Chugach National Forest (Highlighted in Yellow).	CA-2-1	1. Anchor Point/Happy Valley/Nikolaev	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-2	2. Fritz Creek/Fox River (East End Road)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-3	3. Homer/Diamond Ridge/Kachemak	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-4	4. Kaslof/Cobos	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-5	5. Kenai/Kalifornsky	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-6	6. Moose Pass/Crown Point/Pinnose	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-7	7. Nimschik/Clam Gulch	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-8	8. Nimschik/Forties	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-9	9. Nikolski/Salamatof	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-10	10. Hope/Sunrise	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-11	11. Cooper Landing	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-12	12. Seldovia/Seldovia Village	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-13	13. Soldotna/Ridgeway	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-14	14. Sterling/Funny River	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-15	15. Halibut Cove/Bear Cove	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-16	16. Grey Cliffs/Moose Point	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-17	17. Summit (No Census Area)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-18	18. Seward/Bear Cr./Lowell Point	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-19	19. Tyonek/Beluga (Not in WUI)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	CA-2-20	20. Port Graham/Nauyasak (Not in WUI)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	CA-2	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Community Wildfire Protection Plan (CWPP) Development Support</b>  Goal - Provide fire behavior, home ignition, firewise and other staff support to the development of CWPPs.	CA-3-1	1. Anchor Point/Happy Valley/Nikolaev	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-2	2. Fritz Creek/Fox River (East End Road)	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-3	3. Homer/Diamond Ridge/Kachemak	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-4	4. Kaslof/Cobos	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-5	5. Kenai/Kalifornsky	\$ 5,000	\$ -	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-6	6. Moose Pass/Crown Point/Pinnose	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-7	7. Nimschik/Clam Gulch	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-8	8. Nimschik/Forties	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-9	9. Nikolski/Salamatof	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-10	10. Hope/Sunrise	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ -	5,000
	CA-3-11	11. Cooper Landing	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	5,000
	CA-3-12	12. Seldovia/Seldovia Village	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	5,000
	CA-3-13	13. Soldotna/Ridgeway	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	5,000
	CA-3-14	14. Sterling/Funny River	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	5,000
	CA-3-15	15. Halibut Cove/Bear Cove	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ -	5,000
	CA-3-16	16. Grey Cliffs/Moose Point	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	5,000
	CA-3-17	17. Summit (No Census Area)	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	5,000
	CA-3-18	18. Seward/Bear Cr./Lowell Point	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	5,000
	CA-3-19	19. Tyonek/Beluga (Not in WUI)	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	5,000
	CA-3-20	20. Port Graham/Nauyasak (Not in WUI)	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ -	5,000
Project Partners: KPB, USFS, USFWS, RFD's, Census Communities	CA-3	Estimated Annual Total Project Cost	\$ 25,000	\$ 25,000	\$ 25,000	\$ 25,000	\$ -	\$ -	100,000
<b>Community Risk Assessment &amp; Database</b>	CA-4	Estimated Annual Total Project Cost	\$ 1,000	\$ 1,000	\$ 1,000	\$ 1,000	\$ -	\$ -	5,000
Goal - Assess, inventory, & develop database on risk to structures from wildfire, access & egress, etc. to enhance tactical decisions, evacuations, and safety considerations.									
Project Partners: DOF, KPB, RFD's, Census Communities									
<b>Public Education &amp; Assistance</b>	CA-5	Estimated Annual Total Project Cost	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ -	\$ -	4,000
Goal - Provide the public with information and conduct field reviews regarding insect infestation, identification, prevention methods, suppression options, firewise recommendations, etc. Provide for a seasonal position to provide public assistance.									
Project Partners: Pvt.									

**Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

Bio-Energy Project Development	CA-6	Estimated Annual Total Project Cost	\$ 2,000	\$ 2,000	\$ 2,000	\$ 2,000	\$ -	\$ 8,000
Project Partners:								
Total Community Assistance - USFS Chugach National Forest	TOTAL	Estimated Annual Total Project Cost	\$ 30,000	\$ 30,000	\$ 30,000	\$ 30,000	\$ -	\$ 120,000
<b>GRAND TOTAL ALL - USFS CHUGACH NATIONAL FOREST</b>								<b>\$ 16,464,810</b>

**Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

**TABLE E5.0-KENAI NATIONAL WILDLIFE REFUGE 5-YEAR PROJECT IMPLEMENTATION SCHEDULE**

<b>Goal # 1 - Improve Fire Prevention &amp; Protection - USFWS Kenai National Wildlife Refuge</b>									
<b>Project Name</b>	<b>Project</b>		<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>TOTAL</b>	
Program Administration	FP-0	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Fire Prevention &amp; Suppression</b> - Current program funding level for the Kenai Wildfire Refuge (Needs to be maintained) Goal - To provide cost effective fire protection to federal lands in accordance with interagency agreements and the Alaska Interagency Fire Management Plan. Project Partners: DOF, USFS, RFD's, BLM, KPB	FP-1	Annual Estimated Cost	\$ 268,000	\$ 368,000	\$ 368,000	\$ 368,000	\$ 368,000	\$ 1,740,000	
<b>Increased Strength of Force for Preparedness &amp; Suppression</b> Project Partners:	FP-2	Annual Estimated Cost	\$ 100,000	\$ -	\$ -	\$ -	\$ -	\$ 100,000	
<b>Firewise Program</b> - Workshops, Materials, Administration. Goal - Provide Firewise workshops for homeowners within the KPB. Project Partners: DOF, KPB, USFS, USFWS, RFD's	FP-3	Annual Estimated Cost	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 10,000	\$ 50,000	
<b>Air Tanker Contract (90 days)</b> Air tankers are essential to protection of WUI resources during initial attack. Goal - Ensure 90 day contract for a Type 1 air tanker to support initial attack operations. Project Partners: DOF, USFS, BLM	FP-4	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Weather Stations &amp; Improved Data Collection</b> - 10 RAWS Stations Goal - Provide sufficient RAWS stations to obtain accurate weather predictions in support of fire preparedness. Project Partners: DOF, USFS, BLM, USFWS, KPB, RFD's	FP-5	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Communications Upgrades</b> Radio systems are all going to narrow band and require conversion. Project would purchase 30 trunking handhelds & 30 trunking mobile radios. Goal - Provide critical communications with incident personnel. Project Partners: DOF, USFS, KPB, RFD's, BLM	FP-6	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Cooperative Protection Agreements Improvements</b> Goal - Improve fire protection agreements & assess training needs, equipment, and services provided by local fire departments. Project Partners: DOF, KPB, Local Fire Departments	FP-7	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Interagency Fire Prevention Plan</b> Goal - Develop, distribute & annually update an interagency plan for wildland interface communities that includes strategies for training & technology transfer. Project Partners: DOF, KPB, USFS, USFWS, local fire departments.	FP-8	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Fire Training Improvement</b> Goal - Improve fire suppression decision making for line officers, fire managers, and local agency representatives. Provide training on minimum impact suppression activities. Project Partners: DOF, KPB, USFS, USFWS, local fire departments.	FP-9	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Facilities</b> - Refuge Fire Management Workstation - 2008-Planning/Contract/Design/Construction Goal - Construct a Refuge Fire Management Workstation Project Partners:	FP-59	Annual Estimated Cost	\$ -	\$ -	\$ -	\$ 500,000	\$ -	\$ 500,000	
<b>TOTAL</b>		<b>Annual Estimated Program Cost</b>	<b>\$ 378,000</b>	<b>\$ 378,000</b>	<b>\$ 378,000</b>	<b>\$ 878,000</b>	<b>\$ 378,000</b>	<b>\$ 2,390,000</b>	
<b>Total Fire Prevention &amp; Protection - USFWS Kenai National Wildlife Refuge</b>									
<b>Goal # 2 - Reduce Hazardous Fuel Reduction - USFWS Kenai National Wildlife Refuge</b>									
<b>Project Name</b>	<b>Project</b>	<b>Output Units of Measure/Cost Category</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>TOTAL</b>	
Program Administration	FR-0	Estimated Annual Program Administration Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
<b>Helicopter Contract for Prescribed Fire &amp; Wildland Fire Use</b>	FR-1	Number of Parcels	0	0	0	0	0	0	-
	FR-1	Mechanical Acres	0	0	0	0	0	0	-
Goal - Have Helicopter Support Available for Prescribed Fire & Wildland Fire Use	FR-1	Fuel Break Acres	0	0	0	0	0	0	-
	FR-1	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-1	Power Line Miles	0	0	0	0	0	0	-
	FR-1	Hwy Miles	0	0	0	0	0	0	-
	FR-1	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-1	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-1	Contract & Administration	\$ 150,000	\$ 150,000	\$ 150,000	\$ 150,000	\$ 150,000	\$ 750,000	
	FR-1	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-1	Estimated Annual Total Project Cost	\$ 150,000	\$ 150,000	\$ 150,000	\$ 150,000	\$ 150,000	\$ 750,000	
<b>Sterling/Lilly Lake (WUI) Prescribed Fire (Broadcast)</b>	FR-2	Number of Parcels	0	0	0	0	0	0	-
	FR-2	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-2	Fuel Break Acres	0	0	0	0	0	0	-
	FR-2	Prescribe Burn Acres	500	0	0	0	0	500	
	FR-2	Power Line Miles	0	0	0	0	0	0	-
	FR-2	Hwy Miles	0	0	0	0	0	0	-
	FR-2	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-2	Force Account Implementation	\$ 40,000	\$ -	\$ -	\$ -	\$ -	\$ 40,000	
	FR-2	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-2	Cleanup & Monitoring	\$ -	\$ 1,500	\$ -	\$ -	\$ -	\$ 1,500	
Project Partners:	FR-2	Estimated Annual Total Project Cost	\$ 40,000	\$ 1,500	\$ -	\$ -	\$ -	\$ 41,500	
<b>Soldotna/Silikok (WUI) Prescribed Fire (Broadcast)</b>	FR-3	Number of Parcels	0	0	0	0	0	0	-
	FR-3	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-3	Fuel Break Acres	0	0	0	0	0	0	-
	FR-3	Prescribe Burn Acres	153	0	0	0	0	153	
	FR-3	Power Line Miles	0	0	0	0	0	0	-
Includes Units 1 - 42 acres (monitoring only)	FR-3	Hwy Miles	0	0	0	0	0	0	-
Unit 2A - 77 acres	FR-3	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Unit 2B - 76 acres	FR-3	Force Account Implementation	\$ 60,000	\$ -	\$ -	\$ -	\$ -	\$ 60,000	
	FR-3	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-3	Cleanup & Monitoring	\$ 1,000	\$ 2,000	\$ -	\$ -	\$ -	\$ 3,000	
Project Partners:	FR-3	Estimated Annual Total Project Cost	\$ 61,000	\$ 2,000	\$ -	\$ -	\$ -	\$ 63,000	
<b>Quill Lake (Other) Prescribed Fire (Broadcast)</b>	FR-4	Number of Parcels	0	0	0	0	0	0	-
	FR-4	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-4	Fuel Break Acres	0	0	0	0	0	0	-
	FR-4	Prescribe Burn Acres	2500	1000	0	0	0	3,500	
	FR-4	Power Line Miles	0	0	0	0	0	0	-
	FR-4	Hwy Miles	0	0	0	0	0	0	-
Includes Unit 1 - 2,500 acres	FR-4	Assessment and Planning	\$ 4,000	\$ -	\$ -	\$ -	\$ -	\$ 4,000	
Unit 2 - 1,000 acres	FR-4	Force Account Implementation	\$ 73,000	\$ 35,000	\$ -	\$ -	\$ -	\$ 108,000	
	FR-4	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-4	Cleanup & Monitoring	\$ -	\$ 3,000	\$ 1,000	\$ -	\$ -	\$ 4,000	
Project Partners:	FR-4	Estimated Annual Total Project Cost	\$ 77,000	\$ 38,000	\$ 1,000	\$ -	\$ -	\$ 116,000	



# **Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year**

<b>Browse Lake (Other) Prescribed Fire (Broadcast)</b>	FR-5	Number of Parcels	0	0	0	0	0	0	-
	FR-5	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-5	Fuel Break Acres	0	0	0	0	0	0	-
	FR-5	Prescribe Burn Acres	700	0	0	0	0	0	700
	FR-5	Power Line Miles	0	0	0	0	0	0	-
	FR-5	Hwy Miles	0	0	0	0	0	0	-
	FR-5	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-5	Force Account Implementation	\$ 62,000	\$ -	\$ -	\$ -	\$ -	\$ -	62,000
	FR-5	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-5	Cleanup & Monitoring	\$ -	\$ 1,000	\$ -	\$ -	\$ -	\$ -	1,000
Project Partners:	<b>FR-5</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 62,000</b>	<b>\$ 1,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 63,000</b>
<b>Lark Lake (Other) Prescribed Fire (Broadcast)</b>	FR-6	Number of Parcels	0	0	0	0	0	0	-
	FR-6	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-6	Fuel Break Acres	0	0	0	0	0	0	-
	FR-6	Prescribe Burn Acres	1000	1100	0	0	0	0	2,100
	FR-6	Power Line Miles	0	0	0	0	0	0	-
	FR-6	Hwy Miles	0	0	0	0	0	0	-
Includes Unit North A - 215 acres	FR-6	Assessment and Planning	\$ 4,000	\$ -	\$ -	\$ -	\$ -	\$ -	4,000
Unit North B - 785 acres	FR-6	Force Account Implementation	\$ 62,000	\$ 77,000	\$ -	\$ -	\$ -	\$ -	139,000
Unit South - 1,100 acres	FR-6	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-6	Cleanup & Monitoring	\$ -	\$ 3,000	\$ 1,500	\$ -	\$ -	\$ -	4,500
Project Partners:	<b>FR-6</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 66,000</b>	<b>\$ 80,000</b>	<b>\$ 1,500</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 147,500</b>
<b>Moose Pens (WUI) Mechanical &amp; Prescribed Fire (Broadcast)</b>	FR-7	Number of Parcels	0	0	0	0	0	0	-
	FR-7	Mechanical Acres	150	0	0	0	150	0	300
Goal -	FR-7	Fuel Break Acres	0	0	0	0	0	0	-
	FR-7	Prescribe Burn Acres	0	600	0	0	0	0	600
Includes Unit 1 - 150 acres (mechanical)	FR-7	Power Line Miles	0	0	0	0	0	0	-
Unit 1 - 600 acres (prescribed fire broadcast)	FR-7	Hwy Miles	0	0	0	0	0	0	-
Unit 2 - 150 acres (mechanical)	FR-7	Assessment and Planning	\$ 4,000	\$ -	\$ -	\$ -	\$ -	\$ -	4,000
	FR-7	Force Account Implementation	\$ -	\$ 30,000	\$ -	\$ -	\$ -	\$ -	30,000
	FR-7	Contract & Administration	\$ 112,500	\$ -	\$ -	\$ -	\$ 112,500	\$ -	225,000
	FR-7	Cleanup & Monitoring	\$ -	\$ -	\$ 3,000	\$ -	\$ -	\$ -	3,000
Project Partners:	<b>FR-7</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 116,500</b>	<b>\$ 30,000</b>	<b>\$ 3,000</b>	<b>\$ -</b>	<b>\$ 112,500</b>	<b>\$ -</b>	<b>\$ 262,000</b>
<b>Funny River/Browns Lake (WUI) Mechanical</b>	FR-8	Number of Parcels	0	0	0	0	0	0	-
	FR-8	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-8	Fuel Break Acres	0	175	0	0	0	0	175
	FR-8	Prescribe Burn Acres	0	0	175	0	0	0	175
Includes Unit - 175 acre Mechanical Fuelbreak & Prescribed Fire (Pile Burning)	FR-8	Power Line Miles	0	0	0	0	0	0	-
	FR-8	Hwy Miles	0	0	0	0	0	0	-
	FR-8	Assessment and Planning	\$ 6,000	\$ -	\$ -	\$ -	\$ -	\$ -	6,000
	FR-8	Force Account Implementation	\$ -	\$ -	\$ 87,500	\$ -	\$ -	\$ -	87,500
	FR-8	Contract & Administration	\$ -	\$ 175,000	\$ -	\$ -	\$ -	\$ -	175,000
	FR-8	Cleanup & Monitoring	\$ -	\$ -	\$ 1,000	\$ 2,000	\$ -	\$ -	3,000
Project Partners:	<b>FR-8</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 6,000</b>	<b>\$ 175,000</b>	<b>\$ 88,500</b>	<b>\$ 2,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 271,500</b>
<b>Tustumean Cabins (WUI) Cut/Pile/Burn Firewise</b>	FR-9	Number of Parcels	0	0	0	0	0	0	-
	FR-9	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-9	Fuel Break Acres	0	10	0	0	0	0	10
	FR-9	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-9	Power Line Miles	0	0	0	0	0	0	-
	FR-9	Hwy Miles	0	0	0	0	0	0	-
	FR-9	Assessment and Planning	\$ 4,000	\$ -	\$ -	\$ -	\$ -	\$ -	4,000
	FR-9	Force Account Implementation	\$ -	\$ 10,000	\$ -	\$ -	\$ -	\$ -	10,000
	FR-9	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-9	Cleanup & Monitoring	\$ -	\$ -	\$ 1,000	\$ -	\$ -	\$ -	1,000
Project Partners:	<b>FR-9</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 4,000</b>	<b>\$ 10,000</b>	<b>\$ 1,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 15,000</b>
<b>Mystery Creek #1-3 (Other) Post Burn Monitoring</b>	FR-10	Number of Parcels	0	0	0	0	0	0	-
	FR-10	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-10	Fuel Break Acres	0	0	0	0	0	0	-
	FR-10	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-10	Power Line Miles	0	0	0	0	0	0	-
	FR-10	Hwy Miles	0	0	0	0	0	0	-
	FR-10	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-10	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-10	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-10	Cleanup & Monitoring	\$ 4,000	\$ -	\$ -	\$ -	\$ -	\$ -	4,000
Project Partners:	<b>FR-10</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ 4,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 4,000</b>
<b>Willow Lake (Other) Prescribed Fire (Broadcast)</b>	FR-11	Number of Parcels	0	0	0	0	0	0	-
	FR-11	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-11	Fuel Break Acres	0	0	0	0	0	0	-
	FR-11	Prescribe Burn Acres	0	0	1400	0	0	0	1,400
	FR-11	Power Line Miles	0	0	0	0	0	0	-
	FR-11	Hwy Miles	0	0	0	0	0	0	-
	FR-11	Assessment and Planning	\$ -	\$ 4,000	\$ -	\$ -	\$ -	\$ -	4,000
	FR-11	Force Account Implementation	\$ -	\$ -	\$ 42,000	\$ -	\$ -	\$ -	42,000
	FR-11	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-11	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ 2,000	\$ -	\$ -	2,000
Project Partners:	<b>FR-11</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 4,000</b>	<b>\$ 42,000</b>	<b>\$ 2,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 48,000</b>
<b>Beaver Lake (Other) Prescribed Fire (Broadcast)</b>	FR-12	Number of Parcels	0	0	0	0	0	0	-
	FR-12	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-12	Fuel Break Acres	0	0	0	0	0	0	-
	FR-12	Prescribe Burn Acres	0	0	2000	2000	0	0	4,000
	FR-12	Power Line Miles	0	0	0	0	0	0	-
	FR-12	Hwy Miles	0	0	0	0	0	0	-
Includes Unit - South - 2,000 acres	FR-12	Assessment and Planning	\$ -	\$ 4,000	\$ -	\$ -	\$ -	\$ -	4,000
Unit - North - 2,000 acres	FR-12	Force Account Implementation	\$ -	\$ -	\$ 60,000	\$ 60,000	\$ -	\$ -	120,000
	FR-12	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-12	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ 2,000	\$ 2,000	\$ -	4,000
Project Partners:	<b>FR-12</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 4,000</b>	<b>\$ 60,000</b>	<b>\$ 62,000</b>	<b>\$ 2,000</b>	<b>\$ -</b>	<b>\$ 128,000</b>
<b>West Fork Funny River (Other) Prescribed Fire (Broadcast)</b>	FR-13	Number of Parcels	0	0	0	0	0	0	-
	FR-13	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-13	Fuel Break Acres	0	0	0	0	0	0	-
	FR-13	Prescribe Burn Acres	0	0	800	1400	0	0	2,200
	FR-13	Power Line Miles	0	0	0	0	0	0	-
	FR-13	Hwy Miles	0	0	0	0	0	0	-
Includes Unit 1 - 800 acres	FR-13	Assessment and Planning	\$ -	\$ 4,000	\$ -	\$ -	\$ -	\$ -	4,000
Unit 2 - 1,400 acres	FR-13	Force Account Implementation	\$ -	\$ -	\$ 40,000	\$ 70,000	\$ -	\$ -	110,000
	FR-13	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-13	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ 3,000	\$ 2,000	\$ -	5,000
Project Partners:	<b>FR-13</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 4,000</b>	<b>\$ 40,000</b>	<b>\$ 73,000</b>	<b>\$ 2,000</b>	<b>\$ -</b>	<b>\$ 119,000</b>
<b>Skalak Cabins (WUI) Cut/Pile/Burn Firewise</b>	FR-14	Number of Parcels	0	0	0	0	0	0	-
	FR-14	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-14	Fuel Break Acres	0	0	10	0	0	0	10
	FR-14	Prescribe Burn Acres	0	0	0	0	0	0	-
	FR-14	Power Line Miles	0	0	0	0	0	0	-
	FR-14	Hwy Miles	0	0	0	0	0	0	-
	FR-14	Assessment and Planning	\$ -	\$ 4,000	\$ -	\$ -	\$ -	\$ -	4,000
	FR-14	Force Account Implementation	\$ -	\$ -	\$ 10,000	\$ -	\$ -	\$ -	10,000
	FR-14	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-14	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ 1,000	\$ -	\$ -	1,000
Project Partners:	<b>FR-14</b>	<b>Estimated Annual Total Project Cost</b>	<b>\$ -</b>	<b>\$ 4,000</b>	<b>\$ 10,000</b>	<b>\$ 1,000</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 15,000</b>

# Individual Agency/Landowner 5-Year Project Implementation Schedule by NFP/HFRA Goal and Fiscal Year

Remote Refuge Cabins (WUI) Cut/Pile/Burn Firewise	FR-15	Number of Parcels	0	0	0	0	0	0	-
	FR-15	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-15	Fuel Break Acres	0	0	0	10	10	20	-
	FR-15	Prescribe Burn Acres	0	0	0	0	0	-	-
	FR-15	Power Line Miles	0	0	0	0	0	-	-
	FR-15	Hwy Miles	0	0	0	0	0	-	-
	FR-15	Assessment and Planning	\$ -	\$ -	\$ 2,000	\$ -	\$ -	\$ 2,000	-
	FR-15	Force Account Implementation	\$ -	\$ -	\$ -	\$ 20,000	\$ 20,000	\$ 40,000	-
	FR-15	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-15	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-15	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 2,000	\$ 20,000	\$ 20,000	\$ 42,000	-
Kaslo/Pollard (WUI) Mechanical Fuel Break /Prescribed Fire (Broadcast)	FR-16	Number of Parcels	0	0	0	0	0	0	-
	FR-16	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-16	Fuel Break Acres	0	0	0	150	0	150	-
	FR-16	Prescribe Burn Acres	0	0	0	0	500	500	-
	FR-16	Power Line Miles	0	0	0	0	0	-	-
	FR-16	Hwy Miles	0	0	0	0	0	-	-
	FR-16	Assessment and Planning	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ 5,000	-
	FR-16	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ 37,500	\$ 37,500	-
	FR-16	Contract & Administration	\$ -	\$ -	\$ -	\$ 150,000	\$ -	\$ 150,000	-
	FR-16	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-16	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 5,000	\$ 150,000	\$ 37,500	\$ 192,500	-
Bottemintin Lake (WUI) Mechanical Fuel Break /Prescribed Fire (Broadcast)	FR-17	Number of Parcels	0	0	0	0	0	0	-
	FR-17	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-17	Fuel Break Acres	0	0	0	100	0	100	-
	FR-17	Prescribe Burn Acres	0	0	0	0	400	400	-
	FR-17	Power Line Miles	0	0	0	0	0	-	-
	FR-17	Hwy Miles	0	0	0	0	0	-	-
	FR-17	Assessment and Planning	\$ -	\$ -	\$ 5,000	\$ -	\$ -	\$ 5,000	-
	FR-17	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ 30,000	\$ 30,000	-
	FR-17	Contract & Administration	\$ -	\$ -	\$ -	\$ 100,000	\$ -	\$ 100,000	-
	FR-17	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-17	Estimated Annual Total Project Cost	\$ -	\$ -	\$ 5,000	\$ 100,000	\$ 30,000	\$ 135,000	-
Coal Creek Lake (WUI) Mechanical Fuel Break	FR-18	Number of Parcels	0	0	0	0	0	0	-
	FR-18	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-18	Fuel Break Acres	0	0	0	0	300	300	-
	FR-18	Prescribe Burn Acres	0	0	0	0	0	-	-
	FR-18	Power Line Miles	0	0	0	0	0	-	-
	FR-18	Hwy Miles	0	0	0	0	0	-	-
	FR-18	Assessment and Planning	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ 5,000	-
	FR-18	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-18	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 225,000	\$ 225,000	-
	FR-18	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-18	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 5,000	\$ 225,000	\$ 230,000	-
Suip Lake (WUI) Mechanical Fuel Break	FR-19	Number of Parcels	0	0	0	0	0	0	-
	FR-19	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-19	Fuel Break Acres	0	0	0	0	200	200	-
	FR-19	Prescribe Burn Acres	0	0	0	0	0	-	-
	FR-19	Power Line Miles	0	0	0	0	0	-	-
	FR-19	Hwy Miles	0	0	0	0	0	-	-
	FR-19	Assessment and Planning	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ 5,000	-
	FR-19	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-19	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 150,000	\$ 150,000	-
	FR-19	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-19	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 5,000	\$ 150,000	\$ 155,000	-
Grey Cliff (WUI) Mechanical Fuel Break	FR-20	Number of Parcels	0	0	0	0	0	0	-
	FR-20	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-20	Fuel Break Acres	0	0	0	0	200	200	-
	FR-20	Prescribe Burn Acres	0	0	0	0	0	-	-
	FR-20	Power Line Miles	0	0	0	0	0	-	-
	FR-20	Hwy Miles	0	0	0	0	0	-	-
	FR-20	Assessment and Planning	\$ -	\$ -	\$ -	\$ 5,000	\$ -	\$ 5,000	-
	FR-20	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-20	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ 150,000	\$ 150,000	-
	FR-20	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-20	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ 5,000	\$ 150,000	\$ 155,000	-
2010 Outyear Planning	FR-21	Number of Parcels	0	0	0	0	0	0	-
	FR-21	Mechanical Acres	0	0	0	0	0	0	-
Goal -	FR-21	Fuel Break Acres	0	0	0	0	0	-	-
	FR-21	Prescribe Burn Acres	0	0	0	0	0	-	-
	FR-21	Power Line Miles	0	0	0	0	0	-	-
	FR-21	Hwy Miles	0	0	0	0	0	-	-
	FR-21	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ 10,000	\$ 10,000	-
	FR-21	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-21	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	FR-21	Cleanup & Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Project Partners:	FR-21	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ 10,000	\$ 10,000	-
Total Hazardous Fuel Reduction - USFWS Kenai National Wildlife Refuge	ALL	Total Number of Parcels	0	0	0	0	0	0	-
	ALL	Total Mechanical Acres	150	0	0	0	150	300	-
	ALL	Total Fuel Break Acres	0	185	10	260	710	1,165	-
	ALL	Total Prescribe Burn Acres	4853	2700	4375	3400	900	16,228	-
	ALL	Total Power Line Miles	0	0	0	0	0	-	-
	ALL	Total Hwy Miles	0	0	0	0	0	-	-
	ALL	Assessment and Planning	\$ 22,000	\$ 16,000	\$ 12,000	\$ 15,000	\$ 10,000	\$ 75,000	-
	ALL	Force Account Implementation	\$ 297,000	\$ 152,000	\$ 239,500	\$ 150,000	\$ 87,500	\$ 926,000	-
	ALL	Contract & Administration	\$ 262,500	\$ 325,000	\$ 150,000	\$ 400,000	\$ 787,500	\$ 1,925,000	-
	ALL	Cleanup & Monitoring	\$ 5,000	\$ 10,500	\$ 7,500	\$ 10,000	\$ 4,000	\$ 37,000	-
	ALL	Estimated Annual Total Project Cost	\$ 586,500	\$ 503,500	\$ 409,000	\$ 575,000	\$ 889,000	\$ 2,963,000	-
	ALL	Estimated Annual Total Program Cost	\$ 586,500	\$ 503,500	\$ 409,000	\$ 575,000	\$ 889,000	\$ 2,963,000	-

Goal # 3 - Restore Forest Health & Desired Ecosystems - USFWS Kenai National Wildlife Refuge									
Project Name	Project	2005	2006	2007	2008	2009	TOTAL		
Program Administration	FR-0	Estimated Annual Program Admin Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Total Forest Health & Ecosystem Restoration - USFWS Kenai National Wildlife Refuge	ALL	Mechanical Site Prep Acres	-	-	-	-	-	-	-
	ALL	Reforestation Acres	-	-	-	-	-	-	-
	ALL	Prescribe Burn Site Prep Acres	-	-	-	-	-	-	-
	ALL	Project Implementation Monitoring Acres	-	-	-	-	-	-	-
	ALL	Number of Seedlings	-	-	-	-	-	-	-
	ALL	Purchase Tree Seedlings/Collect Tree Seed	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	ALL	Assessment and Planning	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	ALL	Force Account Implementation	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	ALL	Contract & Administration	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	ALL	Monitoring	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
	ALL	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-

Goal # 4 - Promote Community Assistance - USFWS Kenai National Wildlife Refuge									
Project Name	Project	2005	2006	2007	2008	2009	TOTAL		
Program Administration	CA-0	Estimated Annual Total Program Admin Cost					\$		-
Total Community Assistance - USFWS Kenai National Wildlife Refuge	TOTAL	Estimated Annual Total Project Cost	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-

<b>GRAND TOTAL ALL - USFWS Kenai National Wildlife Refuge</b>							\$	<b>5,353,000</b>	
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# Seward/Bear Creek Flood Service Area

## **HAZARD MITIGATION PLAN**

A Service Area of the Kenai Peninsula Borough

**June 2013**

(Originally published July 2005)

# **Seward Bear Creek Flood Service Area**

## **2013 Local Hazard Mitigation Plan (LHMP) Update**

### **Executive Summary**

The Seward Bear Creek Flood Service Area (SBCFSA) 2013 Local Hazard Mitigation Plan (LHMP) supplements the Kenai Peninsula Borough's Multi-Jurisdictional All-Hazard Mitigation Plan. This plan's "All Hazards" approach enables the participating communities to fully integrate essential emergency planning activities.

The SBCFSA's LHMP is a joint planning effort by the SBCFSA, City of Seward, and the Kenai Peninsula Borough. This HMP is intended to serve the SBCFSA's citizens and decision makers to implement actions that would reduce or eliminate future and potentially damaging natural hazard event impacts to their critical facilities, residential structures, and population.

This HMP was drafted and adopted to fulfill requirements mandated by the Disaster Mitigation Act of 2000, under Public Law 106-390, amending the Robert T. Stafford Disaster Relief and Emergency Assistance Act, and Title 42 of the United States Code (5121 et seq.).

Local governments are required to have a FEMA approved, local government adopted natural hazard mitigation plan for FEMA grant programs' eligibility.

The methodology used for developing the SBCFSA Local Hazard Mitigation Plan consisted of the following tasks:

- Plan development, review, and maintenance
- Public and agency coordination and involvement
- Critical facility inventory development
- Hazard impact area identification and description
- Population risk assessment and critical facility vulnerability identification
- Mitigation strategy development identifying, selecting, prioritizing, and implementing mitigation actions
- Local HMP adoption following a public hearing
- Periodic evaluation, review, and update

The HMP is divided into nine sections: Introduction, Community Description, Planning Process, HMP Adoption, Hazard Profiles, Vulnerability Analysis, Mitigation Strategy, and Reference List, with applicable supporting appendices.

The SBCFSA is at risk from eight identified natural hazards: earthquakes, erosion, flood, ground failure, severe weather, tsunamis, volcanic activity, and wildland fire. The primary threat to the SBCFSA is from severe weather and storm events. The Planning Team identified mitigation measures that span a broad spectrum of activities for all potential hazard impacts. They include:

- Promote recognizing and mitigating all natural hazards that affect the SBCFSA.
- Reduce loss and damage possibility from all natural hazards that affect the area.
- Cross reference mitigation goals and actions with other partners' planning mechanisms and projects.
- Reduce structural vulnerability to earthquake, erosion, flood, ground failure, severe weather, tsunamis, volcano, and wildland fire damages.

- Maintaining city monitoring and warning systems, e.g. the City's tsunami warning and early alert broadcasting siren systems.

The plan will be monitored, reviewed, and evaluated annually; and updated every five years. It will also be reviewed and updated as appropriate, such as when new funding sources become available, or after a disaster occurs that significantly affects the SBCFSA.

This plan serves as guide for citizens and policy makers in SBCFSA in order to mitigate potential natural hazard disaster damages. The purpose of the HMP is to ensure public awareness and involvement, and maintenance of hazard mitigation initiatives to best protect and mitigate damages from natural hazard events. Periodic review of this plan is necessary in order to continually evaluate its effectiveness and to make the most efficient use of mitigation resources as they become available.

The 2013 SBCFSA Local Hazard Mitigation Plan developed initiatives will be incorporated into existing SBCFSA, City, Tribal, and Borough planning initiatives such as their respective Comprehensive, Capital Improvement, Emergency Response, and Transportation Plans as appropriate.

*This document was prepared under a grant from the Federal Emergency Management Agency (FEMA)'s Grant Programs Directorate, U.S. Department of Homeland Security and the Alaska Division of Homeland Security and Emergency Management. Points of view or opinions expressed in this document are those of the authors and do not necessarily represent the official position or policies of FEMA's Grant Programs Directorate, the U.S. Department of Homeland Security or the State of Alaska*



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## Appendices

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## Appendices

Appendix A:	Seward Bear Creek Flood Service Area Flood Hazard Mitigation Plan, 2010
Appendix B:	Defines the National Flood Insurance Program and the Community Rating System.
Appendix C:	Delineates Federal, State, and other potential mitigation funding resources. This section will aid plan participants and agencies with researching and applying for funds to implement the mitigation strategy.
Appendix D:	Contains the FEMA Local Mitigation Plan Review Tool, which documents compliance with FEMA criteria.
Appendix E:	Contains KPB Assembly Minutes for SBCFSA HMP Acceptance.
Appendix F:	Contains public outreach information, public notices, and newsletters.
Appendix G:	Contains the Benefit-Cost Analysis Fact Sheet that will be used during actual project grant application process. <i>Note: summarized within the mitigation action plan (MAP).</i>
Appendix H:	Contains plan maintenance documents, such as an Annual Review Questionnaire and the Mitigation Action Progress Report form.
Appendix I:	Contains climate change current and future impact analyses.
Appendix J:	Contains Hazards United States (Hazus) scenario narratives.
Appendix K:	Contains Hazus and GIS-based hazard impact figures.

## Acronyms/Abbreviations

°F	Degrees Fahrenheit
AAG	Adaptation Advisory Group
ACCIMP	Alaska Climate Change Impact Mitigation Program
ACIAC	Alaska Climate Impact Assessment Commission
ACWF	Alaska Clean Water Fund
ADWF	Alaska Drinking Water Fund
AEA	Alaska Energy Authority
AEEE	Alternative Energy And Energy Efficiency
AFG	Assistance to Firefighters Grant
AHFC	Alaska Housing Finance Corporation
AICC	Alaska Interagency Coordination Center
AK	Alaska
ANTHC	Alaska Native Tribal Health Consortium
APA	American Planning Association
ARC	American Red Cross
ARRC	Alaska Railroad Corporation
AVCP	Alaska Village Council Of Presidents
AVEC	Alaska Village Electric Cooperative
AVHRR	Advanced Very High Resolution Radiometers
AVTEC	Alaska Vocational Technical Center
BFE	Base Flood Elevation
CAT (or CT)	Computerized Axial Tomography
CCP	Citizen Corps Program
CDBG	Community Development Block Grant
Census	US Census
CFP	Community Forestry Program
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
City	City of Seward
CReSIS	Center of Remote Sensing Of Ice Sheets
CVRF	Coastal Villages Regional Fund
CWSRF	Clean Water State Revolving Fund
DCCED	Department of Commerce, Community, And Economic Development
DCRA	Division of Community And Regional Affairs
DEC	Department of Environmental Conservation
DEED	Alaska Department of Education And Early Development
Denali	Denali Commission
DGGS	Division of Geological And Geophysical Survey
DHS	US Department of Homeland Security
DHS&EM	Division of Homeland Security And Emergency Management
DHHS	Department of Health and Human Services
DMA 2000	Disaster Mitigation Act of 2000
DMVA	Department of Military and Veterans Affairs
DNR	Department of Natural Resources

DOE	Department of Energy
DOF	Division of Forestry
DOI	Division of Insurance
DOL	Department of Labor
DOT/PF	Department of Transportation And Public Facilities
DSS	Division of Senior Services
EDA	Economic Development Administration
EDI	Economic Development Initiative
EMPG	Emergency Management Performance Grant
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EWP	Emergency Watershed Protection Program
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance
FP&S	Fire Prevention and Safety
ft	Feet
FY	Fiscal Year
g	Gravity
GBS	General Building Stock
ghg	Greenhouse Gas
GI	Geophysical Institute
GIS	Geospatial Information System
Hazus	Hazards United States – Multi-Hazards
HEC-GeoRAS	USACE’s Hydrologic Engineering Center’s GIS Tools for Support of HEC-RAS using ArcGIS
HEC-RAS	USACE’s Hydrologic Engineering Center’s River Analysis System
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HSGP	Homeland Security Grant Program
HUD	Department of Housing and Urban Development
IBHS	Institute for Business And Home Safety
IPCC	Intergovernmental Panel on Climate Change
IRS	Internal Revenue Service
KPB	Kenai Peninsula Borough
Kts	Knots
kW	Kilowatt
LEG	Legislative Grant
LKEDC	Lower Kuskokwim Economic Development Council, Inc.
M	Magnitude
MGL	Municipal Matching Grants and Loans
MMI	Modified Mercalli Intensity
Mtns	Mountains
MP	Mile Post



mph	Miles Per Hour
msl	Mean Sea Level
NASA	National Aeronautics and Space Administration
NCA	National Climate Assessment
NFIP	National Flood Insurance Program
NHC	Northwest Hydraulic Consultants
NIMS	National Incident Management System
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRF	National Response Framework
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
PCIH	Primary Care in Hospitals
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
Ph	Phase
PNP	Private Non-Profit
PWS	Prince William Sound
RAS	River Analysis System
RCASP	Remote Community Alert Systems
RD	US Division of Rural Development
RL	Repetitive Loss
RFA	Rural Fire Assistance Grant
RFC	Repetitive Flood Claim
RPSU	Rural Power System Upgrade
SAFER	Staffing for Adequate Fire and Emergency Response
SBCFSA	Seward Bear Creek Flood Service Area
SBA	US Small Business Administration
SHMP	Alaska State Hazard Mitigation Plan
SHSP	State Homeland Security Program
SLA	State Legislative Action
SLR	Sea Level Rise
SMIC	Seward Marine Industrial Center
SNAP	Scenarios Network for Alaska & Arctic Planning
Snd	Sound
SOA	State of Alaska
Sq.	Square
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
UAF	University of Alaska Fairbanks
UDF	User-Defined Facilities
UNEP	United Nations Environmental Programme
URS	URS Corporation
US or U.S.	United States
USACE	US Army Corps of Engineers

USC	US Code
USDA	US Department of Agriculture
USFS	US Forest Service
USGS	US Geological Survey
VFA	Volunteer Fire Assistance Grant
VSW	Village Safe Water
WARN	Warning, Alert, and Response Network
WC/ATWC	West Coast and Alaska Tsunami Warning Center
WHIP	Wildlife Habitat Incentives Program
WRCC	Western Regional Climate Center
Wrn	Western

This section provides a brief introduction to hazard mitigation planning, the grants associated with these requirements, and a description of this Hazard Mitigation Plan (HMP).

## 1.1 HAZARD MITIGATION PLANNING

In recent years, local hazard mitigation planning has been driven by a new Federal law. On October 30, 2000, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390) which amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Title 42 of the United States Code [USC] 5121 et seq.) by repealing the act's previous mitigation planning section (409) and replacing it with a new mitigation planning section (322). This new section emphasized the need for State, Tribal, and local entities to closely coordinate mitigation planning and implementation efforts. In addition, it provided the legal basis for the Federal Emergency Management Agency's (FEMA) mitigation plan requirements for mitigation grant assistance.

To implement these planning requirements, FEMA published an Interim Final Rule in the Federal Register on February 26, 2002 (FEMA 2002a), 44 CFR Part 201 with subsequent updates. The planning requirements for local entities are described in detail in Section 2 and are identified in their appropriate sections throughout this HMP.

FEMA's October 31, 2007, July 2008, and October 2012 changes to 44 CFR Part 201 combined and expanded flood mitigation planning requirements with local hazard mitigation plans (44 CFR §201.6). Furthermore, all hazard mitigation assistance program planning requirements were combined eliminating duplicated mitigation plan requirements. This change also required participating National Flood Insurance Program (NFIP) communities' risk assessments and mitigation strategies to identify and address repetitively flood damaged properties. Local hazard mitigation plans now qualify communities for several Federal Hazard Mitigation Assistance (HMA) grant programs.

This HMP complies with Title 44 CFR current as of September 28, 2012 and applicable guidance documents.

## 1.2 GRANT PROGRAMS WITH MITIGATION PLAN REQUIREMENTS

FEMA HMA grant programs provide funding to States, Tribes, and local entities that have a FEMA-approved State, Tribal, or Local Mitigation Plan. Two of the grants are authorized under the Stafford Act and DMA 2000, while the remaining three are authorized under the National Flood Insurance Act and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act. The Hazard Mitigation Grant Program (HMGP) is a competitive, disaster funded, grant program. Whereas the other Unified Mitigation Assistance Programs: Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and Severe Repetitive Loss (SRL) programs although competitive, rely on specific pre-disaster grant funding sources, sharing several common elements.

*"Hazard mitigation is any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards and their effects. This definition distinguishes actions that have a long-term impact from those that are more closely associated with immediate preparedness, response, and recovery activities. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage,*

*reconstruction, and repeated damage. As such, States, Territories, Indian Tribal governments, and communities are encouraged to take advantage of funding provided by HMA programs in both the pre- and post-disaster timeframes.*

*Together, these programs provide significant opportunities to reduce or eliminate potential losses to State, Tribal, and local assets through hazard mitigation planning and project grant funding. Each HMA program was authorized by separate legislative action, and as such, each program differs slightly in scope and intent.*

*The Hazard Mitigation Grant Program (HMGP) may provide funds to States, Territories, Indian Tribal governments, local governments, and eligible private non-profits (PNPs) following a Presidential major disaster declaration. The Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), Repetitive Flood Claims (RFC), and Severe Repetitive Loss Pilot (SRL) programs may provide funds annually to States, Territories, Indian Tribal governments, and local governments. While the statutory origins of the programs differ, all share the common goal of reducing the risk of loss of life and property due to natural hazards” (FEMA 2010).*

### 1.2.1 Hazard Mitigation Assistance (HMA) Unified Programs

HMA grant program activities include:

**Table 1-1 HMA Eligible Activities**

Activities	HMGP	PDM	FMA	RFC	SRL
<b>1. Mitigation Projects</b>	✓	✓	✓	✓	✓
Property Acquisition and Structure Demolition	✓	✓	✓	✓	✓
Property Acquisition and Structure Relocation	✓	✓	✓	✓	✓
Structure Elevation	✓	✓	✓	✓	✓
Mitigation Reconstruction					✓
Dry Floodproofing of Historic Residential Structures	✓	✓	✓	✓	✓
Dry Floodproofing of Non-Residential Structures	✓	✓	✓	✓	
Minor Localized Flood Reduction Projects	✓	✓	✓	✓	✓
Structural Retrofitting of Existing Buildings	✓	✓			
Non-Structural Retrofitting of Existing Buildings and Facilities	✓	✓			
Safe Room Construction	✓	✓			
Infrastructure Retrofit	✓	✓			
Soil Stabilization	✓	✓			
Wildfire Mitigation	✓	✓			
Post-Disaster Code Enforcement	✓				
5% Initiative Projects	✓				
<b>2. Hazard Mitigation Planning</b>	✓	✓	✓		
<b>3. Management Costs</b>	✓	✓	✓	✓	✓

(FEMA 2012)

The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

Projects must provide a long-term solution to a problem, for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. FEMA may provide a State or Tribe with up to 20 percent of the total aggregate disaster damage costs to fund HMGP project or planning grants. Fiscal Year (FY) 2006 provided approximately \$232 million, FY 2007 was \$316 million, FY 2008 was \$1.246 billion, FY 2009 was \$359 million, and FY 2010 was \$23 million. The cost-share for these grants is 75 percent Federal/25 percent non-Federal. Communities that fulfill "Impoverished Community" criteria and receive FEMA Regional Administrator approval may be funded at 90 percent Federal/10 percent non-Federal.

The PDM grant program provides funds to States, Tribes, and local entities, including universities, for hazard mitigation planning and mitigation project implementation prior to a disaster event. PDM grants are awarded on a nationally competitive basis. Like HMGP funding, a PDM project's potential savings must be more than the cost of implementing the project. In addition, funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The total amount of PDM funding available is appropriated by Congress on an annual basis. In FY 2008, PDM program funding totaled approximately \$114 million, FY 2009 was \$90 million, and FY 2010 was \$100 million. The cost-share for these grants is 75 percent Federal/25 percent non-Federal.

The goal of the FMA grant program is to reduce or eliminate flood insurance claims under the NFIP. Particular emphasis for this program is placed on mitigating repetitive loss (RL) properties. The primary source of funding for this program is the National Flood Insurance Fund. Grant funding is available for two types of grants that focus on – project implementation and planning to identify flood threats and mitigation initiatives.

*The Seward Bear Creek Flood Service Area (SBCFSA) currently participates as a Special Flood Service Area participant within the Kenai Peninsula Borough (KPB) and the City of Seward's NFIP and is therefore eligible for National Flood Insurance Act Grant Program Grants.*

Project grants, which use the majority of the program's total funding, are awarded to States, Tribes, and local entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP.

FMA provides funding to reduce or eliminate the long-term risk of flood damage to residential and non-residential structures insured under the NFIP.

## HMP Description

The HMP consists of the following sections and appendices.

### Introduction

Section 1 defines what a hazard mitigation plan is, delineates federal requirements and authorities, and introduces the Hazard Mitigation Assistance program listing the various grant programs and their historical funding levels.

## **Community Description**

Section 2 provides a general history and background of the Seward Bear Creek Flood Service Area (SBCFSA), including historical trends for population and the demographic and economic conditions that have shaped the area.

## **Planning Process**

Section 3 describes the HMP Update's planning process, identifies the Planning Team Members, the meetings held as part of the planning process, and the key stakeholders within the SBCFSA and the surrounding area. This section documents public outreach activities (support documents are located in Appendix F); the review and incorporation of relevant plans, reports, and other appropriate information; and actions the SBCFSA plans to implement to assure continued public participation; and their methods and schedule for keeping the plan current.

This section also describes the Planning Team's formal plan maintenance process to ensure that the HMP remains an active and applicable document throughout its 5-year lifecycle. The process includes monitoring, evaluating (Appendix H – Maintenance Documents), updating the HMP; and implementation initiatives.

## **Plan Adoption**

Section 4 describes the community's HMP adoption process (supporting documents are located in Appendix E).

## **Hazard Analysis**

Section 5 describes the process through which the Planning Team identified, screened, and selected the hazards to be profiled in this version of the HMP. The hazard analysis includes the nature, previous occurrences (history), location, extent, impact, and probability of future events for each hazard, considering potential impacts of climate change on hazard occurrence and severity, when possible and relevant. In addition, historical and hazard location figures are included.

## **Vulnerability Analysis**

Section 6 identifies the SBCFSA's potentially vulnerable assets—people, residential and non-residential buildings, dwelling units (where available), critical facilities, and critical infrastructure. The resulting information identifies the full range of hazards that the SBCFSA could face and potential social impacts, damages, and economic losses. Land use, development trends, as well as potential climate change impacts, are also discussed.

## **Mitigation Strategy**

Section 7 defines the mitigation strategy which provides a blueprint for reducing the potential losses identified in the vulnerability analysis. This section lists the community's governmental authorities, policies, programs and resources.

The Planning Team developed a list of mitigation goals and potential actions to address the risks facing the SBCFSA. Mitigation actions include preventive actions, property protection techniques, natural resource protection strategies, climate change adaptation initiatives, structural projects, emergency services, and public information and awareness activities. Mitigation



strategies were developed to address NFIP insured properties (if applicable) while encouraging participation with the NFIP and the reduction of flood damage to flood-prone structures.

**References**

Section 8 lists the reference materials used to prepare this HMP.

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This section describes the location, geography, history and demographics of the Seward Bear Creek Flood Service Area (SBCFSA).

## 2.1 LOCATION, GEOGRAPHY, AND HISTORY

The SBCFSA covers multiple watersheds and includes the Communities of Bear Creek and Lowell Point, and the City of Seward. All communities are located in the Seward Recording District.

The following excerpts are provided by the Alaska Department of Community, Commerce, and Economic Development (DCCED), Division of Community and Regional Affairs (DCRA).



**Figure 2-1 SBCFSA Location Map**

*“Bear Creek is on the east coast of the Kenai Peninsula, northeast of Seward, between Mile 3 and 7 of the Seward Highway. It lies approximately 120 highway miles south of Anchorage. It lies at approximately 60.211280 North Latitude and -149.308700 West Longitude. (Sec. 5, T001N, R001E, Seward Meridian.)*

*Seward is situated on Resurrection Bay on the east coast of the Kenai Peninsula, 125 highway miles south of Anchorage. It lies at the foot of Mount Marathon and is the gateway to the Kenai Fjords National Park. Bear Creek and Lowell Point are adjacent to Seward. It lies at approximately 60.104170 North Latitude and -149.442220 West Longitude. (Sec. 10, T001S, R001W, Seward Meridian.) The area encompasses 14.4 sq. miles of land and 7.1 sq. miles of water.*

*Lowell Point is 2 miles south of the Seward Highway terminus. It is situated on the northwest side of Resurrection Bay, at the foot of Bear Mountain, 125 highway miles south of Anchorage. It lies at approximately 60.071430 North Latitude and -149.434360 West Longitude. (Sec. 22, T001S, R001W, Seward Meridian.)” (DCCED/DCRA 2012).*

The SBCFSA’s temperatures range from an average winter low of 23.2 degrees Fahrenheit (°F) to an average summer (July-August) high of 62.3 °F. The area receives approximately 68.12 inches of precipitation and 83.1 inches of snow (Western Regional Climate Center [WRCC] 2012).

D. H. Sleem is credited with first annotating the Bear Creek area on his Central Alaska Map which he developed to depict travel routes and the railroad railway from Seward to Fairbanks in 1910. His map was created from “U.S. Government and R.R. Surveys, reliable prospectors and personal reconnaissance...” (Rumsey 2012).

The following is a brief sketch of the area’s history (DCRA):

- |      |  |
|------|--|
| 1792 | Alexander Baranof discovered Resurrection Bay when he sought a safe harbor. His discovery occurred on the Russian’s Resurrection Sunday. |
| 1867 | American settlers began arriving shortly after Alaska’s purchase from Russia. Community named after William Seward.                      |

1890s	First settled by Captain Frank Lowell and his family.
1903	John and Frank Ballaine and others began constructing the railroad and other infrastructure.
1912	Seward was incorporated as a City.
1923	Railroad completed to the interior of Alaska
1964	Good Friday earthquake and tsunamis destroyed the harbor area, railroad terminal, and other coastal infrastructure which severely impacted Seward's economy.

## 2.2 DEMOGRAPHICS

Historically, demographic information is not available for the SBCFSA as a single population area. Therefore, this section of the LHMP looks at the individual population areas that are within the SBCFSA and that are considered and documented by the US Census (Census). Seward is one of the Kenai Peninsula Borough's six incorporated cities, whereas Bear Creek and Lowell Point both became Census Designated Places (CDPs) as of the 2000 Census in an attempt to more accurately capture population areas within the Borough. The populations of the City of Seward, Bear Creek, and Lowell Point may not account for every individual within the SBCFSA but it should provide an accurate demographics estimate. The 2010 Census indicates that the SBCFSA focused population areas contains approximately 4,790 residents.

### City of Seward

The 2010 census recorded a total population of 2,693 residents in Seward city. Roughly 38 percent of the population is between 25 and 49 years of age.

Seward residents are predominately white (68.5 percent), with a mixed ethnic population approximately consisting of 16.7 percent American Indian and Alaska Native, 3.1 percent African American, 2.4 percent Asian, 0.6 percent Native Hawaiian and Pacific Islander, and the remaining 8.7 % identifying themselves as "Other" or having diverse cultural heritages. The male and female composition is approximately 61.9 and 38.0 percent, respectively. The 2010 census revealed that there are 1,124 housing units, having a median value of approximately \$192,000; of these, 928 are occupied, of which 459 are "owner-occupied". The average owner-occupied household has approximately 2.3 individuals. The most recent 2012 (July) Alaska Department of Labor estimates the population of Seward city as 2,754. (2010 Census, 2012 DCRA)

### Bear Creek Census Designated Place

The 2010 census recorded a total population of 1,956 residents in Bear Creek Census Designated Place (CDP). Roughly 36 percent of the population of Bear Creek CDP is between the ages of 25 and 49.

Bear Creek CDP residents are predominately white (80.9 percent), with a mixed ethnic population approximately consisting of 10.7 percent American Indian and Alaska Native, 1.6 percent Asian, 0.6 percent African American, 0.2 percent Native Hawaiian and Pacific Islander, and the remaining 6.0 % identifying themselves as "Other" or as having diverse cultural

heritages. The male and female composition is approximately 53.7 and 46.3 percent, respectively. The 2010 Census revealed that there are 727 housing units with a median value of approximately \$186,200; of these, 665 are occupied, of which 541 are “owner-occupied”. The average owner-occupied household has approximately 3 individuals. The most recent 2012 Alaska Department of Labor estimates the population of Bear Creek CDP as 1,997. (2010 Census, 2012 DCRA)

### Lowell Point Census Designated Place

The 2010 census recorded a total population of 80 residents in Lowell Point Census Designated Place (CDP). Roughly 41 percent of the population of Lowell Point CDP is between the ages of 25 and 49.

Lowell Point CDP residents are predominately white (96.2 percent), with the remaining 3.8 percent identifying themselves as American Indian and Alaska Native. The male and female composition is approximately 73.7 and 26.3 percent, respectively. The 2010 census revealed that there are 71 housing units. However, this Census year lacked specific housing value data. Therefore, we reference the 2000 Census data which lists the median value at approximately \$130,800. Of these, the 2012 Census indicates there are 36 occupied, of which 26 are “owner-occupied”. The average owner-occupied household has approximately three individuals. The most recent 2012 Alaska Department of Labor (July) estimates the population of Lowell Point CDP as 59. (2010 Census, 2012 DCRA)

Figure 2-2 illustrates the recent historic population for the three population centers. Population data was not available for Bear Creek and Lowell Point before 2000, as that was the first year they were recognized as CDPs for the 2000 US Census. US Census data for the three population centers were formerly combined with the Kenai Peninsula Borough’s Census data. (DCRA 2012)

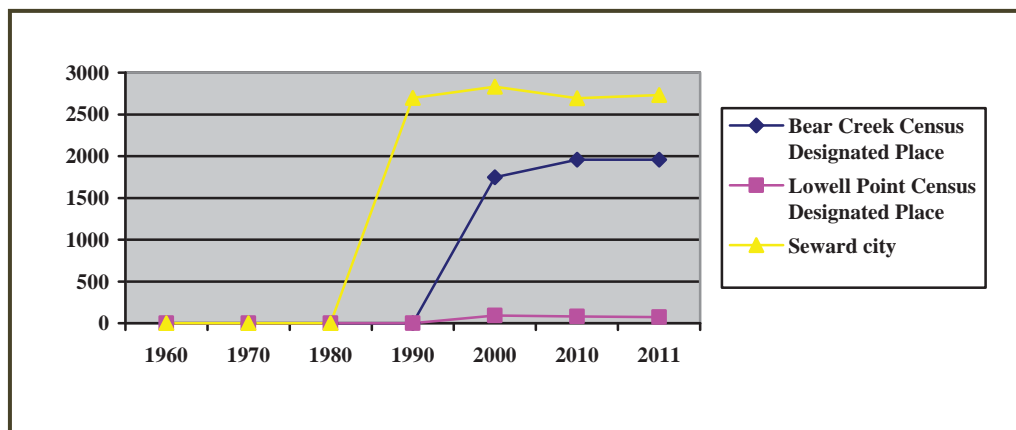


Figure 2-2 Seward Bear Creek Flood Service Area Historic Population

## 2.3 ECONOMY

There are diverse employment opportunities within the SBCFSA, with most residents working in the City of Seward. Established government provides the majority of the employment opportunities such as at the City, State, and Federal agencies. The Alaska Railroad, Kenai

Peninsula School District, Providence Seward Medical Center, State prison, and the University of Alaska Fairbanks Marine Sciences are all major employers. In addition, industries such as seafood processing, commercial and sport fishing, tourism, transportation, ship services and repairs, oil and gas, and local businesses also provide substantial employment opportunities (DCRA 2012, KPB 2005). The Port of Seward acts as an important economic generator for the City of Seward, KPB's Eastern Peninsula Region, as well as connecting to the Alaska railroad terminus. The port serves an important export function for Seward and the State, for example, servicing Usibelli Coal Mine coal shipments, cruise ships, ferries, barges, and ocean freighters.

According to the 2007-2011 American Community Survey, 1,134 Seward residents were listed as employed, almost a quarter of which were employed by the public sector. The same survey listed 968 Bear Creek residents as employed, with 14.0 percent of workers being employed by the public sector; and the US Census' 2007-2011 American Community Survey listed 33 residents of Lowell Point as being employed.

Bear Creek area median household income was \$78,420 and per capita income was \$22,988. Approximately 4.4 percent of Bear Creek residents were reported as having incomes below the poverty level. (2010 Census)

Similar data was not available from the US Census for Lowell Point.

The unemployment rates for Seward was 5.2 percent; and 5.2 percent for Bear Creek. However, these rates included part-time and seasonal jobs, and practical unemployment or underemployment are likely to be significantly higher. (2010 Census)

Figure 2-3 depicts an aerial photograph of the SBCFSA produced for the 2005 and 2010 Flood Hazard Mitigation Plans (FHMP) which is available on the KPB HMP website (KPB 2011).



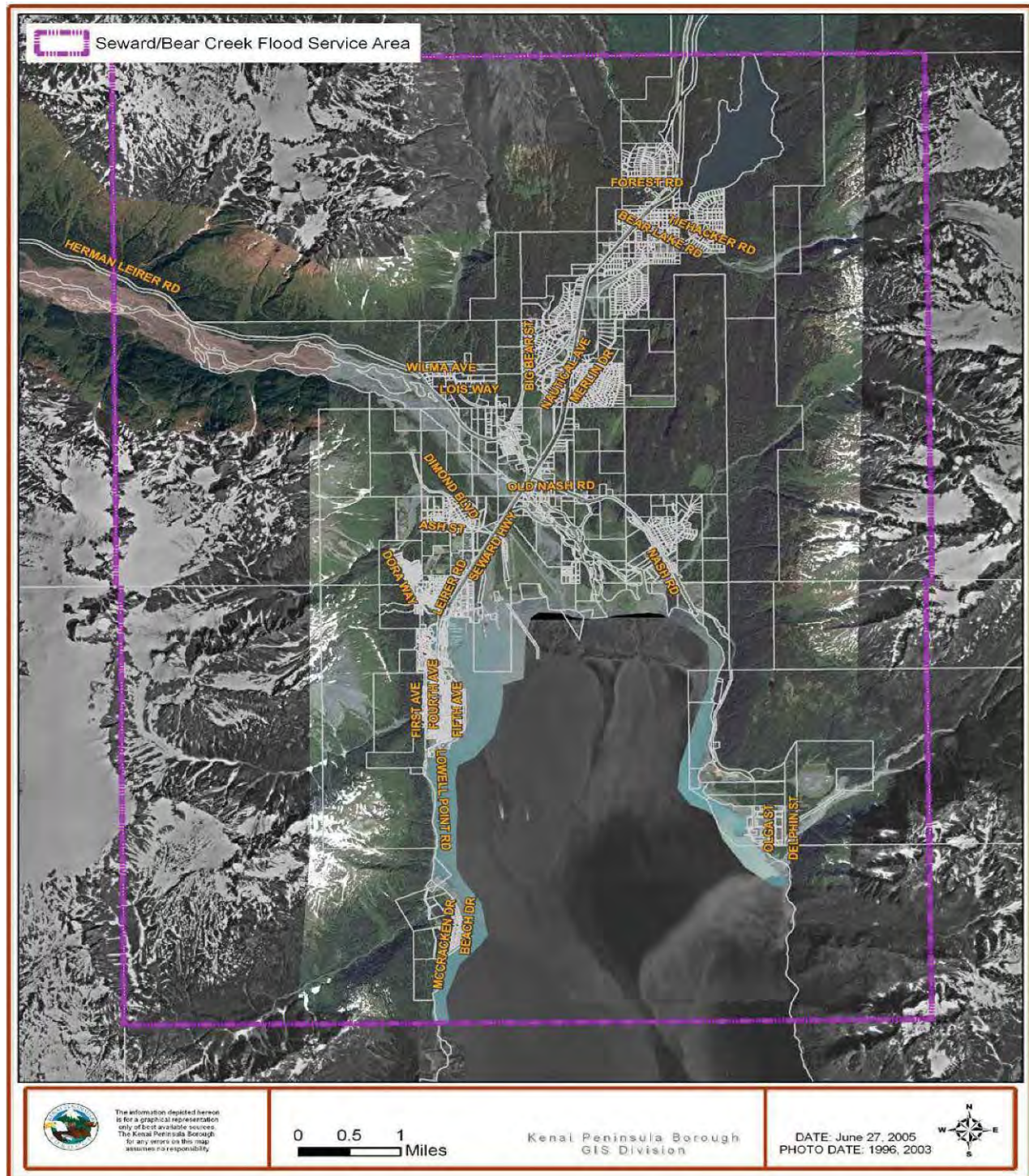


Figure 2-3 Aerial Photograph of the SBCFSA (KPB 2010).

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This section provides an overview of the HMP's update process; identifies the Planning Team Members and key stakeholders; documents public outreach efforts; and summarizes the review and incorporation of existing plans, studies, and reports used to develop this HMP. Outreach support documents and meeting information regarding the Planning Team and public outreach efforts are provided in Appendix F.

The requirements for the planning process, as stipulated in DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements
<b>1. REGULATION CHECKLIST</b>
<p><b>Local Planning Process</b></p> <p><b>§201.6(b):</b> An open public involvement process is essential to the development of an effective plan.</p> <p>In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:</p> <p><b>Element</b></p> <p><b>§201.6(b)(1):</b> An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;</p> <p><b>§201.6(b)(2):</b> An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and nonprofit interests to be involved in the planning process; and</p> <p><b>§201.6(b)(3):</b> Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.</p> <p><b>§201.6(c)(1):</b> [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.</p> <p><b>§201.6(c)(4)(i):</b> The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.</p> <p><b>§201.6(c)(4)(iii):</b> The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.</p>
<b>ELEMENT A. Planning Process</b>
<p>A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))</p> <p>A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))</p> <p>A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))</p> <p>A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))</p> <p>A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))</p> <p>A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle?) (Requirement §201.6(c)(4)(i))</p> <p><i>Does the <u>updated plan</u> document how the planning team reviewed and analyzed each section of the plan and whether each section was revised as part of the update process? (Not applicable until 2013 update).</i></p>
<i>Source: FEMA, October 2011.</i>



### 3.1 PLANNING PROCESS OVERVIEW

The SBCFSA provided funding and project oversight to URS Corporation to facilitate and guide Planning Team development and HMP update process.

The planning process began with Dan Mahalak, KPB Donald Gilman River Center, coordinating a local Planning Team kick-off meeting on September 19, 2012 in the City of Seward. The Planning Team identified applicable SBCFSA resources and capabilities during the meeting. URS explained how the HMP differed from current emergency plans. The Planning Team then discussed the FSA's rolls such as: acting as an advocate for the planning process, assisting with gathering information, and supporting public participation opportunities. There was also a brief discussion about hazards that affect the community such as earthquake, erosion, flood impacts with sediment deposition, tsunamis, severe weather, and wildland fire impacts, which are increasing in intensity.

The Planning Team further discussed the hazard mitigation planning process, asking participants to help identify hazards that affect the City, to identify impacts to residential and critical facilities, and for assisting the Planning Team with identifying and prioritizing mitigation actions for potential future mitigation project funding.

In summary, the following five-step process took place from September 2012 through June 2013.

1. **Organize resources:** Members of the Planning Team identified resources, including staff, agencies, and local community members, who could provide technical expertise and historical information needed in the development of the hazard mitigation plan.
2. **Monitor, evaluate, and update the plan:** The Planning Team developed a process to monitor the HMP's Mitigation Strategy to ensure it was used as intended while fulfilling community needs. The team then developed a process to evaluate the plan to compare how their decisions affected hazard impacts. They then outlined a method to share their successes with community members to encourage support for mitigation activities and to provide data for incorporating mitigation actions into existing planning mechanisms and to provide data for the plan's five year update.
3. **Assess risks:** The Planning Team identified the hazards specific to SBCFSA, and with the assistance of a hazard mitigation planning consultant (URS), developed the risk assessment for the SBCFSA identified hazards. The Planning Team reviewed the risk assessment, including the vulnerability analysis, prior to and during the development of the mitigation strategy.
4. **Assess capabilities:** The Planning Team reviewed current administrative and technical, legal and regulatory, and fiscal capabilities to determine whether existing provisions and requirements adequately address relevant hazards.
5. **Develop a mitigation strategy:** After reviewing the risks posed by each hazard, the Planning Team developed a comprehensive range of potential mitigation goals and actions. Subsequently, the Planning Team identified and prioritized the actions for implementation.

### 3.2 HAZARD MITIGATION PLANNING TEAM

Table 3-1 lists the SBCFSA Planning Team members.

**Table 3-1 Hazard Mitigation Planning Team**

Name	Title	Organization	Key Input
Dan Mahalak	Seward Bear Creek Flood Service Area (SBCFSA) Water Resource Manager	Kenai Peninsula Borough (KPB)	Planning Team Lead, project management, and guidance
SBCFSA Board	SBCFSA Board Members-at-Large	SBCFSA	Plan review, implementation, and coordination
Bill Williamson	SBCFSA Chairman	SBCFSA	Plan review, implementation, and coordination
Randy Stauffer	SBCFSA Vice Chairman	SBCFSA	Plan review, implementation, and coordination
Stephanie Presley	SBCFSA Coordinator	SBCFSA	Plan review and coordination
Jim Hunt	Seward, City Manager	City of Seward (Seward)	Plan review
Ron Long	Director, Seward Community Development	Seward	Plan review, coordination, and implementation
Donna Glenz	Planner	Seward	Plan coordination and implementation
WC Casey	Director, Public Works	Seward	Project status determination
David Squires	Fire Chief	Seward	Hazard coordination
Scott Walden	Director, Emergency Management	KPB	Plan review and incorporation into KPB MHMP, hazard coordination, project coordination
Jon Czarnecki	Resource Planner	KPB	Plan review and coordination
Max Best	Director, Borough Planning	KPB	Plan review and coordination
Marcus Mueller	Land Management Officer	KPB	Plan review and coordination
Dan Bevington	Floodplain Administrator	KPB	Plan review and coordination, flood hazard review
Chris Clough	Manager, KPB Geographic Information System Development	KPB	GIS data sharing
Scott Simmons	Emergency Management, Hazard Mitigation, and Climate Change Planner	URS Corporation, Alaska	Project Lead, plan activity coordination, data acquisition, HMP development, and project reporting
Rich Chamberlain, GISP	GIS Practice Leader, Senior Staff GIS Specialist, Risk Assessment, Hazard United States (Hazus) Modeler	URS Corporation, Colorado	Hazus scenario, infrastructure vulnerability analysis, and population risk assessment
Kimberley Pirri, PE, CFM	Senior Water Resources Engineer, Hazus Development	URS Corporation, Colorado	Hazus scenario, infrastructure vulnerability analysis, and population risk assessment
Jon Philipsborn, MPA	Sustainability, Hazard Mitigation, Climate Change Adaptation Planner	URS Corporation, Georgia	Climate change adaptation and HMP development
Shane Parson, PhD, CFM	Risk Assessment, Hazus Modeler	URS Corporation, Maryland	Hazus scenario, infrastructure vulnerability analysis, and population risk assessment

### 3.3 PUBLIC INVOLVEMENT & OPPORTUNITY FOR INTERESTED PARTIES TO PARTICIPATE

Table 3-2 lists the community's public involvement initiatives focused to encourage participation and insight for the HMP development activities.

**Table 3-2 Public Involvement Mechanisms**

Mechanism	Description
Pre-Award Public Notice	Pre-award public meeting actions, i.e. intended purpose of applying for HMGP, intended outcome if awarded
Post-Award Public Notice	Post-award actions, i.e. SBCFSA board actions to accept grant funds and ordinance process to accept/appropriations.
Newsletter #1 Distribution (October 2012)	In October 2012, the jurisdiction distributed a newsletter describing the upcoming planning activity. The newsletter encouraged the whole community to provide hazard and critical facility information. It was posted at City Hall and Offices, Harbor Masters Office, Library, bulletin boards, shopping centers, and the SBCFSA and KPB websites to enable the widest dissemination.
Newsletter #2 Distribution (April, 2013)	In April 2013, the jurisdiction distributed a second newsletter describing the HMPs availability and present potential HMP projects for review. The newsletter encouraged the whole community to provide comments or input. It was posted at City Hall and Offices, Harbor Masters Office, Library, bulletin boards, shopping centers, and the SBCFSA and KPB websites to enable the widest dissemination.
Website HMP Update Process Notice	KPB public process is specifically described in Code, which also should be exercised / documented in this chart. For example, posted in local media sources or public places of interest (post office) five working days prior to public meeting.

On September 19, 2012, the SBCFSA Chairman introduced the hazard mitigation planning project during their Bi-Monthly Board Meeting. URS extended an invitation to all individuals and entities identified on the project mailing list via a project newsletter describing the planning process and announcing the upcoming public meeting. The newsletter was distributed to relevant academia, nonprofits, and local, state, and federal agencies and placed on the SBCFSA, City of Seward, and KPB websites.

During the meeting, the Planning Team led the attending public through a hazard identification and screening exercise. The attendees identified eight hazards: earthquake, erosion, flood, ground failure (avalanche, landslide, and subsidence), tsunami/seiche, volcano, severe weather, and wildland fire, all of which have historically or could potentially impact the SBCFSA. The Planning Team also discussed climate change and the potential effects to existing hazards that impact the SBCFSA, resulting from changes in precipitation, temperature, and sea level rise. In addition, the Planning Team also discussed the relevance of land use change and development in relation to future risk and hazard mitigation.

Following the hazard screening process, the Planning Team led the attendees through the process for identifying critical facilities in the community. URS also described the specific information needed from the Planning Team and public to complete the risk assessment including the location, value, and resident population, and worker/visitor population for critical facilities in the SBCFSA.



A risk assessment was completed after the community asset data was collected by the Planning Team over the fall and winter of 2012/2013, which identified the assets that are exposed and vulnerable to specified hazards.

A Planning Team meeting was held on March 13, 2012 to review and prioritize the mitigation actions identified based on the results of the risk assessment. A second newsletter was prepared and delivered in April 2012 describing the process to date, presenting the prioritized mitigation actions, and announcing the availability of the draft HMP for public review and comment.

The Planning Team provided SBCFSA residents and stakeholders the opportunity to address hazards and issues pertinent to their respective infrastructure and/or needs. These opportunities provided opportunities for the Planning Team to modify the mitigation strategy to better target stakeholder specific actions for reducing damages and losses.

The Planning Team held a special meeting on April 1, 2013 to review the draft HMP for accuracy – ensuring it meets the SBCFSA’s needs. The meeting was productive with the Team highlighting several minor corrections or refinements. Changes were specifically targeted to plan hazard impacts, community vulnerability analysis, and the mitigation strategy.

### 3.4 INCORPORATING EXISTING PLANS AND OTHER RELEVANT INFORMATION

During the planning process, the Planning Team reviewed and incorporated information from existing plans, studies, reports, and technical reports into the HMP. Table 3-3 lists resources available from various sources and websites; which were reviewed, and referenced throughout this HMP update. A comprehensive reference list is provided in Section 8.

**Table 3-3 Documents Reviewed**

Existing plans, studies, reports, ordinances, etc.	Contents Summary (How will this information improve mitigation planning?)	Update Inclusion Yes / No
Seward/Bear Creek Flood Service Area, Flood Hazard Mitigation Plan, May 2010;	Provided detailed historical flood hazard assessment, watershed, and mitigation initiative development background data.	Yes
City of Seward 2020 Comprehensive Plan, Volume I, (CP 2005)	Plan identifies the goals, objectives, and implementation action items, updated and developed for each comprehensive plan element. The plan defined the City's: economic development, land use, housing, transportation, port and harbor development, recreation, public facilities and services, natural hazards, and quality of life.	Yes
Kenai Peninsula Borough Comprehensive Plan (CP 2005)	Plan details KPB's existing conditions, and identified goals, objectives, and implementation actions. The plan was relevant to current and future land use, transportation, and hazard impacts.	Yes
Earthquakes in Alaska, USGS Open-File Report 95-624, by Peter Haeussler and George Plafker	Defined the location's earthquake threat potential.	Yes
The USACE, Alaska Baseline	Defined the State's erosion threats, lists threatened	Yes

Table 3-3 Documents Reviewed

Existing plans, studies, reports, ordinances, etc.	Contents Summary (How will this information improve mitigation planning?)	Update Inclusion Yes / No
Erosion Assessment, Study Findings and Technical Report	communities, and the various erosion categories.	
The USACE, Alaska Baseline Erosion Assessment, Erosion Information Paper, Seward, Alaska, July 17 2008	Described the City's "Monitor Conditions" erosion classification and threat.	Yes
Kenai Peninsula Borough Situations and Prospects, Economic Trends for Year Ending December 31, 2006	Provided information for key industries, listed significant hazard events, and described the areas geologic hazards and areas for concern. (Note: This plan is no longer maintained).	Yes
State of Alaska, Department of Commerce, Community and Economic Development Community Profile	Provided historical and demographic information.	Yes
Kenai Peninsula Borough Multi-Jurisdictional, All-Hazard Mitigation Plan.	Provided Borough specific information pertinent to updating Appendix I, 2010 SBCFSA Flood Hazard Mitigation Plan to convert into a SBCFSA All-Hazard Mitigation Plan.	Yes
State of Alaska Hazard Mitigation Plan (SHMP), 2010	Defined statewide hazards and their potential locational impacts.	Yes
Hydrology for Floodplain Insurance Restudy of City of Seward, Kenai Peninsula Borough, Alaska - EMS-2001-CO-0067, Task Order #28	Defined the SBCFSA's infrastructure and residential property locations in relation to the area's watersheds.	Yes

### 3.5 PLAN MAINTENANCE

This section describes a formal plan maintenance process to ensure that the HMP remains an active and applicable document. It includes an explanation of how the SBCFSA's Planning Team intends to organize their efforts to ensure that improvements and revisions to the HMP occur in a well-managed, efficient, and coordinated manner.

The following three process steps are addressed in detail here:

1. Implementing the HMP
2. Continued public involvement
3. Monitoring, reviewing, evaluating, and updating the HMP

#### 3.5.1 Incorporating Into Existing Planning Mechanisms

The requirements for implementation through existing planning mechanisms, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements
<b>1. REGULATION CHECKLIST</b>
<b>Incorporation into Existing Planning Mechanisms</b>
<b>§201.6(b)(3):</b> Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.
<b>ELEMENT A Planning Process (Continued)</b>
<b>A4.</b> Does the Plan describe the review and incorporation of existing plans, studies, reports and technical information?
<i>Source: FEMA, October 2011.</i>

Once the HMP is community adopted and receives FEMA’s final approval, each Planning Team Member will ensure that the HMP, in particular each Mitigation Action Project, is incorporated into existing planning mechanisms. Each member of the Planning Team will achieve this incorporation by undertaking the following activities.

- Conduct a review of the community-specific regulatory tools to assess the integration of the mitigation strategy. These regulatory tools are identified in the following capability assessment section.
- Work with pertinent community departments and State and Federal agencies to increase awareness of the HMP and provide assistance in integrating the mitigation strategy (including the Mitigation Action Plan) into relevant planning mechanisms. Implementation of these requirements may require updating or amending specific planning mechanisms.

### 3.5.2 Continued Public Involvement

The requirements for continued public involvement, as stipulated in the DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements
<b>1. REGULATION CHECKLIST</b>
<b>Continued Public Involvement</b>
<b>§201.6(c)(4)(iii):</b> The plan maintenance process shall include a) discussion on how the community will continue public participation in the plan maintenance process.
<b>ELEMENT A Planning Process (Continued)</b>
<b>A5.</b> Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))
<i>Source: FEMA, October 2011.</i>

The SBCFSA is dedicated to involving the public directly in the continual reshaping and updating of the HMP. A paper copy of the HMP and any proposed changes will be available at the SBCFSA, City of Seward, and the Qutekcaq Tribal Office. An address and phone number of the Planning Team Leader to whom people can direct their comments or concerns will also be available at these locations.

The SBCFSA will continue to identify opportunities to raise community awareness about the HMP and the hazards that affect the area. This effort could include attendance and provision of materials at SBCFSA-selected events, outreach programs, public meetings, and through mail-

outs. Any public comments received regarding the HMP will be collected by the Planning Team Leader, included in the annual report, and considered during future HMP updates.

### 3.5.3 Monitoring, Reviewing, Evaluating, and Updating the HMP

The requirements for monitoring, reviewing, evaluating, and updating the HMP, as stipulated in the DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements
Monitoring, Evaluating and Updating the Plan
§201.6(c)(4)(i): The plan maintenance process shall include a) discussion on how the community will continue public participation in the plan maintenance process.
<b>1. REGULATION CHECKLIST</b>
<b>ELEMENT A. Planning Process (Continued)</b>
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle?)
Source: FEMA, October 2011.

This section provides an explanation of how the SBCFSA's Planning Team intends to organize their efforts to ensure that improvements and revisions to the HMP occur in a well-managed, efficient, and coordinated manner.

The following three process steps are addressed in detail here:

1. Review and revise the HMP to reflect development changes, project implementation progress, project priority changes, and resubmit.
2. HMP resubmittal at the end of the plan's five year life cycle for Borough review and approval.
3. Continued mitigation initiative implementation.

#### 3.5.3.1 Monitoring the HMP

The HMP was prepared as a collaborative effort. To maintain momentum and build upon previous hazard mitigation planning efforts and successes, the City will continue to use the Planning Team to monitor, evaluate, and update the HMP. SBCFSA, KPB and City of Seward will be responsible for implementing the Mitigation Action Plan. However, the Borough has ultimate responsibility for regulatory compliance and borough-wide project prioritization.

The SBCFSA Board will designate the SBCFSA hazard mitigation Planning Team Leader as the primary point of contact and will coordinate local efforts to monitor, evaluate, and revise the HMP for submittal to KPB Emergency Management during the KPB Multi-Jurisdictional HMP five year update process.

Each member of the Planning Team will conduct an annual review during the anniversary week of the plan's official FEMA approval date to monitor the progress in implementing the HMP, particularly the Mitigation Action Plan. As shown in Appendix H, the Annual Review Questionnaire will provide the basis for possible changes in the HMP Mitigation Action Plan by refocusing on new or more threatening hazards, adjusting to changes to or increases in resource allocations, and engaging additional support for the HMP implementation. The Planning Team

Leader will initiate the annual review two months prior to the scheduled planning meeting date to ensure that all data is assembled for discussion with the Planning Team. The findings from these reviews will be presented at the annual Planning Team Meeting. Each review, as shown on the Annual Review Worksheet, will include an evaluation of the following:

- Participation of authorities and others in the HMP implementation
- Notable changes in the risk of natural or human-caused hazards
- Impacts of land development activities and related programs on hazard mitigation
- Progress made with the Mitigation Action Plan (identify problems and suggest improvements as necessary)
- The adequacy of local resources for implementation of the HMP

The SBCFSA's 2005 and 2010 Flood Hazard Mitigation Plans (FHMP) were originally formulated to fulfill NFIP requirements which sought to maintain momentum and build upon previous hazard mitigation initiatives and successes. The FHMP sought to track identified mitigation opportunities and initiatives while determining whether identified actions were effectively implemented.

The SBCFSA hazard mitigation Planning Team Leader, (or designee), was identified as the primary point of contact who would coordinate local efforts to monitor and evaluate the HMP.

#### **3.5.3.2    *Reviewing the HMP***

The Planning Team did not perform an annual FHMP review. However, the SBCFSA provided substantial knowledge and insight with historical flood impacts, implemented mitigation measures, and proposed regulatory successes and/or failures.

It was a primary consideration to convert the existing 2010 Flood Hazard Mitigation Plan into a FEMA approvable All-Hazard Mitigation Plan. Table 3-6 delineates Planning Team identified HMP components that need to be addressed to reflect an all-hazard approach. The Team determined how community changes, construction and infrastructure conditions, climate changes, and population increases or decreases have influenced hazard risks and/or vulnerabilities.

The HMP is coordinated with the KPB Multi-Jurisdictional HMP to assure compliance with KPB objectives and requirements.

The current update process brought together new and existing stakeholders to review the existing FHMP to determine what was accomplished versus what was intended for accomplishment. Discussions resulted in refinement within Table 3-4, which guided the HMP review and update process.

**Table 3-4 HMP Review and Update Process**

2010 FHMP Section	2010 FHMP Items to be Updated	2010 FHMP Identified items for Deletion	Newly Identified Items to be Added for HMP Compliance
Planning Process	<ul style="list-style-type: none"> <li>Planning process</li> <li>Planning team membership</li> <li>Mitigation resource list</li> <li>Public outreach initiatives</li> </ul>	N/A	<ul style="list-style-type: none"> <li>Update planning Process to included “HMP review and update” processes</li> </ul>
Risk Assessment	<ul style="list-style-type: none"> <li>Hazard profile history</li> <li>Asset inventory</li> <li>Vulnerability analysis &amp; summaries</li> </ul>	N/A	<ul style="list-style-type: none"> <li>Identify new hazards for All-Hazard Compliance</li> <li>Identify repetitive loss properties as appropriate</li> <li>Develop asset inventory</li> <li>Determine infrastructure vulnerabilities</li> <li>Develop floodplain assessment for each water shed</li> </ul>
Mitigation Strategy	<ul style="list-style-type: none"> <li>Mitigation actions status</li> <li>Mitigation action implementation</li> </ul>	Implemented & non-relevant mitigation actions	<ul style="list-style-type: none"> <li>Identify existing (2010) mitigation plan actions’ status</li> <li>Identify new mitigation actions for newly identified hazard implementation</li> <li>Develop capability assessment</li> </ul>
Plan Maintenance	Plan maintenance process	N/A	Refine plan maintenance process and responsibilities

Each Planning Team Member reviewed the FHMP’s project list and annotated their respective status. Their status will be further defined in Section 7, The Hazard Mitigation Strategy.

Table 3-5 identifies the planning categories which need updating.

**Table 3-5 2010 HMP Status Determination**

*(Did we do what we said we’d do?)*

2010 Flood HMP Section	2010 Activity Commitment	Status: F: Fulfilled NF: Not Fulfilled	New Action Commitment
Planning Process	Hold Planning Team meetings	NF	Planning Team will continue meetings and strive to integrate HMP initiatives into other SBCFSA plans, ordinances, and resolutions.
Risk Assessment	Identified flood risk assessment goals and objectives	NF	<ul style="list-style-type: none"> <li>Define goals and objectives as action items</li> <li>Locate scientific information to augment these data.</li> <li>Filled data gaps with HMGP funded floodplain assessment and climate change scenario future development analysis</li> </ul>
Mitigation Strategy	Implement mitigation actions	F	<ul style="list-style-type: none"> <li>Determined 2010 identified mitigation actions’ status</li> <li>Developed follow-up action plan</li> </ul>



**Table 3-5 2010 HMP Status Determination***(Did we do what we said we'd do?)*

2010 Flood HMP Section	2010 Activity Commitment	Status: F: Fulfilled NF: Not Fulfilled	New Action Commitment
Continued Public Involvement	Continue public involvement	F	<ul style="list-style-type: none"> <li>Defined public involvement process</li> <li>Determined whether mitigation specific information was provided at outreach activities. (Activities may have included fairs, festivals, and public meetings)</li> </ul>
Plan Maintenance	Only identified that preliminary DFIRM's would be released for public in June 2010	NF	<ul style="list-style-type: none"> <li>Conduct plan maintenance meetings to review HMP annually</li> <li>Update plan at 5 year intervals</li> <li>Implement FEMA plan improvement suggestions</li> </ul>

The 44 CFR requires communities to schedule planning team meetings and teleconferences to review, discuss, and determine mitigation implementation accomplishments as well as data relevance for HMP inclusion. Meeting minutes are included in Appendix C, Community Involvement.

Table 3-6 lists relevant meeting information for the 2012 LHMP update which focused on changing the Flood Hazard Mitigation Plan into an all-hazard local hazard mitigation plan that would enable the SBCFSA to qualify for mitigation grant program funding.

**Table 3-6 HMP Update - Planning Team Meeting Summary**

Meeting Date/Method	Meeting Attendees	Meeting Summary
9/19/2012/ In-person	Dan Mahalak, PM, Randy Stauffer, SBCFSA Vice Chairman, Scott Walden, KPB EM, Donna Glenz, Seward Planner, David Squires, Seward Fire Chief	Kick-Off Meeting, Introduced project and initiatives.
3/15/2013/ Teleconference	Dan Mahalak, Water Resource Manager; Randy Stauffer, SBCFSA Vice Chairman; Stephanie Presley, SBCFSA Coordinator; Donna Glenz, City of Seward Planner; Dan Bevington, KPB Floodplain Administrator; Brenda Ahlberg, KPB Capital Projects; Marcus Mueller, KPB Land Management Officer; Scott Simmons, Project Manager, URS Alaska; Richard Chamberlain, GIS, Hazus, URS Colorado, Kimberly Pirri, PE, Hazus, URS Colorado, Jon Philipsborn, Climate Change and Sustainability, URS Georgia, and Shane Parson, PhD., Hazus, URS Maryland.	Teleconference to review, consider, and ultimately select potential mitigation projects for inclusion to the Hazard Mitigation Plan Update.
4/01/2013	SBCFSA Board Members	Review Mitigation Strategy and Mitigation Action Plan (MAP)
4/03-17/2013	SBCFSA Board, City of Seward, KPB	Review Draft HMP

### 3.5.3.3 Evaluating the HMP

The 2012 LHMP development and update provides the Annual Review Questionnaire (Appendix F). This form will provide the basis for future HMP evaluations by guiding the Planning Team with identifying new or more threatening hazards, adjusting to changes to or increases in resource allocations, and garnering additional support for HMP implementation.

The Planning Team Leader will initiate the annual review two months prior to the scheduled planning meeting date to ensure that all data is assembled for discussion with the Planning Team. The findings from these reviews will be presented at the annual Planning Team Meeting. Each review, as shown on the Annual Review Worksheet, will include an evaluation of the following:

- Participation of authorities and others in the HMP implementation
- Notable changes in the risk of natural or human-caused hazards
- Impacts of land development activities and related programs on hazard mitigation
- Progress made with the Mitigation Action Plan (identify problems and suggest improvements as necessary)
- The adequacy of local resources for implementation of the HMP

### 3.5.3.4 Updating the HMP

In addition to the annual review, the Planning Team will update the HMP every five years.

DMA 2000 Requirements
<b>Reviewing, Evaluating, and Implementing the Plan</b> <b>§201.6(d)(3):</b> A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit if for approval within 5 years in order to continue to be eligible for mitigation project grant funding.
<b>ELEMENT D. Planning Process (Continued) <i>Update activities not applicable to the plan version</i></b>
D1. Was the Plan revised to reflect changes in development? (Requirement §201.6(d)(3))
D2. Was the Plan revised to reflect progress in local mitigation effort? (Requirement §201.6(d)(3))
D3. Was the Plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))
Source: FEMA, October 2011.

The SBCFSA will annually review the HMP as described in Section 3.5.3 and update the HMP every five years (or when significant changes are made) by having the identified Planning Team review all Annual Review Questionnaires (Appendix F) to determine the success of implementing the HMP's Mitigation Action Plan.

As shown in Appendix H, the Annual Review Questionnaire will enable the Team to identify possible changes in the HMP Mitigation Action Plan by refocusing on new or more threatening hazards, resource availability, and acquiring stakeholder support for the HMP project implementation.

In the fourth year following adoption of the HMP, the Planning Team will undertake the following activities:

- Request grant assistance for DHS&EM to update the HMP (this can take up to one year to obtain and one year to update the plan).
- Ensure that each authority administering a mitigation project will submit a Progress Report (Appendix H) to the Planning Team.
- Develop a chart to identify those HMP sections that need improvement, the section and page number of their location within the HMP, and describe the proposed changes.
- Thoroughly analyze and update the natural hazard risks.
  - Determine the current status of the mitigation projects.
  - Identify the proposed Mitigation Plan Actions (projects) that were completed, deleted, or delayed. Each action should include a description of whether the project should remain on the list, be deleted because the action is no longer feasible, or include delay reasons.
  - Describe how each action's priority status has changed since the HMP was originally developed and subsequently approved by FEMA and promulgated by the State.
  - Determine whether or not the project has helped achieve the appropriate goals identified in the plan.
  - Describe whether the community has experienced any barriers preventing them from implementing their mitigation actions (projects) such as financial, legal, and/or political restrictions and stating appropriate strategies to overcome them.
  - Update ongoing processes, and change the proposed implementation date/duration timeline for delayed actions the SBCFSA still desires to implement.
  - Prepare a new Mitigation Action Plan Matrix for the SBCFSA.
- Prepare a new draft updated HMP.
- Submit the updated HMP to the Borough for pre-adoption review and approval.

The Planning Team reviewed a wide range of reports, studies, and other research documents to determine appropriateness and incorporation into the updated HMP. Table 3-5 lists those documents and their inclusion status.

### *Formal State and FEMA HMP Review*

Completed Hazard Mitigation Plans do not qualify the SBCFSA for mitigation grant program eligibility until they have been reviewed and adopted by the Borough, and received State and FEMA final approval.

The SBCFSA will submit the draft HMP to the Kenai Peninsula Borough (KPB) for initial review and preliminary approval. Once any corrections are made, the Borough will adopt the

plan into its Multi-Jurisdictional HMP. The Borough will send the complete Multi-Jurisdictional HMP to the State and FEMA for their respective review and conditional approval.

Once the plan has fulfilled all FEMA criteria, the Borough will pass an HMP Adoption Resolution. KPB will then forward all incorporated plans to FEMA during their scheduled update process.

## 4.1 ADOPTION BY LOCAL GOVERNING BODIES AND SUPPORTING DOCUMENTATION

The requirements for the adoption of this HMP by the local governing body, as stipulated in the DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements
<b>Local Plan Adoption</b> <b>§201.6(c)(5):</b> [The plan shall include...] Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County commissioner, Tribal Council). For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.
<b>1. REGULATION CHECKLIST</b> <b>ELEMENT E. Plan Adoption</b>
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval??) (Requirement §201.6(c)(5))
<i>Source: FEMA, October 2011.</i>

The Seward Bear Creek Flood Service Area (SBCFSA) is the Special Service Area represented in this HMP and meets the requirements of Section 409 of the Stafford Act and Section 322 of DMA 2000, and 44 CFR §201.6(c)(5).

The local governing body of the SBCFSA approved the HMP by **vote on**, 2013 and submitted the final draft HMP to the Borough for Adoption and subsequent inclusion within the Borough's Multi-Jurisdictional All-Hazard Mitigation Plan.

A scanned copy of the vote record and the Borough's formal adoption are included in Appendix E.

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This section identifies and profiles the hazards that could affect the SBCFSA.

## 5.1 OVERVIEW OF A HAZARD ANALYSIS

A hazard analysis includes the identification, screening, and profiling of each hazard. Hazard identification is the process of recognizing the natural events that threaten an area. Natural hazards result from unexpected or uncontrollable natural events of sufficient magnitude. Human, Technological, and Terrorism related hazards are beyond the scope of this plan. Even though a particular hazard may not have occurred in recent history in the study area, all natural hazards that may potentially affect the study area are considered; the hazards that are unlikely to occur or for which the risk of damage is accepted as being very low, are eliminated from consideration.

Hazard profiling is accomplished by describing hazards in terms of their nature, history, magnitude, frequency, location, extent, and probability. This information is identified through collecting historical and anecdotal information, reviewing existing plans and studies, and preparing study area hazard maps. Hazard maps are used to determine the geographic extent of each hazard and to define the approximate boundaries of the at-risk areas. In addition, this HMP incorporates future climate change scenarios and projections to consider future hazard risks in the analysis.

DMA 2000 Requirements
<b>Identifying Hazards</b> §201.6(c)(2)(i): The risk assessment shall include a) description of the type, location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events. §201.6(c)(2)(iii): For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.
<b>1. REGULATION CHECKLIST</b>
<b>ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT</b>
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction? B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods?
Source: FEMA, October 2011.

## 5.2 HAZARD IDENTIFICATION AND SCREENING

The requirements for hazard identification, as stipulated in DMA 2000 and its implementing regulations are described below.

For the first step of the hazard analysis, on September 19, 2012 the Planning Team reviewed eight possible hazards that could affect the SBCFSA. The Planning Team then evaluated and screened the comprehensive list of potential hazards based on a range of factors, including prior knowledge or perception of threat, the relative risk presented by each hazard, the ability to mitigate the hazard, and the known or expected availability of information on the hazard (see Table 5-1). The

Planning Team determined that all eight hazards pose a threat to the SBCFSA: earthquake, erosion, flood, ground failure, tsunami/seiche, volcano, severe weather, and wildland/urban interface fire.

**Table 5-1 Identification and Screening of Hazards**

Hazard Type	Should It Be Profiled?	Explanation
Earthquake (EQ)	Yes	Periodic, unpredictable occurrences. The SBCFSA experienced no damage from the 11/2003 Denali Earthquake; but experienced severe structural and extensive infrastructure damage from the 1964 Good Friday Earthquake and its aftershocks, tsunamis, seiches, and flooding.
Erosion	Yes	The SBCFSA experiences storm surge, coastal ice run-up, and coastal wind erosion along the shoreline adjacent to Resurrection Bay and riverine erosion along the area's river, stream, and creek embankments from high water flow, riverine ice flows, wind, and surface runoff.
Flood	Yes	Snowmelt run-off and rainfall flooding occurs during spring thaw and the fall rainy season. Events occur from soil saturation. Several minor flood events cause damage. Severe damages occur from major floods.
Ground Failure (Avalanche, Landslide/Debris Flow, Permafrost, Subsidence)	Yes	Ground Failure occurs throughout Alaska resulting from avalanches, landslides, land subsidence, and permafrost. These hazards periodically cause houses to shift due to ground sinking and upheaval. The SBCFSA has erosion damage along the area's extensive river, stream, and creek system's embankments. The SBCFSA has also indicated that avalanches and landslides periodically occur in known locations.
Tsunami & Seiche	Yes	This hazard has historically destroyed SBCFSA infrastructure.
Volcano	Yes	Volcanic eruptions occur within and adjacent to KPB sending volcanic debris throughout the borough and adversely impacting the SBCFSA.
Weather, Severe (Wind, rain, snow, cold, etc.)	Yes	Annual weather patterns, severe cold, heavy rain, freezing rain, snow accumulations, storm surge, and wind, are the predominate threats. Intense wind and heavy rain are the primary impacts to the community. Severe weather events cause fuel price increases and frozen pipes. Heavy snow loads potentially damage house roofs. Winds potentially remove or damages roofs and moves houses off their foundations.
Wildland/Urban Interface Fire	Yes	The SBCFSA and the surrounding mountainous area becomes very dry in summer months with weather and human caused incidents igniting dry vegetation (e.g., lightning, camp fires, and trash burning).

### 5.3 HAZARD PROFILE

The requirements for hazard profiles, as stipulated in DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements
<b>Profiling Hazards</b> <b>Requirement §201.6(c)(2)(i):</b> [The risk assessment shall include a] description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
<b>1. REGULATION CHECKLIST</b>
<b>ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT</b>
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction? (Requirement §201.6(c)(2)(i)) B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction?
<i>Source: FEMA, October 2011.</i>

The specific hazards selected by the Planning Team for profiling have been examined in a methodical manner based on the following factors:

- Nature (Type)
- History (Previous Occurrences)
- Location
- Extent (to include magnitude and severity)
- Impact (Section 5 provides general impacts associated with each hazard. Section 6 provides detailed impacts to the SBCFSA's residents and critical facilities).
- Future event probability

NFIP insured Repetitive Loss Structures (RLS) are addressed in Section 6.0, Vulnerability Analysis.

Each hazard is assigned a rating based on the following criteria for probability (Table 5-2) and magnitude/severity (Table 5-3). Probability is determined based on historic events, using the criteria identified in Table 5-2, to provide the likelihood of a future event.

Table 5-2 Hazard Probability Criteria

Probability	Criteria
4 - <i>Highly Likely</i>	<ul style="list-style-type: none"> <li>Event is probable within the calendar year.</li> <li>Event has up to 1 in 1 year chance of occurring (1/1=100 percent).</li> <li>History of events is greater than 33 percent likely per year.</li> <li>Event is <b>"Highly Likely"</b> to occur.</li> </ul>
3 - <i>Likely</i>	<ul style="list-style-type: none"> <li>Event is probable within the next three years.</li> <li>Event has up to 1 in 3 years chance of occurring (1/3=33 percent).</li> <li>History of events is greater than 20 per cent but less than or equal to 33 percent likely per year.</li> <li>Event is <b>"Likely"</b> to occur.</li> </ul>
2 - <i>Possible</i>	<ul style="list-style-type: none"> <li>Event is probable within the next five years.</li> <li>Event has up to 1 in 5 years chance of occurring (1/5=20 percent).</li> <li>History of events is greater than 10 percent but less than or equal to 20 percent likely per year.</li> <li>Event could <b>"Possibly"</b> occur.</li> </ul>
1 - <i>Unlikely</i>	<ul style="list-style-type: none"> <li>Event is possible within the next ten years.</li> <li>Event has up to 1 in 10 years chance of occurring (1/10=10 percent).</li> <li>History of events is less than or equal to 10 percent likely per year.</li> <li>Event is <b>"Unlikely"</b> but is possible to occur.</li> </ul>

Similar to estimating probability; magnitude, and severity are determined based on historic events using the criteria identified below.

Table 5-3 Hazard Magnitude/Severity Criteria

Magnitude / Severity	Criteria
4 - <i>Catastrophic</i>	<ul style="list-style-type: none"> <li>Multiple deaths.</li> <li>Complete shutdown of facilities for 30 or more days.</li> <li>More than 50 percent of property is severely damaged.</li> </ul>
3 - <i>Critical</i>	<ul style="list-style-type: none"> <li>Injuries and/or illnesses result in permanent disability.</li> <li>Complete shutdown of critical facilities for at least two weeks.</li> <li>More than 25 percent of property is severely damaged.</li> </ul>
2 - <i>Limited</i>	<ul style="list-style-type: none"> <li>Injuries and/or illnesses do not result in permanent disability.</li> <li>Complete shutdown of critical facilities for more than one week.</li> <li>More than 10 percent of property is severely damaged.</li> </ul>
1 - <i>Negligible</i>	<ul style="list-style-type: none"> <li>Injuries and/or illnesses are treatable with first-aid.</li> <li>Minor quality of life lost.</li> <li>Shutdown of critical facilities and services for 24 hours or less.</li> <li>Less than 10 percent of property is severely damaged.</li> </ul>

The hazards profiled for the SBCFSA are presented throughout Section 5.3. The presentation order does not signify their importance or risk level.

### 5.3.1 Earthquake

#### 5.3.1.1 Nature

An earthquake is a sudden motion or trembling caused by a release of strain accumulated within or along the edge of the earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning and after only a few seconds can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion, or the vibration or shaking of the ground during an earthquake.

Ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. An earthquake causes waves in the earth's interior (i.e., seismic waves) and along the earth's surface (i.e., surface waves). Two kinds of seismic waves occur: P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back and forth oscillation along the direction of travel (vertical motion), and S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side to side (horizontal motion). There are also two types of surface waves: Raleigh waves and Love waves. These waves travel more slowly and typically are significantly less damaging than seismic waves.

In addition to ground motion, several secondary natural hazards can occur from earthquakes such as:

- **Surface Faulting** is the differential movement of two sides of a fault at the earth's surface. Displacement along faults, both in terms of length and width, varies but can be significant (e.g., up to 20 feet [ft]), as can the length of the surface rupture (e.g., up to 200 miles). Surface faulting can cause severe damage to linear structures, including railways, highways, pipelines, and tunnels.
- **Liquefaction** occurs when seismic waves pass through saturated granular soil, distorting its granular structure, and causing some of the empty spaces between granules to collapse. Pore water pressure may also increase sufficiently to cause the soil to behave like a fluid for a brief period and cause deformations. Liquefaction causes lateral spreads (horizontal movements of commonly 10 to 15 ft, but up to 100 ft), flow failures (massive flows of soil, typically hundreds of ft, but up to 12 miles), and loss of bearing strength (soil deformations causing structures to settle or tip). Liquefaction can cause severe damage to property.
- **Landslides, Avalanches, and Debris Flows** occur as a result of horizontal seismic inertia forces induced in the slopes by the ground shaking. The most common earthquake-induced landslides include shallow, disrupted landslides such as avalanches, rock falls, rockslides, and soil slides. Avalanches and debris flows are created when snow and surface soils on steep slopes become totally saturated with water. Once the soil liquefies, it loses the ability to hold together and can flow downhill at very high speeds, taking vegetation and/or structures with it. Slide risks increase after an earthquake during a wet winter.

The severity of an earthquake can be expressed in terms of intensity and magnitude.

- Intensity is based on the damage and observed effects on people and the natural and built environment. It varies on the location with respect to the earthquake epicenter, which is the point on the earth's surface that is directly above where the earthquake occurred. The severity of intensity generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. The scale most often used in the U.S. to measure intensity is the Modified Mercalli Intensity (MMI) Scale. As shown in Table 4-4, the MMI Scale consists of 12 increasing intensity levels that range from imperceptible to catastrophic destruction. Peak ground acceleration (PGA) is also used to measure earthquake intensity by quantifying how hard the earth shakes in a given

location. PGA can be measured as acceleration due to gravity (g) (see Table 5-4) (MMI 2012).

- Magnitude (M) is the measure of the earthquake strength. It is related to the amount of seismic energy released at the earthquake's hypocenter, the actual location of the energy released inside the earth. It is based on the amplitude of the earthquake waves recorded on instruments, known as the Richter magnitude test scales, which have a common calibration (see Table 5-4).

**Table 5-4 Comparisons: Magnitude, Intensity, Ground-Shaking**

Magnitude	Intensity	PGA (% g)	Perceived Shaking
0 – 4.3	I	<0.17	Not Felt
	II-III	0.17 – 1.4	Weak
4.3 – 4.8	IV	1.4 – 3.9	Light
	V	3.9 – 9.2	Moderate
4.8 – 6.2	VI	9.2 – 18	Strong
	VII	18 – 34	Very Strong
6.2 – 7.3	VIII	34 – 65	Severe
	IX	65 – 124	Violent
	X	124 +	Extreme
7.3 – 8.9	XI		
	XII		

(MMI 2012)

### 5.3.1.2 History

There have been over 3,671 earthquakes within 100 miles of the SBCFSA since 1973. The Planning Team determined that the SBCFSA has a minimal concern for earthquake damages from earthquakes below M 5.0 as they inflict minimal damage to the community or its infrastructure. They concluded that the SBCFSA needs to be most concerned with earthquakes with a magnitude > M 5.0.

Table 5-5 lists 27 historical earthquakes that exceeded M 5.0 from 1983 to present located within 100 miles of the SBCFSA.

**Table 5-5 Historical Earthquakes for SBCFSA**

*(Highlight is earthquake of record)*

Year	Month	Day	Time	Latitude	Longitude	Depth (Miles)	Magnitude	Distance (miles)
2011	6	16	5:02:24 AM	60.76	-151.08	36.04	5	71.46
2009	8	19	2:52:48 PM	61.23	-150.86	41.01	5.1	87.61
2006	7	27	8:52:48 AM	61.16	-149.68	14.29	5	66.49
2004	12	21	7:26:24 AM	60.54	-147.6	18.02	5.1	62.76
2004	3	5	9:36:00 AM	60.5	-151.64	37.90	5	82.02
2002	2	6	6:00:00 PM	61.17	-149.73	21.75	5.3	67.73
2002	2	6	7:12:00 PM	61.18	-149.73	22.37	5	68.35
2002	2	25	7:55:12 AM	60.56	-147.15	1.24	5	77.67



**Table 5-5 Historical Earthquakes for SBCFSA**  
(Highlight is earthquake of record)

Year	Month	Day	Time	Latitude	Longitude	Depth (Miles)	Magnitude	Distance (miles)
2002	8	6	12:28:48 AM	61.42	-150.35	34.18	5	90.10
2000	3	16	7:12:00 PM	61.4	-149.89	24.23	5	84.51
1999	4	18	1:55:12 AM	60.39	-151.85	45.36	5.3	88.23
1999	7	22	4:19:12 AM	61.3	-149.38	27.96	5.3	75.19
1997	12	5	1:26:24 PM	60.9	-149.19	22.37	5.1	47.22
1997	5	13	7:55:12 AM	61.05	-150.77	36.04	5	76.43
1995	5	24	10:04:48 PM	61.01	-150.12	25.48	5.6	61.52
1994	4	25	10:04:48 PM	60.9	-151.14	41.63	5.4	78.29
1993	5	18	11:31:12 PM	61.03	-149.95	31.69	5.2	60.89
1992	6	9	7:55:12 AM	61.33	-150.07	22.99	5.1	81.40
1991	4	26	10:04:48 PM	61.25	-150.15	23.61	5.2	77.05
1991	12	7	2:52:48 AM	60.95	-150.34	31.07	5.1	62.14
1987	4	18	9:21:36 PM	61.37	-150.66	42.25	5.7	92.58
1983	7	12	9:36:00 AM	61.03	-147.29	22.99	6.4	88.86
1983	9	7	3:36:00 AM	60.98	-147.5	27.96	6.2	80.78
1983	9	7	12:00:00 PM	60.99	-147.52	28.58	5	81.40
1980	8	1	4:48:00 PM	59.62	-148.94	16.16	5.7	42.87
1979	11	14	7:12:00 PM	61.38	-150.09	35.42	5.1	85.13
1973	8	31	9:36:00 PM	61.1	-147.41	30.45	5.1	88.86

(USGS 2012)

The average magnitude of the SBCFSA's earthquakes is M 3.05. The largest recorded earthquakes within 100 miles of the SBCFSA measured M 6.4 and 6.2 occurring on July 12, 1983 and September 7, 1983 respectively. These earthquakes were felt throughout the area causing minor damages to critical facilities, residences, non-residential buildings, and infrastructure.

Planning Team members stated that SBCFSA experienced moderate ground shaking from the November 3, 2002 M 7.9 Denali Fault earthquake whose epicenter occurred over 200 miles away. No significant damage occurred from this event. North America's strongest recorded earthquake occurred on March 27, 1964 in Prince William Sound, measuring M 9.2. This was a devastating earthquake event (with aftershocks) that caused underwater landslides which in-turn generated a massive local tsunami that ruptured fuel storage tanks which collapsed and quickly caught fire, sank moored ships, and destroyed railroad docks, train cars (rolling stock), and the Seward Highway bridges. There were 11 deaths in the City of Seward. The Resurrection Bay area received \$14.6 million (of the total disaster's \$84 million) in damages. .

### 5.3.1.3 Location, Extent, Impact, and Probability of Future Events

#### Location

Historical events have demonstrated that the entire geographic area of Alaska, and thus the SBCFSA, is prone to earthquake effects. The 1964 Great Alaskan Earthquake caused extensive devastation in Seward. This single event required the City to rebuild while reconsidering building and infrastructure locations.

Figure 5-1 displays Alaska's active and potentially active fault locations.



**Figure 5-1 Active and Potentially Active Faults in Alaska**

The Department of Geological and Geophysical Survey (DGGS) Neotectonic Map of Alaska depicts Alaska's known earthquake fault locations. DGGS states,

*"The Neotectonic Map of Alaska is the most comprehensive overview of Alaskan Neotectonics published to date; however, users of this map should be aware of the fact the map represents the author's understanding of Alaskan Neotectonics at the time of publication. Since publication of the Neotectonic map, our understanding of Alaskan Neotectonics has changed and earthquakes have continued to occur. For example, M7.9 Denali fault earthquake ruptured three faults, including the Susitna Glacier fault, which was previously undiscovered..."* (DGGS 2009).

As depicted in the Neotectonic Map of Alaska (Figure 5-2), the most prominent fault in close proximity to the SBCFSA is the Aleutian Mega-Thrust Fault (approximately 140 miles to the southwest). There are numerous smaller known faults within 100 miles of the SBCFSA. Many are complex fault areas. The SBCFSA can therefore expect to be impacted by significant future earthquake events (DGGS 2009).

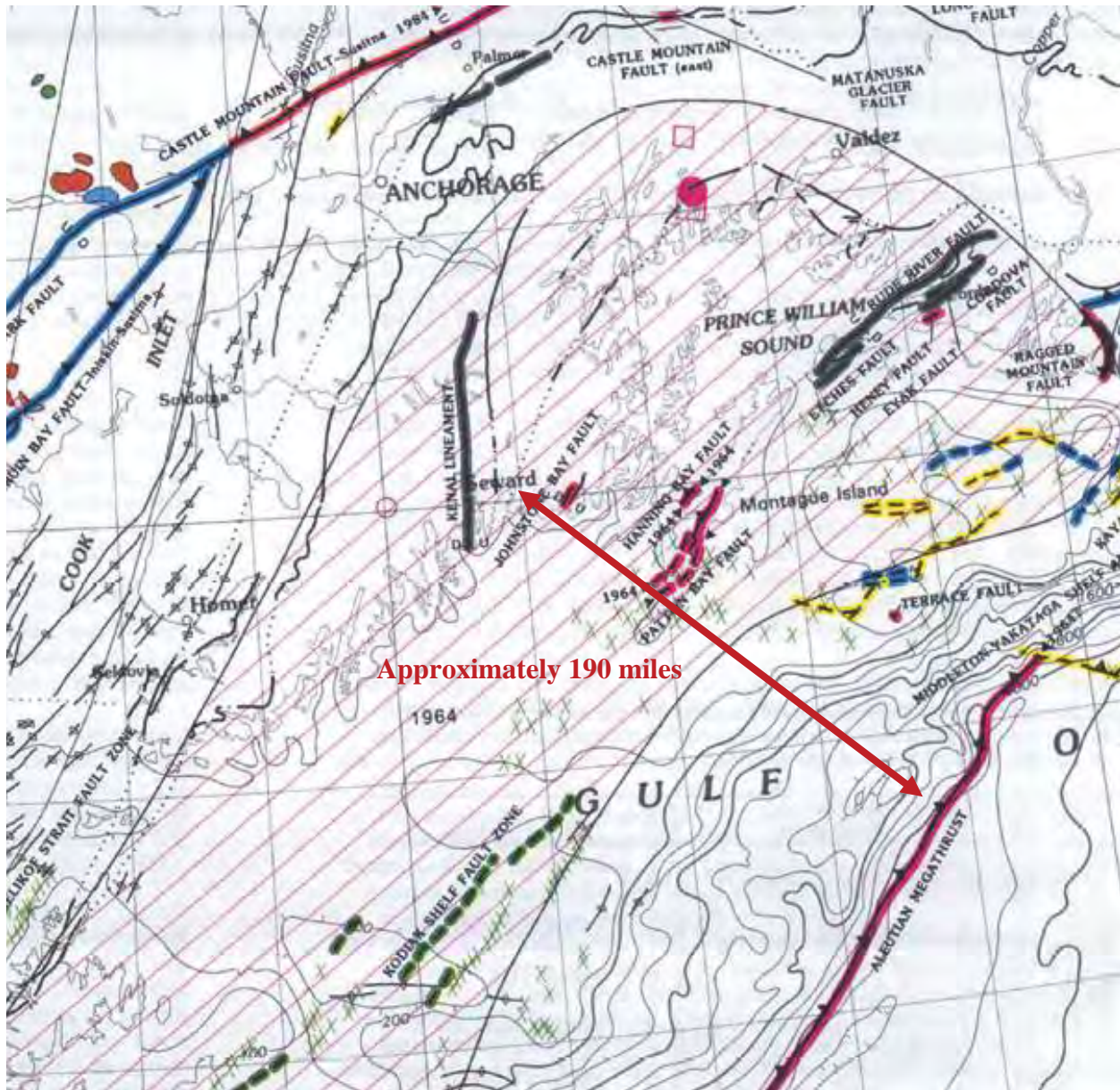


Figure 5-2 “Neotectonic Map of Alaska” Image – SBCFSA Area (DGGS 2009)

Of the 3,671 recorded earthquakes since 1973, 31 exceeded M 5.0. Two occurred with a magnitude of 6.2 and 6.4 (USGS 2009) and with epicenters approximately 82.87 and 91.85 air miles north-east respectively from the SBCFSA.

### Extent

Earthquakes felt in the SBCFSA area have exceeded M 5.0 in the past 36 years, and damage has been reported throughout the project area.

Based on historic earthquake events and the criteria identified in Table 5-5, the magnitude and severity of earthquake impacts in the SBCFSA are considered “Catastrophic” with potential of multiple deaths and injuries, the potential for critical facilities to be shut down for 30 days or



more, more than 50 percent of property or critical infrastructure being severely damaged, and with significant permanent damage to transportation, infrastructure, or the economy.

### Impact

The SBCFSA is located in an area that is very seismically active, and the effects of earthquakes centered elsewhere are expected to be felt in the SBCFSA with significant shaking based on past events (Figure 5-3).

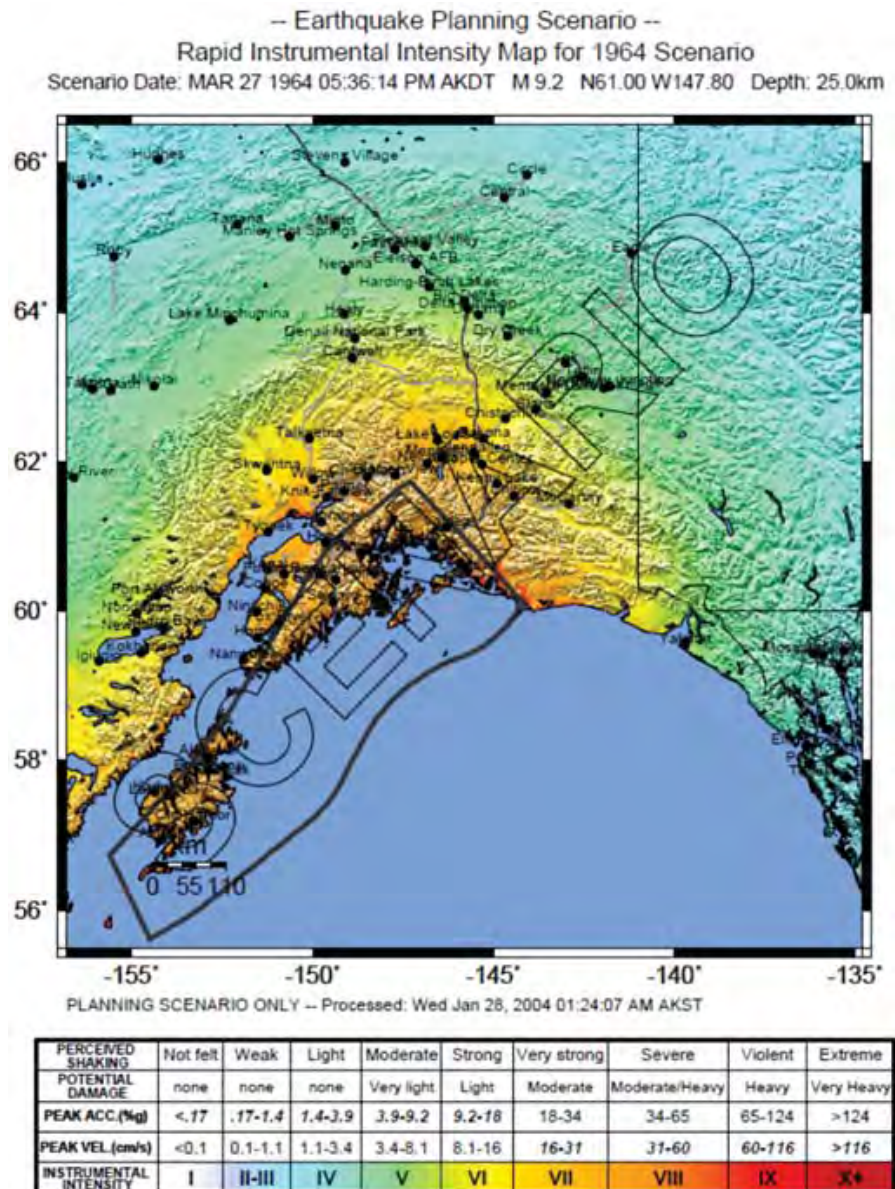


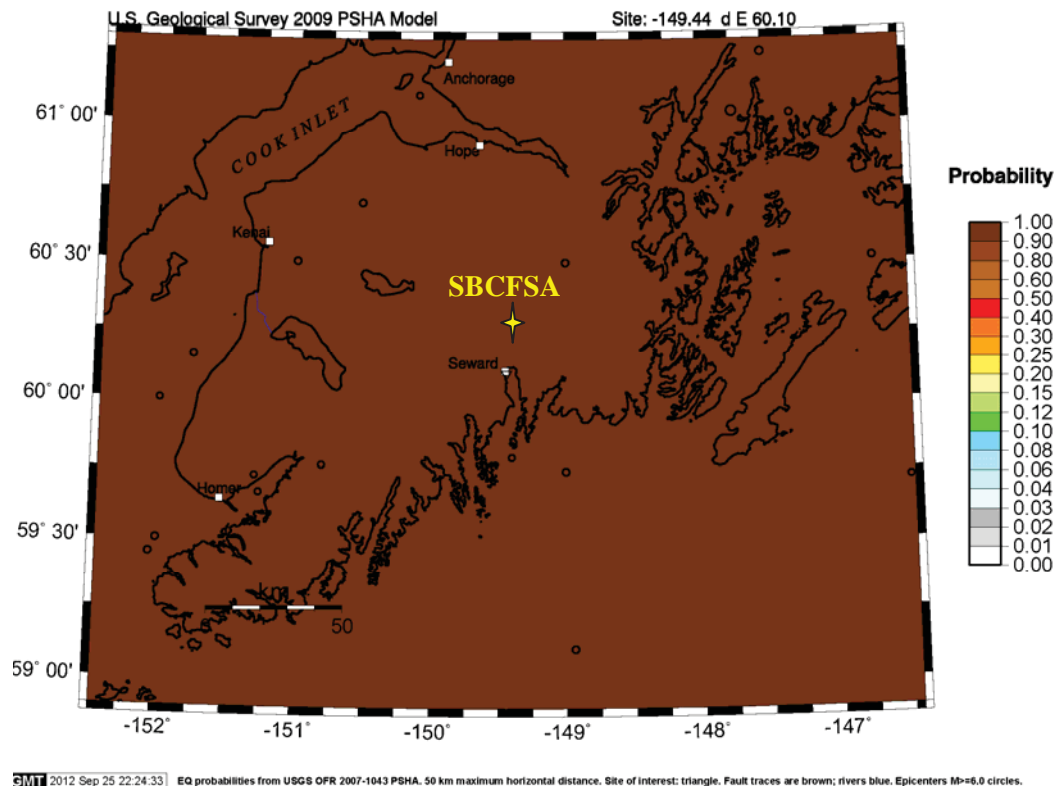
Figure 5-3 1964 Good Friday Earthquake Scenario (USGS 2013)

Impacts to future populations, residences, critical facilities, and infrastructure are anticipated to remain the same.

### Probability of Future Events

The SBCFSA has an extensive record of significant earthquake activity resulting in damage, injuries, and death. While it is not possible to predict when an earthquake will occur, Figure 5-4 was generated using the United States Geological Survey (USGS) Earthquake Mapping model and indicates a 100-percent probability of an M 5.0 or greater earthquake occurring within 100 years and 100 miles of the SBCFSA. Therefore it is expected that an event is “Highly Likely”. An earthquake event is probable within the calendar year, with a 1 in 1 year chance of occurring ( $1/1 = 100$  percent). History of events is greater than 33 percent likely per year.

Probability of earthquake with M > 5.0 within 100 years & 50 km



**Figure 5-4** SBCFSA's Earthquake Probability (USGS 2009)

The analysis of the earthquake hazard was conducted with the FEMA Hazus model (version 2.1). The 1964 Earthquake was modeled as worst-case scenario based on data provided by the USGS Shakemap program. See Appendix J, Section J.1 for more details on the Hazus earthquake modeling.

## 5.3.2 Erosion

### 5.3.2.1 Nature

Erosion rarely causes death or injury. However, erosion causes the destruction of property, development and infrastructure. Erosion is the wearing away, transportation, and movement of

land. It is usually gradual but can occur rapidly as the result of floods, storms or other events, or slowly as the result of long-term environmental changes such as melting permafrost. Erosion is a natural process, but its effects can be exacerbated by human activity.

Coastal and riverine erosion are problems for communities where disappearing land threatens development and infrastructure. Riverine erosion is a major threat to the SBCFSA as it threatens SBCFSA residential structures and utilities.

Erosion is the wearing away of land resulting in embankment loss from natural processes or human activity or influences. It is measured as the rate of change in the position or horizontal displacement of a water-land interface over a period of time. Land loss is the most visible aspect of riverine erosion because of the dramatic change it causes.

Riverine erosion results from the force of flowing water and ice formations in and adjacent to river channels. This erosion affects the bed and banks of the channel and can alter or preclude any channel navigation or riverbank development. In less stable braided channel reaches, erosion, and material deposition are constant issues. In more stable meandering channels, erosion episodes may only occasionally occur.

Erosion rates may also change in different river systems due to climate change impacts. For example, increased precipitation or increased snow melt at certain times of the year could result in increased flood events or greater river flow-rates. These in-turn could have an impact on sediment supply within the river. All of these factors could contribute to greater erosion levels. In addition long-term human factors such as water table depletion or the construction of embankment protection structures could also have an impact on erosion levels.

Land surface erosion results from flowing water across road surfaces due to poor or improper drainage during rain and snowmelt run-off which typically result from fall and winter sea storms.

### 5.3.2.2 History

Several agencies such as the USACE, Alaska Railroad Corporation (ARRC), Alaska Department of Transportation and Public Facilities (DOT/PF), KPB, and the City of Seward have successfully implemented erosion control measures such as embankment armoring, groins, jetties, or revetments. However, several of these have failed for various reasons. It is imperative that more appropriate actions be taken to protect residential properties and essential infrastructure.

The USACE's Alaska Baseline Erosion Assessment, Erosion Information Paper – Seward, Alaska, July 17, 2008 defined the SBCFSA's erosion threat as:

*“Seward has continuous erosion associated with the glacially fed, swift-moving drainages from the mountains surrounding Resurrection Bay. The drainages carry glacial debris that is deposited in the streams and added to the alluvial fans at outlets (2005 Seward/Bear Creek Flood Service Area (SBCFSA) Flood Hazard Mitigation Plan). Glacial streams such as Lowell Creek, Spruce Creek, Fourth of July Creek, and Japanese (local: Japp) Creek erode avalanche and other debris in their courses. Channel migrations in alluvial fan areas, channel migrations in the wider floodplain drainages such as Resurrection River, and periodically heavy rainfall associated with storm events are other contributing factors to erosion...”*



*Residents in Lowell Point were isolated from Seward when an approximate 18-inch rainfall in 3 days during August 1986 eroded debris in Spruce Creek, washing out the bridge and a large portion of Lowell Point Road. A torrent of debris was sent down Spruce Creek when a 15-inch rainfall, combined with one of the highest tides of the year, resulted eroded Lowell Point Road and brought Spruce Creek closer to the sewage lagoon in October 2006. The Lowell Creek diversion tunnel outflow dumped a 25-foot high pile of debris and gravel on the Lowell Creek Bridge at Lowell Point Road, damaging the bridge and backing water into surrounding businesses and streets.*

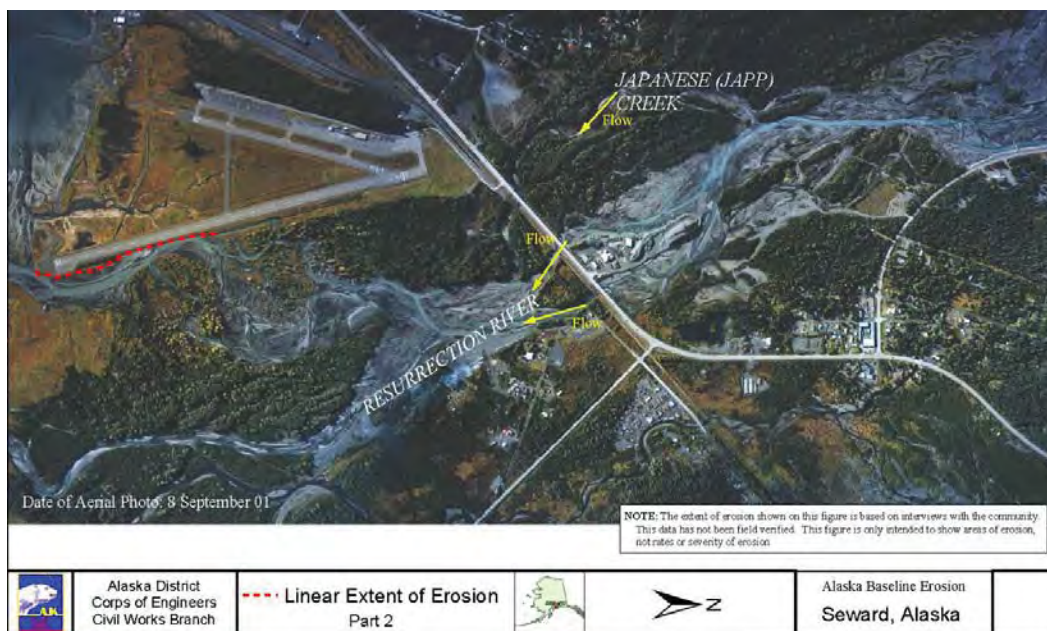
*The alluvial fan area of Japanese Creek has seen increasing development in recent years and supports a number of schools, a military recreation center, several businesses, many private residences, the maximum-security Alaska Spring Creek Prison, several large commercial developments such as the Seward Marine Industrial Center Deep-Water Port Facility, and a future long term care center for the elderly. The city has diverted the river and constructed a levee along each side of the creek channel to protect these facilities. An interim Corps Flood Damage Reduction Reconnaissance Report stated the levees had reduced the active surface of the fan by 70 percent. The 2006 flood eroded the toe of a levee that had been constructed by the city along part of the channel to protect development; however damages have since been repaired” (USACE 2008).*

### 5.3.2.3 Location, Extent, Impact, and Probability of Future Events

#### Location

The USACE 2008 SBCFSA erosion assessment provided comprehensive information describing the SBCFSA’s erosion threat as well as photos depicting the deteriorating embankments which expose critical infrastructure.

Figures 5-5, 5-6, and 5-7 depict SBCFSA’s erosion threatened areas.



**Figure 5-5 Seward Airport Erosion Map (USACE 2008)**

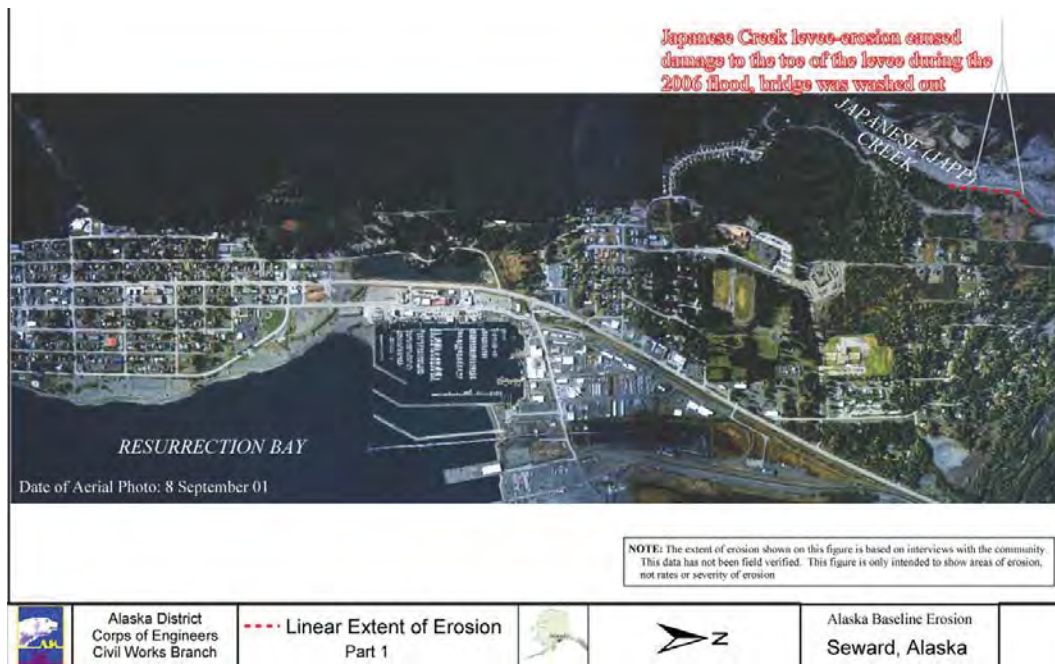


Figure 5-6 Japanese Creek Erosion Location Map (USACE 2008)



Figure 5-7 Seward Airport Erosion Map (USACE 2008)

## Extent

A variety of natural and human-induced factors influence the erosion process within the community. River orientation and proximity to current forces can influence erosion rates.

Embankment composition also influences erosion rates, as sand and silt will erode easily, whereas boulders or large rocks are more erosion resistant. Other factors that may influence riverine erosion include:

- Embankment type
- Geomorphology
- Structure types along the embankment
- Embankment elevation
- Embankment exposure to wind and waves
- Infrastructure encroachment into the high hazard zone
- Proximity to erosion inducing riverine structures
- Coastal and riverine topography
- Development density

Climate change may also contribute to increasing riverine erosion. It is not expected that climate change will have much of a coastal erosion impact in the near future from sea level rise. Increased precipitation is projected, which could contribute to increased erosion. Similarly, projected temperature increases could contribute to seasonal snow and ice melt changes, and accelerate local glacier melt. This may result in additional run-off erosion from numerous glacially-fed streams.

See Appendix I for additional information on potential SBCFSA climate change effects.

Based on the SBCFSA's past erosion events, the USACE Erosion Assessment, and the criteria identified in Table 5-3, the magnitude and severity of erosion impacts in the SBCFSA are considered "Limited" with potential for critical facilities to be shut down for more than a week, and more than 10 percent of property or critical infrastructure being severely damaged.

### Impact

Impacts from erosion include loss of land and any development on that land. Erosion can cause increased river delta sedimentation and hinder channel navigation – affecting marine transport. Other impacts include water quality reduction due to high sediment loads, native aquatic habitat losses, public utility damages (fuel headers and electric and water/wastewater utilities), and other economic impacts associated with the costs of trying to prevent or control erosion sites.

The USACE 2008 erosion assessment lists specific erosion areas (Figures 5-4, 5-5, and 5-6) and associated threats to the SBCFSA's, infrastructure:

*"Lowell Point Road, the only road connection between Seward and Lowell Point, continues to be at risk from shoreline erosion and periodic erosion events associated with Spruce Creek and Lowell Creek. Sewer lines that follow the road and connect to the sewage lagoon south of the Spruce Creek Bridge are at risk if the eroding Spruce Creek channel moves closer. The levee at Japanese Creek and the airport runway are at risk during storm and flood events occur." (USACE 2008).*

Figure 5-8 depicts the SBCFSA's GIS based coastal and riverine erosion area proximity.





**Figure 5-8 Coastal and Riverine Erosion Buffer Zone Map**

### Probability of Future Events

Based on historical impacts and future climate change projections, the USACE's erosion assessment, and the criteria identified in Table 5-2, it is "Likely" that erosion will occur in the next three years (event has up to 1 in 3 years chance of occurring) as the history of events is greater than 20 percent but less than or equal to 33 percent likely per year.

## 5.3.3 Flood

### 5.3.3.1 Nature

Flooding is the accumulation of water where usually none occurs or excess water overflows from a creek, stream, river, lake, reservoir, glacier, or coastal water body onto adjacent floodplains. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected.

A flood is the temporary inundation of water or mud on normally dry land. Heavy or prolonged rain, snowmelt, or dam collapse can cause inundation. Riverine and flash floods are the common flood event types affecting the SBCFSA.

Riverine flooding most frequently occurs in the late spring and fall, and is caused by storms that bring heavy rain and/or warm temperatures that produce rapid snowmelt on saturated or frozen ground. As storms move from the Pacific Ocean across the Alaska Coast, air rises and cools over

the coastal ranges, and heavy rainfall develops over the high-elevation streams. As much as 15 inches of rain has fallen in the SBCFSA over a 24-hour period. Severe and prolonged storms can raise rivers and streams to their flood stages for 3 to 4 days or longer.

Flash floods typically originate from slow-moving storms that can generate immense rainfall volumes which rapidly raise water levels bursting levees and seeking new routes to lower ground. Flash floods quickly reach high velocities; often carrying debris. They can strike SBCFSA populated areas with little to no warning and may bring several feet of water. These events have moved small car-sized boulders, uprooted trees, destroyed structures and facilities, eroded roadways, swept away vehicles and created new water channels. The intensity of flash flooding is a function of rainfall intensity and duration, watershed steepness, stream gradients, watershed vegetation resistance, natural and artificial flood storage area capacities, and streambed and floodplain configuration. Urban areas are more vulnerable to flash flooding because of development, land clearing, drainage system construction, and open areas that allow water to move unobstructed; such as parking lots and ditches. Wildfires exacerbate flood and land slide conditions because wildfires alter soil conditions and remove essential landslide resistant vegetation.

Flood events not only impact communities with high water levels, or fast flowing waters, but sediment and debris transport also impacts infrastructure and limits river vessel access. Dredging may be the only option to maintain an infrastructure's viability and longevity.



**Figure 5-9 Grouse Creek Debris Removal (URS 2012)**

The four primary types of flooding that occur in the SBCFSA are rainfall-runoff, snowmelt, storm surge, and tsunami-seiche floods.

- **Rainfall-Runoff Flooding** occurs in late summer and early fall. The rainfall intensity, duration, distribution, and geomorphic characteristics of the watershed all play a role in determining the magnitude of the flood. Rainfall run-off flooding is the most common type of flood. This type of flood event generally results from weather systems that have associated prolonged rainfall.
- **Snowmelt Floods** typically occur from April through June. The depths of the snowpack and spring weather patterns influence the flooding magnitude.
- **Storm Surge**, or coastal floods, occurs when the sea is driven inland above the high-tide level onto land that is normally dry. Often, heavy surf conditions driven by high winds accompany a storm surge adding to the destructive-flooding water's force. The conditions that cause coastal floods also can cause significant shoreline erosion as the flood waters undercut roads and other structures. Storm surge is a leading cause of property damage in Alaska.

The meteorological parameters conducive to coastal flooding are low atmospheric pressure, strong winds (blowing directly onshore or along the shore with the shoreline to the right of the direction of the flow), and winds maintained from roughly the same direction over a long distance across the open ocean (fetch).

Communities that are situated on low-lying coastal lands with gradually sloping bathymetry near the shore and exposure to strong winds with a long fetch over the water are particularly susceptible to coastal flooding. Several locations along the Resurrection Bay (Lowell Point, City of Seward, and the SBCFSA) have experienced significant damage from coastal floods over the past several decades. Most coastal flooding occurs during the late summer or early fall season in these locations

- **Tsunami-Seiche** events are covered in Section 5.3.5.

### Timing of Events

Many floods are predictable based on rainfall patterns. Most of the annual precipitation is received from April through October with August and September being the wettest. This rainfall leads to flooding in early/late summer and/or fall. Spring snowmelt increases runoff, which can cause flooding. It also breaks the winter ice cover, which causes localized stream and creek ice-jam floods.

#### 5.3.3.2 History

The SBCFSA experiences severe damages from flooding caused by heavy rainfall, snowmelt, and spring run-off. Spring and fall season rain storms result in substantial run-off, subsequent debris accumulation and flooding, and significant damage throughout the service area. The airport, residential structures, businesses, and other community infrastructure have been damaged or destroyed by these events.

SBCFSA residences, which include those located in the City of Seward, are located on alluvial fan deposits which were developed from water run-off and debris transport from the surrounding watersheds. Seward has adopted the KPB Flood Insurance Rate Map.

According to the SBCFSA Planning Team, the area's coastline is prone to severe storm surge and high winds that exacerbate rainfall flooding and erosion. The worst flooding events occur from complex storm events. The area has received extensive damaging flood impacts throughout its history. The Alaska State Legislature passed the 1977 Disaster Act which authorized the DHS&EM. DHS&EM then began tracking disaster damages which are reflected in the Disaster Cost Index from which the following is extracted:

***"13. Southcentral Alaska Rainstorm, July 22, 1981:** A torrential rainstorm resulted in widespread flooding, stream over flow and damage to bridges and culverts in South-central Alaska. This condition made travel hazardous throughout the region and in some cases roads were impassable to all traffic, including emergency vehicles. The Governor's Proclamation of a Disaster Emergency enabled DHS&EM to provide the affected communities with immediate recovery assistance, resulting in the restoration of the area's transportation system. No direct assistance was provided to individuals and families.*



**56. Southcentral Alaska Flood (Major Disaster), October 12, 1986 FEMA declared (DR-0782) on October 27, 1986:** Record rainfall in South-central Alaska caused widespread flooding in Seward, Matanuska-Susitna Borough and Cordova. The President declared a Major disaster implementing all public and individual assistance programs, including [U.S. Small Business Administration] SBA disaster loans and disaster unemployment insurance benefits.

**100. Seward/Kenai Peninsula Borough, August 30, 1989:** This Declaration relates to the same storm and flooding incident that affected Anchorage. Primary area of damage was in the city of Seward. As in Anchorage, State disaster assistance was limited to public property damage, with SBA loans available for individuals and businesses.

**111. '89 Spring Floods Hazard Mitigation, April 14, 1990:** The Major Disaster Declaration by the President in response to statewide flooding in the Spring of 1989 authorized the commitment of federal funds to projects designed to mitigate flood damage in future years. Since the federal funding required a State matching share, the Governor declared a disaster to provide these funds and authorize their expenditure.

**124. Lowell Creek Tunnel, September 27, 1990:** A major rehabilitation of Lowell Creek Tunnel is required to insure continued protection of the City of Seward. This is a mitigation project.

**96-180 South-central Fall Floods declared September 21, 1995 by Governor Knowles then FEMA declared (DR-1072) on October 13, 1996:** On September 21, 1995, the Governor declared a disaster as a result of heavy rainfall in South-central Alaska as a result the Kenai Peninsula Borough, Matanuska-Susitna Borough, and the Municipality of Anchorage were initially affected. On September 29, 1995, the Governor amended the original declaration to include Chugach, and the Copper River Regional Education Attendance areas, including the communities of Whittier and Cordova, and the Richardson, Copper River and Edgerton Highway areas which suffered severe damage to numerous personal residences, flooding, eroding of public roadways, destruction & significant damage to bridges, flood control dikes and levees, water and sewer facilities, power and harbor facilities. On October 13, 1995, the President declared this event as a major disaster (AK-1072-DR) under the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Individual Assistance totaled \$699K for 190 applicants. Public Assistance totaled \$7.97 million for 21 applicants with 140 DSR's. Hazard Mitigation totaled \$1.2 million. The total for this disaster is \$10.5 million.

**03-202 Kenai Peninsula Borough Flooding (AK-DR-1445) Declared November 6, 2002 by Governor Knowles then FEMA Declared December 4, 2002. FEMA amended the Declaration to extend the incident period to December 20<sup>th</sup>:** Starting October 23, 2002 through November 12, 2002, heavy rains (from three inches to fifteen inches) caused widespread damage, school closures, road washouts and stranded residents & hunters throughout the Kenai Peninsula Borough, the Kodiak Borough and the Chignik Bay area, including Chignik Lake and Chignik Lagoon. The driving rain continued for an extended time frame with multiple storm fronts. Although damages were widespread, the Kenai Peninsula Borough received the most damages. Damages in the Kenai Peninsula Borough consisted of road washouts, culvert damages, bridge damage at several locations, and private home damages caused by overflowing rivers and streams. The Kodiak Borough damages included road washouts, culvert damages, river spike damage, and damages to a

pier caused by sea surge. The Four Dam Pool Power Agency received damages to their facility. The Chignik Bay area, including Chignik Lake and Chignik Lagoon damage consisted of sea surge damage to docks and piers, damage a fuel of loading facility and dump truck, damage to a bridge in Chignik, and damage to the Department of Transportation-Chignik Lagoon Airport. The Kodiak Borough and Chignik Bay area also experienced private home damages. Federal Disaster Assistance for Individual Assistance, Debris Removal, Emergency Protective Measures and all categories of Permanent Work were provided under the Public Assistance Program. FEMA also authorized 404 Hazard Mitigation funding. Individual Assistance totaled \$142K. Public Assistance totaled \$16.6 million for 26 applicants with 118 PW's. Hazard Mitigation totaled \$582K. The total for this disaster is \$17.6 million.

**06-217 2006 South Central Storm (AK-06-217) declared March 13, 2006 by Governor Murkowski:** Beginning on February 5, 2006 and continuing through February 11, 2006, a series of strong winter storms with high winds, heavy snow, and freezing rain occurred in the City of Seward and surrounding areas of the Kenai Peninsula Borough in South Central Alaska, causing avalanches that severely damaged power lines and other infrastructures, blocked roads, and threatened further damages. As a result of the disaster, there was severe damage to power transmission and distribution lines supplying the City of Seward and surrounding areas; disruption of normal power supply requiring the prolonged use of emergency backup generators with extraordinary expensive operation costs; and damage and threat to public and private property as a result of power disruption. On March 13, 2006, a letter was submitted to request a federal time extension of 30 days. As of 3/20/06, the decision is pending. Decision made not to seek Federal assistance. Current estimated cost for repairs is \$1,254,730; however, this does not include the ongoing cost of line repair. No federal declaration was sought; therefore, the State is limited to public assistance only (no HM or IA). As of 3/20/06, only the City of Seward and Sealife Center are applicants. Disaster administratively closed out and ltr to applicants on 6/29/07. (7 Nov 08 update)--Formal closeout letter to DMVA/DAS ws dated 6 Nov 08 (funds authorized = \$1,465,321; funds expended = \$1,306,509.72; funds lapsed to DFR = \$158,811.28. (7Nov08, R.B.Stewart)

**07-221 2006 October Southern Alaska Storm (AK-07-221) declared October 14, 2006 by Governor Murkowski FEMA declared (DR-1669) on December 8, 2006:** Beginning on October 8, 2006 and continuing through October 13, 2006, a strong large area of low pressure that developed in the Northern Pacific and moved into the Southwest area of the state, produced hurricane force winds throughout much of the state and heavy rains in the Southcentral and Northern Gulf coast areas, which resulted in severe flooding and wind damage and threats to life in the Southern part of the state, to include the Kenai Peninsula Borough including the Cities of Seward and Seldovia, the Chugach Rural Education Area including the City of Cordova and the City of Valdez, and the Copper River Rural Education Area including the Richardson Highway to the Glennallen and highways and drainages in the McCarthy areas. Initial total damages are estimated at \$557,415 with a public assistance estimate of \$456,855. Federal declaration was made December 2006 including assistance for Public Assistance and Hazard Mitigation but not including Individual Assistance. Revised State of Alaska Cost estimates are \$1,265,000 in Individual Assistance and \$38,241,826 in Public Assistance for a total cost of \$39,506,826. There is \$26,825,918 available from the Federal Highway Administration leaving a requested amount of \$13,948,999. A total of 10 individuals or households applied for assistance through the State's IA Temporary

*Housing program. Six eligible applicants received a total of \$93,611.21 for home replacement, major repair and mitigation, and/or for temporary housing accommodations. Each TH applicant involved extensive case management. The temporary housing program closed 3/10/2008.*

**07-223 2007 January Kenai Ice Jam Flood, AK-07-223, issued March 02, 2007 by Governor Sarah Palin:** *Beginning on January 25 and continuing through February 4, 2007, Skilak glacier-dammed lake breached releasing a four-foot high surge of water into the Kenai River that ultimately dislodged river ice, moved the ice rafts downriver and created ice jams at various points along the river. These ice rafts, some up to 4 feet thick and weighing several tons destroyed or damaged public and private riverbank fishing platforms, stairs, and elevated walkways as they moved downriver. Where ice jams formed, the water and ice rafts overtopped the riverbanks (some up to 15 feet high) and flooded several public campgrounds, fishing parks, and residential homes from the community of Sterling to the City of Soldotna, within the Kenai Peninsula Borough. Approximately 150 homes and riverside businesses in the City of Soldotna and in the Big Eddy, Poacher's Cove, and River Quest portions of the Kenai Borough reported damage to their buildings, fishing structures, and/or docks; another 775 home properties within the borough were also impacted by floodwaters or ice. Some of the damaged fishing platforms were specially designed for handicap access. A voluntary evacuation program was instituted in several areas. Some roads were inundated and impassable due to high water. Ice jams also threatened the temporary highway bridge at Soldotna when the water level rose to 20 feet; however, the water dropped before damage could occur to the bridge or embankment. Preceding the flooding, the National Weather Service issued flood warnings, watches and advisories.*

*Confirmed damages occurred along the Kenai River in the Kenai Peninsula Borough, especially in the area of the City of Soldotna. Public infrastructure, commercial property, and personal property damages were reported in the metropolitan areas and the borough. The Division of Homeland Security and Emergency Management (DHS&EM) has received local disaster declarations from the City of Soldotna through the Kenai Peninsula Borough, requesting State disaster assistance; and from the Kenai Peninsula Borough, dated Feb 13, 2007, expanding the event date through February 5 and expanding the impacted area to include from Skilak Lake to the mouth of the Kenai River into the Cook Inlet. Due to the severity of the initial damage reports, the Governor inspected the flooding damage on February 3, 2007.*

**09-230, 2009 Seward Storm Surge declared by Governor Parnell on December 31, 2009:** *On December 1, 2009 the City of Seward experienced a winter storm event that caused damage to the shoreline and an important roadway within the community. High winds, 3 plus inches of rainfall, and a 12.6 foot tide, caused extensive damage to the wave barrier along Lowell Point Road, the Seward Greenbelt area and the seawall at the Alaska Sea Life Center" (DHS&EM 2011).*

**FEMA 4094-DR Alaska – Severe Storm, Straight-line Winds, Flooding, and Landslides Federal Declaration November 27, 2012.**

*On November 5, 2012, Governor Sean Parnell requested a major disaster declaration due to a severe storm, straight-line winds, flooding, and landslides during the period of September 15-30, 2012. The Governor requested a declaration for Individual Assistance for Alaska Gateway Regional Educational Attendance Area (REAA), Kenai Peninsula Borough, and Matanuska Susitna Borough and Public Assistance for five boroughs and REAAs and Hazard*

*Mitigation statewide. During the period of October 11-27, 2012, joint federal, state, and local government Preliminary Damage Assessments (PDAs) were conducted in the requested counties and are summarized below. PDAs estimate damages immediately after an event and are considered, along with several other factors, in determining whether a disaster is of such severity and magnitude that effective response is beyond the capabilities of the state and the affected local governments, and that Federal assistance is necessary.<sup>1</sup>*

*On November 27, 2012, President Obama declared that a major disaster exists in the State of Alaska. This declaration made Public Assistance requested by the Governor available to state and eligible local governments and certain private nonprofit organizations on a cost-sharing basis for emergency work and the repair or replacement of facilities damaged by severe storm, straight-line winds, flooding, and landslides in the Alaska Gateway REAA, Chugach REAA, Denali Borough, Kenai Peninsula Borough, and the Matanuska Susitna Borough. This declaration also made Hazard Mitigation Grant Program assistance requested by the Governor available for hazard mitigation measures for all boroughs and REAAs in the State of Alaska.*

The USACE Floodplain Manager does not provide any significant information for the SBCFSA on their website. They only list limited information for the City of Seward:

*The City of Seward is a home rule city with a population of 3,010 as of October 2011. There are multiple river systems and the Resurrection Bay Coastal Area. The City is an active NFIP participant with an official flood study available through the FEMA Flood Map Store.*

- *NFIP status is through the Kenai Peninsula Borough.*
- *Published FIRMs show detailed flood information.*
- *FIRMs can be purchased from Federal Emergency Management Agency's (FEMA) Map Service Center at:*  
<https://msc.fema.gov/webapp/wcs/stores/servlet/CategoryDisplay?catalogId=10001&storeId=10001&categoryId=12001&langId=-1&userType=G&type=1&future=false>

The SBCFSA experienced a severe flood event during September 19 through 23, 2012 causing severe damages throughout the area. The Governor requested and received a Federal Disaster Declaration on October 2012.

The National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) website explains that the:

*"...[Alaska Pacific River Forecast Center] APRFC provides operational hydrologic services for three Weather Forecast Offices located in Anchorage, Fairbanks, and Juneau. Operational products generated by the APRFC include flood forecasts, general river forecasts, recreational forecasts, navigation forecasts, reservoir inflow forecasts, water supply outlooks, spring flood outlooks, and various types of flash flood guidance. APRFC also provide hydrologic development support for both the Alaska and Pacific Regions. This includes a variety of other services, such as developing and implementing new procedures, forecast techniques, computer systems, data handling techniques, and hydrologic-related hardware. The APRFC also provides hydrologic expertise on a wide range of hydrologic activities for NWS and other federal, state, and local agencies" (APRFC 2012).*



The Seward Bear Creek Flood Service Area, Flood Hazard Mitigation Plan, A Service Area of the Kenai Peninsula Borough, May 2010 provides the concise flood history. URS performed a field floodplain analysis during the September 2012 flood event. This information is included within Table 5-6.

**Table 5-6 Representative Sampling of Historic Flood Events**

Date	Watershed	Description
1903-1966	Lowell Creek	Lowell Creek flooding began to be recorded almost as soon as settlers arrived to begin building the railroad.
		1903 and 1917 photographs it is evident that Lowell Creek regularly demolished the center of town with floodwaters.
		1918 Another flood occurred before this project could be started.
		1930's Lowell Creek was diverted through an elevated flume.
		1935 flood was estimated that 10,000 cubic yards was deposited in the flume in 11 hours.
		1937 it was determined that the cost of maintaining the deteriorating flume was prohibitive.
		1939 Congress allocated funds to the Army Corps of Engineers to build the Lowell Creek Diversion Tunnel and Dam: original cost of \$143, 929.00.
		1966 Flooding and landslides partially blocked the Lowell Creek Diversion Tunnel and water levels behind the diversion tunnel dam came within 2 feet of overtopping the dam.
	Resurrection River	Flooding is recorded on the Resurrection River in 1946 when the first recorded flooding of the airport occurred, as well as in 1961 and 1962.
1986	Entire SBCFSA	Rainstorm dropped ~18 inches of rain on the Kenai Peninsula from October 9 – 11. Landslides, landslide-dam failure, and resultant floods, debris flows, alluvial fan aggradations and flooding in and around Seward. Damages: ~ \$20 million.
1989	Entire SBCFSA	Heavy rains from August 25 – 27 Damages: over \$1,000,000 to homes, roads, bridges, and infrastructure.
1993	Entire SBCFSA	Heavy rains on August 26 caused Salmon Creek, Clear Creek and the Resurrection River to flood. Damage: Three homes, one business, and the Alaska Rail Road tracks.
1995	Entire SBCFSA	Typhoon Oscar generated rain from September 19 with about 9 inches of rain within a 24 hour period. Damages: <ul style="list-style-type: none"> <li>State authorities closed the Seward Highway from flood near Milepost 3.</li> <li>The Alaska Railroad removed debris accumulated at their Seward Highway Milepost 4.8 bridge and replaced damaged bridge infrastructure.</li> <li>Additional damages: the airport, sewage treatment facility, roads, trails, railroad facilities, power transmission lines and damage to dikes and levees and the Lowell Creek diversion tunnel.</li> <li>Estimated flood damage was 9.8 million dollars.</li> <li>A South Central Fall Flood Hazard Mitigation Grant</li> </ul>

Table 5-6 Representative Sampling of Historic Flood Events

Date	Watershed	Description
		Program (HMGP) was \$1,185,588, for bridge repair mitigation and \$731,658 for a comprehensive flood mitigation project on the lower Resurrection River.
2002	Entire SBCFSA	<p>Heaviest rainfall and most severe flooding occurred October 22 – 24.</p> <p>Damages:</p> <ul style="list-style-type: none"> <li>Salmon Creek flooding severely affected Marathon View II subdivision, Whites, Sawmill and Camelot.</li> <li>Infrastructure damaged included roads, Lowell Creek diversion tunnel, and the small boat harbor.</li> </ul>
2006	Entire SBCFSA	<p>High tides, warm temperatures, and typhoon remnants caused 9 – 15 inches of rain to fall on the Seward area.</p> <p>Damages:</p> <ul style="list-style-type: none"> <li>Heavy rain contributed to the Seward Highway overtopping at Mile 4.</li> <li>The Lowell Creek diversion tunnel outflow dumped a 15 foot high pile of debris and gravel on the bridge, damaging the bridge and backing water up into surrounding businesses and streets.</li> <li>Alaska Sea-Life Center and Institute of Marine Science (IMS) received extensive damage: pump house was completely destroyed,</li> <li>Shell Fish factory was flooded with water and gravel.</li> <li>Power and water lines in the area were damaged.</li> <li>Timber Lane Bridge damaged in Old Mill Subdivision</li> <li>Forest Lane Bridge over Sometimes Creek was destroyed and replaced with two large culverts.</li> <li>The loss of the bridge caused residents of Lowell Point to be cut off by road.</li> <li>Water taxi's had to be pressed into service to help Lowell Point residents get to jobs and stores.</li> <li>Families were evacuated from their homes in the Exit Glacier Road area, Old Mill Subdivision and around the Resurrection River highway bridges.</li> <li>Japanese Creek levee, Box Canyon levee and Kwechak Creek levee were all damaged in the flooding as was the airport.</li> <li>The Seward Highway was blocked by flooding at milepost 3.5</li> <li>Nash Road was blocked by flood waters. Portions of the airport runways were flooded.</li> <li>A federal disaster was declared for this flood event.</li> </ul>
2007	Entire SBCFSA	<p>Flood occurred after steady rain and high ground water conditions.</p> <p>Damages:</p> <ul style="list-style-type: none"> <li>Water to rise in Salmon Creek, Clear Creek, Sometimes Creek, and Lost Creek.</li> <li>Flooding threatened property and infrastructure in these areas including Salmon Creek Road, Nash Road, the Timber Lane Bridge, and the new bridge that had replaced the temporary culverts under Forest Road across Sometimes Creek.</li> <li>The KPB Office of Emergency Management (OEM) instituted Emergency dredging and bank restoration on</li> </ul>



Table 5-6 Representative Sampling of Historic Flood Events

Date	Watershed	Description
		<p>Salmon Creek.</p> <ul style="list-style-type: none"> <li>• SBCFSA obtaining permits and private property owner waivers.</li> <li>• KPB appealed directly to Governor Palin, for DNR to allow a short-term limited area exemption from the material sale fee.</li> <li>• KPB contracted for emergency dredging and bank repair above and below Timber Lane Bridge.</li> <li>• SBCFSA contracted dredging and bank repair project extending further north on Lost Creek.</li> </ul>
2009	Entire SBCFSA	<p>Flooding on July 29 – heavy rains, 3.3 inches in 24 hours. Damages:</p> <p><b>City of Seward:</b></p> <ul style="list-style-type: none"> <li>• Lowell Point Road – closed at the bridge due to debris piled up on the roadway.</li> <li>• Several landslides on Lowell Point Road. Storm surge damaged Lowell Point Road and the small board harbor, waterfront adjacent to the Alaska Sea-life Center, IMS, and the Shell Fish factory.</li> <li>• Seward Airport runway 13/31 closed – water on the runway.</li> <li>• Dimond Boulevard closed – water across the road.</li> </ul> <p><b>Outside City Limits</b></p> <ul style="list-style-type: none"> <li>• Exit Glacier Road closed – water across the road and up to the bottom of Exit Glacier Bridge.</li> <li>• Box Canyon Creek landslides caused Surge release flooding threatened homes in the Old Exit Glacier Subdivision; levee needed emergency restoration.</li> <li>• Bear Creek Fire Department went door-to-door warning residents of flood threat.</li> <li>• Old Mill Subdivision reported – water across the road and the bridge at Sometimes Creek threatening to wash out.</li> <li>• Flooding was reported on low lying properties on Clear Creek.</li> <li>• Kwechak Creek Levee emergency repairs – damaged from surge release flooding.</li> <li>• Local and borough emergency declarations were made. Emergency crews worked during and after the flooding on Lowell Creek Bridge, Box Canyon Levee and Upper Kwechak Levee.</li> </ul>
2012	Entire SBCFSA	Flooding on September 19 – 30, heavy rains, 9 inches in one 24 hour period.

(FEMA 2012, NWS 2011, USACE 2011, DHS&EM 2010)

### Location

The September 21, 2012 Fall Rainstorm event caused severe flooding throughout the SBCFSA. The following figures (5-10, 5-11, and 5-12) depict how debris-laden streams can impact the community; creating debris removal challenges.



**Figure 5-10 Lowell Creek Tunnel Debris Laden Outfall (URS 2012)**



**Figure 5-11 Lowell Creek Bridge During High Water Flow – 9/18/2012 (URS 2012)**



**Figure 5-12 Lowell Creek Bridge Covered - 9/20/2012 (URS 2012)**

Figure 5-13 depicts Keen Eye Photography's aerial photo (provided by the SBCFSA) of the 2012 flood impacts adjacent to, and north of, the Nash Road/Seward Highway intersection.

Nash Road  
Intersection



**Figure 5-13 Seward Highway Flooding (SBCFSA 2012)**

The USACE, Floodplain Management Flood Hazard Data report describes the location of their high water elevation (HWE) markers and flood gages:

*“High Water Elevation (HWE) signs were placed at the water level of the 1964 flood, which represents the BFE. HWE #1 is on a utility pole approximately 150 yards shoreward and downstream of the elementary school. HWE #2 is on the streamward, upstream side of the preschool building. HWE #3 is on the streamward, upstream corner of the SBCFSA generator building. The 1985 flood depth was reported to be approximately 2 ft.” (USACE 2011).*

### Extent

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence.

The following factors contribute to riverine flooding frequency and severity:

- Rainfall intensity and duration.
- Antecedent moisture conditions.
- Watershed conditions, including terrain steepness, soil types, amount, vegetation type, and development density.
- The attenuating feature existence in the watershed, including natural features such as swamps and lakes and human-built features such as dams.
- The flood control feature existence, such as levees and flood control channels.
- Flow velocity.
- Availability of sediment for transport, and the bed and embankment watercourse erodibility.
- SBCFSA location related to the base flood elevation as indicated with their certified high water mark.

The following factors contribute to the coastal flooding frequency and severity:

- Astronomical tides
- Storm surge - the rise in water from wind stress and low atmospheric pressure
- Waves
- Peak still-water elevation

The SBCFSA population and infrastructure receives repetitive and destructive flood impacts from several watersheds. Figure 5-14 depicts the SBCFSA watersheds. The City of Seward and the surrounding area's road system is lightly depicted demonstrating the potential impact on the City and the roadways from uncontrolled flood events.





**Figure 5-14 SBCFSA Watershed Boundaries (FEMA 2007)**

Based on the extensive history of previous occurrence impacts and their widespread impact areas, FEMA's Flood Insurance Studies, Flood Insurance Rate Maps, URS Hazus modeling, and criteria in Table 5-2.

The threat extent is classified as "Limited" where injuries or illnesses do not result in permanent disability, complete shutdown of critical facilities could last for more than one week, and more than ten percent of property is severely damaged.

### **Impact**

Nationwide, floods result in more deaths than any other natural hazard. Physical damage from floods includes the following:

- Structure flood inundation, causing water damage to structural elements and contents.
- Erosion or scouring of stream banks, roadway embankments, foundations, footings for bridge piers, and other features.
- Damage to structures, roads, bridges, culverts, and other features from high-velocity flow and debris carried by floodwaters. Such debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping or backwater damages.
- Sewage and hazardous or toxic materials release as wastewater treatment plants or sewage lagoons are inundated, storage tanks are damaged, and pipelines are severed.

Floods also result in economic losses through business and government facility closure, communications, utility (such as water and sewer), and transportation services disruptions. Floods result in excessive expenditures for emergency response, and generally disrupt the normal function of a community. The 2007 KPB Economic Development Plan states, the SBCFSA's economic losses for real property (\$315,610,200) and personal property (\$24,226,960) for the service area could total approximately \$339,837,130.

Impacts and problems also related to flooding are deposition and stream bank erosion (erosion is discussed in detail in Section 5.3.2). Deposition is the accumulation of soil, silt, and other particles on a river bottom or delta. Deposition leads to the destruction of fish habitat, presents daily challenges and access to residential areas. Deposition also reduces channel capacity, resulting in increased flooding or bank erosion (BKP 1988).

The impacts of climate change on the Kenai Peninsula area will affect future flood event recurrence probability, as well as future flood event severity, in the SBCFSA. Precipitation and temperature both have an impact on flooding, especially in glacially-fed watershed systems, such as those in the SBCFSA, where glacial melt and high altitude snowmelt influence seasonal flooding. Therefore, predicted changes in precipitation and temperature will influence probability and severity of flooding. Based on future climate change scenarios, the SBCFSA is projected to experience an increase in total annual precipitation, and also an increase in the average annual temperature. Both of these impacts will have an effect on the frequency and severity of flood events within the SBCFSA and surrounding areas. Additional information related to climate change analysis is discussed in Appendix I.



The analysis of both riverine and coastal flood hazards for current conditions and future conditions due to climate change was conducted using the FEMA Hazus model (version 2.1). Coastal flood analysis was completed based on the velocity flood zones shown on the KPB FEMA FIRMs. Riverine flood analysis was completed for the 10-, 50-, 100-, and 500-year flood events on each of the streams affecting the SBCFSA for both current and future climate change conditions. See Appendix J, Section J.2 for more details on the flood hazard modeling, and Appendix I for additional information on the climate change scenarios used for the modeling.

### **Probability of Future Events**

Climate change impacts to the Kenai Peninsula area will affect the future flood event recurrence probability, as well as future flood event severity for the SBCFSA. Precipitation and temperature both impact flood severity, especially in glacially fed watershed systems, such as those in the SBCFSA, where glacial melt and high altitude snowmelt influence seasonal flooding. Therefore, predicted changes in precipitation and temperature will influence probability and severity of flooding.

Similarly, sea level rise and accompanying storm surge changes resulting from climate change would potentially exacerbate coastal flooding impacts.

Based on previous occurrences, USACE Floodplain Manager's area threat assessment, and criteria in Table 5-2, it is "Highly Likely" a damaging flood will occur in the SBCFSA, as there is a 1 in 1 year chance of occurring (1/1=100 percent) based on a history of events demonstrating a greater than 33-percent recurrence per year.

*However, based on Hazus analysis, future climate change influenced weather patterns could potentially increase the 100-year flood recurrence probability to a more frequent 50-year event equivalent by the year 2050.*

## **5.3.4 Ground Failure (Avalanche, Landslide, Permafrost, Subsidence, Unstable Soils)**

### **5.3.4.1 Nature**

Ground failure describes gravitational soil movement. Soil movement influences can include rain snow and/or water saturation, seismic activity, melting permafrost, river or coastal embankment undercutting, or a combination of conditions on steep slopes.

Ground failures include dislodgment and fall of a mass of soil or rocks along a sloped surface, or for the dislodged mass itself. The term is used for varying phenomena, including mudflows, mudslides, debris flows, rock falls, rockslides, debris avalanches, debris slides, and slump-earth flows. The susceptibility of hillside and mountainous areas to landslides depends on variations in geology, topography, vegetation, and weather. Landslides may also be triggered or exacerbated by indiscriminate development of sloping ground, or the creation of cut-and-fill slopes in areas of unstable or inadequately stable geologic conditions.

Additionally, ground failure events often occur with other natural hazards, thereby exacerbating conditions, such as:

- Avalanches, the damage amount directly relates to the slide size, avalanche type, the material composition and consistency, the flow's force and velocity, and the avalanche path.
- Earthquake ground movement can trigger events ranging from rock falls and topples to massive slides.
- Intense or prolonged precipitation that causes flooding can also saturate slopes and cause failures leading to landslides.
- Wildfires can remove vegetation from hillsides significantly increasing runoff and landslide potential.

Development, construction, and other human activities can also provoke ground failure events. Increased runoff, excavation in hillsides, shocks and vibrations from construction, non-engineered fill places excess load to the top of slopes, and changes in vegetation from fire, timber harvesting and land clearing have all led to landslide events. Broken underground water mains can also saturate soil and destabilize slopes, initiating slides. Something as simple as a blocked culvert can increase and alter water flow, thereby increasing the potential for a landslide event in an area with high natural risk. Weathering and decomposition of geologic material, and alterations in flow of surface or ground water can further increase the potential for landslides.

The USGS identifies nine landslide types, distinguished by material type and movement mechanism including:

- **Complex** is any combination of landslide types.
- **Cornice Collapse** is an overhanging snow mass formed by wind blowing snow over a ridge crest or the sides of a gully. The cornice can break off and trigger bigger snow avalanches when it hits the wind-loaded snow pillow.
- **Debris Flows** arise from saturated material that generally moves rapidly down a slope. A debris flow usually mobilizes from other types of landslide on a steep slope, then flows through confined channels, liquefying and gaining speed. Debris flows can travel at speeds of more than 35 miles-per-hour (mph) for several miles. Other types of flows include debris avalanches, mudflows, creeps, earth flows, debris flows, and lahars.
- **Falls** are the free-fall movement of rocks and boulders detached from steep slopes or cliffs.
- **Ice Fall Avalanches** result from the sudden fall of broken glacier ice down a steep slope. They can be unpredictable as it is hard to know when ice falls are imminent. Despite common belief, they are unrelated to temperature, time of day or other typical avalanche factors.
- **Lateral Spreads** are a type of landslide generally occurs on gentle slope or flat terrain. Lateral spreads are characterized by liquefaction of fine-grained soils. The event is typically triggered by an earthquake or human-caused rapid ground motion.
- **Slab Avalanches** are the most dangerous types of avalanches. They happen when a mass of cohesive snow breaks away and travels down the mountainside. Slab avalanches occur

as a result of the presence of structural weaknesses within interfacing layers of the snowpack.

- **Slides**, the more accurate and restrictive use of the term landslide, refers to a mass movement of material, originating from a discrete weakness area that slides from stable underlying material. A *rotational slide* occurs when there is movement along a concave surface; a *translational slide* originates from movement along a flat surface.
- **Topples** are rocks and boulders that rotate forward and may become falls.

In Alaska, earthquakes, seasonally frozen ground, and permafrost are often agents of ground failure. Permafrost is defined as soil, sand, gravel, or bedrock that has remained below 32°F for two or more years. Permafrost can exist as massive ice wedges and lenses in poorly drained soils or as relatively dry matrix in well-drained gravel or bedrock. During the summer, the surficial soil material thaws to a depth of a few feet, but the underlying frozen materials prevent drainage. The surficial material that is subject to annual freezing and thawing is referred to as the “active layer”. Except for a few areas in the high alpine areas, the Seward area is free from permafrost (KPB, 2008).

- **Permafrost melting (or degradation)** occurs naturally as a result of climate change, although this is usually a very gradual process spread out over many years. In more northern parts of Alaska, where permafrost is more prevalent, the current increased rate of climate change is causing permafrost to melt leading to problems with the subsidence of land beneath infrastructure including roads, pipelines, and buildings. Thermokarst is the process by which characteristic land forms result from the melting of ice-rich permafrost. As a result of thermokarst, subsidence often creates depressions that fill with melt water, producing water bodies referred to as thermokarst lakes or thaw lakes.

Human induced ground warming can often degrade permafrost much faster than natural degradation caused by a warming climate. Permafrost degradation can be caused by constructing warm structures on the ground surface allowing heat transfer to the underlying ground. Under this scenario, improperly designed and constructed structures can settle as the ground subsides, resulting in loss of the structure or expensive repairs. Permafrost is also degraded by damaging the insulating vegetative ground cover, allowing the summer thaw to extend deeper into the soil causing subsidence of ice-rich permafrost, often leading to creation of thermokarst water bodies. Evidence of this type of degradation can be seen where thermokarst water bodies are abundant in the ruts of an old trail used by heavy equipment (cat trails) or where roads or railroads constructed by clearing and grubbing have settled unevenly. (Subsidence, liquefaction, and surface faulting are described in Section 5.3.1.1).

Seasonal freezing can cause frost heaves and frost jacking. Frost heaves occur when ice forms in the ground and separates sediment pores, causing ground displacement. Frost jacking causes unheated structures to move upwards. Permafrost is frozen ground in which a naturally occurring temperature below 32°F has existed for two or more years. Permafrost can form a stable foundation if kept frozen but when thawed; the soil weakens and can fail. Approximately 85 percent of Alaska is underlain by continuous or discontinuous permafrost (DHS&EM 2010).

Indicators of a possible ground failure include:

- Springs, seeps, or wet ground that is not typically wet
- New cracks or bulges in the ground or pavement
- Soil subsiding from a foundation
- Secondary structures (decks, patios) tilting or moving away from main structures
- Broken water line or other underground utility
- Leaning structures that were previously straight
- Offset fence lines
- Sunken or dropped-down road beds
- Rapid increase in stream levels, sometimes with increased turbidity
- Rapid decrease in stream levels even though it is raining or has recently stopped and
- Sticking doors and windows, visible spaces indicating frames out of plumb

The State of Alaska 2010 State Hazard Mitigation Plan provides additional ground failure information defining mass movement types, topographic and geologic factors which influence ground failure which pertain to SBCFSA.

#### 5.3.4.2 History

There are few written records defining ground failure impacts however, the 2005 City of Seward Comprehensive Plan provides some insight into this hazard's threat potential:

##### 3.8.3 Steep Slopes, Avalanche and Landslide Areas

*Steep slopes, which may be susceptible to avalanches and landslides, occur on the edge of town west of First Avenue, on the west side of Resurrection Bay along Lowell Point Road, the eastern section of Nash Road as it goes up the hill toward the Fourth of July Creek area. Based on recent experience in towns like Cordova which has experienced damage from avalanches, the potential for avalanche/landslide hazards to develop in areas of steep slopes should be analyzed.*

##### 3.8.4 Saturated Soils

*Areas where soils are saturated with water or where the groundwater is high can create problems with foundations, water damage to structures, and cause on-site sewage disposals to malfunction. These areas are often found adjacent to rivers, lakes, and coastal areas and are classified as wetlands by the USACE. Areas classified as wetlands may be subject to development restrictions.*

*The major categories of wetland types that have been mapped for the Seward area by the National Wetlands Inventory (NWI) include estuarine, bogs and muskegs (formally palustrine) and riverine areas. Areas that have been identified as seasonally or temporarily flooded have also been mapped. These areas have certain functions and values with regard to habitat, flood and erosion mitigation, and human use other than development. The functions and values have both practical and regulatory implications for use and management of public and private lands, including the following:*

- *Estuarine and riverine areas are likely to be considered for a variety of functions by state and federal regulatory agencies, which require permits for development in these areas.*
- *Areas of high habitat function and value support species of recreational and commercial importance to Seward (such as salmon); development impacts to these areas will be scrutinized by permitting agencies. Development of public lands with habitat value should be carefully evaluated.*
- *Areas of high function and value for flood and erosion protection help mitigate potential property damage from these hazards; their development, however, can increase damage to other properties, and require carefully evaluation.*

#### **Summary of Planning Issues and Trends**

- *Because of the limited amount of land in the city and because of the desirability of waterfront property, pressure to use the waterfront for higher density development continues. The high seismic risk calls for continued restriction by zoning and implementation of safety codes that promote low density development.*
- *Tsunamis readiness is compromised by not having local, continuous 24-hour earthquake monitoring.*
- *The following flood dangers exist:*
  - *The Lowell Creek Diversion Tunnel could in times of high water clog up or collapse, resulting in flooding of several Lowell Canyon homes and the hospital.*
  - *The stream at Lowell Point being susceptible to landslides can lead to road closures and flooding.*
  - *The dike next to the water tank could breach from high velocities of Japanese Creek, flooding Seward Resort and Forest Acres.*
  - *Resurrection River channel problems can lead to airport erosion and potential flood problems for roads and structures in the industrial area as occurred in the 1995 flood.*
  - *Mile Two streams can clog up and flood roads, damaging them.*
  - *Potential for a flash flood from the breaching of the dike at Fourth of July Creek could endanger lives at Spring Creek Correctional Center and/or community security.*
  - *Some subdivisions, because of the way buildings are sited and spaced, are vulnerable to flooding.*
- *Construction has begun on steep slopes and cliff areas without a good analysis of the stability of soils and of the potential for avalanche and landslide hazards.*
- *Problems with foundations, water damage to structures, and possible malfunction of on-site sewage disposals due to saturated soils are ongoing home owner problems.*

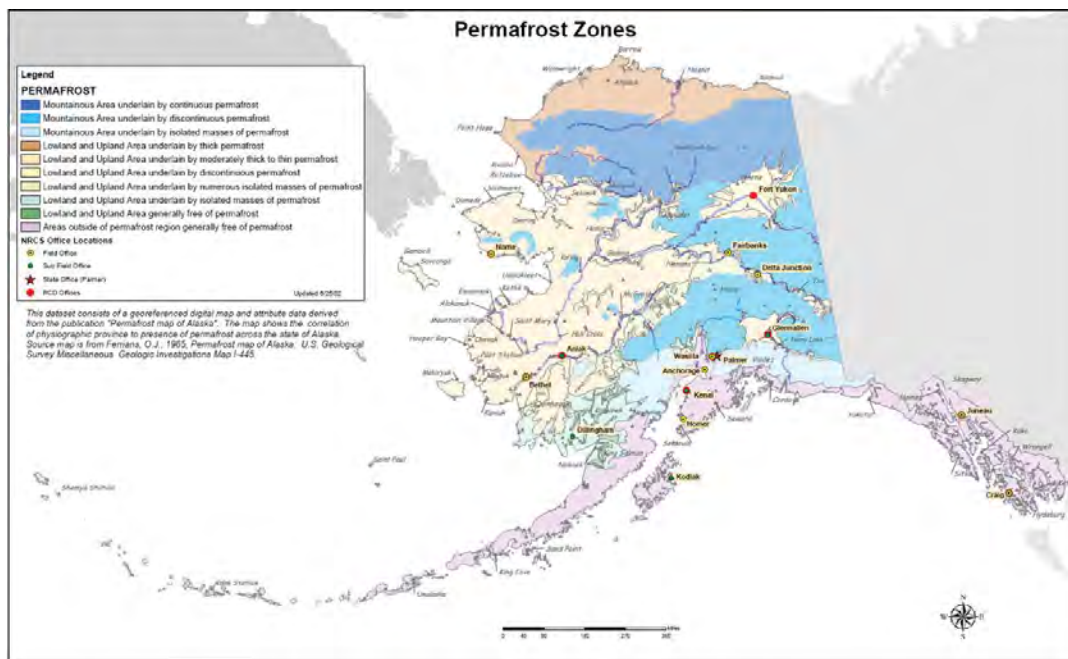
### 5.3.4.3 Location, Extent, Impact, and Probability of Future Events

#### Location

The SBCFSA stated the surround area does not possess permafrost which is validated by the City of Seward's Comprehensive Plan which describes their potential ground failure locations but no permafrost concerns:

*"Steep slopes, which may be susceptible to avalanches and landslides, occur on the edge of town west of First Avenue, on the west side of Resurrection Bay along Lowell Point Road, the eastern section of Nash Road as it goes up the hill toward the Fourth of July Creek area" (Seward 2005)*

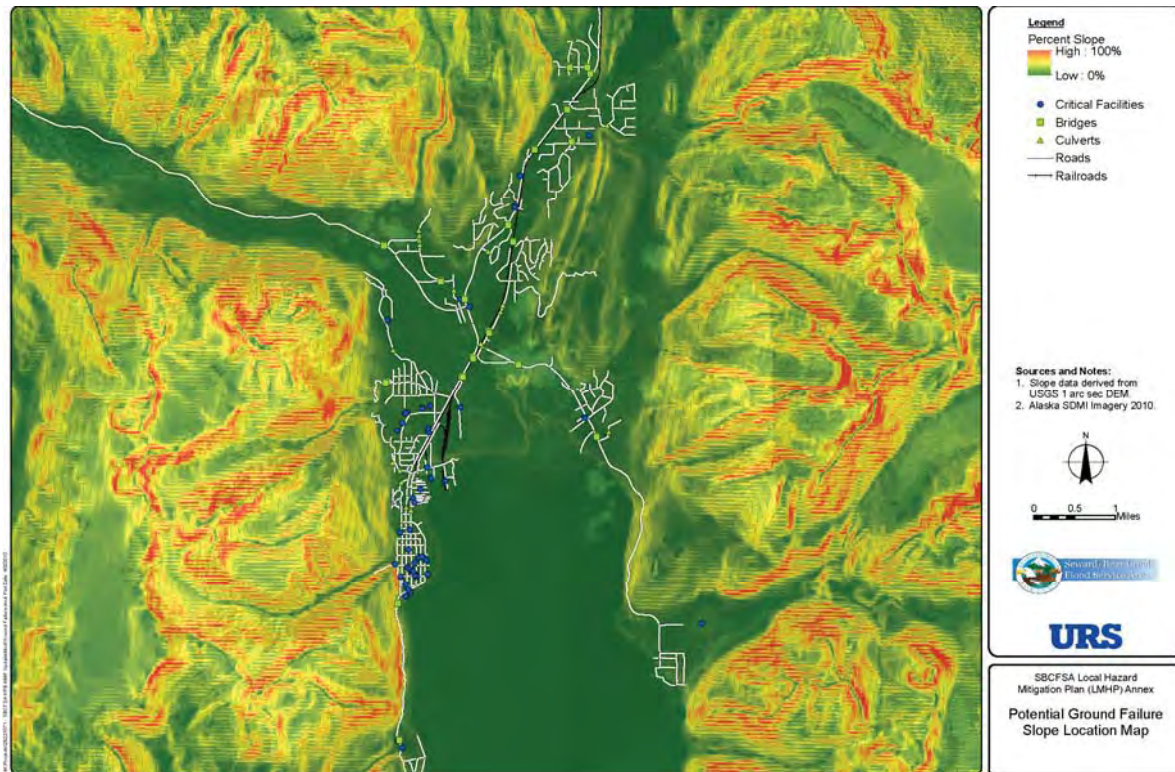
According to Permafrost Zones map (Figure 5-15) developed for the National Snow and Ice Data Center/World Data Center for Glaciology (NSIDC 2002), along with the SBCFSA's Comprehensive Plan, and comments received from the Planning Team, the SBCFSA has substantiated that no permafrost laden soils exist within the SBCFSA.



**Figure 5-15 Permafrost Map of Alaska (NSIDC 2002)**

Figure 5-16 depicts slope angle degrees as an indicator of snow avalanche or landslide potential.





**Figure 5-16 SBCFSA Slope Failure Potential (URS 2012)**

### Extent

The damage magnitude for ground failure could range from minor with some repairs required and little to no damage to transportation, infrastructure, or the economy; to major damage if a critical facility (such as the airport) were damaged and transportation was effected.

Based on research and the Planning Team’s knowledge of past ground failure and permafrost degradation events and the criteria identified in Table 5-3, the extent of ground failure impacts in the SBCFSA are considered “Negligible” impacts would occur mainly from avalanches or landslides resulting from water saturated soils with little to no warning. This hazard could potentially cause injuries or death, however, neither would shut-down critical facilities nor cause major service interruptions for much more than 24 hours; less than 10 percent of property would be damaged by ground failure events; and minor quality of life would be lost.

### Impact

Not all ground failure events pose a sudden and catastrophic hazard. For example, permafrost does not pose a threat to the SBCFSA. Impacts associated with SBCFSA associated ground failure events include damages to infrastructure, buildings, and transportation interruptions from avalanches, landslides, and surface subsidence. To avoid costly damage to these facilities, careful planning and location and facility construction design is warranted.

The Planning Team stated that the Lowell Point Road, the Seward Highway at mile 21, and the airport runway may be susceptible to avalanche, landslide, or subsidence from some form of ground failure impacts.

### Probability of Future Events

There are few written records defining ground failure impacts for the SBCFSA, the Planning Team states that they have experienced significant avalanches and minor landslides which disrupt transportation for short durations.

The Planning Team further stated the probability for ground failure recurring follows the criteria in Table 5-2, the probability of future damage resulting from ground failure is probable within the next three years. Events are “Likely” to occur (event has up to 1 in 3 years chance of occurring) as the history of events is greater than 20 percent but less than 33percent likely per year (SBCFSA 2012).

As discussed in Appendix I, future climate change scenarios project both an increase in total annual precipitation, as well as an increase in average annual temperature within the SBCFSA and surrounding areas. As a result, there is an increasing likelihood that local and regional glacier melt rate – already well documented (e.g., NPS, Tuttle 2011), as well as snow and ice melt in high altitudes, will accelerate. This could potentially impact the occurrence of future avalanches and other landslide-type events in the SBCFSA.

Appendix I further discusses climate change scenarios and potential resulting impact considerations.

### 5.3.5 Tsunami and Seiche

#### 5.3.5.1 *Nature*

A tsunami is a series of waves generated in a body of water by an impulsive disturbance along the seafloor that vertically displaces the water. A seiche is an oscillating wave occurring within a partially or totally enclosed water body.

Subduction zone earthquakes at plate boundaries often cause tsunamis. However, submarine landslides, submarine volcanic eruptions, and the collapses of volcanic edifices can also generate tsunamis. A single tsunami may involve a series of waves, known as a train, of varying heights. In open water, tsunamis exhibit long wave periods (up to several hours) and wavelengths that can extend up to several hundred miles, unlike typical wind-generated swells on the ocean, which might have a period of about 10 seconds and a wavelength of 300 feet.

The actual height of a tsunami wave in open water is generally only 1 to 3 feet and is often practically unnoticeable to people on ships. The energy of a tsunami passes through the entire water column to the seabed. Tsunami waves may travel across the ocean at speeds up to 700 miles per hour (mph). As the wave approaches land, the sea shallows and the wave no longer travels as quickly, so the wave begins to “pile up” as the wave-front becomes steeper and taller, and less distance occurs between crests. Therefore, the wave can increase to a height of 90 feet or more as it approaches the coastline and compresses.

Tsunamis not only affect beaches that are open to the ocean, but also bay mouths, tidal flats, and the shores of large coastal rivers. Tsunami waves can also diffract around land masses and islands. Since tsunamis are not symmetrical, the waves may be much stronger in one direction than another, depending on the nature of the source and the surrounding geography. However, tsunamis do propagate outward from their source, so coasts in the shadow of affected land masses are usually fairly safe.

Local tsunamis and seiches may be generated from earthquakes, underwater landslides, atmospheric disturbances, or avalanches and last from a few minutes to a few hours. Initial waves typically occur quite soon after onslaught, with very little advance warning. They occur more in Alaska than any other part of the US.

Seiches occur within an enclosed water body such as a lake, harbor, cove or bay. They are locally event generated waves characterized as a “bathtub effect” where successive water waves move back and forth within the enclosed area until the energy is fully spent causing repeated impacts and damages.

### 5.3.5.2 History

The SBCFSA has received prior tsunami impacts. Most notable are the catastrophic 1964, Good Friday Earthquake induced distant and locally generated tsunamis. Tsunamis affecting the SBCFSA occur infrequently. The SBCFSA 2010 FHMP states,

*“Alaska has the greatest tsunami potential in the entire United States. Historic tsunamis generated by earthquakes on the Alaska-Aleutian subduction zone have resulted in widespread damage and loss of life along the Alaskan Pacific coast and other places located at exposed locations around the Pacific Ocean. Large seismic events occurring in the vicinity of the Alaska Peninsula, Aleutian Islands, and Gulf of Alaska have a very high potential for generating both local and Pacific-wide tsunamis[within Resurrection Bay]...”*

*In 1964 south central Alaska experienced the strongest earthquake ever recorded in North America, its strength estimated at 9.1 on the Richter Scale. The resulting tsunami in Resurrection Bay inundated and destroyed 300 feet by 3500 feet of the Seward waterfront including the San Juan Army and railroad docks, the tracks leading to the dock, the oil tank farms, fish processors, warehouses and the small boat harbor. The economic loss, particularly to Seward’s port facilities resulted in the destruction of 90% of Seward’s economy...*

*... Seward’s mayor at that time knew firsthand of the disastrous effects of tsunamis, because he lived through the 1964 tsunamis as a young boy. During the Great Alaskan Earthquake, a section of Seward’s waterfront slid into the bay triggering a series of tsunamis that inundated the community a mere 20 minutes later. Twelve people were killed and the destruction was extensive — 14 million dollars (in 1964 dollars)” (SBCFSA 2010).*

### 5.3.5.3 Location, Extent, Impact, and Probability of Future Events

#### Location

The State of Alaska, the University of Alaska Fairbanks, Geophysical Institute (UAF/GI), and the West Coast/Alaska Tsunami Warning Center (WC/ATWC) indicate the SBCFSA has a significant tsunami impact threat.

An excerpt from the Report of Investigations 2010-1, Tsunami Inundation Maps of Seward and Northern Resurrection Bay, Alaska, by E.N. Suleimani et al. states:

*“At the time of the 1964 earthquake, the economy of Seward was based on shipping, and was heavily dependent on the city’s railroad, harbor, and port operations. Seward was severely impacted by the 1964 earthquake and tsunami waves. The loss of harbor*



facilities from the earthquake and resultant offshore slope failures near the Seward waterfront devastated the economic base of the town (Lemke, 1967)...

Seward is built mostly on the alluvial fan of Lowell Creek. Lowell Point, Tonsina Point, and the area at the mouth of Fourth of July Creek (fig. 4) are also alluvial fans that extend into the bay as fan deltas (Lemke, 1967). The entire head of Resurrection Bay is a fjord-head delta, formed by Resurrection River. Haeussler and others (2007) use the term 'bathtub' to describe a flat depression in the middle of the bay extending north to south (fig. 4). The deepest part of the bathtub is approximately 300 m below sea level. Prior to the 1964 earthquake, the average offshore slopes in the vicinity of Seward ranged from 10 to 20 degrees, decreasing to 5 degrees at the depth of about 200 m (Lemke, 1967). Today, that same area has an average slope of about 25 degrees (Lee and others, 2006). A natural barrier formed by Caines Head and a glacial sill divide the bay into two deep basins, separated by a narrow 'neck' with maximum depth above the sill at 195 m. This sill inhibits sediment transport by tidal currents to the southern part of the bay (Haeussler and others, 2007)" (UAF/GI 2010)

Figure 5-17 depicts aerial photos of the 1964 tsunami inundation line against historical as well as current day infrastructure.



Figure 3. Imagery of downtown Seward: top – aerial photo taken before the earthquake of March 27, 1964 (photo by the U.S. Army Corps of Engineers, mosaic by the USGS); middle - aerial photo taken one day after the earthquake of March 27, 1964 (photo by the U.S. Army Corps of Engineers, mosaic by the USGS); bottom – a recent satellite image of Seward (Digital Globe, 2005). Red line indicates the maximum extent of inundation caused by the 1964 tsunami waves.

**Figure 5-17 Historical vs. Present Day Tsunami Inundation Potential (UAF/GI 2010)**

**Extent**

Based on historic earthquake events, WC/ATWC information, and the criteria identified in Table 5-3, the magnitude and severity of earthquake impacts in the City are considered “Catastrophic” with multiple injuries, the potential for critical facilities to be shut down for more than a month, more than 50% of property is severely damaged, and significant damage to transportation, infrastructure, or the economy.

**Impact**

The UAF GI indicates there is a high likelihood of the SBCFSA, specifically the City of Seward and Lowell Point with receiving future tsunami impacts. The most damaging impacts are anticipated from locally generated tsunamis occurring from accumulated glacial silt and debris situated throughout Resurrection Bay’s numerous outflow and alluvial fan locations. The UAF/GI Report defines the 1964 tsunami impacts.

*“The Mw9.2 Alaska earthquake of March 27, 1964, at Seward was characterized by strong ground motion that lasted 3–4 minutes. During the shaking, a section of the waterfront slid into the bay, taking with it docks and other harbor facilities. At the same time, fuel tanks fractured and oil ignited. Both local, landslide-generated waves and distant, tectonically generated waves inundated the Seward shoreline and caused tremendous damage (Lemke, 1967). Damage from the strong ground motion alone was minor compared to tsunami-related destruction. As a result of regional tectonic deformation, the Resurrection Bay area subsided about 3.5 feet (1.1 m), which resulted in low-lying coastal areas being inundated at high tide. Thirteen people were killed and five injured in Seward as a combined result of the earthquake and tsunami waves. Eighty-six houses were totally destroyed and 269 were heavily damaged. According to Lemke (1967), the total cost to repair public and private facilities was estimated at \$22 million (\$153 million in 2009 dollars)” (UAF/GI 2010).*

**Probability of Future Events**

The SBCFSA has a significant tsunami impact history. While it is not possible to predict when a tsunami will occur, WC/ATWC’s (Paul Whitmore’s personal) comments, tsunami forecast modeling, and Table 5-2 indicates a distant source tsunami as well as a locally-generated tsunami are “Highly Likely” to occur, but the recurrence interval is unknown. Too many factors determine when the next event will occur, as supported by known bathymetric conditions within Resurrection Bay.

**5.3.6 Volcanic Hazards****5.3.6.1 Nature**

Alaska is home to 41 historically active volcanoes stretching across the entire southern portion of the state from the Wrangell Mountains to the far western Aleutian Islands. “Historically active” refers to actual eruptions that have occurred during Alaskan historic time, in general the time-period in which written records have been kept; from about 1760. Alaska averages 1-2 eruptions per year. In 1912, the largest eruption of the 20th century occurred at Novarupta and Mount Katmai, located in what is now Katmai National Park and Preserve on the Alaska Peninsula (AVO 2011, USGS 2002).

A volcano is a vent or opening in the earth's crust from which molten lava (magma), pyroclastic materials, and volcanic gases are expelled onto the surface. Volcanoes and other volcanic phenomena can unleash cataclysmic destructive power greater than nuclear bombs, and can pose serious hazards if they occur in populated and/or cultivated regions.

There are four general volcano types:

- Lava domes are formed when lava erupts and accumulates near the vent.
- Cinder cones are shaped and formed by cinders, ash, and other fragmented material accumulations that originate from an eruption.
- Shield volcanoes are broad, gently sloping volcanic cones with a flat dome shape that usually encompass several tens or hundreds of square miles, built from overlapping and inter-fingering basaltic lava flows.
- Composite or stratovolcanoes are typically steep-sided, large dimensional symmetrical cones built from alternating lava, volcanic ash, cinder, and block layers. Most composite volcanoes have a crater at the summit containing a central vent or a clustered group of vents.

Along with the different volcano types there are different eruption classifications. Eruption types are a major determinant of the physical impacts an event will create, and the particular hazards it poses. Six main types of volcano hazards exist including:

- Volcanic gases are made up of water vapor (steam), carbon dioxide, ammonia, as well as sulfur, chlorine, fluorine, and boron compounds, and several other compounds. Wind is the primary source of dispersion for volcanic gases. Life, health, and property can be endangered from volcanic gases within about 6 miles of a volcano. Acids, ammonia, and other compounds present in volcanic gases can damage eyes and respiratory systems of people and animals, and heavier-than-air gases, such as carbon dioxide, can accumulate in closed depressions and suffocate people or animals.
- Lahars are usually created by shield volcanoes and stratovolcanoes and can easily grow to more than 10 times their initial size. They are formed when loose masses of unconsolidated, wet debris become mobilized. Eruptions may trigger one or more lahars directly by quickly melting snow and ice on a volcano or ejecting water from a crater lake. More often, lahars are formed by intense rainfall during or after an eruption since rainwater can easily erode loose volcanic rock and soil on hillsides and in river valleys. As a lahar moves farther away from a volcano, it will eventually begin to lose its heavy load of sediment and decrease in size.
- Landslides are common on stratovolcanoes because their massive cones typically rise thousands of feet above the surrounding terrain, and are often weakened by the very process that created the mountain – the rise and eruption of molten rock (magma). If the moving rock debris is large enough and contains a large content of water and soil material, the landslide may transform into a lahar and flow down valley more than 50 miles from the volcano.



- Lava flows are streams of molten rock that erupt from a vent and move downslope. Lava flows destroy everything in their path; however, deaths caused directly by lava flows are uncommon because most move slowly enough that people can move out of way easily, and flows usually do not travel far from the source vent. Lava flows can bury homes and agricultural land under tens of feet of hardened rock, obscuring landmarks and property lines in a vast, new, hummocky landscape.
- Pyroclastic flows are dense mixtures of hot, dry rock fragments and gases that can reach 50 mph. Most pyroclastic flows include a ground flow composed of coarse fragments and an ash cloud that can travel by wind. Escape from a pyroclastic flow is unlikely because of the speed at which they can move.
- Tephra is a term describing any size of volcanic rock or lava that is expelled from a volcano during an eruption. Large fragments generally fall back close to the erupting vent, while smaller fragment particles can be carried hundreds to thousands of miles away from the source by wind. Ash clouds are common adaptations of tephra.

Ash fall poses a significant volcanic hazard to the Kenai Peninsula Borough because, unlike other secondary eruption effects such as lahars and lava flows, ash fall can travel thousands of miles from the eruption site.

Volcanic ash consists of tiny jagged particles of rock and natural glass blasted into the air by a volcano. Ash can threaten the health of people, livestock, and wildlife. Ash imparts catastrophic damage to flying jet aircraft, operating electronics and machinery, and interrupts power generation and telecommunications. Wind can carry ash thousands of miles, affecting far greater areas and many more people than other volcano hazards. Even after a series of ash-producing eruptions has ended, wind and human activity can stir up fallen ash for months or years, presenting a long-term health and economic risk. Special concern is extended to aircraft because volcanic ash completely destroys aircraft engines.

Ash clouds have caused catastrophic aircraft engine failure, most notably in 1989 when KLM Flight 867, a 747 jetliner, flew into an ash cloud from Mt. Redoubt's eruption and subsequently experienced flameout of all four engines. The jetliner fell 13,000 feet before the flight crew was able to restart the engines and land the plane safely in Anchorage. The significant trans-Pacific and intrastate air traffic traveling directly over or near Alaska's volcanoes, has necessitated developing strong communication and warning links between the Alaska Volcano Observatory (AVO), other government agencies with responsibility for aviation management, and the airline and air cargo industry (AVO 2011, USGS 2002).

Table 5-7 provides the AVO's identified volcano list.

**Table 5-7 Identified Volcanos**

Volcano Names			
Adagdak	Akutan	Alagogshak	Amak
Amchixtam Chaxsxii	Amukta	Andrew Bay volcano	Aniakchak
Atka	Augustine	Basalt of Gertrude Creek	Behm Canal-Rudyard Bay
Black Peak	Blue Mtn	Bobrof	Bogoslof
Buldir	Buzzard Creek	Camille Cone	Capital
Carlisle	Chagulak	Chiginagak	Churchill, Mt
Cleveland	Cone 3110	Cone 3601	Dana

Table 5-7 Identified Volcanos

Volcano Names			
Davidof	Denison	Devils Desk	Double Glacierv
Douglas	Drum	Duncan Canal	Dutton
Edgecumbe	Emmons Lake Volcanic Center	Espenberg	Fisher
Folsoms Bluff	Fourpeaked	Frosty	Gareloi
Gas Rocks, the	Gilbert	Gordon	Gosling Cone
Great Sitkin	Griggs	Hayes	Herbert
Iliamna	Imuruk Lake	Ingakslugwat Hills	Ingrisarak Mtn
Iron Trig cone	Isanotski	Iskut-Unuk River cones	Jarvis
Jumbo Dome	Kagamil	Kaguyak	Kanaga
Kasatochi	Katmai	Kejulik	Kialagvik
Kiska	Klawasi Group	Knob 1000	Kochilagok Hill
Koniujji	Kookooligit Mountains	Korovin	Koyuk-Buckland volcanics
Kukak	Kupreanof	Little Sitkin	Lone basalt
Lost Jim Cone	Mageik	Makushin	Martin
Moffett	Monogenetic QT vents of WWVF	Morzhovoi	Nelson Island
Novarupta	Nunivak Island	Nushkolik Mountain volcanic field	Okmok
Pavlof	Pavlof Sister	Prindle Volcano	Rainbow River cone
Recheshnoi	Redoubt	Roundtop	Sanford
Seguam	Segula	Semisopochnoi	Sergief
Shishaldin	Skookum Creek	Snowy	Spurr
St. George volcanic field	St. Michael	St. Paul Island	Steller
Stepovak Bay 1	Stepovak Bay 2	Stepovak Bay 3	Stepovak Bay 4
Submarine 001	Submarine 002	Submarine 003	Submarine 004
Submarine 005	Submarine 006	Suemez Island	Table Top Mtn
Takawangha	Tana (east)	Tanada Peak	Tanaga
Tlevak Strait	Togiak volcanics	Trader Mtn	Trident
Ugashik-Peulik	Ukinrek Maars	Uliaga	Ungulungwak Hill-Ingrichuak Hill
Unimak 5270	Unnamed (near Ukinrek Maars)	Veniaminof	Vsevidof
Westdahl	Wide Bay cone	Wrangell	Yantarni
Yunaska			

### 5.3.6.2 History

The AVO, and its constituent organizations (USGS, DNR, and UAF), has volcano hazard identification and assessment responsibility for Alaska's active volcanic centers. The AVO monitors active volcanoes several times each day using Advanced Very High Resolution Radiometers (AVHRR) and satellite imagery. Figure 5-18 delineates the AVO's monitoring program.

DHS&EM's Disaster Cost Index records the following volcanic eruption disaster events:

**103. *Mt. Redoubt Volcano, December 20, 1989*** *When Mt. Redoubt erupted in December 1989, posing a threat to the Kenai Peninsula Borough, Mat-Su Borough, and the Municipality of Anchorage, and interrupting air travel, the Governor declared a Disaster Emergency. The Declaration provided funding to upgrade and operate a 24-hr. monitoring and warning capability.*

**104. KPB-Mt. Redoubt, January 11, 1990** The Kenai Peninsula Borough, most directly affected by Mt. Redoubt, experienced extraordinary costs in upgrading air quality in schools and other public facilities throughout successive volcanic eruptions. The Borough also sustained costs of maintaining 24-hr. operations during critical periods. The Governor's declaration of Disaster Emergency supported these activities.

**161. Mt. Spurr, September 21, 1992** Frequent eruptions and the possibility of further eruptions has caused health hazards and property damage within the local governments of the Municipality of Anchorage, Kenai Peninsula Borough and Mat-Su Borough. These eruptions caused physical damage to observation and warning equipment. Funds to replace equipment for AVO.

Alaska's volcanoes have very diverse eruption histories spanning thousands of years. Activity spanning such an extensive timeline is nearly impossible to define. However modern science has enabled the AVO with determining fairly recent historical eruption dates. Table 5-8 lists the AVO's identified volcano's historical eruption dates with explanatory symbols to designate the data's accuracy.

Table 5-8 Volcano Eruption Dates				
Named Volcanoes and Their Respective Eruption Dates				
Amak	Fisher	Kagamil	Pavlof	Trident
✱1700	✱1830	✱1929	✱1762	✱1913
✱1796	Gareloi	Kanaga	✱1790	✱1949
Amukta	✱1760	✱1763	❗1892	Vsevidof
✱1770	❗1873	❗1942	Pavlof Sister	✱1830
Augustine	Great Sitkin	Kasatochi	✱1762	Westdahl
✱1902	✱1760	✱1760	Seguam	✱1979
Chiginagak	✱1784	Kukak	❗1786	Wrangell
✱1929	Iliamna	✱1889	Semisopochnoi	✱1784
Cleveland	✱1741	Makushin	❗1873	✱1819
✱1774	✱1768	❗1769	Shishaldin	✱1884
❗1828	✱1778	✱1796	✱1901	
❗1893	✱1779	✱1865	✱1925	
✱1897	✱1843	Okmok	Tanaga	
✱1938	Little Sitkin	❗1938	✱1763	
✱1975	✱1776			
<b>Key:</b> ❗ Eruption ✱ Questionable eruption ❗ Non-eruptive activity				

### 5.3.6.3 Location, Extent, Impact, and Probability of Future Events

#### Location

Figure 5-18 depicts active and inactive volcanoes throughout Alaska.

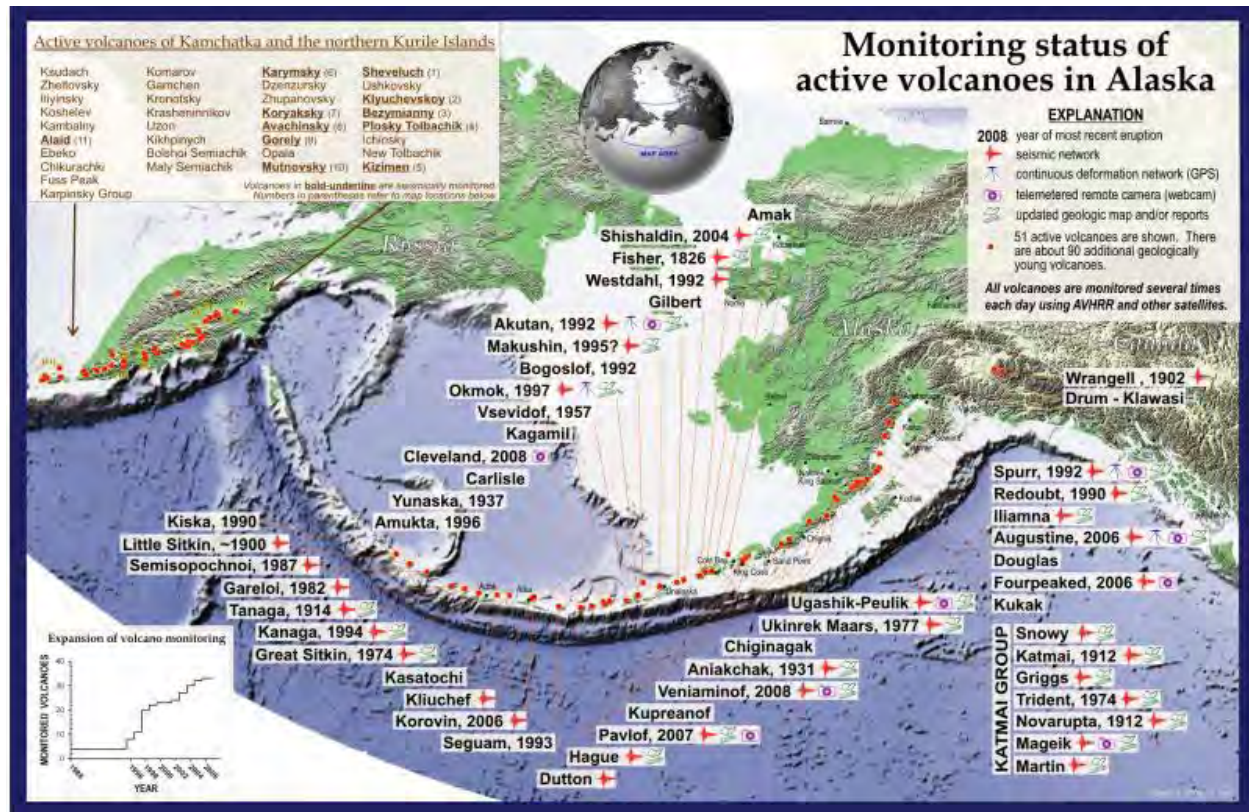


Figure 5-18 AVO's Volcano Monitoring Status Map (AVO 2008)

The AVO publishes individual hazard assessments for each active volcano in Alaska. Table 5-9 lists a representative sample of their preliminary reports and hazard assessments.

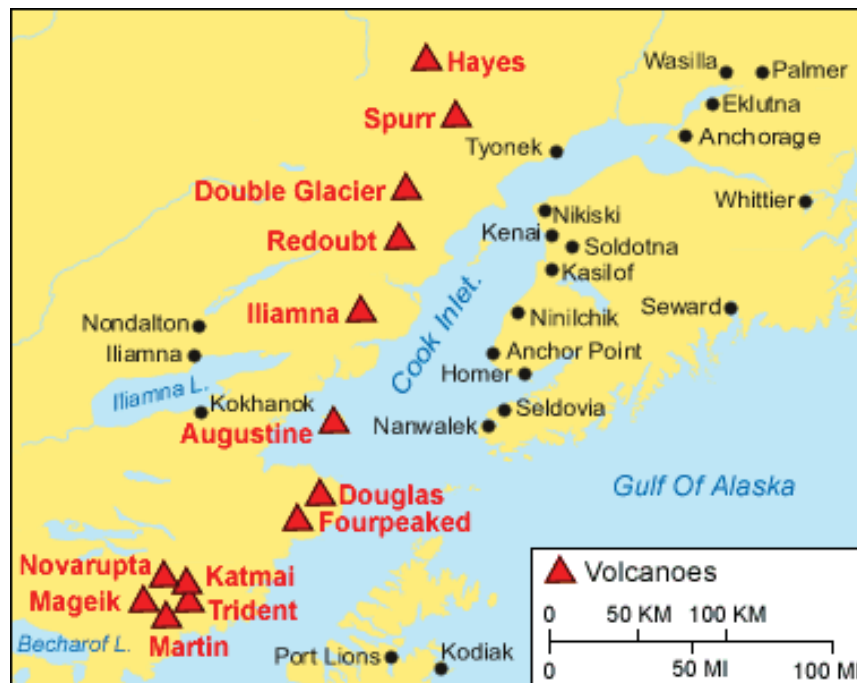
Table 5-9 Published Volcano Hazard Assessments

Volcano Names			
Akutan Volcano	Great Sitkin Volcano	Makushin Volcano	Mount Spurr Volcano
Aniakchak Volcano	Hayes Volcano	Okmok Volcano	Tanaga Island Volcanic Cluster
Augustine Volcano	Iliamna Volcano	Pavlof Volcano	
Emmons Lake Volcanic Center	Kanaga Volcano	Redoubt Volcano	
Gareloi Volcano	Katmai Volcanic Cluster	Shishaldin Volcano	

Each report contains a description of the eruptive history of the volcano, the hazards they pose, and the likely effects of future eruptions to populations, facilities, and ecosystems.

Figure 5-19 depicts those volcanoes closest to the Kenai Peninsula Borough which are the most likely to impact the SBCFSA.





**Figure 5-19 KPB's most threatening volcanoes (AVO 2012)**

Alaska contains 80+ volcanic centers and is at continual risk for volcanic eruptions. Most of Alaska's volcanoes are far from settlements that could be affected by lahars, pyroclastic flows and clouds, and lava flows; however ash clouds and ash fall have historically caused significant impact to human populations.

*"When volcanoes erupt explosively, high-speed flows of hot ash (pyroclastic flows) and landslides can devastate areas 10 or more miles away, and huge mudflows of volcanic ash and debris (lahars) can inundate valleys more than 50 miles downstream. . . Explosive eruptions can also produce large earthquakes. . . the greatest hazard posed by eruptions of most Alaskan volcanoes is airborne dust and ash; even minor amounts of ash can cause the engines of jet aircraft to suddenly fail in flight" (USGS 1998)*

Although the SBCFSA is far from any active volcanoes, many of the volcanoes in Alaska are capable of producing eruptions that can affect the area. The SBCFSA need only be concerned with significant volcanic ash falls. A large ash plume has the capability of shutting down air, and potentially, ferry and barge operations because tephra is damaging to all engine types.

USGS Bulletin 1028-N explains that Mount Katmai's eruption on June 5, 1912 was up to that point "the greatest volcanic catastrophe in the recorded history of Alaska. More than six cubic miles of ash and pumice were blown into the air from Mount Katmai and the adjacent vents in the Valley of Ten Thousand Smokes." The eruption lasted for 3 days. The USGS Fact Sheet 075-98, Version 1.0 states,

*"The ash cloud, now thousands of miles across, shrouded southern Alaska and western Canada, and sulfurous ash was falling on Vancouver, British Columbia;*

*and Seattle, Washington. The next day the cloud passed over Virginia, and by June 17th it reached Algeria in Africa.”*

Figure 5-20 shows the extent of four ash cloud impact areas. The 1912 Katmai ash cloud is gray; the Augustine (blue plume), Redoubt (orange plume), and Spurr (yellow plume) were each dwarfed by the Katmai event. “Volcanologist’s discovered that [this] 1912 [Katmai] eruption was actually from Novarupta, not Mount Katmai” (USGS 1998).



**Figure 5-20** 1912 Katmai Volcano Impact (USGS 1998)

- Archaeological evidence suggests that an eruption of Aniakchak volcano 3,500 years ago spread ash over much of Bristol Bay and generated a tsunami which washed up onto the tundra around Nushagak Bay. Within the past 10,000 years, Aniakchak volcano has significantly erupted on at least 40 occasions.
- The 1989-90 eruption of Mt. Redoubt seriously affected the population commerce, and oil production and transportation throughout the Cook Inlet region.

*“Redoubt Volcano is a strato-volcano located within a few hundred kilometers of more than half of the population of Alaska. This volcano has erupted explosively at least six times since historical observations began in 1778. The most recent*



*eruption occurred in 1989-90 and similar eruptions can be expected in the future. The early part of the 1989-90 eruption was characterized by explosive emission of substantial volumes of volcanic ash to altitudes greater than 12 kilometers above sea level and widespread flooding of the Drift River valley. Later, the eruption became less violent, as developing lava domes collapsed, forming short-lived pyroclastic flows associated with low-level ash emission. Clouds of volcanic ash had significant effects on air travel as they drifted across Alaska, over Canada, and over parts of the conterminous United States causing damage to jet aircraft, as far away as Texas. Total estimated economic costs are \$160 million, making the eruption of Redoubt the second most costly in U.S. history” (USGS 1998).*

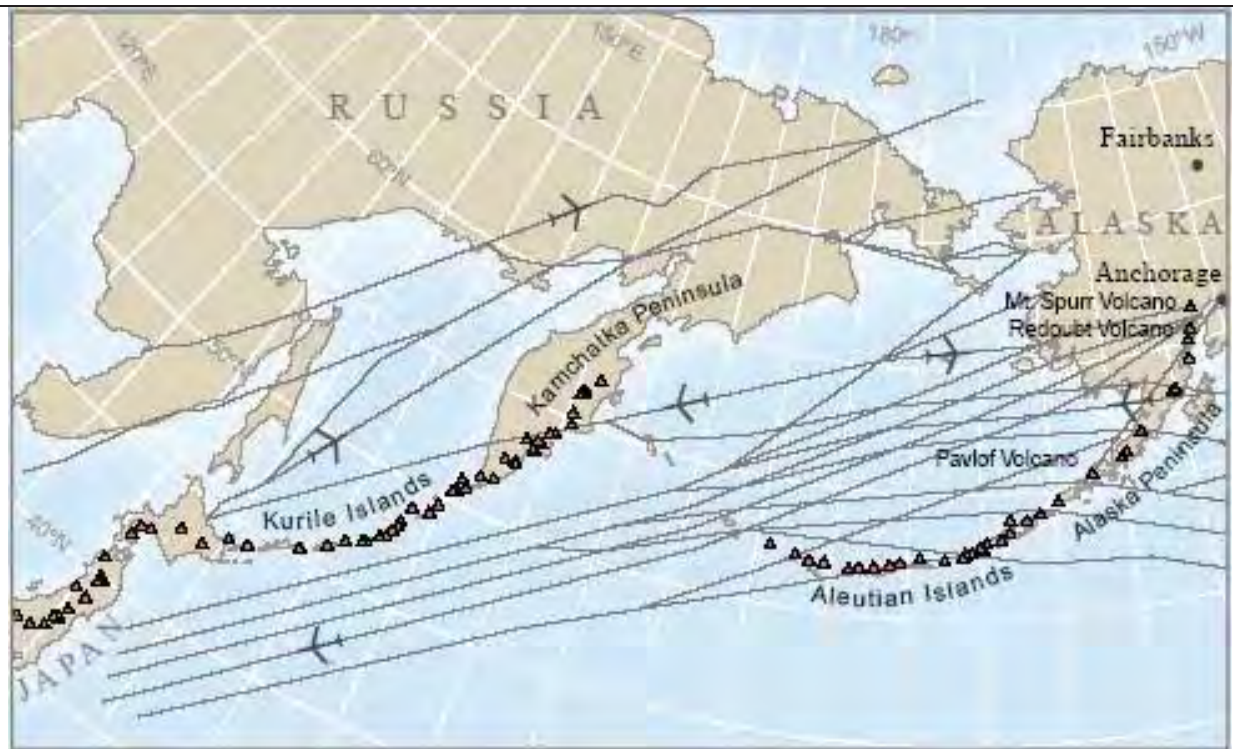
- Mt. Spurr’s 1992 eruption brought business to a halt and forced a 20 hour Anchorage International Airport closure. Communities 400 miles away reported light ash dustings.

*“Eruptions from Crater Peak on June 27, August 18, and September 16–17, 1992, produced ash clouds (fig. 11) that reached altitudes of 13 to 15 kilometers [8-9 miles] above sea level. These ash clouds drifted in a variety of directions and were tracked in satellite images for thousands of kilometers beyond the volcano (Schneider and others, 1995). One ash cloud that drifted southeastward over western Canada and over parts of the conterminous United States and eventually out across the Atlantic Ocean (fig. 12) significantly disrupted air travel over these regions but caused no direct damage to flying aircraft” (USGS 2002)*

In 1992, another eruption series occurred, resulting in three separate eruption events. The first, in June, dusted Denali National Park and Manley Hot Springs with 2 mm of ash – a relatively minor event. In August, the mountain again erupted, covering Anchorage with ash, bringing business to a halt and forcing officials to close Anchorage International Airport for 20 hours. St. Augustine’s 1986 eruption caused similar air traffic disruption.

- Small ash clouds from the 2001 eruption of Mt. Cleveland were noted by USGS to have reached Fairbanks. These clouds dissipated somewhere along the line between Cleveland and Fairbanks. A full plume, visible on satellite imagery, was noted in a line from Cleveland to Nunivak Island.
- The January 10, 2004 eruption of Augustine volcano resulted in a National Weather Service urgent notification of ash fall. No measurable ash was recorded.

Figure 5-21 displays the air travel routes in the North Pacific, Russia, and Alaska and the active volcanoes which could easily disrupt air travel during significant volcanic eruptions with ash fall events.



**Figure 5-21 North Pacific Air Travel Routes (USGS 2001)**

Eruptions, explosive and otherwise, of the Augustine Volcano occur every five to ten years. Plumes from at least one Augustine eruption have been caught on camera.

### Extent

Volcanic effects include severe blast, turbulent ash and gas clouds, lightning discharge, volcanic mudflows, pyroclastic flows, corrosive rain, flash flood, outburst floods, earthquakes, and tsunamis. Some of these activities include ash fallout in various communities, air traffic, road transportation, and maritime activity disruptions.

SBCFSA might receive some ash fall during a massive volcanic eruption. A tsunami is possible if the eruption included a massive, high speed pyroclastic flow into the Pacific Ocean or Prince William Sound. However, SBCFSA has only a minimal tsunami impact threat from volcanic activity. A much more likely impact would be prolonged traffic disruptions (air, land, or rail) preventing essential community resupply e.g. food and medicine delivery, and medivac service capabilities to full service hospitals.

A massive eruption anywhere on earth, such as Tambora in 1815, could severely affect the global climate; radically changing SBCFSA's (and everyone else's) risk from weather events for weeks, months, or years.

Based on historic volcanic activity impacts and the criteria identified in Table 5-3, the magnitude and severity of impacts in the SBCFSA are considered "limited" with minor injuries, the potential for critical facilities to be shut down for more than a week, more than 10% of property or critical infrastructure being severely damaged, and limited permanent damage to transportation, infrastructure, or the economy.

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**Impact**

An ash fall event like the one experienced at Kodiak Island in 1902 would undoubtedly be devastating to the SBCFSA by straining its resources; especially if other hub communities are also significantly affected by a volcanic eruption.

An eruption of significant size in southcentral Alaska will certainly affect air, land, and rail routes, which in turn affects the entire state. Humans would likely experience respiratory problems from airborne ash, personal injury, and potential residential displacement or lack of shelter with general property damage (electronics and unprotected machinery), structural damage from ash loading, state/regional transportation interruptions, loss of commerce, as well as water supply contamination.

These impacts can range from inconvenience – a few days with no transportation capability; to disastrous – heavy, debilitating ash fall throughout the state, forcing the SBCFSA to be completely self-sufficient.

**Probability of Future Events**

Geologists can make general forecasts of long-term activity associated with individual volcanoes by carefully analyzing past activity, but these are on the order of trends and likelihood, rather than specific events or timelines. Short-range forecasts are often possible with greater accuracy. Several signs of increasing activity can indicate that an eruption will follow within weeks or months. Magma moving upward into a volcano often causes a significant increase in small, localized earthquakes, and measurable carbon dioxide and compounds of sulfur and chlorine emissions increases. Shifts in magma depth and location can cause ground level elevation changes that can be detected through ground instrumentation or remote sensing.

Based on the criteria identified in Table 5-2 and information presented in the SHMP, it is “Likely” for a volcanic eruption to occur within the next three years. Event has up to 1 in 3 years chance of occurring (1/3=33 percent). History of events is greater than 20percent but less than or equal to 33 percent likely per year. Vulnerability depends on the type of activity and current weather, especially wind patterns.

**5.3.7 Weather (Severe)****5.3.7.1 Nature**

Severe weather occur throughout Alaska with extremes experienced by the SBCFSA that includes thunderstorms, lightning, hail, heavy and drifting snow, freezing rain/ice storm, extreme cold, and high winds. The SBCFSA experiences periodic severe weather events such as the following:

- **Heavy Rain** occurs rather frequently over the coastal areas along the Bering Sea and the Gulf of Alaska. Heavy rain is a severe threat to the SBCFSA as it usually results in dangerous flooding.
- **Heavy Snow** generally means snowfall accumulating to four inches or more in depth in 12 hours or less or six inches or more in depth in 24 hours or less.

- 
- **Drifting Snow** is the uneven distribution of snowfall and snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.
  - **Freezing Rain and Ice Storms** occur when rain or drizzle freezes on surfaces, accumulating 12 inches in less than 24 hours. Ice accumulations can damage trees, utility poles, and communication towers which disrupts transportation, power, and communications.
  - **Extreme Cold** is the definition of extreme cold varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered “extreme”. In Alaska, extreme cold usually involves temperatures between -20 to -50°F. Excessive cold may accompany winter storms, be left in their wake, or can occur without storm activity. Extreme cold accompanied by wind exacerbates exposure injuries such as frostbite and hypothermia.
  - **High Winds** occur in Alaska when there are winter low-pressure systems in the North Pacific Ocean and the Gulf of Alaska. Alaska’s high wind can equal hurricane force but fall under a different classification because they are not cyclonic nor possess other hurricane characteristics. In Alaska, high winds (winds in excess of 60 mph) occur rather frequently over the coastal areas along the Bering Sea and the Gulf of Alaska. High winds are a severe threat to Quinhagak.

Strong winds occasionally occur over the interior due to strong pressure differences, especially where influenced by mountainous terrain, but the windiest places in Alaska are generally along the coastlines.

(NWS 2011)

- **Winter Storms** include a variety of phenomena described above and as previously stated may include several components; wind, snow, and ice storms. Ice storms, which include freezing rain, sleet, and hail, can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power outages, and personal injury. Ice storms result in the accumulation of ice from freezing rain, which coats every surface it falls on with a glaze of ice. Freezing rain is most commonly found in a narrow band on the cold side of a warm front, where surface temperatures are at or just below freezing temperatures. Typically, ice crystals high in the atmosphere grow by collecting water vapor molecules, which are sometimes supplied by evaporating cloud droplets. As the crystals fall, they encounter a layer of warm air where they particles melt and collapse into raindrops. As the raindrops approach the ground, they encounter a layer of cold air and cool to temperatures below freezing. However, since the cold layer is so shallow, the drops themselves do not freeze, but rather, are supercooled, that is, in liquid state at below-freezing temperature. These supercooled raindrops freeze on contact when they strike the ground or other cold surfaces.

Snowstorms happen when a mass of very cold air moves away from the polar region. As the mass collides with a warm air mass, the warm air rises quickly and the cold air cuts underneath it. This causes a huge cloud bank to form and as the ice crystals within the cloud collide, snow is formed. Snow will only fall from the cloud if the temperature of the air between the bottom of the cloud and the ground is below 40 degrees Fahrenheit. A



higher temperature will cause the snowflakes to melt as they fall through the air, turning them into rain or sleet. Similar to ice storms, the effects from a snowstorm can disturb a community for weeks or even months. The combination of heavy snowfall, high winds and cold temperatures pose potential danger by causing prolonged power outages, automobile accidents and transportation delays, creating dangerous walkways, and through direct damage to buildings, pipes, livestock, crops and other vegetation. Buildings and trees can also collapse under the weight of heavy snow.

Winter storm floods are discussed in Section 5.3.3.

### 5.3.7.2 History

The SBCFSA is continually impacted by severe weather either as severe rain or snow. Severe rain accumulation results typically result in a Governor's Disaster declaration. DHS&EM's Disaster Cost Index records the following severe weather disaster events which affected the area:

**83. Omega Block Disaster, January 28, 1989 & FEMA declared (DR-00826) on May 10, 1989:** *The Governor declared a statewide disaster to provide emergency relief to communities suffering adverse effects of a record breaking cold spell, with temperatures as low as -85 degrees. The State conducted a wide variety of emergency actions, which included: emergency repairs to maintain & prevent damage to water, sewer & electrical systems, emergency resupply of essential fuels & food, & DOT/PF support in maintaining access to isolated communities.*

**112. Snow & Ice Removal, 1990:** *Because of record snowfalls in Southcentral Alaska, the Legislature appropriated a special grant to local governments affected in order to supplement normal snow and ice removal budgets. The Legislature directed that funds be managed by the Division of Homeland Security and Emergency Management. No Disaster Declaration occurred.*

**119. Hazard Mitigation Cold Weather, 1990:** *The Presidential Declaration of Major Disaster for the Omega Block cold spell of January and February 1989 authorized federal funds for mitigation of cold weather damage in future events. The Governor's declaration of disaster provided the State matching funds required for obtaining and using this federal money.*

*(New numbering system began in 1995 to begin with event year)*

**00-191 Central Gulf Coast Storm declared February 4, 2000 by Governor Murkowski Murkowski then FEMA declared (DR-1316) on February 17, 2000:** *On Feb 4 2000, the Governor declared a disaster due to high impact weather events throughout an extensive area of the state. The State began responding to the incident since the beginning of December 21, 1999. The declaration was expanded on February 8 to include City of Whittier, City of Valdez, Kenai Peninsula Borough, Matanuska-Susitna Borough and the Municipality of Anchorage. On February 17, 2000, President Bill Clinton determined the event disaster warranted a major disaster declaration under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288 as amended ("the Stafford Act). On March 17, 2000, the Governor again expanded the disaster area and declared that a condition of disaster exists in Aleutians East, Bristol Bay, Denali, Fairbanks North Star, Kodiak Island, and Lake and Peninsula Boroughs and the census areas of Dillingham, Bethel, Wade Hampton, and Southeast Fairbanks, which is of sufficient severity and magnitude to warrant a disaster declaration. Effective*

on April 4, 2000, Amendment No. 2 to the Notice of a Major Disaster Declaration, the Director of FEMA included the expanded area in the presidential declaration. Public Assistance, for 64 applicants with 251 PW's, totaled \$12.8 million. Hazard Mitigation totaled \$2 million. The total for this disaster is \$15.66 million.

**03-204 Southcentral Windstorm (AK-DR-1461) Declared March 28, 2003 by Governor Murkowski then FEMA declared April 26, 2003:** A major windstorm with sustained and severe winds that exceeded 100 mph occurred between March 6 and March 14, 2003. The windstorm affected the Matanuska-Susitna Borough, the Municipality of Anchorage, and the Kenai Peninsula Borough. Severe damage occurred to numerous personal residences and local businesses; extensive damage occurred to public facilities (i.e. schools, libraries, community centers, airports, buildings and utilities) in the Matanuska-Susitna Borough, Municipality of Anchorage and the Kenai Peninsula Borough. Although damages were widespread, Anchorage facilities received the most damages. Federal Disaster Assistance for Debris Removal, Emergency Protective Measures and all Permanent Work categories were approved under the Public Assistance Program. FEMA also authorized 404 Mitigation funding and individual assistance under the Individual and Household Program. Individual Assistance totaled \$48K. Public Assistance totaled \$2.5 million for 24 potential applicants with 87 PW's. Hazard Mitigation totaled \$532K. The total for this disaster is \$3.47 million. (closeout data: \$2.8 million total paid out (includes \$220,000 mitigation and \$47,600 State IA//posted 7/29/08 rbs).

**06-217 2006 South Central Storm (AK-06-217) declared March 13, 2006 by Governor Murkowski:** Beginning on February 5, 2006 and continuing through February 11, 2006, a series of strong winter storms with high winds, heavy snow, and freezing rain occurred in the City of Seward and surrounding areas of the Kenai Peninsula Borough in South Central Alaska, causing avalanches that severely damaged power lines and other infrastructures, blocked roads, and threatened further damages. As a result of the disaster, there was severe damage to power transmission and distribution lines supplying the City of Seward and surrounding areas; disruption of normal power supply requiring the prolonged use of emergency backup generators with extraordinary expensive operation costs; and damage and threat to public and private property as a result of power disruption. On March 13, 2006, a letter was submitted to request a federal time extension of 30 days. As of 3/20/06, the decision is pending. Decision made not to seek Federal assistance. Current estimated cost for repairs is \$1,254,730; however, this does not include the ongoing cost of line repair. No federal declaration was sought; therefore, the State is limited to public assistance only (no HM or IA). As of 3/20/06, only the City of Seward and Sealife Center are applicants. Disaster administratively closed out and letter sent to applicants on 6/29/07. (7 Nov 08 update)--Formal closeout letter to DMVA/DAS was dated 6 Nov 08 (funds authorized = \$1,465,321; funds expended = \$1,306,509.72; funds lapsed to DFR = \$158,811.28. (7Nov08, R.B.Stewart)

**07-221 2006 October Southern Alaska Storm (AK-07-221) declared October 14, 2006 by Governor Murkowski FEMA declared (DR-1669) on December 8, 2006.** Beginning on October 8, 2006 and continuing through October 13, 2006, a strong large area of low pressure that developed in the Northern Pacific and moved into the Southwest area of the state, produced hurricane force winds throughout much of the state and heavy rains in the Southcentral and Northern Gulf coast areas, which resulted in severe flooding and wind damage and threats to life in the Southern part of the state, to include the Kenai Peninsula Borough including the Cities of Seward and Seldovia, the Chugach Rural



*Education Area including the City of Cordova and the City of Valdez, and the Copper River Rural Education Area including the Richardson Highway to the Glenallen and highways and drainages in the McCarthy areas. Initial total damages are estimated at \$557,415 with a public assistance estimate of \$456,855. Federal declaration was made December 2006 including assistance for Public Assistance and Hazard Mitigation but not including Individual Assistance. Revised State of Alaska Cost estimates are \$1,265,000 in Individual Assistance and \$38,241,826 in Public Assistance for a total cost of \$39,506,826. There is \$26,825,918 available from the Federal Highway Administration leaving a requested amount of \$13,948,999. A total of 10 individuals or households applied for assistance through the State's IA Temporary Housing program. Six eligible applicants received a total of \$93,611.21 for home replacement, major repair and mitigation, and/or for temporary housing accommodations. Each TH applicant involved extensive case management. The temporary housing program closed 3/10/2008.*

**09-230, 2009 Seward Storm Surge declared by Governor Parnell on December 31, 2009.** *On December 1, 2009 the City of Seward experienced a winter storm event that caused damage to the shoreline and an important roadway within the community. High winds, 3 plus inches of rainfall, and a 12.6 foot tide, caused extensive damage to the wave barrier along Lowell Point Road, the Seward Greenbelt area and the seawall at the Alaska Sea Life Center.*

**12-237, 2011 Kenai Peninsula Windstorm declared by Governor Parnell on December 12, 2011 then FEMA declared February 2, 2012 (DR-4054).** *On November 1, 12, and 15, 2011, a series of major windstorms caused widespread power outages threatening life and property. Power was disrupted to 17,300 homes and businesses. Local utilities, Homer Electric Association (HEA) and Chugach Electric employed several work crews to restore power to the area. Public Infrastructure, commercial property, and personal property damages were reported in the metropolitan areas and throughout the borough. DHS&EM received local declarations from the Kenai Peninsula Borough (KPB) requesting state disaster assistance to cover immediate response, public and individual costs and from the City of Seward through the KPB requesting State assistance.*

The Western Regional Climate Center (WRCC) provides weather data throughout the Pacific Northwest. The WRCC's SBCFSA's daily comparative average and extreme data are as follows:

Figure 5-22 provides average and extreme temperature data. As indicated on the graph, October 1986 had a maximum rainfall event with 15.05 inches. Other high accumulation year information for 2006, 2009, and 2012 were not available.

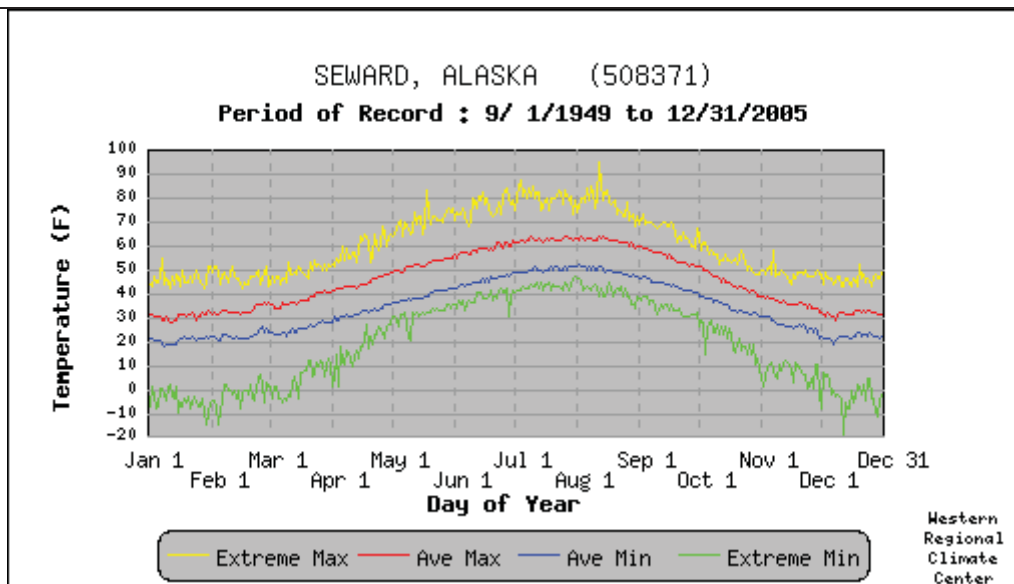


Figure 5-22 SBCFSA's Temperature Extremes (WRCC 2012)

Figure 5-23 displays the areas daily precipitation extremes.

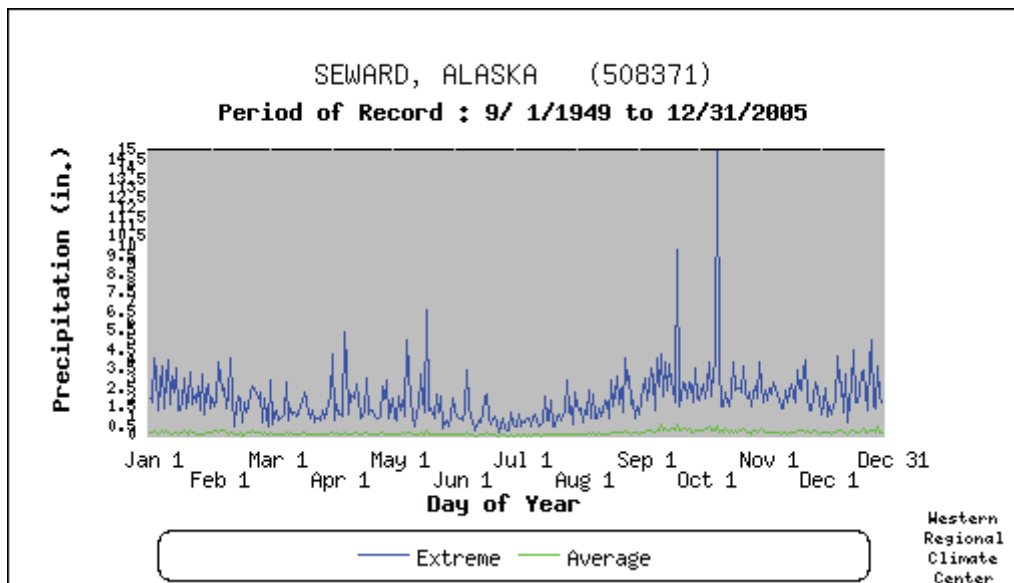


Figure 5-23 SBCFSA's Precipitation Extremes (NWS 2012)

Figure 5-24 displays the areas daily snowfall extremes.

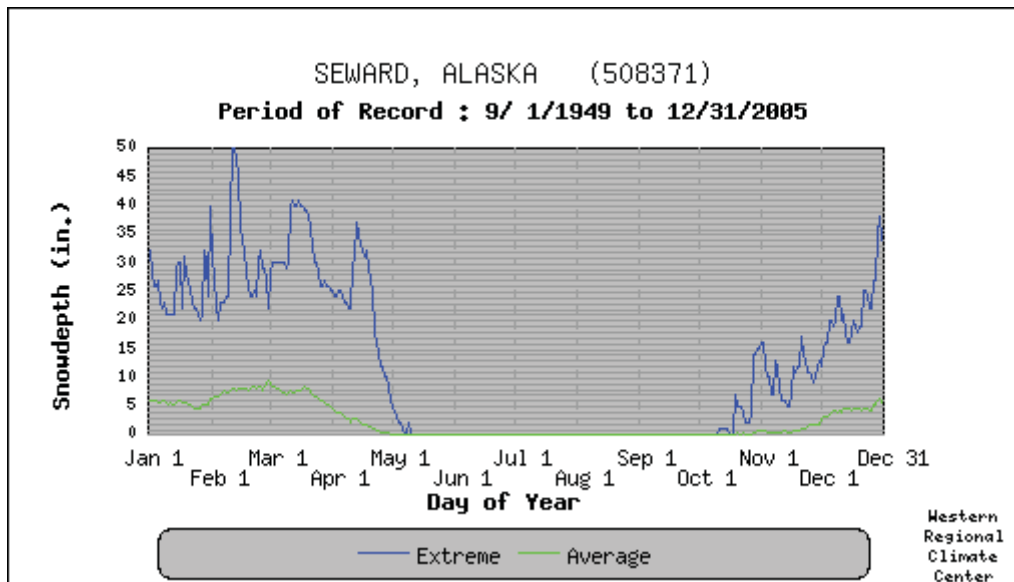


Figure 5-24 SSBCFSA's Snowfall Extremes (WRCC 2012)

### 5.3.7.3 Location, Extent, Impact, and Probability of Future Events

The City is continually impacted by severe weather as depicted in the University of Alaska Fairbanks' (UAF), Scenarios Network for Alaska & Arctic Planning (SNAP) provides the following (Figures 5-25 and 5-26) historical precipitation and temperature weather data:

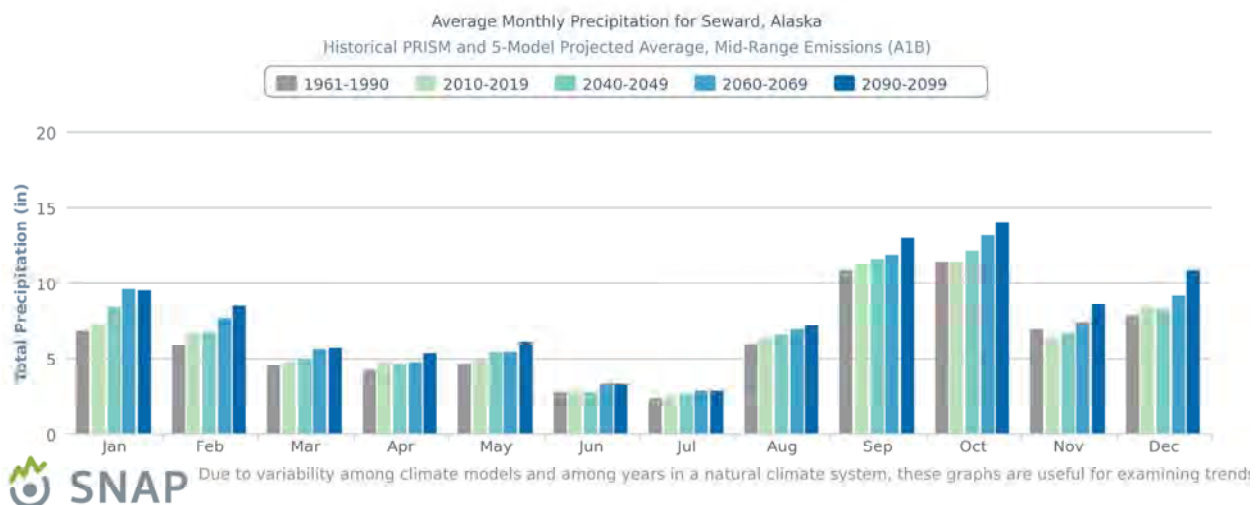
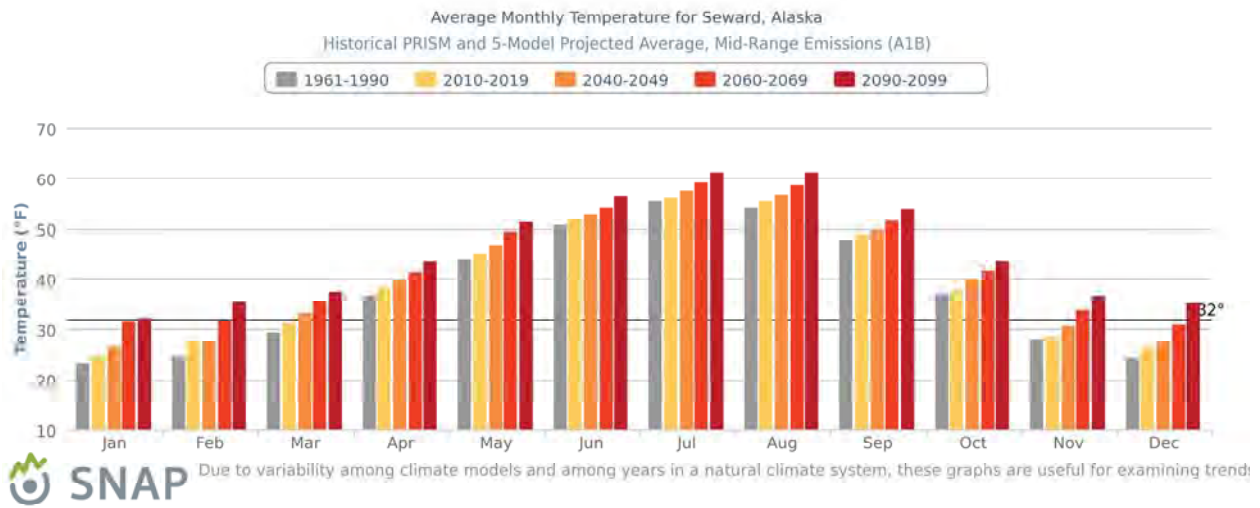


Figure 5-25 Historic and Predicted Precipitation (UAF 2012b)



**Figure 5-26 Historic and Predicted Temperature (UAF 2012b)**

Table 5-10 provides a sample list of 29 major storm events the National Weather Service identified for SBCFSA's Weather Zone. Each weather event may not have specifically impacted the SBCFSA but they are listed due to their close proximity to listed communities or by location within the identified zone.

**Table 5-10 Severe Weather Events**

Location	Date	Event Type and Magnitude
Seward	10/9/2006	Flood, High Wind: 73.6 mph (64 kts.) Damages: \$500K A strong storm in the north Pacific moved into the eastern Bering Sea Monday October 8th. This storm produced strong wind along and in advance of a strong weather front associated with the storm. Strong northwest wind occurred around the west side of this storm in the Eastern Aleutians. This storm had a strong tropical connection that pushed copious amounts of rain into the Prince William Sound area, Cook Inlet, the Susitna Valley, and the Copper River Basin. Along with the extremely heavy rainfall, very warm air resulted in excessive snow melt that contributed to the flooding. Flooding along the Richardson Highway resulted in road wash outs through Keystone Canyon and also in the Copper River Basin at Squirrel Creek and at the Tonsina Lodge. Flooding also occurred in Cordova and Seward resulting in road wash outs in both those communities.
Western (Wrn) Prince William Sound (PWS) & Kenai Mountains (Mtns)	12/22-27/2006	Blizzard A strong low in the northern Gulf of Alaska produced strong north to east wind and areas of snow over the south central region of the state and northern Prince William Sound. This storm produced heavy snow in the northern sound and moderate snow fall across the Kenai Peninsula into the Susitna Valley.
Wrn PWS Snd & Kenai Mtns	1/3/2007	Blizzard A storm moved toward Prince William Sound generating strong wind and snow in the western Sound.
Wrn PWS Snd & Kenai Mtns	1/14/2007	Blizzard, Wind Gusts: 40 mph (34.7 kts.) A low pressure system moved into Prince William Sound bringing snow to the eastern Kenai Peninsula. A moderately

Table 5-10 Severe Weather Events

Location	Date	Event Type and Magnitude
		strong pressure gradient on the west side of the low caused gusty winds especially in and below mountain passes. Gusts to 40 mph reduced visibility to a quarter mile at times along the eastern Kenai Peninsula.
Wrn PWS Snd & Kenai Mtns	1/16/2007	Blizzard A strong low in the Gulf of Alaska produced snow and strong wind in Portage Valley resulting in a blizzard.
Wrn PWS Snd & Kenai Mtns	3/6/2007	Blizzard A strong low moved into Prince William Sound producing strong wind and snow resulting in a Blizzard. A volunteer weather spotter report wind gusting to near 80 mph.
Wrn PWS Snd & Kenai Mtns	3/20-23/2007	Blizzard An intense storm moved into the southwest Gulf of Alaska Tuesday March 20th. Strong channelled wind along with moderate snow fall in Portage Valley produced a blizzard in the valley.
Wrn PWS Snd & Kenai Mtns	4/7/2007	High Wind: 78 mph (68 kts.) An intense area of low pressure over western Alaska combined with rapidly rising pressure in the eastern Gulf of Alaska produced the typically high wind through Portage Valley and along Turnagain Arm.
Moose Pass	6/21/2007	Hail: 0.75 inches Severe thunderstorms developed on the interior Kenai Peninsula. Spotter reports were of hail 1/2 to 3/4 inch and heavy rain with these Thunderstorms.
Wrn PWS Snd & Kenai Mtns	10/25/2007	High Wind: 84 mph (73 kts.) A 996MB Low was centered near the southern tip of the Kenai Peninsula. This storm generated gale force winds across the northern gulf of Alaska and warning level winds over portions of the northern gulf coast through Portage pass and along Turnagain Arm. Rain and winds began across the area on the morning of October 25th. The Portage ASOS recorded periods of heavy rain and winds gusting in the upper teens to upper 20's during the morning hours...with gusts reaching into the upper 40's by afternoon. Winds and rain continued across the zone with gusts increasing through late afternoon. At 5:53 PM, a peak wind of 73KT registered on the ASOS. Winds gradually diminished thereafter.
Wrn PWS Snd & Kenai Mtns	11/8/2007	High Wind: 75.9 mph (66 kts.) A strong low in the Bering Sea and the associated front produced strong wind through the mountain gaps of the Kenai Peninsula. The peak gusts were 85 mph along the hillside and 76 mph in Portage Valley.
Wrn PWS Snd & Kenai Mtns	11/20-22/2007	High Wind: 89.7 mph (78 kts.) A very strong 966MB surface low moved into the western Gulf of Alaska and positioned itself just to the west of Kodiak Island. The surface gradients were oriented in a Northwest to Southeast manner which provided maximum funneling of winds through the Chugach Mountains of western Prince William Sound. The typical gap win through Portage Pass produce gusts to 90 mph in Portage Valley. High winds were generated in conjunction with the strong surface low and channeled terrain of western Prince William sound for the community of Whittier and in Portage Valley. Winds first reached 75 mph at 219 PM in Portage Valley and

**Table 5-10 Severe Weather Events**

Location	Date	Event Type and Magnitude
		frequently gusted to 75 mph or greater through 1 AM November 21st. Whittier reported wind gusts to 72 mph during this storm.
Wrn PWS Snd & Kenai Mtns	12/4/2007	Blizzard A storm in the Gulf of Alaska brought snow and wind to Northern Prince William Sound in Thompson Pass to Keystone Canyon and in Portage Valley. Heavy snow fell across the region with 17 inches of snow reported in Thompson Pass.
Wrn PWS Snd & Kenai Mtns	12/24/2007	Blizzard A strong storm moved across Kodiak Island December 24th to the northern Gulf of Alaska. Snow fell in advance of the low across Kodiak island spreading to the southern Kenai Peninsula. Strong wind associated with this storm combined with the snow to produce blizzard conditions across lake Iliamna followed by blizzard conditions across Kodiak island. Heavy snow fell over the southern Kenai Peninsula to Portage pass. The strong wind hit those areas producing blizzard conditions in the pass and along Turnagain Arm.
Wrn PWS Snd & Kenai Mtns	2/16/2008	Blizzard A weather system and associated front moved onshore from the Gulf of Alaska toward Seward, bringing high winds and blizzard conditions to the Eastern Kenai Peninsula and Western Prince William Sound.
Wrn PWS Snd & Kenai Mtns	1/14/2009	High Wind: 85 mph (74 kts.) A series of intense tropically connected storms moved into the eastern Bering Sea beginning January 13th. The storms pushed the warm tropical air over the existing deep arctic air that had been over Alaska since the end of December 2008. High wind, snow, and freezing rain occurred throughout the south central and southwest regions of Alaska while strong north wind and snow produced blizzard conditions in the Pribilof Islands. Wind at higher elevations of the Chugach Mountains exceeded 120 mph. The upper hillside of the Anchorage area had several spotter reports of wind around 110 mph and wind reached 50 mph in east Anchorage. Freezing rain created chaos across the south central region on the 14th and 15th resulting in many vehicles sliding off the road and numerous roll over accidents. Windows were blown out of a local McDonald's and some vehicles. The rapid warming combined with heavy rain resulted in localized flooding in the Anchorage area, Valdez and Girdwood.
Wrn PWS Snd & Kenai Mtns	1/16/2009	High Wind: 64 mph (64 kts.) Damages, \$2K A series of intense tropically connected storms moved into the eastern Bering Sea beginning January 13th. The storms pushed the warm tropical air over the existing deep arctic air that had been over Alaska since the end of December 2008. High wind, snow, and freezing rain occurred throughout the south central and southwest regions of Alaska while strong north wind and snow produced blizzard conditions in the Pribilof Islands. Wind at higher elevations of the Chugach Mountains exceeded 120 mph. The upper hillside of the Anchorage area had several spotter reports of wind around 110 mph and wind reached 50 mph in east Anchorage. Freezing rain created chaos across the south central region on the 14th and 15th resulting in many vehicles sliding off the road and numerous rollover accidents. Windows were blown out of a local McDonald's and some vehicles. The rapid warming combined with heavy rain resulted in localized flooding in the Anchorage area, Valdez and



Table 5-10 Severe Weather Events

Location	Date	Event Type and Magnitude
		Girdwood.
Wrn PWS Snd & Kenai Mtns	3/16/2009	Blizzard Strong north wind and snow produced blizzard conditions in Turnagain Pass to Seward.
Wrn PWS Snd & Kenai Mtns	3/25/2009	Blizzard A strong low south of the Alaska Peninsula produced strong wind and snow across the eastern Aleutians, Alaska Peninsula, Bristol Bay area and Kuskokwim Delta. The front associated with this storm created high wind and dumped around 2 feet of snow through Portage Valley into Turnagain Pass that resulted in a blizzard.
Wrn PWS Snd & Kenai Mtns	3/28/2009	Blizzard An intense storm moved into the Eastern Bering Sea Saturday. This storm packed high wind and snow as it moved across the Alaska Peninsula to the Bering Sea coast. Strong wind peaked at 100 KT at Saint George in the midst of the Blizzard on the 28th. The strong wind moved into south central Alaska Saturday night and Sunday along with moderate to heavy snow fall. Whittier reported 2 to 2.5 feet of snow with this event. Portage Valley experienced high wind and heavy snow resulting in a white out blizzard.
Wrn PWS Snd & Kenai Mtns	4/9/2009	Blizzard A storm moved from the north Pacific across the Aleutians to south of the Pribilof Islands to southwest of Kodiak Island. Blizzard conditions occurred in the western Aleutians on the 8th then in the Pribilof Islands on the 9th. The front associated with this storm produced snow in the Portage Valley area along with strong wind that resulted in a blizzard.
Wrn PWS Snd & Kenai Mtns	7/21/2009	High Wind: 71.3 mph (62 kts.) An unseasonably intense 974 MB storm for July moved into the Bristol Bay area on the 21st of July. The associated front pushed across south central Alaska producing strong wind across the Chugach Mountains through Portage Pass.
Seward, Lowell Point	7/30/2009	Flood, Heavy Rain, Damages: \$50K A tropically connected storm resulted in heavy rain over the Kenai Peninsula that produced flooding in the Seward area. The approach to the bridge to Lowell Point washed out and a land slide at a tunnel at mile 11 shut down the Alaska Railroad. River gages in Seward exceeded flood stage.
Wrn PWS Snd & Kenai Mtns, Lowell Point	11/29-30/2009	Blizzard, High Wind: 89.7 mph (78 kts.) Damages: \$50K A major Bering sea storm and the associated front that extended to the Gulf of Alaska produced high winds across the Aleutians and blizzard conditions from the Pribilof Islands to the Bering Sea coast and high wind heavy snow and blizzard conditions across south central Alaska and Prince William Sound. High surf caused extensive damage along Lowell Point road and the shore line around Seward and the sea wall near the Sea Life Center were damaged.
Wrn PWS Snd & Kenai Mtns	2/8/2010	Blizzard A strong north Pacific storm moved to the eastern Aleutians. This storm produced blizzards across the central Aleutians to the Pribilof Islands and along the Bering Sea coast of the Kuskokwim Delta. This storm also produced high wind across Kodiak Island and pushed snow and strong wind into Portage Valley.

**Table 5-10 Severe Weather Events**

Location	Date	Event Type and Magnitude
Wrn PWS Snd & Kenai Mtns	3/5/2010	Blizzard, High Wind: 80.5 mph (70 kts.) An intense storm caused high wind and blizzard conditions from the Central Aleutians across the Alaska Peninsula to the Pribilof Islands and across South Central Alaska and Prince William Sound.
Wrn PWS Snd & Kenai Mtns	5/11/2010	High Wind: 77 mph (67 kts.) A strong storm moved into Bristol Bay on May 11th. The associated front moved to along the North Gulf Coast producing the typical high wind through the gaps and across the Chugach Mountains. Peak gusts to 77 mph were observed at the Portage visitor center and to 81 mph along Turnagain Arm.
Seward	10/2/2010	Flood Flooding of the Resurrection River. Light rain in Seward on Sept 29. Light rain through Sept 30, with moderate and even heavy rain Oct 1 and Oct 2. Heavy rainfall along the Eastern Kenai Mountains caused the Resurrection River near Seward, Alaska to reach flood stage. It was over flood stage from Oct 2 at 7 AM ADT through 4 PM ADT Oct 2nd. The crest was at 18.17 ft, which is .67 ft over flood stage. In addition, the Seward Emergency Manager reported a mudslide on mile 19 with only one lane open. Water was up to the road at Salmon Creek road and Nash road. There was also an unconfirmed report of water over the bridge near the prison.
Wrn PWS Snd & Kenai Mtns	11/22/2010	Ice Storm A storm in the Bering Sea resulted in freezing rain that deposited over one quarter inch of ice across portions of south central Alaska. Freezing rain below warning criteria also fell across the Copper River Basin and the western Kenai Peninsula and isolated portions of northern Prince William Sound.
Wrn PWS Snd & Kenai Mtns	12/3/2010	Blizzard Strong wind combined with snow produced blizzard conditions across portions of southwest that then spread into the Cook Inlet region and Prince William Sound.
Wrn PWS Snd & Kenai Mtns	12/22/2010	High Wind: 77 mph (67 kts.) A strong Gulf of Alaska storm coupled with deep cold arctic air over interior Alaska produced strong north winds through the Chugach Mountains.
Wrn PWS Snd & Kenai Mtns	1/3/2011	Blizzard, High Wind: 74.8 mph (65 kts.) A strong low in Bristol Bay produced wind and snow resulting in blizzard conditions in the Kuskokwim Delta. This same storm also produced strong wind through Portage Pass.
Wrn PWS Snd & Kenai Mtns	2/13/2011	Blizzard A strong storm in the Gulf of Alaska produced high winds and snow with blowing snow in the northern and western portions of Prince William Sound as well as strong wind out of the Copper River Delta.
Wrn PWS Snd & Kenai Mtns	4/7/2011	Blizzard, High Wind: 65.5 mph (57 kts.) A large intense Bering Sea storm impacted Aleutian Islands to south central Alaska April 5th through the 7th. Wind gust reached 94 mph along Turnagain Arm and ranged from 72 to 78 mph along the Aleutian Islands... Blizzard conditions also occurred in the Chugach Mountains through Thompson Pass.
Wrn PWS Snd & Kenai Mtns	10/25/2011	High Wind: 69 mph (60 kts.) This storm produced hurricane force wind gust across the Alaska Peninsula to Kodiak Island and across the Kenai

**Table 5-10 Severe Weather Events**

Location	Date	Event Type and Magnitude
		Peninsula and eastern Prince William Sound. The resulting rough surf in Whittier washed 3 feet of the break water from the harbor area. High wind in eastern prince William Sound flipped a small plane over in the community of Ellamar.
Wrn PWS Snd & Kenai Mtns	11/3/2011	Blizzard, A strong storm moved into the eastern Bering Sea producing strong wind and blizzard conditions from the Bering Sea Coast across the Alaska Peninsula into the south central region of Alaska.
Wrn PWS Snd & Kenai Mtns	12/18-22/2011	Blizzard, High Wind: 100 mph (87 kts.) Hgh wind in south central region of Alaska and Prince William Sound along with the high wind, snow and blowing snow in Portage Valley and Thompson Pass produced blizzard conditions.
Wrn PWS Snd & Kenai Mtns	1/10/2012	Blizzard The blizzard conditions and an avalanche forced the Seward highway to be closed the night of the 10th through the afternoon of the 11th.

### Location

Winter storms occur every year in the SBCFSA and the entire area is equally vulnerable to the risk of a winter storm event with the area receiving an average annual snowfall of about 33 inches, an average precipitation of 16 inches; most falling in the form of snow. Severe winter storms statewide have a recurrence interval of about every 13 years. Based on the recurrence interval, the probability of a severe winter storm occurring in the Planning Area is with all critical facilities and residences within the SBCFSA are highly vulnerable to the effects of a severe winter storm.

### Extent

The entire SBCFSA is equally vulnerable to the severe weather effects with residents experiencing severe storm conditions with heavy snow depths; wind speeds exceeding 100 mph; and extreme low temperatures that reach -34°F.

Based on past severe weather events and the criteria identified in Table 5-3, the extent of severe weather in the SBCFSA are considered limited where injuries do not result in permanent disability, complete critical facility shutdown would be unlikely for more than one week, and less than 10 percent of property would be severely damaged.

### Impact

The intensity, location, and the land's topography influence the impact of severe weather conditions on a community.

Heavy snow can immobilize a community by bringing transportation to a halt. Until the snow can be removed, airports and roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage light aircraft and sink small boats. A quick thaw after a heavy snow can cause substantial flooding.

The cost of snow removal, repairing damages, and the loss of business can have severe economic impacts on cities and towns.

Injuries and deaths related to heavy snow usually occur as a result of vehicle and or snow machine accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Extreme cold can also bring transportation to a halt. Aircraft may be grounded due to extreme cold and ice fog conditions, cutting off access as well as the flow of supplies to communities. Long cold spells can cause rivers to freeze, disrupting shipping and increasing the likelihood of ice jams and associated flooding.

Extreme cold also interferes with the proper community infrastructure functions by causing fuel to congeal in storage tanks and supply lines, stopping electric generation. Without electricity, heaters and furnaces do not work, causing water and sewer pipes to freeze or rupture. If extreme cold conditions are combined with low or no snow cover, the ground's frost depth can increase, disturbing buried pipes. The greatest danger from extreme cold is its effect on people. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, and carbon monoxide poisoning is possible as people use supplemental heating devices.

### **Probability of Future Events**

Based on previous occurrences and the criteria identified in Table 5-2, it is likely a severe storm event will occur in the next three years (event has up to 1 in 3 years chance of occurring) as the history of events is greater than 20 percent but less than or equal to 33 percent likely per year.

## **5.3.8 Wildland-Urban Interface Fire**

### **5.3.8.1 Nature**

A wildland fire is a type of wildfire that spreads by rapidly consuming vegetation. It often begins unnoticed, spreads quickly, and is usually signaled by dense smoke that may be visible from great distances. Wildland fires can be caused by human activities (such as arson or campfires) or by natural events such as lightning. Wildland fires often occur in forests or other areas with ample vegetation and may quickly spread to threat the urban environment. Subsequently, these wildland fires can be classified as wildland-urban fires, interface, or inter-mix fires. Prescribed burns are typically set by Department of Forestry or other fire agencies to reduce the fire hazard in predetermined areas.

The following three factors contribute significantly to wildland-urban fire behavior and can be used to identify high fire hazard areas.

- **Topography** describes slope increases, which influences the wildland fire spread rate. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying fire spread behavior. However, ridge tops may mark the end of a fire spread since fire spreads more slowly or may even be unable to spread downhill.

- **Fuel** is the vegetation type and condition that plays a significant role a fire's occurrence and spread potential. Certain plant types are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel a fire (referred to as the "fuel load"). The ratio of living-to-dead plant matter is also important. The risk of fire is increased significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases. The fuel load continuity, both horizontally and vertically, is also an important factor.
- **Weather** is the most variable factor affecting wildland fire behavior. Temperature, humidity, wind, and lightning can affect ignition opportunities and fire spread potential. Extreme weather, such as high temperatures and low humidity, can lead to extreme fire activity. By contrast, cooling and higher humidity often signal reduced fire occurrence and easier containment.

Wildland-urban fire frequency and severity also depends on other hazards, such as lightning, drought, and insect infestations (such as spruce-bark beetle infestation damages). If not promptly controlled, wildland fires may grow into an emergency or disaster threatening population centers. Even small fires can be devastating. In addition to affecting people, wildland fires may severely affect livestock, pets, wildlife, and fish stocks. Such events may require emergency water, food, evacuation, and shelter.

The indirect effects of wildland-urban fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and increase river and stream siltation, thereby reducing flood potential, harming aquatic life, and degrading water quality. Vegetative striped lands also increase ground failure and debris flow hazards.

#### 5.3.8.2 History

The Bear Creek Fire Service Area (BCFSA) was established to provide services to those facilities outside of the City of Seward's Fire Department. The Bear Creek Volunteer Fire & EMS website states:

*"In 1976 a roadside food market caught fire during the night at mile 5.8 of the Seward Highway. A call for help dispatched Seward Volunteer Fire Department with one truck and several volunteers from their station 5 miles away.*

*After arriving on scene, the engine quickly emptied its 500 gallons of water. The apparatus wasn't equipped to draft water and could only refill through a hydrant. Unfortunately, there were no hydrants within 4 miles and the market burned to the ground.*

*After this disastrous fire, friends and neighbors of the roadside market united to establish the Bear Creek Fire Service Area. The doors officially opened in 1977, when the picture above was taken.*

*Since the original building was constructed, the department has expanded to include a second apparatus building and a pump shed" (BCFSA 2012).*

The BCFSA's responsibilities extend from Seward Highway mile 3.5 to Mile 8. The area contains mostly residential buildings, but several commercial businesses are also present along with the Alaska Railroad, National Park Service, State Parks, and the US Forest Service offices and infrastructure.

Wildland fires have not been documented within the boundaries of the SBCFSA; however, wildland fires have occurred in the SBCFSA's vicinity. The Alaska Interagency Coordination Center (AICC) lists only 31 wildland fires (Table 5-11) that occurred within 50 miles of the SBCFSA during the past 72 year historical period (i.e., from 1939 to 2012); none of which threatened residential properties, commercial or public locations.

**Table 5-11 Wildfire Locations Since 1939 Within 50 Miles Of SBCFSA**

Fire Name	Fire Year	Estimated Acres	Latitude	Longitude	Cause
Vfd Bear Creek # 1	2011	0.1	60.2463875	-149.3494415	Human-Railroad
Lowell Point St Park	2010	2	60.065834	-149.4411163	Human
Bear Lake	2009	0.1	60.1833344	-149.3500061	Human-Campfire
Harbor View	2007	0.5	60.25	-149.4166718	Human
Snow River	2005	0.1	60.26583	-149.3278	Lightning
Tonsina Creek Fire	2005	3	60.06667	-149.45	Human
Nash Road Fire	2003	0.1	60.13334	-149.35	Human
Clearcut 103	2003	0.1	60.15	-149.3833	Human
Seward Vfd #1	2001	1	60.13334	-149.4167	Other
Japanese Creek	2000	2	60.11666	-149.45	Children
Camelot	1998	0.1	60.13334	-149.3833	Warming Fire
Mile 4 Seward	1997	0.3	60.1500015	-149.4166718	Slash Burn
Old Nash #2	1997	0.5	60.1333351	-149.3999939	Slash Burn
White` S Mill	1997	0.1	60.1500015	-149.3999939	Land Clear
Old Nash Road	1997	0.1	60.1500015	-149.3999939	Land Clear
Camelot	1997	0.1	60.1333351	-149.3833313	Warming Fire
High School	1997	0.5	60.1166649	-149.4166718	Slash Burn
Resurrection	1996	0.1	60.1833344	-149.5833282	Human-Campfire
Seward Vfd #1	1996	0.2	60.1333351	-149.4499969	Children
Powder Road	1996	0.1	60.1833344	-149.5500031	Human-Campfire
Lost Lake Trail	1996	0.1	60.1833344	-149.4166718	Human-Campfire
Bear Creek Vfd	1996	0.1	60.2666664	-149.3333282	Other
Unnamed	1995	0.1	60.1833344	-149.5833282	Human-Campfire
Exit Glacier	1994	0.1	60.1666679	-149.5166626	Campfire
Exit Glacier	1993	5.5	60.1666679	-149.4833374	Other
Exit Glacier Ii	1993	0.1	60.1833344	-149.5166626	Debris
Exit Glacier Iii	1993	0.1	60.1833344	-149.5166626	Debris
Marathon	1992	0.1	60.0833321	-149.4499969	Not Identified
Power Pole	1992	0.1	60.2666664	-149.3666687	Not Identified
001 Iditarod Trail	1991	0.1	60.1666679	-149.3999939	Not Identified
Lost Lake Sub Div	1992	2	60.1833344	-149.3333282	Not Identified

(AICC 2012)



All SBCFSA fires appear to have occurred within the mountainous areas as depicted by Figure 5-27.

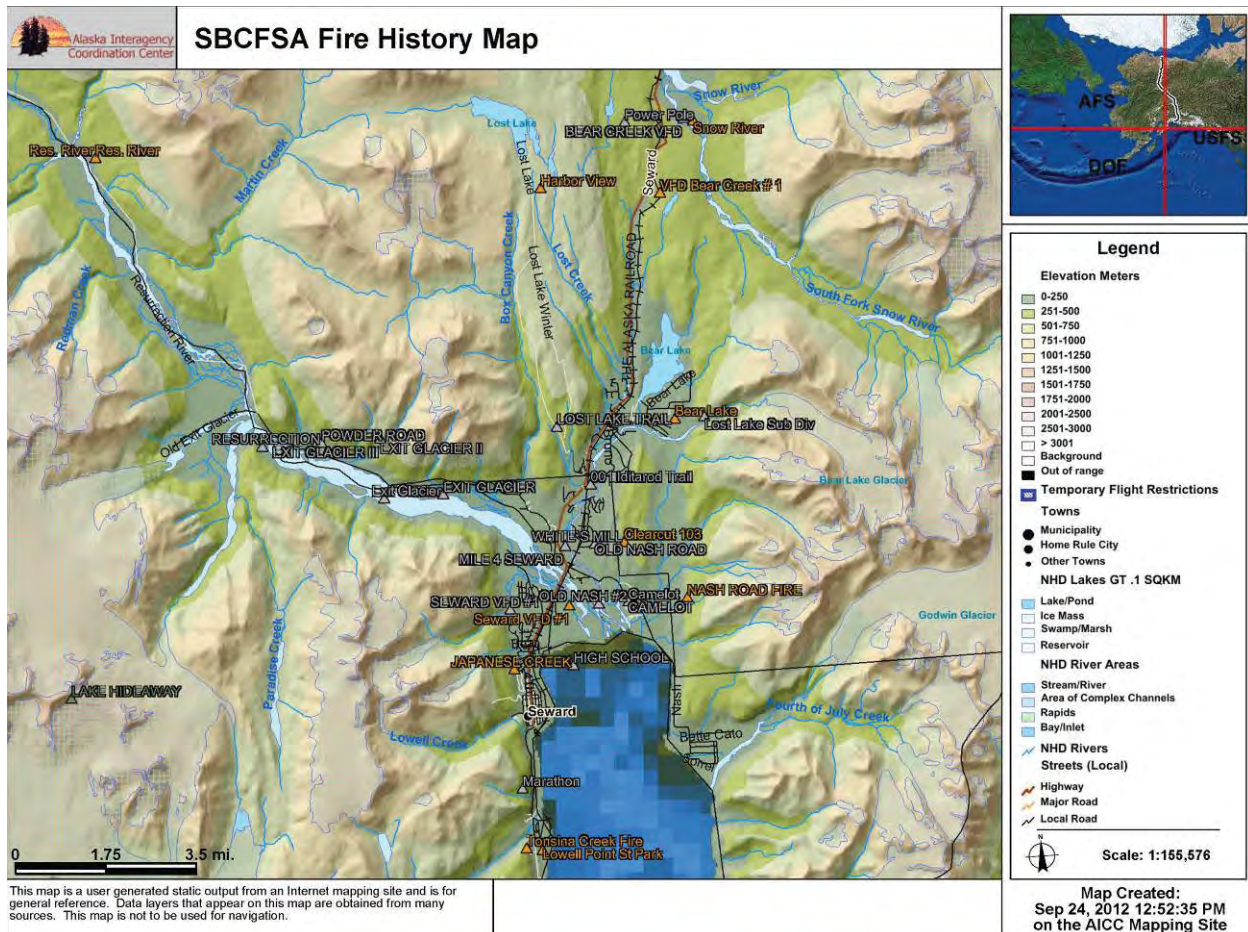


Figure 5-27 SBCFSA's Historical Wildfires (AICC 2012)

### 5.3.8.3 Location, Extent, Impact, and Probability of Future Events

#### Location

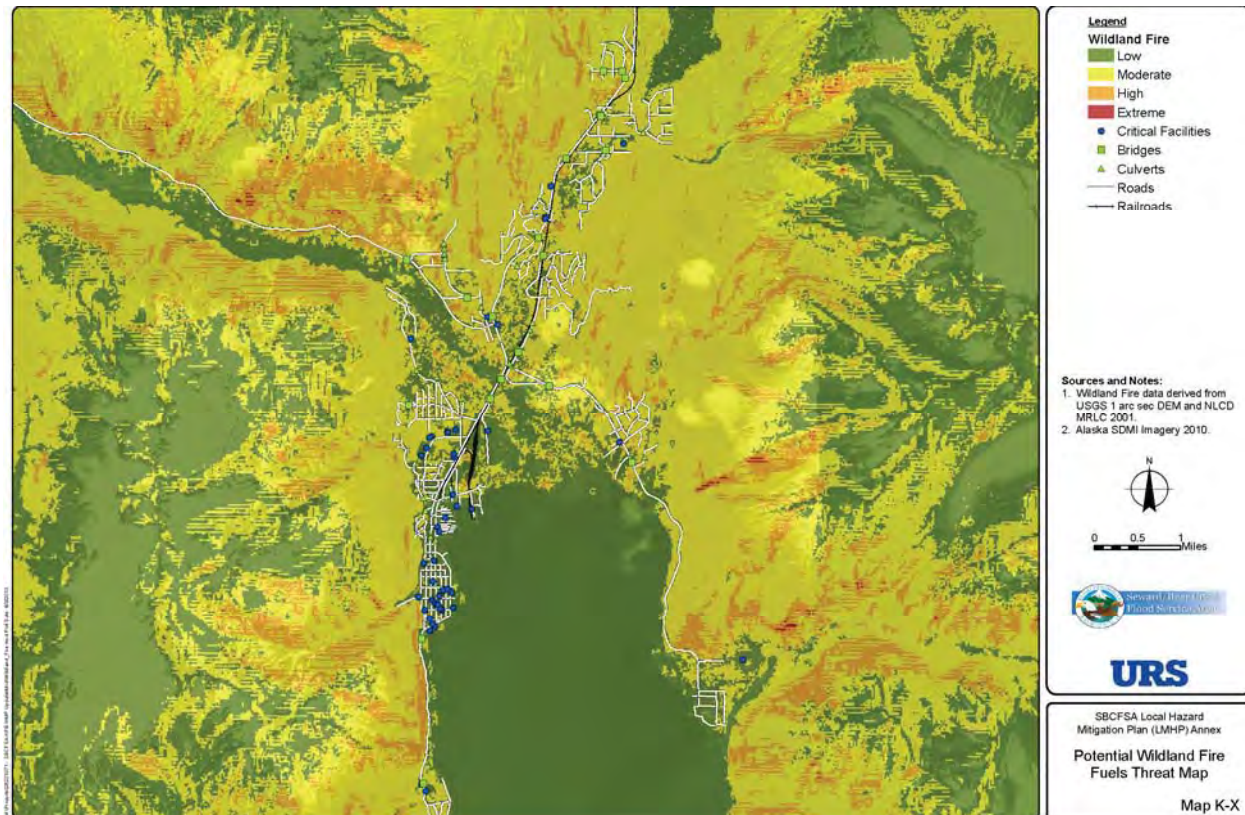
Under certain conditions wildland fires may occur in any area with fuel surrounding the SBCFSA. Since fuels data is not readily available, for the purposes of this plan, all areas outside SBCFSA limits are considered to be vulnerable to tundra/wildland fire impacts. Since 1939, 31 SBCFSA wildland fire events have occurred within 50 miles. (Figure 5-25).

#### Extent

Generally, fire vulnerability dramatically increases in the late summer and early fall as vegetation dries out, decreasing plant moisture content and increasing the ratio of dead fuel to living fuel. However, various other factors, including humidity, wind speed and direction, fuel load and fuel type, and topography can contribute to the intensity and spread of wildland fires. The common causes of wildland fires in Alaska include lightning strikes and human negligence.

Fuel determines how much energy the fire releases, how quickly the fire spreads, and how much effort is needed to contain the fire. Weather is the most variable factor. High temperatures and low humidity encourage fire activity while low temperatures and high humidity retard fire spread. Wind affects the speed and direction of fire spread. Topography directs air movement, which in-turn affects fire behavior. When the terrain funnels air, as happens in a canyon, it can lead to faster spreading. Fire also spreads up-slope faster than down-slope.

Figure 5-28 depicts USGS identified fuel types as a wildland fire potential location indicator.



**Figure 5-28 SBCFSA Wildland Fire Fuel Types**

Very few fires in the SBCFSA exceeded 1 acre. It is difficult to determine the average number of acres burned as the fires were vastly different for each of the 31 wildland fire events identified in Table 5-11 (DOF 2012). An average based on such diverse data would easily be overstated.

Based on the limited number of past wildland fire events and the criteria identified in Table 5-11, the magnitude and severity of impacts in the SBCFSA are considered negligible with minor injuries, there is potential for critical facilities to be shut down for less than 24 hours, less than 10 percent of property or critical infrastructure being severely damaged, and little to no permanent damage to transportation or infrastructure or the economy.

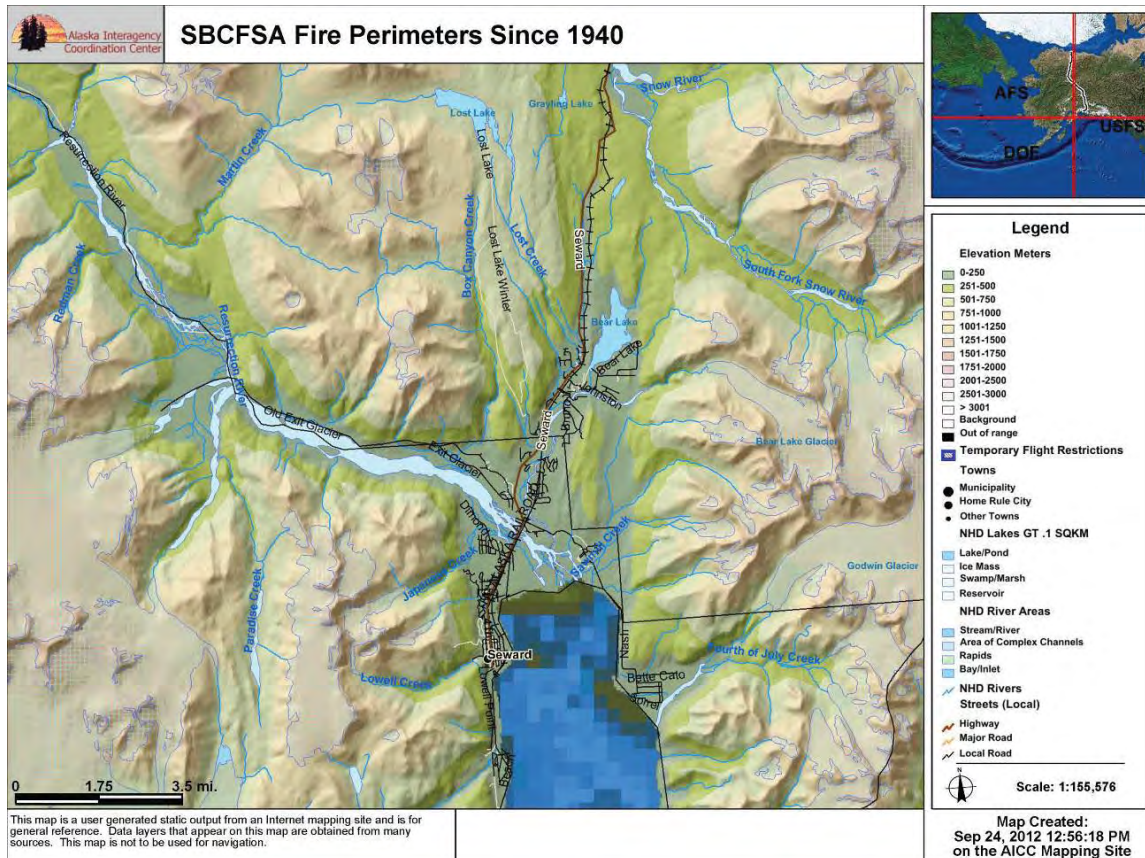
### Impact

Impacts of a wildland fire that interfaces with the population center of the SBCFSA could grow into an emergency or disaster if not properly controlled. A small fire can threaten lives and resources and destroy property. In addition to impacting people, wildland fires may severely



impact livestock, pets, wildlife, and fish stocks. Such events may require emergency watering and feeding, evacuation, and alternative shelter.

Figure 5-29 displays the largest wildland fire perimeters.



**Figure 5-29 SBCFSA Fire Perimeters Since 1940**

Indirect impacts of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thus increasing flood potential, harming aquatic life, and degrading water quality.

### Probability of Future Events

Fire is recognized as a critical feature of the natural history of many ecosystems. It is essential to maintain the biodiversity and long-term ecological health of the land. The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the fire management planning process and the full range of fire management activities is exercised in Alaska, to help achieve ecosystem sustainability, including its interrelated ecological, economic, and social consequences on firefighters, public safety and welfare; natural and cultural resources threatened; and the other values to be protected dictate the appropriate management response to the fire. In Alaska, and within 50 miles of the SBCFSA, the natural fire regime is characterized

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by a return interval of approximately 100 due to their dense timber and high susceptibility to spruce bark beetle infestation, vegetation, gently rolling topography, and coastal location.

Based on the history of wildland fires in the SBCFSA area and applying the criteria identified in Table 5-2, it is unlikely but possible a wildland-urban fire event will occur within in the next ten years. The event has up to 1 in 10 years chance of occurring and the history of events is less than or equal to 10 percent likely each year.

Based on climate change scenarios considered, average annual temperatures are expected to increase throughout the SBCFSA and surrounding areas. As a result, it is possible that the risk of fire could increase within the SBCFSA due to changing local conditions as a result of overall warmer temperatures. See Appendix I for additional information on climate change analysis and projected impacts on local hazards, including wildfires.

## 6.1 VULNERABILITY ANALYSIS OVERVIEW

A vulnerability analysis predicts the extent of exposure that may result from a hazard event of a given intensity in a given area. The analysis provides quantitative data that may be used to identify and prioritize potential mitigation measures by allowing communities to focus attention on areas with the greatest risk of damage. A vulnerability analysis is divided into eight steps:

1. Asset Inventory
2. Exposure Analysis For Current Assets
3. Repetitive Loss Properties
4. Land Use and Development Trends
5. Vulnerability Analysis Methodology
6. Data Limitations
7. Vulnerability Exposure Analysis
8. Future Development

This section provides an overview of the vulnerability analysis for current assets, and area future development initiatives.

DMA 2000 Recommendations
<p><b>Assessing Risk and Vulnerability, and Analyzing Development Trends</b></p> <p><b>§201.6(c)(2)(ii):</b> The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. <i>All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods.</i> The plan should describe vulnerability in terms of:</p> <p><b>§201.6(c)(2)(ii)(A):</b> The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;</p> <p><b>§201.6(c)(2)(ii)(B):</b> An estimate of the potential dollar losses to vulnerable structures identified in ... this section and a description of the methodology used to prepare the estimate.</p> <p><b>§201.6(c)(2)(ii)(C):</b> Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.</p> <p><b>§201.6(c)(2)(iii):</b> For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.</p>
1. REGULATION CHECKLIST
ELEMENT B. Risk Assessment, Assessing Vulnerability, Analyzing Development Trends
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))
B4. Does the Plan address NFIP insured structures within each jurisdiction that have been repetitively damaged by floods?
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))
Source: FEMA, October 2011.

The requirements for a vulnerability analysis as stipulated in DMA 2000 and its implementing regulations are described here.

- A summary of the community's vulnerability to each hazard that addresses the impact of each hazard on the community.
- Identification of the types and numbers of RL properties in the identified hazard areas.
- An identification of the types and numbers of existing vulnerable buildings, infrastructure, and critical facilities and, if possible, the types and numbers of vulnerable future development.
- Estimate of potential dollar losses to vulnerable structures and the methodology used to prepare the estimate.

Table 6-1 lists the SBCFSA population, building stock, and infrastructures' potential hazard vulnerability.

**Table 6-1 Vulnerability Overview**

Hazard	Area's Hazard Vulnerability			
	Percent of Jurisdiction's Geographic Area	Percent of Population	Percent of Building Stock	Percent of Critical Facilities and Utilities
Earthquake	100	100	100	100
Erosion	< 10	~ 10	< 10	< 5
Flood	< 10	~ 10	< 10	< 5
Ground Failure	< 5	< 5	< 5	< 5
Tsunami/Seiche	< 5	< 5	< 5	< 5
Volcano	100	100	100	100
Weather	100	100	100	100
Wildand Fire	100	100	100	100

## 6.2 LAND USE AND DEVELOPMENT TRENDS

Land use in the SBCFSA is predominately residential with limited area for commercial services. Community (or institutional) facilities are primarily located within Seward's City Limits. Suitable developable vacant land is in short supply within the boundaries of the SBCFSA due to steep mountain slopes, water bodies, and protected forests; open space and various hydrological bodies exist throughout the area.



The City of Seward's 2005 Comprehensive Development Plan (2020 Plan), Volume I, states in Section 3 the City's "Goals, Objectives, and Implementation Action Items", which include:

### **3.2 LAND USE**

*3.2.1 Promote residential and commercial development within the city of Seward and its vicinity in accordance with community values.*

*3.2.1.1 Manage land use to facilitate economic development while maintaining the historic, small town character of Seward.*

*3.2.1.2 Expand the opportunity for affordable, diverse, year-round housing through appropriate land use regulations.*

*3.2.1.3 Establish an attractive highway corridor from Mile 0 to 8.*

*3.2.2 Improve the capacity of the office of Community Development.*

*3.2.2.1 Maintain community vision through rigorous implementation and update of the Comprehensive and Land Use plans.*

*3.2.2.2 Improve the capability of the office of Community Development to develop land use and other maps in Seward.*

*3.2.3 Identify habitats such as eagle nesting and roosting areas, anadromous streams, wetlands and other wildlife areas.*

### **3.3 HOUSING**

*3.3.1 Encourage development of new housing in Seward.*

*3.3.1.1 Support a range of housing choices that meet the needs of people in various income and age groups.*

*3.3.1.2 Create incentives to provide land for housing development within the City of Seward.*

*3.3.1.3 Assess solutions to extend cost-effective utilities to home sites on land zoned for residential development.*

### **3.4 TRANSPORTATION**

*3.4.1 Update and use the Seward Transportation Plan (1999) as the primary tool to ensure safe and convenient transportation facilities.*

*3.4.1.1 Provide safe and efficient vehicular transportation facilities that meet the needs of the community.*

*3.4.1.2 Expand and maintain existing sidewalks and the multi-purpose trail system in order to provide safe, fully accessible, pedestrian pathways throughout the city.*

*3.4.1.3 Improve the usability of the state owned airport.*

*3.4.1.4 Support retention of the Alaska Marine Highway presence in Seward.*

### **3.5 PORT AND HARBOR DEVELOPMENT**

*3.5.1 Create a thriving port of Seward through harbor improvements, infrastructure expansion, and implementation of management plans.*

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*3.5.1.1 Encourage the growth and development of an efficient, functional small boat harbor that meets Seward's commercial and recreational needs.*

*3.5.1.2 Plan for adequate port infrastructure that will serve the needs of users in the main industrial/Alaska Railroad area and at the Seward Marine Industrial Center (SMIC), sustain an increase above the current activity, and attract new business...*

### **3.8 NATURAL HAZARDS**

*3.8.1 Promote community safety from natural disasters through mitigation measures and preparedness training.*

*3.8.1.1 Protect citizens from natural hazards by using appropriate land use policies and regulations.*

*3.8.1.2 Create sound public uses of potentially hazardous lands.*

*3.8.1.3 Mitigate flood hazards.*

*3.8.1.3 Mitigate flood hazards.*

*3.8.2 Plan and prepare for disasters.*

*(Seward City, 2005).*

The City of Seward 2020 Comprehensive Plan, Volume II (CSP 2005b) describes their current land use capability in Section 3.2.1. in the following way:

*In the developed part of Seward, most land is held privately, but the City of Seward,*

*Kenai Peninsula Borough, State of Alaska, and Alaska Railroad Corporation (ARRC) have developed substantial portions of public lands. The city, state and ARRC also own undeveloped lands within city limits.*

*Undeveloped city land is concentrated in the southwest part of town and along the northeastern side of Resurrection Bay. Large blocks of state land are located along the*

*Resurrection River and the western boundary of city land. The ARRC owns blocks in the harbor and industrial parts of town. These are strategic locations, which can influence the type of development that occurs in Seward.*

*The borough owns lands developed for the schools and the waste transfer facility while the state has parcels developed throughout town for AVTEC, the airport, and road maintenance facilities.*

The Kenai Peninsula Borough Comprehensive Plan (KPB 2005) describes the breakdown of land ownership (as of 2004) in Chapter 6 in the following figure (Figure 6-2):

**Land Ownership by Major and Minor Category  
2004**

Owner	Acres	Percent of Total
<b>FEDERAL</b>		
Lake Clark National Park (NP)	1,523,000	
Katmai NP	588,000	
Kenai Fjords NP	574,000	
Kenai National Wildlife Refuge	1,894,000	
Alaska Marine National Wildlife Refuge	24,000	
Chugach National Forest	1,216,000	
Public Domain and Other Federal	1,035,375	
<b>Total Federal</b>	<b>6,854,375</b>	<b>65.5%</b>
<b>STATE</b>		
Department of Natural Resources	2,180,794	
Aviation Division	1,087	
Fish and Game	407	
Department of Transportation	159	
Mental Health Trust	18,7724	
University of Alaska	15,048	
Alaska Railroad Corporation	512	
Other State	49	
<b>Total State</b>	<b>2,223,923</b>	<b>21.3%</b>
<b>BOROUGH</b>	<b>72,409</b>	<b>0.7%</b>
<b>CITY</b>	<b>17,116</b>	<b>0.2%</b>
<b>NATIVE CORPORATION OR TRIBE/VILLAGE</b>		
Chugach Alaska Corporation	52,684	
Cook Inlet Region, Inc.	523,108	
English Bay Corporation	61,864	
Kenai Natives Association, Inc.	8,294	
Nanwalek Village and Council	82	
Ninilchik Native Association and Village Council	44,335	
Port Graham Corporation and Village Council	97,057	
Salamatof Native Association, Inc.	24,060	
Seldovia Native Association, Inc.	72,809	
Tyonek Native Corporation and Village	78,849	
<b>Total Native Land</b>	<b>929,174</b>	<b>8.9%</b>
<b>OTHER PRIVATE LAND</b>	<b>357,826</b>	<b>3.4%</b>
<b>TOTAL ALL OWNERS</b>	<b>10,458,699</b>	<b>100%</b>

*Source: KPB Assessing Department, Cogan Owens Gogan*

**Figure 6-1 Kenai Peninsula Borough Comprehensive Plan (KPB 2005)**

## 6.3 VULNERABILITY EXPOSURE ANALYSIS FOR CURRENT ASSETS

### 6.3.1 Asset Inventory

Asset inventory is the first step of a vulnerability analysis. Assets that may be affected by hazard events include population (for community-wide hazards), residential buildings (where data is available), and critical facilities and infrastructure. The assets and associated values throughout the SBCFSA are identified and discussed in detail in the following sections.

### 6.3.1.1 Population and Building Stock

For this analysis, several different sources were examined to determine the most appropriate structure inventory data for flood analysis. For example, Table 6-3 shows 2010 U.S. Census data and more detailed 2012 population data from the Alaska Department of Labor (DOL). The table delineates population data for the study's population areas within the SBCFSA (i.e. City of Seward, Bear Creek, and Lowell Point) and also provides residential structure numbers and replacement value estimates. (US Census 2010, DOL 2012)

**Table 6-3 Estimated Population and Building Inventory**

Location	Population		Residential Buildings	
	2010 Census	DOL 2012	Total Structure Count	Total Structure Replacement Value <sup>1</sup> (\$)
City of Seward	2,693	2,733	947	181,824,000
Bear Creek	1,956	1,958	720	134,064,000
Lowell Point	80	71	71	9,230,000
<b>Total</b>	<b>4,729</b>	<b>4,762</b>	<b>1,738</b>	<b>\$325,118,000</b>

Sources: The SBCFSA, U.S. Census 2010, and 2012 Alaska Department of Labor.

<sup>1</sup> The 2010 US Census estimates residential building values at City of Seward: \$192,000, Bear Creek: \$186,200, and Lowell Point: \$130,000.

A total of 1,738 single-family residential buildings are shown in Table 6-3. Replacement values for those structures were obtained from the Kenai Peninsula Borough's parcels database.

Table 6-4 summarizes the flood analysis study results for the total structure counts and structure replacement values for structure grouping types for the entire census tract for the SBCFSA. (See Appendix J for detailed Hazus analysis.)

**Table 6-4 Hazus Major Release 2.1 Building Inventory Estimates for SBCFSA**

Occupancy Type	Total Structure Count	Total Structure Replacement Values <sup>1</sup>	Total Contents Replacement Values <sup>1</sup>
Residential	1919	\$418,708,000	\$209,354,000
Commercial and Industrial	376	\$233,424,000	\$247,439,000
Other <sup>2</sup>	52	\$118,258,000	\$139,097,000
<b>Total</b>	<b>2,347</b>	<b>\$770,390,000</b>	<b>\$595,890,000</b>

Source: KPB Parcel Data, KPB Building Data, KPB aerial photography, RSMeans 2012 Residential Cost Data and Light Commercial Cost Data, Hazus default data for region, field survey, publically available aerial and street level photography

<sup>1</sup> 2012 Dollars from RSMeans 2012 Residential Cost Data and Light Commercial Cost Data.

<sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.

The residential structure count of 1,919 is much closer to the 1,738 value in Table 6-3 than the 3,622 estimate from Hazus default General Building Stock (GBS) in Appendix J, Table J-1. For

non-residential structures, the Hazus user-defined facilities (UDF) had much higher counts and replacement values than the Hazus GBS values.

### 6.3.1.2 Existing Infrastructure

Table 6-5 list the SBCFSA's DCRA funded "completed" infrastructure improvement projects. They provide a depiction of the community's ongoing development trends and focus toward improving aging infrastructure.

**Table 6-5 Completed Projects**

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
Division of Community and Regional Affairs (DCRA)	2009	Funded	Waterfront Pavilion - Comments: Legislative Grant	Completed	\$195,000
Denali Commission (Denali)	2008	Funded	Providence Seward Endoscopy Equipment - Comments: Funding includes purchase and installation of endoscopy equipment.	Project Close-out Complete	\$84,498
Department of Health and Human Services (DHSS)	2008	Funded	Seaview Community Services - Comments: Other funding: Denali Commission.	Completed	\$18,885
Denali	2008	Funded	East Harbor Reconstruction - Comments: This project will expand the Seward boat harbor to house large commercial fishing and US Coast Guard vessels. Construction includes floats, gangway and approach, utilities and fire suppression system. This large-vessel harbor will improve maneuver safety and overall operations. This facility also extends the life of other harbor areas through reduced wear on smaller floats, piling and gear.	Project Close-out Complete	\$5,500,000
DCRA	2008	Funded	Shellfish Enhancement Project - Comments: Legislative Grant - Named Recipient	Completed	\$250,000
DCRA	2007	Funded	Lowell Point Fire Department Building - Comments: Legislative Grant Lowell Point Fire Department Building	Completed	\$30,000
DCRA	2007	Funded	Seward Senior and Community Center Repairs - Comments: Legislative Grant	Completed	\$50,000
DCRA	2007	Funded	T-Dock and Bulkhead Phase (Ph) 2 - Comments: Legislative Grant	Completed	\$1,000,000
DCRA	2007	Funded	T-Dock and Bulkhead Ph 2 - Comments: Legislative Grant	Completed	\$1,200,000
DCRA	2007	Funded	Alutitq Pride Shellfish Hatchery - Comments: Legislative Grant	Completed	\$150,000
Denali	2006	Funded	Facility Improvements (SCS) - Comments: Seaview Community Services (SCS)	Project Close-out Complete	\$33,119
DCRA	2006	Funded	T-dock and Bulkhead - Comments: Legislative Grant	Completed	\$2,000,000
Denali	2005	Funded	Repair & Renovation: Domestic Violence Facility (SCS) - Comments: Seaview Community Services (SCS)	Project Close-out Complete	\$71,379
DHSS	2005	Funded	Sea View Community Services - Deferred Maintenance Roof Design, Construction, Carport Heater	Completed	\$89,490

Table 6-5 Completed Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
Alaska Energy Authority (AEA)	2005	Funded	Alaska Vocational Technical Center (AVTEC) Power System Upgrade - Comments: Other funding: Denali Commission \$153,507. Upgrade to the switchgear and engine controls of the school's powerhouse operator training equipment, for consistency with the village powerhouse upgrade projects simultaneously occurring.	Completed	\$153,507
Department Of Transportation And Public Facilities (DOT/PF)	2004	Funded	North Forest Acres Road Construction - Comments: Construct a new industrial service road from the Seward Highway (Milepost [MP] 2.8) to the landfill and rock quarry near Japapanese Creek. The road will be constructed on top of a flood control levee that is being constructed by the US Corps of Engineers (USACE) in cooperation with the City of Seward. North Forest Acres Road Construction	Completed	\$200,000
Denali	2004	Funded	Design Long Term Care Facility - Comments: Scope of work: design of long term care facility in Seward, AK	Project Close-out Complete	\$1,665,000
DCRA	2004	Funded	Pristine Products: Floating Oyster Smokehouse Construction - Comments: Fish Econ Dev. Grant	Completed	\$26,588
DCRA	2004	Funded	Portage Distributing: Processing Plant Upgrades - Comments: Fish Econ Dev. Grant	Completed	\$155,930
DCRA	2004	Funded	Marketing Smoked Salmon Sausage - Comments: Salmon Marketing	Completed	\$150,000
DCRA	2004	Funded	Algae Rearing System - Comments: Fish Economic Development Grant	Completed	\$554,781
DOT/PF	2003	Funded	Commuter Bus Purchase - Comments: Purchase two 18-passenger busses with wheelchair lifts, four all-weather waiting stations and signage to operate a local transit system. (Seward)	Completed	\$146,500
Federal Aviation Administration (FAA)	2003	Funded	Conduct Airport Master Plan Study - Comments: Other funding: DOT/PF	Completed	\$92,288
DCRA	2003	Funded	Communication System Upgrade - Comments: Capital Matching	Completed	\$92,396
DCRA	2003	Funded	Police Console - Comments: Legislative Grant	Completed	\$75,000
DHSS	2003	Funded	Sea View Community Services - Equipment - Comments: Capital Grant. Purchase of appliances and furniture. Sea View Community Services - Equipment	Completed	\$24,909
Department Of Environmental Conservation (DEC) /Municipal Matching Grants And Loans (MGL)	2003	Funded	Gateway to Forest Avenue Waterline Extension - Comments: Other funding: Environmental Protection Agency (EPA) \$297,400. Construction of a water line to the undeveloped lots for fire protection and domestic use.	Completed	\$566,571
Alaska Housing Finance Corporation (AHFC)	2003	Funded	Glacier View Renovation - Comments: Construction Dept. - 30 unit senior housing	Completed	\$1,180,206
DHSS	2003	Funded	Sea View Community Services - Computer Server Replacement - Comments: Capital Grant.	Completed	\$142,041



Table 6-5 Completed Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
DHSS	2003	Funded	Sea View Community Services - Computer System Renovation and Training. - Comments: Capital Grant.	Completed	\$119,369
AEA- Alternative Energy And Energy Efficiency (AEFE)	2003	Funded	Fuel Cell Demonstration - Comments: Other funding: US Department of Energy (DOE). Install a fuel cell at Exit Glacier in Seward.	Completed	\$25,000
DHSS	2003	Funded	Providence Seward Medical and Care Center - Purchase new computerized axial tomography (CT) scanner - Comments: Other Funding: Denali Commission. Purchase and installation of a refurbished CT Scanner, accessories, and mobile trailer. The scanner will be permanently housed in the trailer located immediately adjacent to the hospital. This project will eliminate the need for long distance travel by patient in need of this service.	Completed	\$583,770
Denali	2003	Funded	Fuel Cell Demonstration Project - Comments: Funding to assist the Alaska Energy Authority in the fuel cell demo project at the National Park Service's (NPS) new Exit Glacier Visitor Center. The outcome of this demo could be useful in assessing future direction of energy projects in Alaska.	N/A	\$25,000
Alaska Department Of Education And Early Development (DEED)	2002	Funded	Seward Middle School Roof	Completed	\$278,275
US Army Corps of Engineers (USACE)	2002	Funded	Harbor/Construction Ph 1 - Comments: Design due April 2002	Completed	\$2,500,000
Denali	2002	Funded	Unknown	Project Close-out Complete	\$89,823
DOT/PF	2002	Funded	Spruce Creek Bridge #1783 - Comments: Construct Spruce Creek Bridge in Seward.	Completed	\$289,000
DOT/PF	2002	Funded	Nash Road: MP 0.0 to MP 5.3 Rehabilitation, Ph 2 - Comments: Resurface 5.3 miles of road to include signing, striping, and drainage improvements.	Completed	\$4,730,000
DCRA	2002	Funded	Seward Shipyard Portable Work Station - Comments: Legislative Grant	Completed	\$1,000,000
DOT/PF	2002	Funded	Harbor Pedestrian Pathway	Completed	\$675,000
DCRA	2002	Funded	Fire Hydrant Upgrade - Comments: Capital Matching	Completed	\$88,088
DOT/PF	2001	Funded	Exit Glacier Road MP 3.9 to 7.3	Completed	\$2,568,602
DHSS	2001	Funded	Sea View Community Services - Facility repairs, upgrades, and safety improvements - Comments: Capital Grant.	Completed	\$56,509
DCRA	2001	Funded	City Hall Facilities & Equipment - Comments: Capital Matching	Completed	\$90,466
DOT/PF	2001	Funded	Exit Glacier Road MP 7.3 to 8.8	Completed	\$590,368
Economic Development	2001	Funded	Unknown	Completed	\$1,300,000

Table 6-5 Completed Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
Administration (EDA)					
AHFC	2001	Funded	Glacier View valves, roof, elevator	Completed	\$191,482
DCRA	2001	Funded	Media Campaign to Encourage Economic Growth - Comments: Mini-Grant	Completed	\$26,000
DEC/MGL	2001	Funded	Water/Sewer System Analysis/Prelim Design - Comments: Analysis and design of water and sewer improvements needed throughout the City.	Completed	\$189,200
Denali	2001	Funded	Construction & renovation of regional dental clinic & multi-purpose health care - Comments: Construction & renovation of regional dental clinic & multi-purpose health care provider training room	Construction Complete	\$953,034
DHSS	2001	Funded	Wesley Nursing Home - Community Needs Assessment and Engineering Building Assessment. - Comments: Other Funding: Federal \$25,000.	Completed	\$100,000
DEC/MGL	2000	Funded	Water Distribution System Analysis - Comments: Other funding: AHFC \$24,800.	Completed	\$118,700
DHSS	2000	Funded	Sea View Community Services - City System Sewer Line Hookup for the Assisted Living Home - Comments: Capital Grant.	Completed	\$102,200
AHFC	2000	Funded	Glacier View Windows	Completed	\$123,657
DOT/PF	2000	Funded	Seward Railcar Preservation - Comments: Preservation of a 1916 Alaska Railroad railcar. The railcar is to be used as a visitor center/museum. Work would include restrooms.	Completed	\$60,000
DOT/PF	2000	Funded	Pathway Construction - Comments: Construct pedestrian paths along Van Buren Avenue from 4th Ave to 2nd Ave; along Railway Ave from 6th Avenue to 4th Avenue with wheelchair access from Railway Ave; to the historic Railroad Depot; and along Coolidge Drive from Swetmann Avenue to Seward Highway. Pathway Construction	Completed	\$310,000
DOT/PF	2000	Funded	Seward Intermodal Freight and Passenger Facilities - Comments: Construct capital improvements to intermodal freight and passenger facilities.	Completed	\$6,852,100
DCRA	2000	Funded	Curb Cuts for ADA Compliance-Sidewalk, Curb, Gutters - Comments: Capital Matching	Completed	\$34,564
DCRA	2000	Funded	Fire Department Fire Hose Replacement - Comments: Capital Matching	Completed	\$40,000
DCRA	1999	Funded	Replacement electric generator - Comments: Legislative Grant	Completed	\$1,088,500
DCRA	1999	Funded	ADA Campsites and Sewer Dump Station - Comments: Capital Matching	Completed	\$32,925
DCRA	1999	Funded	Library Parking Lot Paving - Comments: Capital Matching	Completed	\$11,008
Housing and Urban Development	1999	Funded	Alaska Vocational Technical Center - Maritime Vessel Simulator - Comments: Economic	Completed	\$2,500,000

Table 6-5 Completed Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
(HUD)			Development Initiative (EDI) Program		
DCRA	1999	Funded	911 Equipment Replacement - Comments: Capital Matching	Completed	\$34,155
DCRA	1998	Funded	Community Facilities and Equipment - Comments: Capital Matching	Completed	\$38,548
DCRA	1998	Funded	Harbor Plaza Renovation - Comments: Capital Matching Harbor Plaza Renovation	Completed	\$55,670
DOT/PF	1998	Funded	Seward Hwy: MP 0 to 8 Reconstruction and Pathway - Seward to Grouse Creek Canyon	Completed	\$17,018,556
DCRA	1998	Funded	Library Information and Technology Automation Project - Comments: Capital Matching	Completed	\$26,611
DCRA	1997	Funded	Museum Darkroom - Comments: Capital Matching	Completed	\$10,465
DCRA	1997	Funded	Street Paving - Comments: Capital Matching	Completed	\$18,236
DCRA	1997	Funded	Historical Records Preservation - Comments: Capital Matching	Completed	\$24,841
DCRA	1997	Funded	Library Basement Remodeling - Comments: Capital Matching	Completed	\$12,396
DCRA	1997	Funded	Prismatic Surgical Lighting Purchase - Comments: Capital Matching	Completed	\$19,862
DCRA	1997	Funded	Children's Library Renovation - Comments: Capital Matching	Completed	\$12,396
DCRA	1997	Funded	Historical Records Preservation - Comments: Capital Matching	Completed	\$33,546
DCRA	1996	Funded	Refurbish Seward Community Cemetery - Comments: Capital Matching Refurbish Seward Community Cemetery	Completed	\$14,867
DCRA	1996	Funded	Purchase Rescue / Emergency Response Vehicle - Comments: Capital Matching	Completed	\$58,172
DOT&PF	1996	Funded	Seward Highway (Hwy): MP 90.3 to 97, Ph 3	Completed	\$8,702,640
DCRA	1996	Funded	Purchase Electrocardiogram and Dynamap Critical Care Monitoring System - Comments: Capital Matching	Completed	\$15,199
DCRA	1996	Funded	Kenai Peninsula Borough - Seward High School Re-roof - Comments: Legislative Grant	Completed	\$29,901
DOT/PF	1996	Funded	Seward Hwy: MP 8 To 18 Rehabilitation	Completed	\$24,269,418
DCRA	1995	Funded	Emergency Response Vehicle - Comments: Capital Matching	Completed	\$50,993
FAA	1995	Funded	Seward Airport: Improve Airport Drainage - Comments: Other funding: DOT/PF	Completed	\$699,992
DCRA	1995	Funded	Gateway Subdivision Land Acquisition/Park Construction - Comments: Capital Matching	Completed	\$59,249
DCRA	1994	Funded	Replace Anesthesia Machine - Comments: Capital Matching	Completed	\$25,700
DCRA	1994	Funded	Hospital Equipment - Comments: Legislative Grant Hospital Equipment	Completed	\$50,000
DCRA	1994	Funded	Cruise Ship Dock - Comments: Legislative Grant	Completed	\$450,000

Table 6-5 Completed Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
DCRA	1994	Funded	Alaska Sea-Life Center Start-up Costs - Comments: Legislative Grant	Completed	\$100,000
DCRA	1994	Funded	Development of the Alaska Sea Life Center - Comments: Legislative Grant. A Recreation and Marine Mammal Rehabilitation Center and Center for Education and Research Related to the Natural Resources Injured by the Exxon Valdez Oil Spill	Completed	\$12,500,000
DCRA	1994	Funded	Community Bike Path Extension - Comments: Capital Matching	Completed	\$50,802
DCRA	1994	Funded	Replace Anesthesia Machine - Comments: Capital Matching	Completed	\$25,700
DCRA	1994	Funded	Renovate Radio Dispatch Electrical Wiring and Radios - Comments: Capital Matching	Completed	\$17,000
DCRA	1994	Funded	Purchase Emergency Shelter Supplies - Comments: Capital Matching	Completed	\$26,501
FAA	1991	Funded	Acquire Land for Development - Comments: Other funding: DOT/PF	Completed	\$221,744
FAA	1991	Funded	Improve Access Road - Comments: Other funding: DOT/PF	Completed	\$376,125
FAA	1991	Funded	Construct Apron - Comments: Other funding: DOT/PF Construct Apron	Completed	\$828,880
FAA	1991	Funded	Construct Taxiway - Comments: Other funding: DOT/PF	Completed	\$39,946

(DCRA 2013)

### 6.3.1.3 Existing Critical Facilities and Infrastructure

A critical facility is defined as a facility that provides essential products and services to the general public, such as preserving the quality of life in the SBCFSA and fulfilling important public safety, emergency response, and disaster recovery functions. The critical facilities profiled in this plan include the following:

- Government facilities, such as SBCFSA and tribal administrative offices, departments, or agencies
- Emergency response facilities, including police department and firefighting equipment
- Educational facilities, including K-12
- Care facilities, such as medical clinics, congregate living health, residential and continuing care, and retirement facilities
- Community gathering places, such as community and youth centers
- Utilities, such as electric generation, communications, water and waste water treatment, sewage lagoons, landfills.

The SBCFSA's critical facilities and infrastructure data is not included within the HMP for Homeland Security reasons. Please contact the Kenai Peninsula Borough Emergency Manager to acquire this data.

## 6.4 REPETITIVE LOSS PROPERTIES

This section estimates the number and type of structures at risk to repetitive flooding. (Properties which have experienced RL and the extent of flood depth and damage potential.)

DMA 2000 Requirements
<p><b>Addressing Risk and Vulnerability to NFIP Insured Structures</b></p> <p><b>§201.6(c)(2)(ii):</b> The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. <i>All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of:</i></p> <p><b>§201.6(c)(2)(ii)(A):</b> The plan should describe vulnerability in terms of] the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas;</p> <p><b>§201.6(c)(2)(ii)(B):</b> The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate;</p> <p><b>§201.6(c)(2)(ii)(C):</b> The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.</p> <p><b>§201.6(c)(3)(ii):</b> The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.</p>
<b>1. REGULATION CHECKLIST</b>
<b>ELEMENT B. NFIP Insured Structures</b>
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods?
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate?
Source: FEMA, October 2011.

The SBCFSA participates in the NFIP through the Kenai Peninsula Borough. There is one repetitive flood property within the SBCFSA that fulfills NFIP criteria. (Table 6-6) This property was identified by the SBCFSA during the September 2012 federally declared flood disaster (FEMA 4095-DR). This property is uninsured and therefore ineligible to file NFIP damage claims.

Future HMP updates will strive to obtain more comprehensive property loss information as indicated in Table 6-6 and identified in the Mitigation Strategy, Table 7-8, Action ID: FL 6.2. to garner additional National Flood Insurance Program (NFIP) and Community Rating System (CRS) benefits.

**Table 6-6 Repetitive Loss Properties**

Type (RL/SRL)	Community Name	Occupancy (#)	No. of Losses	Flood Insurance (Yes/No)	Structure Value (\$) <sup>1</sup>	Total Claims (\$) <sup>2</sup>
RL	House #1: Describe location	Single Family	N/A	Yes	Unknown	Unknown

<sup>1</sup>Insured structural value as of *date*.

<sup>2</sup>Content and building claims.

(KPB 2010)

The City of Seward and KPB have been active NFIP participant since November 20, 1988 and November 12, 1986 as shown in Tables 6-7 and 6-8 respectively.

The City of Seward's FEMA issued Flood Insurance Rate Maps (FIRMs) delineate the SBCFSA's floodplain. Their numbers are: 020012IND0, 0200123255A, 020012360A, 0200123265A, 0200123270A, all of which encompass the SBCFSA.

**Table 6-7 NFIP Participation Data**  
(City of Seward, 020113)

Category	Data	Category	Data
<b>Date joined NFIP</b>	11/20/1986	<b>Number of policies in force</b>	14
<b>CRS class / discount</b>	07/15%	<b>Insurance in force</b>	\$4,357,600
<b>CAV date</b>	06/18/2010	<b>Number of paid losses</b>	--
<b>CAC date</b>	--	<b>Total losses paid</b>	--
<b>Date of current FIRM</b>	12/06/1999	<b>Substantial damage claims since 1978</b>	--

CAC = Community Assistance Contact  
CAV = Community Assistance Visit  
CRS = Community Rating System

FIRM = Flood Insurance Rate Map  
NFIP = National Flood Insurance Program

**Table 6-8 NFIP Participation Data**  
(Kenai Peninsula Borough, 020012)

Category	Data	Category	Data
<b>Date joined NFIP:</b>	11/20/1986	<b>Number of policies in force</b>	324
<b>Reinstatement Date:</b>	11/20/1986	<b>Insurance in force</b>	\$70,655,200
<b>CRS class / discount</b>	08/10%	<b>Number of paid losses</b>	35
<b>CAV date</b>	07/10/2007	<b>Total losses paid</b>	\$410,727.08
<b>CAC date</b>	10/09/2003	<b>Substantial damage claims since 1978</b>	5
<b>Date of current FIRM</b>	12/06/1999		

CAC = Community Assistance Contact  
CAV = Community Assistance Visit  
CRS = Community Rating System

FIRM = Flood Insurance Rate Map  
NFIP = National Flood Insurance Program



## 6.5 VULNERABILITY ANALYSIS METHODOLOGY

A conservative exposure-level analysis was conducted to assess the risks of the identified hazards. This analysis is a simplified assessment of the potential effects of the hazards on values at risk without consideration of probability or level of damage.

The methodology used a two pronged effort. First, The Planning Team used the State's Critical Facility Inventory and locally obtained GPS coordinate data to identify critical facility locations in relation to potential hazard's threat exposure and vulnerability. Second this data was used to develop a vulnerability assessment for those hazards where GIS based hazard mapping information was available.

Replacement structure and contents values were developed for physical assets. These value estimates were provided by the Planning Team. For each physical asset located within a hazard area, exposure was calculated by assuming the worst-case scenario (that is, the asset would be completely destroyed and would have to be replaced). Finally, the aggregate exposure, in terms of replacement value or insurance coverage, for each category of structure or facility was estimated. A similar analysis was used to evaluate the proportion of the population at risk. However, the analysis simply represents the number of people at risk; no estimate of the number of potential injuries or deaths was prepared.

## 6.6 DATA LIMITATIONS

The vulnerability estimates provided herein use the best data currently available, and the methodologies applied result in a risk approximation. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their effects on the built environment as well as the use of approximations and simplifications that are necessary for a comprehensive analysis.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings, and critical facilities and infrastructure to the identified hazards. It was beyond the scope of this HMP to develop a more detailed or comprehensive assessment of risk (including annualized losses, people injured or killed, shelter requirements, loss of facility/system function, and economic losses). Such impacts may be addressed with future updates of the HMP.

## 6.7 VULNERABILITY EXPOSURE ANALYSIS

The Kenai Peninsula Borough provided extensive area wide GIS data which formed the basis for the SBCFSA's critical facility hazard exposure analysis.

### 6.7.1 Existing Infrastructure

Tables 6-9, 6-10, and 6-11 summarize the results of the GIS-based exposure analysis for SBCFSA's loss estimations.

**Table 6-9 SBCFSA Potential Hazard Exposure Analysis Overview – Population and Buildings**

Hazard Type		Hazard Area	Methodology	Population Number <sup>1</sup>	Buildings		
					Residential Number	Residential Value (\$) <sup>2</sup>	Non-Residential Number Value (\$) <sup>2</sup>
Earthquake <sup>3</sup>		Strong	9-20% (g)	4,762	1,919	\$418,708,000	\$351,682,000
		Very strong	20-40% (g)				
		Severe	>40-60% (g)				
Erosion		Within 30 ft of erosion areas	Descriptive	Unknown	12	\$2,051,300	\$31,881,600
		Moderate	500-year floodplain				
		High	100-year floodplain				
Flood	Riverine Flood <sup>4</sup> Coastal Flood	High	Coastal VE Flood Zone	117	51	\$13,013,583	\$20,182,014
		Low	0-11%				
		Moderate	11-21%				
Ground Failure (Avalanche, landslide, subsidence, unstable soils)		High	21-41%	Unknown	11	\$9,506,400	Unknown
		Very High	> 41%				
		--	descriptive				
Severe Weather		DGGS GIS	descriptive	4,762	1,919	\$418,708,000	\$351,682,000
Tsunami Seiche		--	descriptive	645	184	\$78,182,123	\$221,500,871
Volcanic		Low	Low fuel rank	Unknown	892	\$217,771,800	\$351,682,000
		Moderate	Moderate fuel rank				
		High	High fuel rank				
Wildland Fire		Extreme	Extreme fuel rank	Unknown	59	\$79,983,900	\$860,000

1. Affected population was estimated by multiplying the percentage of buildings impacted in each category by the total population.

2. Replacement values taken from User-Defined Facilities data based on KPB parcel datasets and RS Means information. Values are in 2012 dollars.

3. Exposure due to Earthquake is the same for all hazard levels.

4. Exposure due to Lowell Creek is not included in the Riverine Flood overview, as hazard events on Lowell Creek are more extreme than those included here.

Table 6-10 Potential Hazard Exposure Analysis – Critical Facilities

Hazard Type	Hazard Area	Methodology	Government and Emergency Response		Educational		Medical Care		Community	
			# Bldgs/ # Occ <sup>3</sup>	Value <sup>1</sup> (\$)	# Bldgs/ # Occ <sup>3</sup>	Value <sup>1</sup> (\$)	# Bldgs/ # Occ <sup>3</sup>	Value <sup>1</sup> (\$)	# Bldgs/ # Occ <sup>3</sup>	Value <sup>1</sup> (\$)
Earthquake <sup>2</sup>	Strong	9-20% (g)	9/NA <sup>3</sup>	\$15,465,027	6/NA <sup>3</sup>	\$42,501,375	3/NA <sup>3</sup>	\$17,277,387	23/NA <sup>3</sup>	\$45,324,661
	Very strong	20-40% (g)								
	Severe	>40-60% (g)								
Erosion	Within 30 ft of erosion areas	Descriptive	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
	Moderate	500-year floodplain	1/NA <sup>3</sup>	\$2,002,127	0/NA <sup>3</sup>	--	1/NA <sup>3</sup>	\$1,082,668	3/NA <sup>3</sup>	\$3,469,176
	High	100-year floodplain	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--	1/NA <sup>3</sup>	\$1,082,668	2/NA <sup>3</sup>	\$2,695,217
Flood	Coastal	Coastal VE Flood Zone	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--
	Low	0-11%	9/NA <sup>3</sup>	\$7,394,300	6/NA <sup>3</sup>	\$121,762,600	3/NA <sup>3</sup>	\$6,745,400	23/NA <sup>3</sup>	\$100,789,300
	Moderate	11-21%	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
Ground Failure	High	21-41%	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
	Very High	> 41%	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
	--	Descriptive	19/NA <sup>3</sup>	\$36,483,842	11/NA <sup>3</sup>	\$142,498,908	1/NA <sup>3</sup>	\$18,438,505	10/NA <sup>3</sup>	\$19,442,383
Severe Weather			2/NA <sup>3</sup>	\$9,054,415	2/NA <sup>3</sup>	\$4,246,316	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--
Tsunami/ Seiche			19/NA <sup>3</sup>	\$36,483,842	11/NA <sup>3</sup>	\$142,498,908	1/NA <sup>3</sup>	\$18,438,505	10/NA <sup>3</sup>	\$19,442,383
Volcanic	Low	Low fuel rank	8/NA <sup>3</sup>	\$7,071,600	5/NA <sup>3</sup>	\$87,833,700	2/NA <sup>3</sup>	\$4,576,000	15/NA <sup>3</sup>	\$49,698,200
Wildland/ Urban Interface Fire	Moderate	Moderate fuel rank	1/NA <sup>3</sup>	\$322,700	1/NA <sup>3</sup>	\$33,928,900	1/NA <sup>3</sup>	\$2,169,400	8/NA <sup>3</sup>	\$51,091,100
	High	High fuel rank	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
	Extreme	Extreme fuel rank	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown

1. Replacement values taken from User-Defined Facilities data based on KPB parcel datasets and RS Means information. Values are in 2012 dollars.

2. Exposure due to Earthquake is the same for all hazard levels.

3. NA = Not Available. Affected population cannot be estimated for these facilities.

4. Exposure due to Lowell Creek is not included in the Riverine Flood overview, as hazard events on Lowell Creek are more extreme than those included here.

Table 6-11 Potential Hazard Exposure Analysis – Critical Infrastructure

Hazard Type	Hazard Area	Methodology	Highway		Bridges		Transportation Facilities		Utilities	
			Miles	Value (\$)	No.	Value (\$)	# Bldgs/ # Occ <sup>3</sup>	Value (\$)	# Bldgs/ # Occ <sup>3</sup>	Value (\$)
Earthquake	Strong	9-20% (g)								
	Very strong	20-40% (g)								
	Severe	>40-60% (g)								
Erosion	Within 30 ft of erosion areas	Descriptive	Unknown	Unknown	22	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
Flood	Riverine	500-year floodplain	Unknown	Unknown	Unknown	Unknown	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--
		100-year floodplain	Unknown	Unknown	Unknown	Unknown	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--
	Coastal	Coastal VE Flood Zone	Unknown	Unknown	Unknown	Unknown	0/NA <sup>3</sup>	--	0/NA <sup>3</sup>	--
Ground Failure	Low	0-11%	Unknown	Unknown	26	Unknown	6/NA <sup>3</sup>	\$36,605,700	2/NA <sup>3</sup>	\$40,980,000
	Moderate	11-21%	Unknown	Unknown	Unknown	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
	High	21-41%	Unknown	Unknown	Unknown	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
Severe Weather	Very High	> 41%	Unknown	Unknown	26	Unknown	7/NA <sup>3</sup>	\$3,953,138	2/NA <sup>3</sup>	\$1,928,097
Tsunami/ Seiche	--	Descriptive	Unknown	Unknown	2	Unknown	3/NA <sup>3</sup>	\$181,371	1/NA <sup>3</sup>	\$3,700,935
Volcanic	--	Descriptive	Unknown	Unknown	26	Unknown	7/NA <sup>3</sup>	\$3,953,138	2/NA <sup>3</sup>	\$1,928,097
Wildland/ Urban Interface Fire	Low	Low fuel rank	Unknown	Unknown	15	Unknown	5/NA <sup>3</sup>	\$34,489,500	2/NA <sup>3</sup>	\$4,098,000
	Moderate	Moderate fuel rank	Unknown	Unknown	10	Unknown	1/NA <sup>3</sup>	\$2,116,200	--/NA <sup>3</sup>	Unknown
	High	High fuel rank	Unknown	Unknown	1	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown
	Extreme	Extreme fuel rank	Unknown	Unknown	Unknown	Unknown	--/NA <sup>3</sup>	Unknown	--/NA <sup>3</sup>	Unknown

1. Replacement values taken from User-Defined Facilities data based on KPB parcel datasets and RS Means information. Values are in 2012 dollars.

2. Exposure due to Earthquake is the same for all hazard levels.

3. NA = Not Available. Affected population cannot be estimated for these facilities.

4. Exposure due to Lowell Creek is not included in the Riverine Flood overview, as hazard events on Lowell Creek are more extreme than those included here.

The following narrative discussion contains the tabulated data from GIS analysis and information obtained from the Planning Team.

### 6.7.2 Exposure Analysis – Hazard Narrative Summaries

#### *Earthquake*

The community has historically experienced significant seismic activity which generated damaging ground movement that resulted in extensive infrastructure damages. Although all structures are exposed to earthquakes, buildings within the SBCFSA constructed with wood have slightly less vulnerability to the earthquake effects than those with masonry.

Based on earthquake probability (PGA) maps produced by the USGS, the entire SBCFSA area is at risk of experiencing moderate earthquake impacts a result of its proximity to very active fault zones. The probability is high (see Section 5.3.1.3).

Impacts to the community such as significant ground movement that may result in infrastructure damage are expected. The entire existing and future SBCFSA population, residences, and critical facilities are exposed to the effects of an earthquake.

All SBCFSA residential structures, critical facilities, and infrastructure are equally affected by all earthquake risk levels (areas of strong, very strong, severe shaking risk).

This includes:

- 4,762 people in 1,919 residences (approximate value \$418,708,000)
- 478 facilities (approximate value \$351,682,000)
- 9 government\emergency response facilities (approximate value \$15,465,027)
- 6 educational facilities (approximate value \$42,501,375)
- 3 care facilities (approximate value \$17,277,387)
- 23 community facilities (approximate value \$45,324,661)
- 6 transportation facilities (approximate value \$2,724,133)
- Two utility facilities (approximate value \$1,315,489)

Impacts to future populations, residences, critical facilities, and infrastructure are anticipated at the same impact level as the SBCFSA is located in an area with a high probability of strong shaking (i.e., >4.8M).

#### *Erosion*

Impacts from erosion include loss of land and any development on that land. Erosion can cause increased sedimentation of harbors and river deltas and hinder channel navigation, reduction in water quality due to high sediment loads, loss of native aquatic habitats, damage to public utilities (docks, harbors, electric and water/wastewater utilities), and economic impacts associated with costs trying to prevent or control erosion sites. (See Section 5.3.2.3). Only the building's location can lessen its vulnerability to erosion in the SBCFSA.

Impacts to future populations, residences, critical facilities, and infrastructure are anticipated at the same impact level until the SBCFSA institutes land use controls prohibiting new construction in erosion prone areas. Impacts could also be lessened if affected properties could be relocated.

Based on potential 30ft riverine and coastal erosion areas, SBCFSA infrastructure affected by erosion potentially include:

- 12 residences (approximate value \$2,051,300)
- Two bridges (approximate value unknown)

Impacts to future populations, residences, critical facilities, and infrastructure are anticipated at the same impact level.

### *Flood*

#### *Riverine*

The SBCFSA Board of Directors stated “the majority of the SBCFSA is located within the 100 year floodplain.” Impacts associated with flooding in the SBCFSA is water damage to structures and contents, roadbed and railroad bed erosion, saturation, and damage, areas of standing water in roadways, and damage or displacement of fuel tanks, power lines, or other infrastructure.

Buildings on slab foundations, not located on raised foundations, and/or not constructed with materials designed to withstand flooding events (e.g., cross vents to allow water to pass through an open area under the main floor of a building) are more vulnerable to the impacts of flooding (see Section 5.3.3.3). This includes:

#### ***100 Year (1% Chance Probability):***

- 558 people in 199 residences (approximate value \$42,928,270)
- One care facility (approximate value \$1,082,668)
- Two community facilities (approximate value \$2,695,217)

#### ***500-Year (20% Chance Probability):***

- 755 people in 272 residences (approximate value \$59,468,713)
- One care facility (approximate value \$1,082,668)
- Three community facilities (approximate value \$3,469,176)

The SBCFSA anticipates that impacts to future populations, residences, critical facilities, and infrastructure are at the same historical impact level.

### *Coastal*

Coastal flooding is generally caused by wave run-up, resulting from a combination of any or all of the following factors: astronomical tides, storm surge (the rise in water from wind stress and low atmospheric pressure), waves, and peak still-water elevation. Winter storms along the Resurrection, in conjunction with high tides and strong winds, can cause significant wave run-up throughout SBCFSA coastal areas. Impacts from coastal flooding are similar in nature to riverine flooding, namely:

- Water inundation causing structural and contents water damage.



- High-velocity flow as well as debris impacts carried by floodwaters that can damage structures, roads, bridges, culverts, and other features. Debris may also accumulate around bridge piers and in culverts, decreasing flow capacity or causing overtopping or backwater effects.
- Sewage and hazardous or toxic materials releases occur when wastewater treatment plants are inundated, storage tanks are damaged, and pipelines are severed.

Coastal flood damages to the SBCFSA could include:

- 117 people in 51 residences (approximate value \$13,013,583)

Impacts to future populations, residences, critical facilities, and infrastructure are anticipated at the same impact level.

### *Ground Failure*

Ground Failure occurs throughout Alaska from avalanches, landslides, land subsidence, soil instability, and melting permafrost. These hazards periodically cause houses to shift due to ground shifting, sinking, and upheaval. According to mapping completed by the DGGs, the SBCFSA has not permafrost threat. However, there are substantial historical narratives to inundate the area has experienced avalanche, landslide, and unstable soil impacts, both direct and indirect which prohibited community ingress and egress due to Highway 9 (Seward Highway) being the only access road (see Section 5.3.4.3).

Impacts associated with ground failure include surface subsidence, building, infrastructure, and/or road damage. Buildings that are built on slab foundations and/or not constructed with materials designed to accommodate ground movement associated with other land subsidence and impacts are more vulnerable to damage.

Areas with 0-11 Percent Grade:

- 1,885 residences (approximate value \$418,708,000)
- Nine government/emergency response facilities (approximate value \$7,394,300)
- Six educational facilities (approximate value \$121,762,600)
- Three care facilities (approximate value \$6,745,400)
- 23 community facilities (approximate value \$100,789,300)
- 26 bridges (approximate value unknown)
- Six transportation facilities (approximate value \$36,605,700)
- Two utilities (approximate value \$40,980,000)

Areas with 11-21 Percent Grade:

- 23 residences (approximate value \$3,520,000)

Areas with 21-41 Percent Grade:

- 11 residences (approximate value \$9,506,400)

The SBCFSA anticipates that impacts to future populations, residences, critical facilities, and infrastructure are at the same historical impact level.

### *Severe Weather*

Impacts associated with severe weather events includes roof collapse, tree and power line falling, light aircraft and small boat sinking damages, injury and snow machine or vehicle accidents, overexertion while shoveling all due to heavy snow deaths A quick thaw after a heavy snow can also cause substantial flooding. Impacts from extreme cold include hypothermia, halting transportation from fog and ice, congealed fuel, frozen pipes, utility disruptions, frozen pipes, and carbon monoxide poisoning. Section 5.3.7.3 provides additional detail regarding severe weather the impacts. Buildings that are older and/or not constructed with materials designed to withstand heavy snow and wind (e.g., hurricane ties on crossbeams) are more vulnerable to the severe weather impacts of severe weather.

Using information provided by the SBCFSA and the National Weather Service, the entire existing and future SBCFSA's population, residences, and critical facilities are equally exposed to the effects of a severe weather event.

This includes:

- 4,762 people in 1,919 residences (approximate value \$418,708,000)
- 19 government\emergency response facilities (approximate value \$36,483,842)
- 11 educational facilities (approximate value \$142,498,908)
- One care facility (approximate value \$18,438,505)
- 10 community facilities (approximate value \$19,442,383)

The SBCFSA anticipates that impacts to future populations, residences, critical facilities, and infrastructure are at the same historical impact level.

### *Tsunami and Seiche*

The UAF/GI, DGGS, and WC/ATWC indicates there are significant distant and local source tsunami threats for SBCFSA populations and infrastructure located within the identified Resurrection Bay tsunami impact area. (See Section 5.3.5.3)

Using information provided by the UAF/GI, DGGS, and WC/ATWC; SBCFSA's residential structures and infrastructure located adjacent to the Resurrection Bay have a great risk from tsunamigenic impacts.

Potentially threatened population and infrastructure includes:

- 645 people in 184 residences (approximate value \$78,182,123)
- 134 non-residential facilities (approximate value \$221,500,871)
- Two government\emergency response facilities (approximate value \$9,054,415)
- Two educational facilities (approximate value \$4,246,316)
- Two bridge facilities (approximate value unknown)

- Three transportation facilities (approximate value \$181,371)
- One utility facility (approximate value \$3,700,935)

The SBCFSA anticipates that impacts to future populations, residences, critical facilities, and infrastructure are at the same historical impact level.

### *Volcano*

Impacts associated with a volcanic eruption include strain on resources should other hub communities be significantly affected by volcanic eruption. An eruption of significant size in southcentral Alaska will certainly affect air routes, which in turn affects the entire state. Other impacts include respiratory problems from airborne ash, displaced persons, lack of shelter, and personal injury. Other potential impacts include general property damage (electronics and unprotected machinery), structural damage from ash loading, state/regional transportation interruption, loss of commerce, and contamination of water supply. (See Section 5.3.6.3)

Using information provided by the SBCFSA, the USGS, and the Alaska Volcano Observatory, the entire existing and future SBCFSA population, residences, and critical facilities are equally at risk from the effects of a volcanic eruption.

All SBCFSA residential structures, critical facilities, and infrastructure are equally vulnerable to all volcanic impact levels.

This includes:

- 4,762 people in 1,919 residences (approximate value \$418,708,000)
- 478 non-residential facilities (approximate value \$351,682,000)
- 19 government\emergency response facilities (approximate value \$36,483,842)
- 11 educational facilities (approximate value \$142,498,908)
- One care facility (approximate value \$18,438,505)
- 10 community facilities (approximate value \$19,442,383)

The SBCFSA anticipates that impacts to future populations, residences, critical facilities, and infrastructure are at the same historical impact level.

### *Wildland/Urban Interface Fire*

Impacts associated with a wildland fire event include the potential for loss of life and property destruction. It can also impact livestock, pets, and wildlife; destroy forest resources; and contaminate water supplies. Buildings closer to the outer edge of town (structures more likely to have a lot of vegetation surrounding the structure) and those constructed with wood are some of the buildings that are more vulnerable to wildland/urban interface fire impacts.

According to the Alaska Fire Service, there are no wildland fire areas within the SBCFSA's boundaries. However, several wildland fires have occurred within a 50-mile radius of the designated area (see Section 5.3.8.3). There is potential for wildland/urban interface fires within the SBCFSA.

Wildland fire hazard areas were identified using a model incorporating slope, aspect, and fuel load (See Figure 5-12). South-facing, steep, and heavily vegetated areas were assigned the highest fuel values while areas with little slope and natural vegetation were assigned the lowest fuel risk values. Risk levels of low, moderate, high, and extreme were assigned to the entire region based on the results of this modeling.

The SBCFSA has critical facilities and infrastructure located within areas of low, moderate, and high risk:

Low Risk Areas Contain:

- 892 residences (approximate value \$217,771,800)
- Eight government/emergency response facilities (approximate value \$7,071,600)
- Five educational facilities (approximate value \$87,833,700)
- Two medical care facility (approximate value \$4,576,000)
- 15 community facilities (approximate value \$49,698,200)
- 15 bridge facilities (approximate value unknown)
- Five transportation facilities (approximate value \$34,489,500)
- Two utilities (approximate value \$4,098,000)

Moderate Risk Areas Contain

- 968 residences (approximate value \$375,945,900)
- One government/emergency response facilities (approximate value \$322,700)
- One educational facilities (approximate value \$33,928,900)
- One medical care facility (approximate value \$2,169,400)
- Eight community facilities (approximate value \$51,091,100)
- 10 bridge facilities (approximate value unknown)
- One transportation facilities (approximate value \$2,116,200)

High Risk Areas Contain

- 59 residences (approximate value \$79,983,900)
- One bridge facilities (approximate value unknown)

The SBCFSA anticipates that impacts to future populations, residences, critical facilities, and infrastructure are at the same historical impact level.

## 6.8 FUTURE DEVELOPMENT

### 6.8.1 Future Land Use

To represent future land use scenarios, additional points were added to the User-Defined Facility (UDF) data in locations where growth is expected during five and ten year build-out scenarios.

An additional 425 structures were added by the 10-year build-out scenario to the UDF data as summarized in Table 6-12.

Table 6-12 lists data used to develop future structure models for the SBCFSA.

**Table 6-12 Additional Future Structures Modeled with Hazus User Defined Facilities**

Occupancy Type	Total Structure Count	Total Structure Replacement Value <sup>1</sup>	Total Contents Replacement Value <sup>1</sup>
Residential	414	\$100,227,000	\$50,113,000
Commercial and Industrial	11	\$8,464,000	\$12,696,000
Other <sup>2</sup>	0	\$0	\$0
<b>Total</b>	<b>425</b>	<b>\$108,691,000</b>	<b>\$62,809,000</b>
<sup>1</sup> 2012 Dollars from RSMeans 2012 Residential Cost Data and Light Commercial Cost Data.			
<sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.			

The additional residential structures are assumed to be 2,000 square foot single family residences and the additional non-residential structures are 5,000 square foot industrial structures. See Appendix K for figures depicting the future build-out scenarios.

The City of Seward 2020 Comprehensive Plan (CSP 2005a) describes their Future Land Use goals as:

*3.2.1 Promote residential and commercial development within the city of Seward and its vicinity in accordance with community values.*

*3.2.1.1 Manage land use to facilitate economic development while maintaining the historic, small town character of Seward.*

- *Use city-owned land and tidelands to encourage feasible and sound economic development by setting development standards and performance periods through the leasing process.*
- *Evaluate for disposal city-owned lands which have not or will not be dedicated to a public purpose.*
- *Develop infrastructure and utility expansion plans for currently undeveloped residential and commercial property, including ways to reduce service costs once operational.*
- *Evaluate ordinance requirements and provide incentives for property owners that balance economic development with design that is compatible with the historic character of Seward, and provides amenities such as landscaping and adequate parking.*
- *Ensure uniform and consistent enforcement of the zoning code, building code, subdivision ordinance, and city lease agreements, and evaluate potential code changes to make enforcement easier.*
- *Improve methods of communicating and achieving development requirements in each zoning district by preparing information packets that include: construction permits, code requirements, and means of minimizing pollution and drainage problems; and by streamlining the plan approval and building inspection processes.*
- *Revise the Resource Management District to require rezoning before development for residential, commercial or industrial use.*

- *Evaluate reducing the number of zoning districts by combining Urban Residential and Office Residential.*
- *Make code changes to allow more reasonable rebuilding of nonconforming uses after fire or other significant damage or allow expansion of non-conforming uses to a limited extent.*
- *Support the on-going dialogue with the Alaska Railroad Corporation and the State of Alaska regarding the status and disposition of their undeveloped lands.*
- *Find land suitable for cemetery expansion.*
- *Research Conservation options for environmentally sensitive areas.*

(CSP 2005a)

The Kenai Peninsula Borough's Comprehensive Plan 2020 (KPB 2005) describes their Land Use Goals as follows (overarching goals are listed below, while additional goal objectives and specific implementation actions can be seen within the Plan in Chapter 6, "Land Ownership, Management and Use", pages 32-38) as:

#### ***Borough Land Management***

- *To obtain clear title to and manage or dispose of borough-owned land, timber and gravel resources for the benefit of borough residents.*
- *To support efforts to foster responsible agricultural growth and diversity in the Kenai Peninsula Borough.*
- *To ensure that the interests of the Borough and its residents are adequately considered in management decisions regarding state and federal land within the Borough.*

#### ***Private Land***

- *To increase public access to knowledge and information about land characteristics and the location of existing land uses.*
- *To maintain the freedom of property owners in rural areas of the Borough to make decisions and control use of their private land consistent with other goals and objectives of this Comprehensive Plan.*
- *To reduce conflicts arising from incompatible land uses outside of incorporated cities.*
- *To assess and help identify wetlands, floodplains, erosion prone areas, and landslide or avalanche zones.*

(KPB 2005)

#### **6.8.1.1 Future Critical Facilities and Infrastructure**

Immediate plans for future development in the SBCFSA includes: Seward marina upgrades, harbor and vessel security, Seawater Intake Pipelines Bio-fouling Remediation, Alutiq Pride Shellfish Hatchery Repairs and Upgrade, Dredging Cruise Ship Berthing Basins and Approaches, and the Seward community library and museum construction.



### 6.8.1.2 Planned and Funded Projects

Table 6-12 delineates the SBCFSA's, City of Seward's, and KPB's future, planned, and funded projects that pertain to the project area; and their tentative completion status.

**Table 6-12 Planned and Funded Projects**

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
Division of Community and Regional Affairs (DCRA)	2011	Funded	Mooring Dolphins and Dock Improvements at Seward Marine Center - Comments: Legislative - lengthen a dock and affix mooring structures	Preliminary	\$2,000,000
DCRA	2011	Funded	Security and Fire Protection for Commercial Passenger Vessels - Comments: Legislative - security float; previous funding \$2,202,505	Pending	\$5,202,505
DCRA	2011	Funded	Commercial Passenger Vessel Harbor Security - Coast Guard Building Relocation - Comments: Legislative - relocate building	Pending	\$300,000
DCRA	2011	Funded	Seward - Community Library (HD 33-35) - Comments: Legislative - Seward Community Library/ Museum Facility; previous funding \$1,080,000	Preliminary	\$10,000,000
DCRA	2011	Funded	Alaska Community Foundation - Jesse Lee Home Restoration - Comments: Legislative Grant - Restore residential charter school. Prior Year Funding History: FY 09 - \$ 500,000, project dates 07/01/2010 - 06/30/2015.	Preliminary	\$1,500,000
DCRA	2011	Funded	Alaska Sealife Center - Seawater Intake Pipelines Biofouling Remediation - Comments: Legislative Grant - renovate saltwater intake system and relocate freshwater pumping system	Completed	\$1,000,000
DCRA	2011	Funded	Alutiq Pride Shellfish Hatchery Repairs and Upgrade - Comments: Legislative Grant - replace lighting system; completion fall 2010	Preliminary	\$150,000
DCRA	2010	Funded	Dredging Cruise Ship Berthing Basins and Approaches - Comments: Legislative Grant - Dredge the berthing basins and approaches to the berths to accommodate the larger class vessels.	Preliminary	\$4,500,000
DCRA	2010	Funded	Bus Transportation Assistance for Cruise Ship Passengers. - Comments: Legislative Grant - Transportation Assistance to Cruise Ship Passengers for bus transportation assistance to cruise ship passengers.	Preliminary	\$167,000
Department of Transportation and Public Facilities (DOT/PF)	2010	Funded	Regulator Building - Comments: Replace regulator building at Seward Airport.	Preliminary	\$330,000
Alaska Energy Authority / Alternative	2010	Funded	Fourth of July Creek Hydroelectric Recon-Hydro - Comments: OTHER FUNDING:	Preliminary	\$40,000

Table 6-12 Planned and Funded Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
Energy And Energy Efficiency (AEA-AEEE)			Federal		
Alaska Native Tribal Health Consortium (ANTHC)	2009	Funded	Employee parking lot paving at the Northstar Health Clinic in Seward, Alaska.	Preliminary	\$57,210
DOT/PF	2009	Funded	Seward Highway Maintenance Station Replacement - Comments: Legislative Grant	Preliminary	\$3,200,000
Department Of Natural Resources (DNR)	2008	Funded	Jesse Lee Home Preservation - Comments: Legislative Grant Jesse Lee Home Preservation	Preliminary	\$1,000,000
Department Of Environmental Conservation (DEC) Municipal Matching Grants And Loans (MGL)	2004	Funded	Water Source Study - Comments: Identify and preliminary design for compliance with new drinking water regulations	Preliminary	\$142,571
DCRA	2009	Funded	Fish Ditch Restoration - Comments: Legislative Grant	Contract	\$61,250
Economic Development Administration (EDA)	2007	Funded	Marine Safety and Fire training bldg. - Comments: Construction Grants	Contract	\$3,350,000
Federal Aviation Administration (FAA)	2005	Funded	Rehabilitate Runway - Comments: Other funding: DOT/PF	Contract	\$42,000
FAA	2005	Funded	Rehabilitate Runway - Comments: Other funding: DOT/PF	Contract	\$52,500
FAA	2004	Funded	Conduct Airport Master Plan Study - Comments: Other funding: DOT/PF	Contract	\$381,044
EDA	2004	Funded	AVTEC Technology Center - Comments: A new 10,000 sq. ft. facility on the Seward campus to house distance education training programs. Estimated 730 job trainees in first two years; significant \$ anticipated	Contract	\$2,622,272
US Army Corps of Engineers (USACE)	2003	Funded	Harbor/Construction Phase (Ph) 2 - Comments: Construct a new rubble mound breakwater east of the existing harbor, demolish a portion of the existing east and south rubble mound breakwaters, construct a new south rubble mound breakwater head. Dredge, excavate and dispose of material for a new entrance channel and mooring areas. Place dredged material in 2 inter-tidal, 1 sub-tidal and 1 deep-water disposal areas within the immediate vicinity. Construct the existing entrance channel closure. Construct various rock layers to provide slope protection for dredged cut slopes and disposal areas.	Contract	\$8,468,050
USACE	2002	Funded	Lowell Creek Tunnel Repair - Comments: Repair of approximately 2100 feet of tunnel invert of the Lowell Creek Flood Control	Contract	\$1,030,000

Table 6-12 Planned and Funded Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
			Project.		
DOT/PF	2010	Funded	Seward Road Improvements - Comments: Rehabilitate or improve various City streets or roads Seward Road Improvements	Design	\$5,000,000
DOT/PF	2006	Funded	Kenai Fjords National Park - Comments: Recondition and pave 1.5 miles of the Exit Glacier road and loop parking area within Kenai Fjords National Park.	Design	\$261,000
Alaska Department of Education and Early Development (DEED)	2003	Funded	Seward Middle School Replacement - Comments: Debt reimbursement at 70%	Design	\$21,000,000
DOT/PF	2002	Funded	Seward Hwy: Scenic Byway Interpretive Sites, Ph 2 - Comments: Planning, design, and construction of six interpretive sites between MP 18-91 of the Seward Highway Scenic Byway, along with a series of route and site identifier signs along the entire length.	Design	\$3,185,000
DCRA	2012	Funded	Kitchen Expansion Project	Construction	\$100,000
Denali Commission (Denali)	2010	Funded	Alaska Vocational Technical Center (AVTEC) Seward Wind Turbine - Comments: To purchase and install a 100 kilowatt (kW) wind turbine at AVTEC campus in Seward for wind technician training	In-Progress	\$1,011,288
AEA- Legislative Grant (LEG)	2009	Funded	Purchase Backup Generators - Comments: Legislative Grant State Legislative Action (SLA) 2008, Page 61, Line 25-27	Construction	\$2,000,000
DCRA	2009	Funded	Road/Levee Construction - Comments: Legislative Grant	Construction	\$1,750,000
DCRA	2008	Funded	Levee Construction - Comments: Legislative Grant - Grants to Municipalities	Construction	\$1,000,000
AEA-Rural Power System Upgrade (RPSU)	2007	Funded	AVTEC Switchgear upgrade and compatibility - Comments: OTHER FUNDING: Denali Commission \$220,000. Upgrade AVTEC Switchgear equipment so trainees can learn on equipment they will most likely encounter in new power plants.	Construction	\$220,000
DCRA	2006	Funded	Seward Elementary Gym Floor and Carpet Replacement - Comments: Legislative Grant Seward Elementary Gym Floor and Carpet Replacement	Construction	\$170,000
DOT/PF	2002	Funded	Port Avenue Rehabilitation - Comments: Resurface Port Avenue (aka Dock Road) from the Seward Highway (MP 0.0) to the end of the paved road (MP 0.4).	Construction	\$2,695,000
DOT/PF	2001	Funded	Harbor Expansion - Comments: Pending federal appropriation	Construction	\$12,341,000
Denali	2010	Funded	Providence Seward Medical & Care Center Electronic Health Records - Comments:	In-Progress	\$599,984

Table 6-12 Planned and Funded Projects

Lead Agency	Fiscal Year	Project Status	Project Description/Comments	Project Stage	Total Cost
			Authorized ASHNHA to proceed with funding the Providence Seward Medical & Care Center Electronic Health Records project, fully described in Seward Medical & Care Center's FY2010 Primary Care in Hospitals (PCIH) application.		
Denali	2009	Funded	Alaska Sea life Center Seawater Heat Pump Demonstration Project - Comments: The project includes the design and installation of a seawater heat pump, utilizing the existing seawater intake system, to lift latent heat from raw seawater in Resurrection Bay at temperatures ranging from 37 degrees Fahrenheit (°F) to 55 °F and transfer the energy into building heat at a temperature of 120 °F, to demonstrate that seawater heat pumps can provide financial and environmental benefits.	In-Progress	\$479,685

(DCRA 2013)

The Kenai Peninsula Borough (KPB) produces a Comprehensive Plan as part of its planning requirements, the most recent of which was adopted in 2005. One of the stated primary purposes of the Comprehensive Plan is to “Describe existing and expected future conditions in the Borough during the planning period” (KPB 2005) For the most recent Comprehensive Plan, that period is 2005 to 2015. Seward city also produces a Comprehensive Plan for areas within the city boundaries, the most recent being the City of Seward 2020 Comprehensive Plan, which was produced in 2005. For reasons including the KPB and Seward city planning periods and forecasts, this HMP has chosen to look at development trends within the SBCFSA for two build-out scenarios: a 5-year scenario (2017), and a 10-year scenario (2022).

An additional resource that will be used to support choices made in the build-out scenarios discussed below is the KPB “Municipal Entitlement Land Selection Finalization Project 2013”. Based on the Mandatory Borough Act of 1964 and the 1978 Municipal Entitlement Act, A.S. 29.65.10, the KPB is still entitled to receive 28,000 acres of its original allocation of 155,780 acres. Areas within the SBCFSA

The purpose of developing proposed build-out scenarios is to anticipate future change in land use, where possible, within the SBCFSA in order to be able to create plans according to the most informed development trends. In addition, by considering projected build-out scenarios planners increase their ability to reduce vulnerability and develop appropriate mitigation strategies given the projected future land use scenarios. Build-out scenarios are, by nature, based on best available information from State, Borough, and City plans and officials, as well as historical trends, and are not meant to be anything more than potential scenarios for consideration. Instead of representing what *will* happen, build-out scenarios represent what *could* happen, so that planners can consider potential future scenarios within their planning area.

The two future build-out scenarios below assess trends and patterns to project potential changes in types of land use (e.g. residential, commercial, industrial, natural), density of development (e.g., low, medium, high), and location of development.

### **5-Year Build-Out Scenario (2017)**

In its 2005 Comprehensive Plan, KPB presents low-growth rate for the Boroughs population through 2018, as projected by State of Alaska Department of Labor and Workforce Development in 1998 (20-year projection) and the Institute of Social and Economic Research in 2001 (25-year projection), citing “significant development projects are not envisioned in the near future” (KPB 2005)

For the most part, Seward city is currently built out to its fullest potential within city boundaries. Most city land is currently developed to the extent that it can be developed, given the city’s boundaries and geographic constraints (e.g. steep mountains to the west, Resurrection River valley to the north, Resurrection Bay, etc.). There are no current or future plans for a change in the city’s ratio of residential to non-residential housing. Though there are significant initiatives occurring within Seward (i.e., expansion of Institute of Marine Sciences; new AVTEC dormitories; opening of new Library in 2013; etc.), there is little projection of significant change to the city’s footprint in the 5-year build-out scenario.

The lone exception to this is the potential development at Seward Marine Industrial Center (SMIC). Within Seward city boundaries, along the east coast of Resurrection Bay is the industrial complex called SMIC, which contains docks, boat lift, upland staging/repair, utility, and wastewater treatment facilities. In 2008 Seward City Council passed a new resolution (2008-33) adopting the current SMIC Development Plan. The purpose of this Plan is to encourage and promote private sector growth and development at the SMIC. Currently, there are acres available for lease and development. SMIC is currently zoned as industrial. Current initiatives exist to encourage the Coastal Villages Regional Fund (CVRF) to move its entire fleet of fishing vessels from Seattle, WA to Seward and potentially the SMIC site. In 2012, the decision was made to park 5 of CVRF’s vessels in Seward, and there are ongoing discussions about moving the remaining vessels to Seward, as well (CVRF 2012). The State of Alaska has included \$10 Million dollars for Seward’s port project in its transportation bond package, which was passed by voters in early November, 2012. If this port expansion plan were to occur, it is possible that it would begin within the 5-year build out scenario. If this were the case, though, the full development would more likely be achieved within the 10-year build out scenario.

Outside of Seward city limits there is a much higher chance for residential development to occur within SBCFSA limits within the 5-year build out scenario. Infill within some existing subdivisions is likely, as are the developments of new subdivisions. Based on recent trends, current platting, and current development, our analysis suggests that single-family residential developments could occur within Forest Acres Subdivision; Phase 5 of the Nash Woods Subdivision; the Rough Subdivision; and a long Beach Drive. These are represented in the figure below.

Maps K-7a and K-7b, in Appendix K, present the projected land use development within the SBCFSA for the 5-year build out scenario.

### **10-Year Build-Out Scenario (2022)**

Within a 10-year period, there is greater likelihood for additional development in the SBCFSA, both within Seward city limits as well as outside of city limits.

As was discussed in the 5-year build out scenario, the SMIC port project is the major development initiative occurring within Seward's city limits. Within the 10-year build out scenario it is possible that the SMIC area will have developed with industrial facilities to its capacity. In doing so, and in brining CVRF fishing vessels to Seward, the potential exists for a need for additional housing development. If this were to occur, it is most likely that residential development would occur on the area north of SMIC at the 4<sup>th</sup> of July Creek Subdivision #2, locally known as the Nash Road Bench Area. The terrain directly east of Nash Road is very steep, but above this area is a bench, which is where it is most likely that single family residential houses would be developed. This can be seen in Appendix K, Map K-7b.

Furthermore, there is the potential for limited additional residential build-out within Seward city limits in the 10-year forecast. Several parcels of land could follow adjacent parcel trends and become single-family residential subdivisions in this time period. For the purpose of this Plan, parcels that could potentially be developed in the 10-year scenario include the Gateway subdivision.

Outside of Seward city limits there remains a much higher chance for residential development to occur within SBCFSA limits within the 10-year build out scenario. Infill within some existing subdivisions is likely, as are the developments of new subdivisions. In addition, Kenai Peninsula Borough is in the process of a "Municipal Entitlement Land Selection Finalization Project 2013" (<http://www.borough.kenai.ak.us/landmgt/entitlements/projectinformation>), which will provide additional developable land to the KPB in the SBCFSA. This LHMP, based on referenced Plans, discussions with planners, and the "Municipal Entitlement Land Selection Finalization Project 2013", has identified the Subdivisions of Clan Maxwell, Lost Lake, and Bryson, in addition to the parcels surrounding the north and east of Bear Lake, as well as the area known as "Blueberry Hill", as potential developments within the 10-year build out scenario.

Maps K-7a and K-7b, in Appendix K, present the projected land use development within the SBCFSA for the 10-year build out scenario.



## 7.1 MITIGATION STRATEGY OVERVIEW

This section outlines the six-step process for preparing a mitigation strategy including:

1. Identifying each jurisdiction's existing authorities for implementing mitigation action initiatives
2. NFIP Participation
3. Developing Mitigation Goals
4. Identifying Mitigation Actions
5. Evaluating Mitigation Actions
6. Implementing Mitigation Action Plans

DMA requirements for developing a comprehensive mitigation strategy include:

DMA 2000 Requirements
<p><b>Identification and Analysis of Mitigation Actions</b></p> <p><b>§201.6(c)(3):</b> [The plan shall include the following:] A <i>mitigation strategy</i> that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing tools.</p> <p><b>§201.6(c)(3)(i):</b> [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.</p> <p><b>§201.6(c)(3)(ii):</b> [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.</p> <p><b>§201.6(c)(3)(iii):</b> [The hazard mitigation strategy shall include an] action plan, describing how the action identified in paragraph (c)(3)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.</p> <p><b>§201.6(c)(3)(iv):</b> [For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.</p> <p><b>Requirement §201.6(c)(4):</b> [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvements, when appropriate.</p>
<b>ELEMENT C. Mitigation Strategy</b>
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs?
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? <i>(Addressed in Section 6.4)</i>
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards?
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure?
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction?

DMA 2000 Requirements
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate?
Source: FEMA, October 2011.

## 7.2 IMPLEMENTATION THROUGH EXISTING PLANNING MECHANISMS

The requirements for implementation through existing planning mechanisms, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements
<b>Incorporation into Existing Planning Mechanisms</b> §201.6(c)(3): [The plan shall include the following:] A <i>mitigation strategy</i> that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing tools.
<b>ELEMENT C. Incorporate into Other Planning Mechanisms</b>
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs?
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate?
Source: FEMA, October 2011.

## 7.3 SBCFSA CAPABILITY ASSESSMENT

The SBCFSA's capability assessment reviews the technical and fiscal resources available to the special service area. This section outlines the resources available to the SBCFSA for mitigation and mitigation related funding and training. Tables 7-1, 7-2, and 7-3 delineate the SBCFSA's regulatory tools, technical specialists, and financial resource available for project management. Additional funding resources are identified in Appendix B.

**Table 7-1 SBCFSA's Regulatory Tools**

Regulatory Tools (ordinances, codes, plans)	Existing?	Comments (Year of most recent update; problems administering it, etc.)
Comprehensive Plan	Yes	Kenai Peninsula Borough Comprehensive Plan, June 2005, defines the Borough's land use, housing, economic development, and natural hazard trends and impacts.
Comprehensive Plan	Yes	City of Seward, 2020 Comprehensive Plan, Volume I, July 29, 2005, Defines the City's land use, housing, economic development, and natural hazard trends and impacts.
Economic Development Plan	Yes	Kenai Peninsula Borough Situations and Prospects, Economic Trends for Year Ending December 31, 2006
Land Use Plan	Yes	Within both KPB and Seward's Comprehensive Plans

**Table 7-1 SBCFSA's Regulatory Tools**

Regulatory Tools (ordinances, codes, plans)	Existing?	Comments (Year of most recent update; problems administering it, etc.)
Emergency Response Plan	Yes	Both KPB and Seward possess approved EOPs.
Wildland Fire Protection Plan	No	
Building code	Yes	City of Seward has building code.
Zoning ordinances	Yes	City of Seward has zoning ordinances.
Subdivision ordinances or regulations	Yes	City of Seward has subdivision ordinances.
Special purpose ordinances	No	The SBCFSA can exercise this authority.

### Local Resources

The SBCFSA has access to KPB's fiscal, planning, and land management staff that will allow it to implement hazard mitigation activities. The resources available in these areas have been assessed by the hazard mitigation Planning Team, and are summarized below.

**Table 7-2 SBCFSA's Technical Specialists for Hazard Mitigation**

Staff/Personnel Resources	Y/N	Department/Agency and Position
Planner or engineer with knowledge of land development and land management practices	No	The SBCFSA works with the KPB Land Resources Staff.
Engineer or professional trained in construction practices related to buildings and/or infrastructure	No	The SBCFSA works with the City of Seward and KPB engineers on an as needed basis.
Planner or engineer with an understanding of natural and/or human-caused hazards	No	The SBCFSA works with the City of Seward and KPB planners and engineers on an as needed basis.
Floodplain Management	Yes	KPB: Floodplain Administrator SBCFSA: Water Resource Manager, Flood Service Area Coordinator, Certified Floodplain Manager (CFM) with extensive floodplain and land management experience.
Surveyors	No	The SBCFSA works with the City of Seward and KPB engineers on an as needed basis.
Staff with education or expertise to assess the jurisdiction's vulnerability to hazards	No	The SBCFSA works with the City of Seward Fire Chief and Public Works Director and the KPB Emergency Manager to address hazard vulnerabilities.
Personnel skilled in Geospatial Information System (GIS) and/or HAZUS-MH	No	The SBCFSA works with the City of Seward and KPB GIS and land resources staffs on an as needed basis.
Scientists familiar with the hazards of the jurisdiction	No	The SBCFSA works with the U.S. Fish & Wildlife Service local office; Alaska Dept. of Fish & Game local office, the UAF, and USGS.

Emergency Manager	No	The SBCFSA works with the City of Seward Fire Chief and Public Works Director and the KPB Emergency Manager to address hazard vulnerabilities.
Finance (Grant writers)	Yes	SBCFSA: Water Resource Manager, Flood Service Area Coordinator with extensive grant writing, floodplain, and land management experience.
Public Information Officer	Yes	The SBCFSA Board of Directors manages these duties either singly or along with the City of Seward and KPB Public Information staffs on an as needed basis.

**Table 7-3 Financial Resources Available for Hazard Mitigation**

Financial Resource	Accessible or Eligible to Use for Mitigation Activities
General funds	Limited funding, can exercise this authority with voter approval
Community Development Block Grants	Not available to the SBCFSA
Capital Improvement Projects Funding	Limited funding, can exercise this authority with voter approval
Authority to levy taxes for specific purposes	Limited funding, can exercise this authority with voter approval
Incur debt through general obligation bonds	Can exercise this authority with voter approval
Incur debt through special tax and revenue bonds	Can exercise this authority with voter approval
Incur debt through private activity bonds	Can exercise this authority with voter approval
Hazard Mitigation Grant Program (HMGP)	FEMA funding which is available to local and tribal communities and special service areas after a Presidentially-declared disaster. It can be used to fund both pre- and post-disaster mitigation plans and projects.
Pre-Disaster Mitigation (PDM) grant program	FEMA funding which is available on an annual basis. This grant can only be used to fund pre-disaster mitigation plans and projects.
Flood Mitigation Assistance (FMA) grant program	FEMA funding which is available on an annual basis. This grant can be used to mitigate repetitively flooded structures and to provide infrastructure to protect repetitively flooded structures.
United State Fire Administration (USFA) Grants	The purpose of these grants is to assist state, regional, national or local organizations to address fire prevention and safety. The primary goal is to reach high-risk target groups including children, seniors and firefighters.
Fire Mitigation Fees	Finance future fire protection facilities and fire capital expenditures required because of new development within Special Districts.

The Planning Team developed the following mitigation goals and potential mitigation actions for the SBCFSA within Section 7.4 and 7.5 respectively.

## 7.4 DEVELOPING MITIGATION GOALS

The requirements for the local hazard mitigation goals, as stipulated in DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements	
<b>Local Hazard Mitigation Goals</b>	
§201.6(c)(3)(i): The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.	
<b>ELEMENT C. Mitigation Goals</b>	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards?	
Source: FEMA, October 2011.	

The exposure analysis results were used as a basis for developing the mitigation goals and actions. Mitigation goals are defined as general guidelines that describe what a community wants to achieve in terms of hazard and loss prevention. Goal statements are typically long-range, policy-oriented statements representing community-wide visions. As such, eleven goals were developed to reduce or avoid long-term vulnerabilities to the identified hazards (Table 7-4). In addition to considering historic and current hazards, these goals consider and reflect information gained from a comprehensive assessment of projected hazards resulting from potential climate change and associated impacts to the SBCFSA and surrounding region.

The Mitigation Action Plan (MAP) is made more robust by considering potential future climate change and its effect on local and regional hazards as planners and decision makers can make informed decisions today that will reduce future vulnerability and decrease the risk of harm or damage.

**Table 7-4 Mitigation Goals**

No.	Goal Description
<b>Multi-Hazard</b>	
1	Promote recognition and mitigation of all natural hazards that affect the SBCFSA.
2	Promote cross-referencing mitigation goals and actions with other SBCFSA, City of Seward, and KPB planning mechanisms and projects.
3	Reduce vulnerability, damage, or loss of structures from all natural hazards that affect the SBCFSA.
<b>Natural Hazards</b>	
4	Reduce vulnerability, damage, or loss of structures from <b>earthquake</b> damage.
5	Reduce vulnerability, damage, or loss of structures from <b>erosion</b> .
6	Reduce vulnerability, damage, or loss of structures from <b>flood</b> .
7	Reduce vulnerability, damage, or loss of structures from <b>ground failure</b> .

Table 7-4 Mitigation Goals

No.	Goal Description
8	Reduce vulnerability, damage, or loss of structures from <b>tsunami or seiche</b> .
9	Reduce vulnerability, damage, or loss of structures from <b>volcanic debris</b> impacts
10	Reduce vulnerability, damage, or loss of structures from <b>severe weather</b> damage.
11	Reduce vulnerability, damage, or loss of structures from <b>wildland fire</b> .

The Planning Team then developed the new MAP listing only those projects that remained as ongoing, deferred, and newly implemented mitigation actions.

## 7.5 IDENTIFYING MITIGATION ACTIONS

The requirements for the identification and analysis of mitigation actions, as stipulated in DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements
<b>Identification and Analysis of Mitigation Actions</b> §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.
<b>ELEMENT C. Mitigation Actions</b>
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure?
Source: FEMA, October 2011.

After mitigation goals and actions were developed, the Planning Team reviewed the current FHMP and assessed the existing as well as potential new mitigation actions to carry forward into the MAP. Mitigation actions are activities, measures, or projects that help achieve the goals of a mitigation plan. Mitigation actions are usually grouped into three broad categories: property protection, public education and awareness, and structural projects.

### 7.5.1 Determine Existing HMP's Mitigation Strategy's Progress

#### 7.5.1.1 Mitigation Action Progress-HMP Update

FEMA requires that HMP Updates define the status of their prior existing HMP's Mitigation projects, action items, and activities. The jurisdiction must indicate whether the actions were completed, deleted, or deferred with an explanation for any change in their status. The Planning Team determined to label activities as either "ongoing" or "new" projects as well as "deferred", or "deleted".

#### 7.5.1.2 Updated HMP's Mitigation Action Plan Report (Status)

The SBCFSA 2010 Flood Hazard Mitigation Plan listed 52 mitigation action items selected for implementation for the plan's five year planning cycle. On March 13, 2013, the Planning Team



reviewed the existing actions depicted in Table 7-5 below (in blue text). The review found action items completed, completed but still ongoing, ongoing, deleted, and newly considered action items. Many actions were analyzed and combined for greater applicability for an all-hazards approach.

The Planning Team placed particular emphasis on projects and programs that support their HMP goals; reduce the impacts of multiple hazards that address infrastructure, the built environment (both new and existing), and actions that assure the SBCFSA maintains NFIP compliance. They also considered actions concerning:

- Future Development: actions that would prevent new residential and/or critical facility siting within identified or potential hazard impact areas.
- Land Use: potential development in light of current and future hazard conditions.
- Climate Change: future hazard conditions (e.g. type, frequency, intensity, location of hazard) dependent upon future climate change scenarios

On March 13, 2013, the Planning Team reviewed a comprehensive list of 85 potential mitigation actions that would potentially reduce natural hazard impacts within and surrounding the SBCFSA. The SBCFSA, City of Seward, and KPB identified their respective “ongoing” projects from within the list to demonstrate their continuous commitment to protecting people and facilities from potential damage and loss.

Table 7-5 provides the Potential Projects list as they apply to each stated hazard mitigation goal.

**Table 7-5 Mitigation Goals and Potential Actions**

*(Blue text items are the SBCFSA’s pre-identified 2010 Mitigation Action Items)*

Goals		Actions		
No.	Description	Status: <i>Considered, Selected Complete, Deferred, Deleted, or Ongoing</i>	Authority	Description
MH 1	Promote recognition and mitigation of all natural hazards that affect the SBCFSA.	O	FSA	Develop a strategy for accessing (applying for and managing) mitigation grant funds
		O	FSA	Organize a Floodproofing Workshop for Homeowners and Businesses to learn about techniques and funding sources for elevating, and floodproofing structures (agency(ies) to participate – USACE Floodproofing Committee, FEMA, DCCED; Businesses to support SBS, Wells Fargo, others)
		O	FSA	Strive to formalize a Hazard Mitigation Planning Team to develop a sustainable process for implementing, monitoring, reviewing, and evaluating community wide mitigation actions.
		O	FSA, City, KPB	Hold periodic outreach events or activities to educate population concerning existing natural hazards. Activities are designed to provide pertinent natural hazards information to residents about recognizing and mitigating hazards that could potentially affect the SBCFSA. Potential subjects could include: benefits of participating in the NFIP; safe “FireWise” practices; river, stream or creek levee or channel breach; tsunami warnings and response; other emergency management

**Table 7-5 Mitigation Goals and Potential Actions***(Blue text items are the SBCFSA's pre-identified 2010 Mitigation Action Items)*

Goals		Actions		
No.	Description	Status: <i>Considered, Selected Complete, Deferred, Deleted, or Ongoing</i>	Authority	Description
				focused subjects; etc.)
		O	KPB	Develop an outreach program to educate the public concerning NFIP participation benefits, floodplain development, land use regulation, and NFIP flood insurance availability to facilitate continued compliance with the NFIP.
		O	FSA, City, KPB	Develop, produce, and distribute information materials concerning mitigation, preparedness, and safety procedures for all identified natural hazards.
		O	FSA, City, KPB	Develop and implement strategies and educational outreach programs for debris management from natural hazard events.
		O	City, KPB	Review ordinances and develop outreach programs to assure fuel or propane tanks are properly anchored and hazardous materials are properly stored and protected from known natural hazards such as flood or seismic events.
		O	FSA, City, KPB	Disseminate FEMA pamphlets to educate and encourage homeowners concerning structural and non-structural retrofit benefits.
		O	FSA, City, KPB	Develop outreach program to educate residents concerning all-hazard benefits of modern building code compliance during rehabilitation or major repairs for residences or businesses.
		O	KPB	Develop outreach program to educate residents concerning flood proofed well and sewer/septic facility installations.
		O	City, KPB	Update public emergency notification procedures and develop an outreach program for potential hazard impacts or events.
		O	FSA	Disseminate information to increase public knowledge about flood insurance, and the natural and beneficial floodplain functions.
		O	FSA, City, KPB	Identify critical facilities and vulnerable populations based on identified (and mapped where applicable) high hazard areas.
		O	FSA, City, KPB	Identify evacuation routes away from high hazard areas and develop outreach program to educate the public concerning warnings and evacuation procedures.
		O	City, KPB	Acquire emergency warning methods to communicate critical emergency warnings and alerts. City uses radios, cell phones, alert sirens, etc.
		O	City, KPB	Implement 911 reverse call to notify residents
MH 2	Promote cross-referencing mitigation goals and actions with other SBCFSA, City of Seward, and KPB planning mechanisms and projects.	Deleted	Replaced with Similar Action	Express concern and provide recommendations to the appropriate agencies.
		O	FSA (Reworded)	Establish a cooperative relationship with the City of Seward to ensure hazard mitigation efforts are not being duplicated or opportunities missed.
		O	FSA (Reworded)	Coordinate with the Kenai Peninsula Borough and other appropriate agencies to obtain funding and permitting to establish an annual maintenance schedule and contract to remove excess debris throughout the SBCFSA.
		O	City, KPB (Reworded)	Develop, implement, and improve enforcement of floodplain management ordinances.
		O	City, KPB	Prohibit below grade crawlspaces and basements throughout the Service

**Table 7-5 Mitigation Goals and Potential Actions***(Blue text items are the SBCFSA's pre-identified 2010 Mitigation Action Items)*

Goals		Actions		
No.	Description	Status: <i>Considered, Selected Complete, Deferred, Deleted, or Ongoing</i>	Authority	Description
				Area unless PE, architect or Professional Land Surveyor certifies that building site is not subject to flooding, localized drainage, or high ground water.
		O	City, KPB	Avoid building more new homes in the floodway (existing ordinance); revise floodplain ordinance to prohibit any new subdivision of land within the mapped floodplain.
		O	City, KPB	Increase enforcement including fostering a partnership (M.O.U.) for enforcement uniformly within the City and Borough specific to the SBCFSA.
		O	KPB	Review KPB Habitat Protection Ordinance for extension to Service Area for flood/erosion regulation purposes – recognizing gravel/sediment removal needs to continue. Modify ordinance to increase KPB enforcement and field staff.
		O	FSA, City, KPB	The SBCFSA will manage their existing plans to incorporate mitigation planning provisions into all service area planning processes such as comprehensive, capital improvement, and land use plans, etc. to demonstrate multi-benefit considerations and facilitate using multiple funding source consideration.
		O	FSA	Improve flood and erosion hazard aspects in land use decisions, subdivision actions, and Plans that affect the SBCFSA including: KPB All-Hazards Plan, Comprehensive Plan, Coastal Management; Wetlands Management Plan, Seward Long-term development plan.
		C	City, KPB	Develop process to regulate future development in potential high hazard areas (permitting, geotechnical review, soil stabilization techniques, etc.).
		O	City, KPB	Integrate the Mitigation Plan findings for enhanced emergency planning.
		O	FSA, City, KPB	Develop, incorporate, and enforce building ordinances to reflect survivability from flood, fire, wind, seismic, and other hazards to ensure occupant safety.
		O	City, KPB	Develop and incorporate mitigation provisions and recommendations into all community plans and community development processes to maintain protect critical infrastructure, residences, and population from natural hazard impacts.
		O	City, KPB	Update or develop, implement, and maintain jurisdictional debris management plans.
		O	FSA, KPB	Identify and list repetitively flooded structures and infrastructure, analyze the threat to these facilities, and raise mitigation action priorities to protect the threatened population.
		Deleted	Reworded for new action	The entirety of Resurrection River needs to be surveyed and a hydrologist report generated, starting at the mean-low mark working up to the headwaters at Exit Glacier.
		Deleted	Reworded for new action	Perform needed sediment bed load mapping and engineering analysis necessary to obtain permits for channel drainage maintenance.
		C	City, KPB	Develop prioritized list of mitigation actions for threatened critical facilities and other buildings or infrastructure.
		O	City, KPB	Update Emergency Response Plans to discuss volcanic ashfall, tsunami,

**Table 7-5 Mitigation Goals and Potential Actions***(Blue text items are the SBCFSA's pre-identified 2010 Mitigation Action Items)*

Goals		Actions		
No.	Description	Status: <i>Considered, Selected Complete, Deferred, Deleted, or Ongoing</i>	Authority	Description
				and stormwater event management; prioritize response actions; and initiate actions to fill capability gaps.
		C	City, KPB	Require construction companies to provide as-built plans once facilities are constructed.
		C	City, KPB	Develop a community-wide database of as-built plans to enable the community to keep track of existing infrastructure and to determine future requirements. This will eliminate expensive investigations to determine if existing utility infrastructure exists prior to new construction.
		S	FSA, City, KPB	Adopt the Risk MAP coastal velocity zone mapping studies into the floodplain code.
MH 3	Reduce vulnerability, damage, or loss of structures from all natural hazards that affect the SBCFSA.	O	City	Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.
		Deleted	Reworded -combined for all-hazards	Encourage the Kenai Peninsula Borough, the State of Alaska, the City of Seward and other interested Land Trusts to acquire and obtain land for floodplain conservation.
		Deleted	Reworded -combined for all-hazards	Support elevation, floodproofing, buyout or relocation of structures that are highest risk, repetitive losses or substantially damaged, or are in imminent threat of loss due to location on eroding banks.
		Deleted	Reworded -combined for all-hazards	Consider land swaps where appropriate.
		O	FSA, City, KPB	Relocate or acquire (buy-out and demolish) structures away from hazard prone area (erosion, flood, ground failure, etc.) Property deeds "must be" restricted for open space uses for perpetuity to keep people from rebuilding in known hazard areas.
		O	City	Harden utility headers located along river embankments to mitigate potential flood, debris, and erosion damages.
		O	City	Purchase and install generators with main power distribution disconnect switches for identified and prioritized critical facilities susceptible to short term power disruption. (i.e. first responder, medical facilities, schools, correctional facilities, and water and sewage treatment plants, etc.)
		O	FSA, City, KPB	Develop vegetation projects to restore clear-cut and riverine erosion damage and to restore slope stability in avalanche and landslide areas.
		O	City, KPB	Perform hydrologic and hydraulic engineering, drainage, and bed loading studies and analyses for each watershed. Use information obtained for feasibility determination and project design. This information should be a key component, directly related to a proposed project in order to qualify for FEMA funding.
		C	KPB	Develop a vegetation management plan addressing slope-stabilizing root strength to maintain or encourage precipitation containment.
		C	KPB	Develop land use guidelines to minimize vegetation removal to maintain slope stability to reduce rain, snowmelt run-off, and erosion.

**Table 7-5 Mitigation Goals and Potential Actions***(Blue text items are the SBCFSA's pre-identified 2010 Mitigation Action Items)*

Goals		Actions		
No.	Description	Status: <i>Considered, Selected Complete, Deferred, Deleted, or Ongoing</i>	Authority	Description
EQ 4	Reduce vulnerability, damage, or loss of structures from earthquake damage.	O	City	Evaluate critical public facilities with significant seismic vulnerabilities and complete retrofit. (e.g. evaluate fire stations, public works buildings, potable water systems, wastewater systems, electric power systems, and bridges, etc.)
		O	City	Inspect, prioritize, and retrofit any critical facility or public infrastructure that does not meet current State adopted Building Codes.
		C: O:	FSA City, KPB	Install non-structural seismic restraints for large furniture such as bookcases, filing cabinets, heavy televisions, and appliances to prevent toppling damage and resultant injuries to small children, elderly, and pets.
ER 5	Reduce vulnerability, damage, or loss of structures from erosion.	O	FSA, City, KPB	Develop mitigation initiatives such as: Rip-rap (large rocks), sheet pilings, gabion baskets, articulated matting, concrete, asphalt, vegetation, or other armoring or protective materials to provide river bank protection.
		O	FSA, City, KPB	Harden culvert entrance bottoms with, concrete, rock, or similar material to reduce erosion or scour.
		O	FSA, City, KPB	Install walls at the end of a drainage structure to prevent embankment erosion at its entrance or outlet. (headwalls- or wing-walls).
		S	FSA	Harden and/or retrofit existing levees to qualify for USACE certification.
FL 6	Reduce vulnerability, damage, or loss of structures from flooding.	O	FSA	Perform periodic river and stream bed-load removal
		O	FSA	Pursue federal and state funding to improve and update Flood Insurance Rate Maps (FIRMs), as well as other maps and plans that may be more appropriate such as Drainage Plans or watershed management plans in order to meet other goals. This should also include extending coastal floodplain mapping to Lowell Point.
		O	FSA (Reworded)	Work with the US Army Corp of Engineers (USACE) to develop a direct channel to direct water conveyance away from the three Seward Highway Bridges and the airport directing flow to Resurrection Bay.
		O	FSA (Reworded)	Work with USACE, NRCS, and State to pursue sediment and debris management at the mouth of the Resurrection River. This will reduce debris accumulation, encourage water movement from high to low areas; and lessen upstream flood potential.
		O	FSA, City, KPB	Develop and maintain NFIP-compliant Repetitive Loss property inventory. Inventory should include property type, structure type, number of buildings, and their geo-referenced locations.
		O	FSA, City, KPB	Establish flood mitigation priorities for critical facilities, residential structures, and commercial buildings located within the identified flood hazard area(s) (100- and 500-year floodplains, stormwater, etc.) based on current base flood elevation (BFE) and survey elevation data.
		O	FSA, City, KPB	Determine and implement most cost beneficial and feasible mitigation actions for locations with repetitive flooding, significant historical damages, or road closures.
		O	FSA (Reworded)	Pursue an exemption to the Alaska Department of Natural Resources (DNR) Material Sales Fees for sediment and debris management on navigable rivers and streams.
		O	FSA	Seek amendment or standing waiver for State Material Sales Fees for

**Table 7-5 Mitigation Goals and Potential Actions***(Blue text items are the SBCFSA's pre-identified 2010 Mitigation Action Items)*

Goals		Actions		
No.	Description	Status: <i>Considered, Selected Complete, Deferred, Deleted, or Ongoing</i>	Authority	Description
				stream channel maintenance wherein no fees are required from the permittee when activities are focused on maintaining flood carrying capacity.
		S	FSA, City, KPB	Work with State of Alaska Department of Natural Resources to resolve bed load resultant debris removal and financial constraints from Japanese Creek, Resurrection River, and other problematic streams within SBCFSA.
		O	FSA (Reworded)	Evaluate each watershed to develop land use plans for removing and storing creek bed load to: <ul style="list-style-type: none"> <li>• Perform periodic sediment management/bed load removal as necessary.</li> <li>• Identify and permit fill areas for future flood-free development sites.</li> <li>• Identify storage sites that limit gravel transportation costs.</li> </ul>
		S	FSA, City, KPB	Apply for grant funding to assist critical facilities, public infrastructure, and residential properties with elevating flood threatened structures at least two feet above the identified Base Flood Elevation (BFE).
		S	FSA, City, KPB	Acquire and maintain NOAA/NWS stream flow and rainfall measuring gages.
		O	FSA, City, KPB	Increase culvert sizes to increase their drainage capacity or efficiency. Specific locations that would benefit from this improvement include: <ul style="list-style-type: none"> <li>• Bear Creek at Bear Lake Rd</li> <li>• Grouse Creek at Timber Lane</li> <li>• Kwechak Creek at Bruno Road</li> <li>• Salmon Creek at Nash Road</li> <li>• Salmon Creek at the Alaska Railroad culvert northeast of Salmon Creek Road</li> <li>• Salmon Creek at Seward Highway MM 13.9</li> <li>• Salmon Creek at the Alaska Railroad adjacent to Seward Highway MM 13.9</li> <li>• Salmon Creek Overflow at Seward Highway and Granite Loop</li> <li>• Sawmill Creek at Nash Road</li> </ul>
		S	FSA, City, KPB	Construct debris basins or other debris catchment devices to retain debris to prevent downstream drainage structure clogging.
		S	FSA, City, KPB	Seek funding for sediment and debris management to remove excessive stream bed sediment load, gravel, and glacial debris.
GF 7	Reduce vulnerability, damage, or loss of structures from ground failure.	O	KPB	Complete a ground failure (avalanche, landslide etc.) location inventory; identify (and map) threatened critical facilities, residential buildings, infrastructure, and other essential buildings.
		S	FSA, City, KPB	Install wire matting, debris catchment structure, cliff stabilization etc. to prevent Lowell Canyon Creek diversion tunnel obstruction and diversion dam overtopping from landslide debris, woody vegetation, trees, etc.
TS 8	Reduce vulnerability, damage, or loss of structures from tsunami or seiche	C	FSA, KPB	Construct tsunami evacuation structures for remote locations sited in potential tsunami impact areas.
		O	City, KPB	Install tsunami evacuation route signs throughout the communities.
		O	City, KPB	Install tsunami warning siren and early alert system.
		O	City	Install tsunami specific interpretive signs at public facilities.



**Table 7-5 Mitigation Goals and Potential Actions***(Blue text items are the SBCFSA's pre-identified 2010 Mitigation Action Items)*

Goals		Actions		
No.	Description	Status: <i>Considered, Selected Complete, Deferred, Deleted, or Ongoing</i>	Authority	Description
VO 9	Reduce vulnerability, damage, or loss of structures from volcanic debris impacts	C	City	Evaluate water treatment plant's capability to deal with high turbidity from ash fall events.
		C	City	Upgrade water and wastewater treatment facilities' physical plants to deal with ash fall events.
		C	City	Develop water and wastewater plant protection or sustainability plans.
		O	City, KPB	Evaluate potential air quality impacts to public facilities during an ashfall event.
SW 10	Reduce vulnerability, damage, or loss of structures from severe weather damage.	O	FSA, City, KPB, State	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms (snow load, ice, and wind).
		O	FSA, City, KPB, State	Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events.
		O	FSA, City, KPB, State	Develop, implement, and maintain partnership program with electrical utilities to use underground utility placement methods where possible to reduce or eliminate power outages from severe winter storms. Consider developing incentive programs.
WF 11	Reduce vulnerability, damage, or loss of structures from wildland fires.	O	City	Develop Community Wildland Fire Protection Plan to mitigate wildland fire threat.
		O	FSA, City, KPB,	Hold FireWise workshop to educate residents and contractors concerning fire resistant landscaping.
		O	City, KPB	Promote FireWise building siting, design, and construction processes and materials.
		O	City, KPB	Provide wildland fire hazard outreach information in an easily distributed format for all residents.
		O	City, KPB	Develop, adopt, and enforce burn ordinances that control outdoor burning, requires burn permits, and restricts open campfires during identified weather periods (windy, dry, etc.).
		O	KPB	Identify, develop, implement, and enforce mitigation actions such as fuel breaks and reduction zones for potential wildland fire hazard areas.
		C	KPB	Install dry hydrants at strategic locations to enable rapid fire response.

## 7.6 EVALUATING AND PRIORITIZING MITIGATION ACTIONS

The requirements for the evaluation and implementation of mitigation actions, as stipulated in DMA 2000 and its implementing regulations are described below.

DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions	
<b>Implementation of Mitigation Actions</b>	
§201.6(c)(3)(iii): [The hazard mitigation strategy shall include an] action plan, describing how the action identified in paragraph (c)(3)(ii) of this section will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.	
<b>ELEMENT C. MITIGATION STRATEGY</b>	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	
Source: FEMA, October 2011.	

The Planning Team reviewed how hazard impacts would potentially affect the SBCFSA and its constituent members. Current impacts, as well as future hazard impacts resulting from potential climate change were considered for this Mitigation Strategy. Items that were considered are defined in Table 7-6, the simplified Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) evaluation criteria. The Benefit-Cost Analysis Fact Sheet (Appendix E) provided additional information for consideration; opportunities and constraints to implementing each particular mitigation action.

**Table 7-6 STAPLEE Evaluation Criteria**

Evaluation Category	Discussion "It is important to consider..."	Considerations
<b>S</b> ocial	The public support for the overall mitigation strategy and specific mitigation actions.	Community acceptance Adversely affects population
<b>T</b> echnical	If the mitigation action is technically feasible and if it is the whole or partial solution.	Technical feasibility Long-term solutions Secondary impacts
<b>A</b> dministrative	If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.	Staffing Funding allocation Maintenance/operations
<b>P</b> olitical	What the community and its members feel about issues related to the environment, economic development, safety, and emergency management.	Political support Local champion Public support
<b>L</b> egal	Whether the community has the legal authority to implement the action, or whether the community must pass new regulations.	Local, State, and Federal authority Potential legal challenge
<b>E</b> conomic	If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete a Federal Emergency Management Agency (FEMA) Benefit-Cost Analysis.	Benefit/cost of action Contributes to other economic goals Outside funding required FEMA Benefit-Cost Analysis
<b>E</b> nvironmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community.	Effect on local flora and fauna Consistent with community environmental goals Consistent with local, state, and Federal laws

The SBCFSA, City of Seward, and KPB identified 52 current mitigation activities some of which were deleted, reworded, or combined to prevent duplication (Table 7-5). These actions were updated for this LHMP and are classified as “ongoing” within Tables 7-8 and 7-9; and further defined in their respective City of Seward or Kenai Peninsula Borough HMPs.

On March 13, 2013, the hazard mitigation Planning Team prioritized 47 mitigation actions that were chosen to carry forward into the SBCFSA Mitigation Action Plan (MAP). The hazard mitigation Planning Team considered each hazard’s history, extent, and probability to determine each potential actions priority. A rating system based on high, medium, or low was used.

- High priorities are associated with actions for hazards that impact the community on an annual or near annual basis and generate impacts to critical facilities and/or people.
- Medium priorities are associated with actions for hazards that impact the community less frequently, and do not typically generate impacts to critical facilities and/or people.
- Low priorities are associated with actions for hazards that rarely impact the community and have rarely generated documented impacts to critical facilities and/or people.

The Mitigation Action Plan represents mitigation projects and programs to be implemented through the cooperation of multiple entities in the SBCFSA. To complete this task, the Planning Team first prioritized the hazards that were regarded as the most significant within the community (earthquake, erosion, flood, ground failure, tsunامي, volcano, severe weather, and wildland fire).

Prioritizing the mitigation actions in the MAP Matrix was completed to provide the SBCFSA with an approach to implementing the Mitigation Action Plan. SBCFSA reserves the right to focus on individual actions as events or funding opportunities dictate. Table 7-8 delineates the SBCFSA’s mitigation action priorities.

*Note: Blue text identifies the SBCFSA’s existing actions brought forward from the 2010 SBCFSA Flood Hazard Mitigation Plan.*

A qualitative statement is provided regarding the benefits and costs and, where available, the technical feasibility for each action considered for implementation within the MAP. A detailed cost-benefit analysis is anticipated as part of the application process for those projects the SBCFSA chooses to submit for funding.

### 7.7 IMPLEMENTING A MITIGATION ACTION PLAN

Table 7-7 delineates the acronyms used in the Mitigation Action Plan (MAP) (Table 7-8). See Appendix B for complete agency funding source descriptions.

The SBCFSA’s Mitigation Action Plan, Table 7-8, depicts how each mitigation action will be implemented and administered by the Planning Team. The MAP delineates each selected mitigation action, its priorities, the responsible entity, the anticipated implementation timeline, and provides a brief explanation as to how the overall benefit/costs and technical feasibility were taken into consideration.

**Table 7-7      Potential Funding Source Acronym List**

<p>Seward Bear Creek Flood Service Area (SBCFSA)</p> <p>City of Seward (City)</p> <p>Kenai Peninsula Borough (KPB)</p> <p>Qutekcaak Tribal Council (Tribe)</p> <p>Federal Management Agency (FEMA) /</p> <p><i>Hazard Mitigation Assistance (HMA) Grant Programs,</i></p> <p><i>Emergency Management Program Grant (EMPG)</i></p> <p><i>Debris Management Grant</i></p> <p><i>Flood Mitigation Assistance Grants</i></p> <p><i>National Earthquake Hazards Reduction Program (NEHRP)</i></p> <p><i>National Dam Safety Program (NDS)</i></p> <p><b>US Department of Homeland Security (DHS)</b></p> <p><i>Citizens Corp Program (CCP)</i></p> <p><i>Emergency Operations Center (EOC)</i></p> <p><i>Homeland Security Grant Program (HSGP)</i></p> <p><i>State Homeland Security Program (SHSP)</i></p> <p><b>US Department of Commerce (DOC) /</b></p> <p><i>Remote Community Alert Systems Program (RCASP)</i></p> <p><i>National Oceanic and Atmospheric Administration (NOAA)</i></p> <p><b>Denali Commission (Denali)</b></p> <p><i>Energy Program,</i></p> <p><i>Solid Waste Program,</i></p> <p><b>Alaska Department of Military and Veterans Affairs (DMVA), Division of Homeland Security and Emergency Management (DHSEM)</b></p> <p><i>Mitigation Section (for PDM &amp; HMGP projects and plan development)</i></p> <p><i>Preparedness Section (for community planning)</i></p> <p><i>State Emergency Operations Center (SEOC for emergency response)</i></p>
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Alaska Department of Community, Commerce, and Economic Development (DCCED) Division of Community and Regional Affairs (DCRA) /  
*Community Development Block Grant (CDBG)*  
*Alaska Climate Change Impact Mitigation Program (ACCIMP)*  
*Flood Mitigation Assistance Grants (FMA)*

**Alaska Department of Transportation**  
*State road repair funding*

**Alaska Energy Authority (AEA)**  
AEA/Bulk Fuel (ABF)  
AEA/Alternative Energy and Energy Efficiency (AEEE)

**Alaska Department of Environmental Conservation (DEC) /**  
*Village Safe Water (VSW),*  
*DEC/Alaska Drinking Water Fund (ADWF),*  
*DEC/Alaska Clean Water Fund (ACWF),*  
*DEC/Clean Water State Revolving Fund (CWSRF)*

**US Army Corps of Engineers (USACE) /**  
*Planning Assistance*  
*Capital Projects: Erosion, Flood, Ports & Harbors,*

**Alaska Division of Forestry (DOF) /**  
*Volunteer Fire Assistance and Rural Fire Assistance Grant (VFAG/RFAG),*  
*Assistance to Firefighters Grant (AFG),*  
*Fire Prevention and Safety (FP&S),*  
*Staffing for Adequate Fire and Emergency Response Grants (SAFER)*  
*Emergency Food and Shelter (EF&S)*

**US Department of Agriculture (USDA) /**  
*Emergency Watershed Protection Program (EWPP)*  
*Emergency Conservation Fund (ECF),*  
*Rural Development (RD)*

**US Geological Survey (USGS)**  
*Alaska Volcano Observatory (AVO)*

**Assistance to Native Americans (ANA)**  
(NAFSMA),

**Natural Resources Conservation Service (NRCS) /**  
*Emergency Watershed Protection Program (EWP)*  
*Wildlife Habitat Incentives Program (WHIP)*  
*Watershed Planning*

**US Army Corps of Engineers (USACE) /**  
*Planning Assistance Program*

**Lindbergh Foundation Grant Programs (LFGP)**  
*Rasmuson Foundation Grants (LFG)*  
*Resurrection Bay Conservation Alliance (RBCA)*

Table 7-7 contains the SBCFSA's MAP Matrix that designates mitigation action priorities, explains their overall benefit/costs and technical feasibility considerations, and describes each mitigation action's potential funding and implementation responsibility.

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
<b>Multi-Hazards</b>						
MH 1.1	Develop a strategy for accessing (applying for and managing) mitigation grant funds	High	SBCFSA, City, KPB	SBCFSA	Ongoing	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.
MH 1.2	Identify and pursue funding opportunities to implement mitigation actions.	High	SBCFSA, City, KPB	City, KPB	Ongoing	B/C: This ongoing activity is essential for the City as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.
MH 1.3	Organize a Floodproofing Workshop for Homeowners and Businesses to learn about techniques and funding sources for elevating, and floodproofing structures (agency/ies)] to participate – USACE Floodproofing Committee, FEMA, DCCED, Businesses to support SBS, Wells Fargo, others)	Low	SBCFSA, City, KPB	City, KPB, HMA Programs, NRCS, USACE, USDA/EWP, USDA/ECF, DCRA/ ACCIMP	Ongoing	B/C: Flood hazard mitigation is among FEMA's highest national priorities. FEMA desires communities focus on repetitive flood loss properties. This activity will ensure the City and Tribal Councils focus on priority flood locations and projects. TF: Low to no cost makes this outreach activity very feasible.
MH 1.4	Strive to formalize a Hazard Mitigation Planning Team to develop a sustainable process for implementing, monitoring, reviewing, and evaluating community wide mitigation actions.	Low	SBCFSA, City, KPB	SBCFSA, City, KPB	Ongoing	B/C: The existing team has gained experienced throughout this process which can provide invaluable insight for ensuring a sustained effort toward mitigating natural hazard damages. TF: This is feasible to accomplish as no cost is associated with the action and only relies on member availability and willingness to serve their community.



**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
MH 1.5	Hold periodic outreach events or activities to educate population concerning existing natural hazards. Activities are designed to provide pertinent natural hazards information to residents about recognizing and mitigating hazards that could potentially affect the SBCFSA.	Medium	SBCFSA, City, KPB	City, KPB, FEMA HMA Programs, AFG, FP&S, SAFER, ANA, EEFS, Lindbergh, Rasmuson, Denali Commission	Ongoing	B/C: Sustained mitigation outreach program has minimal cost and will help build and support area-wide capacity. This type activity enables the public to prepare for, respond to, and recover from disasters.  Potential subjects could include: benefits of participating in the NFIP; safe "FireWise" practices; river, stream or creek levee or channel breach; tsunami warnings and response; other emergency management focused subjects; etc.)  TF: This low cost activity can be combined with recurring community meetings where hazard specific information can be presented in small increments. This activity is ongoing demonstrating its feasibility.
MH 1.6	Develop, produce, and distribute information materials concerning mitigation, preparedness, and safety procedures for all identified natural hazards.	Low	SBCFSA, City, KPB	City, KPB, FEMA HMA Programs, DOF	Ongoing	B/C: Sustained mitigation outreach programs have minimal cost and will help build and support area-wide capacity. This type activity enables the public to prepare for, respond to, and recover from disasters.  TF: This low cost activity can be combined with recurring community meetings where hazard specific information can be presented in small increments. This activity is ongoing demonstrating its feasibility.
MH 1.7	Develop and implement strategies and educational outreach programs for debris management from natural hazard events.	Medium	SBCFSA, City, KPB	City, KPB, FEMA HMA Programs	Ongoing	B/C: Debris management is an essential disaster management necessity. Focused and coordinated planning enables effective damage abatement and ensures proper attention is assigned to reduce losses, damage, and materials management.  TF: This action is feasible with limited fund expenditures.
MH 1.8	Disseminate FEMA pamphlets to educate and encourage homeowners	Low	SBCFSA	City, KPB, FEMA HMA Programs, AFG,	Ongoing	B/C: FEMA provides free publications for community education purposes.

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years, 2-4 Years, 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
	concerning structural and non-structural retrofit benefits.			FP&S, and SAFER		TF: Low to no cost makes this a very feasible project to successfully educate large populations.
MH 1.9	Develop outreach program to educate residents concerning all-hazard benefits of modern building code compliance during rehabilitation or major repairs for residences or businesses.	Low	SBCFSA, City, KPB	City, KPB, FEMA HMA Programs, AFG, FP&S, SAFER, ANA, EEFSP, Lindbergh, Rasmuson, Denali Commission	Ongoing	B/C: Sustained mitigation outreach programs have minimal cost and will help build and support area-wide capacity. This type activity enables the public to prepare for, respond to, and recover from disasters. TF: This low cost activity can be combined with recurring community meetings where hazard specific information can be presented in small increments. This activity is ongoing demonstrating its feasibility.
MH 1.10	Disseminate information to increase public knowledge about flood insurance, and the natural and beneficial floodplain functions.	High	SBCFSA	SBCFSA, City, KPB, FEMA	Ongoing	B/C: NFIP participation while one of FEMA's highest priorities also enables communities with an effective program focus on repetitive flood loss properties and other priority flood locations and projects. TF: SBCFSA is currently a member through KPB and residents enjoy lower cost insurance. Continuation is relatively simple. KPB is also a CRS jurisdiction providing larger insurance discounts.
MH 1.11	Identify critical facilities and vulnerable populations based on identified (and mapped where applicable) high hazard areas.	Medium	SBCFSA, City, KPB	City, Denali Commission, DCRA, DHS, DOF	Ongoing	B/C: This project will ensure the community looks closely at their hazard areas to ensure they can safely evacuate their residents and visitors to safety during a natural hazard event. TF: This is technically feasible using existing city and tribal resources.
MH 1.12	Identify evacuation routes away from high hazard areas and develop outreach program to educate the public concerning warnings and evacuation procedures.	Low	SBCFSA, City, KPB	City, Denali Commission, DCRA, DHS, DOF	Ongoing	B/C: This project will ensure the community looks closely at their hazard areas to ensure they can safely evacuate their residents and visitors to safety during a natural hazard event. TF: This is technically feasible using existing city and tribal resources.

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
MH 1.13	Establish a cooperative relationship with the City of Seward to ensure hazard mitigation efforts are not being duplicated or opportunities missed.	High	SBCFSA, City, KPB	SBCFSA, City	Ongoing	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This is feasible to accomplish as no cost is associated with the action and only relies on member availability and willingness to serve their community.
MH 1.14	Coordinate with the Kenai Peninsula Borough and other appropriate agencies to obtain funding and permitting to establish an annual maintenance schedule and contract to remove excess debris throughout the SBCFSA.	High	SBCFSA	SBCFSA, City, KPB, DOT/PF, ARRC	Ongoing	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This is technically feasible because it requires application of knowledge of the hazard mitigation plan and other planning efforts. Feasibility is reliant on technical skills already possessed by employees holding positions that would implement this action.
MH 2.1	The SBCFSA will manage their existing plans to incorporate mitigation planning provisions into all service area planning processes such as comprehensive, capital improvement, and land use plans, etc. to demonstrate multi-benefit considerations and facilitate using multiple funding source consideration.	Medium	SBCFSA	SBCFSA	Ongoing	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and residents. TF: This is feasible to accomplish as cost can be associated with plan reviews and updates. The action relies on staff and review committee availability and willingness to serve their community.
MH 2.2	Improve flood and erosion hazard aspects in land use decisions, subdivision actions, and Plans that affect the SBCFSA including: KPB All-Hazards Plan, Comprehensive Plan, Coastal Management, Wetlands Management Plan, Seward Long-term development plan.	High	SBCFSA	SBCFSA, City, KPB, DOT/PF, ARRC	Ongoing	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This is technically feasible because it requires application of knowledge of the hazard mitigation plan and other planning efforts. Feasibility is reliant on technical skills already possessed by employees holding

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years, 2-4 Years, 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
						positions that would implement this action.
MH 2.3	Develop, incorporate, and enforce building ordinances to reflect survivability from flood, fire, wind, seismic, and other hazards to ensure occupant safety.	Low	SBCFSA, City, KPB	City, KPB, NRCS, ANA, USACE, USDA, Lindbergh	Ongoing	B/C: Ordinance development, implementation, and enforcement can effectively reduce future losses to hazardous events. Building codes can actually assist bush communities through making maximum use of materials and shipping costs the first time. TF: This project is technically feasible as the community need only demonstrate cost savings by demonstrating losses from history utility impacts and down time.
MH 2.5	Adopt the Risk MAP coastal velocity zone mapping studies into the floodplain code.	High	City, KPB	SBCFSA, City, KPB	1-3 years	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This action is feasible with limited fund expenditures.
MH 2.6	Relocate or acquire (buy-out and demolish) structures away from hazard prone area (erosion, flood, ground failure, etc.)	Medium	SBCFSA, City, KPB	City, KPB, HMA Programs, NRCS, ANA, USACE, USDA, Lindbergh Grants Program	Ongoing	B/C: This project would remove threatened structures from hazard areas, eliminating future damage while keeping land clear for perpetuity. To qualify for FEMA funding, property deeds "must be" restricted for open space uses for perpetuity to keep people from rebuilding in known hazard areas. F: This project is feasible using existing staff skills, equipment, and materials. Acquiring contractor expertise may be required for large facilities.
<b>Natural Hazards</b>						
EQ 4.1	Install non-structural seismic restraints for large furniture such as bookcases, filing cabinets, heavy televisions, and	Low	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, EFSP,	Ongoing	B/C: Non-structural mitigation projects have minimal cost and will help the community reduce recurring earthquake impact damages from future events.

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
	appliances to prevent toppling damage and resultant injuries to small children, elderly, and pets.					TF: This project is technically feasible using existing Tribal Council staff
ER 5.1	Develop mitigation initiatives such as: Rip-rap (large rocks), sheet piling, gabion baskets, articulated matting, concrete, asphalt, vegetation, or other armoring or protective materials to provide river bank protection.	High	SBCFSA, City, KPB	City, KPB, Tribe, HMA Programs, NRCS, ANA, USACE, USDA, Lindbergh Grants Program	Ongoing	B/C: Improving embankment and slope stability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.
ER 5.2	Harden culvert entrance bottoms with concrete, rock, or similar material to reduce erosion or scour.	Medium	SBCFSA, City, KPB	City, Tribe, HMA Programs, ANA, NRCS, USACE	Ongoing	B/C: This retrofit project can be a very cost effective method for bush communities as materials and shipping costs are very high. This project is technically feasible as the community need only demonstrate cost savings by demonstrating losses from history utility impacts and down time.
ER 5.3	Install walls at the end of a drainage structure to prevent embankment erosion at its entrance or outlet. (headwalls- or wing-walls).	Medium	SBCFSA	City, Tribe, HMA Programs, ANA, NRCS, USACE	Ongoing	B/C: This retrofit project can be a very cost effective method for bush communities as materials and shipping costs are very high. TF: This project is technically feasible as the community need only demonstrate cost savings by demonstrating losses from history utility impacts and down time.
ER 5.4	Harden and/or retrofit existing levees to qualify for USACE certification.	High	SBCFSA, City, KPB	City, Tribe, HMA Programs, ANA, NRCS, USACE	3-5 years	B/C: Pre-planning and implementing appropriate embankment stability will greatly reduce or delay potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: The community has the skill to implement this

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
						action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.
FL 6.1	Pursue federal and state funding to improve and update Flood Insurance Rate Maps (FIRMs), as well as other maps and plans that may be more appropriate such as Drainage Plans or watershed management plans in order to meet other goals. This should also include extending coastal floodplain mapping to Lowell Point.	High	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, USACE, NRCS, Lindbergh, Rasmuson, Denali Commission	Ongoing	B/C: Improving water flow capability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.
FL 6.2	Identify and list repetitively flooded structures and infrastructure, analyze the threat to these facilities, and raise mitigation action priorities to protect the threatened population.	High	SBCFSA	City, KPB, FEMA HMA, AFG, FP&S, SAFER, ANA, EEFSP, Lindbergh, Rasmuson, Denali Commission	Ongoing	B/C: Repetitive damage reduction is a high priority for FEMA and will therefore benefit the community greatly. Identifying RL and SRL properties is the first step to reducing losses. Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This is feasible to accomplish as no cost is associated with the action until appropriate mitigation actions are identified. This activity relies on community member availability and willingness to serve their community.
FL 6.2	Work with the USACE to develop a direct channel to direct water conveyance away from the three Seward Highway Bridges and the airport directing flow to Resurrection Bay.	High	SBCFSA	City, KPB, USACE, NRCS	Ongoing	B/C: Improving water flow capability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out



**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
						with materials and equipment barged in depending on the method selected.
FL 6.3	Work with USACE, NRCS, and State to pursue sediment and debris management at the mouth of the Resurrection River.	High	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, USACE, NRCS, Lindbergh, Rasmuson, Denali Commission	Ongoing	B/C: Scheduling maintenance and implementing cost beneficial mitigation activities will potentially reduce severe debris loading, road, bridge, and property damages caused by heavy floods with high water flow. This will reduce debris accumulation, encourage water movement from high to low areas; and lessen upstream flood potential. TF: This type activity is technically feasible within the community typically using existing labor, equipment, and materials. Specialized methods are not new to rural communities as they are used to importing required contractors.
FL 6.4	Develop and maintain NFIP compliant Repetitive Loss property inventory. Inventory should include property type, structure type, number of buildings, and their geo-referenced locations.	High	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, USACE, NRCS, Lindbergh, Rasmuson, Denali Commission	Ongoing	B/C: Repetitive damage reduction is a high priority for FEMA and will therefore benefit the community greatly. Identifying RL and SRL properties is the first step to reducing losses. Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and City residents. TF: This is feasible to accomplish as no cost is associated with the action until appropriate mitigation actions are identified. This activity relies on community member availability and willingness to serve their community.
FL 6.5	Establish flood mitigation priorities for critical facilities, residential structures, and commercial buildings located within the identified flood hazard area(s) (100- and 500-year floodplains, stormwater,	High	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, USACE, NRCS, Lindbergh, Rasmuson, Denali	Ongoing	B/C: Flood hazard mitigation is among FEMA's highest national priorities. FEMA desires communities focus on repetitive flood loss properties. This activity will ensure the City and Tribal Councils focus on priority flood locations and projects.

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years, 2-4 Years, 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
	etc.) based on current base flood elevation (BFE) and survey elevation data.			Commission		TF: Low to no cost makes this outreach activity very feasible.
FL 6.6	Determine and implement most cost beneficial and feasible mitigation actions for locations with repetitive flooding, significant historical damages, or road closures.	High	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, USACE, NRCS, Lindbergh, Rasmuson, Denali Commission	Ongoing	B/C: Flood hazard mitigation is among FEMA's highest national priorities. FEMA desires communities focus on repetitive flood loss properties. This activity will ensure the City and Tribal Councils focus on priority flood locations and projects. TF: Low to no cost makes this outreach activity very feasible.
FL 6.7	Obtain an exemption to the Alaska Department of Natural Resources (DNR) Material Sales Fees on navigable rivers and streams for sediment and debris management, stream channel maintenance, and flood control or other flood mitigation projects.	High	SBCFSA	SBCFSA, City, KPB, Tribe, DCRA, Denali Commission	1-3 years	B/C: Improving water flow capability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.
FL 6.8	Develop Bridge Maintenance with KPB, DOT/PF, and ARRC for all stream crossings throughout the flood service area to include: sediment removal under bridges.	High	SBCFSA	SBCFSA, City, KPB, Tribe, DOT/PF, ARRC, Denali Commission	1-3 years	B/C: Improving water flow capability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.
FL 6.9	Evaluate each watershed to develop land use plans for removing and storing creek bed load to:	High	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, DOT/PF, Denali	3-5 years	B/C: Improving water flow capability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years, 2-4 Years, 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
	<ul style="list-style-type: none"> <li>Perform periodic sediment management/bed load removal as necessary.</li> <li>Identify and permit fill areas for future flood-free development sites.</li> <li>Identify storage sites that limit gravel transportation costs.</li> </ul>			Commission, NRCS, USACE, USDA/EWP, USDA/ECP, USACE, DCRA/ ACCIMP		TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.
FL 6.10	Seek funding for sediment and debris management to remove excessive stream bed sediment load, gravel, and glacial debris.	High	SBCFSA	City, KPB, Tribe, HMA Programs, NRCS, ANA, USACE, US USDA, Lindbergh Grants Program	2-4 years	<p>B/C: Improving water flow capability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities.</p> <p>TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.</p>
FL 6.11	Apply for grant funding to assist critical facilities, public infrastructure, and residential properties with elevating flood threatened structures at least two feet above the identified Base Flood Elevation (BFE). ( <i>Current FEMA minimum is 1 ft. above BFE.</i> )	High	SBCFSA	City, KPB, Tribe, HMA Programs, ANA, Denali Commission, NRCS, USACE, USACE, DCRA/ ACCIMP	1-5 years	<p>B/C: Acquiring funding is essential for the SBCFSA as there are limited funds available to accomplish effective mitigation actions.</p> <p>This project would exceed FEMA minimum requirements for flood threatened structures by "at least" one foot.</p> <p>F: This project is feasible using existing staff skills, equipment, and materials. Acquiring contractor expertise may be required for large facilities.</p>
FL 6.12	Acquire and maintain NOAA/NWS stream flow and rainfall measuring gages.	High	SBCFSA	City, KPB, Tribe, NOAA	2-4 years	<p>B/C: This project would potentially provide near-term flood threat warning, enabling responders to mitigate potential damages.</p> <p>TF: This project is feasible using existing staff skills, equipment, and materials.</p>
FL	Increase culvert sizes to increase their	High	SBCFSA	City, KPB, Tribe,	Ongoing	B/C: Improving water flow capability will greatly reduce

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
6.13	<p>drainage capacity or efficiency.</p> <p>Specific locations that would benefit from this improvement include:</p> <ul style="list-style-type: none"> <li>• Bear Creek at Bear Lake Rd</li> <li>• Grouse Creek at Timber Lane</li> <li>• Kwechak Creek at Bruno Road</li> <li>• Salmon Creek at Nash Road</li> <li>• Salmon Creek at the Alaska Railroad culvert northeast of Salmon Creek Road</li> <li>• Salmon Creek at Seward Highway MM 13.9</li> <li>• Salmon Creek at the Alaska Railroad adjacent to Seward Highway MM 13.9</li> <li>• Salmon Creek Overflow at Seward Highway and Granite Loop</li> <li>• Sawmill Creek at Nash Road</li> </ul>			HMA Programs, NRCS, ANA, USACE, US USDA, Lindbergh Grants Program		<p>potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities.</p> <p>TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.</p>
FL 6.14	Construct debris basins or other debris catchment devices to retain debris to prevent downstream drainage structure clogging.	High	SBCFSA	City, KPB, Tribe, HMA Programs, NRCS, ANA, USACE, US USDA, Lindbergh Grants Program	2-4 years	<p>B/C: Improving water flow capability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities.</p> <p>TF: The community has the skill to implement this action. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.</p>
GF 7.1	Install wire matting, debris catchment structure, cliff stabilization etc. to prevent Lowell Canyon Creek diversion tunnel obstruction and diversion dam overtopping from landslide debris,	High	SBCFSA, City	City, KPB, Tribe, HMA Programs, NRCS, ANA, USACE, US USDA, Lindbergh Grants Program	3-5 years	<p>B/C: Hardening infrastructure to reduce natural hazard damages potentially reduces future catastrophic impacts to critical facilities at exceedingly higher costs.</p> <p>TF: The City has the technical capability to manage and</p>

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
	woody vegetation, trees, etc.					conduct this project.
GF 7.2	Develop vegetation projects to restore clear-cut and riverine erosion damage and to restore slope stability in avalanche and landslide areas.	Low	SBCFSA	City, KPB, HMA Programs, ANA, NRCS, USACE, RBCA	Ongoing	B/C: Improving slope stability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: Technically feasible as the community has the skill to implement this action using native materials and equipment.
SW 10.1	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms (snow load, ice, and wind).	Low	SBCFSA, City, KPB	City, KPB, Tribe, DCCED/CDBG, Denali Commission	3-5 years	B/C: Scheduling maintenance and implementing mitigation activities will potentially reduce severe winter storm damages caused by heavy snow loads, wind, and freezing rain. TF: This type activity is technically feasible within the community typically using existing labor, equipment, and materials. Specialized methods are not new to rural communities as they are used to importing required contractors.
SW 10.2	Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events.	Low	SBCFSA, City, KPB	City, Tribe, HMA Programs, AFG, FP&S, SAFER DOF: VFAG, RAGP, FireWise	Ongoing	B/C: This mitigation activity will reduce severe winter storm damages caused by heavy snow loads and icy rain by avoiding damage to structures and infrastructure. TF: This type activity is technically feasible within the community by implementing existing programs such as Fire Wise and other State and Federal agency programs.
SW 10.3	Develop, implement, and maintain partnership program with electrical utilities to use underground utility placement methods where possible to reduce or eliminate power outages from	Low	SBCFSA, City, KPB	City, Tribe, HMA Programs, AFG, FP&S, SAFER DOF: VFAG, RAGP, FireWise	Ongoing	B/C: Implementing this mitigation activities will potentially reduce ancillary damage from severe winter storms caused by heavy snow loads, icy rain, and wind. TF: This type activity is technically feasible within the

**Table 7-8 SBCFSA Mitigation Action Plan (MAP) Matrix**  
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority (Low, Medium, High)	Responsible Entity or Department: SBCFSA, City of Seward (City), KPB	Potential Funding	Time-frame (3-5 years 2-4 Years 1-3 Years)	Benefit-Costs (B/C) / Technical Feasibility (T/F)
	severe winter storms. Consider developing incentive programs.					community typically using existing labor, equipment, and materials.
WF 1.1.1	Hold FireWise workshop to educate residents and contractors concerning fire resistant landscaping.	Low	SBCFSA, City, KPB	SBCFSA, City, KPB, Tribe, DOF: FP&S, VFAG, RAGP	Ongoing	B/C: Sustained mitigation outreach programs have minimal cost and will help build and support community capacity enabling the public to appropriately prepare for, respond to, and recover from disasters. T/F: This project is technically feasible using existing City and Tribal staff.



Table 7-9 delineates those activities the City of Seward and the Kenai Peninsula Borough are accomplishing to mitigate potential natural hazard impacts within the SBCFSA.

**Table 7-9 City of Seward and KPB Identified On-Going Mitigation Activities**

(Actions that occur within the FSA but not within SBCFSA authority or responsibility)

Goal	Authority to Implement	Activity Description
<b>Multi-Hazard MH 1</b> Promote recognition and mitigation of all natural hazards that affect the SBCFSA.	City, KPB	Hold periodic outreach events or activities to educate population concerning existing natural hazards. Activities are designed to provide pertinent natural hazards information to residents about recognizing and mitigating hazards that could potentially affect the SBCFSA.  Potential subjects could include: benefits of participating in the NFIP, safe "FireWise" practices; river, stream or creek levee or channel breach, tsunami warnings and response, other emergency management focused subjects, etc.)
	KPB	Develop an outreach program to educate public concerning NFIP participation benefits, floodplain development, land use regulation, and NFIP flood insurance availability to facilitate continued compliance with the NFIP.
	KPB	Develop an outreach program to educate public concerning NFIP participation benefits, floodplain development, land use regulation, and NFIP flood insurance availability to facilitate continued compliance with the NFIP.
	KPB	Develop outreach program to educate residents concerning flood proofed well and sewer/septic facility installations.
	City, KPB	Review ordinances and develop outreach programs to assure propane tanks are properly anchored and hazardous materials are properly stored and protected from known natural hazards such as flood or seismic events.
	City, KPB	Develop, produce, and distribute information materials concerning mitigation, preparedness, and safety procedures for all identified natural hazards.
	City, KPB	Develop and implement strategies and educational outreach programs for debris management from natural hazard events.
	City, KPB	Disseminate FEMA pamphlets to educate and encourage homeowners concerning structural and non-structural retrofit benefits.
	City, KPB	Develop outreach program to educate residents concerning all-hazard benefits of modern building code compliance during rehabilitation or major repairs for residences or businesses.
	City, KPB	Update public emergency notification procedures and develop an outreach program for potential hazard impacts or events.
	City, KPB	Identify critical facilities and vulnerable populations based on identified (and mapped where applicable) high hazard areas.
	City, KPB	Identify evacuation routes away from high hazard areas and develop outreach program to educate the public concerning warnings and evacuation procedures.
	City, KPB	Acquire emergency warning methods to communicate critical emergency warnings and alerts. City uses Radios, cell phones, alert sirens, etc.
	City, KPB	911 reverse call to notify residents.
<b>Multi-Hazard MH 2</b> Promote cross-referencing mitigation goals and actions with other SBCFSA, City of Seward, and KPB planning mechanisms and	City, KPB	Improve enforcement of existing City and Borough NFIP flood damage prevention ordinances.
	City, KPB	Prohibit Below Grade crawlspaces and basements throughout the Service Area unless PE, architect or Professional Land Surveyor certifies that building site is not subject to flooding, localized drainage, or high ground water.
	City, KPB	Avoid building more new homes in the floodway (existing ordinance); revise floodplain ordinance to prohibit any new subdivision of land within the mapped floodplain.
	City, KPB	Increase enforcement including fostering a partnership (M.O.U.) for enforcement uniformly within the City and Borough specific to the SBCFSA.
	KPB	Review KPB Habitat Protection Ordinance for extension to Service Area for

**Table 7-9 City of Seward and KPB Identified On-Going Mitigation Activities**

(Actions that occur within the FSA but not within SBCFSA authority or responsibility)

Goal	Authority to Implement	Activity Description
projects.		flood/erosion regulation purposes – recognizing gravel/sediment removal needs to continue. Modify ordinance to increase KPB enforcement and field staff.
	City, KPB	The SBCFSA will manage their existing plans to incorporate mitigation planning provisions into all service area planning processes such as comprehensive, capital improvement, and land use plans, etc. to demonstrate multi-benefit considerations and facilitate using multiple funding source consideration.
	City, KPB	Integrate the Mitigation Plan findings for enhanced emergency planning.
	City, KPB	Develop, incorporate, and enforce building ordinances to reflect survivability from flood, fire, wind, seismic, and other hazards to ensure occupant safety.
	City, KPB	Develop and incorporate mitigation provisions and recommendations into all community plans and community development processes to maintain protect critical infrastructure, residences, and population from natural hazard impacts.
	City, KPB	Update or develop, implement, and maintain jurisdictional debris management plans.
	KPB	Identify and list repetitively flooded structures and infrastructure, analyze the threat to these facilities, and raise mitigation action priorities to protect the threatened population.
	City, KPB	Perform hydrologic and hydraulic engineering, drainage, and bed loading studies and analyses for each watershed. Use information obtained for feasibility determination and project design. This information should be a key component, directly related to a proposed project.
	City, KPB	Update Emergency Response Plans to discuss volcanic ashfall, tsunami, and stormwater event management, prioritize response actions, and initiate actions to fill capability gaps.
	City, KPB	Adopt the Risk Map coastal velocity zone mapping studies into the floodplain code.
<b>Multi-Hazard MH 3</b>  Reduce vulnerability, damage, or loss of structures from all natural hazards that affect the SBCFSA.	City	Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.
	City, KPB	Acquire (buy-out), demolish, or relocate structures from hazard prone area (erosion, flood, ground failure, etc.) Property deeds “must be” restricted for open space uses for perpetuity to keep people from rebuilding in known hazard areas.
	City	Harden utility headers located along river embankments to mitigate potential flood, debris, and erosion damages.
	City	Purchase and install generators with main power distribution disconnect switches for identified and prioritized critical facilities susceptible to short term power disruption. (i.e. first responder, medical facilities, schools, correctional facilities, and water and sewage treatment plants, etc.)
	City, KPB	Develop vegetation projects to restore clear-cut and riverine erosion damage and to slope stability in avalanche and landslide areas.
	KPB	Develop, implement, and enforce floodplain management ordinances.
<b>Earthquake EQ 4</b>	City	Evaluate critical public facilities with significant seismic vulnerabilities and complete retrofit. (e.g. evaluate fire stations, public works buildings, potable water systems, wastewater systems, electric power systems, and bridges, etc.)
	City	Inspect, prioritize, and retrofit any critical facility or public infrastructure that does not meet current State Adopted Building Codes.
	City, KPB	Install non-structural seismic restraints for large furniture such as bookcases, filing cabinets, heavy televisions, and appliances to prevent toppling damage and resultant injuries to small children, elderly, and pets.
<b>Erosion</b>	City, KPB	Develop mitigation initiatives such as: Rip-rap (large rocks), sheet pilings, gabion baskets, articulated matting, concrete, asphalt, vegetation, or other armoring or protective materials to provide river bank

**Table 7-9 City of Seward and KPB Identified On-Going Mitigation Activities**

(Actions that occur within the FSA but not within SBCFSA authority or responsibility)

Goal	Authority to Implement	Activity Description
ER 5		protection.
	City, KPB	Harden culvert entrance bottoms with asphalt, concrete, rock, or similar material to reduce erosion or scour.
	City, KPB	Install walls at the end of a drainage structure to prevent embankment erosion at its entrance or outlet. (End- or wing-walls).
Flood FL 6	City, KPB	Develop and maintain NFIP compliant Repetitive Loss, Severe Repetitive Loss, and Repetitive Flood Claim (RFC) property inventory. Inventory should include property type, structure type, number of buildings, and their geo-referenced locations.
	City, KPB	Establish flood mitigation priorities for critical facilities, residential structures, and commercial buildings located within the identified flood hazard area(s) (100- and 500-year floodplains, stormwater, etc.) based on current base flood elevation (BFE) survey elevation data.
	City, KPB	Determine and implement most cost beneficial and feasible mitigation actions for locations with repetitive flooding, significant historical damages, or road closures.
	City, KPB	Work with State of Alaska Department of Natural Resources to resolve bed load resultant debris removal and financial constraints from Japanese Creek, Resurrection River, and other problematic streams within SBCFSA.
	City, KPB	Apply for grant funding to assist critical facilities, public infrastructure, and residential properties with elevating flood threatened structures at least two feet above the identified Base Flood Elevation (BFE).
	City, KPB	Acquire and maintain NOAA/NWS stream flow and rainfall measuring gauges.
	City, KPB	Increase culvert sizes to increase their drainage capacity or efficiency.
	City, KPB	Construct debris basins or other debris catchment devices to retain debris in order to prevent downstream drainage structure clogging.
	City, KPB	Seek funding for sediment and debris management to remove excessive stream bed sediment load, gravel, and glacial debris.
Ground Failure GF 7	KPB	Complete a ground failure (avalanche, landslide etc.) location inventory; identify (and map) threatened critical facilities, residential buildings, infrastructure, and other essential buildings.
	City, KPB	Install wire matting, debris catchment structure, cliff stabilization etc. to prevent Lowell Canyon Creek diversion tunnel obstruction and diversion dam overtopping from landslide debris, woody vegetation, trees, etc.
Tsunami TS 8	KPB	Construct tsunami evacuation structures for remote locations sited in potential tsunami impact areas.
	City, KPB	Install tsunami evacuation route signs throughout the communities.
	City, KPB	Install tsunami warning siren and early alert system.
	City	Install tsunami specific interpretive signs at public facilities.
Volcano VO 9	City, KPB	Evaluate potential air quality impacts to public facilities during an ashfall event.
Severe Weather SW 10	City, KPB, State	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms (snow load, ice, and wind).
	City, KPB, State	Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events.
	City, KPB	Develop, implement, and maintain partnership program with electrical utilities to use underground utility placement methods where possible to reduce or eliminate power outages from severe winter storms. Consider developing incentive programs.

**Table 7-9 City of Seward and KPB Identified On-Going Mitigation Activities**

(Actions that occur within the FSA but not within SBCFSA authority or responsibility)

Goal	Authority to Implement	Activity Description
Wildland Fire WF 11	City, KPB	Hold FireWise workshop to educate residents and contractors concerning fire resistant landscaping.
	City, KPB	Promote FireWise building siting, design, and construction processes and materials.
	City, KPB	Provide wildland fire hazard outreach information in an easily distributed format for all residents.
	City, KPB	Develop, adopt, and enforce burn ordinances that control outdoor burning, requires burn permits, and restricts open campfires during identified weather periods (windy, dry, etc.).
	KPB	Identify, develop, implement, and enforce mitigation actions such as fuel breaks and reduction zones for potential wildland fire hazard areas.

## 7.8 IMPLEMENTING MITIGATION STRATEGY INTO EXISTING PLANNING MECHANISMS

The requirements for implementation through existing planning mechanisms, as stipulated in the DMA 2000 and its implementing regulations, are described here.

DMA 2000 Requirements
<b>Incorporation into Existing Planning Mechanisms</b>
§201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.
<b>ELEMENT C. Incorporate into Other Planning Mechanisms</b>
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate?
Source: FEMA, October 2011.

After the adoption of the HMP, each Planning Team Member will ensure that the HMP, in particular each Mitigation Action Project, is incorporated into existing planning mechanisms. Each member of the Planning Team will achieve this incorporation by undertaking the following activities.

- Review the community-specific regulatory tools to determine where to integrate the mitigation philosophy and implementable initiatives. These regulatory tools are identified in Section 7.1 capability assessment.
- Work with pertinent community departments to increase awareness for implementing HMP philosophies and identified initiatives. Provide assistance with integrating the mitigation strategy (including the MAP) into relevant planning mechanisms (i.e. Comprehensive Plan, Capital Improvement Project List, Transportation Improvement Plan, etc.).

Implementing this philosophy and activities may require updating or amending specific planning mechanisms as identified in Section 3.5.3.2.

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**Appendix A**  
**SBCFSA Flood Hazard Mitigation Plan, 2010**

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**For additional SBCFSA flood mitigation programmatic and historical information,  
contact the SBCFSA to review the  
2010 SBCFSA Flood Hazard Mitigation Plan.**

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**Appendix B**  
**National Flood Insurance Program (NFIP)**  
**&**  
**Community Rating System (CRS)**  
**Defined**

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## NATIONAL FLOOD INSURANCE PROGRAM

In 1968, Congress established the National Flood Insurance Program (NFIP). The goals of the program are to reduce future flood damage through floodplain management, and to provide people with flood insurance. The Kenai Peninsula Borough (KPB) has had a tumultuous history with the NFIP. The KPB was suspended from the program when the 1986 flood struck which meant flood insurance and federal disaster assistance was withheld within the mapped floodplain areas. The Borough Assembly quickly passed the necessary ordinance (Title 21.06) to join the NFIP.

The NFIP established Flood Insurance Rate Maps (FIRM) based on hydrologic studies of flood prone areas across the country. These maps have zones where the cost of insurance to property owners is adjusted according to the flood risk as compared to how the building is constructed. Generally, the higher the lowest floor is above flood levels, the lower will be the cost of the flood insurance. Structures built too low after the publish date of the FIRM will have much high flood rates.

The FIRMs include Flood Insurance Zones (A, A2 through A10, V, B, C, and D): In order to set actuarial insurance rates, the Federal Insurance Administration established the following flood hazard map zones:

Zone Designation	Zone Definition
<b>A</b>	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.
<b>AO</b>	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no Flood Hazard Factors determined.
<b>Zone A2 through A5, and A10</b>	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
<b>Zone V</b>	Special flood hazard areas along coasts inundated by the 100-year flood, as determined by approximate methods and that have additional hazards due to velocity (wave action); no base flood elevations shown or Flood Hazard Factors determined.
<b>Zone V1 through V9, V11, V12, V16</b>	Special flood hazard areas along coasts inundated by the 100-year flood, as determined by detailed methods, and that have
<b>And V19</b>	Additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
<b>Zone B</b>	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1-square mile. Zone B is not subdivided.
<b>Zone X</b>	Areas of minimal flooding.
<b>Zone D</b>	Areas of undetermined but possible flood hazard.

Flood insurance is available through the NFIP for anyone but is often mandatory through lenders on structures within the floodplain. It is also mandatory for any proposed acquisition and/or construction of buildings in flood hazard areas if any form of federal funding assistance for the development is sought.

Communities who chose to enact and enforce certain floodplain management practices and regulations and to abide by flood damage prevention ordinances and FIRMs developed by FEMA may apply for a part of the National Flood Insurance Program called the Community Rating System



(CRS). The CRS allows communities who enforce higher standards than federal minimum floodplain standards additional savings on flood insurance premiums to its citizens. Both the Kenai Peninsula Borough and the City of Seward participate in the Community Rating System as of November 2007.

FEMA is producing new DFIRMs (Digital Flood Insurance Rate Maps) for the State of Alaska as part of the congressionally mandated Map Modernization Program. Seward will receive its preliminary maps in March 2010. The new DFIRMs have discontinued “C” Zones which were replaced by “X” or “shaded X” zones. These zones are defined as:

*“Areas outside the 1-percent annual chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone.”*

Insurance purchase is not usually required in these zones.

Access to Flood Insurance Rate Maps and information on how they are to be used is available through the Kenai River Center in Soldotna, AK, 907.260.4882.

## NFIP COMMUNITY RATING SYSTEM (CRS) IMPROVEMENTS

### Channel and Basin Debris Removal (CDR)

The SBCFSA will analyze and consider how to support City and Borough improvements into their CRS scores, thus lowering flood insurance costs, by developing a service area-wide Sediment Channel and Basin Debris Removal (CDR) Plan following CRS guidelines:

#### **Maximum Credit: 300 POINTS**

CDR = the total of the following points, this is a hierarchal credit system where no credit is provided unless credited awarded for preceding activities.

**200 points:** Awarded if the community's drainage maintenance program includes all of the following:

- Community performs an inspection at least once each year.
- Community performs an inspection after each storm that could adversely impact the drainage system.
- Community performs inspections to address citizens' complaints.
- Community takes action to perform maintenance and cleaning as identified during an inspection. Action taken must follow pre-identified community's drainage maintenance procedures and must comply with federal and state environmental protection laws and regulations.

**50 points:** Awarded if the community's program identifies specific “choke points” or other flow obstructions, erosion sites, or sedimentation problems. These points will be inspected and maintained differently or more frequently than other parts of the drainage system. These actions are separate from those credited under item 1(b), above.

The above items recognize maintenance work performed by a public works crew, usually without heavy equipment. The objective of these activities is to remove accumulated debris that obstructs flow which result in adjacent property flooding. It is important that the community's procedures spell-out what can and cannot be removed. In some areas with natural streams, some woody

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debris may remain without causing a flooding problem. In other areas, with concrete lined ditches, all debris may have to be removed to maintain the ditch's carrying capacity.

CRS depends upon regular inspection and maintenance. The community (or other non-Federal agency) must have a program or plan to regularly inspect its drainage facilities and remove debris as needed. Neither the cost of the work, nor the amount of debris removed, affects the credit. This credit is not eligible if the community simply responds to complaints. It must be defined within a program or plan.

CRS credit is not provided if local drainage maintenance procedures violate federal or state laws. There may be special restrictions on streams or a requirement to obtain a federal or state permit before certain work can proceed. Community programs or plans must include all restrictions or permitting requirements.

**50 points:** Awarded if the community has an ongoing program, such as a capital improvements plan, to eliminate or correct drainage problems, improve drainage or storage facilities, or to construct other facilities such as “low maintenance” channels. There is no credit for this item if it is a one-time activity. Communities must develop a funded “improvement” program for scheduled improvement projects or activities. There is no credit if the funded projects are not part of the drainage system that is described in the community's inspection and maintenance program.

The third credit item is designed to recognize a program that makes structural or permanent channel or basin changes to reduce flooding or maintenance problems – not for an ongoing maintenance program.

Creditable examples would be on-going programs to:

- Enlarge culvert and bridge openings to eliminate bottlenecks,
- Install permanent hard or soft bank protection measures,
- Install grates to catch debris during high flows,
- Build new retention basins to reduce flows into existing channels, and/or
- Convert problem channels into "low-maintenance" channels.

The capital improvements program should address the “‘choke points' and other obstructions to flows” that warrant the special attention that is credited in item (2). It must include community drainage system site improvements as defined in its procedures (see the documentation requirements in Section 544.a.2).

***Note:** Once a capital improvements project is completed, it may qualify for CRS credit under Activity 530 (Flood Protection). Projects that protect repetitive loss properties receive higher credits in Activity 530.*

It is the community's responsibility to document the activity for credit even if a separate agency performs the inspection and/or debris removal. In the case of a drainage district or county-wide maintenance program, the community may find it advantageous to develop documentation usable by all affected communities or agencies to simplify the process.

If an agency other than the community performs the inspection and/or debris removal, it is nonetheless the community's responsibility to document the activity for credit. In the case of a drainage district or county-wide maintenance program, the community may find it advantageous to work with other affected communities and the larger agency to develop consistent documentation that can be used by all affected communities.

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The service area has only one repetitive loss property which is a single family dwelling on plot designated TO1N RO1W S27SW0000024 FOLZ. Claims were made for flood loss on this property in 1995 and 2002. This property and structure are in A02 and A04 zones and have been mitigated using Federal Emergency Management Agencies (FEMA) Flood Mitigation Assistance (FMA) and Hazard Mitigation Grant Program (HMGP) funds, property owner's private funds, insurance proceeds, and Increased Cost of Compliance (ICC) funds.

Flood Programmatic Terminology	
<b>100-year Base Flood:</b>	Base flood means a flood having a 1% chance of being equaled or exceeded in any given year.
<b>Alluvial fan:</b>	An area at the base of a valley where the slope flattens out, allowing the floodwater to decrease in speed and spread out, dropping sediment and rock over a fan-shaped area.
<b>Anadromous Stream:</b>	A waterway extending from the salt water to fresh water which provides a
<b>Channel:</b>	Defined landforms that carry water.
<b>Development:</b>	Any man-made change to real estate including dredging and fill.
<b>FEMA:</b>	Federal Emergency Management Agency
<b>FIRM:</b>	Flood insurance rate map.
<b>Flash flood:</b>	A flood in hilly and mountainous areas that may come scant minutes after a heavy rain, one can also occur in urban areas where pavements and drainage improvements speed runoff to a stream.
<b>Flood:</b>	A general and temporary condition of partial or complete inundation of normally dry land areas.
<b>Flood hazard mitigation:</b>	All actions that can be taken to reduce property damage and the threat to life and public health from flooding.
<b>Floodplain:</b>	Any land area susceptible to being inundated by flood waters from any source.
<b>Floodway:</b>	The stream channel and that portion of the adjacent floodplain which must remain open to permit passage of the base flood.
<b>Hydrology:</b>	The science dealing with the waters of the earth; a flood discharge is developed by a hydrologic study.
<b>Ice jam:</b>	Flooding that occurs when warm weather and rain break up frozen rivers and the broken ice floats downriver until it is blocked by an obstruction, creating an ice dam that blocks the channel and causes flooding upstream.
<b>LIDAR:</b> An acronym for <b>Light Detection And Ranging</b> (LiDAR)	<p>A remote sensing technique that provides high resolution elevation data with a vertical accuracy not previously available for the Seward Bear Creek Service Area. LIDAR was used in the SBCFSA to map geomorphic features associated with floodplains and alluvial fans. High resolution LIDAR shows that floodplains and alluvial fans are geomorphically complex.</p> <p>LIDAR is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target. The prevalent method to determine distance to an object or surface is to use laser</p>

Flood Programmatic Terminology	
	pulses. Like the similar radar technology, which uses radio waves instead of light, the range to an object is determined by measuring the time delay between transmission of a pulse and detection of the reflected signal. LiDAR for geographic mapping of ground features.
<b>Mudslide:</b>	A condition where there is a river, flow or inundation of liquid mud down a hillside.
<b>Ordinance:</b>	The generic term for a law passed by a local government.
<b>Runoff:</b>	Rainfall and snowmelt that reaches a stream.
<b>Storm surge:</b>	Water that is pushed toward shore by persistent high wind and changes in air pressure. The level of a large body of water can rise by several feet.
<b>Surge-release flood:</b>	Debris build-up, landslides or avalanches in narrow canyons can cause water to be artificially dammed during heavy rains causing water to be released in large amounts and at great velocity when the temporary dam gives way.
<b>Tsunami:</b>	A large wave caused by an underwater earthquake or volcano which can raise water levels as much as 15 feet.
<b>Watershed:</b>	An area that drains into a lake, stream or other body of water.

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**Appendix C**  
**Federal, State, and Other Funding Resources**



### Federal Funding Resources

The Federal government requires local governments to have a HMP in place to be eligible for mitigation funding opportunities through FEMA such as the UHMA Programs and the HMGP. The Mitigation Technical Assistance Programs available to local governments are also a valuable resource. FEMA may also provide temporary housing assistance through rental assistance, mobile homes, furniture rental, mortgage assistance, and emergency home repairs. The Disaster Preparedness Improvement Grant also promotes educational opportunities with respect to hazard awareness and mitigation.

- FEMA, through its Emergency Management Institute, offers training in many aspects of emergency management, including hazard mitigation. FEMA has also developed a large number of documents that address implementing hazard mitigation at the local level. Five key resource documents are available from FEMA Publication Warehouse (1-800-480-2520) and are briefly described here:
    - How-to Guides. FEMA has developed a series of how-to guides to assist states, communities, and tribes in enhancing their hazard mitigation planning capabilities. The first four guides describe the four major phases of hazard mitigation planning. The last five how-to guides address special topics that arise in hazard mitigation planning such as conducting cost-benefit analysis and preparing multi-jurisdictional plans. The use of worksheets, checklists, and tables make these guides a practical source of guidance to address all stages of the hazard mitigation planning process. They also include special tips on meeting DMA 2000 requirements (<http://www.fema.gov/plan/mitplanning/resources.shtm#1>).
    - Post-Disaster Hazard Mitigation Planning Guidance for State and Local Governments. FEMA DAP-12, September 1990. This handbook explains the basic concepts of hazard mitigation and shows state and local governments how they can develop and achieve mitigation goals within the context of FEMA's post-disaster hazard mitigation planning requirements. The handbook focuses on approaches to mitigation, with an emphasis on multi-objective planning.
    - A Guide to Recovery Programs FEMA 229(4), September 2005. The programs described in this guide may all be of assistance during disaster incident recovery. Some are available only after a Presidential declaration of disaster, but others are available without a declaration. Please see the individual program descriptions for details. (<http://www.fema.gov/txt/rebuild/ltrc/recoveryprograms229.txt>)
    - The Emergency Management Guide for Business and Industry. FEMA 141, October 1993. This guide provides a step-by-step approach to emergency management planning, response, and recovery. It also details a planning process that businesses can follow to better prepare for a wide range of hazards and emergency events. This effort can enhance a business's ability to recover from financial losses, loss of market share, damages to equipment, and product or business interruptions. This guide could be of great assistance to a community's industries and businesses located in hazard prone areas.
    - The FEMA Hazard Mitigation Assistance (HMA Unified Guidance, June 1, 2010. The guidance introduces the five HMA grant programs, funding opportunities, award
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information, eligibility, application and submission information, application review process, administering the grant, contracts, additional program guidance, additional project guidance, and contains information and resource appendices(FEMA 2009).

- FEMA also administers emergency management grants (<http://www.fema.gov/help/site.shtm>) and various firefighter grant programs (<http://www.firegrantsupport.com/>) such as
    - Emergency Management Performance Grant (EMPG). This is a pass through grant. The amount is determined by the State. The grant is intended to support critical assistance to sustain and enhance State and local emergency management capabilities at the State and local levels for all-hazard mitigation, preparedness, response, and recovery including coordination of inter-governmental (Federal, State, regional, local, and tribal) resources, joint operations, and mutual aid compacts state-to-state and nationwide. Sub-recipients must be compliant with National Incident Management System (NIMS) implementation as a condition for receiving funds. Requires 50% match.
    - Assistance to Fire Fighters Grant (AFG), Fire Prevention and Safety (FP&S), Staffing for Adequate Fire and Emergency Response Grants (SAFER), and Assistance to Firefighters Station Construction Grant programs. Information can be found at: (<http://forestry.alaska.gov/fire/vfarfa.htm>).
  - Department of Homeland Security provides the following grants:
    - Homeland Security Grant Program (HSGP), State Homeland Security Program (SHSP) are 80% pass through grants. SHSP supports implementing the State Homeland Security Strategies to address identified planning, organization, equipment, training, and exercise needs for acts of terrorism and other catastrophic events. In addition, SHSP supports implementing the National Preparedness Guidelines, NIMS, and the National Response Framework (NRF). Must ensure at least 25% of funds are dedicated towards law enforcement terrorism prevention-oriented activities.
    - Citizen Corps Program (CCP). The Citizen Corps mission is to bring community and government leaders together to coordinate involving community members in emergency preparedness, planning, mitigation, response, and recovery activities.
    - Emergency Operations Center (EOC) This program is intended to improve emergency management and preparedness capabilities by supporting flexible, sustainable, secure, strategically located, and fully interoperable EOCs with a focus on addressing identified deficiencies and needs. Fully capable emergency operations facilities at the State and local levels are an essential element of a comprehensive national emergency management system and are necessary to ensure continuity of operations and continuity of government in major disasters or emergencies caused by any hazard. Requires 25% match.
  - U.S. Department of Commerce's grant programs include:
    - Remote Community Alert Systems (RCASP) grant for outdoor alerting technologies in remote communities effectively underserved by commercial mobile service for the
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- purpose of enabling residents of those communities to receive emergency messages. This program is a contributing element of the Warning, Alert, and Response Network (WARN) Act.
- National Oceanic and Atmospheric Administration (NOAA), provides funds to the State of Alaska due to Alaska's high threat for tsunami. The allocation supports the promotion of local, regional, and state level tsunami mitigation and preparedness; installation of warning communications systems; installation of warning communications systems; installation of tsunami signage; promotion of the Tsunami Ready Program in Alaska; development of inundation models; and delivery of inundation maps and decision-support tools to communities in Alaska.
  - Department of Agriculture (USDA). Disaster assistance provided includes: Emergency Conservation Program, Non-Insured Assistance, Emergency Forest Restoration Program, Emergency Watershed Protection, Rural Housing Service, Rural Utilities Service, and Rural Business and Cooperative Service.  
(<http://www.fsa.usda.gov/FSA/webapp?area=home&subject=diap&topic=landing>)
  - Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy, Weatherization Assistance Program (<http://www1.eere.energy.gov/wip/wap.html>). This program minimizes the adverse effects of high energy costs on low-income, elderly, and handicapped citizens through client education activities and weatherization services such as an all-around safety check of major energy systems, including heating system modifications and insulation checks.
    - The Tribal Energy Program offers financial and technical assistance to Indian tribes to help them create sustainable renewable energy installations on their lands. This program promotes tribal energy self-sufficiency and fosters employment and economic development on America's tribal lands.  
(<http://www1.eere.energy.gov/wip/tribal.html>)
  - US Environmental Protection Agency (EPA). Under EPA's Clean Water State Revolving Fund (CWSRF) program, each state maintains a revolving loan fund to provide independent and permanent sources of low-cost financing for a wide range of water quality infrastructure projects, including: municipal wastewater treatment projects; non-point source projects; watershed protection or restoration projects; and estuary management projects.  
(<http://yosemite.epa.gov/R10/ecocomm.nsf/6da048b9966d22518825662d00729a35/7b68c420b668ada5882569ab00720988!OpenDocument>)
  - Public Works and Development Facilities Program. This program provides assistance to help distressed communities attract new industry, encourage business expansion, diversify local economies, and generate long-term, private sector jobs. Among the types of projects funded are water and sewer facilities, primarily serving industry and commerce; access roads to industrial parks or sites; port improvements; business incubator facilities; technology infrastructure; sustainable development activities; export programs; brownfields redevelopment; aquaculture facilities; and other infrastructure projects. Specific activities may include demolition, renovation, and construction of public facilities; provision of water or sewer infrastructure; or the development of stormwater control mechanisms (e.g., a retention pond) as part of an
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industrial park or other eligible project.

([http://cfpub.epa.gov/fedfund/program.cfm?prog\\_num=51](http://cfpub.epa.gov/fedfund/program.cfm?prog_num=51))

- Department of Health and Human Services, Administration of Children & Families, Administration for Native Americans (ANA). The ANA awards funds through grants to American Indians, Native Americans, Native Alaskans, Native Hawaiians, and Pacific Islanders. These grants are awarded to individual organizations that successfully apply for discretionary funds. ANA publishes in the Federal Register an announcement of funds available, the primary areas of focus, review criteria, and the method of application. ([http://www.acf.hhs.gov/programs/ana/programs/program\\_information.html](http://www.acf.hhs.gov/programs/ana/programs/program_information.html))
  - Department of Housing and Urban Development (HUD) provides a variety of disaster resources. They also partner with Federal and state agencies to help implement disaster recovery assistance. Under the *National Response Framework* the FEMA and the Small Business Administration (SBA) offer initial recovery assistance. ([http://www.hud.gov/info/disasterresources\\_dev.cfm](http://www.hud.gov/info/disasterresources_dev.cfm))
    - HUD, Office of Homes and Communities, Section 108 Loan Guarantee Programs. This program provides loan guarantees as security for Federal loans for acquisition, rehabilitation, relocation, clearance, site preparation, special economic development activities, and construction of certain public facilities and housing. (<http://www.hud.gov/offices/cpd/communitydevelopment/programs/108/index.cfm>)
    - HUD, Office of Homes and Communities, Section 184 Indian Home Loan Guarantee Programs. The Section 184 Indian Home Loan Guarantee Program is a home mortgage specifically designed for American Indian and Alaska Native families, Alaska Villages, Tribes, or Tribally Designated Housing Entities. Section 184 loans can be used, both on and off native lands, for new construction, rehabilitation, purchase of an existing home, or refinance.
    - Because of the unique status of Indian lands being held in Trust, Native American homeownership has historically been an underserved market. Working with an expanding network of private sector and tribal partners, the Section 184 Program endeavors to increase access to capital for Native Americans and provide private funding opportunities for tribal housing agencies with the Section 184 Program. (<http://www.hud.gov/offices/pih/ih/homeownership/184/>)
    - HUD/CDBG provides grant assistance and technical assistance to aid communities in planning activities that address issues detrimental to the health and safety of local residents, such as housing rehabilitation, public services, community facilities, and infrastructure improvements that would primarily benefit low-and moderate-income persons (<http://www.hud.gov/offices/cpd/communitydevelopment/programs/>)
  - Department of Labor (DOL), Employment and Training Administration, Disaster Unemployment Assistance. Provides weekly unemployment subsistence grants for those who become unemployed because of a major disaster or emergency. Applicants must have exhausted all benefits for which they would normally be eligible. (<http://www.workforcesecurity.doleta.gov/unemploy/disaster.asp>)
    - The Workforce Investment Act contains provisions aimed at supporting employment and training activities for Indian, Alaska Native, and Native Hawaiian individuals.
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The Department of Labor's Indian and Native American Programs (INAP) funds grant programs that provide training opportunities at the local level for this target population. (<http://www.dol.gov/dol/topic/training/indianprograms.htm>)

- U.S. Department of Transportation, Hazardous Materials Emergency Preparedness Grant. To increase State, Territorial, Tribal and local effectiveness in safely and efficiently handling hazardous materials accidents and incidents, enhance implementation of the Emergency Planning and Community Right-to-Know Act of 1986, and encourage a comprehensive approach to emergency training and planning by incorporating the unique challenges of responses to transportation situations, through planning and training. Requires a 20% local match.
  - Federal Financial Institutions. Member banks of Federal Deposit Insurance Corporation, Financial Reporting Standards or Federal Home Loan Bank Board may be permitted to waive early withdrawal penalties for Certificates of Deposit and Individual Retirement Accounts.
  - Internal Revenue Service (IRS), Disaster Tax Relief. Provides extensions to current year's tax return, allows deductions for disaster losses, and allows amendment of previous year's tax returns (<http://www.irs.gov/newsroom/article/0,,id=108362,00.html>).
  - Natural Resources Conservation Service (NRCS) has several funding sources to fulfill mitigation needs. Further information is located at: <http://www.ak.nrcs.usda.gov/sitemap.html>
    - The Emergency Watershed Protection Program (EWP). This funding source is designed is to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed.
    - Wildlife habitat Incentives Program (WHIP). This is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land.
    - Watershed Planning. NRCS watershed activities in Alaska are voluntary efforts requested through conservation districts and units of government and/or tribes. The watershed activities are lead locally by a "watershed management committee" that is comprised of local interest groups, local units of government, local tribal representatives and any organization that has a vested interest in the watershed planning activity. This committee provides direction to the process as well as provides the decision-making necessary to implement the process. Technical assistance is provided to the watershed management committee through a "technical advisory committee" comprised of local, state and federal technical specialist. These specialists provide information to the watershed management committee as needed to make sound decisions. NRCS also provides training on watershed planning organization and process.
  - U.S. SBA Disaster Assistance (<http://www.sba.gov/category/navigation-structure/starting-managing-business/managing-business/running-business/emergency->
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preparedness-and-disaster-) provides information concerning disaster assistance, preparedness, planning, cleanup, and recovery planning.

- May provide low-interest disaster loans to individuals and businesses that have suffered a loss due to a disaster. (<http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans>). Requests for SBA loan assistance should be submitted to DHS&EM.
- United States Army Corps of Engineers (USACE) Alaska District's Civil Works Branch studies potential water resource projects in Alaska. These studies analyze and solve water resource issues of concern to the local communities. These issues may involve navigational improvements, flood control or ecosystem restoration. The agency also tracks flood hazard data for over 300 Alaskan communities on floodplains or the sea coast. These data help local communities assess the risk of floods to their communities and prepare for potential future floods (<http://www.poa.usace.army.mil/en/cw/index.htm>). The USACE is a member and co-chair of the Alaska Climate Change Sub-Cabinet.

### State Funding Resources

- DHS&EM is responsible for improving hazard mitigation technical assistance for local governments for the State of Alaska. Providing hazard mitigation training, current hazard information and communication facilitation with other agencies will enhance local hazard mitigation efforts. DHS&EM administers FEMA mitigation grants to mitigate future disaster damages such as those that may affect infrastructure including elevating, relocating, or acquiring hazard-prone properties. (<http://www.ak-prepared.com/plans/mitigation/mitigati.htm>)

DHS&EM also provides mitigation funding resources for mitigation planning on their Web site at <http://www.ak-prepared.com/plans/mitigation/localhazmitplan.htm>.

- Division of Senior Services (DSS): Provides special outreach services for seniors, including food, shelter and clothing. (<http://www.hss.state.ak.us/dsds/seniorInfoResources.htm>)
  - Division of Insurance (DOI): Provides assistance in obtaining copies of policies and provides information regarding filing claims. (<http://www.dced.state.ak.us/insurance/>)
  - Department of Military and Veterans Affairs (DMVA): Provides damage appraisals and settlements for VA-insured homes, and assists with filing of survivor benefits. (<http://veterans.alaska.gov/links.htm>)
  - DCRA within the DCCED. DCRA administers the HUD/CDBG, FMA Program, and the Climate Change Sub-Cabinet's Interagency Working Group's program funds and administers various flood and erosion mitigation projects, including the elevation, relocation, or acquisition of flood-prone homes and businesses throughout the State. This department also administers programs for State "distressed" and "targeted" communities. (<http://www.commerce.state.ak.us/dca/>)
  - Department of Environmental Conservation (DEC). The DEC primary roles and responsibilities concerning hazards mitigation are ensuring safe food and safe water, and pollution prevention and pollution response. DEC ensures water treatment plants, landfills, and bulk fuel storage tank farms are safely constructed and operated in
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communities. Agency and facility response plans include hazards identification and pollution prevention and response strategies. (<http://dec.alaska.gov/>)

- The Division of Water's Village Safe Water (VSW) Program works with rural communities to develop sustainable sanitation facilities. Communities apply each year to VSW for grants for sanitation projects. Federal and state funding for this program is administered and managed by the State of Alaska's VSW program. VSW provides technical and financial support to Alaska's smallest communities to design and construct water and wastewater systems. In some cases, funding is awarded by VSW through the Alaska Native Tribal Health Consortium (ANTHC), who in turn assist communities in design and construct of sanitation projects.
- Municipal Grants and Loans Program. The Department of Environmental Conservation / Division of Water administer the Alaska Clean Water Fund (ACWF) and the Alaska Drinking Water Fund (ADWF). The division is fiscally responsible to the Environmental Protection Agency (EPA) to administer the loan funds as the EPA provides capitalization grants to the division for each of the loan funds. In addition, it is prudent upon the division to administer the funds in a manner that ensures their continued viability.
- Under EPA's Clean Water State Revolving Fund (CWSRF) program, each state maintains a revolving loan fund to provide independent and permanent sources of low-cost financing for a wide range of water quality infrastructure projects, including: municipal wastewater treatment projects; non-point source projects; watershed protection or restoration projects; and estuary management, [and stormwater management] projects.  
(<http://yosemite.epa.gov/R10/ecocomm.nsf/6da048b9966d22518825662d00729a35/7b68c420b668ada5882569ab00720988!OpenDocument>)

Alaska's Revolving Loan Fund Program, prescribed by Title VI of the Clean Water Act as amended by the Water Quality Act of 1987, Public Law 100-4. DEC will use the ACWF account to administer the loan fund. This Agreement will continue from year-to-year and will be incorporated by reference into the annual capitalization grant agreement between EPA and the DEC. DEC will use a fiscal year of July 1 to June 30 for reporting purposes.

([http://www.epa.gov/region10/pdf/water/srf/cwsrf\\_alaska\\_operating\\_agreement.pdf](http://www.epa.gov/region10/pdf/water/srf/cwsrf_alaska_operating_agreement.pdf))

- Department of Transportation and Public Facilities (DOT/PF) personnel provide technical assistance to the various emergency management programs, to include mitigation. This assistance is addressed in the DHS&EM-DOT/PF Memorandum of Agreement and includes but is not limited to: environmental reviews, archaeological surveys, and historic preservation reviews.
    - DOT/PF and DHS&EM coordinate buy-out projects to ensure that there are no potential right-of-way conflicts with future use of land for bridge and highway projects, and collaborate on earthquake mitigation.
    - Additionally, DOT/PF provides the safe, efficient, economical, and effective State highway, harbor, and airport operation. DOT/PF uses its Planning, Design and Engineering, Maintenance and Operations, and Intelligent Transportation Systems
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resources to identify hazards, plan and initiate mitigation activities to meet the transportation needs of Alaskans, and make Alaska a better place to live and work. DOT/PF budgets for temporary bridge replacements and materials necessary to make the multi-modal transportation system operational following natural disaster events.

- DNR administers various projects designed to reduce stream bank erosion, reduce localized flooding, improve drainage, and improve discharge water quality through the stormwater grant program funds. Within DNR,
  - The Division of Geological and Geophysical Survey (DGGS) is responsible Alaska's mineral, land, and water resources use, development, and earthquake mitigation collaboration.

Their geologists and support staff are leaders in researching Alaska's geology and implementing technological tools to most efficiently collect, interpret, publish, archive, and disseminate information to the public. Information is available at: ([http://www.dggs.dnr.state.ak.us/index.php?menu\\_link=publications&link=publications\\_search#](http://www.dggs.dnr.state.ak.us/index.php?menu_link=publications&link=publications_search#))

- The DNR's Division of Forestry (DOF) participates in a statewide wildfire control program in cooperation with the forest industry, rural fire departments and other agencies. Prescribed burning may increase the risks of fire hazards; however, prescribed burning reduces the availability of fire fuels and therefore the potential for future, more serious fires.  
(<http://forestry.alaska.gov/pdfs/08FireSuppressionMediaGuide.pdf>)
- DOF also manages various wildland fire programs, activities, and grant programs such as the FireWise Program (<http://forestry.alaska.gov/fire/firewise.htm>), Community Forestry Program (CFP) (<http://forestry.alaska.gov/community/>), Assistance to Fire Fighters Grant (AFG), Fire Prevention and Safety (FP&S), Staffing for Adequate Fire and Emergency Response Grants (SAFER), and Volunteer Fire Assistance and Rural Fire Assistance Grant (VFA-RFA) programs (<http://forestry.alaska.gov/fire/vfarfa.htm>). Information can be found at <http://forestry.alaska.gov/fire/current.htm>.

### Other Funding Resources

The following provide focused access to valuable planning resources for communities interested in sustainable development activities.

- FEMA, <http://www.fema.gov> - includes links to information, resources, and grants that communities can use in planning and implementation of sustainable measures.
  - American Planning Association (APA), <http://www.planning.org> - a non-profit professional association that serves as a resource for planners, elected officials, and citizens concerned with planning and growth initiatives.
  - Institute for Business and Home Safety (IBHS), <http://ibhs.org> - an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters.
  - American Red Cross (ARC). Provides for the critical needs of individuals such as food, clothing, shelter, and supplemental medical needs. Provides recovery needs such as
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furniture, home repair, home purchasing, essential tools, and some bill payment may be provided.

- Crisis Counseling Program. Provides grants to State and Borough Mental Health Departments, which in turn provide training for screening, diagnosing and counseling techniques. Also provides funds for counseling, outreach, and consultation for those affected by disaster. (<http://dialoguemakers.org/Resourses4states+Nonprofits.htm>)
- Denali Commission. Introduced by Congress in 1998, the Denali Commission is an independent federal agency designed to provide critical utilities, infrastructure, and economic support throughout Alaska. With the creation of the Denali Commission, Congress acknowledged the need for increased inter-agency cooperation and focus on Alaska's remote communities. Since its first meeting in April 1999, the Commission is credited with providing numerous cost-shared infrastructure projects across the State that exemplifies effective and efficient partnership between federal and state agencies, and the private sector.  
([http://www.denali.gov/index.php?option=com\\_content&view=section&id=1&Itemid=3](http://www.denali.gov/index.php?option=com_content&view=section&id=1&Itemid=3))
  - The Energy Program primarily funds design and construction of replacement bulk fuel storage facilities, upgrades to community power generation and distribution systems, alternative-renewable energy projects, and some energy cost reduction projects. The Commission works with the Alaska Energy Authority (AEA), Alaska Village Electric Cooperative (AVEC), Alaska Power and Telephone and other partners to meet rural communities' fuel storage and power generation needs.
  - The goal of the solid waste program at the Denali Commission is to provide funding to address deficiencies in solid waste disposal sites which threaten to contaminate rural drinking water supplies.
- Lindbergh Foundation Grants. Each year, The Charles A. and Anne Morrow Lindbergh Foundation provides grants of up to \$10,580 (a symbolic amount representing the cost of the Spirit of St. Louis) to men and women whose individual initiative and work in a wide spectrum of disciplines furthers the Lindberghs' vision of a balance between the advance of technology and the preservation of the natural/human environment.  
(<http://www.lindberghfoundation.org/docs/index.php/our-grants>)
- Rasmuson Foundation Grants. The Rasmuson foundation invests both in individuals and well-managed 501(c)(3) organizations dedicated to improving the quality of life for Alaskans.

The Foundation seeks to support not-for-profit organizations that are focused and effective in the pursuit of their goals, with special consideration for those organizations that demonstrate strong leadership, clarity of purpose and cautious use of resources.

The Foundation trustees believe successful organizations can sustain their basic operations through other means of support and prefer to assist organizations with specific needs, focusing on requests which allow the organizations to become more efficient and effective. The trustees look favorably on organizations which demonstrate broad community support, superior fiscal management and matching project support.  
(<http://www.rasmuson.org/index.php>)

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- Resurrection Bay Conservation Alliance. In 2005, the Resurrection Bay Conservation Alliance (RBCA), based in Seward Alaska, formed to advance the environmental integrity of our community. We focus on watershed issues like air and water pollution, protection and restoration of habitat, reducing bear and human conflicts, pursuing new energy sources, and weighing in on development proposals.

The RCBA's Resurrection Bay Watershed Conservation Program's mission is to protect and enhance the Resurrection Bay watershed through monitoring, habitat assessment, public education, and advocacy of science-based resource management.

Watershed program goals include:

- Promote community awareness and understanding of local ecosystems and associated conservation issues.
- Protect the Resurrection Bay watershed through education, outreach, partnerships, and citizen science.
- Monitor compliance with the Clean Water Act and other state and federal environmental regulations to ensure the protection of watershed resources.
- Develop projects to monitor and enhance the health of the Resurrection Bay Watershed.

(<http://rbca-alaska.org/page6/page31/page31.html>.)

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**Appendix D**  
**FEMA's Local Mitigation Plan Review Tool**

## APPENDIX A:

### LOCAL MITIGATION PLAN REVIEW TOOL

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The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA’s evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan’s strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

<b>Jurisdiction:</b> Seward Bear Creek Flood Service Area (SBCFSA)	<b>Title of Plan:</b> SBCFSA Hazard Mitigation Plan, A Service Area of the Kenai Peninsula Borough (KPB)	<b>Date of Plan:</b> June 2013
<b>Local Point of Contact:</b> Daniel Mahalak	<b>Address:</b> Seward Bear Creek Flood Service Area Seaview Plaza 302 Railway Avenue, #122 Seward, AK 99664	
<b>Title:</b> Water Resources Manager		
<b>Agency:</b> Kenai Peninsula Borough (KPB)		
<b>Phone Number:</b> 1.907.224.9515	<b>E-Mail:</b> DMahalak@borough.kenai.ak.us	

<b>State Reviewer:</b>	<b>Title:</b>	<b>Date:</b>
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<b>FEMA Reviewer:</b>	<b>Title:</b>	<b>Date:</b>
<b>Date Received in FEMA Region (insert #)</b>		
<b>Plan Not Approved</b>		
<b>Plan Approvable Pending Adoption</b>		
<b>Plan Approved</b>		



## SECTION 1: REGULATION CHECKLIST

**INSTRUCTIONS:** The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been ‘Met’ or ‘Not Met.’ The ‘Required Revisions’ summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is ‘Not Met.’ Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
<b>Regulation (44 CFR 201.6 Local Mitigation Plans)</b>				
<b>ELEMENT A. PLANNING PROCESS</b>				
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Section 3.1, Page 3-2	X		
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Section 3.3, Page 3-4	X		
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Section 3.3, Page 3-4	X		
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 3.4, Page 3-5	X		
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 3.5.2, Page 3-7	X		
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Section 3.5.3 Page 3-8	X		
<b><u>ELEMENT A: REQUIRED REVISIONS</u></b>				

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
Regulation (44 CFR 201.6 Local Mitigation Plans)				
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT				
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Section 5.2, Table 5-1, Page 5-2 <b>Earthquake</b> Section 5.3.1, Pg. 5-4 <b>Erosion,</b> Section 5.3.2, Page 5-11 <b>Flood,</b> Section 5.3.3, Page 5-16 <b>Ground Failure,</b> Section 5.3.4, Page 5-31 <b>Tsunami,</b> Section 5.3.5, Page 5-38 <b>Volcanic,</b> Section 5.3.6, Page 5-41 <b>Weather (Severe)</b> Section 5.3.7, Page 5-51 <b>Wildland-Urban Fire,</b> Section 5.3.8, Page 5-64		X	

<p>B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))</p>	<p><b>Earthquake,</b> Section 5.3.1.2 History, Page 5-6, Probability, Page 5-11 <b>Erosion,</b> Sec. 5.3.2.2, History, Page 5-12 Probability, Page. 5-15 <b>Flood,</b> Section 5.3.3.2 History, Page 5-18 Probability, Page 5-30 <b>Ground Failure,</b> Section 5.3.4. 2 History, Page 5-34 Probability, Page 5-38 <b>Tsunami,</b> Section 5.3.5.2 History, Page 5-39 Probability, Page 5-41 <b>Volcanic,</b> Section 5.3.6.2 History, Page 5-44 Probability, Page 5-51 <b>Weather (Severe)</b> Section 5.3.7.2 History, Page 5-53 Probability, Page 5-64 <b>Wildland-Urban Fire,</b> Section 5.3.8.2 History Page 5-65 Probability, Page 5-69</p>	<p>X</p>	
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<p>B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))</p>	<p><b>Earthquake,</b> Section 5.3.1.3 Impact, Page 5-10 Extent, Page 5-9 <b>Erosion,</b> Section 5.3.2.3, Impact, Page 5-15 Extent, Page 5-14 <b>Flood,</b> Section 5.3.3.3 Impact, Page 5-30 Extent, Page 5-28 <b>Ground Failure,</b> Section 5.3.4.3 Impact, Page 5-37 Extent, Page 5-37 <b>Tsunami,</b> Section 5.3.5.3 Impact, Page 5-41 Extent, Page 5-41 <b>Volcanic,</b> Section 5.3.6.3 Impact, Page 5-51 Extent, Page 5-51 <b>Weather (Severe)</b> Section 5.3.7.3 Impact, Page 5-63 Extent, Page 5-63 <b>Wildland-Urban Fire,</b> Section 5.3.8.3 Impact, Page 5-67 Extent Page 5-67 <b>Vulnerability Analysis Overview,</b> Section 6.1, Page 6-1</p>	<p>X</p>	
<p>B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))</p>	<p>Section 6.4, Page 6-9</p>	<p>X</p>	
<p><b><u>ELEMENT B: REQUIRED REVISIONS</u></b></p>			

<b>ELEMENT C. MITIGATION STRATEGY</b>			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Section 7.2, Page 7-2 Tables 7-1, 7-2, 7-3, Page 7-3	<b>X</b>	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Section 6.4 Tables 6-7 and 6-8, Page 6-10	<b>X</b>	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Section 7.4 Table 7-4, Page 7-5	<b>X</b>	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Section 7-5 Table 7-5, Page 7-6 MH-3 Goal addresses structures, Page 7-10	<b>X</b>	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Section 7-6, Process, Page 7-13 Section 7.7 Implementation Plan Tables 7-7, 7-8, Page 7-16	<b>X</b>	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Section 7.8 Page 7-34	<b>X</b>	
<b><u>ELEMENT C: REQUIRED REVISIONS</u></b>			

1. REGULATION CHECKLIST		Location in Plan (section and/or page number)	Met	Not Met
<b>Regulation</b> (44 CFR 201.6 Local Mitigation Plans)				
<b>ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION</b> (applicable to plan updates only)				
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	N/A Plan is a supplemental document, reflecting an all hazard plan.	X		
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	N/A	X		
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	N/A	X		
<b><u>ELEMENT D: REQUIRED REVISIONS</u></b>				
<b>ELEMENT E. PLAN ADOPTION</b>				
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	Section 4.1, Page 4-1	X		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	N/A	X		
<b><u>ELEMENT E: REQUIRED REVISIONS</u></b>				
<b>ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)</b>				
F1.				
F2.				
<b><u>ELEMENT F: REQUIRED REVISIONS</u></b>				



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**Appendix E**  
**Jurisdictional Resolutions**

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Introduced by:	Mayor
Date:	01/07/14
Shortened Hearing:	01/21/14
Action:	Enacted as Amended
Vote:	9 Yes, 0 No, 0 Absent

**KENAI PENINSULA BOROUGH  
ORDINANCE 2014-03**

**AN ORDINANCE AMENDING THE 2010 KENAI PENINSULA BOROUGH  
ALL-HAZARD MITIGATION PLAN BY DELETING EXISTING ANNEX I, 2010  
SEWARD/BEAR CREEK FLOOD SERVICE AREA FLOOD HAZARD MITIGATION  
PLAN, AND ADOPTING THE 2013 SEWARD/BEAR CREEK FLOOD SERVICE AREA  
HAZARD MITIGATION PLAN AS THE NEW ANNEX I**

- WHEREAS,** the Federal Emergency Management Agency (FEMA) requires all States to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and
- WHEREAS,** on July 6, 2010, the Kenai Peninsula Borough (KPB) Assembly enacted Ordinance 2010-26, adopting the 2010 KPB All-Hazard Mitigation Plan (AHMP) as the local mitigation plan for the area within the Kenai Peninsula Borough, and a required component of the State of Alaska Hazard Mitigation Plan; and
- WHEREAS,** the KPB AHMP is a multi-jurisdictional plan, developed in coordination with the incorporated cities within the KPB, the Seward/Bear Creek Flood Service Area (SBCFSA) board, the All Lands/All Hands Interagency Wildfire Mitigation Group, the State of Alaska Division of Homeland Security and Emergency Management (DHS&EM), and the Federal Emergency Management Agency (FEMA); and
- WHEREAS,** the KPB All-Hazard Mitigation Plan was designed to assist borough residents, local and private organizations and other parties interested in hazard mitigation planning, as well as to coordinate planning efforts between government agencies; and
- WHEREAS,** the SBCFSA Flood Hazard Mitigation Plan (FMP) was adopted as Annex I to the 2010 KPB All-Hazard Mitigation Plan; and
- WHEREAS,** FEMA disaster recovery funding and grant programs require regular updates to the mitigation plans; and
- WHEREAS,** the KPB on behalf of the SBCFSA received a grant from the Alaska Division of Homeland Security and Emergency Management in the amount of \$230,220 for the purpose of updating the existing FMP; and



**WHEREAS,** the SBCFSA contracted with URS Corporation and prepared an update to the FMP, entitled the 2013 Hazard Mitigation Plan (HMP), which reflects an “all-hazards” approach, and includes earthquakes, erosion, ground failure, tsunami and seiches, volcanic hazards, weather and wildland-urban interface fires; and

**WHEREAS,** the HMP update identifies a prioritized list of mitigation projects and also considers how the potential impacts of climate change may evolve hazard risk over time; and

**WHEREAS,** the SBCFSA HMP serves as a guide for citizens and policy makers in the SBCFSA in order to mitigate potential natural hazard disaster damages and to ensure public awareness and involvement; and

**WHEREAS,** the planning process included planning committee meetings, a public review and comment period, two work sessions, and an informational newsletter posted at the KPB offices in Seward, the Seward Post Office, City Hall & Library and also on the SBCFSA website; and

**WHEREAS,** at its meeting of May 6, 2013, the SBCFSA Board reviewed the final draft plan and recommended approval of the 2013 Seward/Bear Creek Flood Service Area Hazard Mitigation Plan; and

**WHEREAS,** the City of Seward considered Resolution 2013-032 in support of the HMP at its meeting of May 13, 2013, and recommended approval; and

**WHEREAS,** the Kenai Peninsula Borough Planning Commission reviewed this ordinance during its regularly scheduled meeting of January 6, 2014, and recommended approval by unanimous consent;

**NOW, THEREFORE, BE IT ORDAINED BY THE ASSEMBLY OF THE KENAI PENINSULA BOROUGH:**

**SECTION 1.** That the existing Annex I in the 2010 KPB All Hazard Mitigation plan adopted by KPB 2.80.010, is hereby deleted.

**SECTION 2.** That the 2010 KPB All-Hazard Mitigation Plan is hereby amended by adopting the 2013 Seward Bear Creek Flood Service Area Hazard Mitigation Plan as the new Annex I.

**SECTION 3.** That this ordinance takes effect immediately upon its enactment.

ENACTED BY THE ASSEMBLY OF THE KENAI PENINSULA BOROUGH THIS 21ST DAY OF JANUARY, 2014.

Hal Smalley  
Hal Smalley, Assembly President

ATTEST:

John Blankenship  
John Blankenship, MMC, Borough Clerk



Yes: Bagley, Haggerty, Johnson, McClure, Ogle, Pierce, Smith, Wolf, Smalley  
No: None  
Absent: None



Sponsored by: Staff

**CITY OF SEWARD, ALASKA  
PLANNING AND ZONING COMMISSION  
RESOLUTION 2013-09**

**A RESOLUTION OF THE PLANNING AND ZONING COMMISSION OF  
THE CITY OF SEWARD, ALASKA, RECOMMENDING COUNCIL  
SUPPORT THE KPB APPROVAL OF THE SEWARD BEAR CREEK  
FLOOD SERVICE AREA 2013 LOCAL HAZARD MITIGATION PLAN  
UPDATE**

**WHEREAS**, the Federal Emergency Management Agency (FEMA) requires all states to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

**WHEREAS**, the Seward Bear Creek Flood Service Area (SBCFSA) 2013 Local Hazard Mitigation Plan (LHMP) supplements the Kenai Peninsula Borough's Multi-Jurisdictional All-Hazard Mitigation Plan as annex I; and

**WHEREAS**, FEMA disaster recovery funding and grant programs require regular updates to the Plan; and

**WHEREAS**, the KPB on behalf of the SBCFSA received a grant from the Alaska Division of Homeland Security and Emergency Management in the amount of \$230,220 for the purpose of updating the existing FMP; and

**WHEREAS**, the SBCFSA's LHMP is a joint planning effort by the SBCFSA Board, City of Seward, and the Kenai Peninsula Borough; and

**WHEREAS**, this plan serves as guide for citizens and policy makers in the SBCFSA in order to mitigate potential natural hazard disaster damages and to ensure public awareness and involvement; and

**WHEREAS**, the complete Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward and SBCFSA LHMP annexes, is scheduled for review and adoption July 2016.

**NOW, THEREFORE, BE IT RESOLVED BY THE PLANNING AND ZONING COMMISSION OF THE CITY OF SEWARD, ALASKA that:**

**Section 1.** The Commission recommends Seward City Council support the Kenai Peninsula

Borough approval of the Seward Bear Creek Flood Service Area 2013 Local Hazard Mitigation Plan.

**Section 2.** This resolution shall take effect immediately upon its adoption.

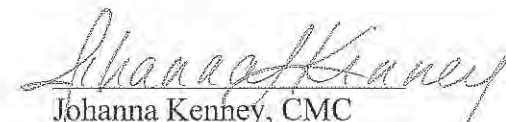
**PASSED AND APPROVED** by the Planning and Zoning Commission of the City of Seward, Alaska, this 7<sup>th</sup> day of May, 2013.

**THE CITY OF SEWARD, ALASKA**

  
\_\_\_\_\_  
**Sandie Roach', Chair**

AYES: Fleming, Campestre, McClure, Ecklund, Roach'  
NOES: None  
ABSENT: Butts  
ABSTAIN: None  
VACANT: One

**ATTEST:**

  
Johanna Kenney, CMC  
City Clerk

(City Seal)





**CITY OF SEWARD, ALASKA  
RESOLUTION 2013-032**

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SEWARD,  
ALASKA, RECOMMENDING KENAI PENINSULA BOROUGH APPROVAL  
OF THE SEWARD BEAR CREEK FLOOD SERVICE AREA 2013 LOCAL  
HAZARD MITIGATION PLAN UPDATE**

**WHEREAS**, the Federal Emergency Management Agency (FEMA) requires all states to submit a Hazard Mitigation Plan to be eligible for any FEMA funding in disasters; and

**WHEREAS**, FEMA disaster recovery funding and grant programs require regular updates to the Plan; and

**WHEREAS**, the Seward Bear Creek Flood Service Area (SBCFSA) 2013 Local Hazard Mitigation Plan (LHMP) supplements the Kenai Peninsula Borough's (KPB) Multi-Jurisdictional All-Hazard Mitigation Plan as annex I; and

**WHEREAS**, the KPB, on behalf of the SBCFSA, received a grant from the Alaska Division of Homeland Security and Emergency Management in the amount of \$230,220 for the purpose of updating the existing Hazard Mitigation Plan; and

**WHEREAS**, the SBCFSA's LHMP is a joint planning effort by the SBCFSA Board, City of Seward, and the Kenai Peninsula Borough; and

**WHEREAS**, this plan serves as guide for citizens and policy makers in the SBCFSA in order to mitigate potential natural hazard disaster damages and to ensure public awareness and involvement; and

**WHEREAS**, the complete Kenai Peninsula Borough's All-Hazard Mitigation Plan, including the City of Seward and SBCFSA LHMP annexes, is scheduled for review and adoption July 2016; and

**WHEREAS**, on May 7, 2013 the Planning and Zoning Commission approved Resolution 2013-09 recommending the City Council support the Kenai Peninsula Borough approval of the SBCFSA Local Hazard Mitigation Plan.

**NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SEWARD, ALASKA that:**

**Section 1.** The Seward City Council hereby supports the Kenai Peninsula Borough's approval of the Seward Bear Creek Flood Service Area 2013 Local Hazard Mitigation Plan update.

CITY OF SEWARD, ALASKA  
RESOLUTION 2013-032

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**Section 2.** This resolution shall take effect immediately upon its adoption.

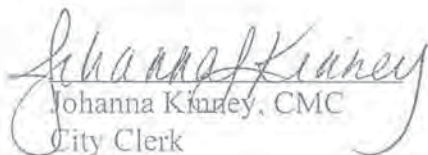
**PASSED AND APPROVED** by the City Council of the City of Seward, Alaska, this 13<sup>th</sup> day of May, 2013.

THE CITY OF SEWARD, ALASKA

  
\_\_\_\_\_  
David Seaward, Mayor

AYES: Valdatta, Bardarson, Keil, Shafer, Terry, Seaward  
NOES: None  
ABSENT: Casagrande  
ABSTAIN: None

**ATTEST:**

  
Johanna Kinney, CMC  
City Clerk

(City Seal)





## **KENAI PENINSULA BOROUGH**

### **PLANNING DEPARTMENT**

144 North Binkley Street • Soldotna, Alaska 99669-7520

**PHONE:** (907) 714-2200 • **FAX:** (907) 714-2378

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[www.borough.kenai.ak.us](http://www.borough.kenai.ak.us)

**MIKE NAVARRE**  
**BOROUGH MAYOR**

### **M E M O R A N D U M**

**TO:** Linda Murphy, Assembly President  
Kenai Peninsula Borough Assembly Members

**THRU:** Mike Navarre, Borough Mayor

**FROM:** Max Best, Planning Director 

**DATE:** May 30, 2013

**SUBJECT:** Ordinance 2013-16; ordinance amending the 2010 Kenai Peninsula Borough All-Hazard Mitigation Plan by deleting existing Annex I, "2010 Seward/Bear Creek Flood Service Area Flood Hazard Mitigation Plan", and Adopting the "2013 Seward / Bear Creek Flood Service Area Hazard Mitigation Plan" as the new Annex I.

The Planning Commission reviewed the subject ordinance during their regularly scheduled May 28, 2013 meeting. A motion passed by unanimous consent to recommend approval of the ordinance.

In the ordinance, please make the following amendment to the last WHEREAS:

*WHEREAS, the Kenai Peninsula Borough Planning Commission reviewed this ordinance during its regularly scheduled meeting of May 28, 2013 and recommended approval by unanimous consent.*

Attached are the unapproved minutes of the subject portion of the meeting.



## AGENDA ITEM F. PUBLIC HEARINGS

1. Ordinance 2013-16; ordinance amending the 2010 Kenai Peninsula Borough All-Hazard Mitigation Plan by deleting existing Annex I, "2010 Seward/Bear Creek Flood Service Area Flood Hazard Mitigation Plan", and Adopting the "2013 Seward / Bear Creek Flood Service Area Hazard Mitigation Plan" as the new Annex I.

Memorandum & Staff Report given by Max Best

PC Meeting: 5/28/13

The 2010 Kenai Peninsula Borough (KPB) All-Hazard Mitigation Plan (AHMP) was adopted by the KPB assembly on June 6, 2012, through Ordinance 2010-26, codified as KPB 2.80.010. The KPB AHMP is a multi-jurisdictional plan which includes Annex I, "The Seward Bear Creek Flood Service Area (SBCFSA) Hazard Mitigation Plan (HMP)". The KPB, on behalf of the SBCFSA, received a grant from the Alaska Division of Homeland Security and Emergency Management in the amount of \$230,220 to review and update the HMP (Ordinance 2011-19-81).

URS Corporation was hired to develop a plan that identifies and prioritizes mitigation projects, and reflects an "all-hazards" approach, including earthquakes, erosion, ground failure, tsunami and seiches, volcanic hazards, weather and wildland-urban interface fires. Meetings for the update began in September 2012.

The updated annex will facilitate proactive, sustainable flood risk adaptation practices and mitigation projects in the Seward / Bear Creek Flood Service Area. The plan incorporates a comprehensive evaluation of flood risk (physical, economic and social), that will improve upon the previous assessments that focused predominately on flood hazards. In addition to assessing present day risks, the study also considers the potential impacts of climate change and how that may evolve the risk over time. The plan utilizes the HAZUS-MH MR4 flood module to quantify risk(s) within the SBCFSA and substantiates future conditions, hazard identification and risk assessments that support the development and evaluation of mitigation options.

The Seward City Council, Planning & Zoning Commission along with the Seward /Bear Creek Flood Service Area have adopted and moved for adoption of the ordinance through resolution.

Adoption of the 2013 SBCFSA Hazard Mitigation Plan as the new Annex I in the Kenai Peninsula Borough All-Hazard Mitigation Plan will provide the level of support required by funding agencies and grantors when considering projects in this document. Thank you for your consideration.

**Staff Recommendation:** Staff recommends the Planning Commission recommend adoption of Ordinance 2013-16 to the Borough Assembly.

### END OF MEMORANUM & STAFF REPORT

Vice Chairman Martin opened the meeting for public comment. Seeing and hearing no one wishing to speak, Vice Chairman Martin closed the public comment period and opened discussion among the Commission.

**MOTION:** Commissioner Ruffner moved, seconded by Commissioner Isham to recommend approval of Ordinance 2013-16.

Commissioner Isham asked Mr. Mahalak for an overview of the Plan.

#### Dan Mahalak, Water Resource Manager

Mr. Mahalak stated that this plan comes to the Planning Commission after a year with URS. A freeware was used by the name of Hazus MH which is federal software that generates estimated losses based on scenarios. There were four different scenarios that were generated for the present day and in the future. He stated that the plan incorporates disasters such as tsunamis, earthquakes, ground failure, flood, and erosion which are the major concerns.



Mr. Mahalak commented that the plan was paid for by Homeland Security through a 5% fund from the Eagle flooding that occurred back in 2009. Ultimately, they hope to use the benefit cost analysis which is in Appendix J and the map which is the mitigation action plan that is in Chapter 7. The mitigation action plan is a prioritized list based on the benefit cost analysis from the scenarios that were generated.

Commissioner Isham asked how much it cost to generate the plan. Mr. Mahalak replied that they had a \$230,000 appropriation and a competitive bid of \$198,680.

Commissioner Ruffner felt that one of the flooding issues that was never tackled in a way that he was personally satisfied had to do with the alluvial fan issue. He felt that FEMA left them short on addressing the alluvial fan concerns. Commissioner Ruffner also asked if there was better support from the Federal government. Mr. Mahalak replied that they have gone above and beyond where the federal government stopped mapping because it didn't fit into their nice, easy methodology. They were able to generate scenarios on those alluvial fans that were discussed that represent what they know happens today. Those landforms are changing and developing greatly. He stated they use the knowledge they have to come up with what they have today and try to project it.

Mr. Mahalak felt they were not getting the Federal support that was needed for those fans, as far as the mapping goes but they could use this to help the Federal government map those better. What they did was take the 2006 LIDAR and the cross sections that generate the federal insurance rate maps and generated another data set in 2009 capturing the 2006 flood. They took those cross sections with the new LIDAR and applied it to the modeling that they were already in receipt of to try to see what the difference was due to that one episodic change. He felt they have more updated information than what the federal government has at this time.

Mr. Mahalak stated that the Federal Insurance Rate maps should be coming out soon. By their methodology, FEMA in Appendix G calls Alluvial fans ultra-hazardous yet FEMA mapped them low to moderate risk in the new maps which helps the people in Seward that needs flood insurance to be able to get low cost flood insurance.

Commissioner Ruffner stated he doesn't expect FEMA to do it all for them but felt it was important to bring the local knowledge which should greatly help public health interests into the future.

Commissioner Ecklund recused herself from voting and discussion due to voting on this ordinance at the Seward Planning & Zoning Commission meeting. Mr. Best stated that this is a legislative issue so Commissioner Ecklund did not need to recuse herself from voting and discussion.

**VOTE:** The motion passed by unanimous consent.

BRYSON ABSENT	CARLUCCIO YES	COLLINS YES	ECKLUND YES	FOSTER YES	GROSS YES	HOLSTEN ABSENT
ISHAM YES	LOCKWOOD ABSENT	MARTIN YES	RUFFNER YES	TAURIANEN ABSENT	WHITNEY YES	9 YES 4 ABSENT

#### AGENDA ITEM F. PUBLIC HEARINGS

2. Ordinance 2013-\_\_\_; An ordinance authorizing a negotiated lease at less than fair market value of certain real property to Peninsula Modelers, Inc.

Staff Report given by Marcus Mueller

PC Meeting: 5/28/13

Since 1991 the site formerly known as the Kenai Landfill containing approximately 31 acres has been leased to the Peninsula Modelers Inc. (PMI) previously known as the Peninsula Modelers Association. The original lease was for ten years with two five year extensions authorized by Ordinance 91-30. May 31, 2013 will conclude the final renewal option. This proposal is a new lease which would replace the expiring lease to the PMI of an area in the City of Kenai that was the former landfill cap.

**Appendix F**  
**Public Outreach**



M e m o

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## Project: Seward Bear Creek Flood Service Area LHMP

SUBJECT: Posters for Mark-Up

DATE: October 10, 2012

FROM: R. Scott Simmons, PM

**Dan Mahalak,**

*Here are three copies of the maps that Rich Chamberlain discussed with you the other day. Please share them with others and encourage them to annotate as discussed memo dated October 8, 2012.*

To: Dan Mahalak, SBCFSA Project Manager, Kenai Peninsula Borough

From: URS Consultant Team

Date: October 8, 2012

Regarding: URS' Data Needs and Requests for SBCFSA LHMP Annex

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### High Priority Data Requests/Questions:

- On the aerial maps showing NHD stream data and names provided to you please:
  - Delineate (or somehow markup) the current stream alignment for those reaches we will be modeling.
  - Indicate the preferred stream names for each of these reaches. Please make sure to mark names both upstream and downstream of the junctions (confluences) of the streams.
  - Delineate the upper limit of Hazus flood modeling for each reach.
- Also on the maps, please remove, modify, add, etc. the critical facilities that are currently shown using the red triangle symbol and associated label. These data points were provided by KPB GIS.
  - As we learned during the kickoff meeting, roads that lead to critical facilities should also be included so mark these roads as appropriate.
  - Identify all source(s) of drinking water
  - Annotate (e.g., draw a large circle around) areas covered by municipal water systems or private systems (wells, other)
  - Annotate areas covered by municipal sewer systems or private systems (septic, other)
- Please confirm whether Lowell Creek is to be included in our study. If so, we need to obtain the H&H analysis and scenario-based inundation mapping for Lowell Creek from the USACE. Do you have these data or know who we should contact?
- We briefly discussed how gravel berms, and other "levees" (not technically levees) are not considered infrastructure by the City/Borough. How should we account for these,

both current and future? For those non-technical “levees” within the SBCFSA, please indicate on the maps where and what type these features are.

- Please confirm what you would like future “build-out” scenarios to be. We suggest using current (2012), 10 years out (2022), and 20 years out (2032). If you have other ideas about future build out scenarios please suggest.
- Please confirm what you would like climate change scenarios to be. We suggest looking at a range for each climate change effect (i.e. change in precipitation and temperature) produced from low/medium/high greenhouse gas emission scenarios. Using data provided by University of Alaska-Fairbanks, we suggest looking at dates: 2012, 2022, 2032, 2050, and 2100. These dates were chosen to match build-out scenarios as well as to provide future possible climate conditions.

### **Medium Priority Data Needs/Requests/Questions:**

- Are there any elevation datasets available prior to 2006? If so, could these be provided? These “older” elevation datasets will help our team assess stream aggradation and degradation patterns and issues. Any additional information you have concerning changes in stream aggradation/degradation would be appreciated.
- Please provide as-built plans for any recently constructed hydraulic structures (culverts, bridges, levees, etc.). Whatever digital format you have is fine. If appropriate, please mark the location(s) of these features on the maps.
- Please send Rich Chamberlain the development pattern datasets that are mapped on your wall.
- Future zoning and land use data: Any available documents or other information from both KPB (via Dan) and from City of Seward (Donna via Dan).
- Future development data: Any available documents or other information from both KPB (via Dan) and from City of Seward (Donna via Dan).
  - Future plans for changes in infrastructure, especially roads and hydraulic structures (culverts, bridges, levees, etc.)
  - We have Seward’s 2020 comprehensive plan. Are there other plans or relevant documents/information/datasets related to planning, such as a comprehensive plan for KPB?

### **Low Priority Data Needs/Requests/Questions:**

- Please provide any building footprint datasets that are available.



# Seward/Bear Creek Flood Service Area

**MONDAY, MAY 6<sup>th</sup>**

**Regular Board Meeting  
& Hazard Mitigation Plan  
Presentation by URS Corporation  
7:00 pm**

**Seward Community Library Museum  
Community Room (Downstairs)**

**Agenda & board packet posted at SBCFSA Office or  
[www.sewardbearcreekfloodservicearea.org](http://www.sewardbearcreekfloodservicearea.org)**

**PUBLIC WELCOME**

# SEWARD/ BEAR CREEK FLOOD SERVICE AREA

## Regular Board Meeting Agenda

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7:00 pm

May 6, 2013

Seward Community Library Museum

A Karl Van Buskirk  
Board Member  
Term Expires 10/2013

B Robert Reisner  
Board Member  
Term Expires 10/2015

C John Eads  
Board Member  
Term Expires 10/2013

D Bill Williamson  
Chairman  
Term Expires 10/2014

E Randy Stauffer  
Vice Chairman  
Term Expires 10/2015

F Christina Stauffer  
Board Member  
Term Expires 10/2013

G Robert White  
Board Member  
Term Expires 10/2013

A. CALL TO ORDER

B. ROLL CALL

C. APPROVAL OF AGENDA

D. APPROVAL OF MINUTES

1. April 15<sup>th</sup>

E. REPORTS & PRESENTATIONS

1. City of Seward

2. Kenai Peninsula Borough

3. URS Corporation Alaska Hazard Mitigation Plan

F. PUBLIC COMMENTS – LIMIT 3 MINUTES

G. BOARD'S RESPONSE TO PUBLIC COMMENTS

H. CORRESPONDENCE & REVIEW OF PAYMENT REQUESTS

I. PERMITS FOR REVIEW

1. KPB File 2013-070 Bear Creek Fire Station 2013 Replat

J. UNFINISHED BUSINESS

K. NEW BUSINESS

1. Board Recommendation on 2013 Seward/Bear Creek Flood Service Area Hazard Mitigation Plan

L. INFORMATIONAL ITEMS AND REPORTS (No action required)

1. Mayor Navarre's News April 2013

2. STARR News from Region X Special Edition Biggert-Waters Reform Act

3. Reminder of May 7<sup>th</sup> City Planning & Zoning Commission Meeting

4. Reminder of KPB Service Area Board Member Training May 11<sup>th</sup>

5. Permitting & Agency Information Day May 15<sup>th</sup>

M. PUBLIC COMMENT – LIMIT 3 MINUTES

N. BOARD COMMENTS

O. ADJOURNMENT





700 G Street, Suite 500  
Anchorage, AK 99503  
Phone: 907.261.9706  
Fax: 907.562.1297

# Meeting Notes

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**SUBJECT:** SBCFSA Mitigation Action Plan Project Selection Process

**DATE/TIME:** March 13, 2013, 10:00 a.m. to 12:16 p.m.

**LOCATION:** Teleconference

**ATTENDEES:**

URS Corporation

- URS Alaska: Scott Simmons
- URS CO: Richard Chamberlain, Kim Pirri
- URS GA: Jon Philipsborn
- URS MD: Shame Parsons

Seward Bear Creek Flood Service Area

- Bill Williamson, Chairman
- Randy Stauffer, Vice Chairman

City of Seward

- Jim Hunt, City Manager
- Donna Glenz, Planner

Kenai Peninsula Borough

- Dan Mahalak, Water Resource Manager
- Dan Bevington, Floodplain Administrator
- Marcus Mueller, Land Management Officer
- Brenda Ahlberg, Community & Fiscal Projects Manager

**PRESENTATION SUMMARY**

Introduced mitigation project selection process: review potential projects and categorize as consider or select for implementation within the Mitigation Action Plan (MAP). Identify any projects that are currently in-process or that have been completed by partner SBCFSA, Kenai Peninsula Borough, City of Seward, State or Federal agencies.

---

**KEY POINTS**

1. Section 7, Mitigation Strategy
2. Select Mitigation Goals
3. Review, consider, and select from listed potential mitigation projects/actions

---

**COMMENTS**

- Explained the Mitigation Strategy development process
- Introduced Mitigation Goals purpose and reached consensus on suggested goals for the City
- Reviewed the Mitigation Project Consideration Sheet,
- Identified ongoing or existing City mitigation initiatives
- Selected mitigation initiatives for implementation and refinement within the Mitigation Action Plan Matrix.
- Explained how the information discussed would be implemented and expanded within the Mitigation Action Plan Matrix and returned to the community for review.

- 
- Matrix will include:
    - Initiative Priority
    - Responsible Entity
    - Potential Funding Sources
    - Timeframe for implementation
    - Benefit /Cost and Technical Feasibility narrative description
  - Teleconference Follow-up
  - A second newsletter will be developed once the Mitigation Strategy is finalized and incorporated into the Draft HMP. The newsletter should be posted or distributed throughout the community to inform the community that the HMP is available for public review and comment.
- 

**ACTION ITEMS:**

- Refine suggested wording for participant review
- Insert information into HMP's MAP for April 1 delivery (SBCFSA MAP Workgroup meeting)
- Develop and forward Newsletter #2 to fulfill FEMA public participation and HMP review criteria

# SEWARD BEAR CREEK FLOOD SERVICE AREA (SBCFSA)

## HAZARD MITIGATION PLAN (HMP)

### MITIGATION STRATEGY FOR REVIEW

April 2013

Newsletter

*This newsletter discusses the preparation of the SBCFSA Hazard Mitigation Plan's Mitigation Strategy. It has been prepared to inform interested agencies, stakeholders, and the public about the project and to solicit comments.*

#### HMP Development

The SBCFSA selected URS Corporation Alaska to convert their Flood Hazard Mitigation Plan to a Local Hazard Mitigation Plan (HMP) to fulfill FEMA's stringent criteria. The new HMP update is expanded to include an all-hazards analysis, risk assessment and vulnerability analysis – essential information which will qualify the SBCFSA for numerous project funding grant opportunities. The plan identifies natural hazards that affect the community including earthquake, erosion, flood, ground failure, severe weather, and wildland fire. The HMP also identifies the people and facilities potentially at risk and ways to mitigate hazards. The project also includes a comprehensive floodplain impact assessment for all SBCFSA watersheds. The public participation and planning process has been documented as part of the project.

#### What is Hazard Mitigation?

Across the United States, natural disasters have increasingly caused injury, death, property damage, and business and government service interruptions. The toll on individuals, families, and businesses can be very high. The time, money, and emotional effort required to respond to and recover from these disasters take public resources and attention away from other important programs and problems.

The people and property in the State of Alaska are at risk from a variety of hazards that have the potential for causing human injury, property damage, or environmental harm.

The purpose of hazard mitigation is to implement projects that eliminate the risk or reduce the severity of hazards on people and property. Mitigation programs may include short-term and long-term activities to reduce the hazards, reduce exposure to hazards, or reduce the effects of hazards. Mitigation could include education, and construction projects. Hazard mitigation activity examples include relocating buildings, developing or strengthening building codes, and educating residents and building owners.

#### Why Do We Need A Hazard Mitigation Plan?

Local and Tribal governments as well as special service areas are only eligible to receive grant money for mitigation programs by preparing and adopting a hazard mitigation plan. Each of these entities must have an

approved mitigation plan to receive grant funding from the Federal Emergency Management Agency (FEMA) for eligible mitigation projects.

#### The Planning Process

There are very specific federal requirements that must be met when preparing a hazard mitigation plan. These requirements are commonly referred to as the Disaster Mitigation Act of 2000, or DMA2000 criteria. Information about the criteria may be found on the Internet at: <http://www.fema.gov/mitigation-planning-laws-regulations-guidance>.

The DMA2000 requires the plan to document the following topics:

- ☐ Planning process
- ☐ Hazard identification
- ☐ Risk assessment
- ☐ Goals
- ☐ Mitigation programs, actions, and projects
- ☐ A resolution from the community adopting the plan

FEMA has prepared Planning Guidance which is available at: <http://www.fema.gov/library/viewRecord.do?fromSearch=fromsearch&id=4859>, and "How to" Guides that explain in detail how each of the DMA2000 requirements is met. These guides are available at <http://www.fema.gov/hazard-mitigation-planning-resources>. The SBCFSA Hazard Mitigation Plan will follow those guidelines.

The planning process kicked-off in September 2012 by establishing a local planning committee and holding a public meeting. The planning committee examined the full spectrum of hazards listed in the State Hazard Mitigation Plan and identified those hazards the HMP would address.

After the first public meeting, SBCFSA participating members and URS began identifying critical facilities, compiling the hazard profiles, assessing capabilities, and conducting the risk assessment for the identified hazards. Critical facilities are facilities that are critical to the SBCFSA's recovery in the event of a disaster. After collection of this information, URS helped to determine which critical facilities and estimated populations are vulnerable to the identified hazards in the SBCFSA.

A mitigation strategy was the next component of the plan to be developed. Understanding the community's local capabilities and using information gathered from the public,

Planning Team, and the expertise of the consultants and agency staff, a mitigation strategy was developed. The mitigation strategy is based on an evaluation of the hazards, and the assets at risk from those hazards. Mitigation goals and a list of potential actions or projects were developed as the foundation of the mitigation strategy.

Mitigation goals are defined as general guidelines that explain what a community wants to achieve in terms of hazard and loss prevention. Goals are positively stated future situations that are typically long-range, policy-oriented statements representing community-wide visions. Mitigation actions and projects are undertaken in order to achieve the SBCFSA and participating member's stated objectives. On March 15, 2013, the Planning Team identified approximately 45 projects and actions that focus on six categories: prevention, property protection, public education and awareness, natural resource protection, emergency services, and structural projects. A representative sample of the Planning Team's newly identified mitigation actions are listed below and explained in more detail within the HMP.

The selected projects and/or actions will potentially be implemented over the next five years as funding becomes available. A HMP maintenance plan was also developed to

guide the review and future update processes. It outlines how the SBCFSA will monitor progress on achieving the projects and actions that will help meet the stated goals and objectives, as well as outlining continuous public involvement.

The draft HMP will be available in the SBCFSA, City of Seward, and Kenai Peninsula Borough Offices for public review and comment. Comments should be made via email, fax, or phone to Scott Simmons (listed below) and be received no later than April 17, 2013. The plan will be provided to the Kenai Peninsula Borough for their preliminary approval and returned to the SBCFSA for updating once all comments have been processed.

## The Planning Committee

The plan was developed with the assistance from a Planning Team consisting of a cross section of the SBCFSA's participating members. Planning Team members include the SBCFSA Board, City of Seward, Kenai Peninsula Borough staff, and URS Corporation.

Sample of the SBCFSA's Mitigation Actions. Review the draft HMP for a complete list.		
Adopt the Risk MAP coastal velocity zone mapping studies into the floodplain code.	Harden and/or retrofit existing levees to qualify for USACE certification.	Seek funding for sediment and debris management to remove excessive stream bed sediment load, gravel, and glacial debris.
Obtain an exemption to the Alaska Department of Natural Resources (DNR) Material Sales Fees on navigable rivers and streams for sediment and debris management, stream channel maintenance, and flood control or other flood mitigation projects.	Develop Bridge Maintenance with KPB, DOT/PF, and ARRC for all stream crossings throughout the flood service area to include: sediment removal under bridges.	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms (snow load, ice, and wind).
Evaluate each watershed to develop land use plans for removing and storing creek bed load to: <ul style="list-style-type: none"> <li>Perform periodic sediment management/bed load removal as necessary.</li> <li>Identify and permit fill areas for future flood-free development sites.</li> <li>Identify storage sites that limit gravel transportation costs.</li> </ul>	Apply for grant funding to assist critical facilities, public infrastructure, and residential properties with elevating flood threatened structures at least two feet above the identified Base Flood Elevation (BFE). <i>(Current FEMA minimum is 1 ft. above BFE.)</i>	Install wire matting, debris catchment structure, cliff stabilization etc. to prevent Lowell Canyon Creek diversion tunnel obstruction and diversion dam overtopping from landslide debris, woody vegetation, trees, etc.
Construct debris basins or other debris catchment devices to retain debris to prevent downstream drainage structure clogging.	Acquire and maintain NOAA/NWS stream flow and rainfall measuring gages.	

*We encourage you to learn more about the SBCFSA's Hazard Mitigation Plan. The purpose of this newsletter is to keep you informed and to allow you every opportunity to voice your opinion regarding this important project. If you have any questions, comments, or requests for more information, please contact:*

Scott Simmons, Hazard Mitigation, Emergency Management, and Climate Change Planner  
URS Corporation  
700 G Street, Suite 500  
Anchorage, Alaska 99501  
907.261.9706 or 800.909.6787  
scott\_simmons@urscorp.com

Scott Nelsen, Emergency Management Specialist  
DHS&EM  
P.O. Box 5750  
Fort Richardson, Alaska 99506  
907.428.7010 or 800.478.2337  
Scott.Nelsen@alaska.gov

**Appendix G**  
**Benefit–Cost Analysis Fact Sheet**

## Benefit-Cost Analysis Fact Sheet

Hazard mitigation projects are specifically aimed at reducing or eliminating future damages. Although hazard mitigation projects may sometimes be implemented in conjunction with the repair of damages from a declared disaster, the focus of hazard mitigation projects is on strengthening, elevating, relocating, or otherwise improving buildings, infrastructure, or other facilities to enhance their ability to withstand the damaging impacts of future disasters. In some cases, hazard mitigation projects may also include training or public-education programs if such programs can be demonstrated to reduce future expected damages.

A Benefit-Cost Analysis (BCA) provides an estimate of the “benefits” and “costs” of a proposed hazard mitigation project. The benefits considered are avoided future damages and losses that are expected to accrue as a result of the mitigation project. In other words, benefits are the reduction in expected future damages and losses (i.e., the difference in expected future damages before and after the mitigation project). The costs considered are those necessary to implement the specific mitigation project under evaluation. Costs are generally well determined for specific projects for which engineering design studies have been completed. Benefits, however, must be estimated probabilistically because they depend on the improved performance of the building or facility in future hazard events, the timing and severity of which must be estimated probabilistically.

### All Benefit-Costs must be:

- Credible and well documented
- Prepared in accordance with accepted BCA practices
- Cost-effective ( $BCR \geq 1.0$ )

### General Data Requirements:

- All data entries (other than Federal Emergency Management Agency [FEMA] standard or default values) MUST be documented in the application.
- Data MUST be from a credible source.
- Provide complete copies of reports and engineering analyses.
- Detailed cost estimate.
- Identify the hazard (flood, wind, seismic, etc.).
- Discuss how the proposed measure will mitigate against future damages.
- Document the Project Useful Life.
- Document the proposed Level of Protection.
- The Very Limited Data (VLD) BCA module cannot be used to support cost-effectiveness (screening purposes only).
- Alternative BCA software MUST be approved in writing by FEMA HQ and the Region prior to submittal of the application.

### Damage and Benefit Data

- Well documented for each damage event.
- Include estimated frequency and method of determination per damage event.
- Data used in place of FEMA standard or default values MUST be documented and justified.



- The Level of Protection MUST be documented and readily apparent.
- When using the Limited Data (LD) BCA module, users cannot extrapolate data for higher frequency events for unknown lower frequency events.

## Building Data

- Should include FEMA Elevation Certificates for elevation projects or projects using First Floor Elevations (FFE's).
- Include data for building type (tax records or photos).
- Contents claims that exceed 30 percent of building replacement value (BRV) MUST be fully documented.
- Method for determining BRVs MUST be documented. BRVs based on tax records MUST include the multiplier from the County Tax Assessor.
- Identify the amount of damage that will result in demolition of the structure (FEMA standard is 50 percent of pre-damage structure value).
- Include the site location (i.e., miles inland) for the Hurricane module.

## Use Correct Occupancy Data

- Design occupancy for Hurricane shelter portion of Tornado module.
- Average occupancy per hour for the Tornado shelter portion of the Tornado module.
- Average occupancy for Seismic modules.

## Questions to Be Answered

- Has the level of risk been identified?
- Are all hazards identified?
- Is the BCA fully documented and accompanied by technical support data?
- Will residual risk occur after the mitigation project is implemented?

## Common Shortcomings

- Incomplete documentation.
  - Inconsistencies among data in the application, BCA module runs, and the technical support data.
  - Lack of technical support data.
  - Lack of a detailed cost estimate.
  - Use of discount rate other than FEMA-required amount of 7 percent.
  - Overriding FEMA default values without providing documentation and justification.
  - Lack of information on building type, size, number of stories, and value.
  - Lack of documentation and credibility for FFE's.
  - Use of incorrect Project Useful Life (not every mitigation measure = 100 years).
-

**Appendix H**  
**Plan Maintenance Documents**

Annual Review Questionnaire				
PLAN SECTION	QUESTIONS	YES	NO	COMMENTS
PLANNING PROCESS	Are there internal or external organizations and agencies that have been invaluable to the planning process or to mitigation action?			
	Are there procedures (e.g., meeting announcements, plan updates) that can be done more efficiently?			
	Has the Task Force undertaken any public outreach activities regarding the MHMP or implementation of mitigation actions?			
HAZARD PROFILES	Has a natural and/or human-caused disaster occurred in this reporting period?			
	Are there natural and/or human-caused hazards that have not been addressed in this HMP and should be?			
	Are additional maps or new hazard studies available? If so, what have they revealed?			
VULNERABILITY ANALYSIS	Do any new critical facilities or infrastructure need to be added to the asset lists?			
	Have there been changes in development patterns that could influence the effects of hazards or create additional risks?			
MITIGATION STRATEGY	Are there different or additional resources (financial, technical, and human) that are now available for mitigation planning within the			
	Are the goals still applicable?			
	Should new mitigation actions be added to the a community's Mitigation Action Plan?			
	Do existing mitigation actions listed in a community's Mitigation Action Plan need to be reprioritized?			
	Are the mitigation actions listed in a community's Mitigation Action Plan appropriate for available resources?			

Page 1 of 3

Progress Report Period: \_\_\_\_\_ to \_\_\_\_\_  
                                     (date)                                     (date)

Project Title: \_\_\_\_\_ Project ID# \_\_\_\_\_

Responsible Agency: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_

Contact Person: \_\_\_\_\_ Title: \_\_\_\_\_

Phone #(s): \_\_\_\_\_ email address: \_\_\_\_\_

List Supporting Agencies and Contacts:

\_\_\_\_\_

\_\_\_\_\_

Total Project Cost: \_\_\_\_\_

Anticipated Cost Overrun/Underrun: \_\_\_\_\_

Date of Project Approval: \_\_\_\_\_ Start date of the project: \_\_\_\_\_

Anticipated completion date: \_\_\_\_\_

Description of the Project (include a description of each phase, if applicable, and the time frame for completing each phase): \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

[illegible]

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Plan Goal (s) Addressed:

Page 2 of 3

Goal: \_\_\_\_\_

Indicator of Success: \_\_\_\_\_

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Project Status

Project Cost Status

☐ Project on schedule

☐ Cost unchanged

☐ Project completed

☐ Cost overrun\*

☐ Project delayed\*

\*explain: \_\_\_\_\_

\*explain: \_\_\_\_\_

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☐ Cost underrun\*

☐ Project canceled

\*explain: \_\_\_\_\_

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Summary of progress on project for this report:

A. What was accomplished during this reporting period?

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B. What obstacles, problems, or delays did you encounter, if any?

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C. How was each problem resolved?

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Next Steps: What is/are the next step(s) to be accomplished over the next reporting period?

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Other Comments:

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## **Appendix I**

### **Climate Change Analysis**

## **I. Climate Change**

### **I.1 Background**

It is now widely accepted that global climate change is occurring; that regions are impacted differently depending on regional characteristics; and that the effects of climate change are already being felt in certain areas across the globe (e.g., Intergovernmental Panel on Climate Change [IPCC] 2007, IPCC 2012, National Climate Assessment [NCA] 2013, etc.). The arctic regions are particularly sensitive to climate change and have been experiencing increased effects already, with, for example, air temperatures increasing at nearly twice the global average, and the surface of the Arctic Ocean warming (e.g., IPCC 2007, United Nations Environmental Programme (UNEP) 2013, etc.). As a resulting consequence, the effects of climate change are already having an impact in arctic regions. The State of Alaska is no exception to this, with observed changes including “species shifts, permafrost thaw, coastal erosion, wetland drying, glacial and sea ice recession, and an increase in fire frequency and intensity” (University of Alaska-Fairbanks [UAF] Scenarios Network for Alaska & Arctic Planning [SNAP] 2012b). In an acceptance of the threat of global climate change, the State of Alaska established cabinets (e.g., “Climate Change Sub-Cabinet”) to advise the Office of the Governor, and commissioned multiple studies (e.g., Alaska Climate Impact Assessment Commission (ACIAC) 2008, Adaptation Advisory Group (AAG) 2010, etc.) in order to better comprehend the potential impact of climate change on State citizens, communities, and resources – natural, economic, and cultural.

Furthermore, given the relationship between greenhouse gas emissions from global manmade and land use change (e.g., IPCC, National Aeronautical and Space Administration (NASA), etc.), climate change is expected to continue into the future as a result of continued and increasing trends in global emissions. As a result, “temperatures and precipitation are expected to increase across the state (of Alaska) throughout the next century”, which includes higher temperatures predicted for every month, particularly in the winter, and “statewide trends in Alaska call(ing) for future increases in precipitation, shorter and warmer winters, (and) substantial decreases in snow cover and ice cover” (UAF SNAP 2012b).

### **I.2 Seward Bear Creek Flood Service Area**

Based on this and other evidence, the Seward Bear Creek Flood Service Area (SBCFSA) deemed it prudent to consider what climate change impacts are most relevant to consider for the SBCFSA, and how climate change may affect local conditions in the future, including hazard characteristics (type, frequency, intensity). Future climate change, in the form of changes in amounts of precipitation, changes in temperature, sea level rise, and changes in the intensity and frequency of storms, can both create new hazards as well as change the scale of existing hazards.

Impacts of climate change constitute and pose both direct and indirect impacts on the SBCFSA. For example, the impact from increased precipitation or a rise in sea level could directly lead to increased riverine or coastal flooding. An increase in temperatures, however, may result in greater ice or snow melt from ice fields or glaciers, or effect seasonal snow melt, thus impacting flooding in a different manner. Increased temperatures may also increase the risk of forest fires by drying out trees and making them more susceptible to igniting.

By assessing the potential impacts from climate change on the Kenai Peninsula and the SBCFSA when possible, planners and decision makers will be able to consider how future climate

scenarios may impact local hazards as well as local vulnerability and risk to hazards in decisions moving forward. This information, though not guaranteed as future projections are based on best available data, scientific research and understanding, and models, and are not certain to occur, could influence planning decisions towards where future development should occur; direct limited resources to key areas of concern; identify areas that will be increasingly within harm's way in advance so that mitigation measures can be taken to avoid negative consequences; and present opportunities for smart and sustainable planning and growth given a more robust understanding of future scenarios and conditions.

Hazards within the SBCFSA have long been documented in Hazard Mitigation Plans, other plans, and papers. Due to the unique topography of the SBCFSA – a narrow basin surrounded by mountains and glaciers that ends on an alluvial fan – and the many streams and rivers that confluence in the valley that drains into Resurrection Bay, flooding is consistently the predominant hazard of concern for the SBCFSA and surrounding region. Some streams are glacier fed; others originate in lakes and/or sources further up the valley. As it relates to climate change, this is important as different factors contribute to flooding in different drainages, and climate change effects (i.e., changes in precipitation and temperature) will impact each differently. This HMP researched existing information, and utilized projected data from modeled future climate change scenarios in order to better understand the potential impacts of climate change on hazards within the SBCFSA.

### **I.3 Methodology**

This HMP uses best available data and scientific literature in order to gain an understanding of what research exists on current and projected climate change impacts and effects within the Kenai Peninsula Borough and the SBCFSA. In addition to considering best available existing studies and reports, this study also used downscaled historical and projected monthly climate data for precipitation and temperature in order to consider future precipitation and temperature trends within and surrounding the SBCFSA and the effects that each would have on hazards. This downscaled data was acquired from the UAF/SNAP. “Downscaling takes known information at large scales to make projections at local scales” (UAF SNAP 2012). UAF/SNAP used selected global climate models which are developed by research organizations and submitted to the IPCC on regular intervals to determine the current state of scientific consensus regarding global climate change. Additional information as to the specific global climate models used by UAF/SNAP can be found on their website at <http://www.snap.uaf.edu/downscaling.php> (UAF/SNAP 2012).

For the purpose of the climate change analysis performed in this HMP, in addition to using current data (2012), data was chosen for five future scenarios: 2022, 2032, 2052, 2060, and 2100. These dates were chosen to show future climate change scenarios to be considered for both near- and long-term planning purposes.

For each year, projected precipitation and temperature data were produced by UAF/SNAP for three separate emissions scenarios as depicted in Figure I-1: B1, A1B, and A2. As stated above, the degree to which climate change is occurring is directly linked to the amount of greenhouse gas (ghg) emissions from human activities and land use changes entering into the atmosphere. Thus, differing amounts of future ghg emissions will produce different future climate change scenarios which will result in varying degrees of related impacts (i.e. greater or smaller degree of change in temperature or precipitation, etc.). Each of the three emissions scenarios represents a different future in which the world will generate a different amount of ghg emissions.

*“In 2000, the Intergovernmental Panel on Climate Change (IPCC) used data from the Earth Institute at Colombia University to prepare the Special Report on Emissions Scenarios, which outlined a range of possible emission futures. In order to represent a range of possibilities, SNAP uses model outputs based on three of these (emission scenarios): B1, A1B, A2” (UAF SNAP).*

The three scenarios are summarized by UAF SNAP as follows:

*The B1 scenario represents a more integrated and more ecologically friendly world:*

- *Rapid economic growth as in A1B, but with rapid changes towards a service and information economy.*
- *Population rising to 9 billion in 2050 and then declining as in A1.*
- *Reductions in material intensity and the introduction of clean and resource efficient technologies.*
- *An emphasis on global solutions to economic, social and environmental stability.*

*The A1B scenario represents a world characterized by:*

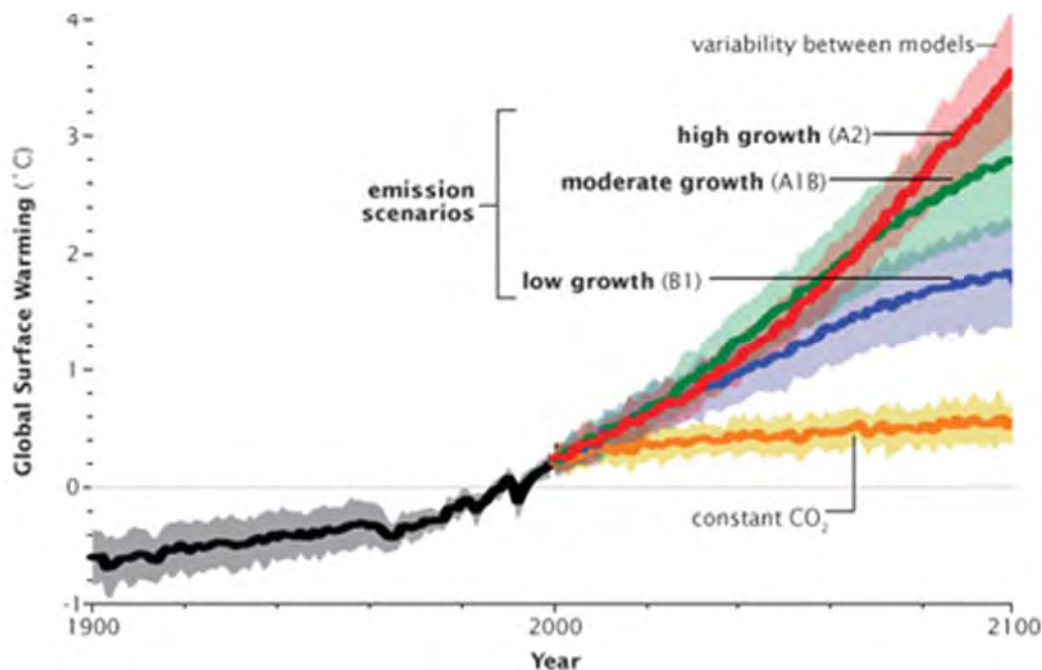
- *Rapid economic growth.*
- *A global population that reaches 9 billion in 2050 and then gradually declines.*
- *The quick spread of new and efficient technologies.*
- *A convergent world - income and way of life converge between regions.*
- *Extensive social and cultural interactions worldwide.*
- *A balanced emphasis on all energy sources.*

*The A2 scenario represents a more divided world characterized by:*

- *A world of independently operating, self-reliant nations.*
- *Continuously increasing population.*
- *Regionally oriented economic development.*
- *Slower and more fragmented technological changes and improvements to per capita income.”*

Though the descriptions of the scenarios do not state a specific rise in ghg emissions, they each describe a future world of differing ghg emission production. To look into each scenario a bit further, the B1 scenario represents the best case scenario in terms of limiting ghg emissions. In addition to a peaking global population mid-century, as the most ecologically friendly scenario, ghg emissions would have already begun to level off by 2050 and would rapidly decline thereafter to roughly half of what they are in 2020 by 2100. The A2 scenario represents a world in which global population as well as global ghg emissions continue to rise unabated. Global ghg emissions steadily increase from 2020 to 2050 followed by a sharp increase from 2050 to 2100. The third scenario, A1B, represents a world in which the global population also peaks mid-century, and after an initial increase in emissions from 2020 to 2050, global emissions level off and decline to just above 2020 global ghg emissions by the year 2100 (IPCC 2000).

To summarize, as can be seen in Figure I-1 below, the B1 scenario is associated with a “low growth” emission scenario; the A2 scenario is associated with a “high growth” emission scenario; and the A1B scenario is associated with the “moderate growth” emission scenario (Riebeek 2010).



**Figure I-1** IPCC emissions scenarios (Riebeek 2010).

In order to focus efforts of this HMP to be most useful for SBCFSA and other planners, the decision was made to use the A1B scenario as the basis for future modeling of climate change impacts and effects of the SBCFSA. This decision was made as the A1B scenario was considered to provide the most likely emission scenario for the time period considered in this HMP and therefore present the most likely climate change effects and impacts for SBCFSA. Future projections made using the A1B emission scenario will provide planners and decision makers with useful information to consider for future planning purposes.

One of the many challenges faced when attempting to understand and quantify potential impacts of climate change is the inability to accurately predict outcomes at a local level. Modeling inefficiencies, high costs, and lack of data, all contribute to the challenges of downscaling global climate change scenarios to a local level. That said, it is still possible to draw broad conclusions from best available data and models so that planners and decision makers can better understand the potential impacts of climate change on an area or region. This HMP attempts to do just that using the data obtained from UAF/SNAP. No information reported on projected future climate change impacts and effects should be taken to be certain outcomes. All projections made are based off of best available scientific data, models, and reports, and are used to develop climate change scenarios for the SBCFSA so as to consider hazards, and thus hazard mitigation strategies, for potential future climate change.

## I.4 Results

Due to the current nature of hazards within the SBCFSA, as discussed in the main body of this HMP, as well as research conducted on potential climate change, the following impacts of climate change were assessed:

- Change in temperature
- Change in precipitation
- Sea level rise

This section describes results of future temperature change and precipitation change within the Kenai Borough Peninsula and SBCFSA and surrounding region based on mapping and analysis using data obtained from UAF/SNAP for current year (2012) and future years 2022, 2032, 2052, 2060, and 2100, and using the A1B emissions scenario. In addition this section discusses sea level rise and the potential impacts to the SBCFSA of future sea level rise.

### Temperature

Using temperature data obtained from UAF/SNAP for current year (2012) and future years (2022, 2032, 2052, 2060, and 2100) this HMP attempts to depict potential changes in average annual temperature as a result of potential climate change in the SBCFSA and surrounding areas. Maps K-1 and K-2 represent the findings of changes in temperature in the Kenai Peninsula Borough (KPB) and SBCFSA, respectively, based on the A1B climate change emissions scenario for all six time periods (current and future). The maps portrayed in Maps K-1 and K-2 represent average annual projected temperature for each year considered. The maps use colors to display the variation in temperature across KPB (Map K-1) and across a more localized SBCFSA and surrounding region (Map K-2). The light blue represents areas with the relative *low* average annual temperature, whereas the dark red color represents areas with the relative *high* average annual temperature.

Map K-1 is included to provide an overall reference of future average annual temperature trends for the entire Borough. On each of these maps it is easy to decipher the higher altitudes, as the light and dark blues represent mountains and glaciers within KPB. Throughout each map, the highest average annual temperatures can be seen on the coastal areas in the south and southeastern portion of the Borough. Potential impacts of climate change can be seen when viewing the range of average annual projected temperature listed below each map (for Maps K-1 and K-2, the top number represents the highest average annual temperature and the bottom number represents the lowest average annual temperature based on the data analyzed for the area within the region displayed on the map). Though there is a decrease in 2022 for both the average high and average low annual temperatures, the overall trend from current year (2012) is increasing average annual temperatures from 2012 through 2100. In 2012, the lowest average annual temperature is 7.2 degrees Fahrenheit (°F) and the highest average annual temperature is 42.4 °F. By 2100, the lowest average annual temperature is 13.3 °F while the highest average annual temperature is 47.3 °F.

Map K-2 provides a more focused look of the projected changes in temperature in the SBCFSA and surrounding areas. As was the case in Map K-1, the six maps in Map K-2 display an overall increasing trend in average annual temperatures: the lowest and highest average annual temperatures for current year (2012) are 24.1 and 41.7 °F, respectively. Though both lowest and highest average annual temperatures decrease in the 2022 scenario, the overall trend from 2022



to 2100 is for an increase in both. In the 2100 scenario the lowest average annual temperature is projected to be 29.0 °F while the highest average annual temperature is projected to be 46.5 °F. Table I-1 defines the average annual projected temperature in degree Fahrenheit at Exit Glacier and in Downtown City of Seward for current and future climate change scenarios.

**Table I-1 Total Annual Projected Temperature**

Year	Exit Glacier (°F)	Downtown City of Seward (°F)
2012	25.6	40.2
2022	24.9	39.5
2032	26.4	41.0
2052	26.3	41.0
2060	29.2	43.8
2100	30.5	45.1

As an example of how changes in temperature will potentially occur within the SBCFSA and in surrounding areas, Table I-1 displays average annual projected temperature (°F) at two locations over the six time periods considered. The first location represents where average annual temperature is at, or close to, the lowest in the area surrounding the SBCFSA. This location is at Exit Glacier. The second location represents where average annual temperature is at, or close to, the highest within the SBCFSA. This location is in Downtown City of Seward. In both locations, a general trend of increasing average annual temperatures can be seen. Though average annual temperatures drop in the 2022 scenario, they increase by 2032, and then again by 2060, and again by 2100.

At the location near Exit Glacier, average annual temperature is projected to reach 30.5 °F by 2100, an increase of 4.9 °F over current (2012) average annual temperature. At the location in Downtown City of Seward, average annual temperature is projected to reach 45.1 °F by 2100, also an increase of 4.9 °F over current (2012) average annual temperature.

### **Precipitation**

Using precipitation data obtained from UAF/SNAP for current year (2012) and future years (2022, 2032, 2052, 2060, and 2100) this HMP also attempted to depict potential changes in total annual precipitation as a result of potential climate change in the SBCFSA and surrounding areas. Maps K-3 and K-4 represent the findings of changes in precipitation in KPB and SBCFSA, respectively, based on the A1B climate change emissions scenario for all six time periods (current and future). The maps portrayed in Maps K-3 and K-4 represent total annual projected precipitation (in inches) for each year considered. The maps use colors to display the variation in precipitation across KPB (Map K-3) and across a more localized SBCFSA and surrounding region (Map K-4). The light blue represents areas with the relative least amount of precipitation, whereas the pink and purple represent areas with the relative greatest amount of precipitation. Similar to the temperature maps, a range of precipitation (in inches) is given below each map in Maps K-3 and K-4. The top number represents the highest total annual precipitation and the bottom number represents the lowest total annual precipitation based on the data analyzed for the area within the region displayed on the map.

Map K-3 is included to provide an overall reference of future precipitation trends for the entire Borough. There is a noticeable difference in precipitation between the north and western parts of

the Borough and the southeastern quadrant of the Borough. As can be seen in the range of total annual projected precipitation listed below each map, both the low (bottom number) and the high (top number) increase from current year (2012) through the future scenarios leading up to year 2100. The year 2012 has a total annual precipitation range from a low of 11.8 inches to a high of 343.8 inches. As seen in Map K-3, the low and high increase until the future scenario in year 2100 where the total annual precipitation range is from a low of 15.1 inches to a high of 445.3 inches.

Map K-4 provides a more focused look of the projected changes in precipitation on the SBCFSA and surrounding areas. As was the case in Map K-3, the six maps display an overall increasing trend in total annual precipitation: the low values for total annual projected precipitation for current year and 2022 are the same at 12.6 inches but increase after 2022 to 15.9 inches in 2100, while the high value decreases initially from 244.0 inches in 2012 to 238.0 inches in 2022 before peaking in 2062 at 302.9 inches and then slightly decreasing from there to 297.7 inches by 2100 (though remaining significantly higher than in 2012).

Table I-2 defines the SBCFSA's total annual projected precipitation for current and future climate change scenarios in two identified locations in or surrounding the SBCFSA (above Bear Lake and in Downtown City of Seward).

**Table I-2      Average Annual Projected Precipitation**

<b>Year</b>	<b>Above Bear Lake (Inches)</b>	<b>Downtown City of Seward (Inches)</b>
2012	238.8	75.8
2022	233.3	73.8
2032	242.6	75.9
2052	261.7	81.9
2060	297.1	94.8
2100	291.6	92.1

As an example of how changes will potentially occur within the SBCFSA, Table I-2 displays total annual projected precipitation (in inches) at two locations over the six time periods considered. The first location represents where total annual precipitation is at, or close to, the highest within the SBCFSA. This location is high in the mountains directly east of Bear Lake. The second location represents where total annual precipitation is at, or close to, the lowest within the SBCFSA. This location is in Downtown City of Seward. In both locations, a general trend of increased total annual precipitation can be seen from the current year (2012) throughout the different climate change scenarios (years) modeled. At the location near Bear Lake, total annual projected precipitation peaks in 2060 at a high of 297.1 inches per year, an increase of 58.3 inches per year from current year (2012). At the location in Downtown City of Seward, total annual projected precipitation peaks in 2060 at a high of 94.8 inches per year, an increase of 19.0 inches per year from current year (2012).

### **Sea Level Rise**

In many parts of the world, including parts of Alaska, sea level rise is a well-documented effect of climate change (IPCC 2007, NCA 2013). Both the IPCC and the NCA attribute global sea level rise (SLR) to ocean warming and ice sheet loss, and present that there is a "highly significant correlation between observations of global mean SLR and increasing global mean

temperature (IPCC 2007, Parris et al. 2012). Given the location of the SBCFSA (surrounding the top of Resurrection Bay) as well as the fact that part of Seward, including the airport, rests on an alluvial fan, this HMP attempted to consider the potential impacts of SLR on the SBCFSA. In doing so, SLR was considered based on the potential for SLR to occur, but also the potential extent of inundation if SLR were to occur. For the first, best available data on historical and current change in sea level was reviewed. For much of southern Alaska, including Seward, data has shown that sea level is actually falling, in part due to vertical land rise from tectonics and post-glacier land rise (Parris et al. 2012, UAF/SNAP 2012b). In addition, recent historical mean sea level (msl) trends for Seward, as documented by NOAA (NOAA 2012) echoes that sentiment by documenting a slight decrease in sea level in recent years.

Though research shows that sea level at Seward is decreasing, this HMP also considered what height of sea level rise would impact the SBCFSA if it were to occur. The decision to look at these potential impacts was made in part to allow planners to see the vulnerability of low lying areas within the SBCFSA to sea level rise, or coastal storm surge. Using data obtained from Center of Remote Sensing of Ice Sheets (CReSIS) at the University of Kansas, potential SLR ranging from 1 meter to six meters was analyzed to assess the relative extent of coastal flooding that would occur within the SBCFSA. Based on an assessment of the projected inundation, it was determined that not until a SLR of three meters would the impact of SLR be felt within the SBCFSA. Map K-5 provides four maps of the City of Seward, focusing on the area around the Seward Airport. Maps represent the extent of flooding that would occur based on a SLR of three-meters, four-meters, five-meters, and six-meters. As can be seen in each of the maps, the extent of flooding starts and focuses at the Seward Airport and extends west and east as the degree of SLR increases.

## **I.5 Conclusion**

As was represented in the literature review conducted, models from UAF/SNAP present data that supports both annual average temperatures and total annual precipitation are expected to increase in the SBCFSA and surrounding region. This is relevant information for SBCFSA and other planners and decision makers as these future impacts of climate change could potentially affect the severity of hazards within the SBCFSA.

Increases in temperature and precipitation could produce a variety of secondary effects throughout the SBCFSA. For example, historically “increases in wildfire activity in Alaska from 1950 to 2003 have been linked to increased temperatures” (IPCC 2012). Models have shown that warming temperatures could further increase the risk of fires in future decades in the southeastern part of Alaska (UAF/SNAP 2012b). In addition, warming temperatures presents a scenario in which the speed of glacier melt increases. Throughout southeast Alaska, and around the globe, glaciers are expected to experience a trend of accelerated melting (UAF/SNAP 2012b). The shrinking of Harding Icefield, home of over 30 outflowing glaciers directly west of the SBCFSA, has been documented in recent years (National Park Service [NPS] 2013). Of greater prominence has been the recording of the retreat of Exit Glacier, part of Harding Icefield, and a direct source of the Resurrection River which flows through the SBCFSA and into Resurrection Bay (Tuttle 2011). Continued rising temperatures and shorter, warmer cold seasons could accelerate the melting of regional glaciers potentially increasing flooding and sedimentation. Regarding SLR, as is stated above, based on historic and projected trends there is currently no threat to the SBCFSA from SLR. That said, planners could utilize the provided SLR

maps to better understand the existing vulnerability within low-lying areas of the SBCFSA to coastal flooding from storm surges or other events producing a SLR of three-to six-meters.

Review of existing scientific data and research, along with the use of future climate change scenario modeling at the regional level has projected a warmer and wetter SBCFSA in the time period between 2012 and 2100. Warming temperatures and increased precipitation within and surrounding the SBCFSA could have several implications for the future state of hazards in the region. Specifically as it relates to the effects of climate change on flooding, Appendix J discusses the results of flood models and mapping used to analyze the potential influence of future climate change (projected future temperature and precipitation data using the same projected future climate change scenarios discussed above) on flooding for the major streams and rivers within the SBCFSA.

**Appendix J**  
**Hazus Data and Narratives**

## **J. Hazus Scenarios**

### **J.1 Earthquake**

#### **J.1.1 Hazard Scenario Development Methodology**

The earthquake loss analysis for the SBCFSA makes use of the FEMA Hazus software. Hazus provides the options to model probabilistic or deterministic earthquake events. Probabilistic hazard modeling makes use of regional earthquake data to approximate earthquake characteristics associated with different recurrence intervals (return periods). Deterministic events are specific user-defined events based on historical events or user-entered locations and earthquake parameters. This can include events definition based on point locations and intensity parameters or more sophisticated scenarios from earthquake models.

For the SBCFSA, a scenario based on the 1964 Good Friday Earthquake was used. A scenario was developed by the USGS for the 1964 earthquake using the Shakemap data format. The USGS Earthquake Hazards Program manages the Shakemap Program (<http://earthquake.usgs.gov/earthquakes/shakemap/>) with regional seismic network operators. ShakeMap provides near-real-time maps of ground motion and shaking intensity following significant earthquakes. The Hazus model developers have worked with Shakemap to establish data standards to allow Shakemap data to be imported directly into Hazus. Specifically, Shakemap provides earthquake event GIS layers for Peak Ground Acceleration, Peak Ground Velocity, and Spectral Response (0.3 and 1.0 sec period). Map J-1 shows a representation of the 1964 Earthquake scenario from the Shakemap program.

This 1964 event scenario was entered into Hazus by using the 4 maps provided by the Shakemap Program. Hazus also required the Magnitude to be entered. Although the actual magnitude was 9.2, Hazus only allows a maximum value of 9.0, which used for this scenario.

#### **J.1.2 Inventory**

By default, Hazus Level 1 analysis for earthquake makes use of census tract data based on Hazus general building stock (GBS) data. Hazus GBS data provides structure counts and structure replacement values for over 30 different occupancy types (structure usage). The current GBS data within Hazus (Major Release 2.1) is based in 2000 Census data for most residential structures and 2006 Dunn and Bradstreet data for other occupancy types. Table J-1 summarizes the total structure counts and structure replacement values for groupings of occupancy types for the entire census tract that covers the SBCFSA.

Table J-1 delineates Hazus Major Release 2.1, building inventory estimates for the SBCFSA using the 2000 Census Tract 02122001300.



**Table J-1 Hazus Major Release 2.1, SBCFSA Building Inventory Estimates**

Occupancy Type	Total Structure Count	Total – Structure Replacement Values <sup>1</sup>	Total – Content Replacement Values <sup>1</sup>
Residential	3622	\$358,760,000	\$179,580,000
Commercial and Industrial	143	\$108,840,000	\$116,840,000
Other <sup>2</sup>	29	\$14,620,000	\$15,970,000
<b>Total</b>	<b>3,794</b>	<b>\$482,220,000</b>	<b>\$312,390,000</b>
Source: Hazus Major Release 2.1, General Building Stock data for Census Tract 02122001300.			
<sup>1</sup> 2006 Dollars from RSMeans, rounded to nearest \$10,000.			
<sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.			

The census tract that covers the SBCFSA also includes land area outside of the study area. However, a comparison of the GBS values for only the census blocks within the study area versus the entire tract found that over 99% of the structures and structure replacement values in the census tract fall within the SBCFSA. Therefore, loss estimates for the entire census tract could be applied to only the SBCFSA without the need for any prorating.

### J.1.3 Hazus Results

While the Hazus GBS data was enhanced for the flood analysis to included structure specific data, the study scope did not allow as detailed an analysis for earthquake. Instead, a Hazus earthquake analysis was conducted using the default Hazus GBS inventory data with the US Geological Survey's (USGS) 1964 earthquake Shakemap scenario. Table J-2 summarizes the number of damaged structures and estimated structure and contents losses based on Hazus GBS data. The table also shows the relative percent of each value as compared to the value in Table J-1 that represents the entire GBS inventory value.

**Table J-2 Hazus GBS-based SBCFSA Losses - 1964 Earthquake Scenario**

Occupancy Type	Damaged Structure Counts	Total Loss to Structures <sup>1</sup>	Total Loss to Contents <sup>1</sup>
Residential	3493 (96%)	\$106,470,000 (30%)	\$29,020,000 (16%)
Commercial and Industrial	143 (100%)	\$100,940,000 (93%)	\$39,320,000 (34%)
Other <sup>2</sup>	29 (100%)	\$11,630,000 (80%)	\$4,750,000 (30%)
<b>Total</b>	<b>3,665 (97%)</b>	<b>\$219,040,000 (45%)</b>	<b>\$73,090,000 (23%)</b>
Source: Hazus Major Release 2.1, General Building Stock data for Census Tract 02122001300, percent values are based on comparison with total inventory values from Hazus GBS data.			
<sup>1</sup> 2006 Dollars for replacement values, rounded to nearest \$10,000.			
<sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.			

This table shows that Hazus predicts that almost all structures (97%) will have some level of damage from an event as severe as a repeat of the 1964 earthquake. This is especially true for non-residential structures, which will have greater than 80% structural losses. The key structure characteristic that drives the level of damage is construction type (called building type in Hazus). Hazus GBS assumes most non-residential structures will be built with materials other than wood, such as concrete blocks, masonry, or steel. Because of the severity of the 1964 event, all of these non-wood materials are predicted to have close to complete structural failure, resulting in close to complete loss. Residential structures are predicted to perform better, since a majority of the

structures are built from wood, which can better resist damage from earthquake shaking. Very few residential structures, except manufactured housing (mobile homes), are expected to have extensive or complete failure according to the Hazus analysis. Contents losses are about half as severe (in terms of percent loss) of structural loss, because Hazus model parameters assumes many contents can be salvaged from a damaged structure.

Although Hazus earthquake analysis was not conducted on the individual structure data developed for the flood analysis (see Section J.2.4 of this Appendix for more detailed discussion), the percentages from Table J-2 can be applied to the individual structure data to provide a rough estimate of what earthquake losses might be based on this better structure data. Table J-3 shows the total inventory values based on the Hazus user-defined facilities data developed for flood analysis. Table J-4 applies the percent losses from Table J-2 to the values in Table J-3 to estimate losses based on individual structure information.

**Table J-3 Hazus SBCFSA User-Defined Facilities (UDF) Building Inventory Estimates**

Occupancy Type	Total Structure Count	Total – Structure Replacement Values <sup>1</sup>	Total – Content Replacement Values <sup>1</sup>
Residential	1919	\$418,710,000	\$209,350,000
Commercial and Industrial	376	\$233,420,000	\$247,440,000
Other <sup>2</sup>	52	\$118,260,000	\$139,100,000
<b>Total</b>	<b>2,347</b>	<b>\$770,390,000</b>	<b>\$595,890,000</b>
Sources: KPB Parcel Data, KPB Building Data, KPB aerial photography, RSMeans 2012 Residential Cost Data and Light Commercial Cost Data, Hazus default data for region, field survey, publically available aerial and street level photography			
<sup>1</sup> 2012 Dollars from RSMeans 2012 Residential Cost Data and Light Commercial Cost Data, rounded to nearest \$10,000.			
<sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.			

**Table J-4 SBCFSA Estimated Earthquake Losses**

Occupancy Type	Total Structure Count	Total – Structure Replacement Values <sup>1</sup>	Total – Content Replacement Values <sup>1</sup>
Residential	1842 (96%)	\$124,260,000 (30%)	\$33,830,000 (16%)
Commercial and Industrial	376 (100%)	\$216,480,000 (93%)	\$83,270,000 (34%)
Other <sup>2</sup>	52 (100%)	\$94,070,000 (80%)	\$41,370,000 (30%)
<b>Total</b>	<b>2,270 (97%)</b>	<b>\$434,810,000 (56%)</b>	<b>\$158,470,000 (27%)</b>
Sources: Applied percent losses from Hazus GBS Earthquake Analysis to UDF Building Inventory values to all value except totals.			
<sup>1</sup> 2012 Dollars, rounded to nearest \$10,000.			
<sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.			

These UDF-based earthquake loss estimates show a much higher total loss (\$593.28 million vs. \$292.13 million) than the Hazus GBS-based losses. This is mostly due to the greater number and dollar value of the non-residential occupancy types in the UDF data. With Hazus predicting high damage levels to these non-residential structures, this produces a slightly more than doubling in the loss estimate based on UDF data. While an actual Hazus earthquake analysis with structure specific data may result in slightly lower losses (since some of the non-residential structures are made of wood), the estimate shown on Table J-4 gives a worse-case scenario of the severity that a repeat of the 1964 earthquake might cause in the SBCFSA.

## **J.2 Flood**

For the Seward-Bear Creek Flood Service Area LHMP Annex assessment, fifteen watersheds were evaluated for riverine flood hazards.

### **J.2.1 Watershed Descriptions**

A brief description of each watershed is provided below. All of the studied streams, along with their approximate watersheds, are shown on Map K-8.

#### ***Bear Creek***

Bear Creek serves as the outlet for Bear Lake and is a left bank tributary to Lost Creek, which is subsequently tributary to Salmon Creek. The Bear Creek watershed is approximately 6.5 square miles. The watershed is mostly undeveloped, although some residential development exists along the creek south and west of Bear Lake. The Bear Creek study reach extends approximately 1.2 miles from Bear Lake, across Seward Highway, then downstream to the confluence with Lost Creek. Northwest Hydraulic Consultants, Inc. (NHC) prepared a HEC-RAS hydraulic model for Bear Creek during their work for an update of the Flood Insurance Study (FIS) for the Kenai Peninsula Borough (KPB) in 2008 (NHC, 2008), which URS obtained for use in this assessment.

#### ***Box Canyon Creek***

Box Canyon Creek is a left bank tributary to Resurrection River. The Box Canyon Creek watershed is approximately 14.7 square miles of undeveloped, forested, and mountainous terrain. The study area for Box Canyon Creek includes a 0.9 mile reach of Box Canyon Creek that starts at the confluence with Clear Creek, crosses Glacier Road, and terminates at the Resurrection River. Based on information provided by the SBCFSA, this study assumes a failure of the left levee near Clear Creek that forms an approximately 1.8 mile long split flow path through Clear Creek that terminates at the Resurrection River. This system was evaluated as a single unit, so the results presented for Box Canyon Creek in Section 2.5 include the impacts of flooding on both the main stem of Box Canyon Creek and the split flow path through the Clear Creek watershed.

#### ***Clear Creek***

Clear Creek is a right bank tributary to Salmon Creek. The Clear Creek watershed consists of approximately 2.87 square miles of predominantly undeveloped land. There is sparse large-lot residential development in the area just west of Seward Highway, which is located near the confluence with Salmon Creek. The Clear Creek study reach includes approximately 0.9 miles of channel that terminates at the confluence with Salmon Creek. This study reach along Clear Creek was evaluated independently of the split flow from Box Canyon Creek described in Section J.2.1.2. Results presented for Clear Creek in Section J.2.5 include only the flooding impacts due to flooding from Clear Creek.

#### ***Fourth of July Creek***

Fourth of July Creek discharges directly into the east side of Resurrection Bay. The Fourth of July Creek watershed is approximately 25.7 square miles. The watershed is undeveloped land that includes both forested terrain near the outfall and glacial land, including Godwin Glacier, in the upper watershed. The Fourth of July Creek study reach extends upstream approximately 1.6 miles from the outfall at Resurrection Bay.

***Grouse Creek***

Grouse Creek is a left bank tributary of Lost Creek. The Grouse Creek watershed is approximately 6.2 square miles of predominantly undeveloped, forested land with sparse residential development at the south end of the watershed, near the confluence with Lost Creek. The Grouse Creek study reach includes an approximately 0.6 mile channel that parallels Seward Highway on the west side and terminates at the confluence with Lost Creek. NHC prepared a HEC-RAS hydraulic model for Grouse Creek for the KPB FIS update in 2008 (NHC, 2008). URS obtained that model for use in this assessment.

***Japanese Creek***

Japanese Creek is a right bank tributary to Resurrection River. The Japanese Creek watershed is approximately 4.3 square miles and contains a mixture of rock outcrop and forested terrain. The majority of the Japanese Creek watershed is undeveloped; however, there is a developed area located southeast of Japanese Creek near its confluence with Resurrection River. The Japanese Creek study reach extends approximately 0.4 mile upstream from the Dimond Boulevard crossing, located just upstream from the Resurrection River floodplain.

***Kwechak Creek***

Kwechak Creek is a left bank tributary of Salmon Creek. The Kwechak Creek watershed is approximately 7.0 square miles of predominantly undeveloped land that includes a mixture of forested terrain and glacial land, including Bear Lake Glacier, on the east side of the watershed. There is a developed area on the west side of the watershed, near the confluence with Salmon Creek, consisting mostly of large-lot residential development. The Kwechak Creek study reach extends approximately 2.5 miles upstream from the terminus at Salmon Creek. NHC developed a HEC-RAS hydraulic model for Kwechak Creek for the KPB FIS update in 2008 (NHC, 2008), which URS obtained for use in this assessment.

***Lost Creek***

Lost Creek is a right bank tributary of Salmon Creek. The Lost Creek watershed is approximately 9.3 square miles of undeveloped, forested terrain, with a small pocket of large-lot residential development near the confluence with Grouse Creek. The watershed includes Lost Lake, a recreational lake located in the upper watershed that has a surface area of approximately 0.7 square mile. The Lost Creek study reach is approximately 0.6 miles long and terminates at the confluence with Grouse Creek.

***Lowell Creek***

Lowell Creek discharges directly into the west side of Resurrection Bay. The current Lowell Creek watershed, which terminates just below the diversion dam for the Lowell Creek Flood Control Project, is approximately 4.2 square miles of predominantly undeveloped land, with a mix of forested and glacial terrain.

Lowell Creek conveyed flows directly through the City of Seward along what is now Jefferson Street until 1940, when construction of the Lowell Creek Flood Control Project was completed and successfully diverted flows to an outfall into Resurrection Bay just south of the City. The project included construction of the Lowell Creek Dam, a concrete diversion tunnel through Bear Mountain known as the Lowell Creek Tunnel, and a new concrete outfall to Resurrection Bay. A map of the Lowell Creek Flood Control Project area is shown on Figure J-1. Hydraulic modeling



results were obtained from the U.S. Army Corps of Engineers for use in this assessment. See Section J.2.2.3 for a description of the Lowell Creek analysis.



**Figure J-1 Aerial View of the Lowell Creek Flood Control Project**

### ***Resurrection River***

The Resurrection River flows predominantly northwest to southeast and discharges directly into the north end of Resurrection Bay. The Resurrection River watershed is approximately 221 square miles of glacial terrain which includes the watersheds for Salmon Creek, and Japanese Creek, which are tributary to the river. There are developed areas on both sides of the river, with the largest area to the west, including the Seward Airport, which is located on the west bank of the river adjacent to Resurrection Bay. The Resurrection River study reach extends approximately 3.1 miles upstream from the outfall at Resurrection Bay. NHC developed a HEC-RAS hydraulic model for Resurrection River for the KPB FIS update in 2008 (NHC, 2008). URS obtained that model for use in this assessment.

### ***Salmon Creek***

Salmon Creek is a left bank tributary to Resurrection River. The Salmon Creek watershed is approximately 37.0 square miles and includes the watersheds for Clear Creek, Sometimes Creek,

Lost Creek, Grouse Creek, Bear Creek, and Kwechak Creek, which are tributary to Salmon Creek. The majority of the Salmon Creek watershed is undeveloped with the exception of commercial and residential developments along Seward Highway. The Salmon Creek study reach includes approximately 6.3 miles of the main channel as well as multiple split flow paths. NHC developed a HEC-RAS hydraulic model for Salmon Creek for the KPB FIS update in 2008 (NHC, 2008), which URS obtained for use in this analysis.

#### ***Sawmill Creek***

Sawmill Creek discharges directly into the northeast corner of Resurrection Bay. The Sawmill Creek watershed is approximately 11.4 square miles with a mixture of forested and glacial terrain. There is residential development near the Nash Road crossing. The Sawmill Creek study reach terminates at the outfall to Resurrection Bay and includes 1.7 miles of the main channel and one split flow path. NHC developed a HEC-RAS hydraulic model for Sawmill Creek for the KPB FIS update in 2008 (NHC, 2008), which URS obtained for use in this assessment.

#### ***Scheffler Creek***

Scheffler Creek discharges directly into the west side of Resurrection Bay. The Scheffler Creek watershed is bounded by the Japanese Creek and Lowell Creek watersheds and is approximately 1.8 square miles. The upstream portion of the watershed is predominantly glacial and the downstream portion is a mixture of forested and developed land near the Resurrection Bay. The developed land includes residential and commercial developments, including a marina near the outfall. The Scheffler Creek study reach is approximately 0.9 miles long and flow through the Lagoon and Fish Ditch before terminating at the outfall to Resurrection Bay.

#### ***Sometimes Creek***

Sometimes Creek is a right bank tributary of Lost Creek. The Sometimes Creek watershed is approximately 2.3 square miles of predominantly undeveloped land. The majority of the watershed consists of undeveloped forested land; however there is residential development at the downstream end of the watershed near the Lost Creek confluence. The Sometimes Creek study reach extends approximately 0.5 miles upstream from the confluence with Lost Creek.

#### ***Spruce Creek***

Spruce Creek discharges directly into the west side of Resurrection Bay near the Lowell Point Water Treatment Plant. The Spruce Creek watershed is approximately 9.7 square miles of forested, mountainous terrain, including the south face of Bear Mountain. There are several structures at the downstream end of the watershed, including a fire department and the municipal water treatment plant. The Spruce Creek study reach extends approximately 0.4 miles upstream from the outlet at Resurrection Bay.

### **J.2.2 Current Day Hazard Methods**

The following section describes the methods used to estimate the flood hazards and resulting damages for the current day scenario.

#### ***J.2.2.1 Hydrology***

Two hydrological analysis methods were used for this assessment, based on the availability of existing flood hazard modeling for a given stream. The two methods are described below.



### *Regional Regression Equations*

Hydrologic analyses of the several of the studied streams were performed using regional regression equation methods as published in “*Estimating the Magnitude and Frequency of Peak Streamflows for Ungaged Sites on Streams in Alaska and Conterminous Basins in Canada, Water Resources Investigations Report 03-4188*” (WRIR 03-4188) by the USGS (USGS, 2003). See Table J.2-1 for a listing of the streams where this method was used. The regional regression equations were used to calculate peak flow rates for the 10-, 50-, 100-, and 500-year frequency storm events. Input parameters for the equations include: drainage area (square miles), area of lakes and ponds (percentage), mean annual precipitation (inches), and mean minimum January temperature (degrees Fahrenheit). Mean annual precipitation and mean minimum January temperatures were taken from the reference date provided in WRIR 03-4188. The drainage area and area of lakes and ponds for each watershed were estimated using GIS techniques and the 2009 LiDAR data and USGS Quadrangle maps. Peak flow rates for each stream can be found in Table J-5. The watersheds are shown on Map K-8.

### *FEMA Models*

Six of the studied streams in the City of Seward and surrounding KPB area were modeled as part of NHC’s work on the KPB FIS Update in 2008 (NHC, 2008). In Table J-5, the Hydrology Method for these streams is shown as “FEMA”. Peak flow rates from the obtained models were adopted for use in this assessment for Current Day conditions. NHC used the regional regression equations described above to estimate the peak flows, then adjusted the flows to account for the effects of surge-release floods and other anomalous events. Peak flow rates for each stream can be found in Table J-5. The watersheds are shown on Map K-8.

*Note: Lowell Creek is not shown in this table because it was analyzed differently, as described in Section J.2.2.2.*

**Table J-5 FEMA Peak Flow Rates for Current Conditions**

Watershed	Hydrology Method	Current Peak Flow (cfs)			
		10-Year	50-Year	100-Year	500-Year
Bear Creek	FEMA	440	610	690	880
Box Canyon Creek	Regional Regression Equations	2,174	2,992	3,342	4,216
Clear Creek	Regional Regression Equations	552	764	855	1,082
Fourth of July Creek	Regional Regression Equations	3,540	4,870	5,440	6,860
Grouse Creek	FEMA	740	1,020	1,140	1,450
Japanese Creek	Regional Regression Equations	897	1,220	1,360	1,700
Kwechak Creek	FEMA	1,190	2,140	2,780	5,160
Lost Creek	Regional Regression Equations	1,372	1,905	2,134	2,709
Resurrection River	FEMA	19,230	26,190	29,160	36,570
Salmon Creek	FEMA	2,650	5,170	7,120	15,730
Sawmill Creek	FEMA	1,460	2,350	2,860	4,590
Scheffler Creek	Regional Regression Equations	418	572	673	799
Sometimes Creek	Regional Regression Equations	441	612	685	869
Spruce Creek	Regional Regression Equations	1,050	2,020	2,240	2,790

*Note: cfs = cubic feet per second*

### *J.2.2.2 Hydraulics*

As with the hydrology, two hydraulic analysis methods were used for this assessment, based on the availability of existing flood hazard modeling for a given stream. The two methods are described below.

#### ***Original Models***

The USACE's Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 4.1.0 and its steady flow analysis capability was used to route frequency flood events through the study reaches described above. The USACE's HEC-GeoRAS extension was used within ArcGIS to build geometry data for the HEC-RAS hydraulic models using the 2009 LiDAR data that was obtained from SBCFSA. Manning's roughness coefficients (n-values) used in the analysis were taken from similar FEMA models (see next section) and were verified using aerial photography. The steady flow data were calculated using the regional regression equation analysis described in Section J.2.2.1.

The HEC-RAS results were exported into ArcGIS, where floodplain boundaries and depth grids were processed using the HEC-GeoRAS extension. The depth grids were then imported into Hazus to estimate potential flood damages during each flood event. The 100- and 500-year depth grids for all studied streams are shown on Maps K-9 and K-10 respectively. The calculated depth grids for each stream, individually, are shown on Maps K-11 to K-58.

#### ***FEMA Models***

The six HEC-RAS models that were obtained from FEMA were used to evaluate flood hazards along those streams. The geometry in the FEMA models was based on 2006 LiDAR data and survey field survey information. Given the highly-dynamic morphology of the streams in the SBCFSA area, where bed load is transported in even the most routine flood events, HEC-GeoRAS was used to update the ground geometry for each stream to reflect the 2009 LiDAR data. In some cases, cross sections were added or extended to facilitate development of complete depth grids. The steady flow file and all other inputs remained unchanged. The 100- and 500-year depth grids for all studied streams are shown on Maps K-9 and K-10 respectively. The calculated depth grids for each stream, individually, are shown on Maps K-11 to K-58.

#### ***Lowell Creek***

No hydrologic or hydraulic modeling for Lowell Creek was performed for this project. Hydraulic analyses for Lowell Creek were performed by the U.S. Army Corps of Engineers (USACE) as part of the "*Lowell Creek Inundation Study, Seward, Alaska*", dated January 2012 (USACE, 2012). URS obtained water surface depth data points from USACE for the three flood scenarios described below. Depth grids were created from the water surface depth points and were imported into Hazus to estimate potential flood damages for each scenario. The calculated depth grids are shown on Maps K-59 to K-61. These depth grids were developed assuming all non-zero water depth values represented a modeled flood depth. This assumption resulted in the depth grids having a slightly wider spatial extent than the mapping shown in the USACE's report (USACE, 2012), because lower flood depth values were mapped.

#### ***Flood Scenario 1***

The first flood scenario for Lowell Creek considered the 100-year peak flow in Lowell Creek, estimated to be 2,000 cubic feet per second (cfs), with the Lowell

Creek Tunnel entrance completely blocked. The blockage of the Lowell Creek Tunnel caused the diversion dam to overtop, and flow was conveyed through Seward. (USACE, 2012).

### ***Flood Scenario 2***

The second flood scenario for Lowell Creek considered the Probable Maximum Flood (PMF), estimated to be 7,600 cfs, with the Lowell Creek Tunnel fully operational. During this event, approximately 3,000 cfs was conveyed through the tunnel, while approximately 4,600 cfs overtopped the diversion dam to be conveyed through Seward (USACE, 2012).

### ***Flood Scenario 3***

The third flood scenario for Lowell Creek considered the PMF causing a landslide, with the diversion dam and tunnel fully operational. Per the USACE, it was assumed that the landslide formed a temporary reservoir that collected water and failed during the peak of the runoff hydrograph. This worst-case scenario resulted in a peak flow of 3,200 cfs through the tunnel and 15,800 cfs overtopping the diversion dam and flowing through Seward (USACE, 2012).

## **J.2.3 Climate Change Hazard Methods**

The following section describes the methods used to estimate the flood hazards and resulting damages for the future year scenarios.

### ***J.2.3.1 Hydrology***

As described in Appendix I, climate change will have a significant influence on flooding in future years. Using the temperature and precipitation data obtained from UAF SNAP for 2012 and for future years (2022, 2032, 2050, 2062, and 2099/2100), as inputs for the regional regression equations described in Section J.2.2.2, flows were calculated for each combination of return period, year, and emission scenario (A1B, A2, B1). Although, as described in Appendix I, Emission Scenario A1B was selected for the full hazard analysis, flows were calculated for all emission scenarios to provide a general understanding of the impacts of the three scenarios.

The resulting flows were then used to calculate a scale factor that would be applied to the current day flow data to give the final peak flow data for each flood scenario. Rather than direct application of the future flows from the regression equations, a scale factor was needed because the FEMA flows described in Section J.2.2.1 above were not based solely on the regional regression equations. Additionally, because both sets of current day flows were based on the reference data included in WRIR 03-4188, which is older than 2012 but was used for consistency with typical current day methods, the 2012 climate change data was used as a baseline to develop the scale factors, so that the scale factors would be based entirely on the same source temperature and precipitation data.

The scale factor was calculated by dividing the projected flows for each future year flood scenario by the projected 2012 flow data for that flood scenario. The resulting ratio was then multiplied by the current peak flow data to calculate the final peak flow value for each scenario, as shown in Equations 1 and 2.

$$\text{Scale Factor (SF)} = \frac{Q_{2xxx}}{Q_{2012}} \quad (\text{Equation 1})$$

where:

$Q_{2xxx}$  = flow rate for a given future year, flood event, and scenario, as calculated using regression equations and climate change data

$Q_{2012}$  = flow rate for 2012 for a given flood event and scenario, as calculated using regression equations and climate change data

$$Q_{final} = Q_{current} \times (SF) \quad (\text{Equation 2})$$

where:

$Q_{final}$  = final flow rate for a given future year, flood event, and scenario

$Q_{current}$  = current flow rate for a given flood event as described in Section 2.2.1

(SF) = Scale Factor calculated using Equation 1

The peak flow rates for current conditions and all future scenarios are shown in Tables J-6, J-7, and J-8.

*Note: Lowell Creek is not shown in these tables because it was analyzed differently, as described in Section J.2.2.2.*

## HAZUS SCENARIO DATA AND NARRATIVES

## APPENDIX J

Table J-6 Peak Flow Rates for Current Conditions and Future Conditions: Emissions Scenario A1B

Watershed	Hydrology Method	Current Flow Data						Future Flow Data																													
		Current Peak Flow (cfs)						2022 Peak Flow (cfs)						2032 Peak Flow (cfs)						2050 Peak Flow (cfs)						2062 Peak Flow (cfs)						2100 Peak Flow (cfs)					
		10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year		
Bear Creek	FEMA	440	610	690	880	515	710	801	1,015	512	706	796	1,008	545	746	840	1,058	806	1,081	1,204	1,485	641	867	971	1,211												
Box Canyon Creek	RRE	2,174	2,992	3,342	4,216	2,565	3,511	3,910	4,896	2,553	3,490	3,886	4,863	2,702	3,672	4,080	5,084	4,039	5,368	5,905	7,194	3,184	4,273	4,723	5,821												
Clear Creek	RRE	552	764	855	1,082	648	892	995	1,251	645	887	990	1,243	684	935	1,041	1,302	1,019	1,362	1,502	1,836	803	1,085	1,201	1,486												
Fourth of July Creek	RRE	3,540	4,870	5,440	6,860	4,109	5,628	6,271	7,857	4,100	5,607	6,245	7,819	4,362	5,929	6,588	8,209	6,415	8,530	9,390	11,448	5,079	6,820	7,544	9,305												
Grouse Creek	FEMA	740	1,020	1,140	1,450	867	1,190	1,326	1,675	860	1,179	1,314	1,659	914	1,245	1,385	1,740	1,362	1,815	1,999	2,457	1,082	1,454	1,609	1,999												
Japanese Creek	RRE	897	1,220	1,360	1,700	1,051	1,423	1,582	1,963	1,046	1,414	1,571	1,949	1,111	1,492	1,655	2,044	1,658	2,178	2,391	2,886	1,294	1,718	1,896	2,317												
Kwechak Creek	FEMA	1,190	2,140	2,780	5,160	1,392	2,491	3,227	5,948	1,387	2,478	3,210	5,913	1,473	2,617	3,382	6,201	2,180	3,787	4,847	8,695	1,726	3,028	3,894	7,066												
Lost Creek	RRE	1,372	1,905	2,134	2,709	1,619	2,236	2,498	3,148	1,609	2,220	2,479	3,123	1,706	2,339	2,606	3,268	2,549	3,419	3,773	4,626	2,023	2,738	3,035	3,763												
Resurrection River	FEMA	19,230	26,190	29,160	36,570	22,814	30,894	34,291	42,672	22,718	30,727	34,096	42,410	24,026	32,305	35,769	44,294	36,156	47,522	52,098	63,056	28,355	37,634	41,461	50,778												
Salmon Creek	FEMA	2,650	5,170	7,120	15,730	3,110	6,038	8,292	18,190	3,093	5,998	8,236	18,059	3,285	6,330	8,671	18,925	4,885	9,209	12,493	26,668	3,871	7,366	10,041	21,678												
Sawmill Creek	FEMA	1,460	2,350	2,860	4,590	1,705	2,732	3,316	5,286	1,699	2,718	3,298	5,255	1,805	2,869	3,474	5,508	2,671	4,154	4,980	7,725	2,113	3,319	3,998	6,274												
Scheffler Creek	RRE	418	572	673	799	488	665	780	920	486	661	776	915	516	697	816	958	770	1,018	1,179	1,352	600	802	934	1,084												
Sometimes Creek	RRE	441	612	685	869	519	717	800	1,008	516	711	794	999	548	751	836	1,047	815	1,092	1,205	1,476	645	873	967	1,199												
Spruce Creek	RRE	1,050	2,020	2,240	2,790	1,218	2,334	2,582	3,195	1,215	2,325	2,570	3,179	1,291	2,455	2,709	3,334	1,916	3,562	3,891	4,684	1,498	2,815	3,091	3,767												

Notes: 1. cfs = cubic feet per second 2. RRE = Regional Regression Equations

Table J-7 Peak Flow Rates for Current Conditions and Future Conditions: Emissions Scenario A2

Watershed	Hydrology Method	Current Flow Data												Future Flow Data																							
		Current Peak Flow (cfs)						2022 Peak Flow (cfs)						2032 Peak Flow (cfs)						2050 Peak Flow (cfs)						2062 Peak Flow (cfs)						2100 Peak Flow (cfs)					
		10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year			10-Year	50-Year	100-Year	500-Year		
Bear Creek	FEMA	440	610	690	880		2,174	2,992	3,342	4,216		2,174	2,992	3,342	4,216		2,174	2,992	3,342	4,216		2,174	2,992	3,342	4,216		2,174	2,992	3,342	4,216		2,174	2,992	3,342	4,216		
Box Canyon Creek	RRE	552	764	855	1,082		552	764	855	1,082		552	764	855	1,082		552	764	855	1,082		552	764	855	1,082		552	764	855	1,082		552	764	855	1,082		
Clear Creek	RRE	3,540	4,870	5,440	6,860		3,540	4,870	5,440	6,860		3,540	4,870	5,440	6,860		3,540	4,870	5,440	6,860		3,540	4,870	5,440	6,860		3,540	4,870	5,440	6,860		3,540	4,870	5,440	6,860		
Fourth of July Creek	RRE	740	1,020	1,140	1,450		740	1,020	1,140	1,450		740	1,020	1,140	1,450		740	1,020	1,140	1,450		740	1,020	1,140	1,450		740	1,020	1,140	1,450		740	1,020	1,140	1,450		
Grouse Creek	FEMA	897	1,220	1,360	1,700		897	1,220	1,360	1,700		897	1,220	1,360	1,700		897	1,220	1,360	1,700		897	1,220	1,360	1,700		897	1,220	1,360	1,700		897	1,220	1,360	1,700		
Japanese Creek	RRE	1,190	2,140	2,780	5,160		1,190	2,140	2,780	5,160		1,190	2,140	2,780	5,160		1,190	2,140	2,780	5,160		1,190	2,140	2,780	5,160		1,190	2,140	2,780	5,160		1,190	2,140	2,780	5,160		
Kwechak Creek	FEMA	1,372	1,905	2,134	2,709		1,372	1,905	2,134	2,709		1,372	1,905	2,134	2,709		1,372	1,905	2,134	2,709		1,372	1,905	2,134	2,709		1,372	1,905	2,134	2,709		1,372	1,905	2,134	2,709		
Lost Creek	RRE	19,230	26,190	29,160	36,570		19,230	26,190	29,160	36,570		19,230	26,190	29,160	36,570		19,230	26,190	29,160	36,570		19,230	26,190	29,160	36,570		19,230	26,190	29,160	36,570		19,230	26,190	29,160	36,570		
Resurrection River	FEMA	2,650	5,170	7,120	15,730		2,650	5,170	7,120	15,730		2,650	5,170	7,120	15,730		2,650	5,170	7,120	15,730		2,650	5,170	7,120	15,730		2,650	5,170	7,120	15,730		2,650	5,170	7,120	15,730		
Salmon Creek	FEMA	1,460	2,350	2,860	4,590		1,460	2,350	2,860	4,590		1,460	2,350	2,860	4,590		1,460	2,350	2,860	4,590		1,460	2,350	2,860	4,590		1,460	2,350	2,860	4,590		1,460	2,350	2,860	4,590		
Sawmill Creek	FEMA	418	572	673	799		418	572	673	799		418	572	673	799		418	572	673	799		418	572	673	799		418	572	673	799		418	572	673	799		
Scheffler Creek	RRE	441	612	685	869		441	612	685	869		441	612	685	869		441	612	685	869		441	612	685	869		441	612	685	869		441	612	685	869		
Sometimes Creek	RRE	1,050	2,020	2,240	2,790		1,050	2,020	2,240	2,790		1,050	2,020	2,240	2,790		1,050	2,020	2,240	2,790		1,050	2,020	2,240	2,790		1,050	2,020	2,240	2,790		1,050	2,020	2,240	2,790		
Spruce Creek	RRE																																				





As shown in the tables, the highest flows along each stream occur in the 2062 scenario year, which reflects the peak of the A1B Emissions Scenario. Flows then go down in the 2100 scenario year, as the emissions are reduced in the A1B Emissions Scenario.

Additionally, the flows for the most frequent flood events in the 2062 scenario year (eg. the 10-year flood event) often correlate to the flows for the extreme or least frequent flood events (the 100- and 500-year) in the current year scenario. For example the Current Day 500-year flood flow along Bear Creek is approximately 880 cfs, which the 2062 10-year flood flow is approximately 806 cfs. So, in future years, the most common floods will have nearly the same magnitude as today's extreme events.

#### ***J.2.3.2 Hydraulics***

The HEC-RAS models that were used to model the current flood events were also used to model the future flood events. The future flows were input into the model for each scenario year. The geometry files for several models were modified to accommodate significant flow increases from the future events. All n-values and hydraulic structure geometry remained the same.

The HEC-RAS results were exported into ArcGIS, where floodplain boundaries and depth grids were processed using the HEC-GeoRAS extension. The depth grids were then imported into Hazus to estimate potential flood damages during each flood event.

For Salmon Creek, because the current year (2012) hydraulic analysis indicated that this stream would have the most significant general flooding impact, HEC-RAS models were completed for every combination of return period, year, and emission scenario (A1B, A2, and B1).

Based on review of the flow data presented in Tables J-6, J-7, and J-8, the 2022 and 2062 scenario years represent the upper and lower bounds, respectively, of the flows for the future years. While HEC-RAS models were generated for every scenario year, depth grids were only generated for the 2022 and 2062 years, to limit the number of Hazus runs needed to estimate damages.

The calculated depth grids for the 2022 and 2062 scenario years for all studied streams are shown on Maps K-11 to K-58.

#### **J.2.4 Inventory**

For this analysis, several different sources were examined to determine the most appropriate structure inventory data for flood analysis. For example, Table J-9 shows how 2010 U.S. Census data and more detailed data from the Alaska Department of Labor (DOL) can be used to derive 2012 population. The table delineates population data for the study's population areas within the SBCFSA (i.e. City of Seward, Bear Creek, and Lowell Point) and also provides an estimate of number of residential structures and their estimated replacement value.

**Table J-9 Census-Based Population and Residential Building Inventory Estimates**

Location	Population		Residential Structures	
	2010 Census	DCCED 2012	Total Structure Count	Total Replacement Value of Structures <sup>1</sup>
City of Seward	2,693	2,733	947	\$181,824,000
Bear Creek	1,956	1,958	720	\$134,064,000
Lowell Point	80	71	71	\$9,230,000
<b>Total</b>	<b>4,729</b>	<b>4,762</b>	<b>1,738</b>	<b>\$325,118,000</b>

Sources: The SBCFSA, U.S. Census 2010, and 2011 Alaska Department of Labor.  
<sup>1</sup> 2010 Dollars. The 2010 US Census estimates residential building values at City of Seward: \$192,000, Bear Creek: 186,200, and Lowell Point: \$130,000.

However, these estimates do not include all non-residential structures, structure contents values, and also do not provide detail at a resolution greater than the Census designated areas.

A second data source considered for the flood analysis was default census block-level structure data provided with the FEMA Hazus software. This default inventory data, referred to in the Hazus documentation as Level 1 General Building Stock (GBS) data, provides structure counts and structure replacement values for over 30 different occupancy types, where occupancy type related to usage of the structure (residential, commercial, etc.) The current data at the census block-level within Hazus (Major Release 2.1) is based in 2000 Census data for most residential structures and 2006 Dunn and Bradstreet data for other occupancy types. Table J-10 summarizes the total structure counts and structure replacement values for the entire SBCFSA census tract.

**Table J-10 Hazus Major Release 2.1 SBCFSA Building Inventory Estimates**

Occupancy Type	Total Structure Count	Total Replacement Value of Structures <sup>1</sup>	Total Replacement Value of Contents <sup>1</sup>
Residential	3622	\$358,755,000	\$179,584,000
Commercial and Industrial	143	\$108,843,000	\$116,838,000
Other <sup>2</sup>	29	\$14,618,000	\$15,971,000
<b>Total</b>	<b>3,794</b>	<b>\$482,216,000</b>	<b>\$312,393,000</b>

Source: Hazus Major Release 2.1, General Building Stock data for Census Tract 02122001300.  
<sup>1</sup> 2006 Dollars from RSMeans.  
<sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.

These default Hazus GBS values have several issues that provide challenges for flood analysis. First, these values represent the land area of a census block, not individual structures. For many flood scenarios with detailed flood boundaries, census blocks are too generalized to provide site-specific flood loss estimates. Second, the residential structure counts have not been updated since the 2000 census and are based on default relationships between population and structure counts. When compared with Table J-9, the residential structure counts are more than doubled, which appears excessive. Third, the basis for replacement values was 2006 RSMeans publications, which does not reflect the changes to housing costs since the 2008 recession. For all these reasons, the decision was made to conduct all flood analysis using data for individual structures.

### J.2.4.1 Current Day

The flood loss analysis was conducted using the FEMA Hazus model for individual structures. Known as a User-defined Facilities (UDF) analysis, the Hazus model requires detailed information on each structure to establish the relationships used to model flood losses. Table J-11 summarizes the data required for UDF analysis and the sources used for this analysis.

**Table J-11 Hazus User Defined Facilities (UDF) Data Requirements**

Data type	Description	Sources
Occupancy type	Usage of the structure (residential, commercial, etc.) based on Hazus categories	KPB Parcel and Building Data, Field survey, KPB and publically available aerial and street level photography
Stories	Number of stories	KPB Parcel and Building Data, Publically available street level photography
Finished floor area	Square footage of finished floor area in the structure	KPB Parcel and Building Data, Hazus default data for region
Construction type	Structure primary construction material (wood, concrete, etc.) based on Hazus categories	KPB Parcel and Building Data, Hazus default data for region
Foundation Type	Structure foundation type (basement, crawlspace, etc.) based on Hazus categories	KPB Parcel and Building Data, Hazus default data for region
First Floor Height	First floor (finished) height above grade	Field survey, Publically available street level photography, Hazus default data for region
Location	Location of structure (given as latitude and longitude)	KPB Parcel and Building Data, KPB and publically available aerial photography
Replacement Costs	Replacement cost for structure and structure contents	RSMeans 2012 Residential Cost Data and Light Commercial Cost Data
Depth-Damage Functions (DDFs)	Relationships for structure and structure contents of estimates damages versus flood depth based on Hazus categories	Hazus default data with categories selected based on occupancy type, stories, and foundation type

Developing UDF data for Hazus had three major steps:

1. Adjusting structure locations
2. Obtaining structure data from KPB sources
3. Deriving additional structure data from other sources

#### Step 1: Structure Locations

The first step was to establish the structure locations. Existing KPB data had address points established in the center of tax parcels. These points were edited (some additions and deletions) and moved over building locations based on aerial photography. Where possible, these structure points had associated tax parcel ID numbers to link to other KPB tax and parcel data tables.

#### Step 2: Structure data based on KPB data

The second step of the UDF data development was converting the available structure characteristic data into the formats required by Hazus. Many data types, such as occupancy type,

stories, finished floor area, construction type, and foundation types, had fields in KPB data tables that were similar to Hazus categories. For a majority of structures, the KPB data tables provided the information needed to establish the Hazus categories. Where there were data gaps, information from the available data were used to estimate default values for similar structures.

For example, finished floor area data were not available for around 300 structures, representing 13% of the total structures. Default values were established based on the finished floor area of the known structures. Table J-12 summarizes some of these finished floor area assumptions.

**Table J-12 Default Values for Finished Floor Area**

Finished floor category	Default finished floor area
Residential single family with 1 story	1,100 square feet
Residential single family with 1 1/2 stories	1,600 square feet
Residential single family with 2 stories	2,000 square feet
Mobile Home (assume single wide)	800 square feet
Apartment	2,600 square feet
Temporary Lodging	2,700 square feet
Small Commercial and Industrial	1,700 square feet
Government	2,400 square feet
Educational	30,000 square feet

For some structures with missing data, neighboring structures were used to estimate the missing data, such as stories or foundation type.

### Step 3: Structure data from other sources

There were some data types, such as first floor heights and replacement costs, which were not in KPB data tables and had to be derived for other sources. Some typical first floor heights were established by a combination of field survey and use of publicly-available street level photography. Around 81 structures (3% of total structures) had first floor height directly estimated. For those structures that did not have the first floor height directly estimated, some default values (Table J-13) were established based on combinations of occupancy and foundation type.

**Table J-13 First Floor Height Above Grade - Default Values**

Occupancy and foundation type combination	Default first floor height above grade	Description
Any structure with a basement or slab foundation	0 feet	Structures with basements or slab foundations are assumed to begin having flood damage when flood waters touch any part of the foundation walls.
Residential structures with pier, crawlspace, or solid wall foundations	2 feet	Field survey and street level aerial photography found for residential structures with these foundation types that the average first height above grade was 2 feet.
Non-residential structures	0 feet	Hazus default values assume most non-residential structures in the area have either slab or basement foundations. This was spot checked during field survey and from street level aerial photography.

Replacement costs were estimated using the replacement cost guides from RSMeans, specifically the 2012 Residential Cost Data and Light Commercial Cost Data publications. Table J-14 summarizes the structure replacement values provided by RSMeans.

**Table J-14 Replacement Value Ranges (RSMeans)**

Replacement Value Category	Range of Replacement Value per Square Foot (adjusted for Seward Area) from RSMeans 2012
Residential single family with 1 story (regular)	\$100 - \$178
Residential single family with 1 1/2 stories (regular, includes split level)	\$90 - \$199
Residential single family with 2 stories (regular)	\$98 - \$157
Residential single family with 1 story (log)	\$114 - \$198
Residential single family with 2 stories (log)	\$111 - \$176
Mobile Home (assume single wide)	\$69*
Apartment	\$162 - \$187
Temporary Lodging	\$175 - \$190
Nursing Home	\$217 - \$245
Retail Commercial	\$108 - \$163
Wholesale Commercial	\$104 - \$129
Repair Services	\$122 - \$172
Office Commercial	\$177 - \$282
Banks	\$235 - \$289
Medical	\$452 - \$493
Restaurants	\$222 - \$261
Industrial	\$131 - \$154
Religion	\$180 - \$321
Government	\$180 - \$286
Educational	\$188 - \$199
*Mobile home replacement value based on the Pacific region in 2011 Manufactured Housing survey by the U.S. Commerce Department's Census Bureau.	

Table J-15 summarizes from the UDF data total structure counts and structure replacement values for groupings of structures types for the study area.

**Table J-15 Hazus User Defined Facilities Building Inventory Estimates for SBCFSA**

Occupancy Type	Total Structure Count	Total Structure Replacement Value <sup>1</sup>	Total Contents Replacement Value <sup>1</sup>
Residential	1919	\$418,708,000	\$209,354,000
Commercial and Industrial	376	\$233,424,000	\$247,439,000
Other <sup>2</sup>	52	\$118,258,000	\$139,097,000
<b>Total</b>	<b>2,347</b>	<b>\$770,390,000</b>	<b>\$595,890,000</b>
<i>Sources: KPB Parcel Data, KPB Building Data, KPB aerial photography, RSMeans 2012 Residential Cost Data and Light Commercial Cost Data, Hazus default data for region, field survey, publically available aerial and street level photography</i> <sup>1</sup> 2012 Dollars from RSMeans 2012 Residential Cost Data and Light Commercial Cost Data. <sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.			

Some items should be noted when comparing Table J-15 with the two previous estimates of structure counts and replacement values in Tables J-9 and J-10. The residential structure count of 1,919 is much closer to the 1,738 value in Table J-9 than the 3,622 estimate from Hazus default GBS in Table J-10. The UDF residential replacement values were greater than either of the other two tables, which is surprising when compared to the Hazus GBS values with their much greater residential structure counts. For non-residential structures, the Hazus UDF had much higher counts and replacement values than the Hazus GBS values.

#### **J.2.4.2 Future Land Use**

To represent future land use scenarios, additional points were added to the UDF data in locations (as described in Appendix I) where growth is expected over the next 10 years. An additional 425 structures were added to the UDF data as summarized in Table J-16.

**Table J-16 Additional Future Structures Modeled with Hazus UDFs for SBCFSA**

Occupancy Type	Total Structure Count	Total Replacement Value of Structures <sup>1</sup>	Total Replacement Value of Contents <sup>1</sup>
Residential	414	\$100,227,000	\$50,113,000
Commercial and Industrial	11	\$8,464,000	\$12,696,000
Other <sup>2</sup>	0	\$0	\$0
<b>Total</b>	<b>425</b>	<b>\$108,691,000</b>	<b>\$62,809,000</b>
<i>Notes: 1. 2012 Dollars from RSMeans 2012 Residential Cost Data and Light Commercial Cost Data.</i> <sup>2</sup> Other occupancy types include Government, Education, Religion, and Agriculture.			

The additional residential structures are assumed to be 2,000 square foot single family residences and the additional non-residential structures are 5,000 square foot industrial structures. See Appendix I for more information on future land use assumptions.

Critical facility data were used to develop the SBCFSA's Vulnerability Exposure Analysis as summarized in Tables 6-9, 6-10, and 6-11.

Appendix K provides maps that depict colored hazard impact areas. The various color codes define the extent of the impact area. Critical facilities are depicted as point locations within the planning area; and subsequently indicate their relative location within an identified potential hazard impacted area.



Tables 6-9, 6-10, and 6-11 tabulate this potential loss estimation data. Section 6.7.1 Exposure Analysis – Hazard Narrative Summaries provides an explanatory description of the tabulated exposure analysis.

### J.2.5 Hazus Results

Using the depth grids and UDF data described in the previous sections, Hazus runs were completed for riverine flood hazards to estimate the total number of structures impacted by flooding (e.g. all of the structures that get wet), the number from that total that experience damage, and then the aggregate cost of structure and building damages.

#### *All Streams except Salmon Creek & Lowell Creek*

For all studied streams except Salmon Creek and Lowell Creek, Hazus runs were completed for the current year (2012) and for the 2022 and 2062 scenario years under the A1B Emissions Scenario using current and future land development data. As damages are directly correlated with flood flow, curve fit techniques based on the calculated damages for the 2022 and 2062 scenario years were used to estimate total damages for the 2032, 2050, and 2100 scenario years. The results of the Hazus runs for all streams except Salmon Creek and Lowell Creek are presented in Table J-17.

As shown in Table J-17, there are no damages along Fourth of July Creek, Japanese Creek, or Spruce Creek in any year/event scenario. Additionally, along Sometimes Creek, there are no flood damages in any year/event scenario until the 2062 scenario year, when there are damages due to the 100- and 500-year events. Then, in 2100, because flows go down, there are no damages along Sometimes Creek except for the 500-year event.

The table also shows that several streams do not experience damaging floods except in the most extreme events or in the later scenario years.

As can be expected, the highest damages are correlated with the highest flows, so the highest damages along each stream occur in the 2062 scenario year for the 500-year flow event.

**Table J-17 Hazus-Estimated Damages**

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
<b>Bear Creek</b>							
<b>2012 (Current Day)</b>	<b>10</b>	440	There were no building damages in the 10-year event.				
	<b>50</b>	610	2	1	\$1,577	\$236	<b>\$1,813</b>
	<b>100</b>	690	5	2	\$9,015	\$1,877	<b>\$10,892</b>
	<b>500</b>	880	7	4	\$51,063	\$18,999	<b>\$70,061</b>
<b>2022</b>	<b>10</b>	515	1	0	\$0	\$0	<b>\$0</b>
	<b>50</b>	710	5	2	\$10,014	\$2,241	<b>\$12,254</b>
	<b>100</b>	801	6	2	\$14,307	\$3,802	<b>\$18,109</b>
	<b>500</b>	1,015	8	4	\$66,332	\$24,742	<b>\$91,074</b>
<b>2032</b>	<b>10</b>	512	There were no building damages in the 10-year event.				
	<b>50</b>	706	Not Estimated				<b>\$4,537</b>

Table J-17 Hazus-Estimated Damages

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES	
	100	796	Not Estimated				\$22,276	
	500	1,008	Not Estimated				\$75,863	
2050	10	545	There were no building damages in the 10-year event.					
	50	746	Not Estimated				\$11,988	
	100	840	Not Estimated				\$32,218	
	500	1,058	Not Estimated				\$89,799	
2062	10	806	6	2	\$14,595	\$3,907	\$18,502	
	50	1,081	8	6	\$71,864	\$26,915	\$98,779	
	100	1,204	8	7	\$91,298	\$34,549	\$125,846	
	500	1,485	9	8	\$141,683	\$55,429	\$197,112	
2100	10	641	There were no building damages in the 10-year event.					
	50	867	Not Estimated				\$38,897	
	100	971	Not Estimated				\$65,842	
	500	1,211	Not Estimated				\$131,782	
Box Canyon Creek								
2012 (Current Day)	10	2,174	32	19	\$514,313	\$881,150	\$1,395,462	
	50	2,992	41	22	\$606,397	\$1,020,480	\$1,626,878	
	100	3,342	44	24	\$666,675	\$1,203,360	\$1,870,035	
	500	4,216	47	29	\$772,279	\$1,484,950	\$2,257,230	
2022	10	2,565	35	19	\$551,501	\$938,612	\$1,490,113	
	50	3,511	45	25	\$691,345	\$1,283,832	\$1,975,177	
	100	3,910	46	28	\$737,315	\$1,403,279	\$2,140,593	
	500	4,896	48	32	\$816,632	\$1,572,986	\$2,389,618	
2032	10	2,553	Not Estimated				\$1,553,520	
	50	3,490	Not Estimated				\$1,922,887	
	100	3,886	Not Estimated				\$2,078,749	
	500	4,863	Not Estimated				\$2,463,976	
2050	10	2,702	Not Estimated				\$1,612,352	
	50	3,672	Not Estimated				\$1,994,723	
	100	4,080	Not Estimated				\$2,155,282	
	500	5,084	Not Estimated				\$2,550,771	
2062	10	4,039	46	28	\$745,537	\$1,423,587	\$2,169,125	
	50	5,368	53	38	\$938,767	\$1,776,821	\$2,715,588	
	100	5,905	54	38	\$1,001,378	\$1,865,201	\$2,866,580	
	500	7,194	60	44	\$1,236,333	\$2,129,670	\$3,366,003	
2100	10	3,184	Not Estimated				\$1,802,221	

Table J-17 Hazus-Estimated Damages

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
	50	4,273	Not Estimated				\$2,231,224
	100	4,723	Not Estimated				\$2,408,737
	500	5,821	Not Estimated				\$2,841,500
Clear Creek							
2012 (Current Day)	10	552	27	21	\$1,058,932	\$4,548,128	\$5,607,060
	50	764	31	27	\$1,246,625	\$5,154,617	\$6,401,242
	100	855	33	30	\$1,348,252	\$5,396,084	\$6,744,336
	500	1,082	35	32	\$1,531,715	\$5,922,858	\$7,454,573
2022	10	648	29	24	\$1,156,348	\$4,849,768	\$6,006,116
	50	892	33	31	\$1,377,846	\$5,484,270	\$6,862,116
	100	995	33	31	\$1,462,791	\$5,725,360	\$7,188,151
	500	1,251	37	32	\$1,647,243	\$6,255,076	\$7,902,319
2032	10	645	Not Estimated				\$5,963,422
	50	887	Not Estimated				\$6,880,974
	100	990	Not Estimated				\$7,195,880
	500	1,243	Not Estimated				\$7,851,786
2050	10	684	Not Estimated				\$6,132,086
	50	935	Not Estimated				\$7,032,169
	100	1,041	Not Estimated				\$7,340,756
	500	1,302	Not Estimated				\$7,983,422
2062	10	1,019	33	31	\$1,482,740	\$5,781,619	\$7,264,359
	50	1,362	39	32	\$1,695,922	\$6,428,483	\$8,124,405
	100	1,502	41	34	\$1,750,443	\$6,632,672	\$8,383,115
	500	1,836	44	36	\$1,901,297	\$7,079,636	\$8,980,933
2100	10	803	Not Estimated				\$6,594,225
	50	1,085	Not Estimated				\$7,458,292
	100	1,201	Not Estimated				\$7,752,809
	500	1,486	Not Estimated				\$8,364,766
Fourth of July Creek							
There are no building damages along Fourth of July Creek in any year/event scenario.							
Grouse Creek							
2012 (Current Day)	10	740	2	2	\$73,622	\$38,426	\$112,049
	50	1,020	2	2	\$90,699	\$59,620	\$150,319
	100	1,140	3	3	\$143,400	\$82,822	\$226,221
	500	1,450	3	3	\$214,593	\$140,048	\$354,641
2022	10	867	3	3	\$162,681	\$88,460	\$251,141

Table J-17 Hazus-Estimated Damages

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
	50	1,190	5	5	\$257,044	\$161,426	\$418,470
	100	1,326	5	5	\$301,187	\$206,589	\$507,776
	500	1,675	6	6	\$423,335	\$329,034	\$752,369
2032	10	860	Not Estimated				\$244,821
	50	1,179	Not Estimated				\$423,631
	100	1,314	Not Estimated				\$490,643
	500	1,659	Not Estimated				\$638,843
2050	10	914	Not Estimated				\$277,258
	50	1,245	Not Estimated				\$457,206
	100	1,385	Not Estimated				\$523,699
	500	1,740	Not Estimated				\$668,645
2062	10	1,362	5	5	\$307,495	\$202,037	\$509,532
	50	1,815	6	6	\$415,116	\$291,858	\$706,973
	100	1,999	6	6	\$429,344	\$308,975	\$738,319
	500	2,457	7	6	\$478,485	\$376,067	\$854,552
2100	10	1,082	Not Estimated				\$372,041
	50	1,454	Not Estimated				\$554,857
	100	1,609	Not Estimated				\$619,169
	500	1,999	Not Estimated				\$751,844
Japanese Creek							
There are no building damages along Japanese Creek in any year/event scenario.							
Kwechak Creek							
2012 (Current Day)	10	1,190	17	12	\$422,674	\$269,685	\$692,359
	50	2,140	21	14	\$501,855	\$320,290	\$822,145
	100	2,780	27	19	\$631,050	\$382,166	\$1,013,216
	500	5,160	40	28	\$880,222	\$516,334	\$1,396,556
2022	10	1,392	20	13	\$439,539	\$281,193	\$720,731
	50	2,491	25	16	\$557,287	\$348,117	\$905,404
	100	3,227	31	21	\$684,240	\$405,393	\$1,089,633
	500	5,948	46	32	\$948,840	\$565,214	\$1,514,054
2032	10	1,387	Not Estimated				\$742,866
	50	2,478	Not Estimated				\$928,848
	100	3,210	Not Estimated				\$1,053,434
	500	5,913	Not Estimated				\$1,514,019
2050	10	1,473	Not Estimated				\$757,647
	50	2,617	Not Estimated				\$952,485

### Table J-17 Hazus-Estimated Damages

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
	100	3,382	Not Estimated				\$1,082,744
	500	6,201	Not Estimated				\$1,563,007
2062	10	2,180	23	15	\$536,127	\$335,395	\$871,522
	50	3,787	34	22	\$741,831	\$434,189	\$1,176,020
	100	4,847	37	27	\$853,230	\$500,959	\$1,354,189
	500	8,695	58	40	\$1,211,983	\$757,576	\$1,969,559
2100	10	1,726	Not Estimated				\$800,687
	50	3,028	Not Estimated				\$1,022,550
	100	3,894	Not Estimated				\$1,170,081
	500	7,066	Not Estimated				\$1,710,446
Lost Creek							
2012 (Current Day)	10	1,372	9	8	\$317,133	\$567,260	\$884,394
	50	1,905	9	9	\$366,497	\$648,787	\$1,015,284
	100	2,134	11	10	\$412,391	\$689,588	\$1,101,978
	500	2,709	13	10	\$456,352	\$758,837	\$1,215,189
2022	10	1,619	9	9	\$339,014	\$605,928	\$944,942
	50	2,236	11	10	\$420,382	\$704,402	\$1,124,784
	100	2,498	11	10	\$440,914	\$738,469	\$1,179,383
	500	3,148	14	12	\$492,688	\$808,035	\$1,300,723
2032	10	1,609	Not Estimated				\$954,586
	50	2,220	Not Estimated				\$1,099,841
	100	2,479	Not Estimated				\$1,161,409
	500	3,123	Not Estimated				\$1,314,453
2050	10	1,706	Not Estimated				\$977,657
	50	2,339	Not Estimated				\$1,128,178
	100	2,606	Not Estimated				\$1,191,656
	500	3,268	Not Estimated				\$1,348,900
2062	10	2,549	12	10	\$444,774	\$743,516	\$1,188,290
	50	3,419	14	12	\$517,929	\$834,186	\$1,352,115
	100	3,773	15	15	\$592,887	\$881,642	\$1,474,529
	500	4,626	15	15	\$727,145	\$958,964	\$1,686,109
2100	10	2,023	Not Estimated				\$1,053,084
	50	2,738	Not Estimated				\$1,223,042
	100	3,035	Not Estimated				\$1,293,638
	500	3,763	Not Estimated				\$1,466,666
Lowell Creek							

Table J-17 Hazus-Estimated Damages

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
See Table J-19 for Lowell Creek results.							
Resurrection River							
2012 (Current Day)	10	19,230	10	8	\$59,762	\$143,019	\$202,781
	50	26,190	21	19	\$172,668	\$320,641	\$493,308
	100	29,160	25	23	\$277,688	\$741,105	\$1,018,794
	500	36,570	30	28	\$543,318	\$1,127,737	\$1,671,055
2022	10	22,814	19	17	\$459,626	\$359,998	\$819,624
	50	30,894	34	32	\$854,971	\$1,053,638	\$1,908,608
	100	34,291	36	34	\$1,005,982	\$1,238,168	\$2,244,150
	500	42,672	47	43	\$1,357,047	\$1,791,508	\$3,148,555
2032	10	22,718	Not Estimated				\$896,398
	50	30,727	Not Estimated				\$1,804,754
	100	34,096	Not Estimated				\$2,186,743
	500	42,410	Not Estimated				\$3,129,663
2050	10	24,026	Not Estimated				\$1,044,789
	50	32,305	Not Estimated				\$1,983,626
	100	35,769	Not Estimated				\$2,376,542
	500	44,294	Not Estimated				\$3,343,277
2062	10	36,156	39	37	\$1,124,368	\$1,373,879	\$2,498,247
	50	47,522	54	46	\$1,563,824	\$2,080,301	\$3,644,125
	100	52,098	62	52	\$1,758,582	\$2,371,472	\$4,130,054
	500	63,056	75	69	\$2,339,380	\$3,195,608	\$5,534,988
2100	10	28,355	Not Estimated				\$1,535,733
	50	37,634	Not Estimated				\$2,588,058
	100	41,461	Not Estimated				\$3,021,960
	500	50,778	Not Estimated				\$4,078,630
Salmon Creek							
See Table J-18 for Salmon Creek results.							
Sawmill Creek							
2012 (Current Day)	10	1,460	3	1	\$12,819	\$42,670	\$55,489
	50	2,350	4	3	\$17,783	\$60,723	\$78,506
	100	2,860	5	4	\$54,102	\$77,567	\$131,669
	500	4,590	7	5	\$68,529	\$100,394	\$168,923
2022	10	1,705	3	1	\$14,529	\$48,940	\$63,469
	50	2,732	5	4	\$33,160	\$218,580	\$251,740
	100	3,316	5	5	\$49,067	\$271,319	\$320,386



Table J-17 Hazus-Estimated Damages

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
	500	5,286	8	6	\$157,417	\$570,207	\$727,624
2032	10	1,699	Not Estimated				\$18,556
	50	2,718	Not Estimated				\$264,385
	100	3,298	Not Estimated				\$385,134
	500	5,255	Not Estimated				\$690,191
2050	10	1,805	Not Estimated				\$46,006
	50	2,869	Not Estimated				\$297,167
	100	3,474	Not Estimated				\$418,930
	500	5,508	Not Estimated				\$718,169
2062	10	2,671	5	4	\$30,896	\$210,034	\$240,930
	50	4,154	7	6	\$88,445	\$304,272	\$392,717
	100	4,980	8	6	\$150,302	\$543,855	\$694,157
	500	7,725	9	6	\$174,262	\$658,691	\$832,952
2100	10	2,113	Not Estimated				\$123,526
	50	3,319	Not Estimated				\$389,090
	100	3,998	Not Estimated				\$512,394
	500	6,274	Not Estimated				\$786,592
Scheffler Creek							
2012 (Current Day)	10	418	There were no building damages in the 10-year event.				
	50	572	1	0	\$0	\$0	\$0
	100	673	1	0	\$0	\$0	\$0
	500	799	1	0	\$0	\$0	\$0
2022	10	488	There were no building damages in the 10-year event.				
	50	665	1	0	\$0	\$0	\$0
	100	780	1	0	\$0	\$0	\$0
	500	920	2	2	\$34,311	\$12,317	\$46,628
2032	10	486	There were no building damages in the 10-, 50-, or 100-year events.				
	50	661					
	100	776					
	500	915	Not Estimated				\$43,407
2050	10	516	There were no building damages in the 10-, 50-, or 100-year events.				
	50	697					
	100	816					
	500	958	Not Estimated				\$47,360
2062	10	770	1	0	\$0	\$0	\$0
	50	1,018	3	2	\$39,303	\$15,403	\$54,706

Table J-17 Hazus-Estimated Damages

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Structures Damaged	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
	100	1,179	3	2	\$43,630	\$19,074	\$62,703
	500	1,352	3	2	\$54,567	\$24,853	\$79,419
2100	10	600	There were no building damages in the 10- or 50-year events.				
	50	802					
	100	934	Not Estimated				\$45,323
	500	1,084	Not Estimated				\$53,840
	Sometimes Creek						
2012 (Current Day)	10	441	There were no building damages in any event.				
	50	612					
	100	685					
	500	869					
2022	10	519	There were no building damages in any event.				
	50	717					
	100	800					
	500	1,008					
2032	10	516	There were no building damages in any event.				
	50	711					
	100	794					
	500	999					
2050	10	548	There were no building damages in any event.				
	50	751					
	100	836					
	500	1,047					
2062	10	815	There were no building damages in the 10- or 50-year events.				
	50	1,092					
	100	1,205	1	1	\$43,543	\$18,362	\$61,906
	500	1,476	1	1	\$44,439	\$18,810	\$63,250
2100	10	645	There were no building damages in the 10-, 50-, or 100-year events.				
	50	873					
	100	967					
	500	1,199	Not Estimated				\$61,877
Spruce Creek							
There are no building damages along Spruce Creek in any year/event scenario.							

Notes: 1. All damage estimates are in 2012 dollars based on RSMeans data. 2. Damages for years 2032, 2050, and 2100 were estimated using curve fit techniques based on the calculated results for 2022 and 2062. These values are shown in italicized text and highlighted in yellow.

*Salmon Creek*

As described in previous sections, Salmon Creek experiences the most impactful riverine flooding in the SBCFSA area. Therefore, Hazus runs were completed for every combination of return period, year, and emission scenario (A1B, A2, and B1). The results of the Hazus runs for Salmon Creek are presented in Table J-18.

As with the other streams, the worst total damages of 173 structures for \$21,837,716 are experienced during the 500-year flood event in the 2062 scenario year of the A1B emissions scenario, while the damages for the event in the A2 and B1 emissions scenarios are somewhat lower at 157 structures for \$17,093,243 and 149 structures for \$16,337,729, respectively. As the A2 and B1 emissions scenarios do not exhibit the early peak, the worst damages in those scenarios are experienced during the 500-year flood event in the 2100/2099 emissions scenarios, with 165 structures at \$20,362,628 and 165 structures at \$17,622,084.

**Table J-18 Hazus-Estimated Damages for Salmon Creek**

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Damaged Structures	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
Current Day							
2012	10	2,650	50	39	\$1,201,994	\$4,678,107	<b>\$5,880,101</b>
	50	5,170	79	63	\$1,916,410	\$6,277,339	<b>\$8,193,748</b>
	100	7,120	121	84	\$2,526,043	\$7,233,455	<b>\$9,759,498</b>
	500	15,730	190	147	\$4,552,961	\$11,525,986	<b>\$16,078,947</b>
Emissions Scenario A1B							
2022	10	3,110	54	43	\$1,350,014	\$5,039,112	<b>\$6,389,125</b>
	50	6,038	87	66	\$2,195,976	\$6,638,966	<b>\$8,834,943</b>
	100	8,292	137	94	\$2,890,635	\$7,862,389	<b>\$10,753,024</b>
	500	18,190	189	152	\$4,982,299	\$12,057,142	<b>\$17,039,440</b>
2032	10	3,093	54	43	\$1,346,070	\$5,029,430	<b>\$6,375,500</b>
	50	5,998	86	65	\$2,159,665	\$6,601,573	<b>\$8,761,237</b>
	100	8,236	135	94	\$2,877,167	\$7,834,631	<b>\$10,711,798</b>
	500	18,059	188	152	\$4,957,522	\$11,983,643	<b>\$16,941,165</b>
2050	10	3,285	54	43	\$1,390,920	\$5,156,896	<b>\$6,547,816</b>
	50	6,330	87	67	\$2,233,323	\$6,718,267	<b>\$8,951,590</b>
	100	8,671	139	96	\$2,945,279	\$8,021,013	<b>\$10,966,292</b>
	500	18,925	191	160	\$5,176,179	\$12,497,319	<b>\$17,673,498</b>
2062	10	4,885	70	56	\$1,759,905	\$5,944,580	<b>\$7,704,485</b>
	50	9,209	112	90	\$2,933,085	\$8,085,164	<b>\$11,018,249</b>
	100	12,493	163	119	\$3,764,598	\$9,732,067	<b>\$13,496,665</b>
	500	26,668	219	173	\$6,654,296	\$15,183,420	<b>\$21,837,716</b>
2100	10	3,871	60	49	\$1,611,533	\$5,506,283	<b>\$7,117,816</b>

Table J-18 Hazus-Estimated Damages for Salmon Creek

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Damaged Structures	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
	50	7,366	97	80	\$2,580,128	\$7,217,738	<b>\$9,797,866</b>
	100	10,041	152	106	\$3,328,203	\$8,682,594	<b>\$12,010,798</b>
	500	21,678	185	152	\$5,690,036	\$13,371,759	<b>\$19,061,795</b>
Emissions Scenario A2							
2022	10	2,041	43	32	\$965,355	\$4,049,912	<b>\$5,015,266</b>
	50	4,011	68	56	\$1,705,781	\$5,748,591	<b>\$7,454,372</b>
	100	5,548	101	70	\$2,166,837	\$6,551,755	<b>\$8,718,592</b>
	500	12,395	176	131	\$4,001,350	\$10,079,940	<b>\$14,081,290</b>
2032	10	2,874	53	43	\$1,286,295	\$4,864,428	<b>\$6,150,724</b>
	50	5,564	85	65	\$2,094,242	\$6,457,303	<b>\$8,551,545</b>
	100	7,642	132	91	\$2,748,077	\$7,564,192	<b>\$10,312,269</b>
	500	16,783	189	154	\$4,883,597	\$12,022,067	<b>\$16,905,664</b>
2050	10	3,227	54	43	\$1,378,055	\$5,119,962	<b>\$6,498,017</b>
	50	6,174	92	68	\$2,223,104	\$6,700,165	<b>\$8,923,269</b>
	100	8,442	144	99	\$2,924,508	\$7,945,190	<b>\$10,869,698</b>
	500	18,372	195	160	\$5,037,929	\$12,151,574	<b>\$17,189,503</b>
2062	10	2,964	54	43	\$1,315,321	\$4,944,308	<b>\$6,259,629</b>
	50	5,699	89	68	\$2,142,086	\$6,529,342	<b>\$8,671,428</b>
	100	7,809	134	93	\$2,779,915	\$7,648,574	<b>\$10,428,489</b>
	500	17,077	191	157	\$4,925,706	\$12,167,537	<b>\$17,093,243</b>
2099	10	4,342	65	52	\$1,646,185	\$5,713,532	<b>\$7,359,717</b>
	50	8,164	108	87	\$2,745,059	\$7,668,165	<b>\$10,413,224</b>
	100	11,080	162	116	\$3,520,755	\$9,219,811	<b>\$12,740,566</b>
	500	23,706	207	165	\$6,126,847	\$14,235,781	<b>\$20,362,628</b>
Emissions Scenario B1							
2022	10	2,338	46	34	\$1,073,118	\$4,364,925	<b>\$5,438,043</b>
	50	4,591	76	61	\$1,839,196	\$6,024,966	<b>\$7,864,162</b>
	100	6,342	108	72	\$2,309,257	\$6,831,469	<b>\$9,140,726</b>
	500	14,106	176	131	\$4,336,781	\$10,833,560	<b>\$15,170,341</b>
2032	10	2,010	42	31	\$954,205	\$4,013,579	<b>\$4,967,785</b>
	50	3,981	68	55	\$1,674,310	\$5,706,193	<b>\$7,380,504</b>
	100	5,519	101	70	\$2,161,775	\$6,540,655	<b>\$8,702,430</b>
	500	12,381	176	131	\$3,991,287	\$10,068,966	<b>\$14,060,253</b>
2050	10	3,339	54	43	\$1,401,534	\$5,187,114	<b>\$6,588,648</b>

**Table J-18 Hazus-Estimated Damages for Salmon Creek**

Scenario Year	Recurrence Interval (yr)	Outlet Discharge (cfs)	Number of Wet Structures	Number of Damaged Structures	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
	50	6,421	93	69	\$2,251,495	\$6,757,934	<b>\$9,009,430</b>
	100	8,789	146	100	\$2,998,656	\$8,113,306	<b>\$11,111,963</b>
	500	19,152	200	169	\$5,301,949	\$12,648,722	<b>\$17,950,671</b>
2062	10	2,713	52	42	\$1,237,968	\$4,735,148	<b>\$5,973,116</b>
	50	5,282	83	63	\$2,013,403	\$6,337,681	<b>\$8,351,084</b>
	100	7,268	128	88	\$2,661,628	\$7,361,030	<b>\$10,022,658</b>
	500	16,031	187	149	\$4,714,327	\$11,623,402	<b>\$16,337,729</b>
2100	10	3,249	54	43	\$1,381,483	\$5,129,127	<b>\$6,510,610</b>
	50	6,240	92	69	\$2,232,567	\$6,720,810	<b>\$8,953,378</b>
	100	8,542	145	99	\$2,932,663	\$7,992,966	<b>\$10,925,628</b>
	500	18,621	197	165	\$5,178,293	\$12,443,791	<b>\$17,622,084</b>

Notes: 1. All damage estimates are in 2012 dollars based on RSMeans data. 2. For the A1B and B1 scenarios, the results are for year 2100. For the A2 scenario, the data is for the year 2099, per the data provided by UAF SNAP.

### **Lowell Creek**

Hazus runs were completed for the three flooding scenarios developed by the USACE and described in Section J.2.2.2 under both current and future land use development conditions. The results of the Hazus runs for Lowell Creek are shown in Table J-19.

As might be expected, the worst damages from Lowell Creek flooding would be realized during Flood Scenario 3, which is the PMF with a landslide, for both current and future land development conditions. This event would practically wipe-out downtown Seward, damaging 259 structures for \$53,204,832 in total damages and 261 structures for \$53,668,957 in total damages under current and future development conditions, respectively.

There is still significant damage during Flood Scenario 1, which is a more likely scenario than Scenario 3, with 133 structures damaged for a total of \$17,453,823 under current conditions and with 135 structures damaged for a total of \$17,509,649 under future land development conditions.

**Table J-19 Hazus-Estimated Damages for Lowell Creek**

Land Use Scenario	Flooding Scenario	Number of Wet Structures	Number of Damaged Structures	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
Current Day	1% Chance Flood, Tunnel Blocked	179	133	\$6,256,968	\$11,196,855	<b>\$17,453,823</b>
	PMF, Tunnel Operational	221	171	\$9,621,140	\$19,849,234	<b>\$29,470,375</b>
	PMF with Surge Release, Tunnel Operational	339	259	\$16,400,583	\$36,804,249	<b>\$53,204,832</b>

Table J-19 Hazus-Estimated Damages for Lowell Creek

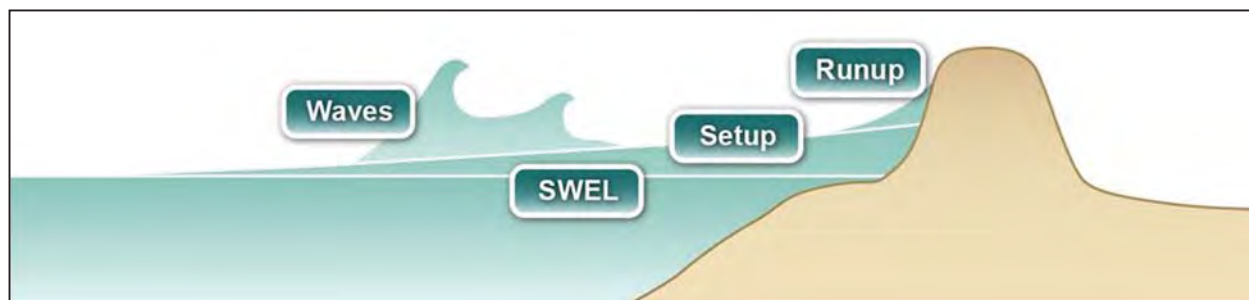
Land Use Scenario	Flooding Scenario	Number of Wet Structures	Number of Damaged Structures	Total Structure Damages	Total Contents Damages	TOTAL DAMAGES
Future Land Development	1% Chance Flood, Tunnel Blocked	181	135	\$6,287,404	\$11,222,246	<b>\$17,509,649</b>
	PMF, Tunnel Operational	223	173	\$9,691,566	\$19,942,109	<b>\$29,633,675</b>
	PMF with Surge Release, Tunnel Operational	341	261	\$16,561,753	\$37,107,205	<b>\$53,668,957</b>

Notes: 1. All damage estimates are in 2012 dollars based on RSMMeans data. 2. 1% Chance Flood = 100-year Flood. 3. PMF = Probable Maximum Flood. 4. Flooding scenarios were taken from the USACE's Lowell Creek Inundation Study, Seward, Alaska, January 2012.

### J.3 Coastal

#### J.3.1 Hazard Scenario Development Methodology

The coastal flood loss analysis for the SBCFSA makes use of the FEMA Hazus software. The coastal flood hazard is represented as a flood depth raster based on the best available 100-yr coastal floodplain zones from FEMA. FEMA coastal floodplain modeling involves combining a number of different analyses. The flooding associated with stillwater elevation (SWEL) comes primarily from storm surge modeling. Wave setup modeling estimates the increase in water elevation shoreward of the region in which breakers form at the seashore, caused by the onshore flux of momentum against the beach. Wave runup is also modeling, which is added on top the wave setup when water from a specific wave will “run up” the face of a dune or structure. Figure J-2 illustrates how all of these analyses are combined to produce coastal flood elevation estimates.



**Figure J-2 Coastal Floodplain Modeling Components**

For the coastal flood analysis, the latest coastal floodplain zones were obtained from the Kenai Peninsula Borough. These zones come from a draft restudy being conducted by FEMA for the Seward area and all of the Kenai Peninsula Borough. The following description of the coastal analysis comes from excerpts from the draft Flood Insurance Study (FEMA, 2012) for this restudy:

*“A detailed coastal study was performed so that an estimate of coastal flooding at specific sites could be made. Analyses of storm surge, wave setup, and wave runup were performed in accordance with the design criteria in the Shore Protection Manual of 1973, written by the U.S. Army Corps of Engineers Coastal Engineering Research Center (USACE, 1973). The under-water and above-water topography were determined by the use of maps, U.S. Coast and Geodetic Survey navigation charts and by visual inspection.*



*Wind data are sparse, but some data are available in the vicinity of each site. Therefore, wind data used for a specific site are representative of the general wind conditions. By use of the available wind data, wind frequency curves were derived for the specific sites.*

*Tide frequency curves were derived by use of the frequency distribution functions developed by the U.S. Army Corps of Engineers Coastal Engineering Research Center for the tide reference stations in Alaska (NOAA, 1973). The tide frequency curves and wind frequency curves were used in conjunction in order to determine the 1-percent-annual-chance event. These calculations yielded three tide/wind combinations; a 1-percent-annual-chance tide event with a low wind velocity, a 1-percent-annual-chance wind event with a lower high tide, and a tide/wind combination between the two events. The combination yielding the highest elevation was used as the 1-percent-annual-chance elevation. The 10-percent-annual-chance event was computed similarly. FEMA did not require that the 2-percent-annual-chance and 0.2-percent-annual-chance elevations be computed for the tidal areas.*

*Wave setup, runoff, and surge were calculated for all three tide/wind combinations, and the maximum flood elevation was plotted. The computed surge is the result of wind setup only and does not take into account the surge caused by pressure differences on the open coast. Most locations in this study are substantially away from the open coast. Seward, however, is subject to the pressure-caused surges in the Gulf of Alaska as it is only separated from the gulf by the relatively small Resurrection Bay. The only way to predict these surges and their effect on Seward is through the use of hydrodynamic equations. The data for development of these equations are not available; therefore, the open-sea surge was not considered in this study. In order to determine the flood elevations, allowances were made for the irregularity of the coastline, the changes in beach slope, and the variation of beach materials. The calculated flood levels compared favorably with the observations of local residents and with previous high-water marks. Areas specified for approximate study were compared with areas of detailed study, and the approximate flood elevations were derived. Detailed coastal studies were made for Homer, Seward, Seldovia, Port Graham, English Bay, Kenai, and Nikishka.*

*All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD) except for Resurrection Bay which was converted to the North American Vertical Datum of 1988 (NAVD) as part of an update in 2009. All flood elevations shown in this FIS report and on the FIRM are referenced to NGVD except for the areas in and around the city of Seward which are referenced to NAVD.*

*Stillwater elevations for Resurrection Bay were taken from the prior effective FIS and adjusted to NAVD. The average conversion factor that was used to convert these data were from National Geodetic Survey (NGS) benchmarks and computed from Kenai Peninsula Borough (KPB) benchmarks using the GEOID99 ellipsoid model (Cline and Associates, 2008). The data points used to determine the conversion are listed below [Table J-19].*

**Table J-20 Elevation Datapoint Conversions**

<i>NGS or KPB Station</i>	<i>Location</i>	<i>NGVD29 (Feet)</i>	<i>NAVD88 (Feet)</i>	<i>Conversion from NGVD29 to NAVD88 (Feet)</i>
<i>BM-X-74</i>	<i>Seward Airport</i>	<i>26.45</i>	<i>32.64</i>	<i>6.19</i>
<i>BM E-76</i>	<i>Mile 7 Seward Highway</i>	<i>208.35</i>	<i>214.63</i>	<i>6.18</i>
<i>BM B-76</i>	<i>Mile 4 Seward Highway</i>	<i>64.28</i>	<i>70.48</i>	<i>6.20</i>
<i>KPB BM-3</i>	<i>Nash Road &amp; Seward Highway</i>	<i>28.57</i>	<i>34.76</i>	<i>6.19</i>
<i>KPB BM-7</i>	<i>Bruno Road</i>	<i>151.39</i>	<i>157.58</i>	<i>6.19</i>
			<b>Average:</b>	<b>6.19</b>

*The USACE has established the 3-foot wave height as the criterion for identifying coastal high hazard zones (USACE, 1975). This was based on a study of wave action effects on structures. This criterion has been adopted by FEMA for the determination of VE zones. Because of the additional hazards associated with high-energy waves, the NFIP regulations require much more stringent floodplain management measures in these areas, such as elevating structures on piles or piers. In addition, insurance rates in VE zones are higher than those in AE zones. The location of the VE zone is determined by the 3-foot wave as discussed previously. The detailed analysis of wave heights performed in this study allowed a much more accurate location of the VE zone to be established. The VE zone generally extends inland to the point where the 1-percent-annual-chance stillwater flood depth is insufficient to support a 3-foot wave.”*

Map K-20 shows the location of these coastal floodplain zones with elevations based on the NAVD 88 vertical datum. The location of the boundaries of these zones is identical to the current effective FIRMs (dated 1981), but elevations have gone up 6 feet due to the datum shift as described earlier.

One challenge with using the coastal floodplain boundaries is that they do not cover all of the SBCFSA. As shown on Map K-62, on the west side of Resurrection Bay the coastal floodplain zones begin in the vicinity of the Sea Life Center in downtown Seward. The coastal floodplain zones go around the north end of the Bay and go down the east side to just north of the prison near Fourth of July Creek. Therefore, for this analysis the coastal flood zones with elevation = 16 were extended to cover all of Lowell Point and all of the Fourth of July Creek area.

The coastal flood depth grid was then developed from these extended coastal floodplain zones. The elevation associated with each zone was used to create a coastal flood elevation raster. This raster was then subtracted from the ground raster to produce the coastal flood depth grid. To import the coastal depth grid into Hazus, the raster also was clipped to the land boundary (census tract) used within the Hazus analysis.

No sea level rise scenarios were developed for this study. As detailed in Appendix I in the Sea Level Rise section, most sea level rise studies predict and current trends show no rise or an actual decrease in sea levels for Resurrection Bay. Most of the “what-if” scenarios mapped for the Appendix I (3, 4, 5, and 6 meters) are less than or roughly equal to the coastal flood elevations (which range from 15 to 17 feet). Therefore, the current 100-yr coastal depth grid also provides a representation what structures would be impacted by these “what-if” sea level rise scenarios.

### J.3.2 Inventory

The coastal floodplain loss analysis made use of the Hazus user-defined facilities (UDF) data described in the riverine flooding section. This includes both current and future land use UDF data. See Section J.2.4 for more details and summary tables for the UDF inventory data.

### J.3.3 Hazus Results

Map K-63 and Map K-64 show the structures that are predicted to be impacted by coastal flooding based on current and future land use scenarios. Table J-21 summarizes the potential SBCFSA losses associated with each scenario.

**Table J-21 Hazus UDF Potential Losses From 100-yr Coastal Flooding**

Scenario	# Wet Bldgs	# Bldgs Damaged	Total Bldg Damages <sup>1</sup>	Total Contents Damages <sup>1</sup>	TOTAL DAMAGES
100-yr Coastal Flood for Current Land Use	58	40	\$2,671,610	\$6,671,931	\$9,343,541
100-yr Coastal Flood for Future Land Use	73	55	\$3,594,372	\$7,104,491	\$10,698,863
<i>Source: KPB Parcel Data, KPB Building Data, KPB aerial photography, RSMeans 2012 Residential Cost Data and Light Commercial Cost Data, Hazus default data for region, field survey, publically available aerial and street level photography</i> <sup>1</sup> 2012 Dollars from RSMeans 2012 Residential Cost Data and Light Commercial Cost Data					

As shown on the maps, the coastal flood losses are concentrated in Lowell Point and in the dock area in Seward. Both areas have commercial structures which tend to have higher contents values and higher relative contents damages, which result in the contents damages being over twice the building damages. Some structures in Lowell Point are shown as wet, but not damaged, because the structures have been elevated on piers above the coastal flood elevation.

The future land use scenario has greater damages, because of the additional structures predicted to be built in Lowell Point. These structures are assumed to be built within a few feet of the ground. If these structures are elevated higher above ground, these damages could be avoided.

## J.4 Tsunami

### J.4.1 Hazard Scenario Development Methodology

The tsunami loss analysis for the SBCFSA makes use of the FEMA Hazus software. The tsunami hazard is represented as a flood depth raster based on the worse-case tsunami scenario provided in the Report Of Investigations 2010-1, Tsunami Inundation Maps of Seward and Northern Resurrection Bay, Alaska, by E.N. Suleimani et.al., 2010. In this report, there were four different tsunami scenarios modeled and mapped for Resurrection Bay. The worst case scenario tsunami inundation boundary line, shown on Map K-65 along with the 1964 Tsunami observed inundation limit (Lemke, 1967), is associated with two related scenarios. One scenario was a repeat of 1964 tsunami event using information a coseismic deformation model by Suito and Freymueller (2009). The source function used for this scenario represents the entire rupture area of the 1964 earthquake, which include slips in two locations known as the Kodiak block and the Prince William Sound (PWS) block. The second scenario represents a modified 1964 event with only the PWS block. When both scenarios were mapped, there was little difference between the two inundation limits and they were mapped using one boundary line.

The tsunami flood depth grid was developed based on this maximum tsunami inundation line. By comparing the location of the tsunami line with 2009 Seward elevation data, the study team determined that the water surface elevation was approximately 30 feet (NAVD88 vertical datum). A tsunami water surface elevation raster was developed at 30 feet using the tsunami boundary line. This raster was then subtracted from the ground raster to produce the tsunami flood depth grid. To import the depth grid into Hazus, the raster also was clipped to the land boundary (census tract) used within the Hazus analysis.

No sea level rise scenarios were developed for the tsunami analysis. As detailed in Appendix I in the Sea Level Rise section, most sea level rise studies predict no rise or an actual decrease in sea levels for Resurrection Bay. A new tsunami analysis would need to be conducted to reflect any possible sea level rise scenarios.

#### J.4.2 Inventory

The tsunami floodplain loss analysis made use of the Hazus user-defined facilities (UDF) data described in the riverine flooding section. This includes both current and future land use UDF data. See Section J.2.4 for more details and summary tables for the UDF inventory data.

#### J.4.3 Hazus Results

Map K-66 and Map K-67 show the structures that are predicted to be impacted by tsunami flooding based on current and future land use scenarios. Table J-22 summarizes the potential SBCFSA losses associated with each scenario.

**Table J-22 Hazus UDF Potential SBCFSA Losses From Tsunami Flooding**

Scenario	No. of Wet Structures	No. of Damaged Structures	Total – Structure Damages <sup>1</sup>	Total – Contents Damages <sup>1</sup>	TOTAL DAMAGES <sup>1</sup>
Tsunami Flooding for Current Land Use	318	299	\$ 53,466,288	\$ 92,373,968	\$145,840,256
Tsunami Flooding for Future Land Use	342	323	\$ 58,105,894	\$ 98,692,261	\$156,798,155
<i>Source: KPB Parcel Data, KPB Building Data, KPB aerial photography, RSMeans 2012 Residential Cost Data and Light Commercial Cost Data, Hazus default data for region, field survey, publically available aerial and street level photography</i> <sup>1</sup> 2012 Dollars from RSMeans 2012 Residential Cost Data and Light Commercial Cost Data					

As shown on the maps, the tsunami flood losses include structures all along Resurrection Bay from Lowell Point all the way around to outlet of Fourth of July Creek. Similar to the coastal flood damages, tsunami structure damages tend to include a high percentage of commercial structures, which have higher contents values and higher relative contents damages, which results in the contents damages being almost twice the building damages.

The future land use scenario has greater damages, because of the additional structures predicted to be built in Lowell Point and Fourth of July Creek area. Because of the estimated flood elevation for a tsunami (30 feet), it would be difficult to construct structures close to the Bay in these locations that are above this elevation.

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**Appendix K**  
**Hazus Based – Hazard Impact Maps**

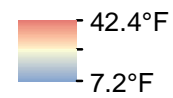
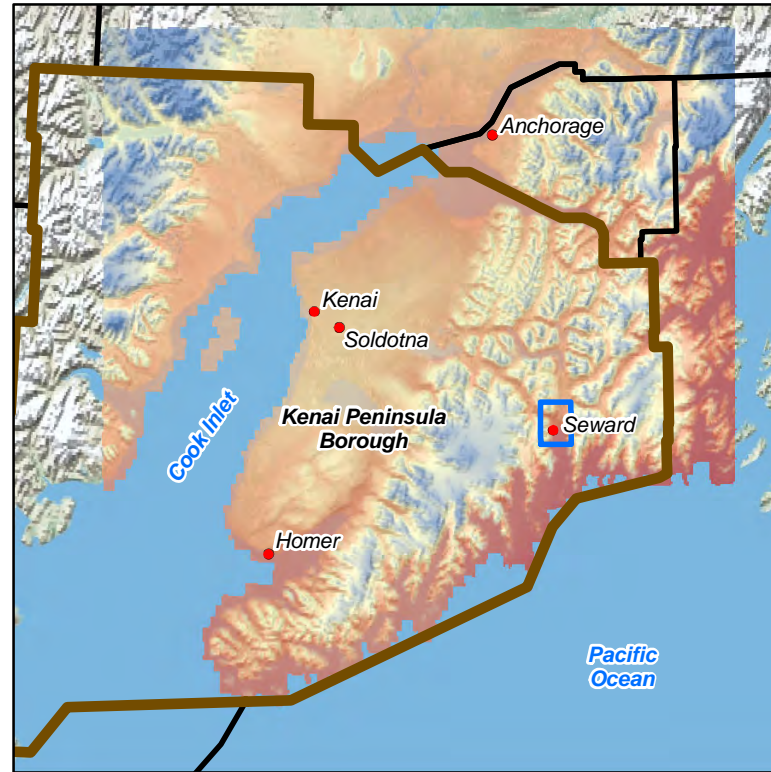


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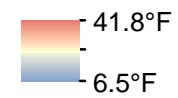
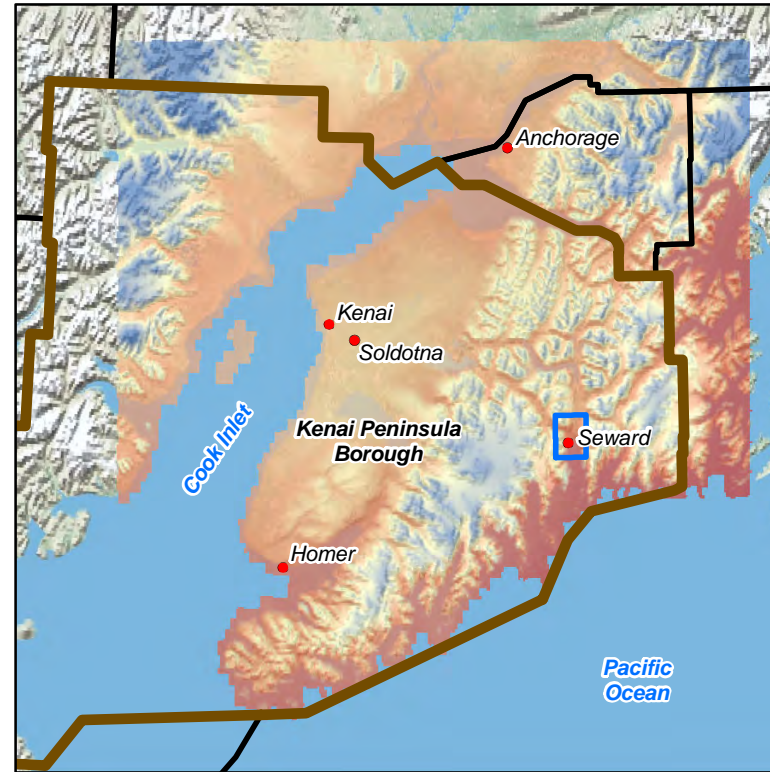


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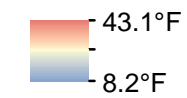
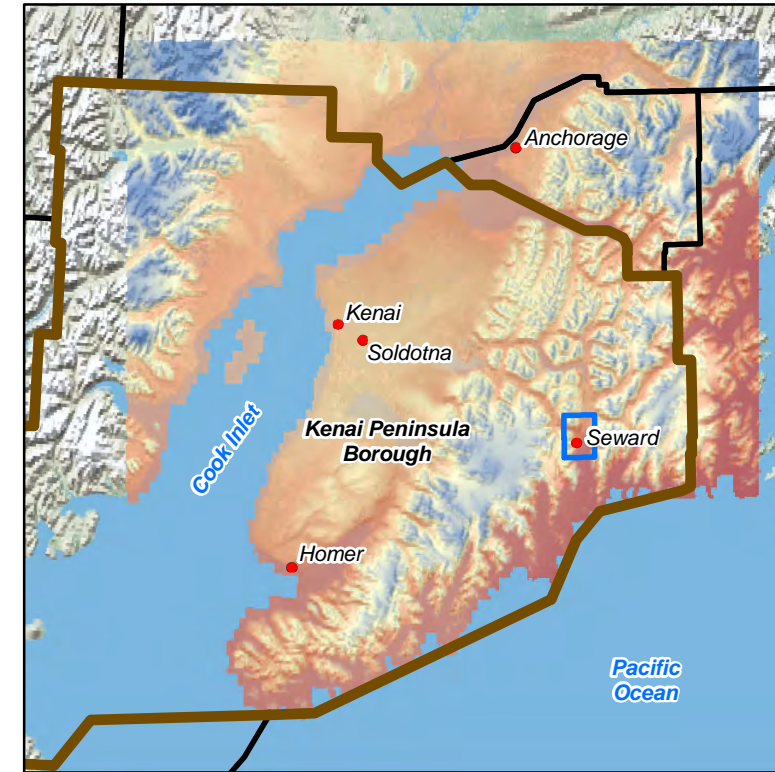
2012



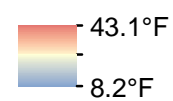
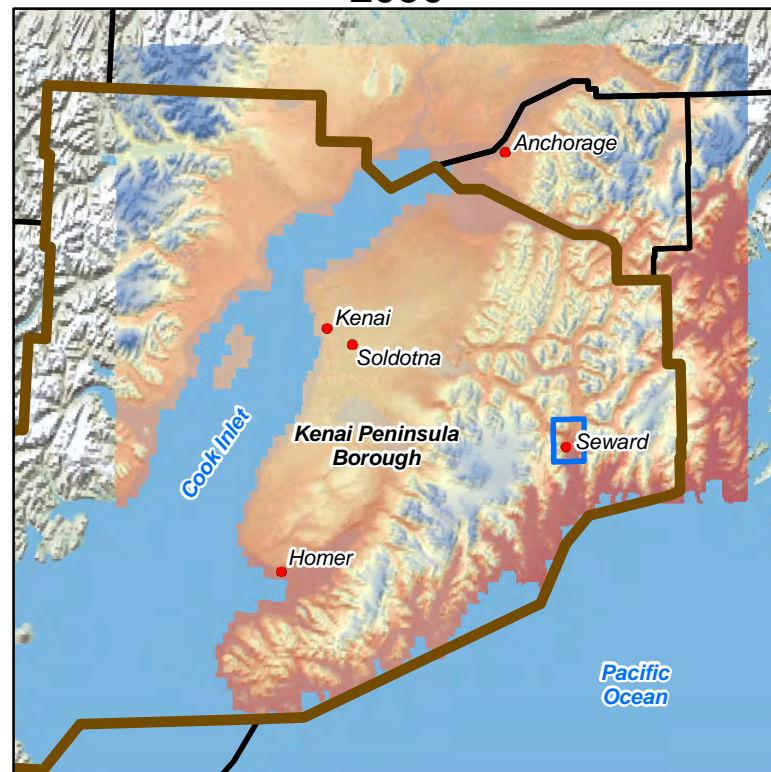
2022



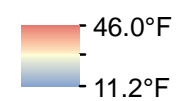
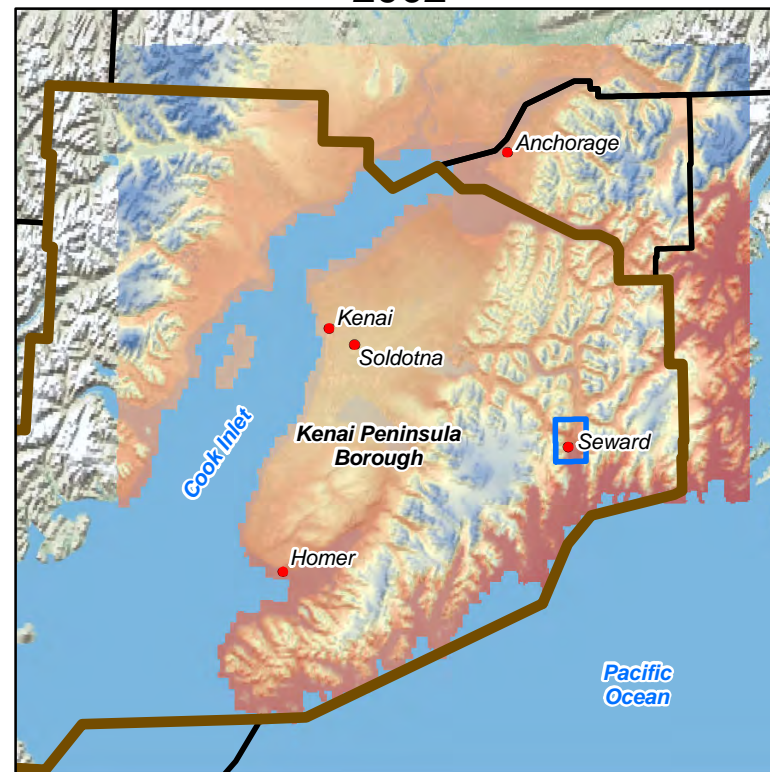
2032



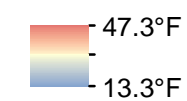
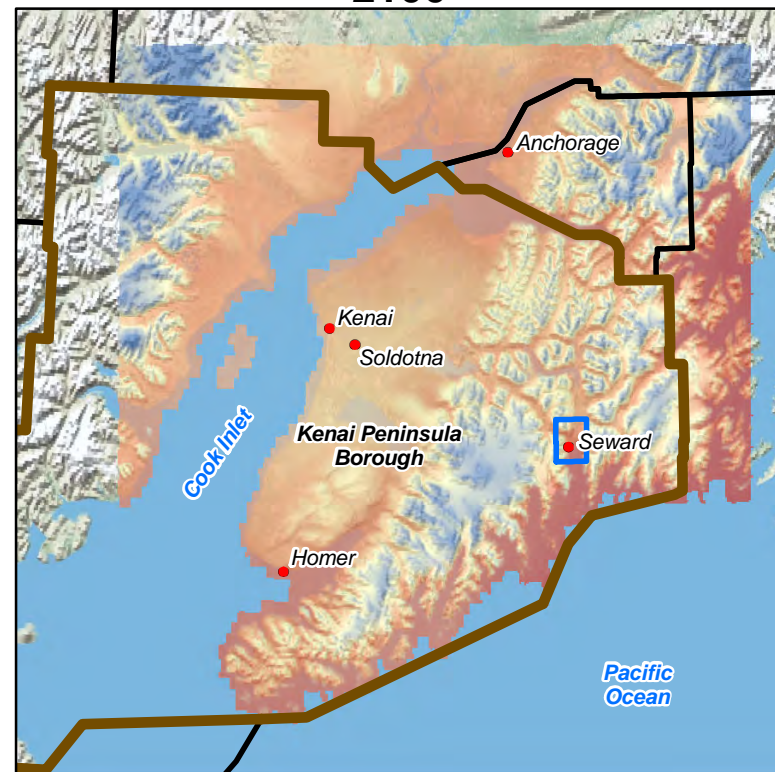
2050



2062



2100

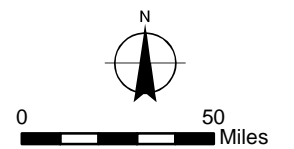


**Legend**

- SBCFSA
- Kenai Peninsula Borough
- Other Boroughs

**Sources and Notes:**

- Climate data from Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska-Fairbanks, 2012. Data are for A1B model scenario.
- Base imagery © 2011 National Geographic Society and i-cubed.



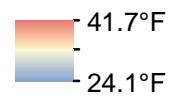
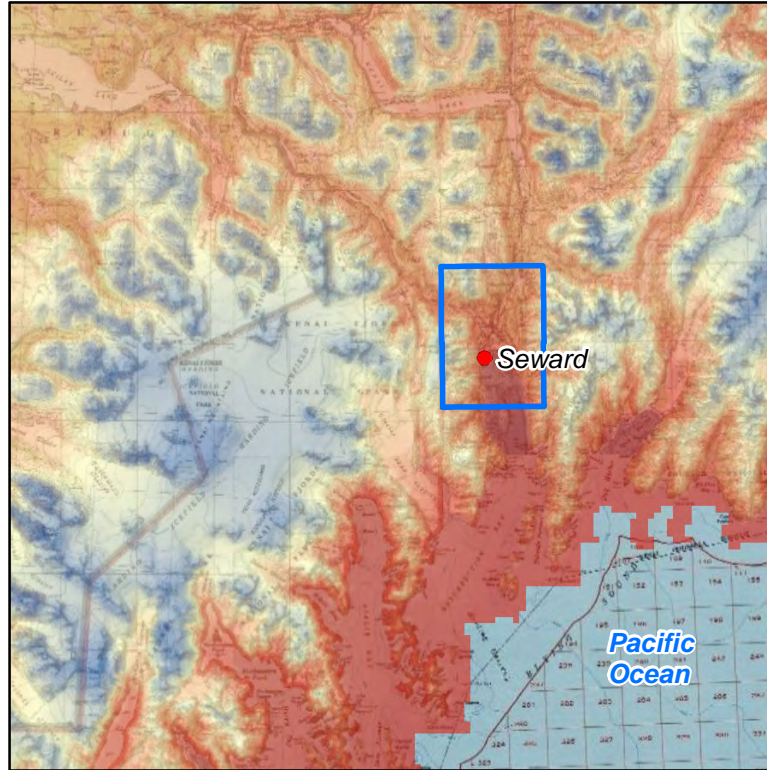
**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX  
AVERAGE ANNUAL  
PROJECTED TEMPERATURE,  
KENAI PENINSULA AREA,  
2012 - 2100  
MAP K-1

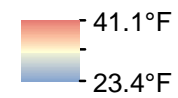
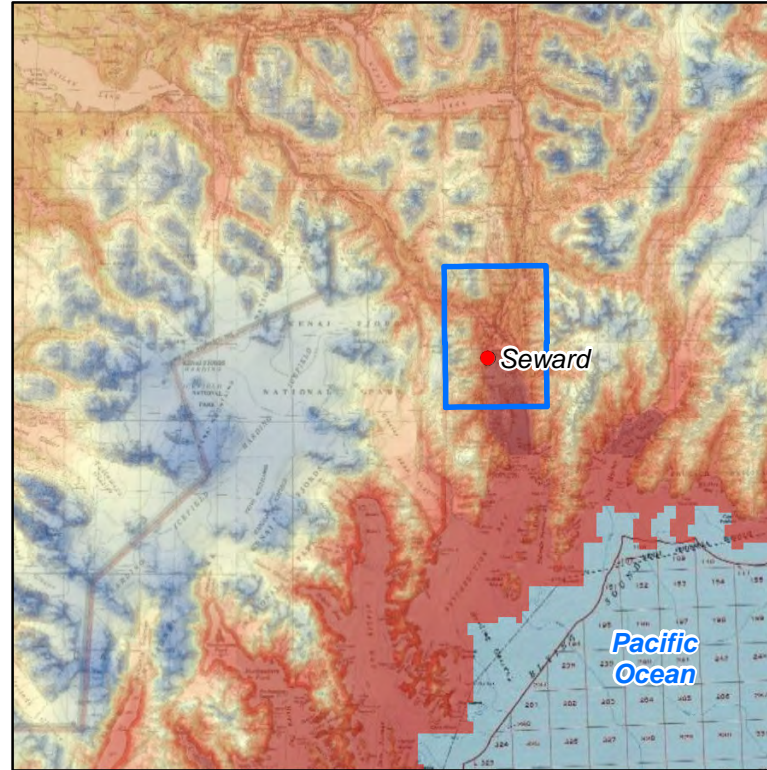


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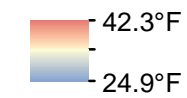
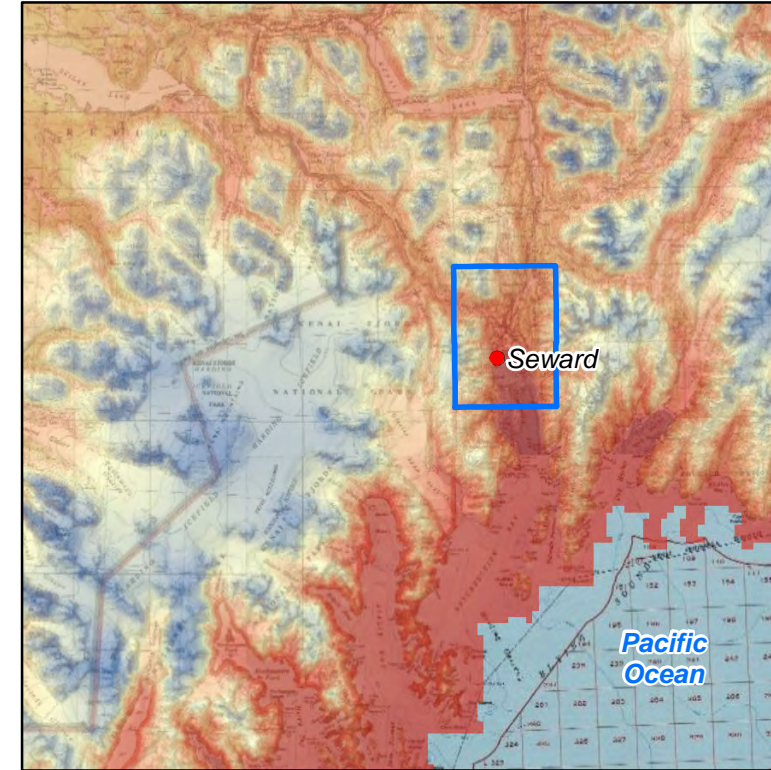
2012



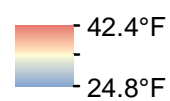
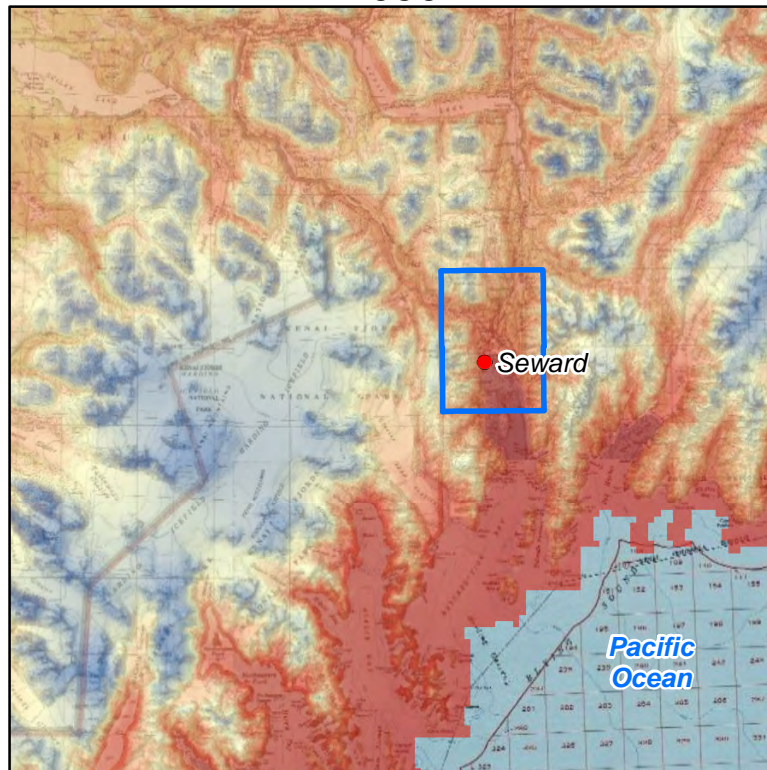
2022



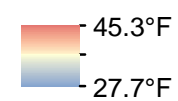
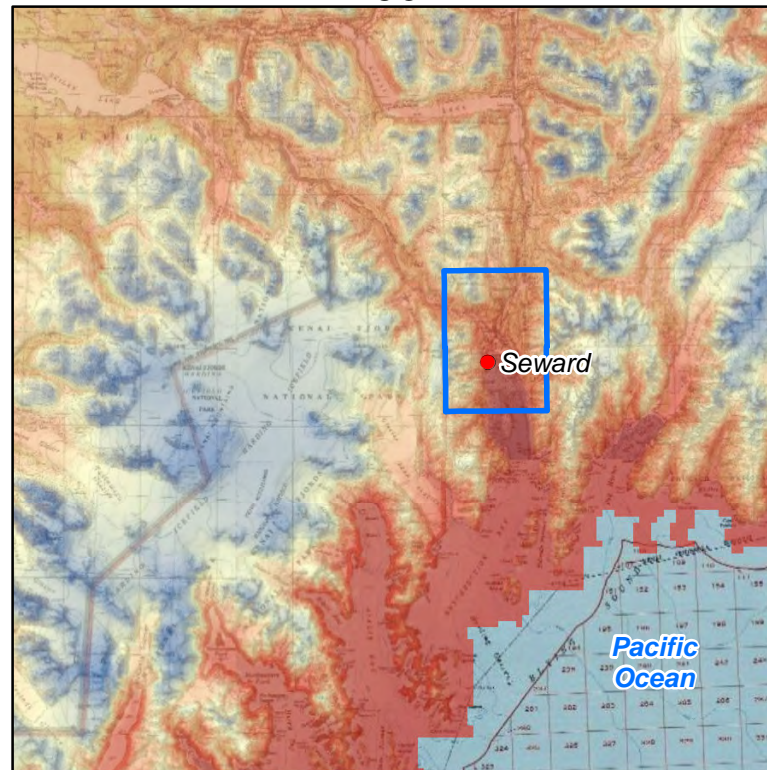
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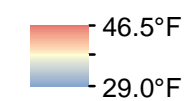
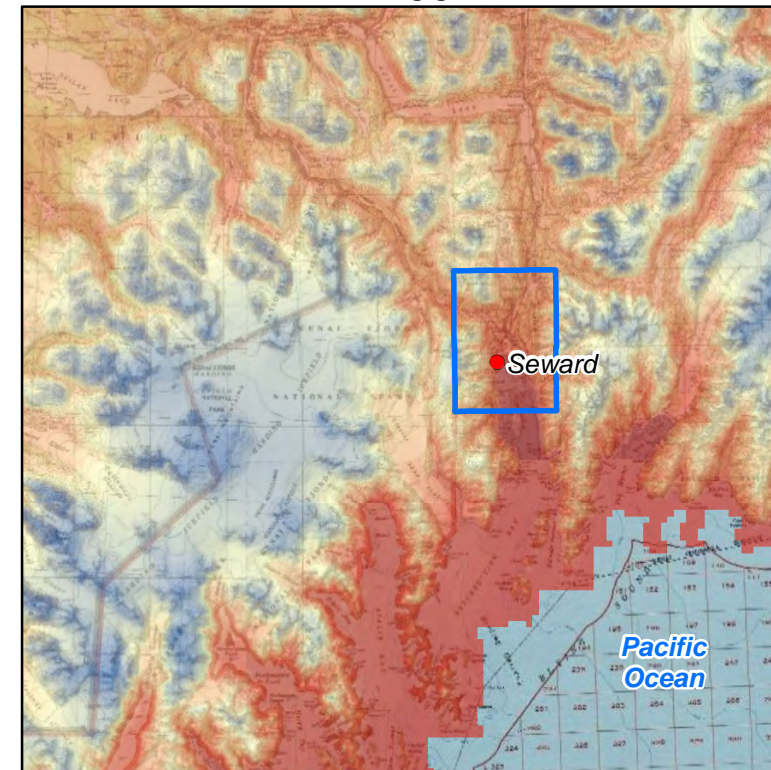
2050



2062



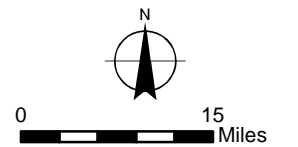
2100



**Legend**

 SBCFSA

- Sources and Notes:**
1. Climate data from Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska-Fairbanks, 2012. Data are for A1B model scenario.
  2. Base imagery © 2011 National Geographic Society and i-cubed.



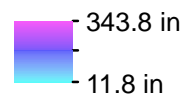
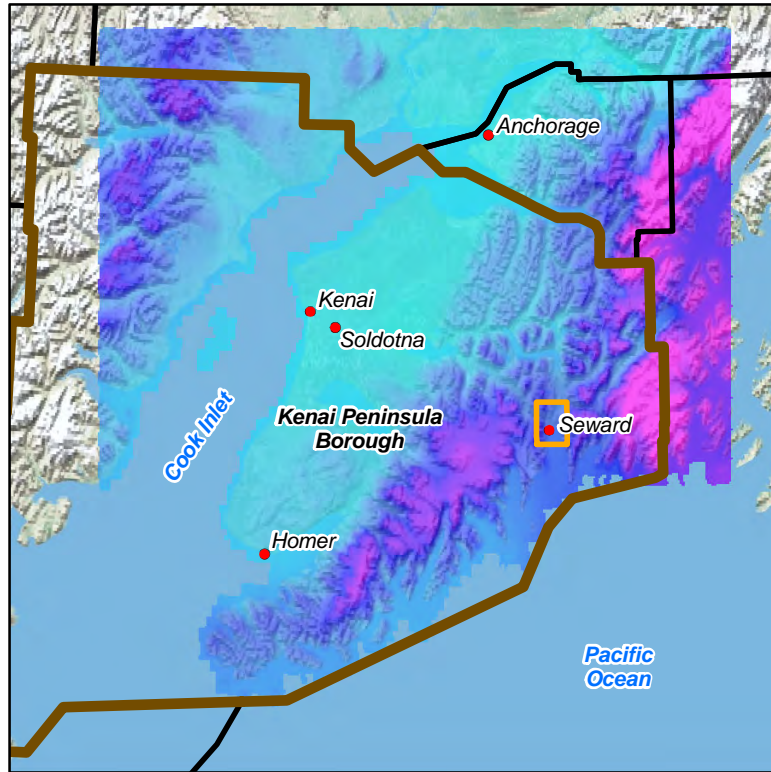
**URS**

**SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX  
AVERAGE ANNUAL  
PROJECTED TEMPERATURE,  
SEWARD AREA,  
2012 - 2100  
MAP K-2**

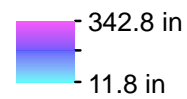
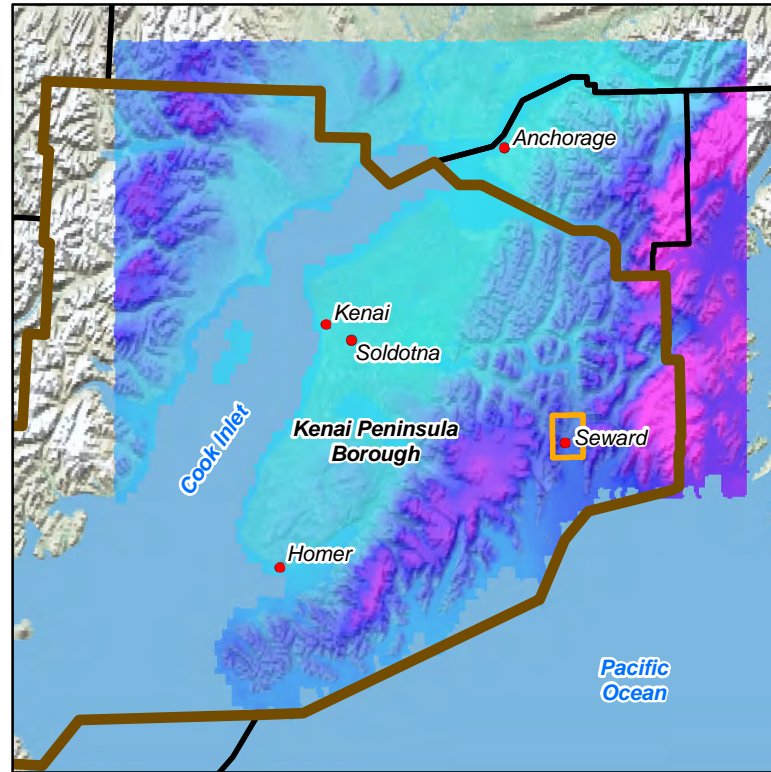


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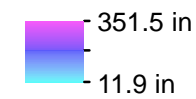
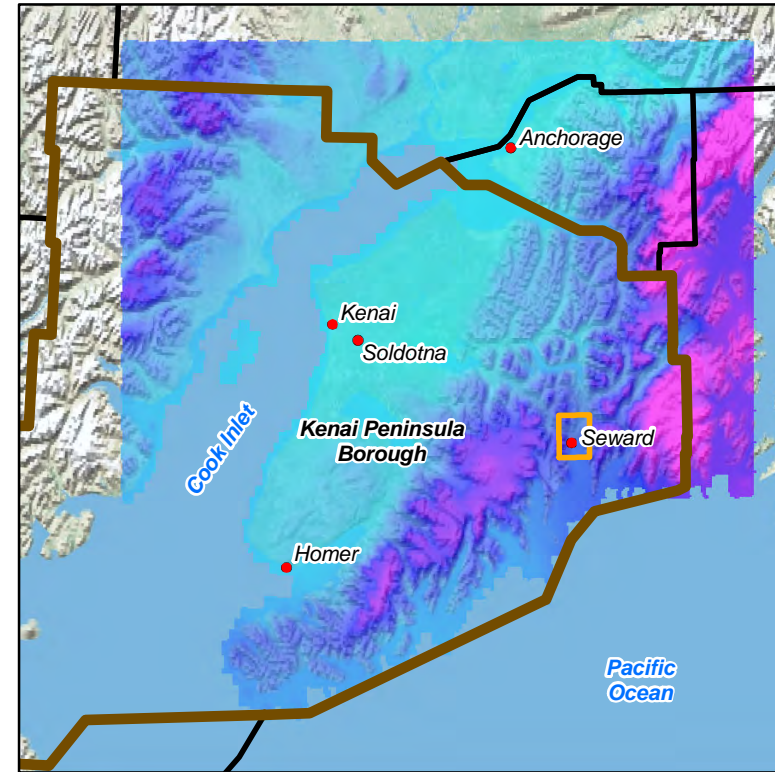
2012



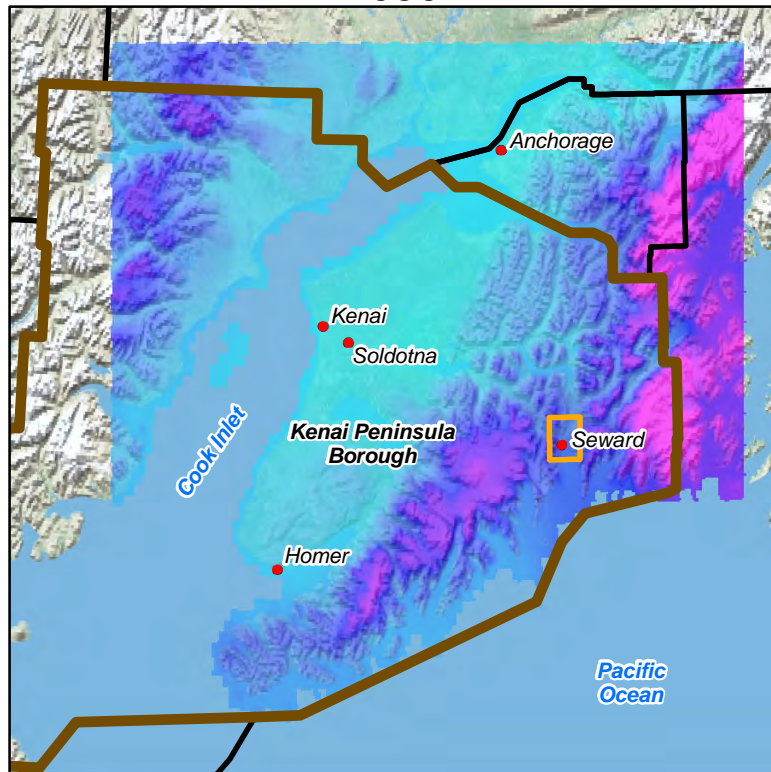
2022



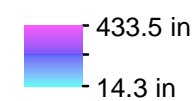
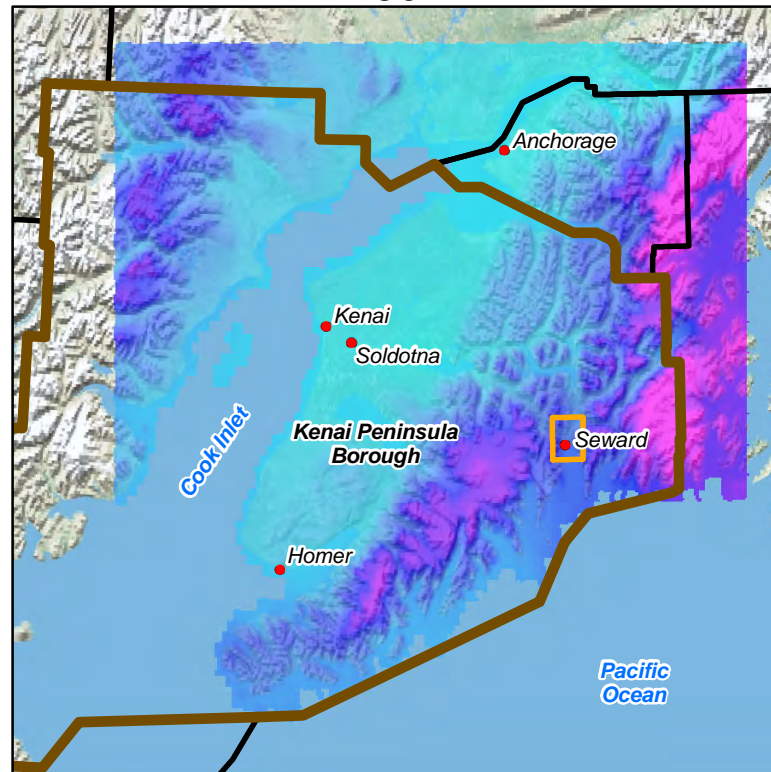
2032



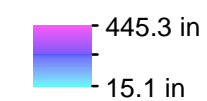
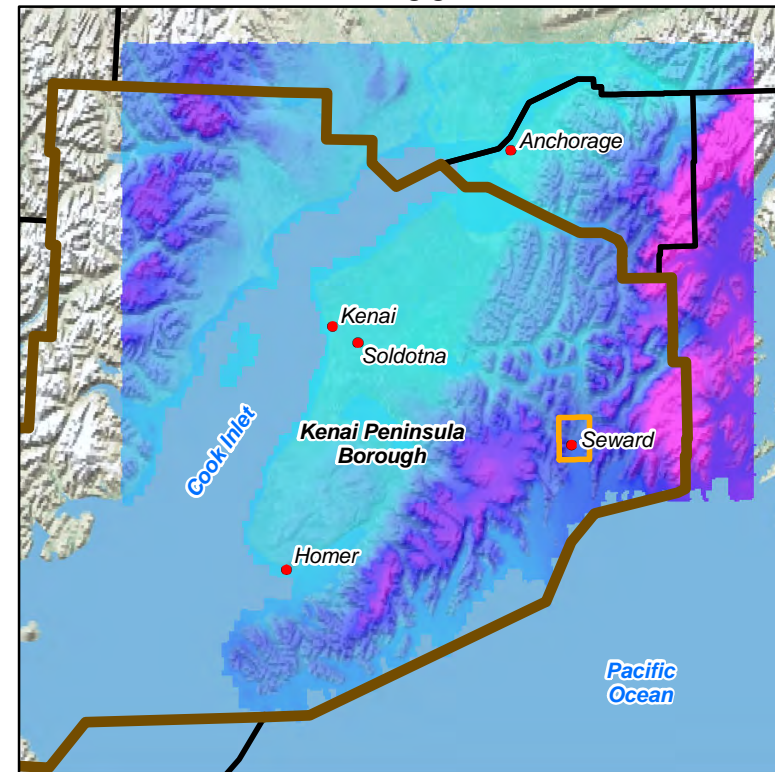
2050



2062



2100

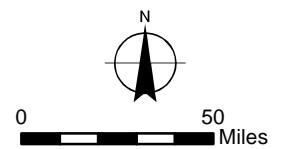


**Legend**

- SBCFSA
- Kenai Peninsula Borough
- Other Boroughs

**Sources and Notes:**

1. Climate data from Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska-Fairbanks, 2012. Data are for A1B model scenario.
2. Base imagery © 2011 National Geographic Society and i-cubed.



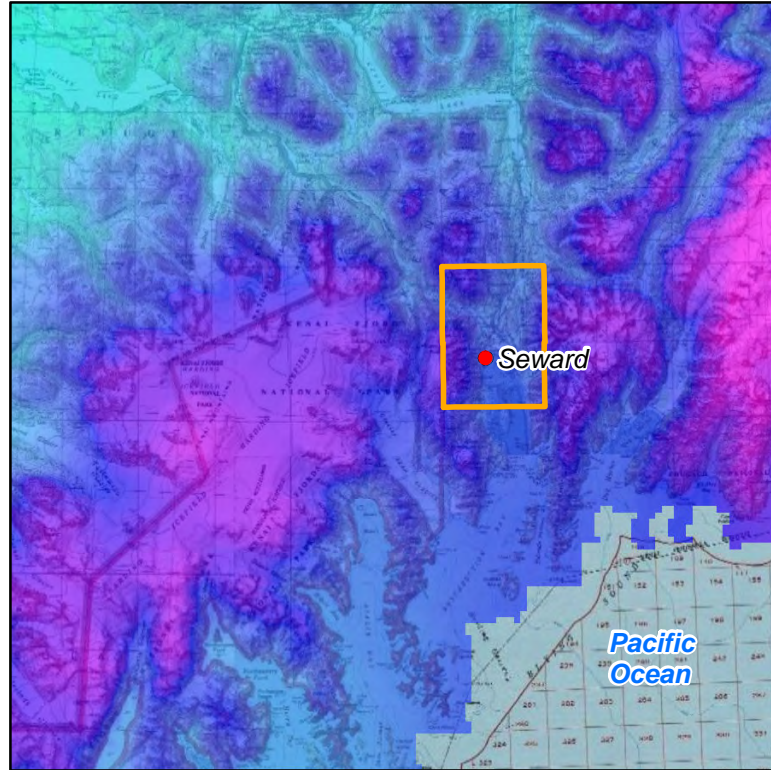
**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX  
TOTAL ANNUAL  
PROJECTED PRECIPITATION,  
KENAI PENINSULA AREA,  
2012 - 2100  
MAP K-3

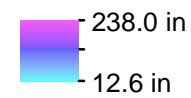
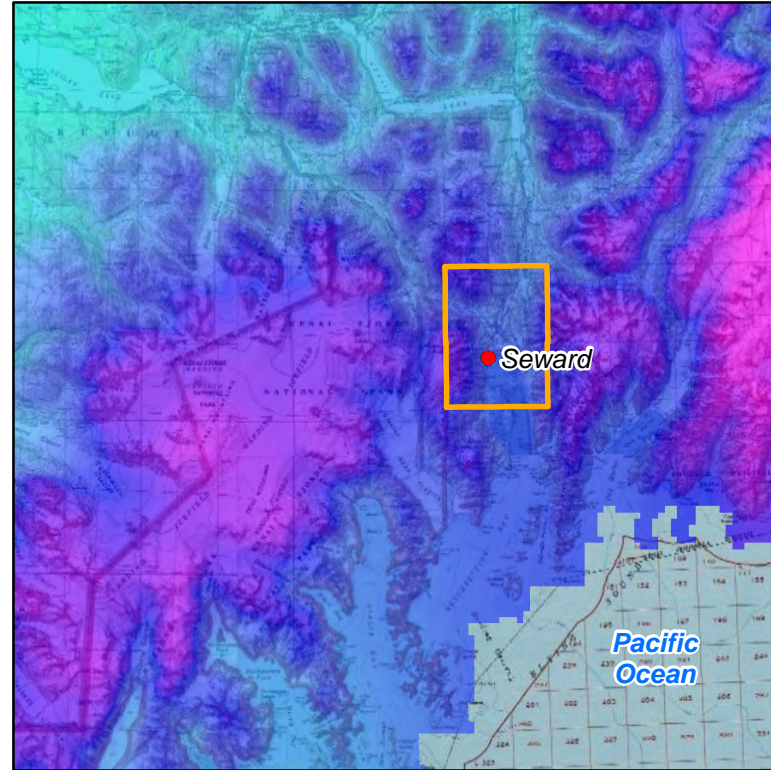


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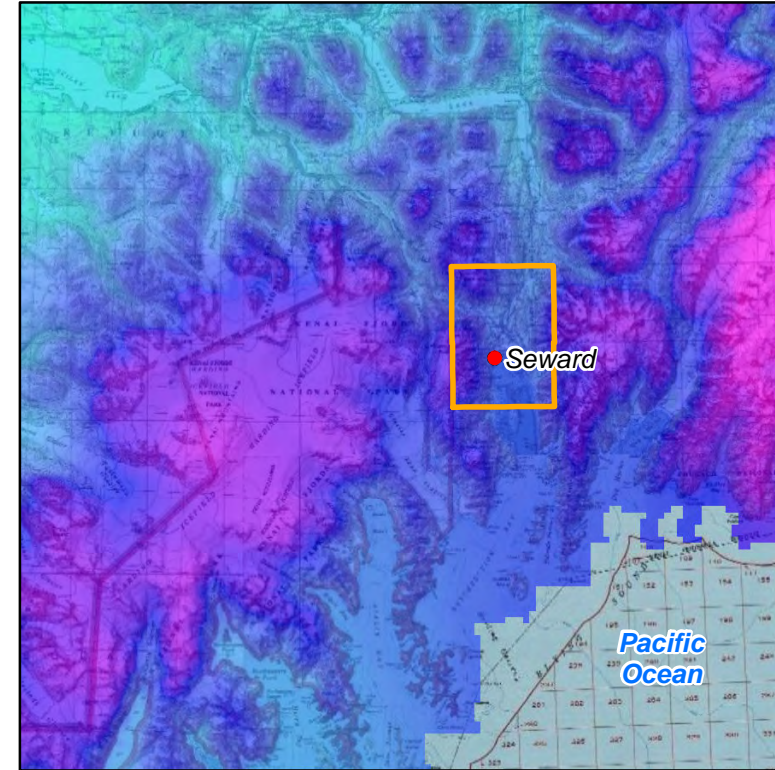
2012



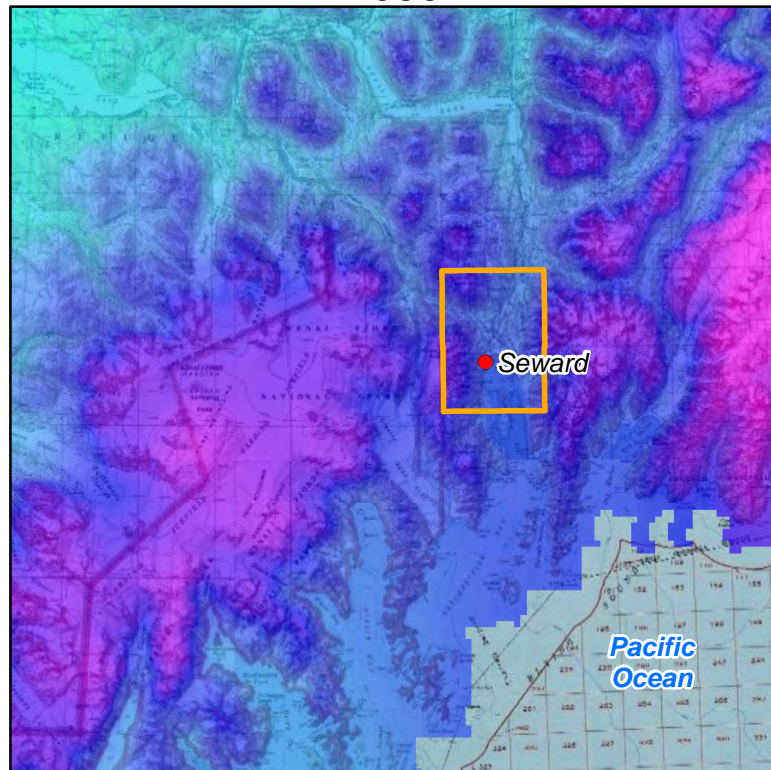
2022



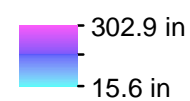
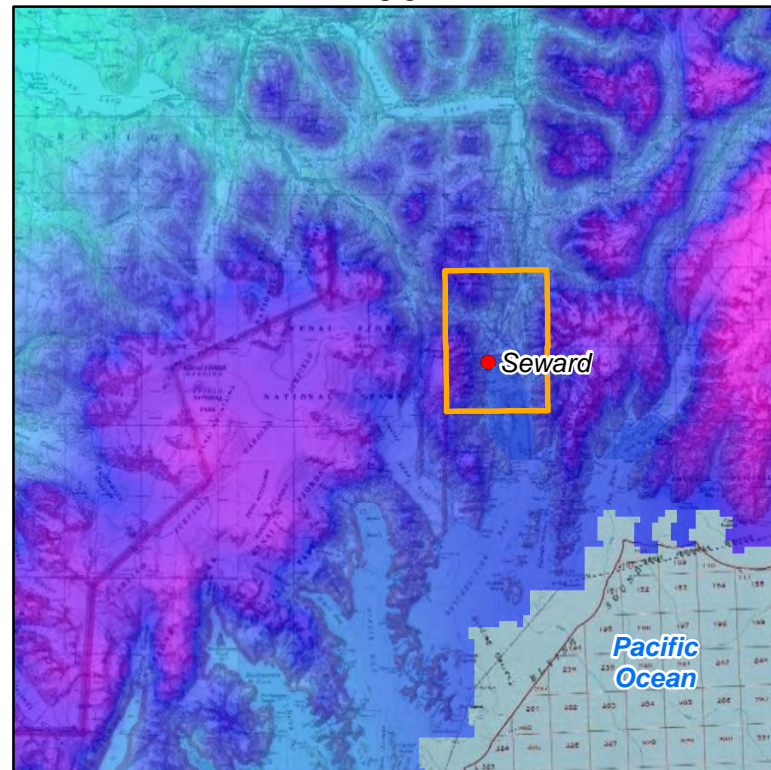
2032



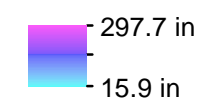
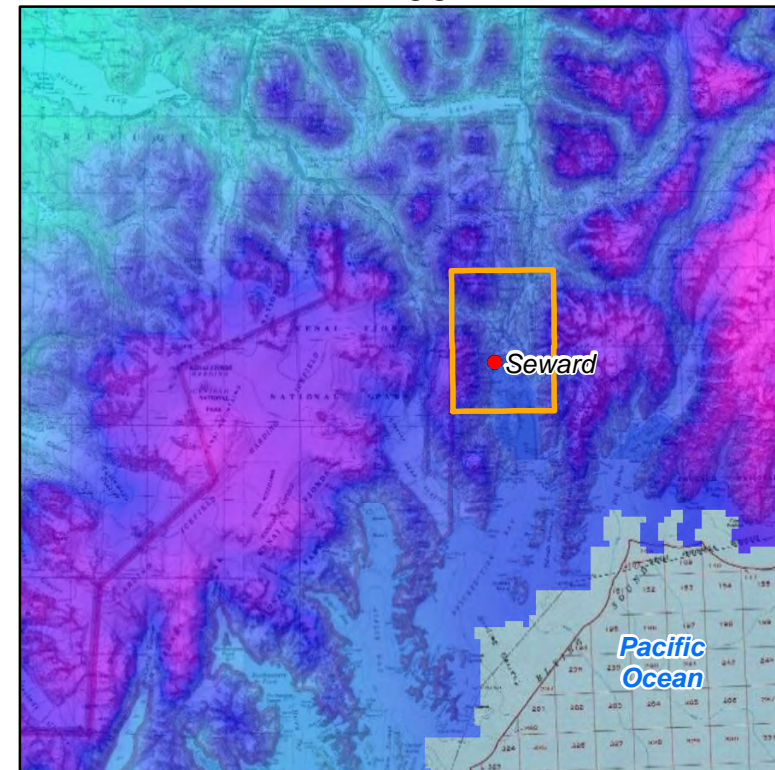
2050



2062



2100

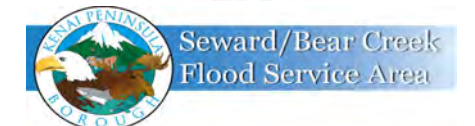
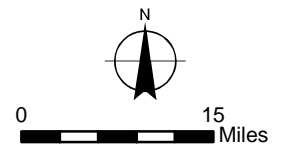


Legend



Sources and Notes:

1. Climate data from Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska-Fairbanks, 2012. Data are for A1B model scenario.
2. Base imagery © 2011 National Geographic Society and i-cubed.



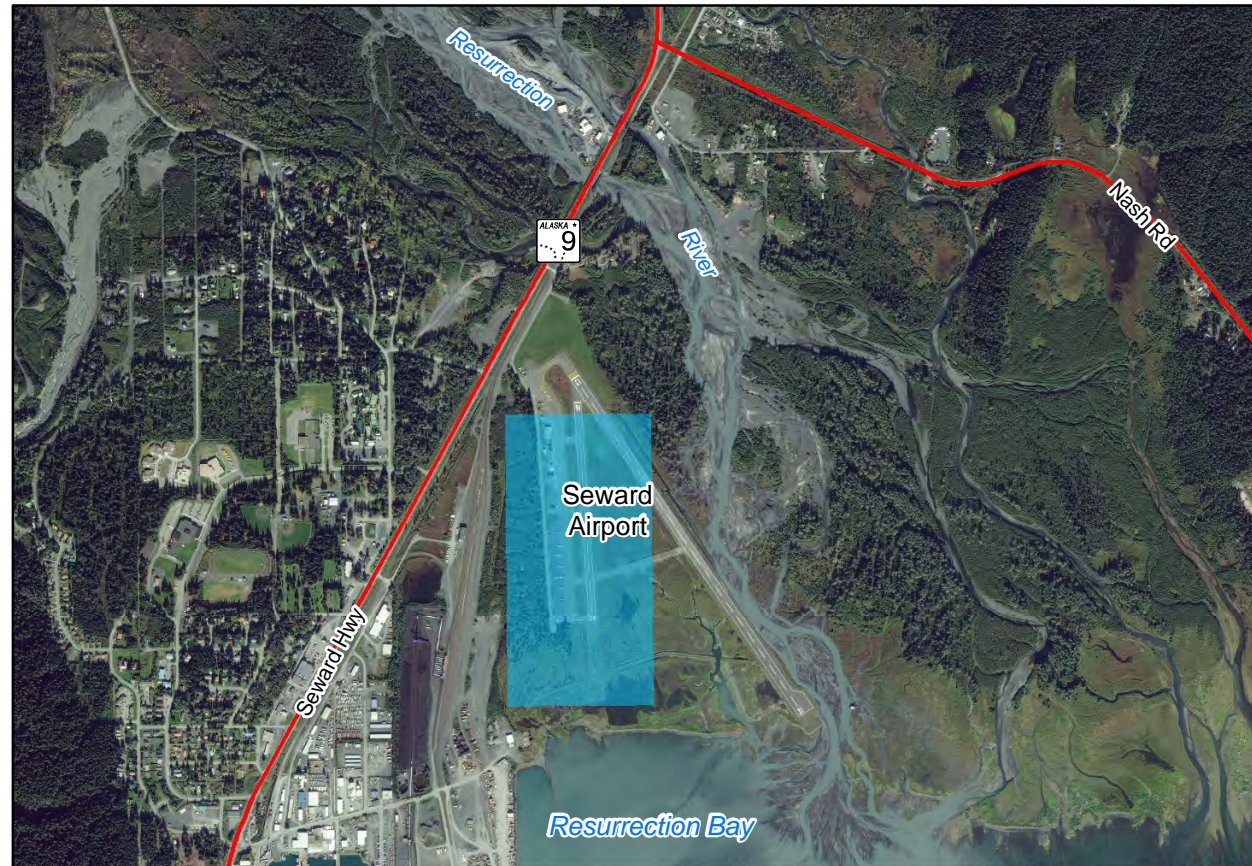
URS

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX  
TOTAL ANNUAL  
PROJECTED PRECIPITATION,  
SEWARD AREA,  
2012 - 2100  
MAP K-4

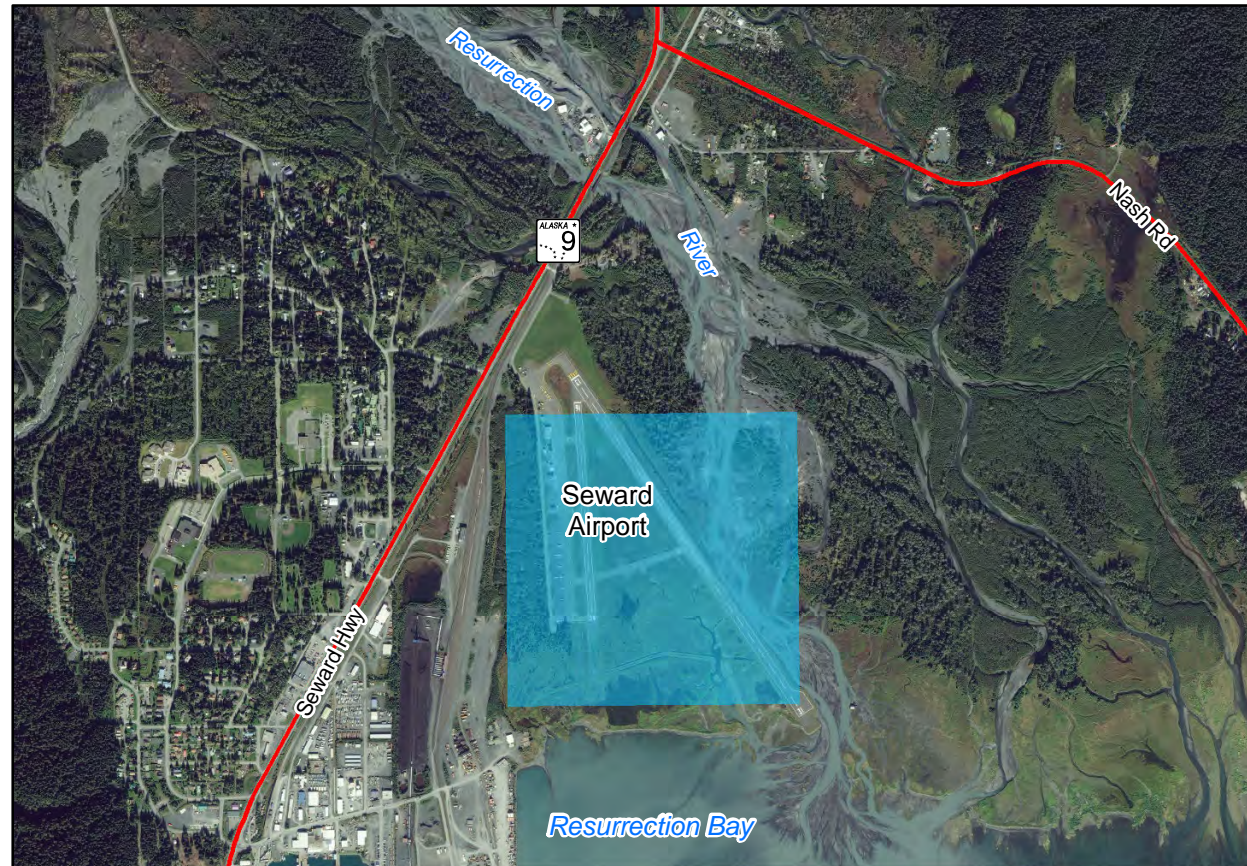


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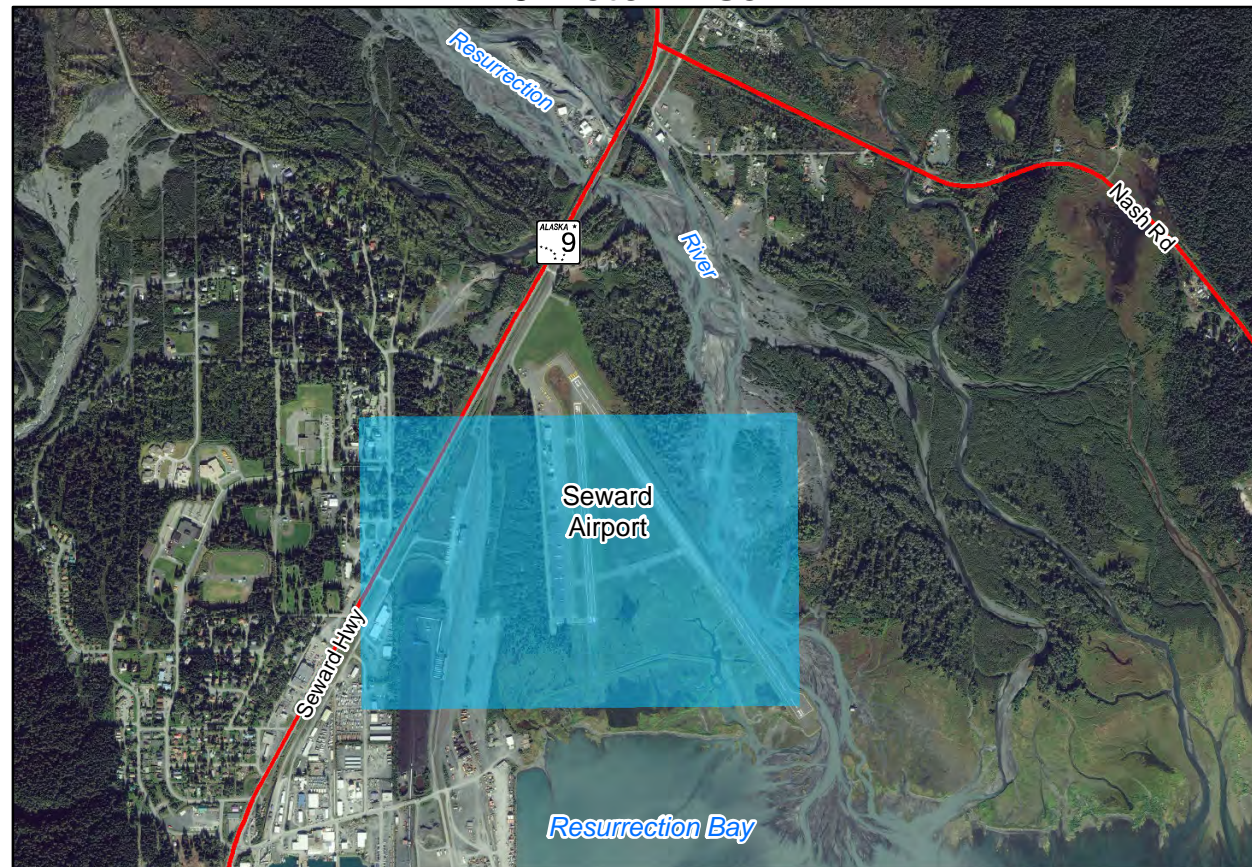
3 Meter Rise



4 Meter Rise




5 Meter Rise



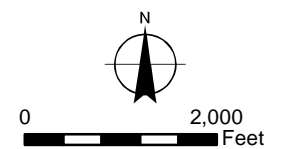
6 Meter Rise



**Legend**

 Predicted Inundation Area

**Sources and Notes:**  
1. Sea level rise data from Center of Remote Sensing of Ice Sheets (CRISIS), University of Kansas, 2012.  
2. Base reference data from Kenai Peninsula Borough.



**URS**

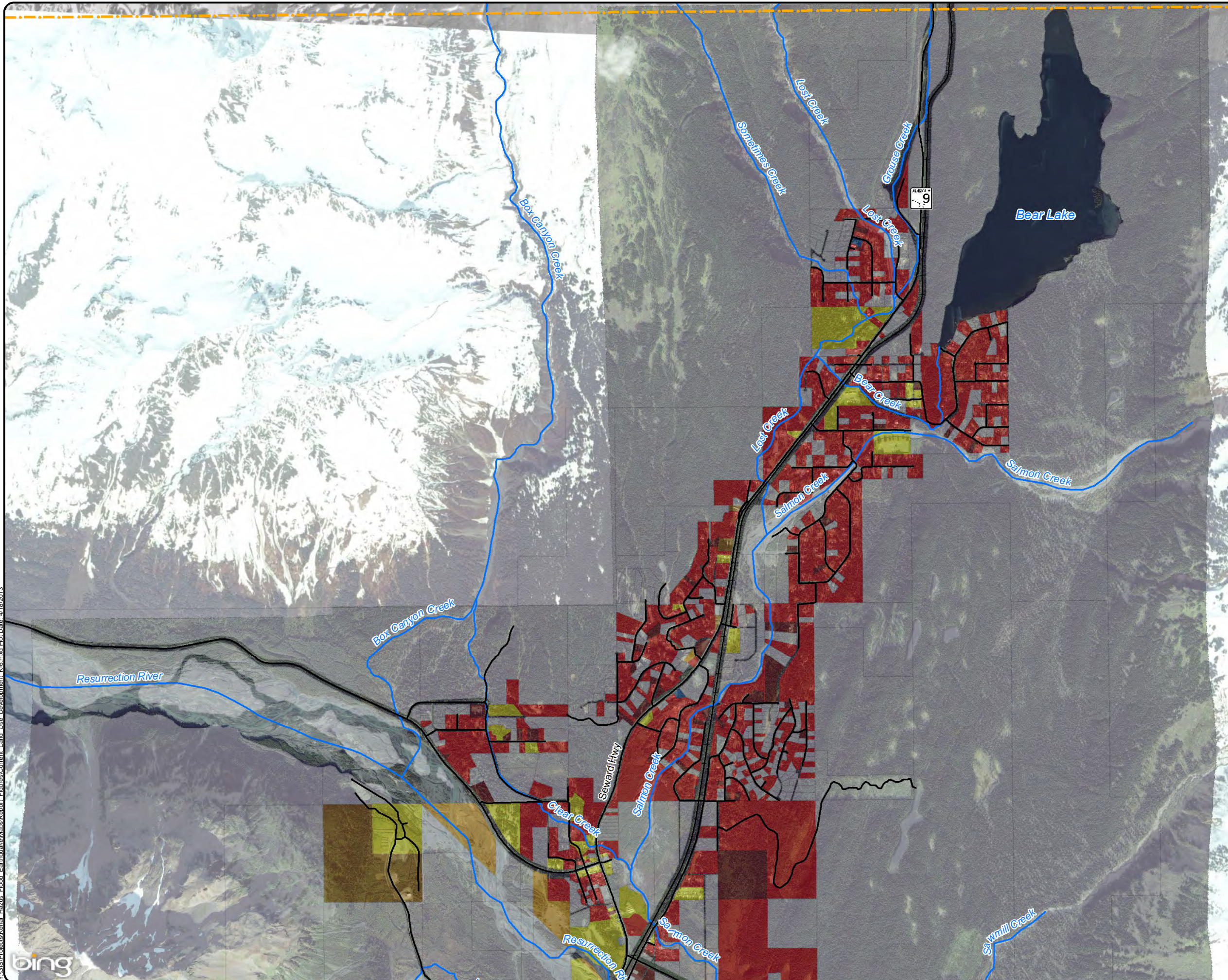
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**PREDICTED INUNDATION  
FROM SEA LEVEL RISE**

**MAP K-5**



Y:\GIS\Projects\Kenai Hazard Flood Earthquake\Maps\Report Figures\Current Land Use Development K-6.mxd Plot Date: 4/18/2013



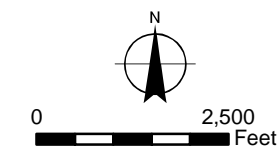
## Legend

### Current Land Use (2012)

- Residential
- Residential Vacant
- Residential Improved Land
- Commercial
- Commercial Vacant
- Commercial Improved Land
- Leased Vacant Land
- Industrial
- Institutional
- Institutional Vacant
- Tideland
- Roads
- Railroads
- Streams
- SBCFSA

### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, ©2010 GeoEye, and ©2013 Microsoft Corporation.



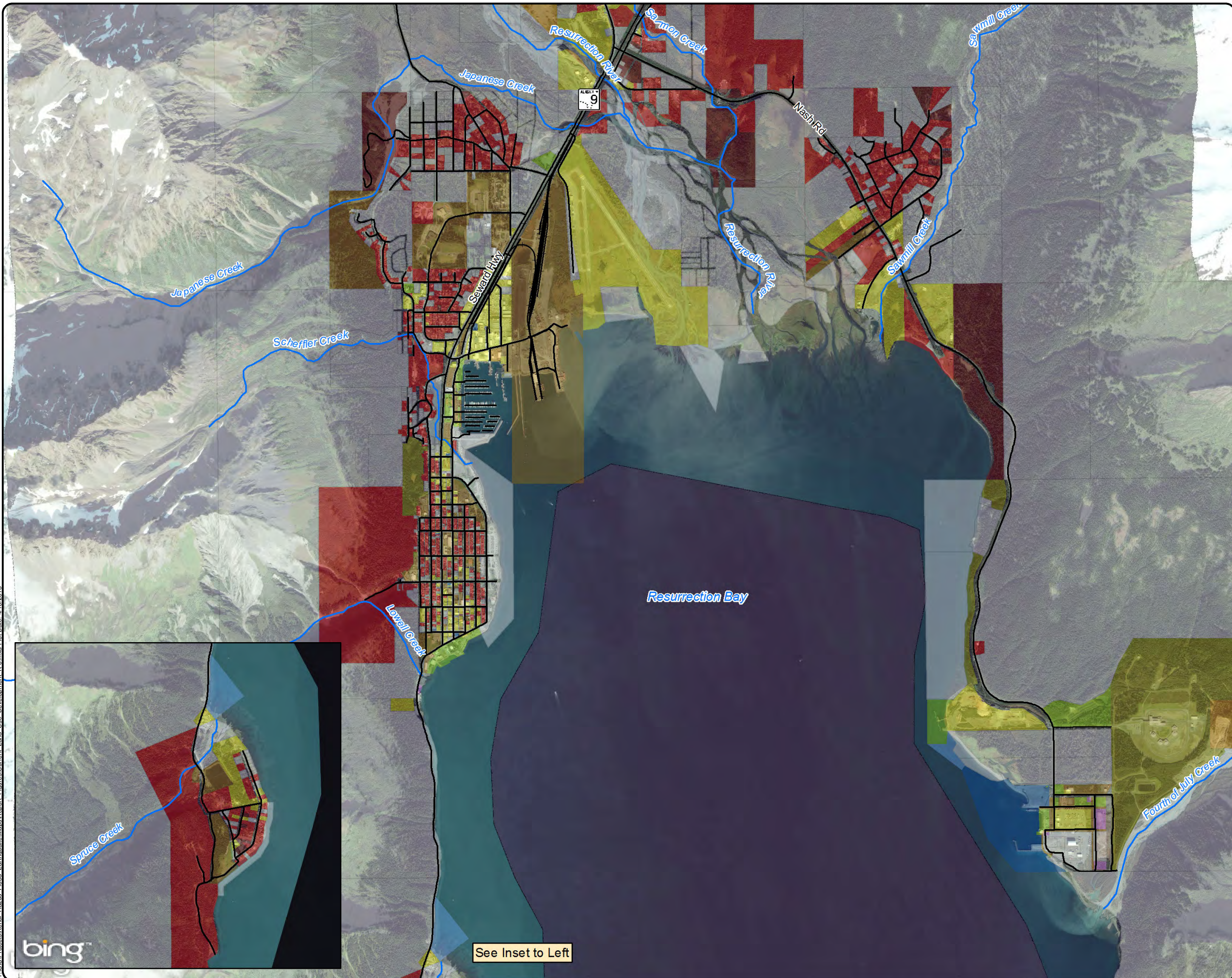
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

CURRENT LAND USE,  
NORTH AREA  
(2012)

MAP K-6A



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Current\_Land\_Use\_Development\_K-6.mxd Plot Date: 4/18/2013



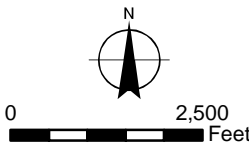
#### Legend

##### Current Land Use (2012)

- Residential
- Residential Vacant
- Residential Improved Land
- Commercial
- Commercial Vacant
- Commercial Improved Land
- Leased Vacant Land
- Industrial
- Institutional
- Institutional Vacant
- Tidelands
- Roads
- Railroads
- Streams
- SBCFSA

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, ©2010 GeoEye, and ©2013 Microsoft Corporation.



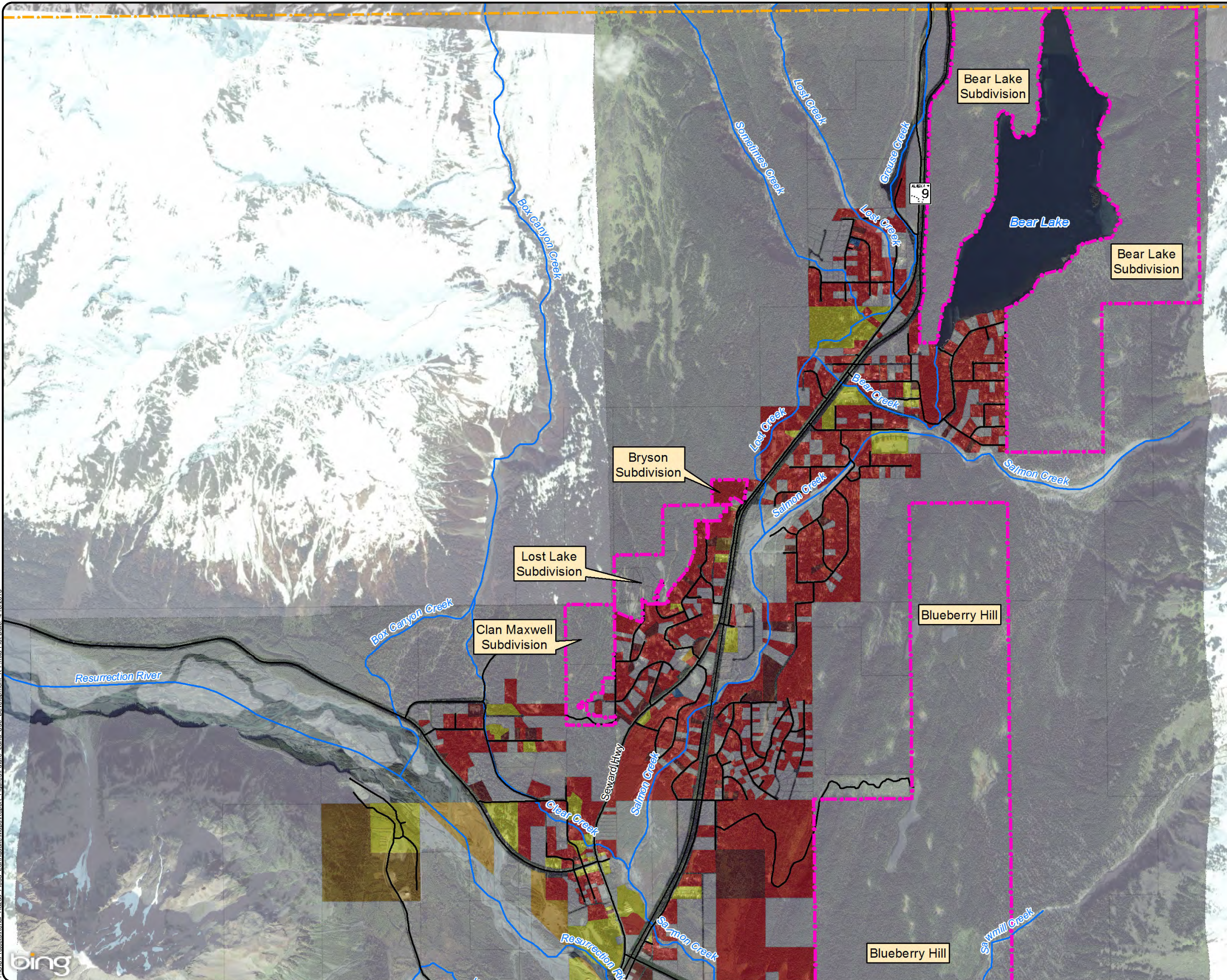
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**CURRENT LAND USE,  
SOUTH AREA  
(2012)**

**MAP K-6B**



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Future\_Land\_Use\_Development\_K7.mxd Plot Date: 4/18/2013



#### Legend

##### Future Land Use (2017)

- Residential - Single Family
- Commercial Infill
- Industrial

##### Future Land Use (2022)

- Residential - Single Family
- Industrial

##### Current Land Use (2012)

- Residential
- Residential Vacant
- Residential Improved Land
- Commercial
- Commercial Vacant
- Commercial Improved Land
- Leased Vacant Land
- Industrial
- Institutional
- Institutional Vacant
- Tidelands

Roads

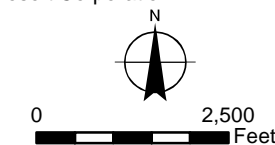
Railroads

Streams

SBCFSA

##### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, ©2010 GeoEye, and ©2013 Microsoft Corporation.



URS

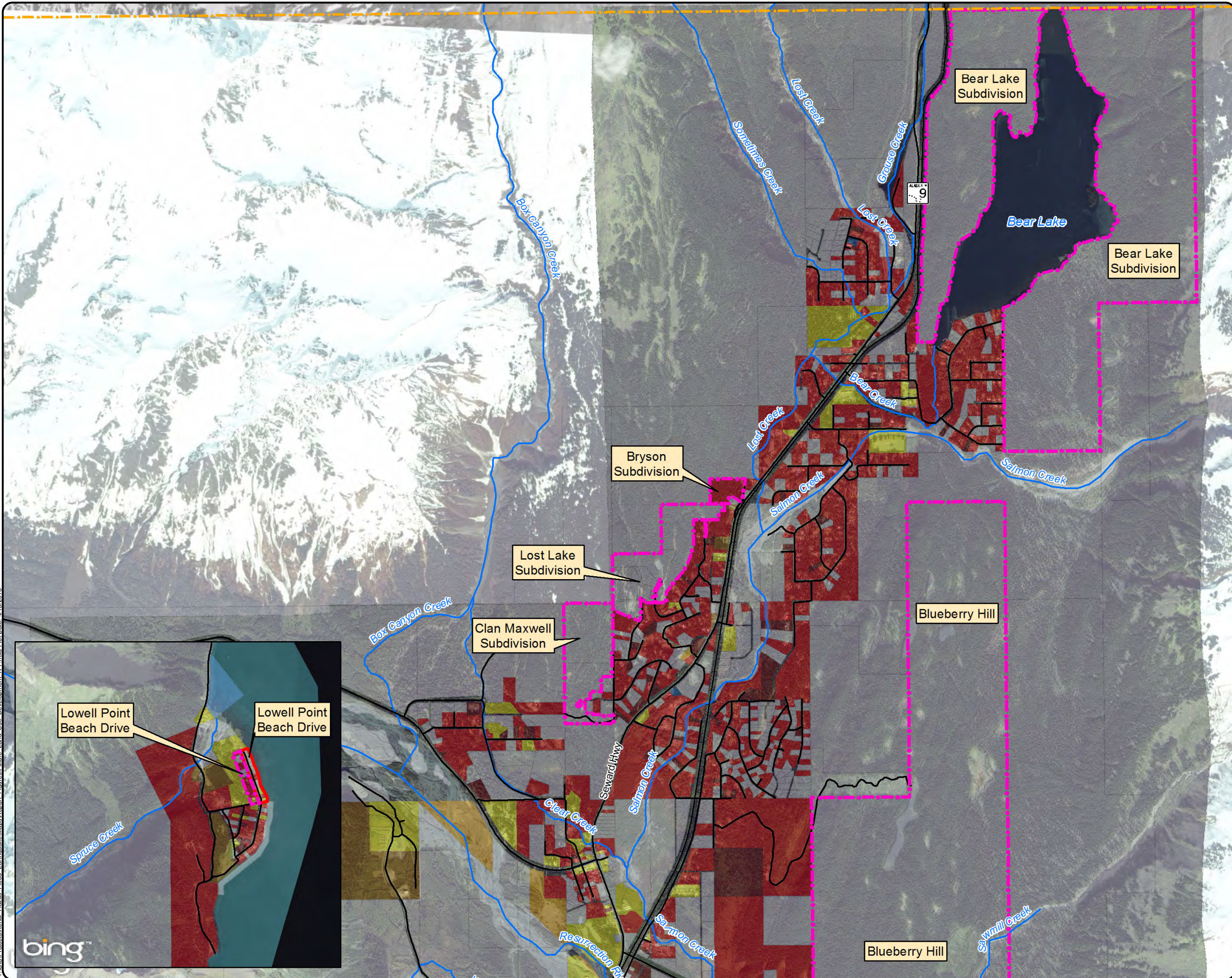
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

FUTURE LAND USE,  
NORTH AREA  
(2017/2022)

MAP K-7A



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Future\_Land\_Use\_Development\_K7.mxd Plot Date: 4/18/2013



#### Legend

##### Future Land Use (2017)

- Residential - Single Family
- Commercial Infill
- Industrial

##### Future Land Use (2022)

- Residential - Single Family
- Industrial

##### Current Land Use (2012)

- Residential
- Residential Vacant
- Residential Improved Land
- Commercial
- Commercial Vacant
- Commercial Improved Land
- Leased Vacant Land
- Industrial
- Institutional
- Institutional Vacant
- Tidelands

— Roads

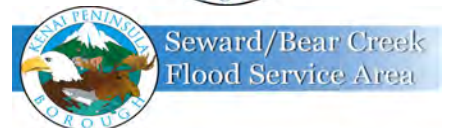
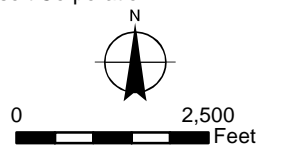
+— Railroads

~ Streams

SBCFSA

##### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, ©2010 GeoEye, and ©2013 Microsoft Corporation.



URS

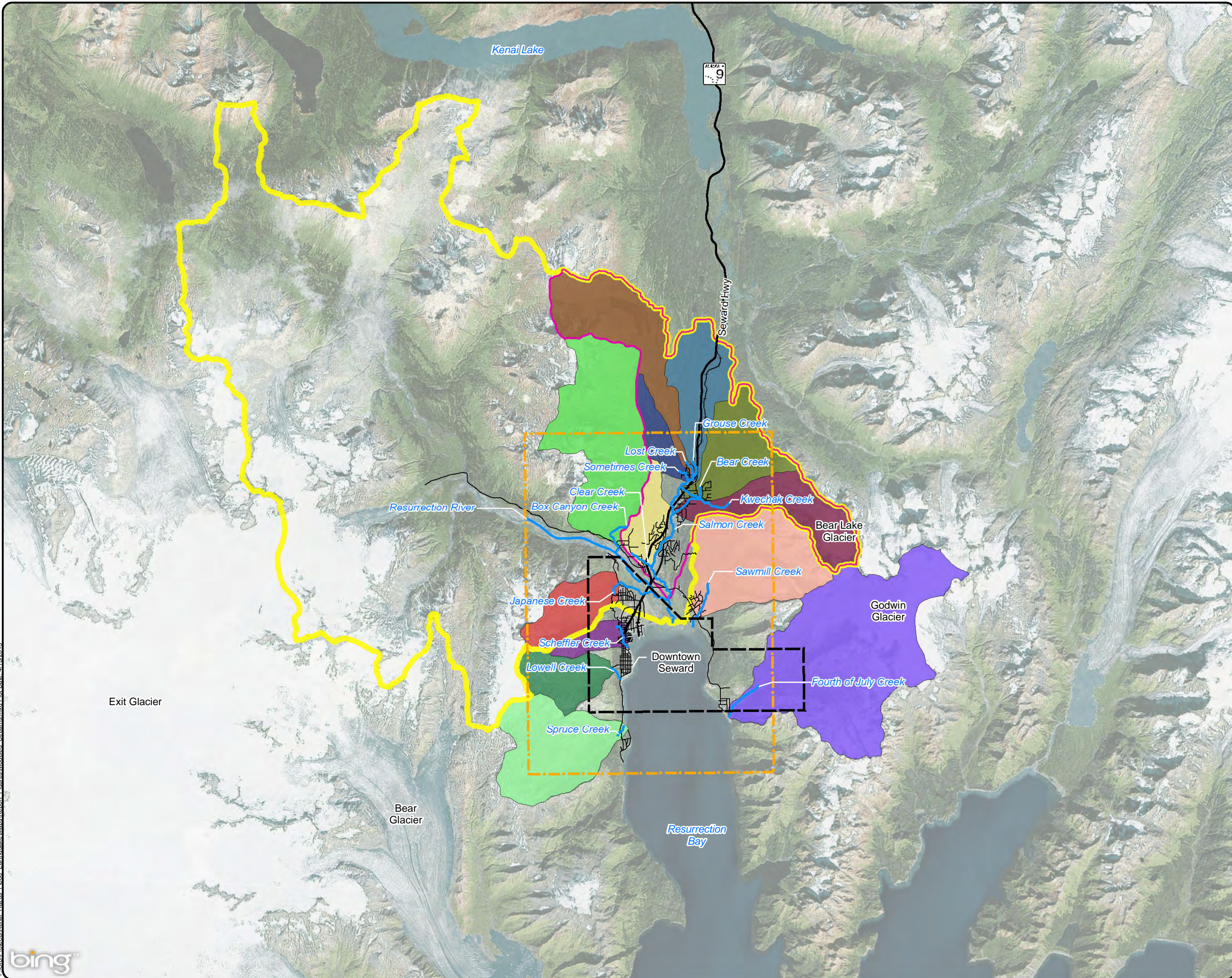
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

FUTURE LAND USE,  
SOUTH AREA  
(2017/2022)

MAP K-7B



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Modeled\_Streams.mxd Plot Date: 4/18/2013



#### Legend

##### Watersheds

- Bear Creek
- Box Canyon Creek
- Clear Creek
- Fourth of July Creek
- Grouse Creek
- Japanese Creek
- Kwechak Creek
- Lost Creek
- Lowell Creek
- Resurrection River
- Salmon Creek
- Sawmill Creek
- Scheffler Creek
- Sometimes Creek
- Spruce Creek
- Modeled Streams

Seward Highway

Other Roads

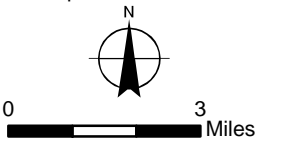
Railroads

Seward City Limits

SBCFSA

##### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, ©2010 GeoEye, and ©2013 Microsoft Corporation.



URS

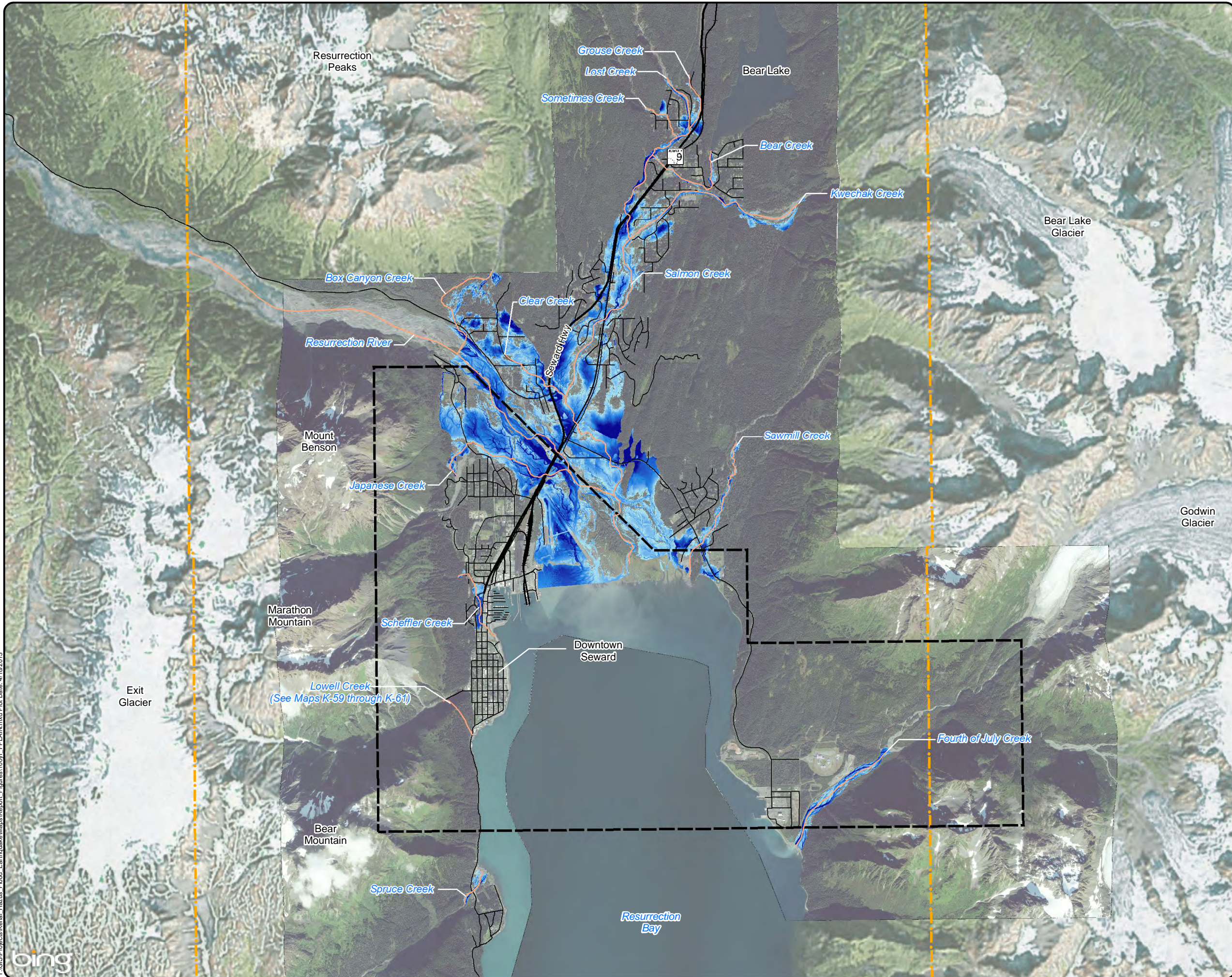
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

MODELED STREAMS  
& WATERSHEDS

MAP K-8



Y:\GIS\Projects\Kenai Hazus Flood Earthquake\Maps\Report\_Figures\100yr\_FPLAIN.mxd Plot Date: 4/19/2013

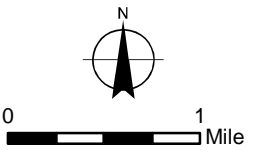


#### Legend

- Flood Depth  
Deeper Depth  
Shallower Depth
- Modeled Streams  
Seward Highway  
Other Roads  
Railroads  
Seward City Limits  
SBCFSA

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©Harris Corp and Earthstar Geographics LLC ©2013 Microsoft Corporation.



**URS**

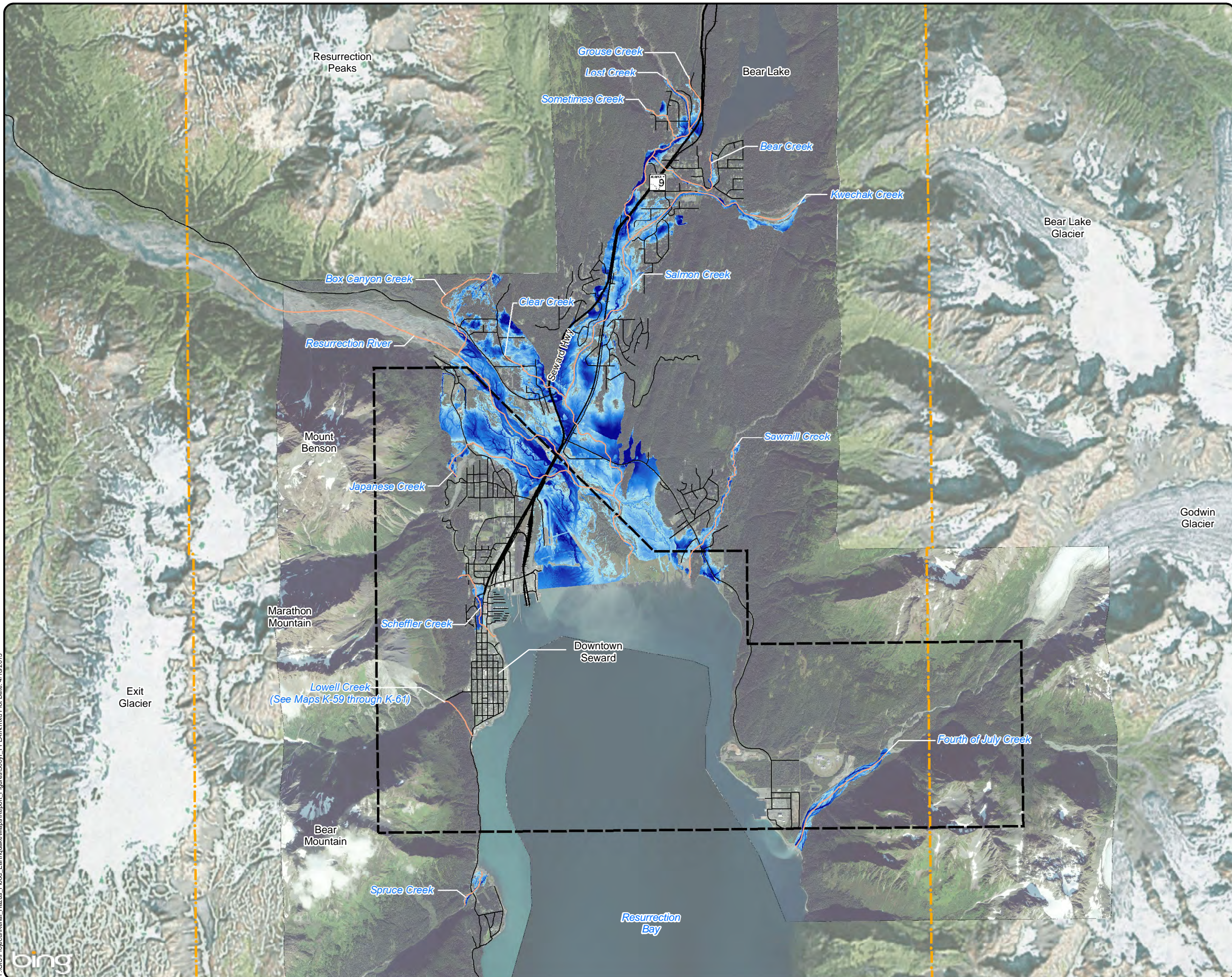
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**100-YEAR FLOODPLAINS  
(2012)**

**MAP K-9**



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\500yr\_FPLAIN.mxd Plot Date: 4/19/2013

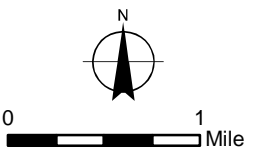


#### Legend

- Flood Depth  
Deeper Depth  
Shallower Depth
- Modeled Streams  
Seward Highway  
Other Roads  
Railroads  
Seward City Limits  
SBCFSA

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©Harris Corp and Earthstar Geographics LLC ©2013 Microsoft Corporation.



**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**500-YEAR FLOODPLAINS  
(2012)**

**MAP K-10**



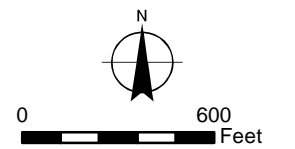


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.

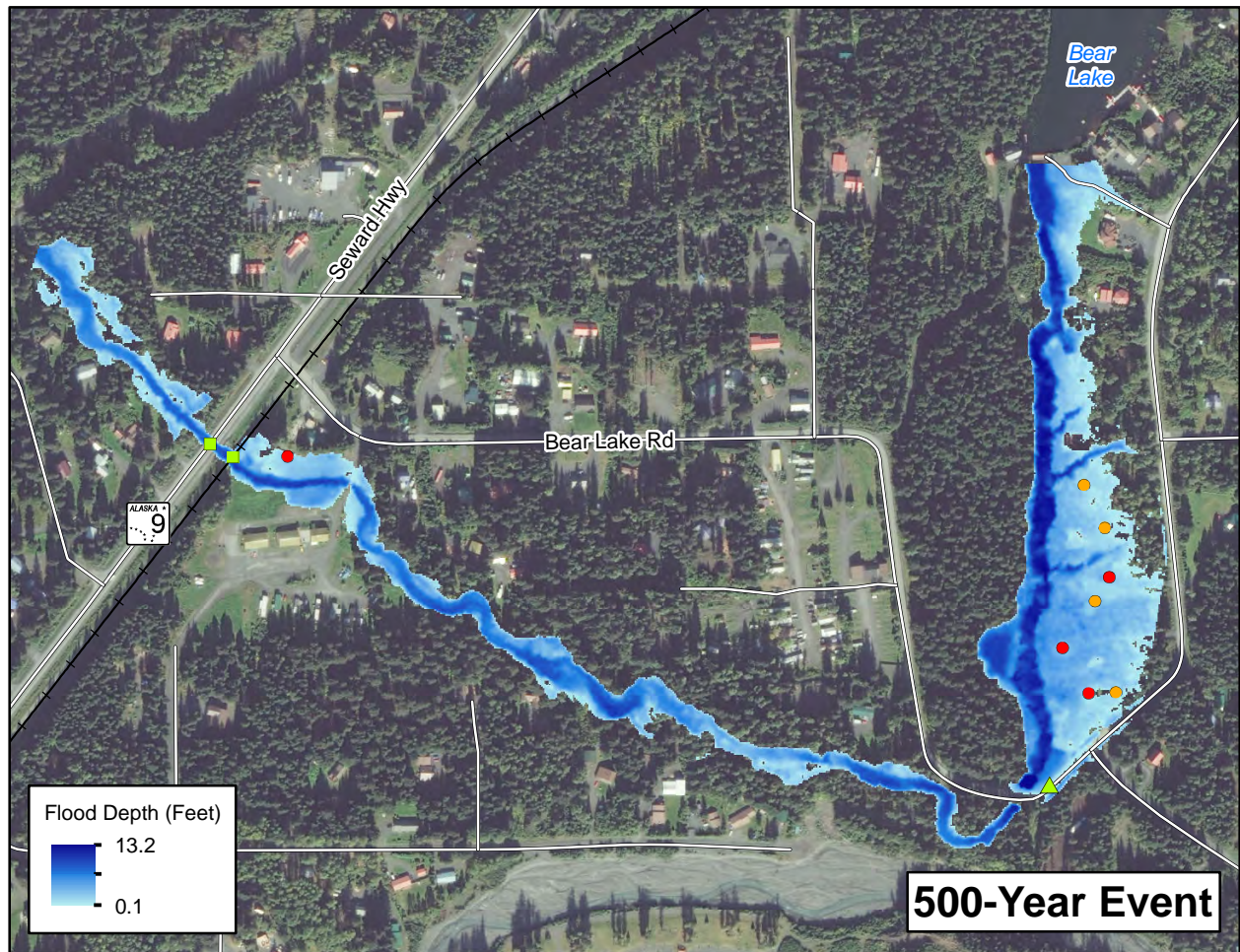
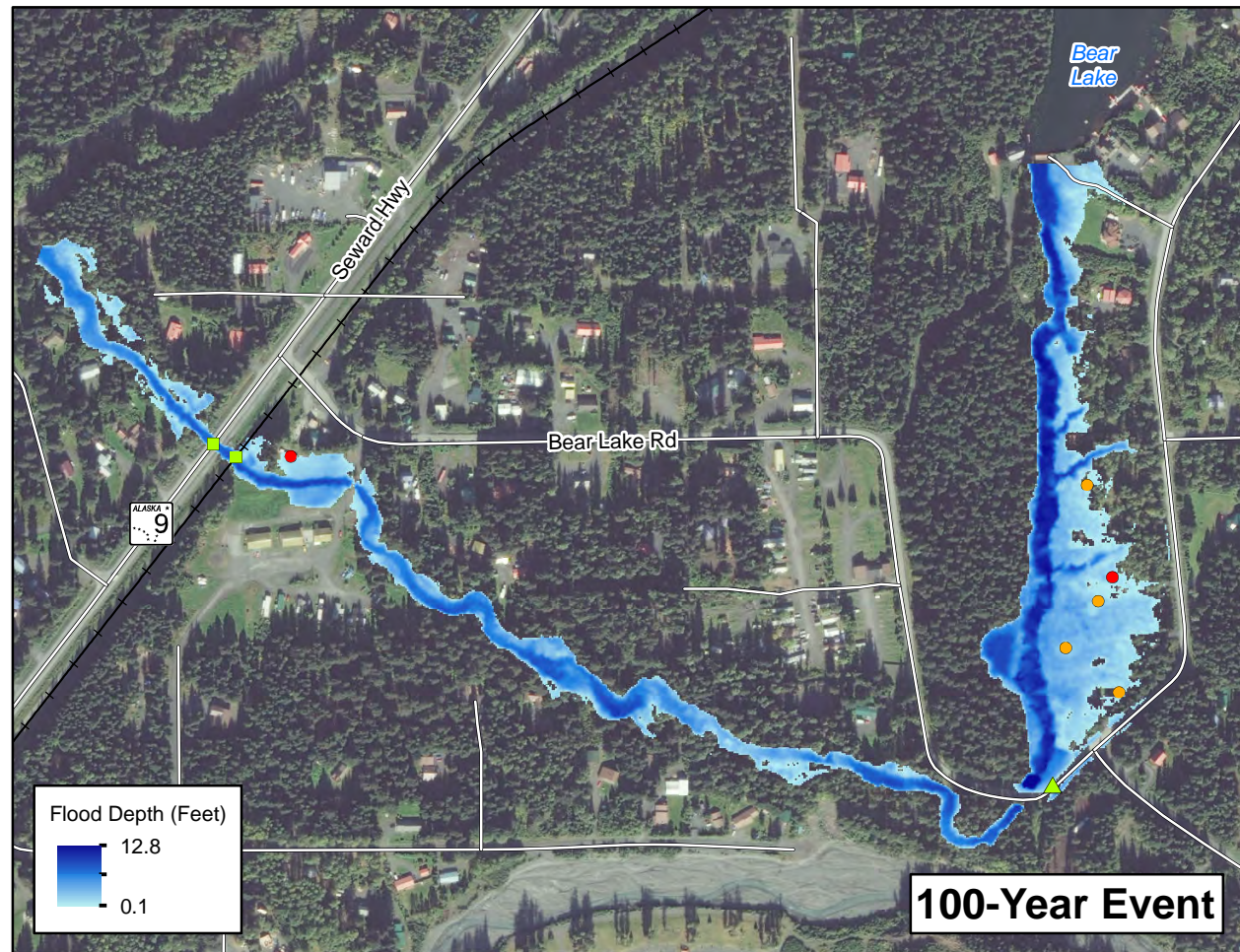


SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**BEAR CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-11



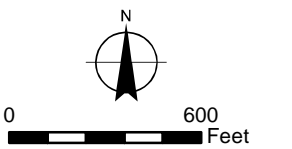


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**BEAR CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-12



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Bear\_2052.mxd Plot Date: 4/19/2013

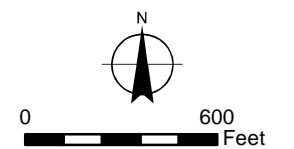


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



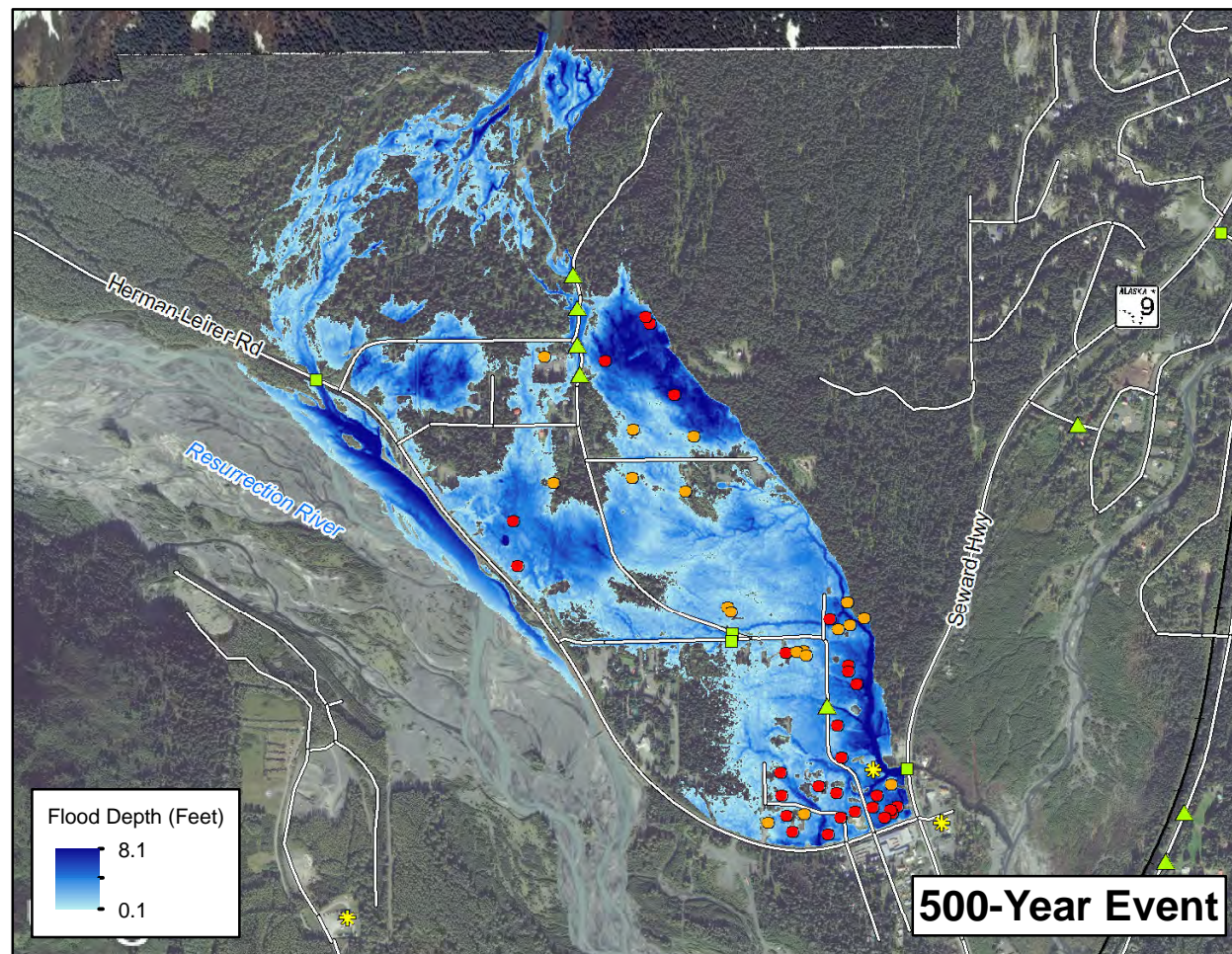
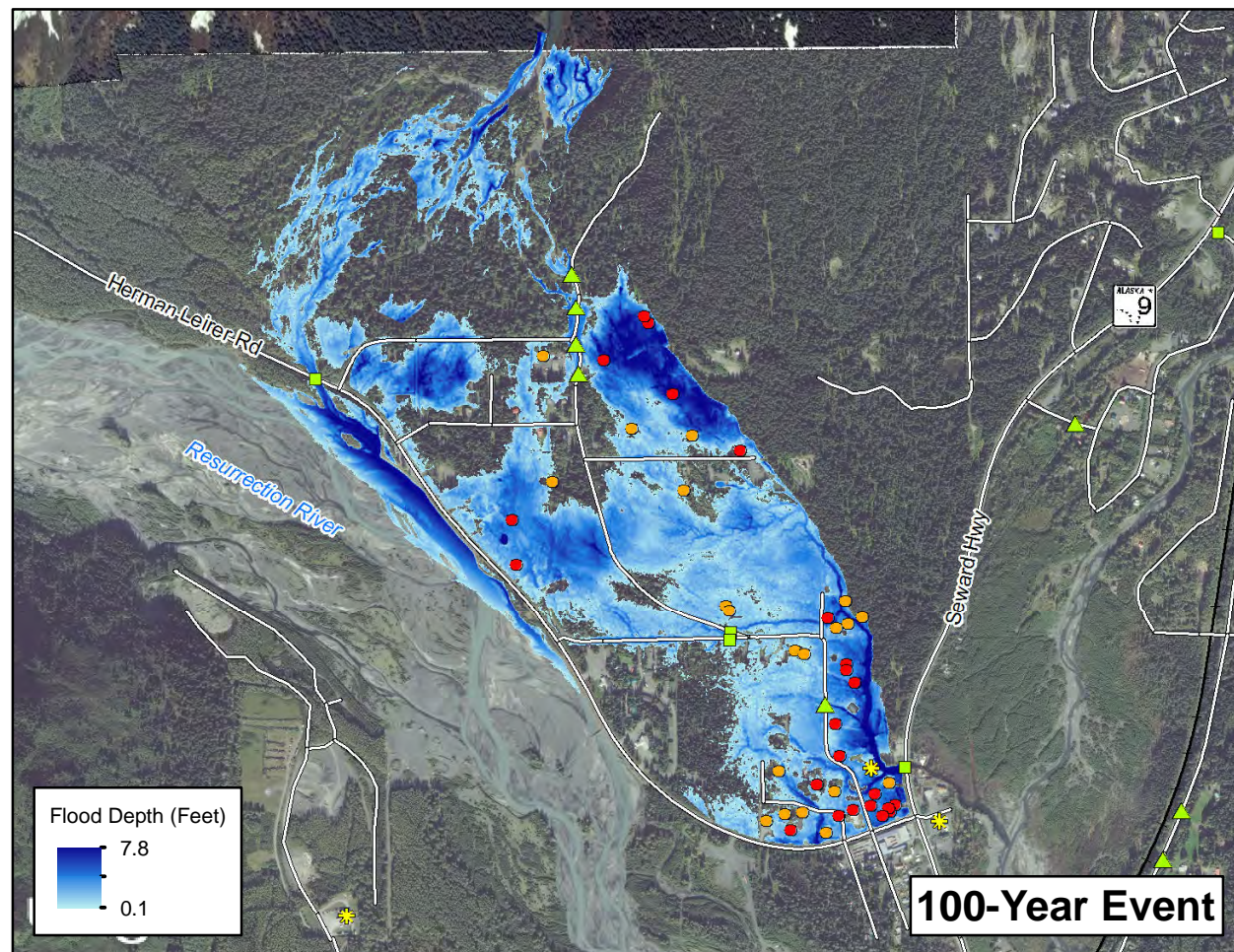
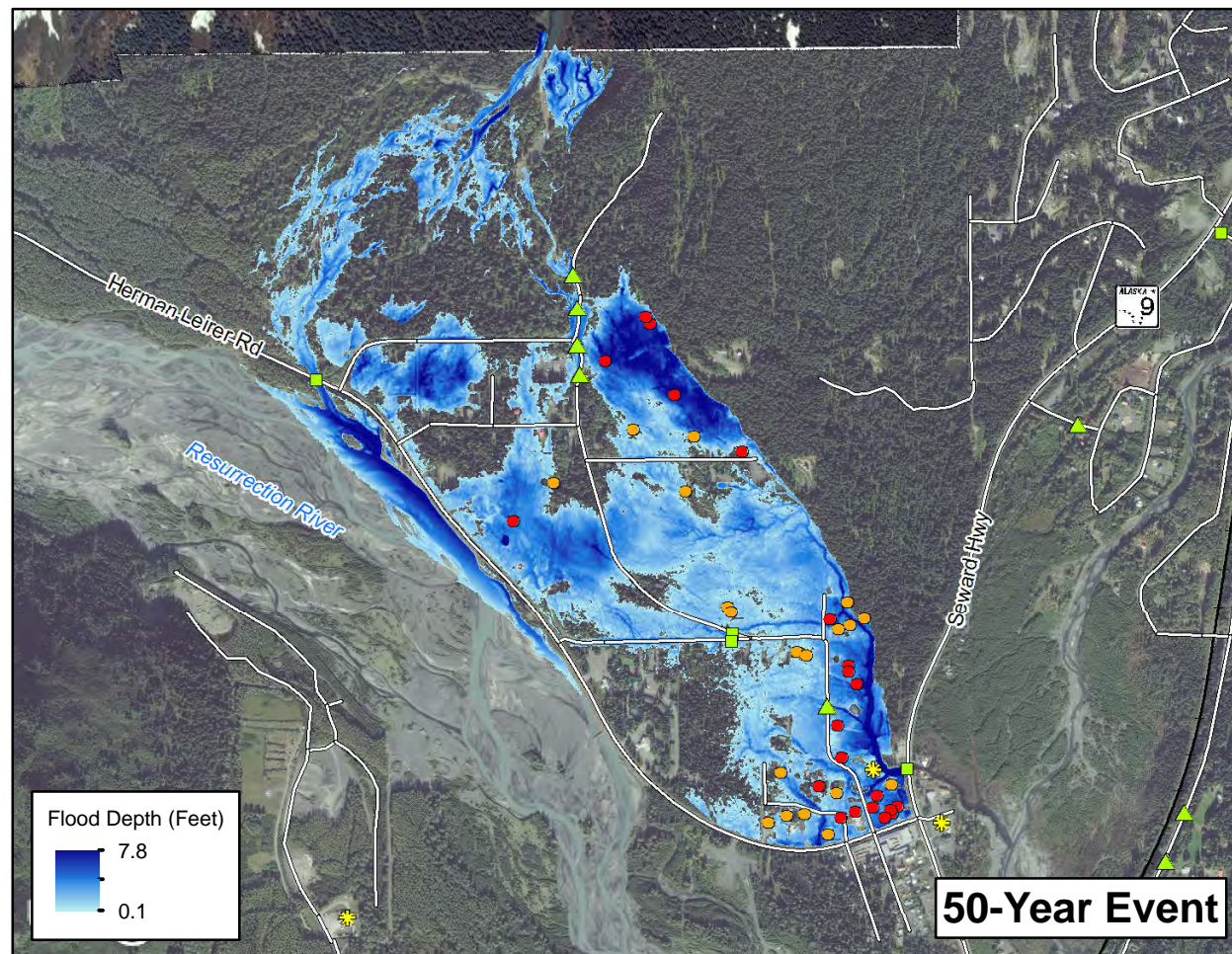
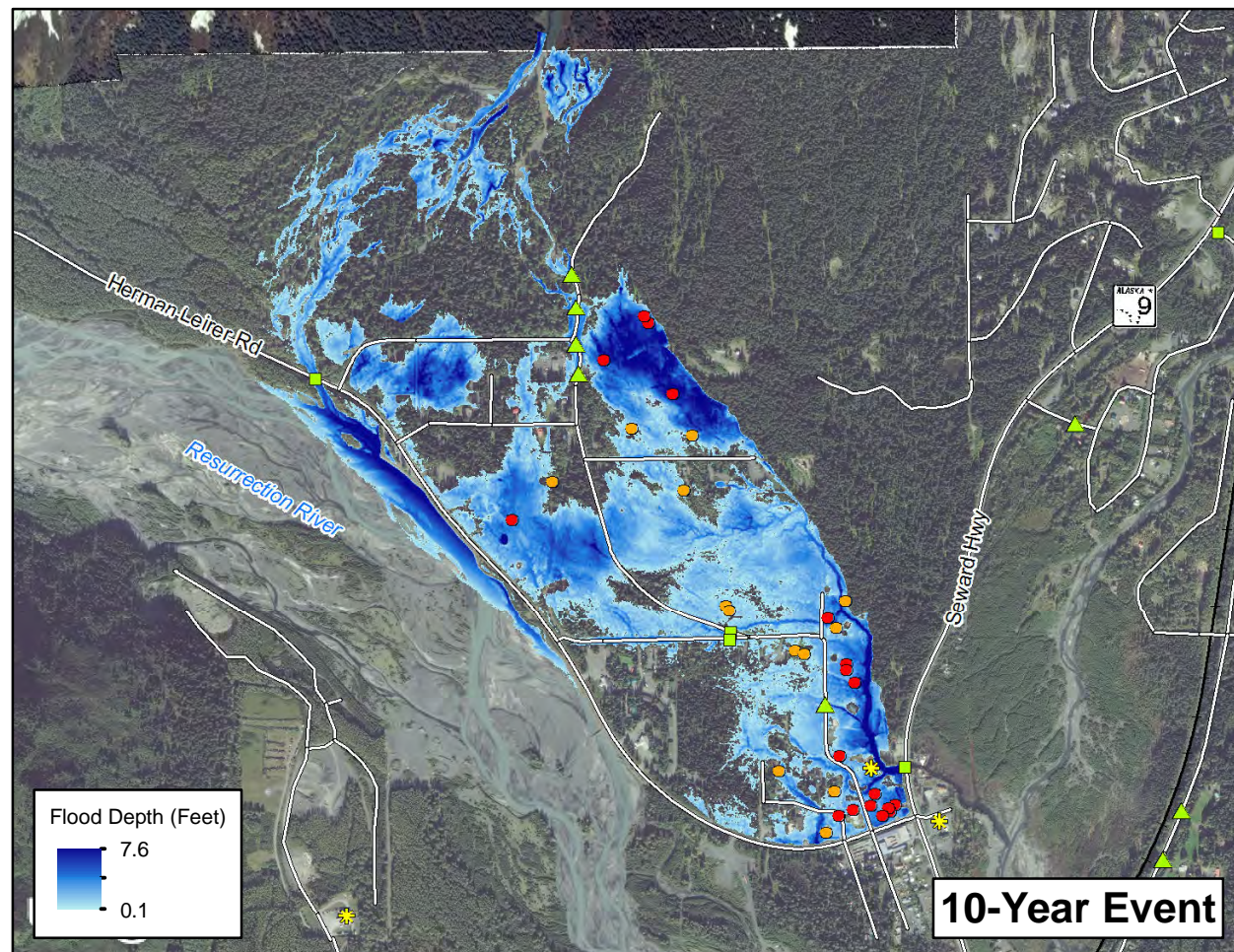
**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**BEAR CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-13



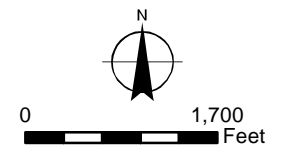


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



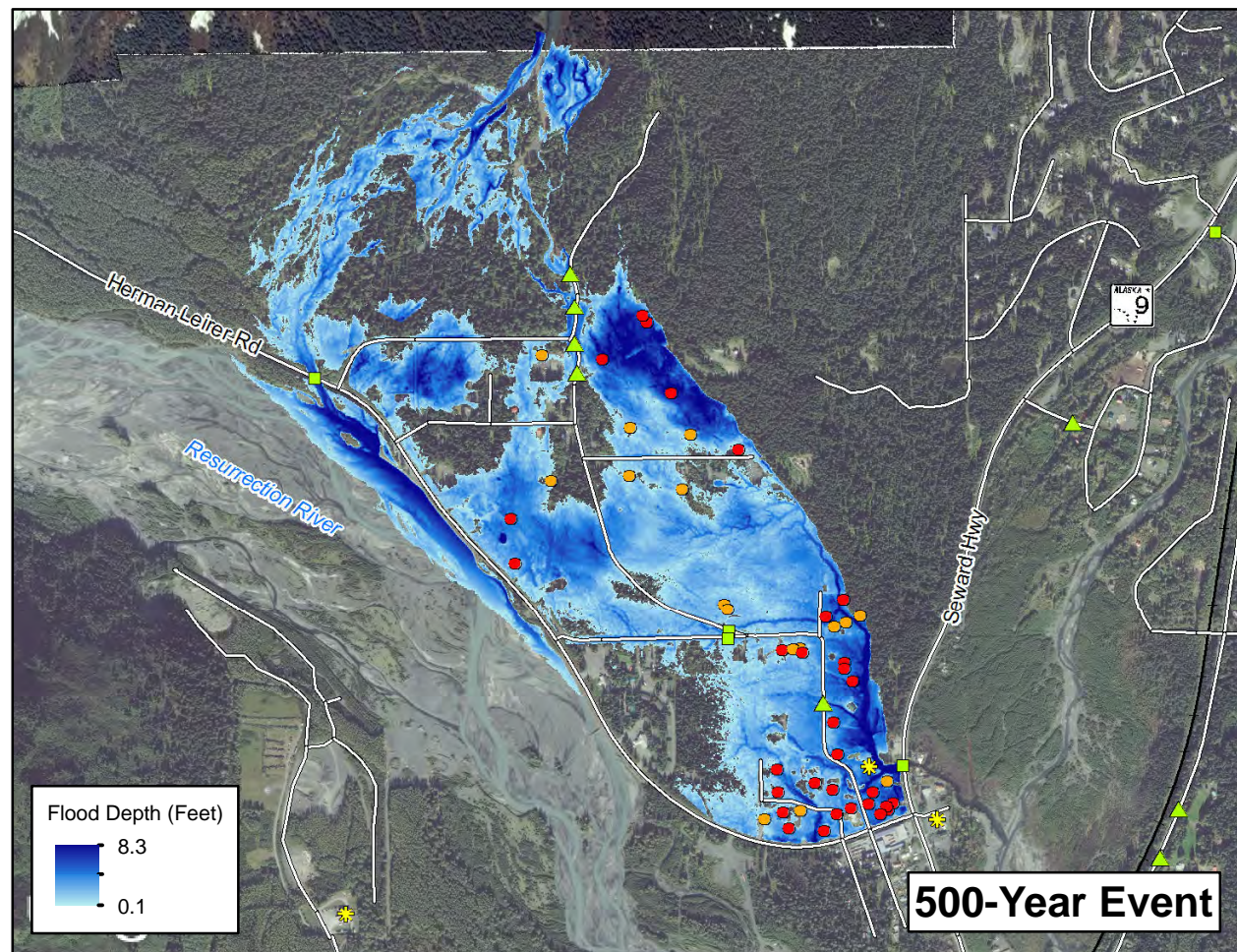
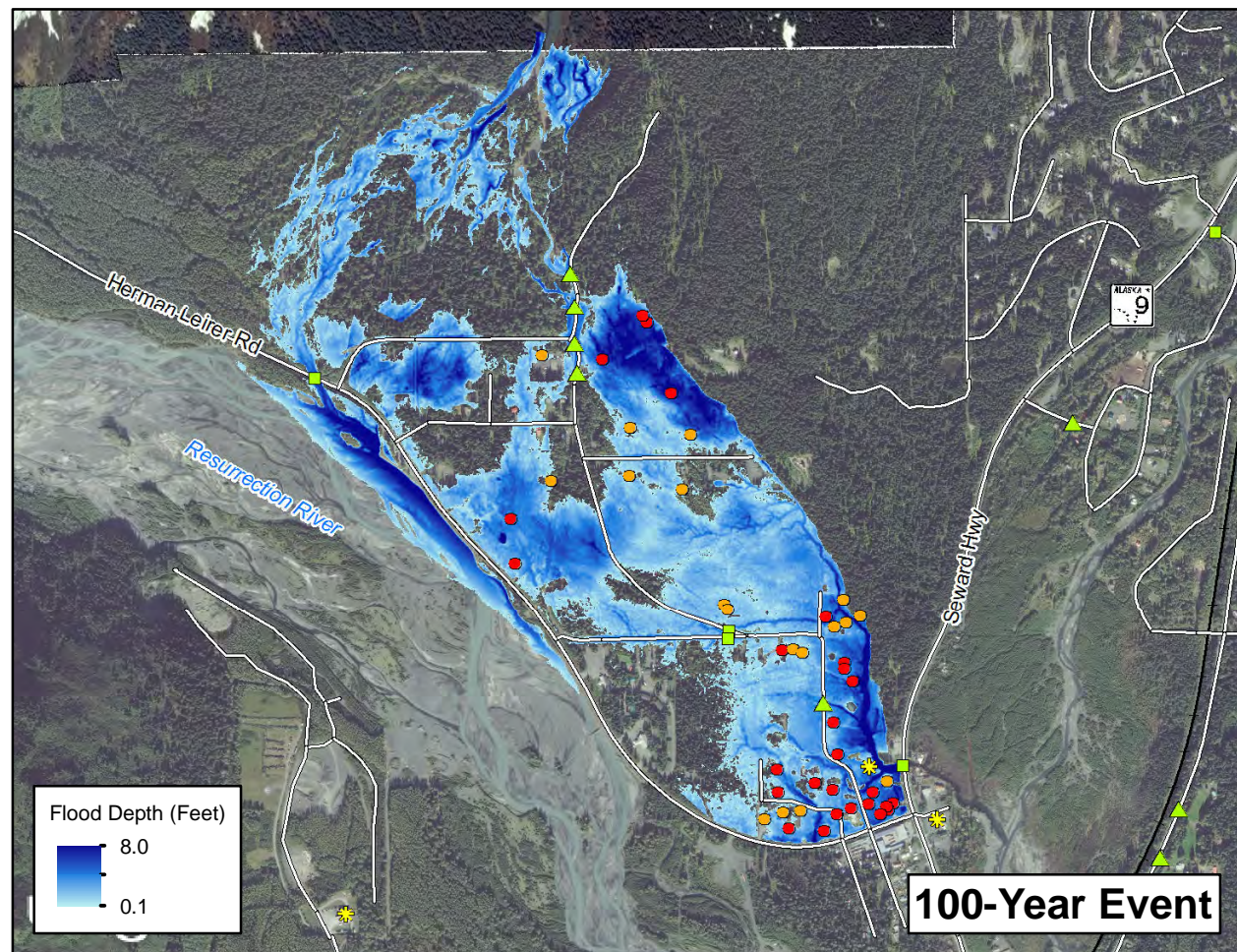
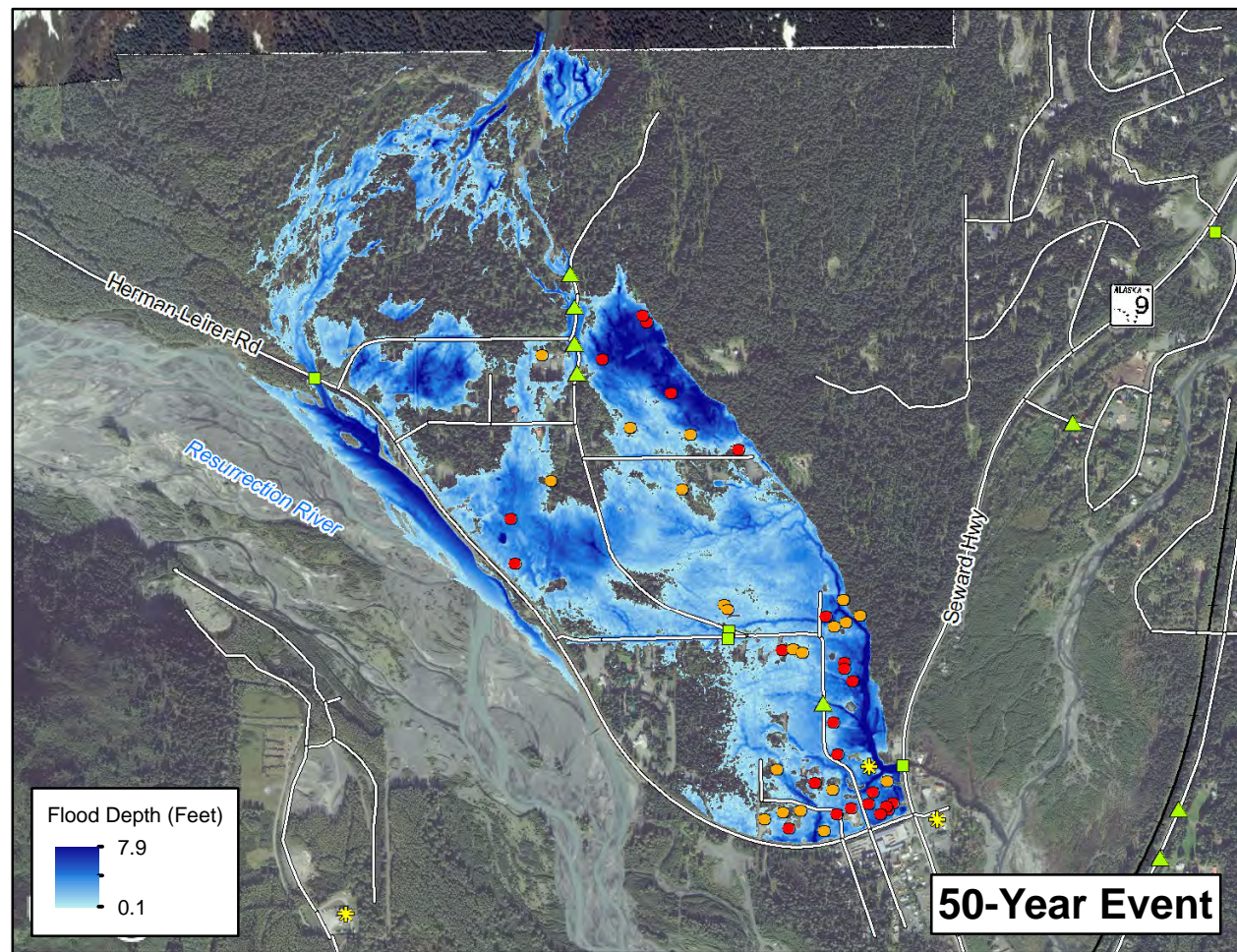
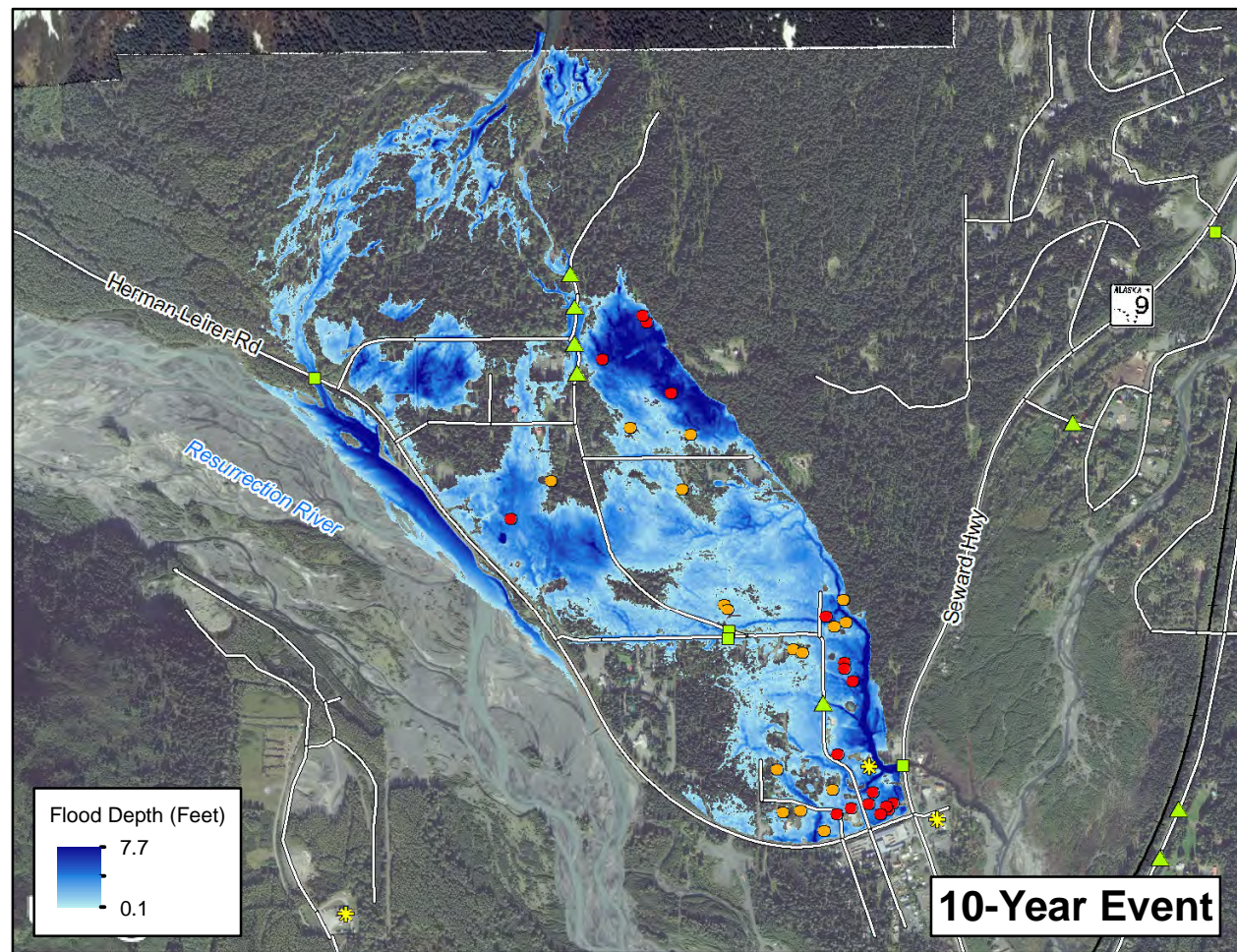
**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**BOX CANYON CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-14



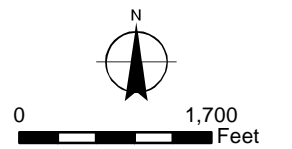


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.

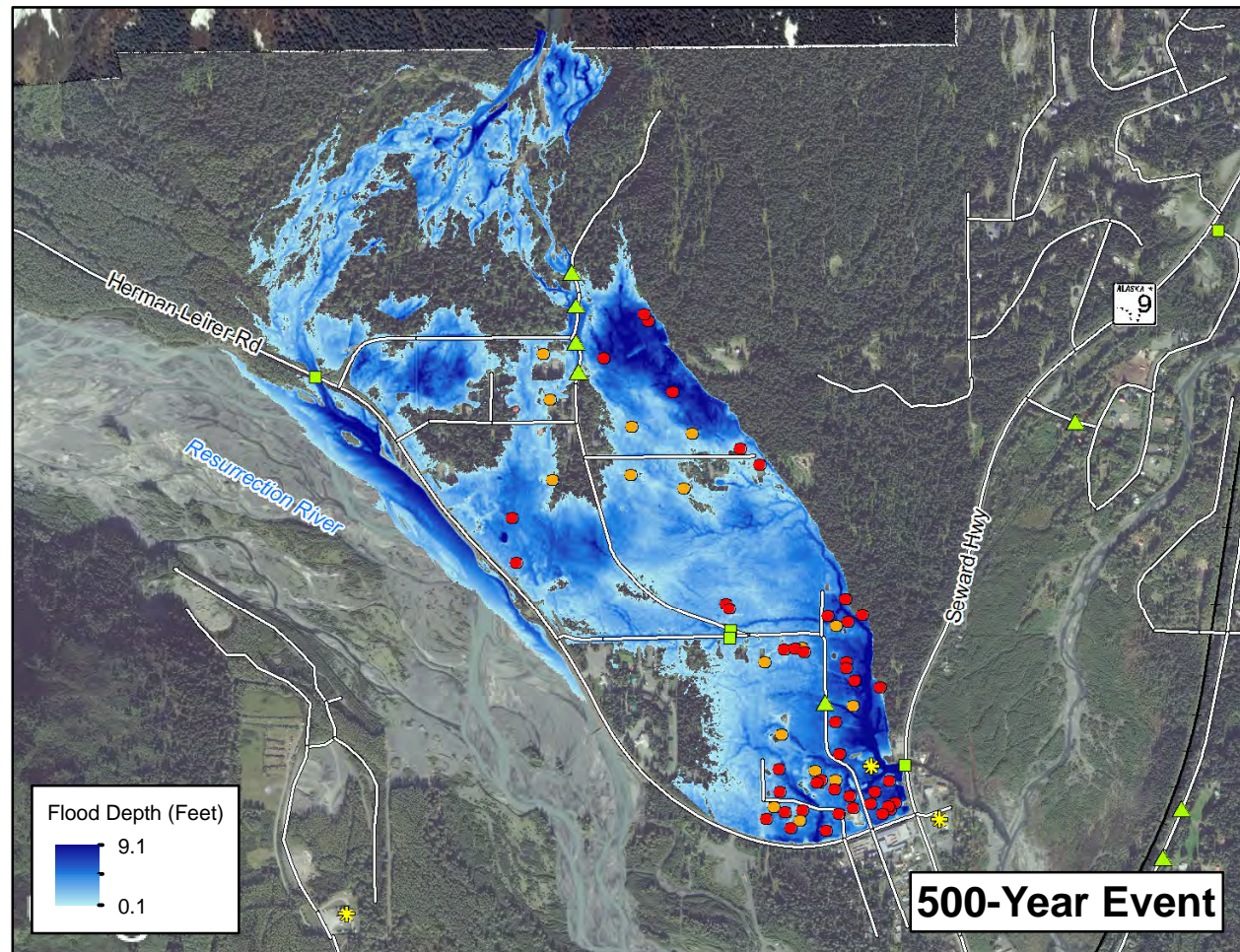
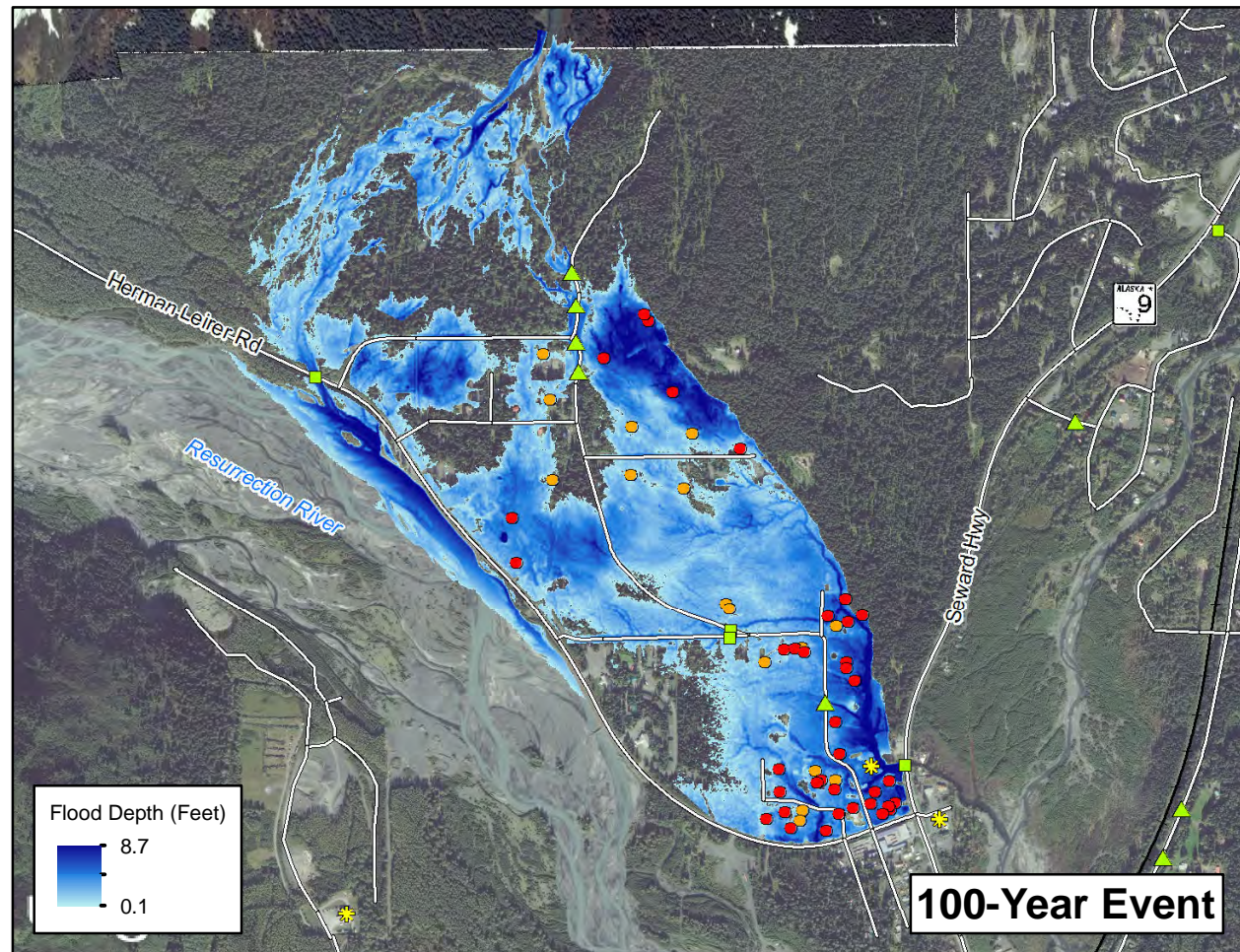
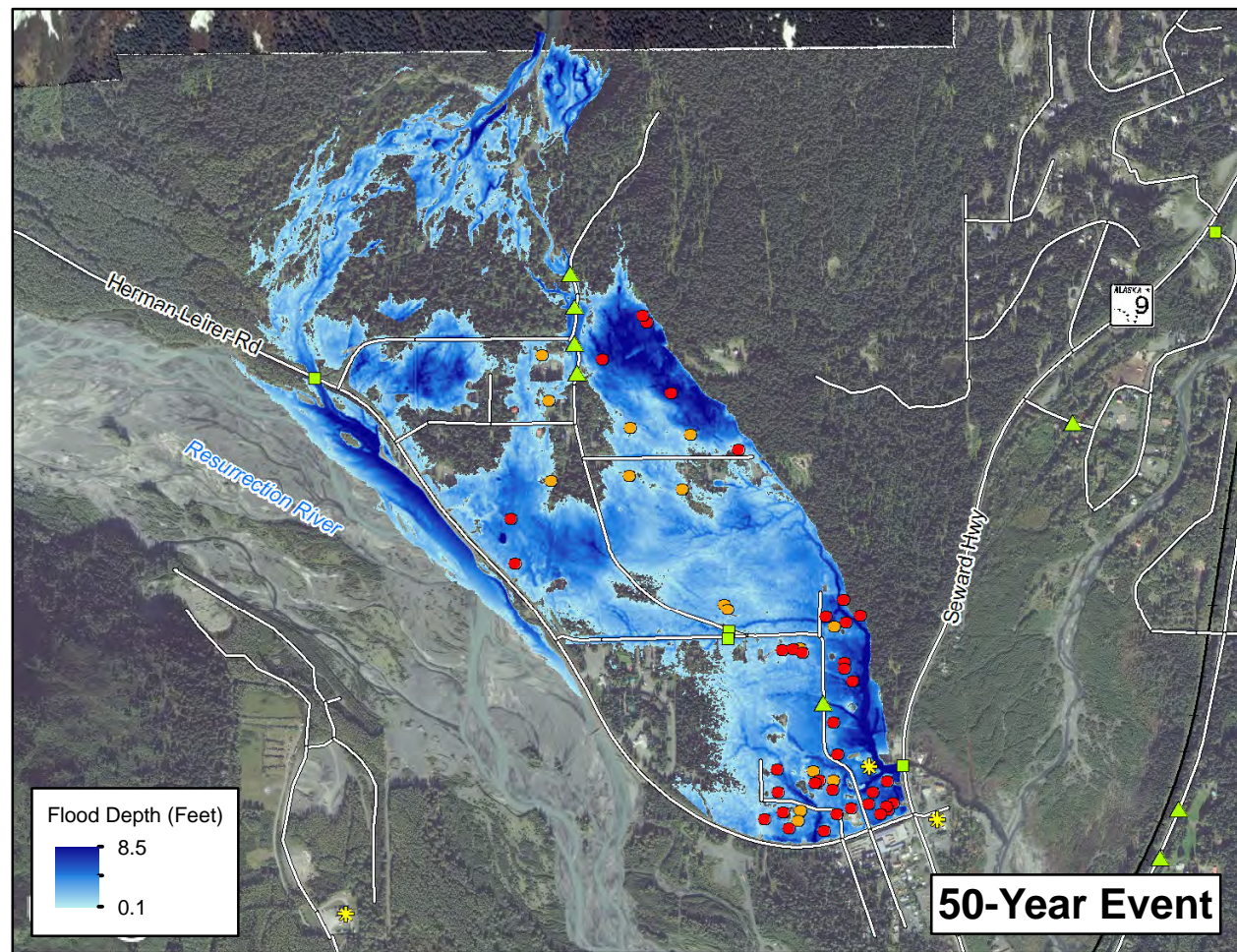
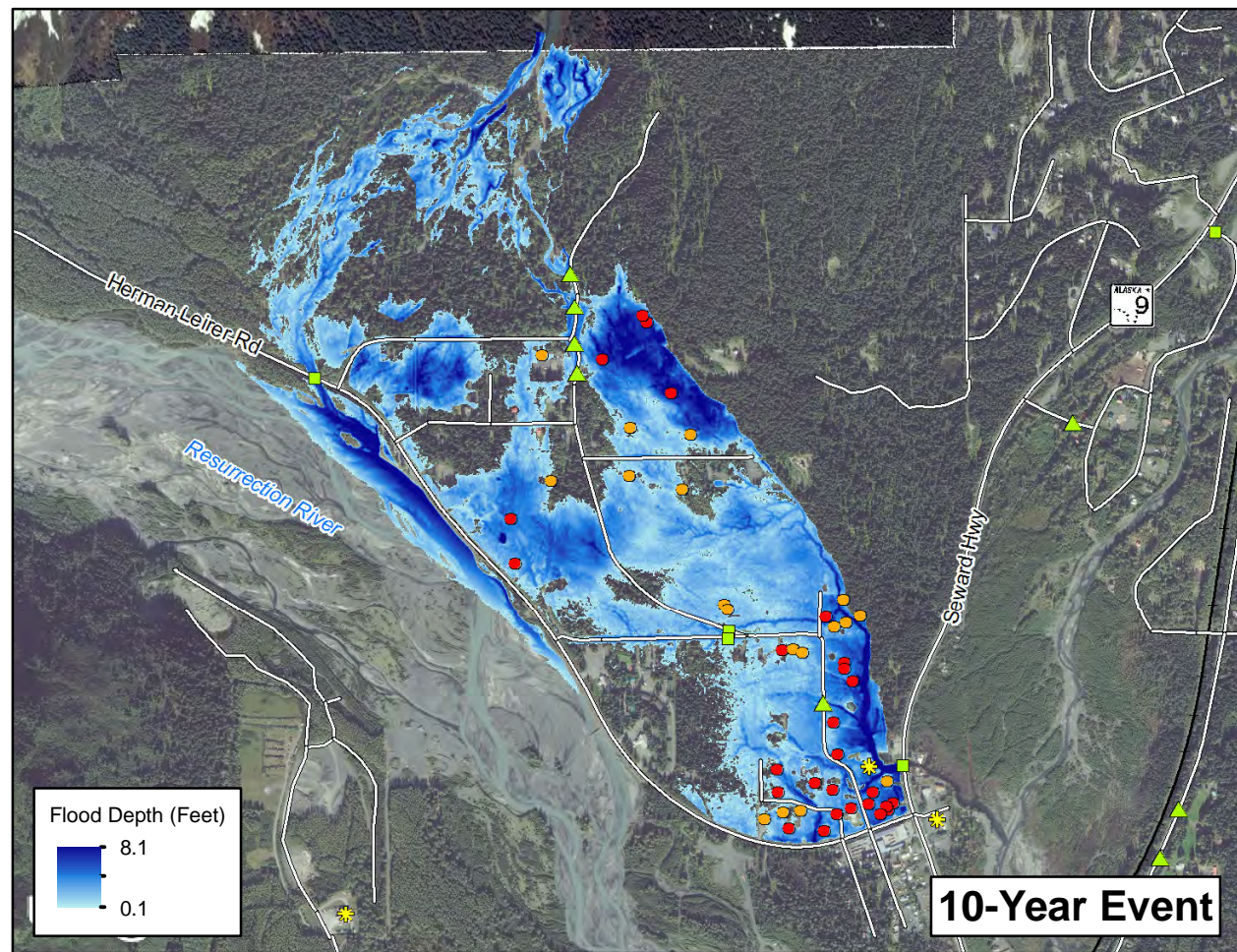


SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**BOX CANYON CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-15



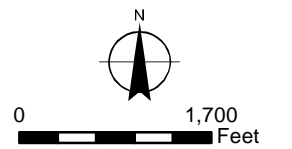


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

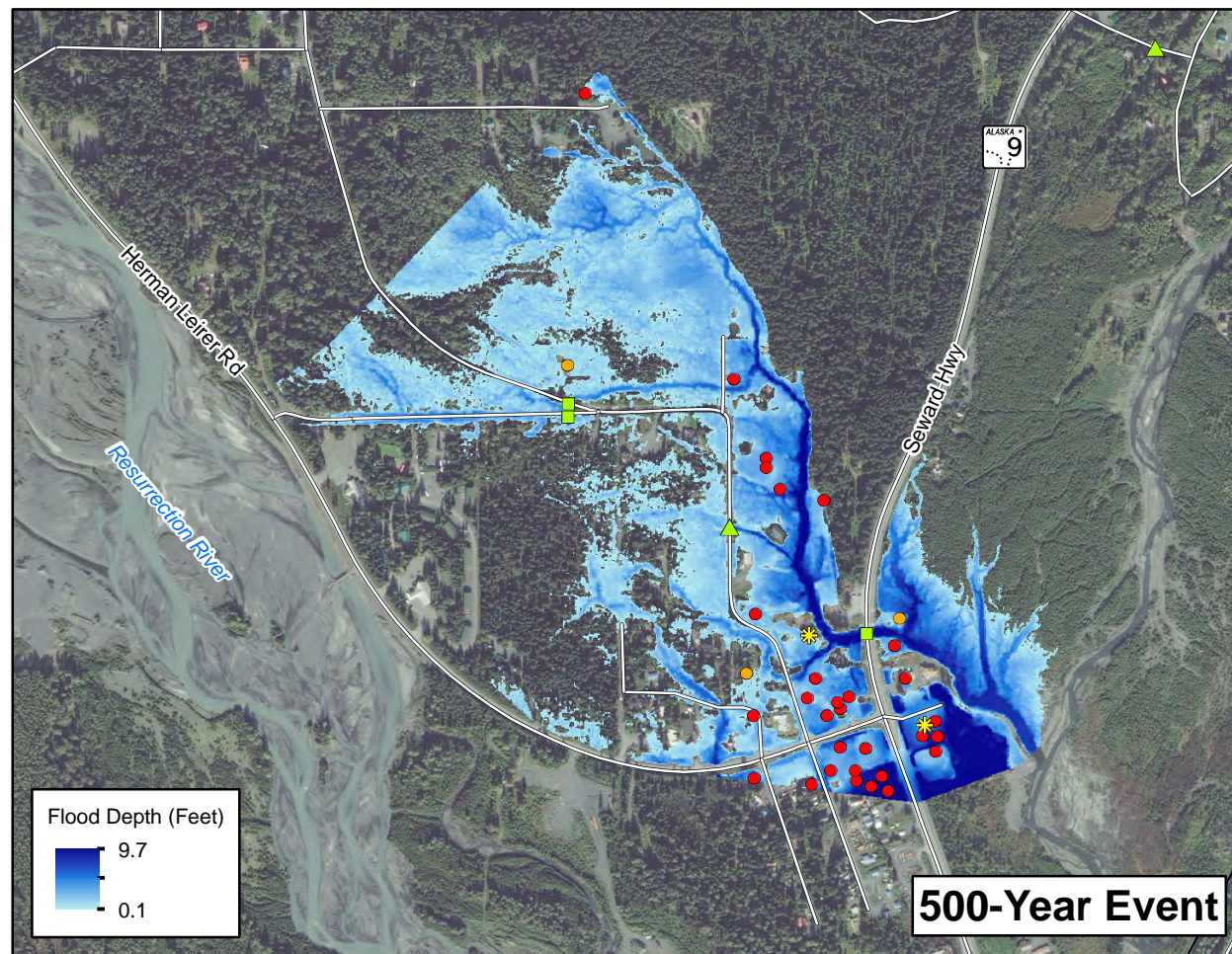
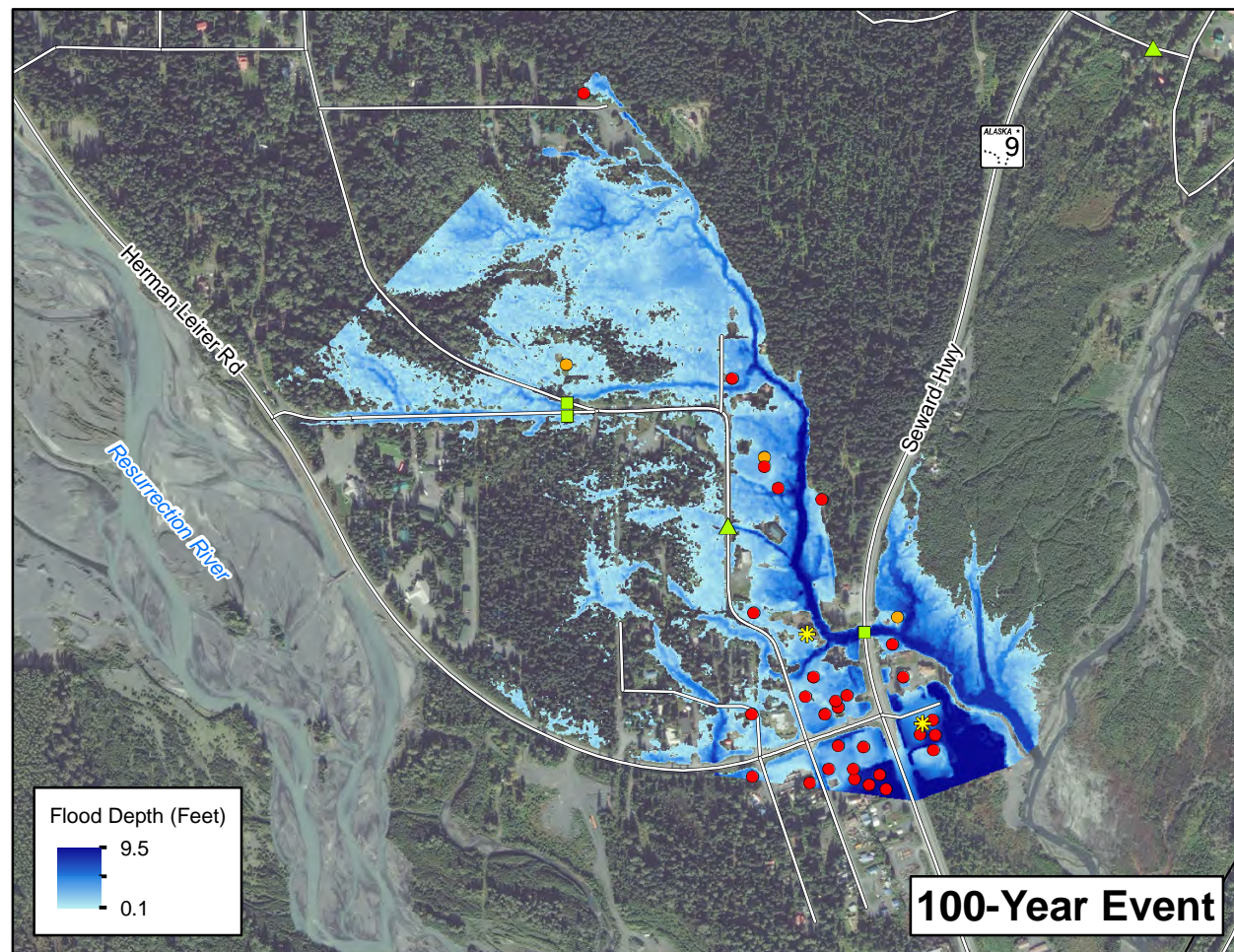
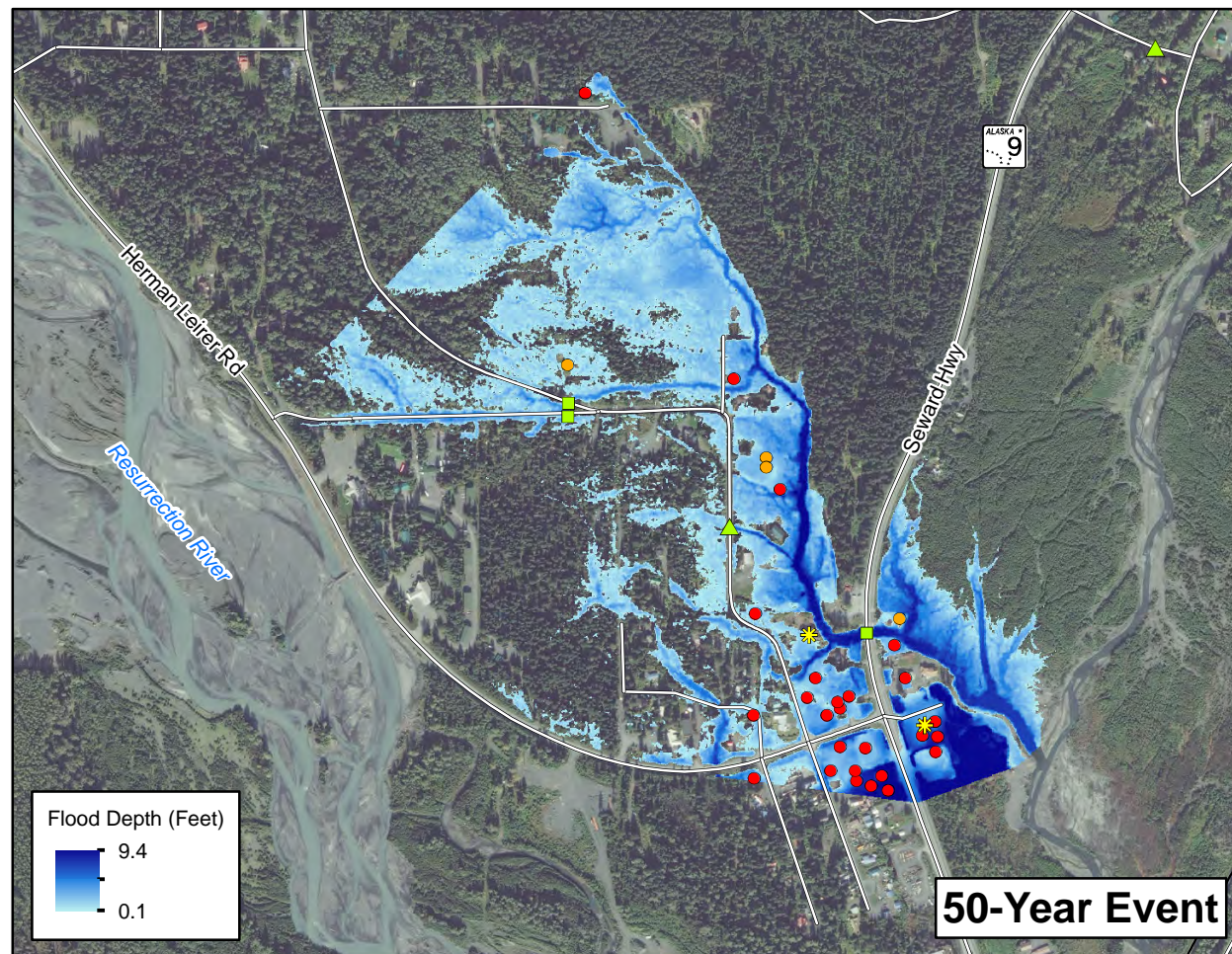
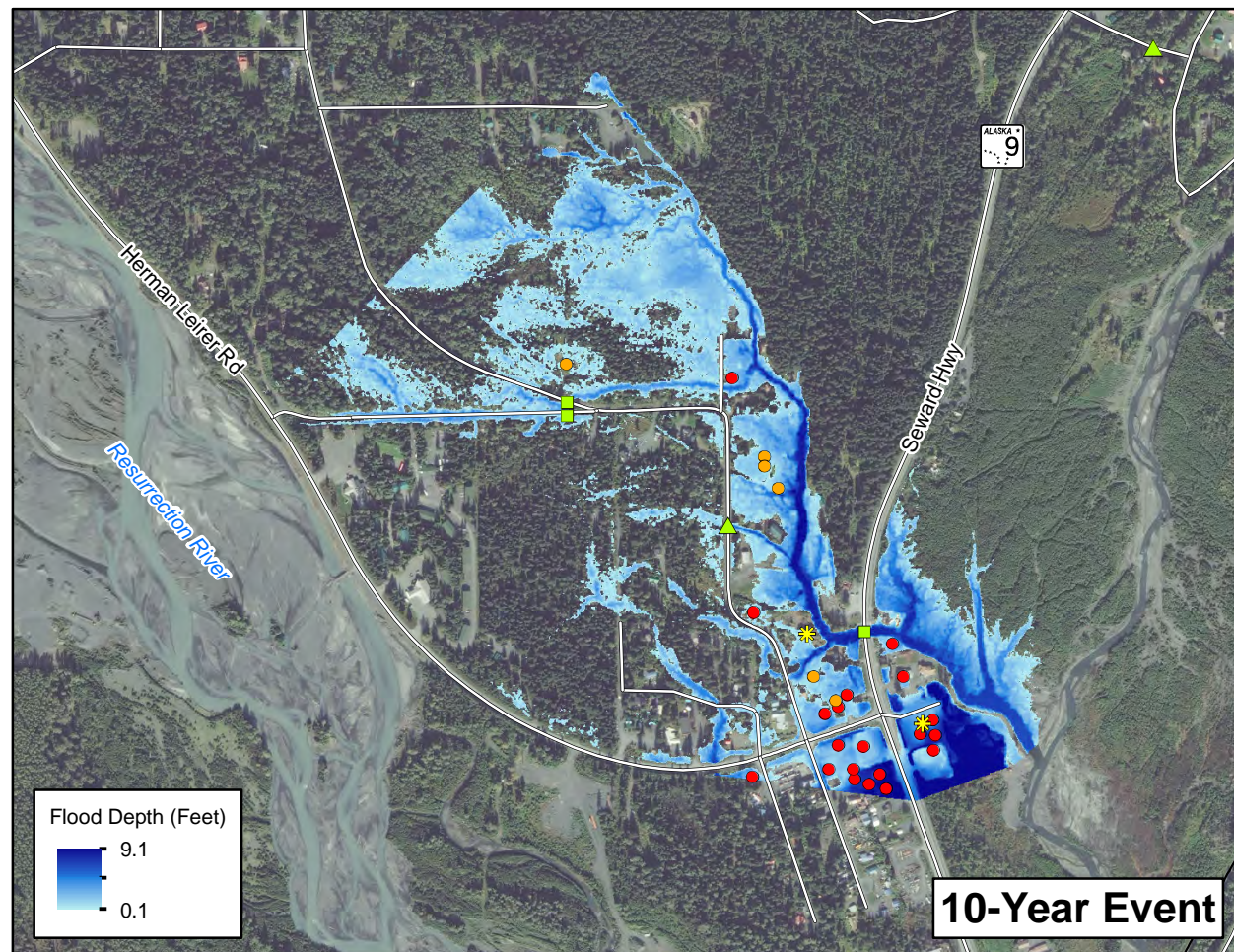
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**BOX CANYON CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-16



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\CLEAR\_2012.mxd Plot Date: 4/19/2013

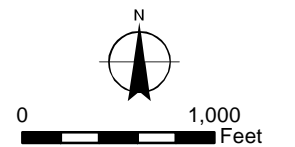


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.



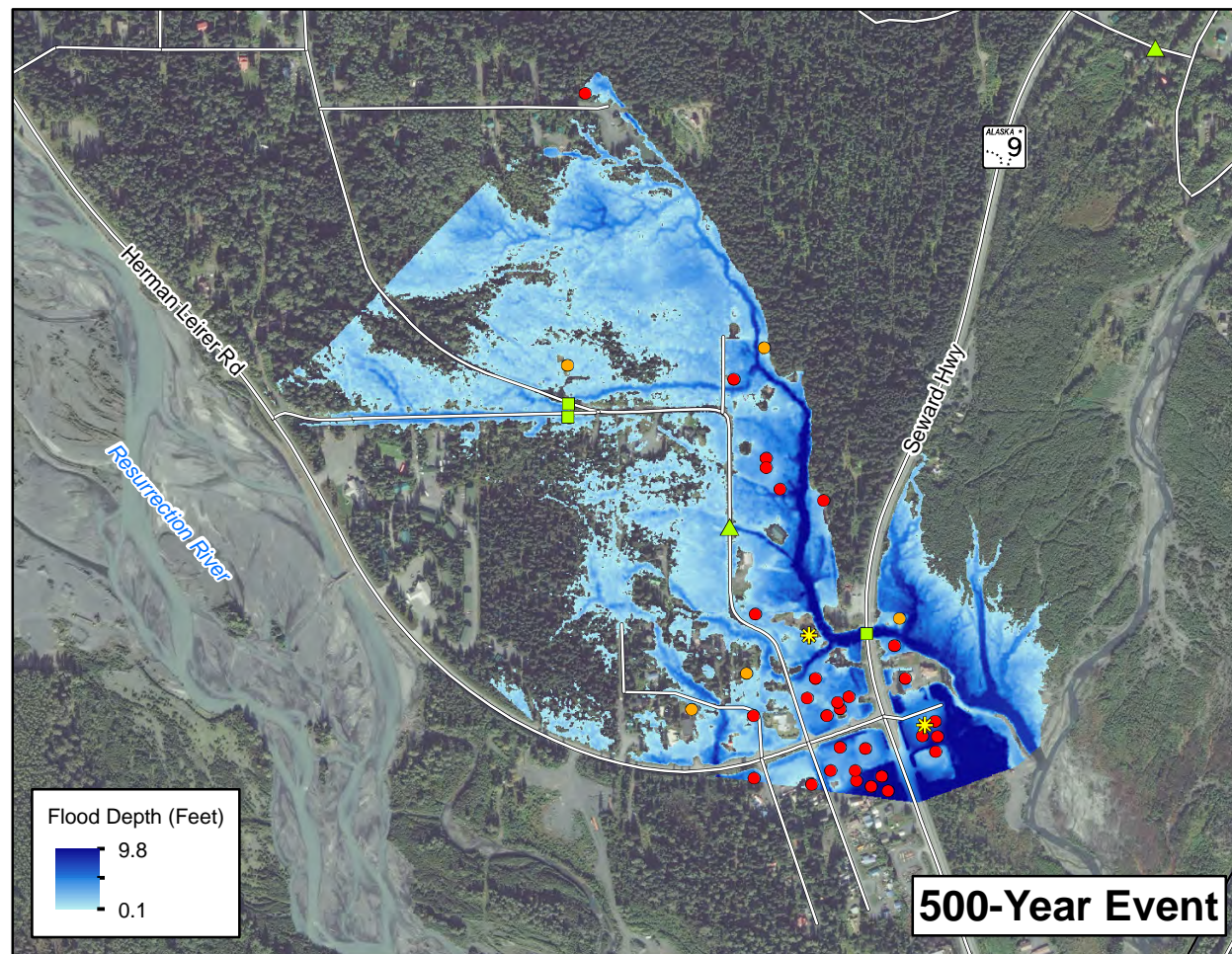
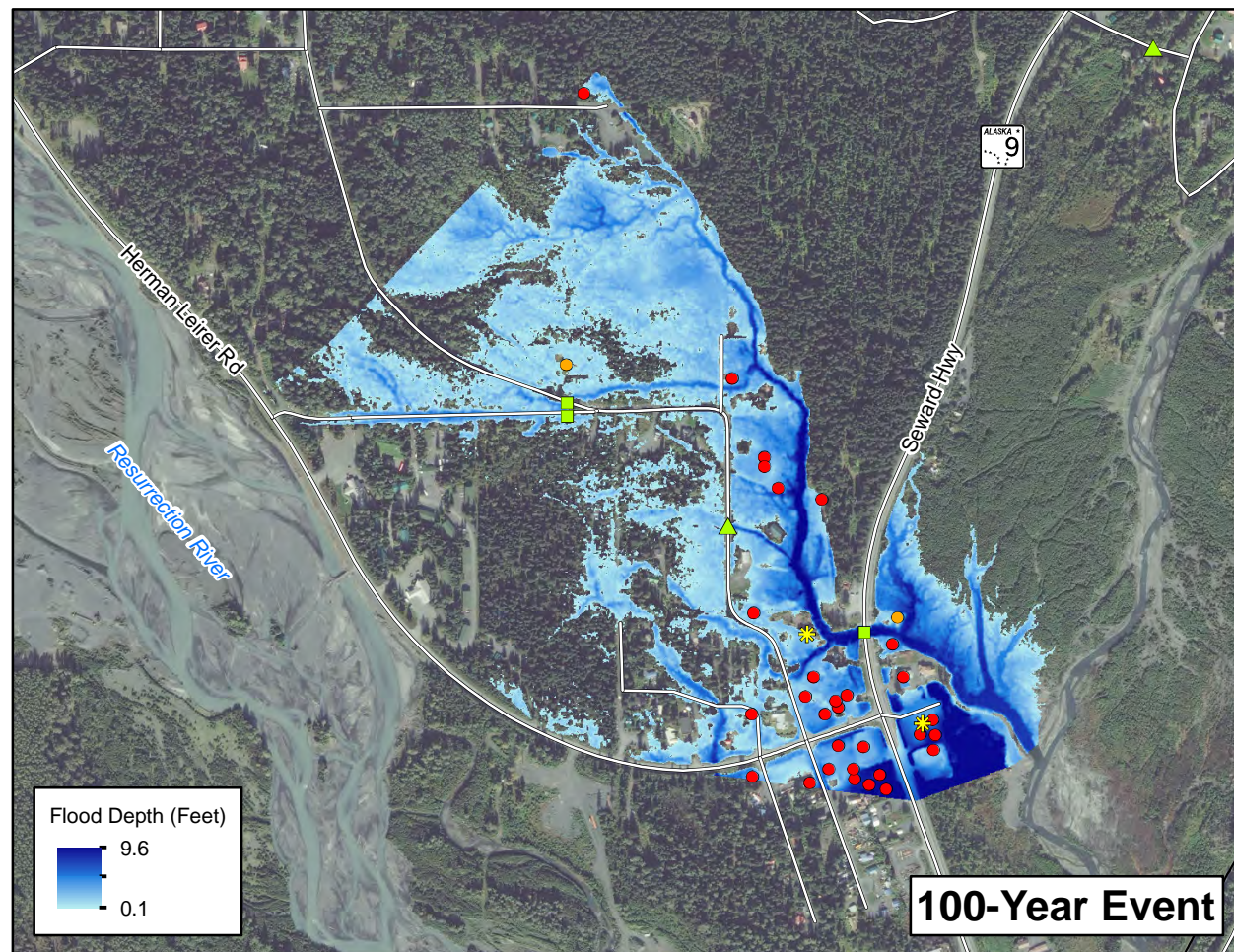
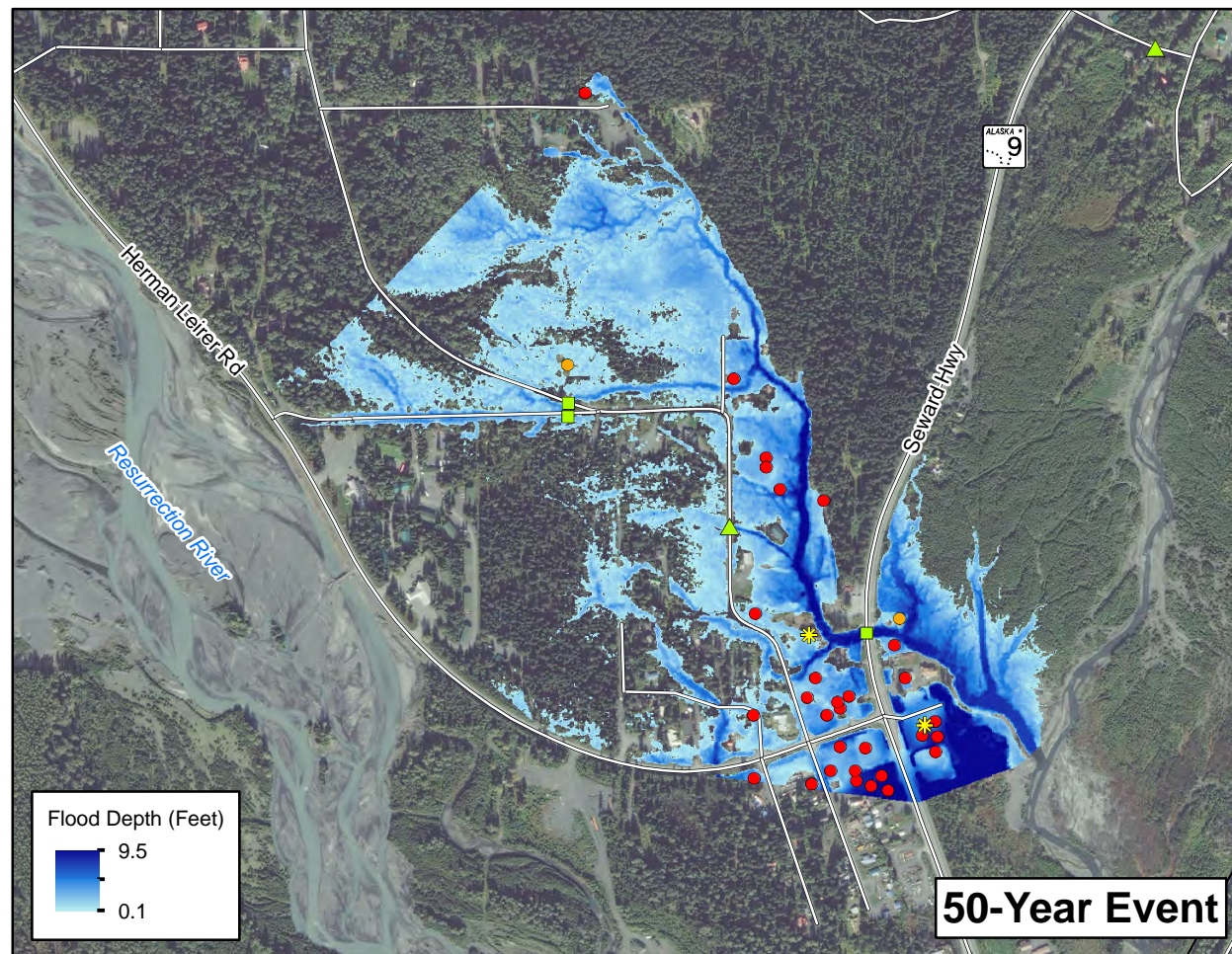
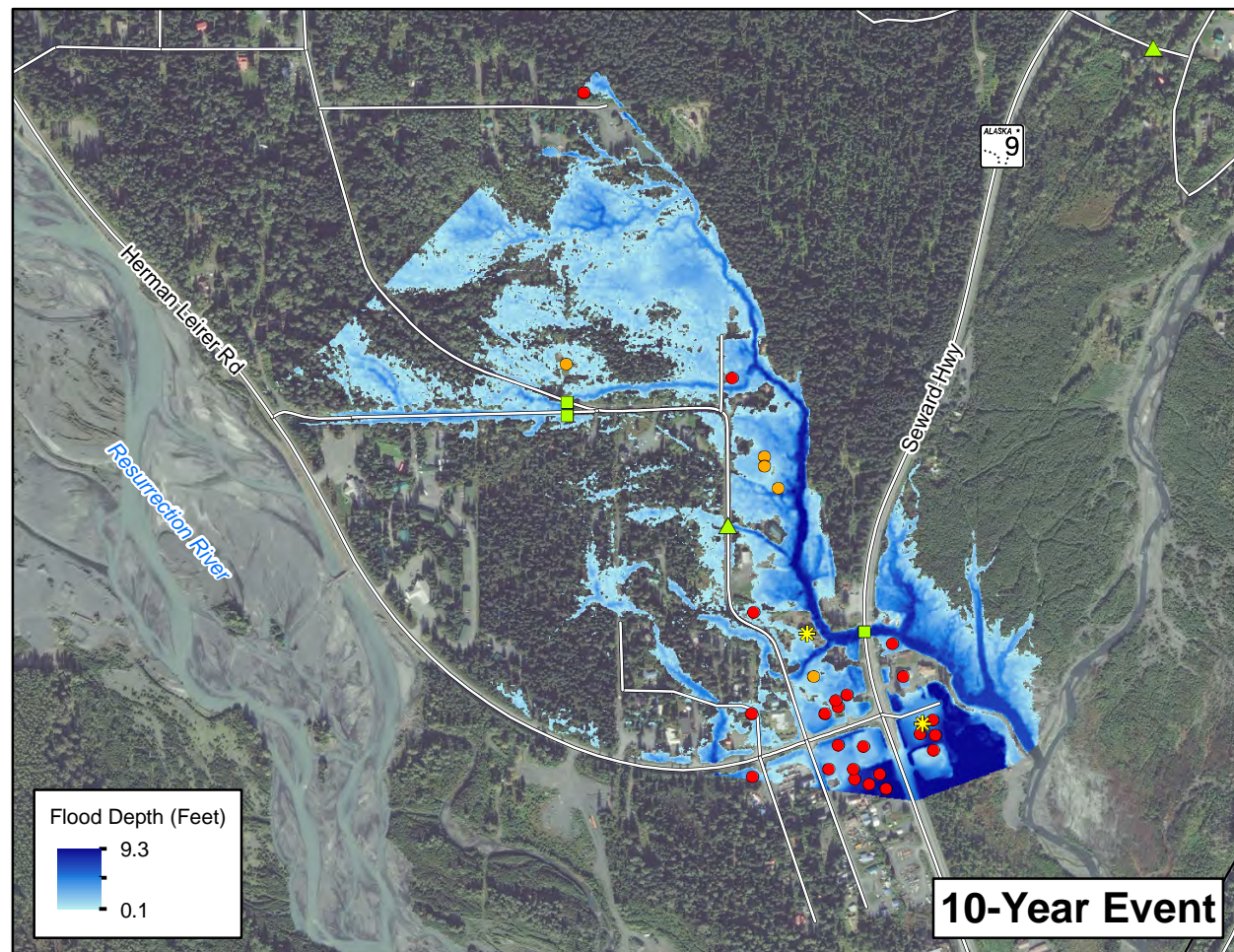
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**CLEAR CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-17



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\CLEAR\_2022.mxd Plot Date: 4/19/2013

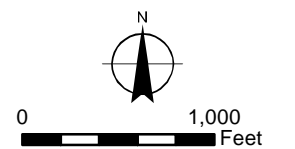


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



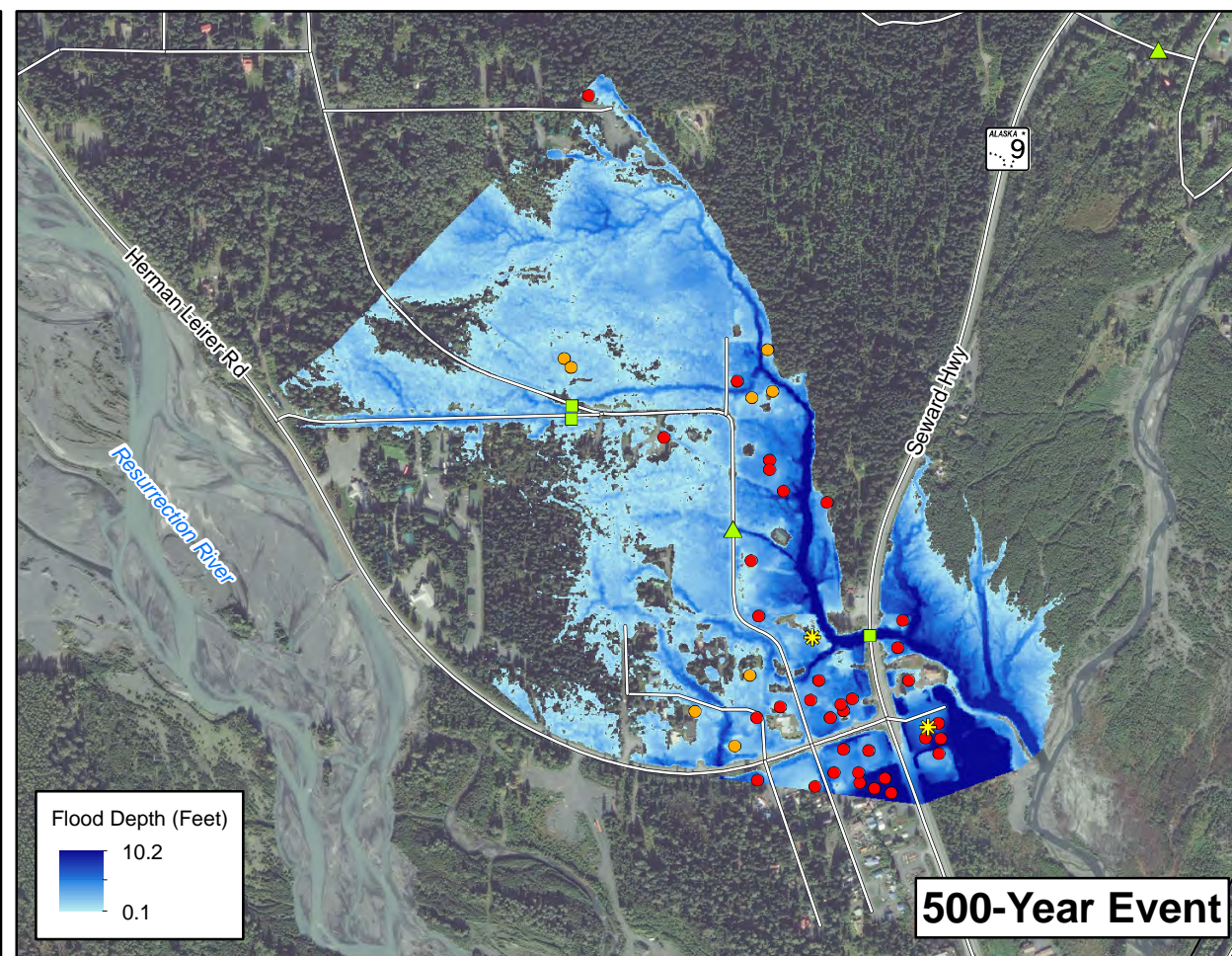
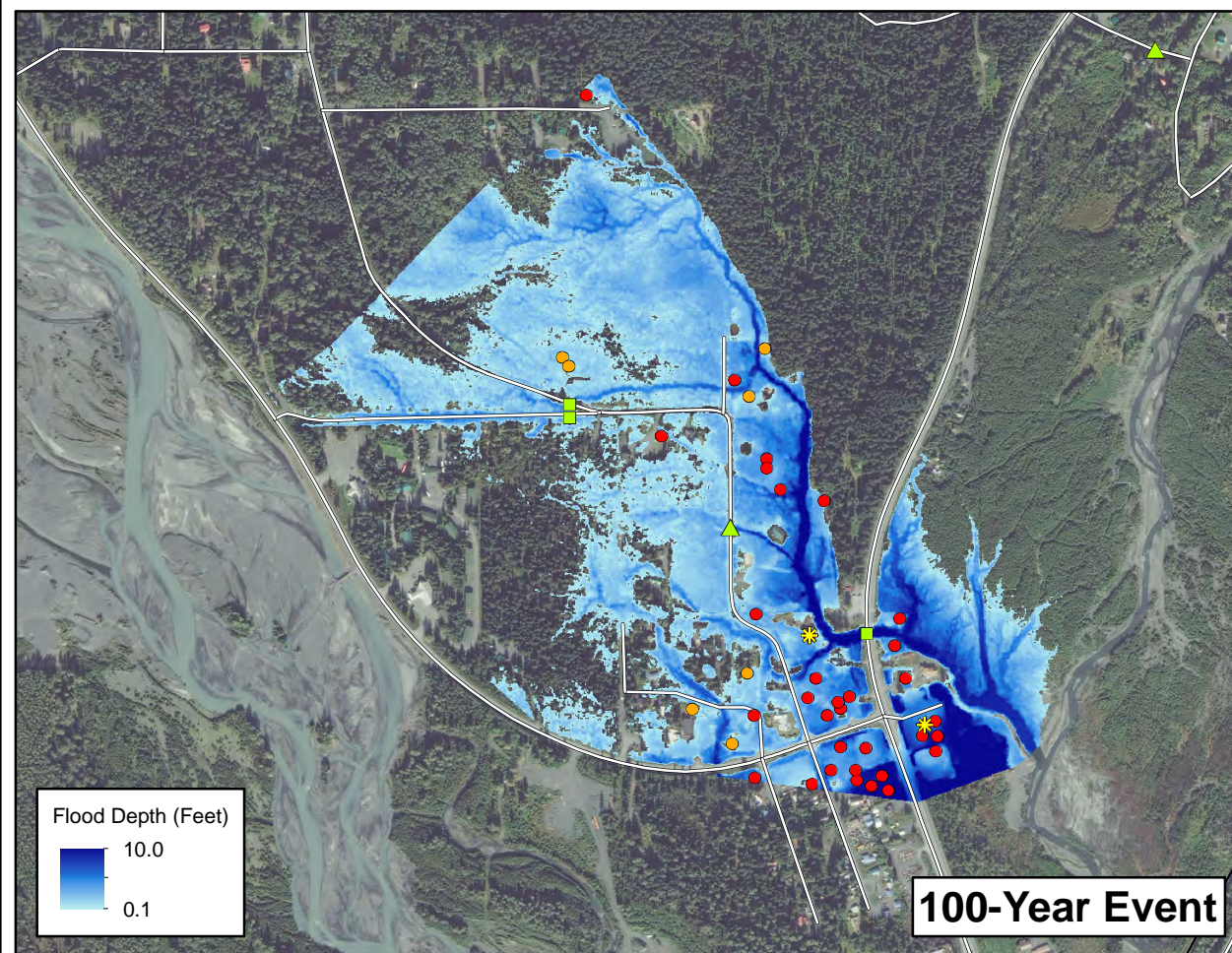
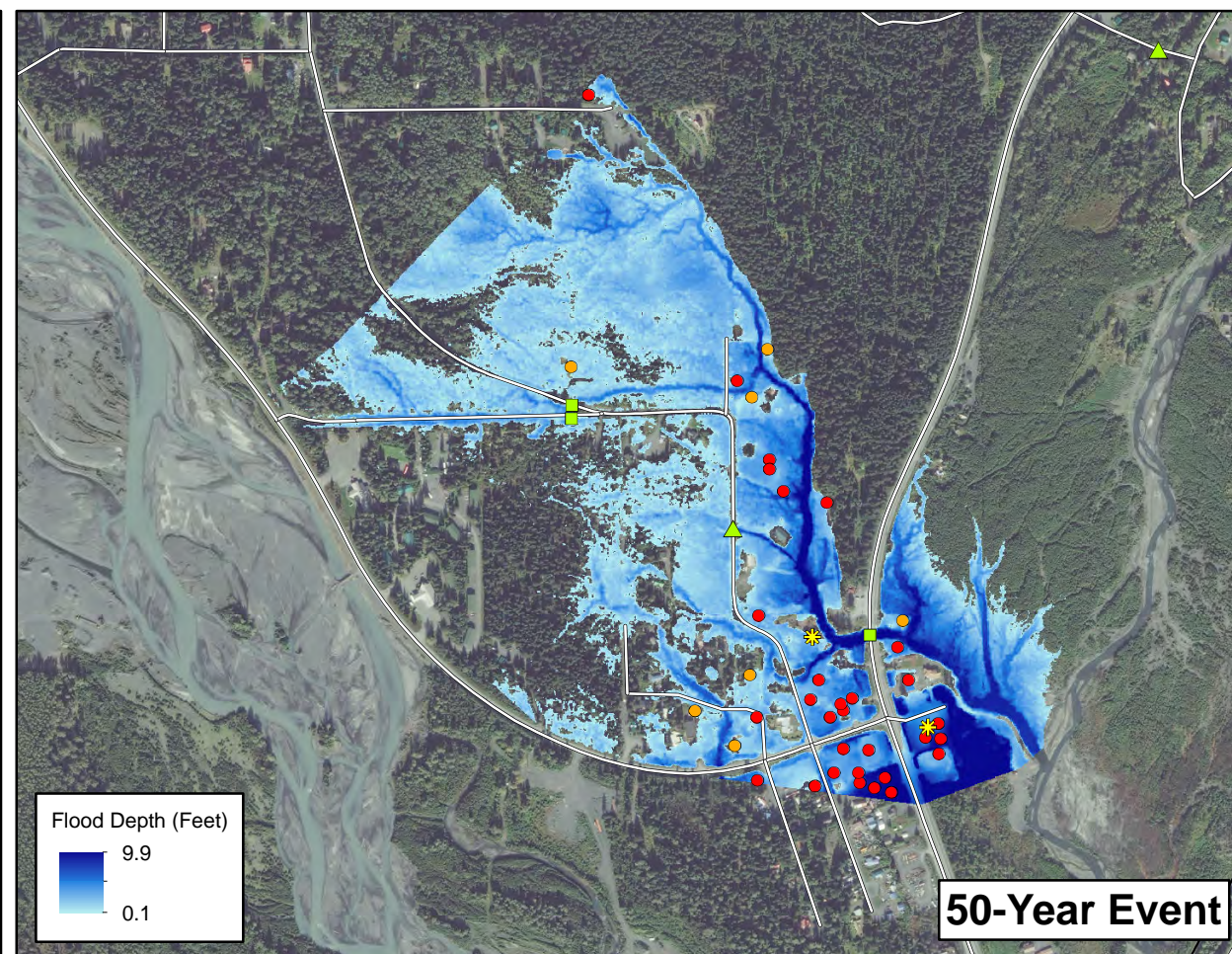
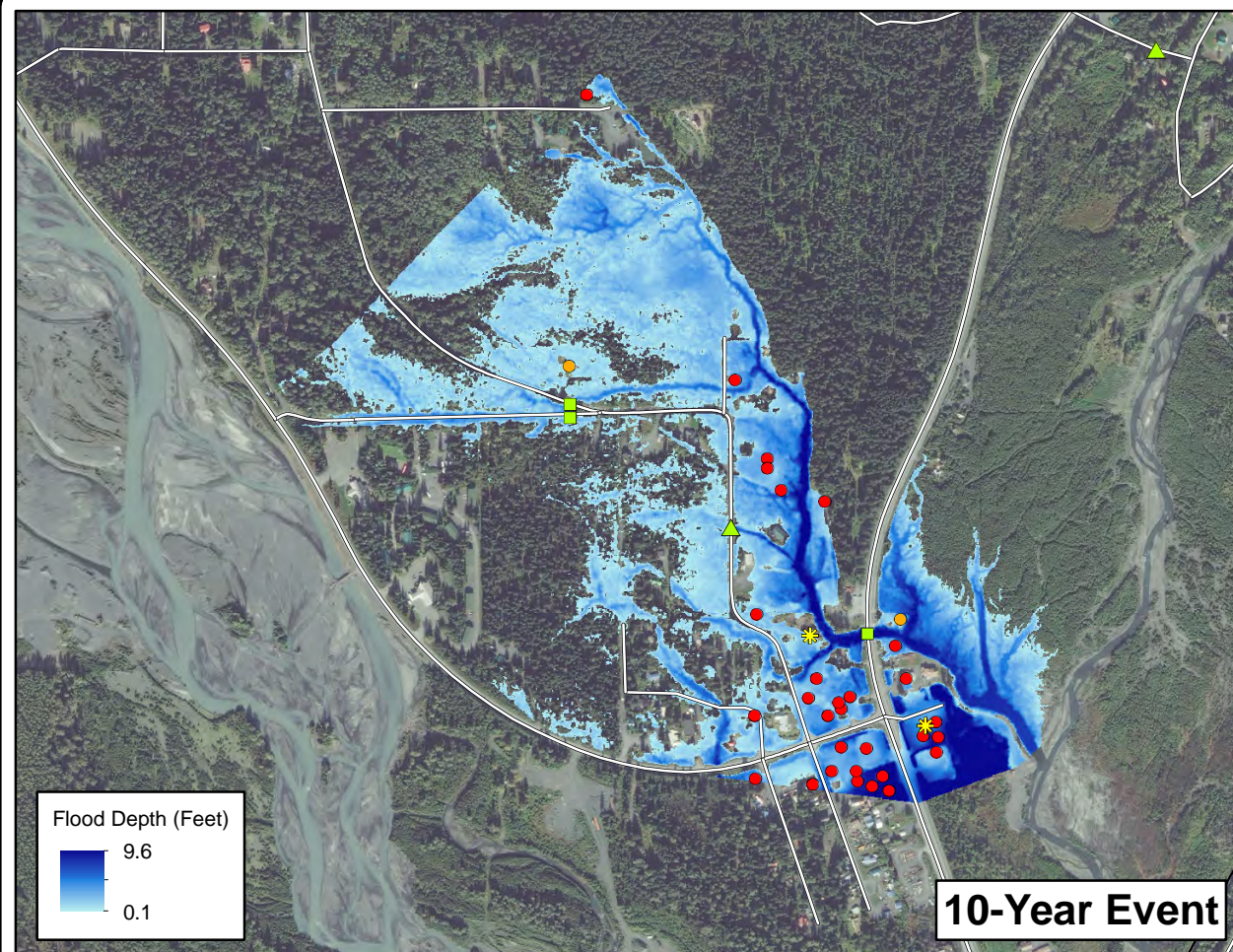
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**CLEAR CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-18



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\CLEAR\_2062.mxd Plot Date: 4/19/2013

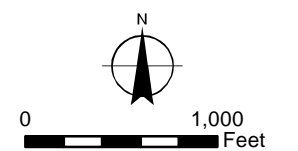


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



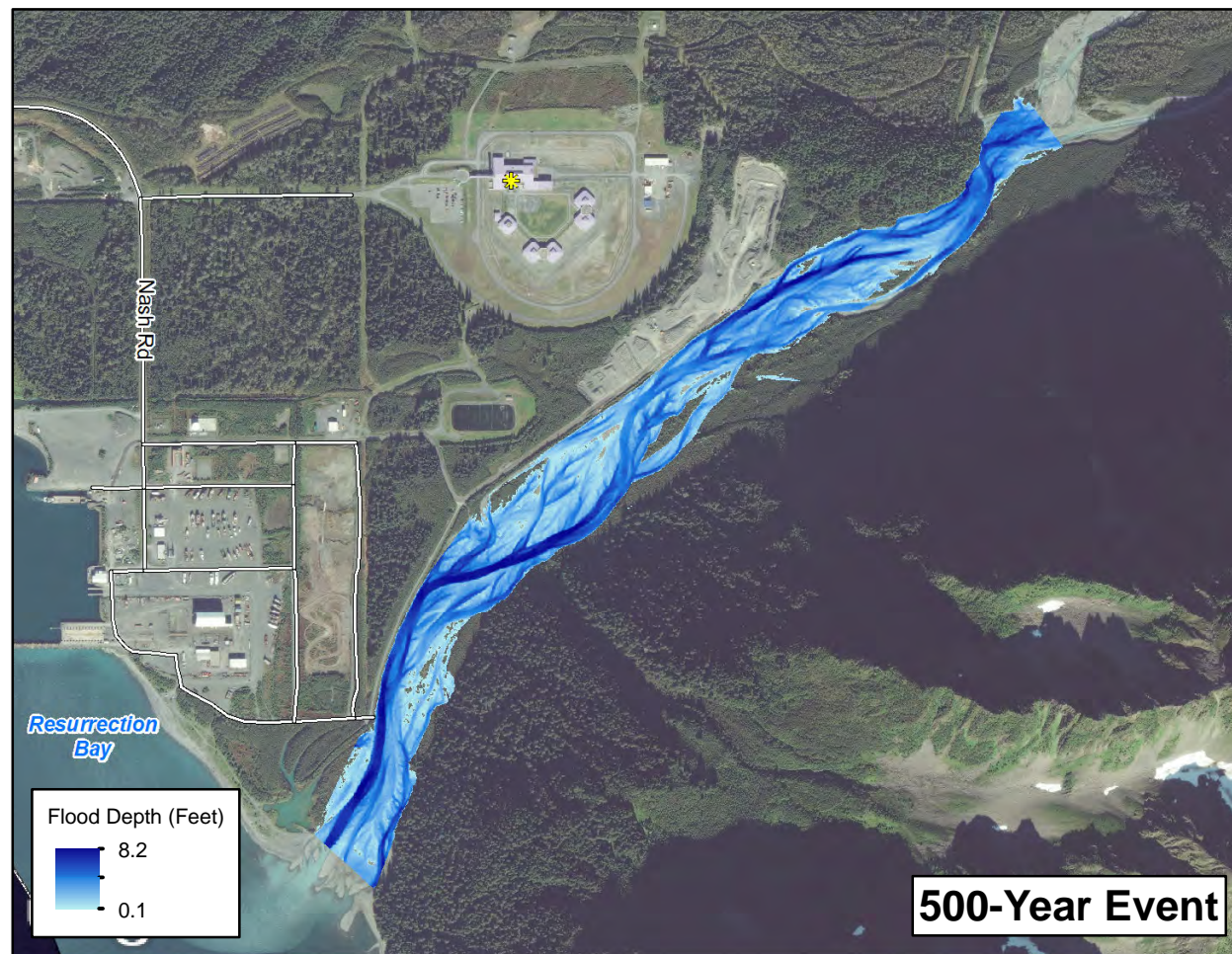
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**CLEAR CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-19



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\FourthofJuly\_2012.mxd Plot Date: 4/19/2013

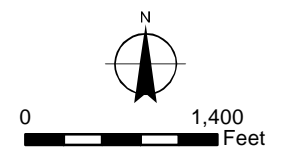


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

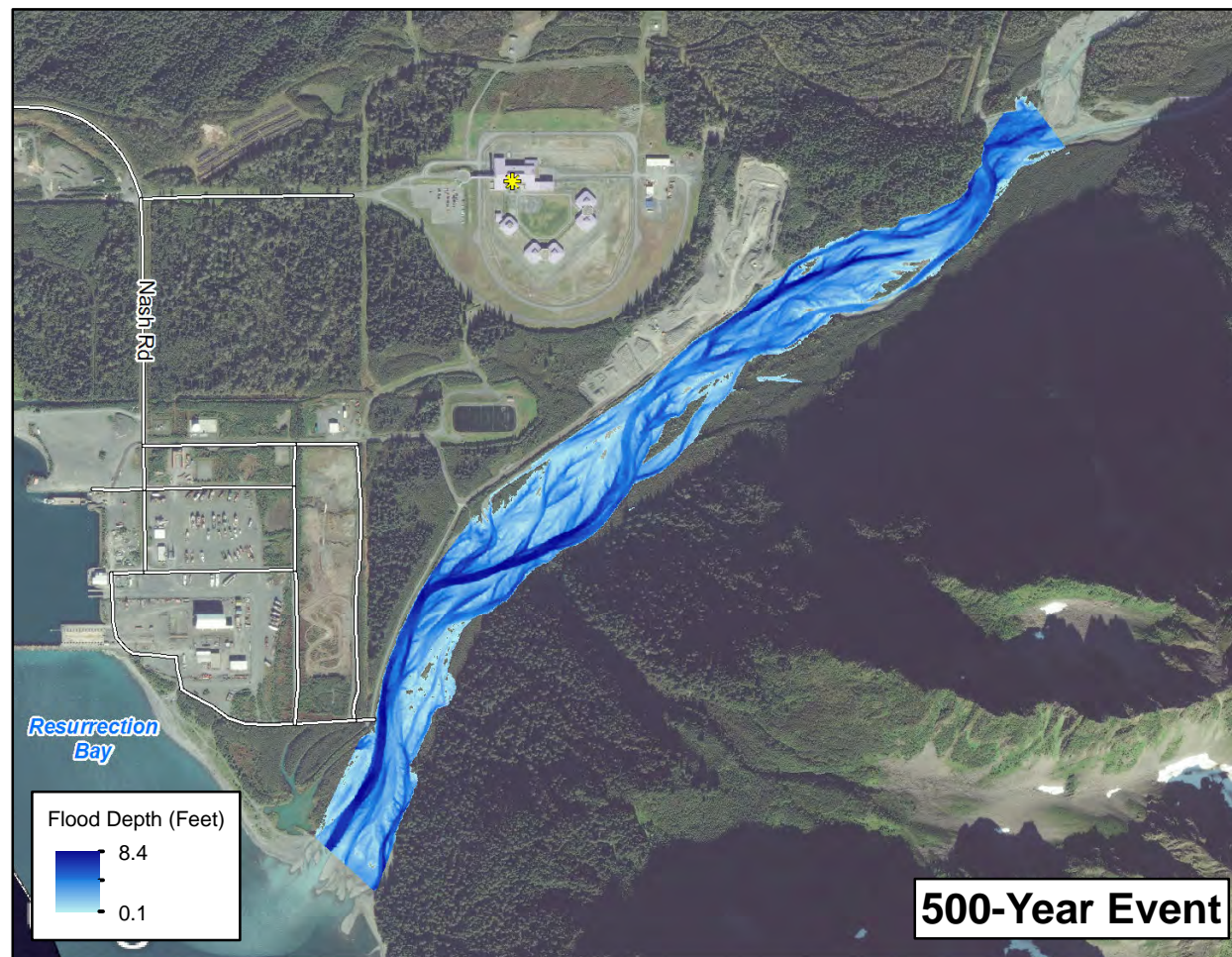
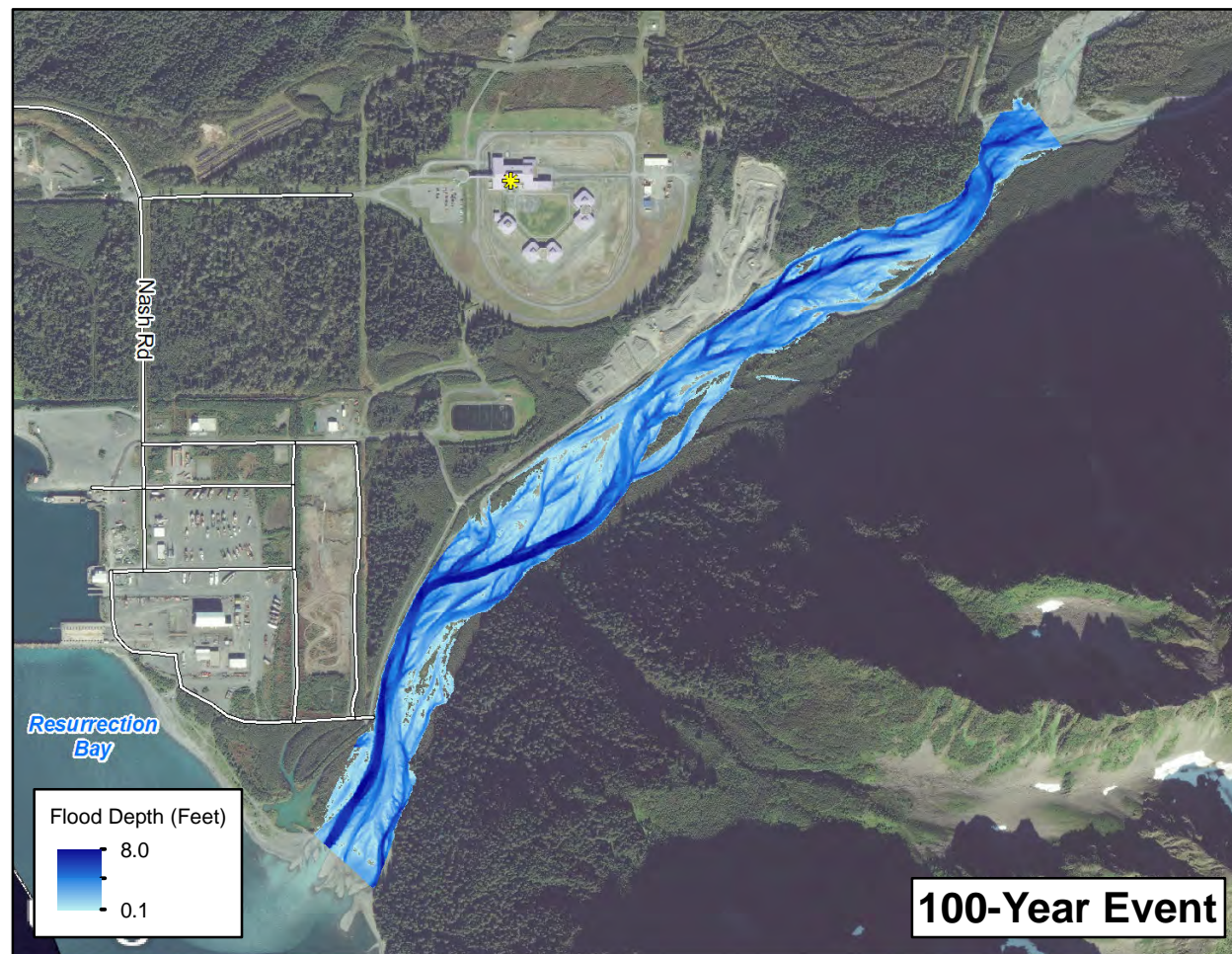
1. No structures are wet or damaged with this scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX  
**FOURTH OF JULY CREEK  
MODELED FLOODPLAIN  
2012**  
MAP K-20



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\FourthofJuly\_2022.mxd Plot Date: 4/19/2013

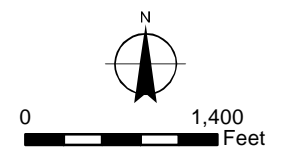


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

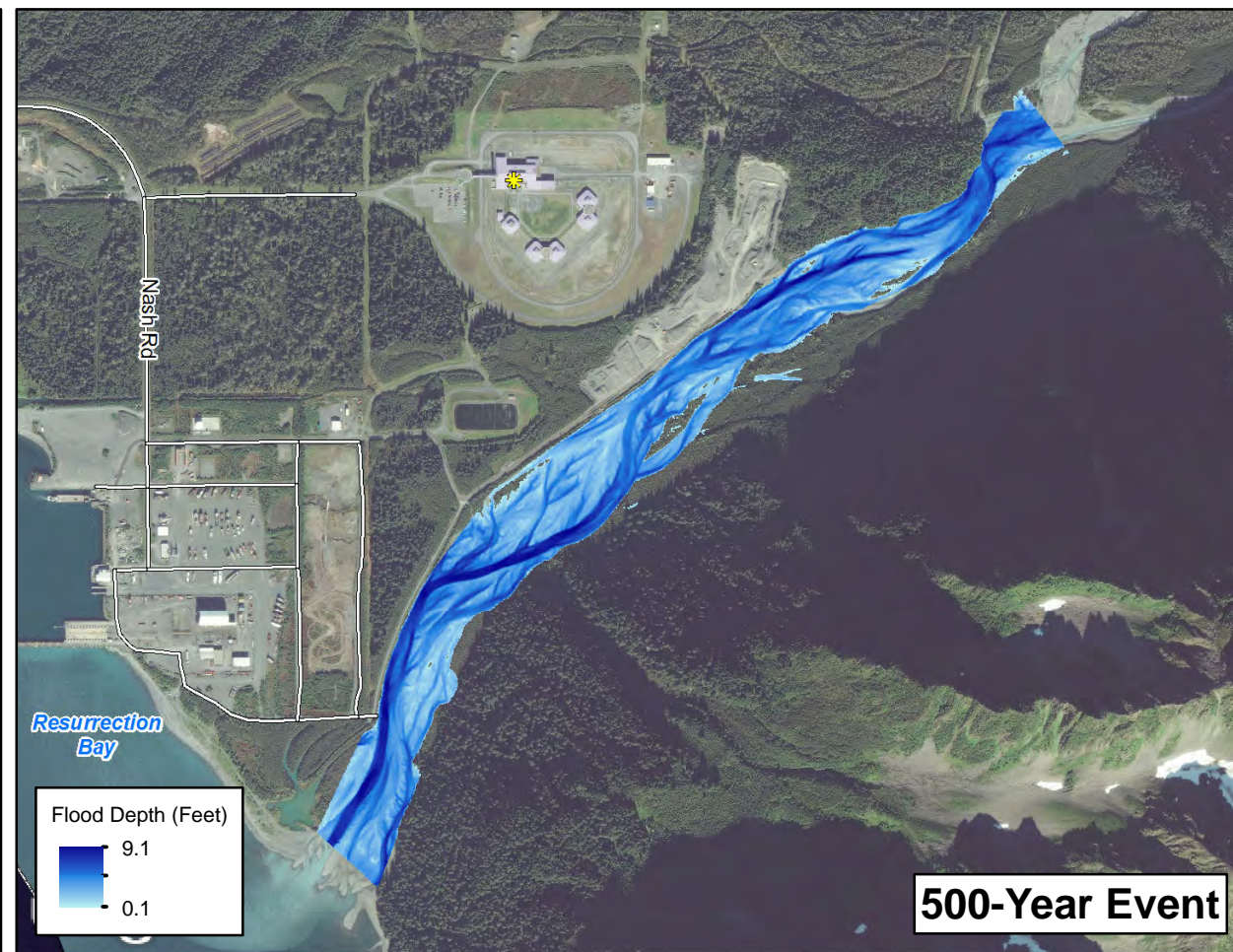
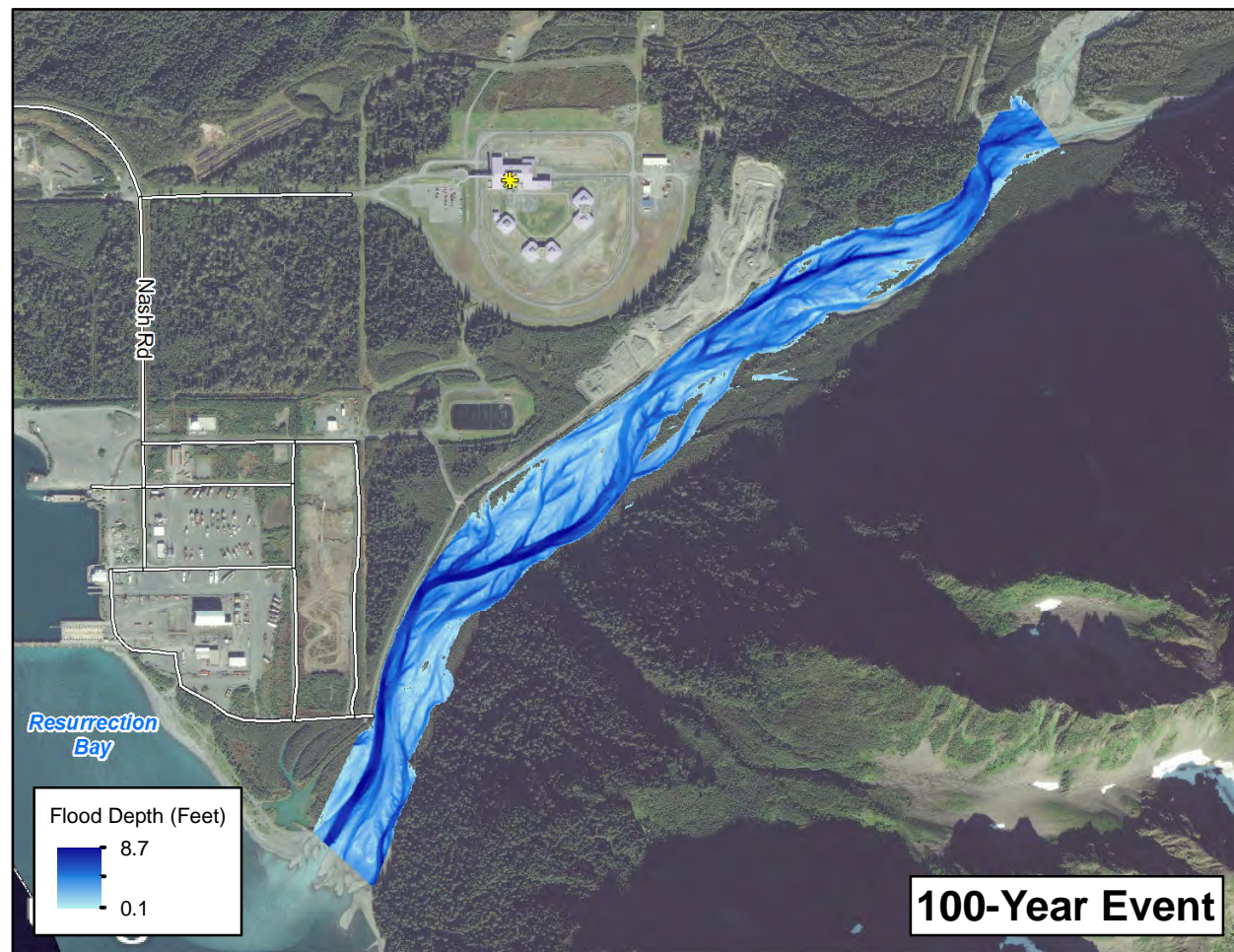
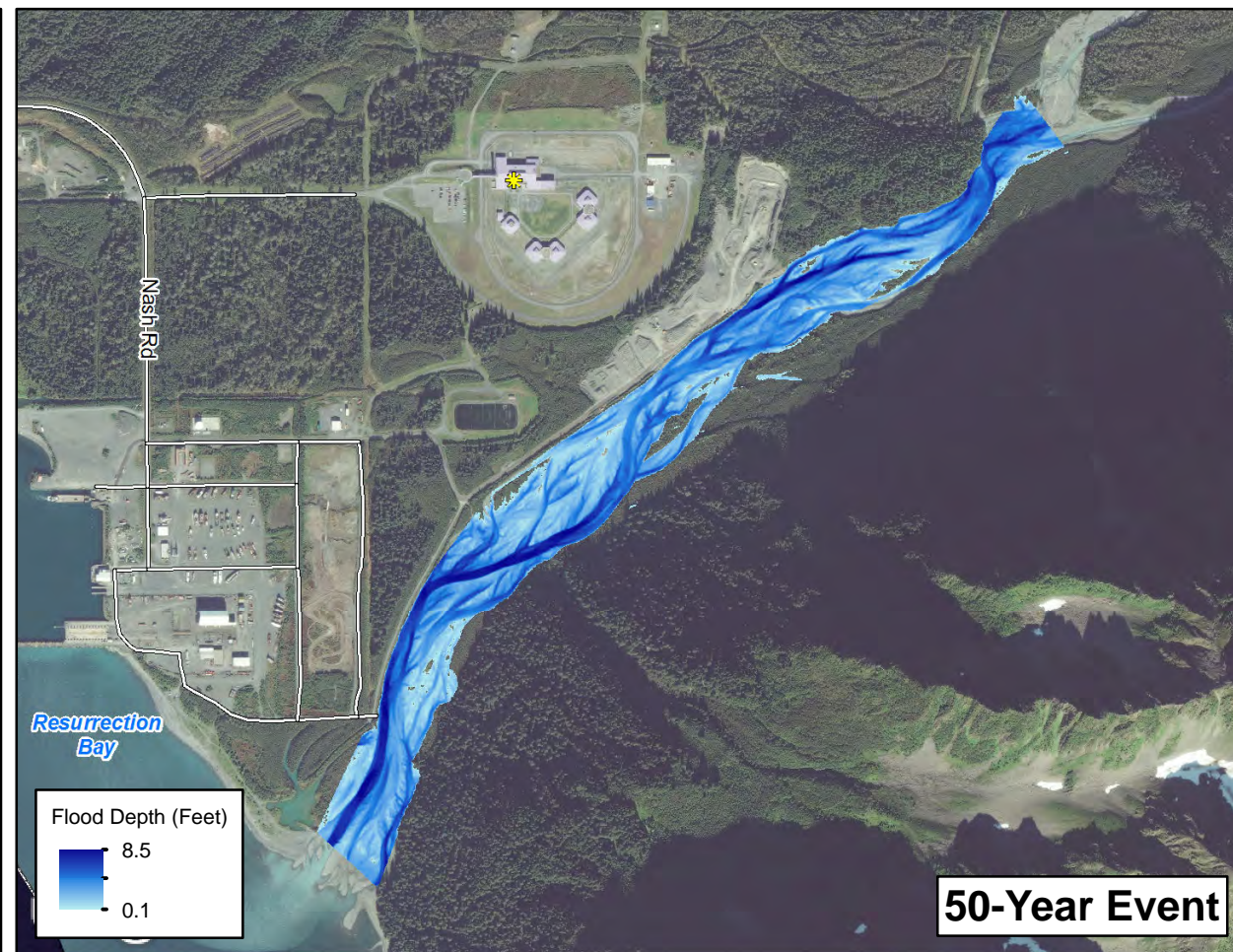
1. No structures are wet or damaged with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.
4. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX  
**FOURTH OF JULY CREEK  
MODELED FLOODPLAIN  
2022**  
MAP K-21



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\FourthofJuly\_2062.mxd Plot Date: 4/19/2013

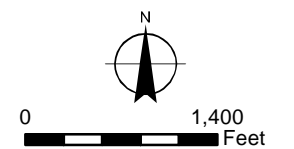


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.
4. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

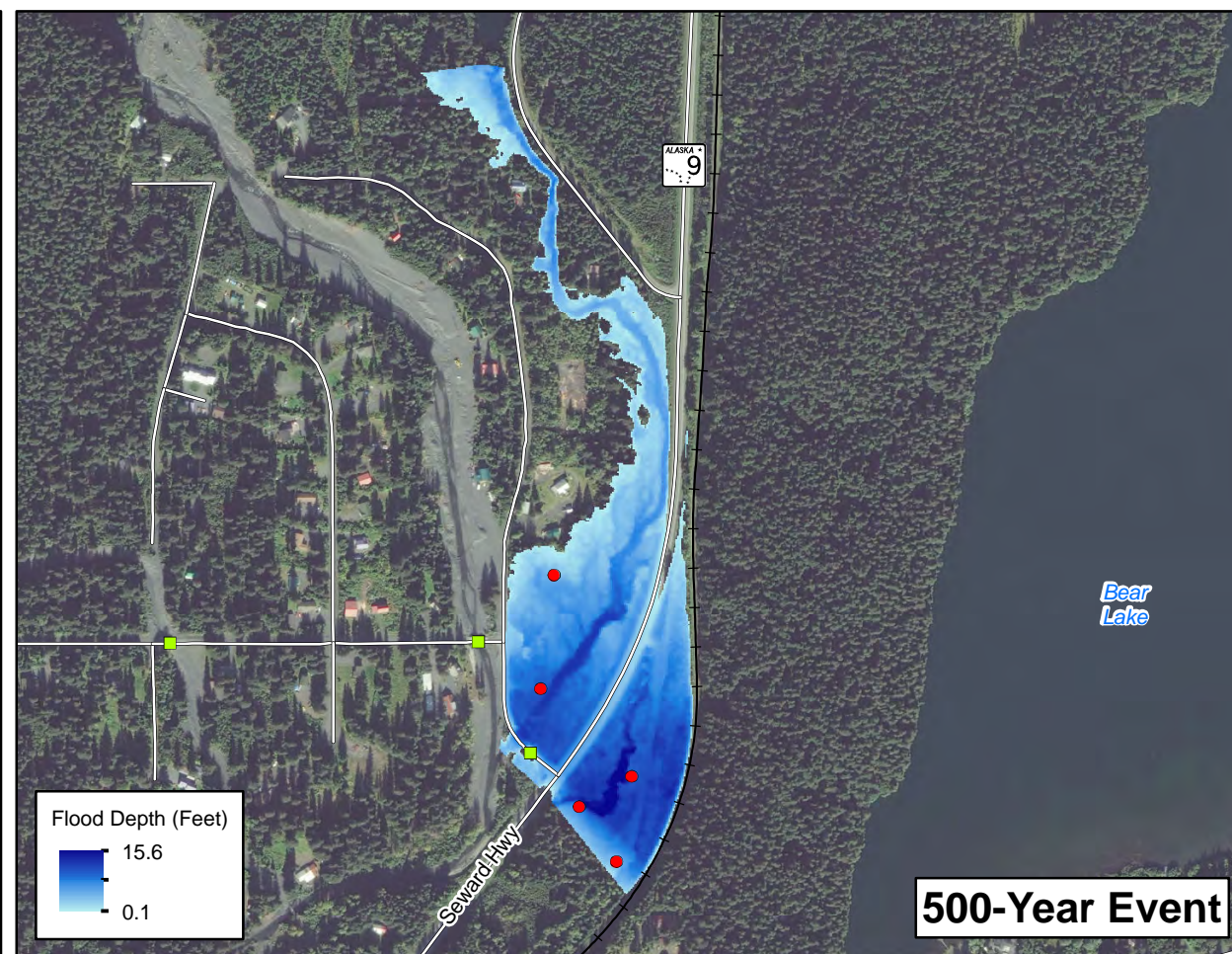
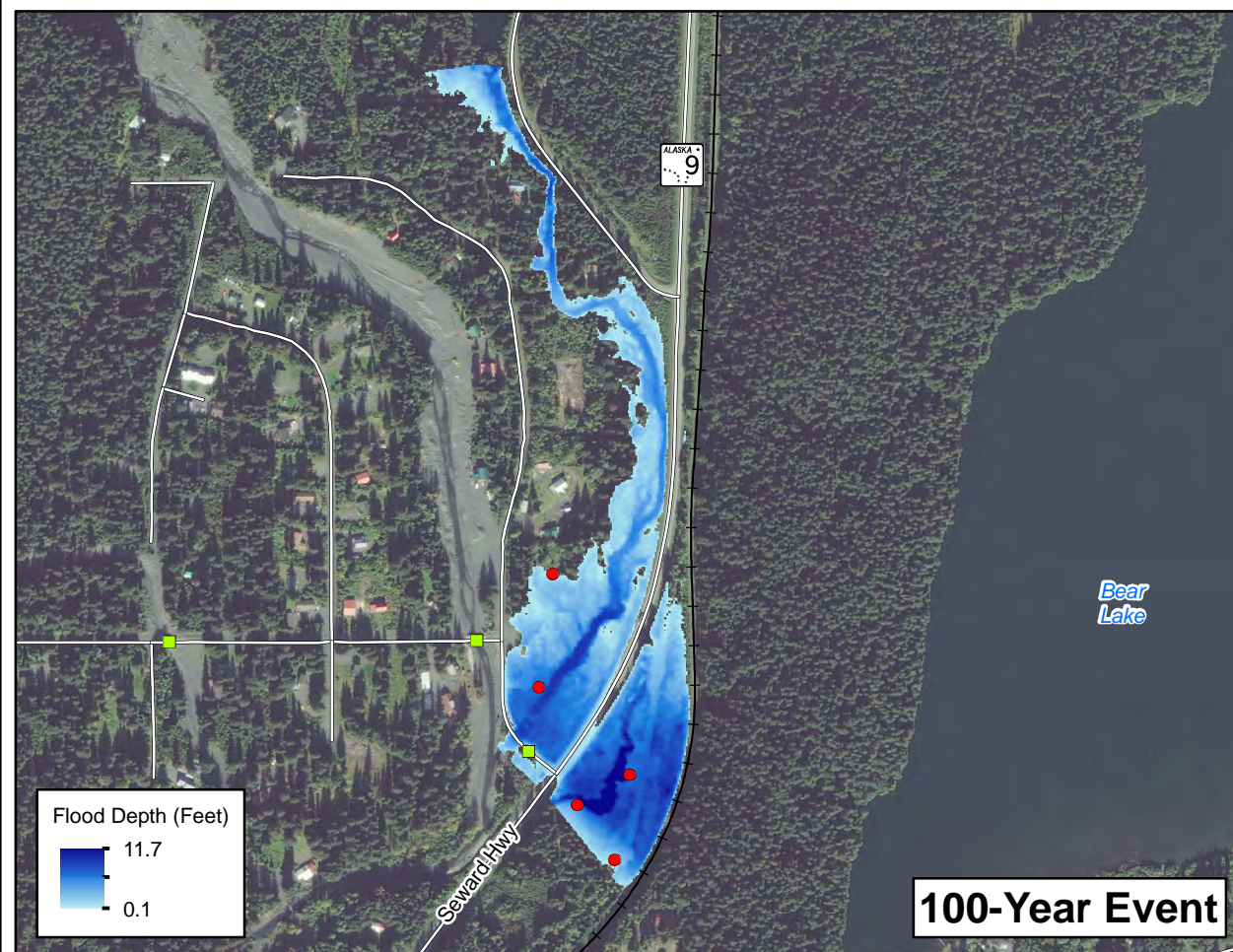
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**FOURTH OF JULY CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-22



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Grouse\_2012.mxd Plot Date: 4/19/2013

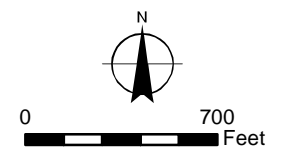


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. There were no wet, undamaged structures with this scenario
2. Base reference data from Kenai Peninsula Borough.



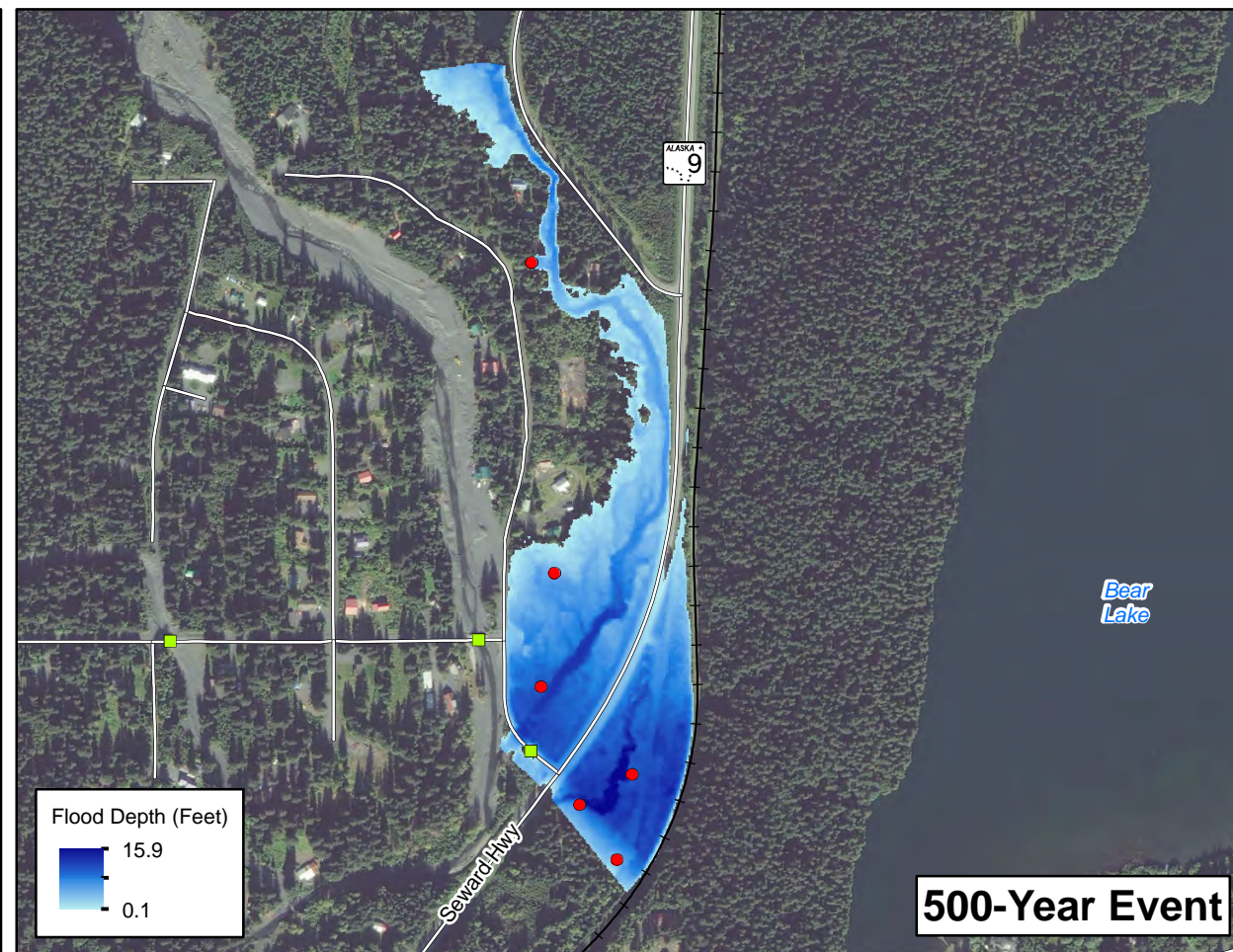
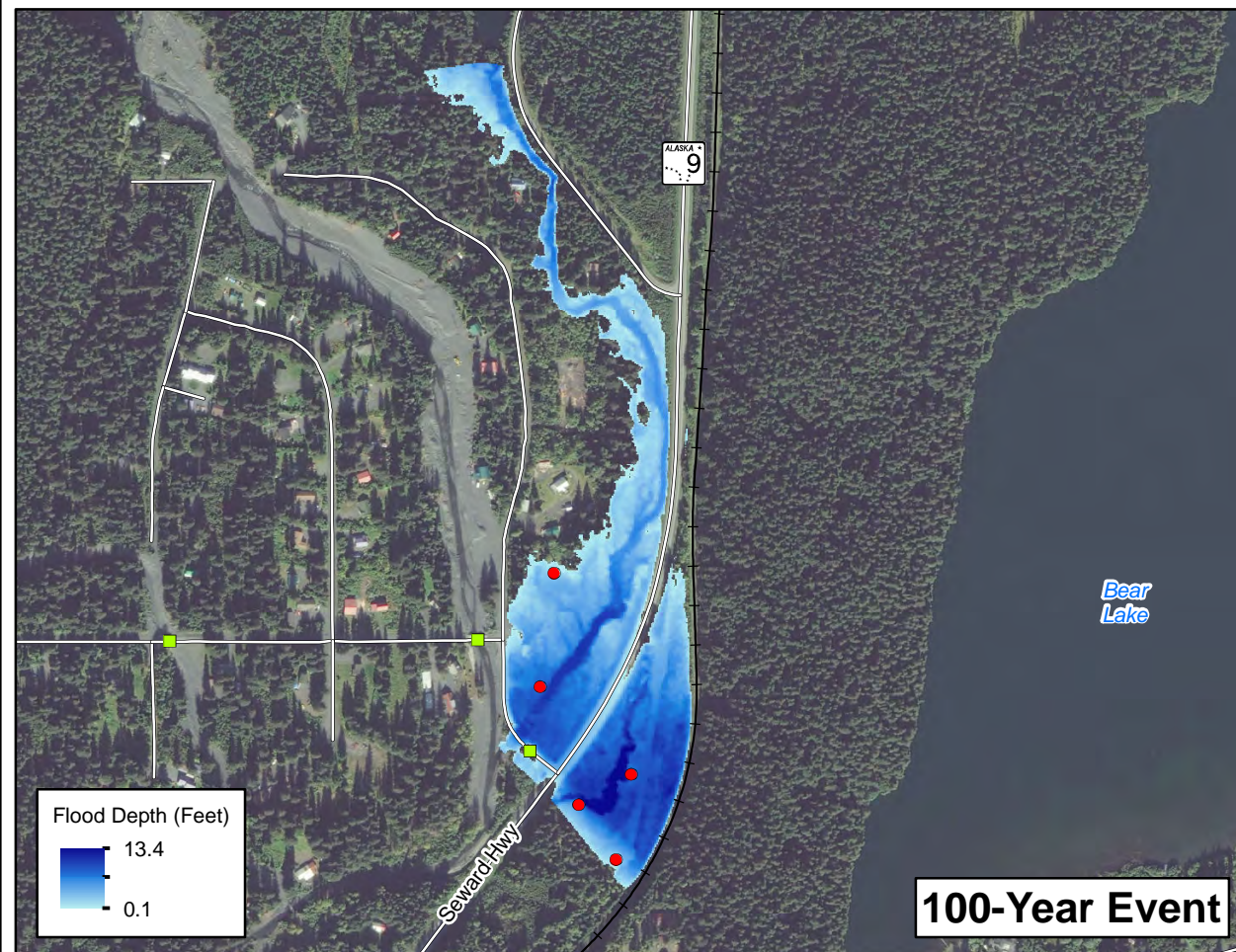
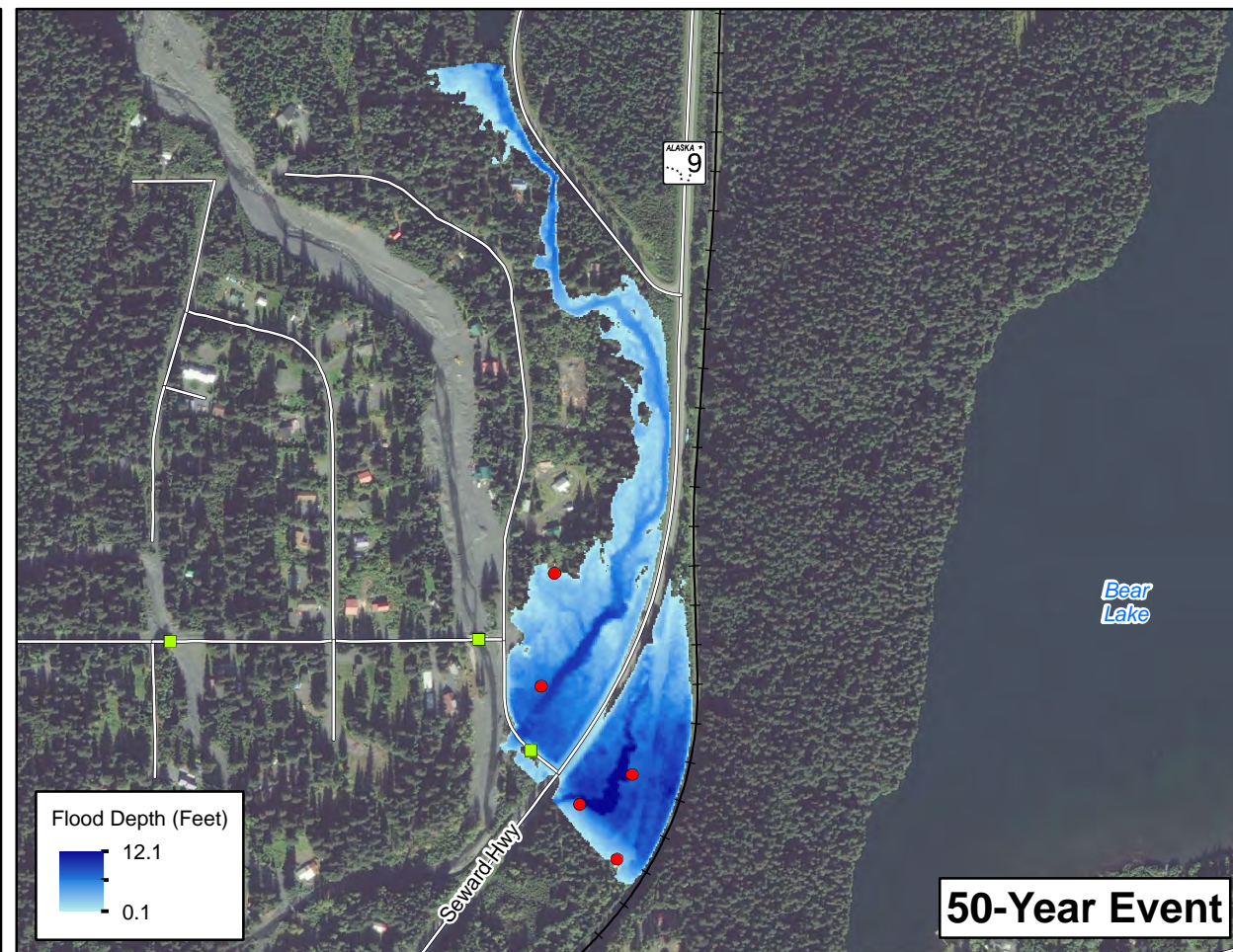
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**GROUSE CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-23



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Grouse\_2022.mxd Plot Date: 4/19/2013

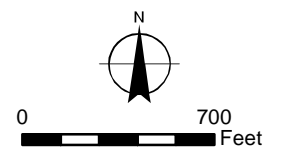


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. There were no wet, undamaged structures with this scenario
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.



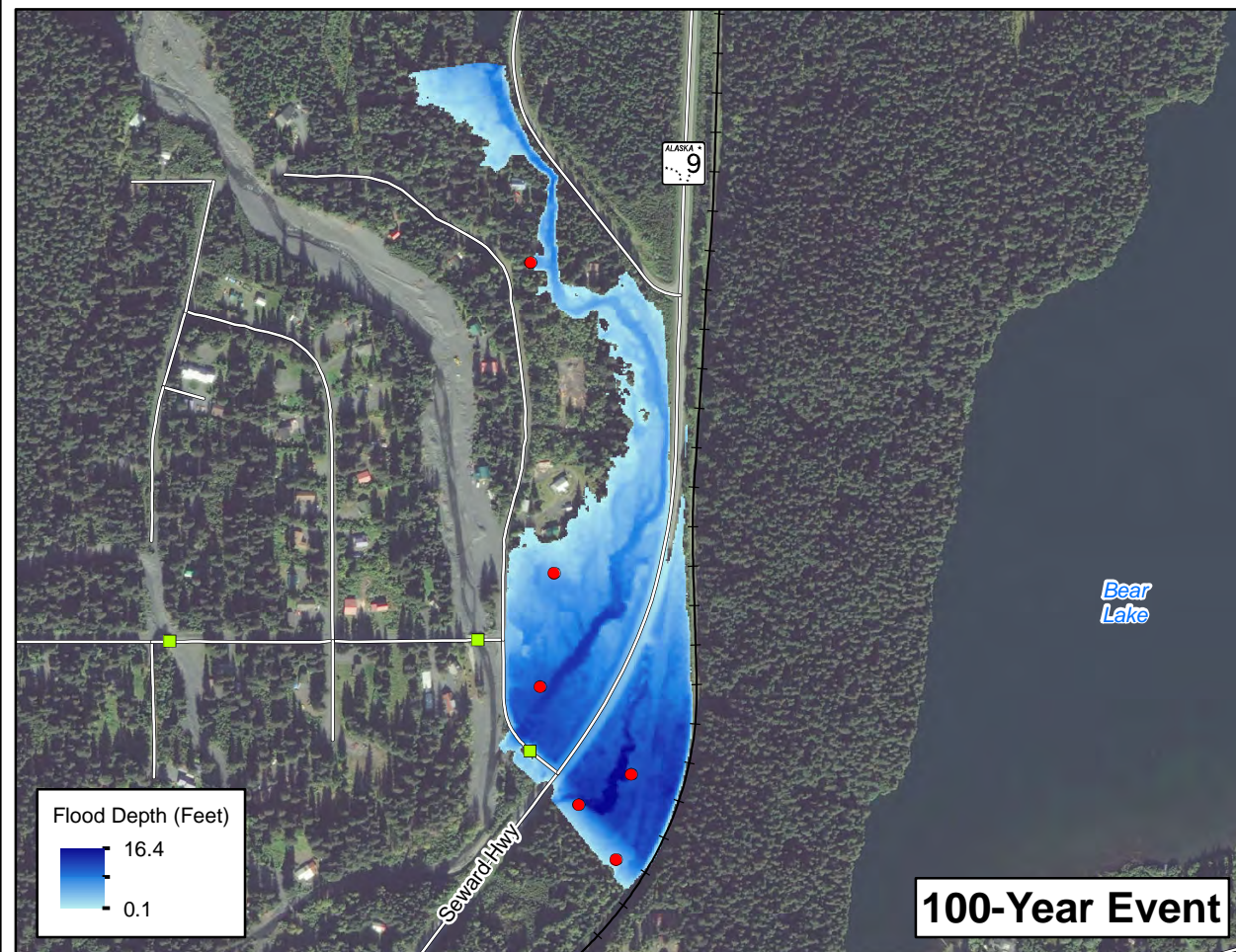
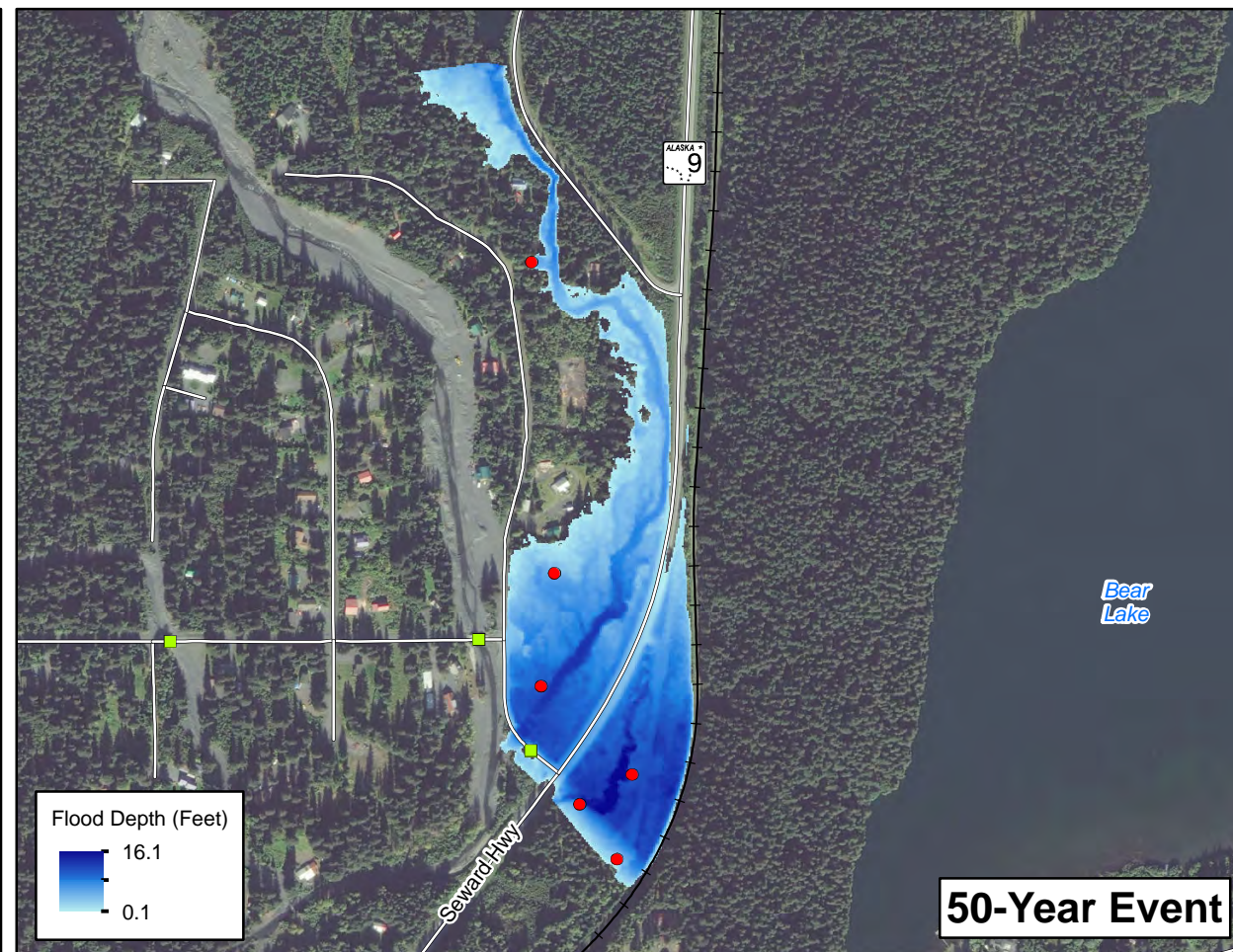
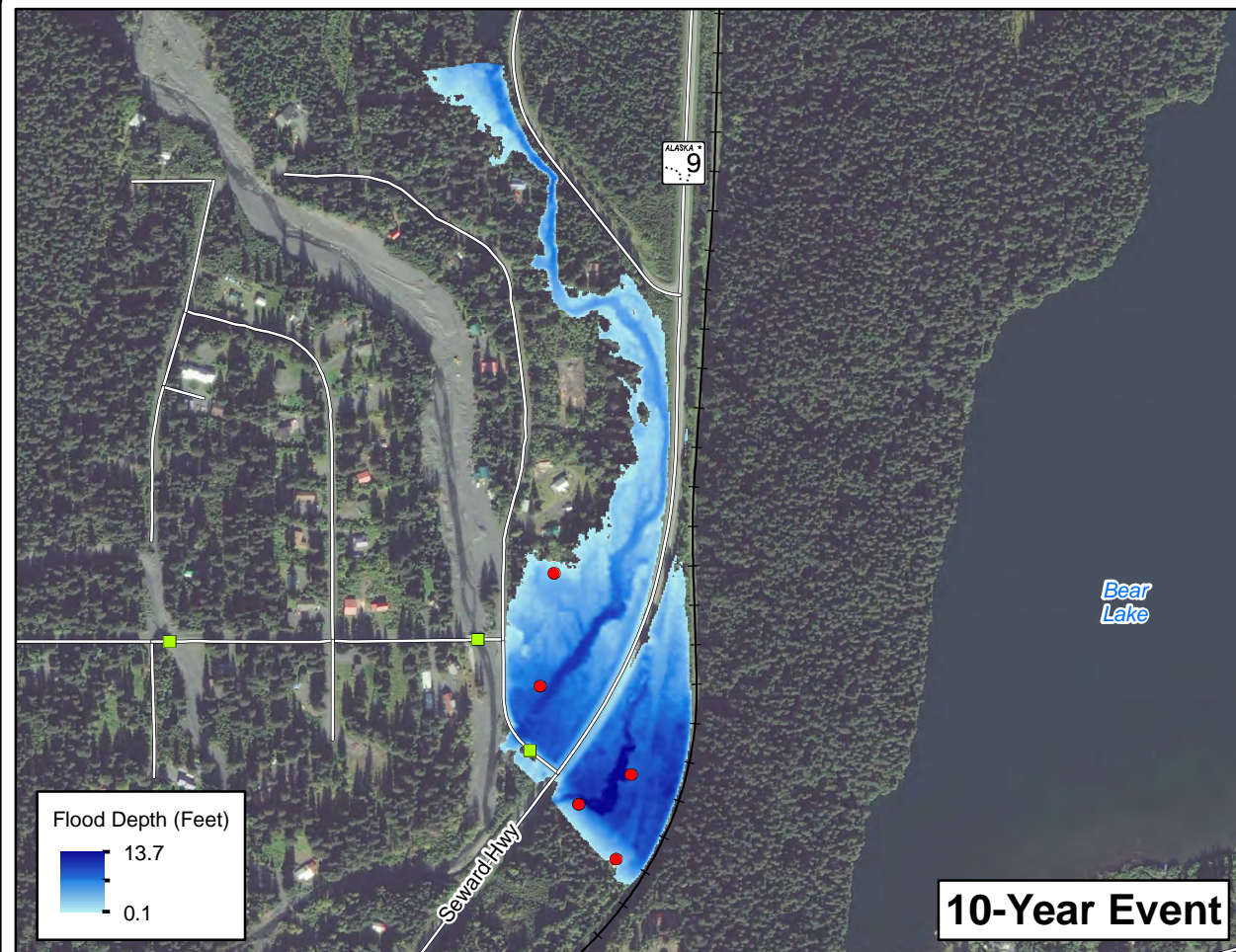
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

GROUSE CREEK  
MODELED FLOODPLAIN  
2022

MAP K-24



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Grouse\_2062.mxd Plot Date: 4/19/2013

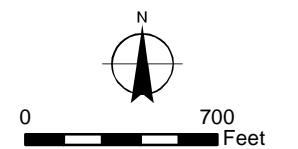


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



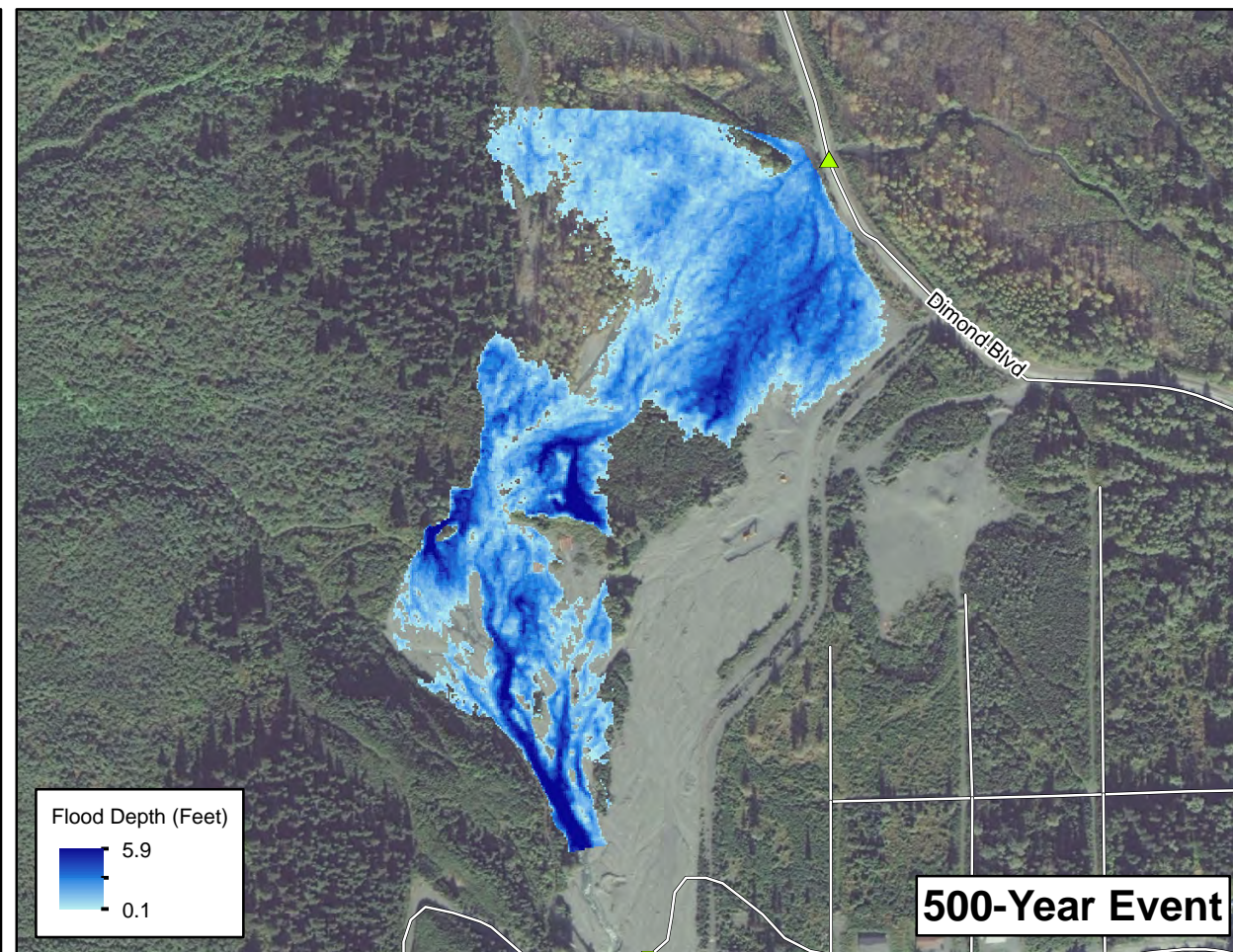
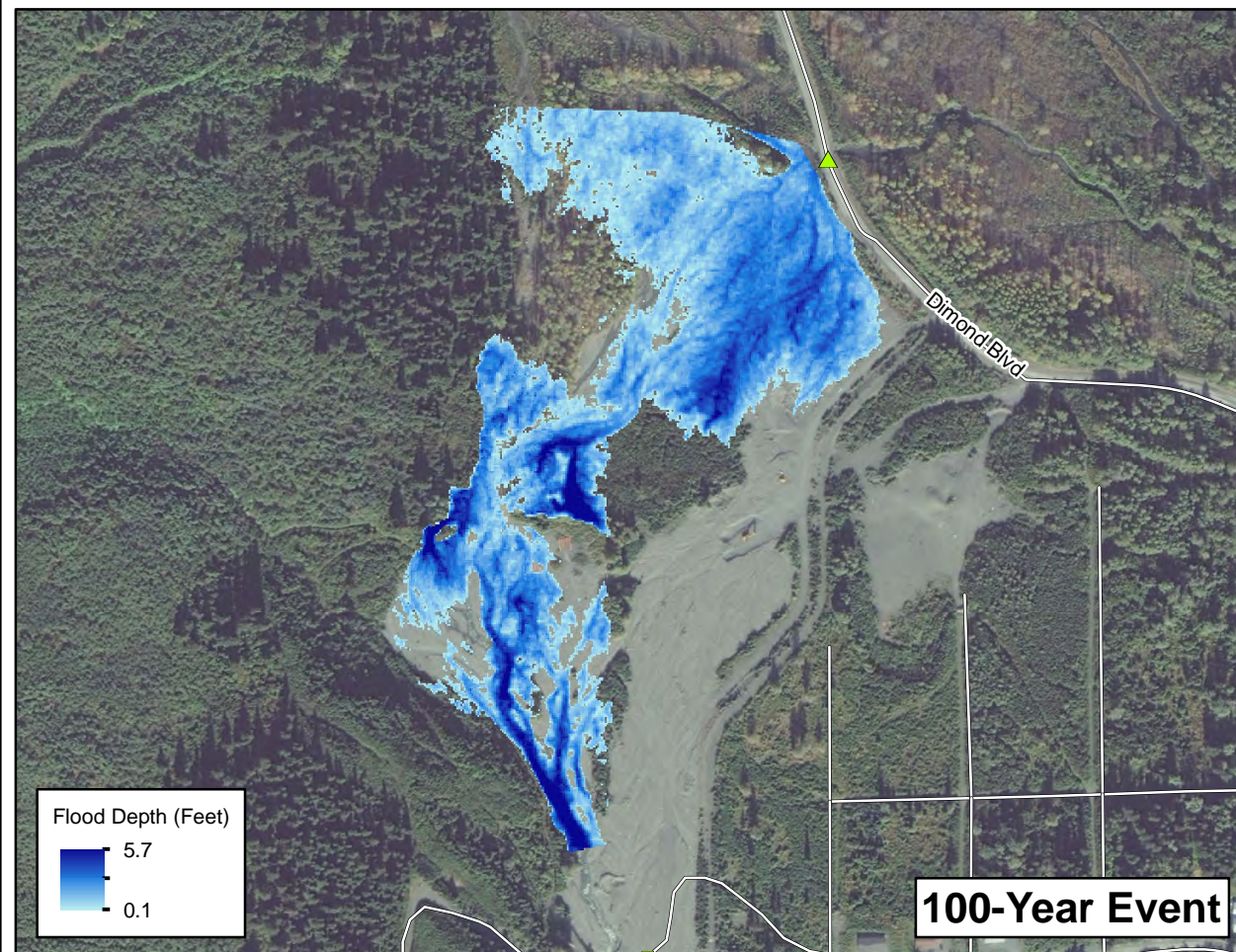
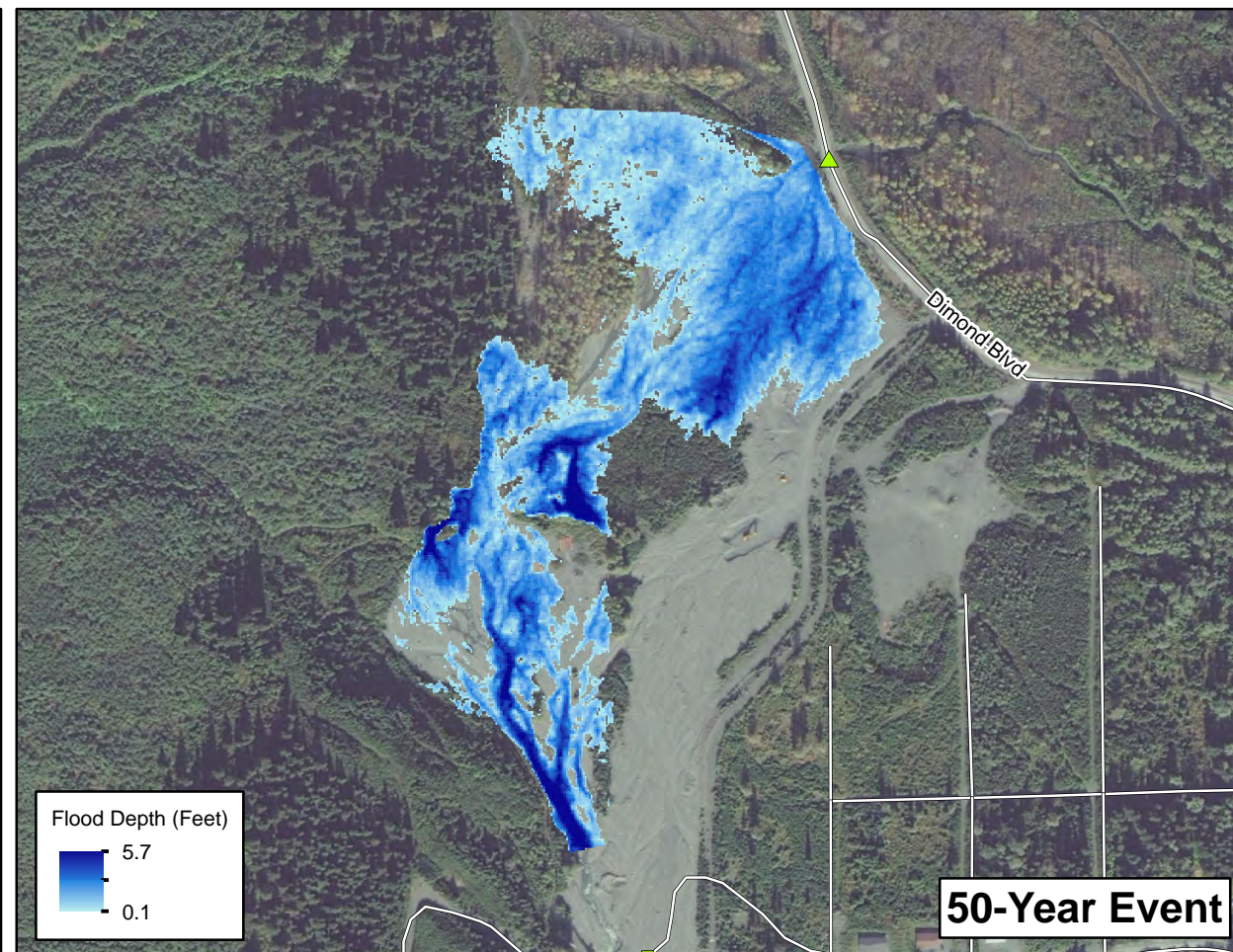
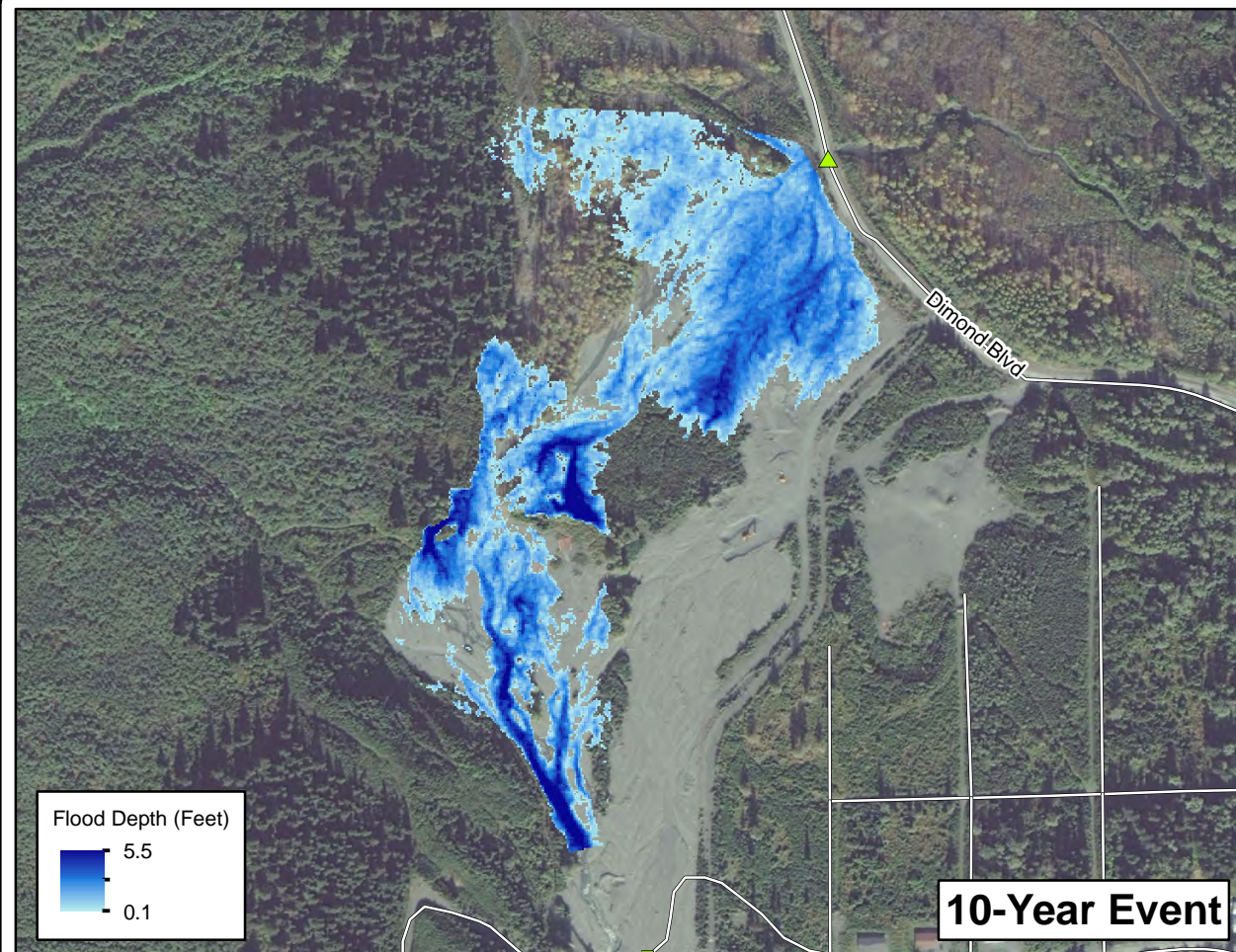
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

GROUSE CREEK  
MODELED FLOODPLAIN  
2062

MAP K-25



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Japanese\_2012.mxd Plot Date: 4/19/2013

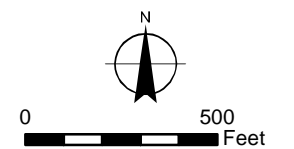


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- + Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Base reference data from Kenai Peninsula Borough.



**URS**

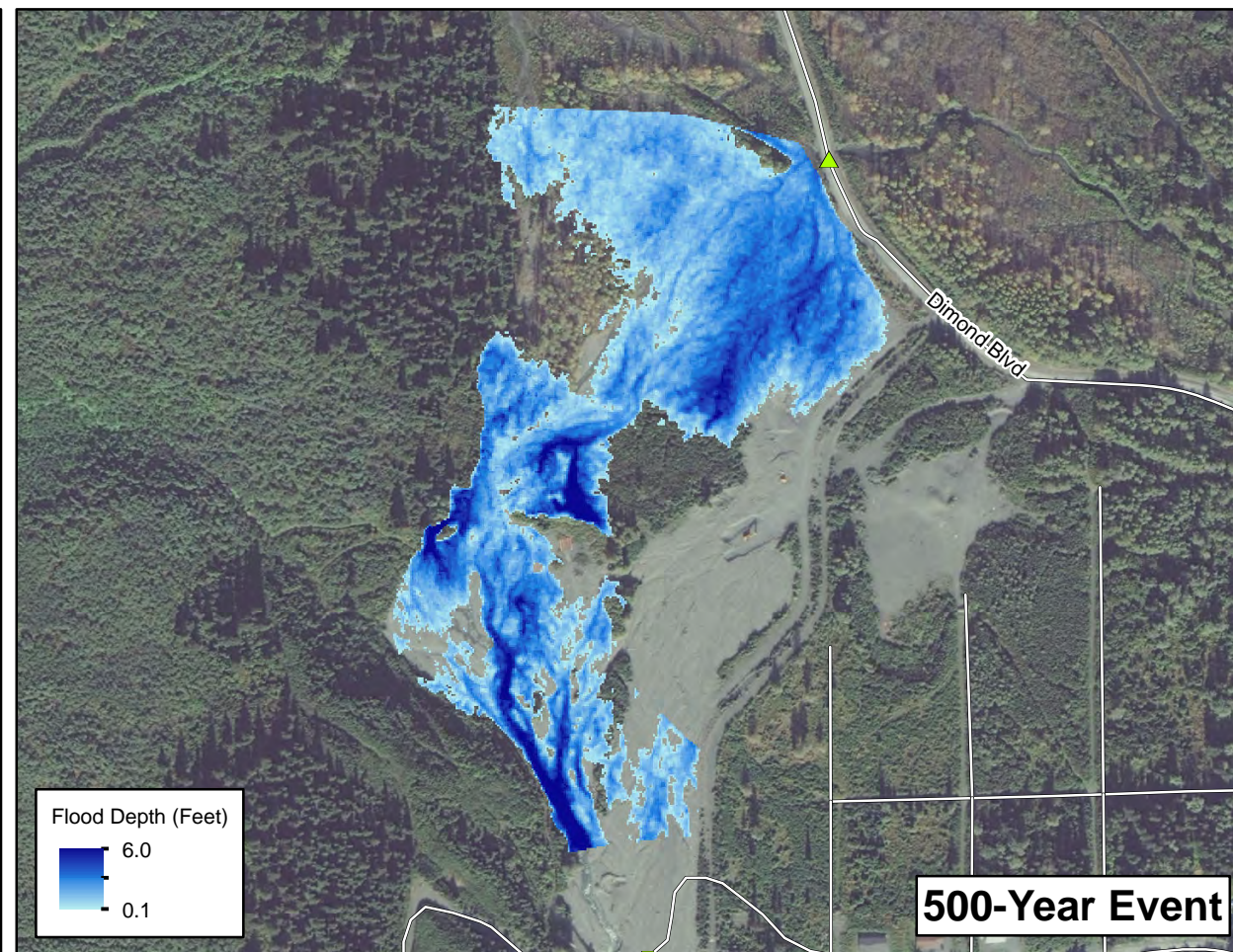
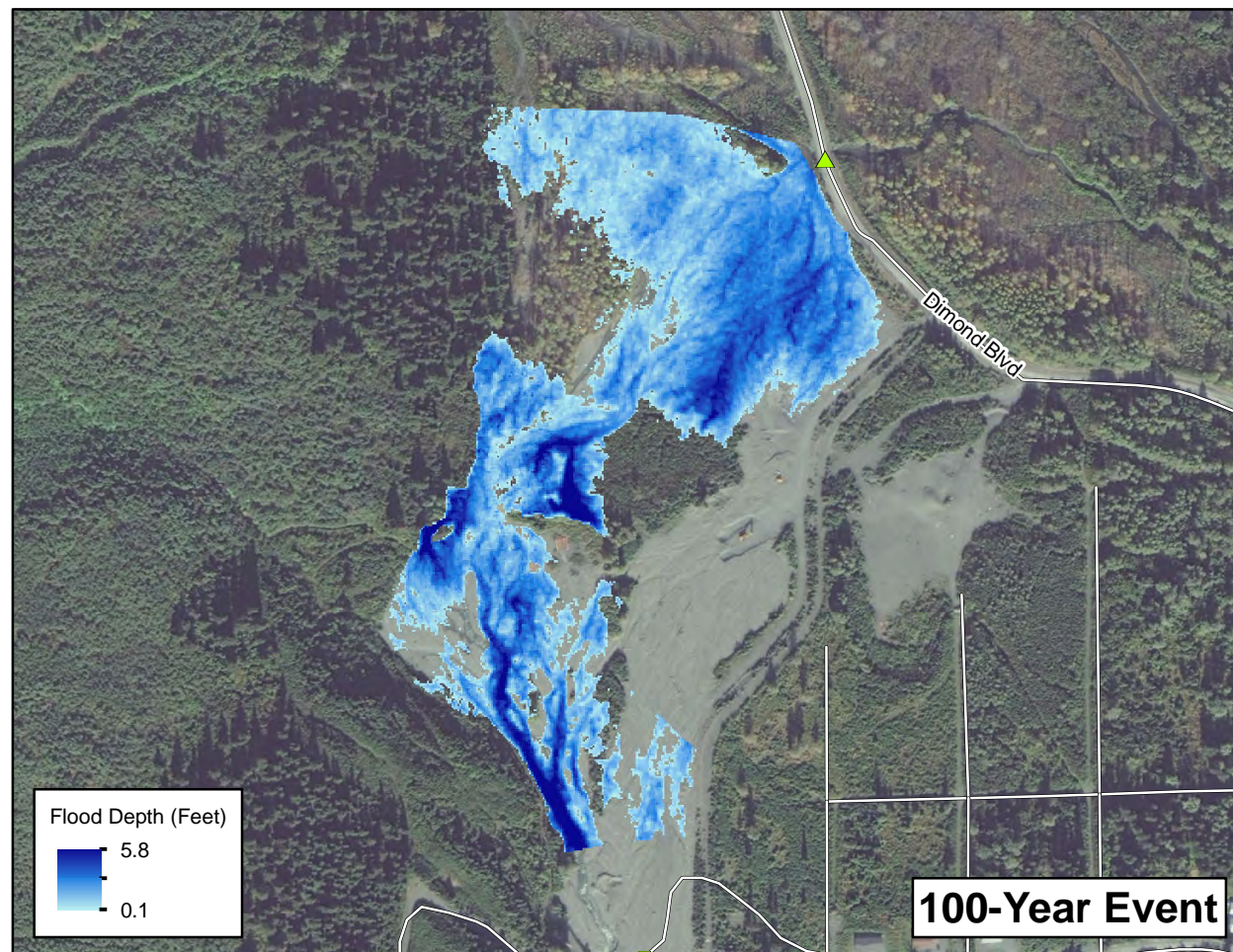
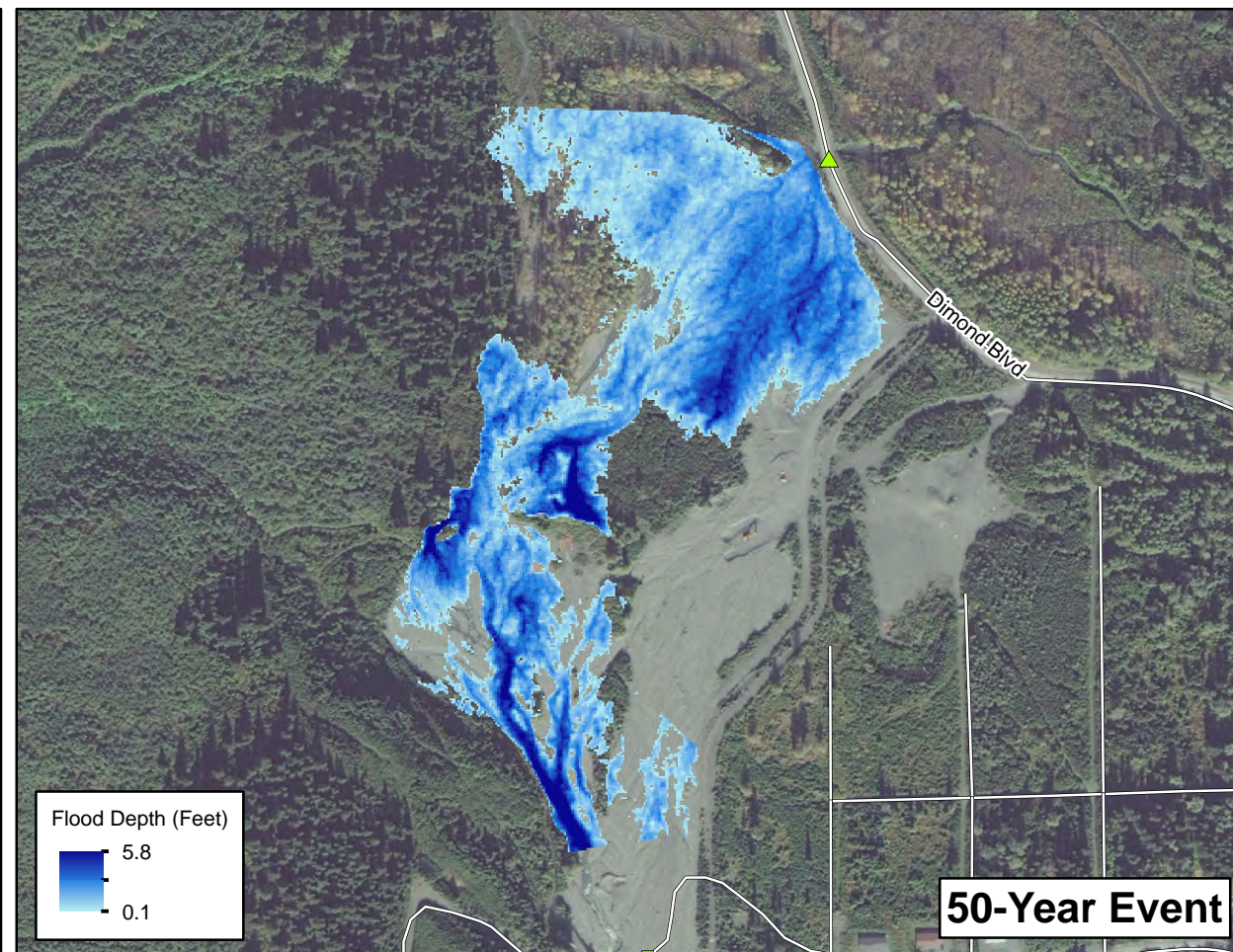
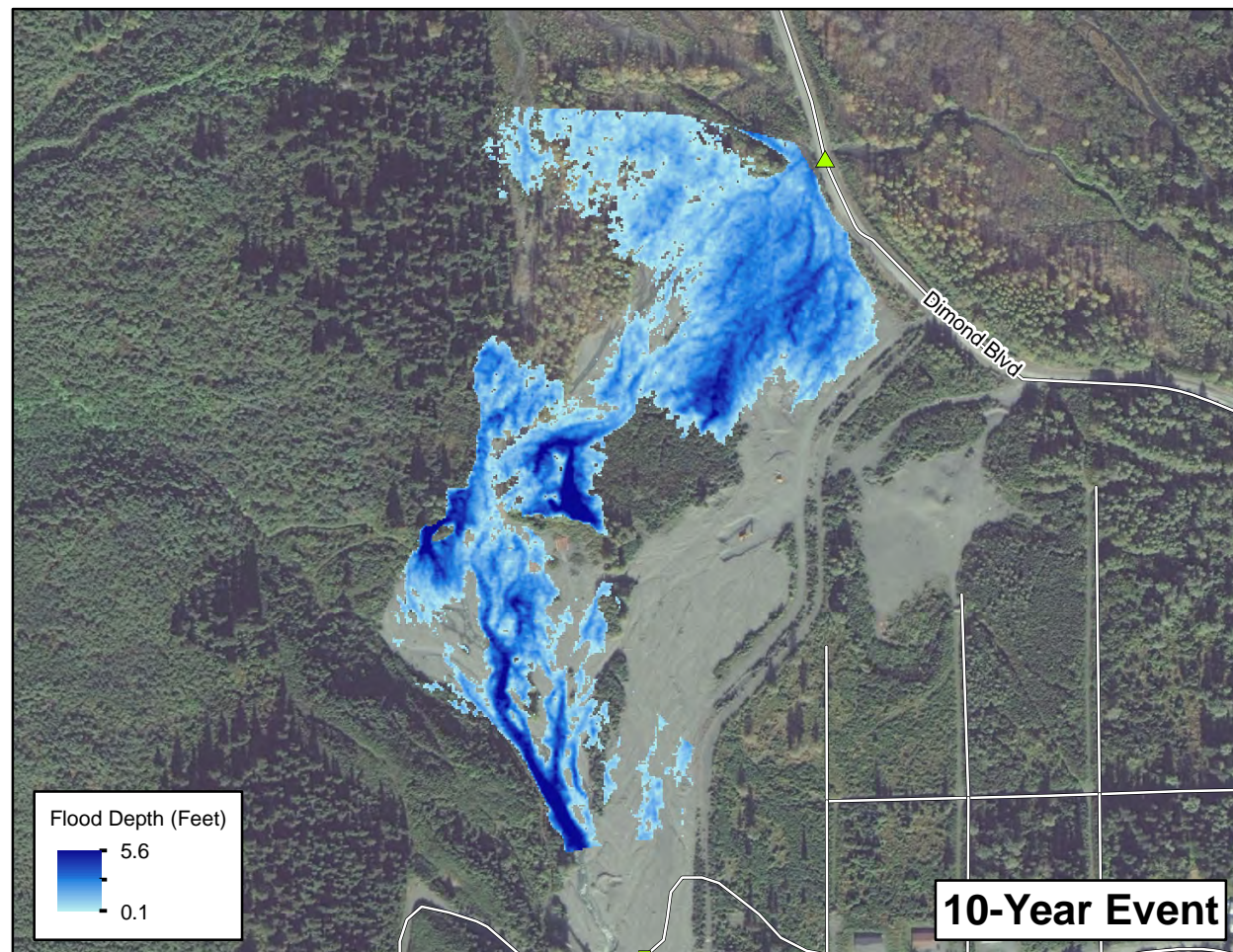
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**JAPANESE CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-26



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Japanese\_2022.mxd Plot Date: 4/19/2013

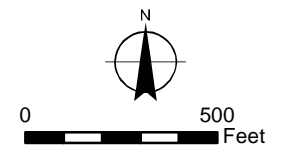


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- + Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.



URS

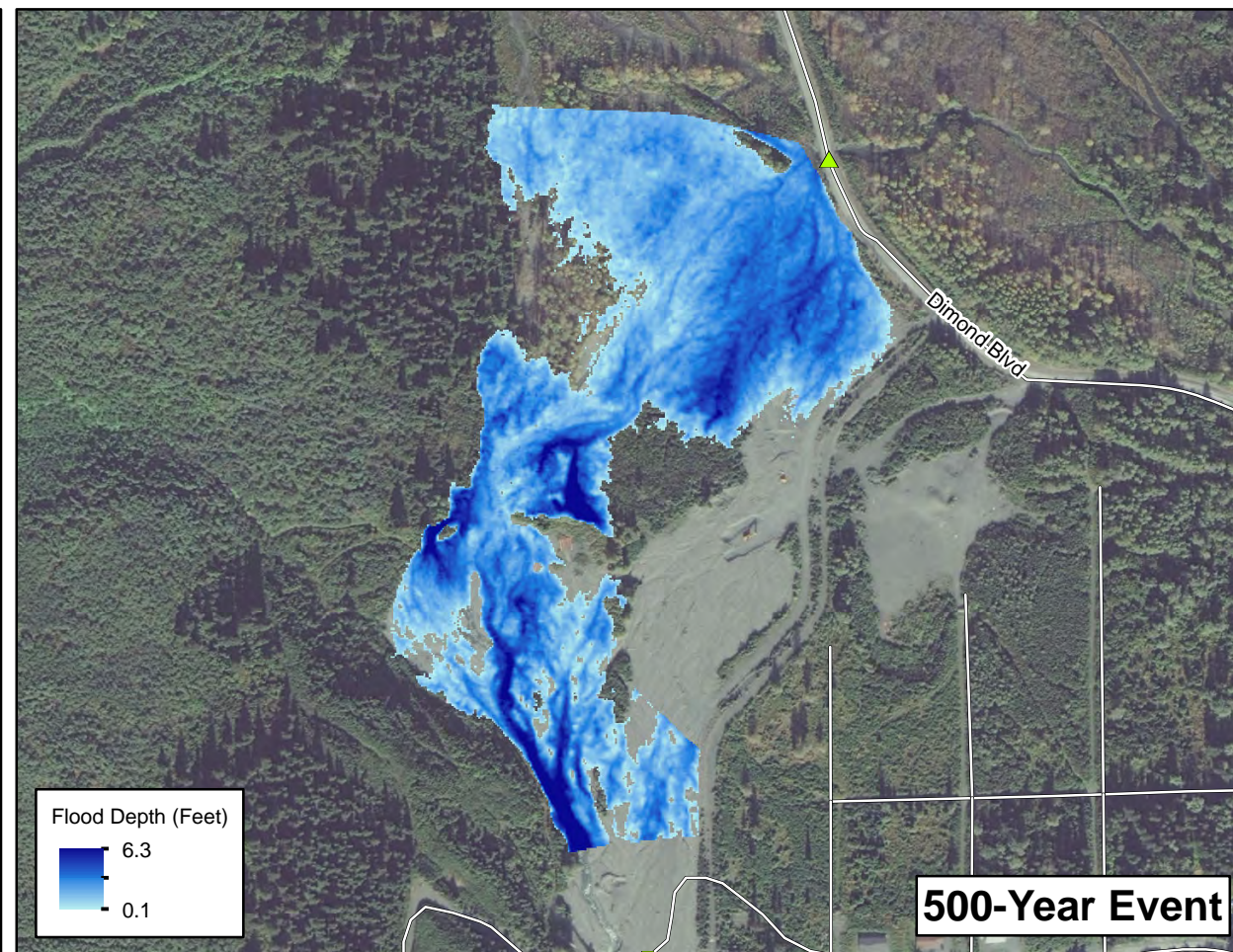
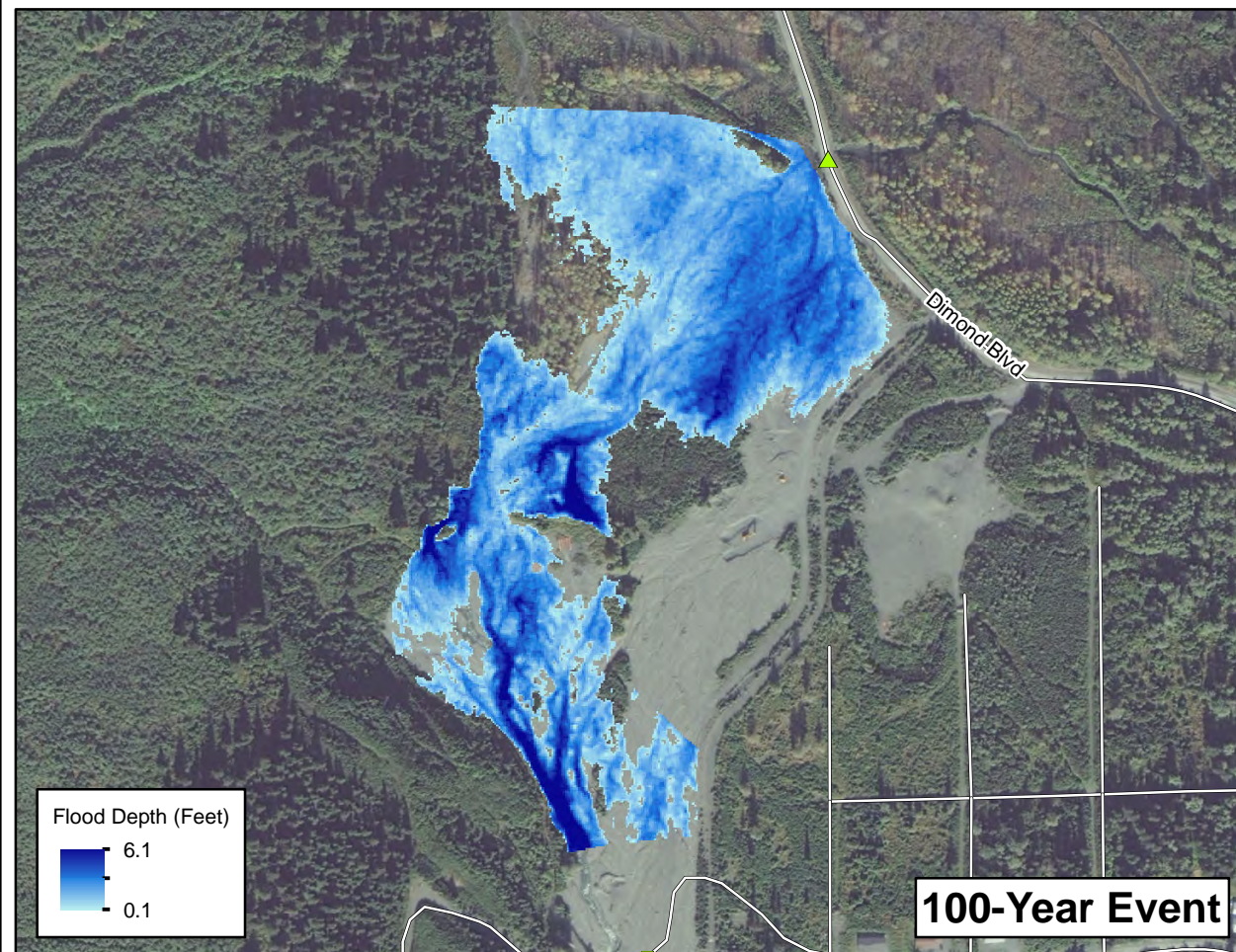
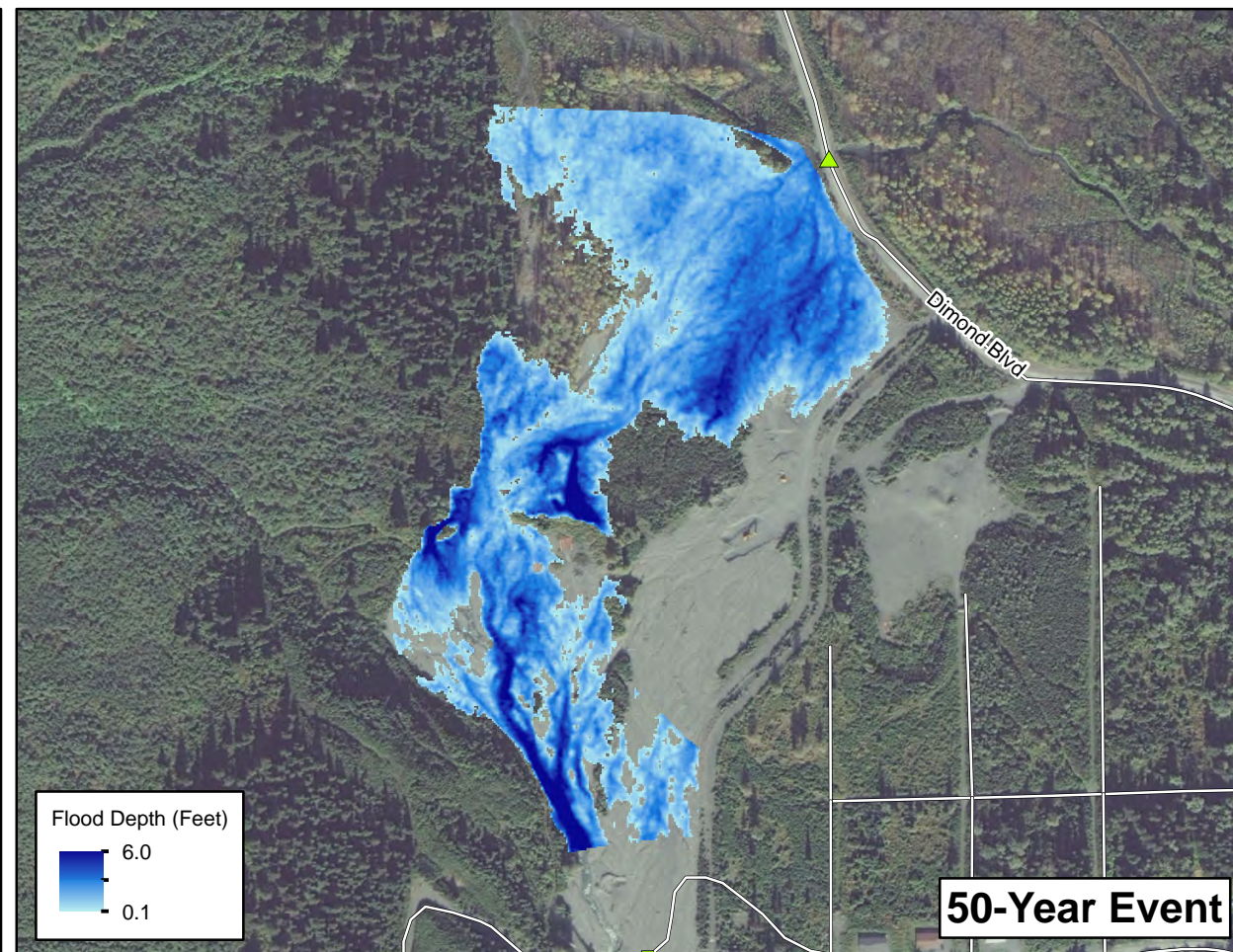
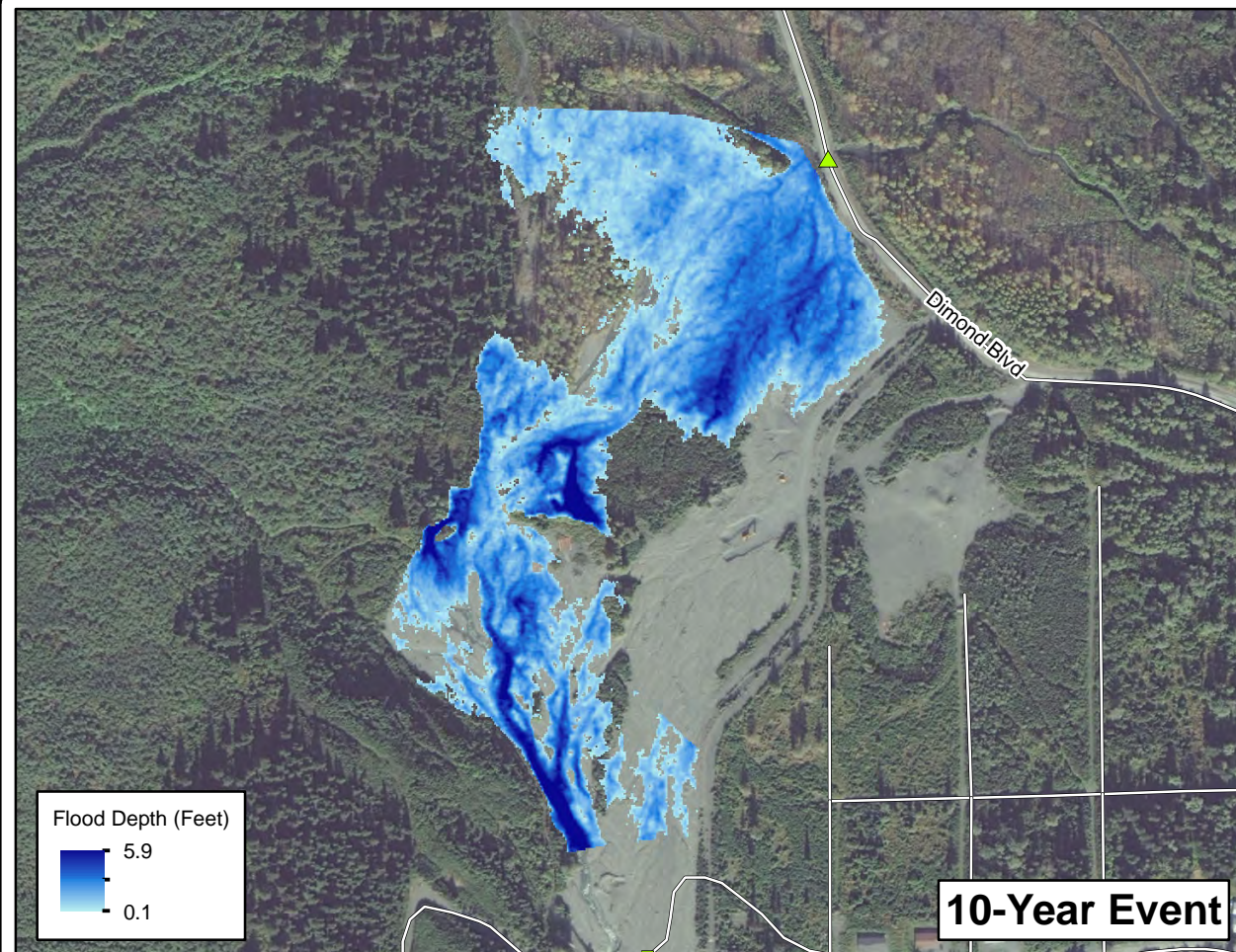
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

JAPANESE CREEK  
MODELED FLOODPLAIN  
2022

MAP K-27



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Japanese\_2062.mxd Plot Date: 4/19/2013

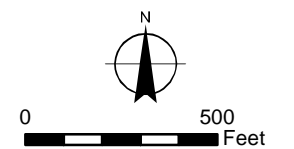


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- + Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.



URS

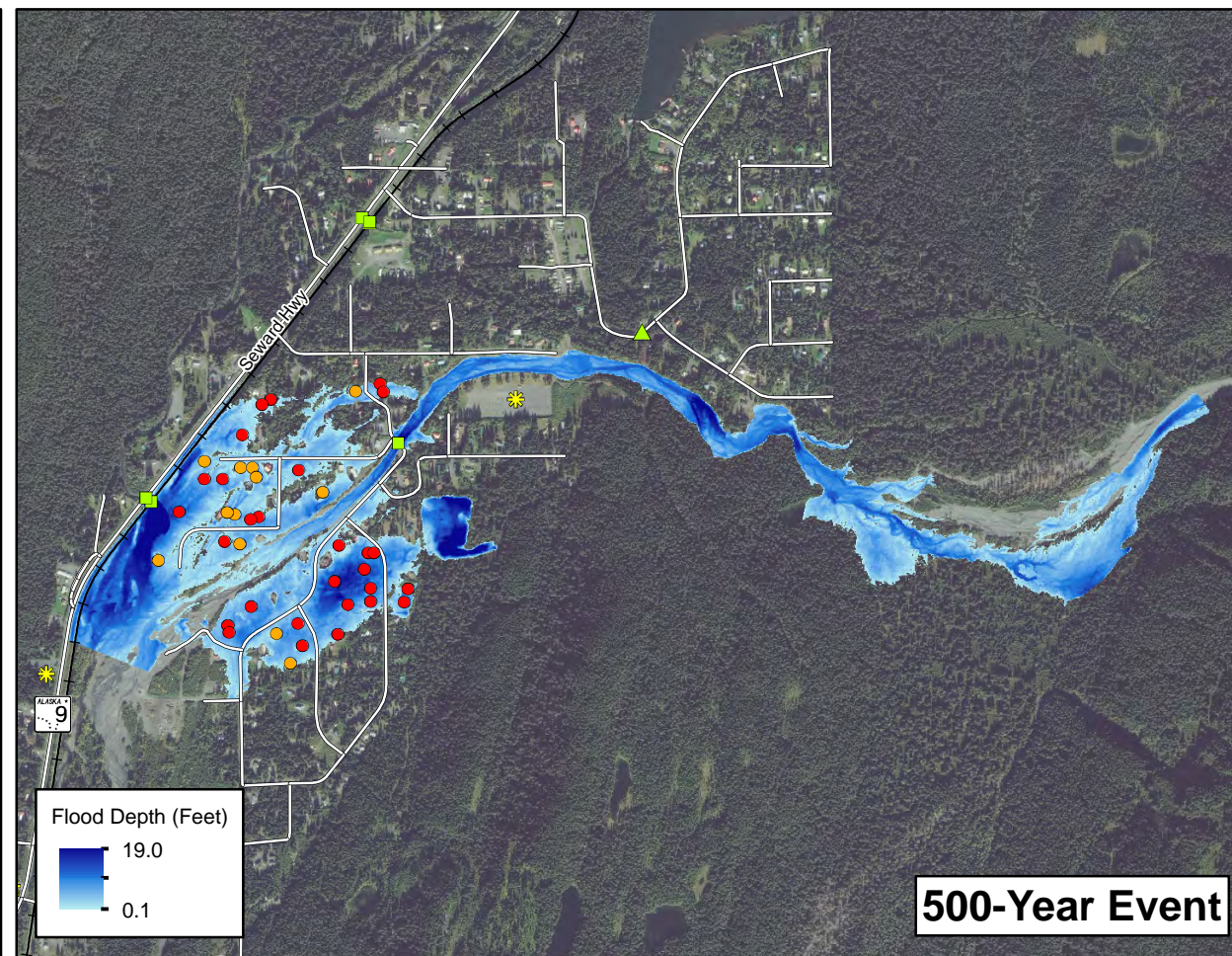
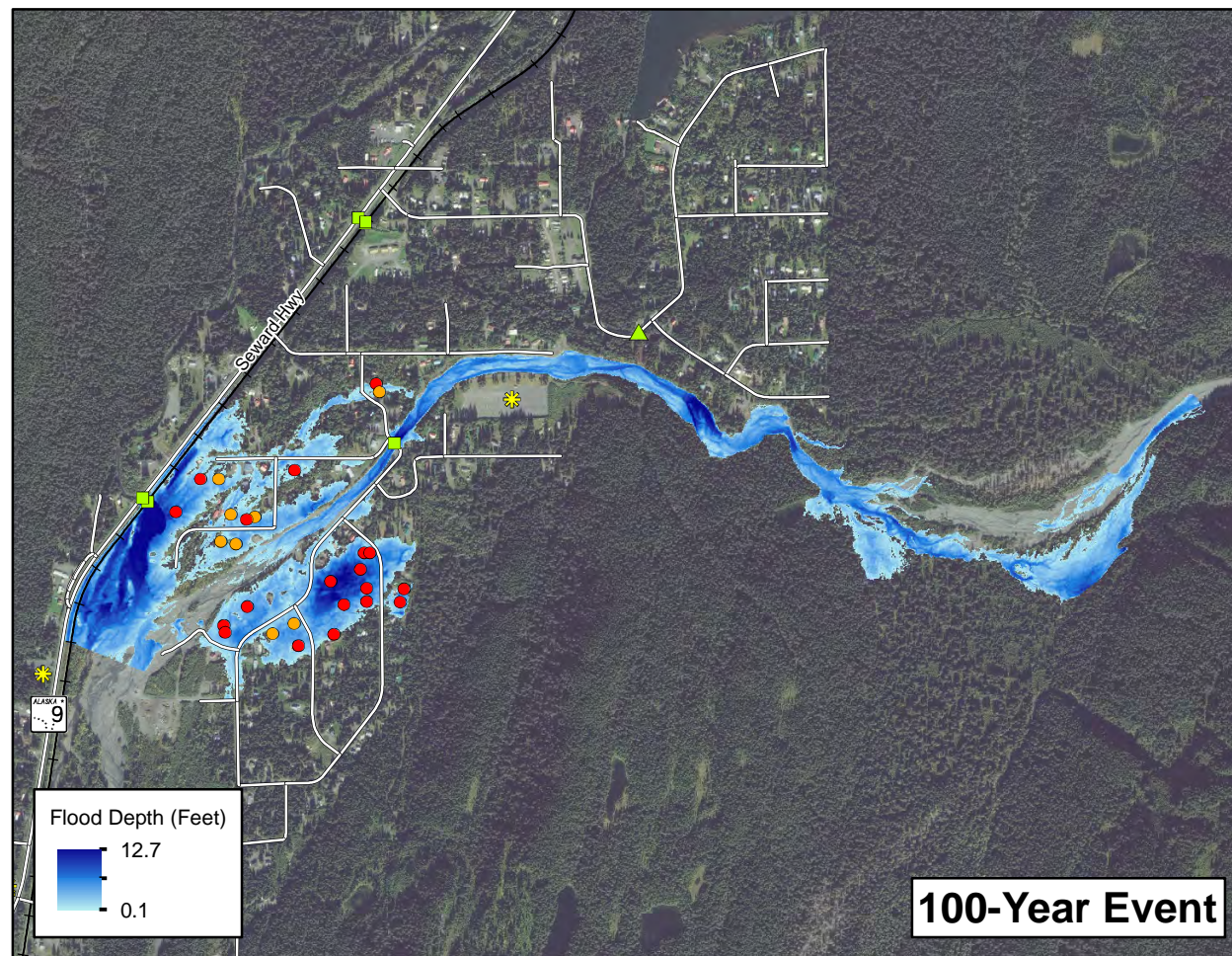
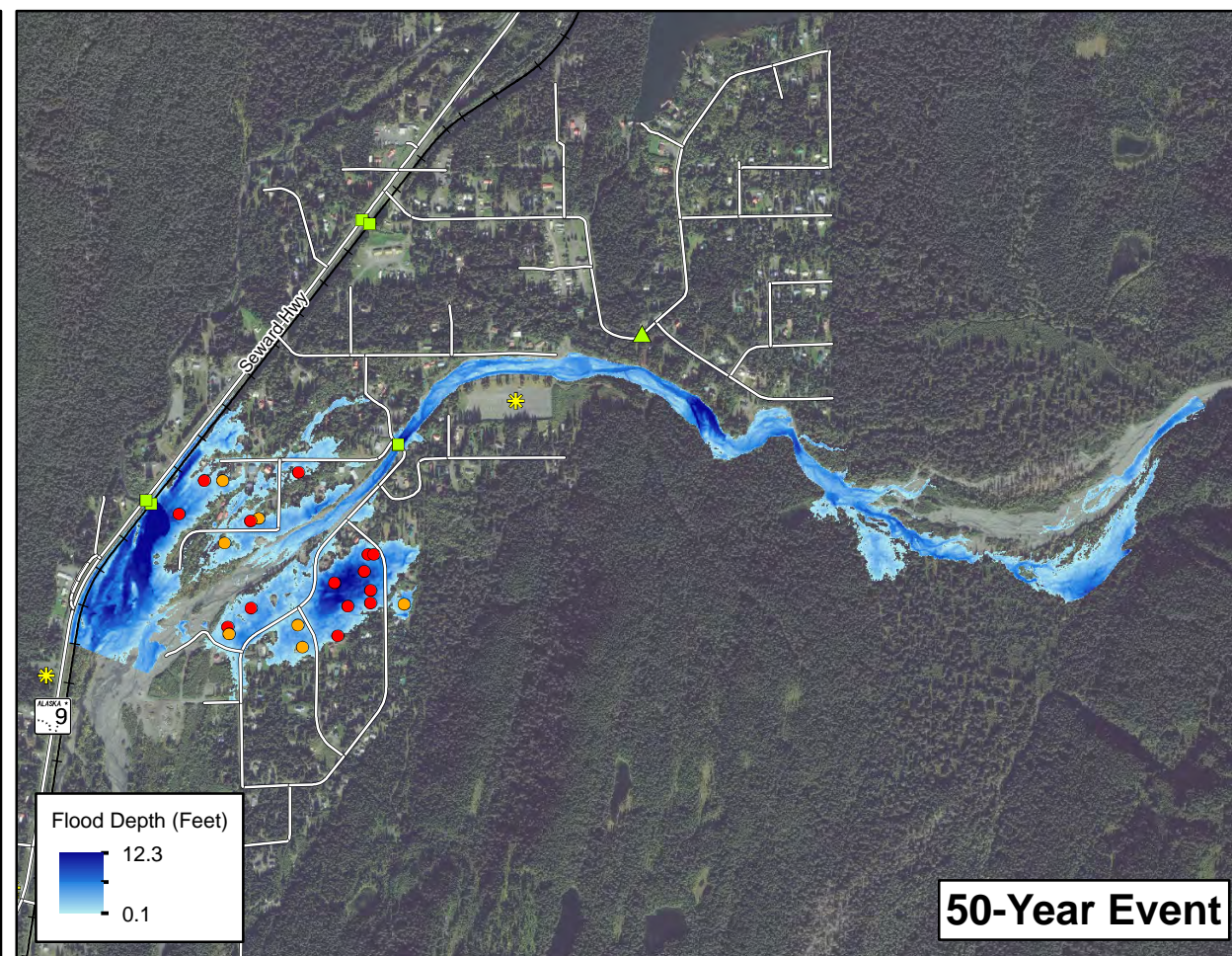
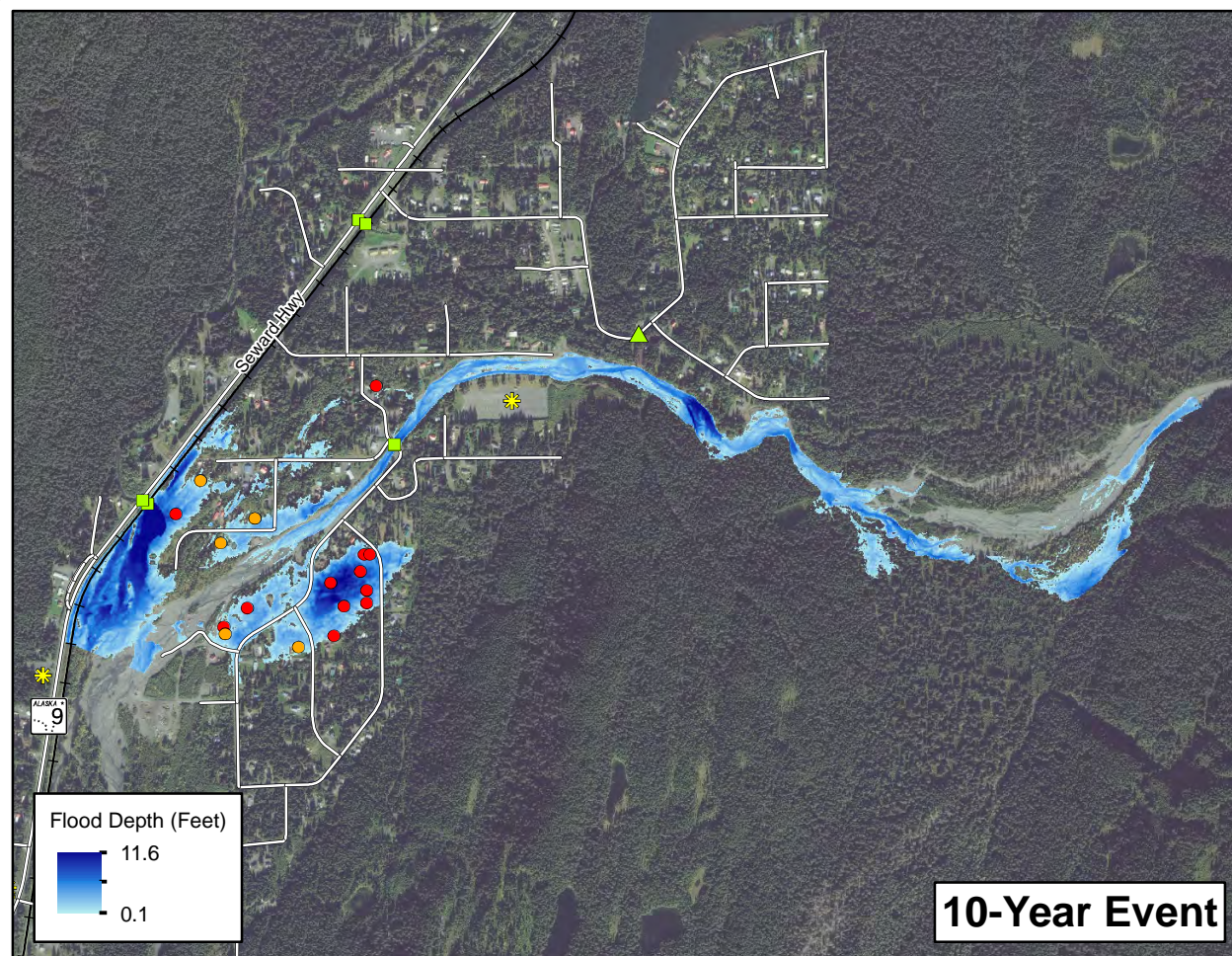
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

JAPANESE CREEK  
MODELED FLOODPLAIN  
2062

MAP K-28



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Kwechak\_2012.mxd Plot Date: 4/19/2013

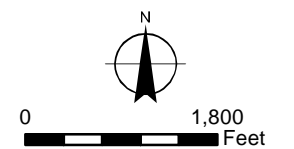


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.



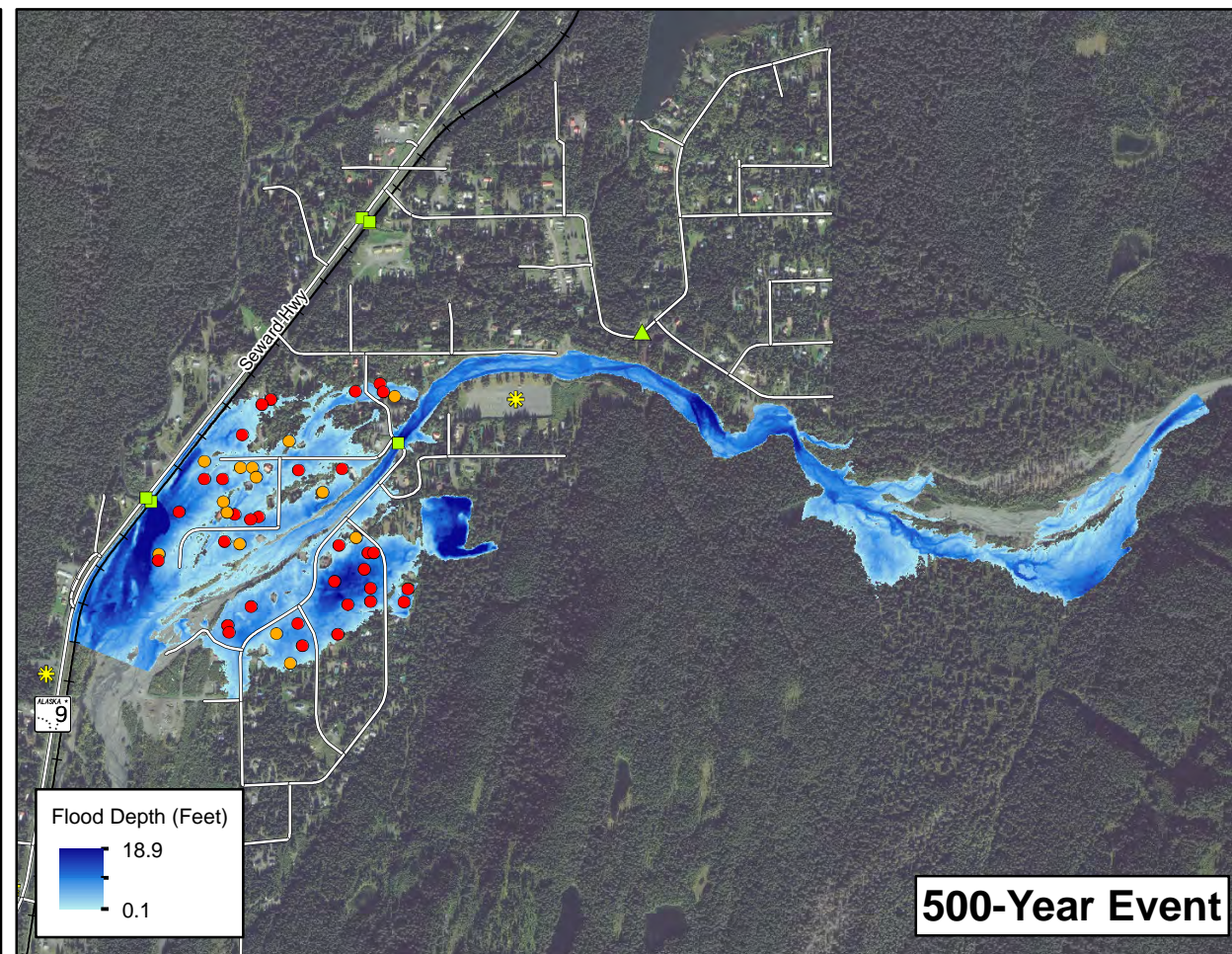
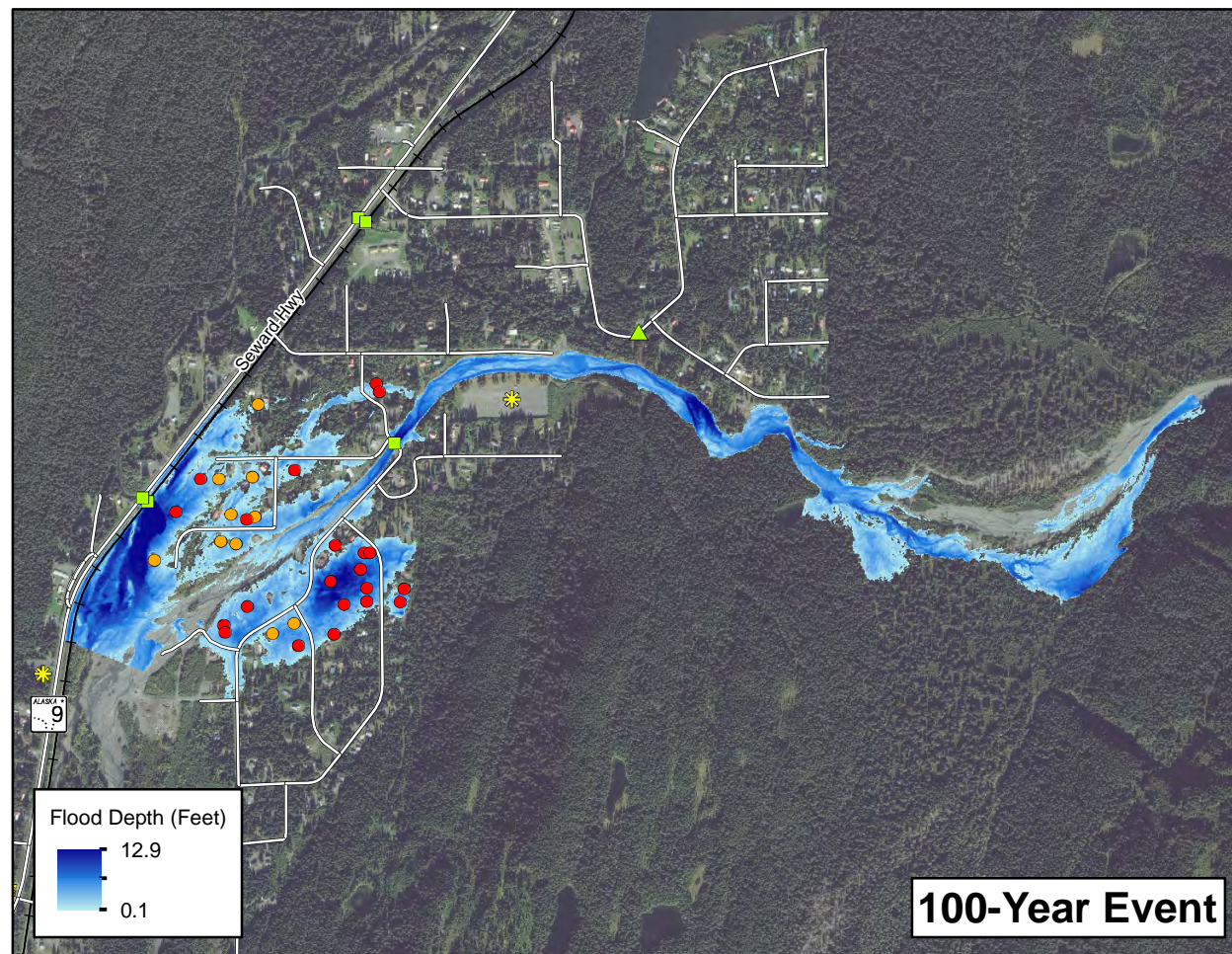
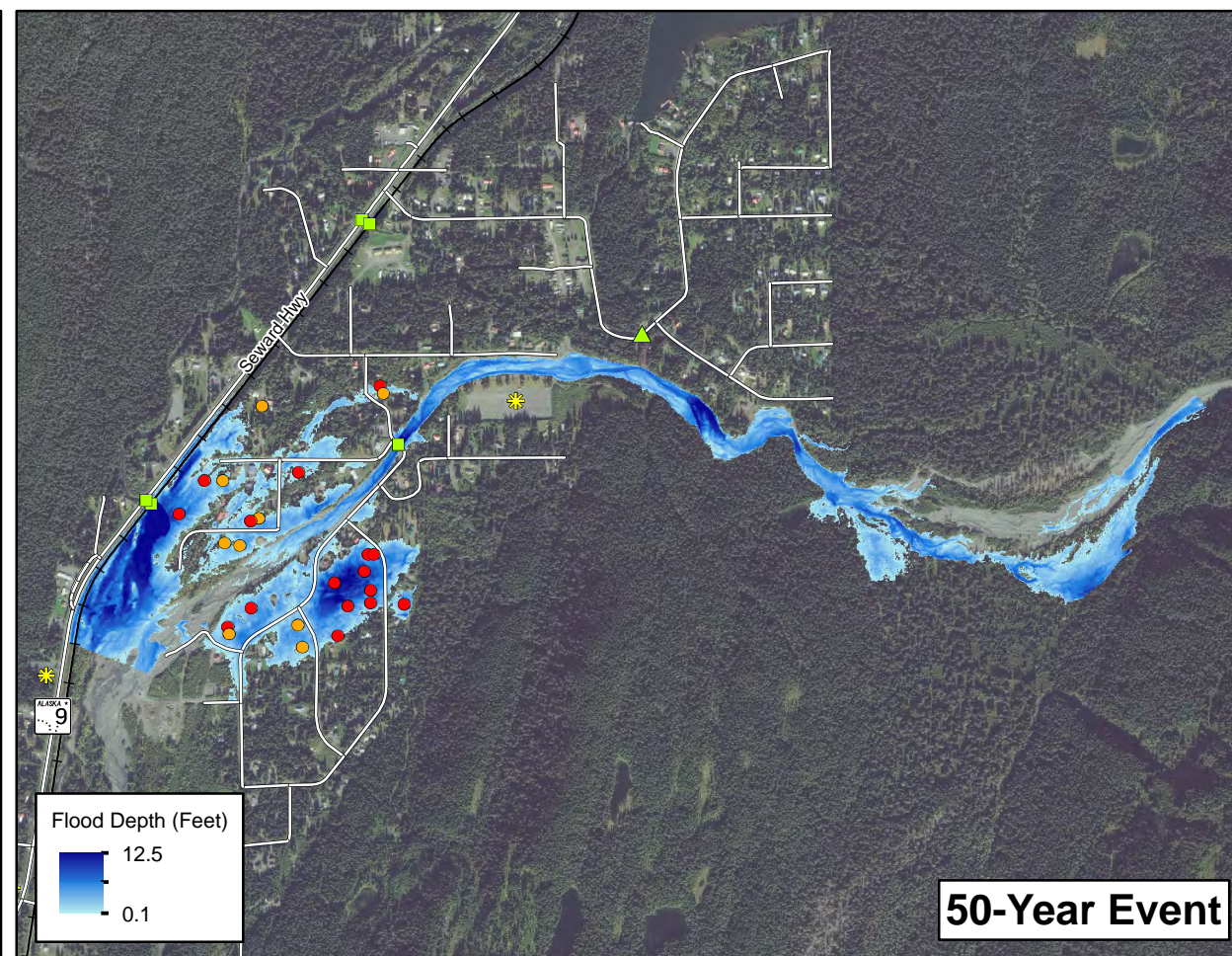
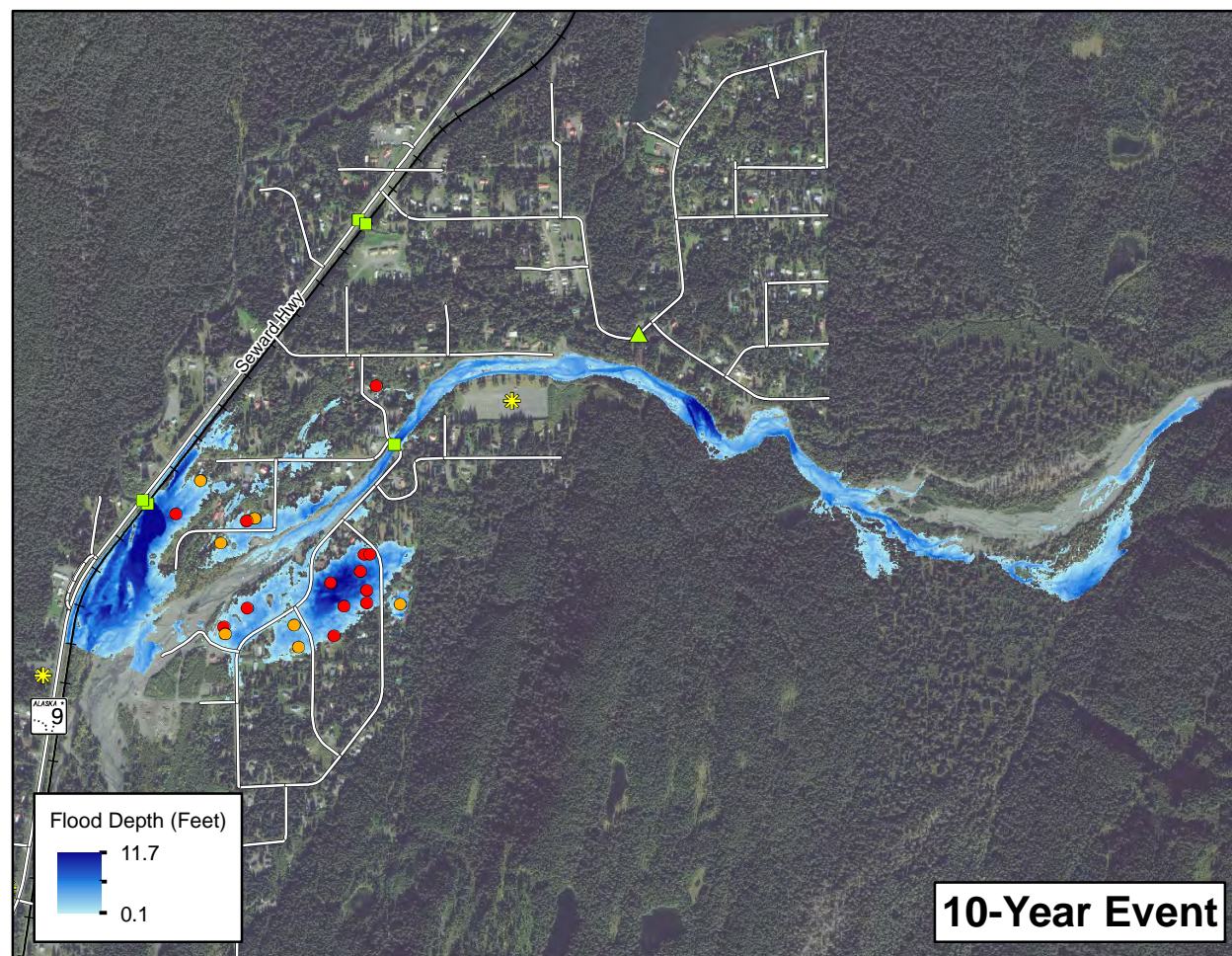
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**KWECHAK CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-29



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Kwechak\_2022.mxd Plot Date: 4/19/2013

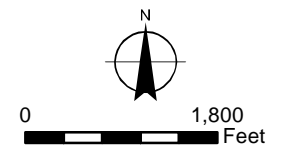


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



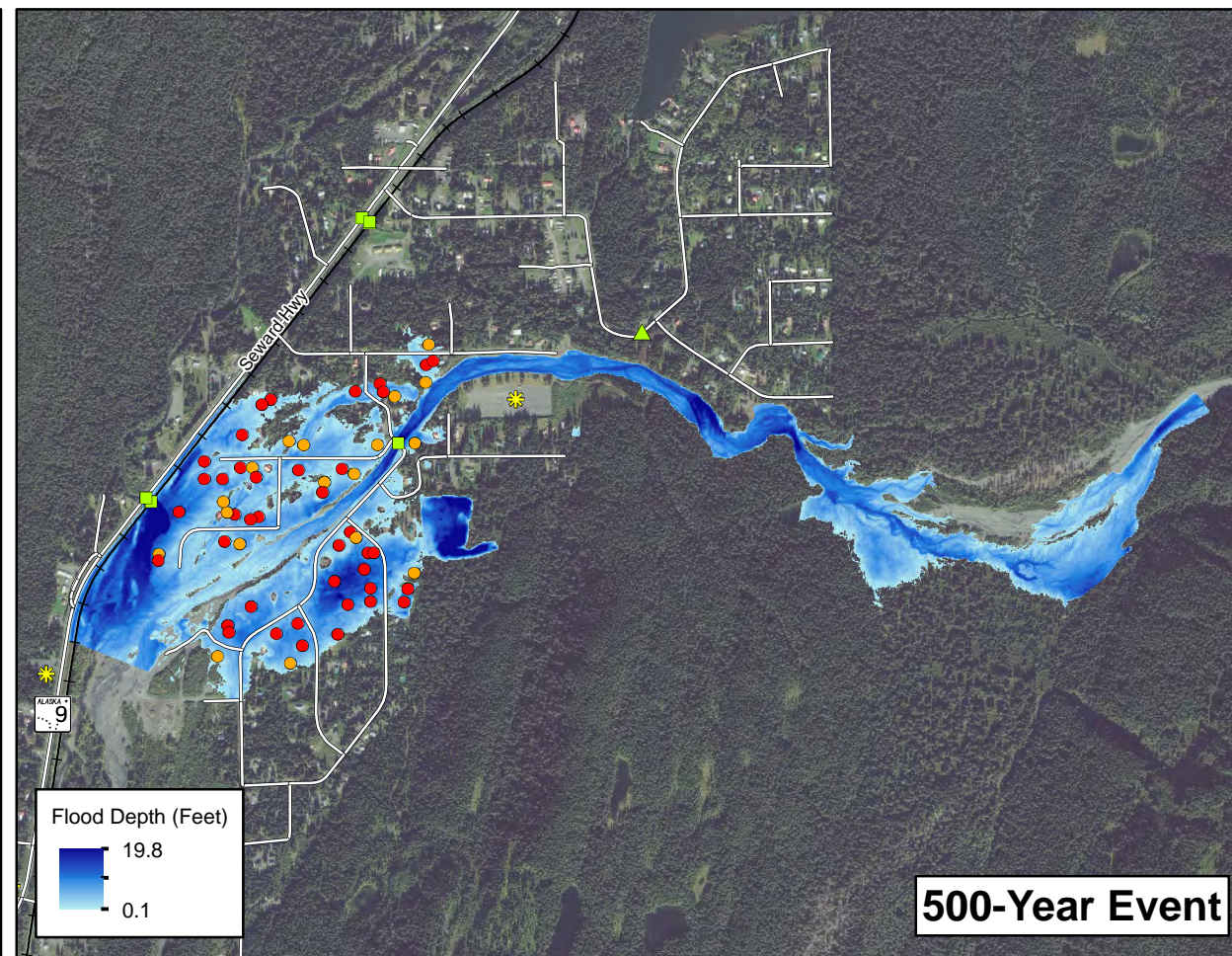
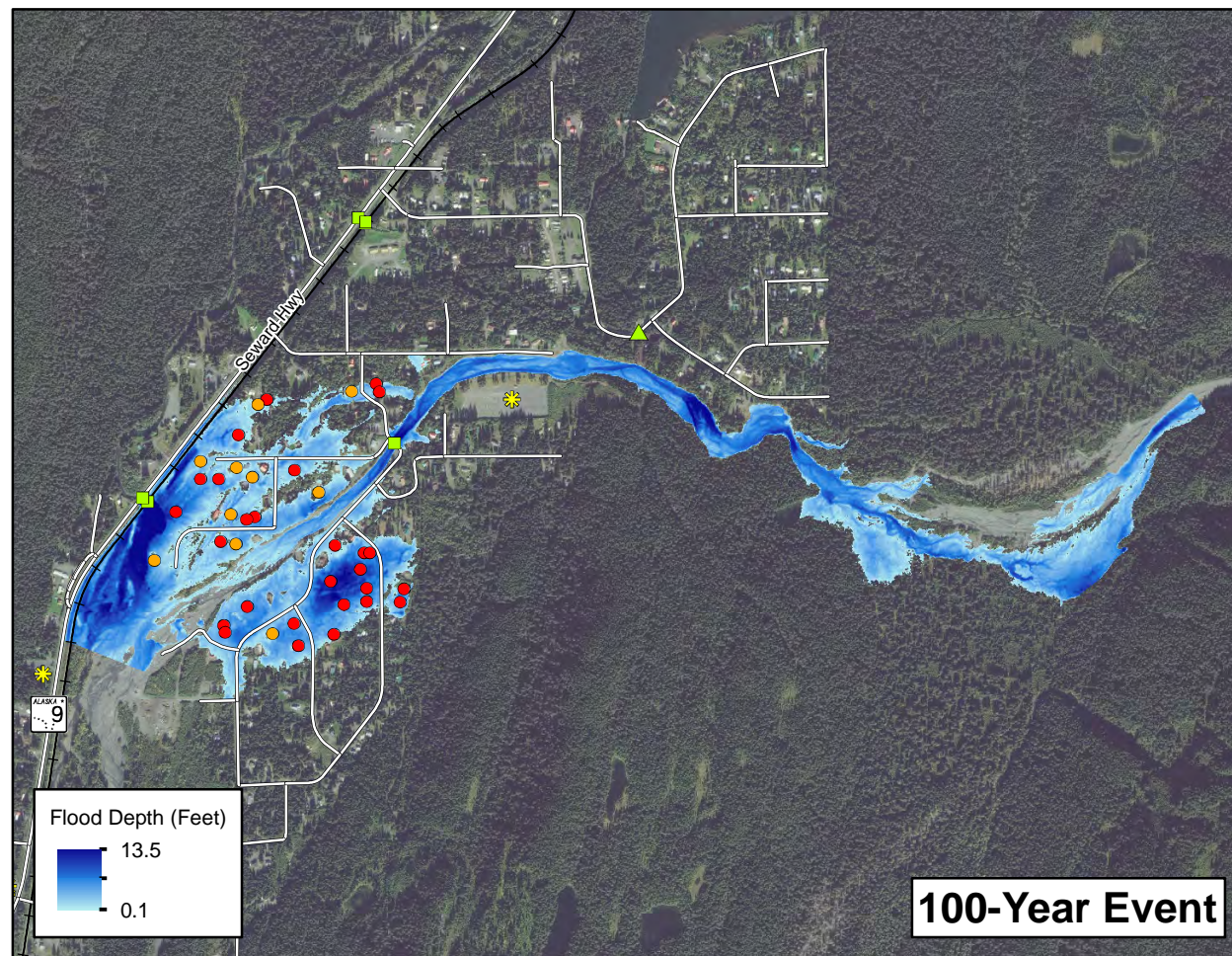
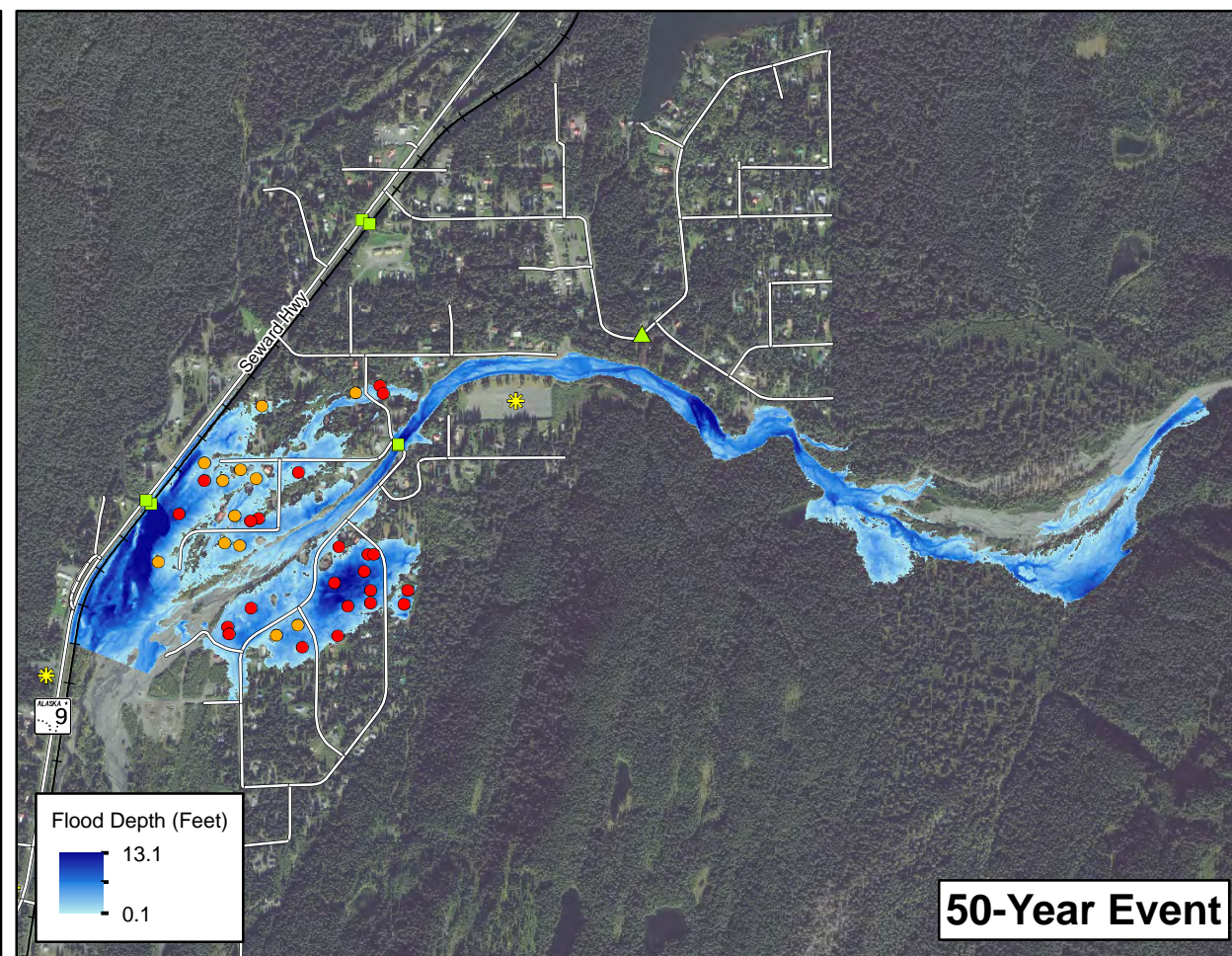
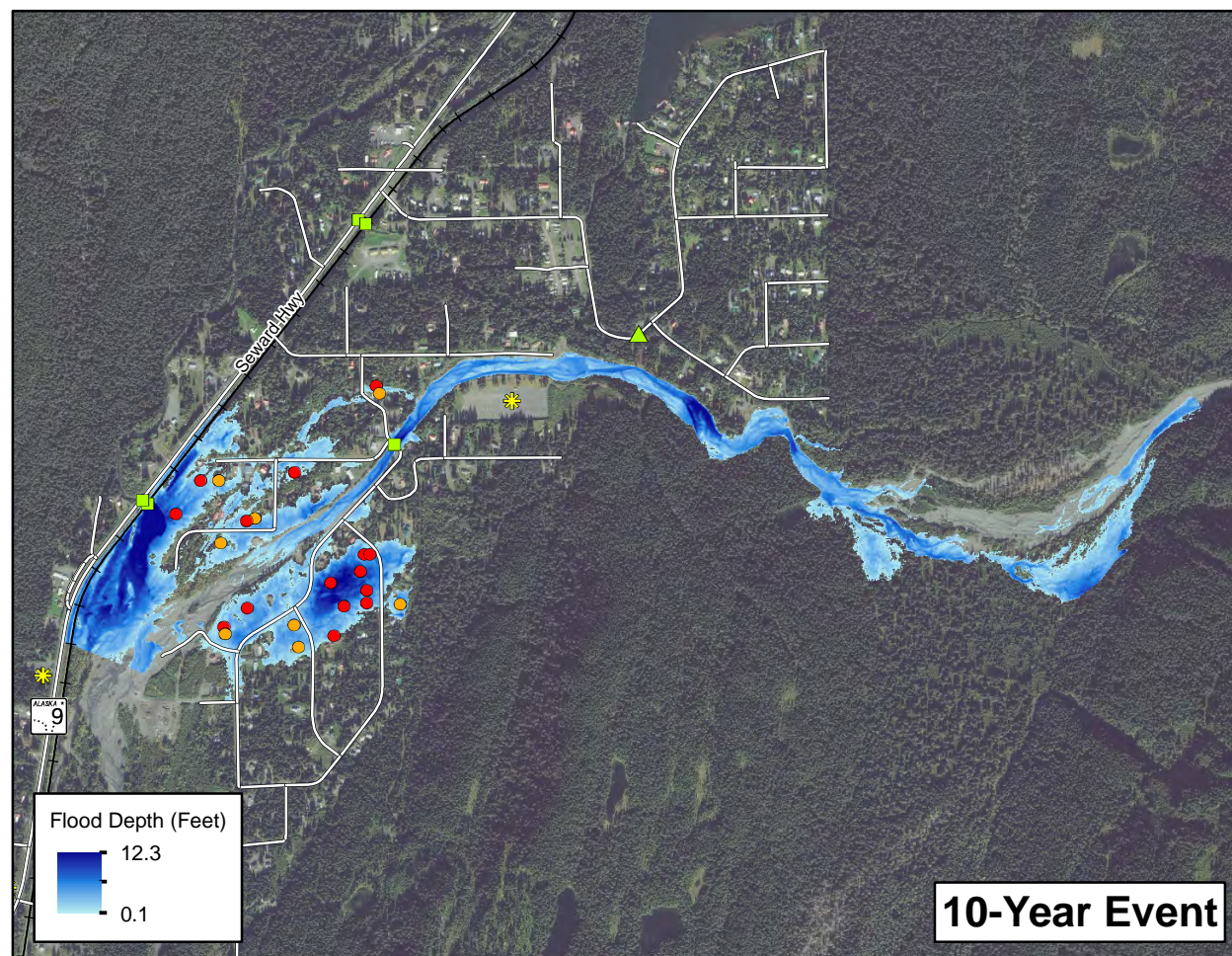
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**KWECHAK CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-30



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Kwechak\_2062.mxd Plot Date: 4/19/2013

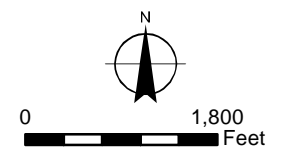


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



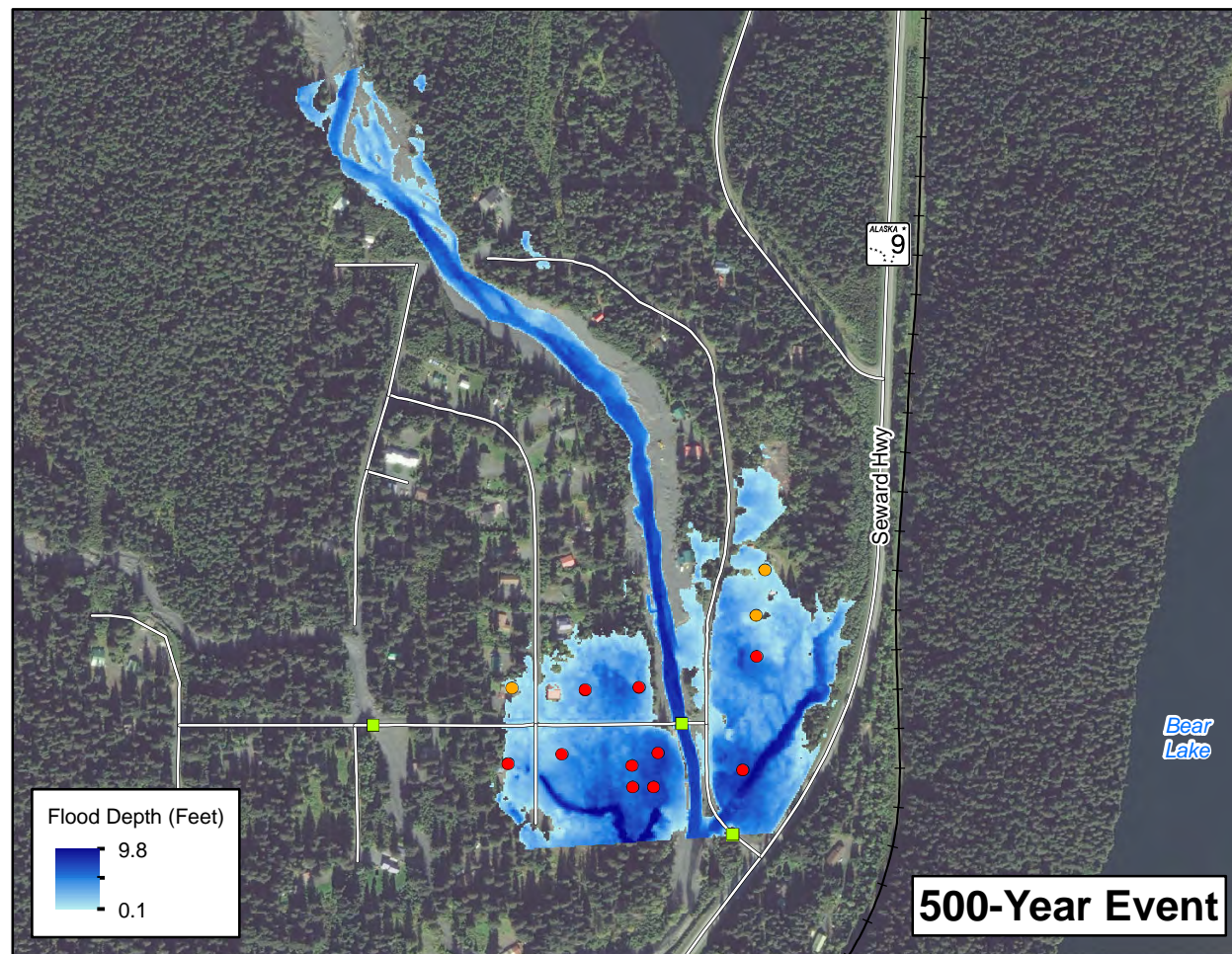
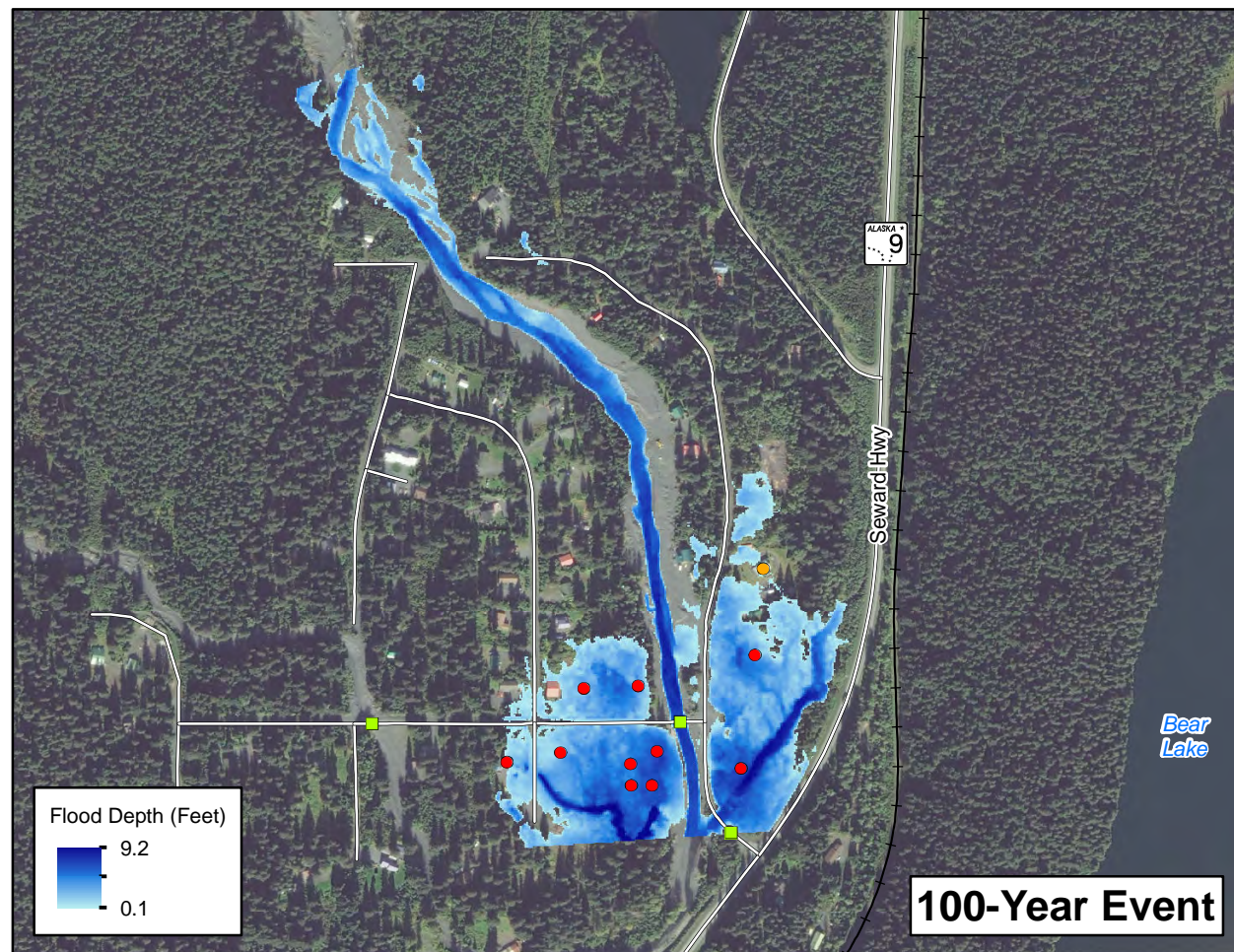
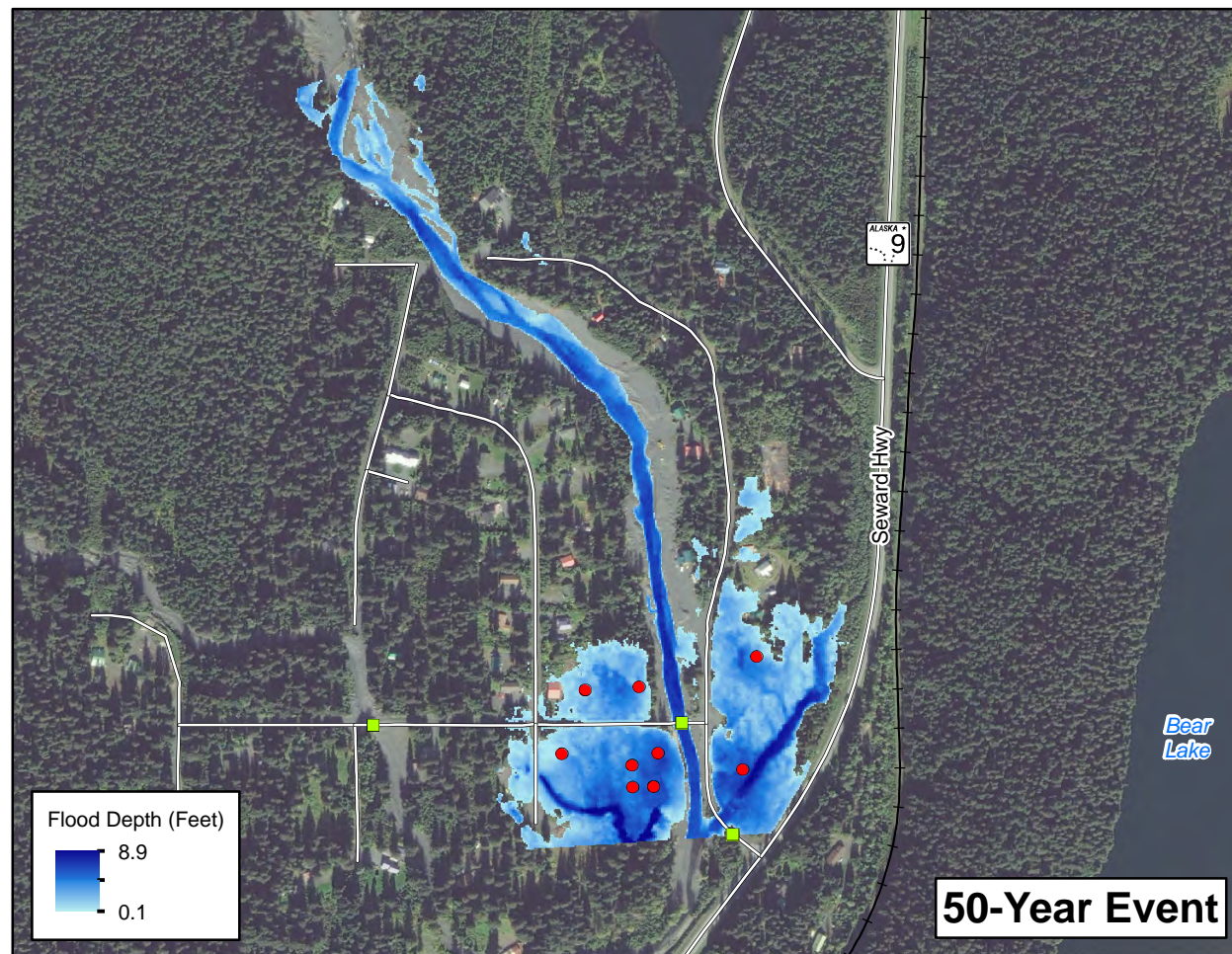
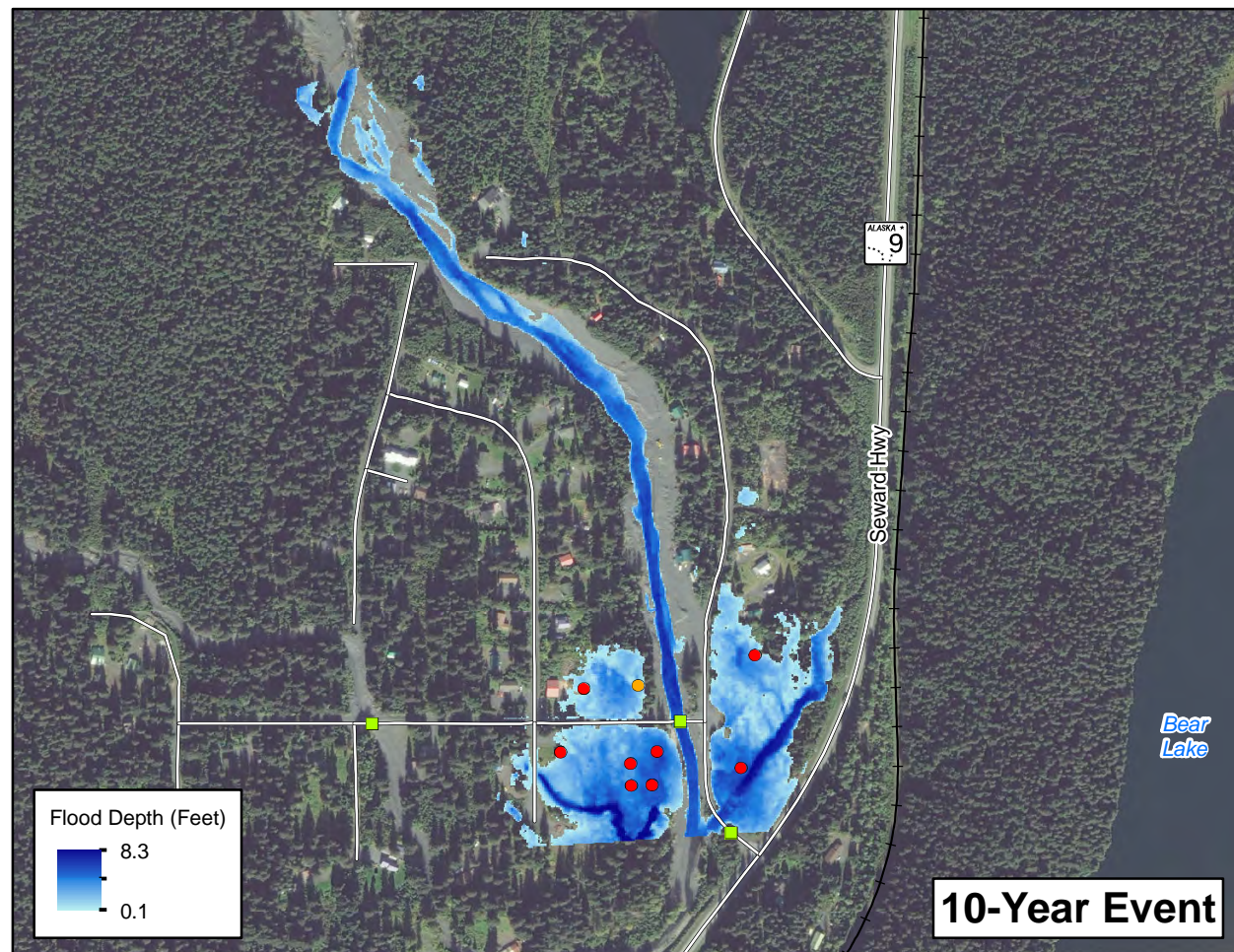
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**KWECHAK CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-31



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Lost\_2012.mxd Plot Date: 4/22/2013

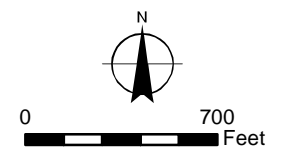


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.



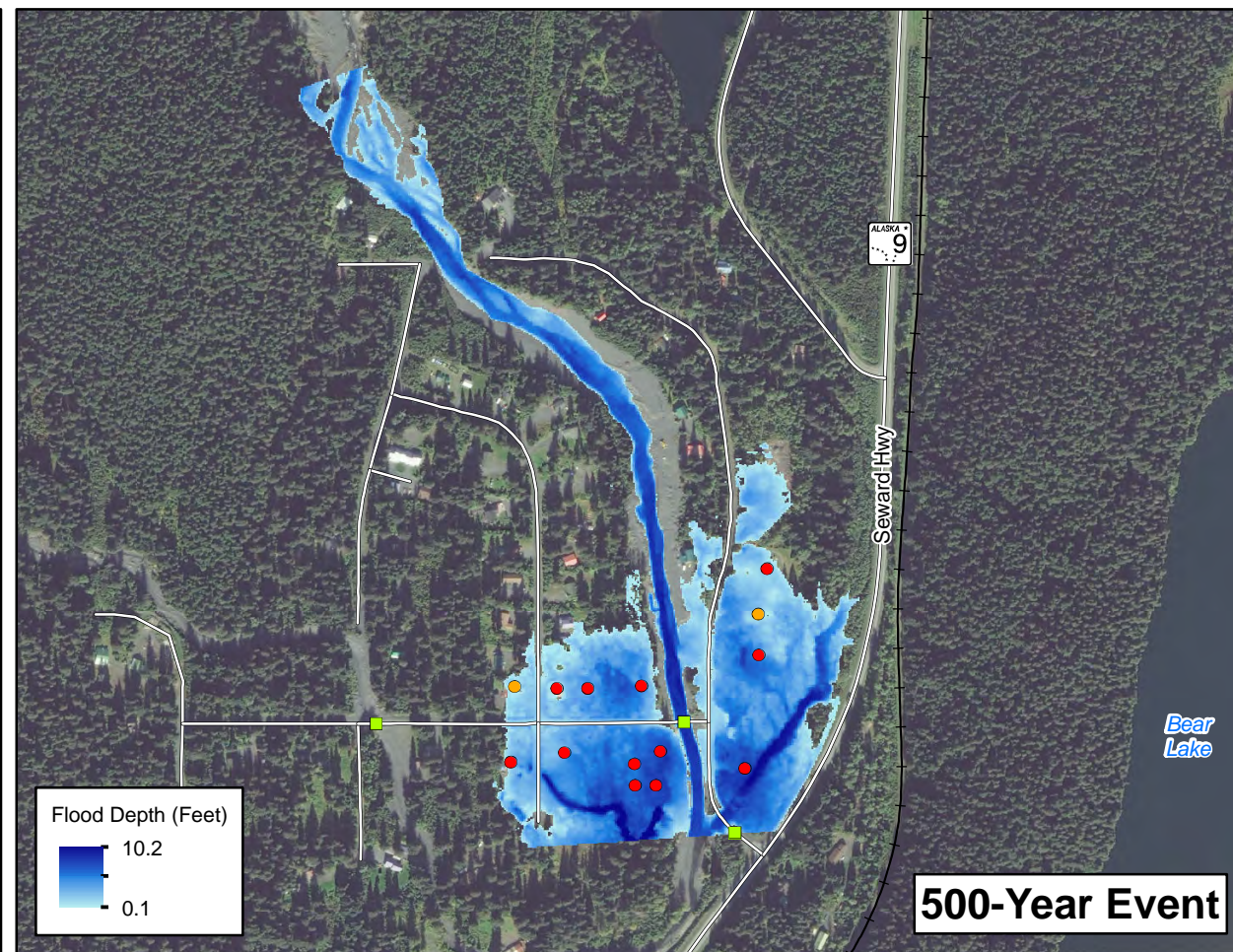
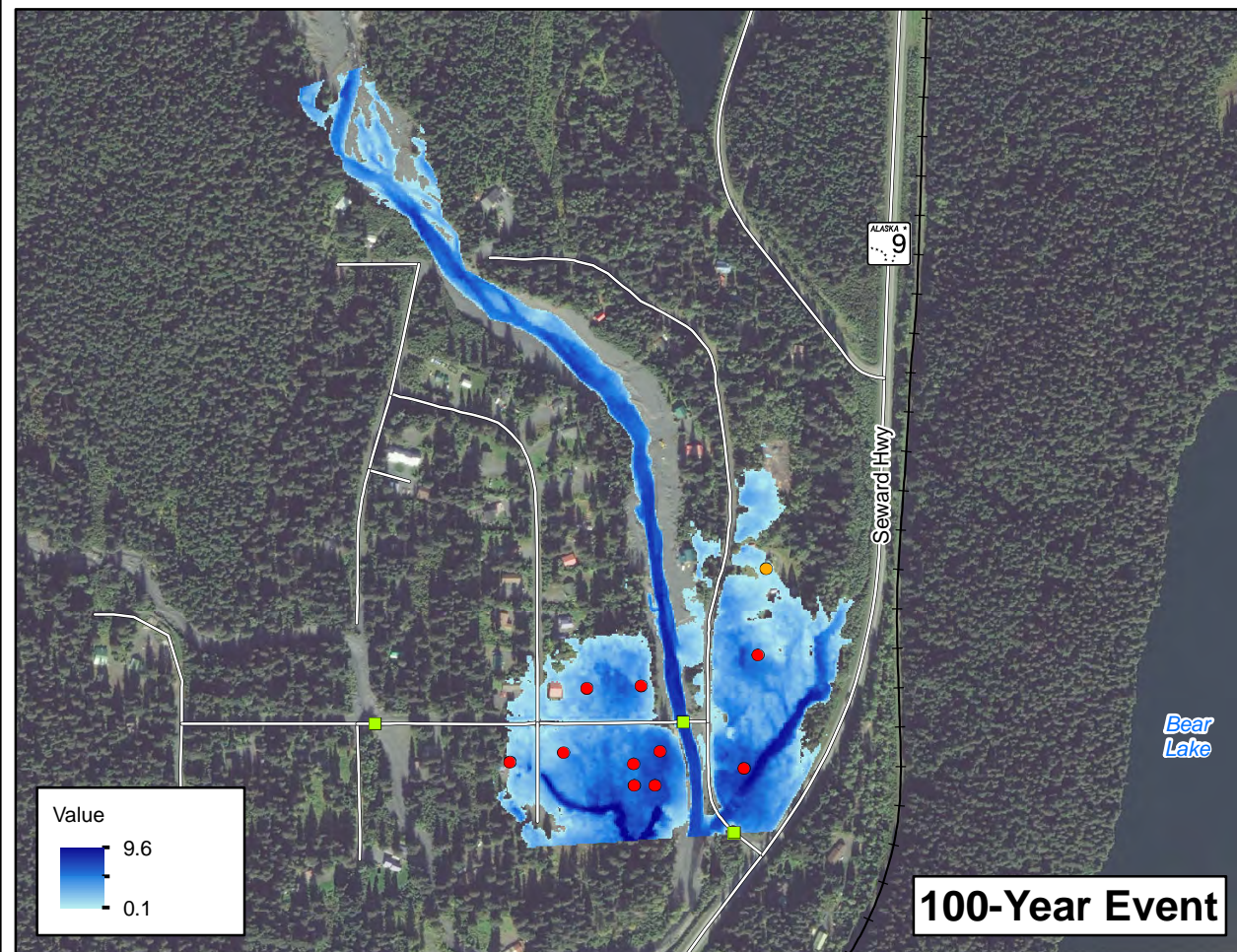
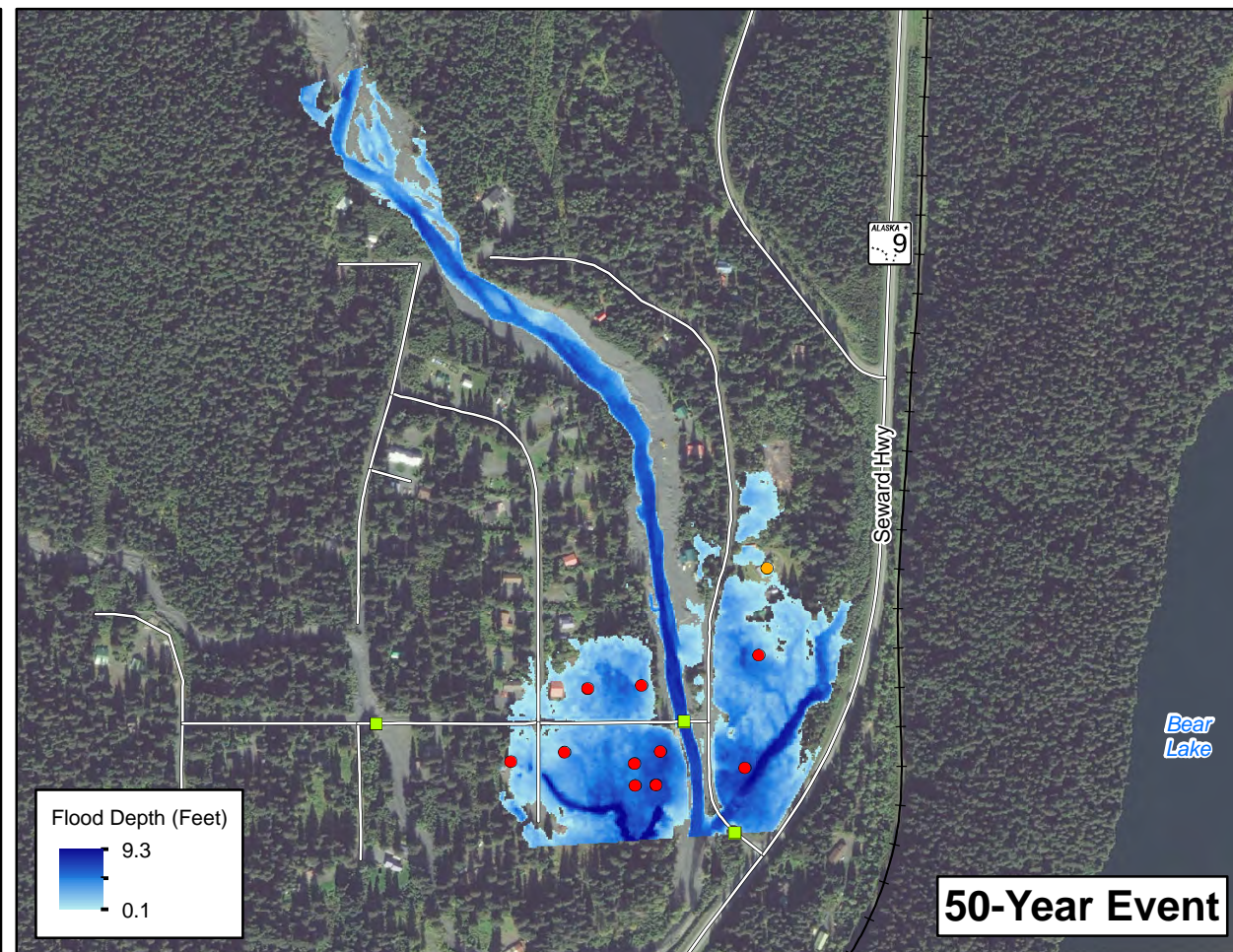
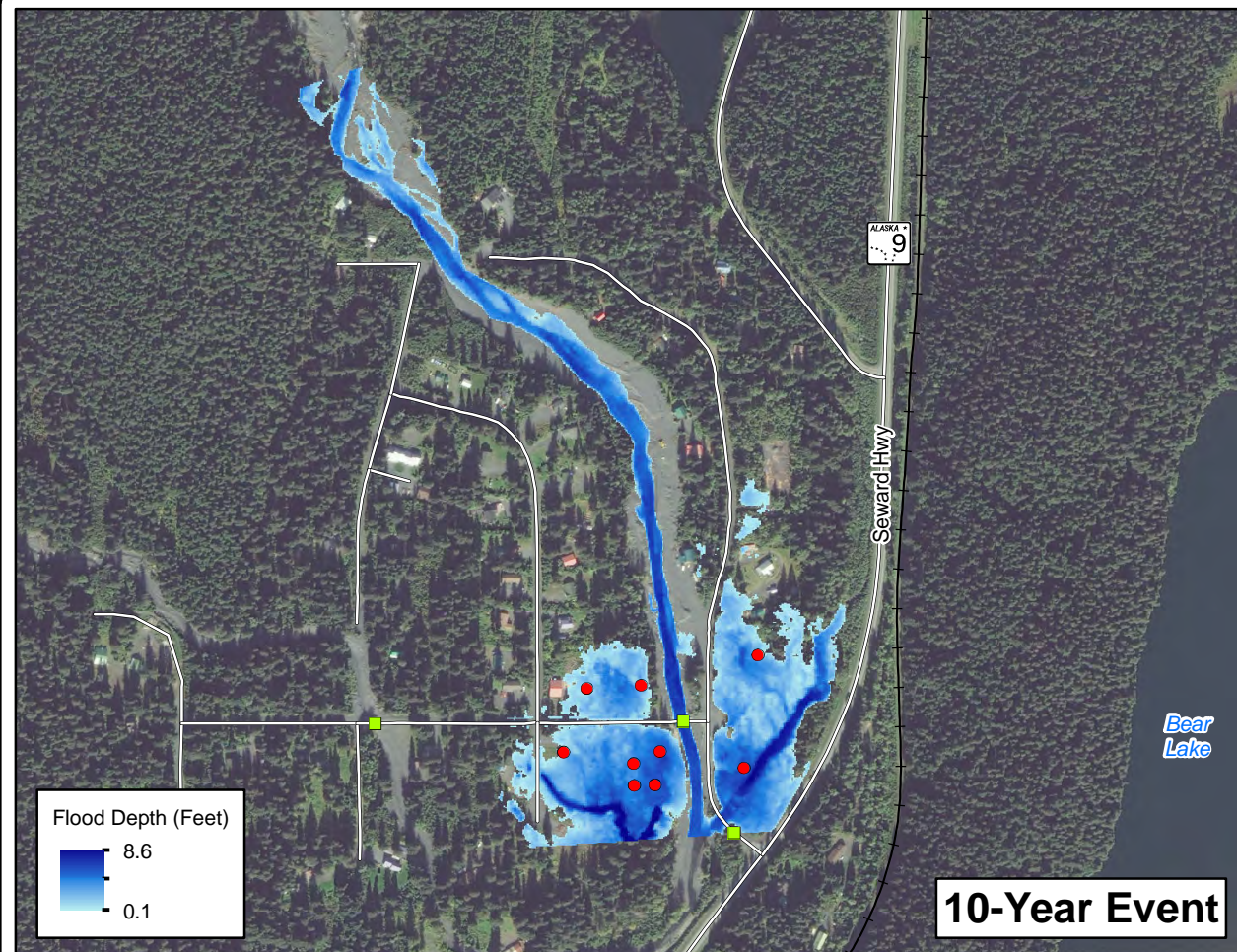
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**LOST CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-32



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Lost\_2022.mxd Plot Date: 4/22/2013

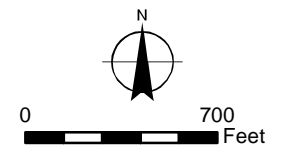


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



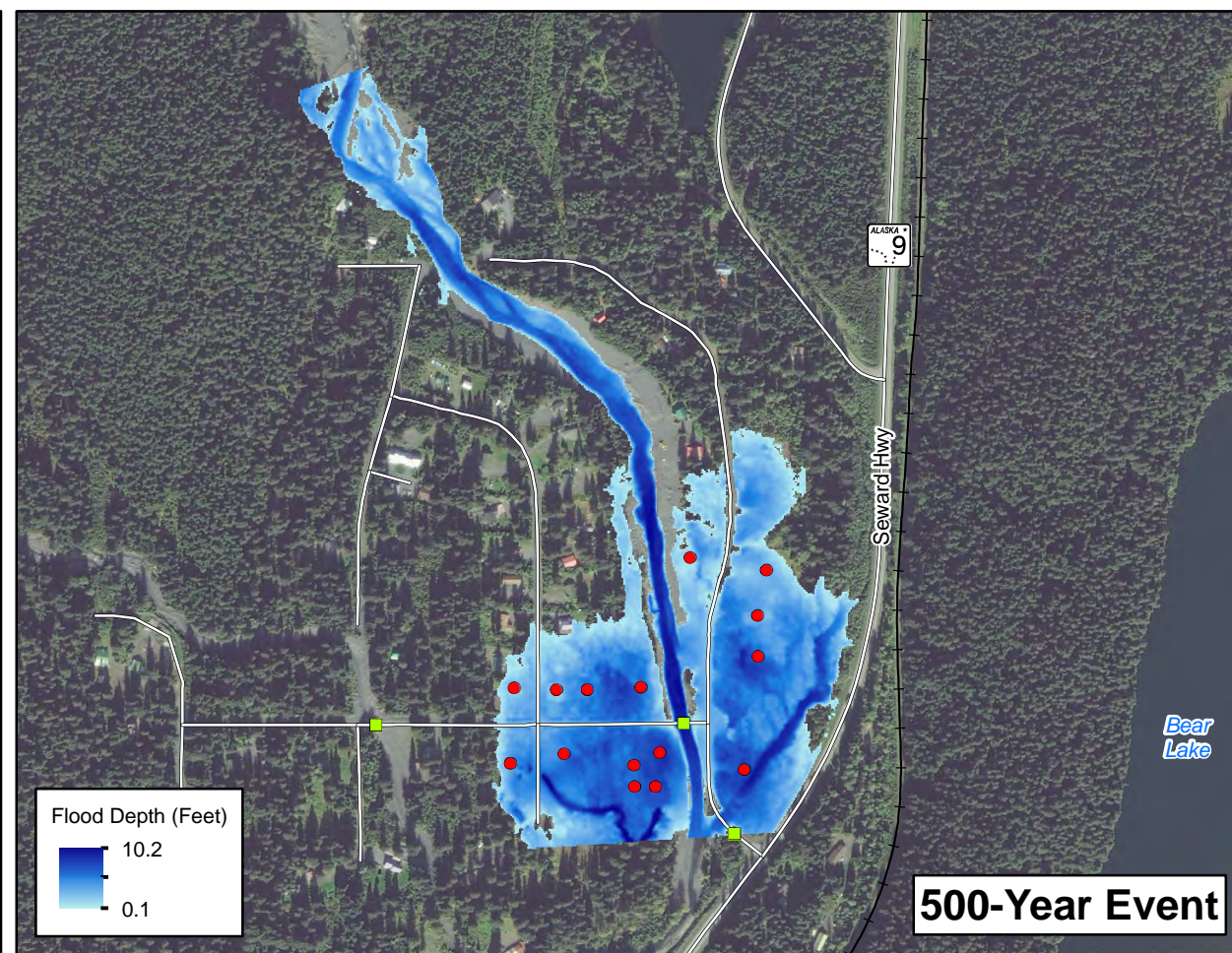
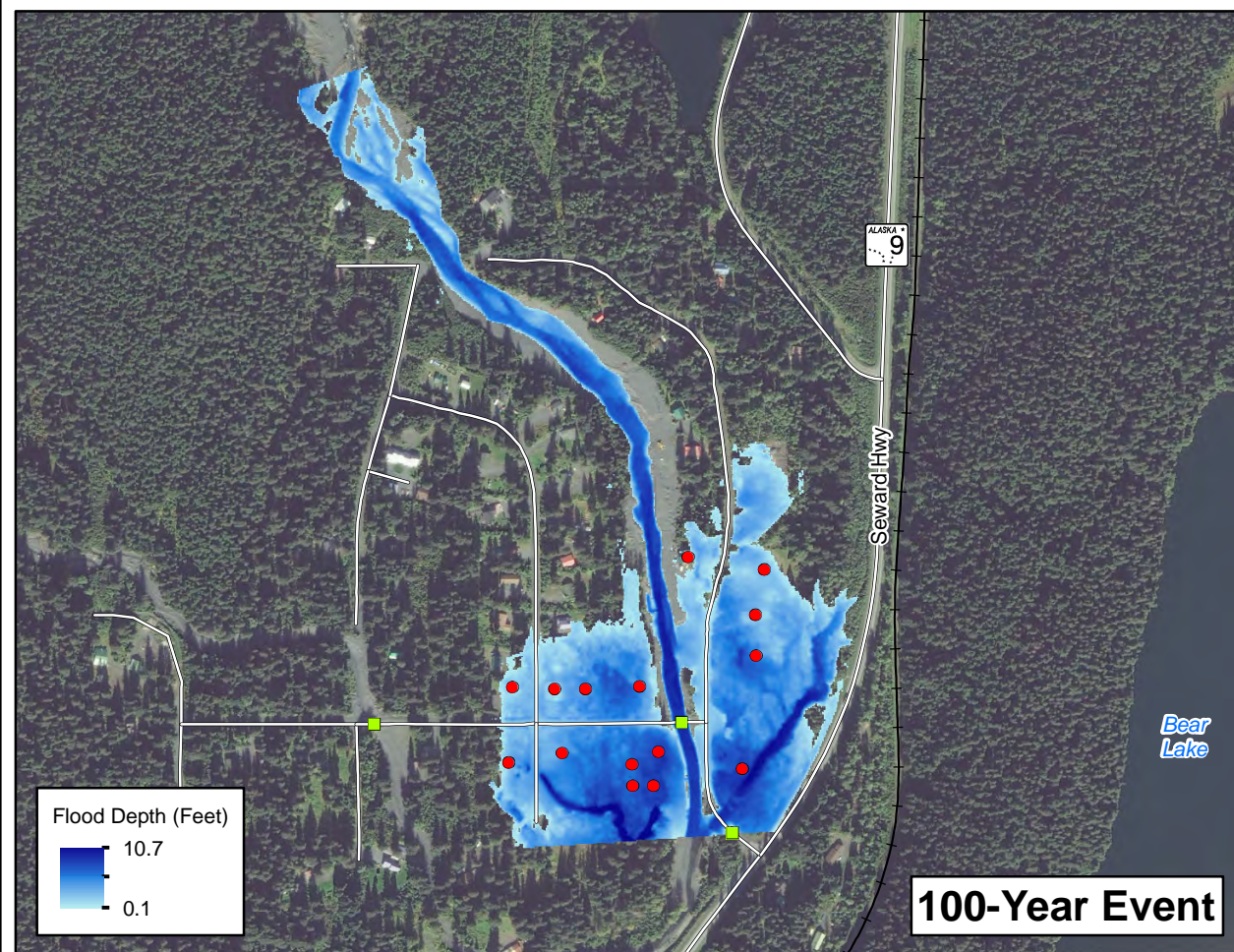
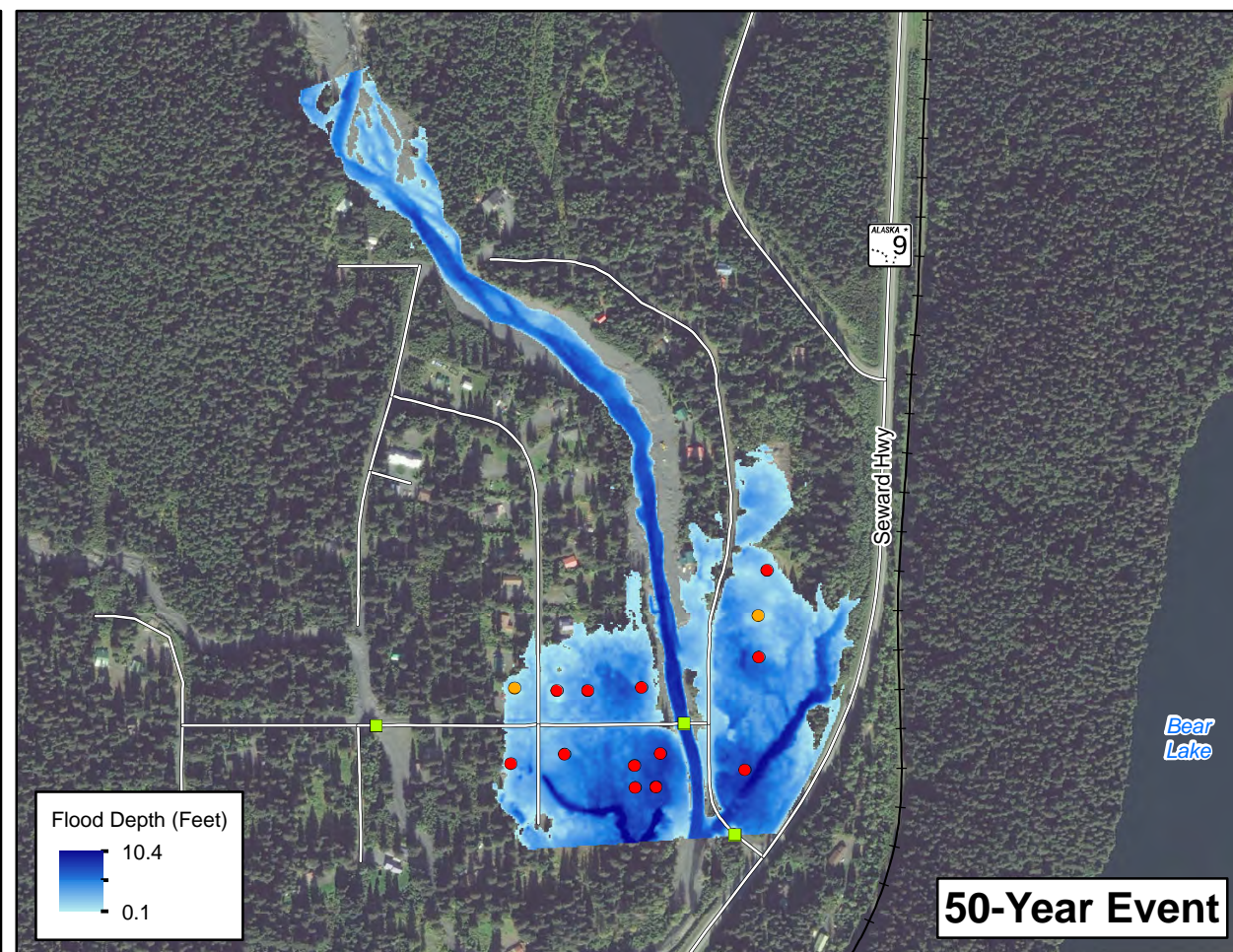
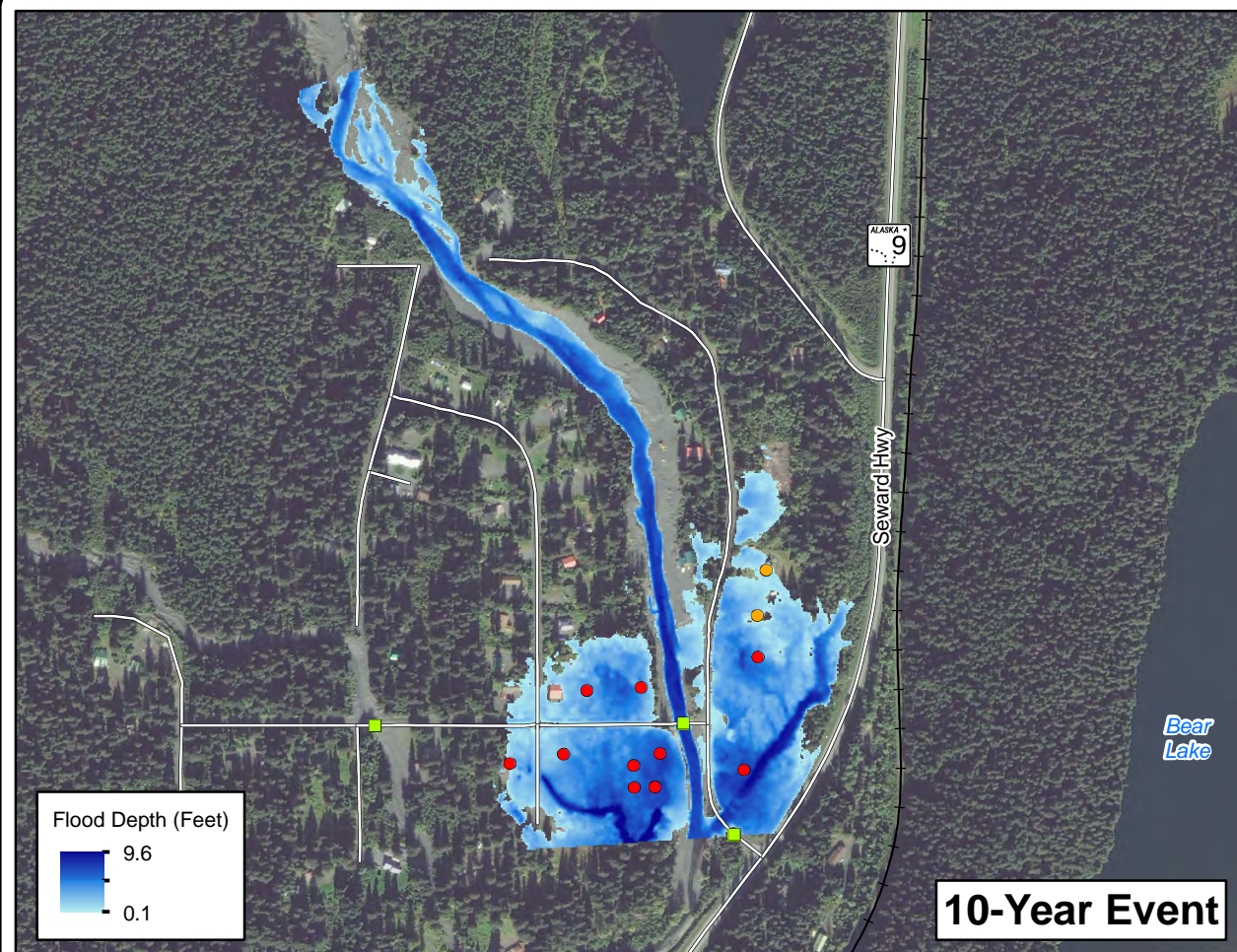
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**LOST CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-33



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Lost\_2062.mxd Plot Date: 4/22/2013

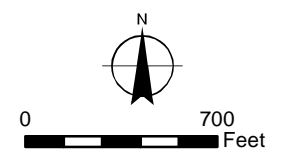


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



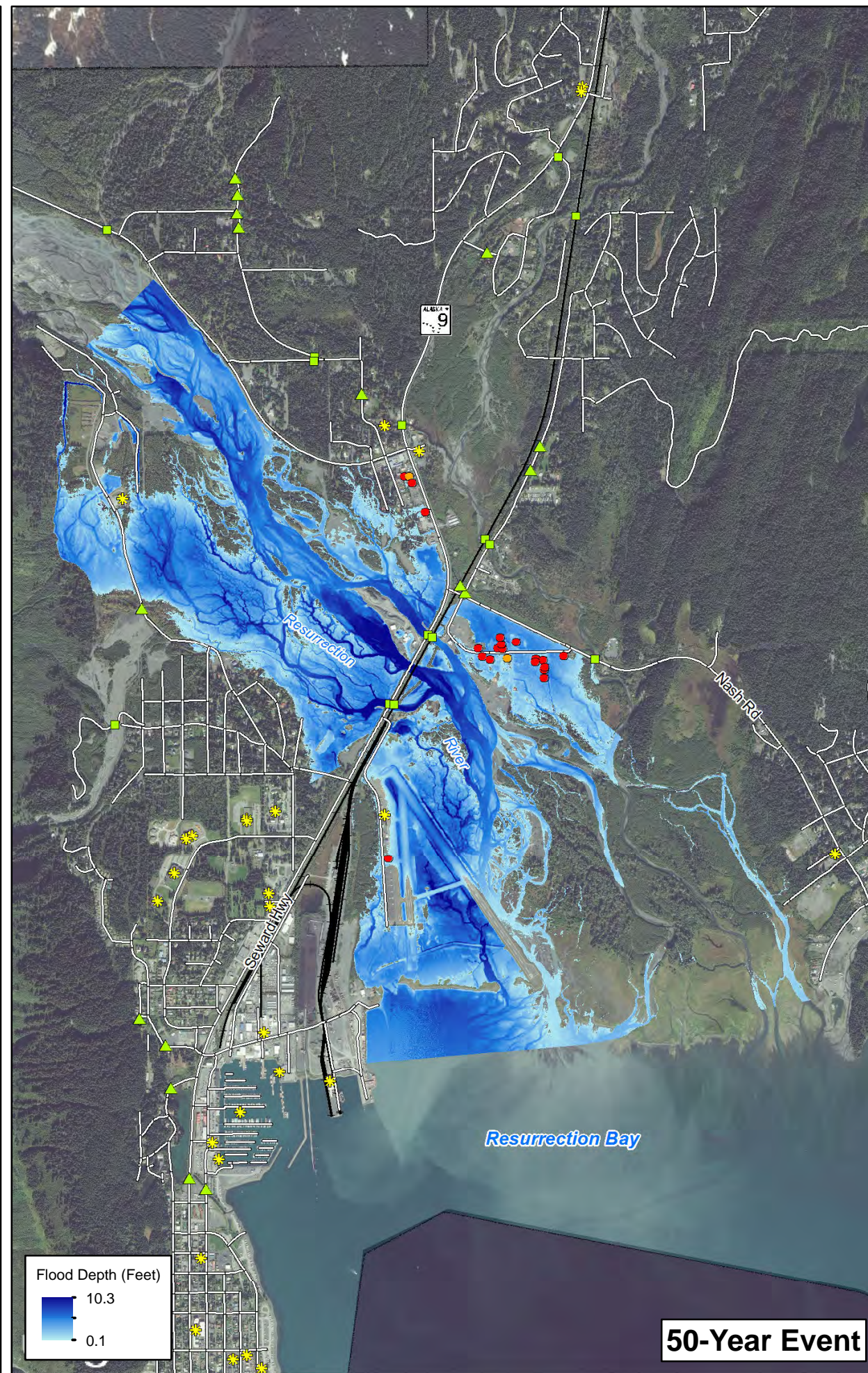
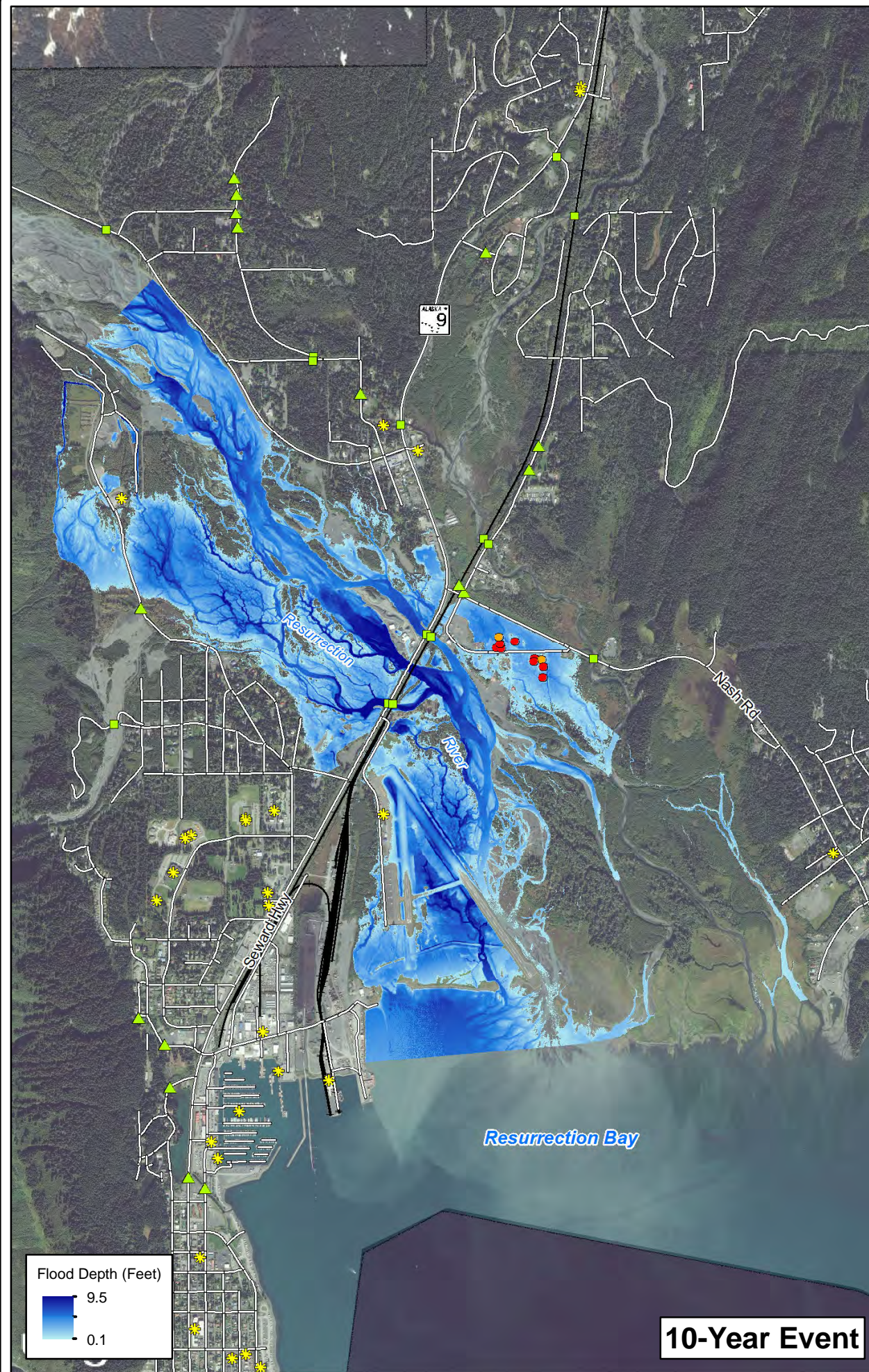
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**LOST CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-34



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Resurrection\_2012\_10\_50.mxd Plot Date: 4/22/2013

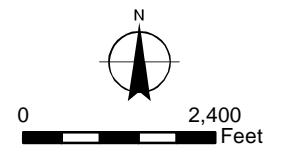


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

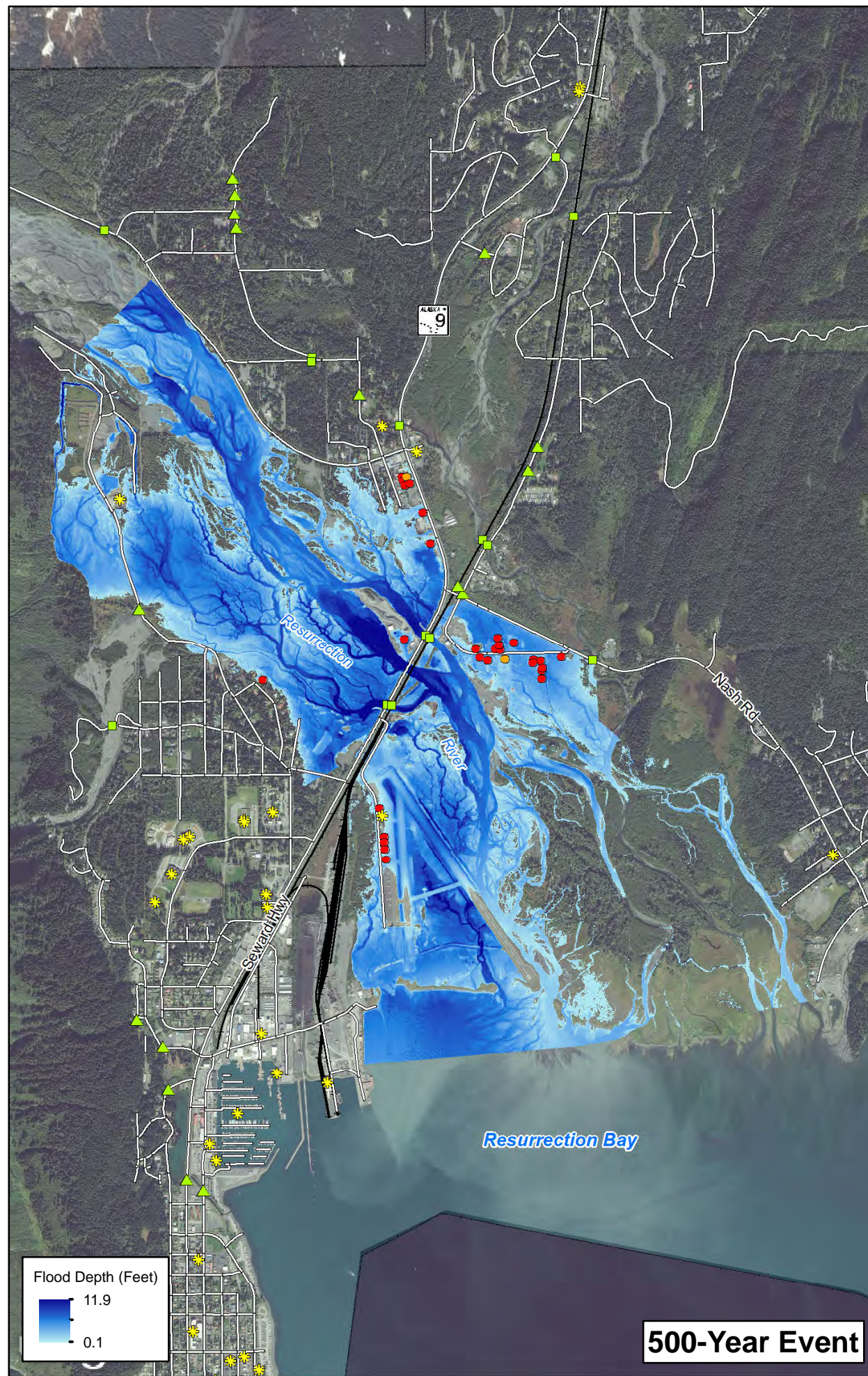
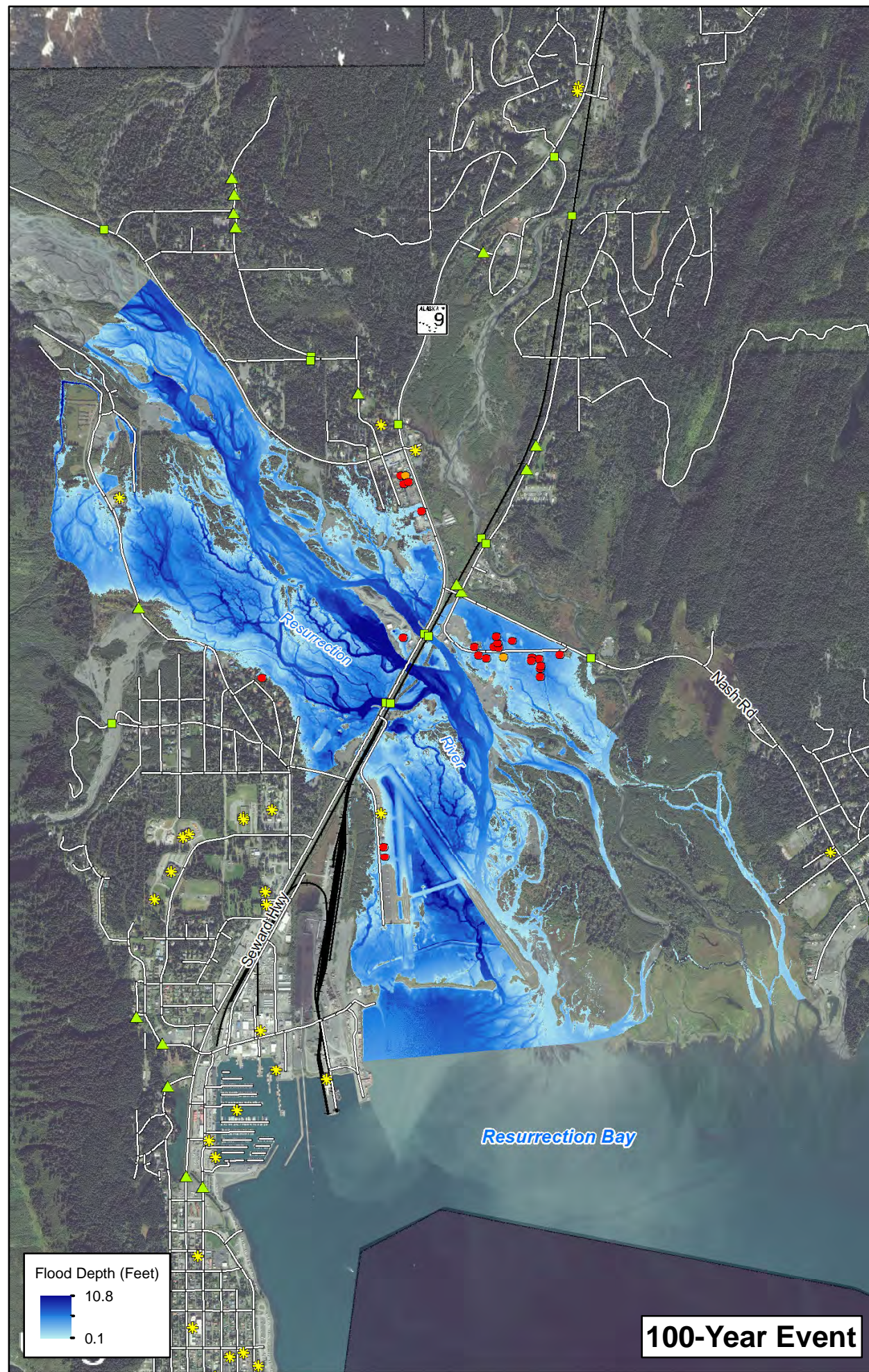
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**RESURRECTION RIVER  
MODELED FLOODPLAIN  
2012: 10- & 50-YEAR**

MAP K-35



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Resurrection\_2012\_100\_500.mxd Plot Date: 4/22/2013

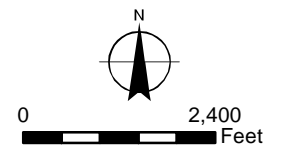


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



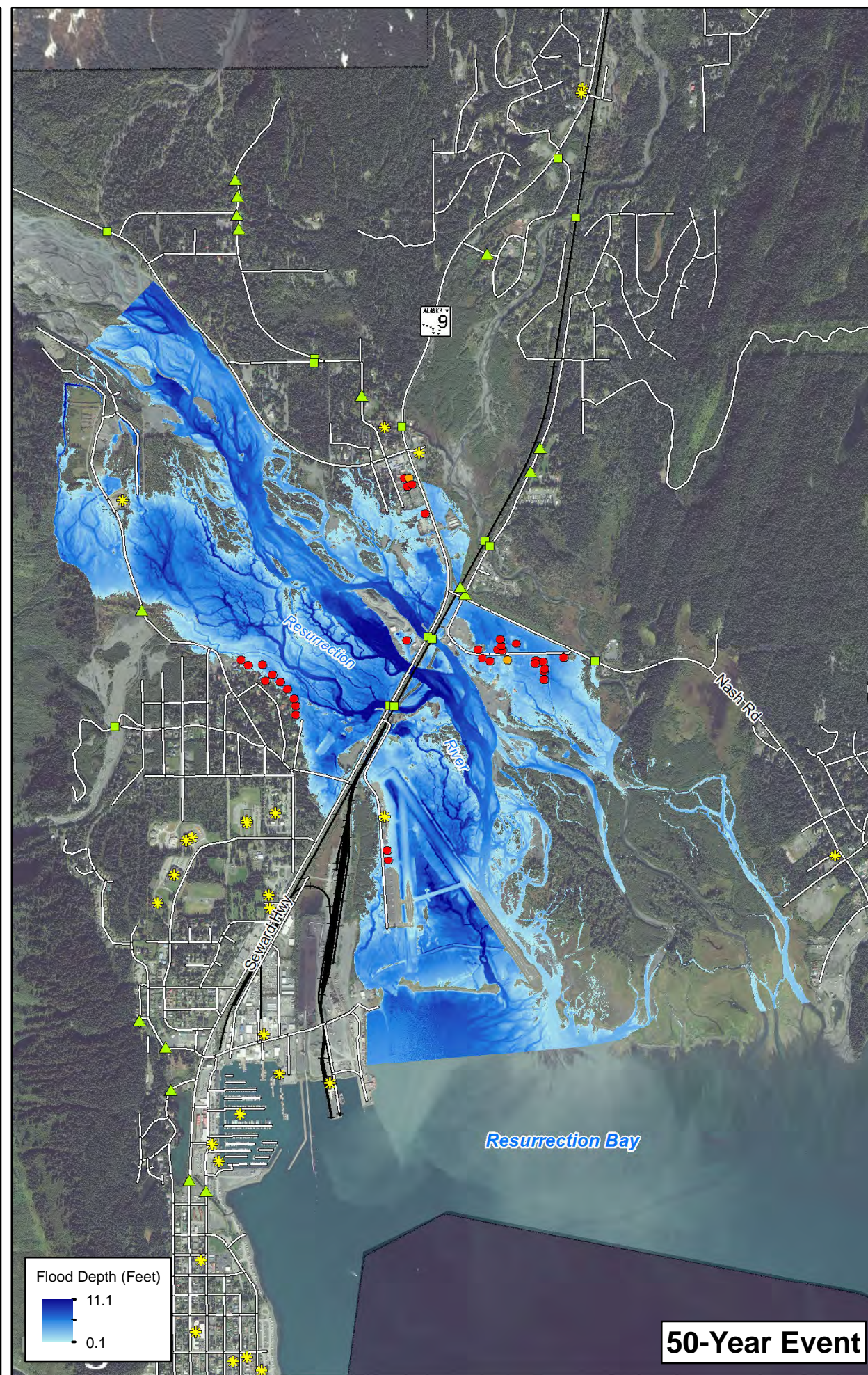
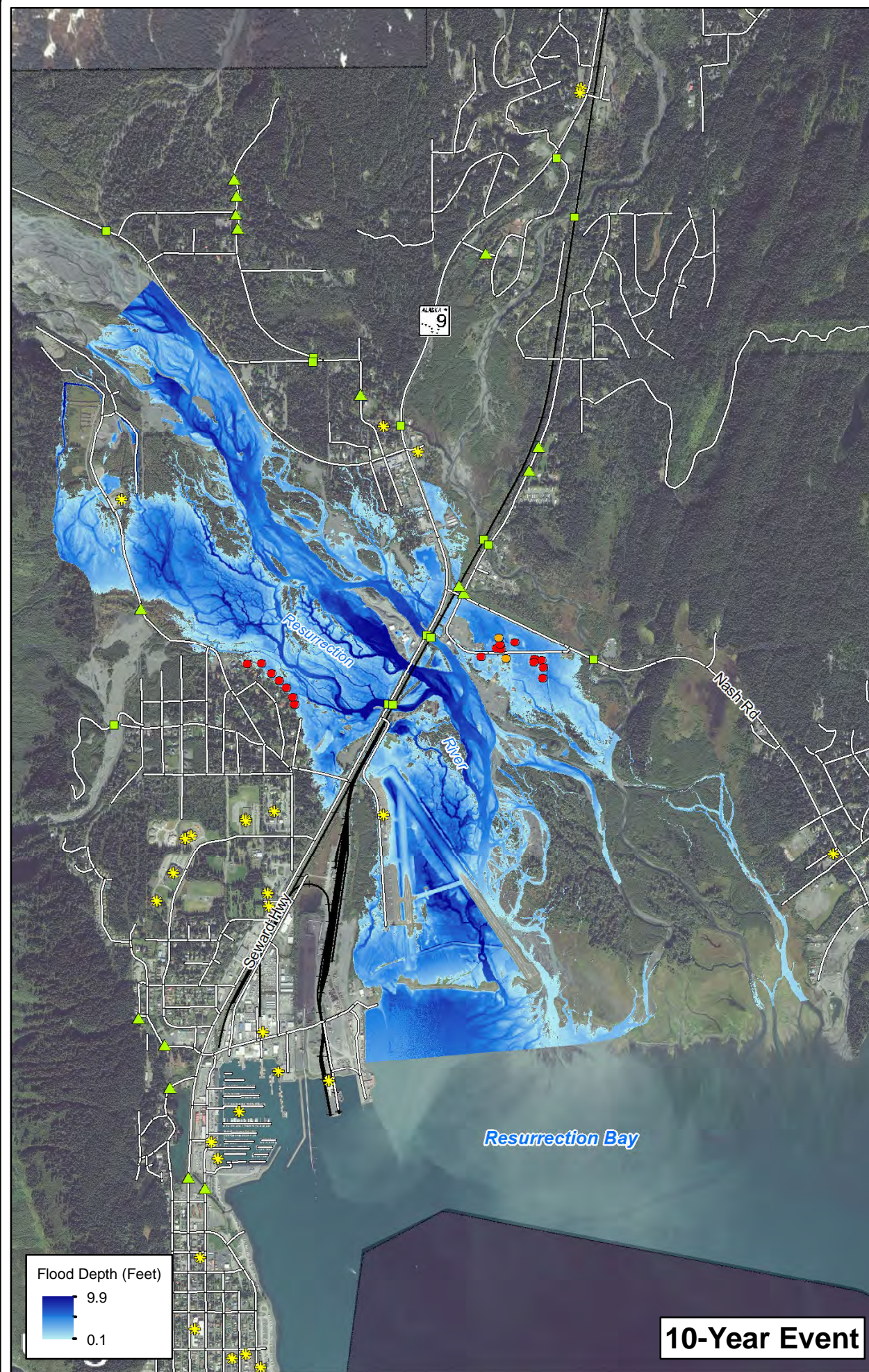
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**RESURRECTION RIVER  
MODELED FLOODPLAIN  
2012: 100- & 500-YEAR**

MAP K-36



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Resurrection\_2022\_A1B\_10\_50.mxd Plot Date: 4/22/2013

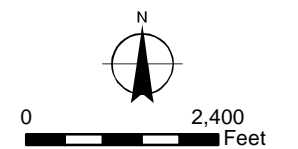


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

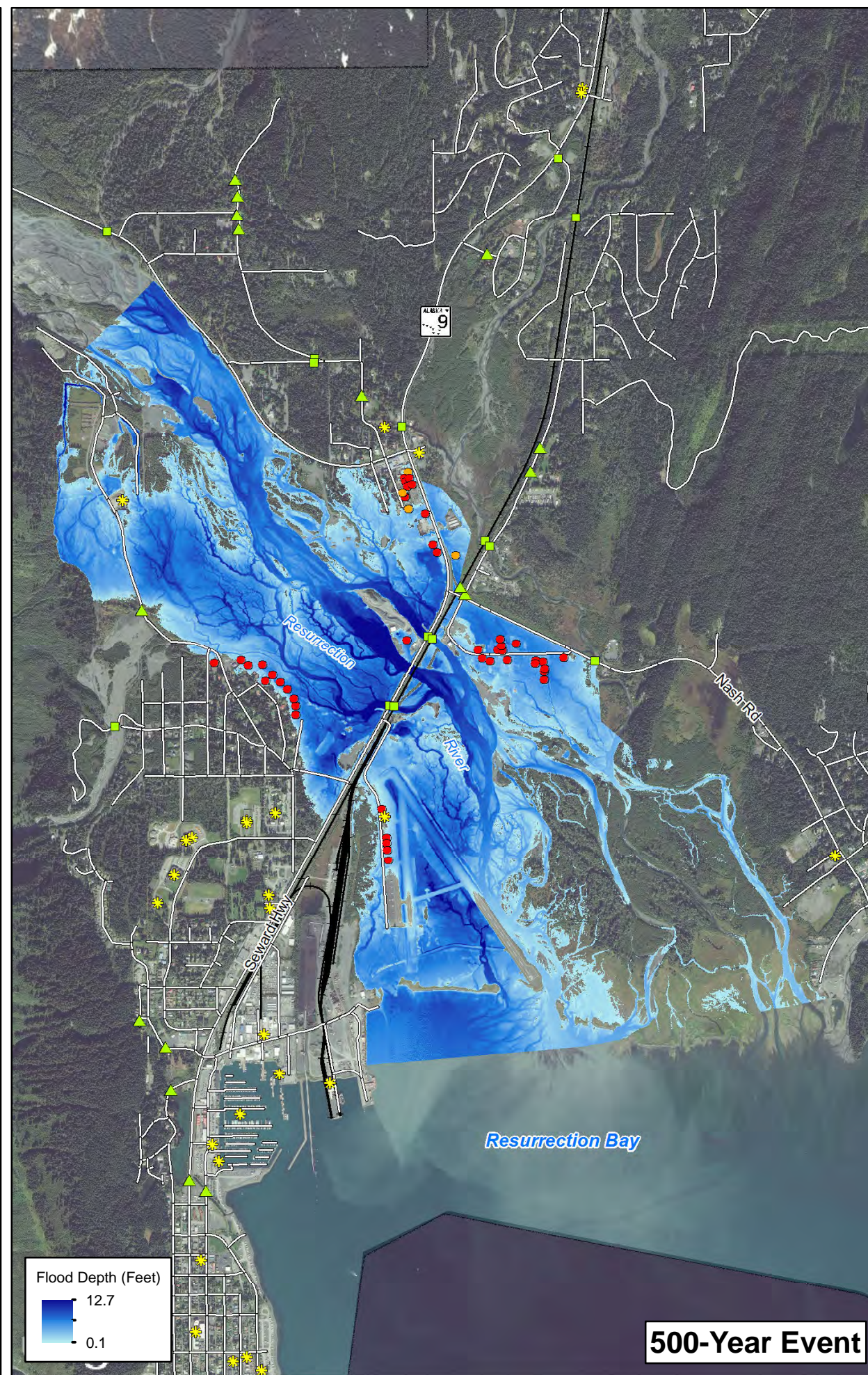
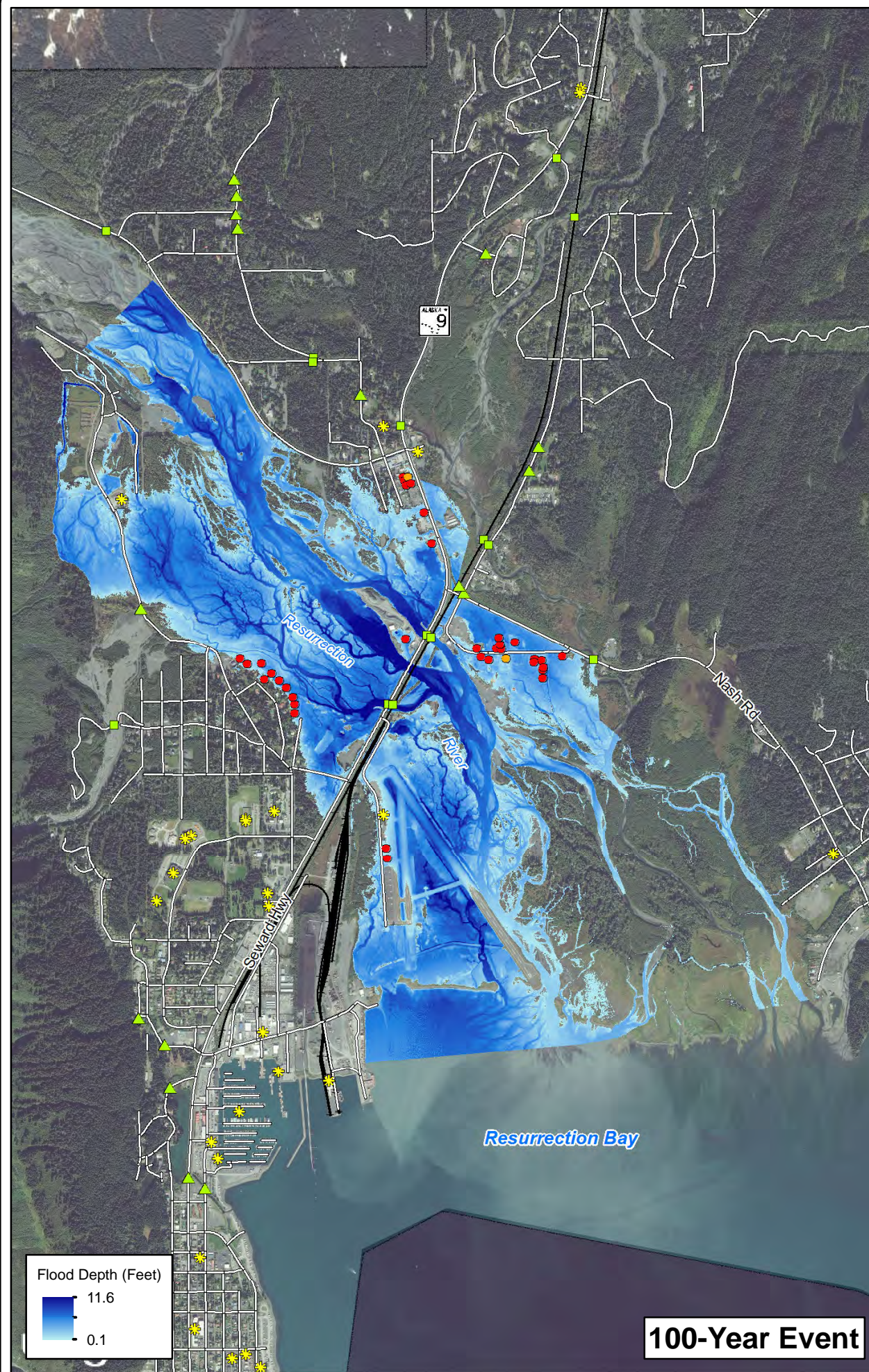
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**RESURRECTION RIVER  
MODELED FLOODPLAIN  
2022: 10- & 50-YEAR**

MAP K-37



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Resurrection\_2022\_A1B\_100\_500.mxd Plot Date: 4/27/2013

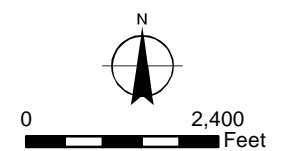


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



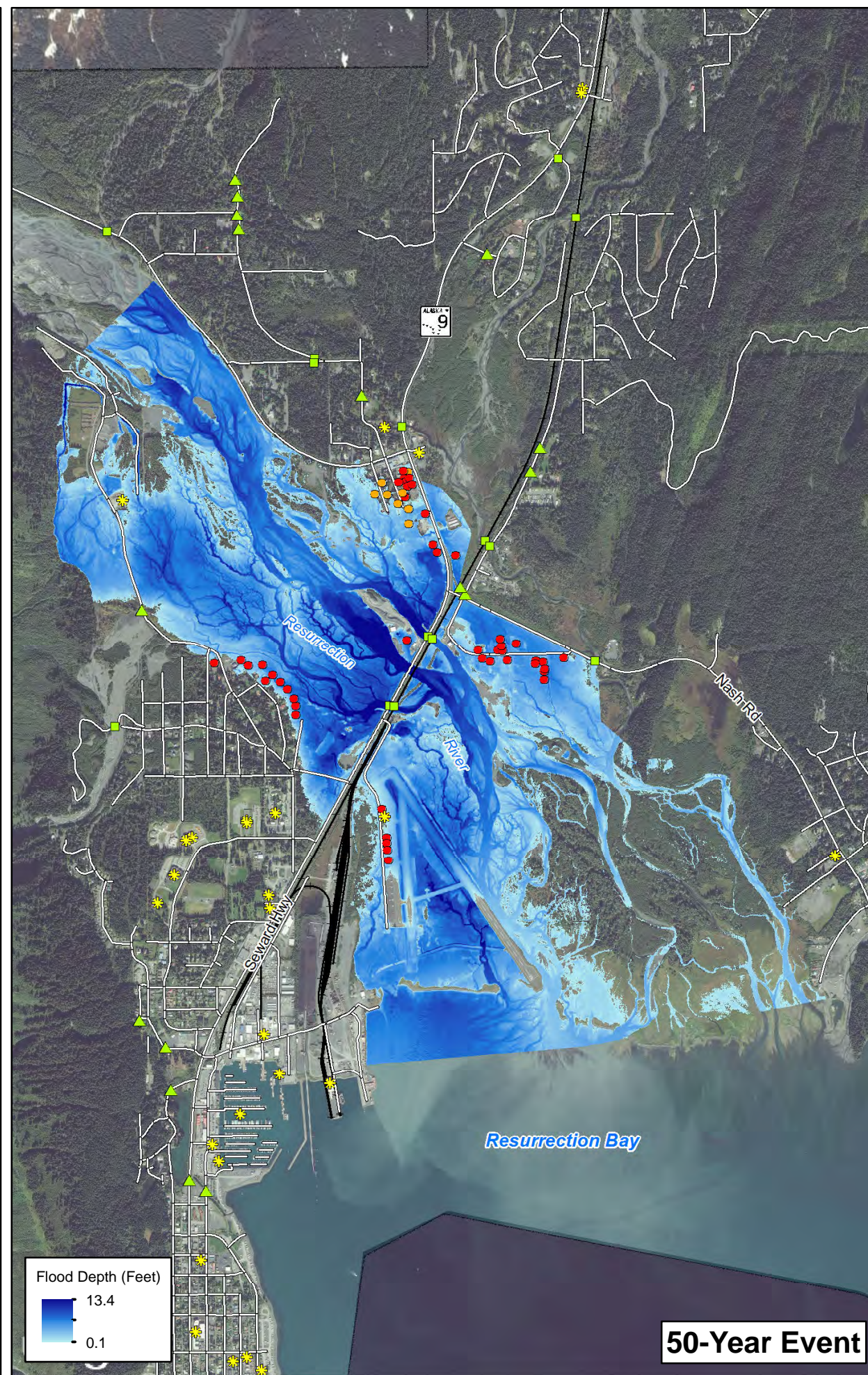
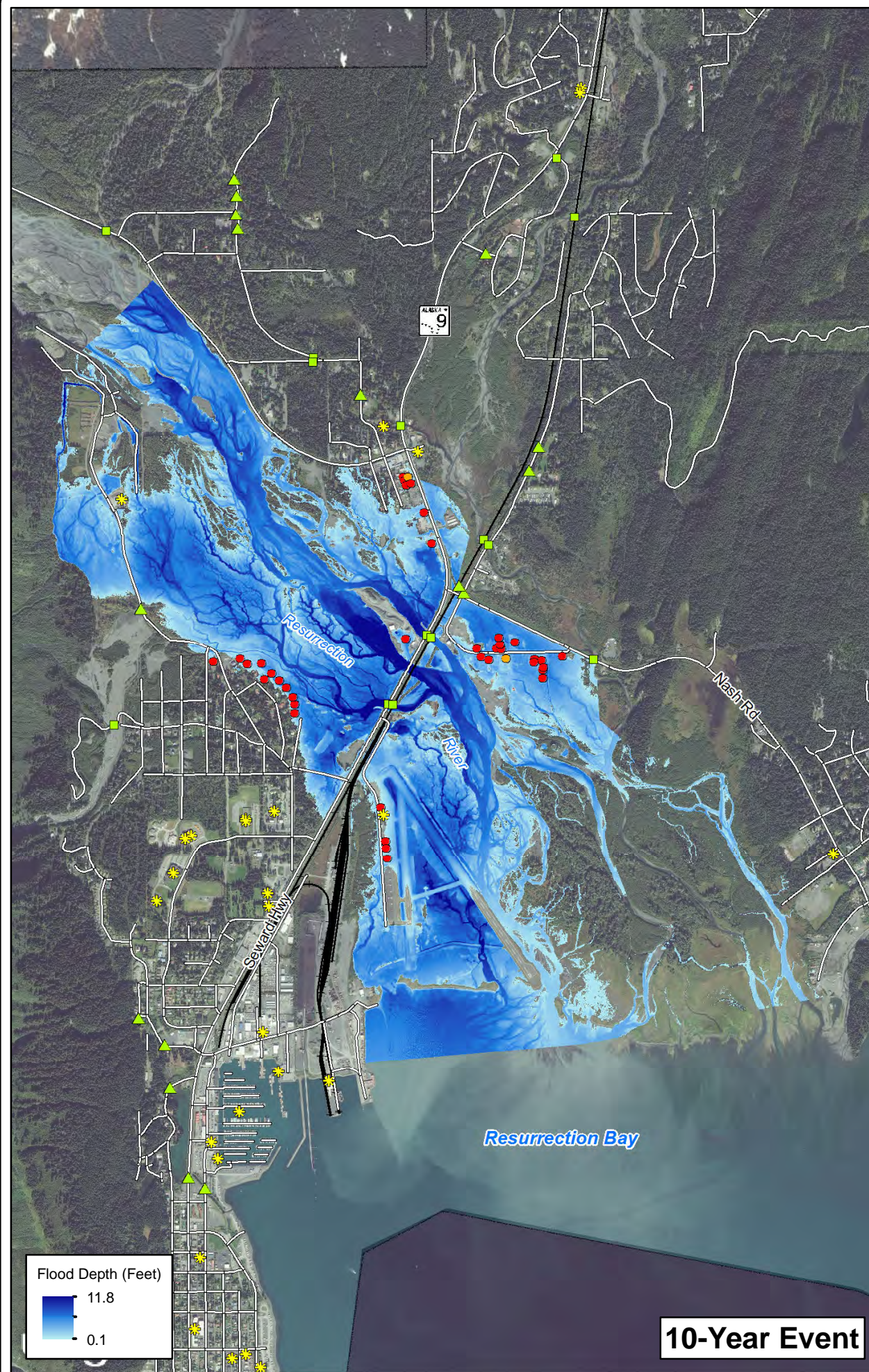
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**RESURRECTION RIVER  
MODELED FLOODPLAIN  
2022: 100- & 500-YEAR**

MAP K-38



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Resurrection\_2062\_A1B\_10\_50.mxd Plot Date: 4/22/2013

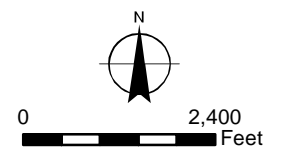


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



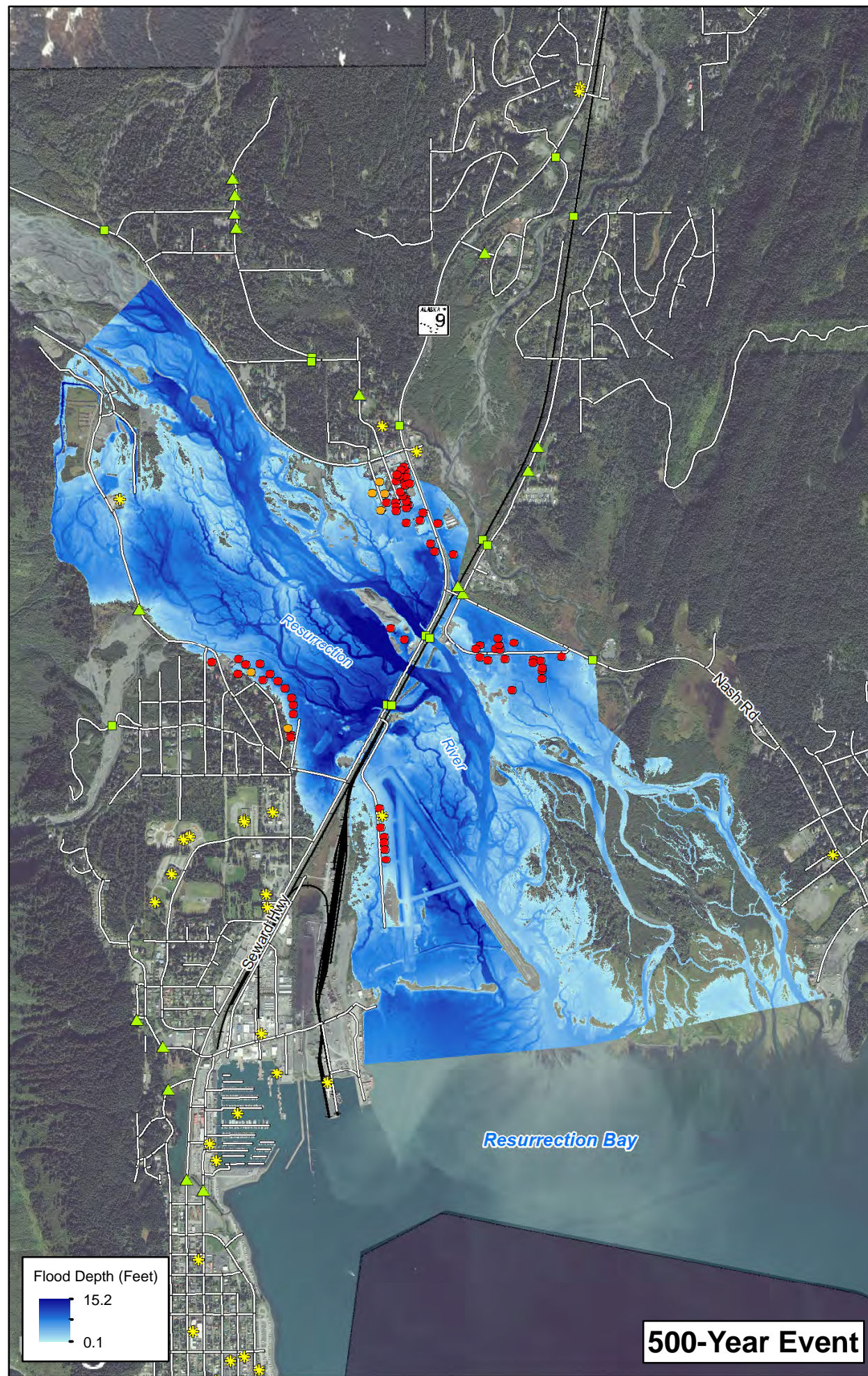
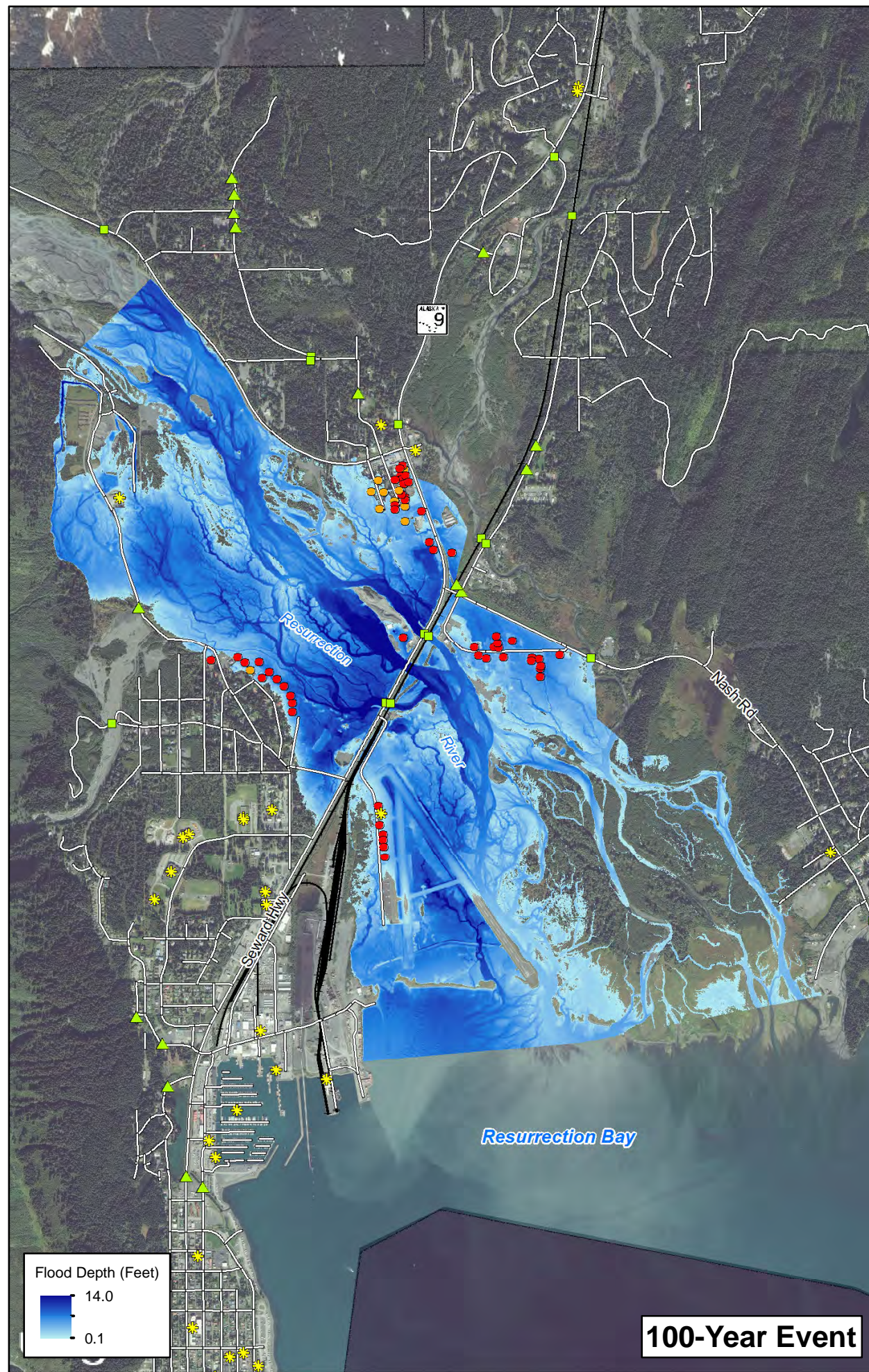
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**RESURRECTION RIVER  
MODELED FLOODPLAIN  
2062: 10- & 50-YEAR**

MAP K-39



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Resurrection\_2062\_A1B\_100\_500.mxd Plot Date: 4/27/2013

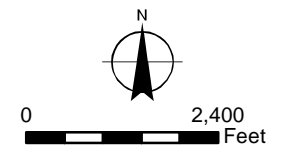


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



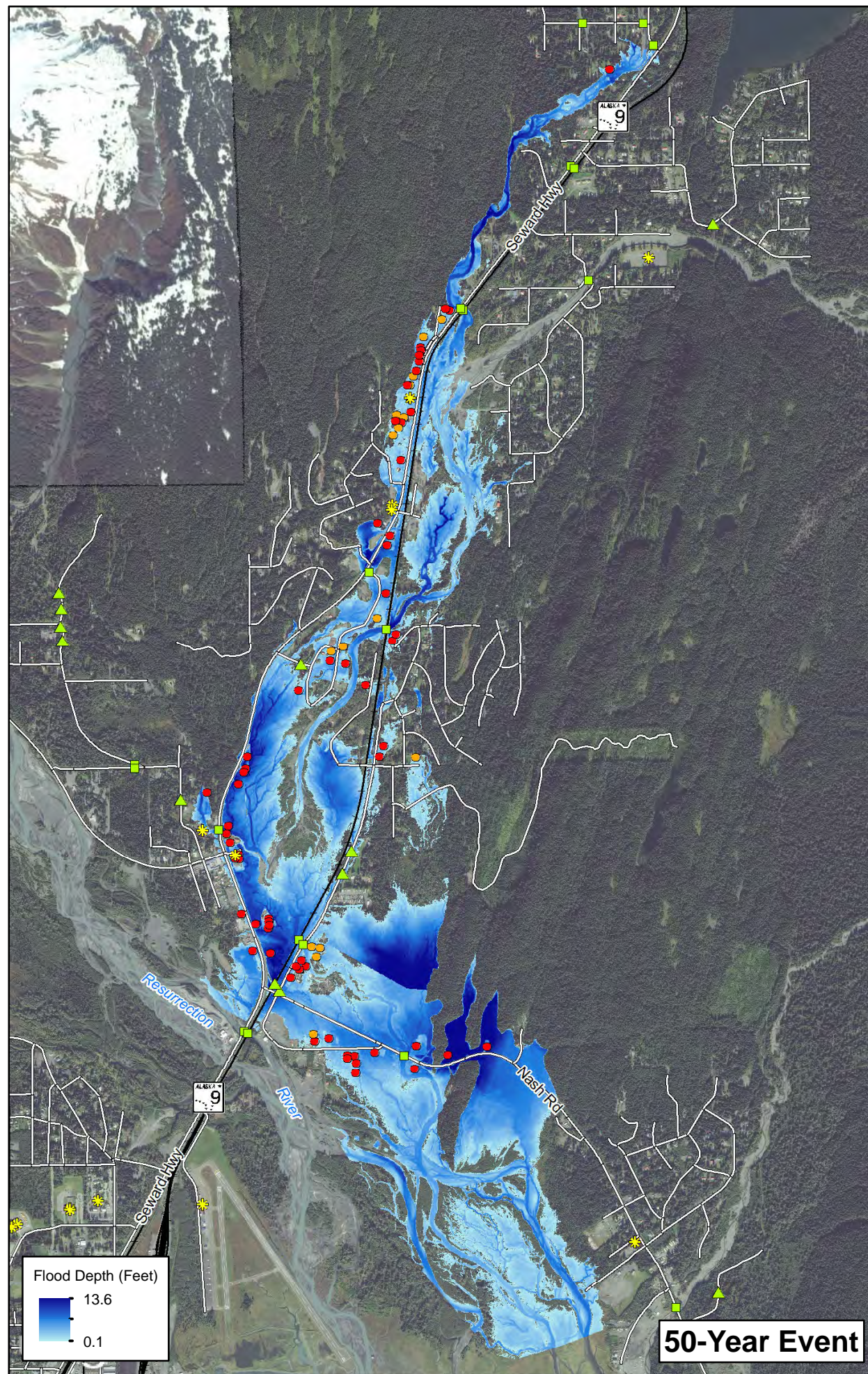
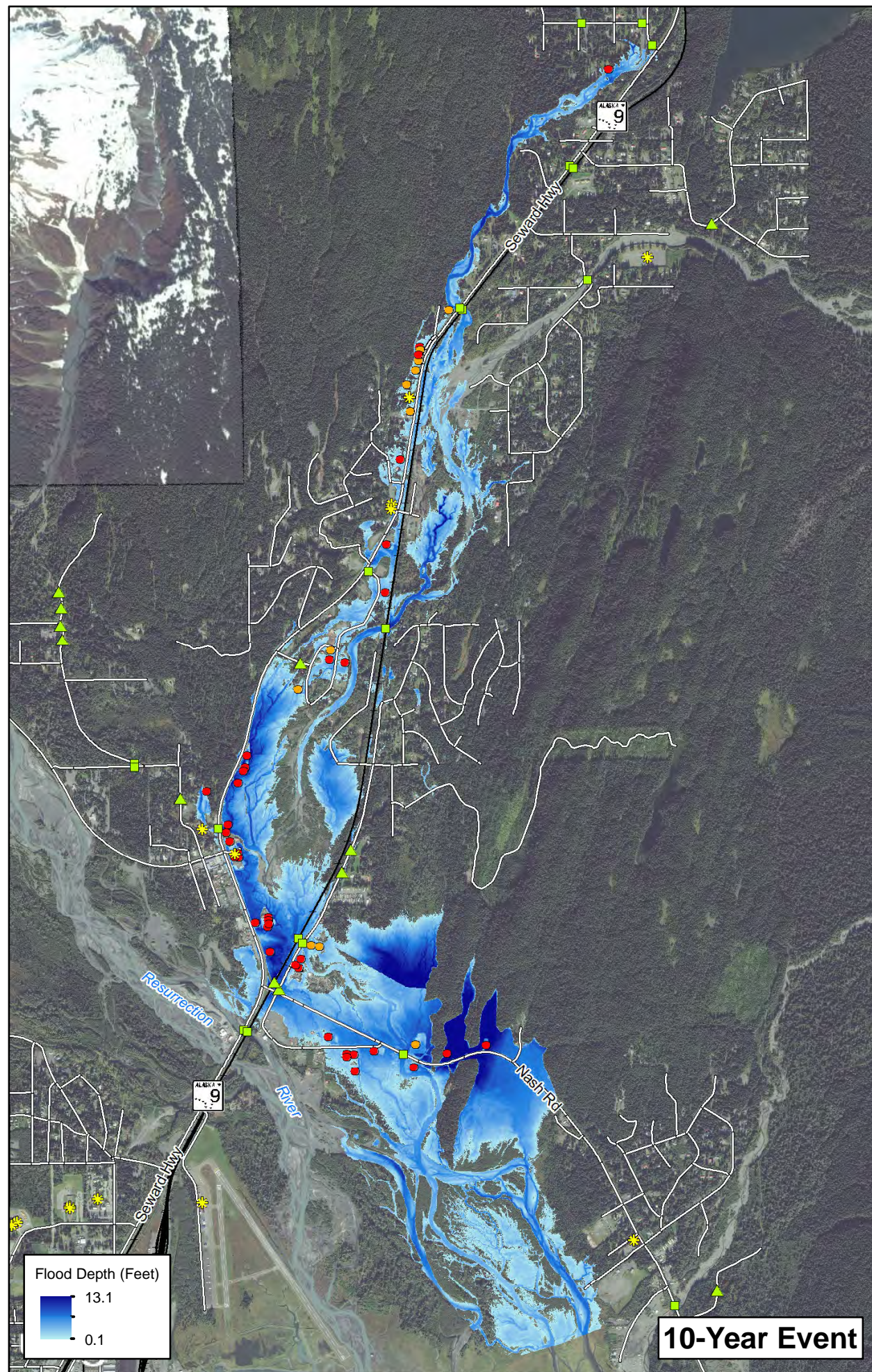
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**RESURRECTION RIVER  
MODELED FLOODPLAIN  
2062: 100- & 500-YEAR**

MAP K-40



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Salmon\_2012\_A1B\_10\_50.mxd Plot Date: 4/22/2013

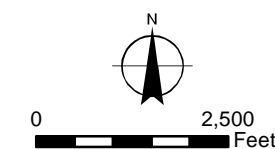


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

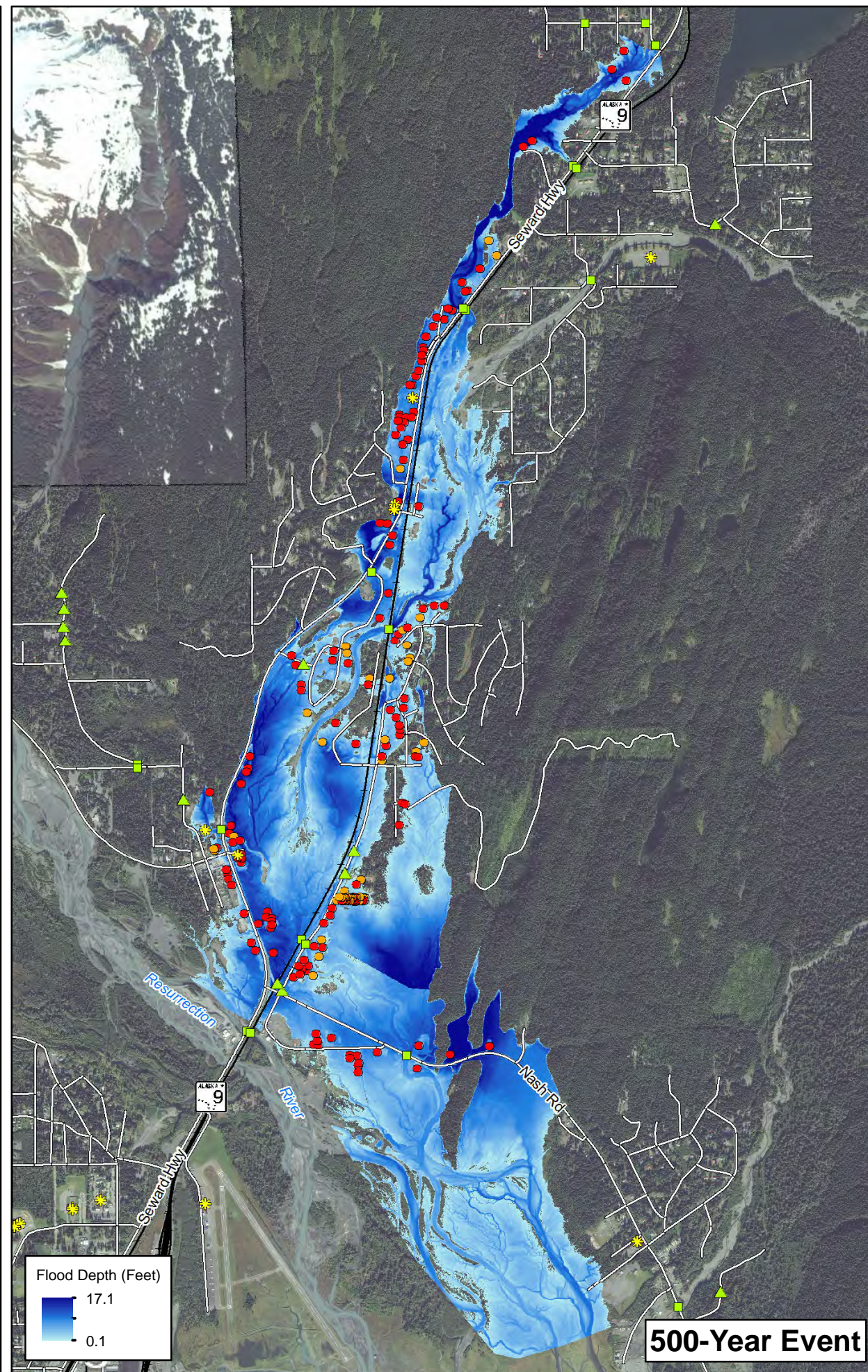
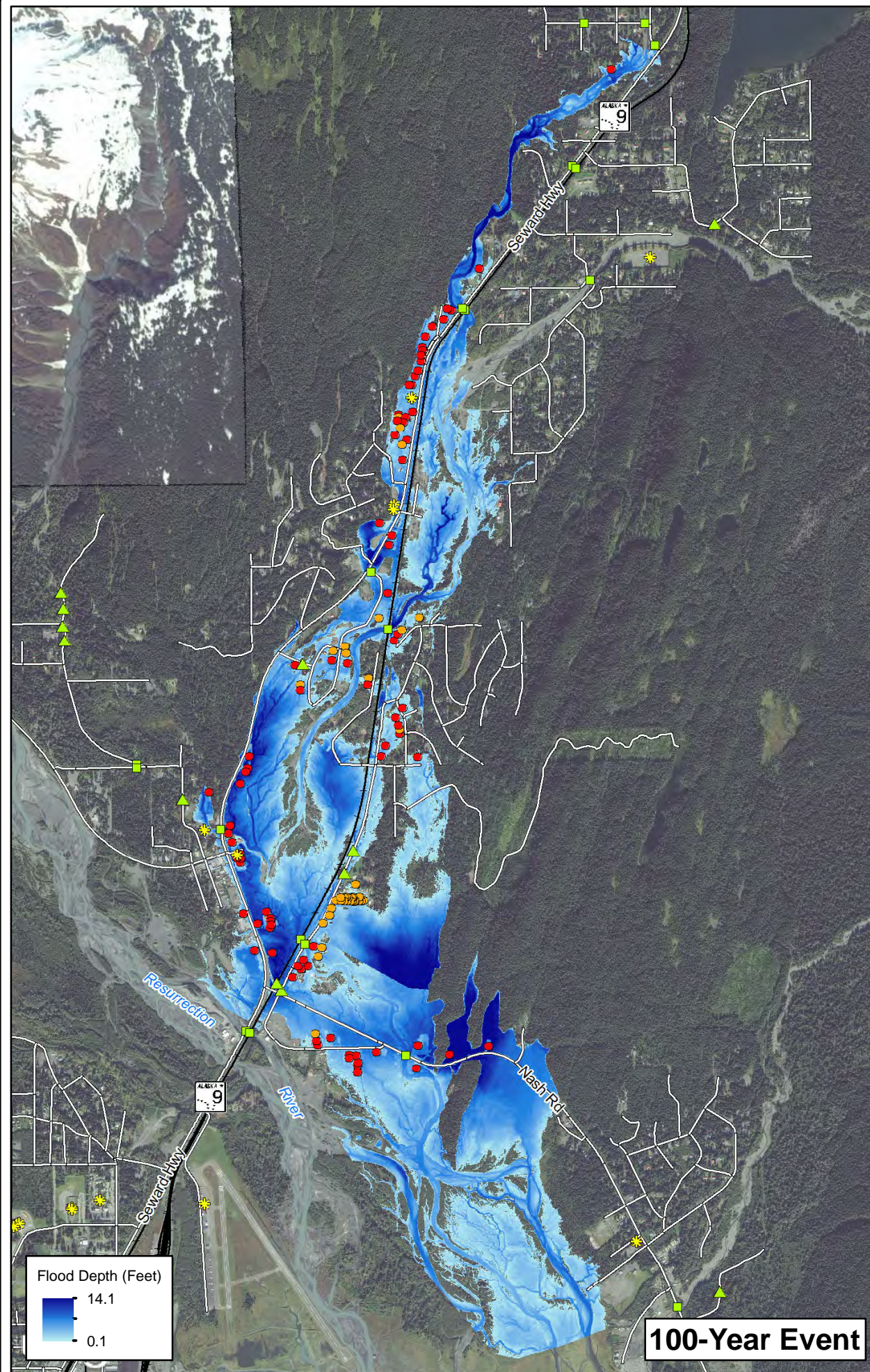
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SALMON CREEK  
MODELED FLOODPLAIN  
2012: 10- & 50-YEAR**

MAP K-41



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Salmon\_2012\_A1B\_100\_500.mxd Plot Date: 4/22/2013

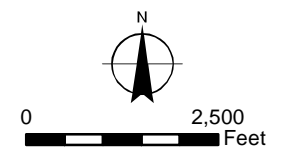


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.
2. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



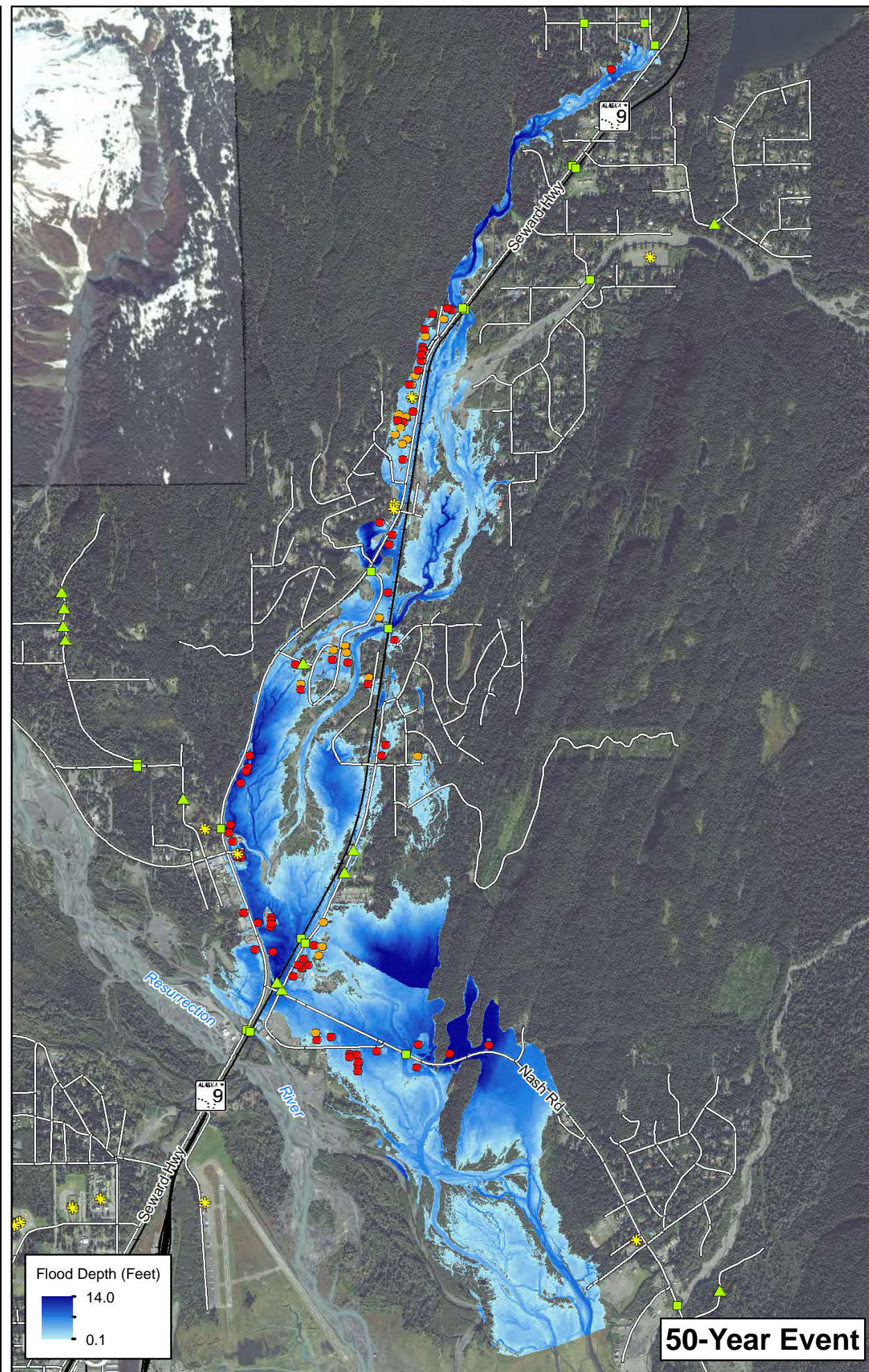
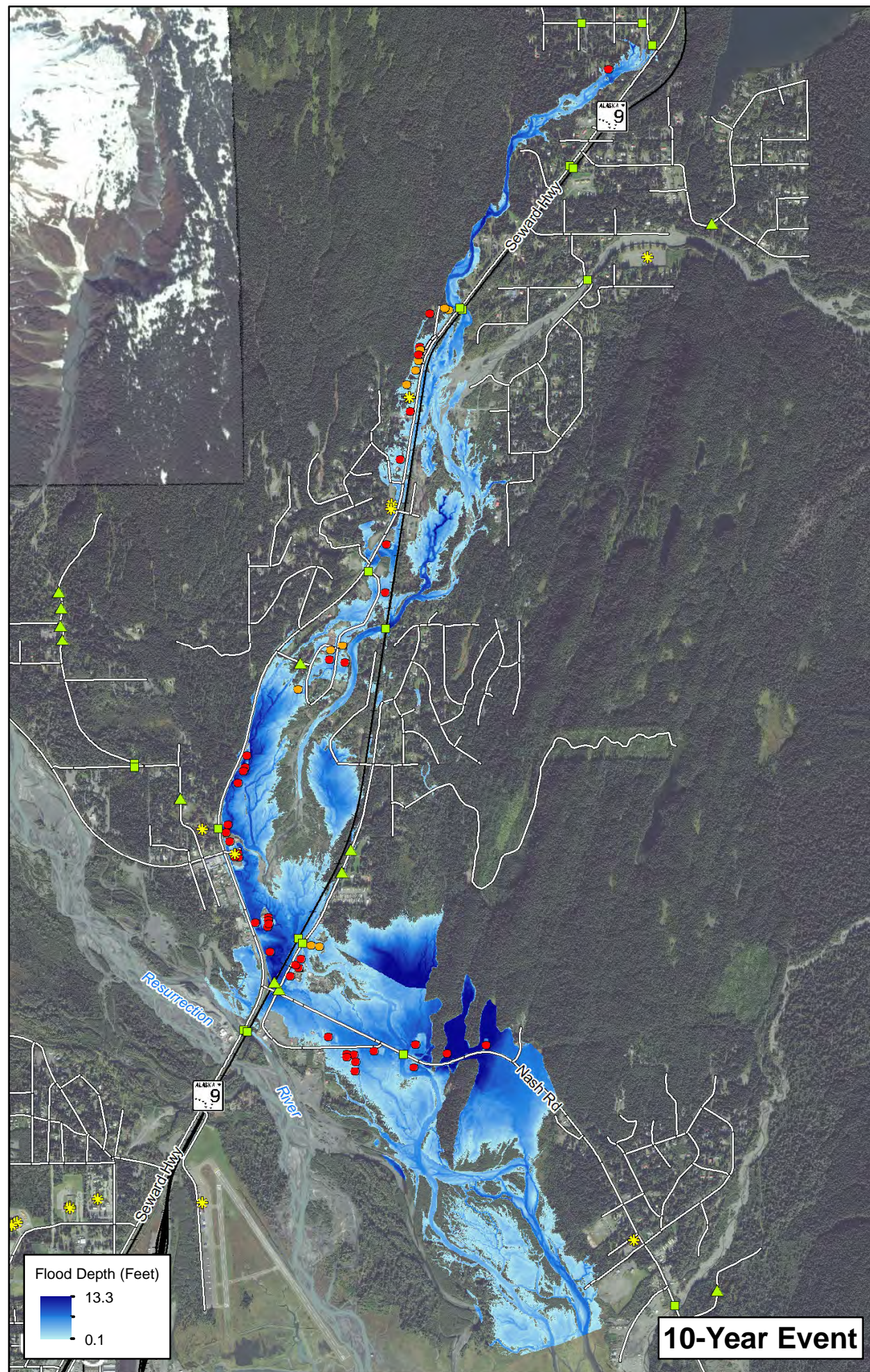
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SALMON CREEK  
MODELED FLOODPLAIN  
2012: 100- & 500-YEAR**

MAP K-42



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Salmon\_2022\_A1B\_10\_50.mxd Plot Date: 4/22/2013

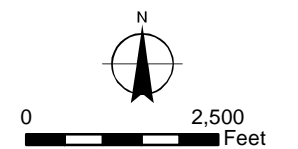


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



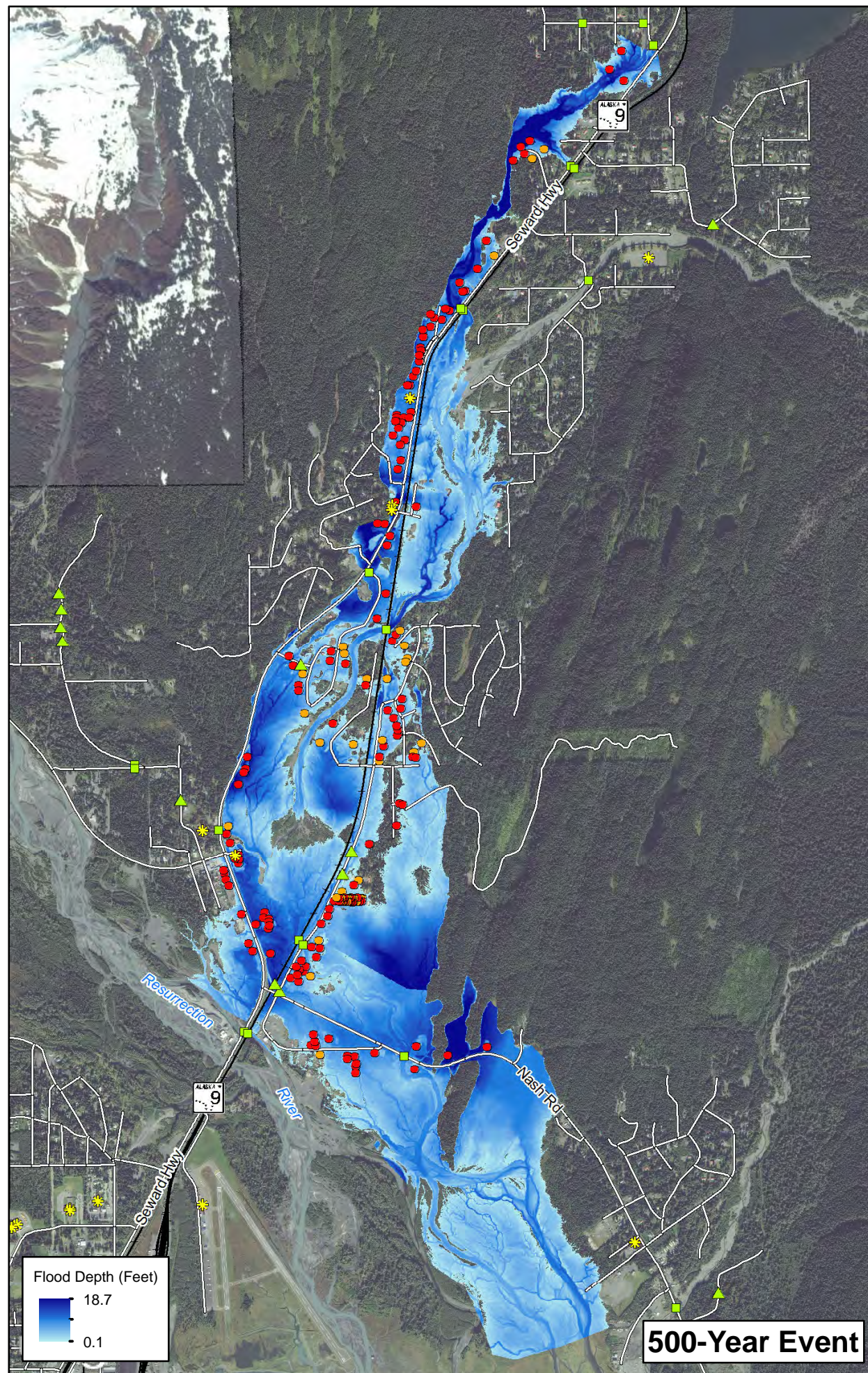
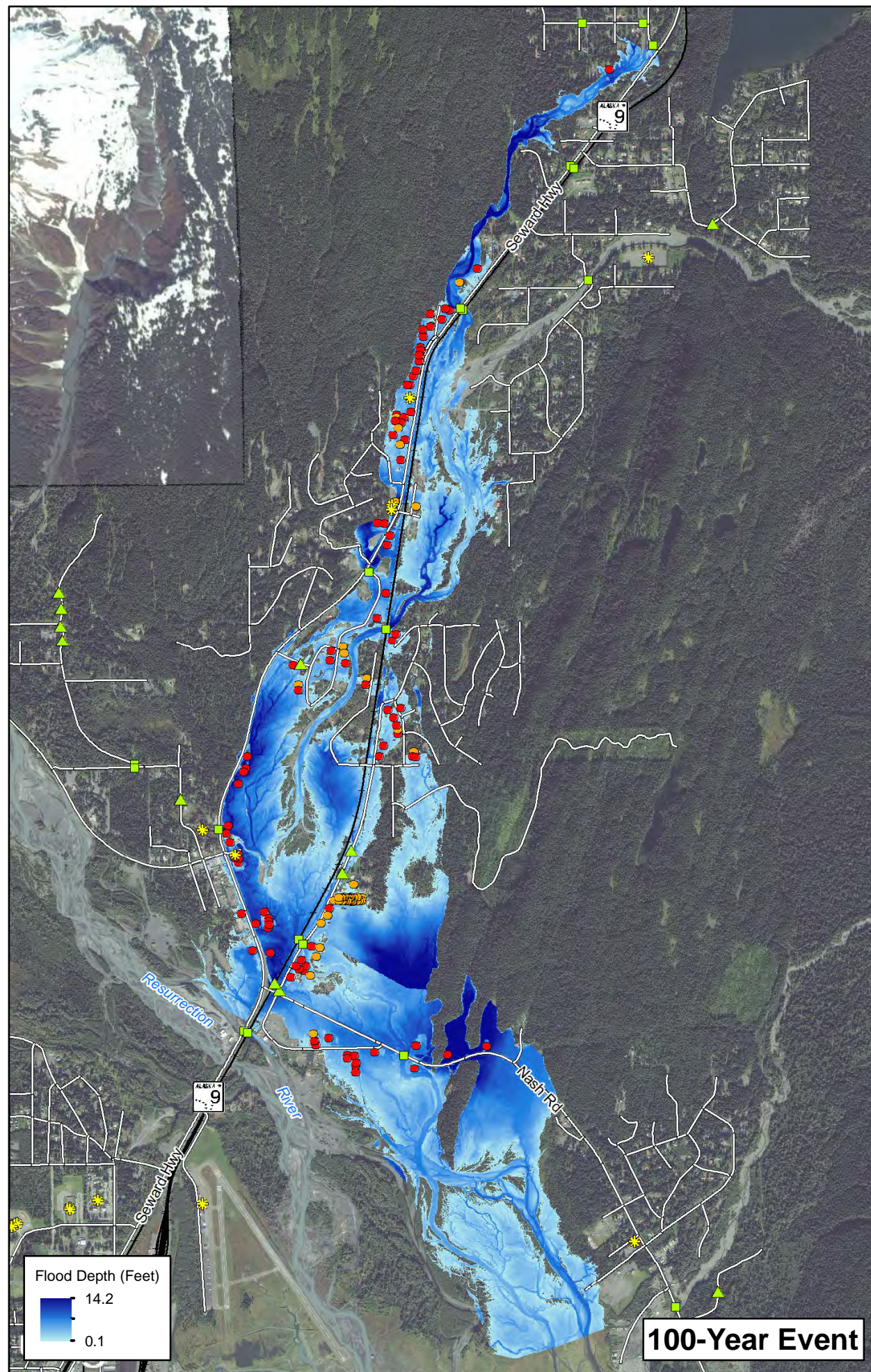
**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SALMON CREEK  
MODELED FLOODPLAIN  
2022: 10- & 50-YEAR**

MAP K-43



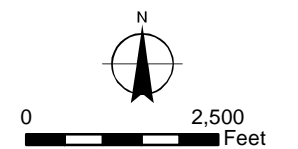


**Legend**

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

**Sources and Notes:**

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



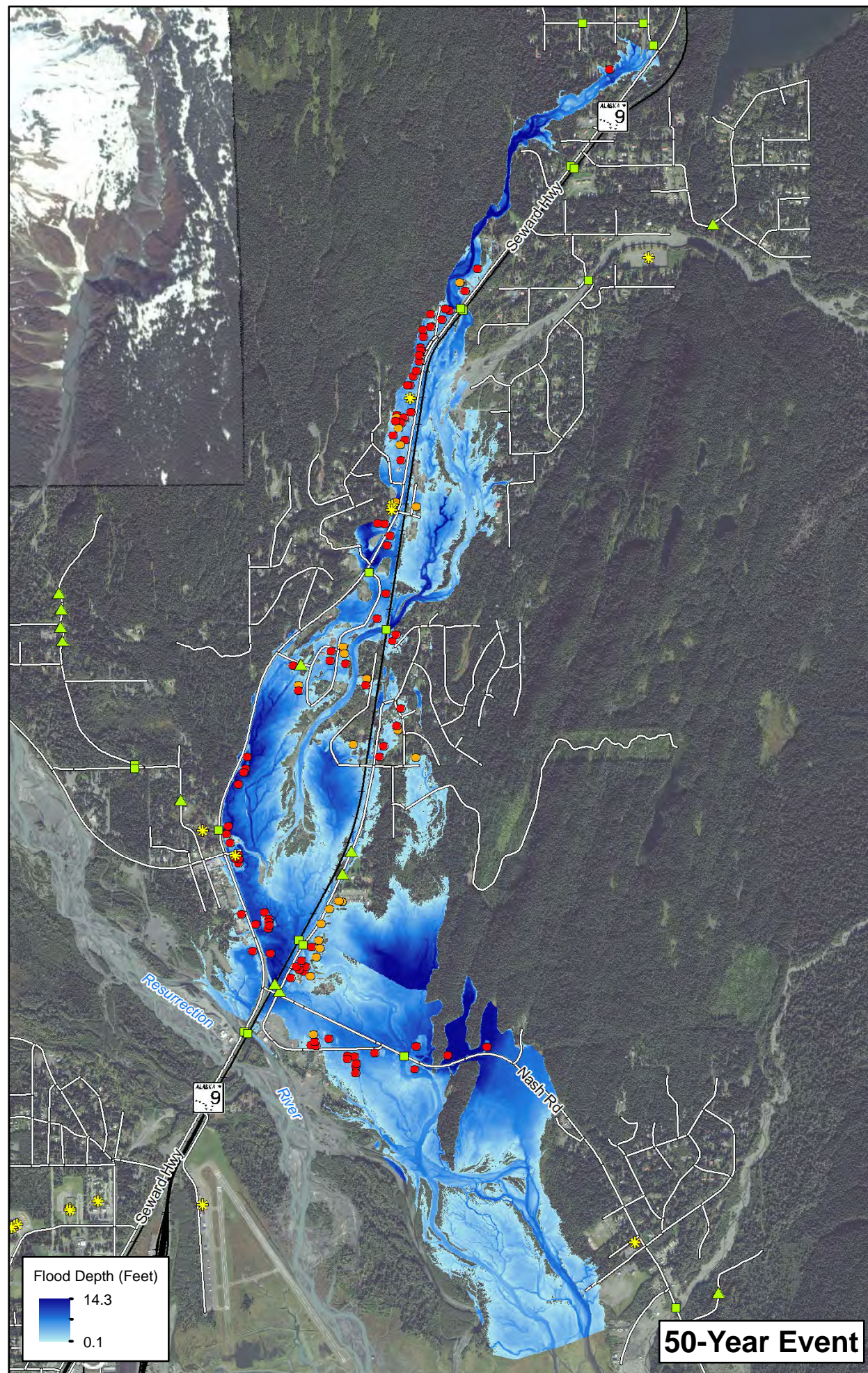
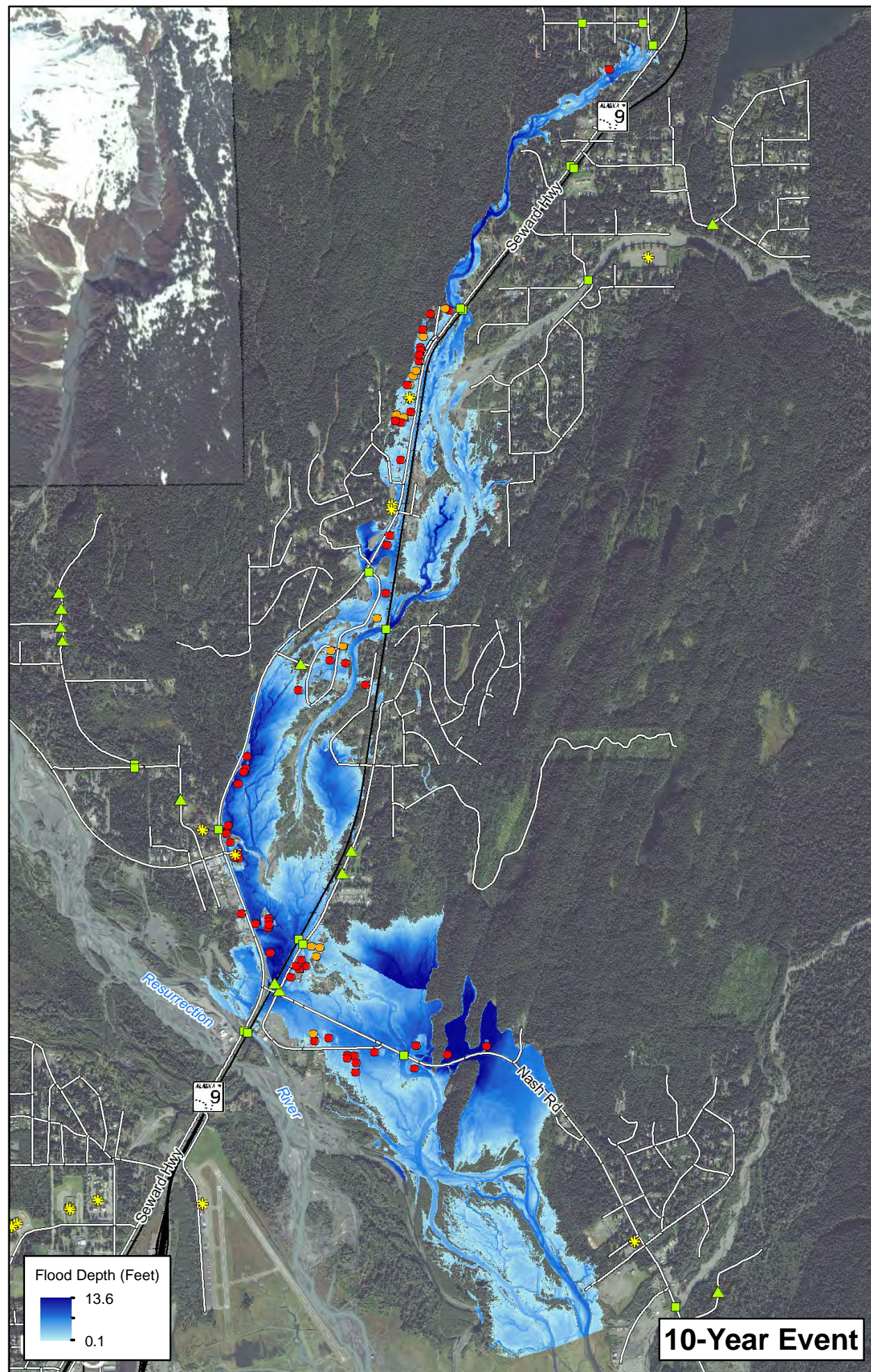
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SALMON CREEK  
MODELED FLOODPLAIN  
2022: 100- & 500-YEAR**

MAP K-44



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Salmon\_2062\_A1B\_10\_50.mxd Plot Date: 4/22/2013

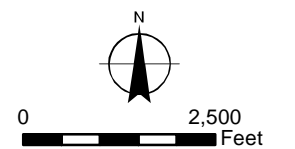


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

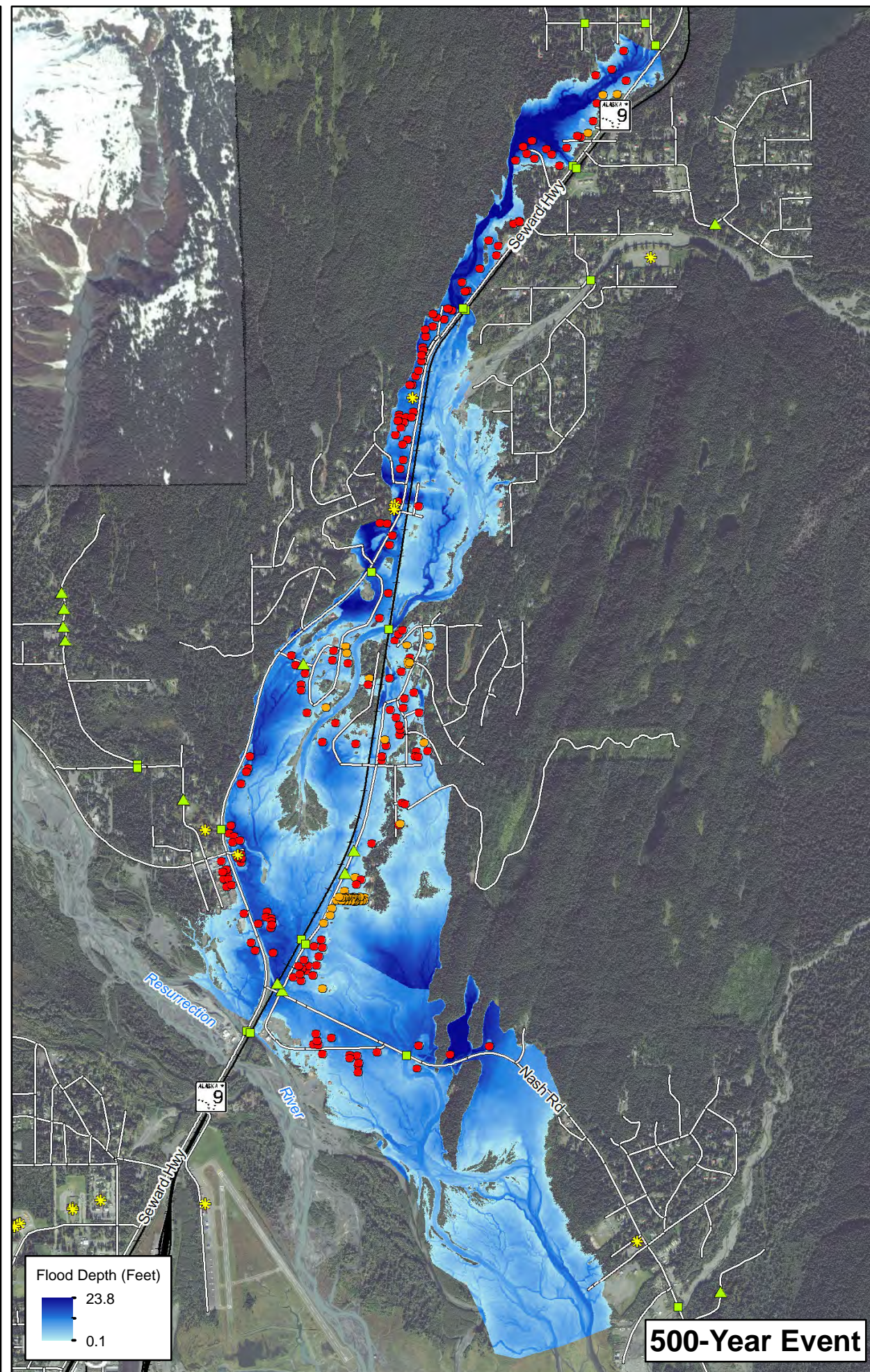
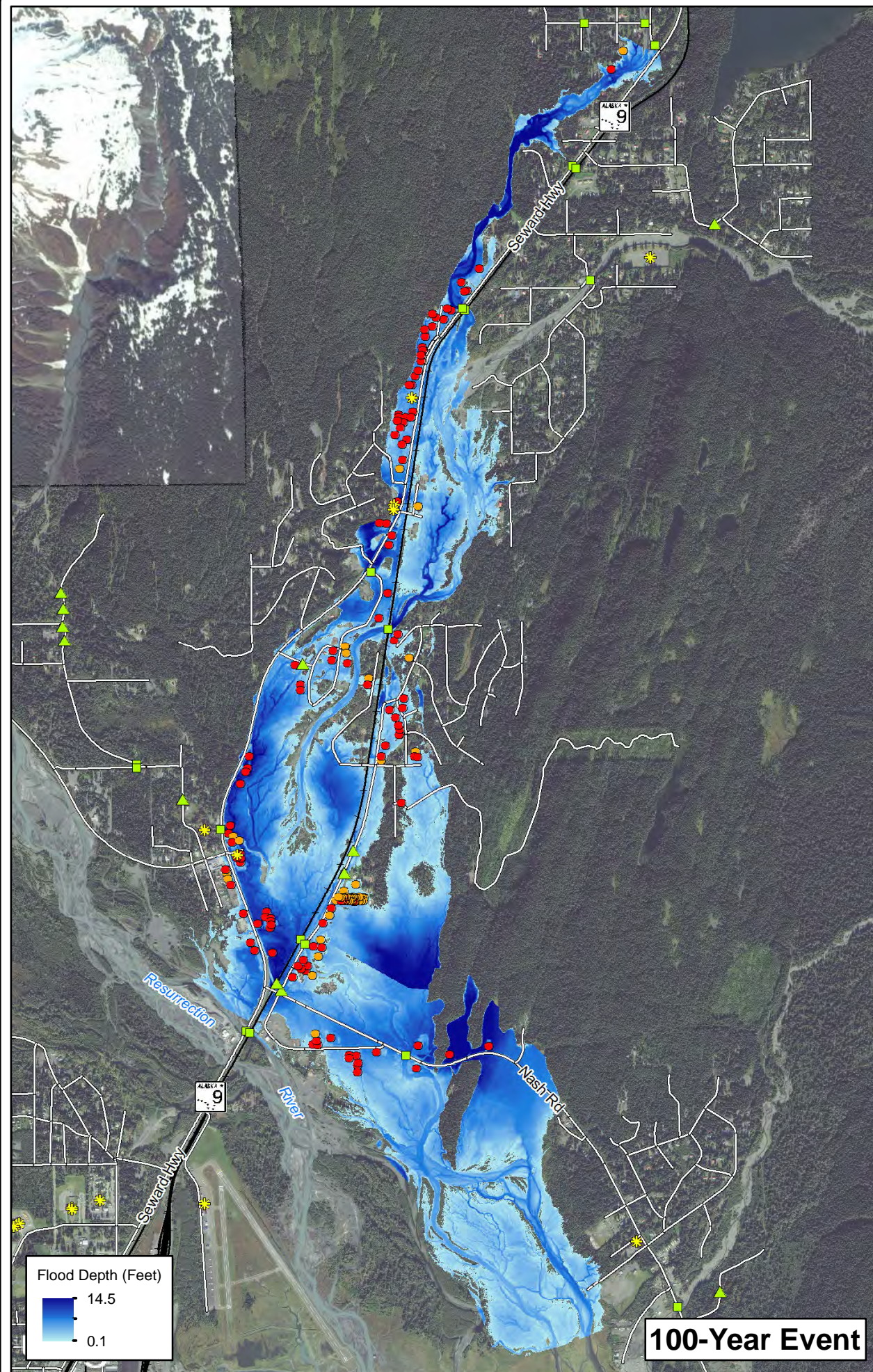
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SALMON CREEK  
MODELED FLOODPLAIN  
2062: 10- & 50-YEAR**

MAP K-45



Y:\GIS\Projects\Kenai Hazard Flood Earthquake\Map\Report\_Figures\Salmon\_2062\_A1B\_100\_500.mxd Plot Date: 4/22/2013

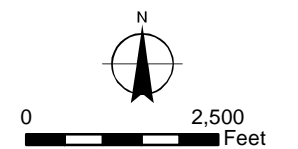


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.

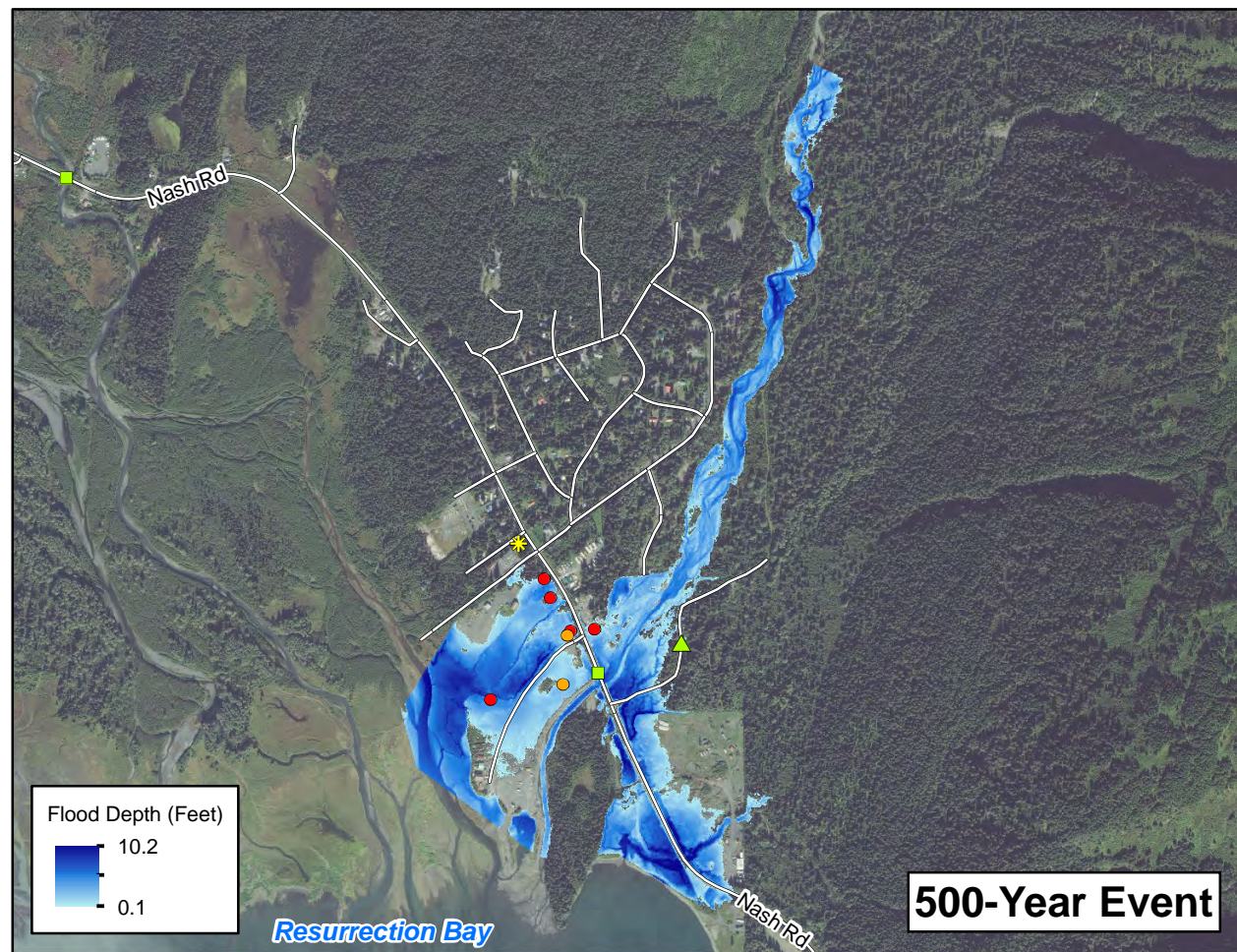
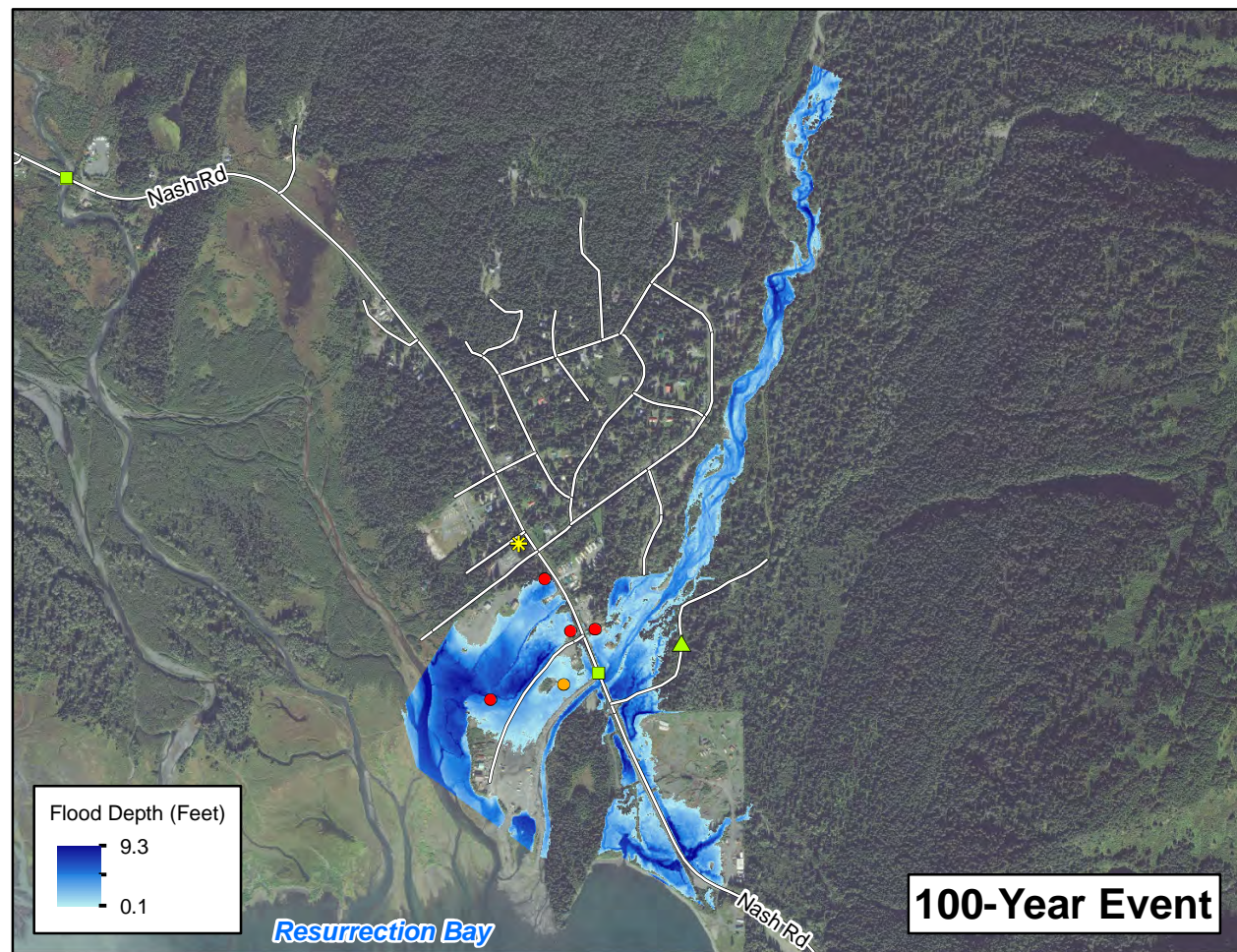
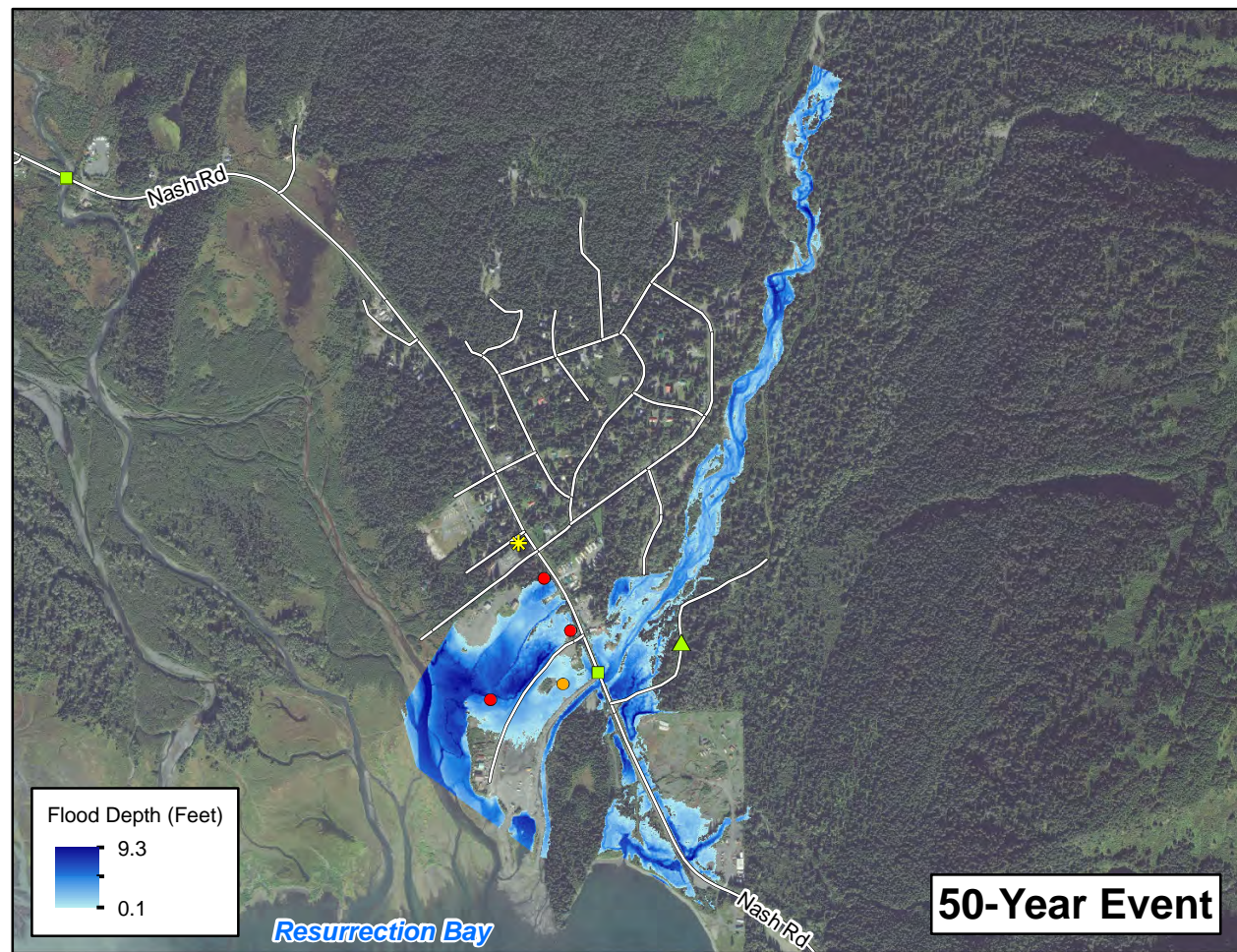
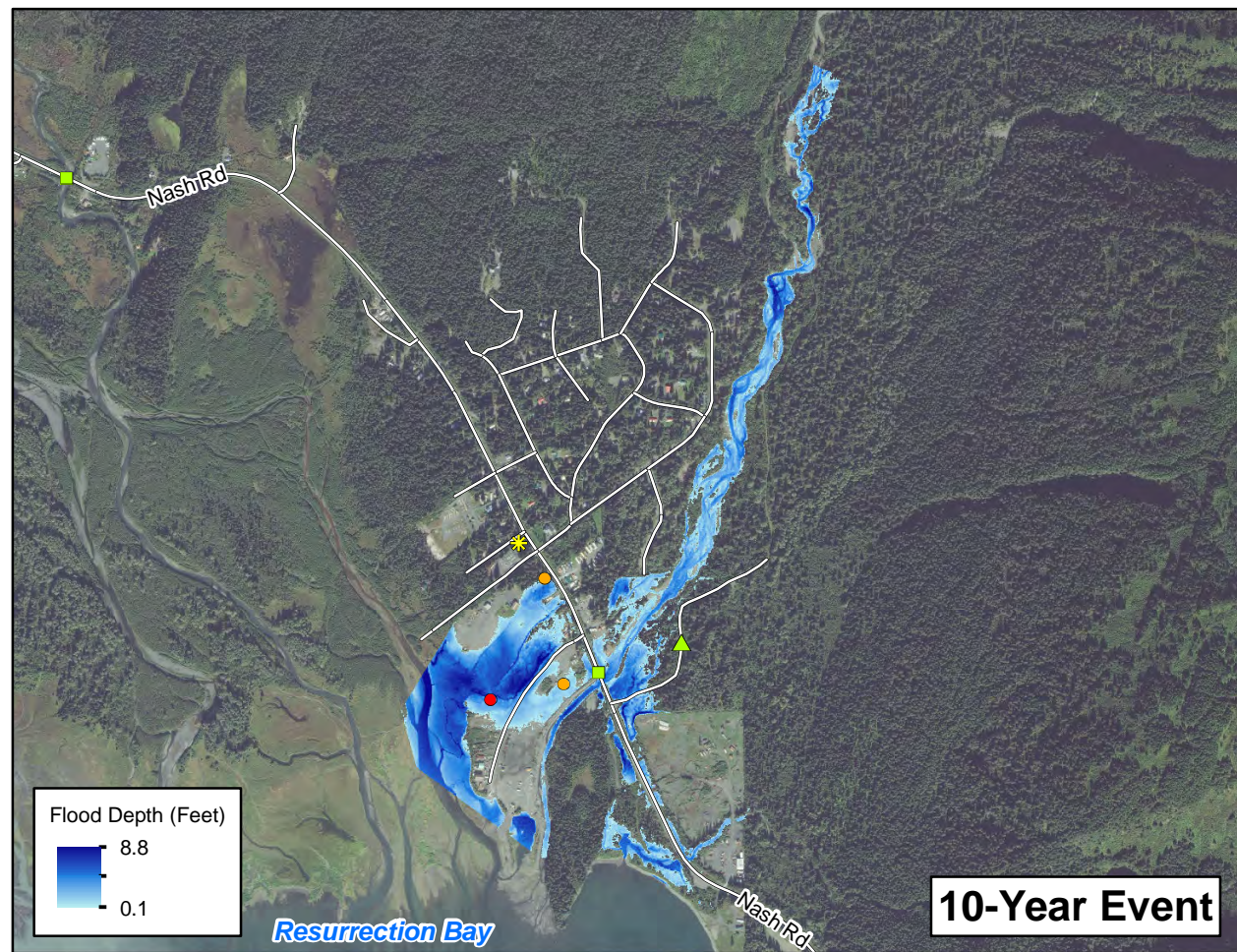


SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SALMON CREEK  
MODELED FLOODPLAIN  
2062: 100- & 500-YEAR**

MAP K-46



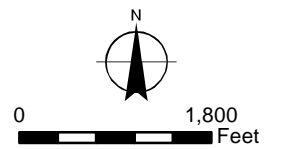


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.



**URS**

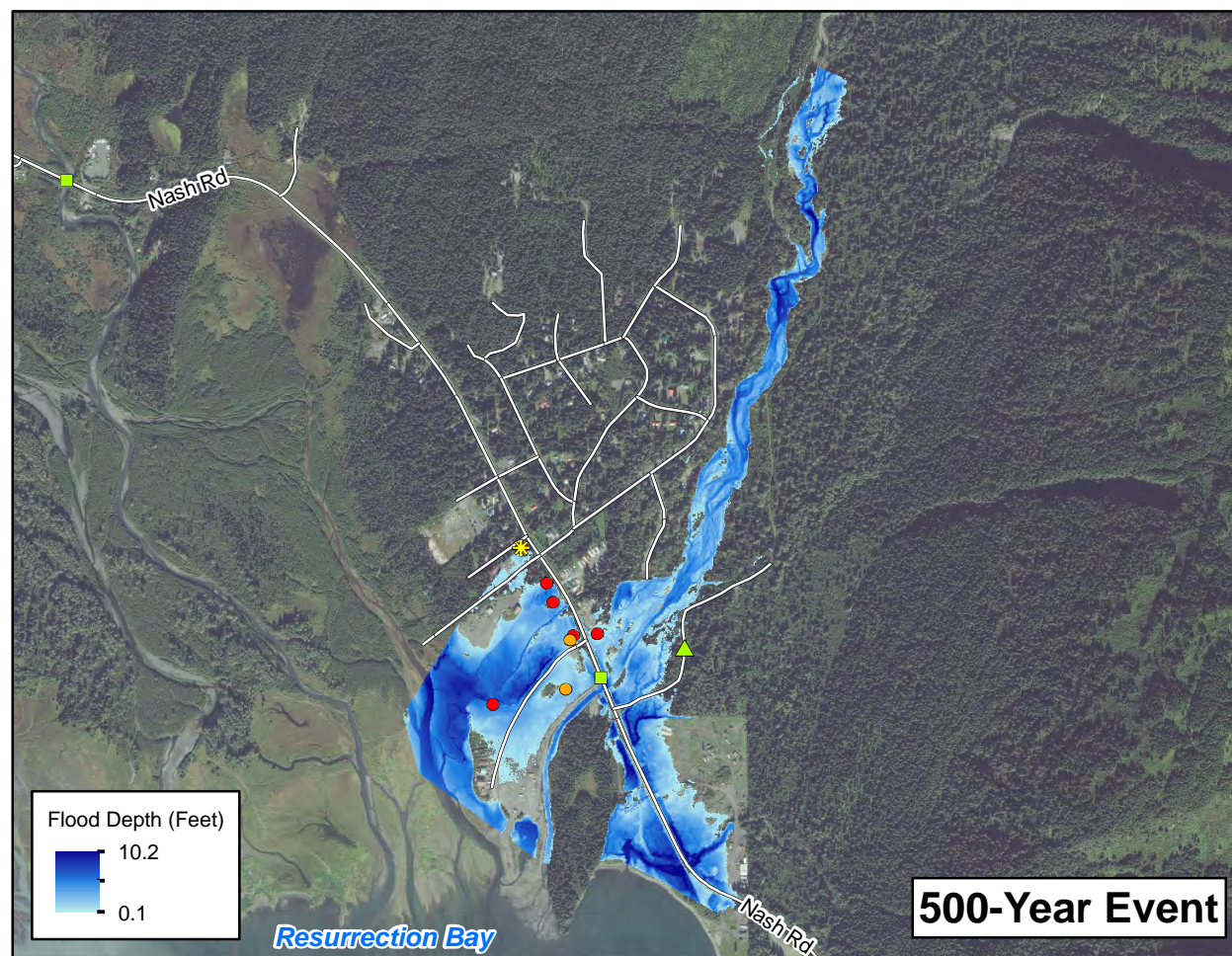
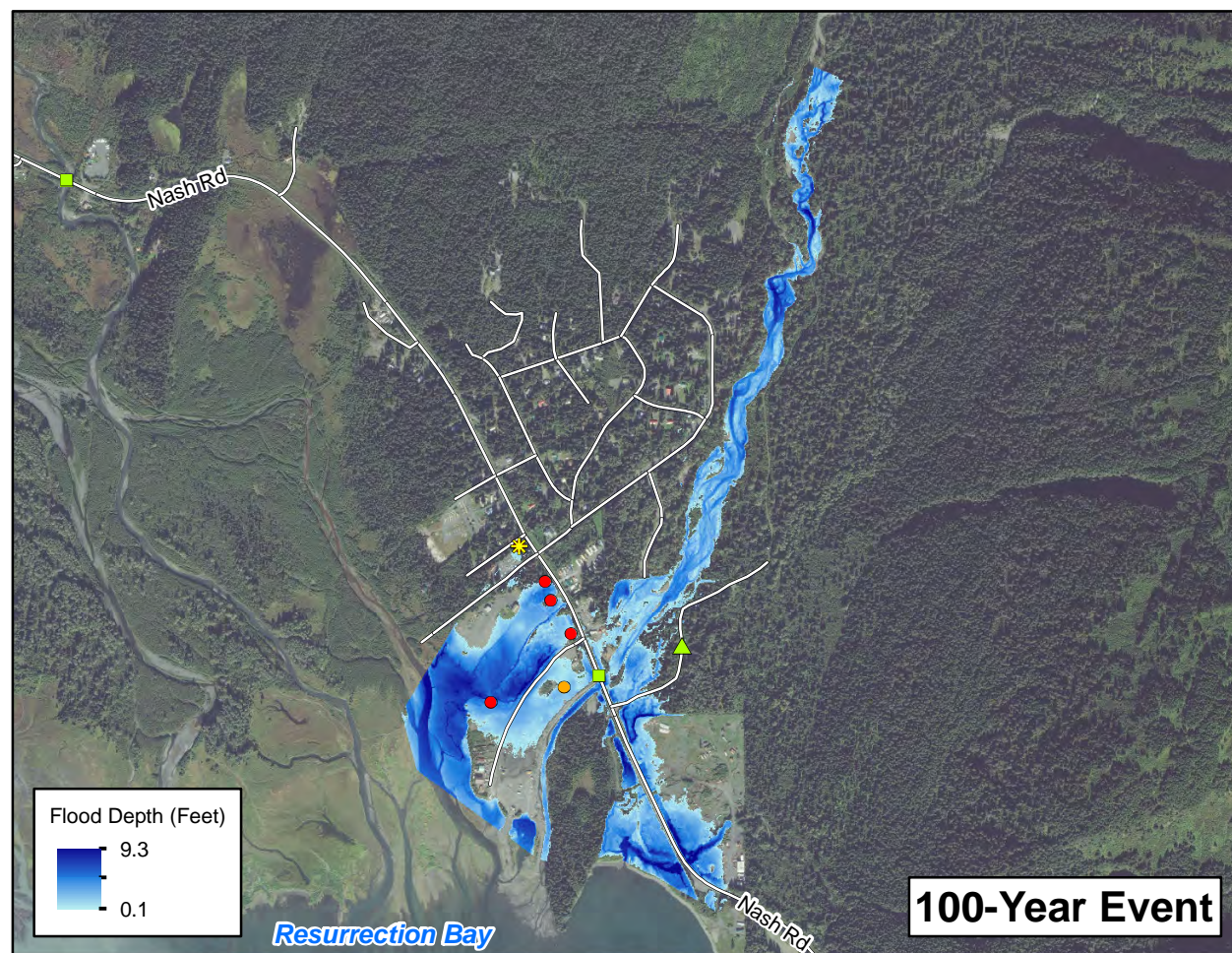
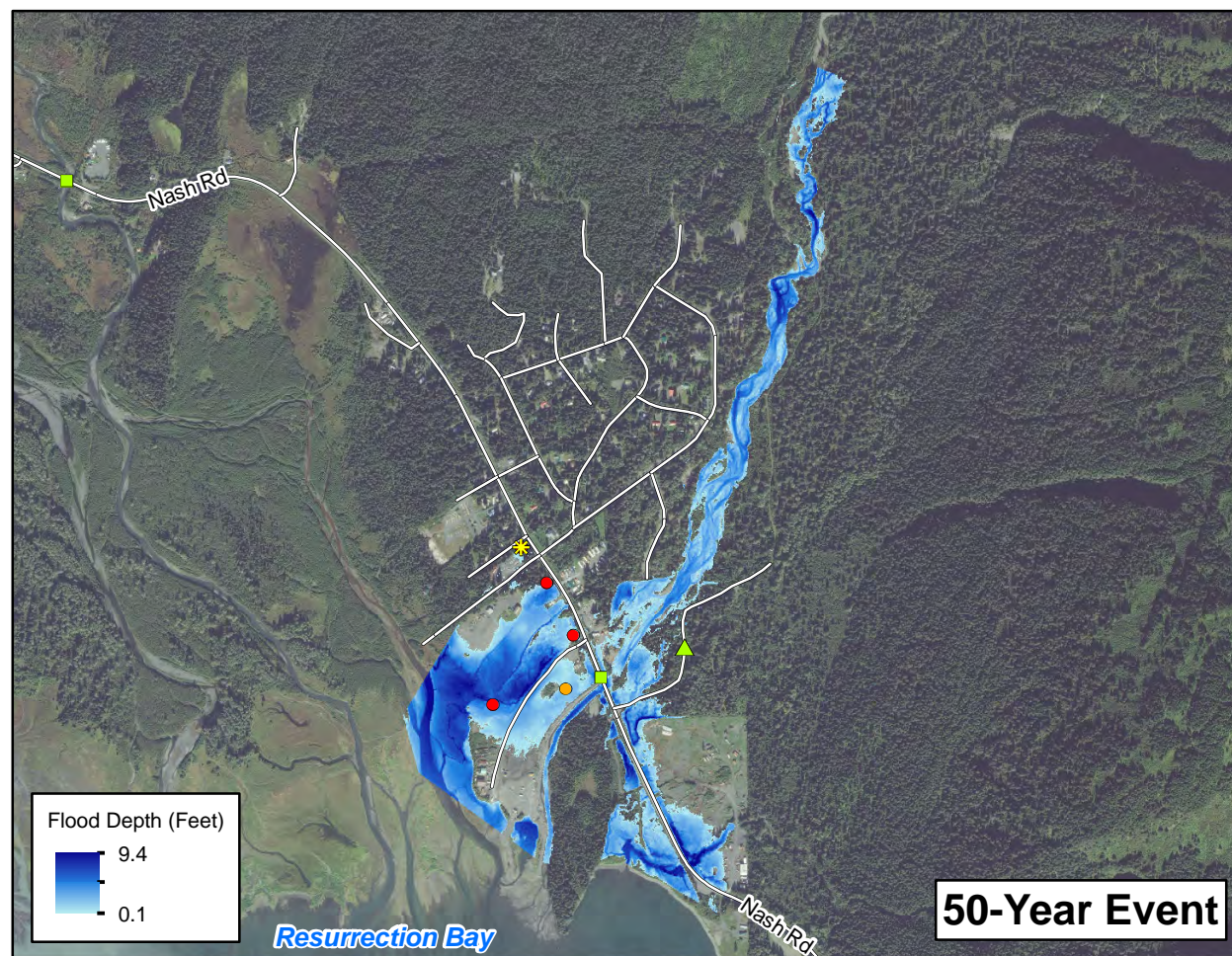
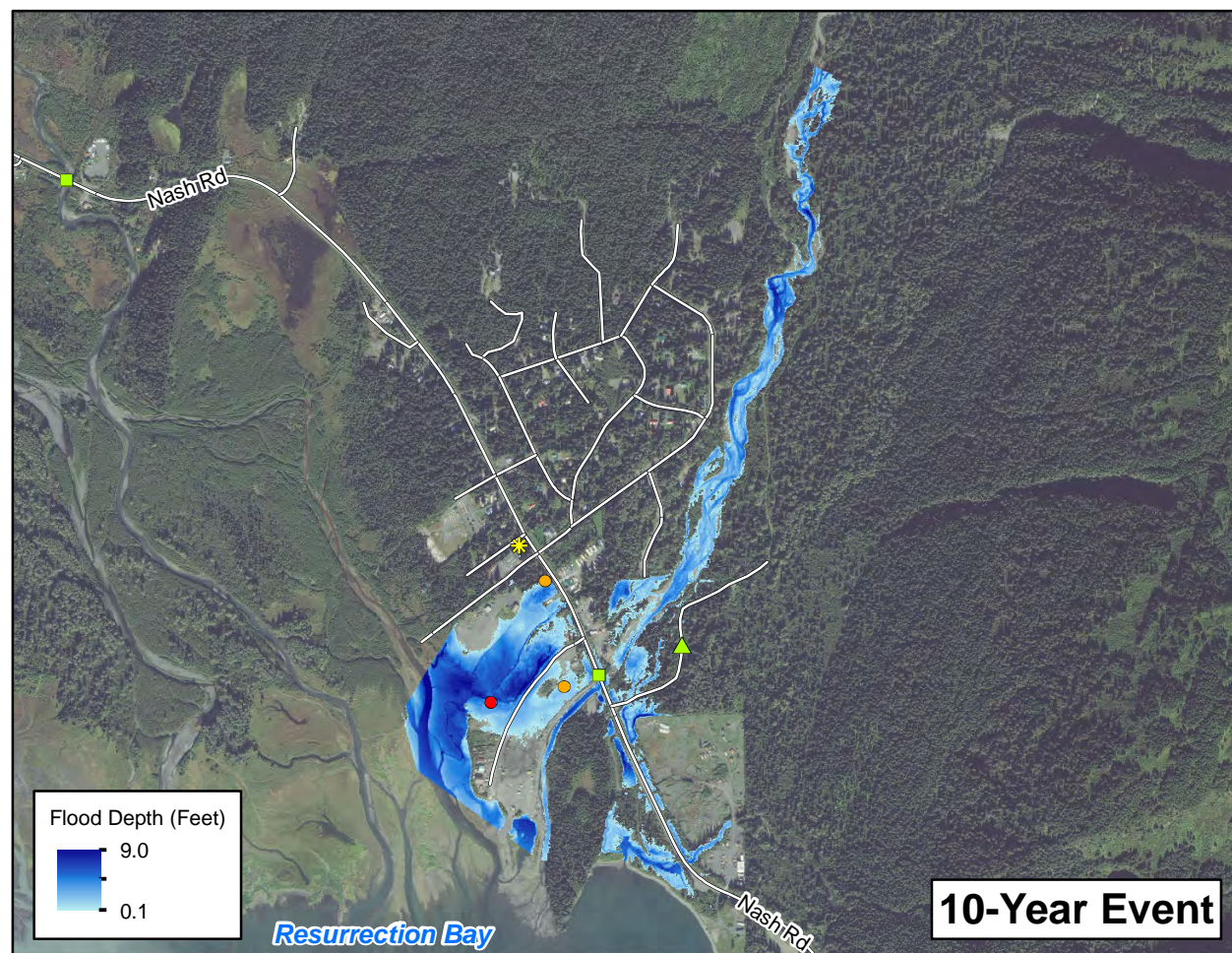
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SAWMILL CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-47



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Sawmill\_2022.mxd Plot Date: 4/22/2013

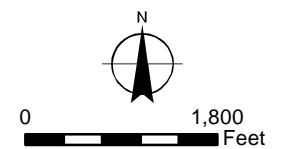


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



**URS**

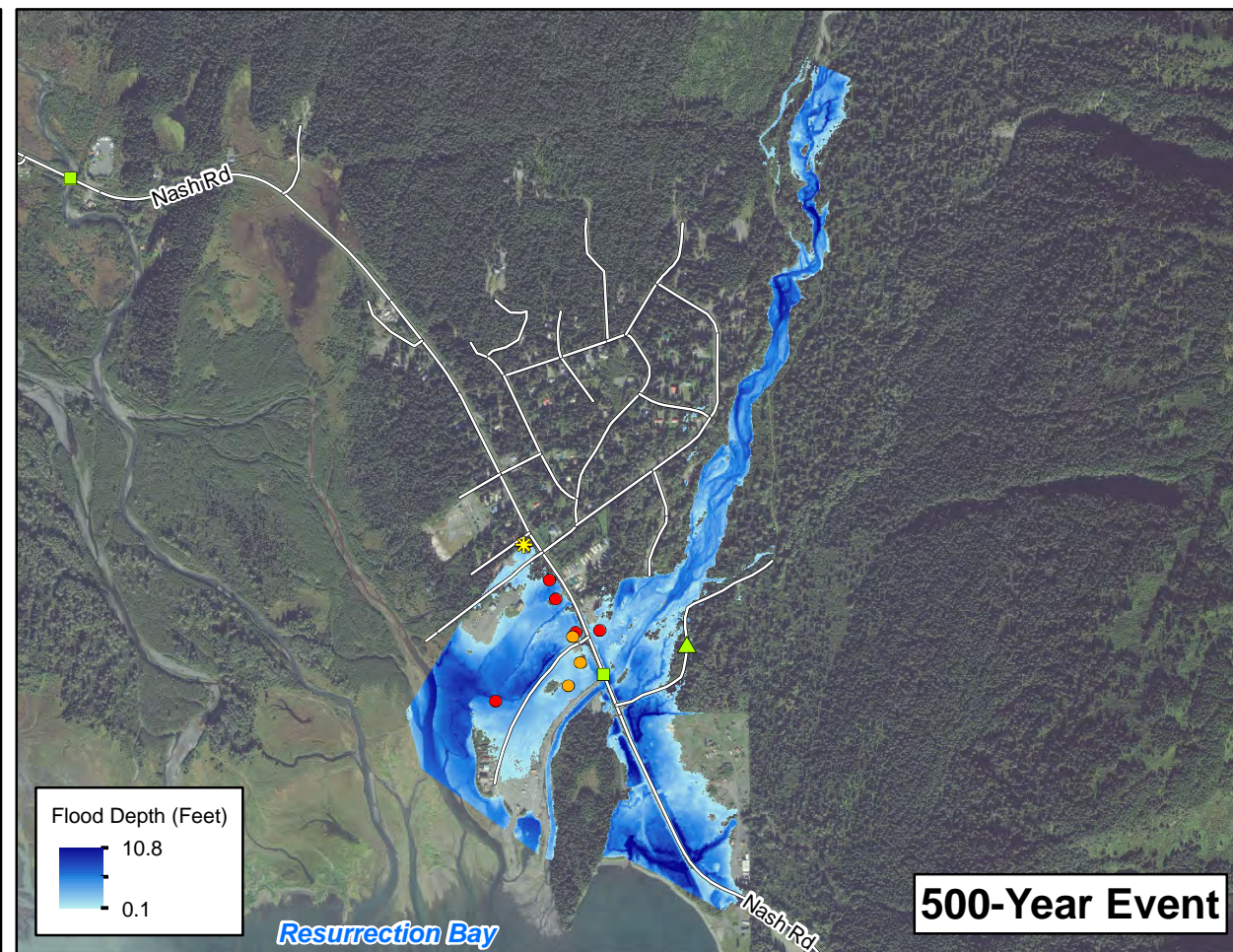
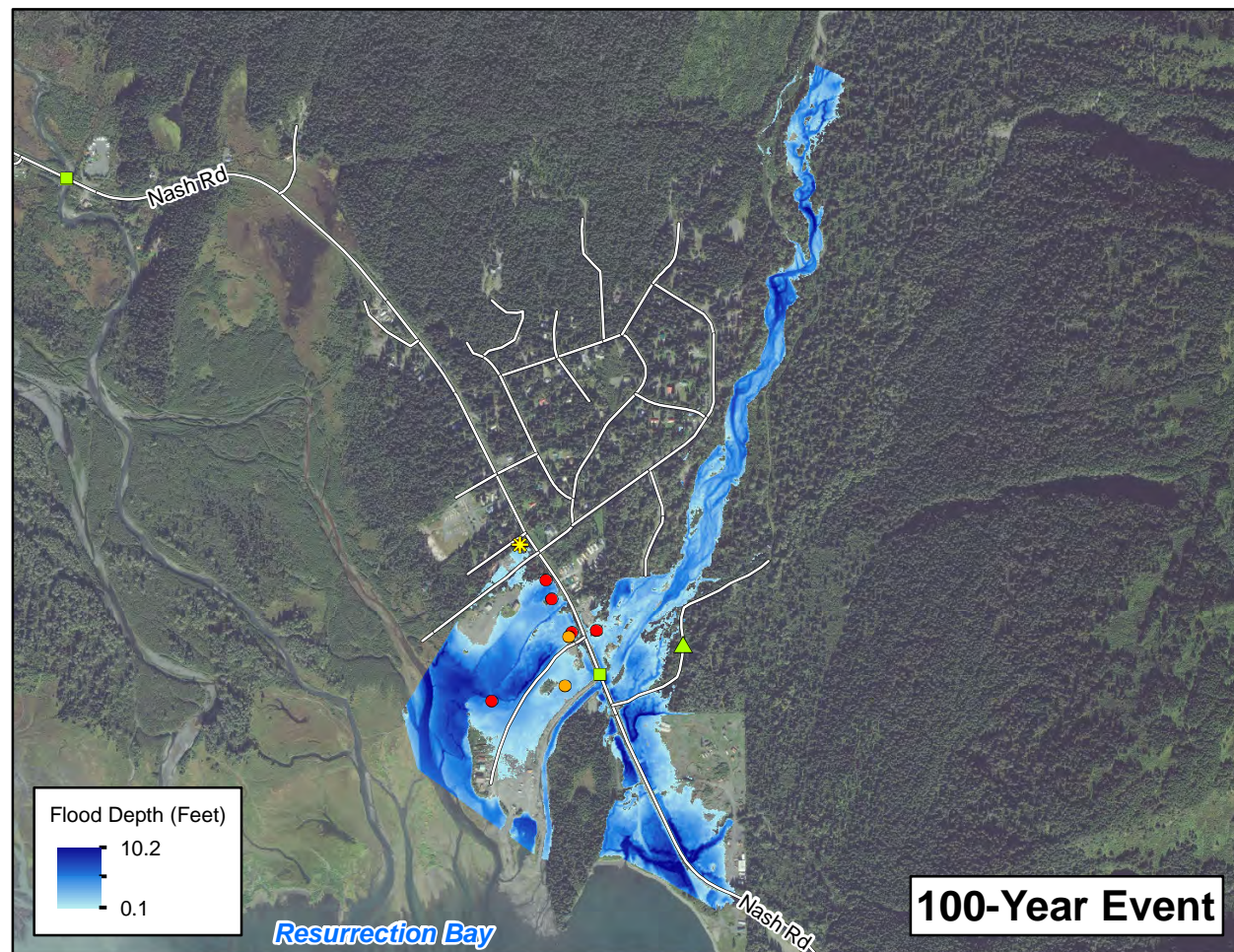
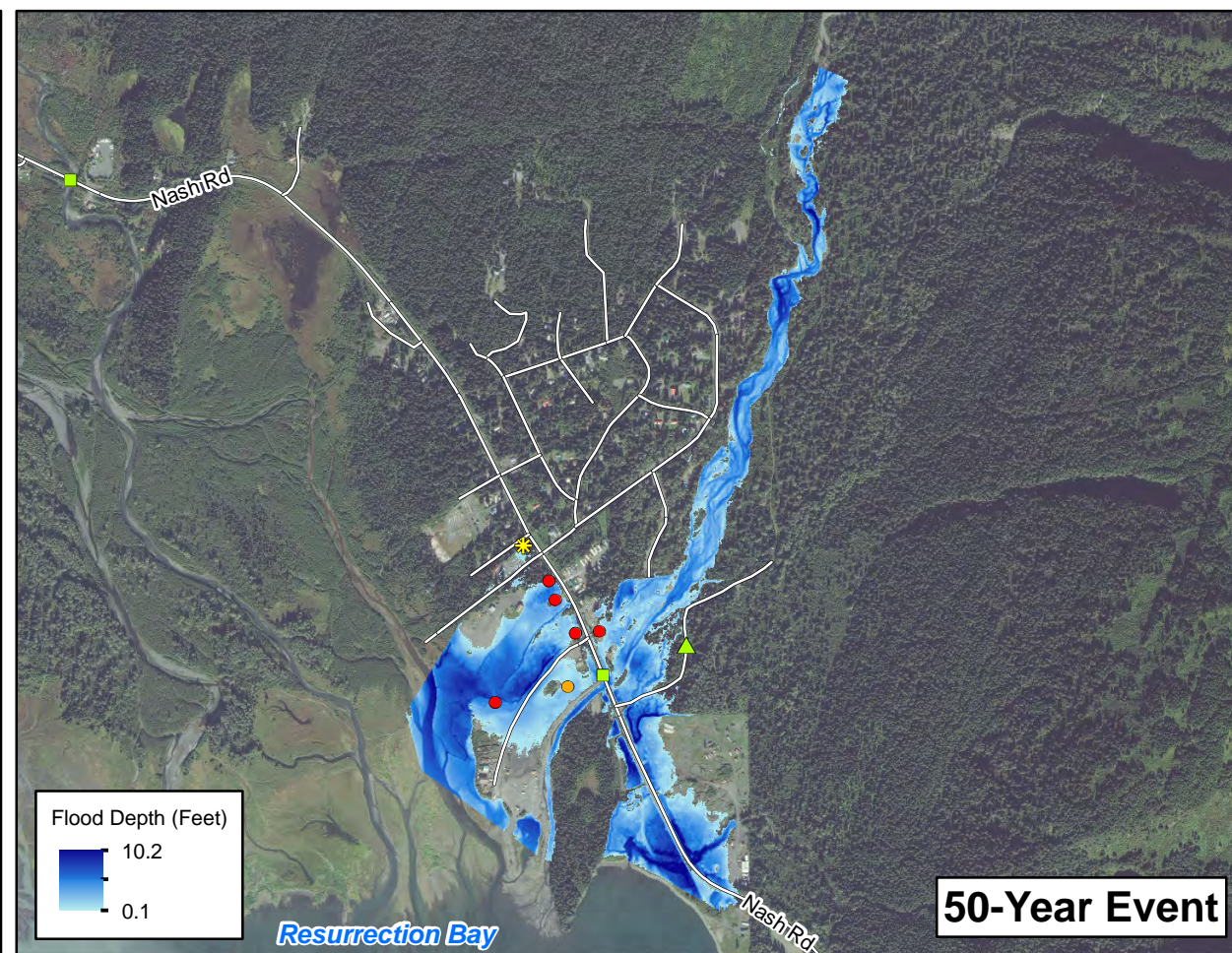
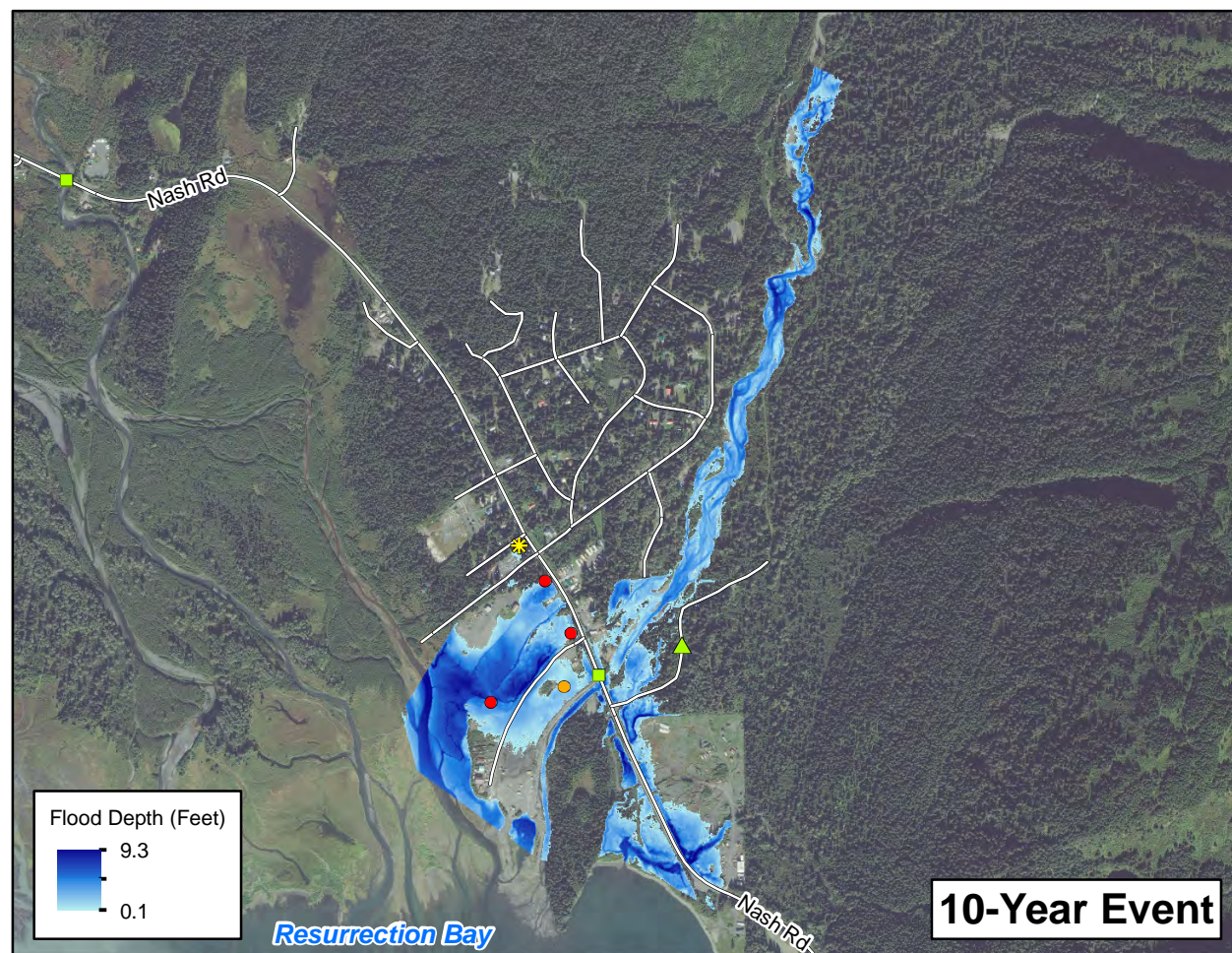
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SAWMILL CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-48



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Sawmill\_2062.mxd Plot Date: 4/22/2013

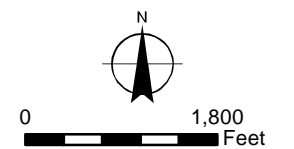


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



**URS**

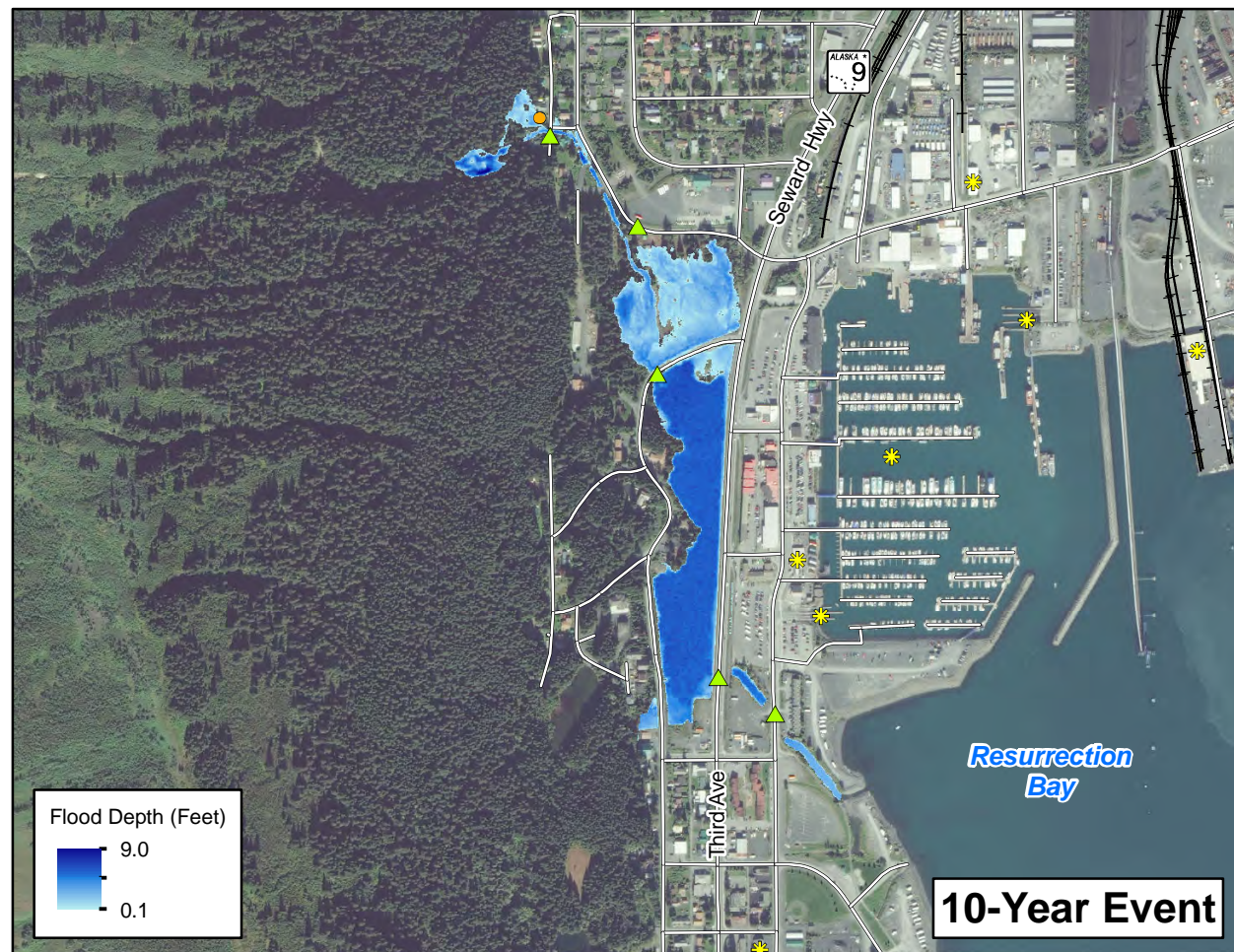
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SAWMILL CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-49



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Scheffler\_2012.mxd Plot Date: 4/22/2013

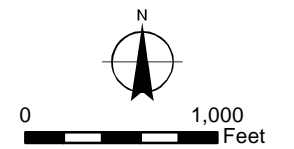


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Base reference data from Kenai Peninsula Borough.



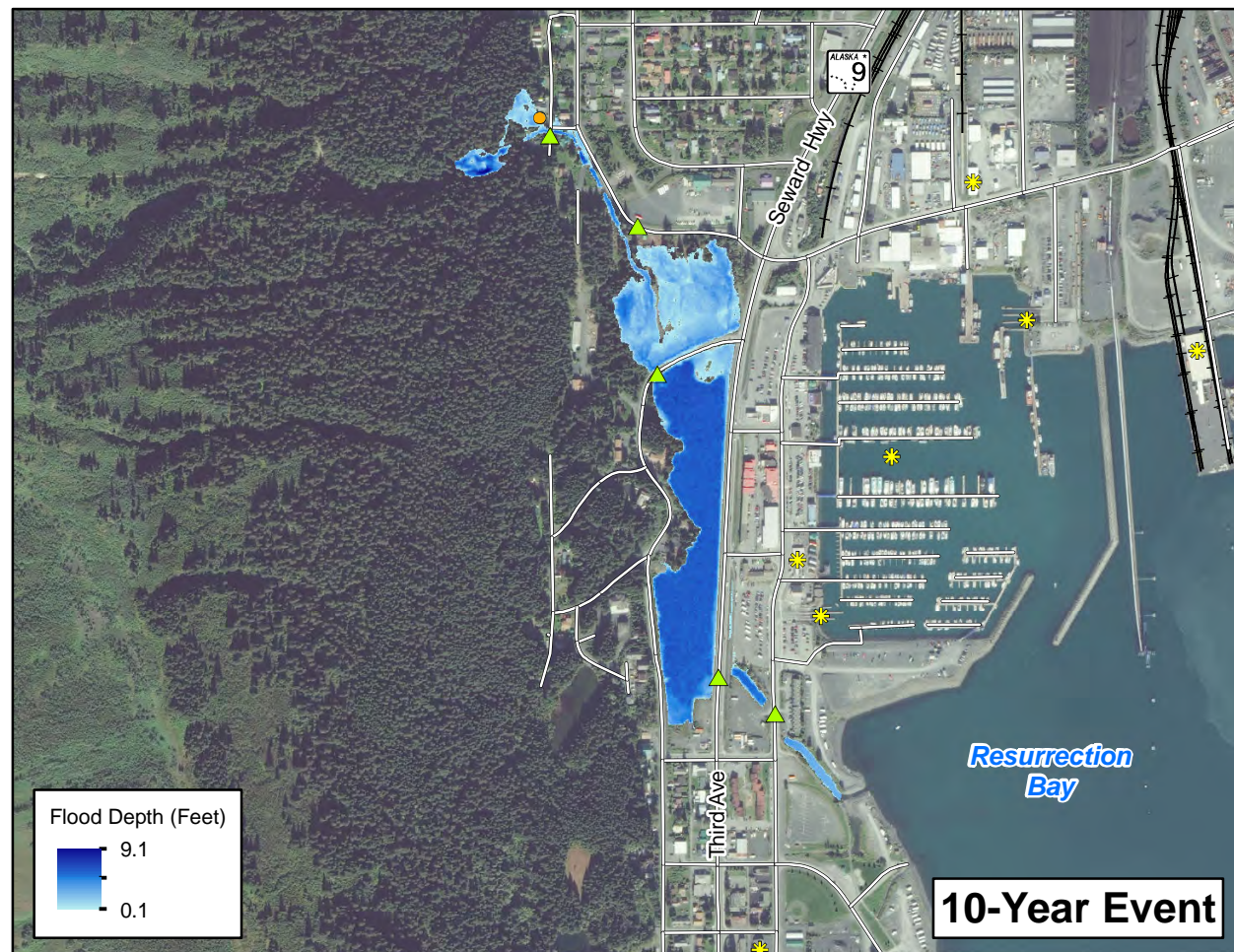
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SCHEFFLER CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-50



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Scheffler\_2022.mxd Plot Date: 4/22/2013

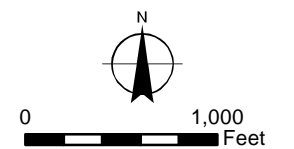


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



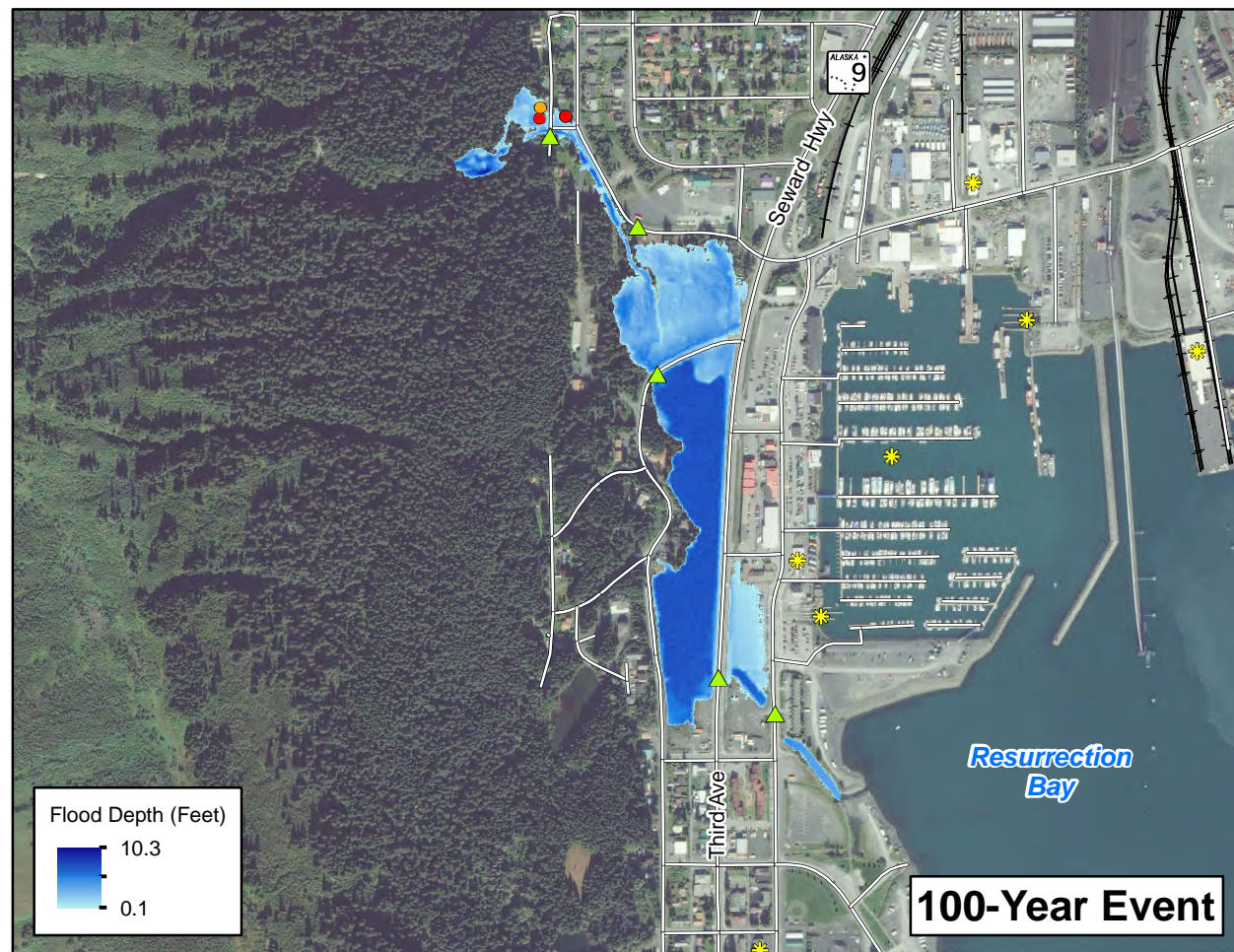
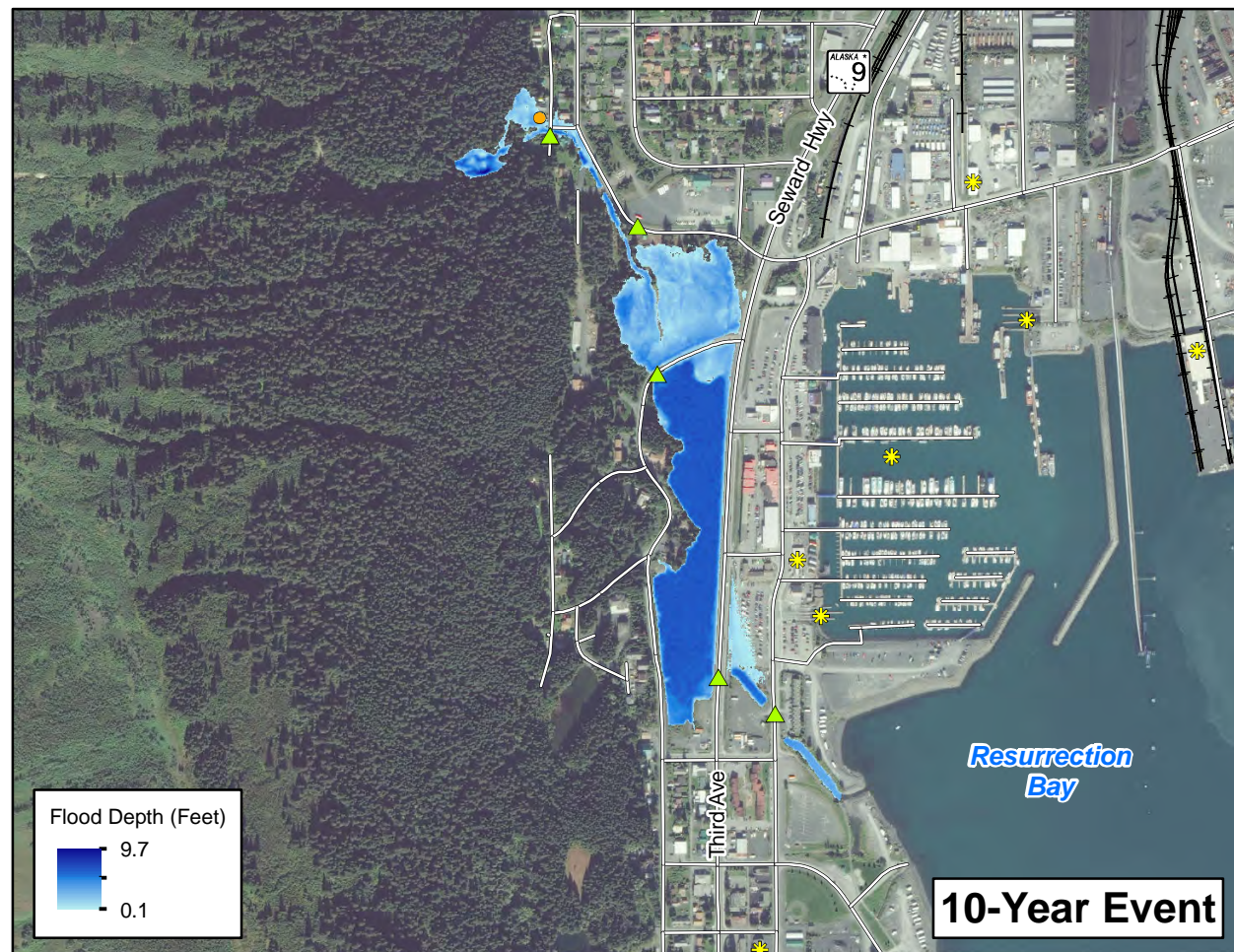
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SCHEFFLER CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-5 1



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Scheffler\_2062.mxd Plot Date: 4/22/2013

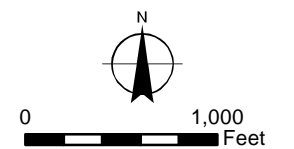


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Floodplain represents A1B scenario.
2. Base reference data from Kenai Peninsula Borough.



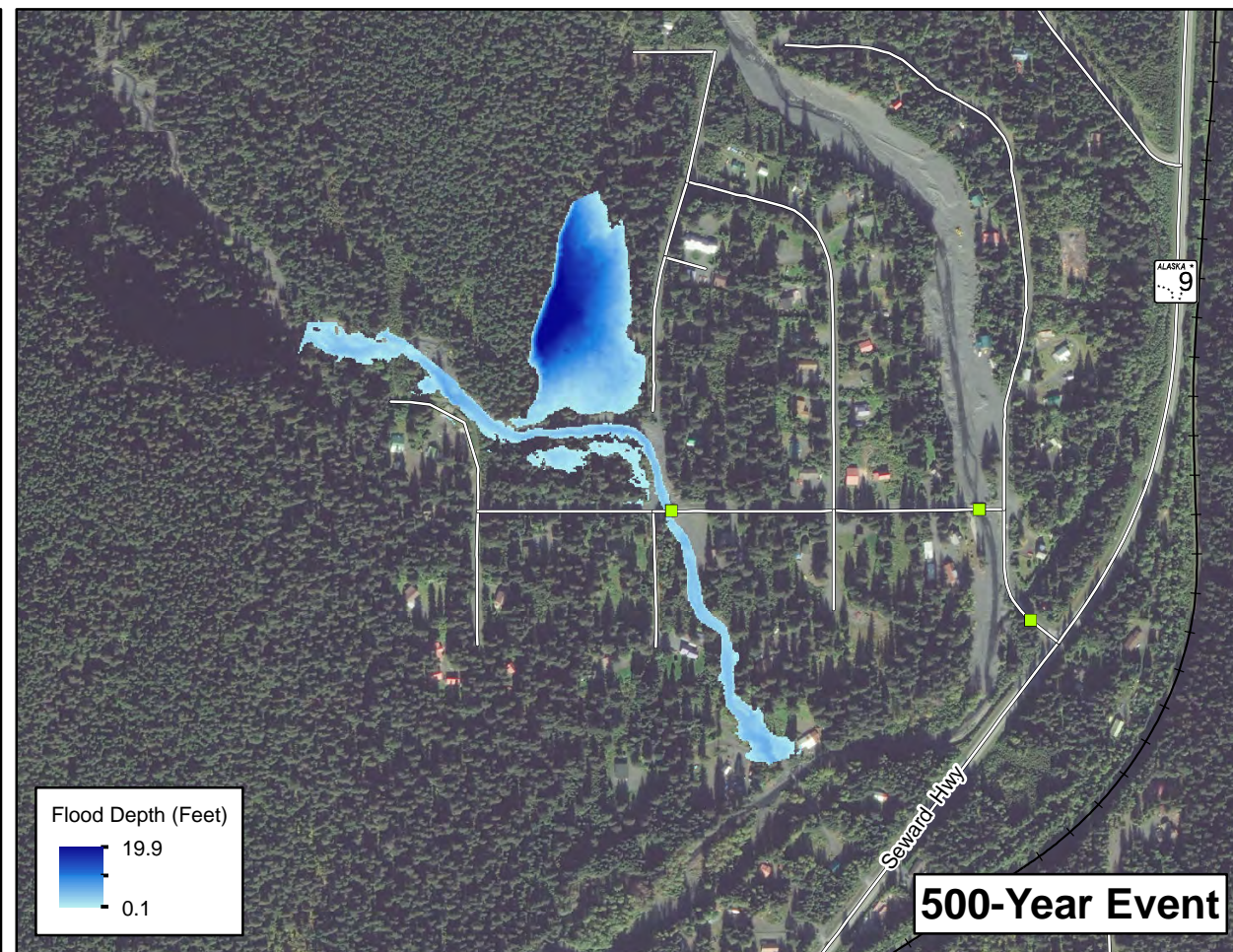
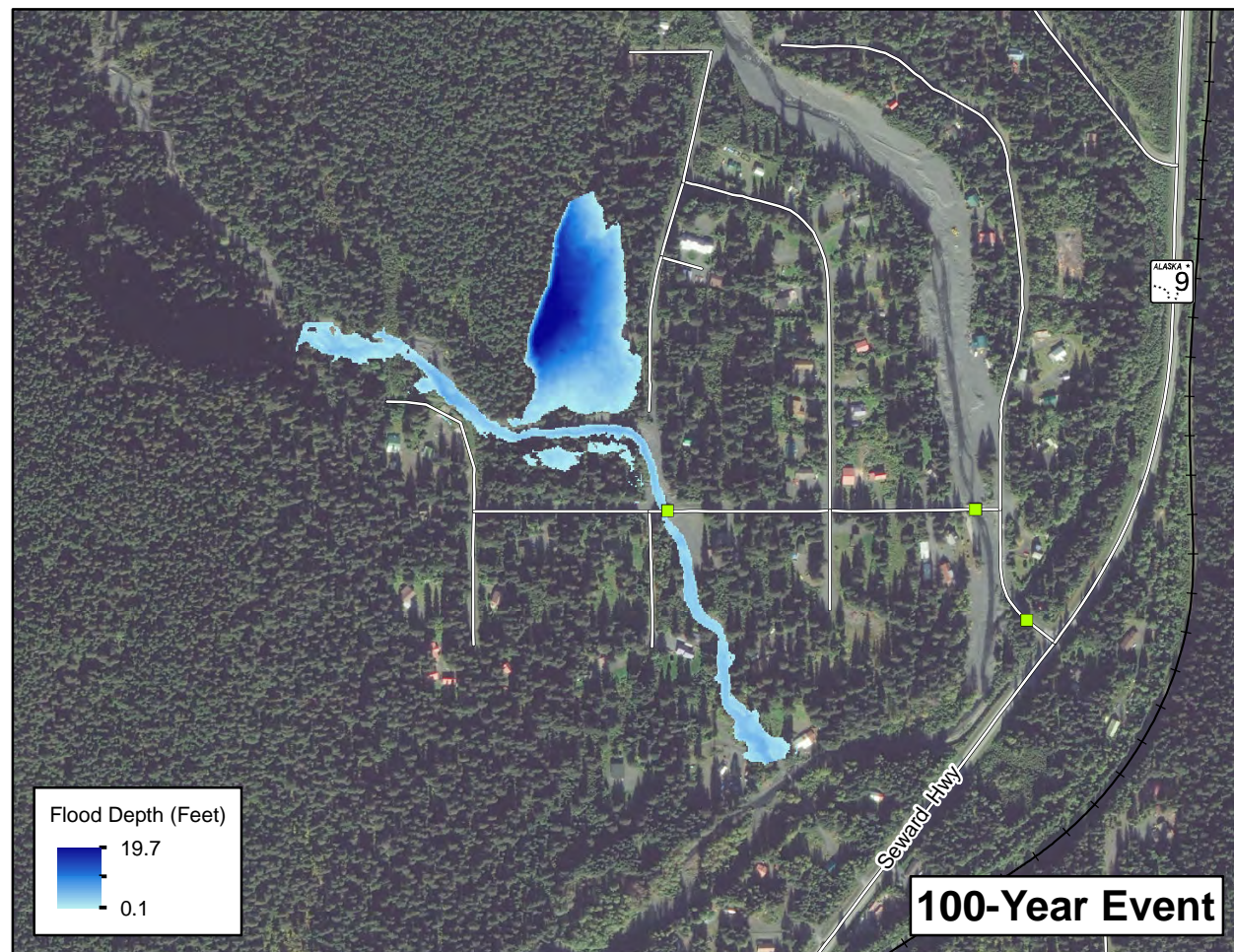
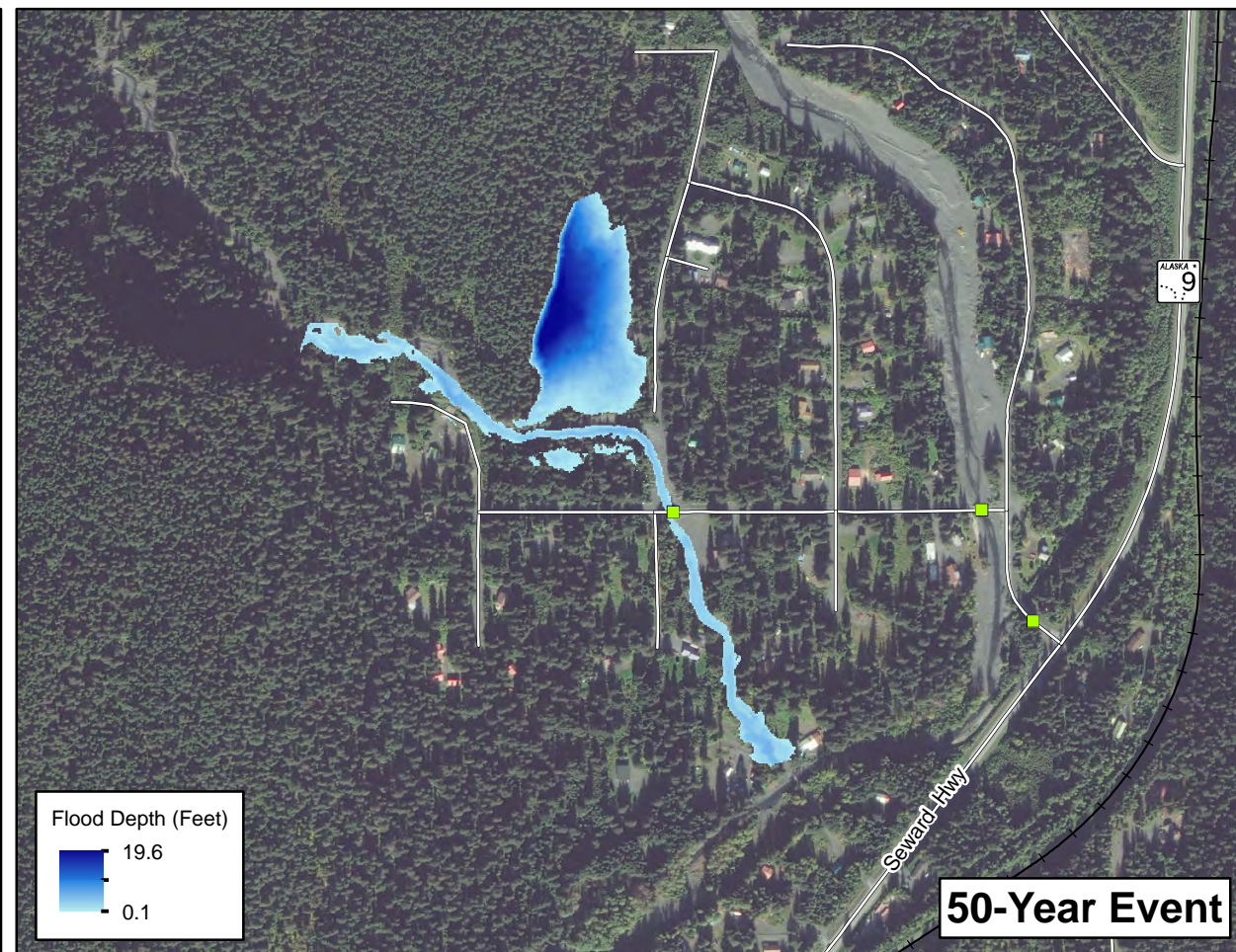
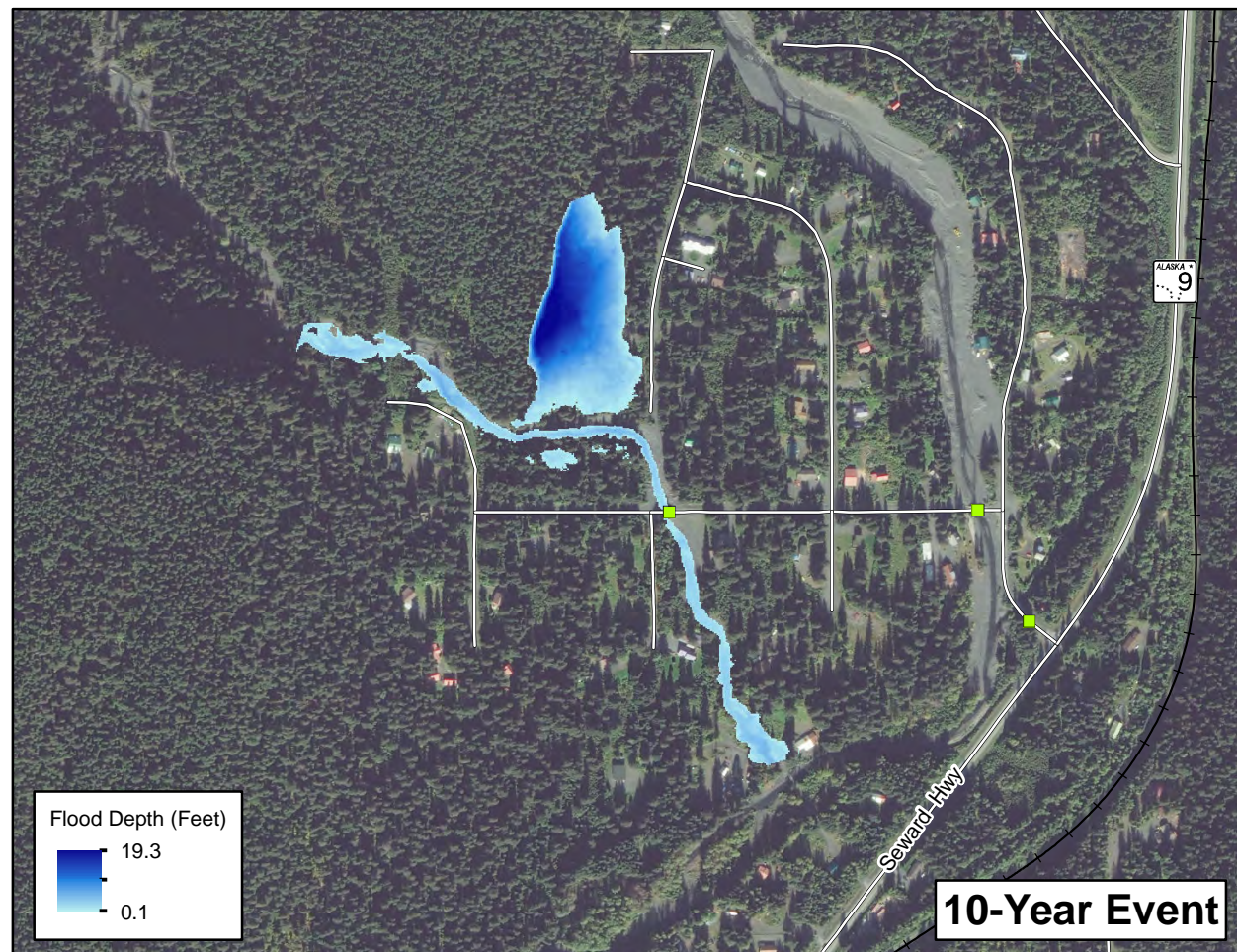
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SCHEFFLER CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-52



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Sometimes\_2012.mxd Plot Date: 4/22/2013

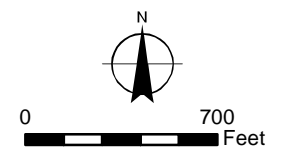


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Base reference data from Kenai Peninsula Borough.



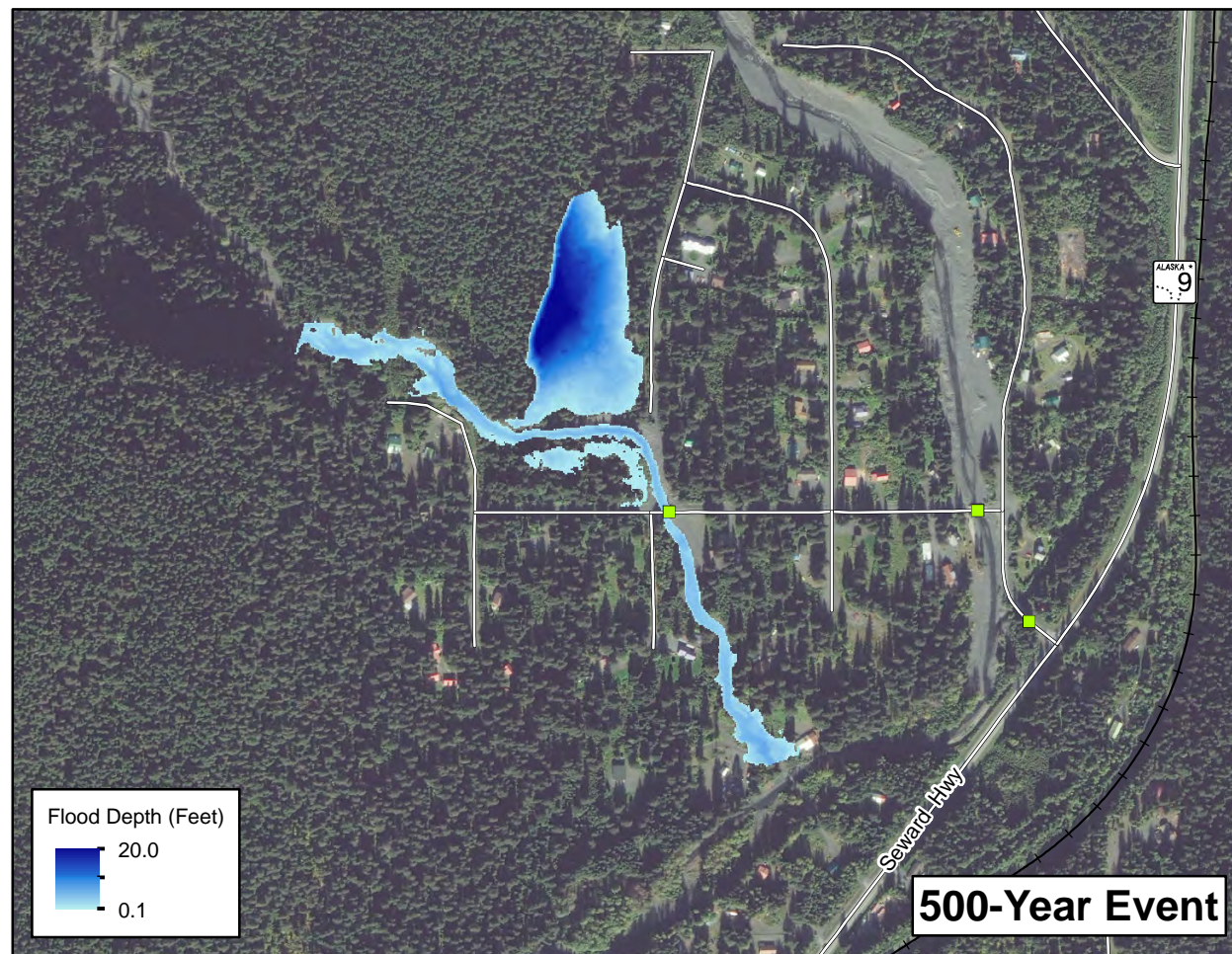
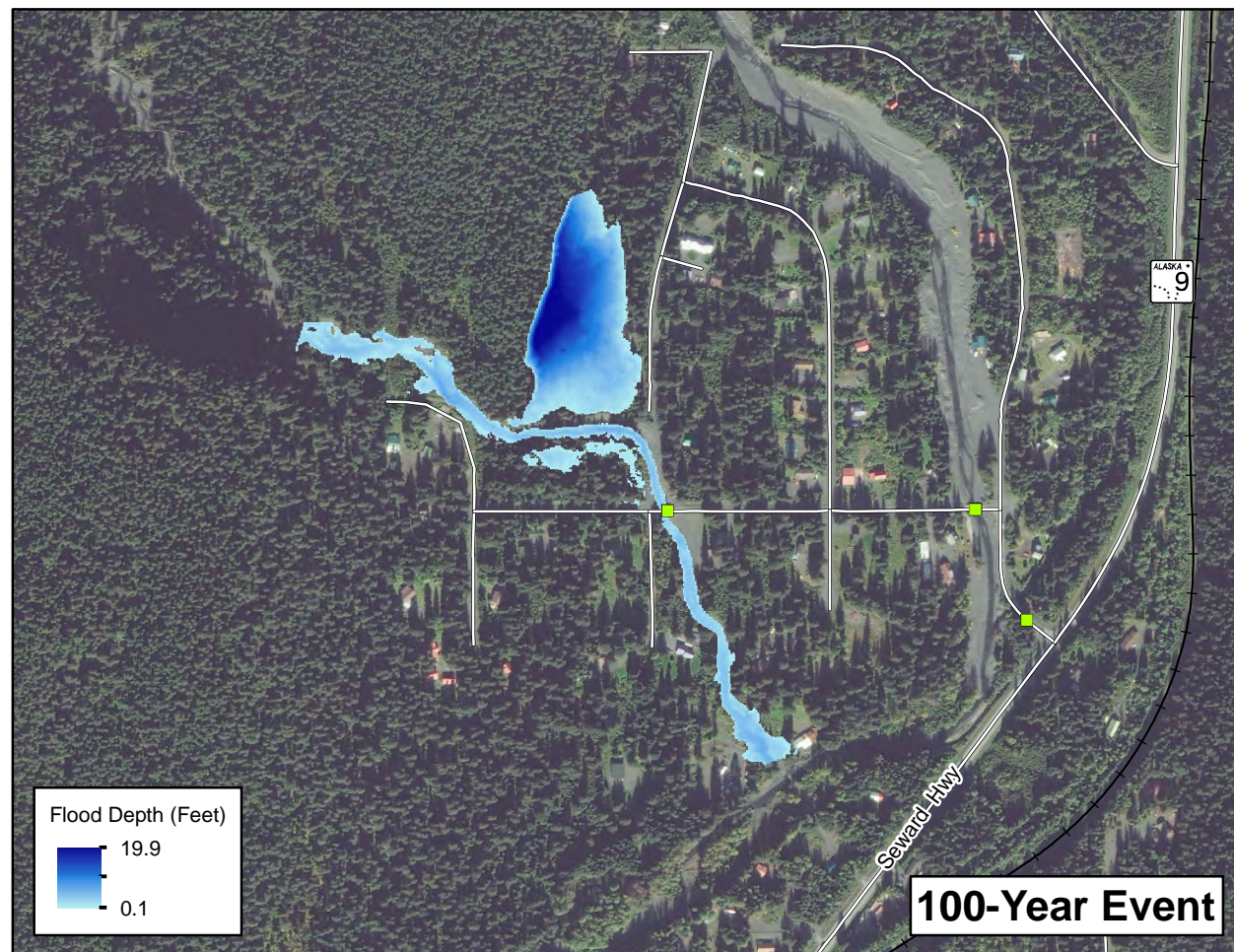
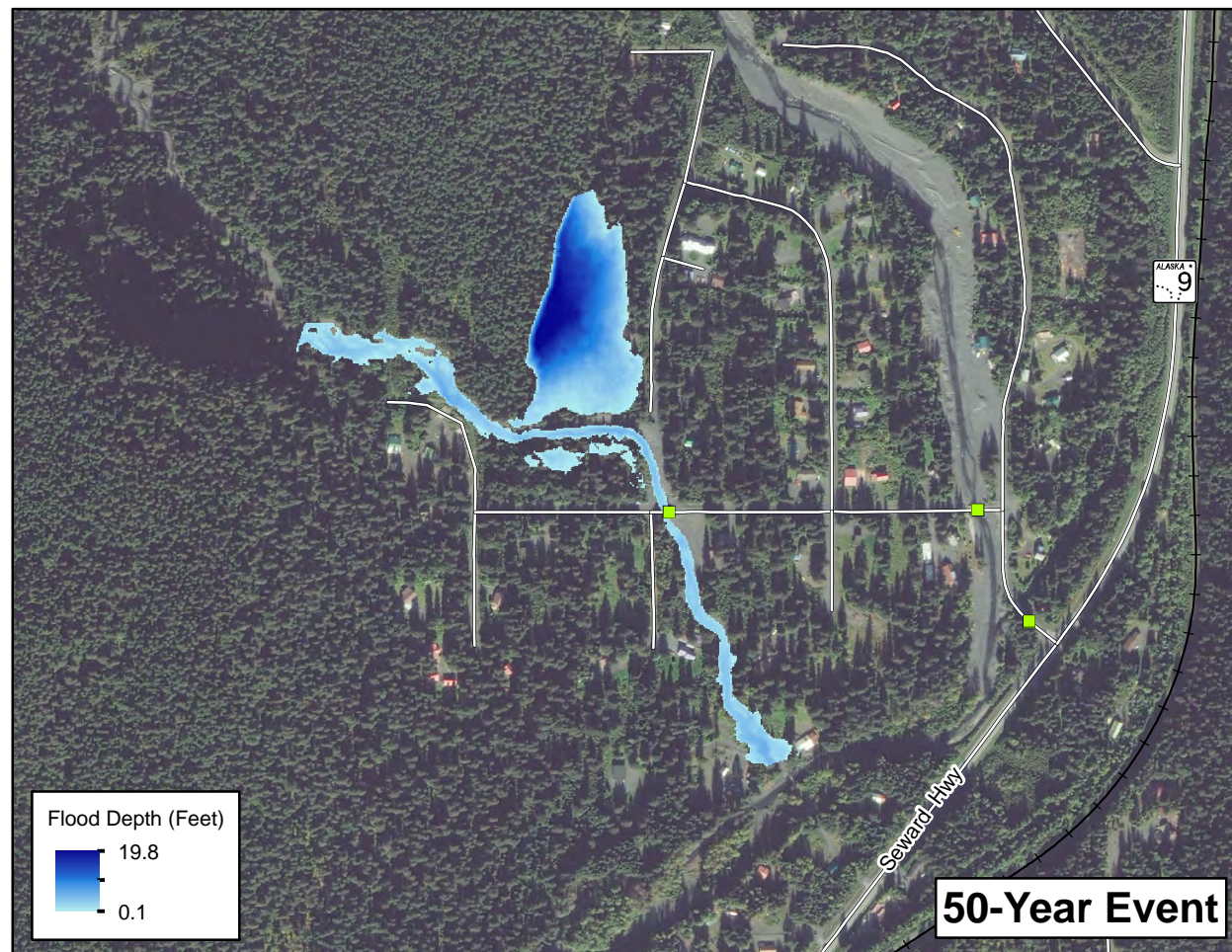
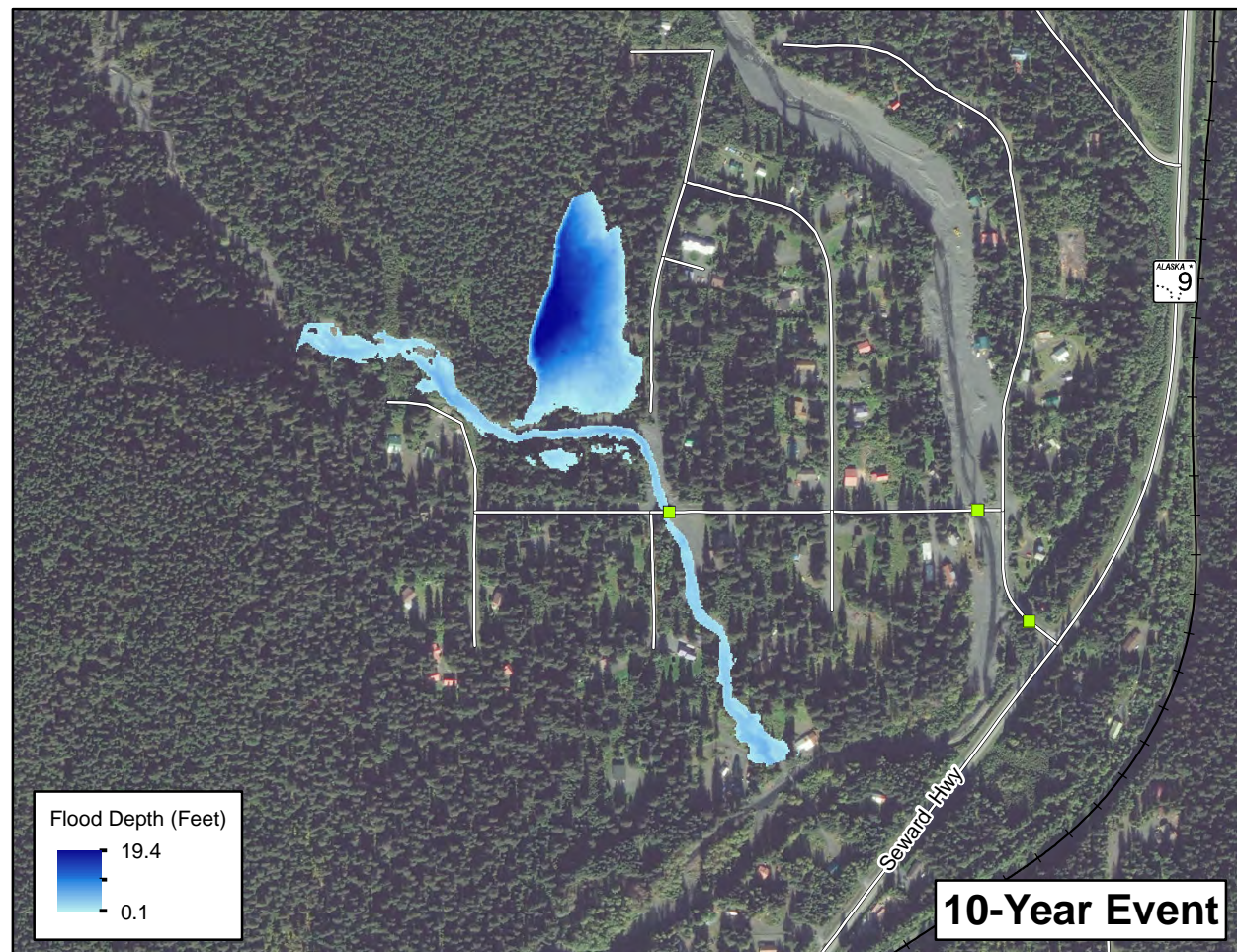
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SOMETIMES CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-53



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Sometimes\_2022.mxd Plot Date: 4/27/2013

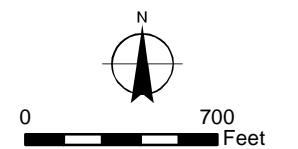


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.



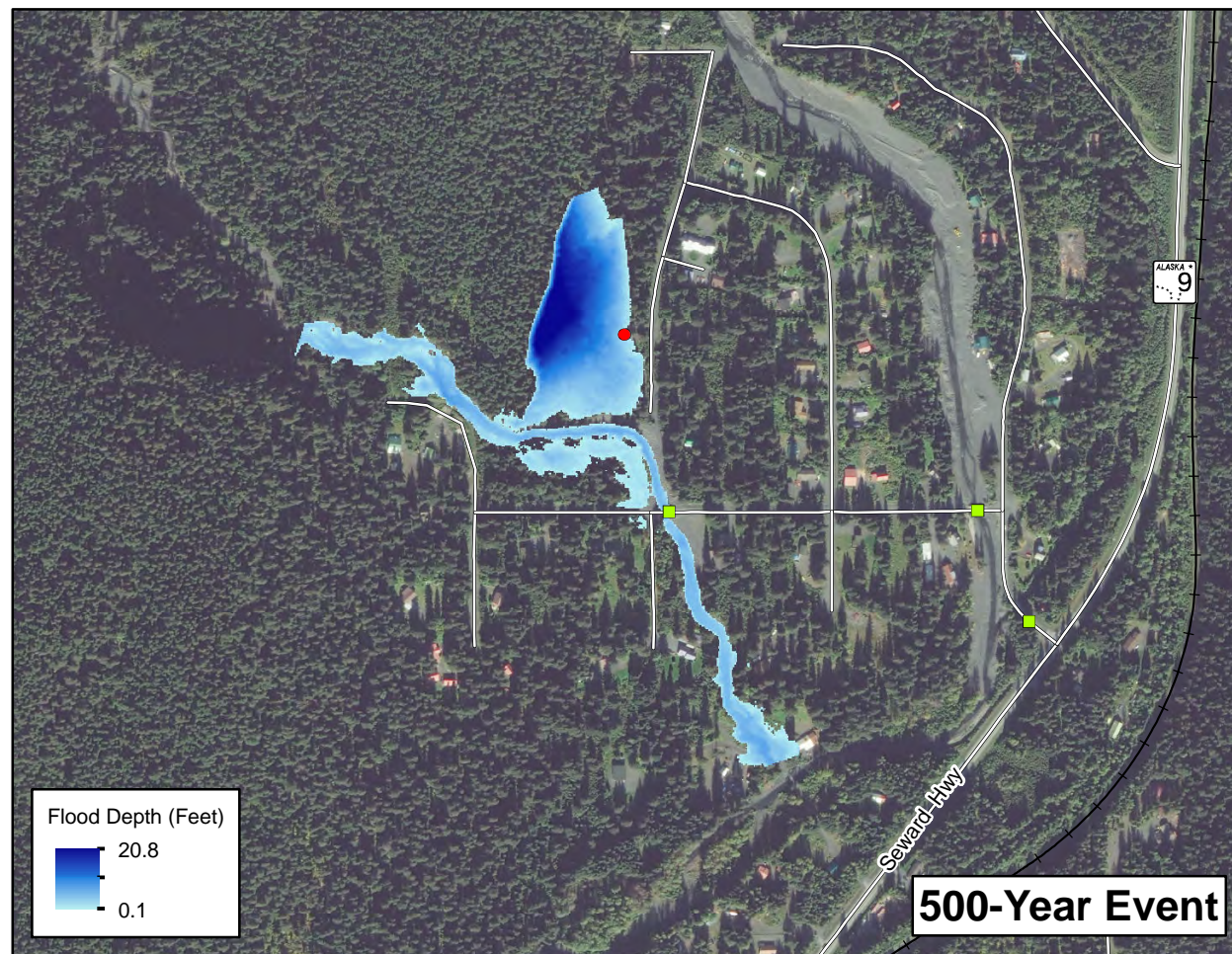
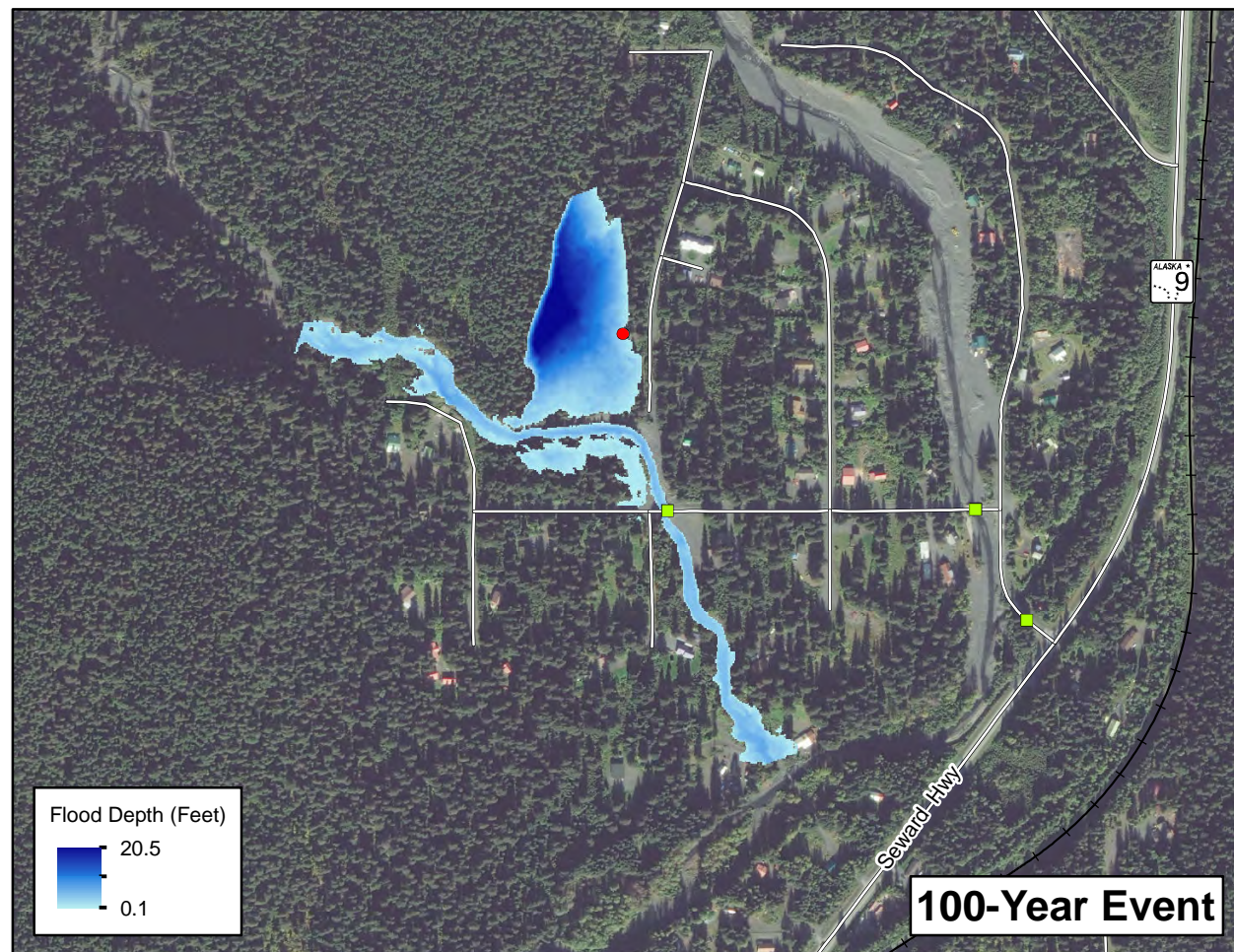
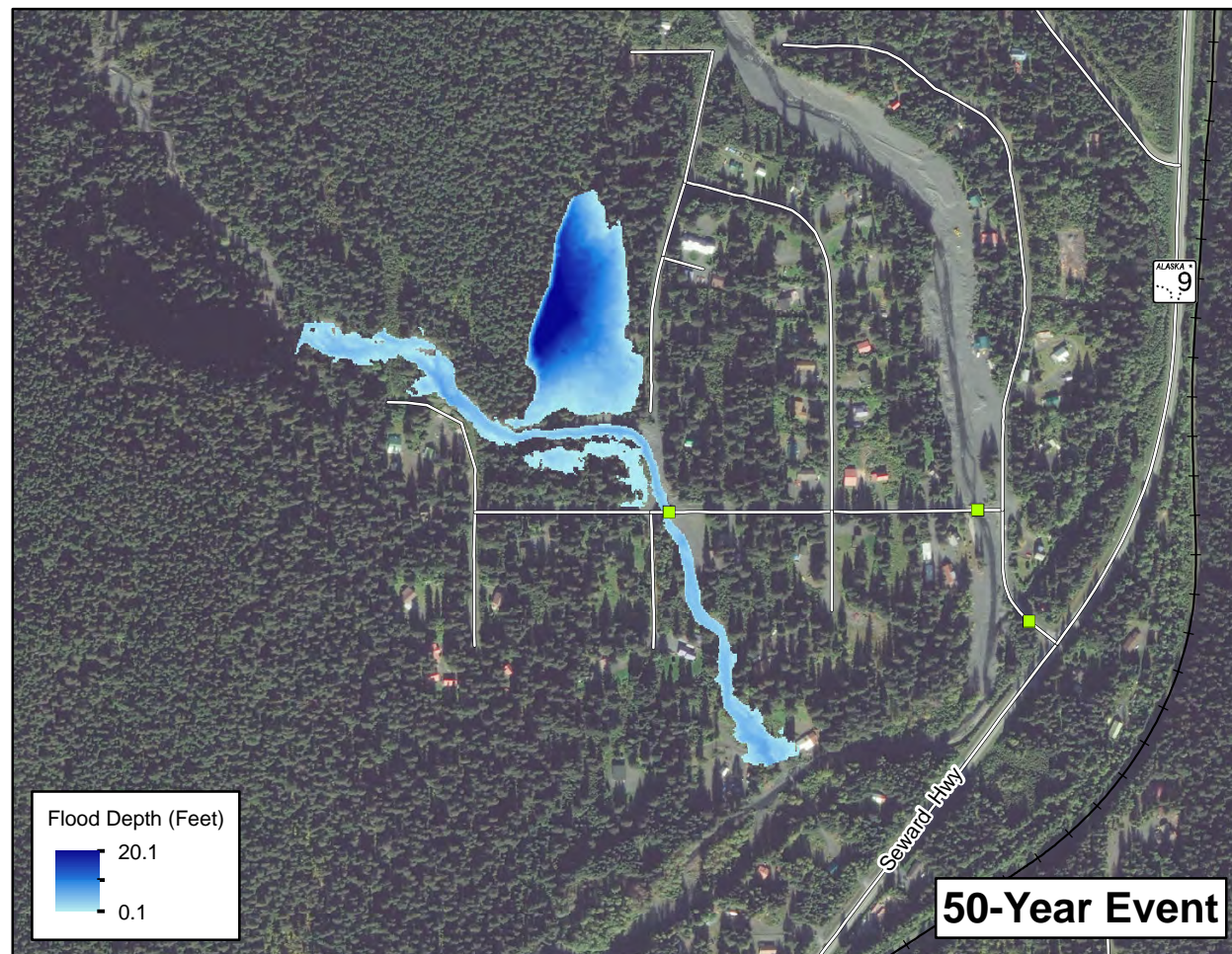
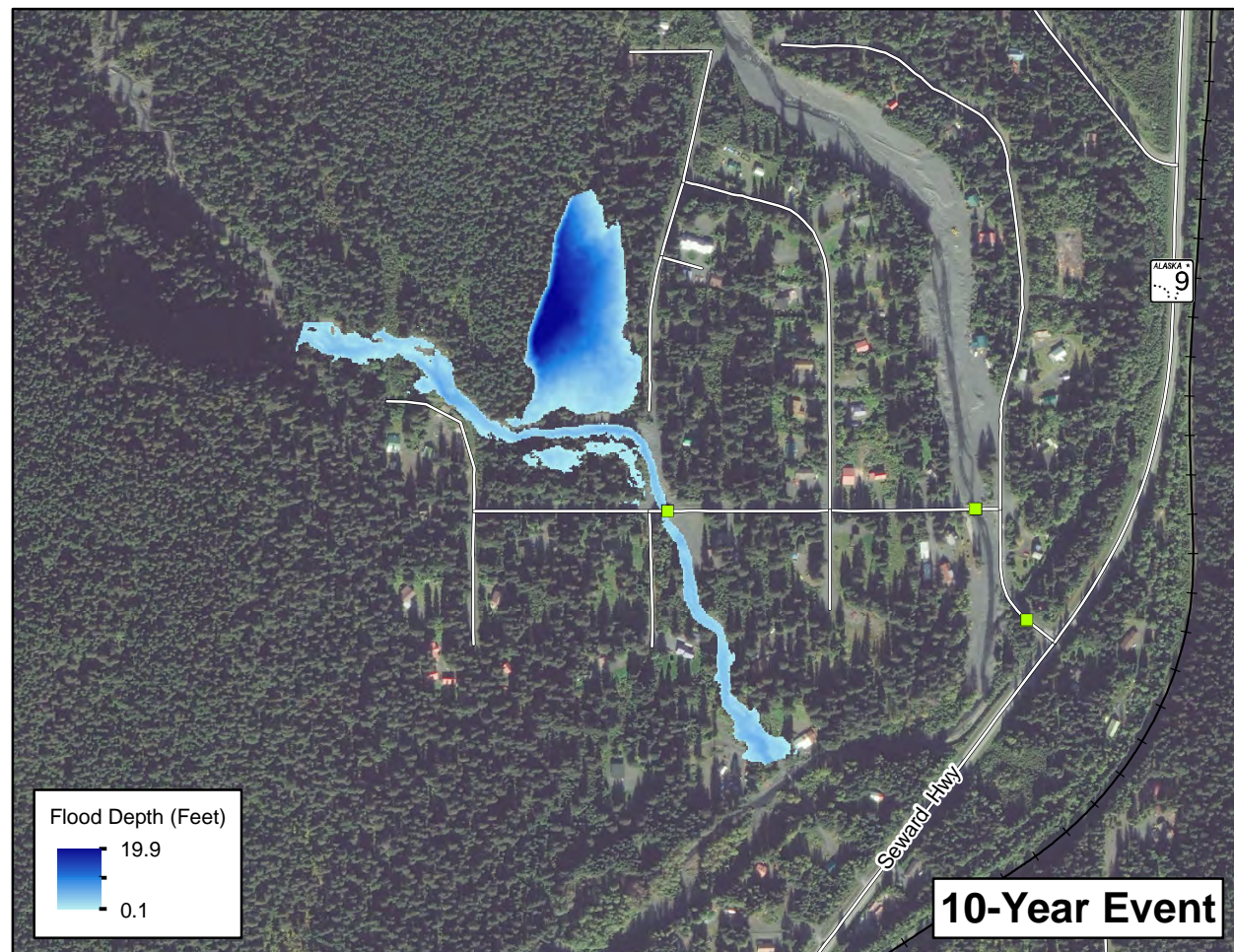
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SOMETIMES CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-54



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Sometimes\_2062.mxd Plot Date: 4/27/2013

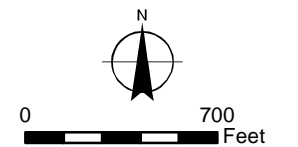


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. There were no wet, undamaged structures with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.



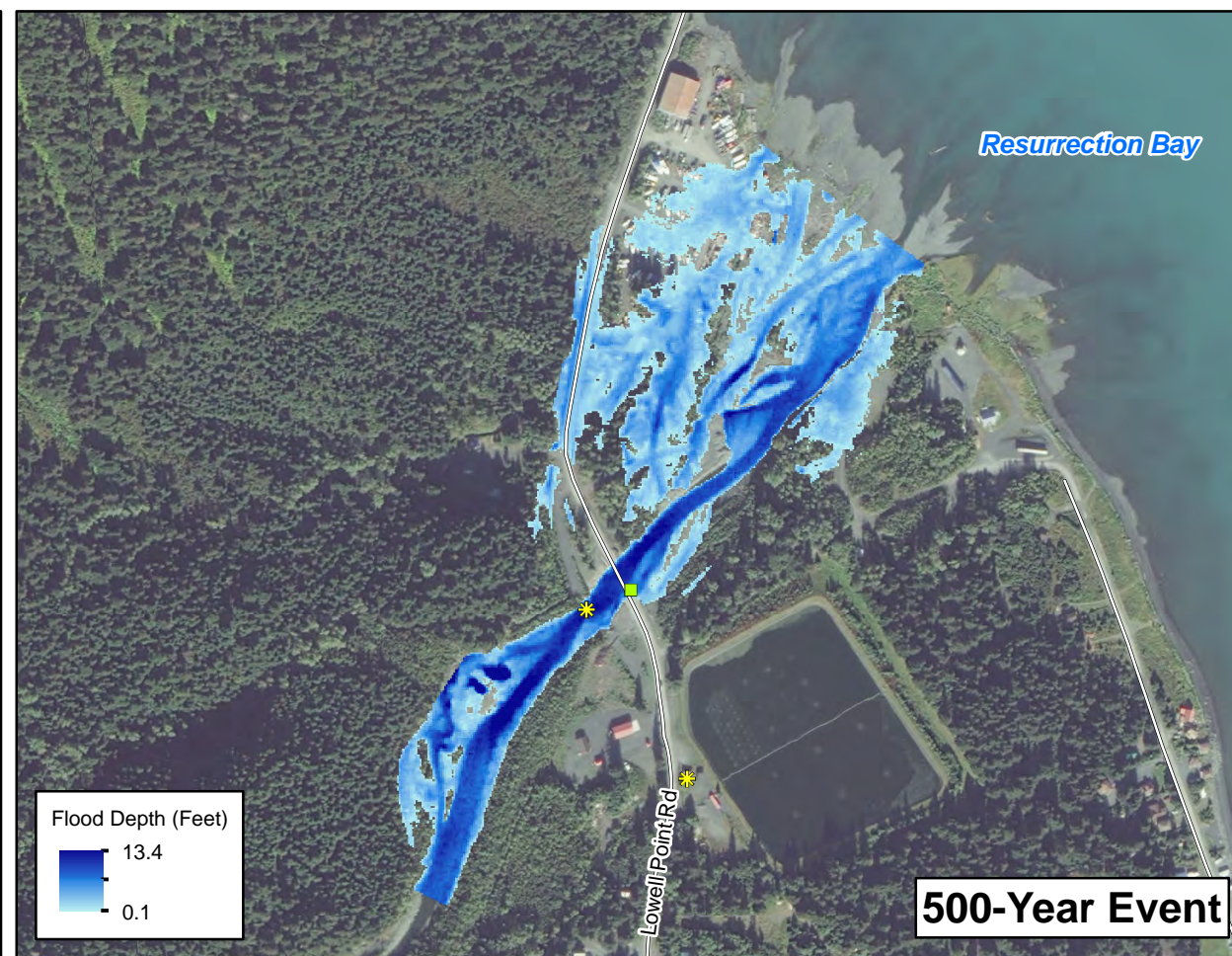
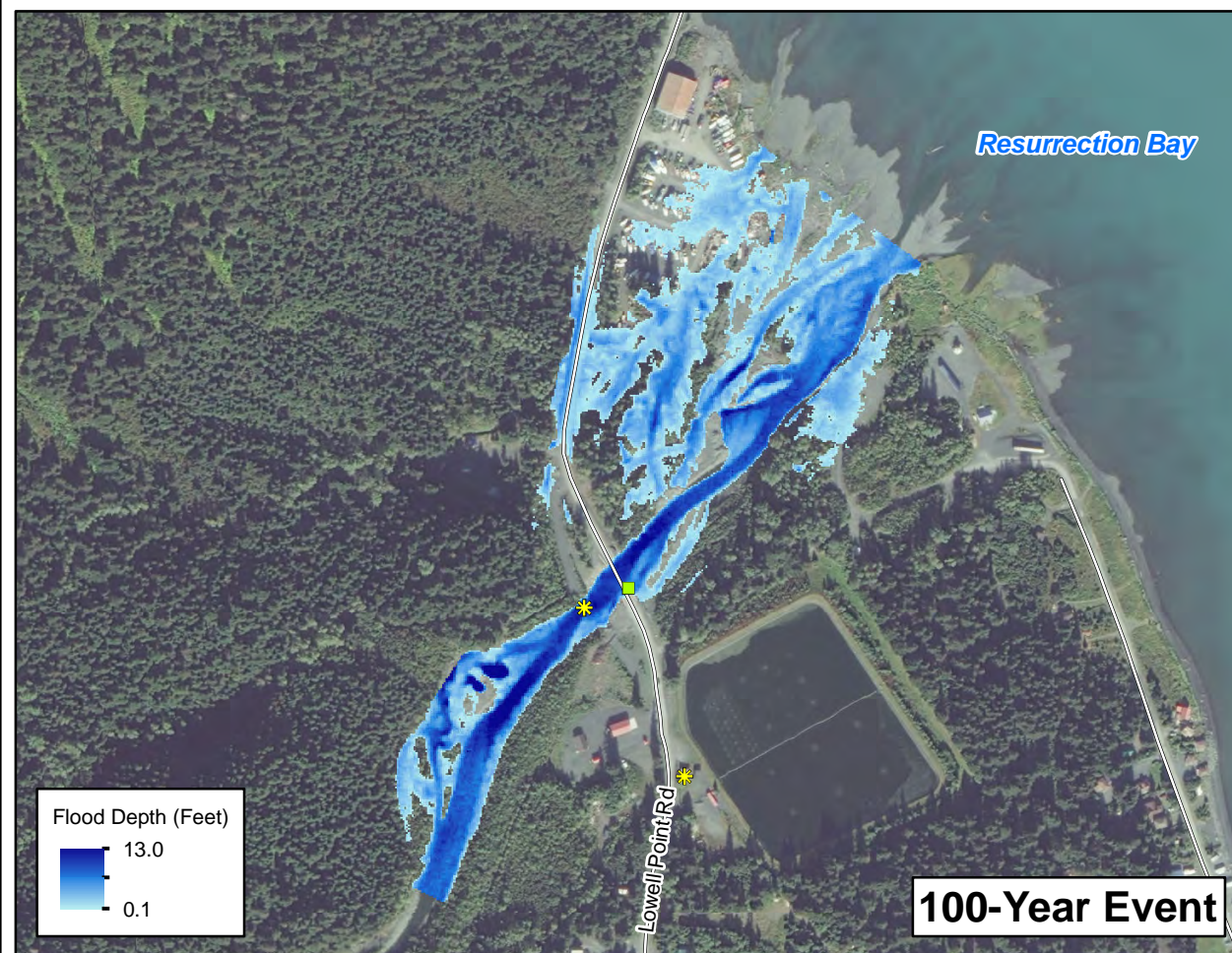
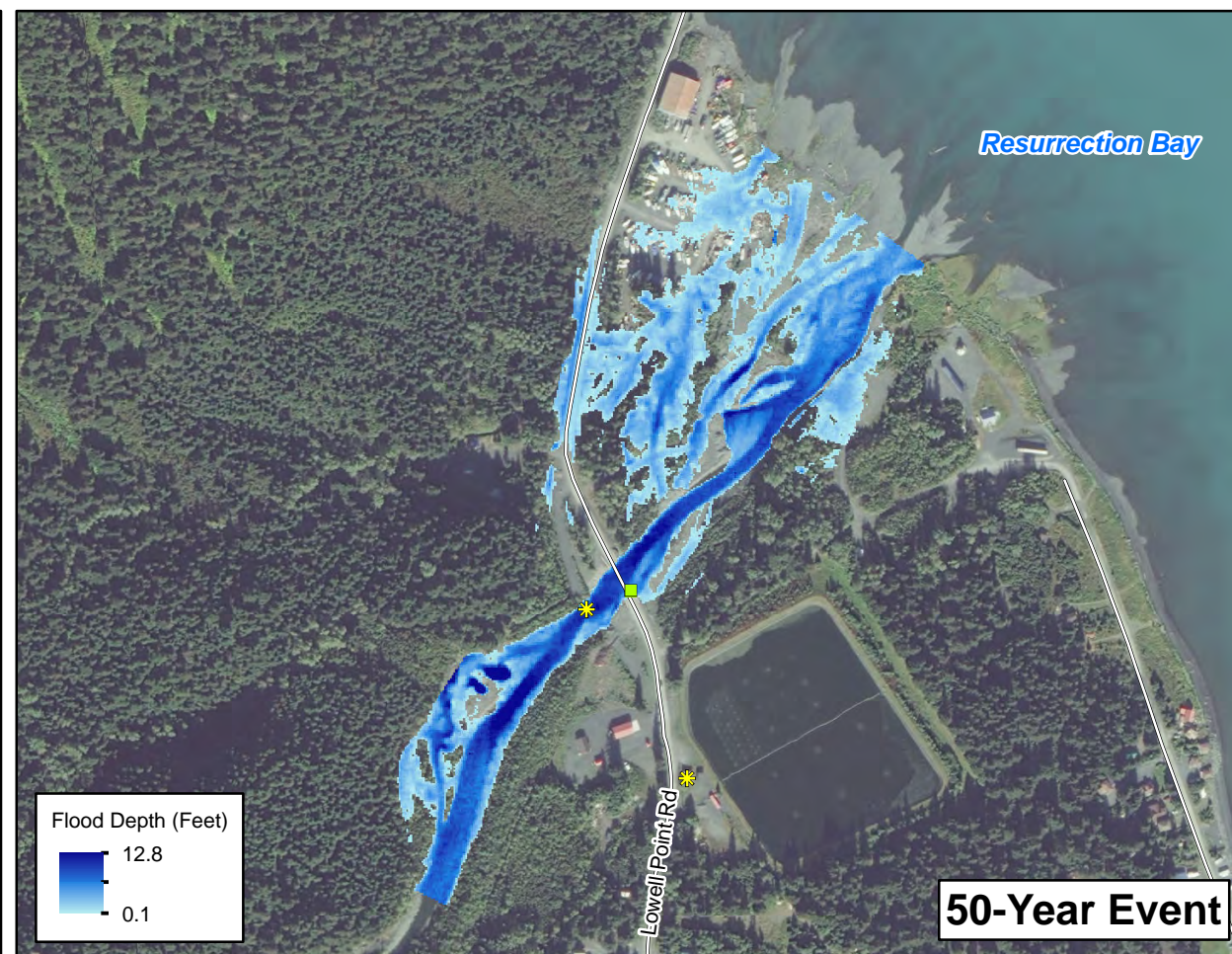
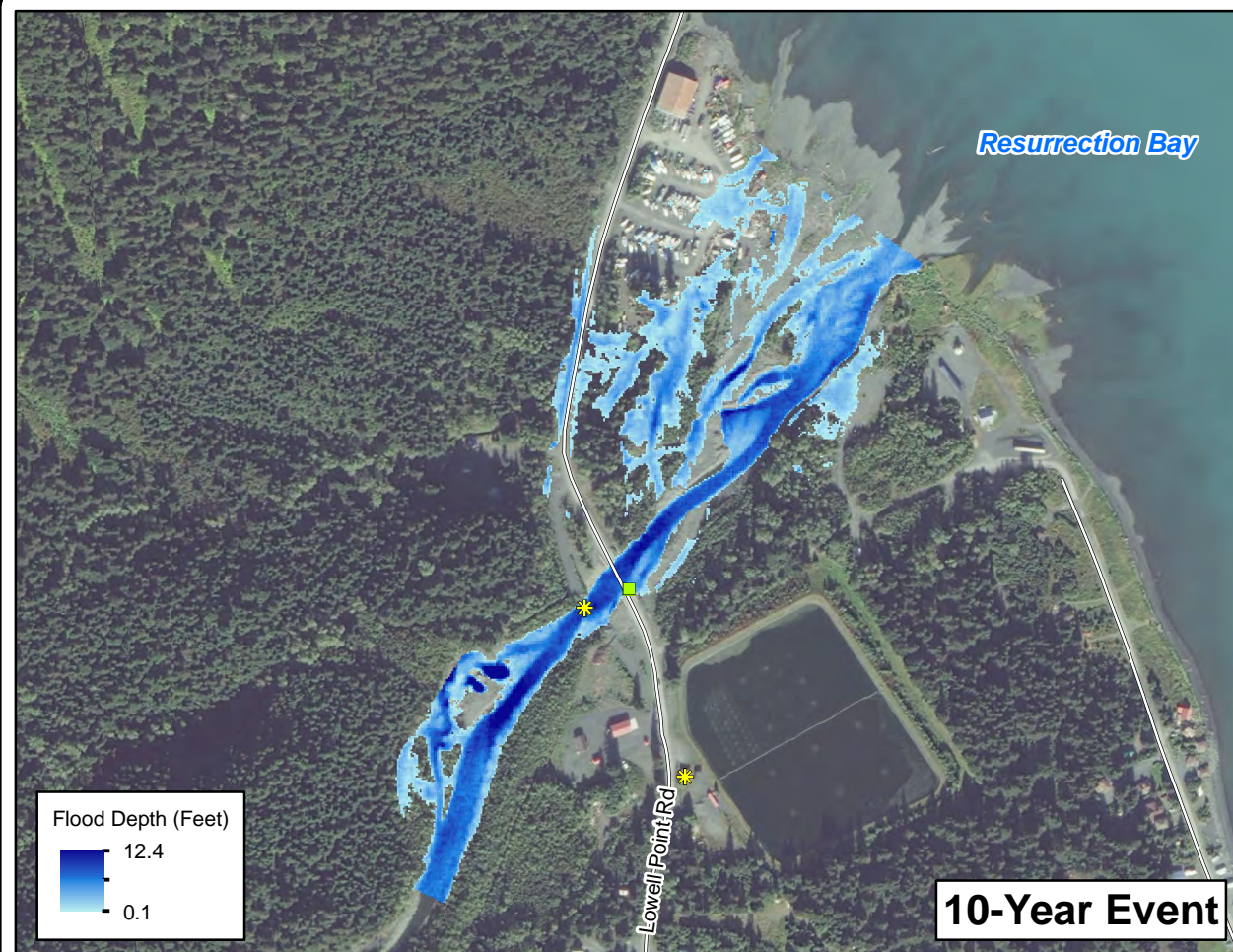
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SOMETIMES CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-55



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Spruce\_2012.mxd Plot Date: 4/22/2013

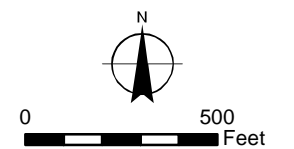


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Base reference data from Kenai Peninsula Borough.



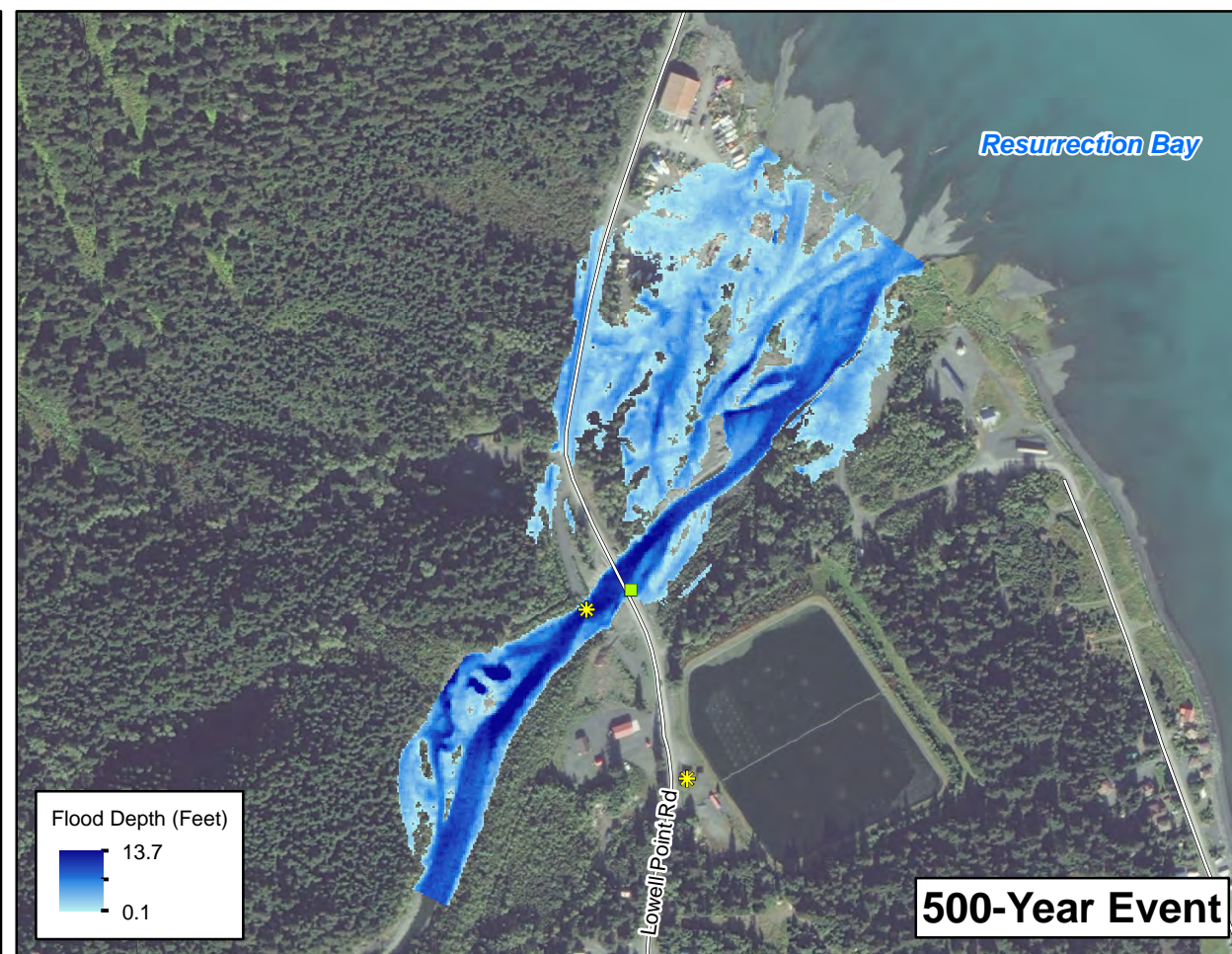
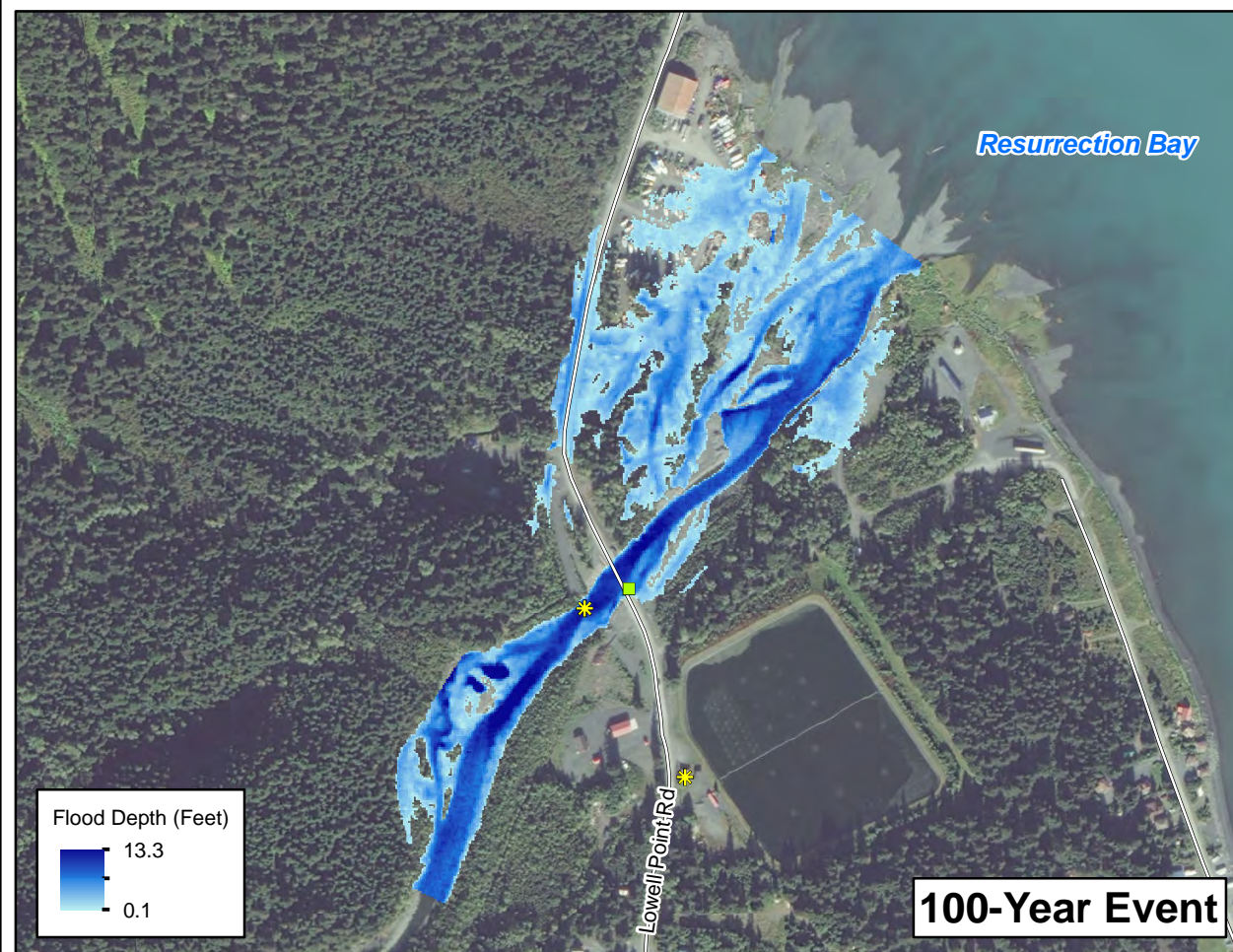
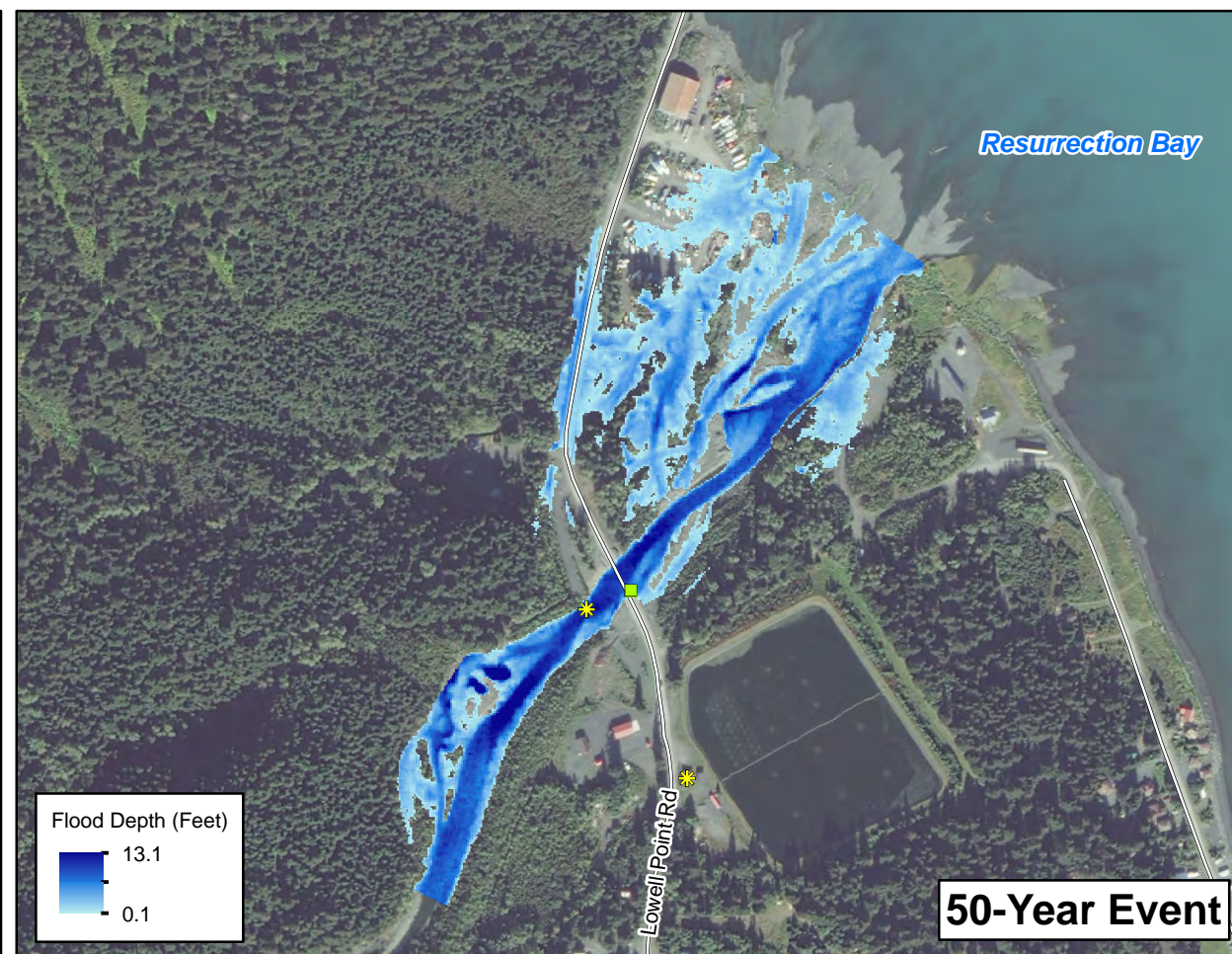
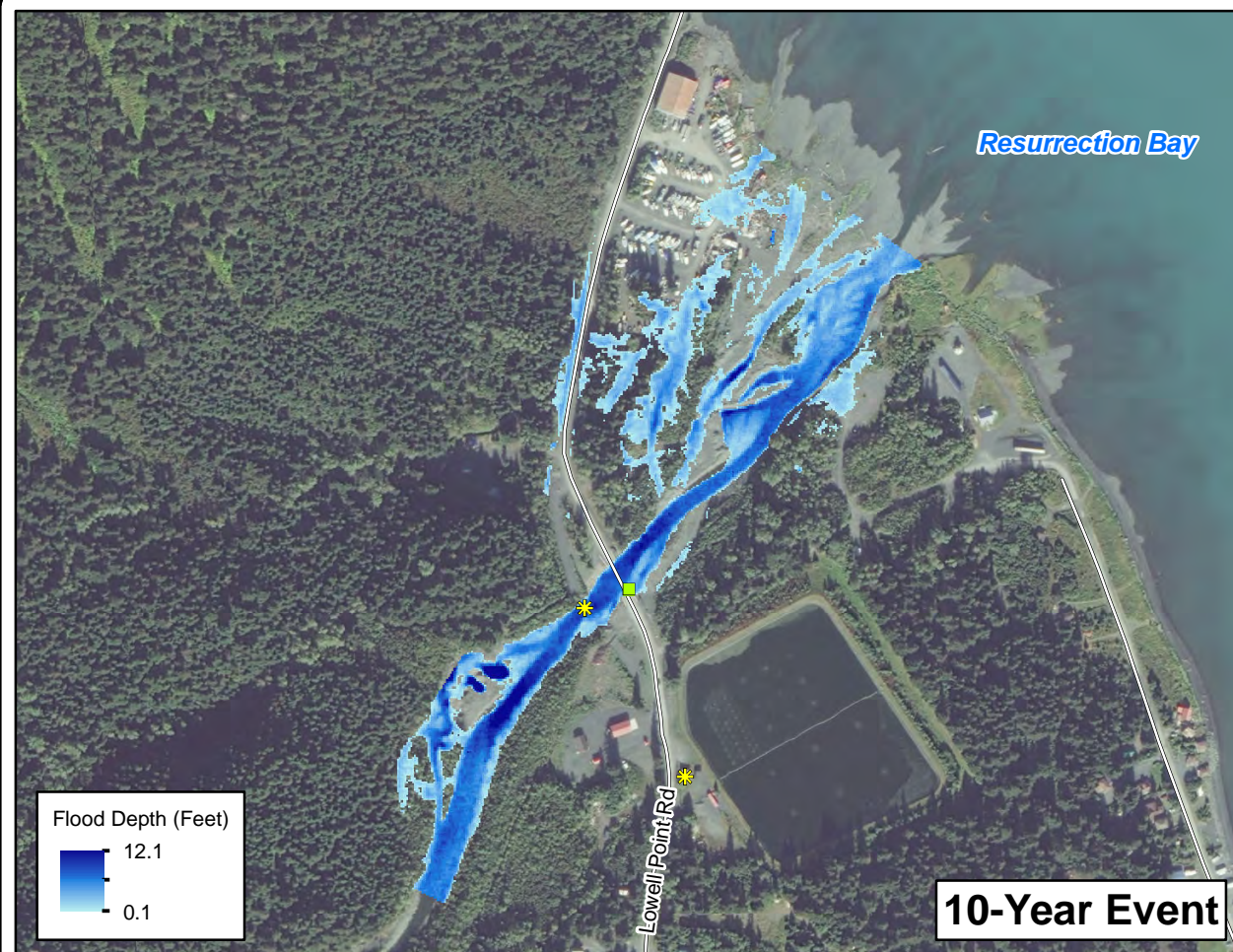
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SPRUCE CREEK  
MODELED FLOODPLAIN  
2012**

MAP K-56



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Spruce\_2022.mxd Plot Date: 4/22/2013

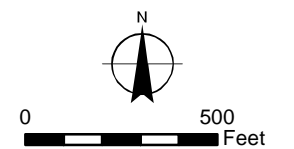


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.



**URS**

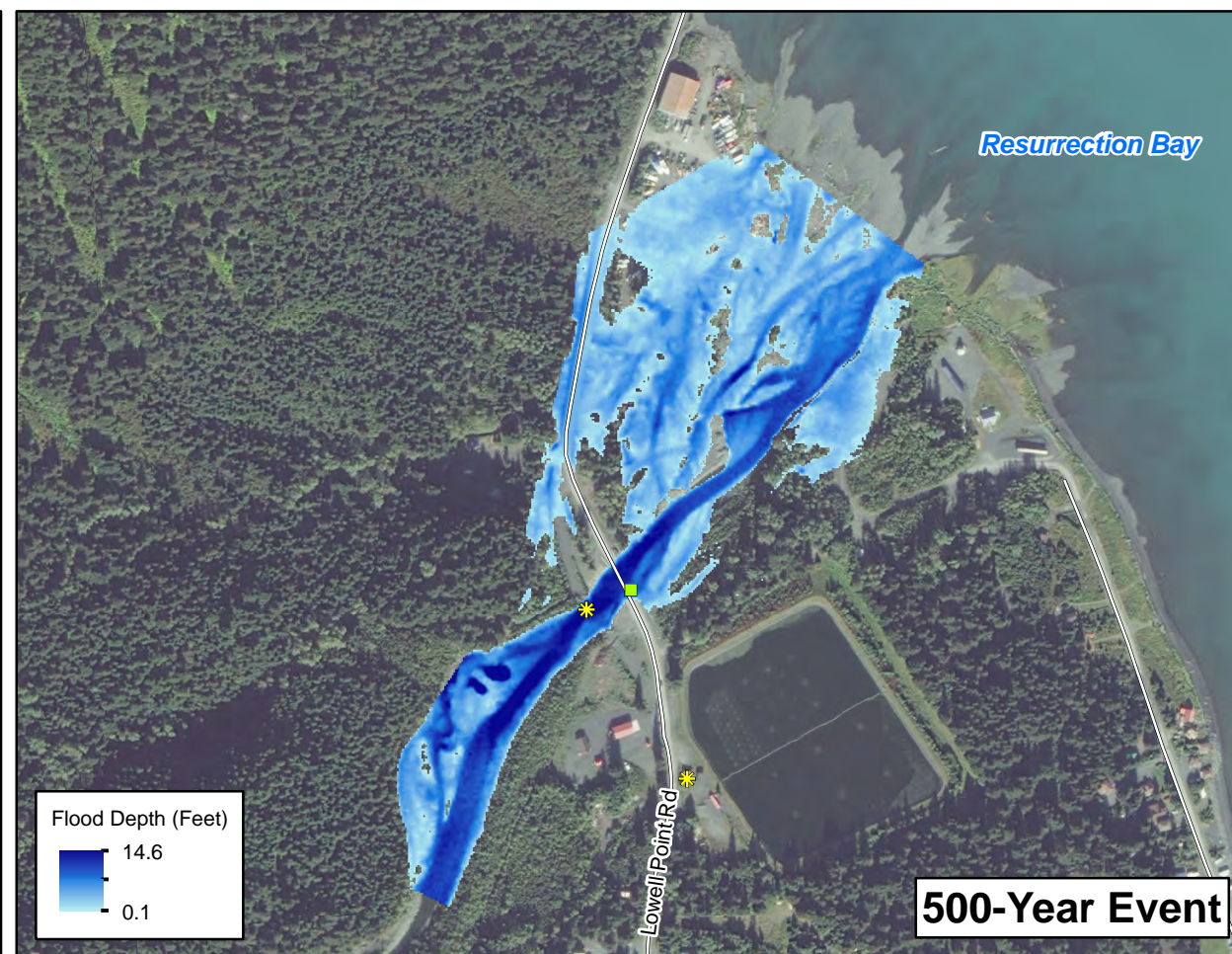
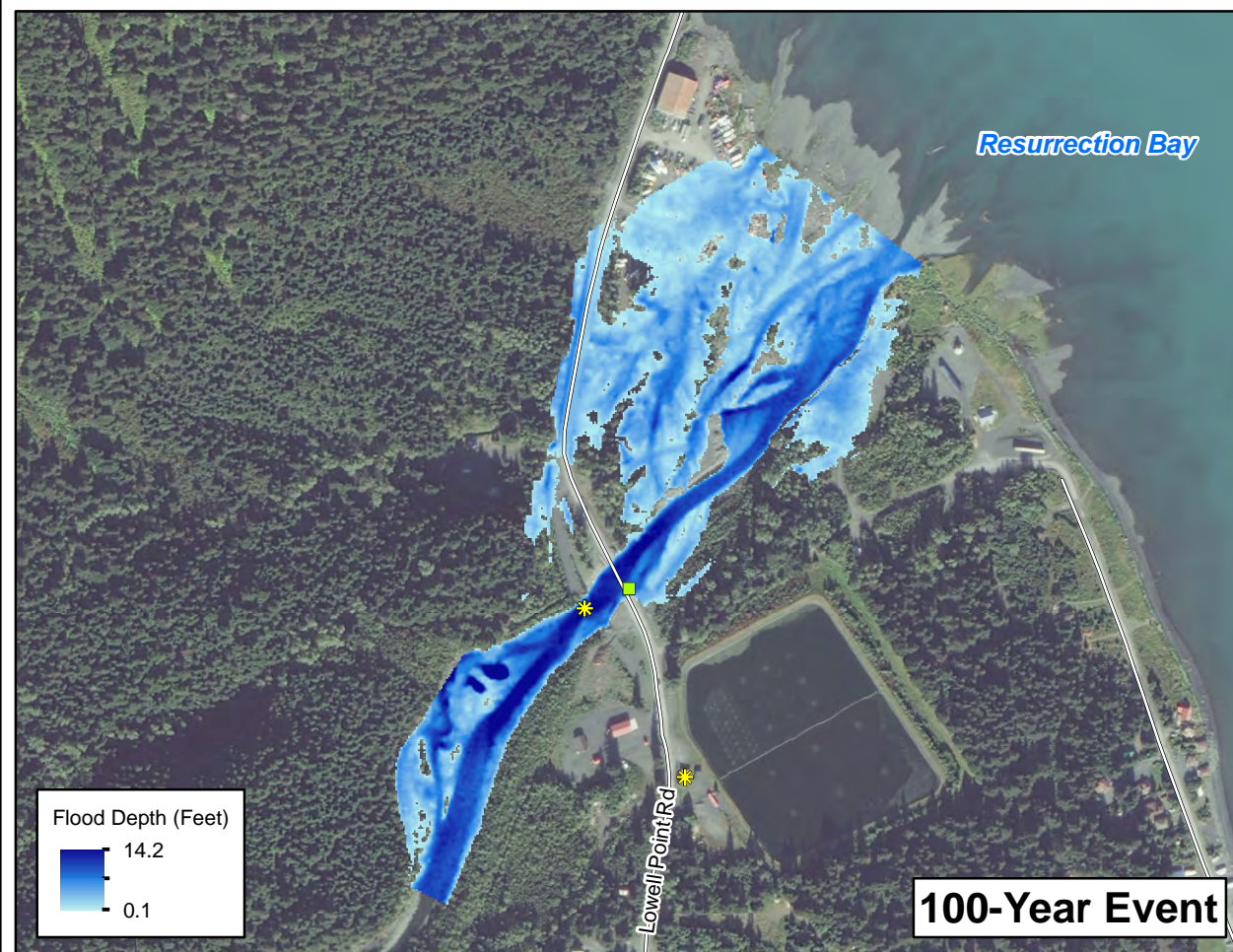
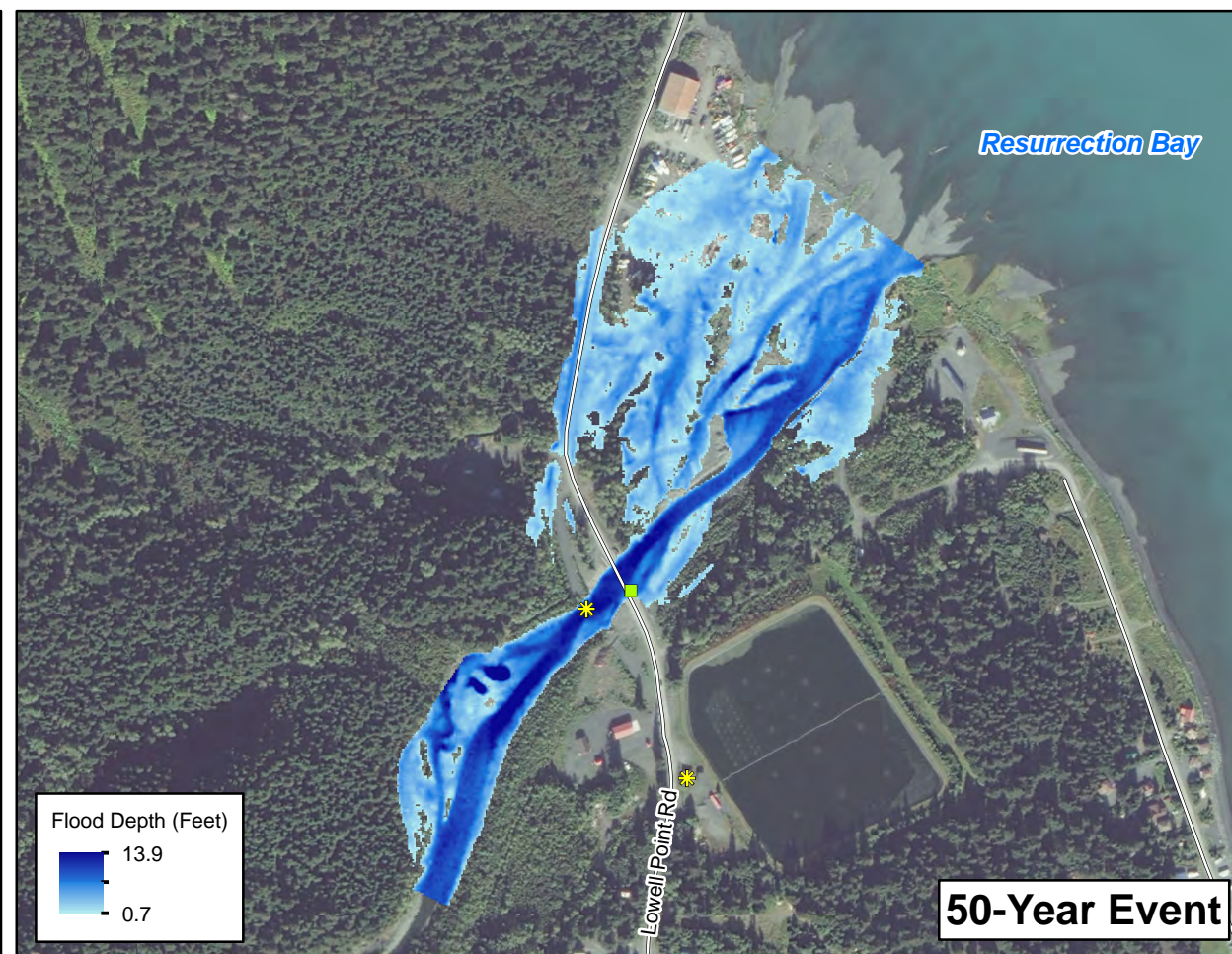
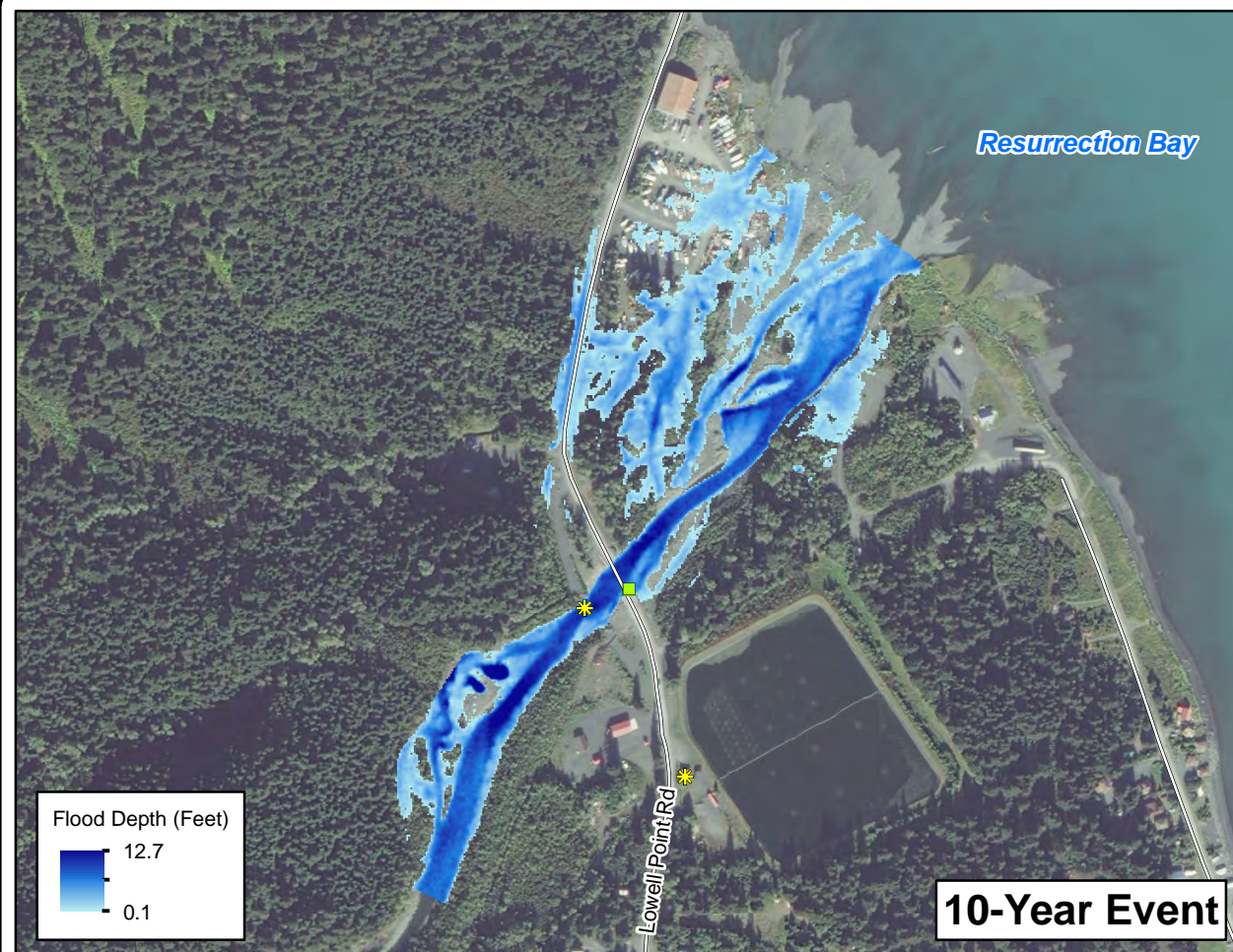
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SPRUCE CREEK  
MODELED FLOODPLAIN  
2022**

MAP K-57



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Spruce\_2062.mxd Plot Date: 4/22/2013

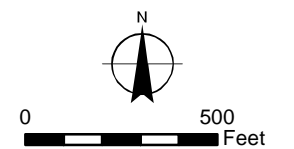


#### Legend

- Damaged Structures
- Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- +— Railroads

#### Sources and Notes:

1. No structures are wet or damaged with this scenario.
2. Floodplain represents A1B scenario.
3. Base reference data from Kenai Peninsula Borough.



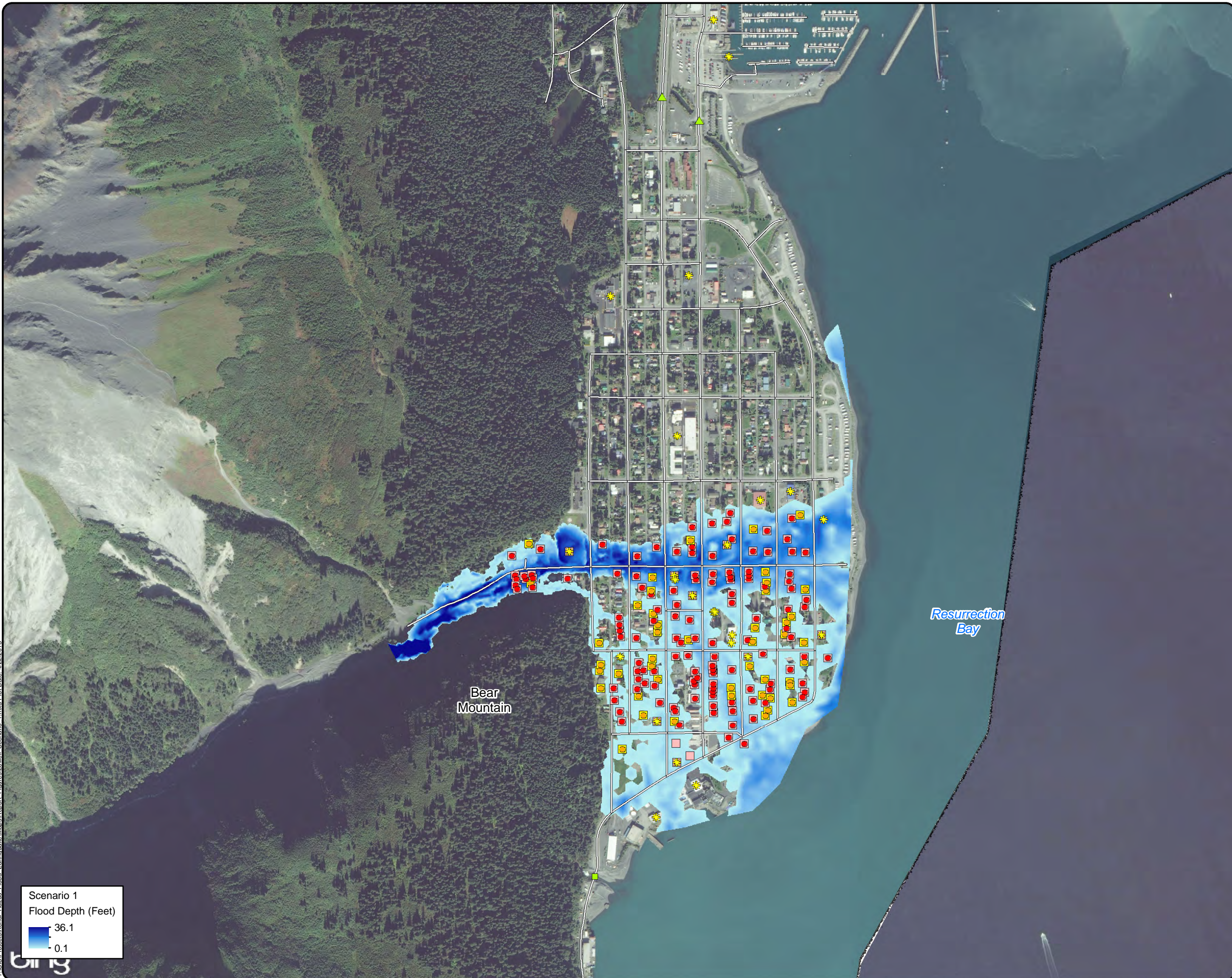
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**SPRUCE CREEK  
MODELED FLOODPLAIN  
2062**

MAP K-58



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Lowell\_Scenario\_1.mxd Plot Date: 4/22/2013



Scenario 1  
Flood Depth (Feet)

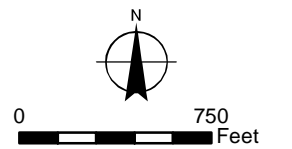
36.1  
0.1

#### Legend

- 2012 Damaged Structures
- 2012 Wet, Not Damaged Structures
- Future Damaged Structures
- Future Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Scenario 1 represents the 100-Year storm event with the Lowell Creek Tunnel completely blocked (USACE, 2012).
2. Future damages account for future land development. The limits and depth of flooding remain the same.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

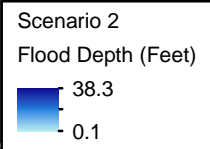
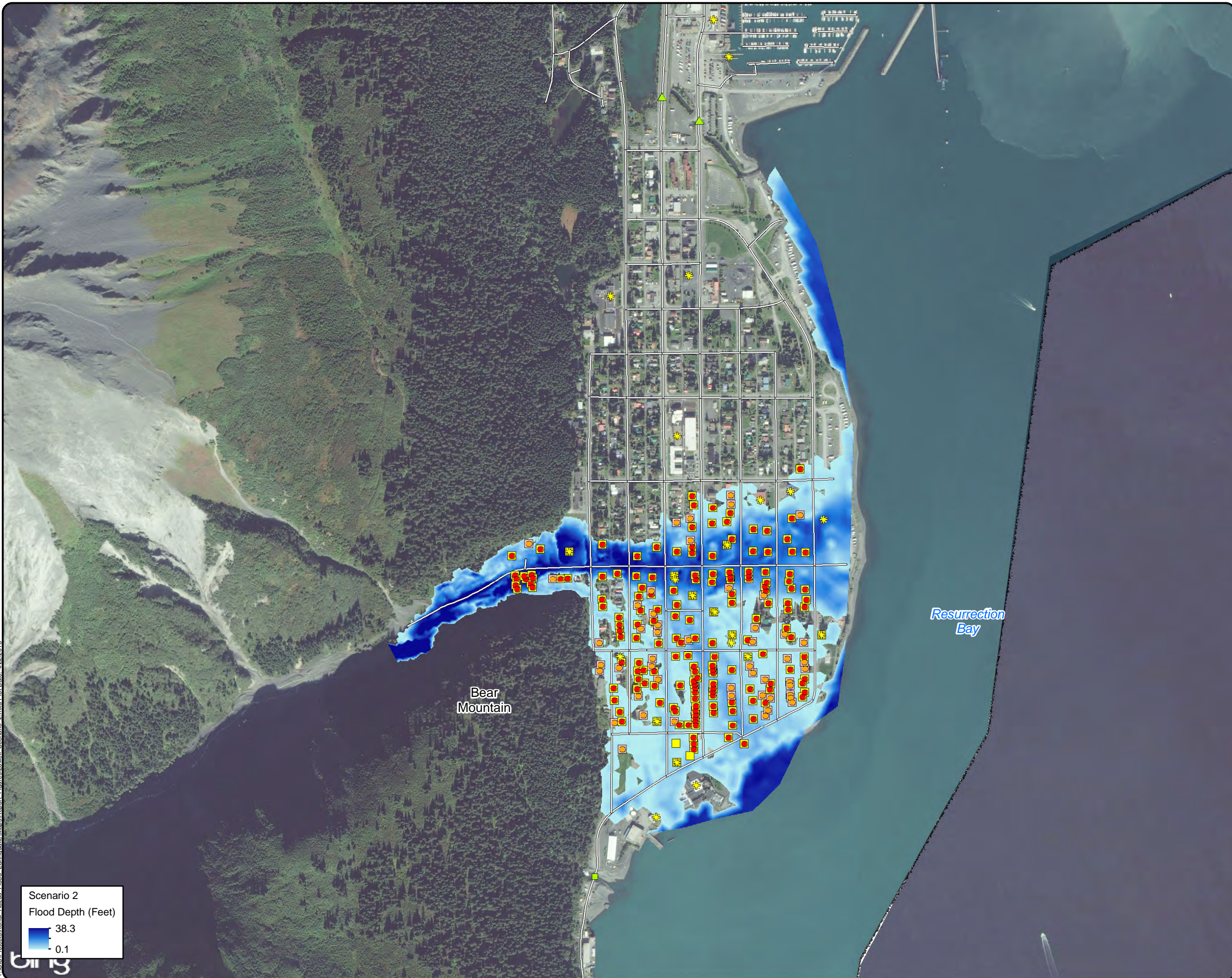
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**LOWELL CREEK  
SCENARIO 1  
(2012 & FUTURE)**

MAP K-59



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Lowell\_Scenario\_2.mxd Plot Date: 4/22/2013

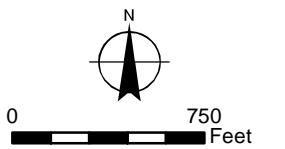


#### Legend

- 2012 Damaged Structures
- 2012 Wet, Not Damaged Structures
- Future Damaged Structures
- Future Wet, Not Damaged Structures
- ★ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Scenario 2 represents the Probable Maximum Flood event with the Lowell Creek Tunnel fully operational (USACE, 2012).
2. Future damages account for future land development. The limits and depth of flooding remain the same.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

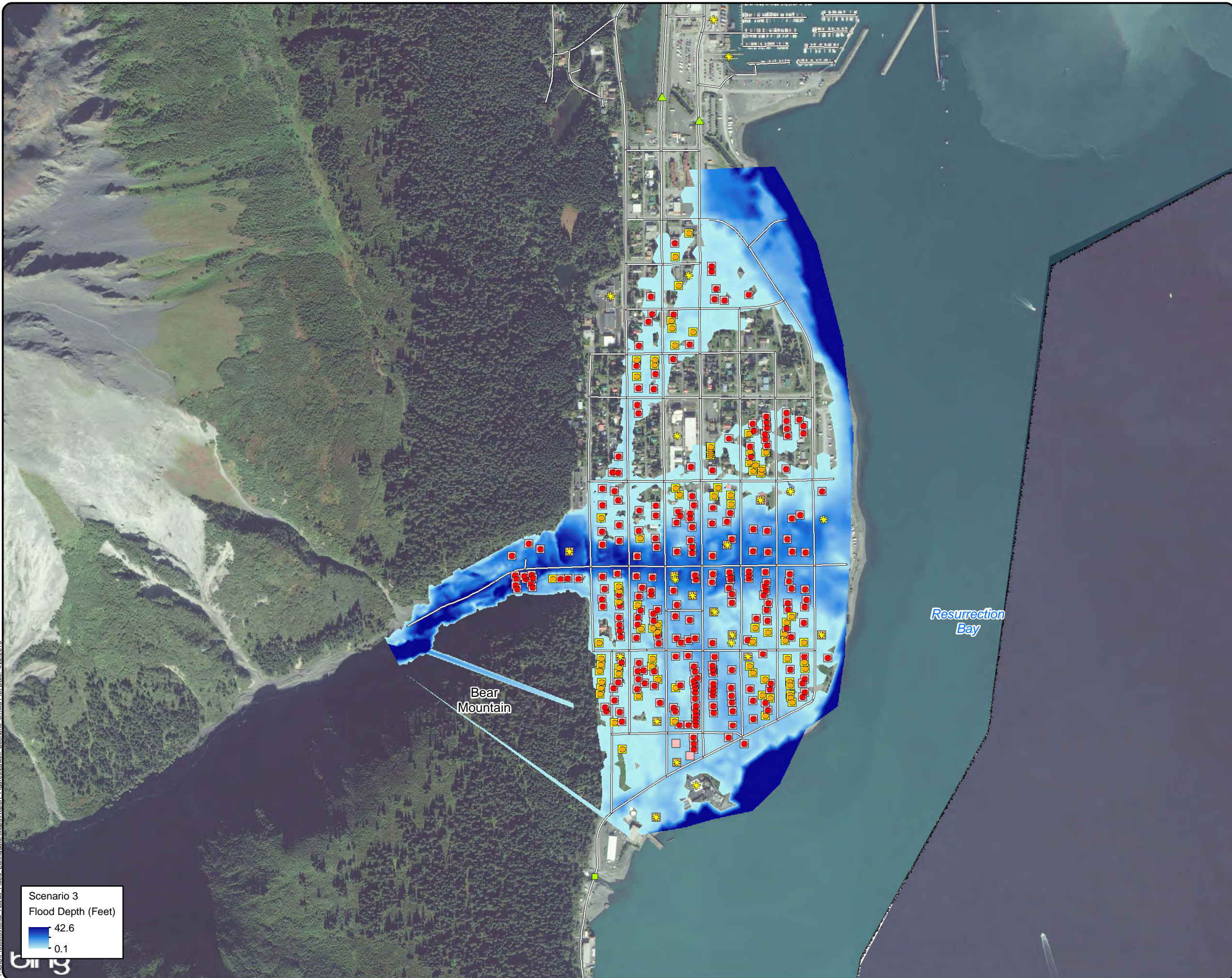
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**LOWELL CREEK  
SCENARIO 2  
(2012 & FUTURE)**

MAP K-60



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Lowell\_Scenario\_3.mxd Plot Date: 4/22/2013



Scenario 3  
Flood Depth (Feet)

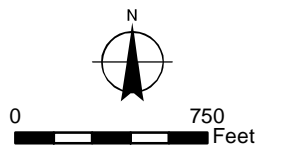
42.6
0.1

#### Legend

- 2012 Damaged Structures
- 2012 Wet, Not Damaged Structures
- Future Damaged Structures
- Future Wet, Not Damaged Structures
- ✱ Critical Facilities
- Bridges
- ▲ Culverts
- Roads
- Railroads

#### Sources and Notes:

1. Scenario 3 represents the Probable Maximum Flood event causing a landslide. The landslide was assumed to create a temporary reservoir that collected water and failed during the peak of the runoff hydrograph. (USACE, 2012).
2. Future damages account for future land development. The limits and depth of flooding remain the same.
3. Bing aerial photos ©2010 DigitalGlobe, USGS, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**LOWELL CREEK  
SCENARIO 3  
(2012 & FUTURE)**

MAP K-6 1





#### Legend

- Critical Facilities
- Bridges
- Culverts
- Roads
- Railroads

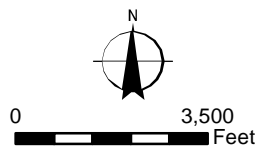
#### Coastal Zone Modeling Areas

- FEMA Zone VE
- URS Extension

**16** Stillwater Base Flood  
Elevation (NAVD 1988, Feet)

#### Sources and Notes:

1. The FEMA Zone VE extends inland to the point where the 1%-annual-chance stillwater flood depth is insufficient to support a 3-foot wave (FEMA).
2. URS extension zones represent areas that are part of the LMHP study area but are outside of FEMA Zone VE.



**URS**

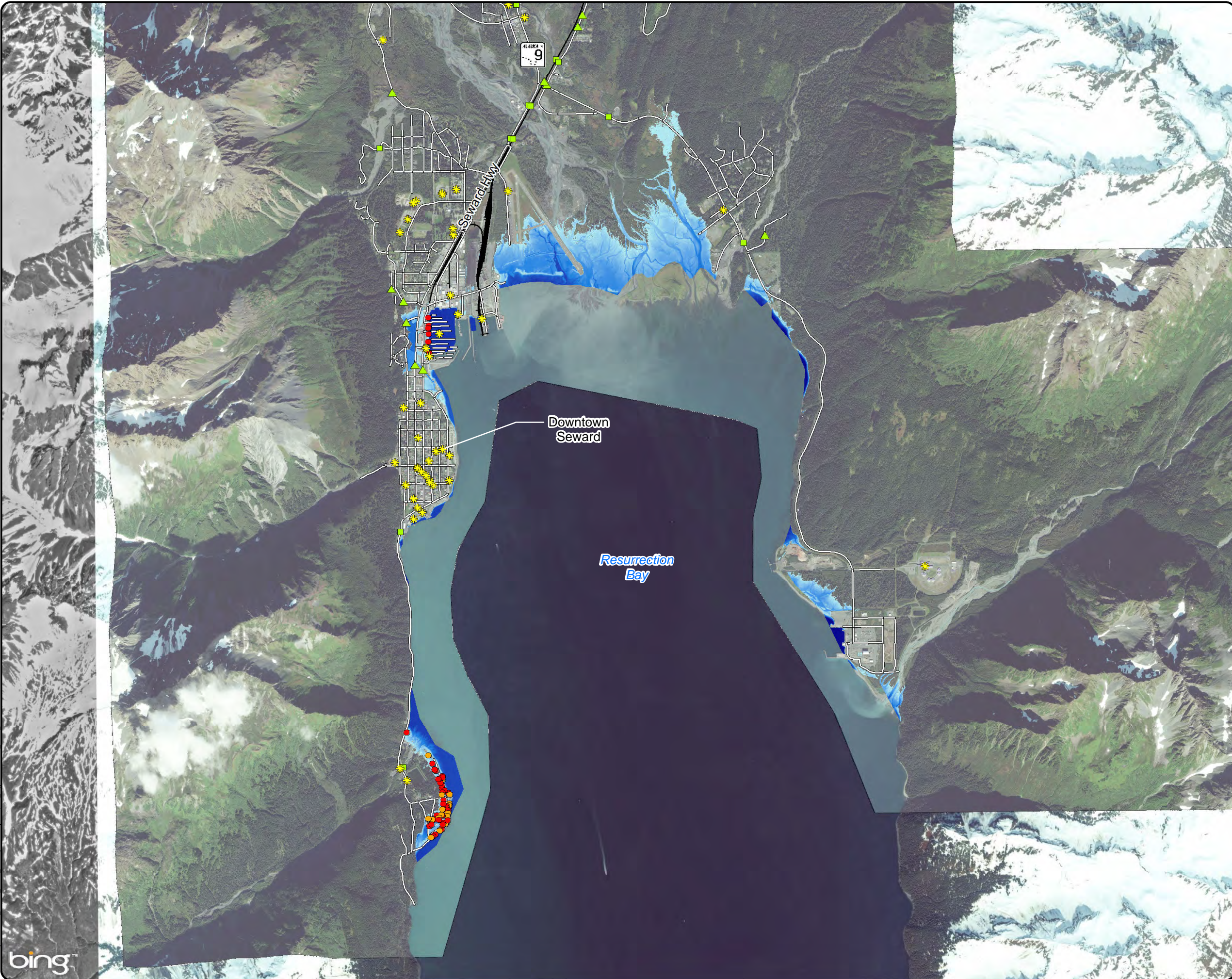
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**COASTAL FLOOD  
HAZARD ZONES**

**MAP K-62**



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Coastal\_2012\_Losses.mxd Plot Date: 4/19/2013

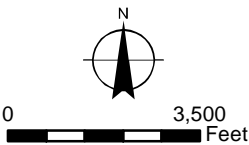


#### Legend

- Damaged Structures
  - Wet, Not Damaged Structures
  - ✱ Critical Facilities
  - Bridges
  - ▲ Culverts
  - Roads
  - +— Railroads
- Flood Depth (Feet)
- 15.6  
0.1

#### Sources and Notes:

1. Damages are based on the 100-Year coastal flood under current land use conditions.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**COASTAL FLOOD,  
CURRENT DAMAGES**

MAP K-63



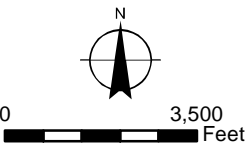


**Legend**

- Damaged Structures
  - Wet, Not Damaged Structures
  - ✱ Critical Facilities
  - Bridges
  - ▲ Culverts
  - Roads
  - +— Railroads
- Flood Depth (Feet)
- 15.6  
0.1

**Sources and Notes:**

1. Damages are based on the 100-Year coastal flood under future land use conditions.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

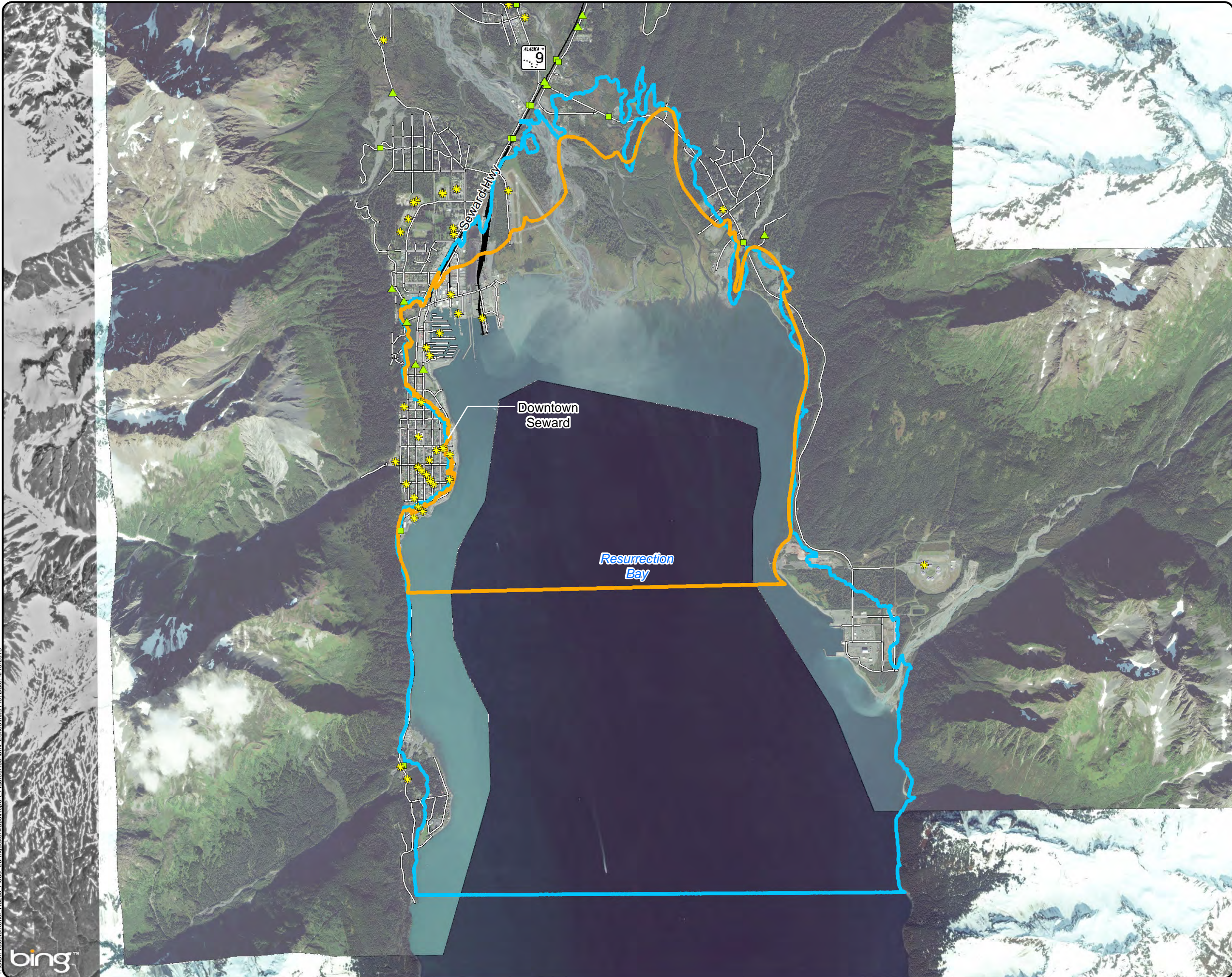
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**COASTAL FLOOD,  
FUTURE DAMAGES**








MAP K-64



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Maps\Report\_Figures\Tsunami\_Zones.mxd Plot Date: 4/19/2013

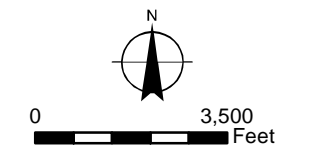


**Legend**

-  1964 Tsunami Inundation Limits
-  Maximum Inundation Limits
-  Critical Facilities
-  Bridges
-  Culverts
-  Roads
-  Railroads

**Sources and Notes:**

1. 1964 tsunami inundation limit is based on observed inundation limits from the 1964 earthquake.
2. Maximum inundation limit is based on the theoretical worst-case tsunami scenario.
3. Base reference data from Kenai Peninsula Borough.
4. Bing aerial photos ©2010 DigitalGlobe, © 2010 GeoEye, and © 2013 Microsoft Corporation.



**URS**

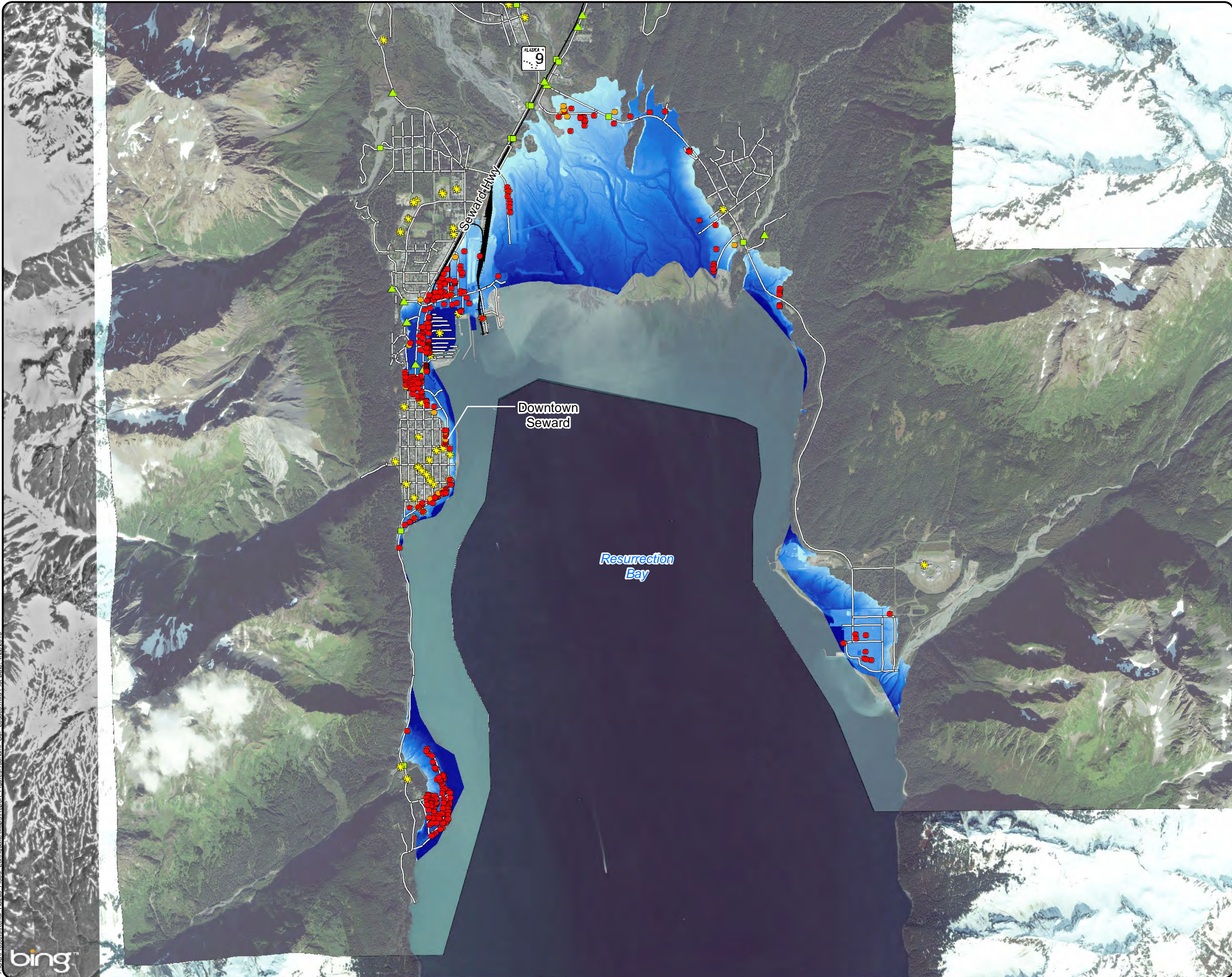
SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**TSUNAMI FLOOD  
INUNDATION LIMITS**

MAP K-65



Y:\GIS\Projects\Kenai\_Hazus\_Flood\_Earthquake\Map\Report\_Figures\Tsunami\_Cur\_Losses.mxd Plot Date: 4/22/2013

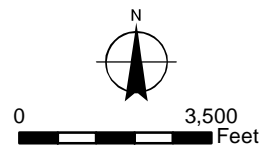


**Legend**

- Damaged Structures
  - Wet, Not Damaged Structures
  - ★ Critical Facilities
  - Bridges
  - ▲ Culverts
  - Roads
  - +— Railroads
- Flood Depth (Feet)
- 29.6
- 0.0

**Sources and Notes:**

1. Current damages are based on the worst-case scenario tsunami and current land use.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, © 2010 GeoEye, and © 2013 Microsoft Corporation.

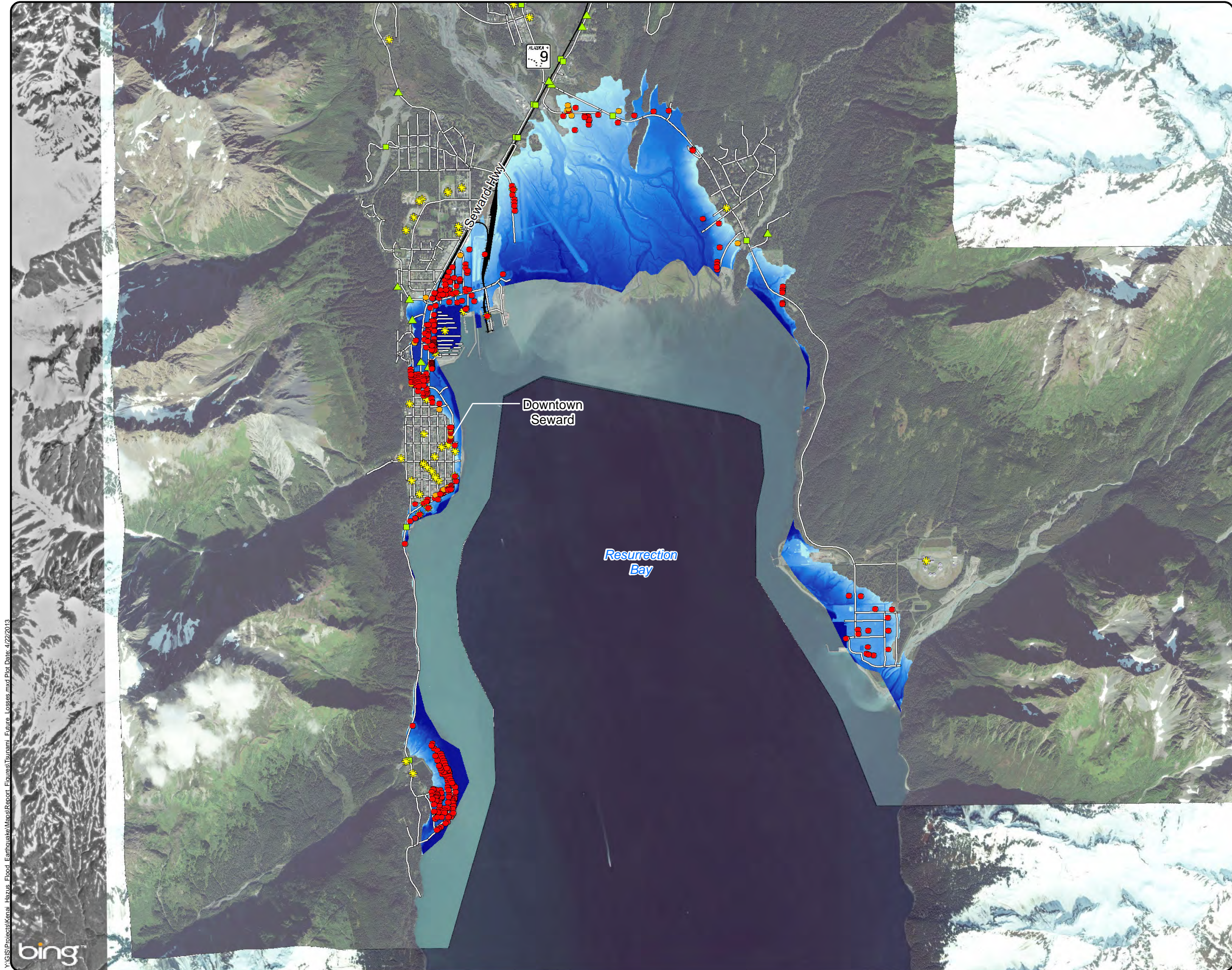


SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**TSUNAMI  
CURRENT DAMAGES**

MAP K-66



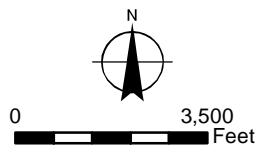


**Legend**

- Damaged Structures
  - Wet, Not Damaged Structures
  - ✱ Critical Facilities
  - Bridges
  - ▲ Culverts
  - Roads
  - +— Railroads
- Flood Depth (Feet)
- 29.6
- 0.0

**Sources and Notes:**

1. Future damages are based on the worst-case scenario tsunami and future land use.
2. Base reference data from Kenai Peninsula Borough.
3. Bing aerial photos ©2010 DigitalGlobe, © 2010 GeoEye, and © 2013 Microsoft Corporation



**URS**

SBCFSA LOCAL HAZARD  
MITIGATION PLAN (LMHP) ANNEX

**TSUNAMI  
FUTURE DAMAGES**

**MAP K-67**





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## APPENDIX A

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# PUBLIC PARTICIPATION PROCESS

A Planning Team was organized and met from September, 2012 to June 2013. Progress reports were provided by Dan Mahalek at the December 3, 2012, March 18, April 15, 2013 Seward/Bear Creek Flood Service Area meetings, a draft was provided for comment at the March 4, 2013 meeting, a work session was scheduled for April 1, 2013 (no minutes available on the website), URS presented the updated plan at the May 6, 2013 meeting, where the board voted to approve the plan. Abridged minutes and links to the full audio files for meetings can be found at:

<http://www.borough.kenai.ak.us/service-areas/sbcfsa/sbcfsa-meetings>

A detailed discussion of the public participation process, including copies of the flyer and newsletters used to notify the public of the participation process, can be found in Section 3.3 and in Appendix F of Annex I - Seward/Bear Creek Flood Service Area Hazard Mitigation Plan:

[http://www.borough.kenai.ak.us/images/KPB/OEM/AHMP/Annexes/SBCFSA\\_LHMP\\_Final\\_wApp\\_A-J\\_6\\_19\\_2013.pdf](http://www.borough.kenai.ak.us/images/KPB/OEM/AHMP/Annexes/SBCFSA_LHMP_Final_wApp_A-J_6_19_2013.pdf)

The Borough Planning Commission held a public hearing on the proposed update on January 6, 2014 and recommended approval on pages 7 and 8 of the minutes:

[http://www.borough.kenai.ak.us/components/com\\_papyruslist/document.php?d=1156299](http://www.borough.kenai.ak.us/components/com_papyruslist/document.php?d=1156299)

2014 Borough Assembly meetings and public hearings for the adoption of the 2013 updated SBCFSA Hazard Mitigation Plan took place on January 7 and 21, 2014; information from those meetings, including minutes, can be found at:

<http://www.borough.kenai.ak.us/assembly-clerk/assembly-meetings/2014>

Kenai Peninsula Borough Ordinance 2014-03, adopting the 2013 updated SBCFSA Hazard Mitigation Plan and replacing Annex I with that update can be found at:

<http://www.borough.kenai.ak.us/assembly-clerk/legislation/ordinances>

The draft plan with the revisions and inclusion of the updated Annex I will be posted on the Borough website, and will replace the current plan when approved by FEMA. The Borough website is a public site and people are welcome to comment on any contents. For the complete plan revision in 2015/2016, the public participation will be expanded to direct contact, meetings, work sessions and questionnaires with all communities and agencies in the Borough.



# PUBLISHER'S AFFIDAVIT

UNITED STATES OF AMERICA, }  
STATE OF ALASKA } ss:

Becky Thomas being first duly  
sworn, on oath deposes and says:

That I am and was at all times here  
in this affidavit mentions, Supervisor of  
Legals of the Peninsula Clarion, a news-  
paper of general circulation and published  
at Kenai, Alaska, that the

Agenda

a printed copy of which is hereto annexed was  
published in said paper one each and  
every day for one successive and  
consecutive day in the issues on the  
following dates:

May 22, 2014

Becky Thomas

SUBSCRIBED AND SWORN to me before  
this 23rd day of May, 2014

Jane Russell

NOTARY PUBLIC in favor for the  
State of Alaska.

My Commission expires 27-Aug-16





**KENAI PENINSULA BOROUGH PLANNING COMMISSION  
MAY 27, 2014 TENTATIVE AGENDA**

**KENAI PENINSULA BOROUGH  
PLAT COMMITTEE**

The next regularly scheduled meeting of the Plat Committee will be held **Tuesday, May 27, 2014 at 6:30 p.m.** in the Assembly Chambers of the KPB George A. Navarre Administration Bldg, 144 N. Binkley, Soldotna.

**Subdivision Plat Public Hearings**

1. Sprucewood Terrace Jones Addition; File 2014-059 [Segesser / Jones] Location: On Burnett Way in Soldotna area
2. Salamatof Air Park Kustatan Leasing Addn, File 2014-060 [Segesser / Brewer] Location: On Citabria Street in Nikiski *(Surveyor requested Postponement)*
3. Ravenwood Sub Addn. No. 8; File 2014-061 [Integrity / Davis] Location: On Mud Duck Avenue in Soldotna
4. Soaring Eagle Sub Phase Two; File 2014-062 [Integrity / Foster] Location: On Forest Lane in Soldotna
5. Alaska State Land Survey No. 2014-37; File 2014-053 [Cooper / SOA-DOT] Location: On Seward Highway in Moose Pass; Moose Pass APC. *(Postponed from May 12, 2014)*

**KENAI PENINSULA BOROUGH  
PLANNING COMMISSION**

The next regularly scheduled Planning Commission meeting will be held **Tuesday, May 27, 2014 at 7:30 p.m.** in the Assembly Chambers of the KPB George A. Navarre Administration Bldg, 144 N. Binkley, Soldotna.

**Utility Easement Vacations**

- a. Vacate a 5' x 5' portion of the utility easement to accommodate an encroaching 2-foot septic pipe into the 15-foot easement within Lot 4B Block 6 granted by Questa Woods Estates 2013 Replat (Plat SW 2013-9); within S13 T1N R1W, SM, AK, within the KPB. File 2014-058. Petitioners: Victor P. Stoltz & Jackie R. Woodruff of Seward, AK. Location: On Brierwood Avenue in Seward

- b. Vacate the north 5-feet of the east one-half of the 10-foot utility easement within Lot 2 of Porter Subdivision No. 2 to accommodate a building and vent pipe(s) encroachment adjacent to Dehaviland Beaver Circle. The south 5-feet and the entire west 10-feet of the utility easement will remain as originally granted by said plat (Plat KN 94-90); all lying within S2 T7N R12W, SM, AK and within the KPB. File 2014-057. Petitioner: Lyla Rediske for Rediske Family Limited Partnership of Nikiski, Alaska. Location: On Dehaviland Beaver Circle in Nikiski

**Public Hearings**

1. All Hands Mitigation Plan update

**Special Considerations**

Porter Subdivision No. 2 Lot 2 Bldg. Setback Exception; File 2014-057; Resolution No 2014-06; Petitioner: Lyla Rediske for Rediske Family Limited Partnership of Nikiski, AK. Location: On Dehaviland Beaver Circle in Nikiski

**FUTURE MEETINGS**

**Plat Committee Meeting**

The next regularly scheduled Plat Committee meeting will be held **Monday, June 9, 2014** at the KPB George A. Navarre Administration Building, 144 North Binkley St, Soldotna, AK at 5:30 p.m.

**Planning Commission Meeting**

The next regularly scheduled Planning Commission meeting will be held **Monday, June 9, 2014** at the KPB George A. Navarre Administration Building, 144 North Binkley St, Soldotna, AK at 7:30 p.m.

**ADVISORY PLANNING COMMISSIONS**

Check the Kenai Peninsula Borough Website for Advisory Planning Commission meeting dates & times



**KPB PLANNING DEPARTMENT**

Patti Hartley  
Administrative Assistant  
PHONE: (907) 714-2200, ext. 2215  
FAX: (907) 714-2378  
Toll free within the Borough  
1-800-478-4441, ext. 2215

**Publish: 5/22, 2014**

**D232/224**

KENAI PENINSULA BOROUGH PLANNING COMMISSION  
ASSEMBLY CHAMBERS  
GEORGE A. NAVARRE ADMINISTRATION BUILDING  
144 NORTH BINKLEY STREET  
SOLDOTNA, ALASKA 99669

May 27, 2014 - 7:30 P.M.

APPROVED MINUTES

AGENDA ITEM A.      CALL TO ORDER

Chairman Bryson called the meeting to order at 7:30 p.m.

AGENDA ITEM B.      ROLL CALL

*Commissioners Present*

Paulette Bokenko-Carluccio, City of Seldovia  
Philip Bryson, City of Kenai  
JoAnne Collins, Anchor Point / Ninilchik  
Cindy Ecklund, City of Seward  
Rick Foster, City of Homer  
Mari Anne Gross, Southwest Borough  
Sandra Holsten, East Peninsula  
James Isham, Sterling  
Harry Lockwood, Ridgeway  
Blair Martin, Kalifornsky Beach  
Robert Ruffner, Clam Gulch / Kasilof  
Jason Tauriainen, Northwest Borough  
Paul Whitney, City of Soldotna

With 13 members of a 13 member Commission in attendance, a quorum was present.

*Staff Present*

Max Best, Planning Director  
Patti Hartley, Administrative Assistant  
Paul Voeller, Platting Officer

*Others Present*

No members of the public present.

AGENDA ITEM F.      PUBLIC HEARINGS

1. Ordinance 2014-22; An Ordinance adopting an updated 2010 KPB All-Hazard Mitigation Plan

Memorandum and Staff Report given by Max Best

PC Meeting: 5/27/14

In October 2004, the Kenai Peninsula Borough (KPB) enacted Ordinance 2004-33, adopting a borough-wide multi-jurisdictional All-Hazard Mitigation Plan (Plan). This Plan was subsequently updated in 2010 by assembly enactment of ordinance 2010-26 and again in 2014 by enactment of ordinance 2014-03 to include the Seward-Bear Creek Flood Service Area Annex I. This update of the Plan was then reviewed by FEMA which required additional modifications for the borough to be eligible for certain types of hazard mitigation funding from FEMA. These modifications are included in the proposed updated Plan and will be submitted to FEMA for approval following assembly adoption.

The purpose of this hazard mitigation planning effort is twofold: first, as a viable tool for reducing community vulnerability to disaster loss and damage; and second, as a prerequisite for receiving certain types of future federal and state hazard mitigation funding.

The KPB cooperated and coordinated this update with the Alaska Division of Homeland Security and Emergency Management.

Shortened hearing is requested as the FEMA deadline for approval is June 1, 2014. The State has submitted a request for additional time on behalf of the KPB and other municipalities but has not yet received a response.

The Plan is available for review at the borough clerk's office and also on the Internet through the planning department's web page under hot topics which can be reached from [www.kpb.us](http://www.kpb.us).

Staff will be going out to the public communities in the next year to find out if their hazard mitigation plan and projects were still in order.

#### END OF MEMORANDUM & STAFF REPORT

Chairman Bryson read the rules by which public testimony is taken.

Chairman Bryson opened the meeting for public comment noting no members of the public were present; Chairman Bryson closed the public comment period and opened discussion among the Commission.

Commissioner Foster asked for clarification of what the procedures were for an evacuation plan, for instance for the East End Road in Homer which is a single road. He asked who would be in charge of that. Mr. Best replied that each of the 20 communities within the Borough has a Community Wild Fire Protection Plan. They employ a CERT program which is a Community Emergency Response Team. Those folks are trained on how to get to the houses and what to say to provide assistance to the Troopers or the Central Emergency Service personnel. He stated that was the only real evacuation plan that was in place until they know what was being threatened.

Commissioner Foster asked if there was anywhere in the plan that would refer to other types of evacuation. Mr. Best replied that the only actual evacuation scenario was in the tsunami section of the plan. He stated it wasn't covered much with other events.

**MOTION:** Commissioner Ruffner moved, seconded by Commissioner Carluccio to recommend adoption of Ordinance 2014-22; ordinance adopting the updated 2010 KPB All-Hazard Mitigation Plan.

**VOTE:** The motion passed by unanimous consent.

BRYSON YES	CARLUCCIO YES	COLLINS YES	ECKLUND YES	FOSTER YES	GROSS YES	HOLSTEN YES
ISHAM YES	LOCKWOOD YES	MARTIN YES	RUFFNER YES	TAURIAINEN YES	WHITNEY YES	13 YES

AGENDA ITEM G. ANADROMOUS WATERS HABITAT PROTECTION (KPB 21.18) - None

AGENDA ITEM H. VACATIONS NOT REQUIRING A PUBLIC HEARING - None

AGENDA ITEM I. SPECIAL CONSIDERATIONS

1. Building Setback Exception; Lot 2 Porter Subdivision No. 2  
KPB File 2014-057; Resolution No 2014-06  
Location: On DeHaviland Beaver Circle in Nikiski

Staff Report given by Max Best

PC Meeting: 5/27/14

Petitioner(s): Lyla Rediske for Rediske Family Limited Partnership of Nikiski, Alaska.

Submittal: An airplane hangar has been constructed in the best location, which happens to place a corner of the building within the building setback. The area is open and generally flat.

KENAI PENINSULA BOROUGH PLANNING COMMISSION  
 GEORGE A. NAVARRE ADMINISTRATION BUILDING  
 144 NORTH BINKLEY STREET  
 SOLDOTNA, ALASKA 99669

May 27, 2014 - 7:30 P.M.

Tentative Agenda

Philip Bryson  
**Chairman**  
 Kenai City  
 Term Expires 2016

Paulette Bokenko-  
 Carluccio  
 PC Member  
 City of Seldovia  
 Term Expires 2015

Alice Joanne Collins  
 PC Member  
 Anchor Point/ Ninilchik  
 Term Expires 2016

Cindy Ecklund  
 PC Member  
 City of Seward  
 Term Expires 2014

Dr. Rick Foster  
**Parliamentarian**  
 Homer City  
 Term Expires 2016

Mari Anne Gross  
 PC Member  
 Southwest Borough  
 Term Expires 2014

Sandra Key Holsten  
 PC Member  
 East Peninsula  
 Term Expires 2016

James Isham  
 PC Member  
 Sterling  
 Term Expires 2015

Harry Lockwood  
 PC Member  
 Ridgeway  
 Term Expires 2016

Blair Martin  
**Vice Chairman**  
 Kalifornsky Beach  
 Term Expires 2015

Paul Whitney  
 PC Member  
 City of Soldotna  
 Term Expires 2014

Robert Ruffner  
 PC Member  
 Kasilof/Clam Gulch  
 Term Expires 2015

A. CALL TO ORDER

B. ROLL CALL

C. APPROVAL OF CONSENT AND REGULAR AGENDA

All items marked with an asterisk (\*) are consent agenda items. Consent agenda items are considered routine and non-controversial by the Planning Commission and will be approved by one motion. There will be no separate discussion of consent agenda items unless a Planning Commissioner so requests in which case the item will be removed from the consent agenda and considered in its normal sequence on the regular agenda.

If you wish to comment on a consent agenda item or a regular agenda item other than a public hearing, please advise the recording secretary before the meeting begins, and she will inform the Chairman of your wish to comment.

\*1. Time Extension Request - None

\*2. Planning Commission Resolutions - None

\*3. Plats Granted Administrative Approval ..... 1

\*4. Plats Granted Final Approval (20.10.040) ..... 5

\*5. Plat Amendment Request - None

\*6. Utility Easement Vacations

a. Vacate a 5' x 5' portion of the utility easement to ..... 7  
 accommodate an encroaching 2-foot septic pipe into the  
 15-foot easement within Lot 4B Block 6 granted by  
 Questa Woods Estates 2013 Replat (Plat SW 2013-9);  
 within Section 13, Township 1 North, Range 1 West,  
 Seward Meridian, Alaska, within the Kenai Peninsula  
 Borough. KPB File 2014-058. Petitioners: Victor P.  
 Stoltz and Jackie R. Woodruff of Seward, Alaska.  
 Location: On Brierwood Avenue in Seward

b. Vacate the north 5-feet of the east one-half of the ..... 16  
 10-foot utility easement within Lot 2 of Porter Subdivision  
 No. 2 to accommodate a building and vent pipe(s)  
 encroachment adjacent to Dehaviland Beaver Circle.  
 The south 5-feet and the entire west 10-feet of the utility  
 easement will remain as originally granted by said plat  
 (Plat KN 94-90); all lying within Section 2, Township 7  
 North, Range 12 West, Seward Meridian, Alaska and  
 within the Kenai Peninsula Borough. KPB File 2014-  
 057. Petitioner: Lyla Rediske for Rediske Family  
 Limited Partnership of Nikiski, Alaska. Location: On  
 Dehaviland Beaver Circle in Nikiski



Jason Tauriainen  
PC Member  
Northwest Borough  
Term Expires 2014

Max J. Best  
Planning Director

Mike Navarre  
Borough Mayor

\*7. Commissioner Excused Absences

\*8. Minutes

a. May 12, 2014 Plat Committee Minutes

b. May 12, 2014 Planning Commission Minutes

D. PUBLIC COMMENT/PRESENTATIONS/COMMISSIONERS

(Items other than those appearing on the agenda. Limited to five minutes per speaker unless previous arrangements are made.)

E. UNFINISHED BUSINESS

F. PUBLIC HEARINGS

1. All-Hazard Mitigation Plan update ..... 26

G. ANADROMOUS WATERS HABITAT PROTECTION (KPB 21.18) - None

H. VACATIONS NOT REQUIRING A PUBLIC HEARING - None

I. SPECIAL CONSIDERATIONS

1. Porter Subdivision No. 2 Lot 2 ..... 38  
Bldg. Setback Exception  
KPB File 2014-057 Resolution No 2014-06  
Petitioner: Lyla Rediske for Rediske Family Limited Partnership of  
Nikiski, Alaska.  
Location: On Dehaviland Beaver Circle in Nikiski

J. SUBDIVISION PLAT PUBLIC HEARINGS

1. The Plat Committee is scheduled to review 5 preliminary plats.

K. OTHER/NEW BUSINESS

L. ASSEMBLY COMMENTS

M. LEGAL REPRESENTATIVE COMMENTS

N. DIRECTOR'S COMMENTS

O. COMMISSIONER COMMENTS

P. PENDING ITEMS FOR FUTURE ACTION

Q. ADJOURNMENT

**MISCELLANEOUS INFORMATIONAL ITEMS  
NO ACTION REQUIRED**

1. Kenai Planning & Zoning Commission Minutes ..... 47  
- April 9, 2014

### **NEXT REGULARY SCHEDULED PLANNING COMMISSION MEETING**

The next regularly scheduled Planning Commission meeting will be held **Monday, June 9, 2014** at the Kenai Peninsula Borough George A. Navarre Administration Building, 144 North Binkley Street, Soldotna, Alaska at **7:30 p.m.**

### **ADVISORY PLANNING COMMISSION MEETINGS**

<b>Advisory Commission</b>	<b>Meeting Location</b>	<b>Date</b>	<b>Time</b>
Anchor Point	Anchor Point Chamber of Commerce	June 3, 2014	7:00 p.m.
Cooper Landing	Cooper Landing Community Hall	June 4, 2014	6:00 p.m.
Hope / Sunrise	Hope Social Hall	June 5, 2014	7:00 p.m.

The Kachemak Bay and Funny River  
Advisory Planning Commissions are inactive at this time.

**NOTE:** Advisory planning commission meetings are subject to change. Please verify the meeting date, location, and time with the advisory planning commission chairperson. Chairperson contact information is on each advisory planning commission website, which is linked to the Planning Department website.

### **CONTACT INFORMATION**

#### **KENAI PENINSULA BOROUGH PLANNING DEPARTMENT**

Phone: 907-714-2200

Phone: toll free within the Borough 1-800-478-4441, extension 2215

Fax: 907-714-2378

e-mail address: [planning@borough.kenai.ak.us](mailto:planning@borough.kenai.ak.us)

web site: [www.borough.kenai.ak.us/planningdept](http://www.borough.kenai.ak.us/planningdept)



Kenai Peninsula Borough Alaska

# Planning Department

144 North Binkley Street, Soldotna, Alaska 99669 · (907) 714-2200 · (907) 714-2378 Fax

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## PLANNING MENU

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- [Platting](#)
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- [911 Street Naming](#)
- [Material Site Information](#)
- [Local Option Zoning](#)
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- [Plans/Reports](#)

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## Planning Home

### Welcome to the Resource Planning Department's home page!

The KPB Resource Planning Department consists of the following borough divisions; Planning & Platting Divisions; [Land Management Division](#), [Geographic Information Services](#) and the [Donald E. Gilman River Center](#).

The Planning & Platting Divisions of the Resource Planning Department provides professional advice and information to the Planning Commission, Borough Assembly and other departments for the purpose of assisting in the ongoing socioeconomic development of the Borough. It oversees all planning, zoning and platting powers on an aerawide basis within the rural district of the borough. The department provides information and assistance to other municipalities, local community groups, and the general public regarding subdivision regulations, local option zoning, land use regulations and land use planning.

### Hot Topics

- [Comments](#)
- [Department Organizational Chart](#)
- [KPB Code of Ordinances](#)
- [Fee Schedule](#)
- [Planning Commission Meetings](#)
- [Plat Committee Meetings](#)
- [Ordinance 2014-02 - Subdivision Title 20 \(enacted 2/11/14\)](#)
- [Title 20 - Subdivision](#)
- [All-Hazard Mitigation Plan Update](#)
- [City of Seldovia Comprehensive Plan](#)

## CONTACTS

### Planning Director

[Max Best](#)

### Administrative Assistant

[Patti Hartley](#)

### Code Compliance Officer

[Stacey Mattson](#)

### Planner

[Bruce Wall](#)

### E911 Addressing Officer

[Carrie Henson](#)

### Platting Officer

[Paul Voeller](#)

### Platting Specialist

[Maria Sweppy](#)

### Platting Technician

[Sylvia Vinson-Miller](#)

### Clerk Tvdst

**All Hazard Mitigation Plan Update is on main page of Planning Department website.**

**Will eventually be moved to Plans / Reports on the Planning Website.**



## APPENDIX C

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# GLOSSARY OF TERMS

<b>A-Zones</b>	A-Zones are found on all Flood Hazard Boundary Maps (FHBM), Flood Insurance Rate Maps (FIRM), and Flood Boundary and Floodway Maps (FBFM). An A-Zone is an area that would be flooded by the Base Flood, and is the same as a Special Flood Hazard Area (SFHA) or a 100-year floodplain. These areas may be unnumbered as AE, AH, or AO Zones. Numbered A-Zones indicates an area's risk to flooding.
<b>Acquisition</b>	Local governments can acquire lands in high hazard areas through conservation easements, purchase of development rights, or outright purchase of property.
<b>Alluvial Fan</b>	Area of deposition where steep mountain drainages empty into valley floors. Flooding in these areas often have characteristics that differ from those in riverine or coastal areas. (See Alluvial Fan Flooding)
<b>Alluvial Fan Flooding</b>	Flooding that occurs on the surface of an alluvial fan (or similar landform) that originates at the apex of the fan and is characterized by high-velocity flows; active processes of erosion, sediment transport, and deposition; and unpredictable flow paths.
<b>Anabatic Wind</b>	Any wind blowing <i>up</i> an incline; the opposite to katabatic wind.
<b>Asset</b>	Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.
<b>Aufeis</b>	When new ice continues to form on top of older ice. Ice-forming situations occur wherever there are continuous sources of water and freezing temperatures.
<b>Avalanche</b>	Mass of snow and ice falling suddenly down a mountain slope and often taking with it earth, rocks, trees, and rubble of every description.
<b>Base Flood</b>	A term used in the National Flood Insurance Program to indicate the minimum size of a flood. This information is used by a community as a basis for its floodplain management regulations. It is the level of a flood which has a one-percent chance of occurring in any given year. Also known as a 100-year flood elevation or one-percent chance flood.
<b>Base Flood Elevation (BFE)</b>	The elevation for which there is a one-percent chance in any given year that flood water levels will equal or exceed it. The BFE is determined by statistical analysis for each local area and designated on the Flood Insurance Rate Maps. It is also known as 100-year flood elevation.
<b>Base Floodplain</b>	The area that has a one percent chance of flooding (being inundated by flood waters) in any given year.





## APPENDIX C

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<b>Borough</b>	The basic unit of local government in Alaska.
<b>Building</b>	A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.
<b>Building Code</b>	The regulations adopted by a local governing body setting forth standards for the construction, addition, modification, and repair of buildings and other structures for the purpose of protecting the health, safety, and general welfare of the public.
<b>Caldera</b>	A caldera is a large, usually circular depression at the summit of a volcano formed when magma is withdrawn or erupted from a shallow underground magma reservoir.
<b>Chinook</b>	A warm down-slope wind.
<b>Community</b>	Any state, area or political subdivision thereof, or any Indian tribe or tribal entity that has the authority to adopt and enforce statutes for areas within its jurisdiction.
<b>Community Rating System (CRS)</b>	The Community Rating System is a voluntary program that each municipality or county government can choose to participate in. The activities that are undertaken through CRS are awarded points. A community's points can earn people in their community a discount on their flood insurance premiums.
<b>Critical Facility</b>	Facilities that are critical to the health and welfare of the population and that are especially important during and after a hazard event. Critical facilities include, but are not limited to, shelters, hospitals, and fire stations.
<b>Dam</b>	A structure built across a waterway to impound water.
<b>Designated Floodway</b>	The channel of a stream and that portion of the adjoining floodplain designated by a regulatory agency to be kept free of further development to provide for unobstructed passage of flood flows.
<b>Development</b>	Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or of equipment or materials.
<b>Digitize</b>	To convert electronically points, lines, and area boundaries shown on maps into x, y coordinates (e.g., latitude and longitude, universal transverse mercator (UTM), or table coordinates) for use in computer applications.
<b>Disaster Mitigation Act</b>	DMA 2000 (public Law 106-390) is the latest legislation of 2000 (DMA 2000) to improve the planning process. It was signed into law on October 10, 2000. This new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.
<b>Earthquake</b>	A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the earth's tectonic plates.
<b>Earthquake Swarm</b>	A collection of earthquakes that is frequent in time. There is no identifiable main shock.



## APPENDIX C

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<b>Elevation</b>	The raising of a structure to place it above flood waters on an extended support structure.
<b>Emergency Operations Plan</b>	A document that: describes how people and property will be protected in disaster and disaster threat situations; details who is responsible for carrying out specific actions; identifies the personnel, equipment, facilities, supplies, and other resources available for use in the disaster; and outlines how all actions will be coordinated.
<b>Erosion</b>	The wearing away of the land surface by running water, wind, ice, or other geological agents.
<b>Federal Disaster Declaration</b>	The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended. Same meaning as a Presidential Disaster Declaration
<b>Federal Emergency Management Agency (FEMA)</b>	A federal agency created in 1979 to provide a single point of accountability for all federal activities related to hazard mitigation, preparedness, response, and recovery.
<b>Flash Flood</b>	A flood event occurring with little or no warning where water levels rise at an extremely fast rate. It is often the result of heavy rainfall in a localized area.
<b>Flood</b>	A general and temporary condition of partial or complete inundation of water over normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.
<b>Flood Control</b>	Keeping floodwaters away from specific developed or populated areas by the construction of flood storage reservoirs, channel alterations, dikes and levees, bypass channels, or other engineered structures.
<b>Flood Disaster Assistance</b>	Flood disaster assistance includes development of comprehensive preparedness and recovery plans, program capabilities, and organization of Federal agencies and of State and local governments to mitigate the adverse effects of disastrous floods. It may include maximum hazard reduction, avoidance, and mitigation measures, as well policies, procedures, and eligibility criteria for Federal grant or loan assistance to State and local governments, private organizations, or individuals as the result of the major disaster.
<b>Flood Elevation</b>	Elevation of the water surface above an establish datum (reference mark), e.g., National Geodetic Vertical Datum of 1929, North American Datum of 1988, or Mean Sea Level.
<b>Flood Frequencies</b>	Frequencies are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. The frequency is the chance of a flood occurring during a given timeframe. It is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1% chance and the 10-year flood has a 10% chance of occurring in any given year.



## APPENDIX C

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<b>Flood Fringe</b>	That portion of the floodplain that lies beyond the floodway and serves as a temporary storage area for floodwaters during a flood. This section receives waters that are shallower and of lower velocities than those of the floodway.
<b>Flood Hazard</b>	Flood Hazard is the potential for inundation and involves the risk of life, health, property, and natural value. Two reference base are commonly used: (1) For most situations, the Base Flood is that flood which has a one-percent chance of being exceeded in any given year (also known as the 100-year flood); (2) for critical actions, an activity for which a one-percent chance of flooding would be too great, at a minimum the base flood is that flood which has a 0.2 percent chance of being exceeded in any given year (also known as the 500-year flood).
<b>Flood Hazard Boundary Map</b>	Flood Hazard Boundary Map (FHBM) means an Official (FHBM) map of a community, issued by the Administrator, where the boundaries of the flood, mudslides (i.e., mudflow) related erosion areas having special hazards have been designated as Zones A, M, and/or E.
<b>Flood Insurance Rate Map</b>	Flood Insurance Rate Map (FIRM) means an official map of a community, on which the Administrator has delineated both the special hazard areas and the risk premium zones applicable to the community.
<b>Flood Insurance Study</b>	Flood Insurance Study or Flood Elevation Study means an examination, evaluation and determination of flood hazards and, if appropriate, corresponding water surface elevations, or an examination, evaluations and determination of mudslide (i.e., mudflow) and/or flood-related erosion hazards.
<b>Floodplain</b>	A "floodplain" is the lowland adjacent to a river, lake or ocean. Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood. The 100-year floodplain by the 100-year flood.
<b>Floodplain Management</b>	The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.
<b>Floodplain Management Regulations</b>	Floodplain Management Regulations means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as floodplain ordinance, grading ordinance and erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.
<b>Flood Proofing</b>	Any combination of structural and nonstructural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved property, water and sanitary facilities, structures and their contents
<b>Floodway</b>	Floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.



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<b>Flood Zones</b>	Zones on the Flood Insurance Rate Map (FIRM) in which a Flood Insurance Study has established the risk premium insurance rates.
<b>Flood Zone Symbol</b>	<p><b>A</b> - Area of special flood hazard without water surface elevations determined.</p> <p><b>A1-30, AE</b> - Area of special flood hazard with water surface elevations determined.</p> <p><b>AO</b> - Area of special flood hazard having shallow water depths and/or unpredictable flow paths between one and three feet.</p> <p><b>A-99</b> - Area of special flood hazard where enough progress has been made on a protective system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes.</p> <p><b>AH</b> - Area of special flood hazard having shallow water depths and/or unpredictable flow paths between one and three feet and with water surface elevations determined.</p> <p><b>B, X</b> - Area of moderate flood hazard.</p> <p><b>C, X</b> - Area of minimal hazard.</p> <p><b>D</b> - Area of undetermined but possible flood hazard.</p>
<b>Freeboard</b>	Freeboard means a factor of safety usually expressed in feet above a flood level for purposes of floodplain management. Freeboard tends to compensate for many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed.
<b>Fumarole</b>	Fumaroles are vents from which volcanic gas escapes into the atmosphere. Fumaroles may occur along tiny cracks or long fissures, in chaotic clusters or fields, and on the surfaces of lava flows and thick deposits of pyroclastic flows. They may persist for decades or centuries if they are above a persistent heat source or disappear within weeks to months if they occur atop a fresh volcanic deposit that quickly cools.
<b>Geographic Information System</b>	A computer software application that relates physical features of the earth to a database that can be used for mapping and analysis.
<b>Governing Body</b>	The legislative body of a municipality that is the assembly of a borough or the council of a city.
<b>Hazard</b>	A source of potential danger or adverse condition. Hazards in the context of this plan will include naturally occurring events such as floods, earthquakes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.
<b>Hazard Event</b>	A specific occurrence of a particular type of hazard.
<b>Hazard Identification</b>	The process of identifying hazards that threaten an area.
<b>Hazard Mitigation</b>	Any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. (44 CFR Subpart M 206.401)





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<b>Hazard Mitigation Grant Program</b>	The program authorized under section 404 of the Stafford Act, which may provide funding for mitigation measures identified through the evaluation of natural hazards conducted under §322 of the Disaster Mitigation Act 2000.
<b>Hazard Profile</b>	A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.
<b>Hazard and Vulnerability Analysis</b>	The identification and evaluation of all the hazards that potentially threaten a jurisdiction and analyzing them in the context of the jurisdiction to determine the degree of threat that is posed by each.
<b>Hydrology</b>	The science of the behavior of water in the atmosphere, on the earth's surface, and underground.
<b>Infrastructure</b>	The public services of a community that have a direct impact to the quality of life. Infrastructure refers to communication technology such as phone lines or Internet access, vital services such as public water supply and sewer treatment facilities, and includes an area's transportation system, regional dams or bridges, etc.
<b>Intensity</b>	A measure of the effects of a hazard event at a particular place.
<b>Interferometer</b>	A method employing the interference of electromagnetic radiation to make highly precise measurements of the angle between the two rays of light.
<b>Inundation</b>	The maximum horizontal distance covered by floodwater, a seiche or a tsunami.
<b>Jökulhlaup</b>	A sudden flood-like release of water from a glacier-dammed lake (Glacier outburst flooding).
<b>Katabatic wind</b>	Any wind blowing down an incline; the opposite to anabatic wind.
<b>Knot</b>	A unit of measurement equaling 1 nautical mile per hour. This is roughly 1.15 statute miles per hour or 1.852 kilometers per hour.
<b>Lahar</b>	Lahar is an Indonesian word for a rapidly flowing mixture of rock debris and water that originates on the slopes of a volcano. Lahars are also referred to as volcanic mudflows or debris flows. They form in a variety of ways, chiefly by the rapid melting of snow and ice by pyroclastic flows, intense rainfall on loose volcanic rock deposits, breakout of a lake dammed by volcanic deposits, and as a consequence of debris avalanches.
<b>Landslide</b>	Downward movement of a slope, soil, and other materials or debris under the force of gravity.
<b>Lava dome</b>	Lava domes are rounded, steep-sided mounds built by very viscous magma. Such magmas are typically too viscous (resistant to flow) to move far from the vent before cooling and crystallizing. Domes may consist of one or more individual lava flows.



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<b>Liquefaction</b>	The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like a thick or viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.
<b>Littoral</b>	Of or pertaining to the shore, especially of the sea.
<b>Local Emergency Planning Committee (LEPC)</b>	LEPCs consist of community representatives and are appointed by the State Emergency Response Commissions (SERCs), as required by Superfund Amendments and Reauthorization Act (SARA), Title III. They develop an emergency plan to prepare for and respond to a chemical emergency. They are also responsible for coordinating with local facilities to find out what they are doing to reduce hazards, prepare for accidents, and reduce hazardous inventories and releases. The LEPC serves as a focal point in the community for information and discussion about hazardous substances, emergency planning, and health and environmental risks.
<b>Local Government</b>	Any county, borough, municipality, city, township, public authority, school district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency, or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity, for which an application for assistance is made by a State or political subdivision of a State.
<b>Magma</b>	Molten rock originating from the Earth's interior.
<b>Magnitude</b>	A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.
<b>Mitigate</b>	To cause something to become less harsh or hostile, to make less severe or painful
<b>Mitigation Plan</b>	A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the State and includes a description of actions to minimize future vulnerability to hazards.
<b>Municipality</b>	A political subdivision incorporated under the laws of the State that is a home rule or general law city, a home rule or general law borough, or a unified municipality.
<b>National Flood Insurance</b>	The Federal program, created by an act of Congress in Program (NFIP) 1968 that makes flood insurance available in communities that enact satisfactory floodplain management regulations.
<b>National Weather Service</b>	Prepares and issues flood, severe weather, and coastal (NWS) storm warnings and can provide technical assistance to federal and State entities in preparing weather and flood warning plans.
<b>Natural Disaster</b>	Any natural catastrophe, including hurricane, tornado, storm, high water, wind, driven water, tsunami, earthquake, volcanic eruption, landslide, snowstorm, fire, or drought. (44 CFR Subpart M 206.401)



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<b>New Construction</b>	New construction means structures for which the “start of construction” on or after the effective date of a floodplain management regulation adopted by a community and includes any subsequent improvement to such structures.
<b>Nonstructural Floodplain</b>	Those measures, such as flood proofing, employed to Management Measures to modify the exposure of buildings to floods and use planning, warning, schemes, and insurance as opposed to structural measures (such as dams, levees, and channel modifications).
<b>One Hundred (100)-Year</b>	The flood elevation that has a one-percent chance of occurring in any given year. It is also known as the Base Flood.
<b>Orthophoto</b>	An aerial photo that has been corrected to eliminate the effects of camera tilt and relief displacement. The ground geometry is recreated as it would appear from directly above each and every point.
<b>Overlay Zone</b>	Overlay zones (overlay districts) create a framework for conservation or development of special geographical areas. In a special resource overlay district, overlay provisions typically impose greater restrictions on the development of land, but only regarding those parcels whose development, as permitted under the zoning, may threaten the viability of the natural resource. In a development area overlay district, the provisions may impose restrictions as well, but also may provide zoning incentives and waivers to encourage certain types and styles of development. Overlay zone provisions are often complemented by the adoption of other innovative zoning techniques, such as floating zones, special permits, incentive zoning, cluster development and special site plan or subdivision regulations, to name a few.
<b>Period</b>	The length of time between two successive peaks or troughs of a wave. The Period may vary due to complex interferences of waves. Tsunami wave periods generally range from 5 to 60 minutes apart.
<b>Permeability</b>	The property of soil or rock that allows water to pass through it.
<b>Planning</b>	The act or process of making or carrying out plans; the establishment of goals, policies, and procedures for a social or economic unit.
<b>Preparedness</b>	The steps taken to decide what to do if essential services break down, developing a plan for contingencies, and practicing the plan. Preparedness ensures that people are ready for a disaster and will respond to it effectively. Actions that strengthen the capabilities of government, citizens, and communities to respond to disasters.
<b>Presidential Disaster Declaration</b>	The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended.
<b>Probability</b>	A statistical measure of the likelihood that a hazard event will occur.
<b>Pyroclastic</b>	Pertaining to fragmented rock material formed by a volcanic explosion or ejection from a volcanic vent.
<b>Pyroclastic Flow</b>	Lateral flow of a turbulent mixture of hot gases and unsorted pyroclastic material (volcanic fragments, ash, etc.) that can move at high speeds.



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<b>Recovery</b>	The actions taken by an individual or community after a catastrophic event to restore order and lifelines in a community.
<b>Regulatory Floodplain</b>	That portion of the floodplain subject to floodplain regulations (usually the floodplain inundated by one-percent chance flood).
<b>Regulatory Floodway</b>	Regulatory Floodway means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.
<b>Regulatory Power</b>	Local jurisdictions have the authority to regulate certain activities in their jurisdiction. With respect to mitigation planning, the focus is on such things as regulating land use, development, and construction through zoning, subdivision regulations, design standards, and floodplain regulations.
<b>Relocation</b>	The moving of a structure from a flood area to a new location, normally to one where there is no threat of flooding.
<b>Repetitive Loss Property</b>	A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least \$1000 each have been paid within any 10-year period since 1978.
<b>Response</b>	Those activities and programs designed to address the immediate and short-term effects of the onset of an emergency or disaster.
<b>Retrofit</b>	The strengthening of structures to reduce or eliminate (mitigate) future disaster risks.
<b>Richer Scale</b>	A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.
<b>Rift Zone</b>	A rift zone is an elongated system of crustal fractures associated with an area that has undergone extension (the ground has spread apart).
<b>Risk</b>	The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It can also be expressed in terms of potential monetary losses associated with the intensity of the hazard.
<b>Riverine</b>	Relating to, formed by, or resembling rivers (including tributaries), streams, creeks, brooks, etc.
<b>Riverine Flooding</b>	Flooding related to or caused by a river, stream, or tributary overflowing its banks due to excessive rainfall, snowmelt or ice.
<b>Runoff</b>	That portion of precipitation that is not intercepted by vegetation, absorbed by land surface, or evaporated, and thus flows overland into a depression, stream, lake, or ocean (runoff, called immediate subsurface runoff, also takes place in the upper layers of soil).





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<b>Run-up</b>	The maximum vertical height of a tsunami in relation to sea level.
<b>Scale</b>	A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.
<b>Seiche</b>	An oscillating wave (also referred to as a seismic sea wave) in a partially or fully enclosed body of water. May be initiated by landslides, undersea landslides, long period seismic waves, wind and water waves, or a tsunami.
<b>Seismicity</b>	Describes the likelihood of an area being subject to earthquakes.
<b>Special Flood Hazard</b>	An area within a floodplain having a 1 percent or greater Area (SFHA) chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designation that include the latter A or V.
<b>Special Hazard Area</b>	Special Hazard Area means an area having special flood, mudslide (i.e., mudflow) and/or flood-related erosion hazards, as shown on a FHBM or FIRM as Zone A, AOA, A1-30, AE, A99, AH, VO, V1-30, VE, V, M, or E.
<b>Stafford Act</b>	1) The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended. 2) The Stafford Act provides an orderly and continuing means of assistance by the Federal Government to State, local and tribal governments in carrying out their responsibilities to alleviate the suffering and damage which result from disaster.
<b>Stakeholder</b>	Individual or group that will be affected in any way by an action or policy. They include businesses, private organizations, and citizens.
<b>Standard Project Flood</b>	A term used by the U.S. Army Corps of Engineers to designate a flood that may be expected from the most severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. The peak flow for a standard project flood is generally 40 to 60 percent of the probable maximum flood for the same location.
<b>State Coordinating Agency</b>	State Coordinating Agency means the agency of the State government, or other office designated by the Governor of the State or by State Statute at the request of the Administrator to assist in the implementation of the National Flood Insurance Program in that State.



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### **State Disaster Declaration**

A disaster emergency shall be declared by executive order or proclamation of the Governor upon finding that a disaster has occurred or that the occurrence or the threat of a disaster is imminent. The state of disaster emergency shall continue until the governor finds that the threat or danger has passed or that the disaster has been dealt with to the extent that emergency conditions no longer exist and terminates the state of disaster emergency by executive order or proclamation.

Along with other provisions, this declaration allows the governor to utilize all available resources of the State as reasonably necessary, direct and compel the evacuation of all or part of the population from any stricken or threatened area if necessary, prescribe routes, modes of transportation and destinations in connection with evacuation and control ingress and egress to and from disaster areas.

It is required before a Presidential Disaster Declaration can be requested.

### **State Hazard Mitigation Officer (SHMO)**

The SHMO is the representative of State government who is the primary point of contact with FEMA, other State and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.

### **Stile**

A set of stairs to allow access over an obstruction, such as a floodwall.

### **Storm Surge**

Rise in the water surface above normal water level on open coast due to the action of wind stress and atmospheric pressure on the water surface.

### **Stream**

A body of water flowing in a natural surface channel. Flow may be continuous or only during wet periods. Streams that flow only during wet periods are termed "intermittent streams."

### **Structure**

Something constructed. (see also Building)

### **Structural Floodplain**

Those physical or engineering measures employed to modify the way floods behave; examples included dams, dikes, levees, channel enlargements, and diversions.

### **Structural Mat Slab**

The concrete slab of a building that includes structural reinforcement to help support the building's structure.

### **Structure**

A walled and roofed building, including a gas or liquid storage tank, that is principally above ground and mounted to a permanent site, as well as a manufactured home.

### **Subdivision Regulations**

Ordinances or regulations governing the subdivision of land with respect to things such as adequacy and suitability of building sites and utilities and public facilities.

### **Subsidence**

Sinking of the land surface, usually due to withdrawals of underground water, oil, or minerals.

### **Subsidized Rates**

Subsidized rates mean the rules established by the Administrator involving in the aggregate subsidization by the Federal Government.



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<b>Substantial Damage</b>	Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceeds 50 percent of the market value of the structure before the damage.
<b>Substantial Improvement</b>	Substantial improvement means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures, which have incurred "substantial damage," regardless of the actual repair work performed. The term does not, however, include either: (1) Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions or (2) Any alteration of a "historic structure," provided that the alteration will not preclude the structure's continued designation as a "historic structure."
<b>Tectonic Plate</b>	Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.
<b>Tephra</b>	Tephra is a general term for fragments of volcanic rock and lava regardless of size that are blasted into the air by explosions or carried upward by hot gases in eruption columns or lava fountains. Tephra includes large dense blocks and bombs, and small light rock debris.
<b>Topography</b>	The contour of the land surface. The technique of graphically representing the exact physical features of a place or region on a map.
<b>Tribal Government</b>	A Federally recognized governing body of an Indian or Alaska Native Tribe, band, nation, pueblo, village or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Tribe List Act of 1994, 25 U.S.C. 479a. This does not include Alaska Native corporations, the ownership of which is vested in private individuals.
<b>Tsunami</b>	A sea wave produced by submarine earth movement or volcanic eruption with a sudden rise or fall of a section of the earth's crust under or near the ocean. A seismic disturbance or land slide can displace the water column, creating a rise or fall in the level of the ocean above. This rise or fall in sea level is the initial formation of a tsunami wave.
<b>Variance</b>	Variance means a grant of relief by a community from the terms of a floodplain management regulation.
<b>Vent</b>	Vents are openings in the Earth's crust from which molten rock and volcanic gases escape onto the ground or into the atmosphere. Vents may consist of a single circular-shaped structure, a large elongated fissure and fracture, or a tiny ground crack.



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<b>Venting</b>	A system designed to allow floodwaters to enter an enclosure, usually the interior of foundation walls, so that the rising water does not create a dangerous differential in hydrostatic pressure. This is usually achieved through small openings in the wall, such as a missing or rotated brick or concrete block or small pipe.
<b>Vulnerability</b>	Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. The vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electrical substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Other, indirect effects can be much more widespread and damaging than direct ones.
<b>Vulnerability Assessment</b>	The extent of injury and damage that may result from hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.
<b>Watercourse</b>	A natural or artificial channel in which a flow of water occurs either continually or intermittently.
<b>Watershed</b>	An area that drains to a single point. In a natural basin, this is the area contributing flow to a given place or stream.
<b>Water Surface Elevation</b>	Water surface elevation means the height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929, (or other datum, where specified) of floods of various magnitudes and frequencies in the floodplains of coastal riverine areas.
<b>Water Table</b>	The uppermost zone of water saturation in the ground.
<b>Wetlands</b>	Areas that are inundated or saturated frequently and for long enough to support vegetative or aquatic life requiring saturated or seasonally saturated soil conditions for growth and reproduction.
<b>Wildfire</b>	An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.
<b>Zoning Ordinance</b>	An ordinance under the State or local government's police powers that divides an area into districts and, within each district, regulates the use of land and buildings, height, and bulk of buildings or other structures, and the density of population.





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# LIST OF ACRONYMS

ACMP	Alaska Coastal Management Program
ADF&G	Alaska Department of Fish and Game
ADHS&EM	Alaska Division of Homeland Security & Emergency Management
ADLWD	Alaska Department of Labor and Workforce Development
ADOI	Alaska Division of Insurance
AEIC	Alaska Earthquake Information Center
AEMS	Alaska Emergency Management System
AFS	Alaska Fire Service
AGDC	Alaska Geospatial Data Committee
AHFC	Alaska Housing Finance Corporation
AHS	Alaska Hydrologic Survey
ARRC	Alaska Railroad Corporation
ALCOM	Alaskan Command
ANILCA	Alaska National Interest Lands Conservation Act
AOR	Area of Responsibility
AMSC	Alaska Mountain Safety Center
ANSS	Advanced National Seismic System
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
ARNG	Army National Guard
ARRL	American Radio Relay League
AS	Alaska Statute
AST	Alaska State Troopers
ATV	All Terrain Vehicle
AVO	Alaska Volcano Observatory
AWCG	Alaska Wildfire Coordinating Group
BLM	Bureau of Land Management
CAP	Community Assistance Program
CAP	Civil Air Patrol
CDBG	Community Development Block Grant
CIAP	Coastal Impact Assistance Program
CRS	Community Rating System
CTOC	Communications Technology, Operations & Coordination
DART	Deep-ocean Assessment and Reporting of Tsunamis
DAS	Department of Administration
DC	Department of Corrections
DCA	Department of Community Advocacy
DCBD	Alaska Division of Community & Business Development
DCED	Alaska Department of Community & Economic Development



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DEC	Alaska Department of Environmental Conservation
DEED	Alaska Department of Education & Early Development
DGGS	Alaska Division of Geologic & Geophysical Surveys
DHSS	Department of Health & Social Services
DLAW	Alaska Department of Law
DMVA	Alaska Department of Military & Veterans Affairs
DNR	Alaska Department of Natural Resources
DOA	Department of Agriculture (U.S.)
DOD	Department of Defense (U.S.)
DOF	Alaska Division of Forestry
DOI	Department of the Interior (U.S.)
DOJ	Department of Justice (U.S.)
DOT&PF	Alaska Department of Transportation & Public Facilities
DPC	Alaska Governor's Disaster Policy Cabinet
DPS	Alaska Department of Public Safety
EAS	Emergency Alert System
EMPG	Emergency Management Program Grant
EOC	Emergency Operation Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geospatial Data Clearinghouse
FMA	Flood Mitigation Assistance Program
GIS	Geographic Information System
GOES	Geostationary Operational Environmental Satellite
HMGP	Hazard Mitigation Grant Program
HUD	U.S. Department of Housing and Urban Development
HVA	Hazard and Vulnerability Analysis
IHCA	Interagency Hydrology Committee for Alaska
KPB	Kenai Peninsula Borough
LEPC	Local Emergency Planning Committee
MSB	Matanuska-Susitna Borough
NAWAS	National Warning System
NFIP	National Flood Insurance Program



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NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NOS	National Ocean Service
NPS	National Park Service
NWS	National Weather Service
OHMP	Alaska Office of Habitat Management and Permitting (State of
OPMP	Office of Project Management and Permitting
PMEL	Pacific Marine Environmental Laboratory
SBA	Small Business Administration
SBCFSA	Seward/Bear Creek Flood Service Area
SEAAC	South-east Alaska Avalanche Center
SECC	State Emergency Coordination Center
SERC	State Emergency Response Commission
SHMO	State Hazard Mitigation Officer
SRC	Senate Concurrent Resolution
TIME	Tsunami Inundation Mapping Effort
UAF	University of Alaska Fairbanks
UAF/GI	University of Alaska Fairbanks Geological Institute
USACOE	United States Army Corps of Engineers
USAF	United States Air Force
USCG	United States Coast Guard
USFA	United States Fire Administration
USFS	United States Forest Service
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
WC&ATWC	West Coast/Alaska Tsunami Warning Center
WMD	Weapons of Mass Destruction
WP	Warning Point





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# APPENDIX E

## 1. Hazard Analysis Method

The following method provides a quantitative aid to compare relative hazard risks<sup>1</sup>. It does not predict the occurrence of a particular hazard, rather it provides hazard “score” useful for examining multiple hazards borough-wide.

Steps:

1. Multiply the “severity rating” by the “factor weight”. This provides a subscore for each factor (history, vulnerability, maximum threat and probability).
2. Total subscores for each factor. This provides a total score for that hazard.
3. Compare total scores for all hazards to prioritize mitigation actions among hazards

### History (factor weight = 2)

The record of occurrences of previous disasters or events.

#### Severity Rating

Low	0-1 event per 100 years	1 point
Moderate	2-3 events per 100 years	5 points
High	4 + events per 100 years	10 points

### Vulnerability (factor weight = 5)

The percentage of population and property that is at obvious risk to each hazard.

#### Severity Rating

Low	<1 % affected	1 point
Moderate	1-10 % affected	5 points
High	>10 % affected	10 points

### Maximum Threat (factor weight = 10)

The maximum percentage of population and property that could be impacted by a particular hazard.

#### Severity Rating

Low	<5 % affected	1 point
Moderate	5-25 % affected	5 points
High	>25 % affected	10 points

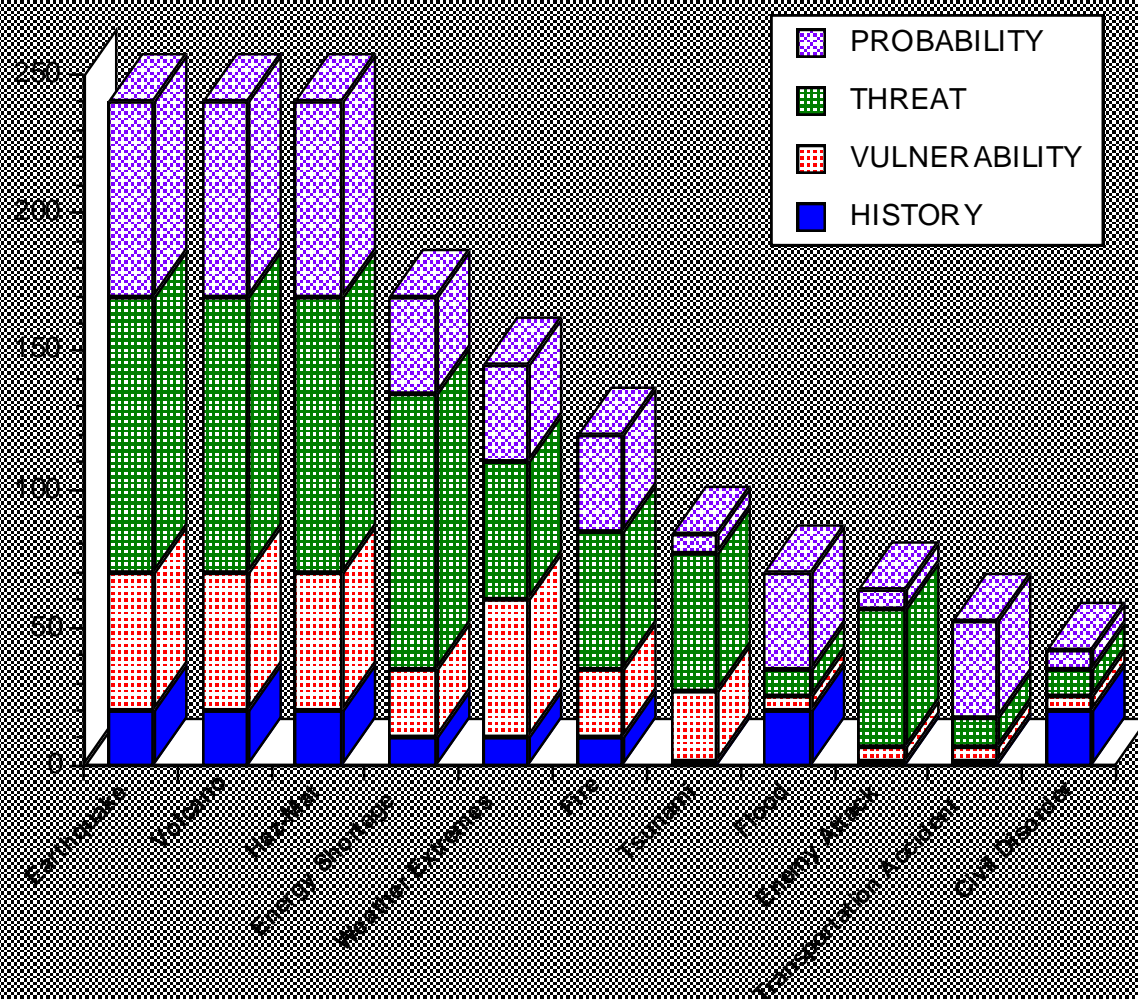
### Probability (factor weight = 7)

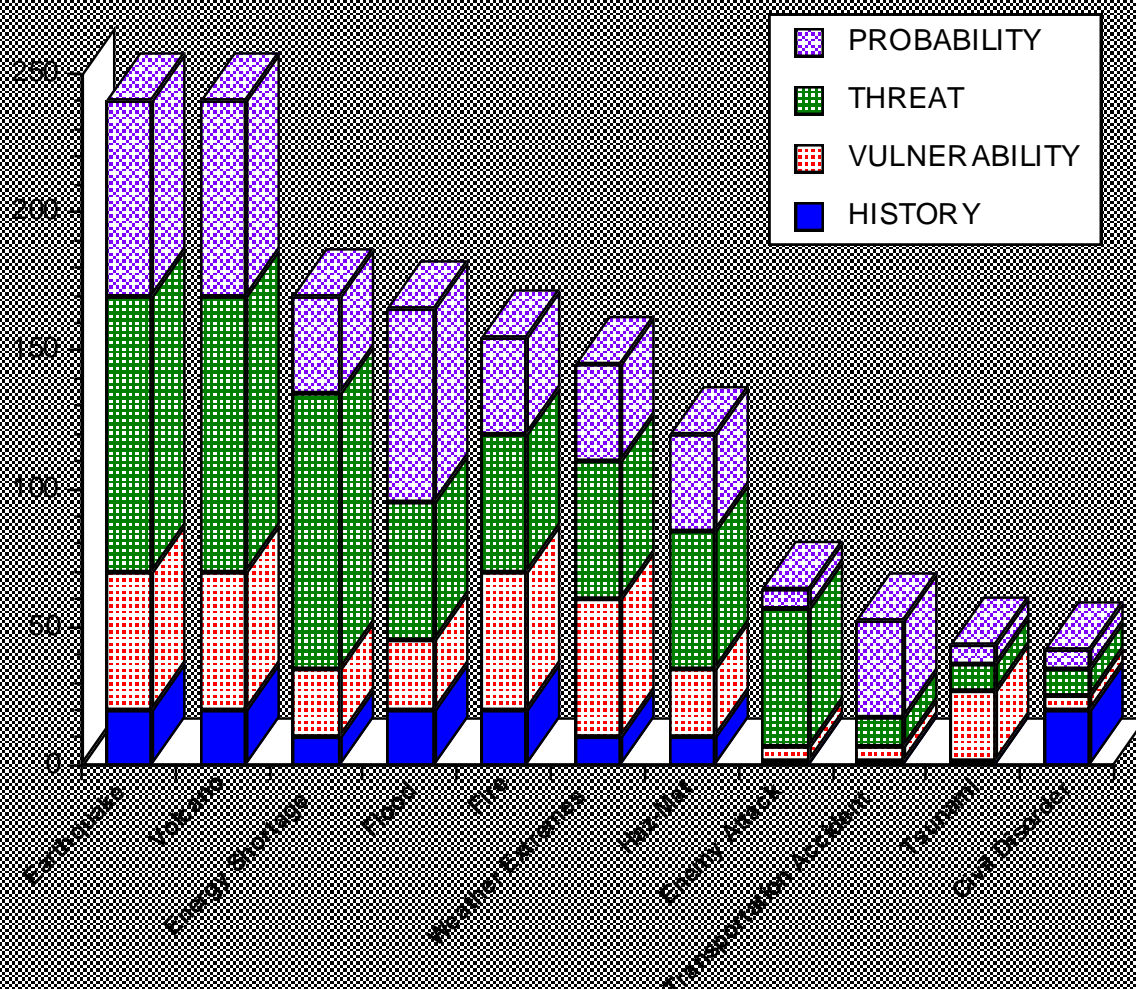
The number of occurrences of each hazard in the past 100 years and the factors that have contributed to increase or decrease risk for the area involved.

#### Severity Rating

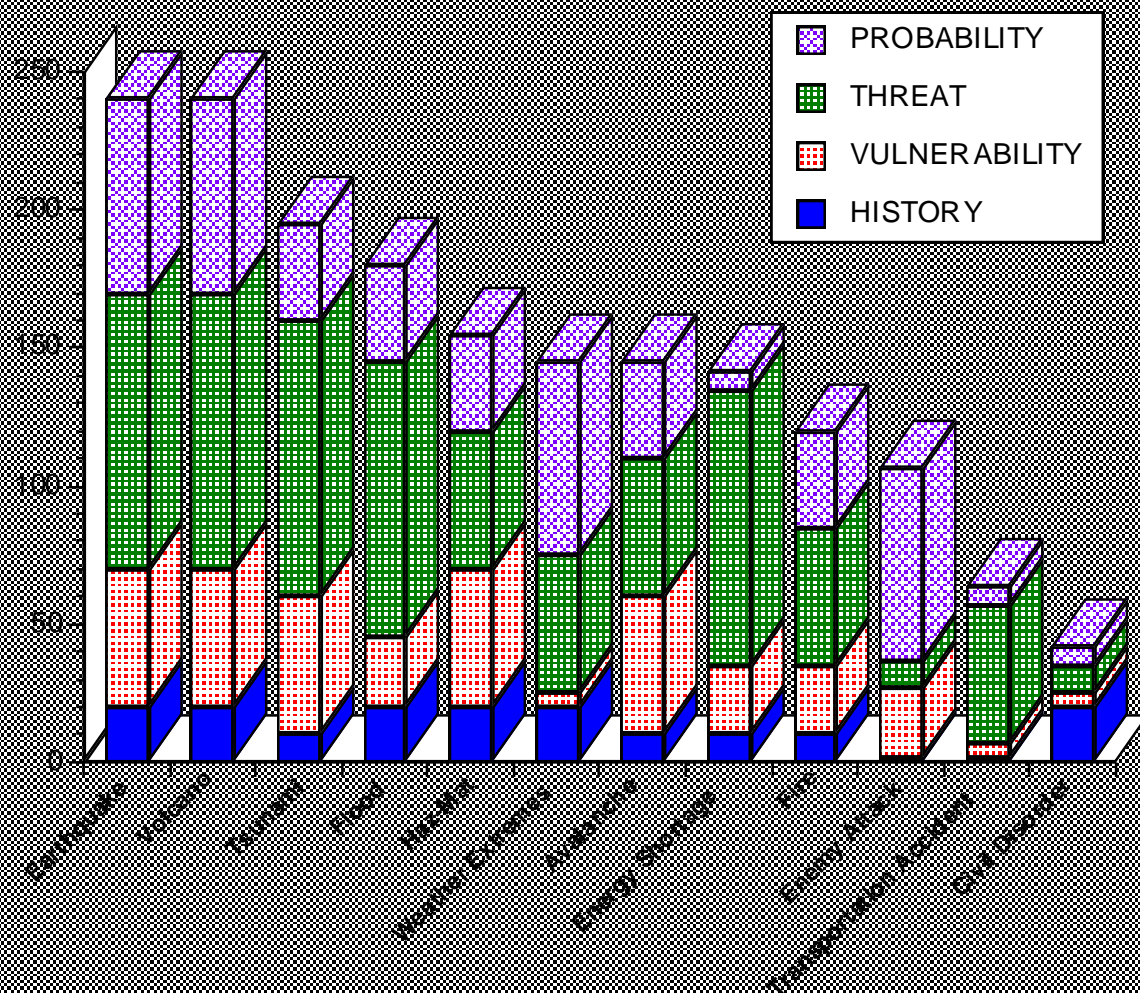
Low	>1 event per 100 years	1 point
Moderate	>1 event per 50 years	5 points
High	>1 event per 10 years	10 points

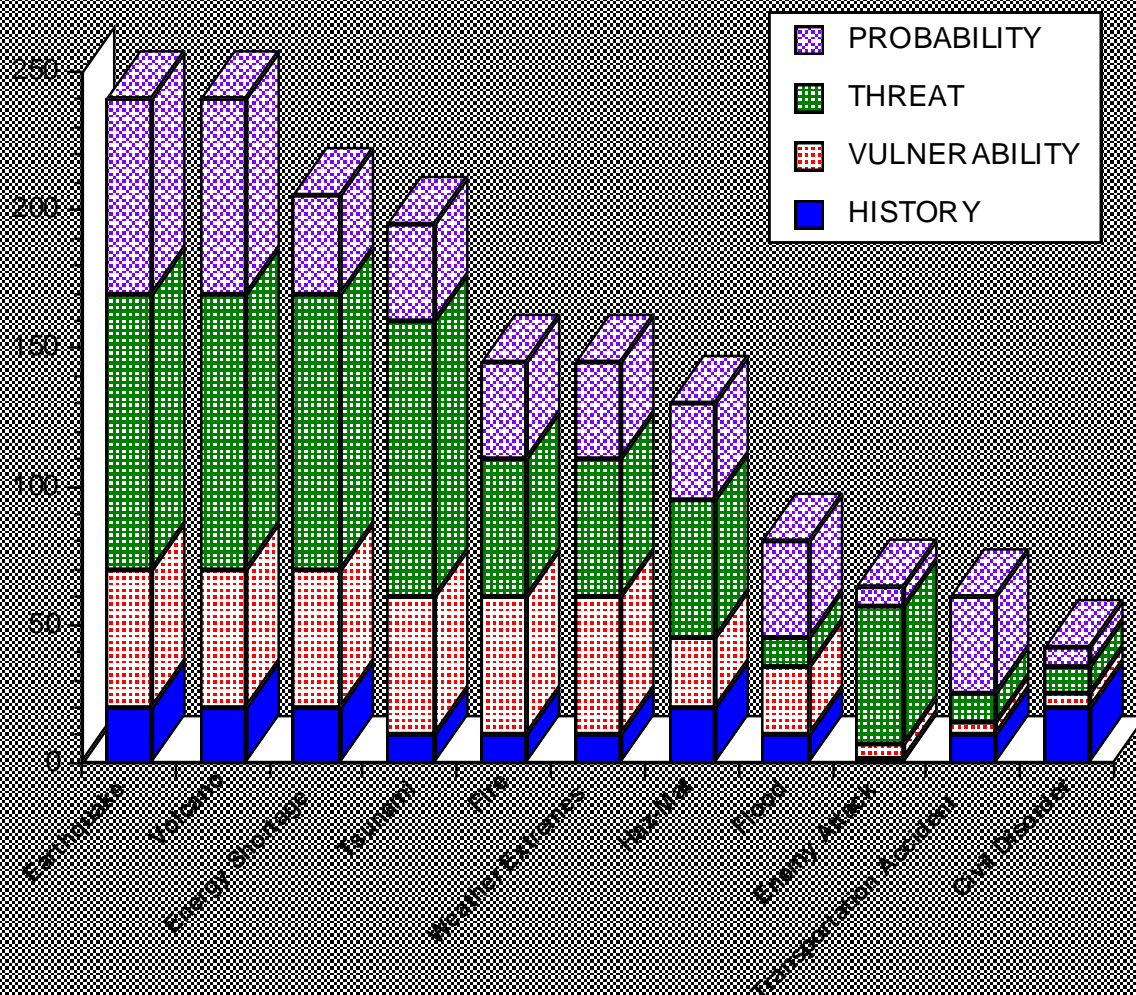
<sup>1</sup> Both the methods and calculations are from the Kenai Peninsula Borough, Office of Emergency Management – *Emergency Response Plan* (OEM 2004).













## APPENDIX E

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## APPENDIX F

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# SNOW AND SKILAK GLACIER-DAMMED LAKE INFORMATION

## Skilak Glacier-Dammed Lake Dump History

Lake is located at 60 11' N 149 58' W, along the margin of a lobe of the Harding Ice Field, east of the lobe labeled "Skilak Glacier". The water drains subglacially into Skilak River.

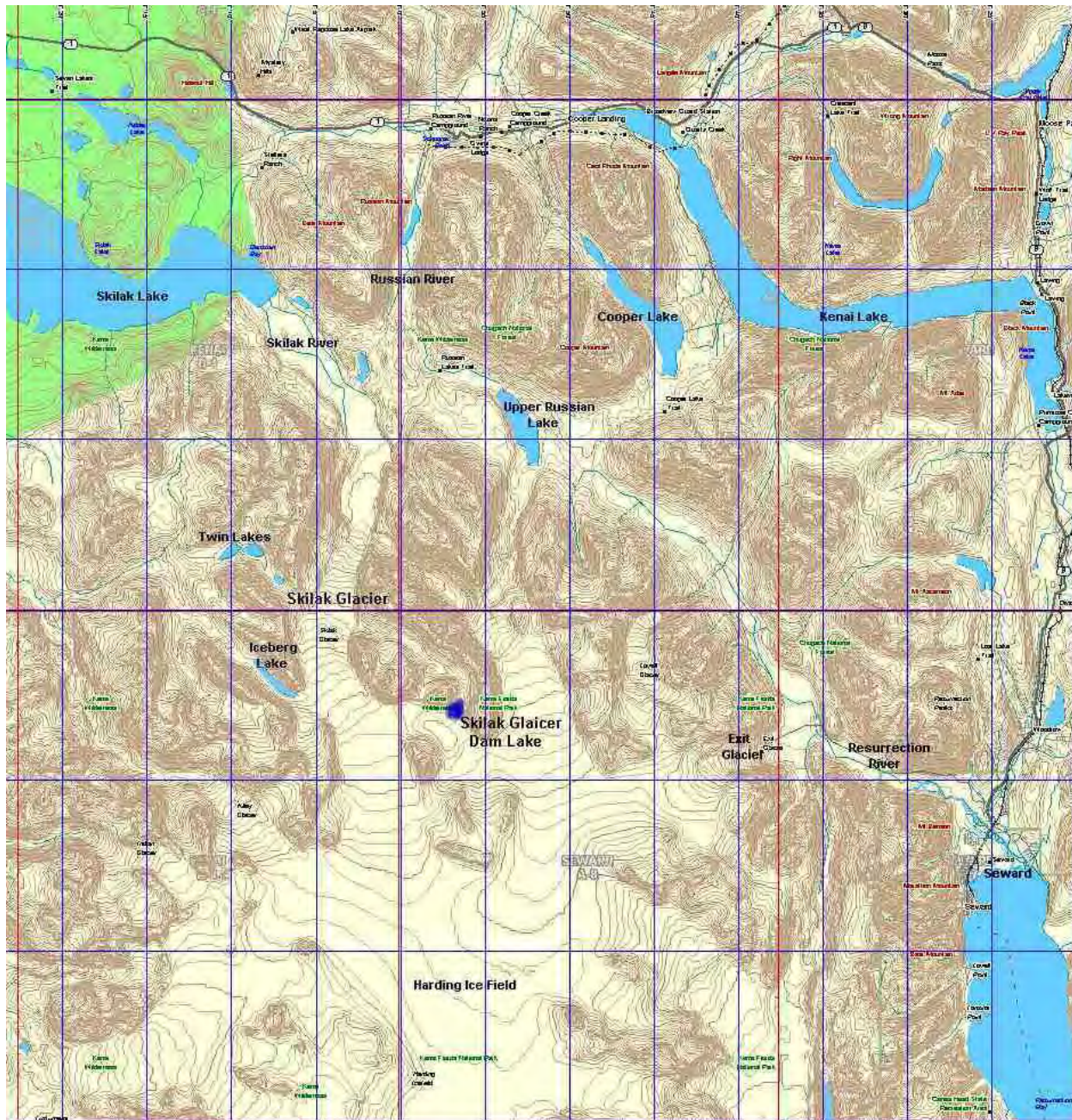
### Dump History (based on available information):

- Jan. 1969 - Occurred when the Kenai River had an ice cover; caused ice jam flooding downriver from Skilak Lake. The river stage at Soldotna was the highest ever recorded 22.62 ft, 1/18/69.
- Sep. 1971 - Inferred from a series of photos taken at the site from 7/21/71 to 9/10/71.
- Aug. 1974 - Possible partial release; possibly along margin of glacier to the southeast of the lake.
- Sep. 1977 - Observed in the process of dumping.
- between 10/18/79 and 7/17/80 - Based on overflights on those two dates.
- Nov. 1985 - Based on rise at Keys and Soldotna, but not Cooper Landing.
- Nov. 1990 - We think. It occurred coincident to a dump of the Snow River glacier-dammed lake.
- Jan. 1994 - Observed at Keys; CAP overflight to verify.
- Oct. 1995 - Observed at Keys; verified by RFC overflight.
- Oct. 1997 - Began on or about the 16th; observed at Keys.
- Nov. 1999 - Began on or about Oct 29th; observed at Keys and Soldotna.
- Nov. 2002 - Release estimated to have begun on or before November 23.
- Oct. 2004 - Release began on 22nd. Crested on 28th after 2 - 2.5 ft rise.
- Jan. 2007 - Release began on 16th; crested on 27th after 3.8 ft rise at Skilak Lake; occurred when lower Kenai River had ice cover; caused ice jam flooding from river mile 32 to below Big Eddy; the river stage at Soldotna reached 20.00 ft, 1/28/07 when a jam formed 1/2 mile downstream of the Sterling Hwy bridge.
- Aug. 2009 - Release began on 8th and water levels crested 10 days later on 17th. The gage below Skilak came up 2.5 ft to 15.0 ft and minor flooding occurred in Kenai Keys and Big Eddy areas. A flight on Aug 1st confirmed that the lake had not released and water level was 2925 feet.





## APPENDIX F



Skilak Glacier-Dammed Lake and Surrounding Area



## APPENDIX F

### Snow Glacier-Dammed Lake Dump History

Drains every 2 to 3 years during Nov, Dec, or Jan beginning 1911 or earlier thru 1953; after 1953, Sep, Oct, and Nov have been typical months of release.

Glacier Dammed Lake					Snow River		Cooper Landing (flood=13400cfs)		
Yr.	Release Dates Begin End	Est. Pool Elev (Ft)	Est. Volume (Ac-Ft)	Est. Peak Outflow (CFS)	Peak Flow (CFS)	Date	Peak Flow (CFS)	Date	
1949	10/18 10/29	2677	116,300	14,900	16,400	10/27	11,600	10/28	
1951	11/05 11/20	2582	77,900	11,000	11,500	11/17	6,250*	11/18	
1953	12/04 12/19	2587	80,000	7,000	7,300	12/15	4,420*	12/17	
1956	10/18 11/01	2651	105,200	12,500	12,900	10/29	7,310*	10/30	
1958	10/06 10/20	2649	104,400	13,900	14,200	10/17	8,350*	10/17	
1961	09/28 10/08	2732	141,900	19,200	20,000	10/07	14,000	10/08	
1964	09/15 09/27	2697	125,500	15,900	17,900	09/23	14,200	09/24	
1967	08/26 09/02	2689	121,900	26,800	28,600	08/31	21,500	09/01	
1970	09/08 09/24	2754	152,900	17,000	17,800	09/22	12,100*	09/23	
1974	09/09 09/22	2833	194,800	25,000	26,400	09/20	23,100	09/21	
1977	08/29 09/08	2760	122,400	13,900	16,700	09/05	14,900*	09/06	
1979	10/18 10/24	2645	102,900	14,800	15,700	10/24	12,800	10/24	
1982	09/17 10/01	2736	143,900	13,700	16,100	09/29	15,500	09/29	
1985	11/21 12/05	2730	129,000	11,800	12,000	12/02	8,230	12/03	
1988	10/19 11/03	2725	138,600	11,500	11,800	10/29	8,820	10/30	
1990	10/28 11/09	2720	136,200	14,800	15,700	11/07	9,100	11/08	
1993	09/11 09/21	2715	133,900	17,500	29,600	09/19	17,200	09/19	
1996	07/27 08/08	2684	119,800	14,700	15,500	08/05	14,700	08/06	
1998	09/30 10/14	2675	115,700	12,600	13,400	10/10	9,940	10/11	
2001	09/06 09/22	2705	130,000	***	***	09/22	15,780	09/23	
2003	11/07 11/22	2665	99,000	12,200	13,300	11/16	10,600	11/17	
2005	10/23 11/05	2660	98-107K	***	***	10/30	10,000	10/31	
2007	10/28 11/09	NA	96,000	10,300	11,700	11/09	8,790	11/10	

\* indicates daily mean flow (cfs)

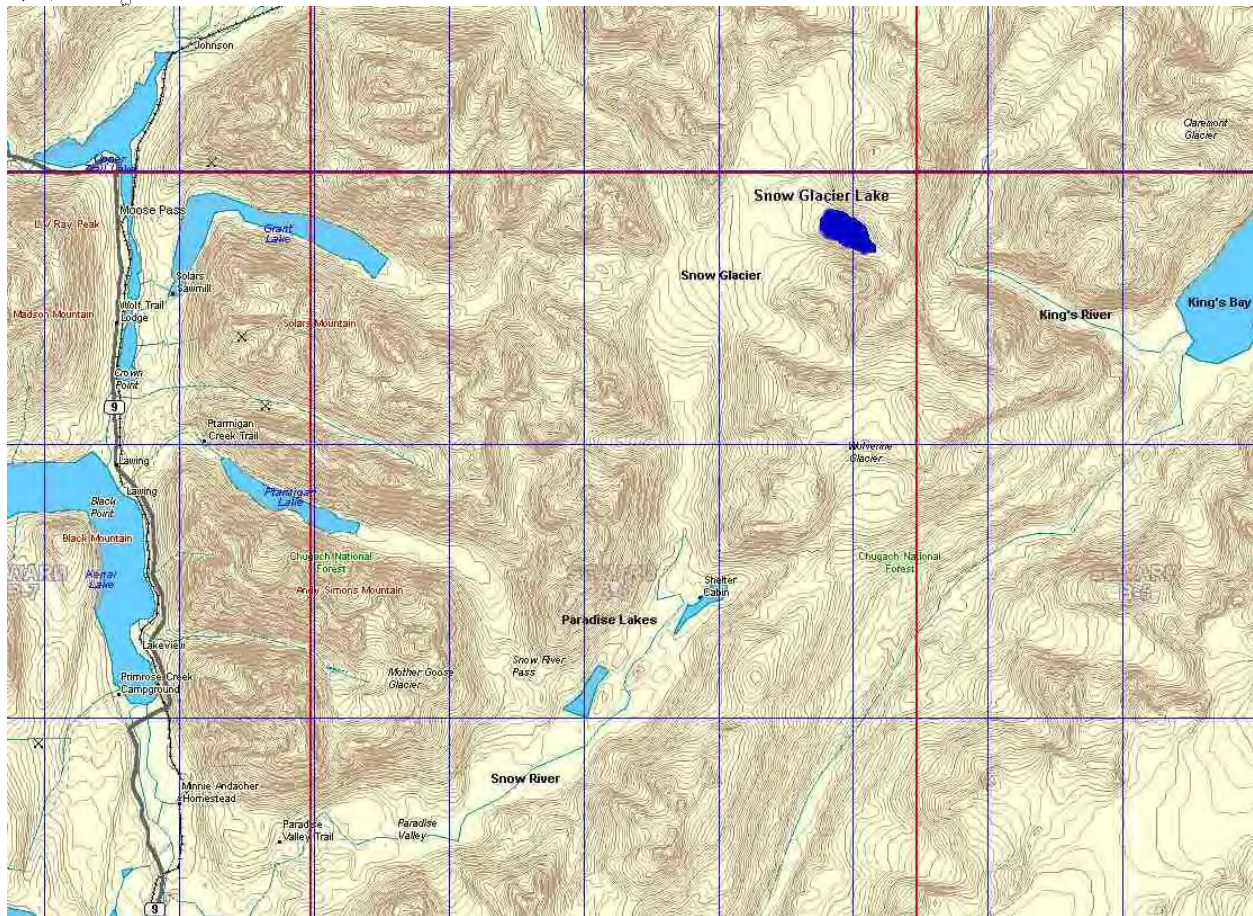
\*\*\* extensive scour at the Snow River gauge; unable to accurately estimate peak outflow from the glacier dammed lake or peak flow on the Snow River

In 2007, an overflight on Nov 5 confirmed the release of the lake. However, an estimate of the release level of the lake and corresponding lake volume could not be made due to recent snowfall.





## APPENDIX F



### Snow Glacier-Dammed Lake and Surrounding Area



## Appendix G

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### COMPLETED FEMA PLAN REVIEW TOOL





## APPENDIX H

### 2014 PLAN CONTRIBUTORS

Contributor	Title/Agency	Method of Involvement
Scott Walden (2014)	Director, KPB Office of Emergency Management	Plan review and incorporation into KPB HMP, hazard coordination, project coordination, SBCFSA Planning Team member
Dan Mahalek (2010, 2014)	Water Resource Manager, KPB Seward/Bear Creek Flood Service Area	SBCFSA Planning Team leader, project management and coordination
Max Best (2004, 2010, 2014)	Director, KPB Planning Dept.	Plan review and coordination, SBCFSA Planning Team member
Bonnie Hanson (2004, 2010, 2014)	KPB Office of Emergency Management	Administrative assistance
Janelle Hames (2014)	KPB Office of Emergency Management	Administrative assistance
Mary Toll (2014)	KPB Planning Dept.	Plan review and editing
Chris Clough (2004, 2010, 2014)	GIS Manager, KPB Planning Dept.	Data sharing, SBCFSA Planning Team member
Brenda Ahlberg (2014)	Community and Fiscal Projects Manager, KPB Mayor's Office	Grant Administration; Plan implementation process discussion
Paul Ostrander (2014)	Chief of Staff, KPB Mayor's Office	Interdepartmental support
Ben Hanson (2004, 2014)	Director, KPB Management Information Services	Computer, network, and telephone support
Jon Czarneski (2014)	Planner, KPB Donald E. Gilman River Center	Plan review and coordination, SBCFSA Planning Team member
Dan Bevington (2014)	Floodplain Administrator, KPB Donald E. Gilman River Center	Plan review and coordination, flood hazard review; SBCFSA Planning Team member
Marcus Mueller (2010, 2014)	Land Management Officer, KPB Land Mgmt. Dept.	Plan review and coordination, SBCFSA Planning Team member
SBCFSA Board (2004, 2010, 2014)	KPB Seward/Bear Creek Flood Service Area Board	Plan review, implementation, and coordination; SBCFSA Planning Team members
Bill Williamson (2014)	Chairman, KPB Seward/Bear Creek Flood Service Area Board	Plan review, implementation, and coordination; SBCFSA Planning Team member
Randy Stauffer (2014)	Vice Chairman, KPB Seward/Bear Creek Flood Service Area Board	Plan review, implementation, and coordination; SBCFSA Planning Team member
Stephanie Presley (2014)	Coordinator, KPB Seward/Bear Creek Flood Service Area Board	Plan review and coordination, SBCFSA Planning Team member
Jim Hunt (2014)	City Manager, City of Seward	Plan review, SBCFSA Planning Team member



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Ron Long (2010, 2014)	Director, City of Seward Community Development	Plan review, implementation, and coordination; SBCFSA Planning Team member
Donna Glenz (2014)	Planner, City of Seward	Plan coordination and implantation; SBCFSA Planning Team member
WC Casey (2014)	Director, City of Seward Public Works	Project status determination, SBCFSA Planning Team member
David Squires (2014)	Fire Chief, City of Seward	Hazard coordination
Scott Simmons (2014)	Emergency Mgmt, Hazard Mitigation and Climate Change Planner, URS Corporation, Alaska	SBCFSA HMP Project Leader, Plan activity coordination, data acquisition, HMP development and project reporting, SBCFSA Planning Team member
Rich Chamberlain, GISP (2014)	GIS Practice Leader, Senior Staff GIS Specialist, Risk Assessment, Hazard United States (Hazus) Modeler	Hazus scenario, infrastructure vulnerability analysis, population risk assessment; SBCFSA Planning Team member
Kimberley Pirri, PE, CFM (2014)	Senior Water Resources Engineer, Hazus Development	Hazus scenario, infrastructure vulnerability analysis, population risk assessment; SBCFSA Planning Team member
John Phillipsborn, MPA (2014)	Sustainability, Hazard Mitigation, Climate Change Adaptation Planner	Climate change adaptation and HMP development; SBCFSA Planning Team member
Shane Parson, PhD, CFM (2014)	Risk Assessment, Hazus Modeler	Hazus scenario, infrastructure vulnerability analysis, population risk assessment; SBCFSA Planning Team member
Deborah Farmer (2014)	FM&I Branch Chief (Acting), FEMA Region 10/Mitigation	Provided updated NFIP policy information
Susan Bernstein, Esq. (2014)	I&PR, Mitigation Directorate, NFIP, FEMA, DHS	Provided updated NFIP policy information
Jeff Conaway (2014)	Hydrologic Data Program Chief, USGS Alaska Science Center	Provided updated stream gage information
Steve Frenzel (2004, 2014)	Water Office Chief/Supv. Hydrologist, USGS Alaska Science Center	Provided updated stream gage information
Rich Koehler (2014)	Geologist, State of Alaska/DNR, Division of Geological & Geophysical Surveys	Provided earthquake information
Joyce Outten (2014)	Natural Resources Tech., State of Alaska/DNR, Division of Geological & Geophysical Surveys	Provided earthquake information



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## APPENDIX I

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KENAI PENINSULA BOROUGH  
Office of Emergency Management

### FLOOD FORECASTING AND STREAM GAGE PROGRAM

Steven A. Frenzel  
and  
R.L. Rickman

Water Resources Office

**Alaska Science Center**  
**4230 University Drive, Suite 201**  
**Anchorage, Alaska 99508-4664**





## APPENDIX I

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The flood-forecasting stream-gage program is designed to provide near real-time river stage and discharge data used by the Kenai Peninsula Borough and National Weather Service River Forecast Center to provide flood warning and flood watch information. Data collected at these gages are also used to determine the magnitude and frequency of floods, and can be used for numerous hydraulic and hydrologic applications. Current and historical data are available through the U.S. Geological Survey (USGS) web site: [waterdata.usgs.gov/ak/nwis](http://waterdata.usgs.gov/ak/nwis). Data are archived by the USGS and published in an annual water data report.

This appendix briefly describes each flood-forecasting stream gage funded cooperatively between the Kenai Peninsula Borough and the USGS. The flood-forecasting stream-gage program is supplemented with other stream gages funded by the USGS, U.S. Army Corps of Engineers, U.S. Forest Service, National Park Service, Municipality of Anchorage, and the Alaska Energy Authority. Gages that enhance the flood forecast network, which are funded by other sources, are listed in Table 1 at the end of this report.

### FLOOD FORECASTING STREAM GAGE DESCRIPTIONS

#### Grouse Creek at Grouse Lake Outlet near Seward (USGS gaging station number 15237730)

Grouse Creek periodically overflows its banks resulting in road closure and damage to the Seward Highway. The creek is prone to rapid changes in stage. The gage is located on the right bank, 200 feet downstream from the Grouse Lake outlet, 0.2 mile upstream from the Seward Highway, and 7 miles north of Seward. Rainfall and river stage are measured every 15 minutes, and these data are transmitted via GOES satellite every 4 hours. Data can also be transmitted via phone modem.

#### Anchor River near Anchor Point (USGS gaging station number 15239900)

This gage is located on the South Fork of the Anchor River. Periodic flooding has caused the intermittent closure of the Sterling Highway. The gage is located on the right bank at the Sterling Highway bridge (mile 161), 4.3 miles southeast of Anchor Point. Rainfall and river stage are measured every 15 minutes and these data are transmitted via GOES satellite every 4 hours.

#### Snow River near Seward (USGS gaging station number 15243900)

The Snow River basin contains several glaciers. Glacier-dammed lake outburst flooding is common, and has resulted in significant property damage along the Kenai River. The gage is located on the left bank, 0.5 mile downstream from the Alaska Railroad bridge, 3 miles upstream from the mouth at Kenai Lake, and 13.5 miles north of Seward. Rainfall and river stage are measured every 15 minutes and these data are transmitted via GOES satellite every 4 hours.

#### Kenai River at Cooper Landing (USGS gaging station number 15258000)

The Kenai River begins at the outlet to Kenai Lake. The upper reaches of the river receive heavy recreation use. Numerous homes line the banks of Kenai Lake and the Kenai River at Cooper Landing. The Sterling Highway crosses the Kenai River at several locations near Cooper Landing. Flooding has occurred as the result of heavy rainfall and glacier-dammed lake outbursts from the Snow River basin. The gage is located on the right bank at the Sterling Highway bridge at the Kenai Lake outlet, 0.9 miles upstream from Bean Creek, and 0.9 mile



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east of Cooper Landing. Rainfall and river stage are measured every 15 minutes and these data are transmitted via GOES satellite every 3 hours.

### Kenai River below Skilak Lake Outlet near Sterling (USGS gaging station number 15266110)

The Kenai River is an important fishery and probably has the most recreational use of any river in Alaska. Flooding from rainfall events and glacier-dammed lake outbursts is relatively common. The gage is located on the right bank, 3.5 miles downstream from Skilak Lake, and 7 miles southeast of Sterling. Rainfall and river stage are measured every 15 minutes, and these data are transmitted via GOES satellite every 4 hours. Data can also be transmitted via phone modem.

**Table 1.** Stream gages within the Kenai Peninsula Borough, funded by other sources, which enhance the flood forecast network.

Station number	Station name	Data type <sup>1</sup> and telemetry	Funded by	Remarks
15236900	Wolverine Creek near Lawing	Stage, discharge, air temperature, rainfall; transmitted via GOES satellite every 4 hours	U.S. Geological Survey	A good indicator of snow melt and rainfall runoff from a heavily glaciated maritime basin
15238648	Upper Nuka River near Park Boundary near Homer	Stage, discharge, air temperature, precipitation (includes snow); transmitted via GOES satellite every 4 hours	Alaska Energy Authority and USGS	Precipitation/ runoff is similar to Harding ice field. Past flooding occurred because of rapid snowmelt during September-October rainfall events
15238990	Upper Bradley River near Nuka Glacier near Homer	Stage, discharge, air temperature; transmitted via GOES satellite every 4 hours	Alaska Energy Authority and USGS	A good indicator of snowmelt and rainfall events in the Kenai Mountains
15239050	Middle Fork Bradley River near Homer	Stage, discharge, air temperature, rainfall; transmitted via GOES satellite every 4 hours	Alaska Energy Authority and USGS	A good indicator of snowmelt and rainfall events in the Kenai Mountains.
15239070	Bradley River near Tidewater near Homer	Stage, discharge, air temperature, rainfall; transmitted via GOES satellite every 4 hours	Alaska Energy Authority	A good indicator of snow melt and rainfall events in the Kenai Mountains
15261000	Cooper Creek at Mouth near Cooper Landing	Stage, discharge, water temperature; transmitted via GOES satellite every 4 hours	Municipality of Anchorage and USGS	A good indicator of snow melt and rainfall events in the Kenai Mountains near Cooper Landing
15266300	Kenai River at Soldotna	Stage, discharge, water temperature; transmitted via GOES satellite every 4 hours	U.S. Army Corps of Engineers	A critical part of the Kenai River flood forecast network
15271000	Sixmile Creek near Hope	Stage, discharge, air temperature, rainfall; transmitted via GOES satellite every 4 hours	U.S. Forest Service	A good indicator of snow melt and rainfall events in the northern Kenai Mountains

<sup>1</sup> Recording interval is 15 minutes.



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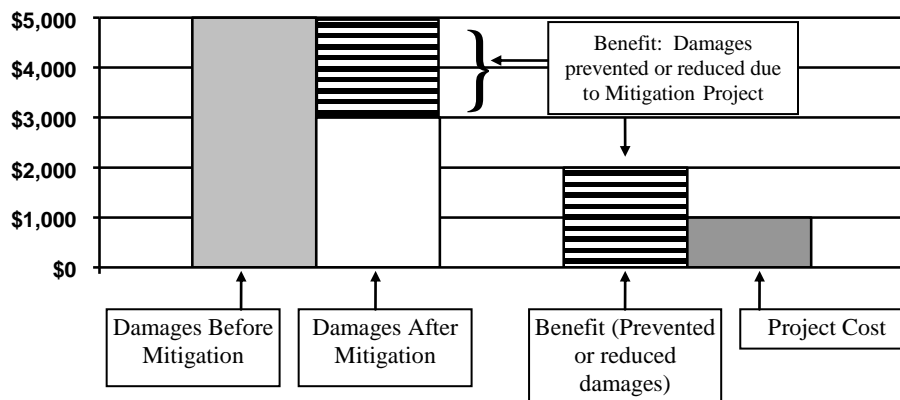
### State Project Review and Prioritization Process (From 2013 State of Alaska Hazard Mitigation Plan)

#### How to Determine Cost-Effectiveness of Mitigation Projects

As the well-publicized devastation of floods, earthquakes, and hurricanes attests, disasters are random and inevitable events that we can't control. But how we reduce – or mitigate – damage from disasters is something that we *can* control. That is why FEMA funds hazard mitigation projects: to reduce future damages, losses, casualties, and other devastating impacts from disasters. Some examples of flood mitigation projects include elevating buildings or upgrading culverts. Projects in earthquake-prone areas might focus on retrofitting buildings to lower future damages and casualties. So instead of continuously picking up the pieces after disasters, states and communities can identify and carry out hazard mitigation measures that will reduce damage and hardship –the “loss”– due to future disasters. A key criterion for mitigation projects to be eligible for funding is that they must be cost-effective. If the project benefits are higher than the project costs, then the project is cost-effective.

Benefit-cost analysis is used for all cost-effectiveness determinations – for flood and earthquake mitigation projects alike. Although the following graph is an oversimplification, the concepts it illustrates are important. At its most basic level, benefit-cost analysis determines whether the cost of investing in a mitigation project today (the “cost”) will result in sufficiently reduced damages in the future (the “benefits”) to justify spending money on the project. If the benefit is greater than the cost, then the project *is* cost-effective; if the benefit is less than the cost, then the project *is not* cost-effective. This graph provides an example of the kind of comparative benefit and cost data you might see after conducting a benefit-cost analysis.

*Basic Benefit-Cost Model*







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*For more information about FEMA's Benefit-Cost Modules, please contact the FEMA Region X Mitigation Division at 425-487-4600*

*It is important to understand that benefit-cost analysis is basically the same for each type of hazard mitigation project. The only differences are the types of data that are used in the calculations, depending on whether the project is for floods, earthquakes, or other natural hazards. For example, whereas the depth of flooding is used to estimate damage for flood mitigation projects, the severity of ground shaking is used to estimate damage for earthquake mitigation projects.*

### **Calculating the Benefit-Cost Ratio**

In the previous graph, cost-effectiveness is determined by comparing the project cost of \$1,000, to the value of damages prevented after the mitigation measure, which is \$2,000. Because the dollar-value of benefits exceeds the costs of funding the project, the project is cost-effective. This relationship is depicted numerically by dividing the benefits by the costs, resulting in a benefit-cost ratio (BCR). The BCR is simply a way of stating whether benefits exceed project costs, and by how much. To derive the BCR, divide the benefits by the cost ( $\$2,000 \div \$1,000$ ). If the result is 1.0 or greater, then the project is cost-effective. In this instance, the BCR is 2.0, which far exceeds the 1.0 level. On the other hand, if the cost of the project is \$2,000 and the benefits are only \$1,000, the project would have a BCR of 0.50 ( $\$1,000 \div \$2,000$ ) and would not be cost-effective.

By conducting a benefit-cost analysis, you determine one of two things: either the project is cost-effective ( $BCR > 1.0$ ) or it is not ( $BCR < 1.0$ ). If the project is cost-effective, then no further work or analysis needs to be done; there is no third step other than to move the project to the next phase in the approval process. If, however, the project is not cost-effective, then it is not eligible for funding.

FEMA utilizes a computer software program to calculate a project's cost-effectiveness. The following is a technical illustration of how benefit-cost analysis works. There are four key elements to all benefit-cost analyses of hazard mitigation projects:

1. an estimate of damages and losses *before* mitigation
2. an estimate of damages and losses *after* mitigation
3. an estimate of the frequency and severity of the hazard causing damages (e.g. floods), and
4. the economic factors of the analysis (i.e. discount rate and mitigation project useful lifetime)

These four key elements and their relationships to one another are detailed in the following example.



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**EXAMPLE:** Consider a 1500 square foot, one-story, single family residence located in the Acorn Park subdivision along Squirrel Creek. A proposed mitigation project will elevate the structure four feet at a cost of \$20,000. Whether this project is cost-effective depends on the damages and losses from flooding without the mitigation project; the effectiveness of the mitigation project in reducing those damages and losses; the frequency that the house is flooded and the depth of the flood water; and, the mitigation project's useful lifetime.

If the pre-mitigation damages are frequent and/or severe, then the project is more likely to be cost-effective. Even minor damage that occurs frequently can exceed, over the life of a project, the up-front costs of implementing a mitigation measure. On the other hand, if the building in the example above only flooded once, then it may not be cost-effective to elevate, unless the damages were significant in relation to the value of the structure and its contents.

FEMA is trying to maximize its investment in damage reduction by focusing mitigation resources on those projects that have the best chance of making an impact on losses in property and life. Determining cost-effectiveness of mitigation projects is of critical importance, therefore, to ensure that FEMA is fulfilling its mission of not just responding to disasters, but also in reducing the economic loss and suffering that they bring.



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Appendix K: The All-Hazards Mitigation Plan is incorporated into the following Borough plans:

Page 1-9	1. KPB Emergency Operations Plan Section 1 <b>Background and Overview</b>
Page 1-14	2. KPB Emergency Operations Plan Section 1 <b>Mitigation</b>
Page 1-25	3. KPB Emergency Operations Plan <b>Plans, Policies and Resources</b>
Page 3-4	4. KPB Emergency Operations Plan Section 3 <b>Response Actions</b>
Page 4-14	5. KPB Comprehensive Plan Chapter 4 <b>OEM Responsibilities</b>
Page 4-30	6. KPB Comprehensive Plan Goal 4.4 <b>Preparation for disasters</b>
Page 6-15	7. KPB Comprehensive Plan Table 6-2 <b>City Planning Documents</b>
Pages 6-26-30	8. KPB Comprehensive Plan <b>Development Constraints</b>
Page 6-32	9. KPB Comprehensive Plan <b>Issues</b>
Pages 6-34-35	10. KPB Comprehensive Plan Goal 6.1 <b>Borough Land Management*</b>
Page 6-35	11. KPB Comprehensive Plan Goal 6.2 <b>Responsible Growth*</b>
Page 6-36	12. KPB Comprehensive Plan Goal 6.3 <b>Land Management Decisions*</b>
Page 6-37	13. KPB Comprehensive Plan Goal 6.4 <b>Increase Public Access*</b>
Page 6-38	14. KPB Comprehensive Plan Goal 6.5 <b>Private Lands*</b>
Page 6-37	15. KPB Comprehensive Plan Goal 6.6 <b>Incompatible Land Uses*</b>
Pages 6-38-40	16. KPB Comprehensive Plan Goal 6.7 <b>Identify ... landslide or avalanche areas</b>
Page 7-31	17. KPB Comprehensive Plan Goal 7.4 <b>Hazardous Materials</b>
Page A-12	18. KPB Comprehensive Plan Appendix A <b>Public Services</b>
Page A-30	19. KPB Comprehensive Plan Appendix A <b>Land Ownership</b>
Page A-35	20. KPB Comprehensive Plan Appendix A <b>Environmental Quality</b>
	<b>Notes</b> * All Hazard Mitigation Plan is not mentioned by name but is implied by content.



## Appendix N: Changes to the 2010 Hazard Mitigation Plan For the 2014 Update

SECTION	PG. NO.	REVIEW COMMENT	KPB ACTION
<b>Introduction 1.0</b>	1	Footnote 1 highlighted	Changed 2004 to 2013 for state plan update.
1.1.2 Overall Plan Development Guidelines	2	'Crosswalk' now 'Review Tool'	Did document search; changed in this location and on Page 7.
1.1.3 Authority	3	Noted that FEMA Final Rule was published Sept 16, 2009	Added Final Rule publication date and CFR location information
1.1.3 Authority	3	Added 2014 to the dates for the 'review and revision' process	Added information that a minor review and revision process was undertaken in 2014 for Annex I amendment to replace it with updated SBCFSA Hazard Mitigation Plan.
1.2 Plan organization	5	Under Weather, review wants to know if anything between 2010 & 2014	Changed dates to include through 2013; summary under Section 5.0 also changed
	5	Under Volcanoes, State Plan date needs updating	Changed from 2007 to 2013.
	6	Under Volcanoes, review wants to know if any new activity 2010-2014	Per Scott Walden, no new events. Changed date to February 2014. Section 7 still current.
	6	Under Avalanches, update State Plan date	Changed from 2007 to 2013; changed 'All-Hazard' to 'Hazard' in plan title.
	7	Appendices: state wants L and N 'deleted'	Corrected dates from 2004 to 2010 in each to reflect what is shown in the Appendices.
	7		Appendix G - Changed FEMA Crosswalk to FEMA Plan Review Tool.
1.3 Methodology 1.3.1 Planning Process	8	Wanted it noted that our plan was also on the web for public comment for 2010 revision	Added
1.3.3 Public Participation and Outreach	9	Review wanted Website paragraph updated	Added explanation of 2014 minor update process; updated website address and description to 2010 plan.
	9	Under Online Hazard Survey, review wanted the number of respondents updated to 2014	No Online Hazard Survey done for 2014 update - no change made; no online Hazard Survey for SBCFSA; 'for 2010 update' added in titles for clarification (Pg 9, 10).
	10	Highlighted Newspaper Public Notices dates	No public notices published for 2014 update, not even SBCFSA, no change made.
	10	Table 1.1 KPB All-Hazard Mitigation Plan Outreach, 2010 : review highlighted title and wanted new meetings added, plus adding statement of non-participation by	Added update 2014 to table title; added statement of non-public participation for 2014 update at start of section (Pg 8, 9).

		public and communities in 2014 update cycle but will participate in 2016 update	
	10, 11	Review wanted new Seward meeting dates in Table 1.1	Pg 12 – added SBCFSA meeting date to table, added KPB Planning Commission and Assembly dates for SBCFSA Appendix I approval, added ordinance numbers to table for 2010 update and 2014 SBCFSA approval.
	11, 12	Review highlighted Public Review and Adoption Process with no comment.	Updated with ordinance number for 2010 adoption; added information about adoption of SBCFSA Plan adoption and Appendix I amendment to plan.
	12	State wants their plan date updated	Updated from 2004 to 2013 (now on Pg 13).
	13	Review says all info from 2004 and 2007 plans in 2013 plan; wants link updated	Removed 2004 and 2007 updates; updated link.
	13	Verify if 2008 Comp Plan is most current	2008 was incorrect, corrected to most current – 2005 (Pg 14).
1.3.5 Plan Update Process	16	Under On-going, reviewer wants a call for his help with explanation	Called Scott Nelsen; inserted paragraph worded with his help to explain all non-Seward area communities lack of participation in 2014, with full Borough community participation in 2016 update.
	16	Reviewer likes that plan link still works	
1.3.6 All-Hazard Mitigation Action Status	17	Highlighted with no comment	Corrected 2004 Appendix L date to 2010 Appendix L date (Pg 17).
1.4 Community Profile 1.4.1 Geography	17	Footnote 2 – wants 2000 census changed to 2010 census	Corrected source and date.
	17	Footnote 3 highlighted with no comment	Updated from 2008 to 2010 date and source.
	18	Wants Figure 1-2 KPB Relief Map (Borough boundary) date changed	This is a graphic dated 2004, will need to regenerate new map – all maps will be reviewed, updated and regenerated for 2016 revision.
	19	No comment on Figure 1-3 KPB Land Ownership Map	Also dated 2004, municipal entitlements may have changed this map; will review, update and regenerate all maps for 2016 revision.
1.4.4 Economy	22	Footnote 3 highlighted, no comment	'Pers. comm.' (Personal communication?); no change made.
1.4.5 Transportation	25	Wants all footnoted plan update dates checked	2003 KPB Transportation Plan current; no change made.
1.4.6 Population and Demographics	31-32	Date ranges, table name (KPB 2009 Community Population Estimates) and footnotes 2 and 4 highlights. No comment, but all refer to 2009	Updated all with 2012 Alaska Vintage Place estimates and source.

		population data.	
1.5 Risk Assessment 1.5.2 Probability of Hazard Occurrence	36	Footnote 1 highlighted with no comment.	Updated date to 2013 State plan
	38-39	Footnote 1 highlighted for Table 1-10 Hazard Rating for Floods by KPB Emergency Mgmt. Zone with comment that website shows 2008 plan	Update footnote to the 2008 plan. Will review and verify all tables in 2016 revision.
1.5.4 Regional Overview of Structures at Risk	44-45	Table 1-20 Assessed Values by Community: source note highlighted with comment that it is way too conservative.	This is based on 2009 Assessing valuations. All tables will be re-evaluated, reviewed and updated for 2016 update.
<b>2.0 Flood and Coastal Erosion</b>	45	Reviewer wants flood events since 2009 added.	Added 2 new storms – Scott W provided 3 but 2011 looks like a windstorm and not a major fall rainstorm. 2012 and 2013 had disaster declarations.
2.1.1 Past Flood Hazard Mitigation Plans	46	Reviewer wants SBCFSA Plan updated from 2007 to 2013	Changed
2.1.2 Flood Terminology	47	Reviewer wants FEMA RiskMAP program added if available	Program has coastal funding for KPB but not yet mapped. Projected to be mapped in 2014. Included this info in narrative.
2.4 Flood History	52	Reviewer wants Table 2-1 Floods of Record – Resurrection River, Salmon Creek, Kenai River and Anchor River updated though 2014	Updated table with info from Bonnie H (OEM).
	58	Update needed for Table 2-2 KPB Floods of Record	Added 2012 Seward flood, OEM (Bonnie H) provided description of the 2013 floods.
2.5 Floodplain Management 2.5.1 NFIP	58	Want Seward info updated	Updated Seward FIRM info – the maps are dated 9/27/13 and have been provided by FEMA
2.5.2 Flood Insurance	60	Want Table 2-3 KPB Flood Insurance Summary updated	Email sent to source (NFIP State Coord., Div Comm Advocacy, Dept Commerce, Community and Econ Dev) 2/28/14 requesting update. Updated with their info. Changed footnote source.
2.6 Flood Hazard Assessment Overview 2.6.2 Floodplain Maps and Flood Risk Prediction	62	Highlighted “As of January 2010” sentence	Sentence deleted per OEM (Scott Walden) – funding obtained, paid for update.
	62	Want flood information for Anchor and Ninilchik Rivers and update for 2013-14 floods.	Updated (Scott Walden info)
	62	Want Seward FIRM info updated	Changed - new maps have been provided, dated 9/27/13.
2.6.3 Vulnerability	64	FIRM update projection highlighted	Changed to include date maps have

Assessment			been provided.
	64	KPB pursuit of grant funding sentence highlighted	Changed to provide info for projects funded by state grants.
	64	Wants Table 2-4 Summary of Nine Mapped (FIRM) Floodplains updated	Updated with 2013 fiscal year Assessing data from GIS, noted update source.
2.6.4 Critical Facilities 2.6.4.1 Roads	65	Footnote 1 highlighted with no comment	Footnote was 'Pers. Comm.' regarding the number of roads in the KPB that are subject to repetitive flooding. This type of narrative will be re-evaluated, updated and revised throughout the document for 2016 after input from the individual communities, service providers and affected government agencies, such as KPB Roads and State DOT. No change made.
	65		Footnote 2 – link to Trans Plan replaced with updated location link (Planning Dept has hard copy; digital copy link no longer available).
2.7 North Zone 2.7.1 North Zone Communities	67	Wants Population Estimate column in Table 2-5 North Zone Communities with Flood Hazard Risk updated	Updated from same Footnote 2 source with 2013 estimated populations (AK Dept of Labor and Workforce Dev).
	67	Footnote 2 highlighted – no comment	Calculation method shown for 'at-risk population'; Per Bonnie H - no change.
2.7.2 Characteristics of Flooding	70	Footnotes 1 and 2 highlighted with no comment	Both are Pers. comm. – no change made.
2.7.3 What is Susceptible to Damage During a Flood Event	71	Are values still valid in Table 2-6 City of Kenai FIRM Area Parcel Summary	Updated table with new GIS search data and source (updated following paragraph in narrative).
	72	No comment	For consistency in this update, Table 2-7 City of Kenai FIRM Area Summary by Ownership Category was updated from GIS search of 2013 Assessing data; update source noted.
2.8 Central Zone 2.8.1 Central Zone Communities	74	Wants update to Table 2-8 Central Zone Communities with Flood Hazard Risk	Updated with 2013 pop estimates (AK Dept of Labor and Workforce Dev). 'At risk' estimated population unchanged due to minimal overall population increase.
2.8.3 What is Susceptible to Damage During a Flood Event 2.8.3.3 FIRM Floodplain Analysis	78	2009 data source highlighted with no comment for Table 2-9 Central Zone FIRM Area Parcel Summary	Updated to 2013 Assessing data from GIS report (assessing is on fiscal year), updated source.
	79	Want values checked for Table 2-10 Upper Kenai River FIRM Area Parcel Summary by Ownership Category; Footnote 1 highlighted	Updated with 2013 Assessing data from GIS search.
	80	Check values for Table 2-11 Lower	Updated with 2013 Assessing data



		Kenai River; Footnote 1 highlighted	from GIS search.
	82	Footnote 1 highlighted with no comment	For consistency in update, table 2-12 Kasilof River FIRM Area Summary by Ownership Category updated from 2013 Assessing date by GIS search.
2.8.4 Development Trends	84	Comparison discussion between 1996 Assessment and 2009 GIS data highlighted with no comment	Will review and revise for 2016 for all areas.
	84	Want update to Table 2-13 Floodplain Development Trends 1996 to 2009	Will review and update for 2016 for all areas.
	85	No comment	For consistency, update Table 2-14 Kasilof River FIRM Area – private Land Parcel Size Summary with 2013 Assessing date from GIS search.
2.9 East Zone 2.9.1 East Zone Communities	86	Wants update to Table 2-15 East Zone Communities with Flood Hazard Risk	Updated with 2013 population estimates (AK Dept of Labor and Workforce Development).
2.9.2 Characteristics of Flooding	91	Requested status of Flood Plain Task Force	Updated to give last meeting date and total number of meetings.
	93	Wants SBCFSA Board meetings/work sessions updated, highlighted Footnote 1	Added footnote pointing to new SBCFSA Plan as Annex I of KPB Plan. Dan Mahalek said table 7-8 is less specific to allow more flexibility. Entire table will be re-evaluated and modified for 2016 update with community/public/agency input process. Added link to SBCFSA 2013 plan in footnote.
	95	Footnote 1 highlighted – SBCFSA Board Work Session date	May need to regenerate the map of Chronic Flood Problems for 2016 update. Current Haz Mit projects may change the map. SBCFSA will review all pertinent maps and tables for 2016 update.
2.9.3 What is Susceptible to Damage During a Flood Event 2.9.3.1 Critical Facilities	97	Want flooding dates for Bear Creek Fire Station updated	Scott Walden (OEM) – mapping shows it flooded 2009/2012. Changed dates.
	97	Highlighted footnote 1 with no comment	No change
2.9.3.4 FIRM Floodplain Analysis	98	Highlighted Footnote 2 (2009 data) with no comment.	For consistency, Table 2-17 East Zone FIRM Area Summary updated with GIS data search of 2013 Assessing.
Resurrection Creek FIRM Area	99	Highlighted Footnote 1 (2009 data) with no comment	For consistency, Table 2-18 Parcel Summary for the Resurrection River FIRM Area by Ownership updated from GIS search of 2013 Assessing data.
Trail River FIRM Area	100	No review comments.	For consistency, Table 2-19 Parcel Summary for Trail River FIRM Area by

			Ownership Category updated from GIS search of 2013 Assessing data.
Seward FIRM Area	100	Footnote 2 (2009 data) highlighted by reviewer, no comment	For consistency, Table 2-20 Parcel Summary of Seward FIRM Area by Ownership Category updated from GIS search of 2013 Assessing data.
2.10 South Zone 2.10.1 South Zone Communities	102	Review wants update to Table 2.21 South Zone Communities and Known Flood Hazards	Updated to 2013 pop. data; approx. 'at risk population' not changed – population change was not substantial. Verify and update CDPs listed in each zone for 2016 update.
2.10.3.3 FIRM Floodplain Analysis	107	Review highlighted Footnote 1 (2009 data) with no comment	Table 2-22 South Zone Overall FIRM Parcel Summary updated from GIS report of Assessing 2013 data; Footnote 1 updated.
Anchor River FIM Area	108	No state comment	Table 2-23 Anchor River FIRM Area Parcel Summary by Ownership Category updated from GIS search of 2013 Assessing data.
Ninilchik River FIRM Area	109	Review highlighted Footnote 1 (2009 data) with no comment	Table 2-24 Ninilchik River FIRM Area Parcel Summary by Ownership Category updated from GIS search of 2013 Assessing data.
Seldovia FIRM Area	109	Review highlighted Footnote 2 (2009 data) with no comment	Table 2-25 Seldovia FIRM Area Parcel Summary by ownership Category updated from GIS search of 2013 Assessing data.
Flood Mitigation Strategies Strategy 7	123	Review highlighted Footnotes 1 and 2 with no comment (Pers. Comm.)	No changes made.
Strategy 10	127	Review highlighted Ninilchik River gage system approximate cost, highlighted associated footnote 1, commented that the source person still working and should be contacted to check the approx. cost shown	Funding has been obtained and gages are active. Added cost shares with USGS for each, per Jeff Conaway email. Added info source.
<b>3.0 Wildfires</b> 3.1 Wildfire History	138	Most recent fire on Ken Pen highlighted by reviewer with no comment	Checked with OEM if any newer fires; none – no change made.
	139	Figure 3.1 Fire History on the Kenai Peninsula, 1947-2009 highlighted by reviewer with no comment	Added footnote for no major fires since 2009, map will be regenerated and updated for 2016 plan update.
<b>4.0 Earthquakes</b> 4.1 Why Focus on Earthquake Hazard Mitigation	142	Reviewer highlighted footnotes 1 and 2 with no comment. Both are 'Pers. comm.' footnotes	No changes made.
	143	Review wants publication date changed to current year for Figure 4-2 Major Faults in the Kenai Peninsula Borough.	This is a GIS graphic. For consistency, all maps will be reviewed and regenerated with updates for 2016 plan revision.
4.2 Earthquake History	146	Review highlighted date on title of	AEIC site shows none more current

		Table 4-2 Earthquakes with Their Epicenter Located in the KPB with a Magnitude of 6.0 or Greater from 01/1898 Through 04/09/2010 with no comment	than table, updated date thru Feb 2014.
	147	Review wants publication date changed to current year for Figure 4-4 Location of Earthquakes Within KPB Boundaries From 1898 through April 2010 with Magnitude $\geq 5.0$	This is a GIS graphic. For consistency, all maps will be reviewed and regenerated with updates for 2016 plan revision.
	150	Review highlighted footnotes 4 and 5 with no comment. Both are 'Pers. comm.'.	No changes made.
4.3 Earthquake Risk Assessment	151	Review highlighted Footnotes 2 and 3 with no comment. Both are 'Pers. comm.'.	No changes made.
4.3.1.1 Transportation	152	Review highlighted Footnote 3 with no comment, 'Pers. Comm.'	No changes made.
4.3.1.2 Other Facilities	154	Review highlighted Footnotes 1 and 3 with no comment. Both are 'Pers. comm.'	No changes made.
4.3.3 Community Preparedness	155	Review highlighted number of CERT volunteers as of March 2010.	Dan Nelson says number is now approx. 100, changed.
4.5 Earthquake Mitigation Strategies and Implementation Ideas Strategy 5	160	Review highlighted Footnote 2 with no comment, 'Pers. comm.'	No changes made.
Strategy 8	163	Review highlighted Footnote 1 with no comment	Verified the number of private UBC and IRC inspectors listed with AHFC certification on Kenai Peninsula.
	163	Review highlighted Footnote 2 with no comment.	'Pers. comm.' Replaced with City of Kenai website, which now shows this information. Information is still current.
	163	Review highlighted Footnote 3-5 with no comments	These pertain to the method used to estimate the cost of implementing a Borough-wide building inspection program. It is likely this method and discussion will change in the 2016 plan revision. No changes made at this time.
<b>5.0 Weather</b> 5.1 Why Focus on Mitigation for Weather Events?	169	Review highlighted Footnote 2 and commented, asking for updated disaster references	Added DR 4054, 4094 and 4161, and updated footnote.
5.2 Types of Weather Events Thunderstorms & Lightning	173	Review highlighted dates for lightning caused fires, with no comment.	Verified source – corrected Footnote 1: Figure A6 changed to Table A5, Annex H changed to Appendix A, 'final draft' removed. Updated data would require an updated AHAL plan.
5.7 Weather Resource	189		FEMA: Mitigation Division – fixed link

Directory Federal Resources			
Additional Resources	190		Public Assistance Debris Management Guide – fixed link
	191		Western Regional Climate Center – fixed link
	192		Kachemak Bay Research Reserve – fixed link
	192		Coastal Training Program Alaska - fixed link
<b>6.0 Tsunamis &amp; Seiches</b> 6.3 Historical Tsunami Events	198	Review highlighted Footnote 1 for Annex E – City of Seward, commented that this is a 2010 annex	Updated Footnote 1 to 2010
	198	Review highlighted Footnote 2, commented that this is now 2013 update	Updated Footnote 2 to 2013
6.4 Tsunami & Seiche Risk Assessment	201	Review comment wanted former DHS&EM name deleted	Deleted: (formerly Alaska Division of Emergency Services)
	201	Review highlighted Footnote 1 re: mapping for Homer and Seldovia.	Changed footnote to link to maps.
	201	Review highlighted statement regarding 2010 date for Seward map availability, and Footnote 2, with no comment	Changed wording – they have received the maps – updated link to project in Footnote 2
6.5 Tsunami & Seiche Mitigation Goals 6.5.2 Existing Tsunami & Seiche Mitigation Programs and Activities 6.5.2.3 Tsunami Inundation Mapping Program	207	Review highlighted discussion of projected Seward maps, with no comment	Changed wording to indicate the study was completed in 2010. Added footnote with link to study.
<b>7.0 Volcanoes</b>	217	Review highlighted Footnote 1 with no comment.	Changed State HMP to 2013 in Footnote 1
	217	Review highlighted Footnote 2 with no comment	Verified number of historically active volcanoes has not changed on AVO site; updated date.
7.7 Volcano Mitigation Goals	227	Review highlighted Footnote 1, with no comment	Goals and Objectives have changed in 2013 State HMP, if date changed to new plan, 7.7 no longer ‘taken from the state plan’. No changes, the whole plan will be reviewed and revised in 2016.
Goal 2	228	Review highlighted Footnote 1 and commented that ERP had been updated.	Added completion date in Action 2.1.1; replaced contents of Footnote 1 with link to ERP.
<b>8.0 Avalanches</b>	231	Review highlighted description box and link at the top, wanted update	Plan date not changed – that would require new description to be derived



		to 2013 plan.	– that will be undertaken in the complete 2016 review and revision; noted there is a 2013 plan and updated the link
8.3 Avalanche Hazard Areas on the Kenai Peninsula	235	Review highlighted January 2010 date, commenting that it should be updated to 2013-2014.	OEM verified no additional deaths since 2010. Changed date range to February 2014.
	236	Review comment that Figure 8-1 Number of People Killed and/or Trapped in Avalanches on the Kenai Peninsula Since 1999 should be updated to 2013-14	This is a more involved search for death and/or being trapped in avalanches, further broken out by type of incident. This whole section will be reviewed and updated in 2016 complete plan review/revision. No change made.
<b>9.0 Human-Caused Hazards</b> 9.3.1 Nature of the Hazard	256	Review comment want to know if anything beyond 2009 for Table 9.7 Examples of Hazardous Material Events on the Kenai Peninsula	OEM says no, added 'Through 2013' to table name
9.3.3 Resources	257	Review highlighted March 2010 date, with no comment.	Scott Walden indicates no change in capabilities, changed date to current.
9.3.4 Ongoing Mitigation	258	Review highlighted Footnote 1, comment wants reference date updated.	The February 24, 2010 list was the most current ADEC radar detection equipment list date available. No change made.
	258		No list of specific CSR Agreements found to verify or update. Found a 2010 map, nothing newer. No change made.
<b>Executive Summary</b>	xi	Review comment wants KPB population updated	Update population and Footnote 1
Contributing Plans	xii	Review comment wants city participation discussion updated.	Updated to note that they did not participate in 2013/2014 partial update but will participate in the complete 2016 update. Added discussion and footnote for SBCFSA Plan.
	xii	Review comment wants it noted that each city is due for an update before 2016.	Added to discussion.
Mitigation Strategy Chart	xiii-xvii	Review wants Timelines updated	
Floods and Erosion	xiii		Row 2: Changed '1-2 years' to 'in progress' and ongoing, process is undergoing changes currently. Will address specifics in section 2 in 2016 update.
			Row 3: changed '1-5 years' to 'in progress'. Some areas have received new maps, others are in review process.
			Row 4: Changed '1-5 years' to 'in progress' to reflect adoption of

			SBCFSA Plan
			Row 5: changed '1-5 years' to 'in progress and ongoing'. Floodplain codes were changed in conjunction with renewal of SMFDA. KRC will continue to update the codes as new flood maps become available.
Wildfires	xiv		Row 1: Changed '5 years' to 'ongoing' – this is a continuing effort.
			Row 2: Changed '5 years' to 'ongoing' – this is a continuing effort.
			Row 3: Changed '5 years' to 'ongoing' – this is a continuing effort. Funding dependent.
			Row 4: Changed '5 years' to 'ongoing' – this is a continuing effort. Funding dependent.
			Row 5: Changed '5 years' to 'ongoing' – this is a continuing effort. Situational and funding dependent – reactive to fires.
Earthquakes	xv		Row 5: KPB GIS, DGGS, internet search: no one knows of anyone doing liquefaction susceptibility maps. No change made.
Index		Review highlighted numerous sections – indicative of review locations?	Changed dates from 2004 to 2010 in Annex L and N, removed highlighting everywhere else. Saved as .pdf; no Word doc.
Appendix A	A-1		Changed Vintage Place Estimates to 2013; updated CNF Avalanche Information Center to 2014
	A-3		Deleted KPB 1996 Flood Mitigation Plan – this is included in the HMP.
	A-4		Updated NOAA Snow and Skilak Glacier Dammed Lakes Dump History to 2013
Appendix B			Updated to the 2014 public participation process for replacement of Annex I with the current SBCFSA Hazard Mitigation Plan
Appendix D	D-3		Added SBCFSA: Seward/Bear Creek Flood Service Area
Appendix J	J-1		Updated source in title to 2013 State Hazard Mitigation Plan
Appendix N			Replaced with table of 2014 changes
Annex I			Replaced 2010 SBCFSA Flood Hazard Mitigation Plan with 2013 SBCFSA Hazard Mitigation Plan (KPB Assembly Ordinance 2014-03)
Table of Contents			Corrected page numbers, names