City of Valdez, Alaska

Local Hazards Mitigation Plan

Snow Removal, January 2004

Prepared by:
City of Valdez
Bechtol Planning and Development

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Acronyms

AEIS Alaska Earthquake Information System
AWCG Alaska Wildfire Coordinating Group
BCA Benefit- Cost Analysis

BCR	Benefit-Cost Ratio
BFE	Base Flood Elevation (100 year flood)
CDBG	Community Development Block Grant
CED	Community and Economic Development Department
CFR	Code of Federal Regulations
CMP	Coastal Management Plan
cps	cubic feet per second
DCCED	(Alaska) Department of Commerce, Community and Economic Development
DHS&EM	Alaska Division of Homeland Security and Emergency Management
FBFM	Flood Boundary and Floodway Maps
FDIC	Federal Deposit Insurance Corporation
FEMA	Federal Emergency Management Agency
FHLBB	Federal Home Loan Bank Board
FIRM	Flood Insurance Rate Maps
FLD	Flood Projects
fps	feet per second
FLD	Flood Projects
HMP	Hazard Mitigation Plan
HMPG	Hazard Mitigation Planning Grant
LHMP	Local Hazard Mitigation Plan
NFIP	National Flood Insurance Program
NOAA	National Oceanographic and Atmospheric Administration
PDMG	Pre Disaster Mitigation Grant
SBA	Small Business Administration
STIP	Statewide Transportation Improvement Program
T/S	Tsunami/Seiche Projects
USCOE	United States Army Corps of Engineers
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

Sample Resolution

To be completed after State and FEMA Pre- Approval.

City of Valdez, Alaska
Local Hazards Mitigation Plan Adoption Resolution
Resolution # _______

Adoption of the City of Valdez Local Hazards Mitigation Plan

Whereas, the City of Valdez recognizes the threat that local natural hazards pose to people and property; and

Whereas, undertaking hazard mitigation projects before disasters occur will reduce the potential for harm to people and property and save taxpayer dollars; and

Whereas, an adopted Local Hazards Mitigation Plan is required as a condition of future grant funding for mitigation projects; and

Whereas, the Valdez Local Hazards Mitigation Plan has been sent to the Alaska Division of Homeland Security and Emergency Management and the Federal Emergency Management Agency for their approval.

Now, therefore, be it resolved, that the Valdez City Council*,* hereby adopts the City of Valdez Local Hazards Mitigation Plan as an official plan; and

Be it further resolved, that the City of Valdez will submit the adopted Local Hazards Mitigation Plan to the Alaska Division of Homeland Security and Emergency Management and the Federal Emergency Management Agency officials for final review and approval.

Passed: _____________
Date

____
Certifying Official

Chapter 1. Planning Process and Methodology

Introduction

The scope of this plan is natural hazards: flooding, erosion, severe weather (high winds and snowfall), wildland fire, avalanche, tsunami and earthquake hazards. However, some of the mitigation projects for the natural hazards would also mitigate impacts from other hazards.

The City of Valdez Local Hazards Mitigation Plan (LHMP) includes information to assist the city government and residents with planning to avoid potential future disaster losses. The plan provides information on natural hazards that affect Valdez, descriptions of past disasters, and lists projects that may help the community prevent disaster losses. The plan was developed to help the City make decisions regarding natural hazards that affect Valdez.

Plan Development

Location

Valdez is the northern most ice-free port in the United States. The city is located on the north shore of Port Valdez, a deep-water fjord in Prince William Sound. On the road system, Valdez is 305 road miles east of Anchorage, and 364 road miles south of Fairbanks. Valdez is the southern terminus of the Trans-Alaska oil pipeline. It lies at approximately 61.130830° North Latitude and -146.34833° West Longitude. (Sec. 32, T008S, R006W, Copper River Meridian.) The city encompasses 222.0 square miles of land and 55.1 square miles of water.

Project Staff

The Valdez LHMP City staff included Project Manager Carol Smith, Community and Economic Development Director Lisa Von Bargen, Fire Chief George Keeney, and Denise Schanbeck. The Valdez Planning Commission held public meetings on the plan and provided revisions.

Eileen R. Bechtol, AICP, of Bechtol Planning & Development was hired to write the plan with the City.

Scott Simmons and Ervin Petty of the Division of Homeland Security & Emergency Management (DHS&EM) provided technical assistance and reviewed the drafts of this plan.

Plan Research

The plan was developed utilizing existing Valdez plans and studies as well as outside information and research. The following list contains the most significant of the plans and studies that were used in preparing this document. Please see the bibliography for additional sources.

1. *Alpine Woods Estates Detailed Flood Evaluation.* Prepared by Woodward-Clyde for the City of Valdez, Alaska. April 18, 1984.

2. *Alaska State Hazard Plan*. Prepared by and for DHS&EM. September 2004

3. *Avalanche Hazard Evaluation & Mitigation Recommendations for Town Mountain and Duck Flats Avalanche Areas*. Prepared by Doug Fesler and Jill Fredston, Alaska Mountain Safety Center, Inc. for the City of Valdez. May 1, 2000

4. *Avalanche Hazard Phase 2 Report, Supplemental Avalanche Dynamics Analysis and Mitigation Design for the Porcupine Street Avalanche Area.* Prepared by: Doug Fesler and Jill Fredston, Alaska Mountain Safety Center, Inc. for the City of Valdez. September 19, 2000

5. *Evaluation of Stream Stability in the Valdez, Alaska Area*. Prepared by GEOMAX, P.C. for the City of Valdez, Alaska. July 27, 1989.

6. *Lowe River Stabilization Relocation Study.* Prepared by CH2M Hill, Inc. for the City of Valdez, Alaska. December 1990.

7. *Old Town Hazards Assessment*. Prepared by DOWL Engineers for City of Valdez., Alaska. March 1983.

8. *Valdez Tsunami/Seiche Mitigation Plan.* Prepared by City of Valdez, Denise Schanbeck, for DHS&EM and the City of Valdez, March 2005.

9. *Valdez Coastal Management Plan, 2006 Plan Amendment (Draft).* Prepared By BP&D for DNR and the Valdez Coastal District. December 2006.

10. *Valdez Comprehensive Plan*. Prepared by and for the City of Valdez. 2000.

Public Involvement

Site visits were conducted on January 25, 2006 and April 13, 2007. The October 11, 2006 flood event (see Chapter 3, Section 1, Floods, page 30) delayed a scheduled meeting on the plan and pushed back the project a year. Teleconferences on the draft plan were conducted on February 27, 2007 and October 25, 2007.

The Valdez Planning Commission held a public meeting on November 14, 2007 to review the draft plan, and provided revisions to the plan at that meeting. This meeting was advertised using usual city notice procedures and the public was invited to attend and provide input. The City also sent notices of the plan to various organizations in town.

The Valdez Planning Commission will hold another round of public participation and the City Council will review and approve the plan after pre-approval by the State of Alaska and FEMA.

The meetings were advertised using usual city meeting notices, the attendances at these meetings were the City Council, Planning Commission, City Staff, and members of the public. A copy of the draft LHMP is available for public perusal at the Fire Department, Community and Economic Development, City Library and online at the city website: http://www.ci.valdez.ak.us.

Plan Implementation and Incportation

The City Council of Valdez will be responsible for adopting the Valdez LHMP and all future updates or changes. This governing body has the authority to promote sound public policy regarding hazards. The Hazards Mitigation Plan will be incorporation and assimilated into other Valdez plans and documents as they come up for review according to each plans' review schedule.

Please see the following table for plan review schedules.

Table 1. Valdez Plans to Assimilate LHMP Into in Future Plans

Document	Completed	Next Review
Valdez Comprehensive Plan	2000	Next scheduled yet
Capital Improvement Projects Plan	Annual Plan	FY 2008
Emergency Operations Plan	1997	Ongoing Currently
Valdez Coastal Management Plan	2007	2010

Continuing Review Process

The **Community and Economic Development Director of Valdez will evaluate the Valdez LH**MP on an annual basis to determine the effectiveness of programs and to reflect changes in land development, status, or other situations that make changes to the plan necessary. The Community and Economic Development Director and her staff will review the mitigation project items to determine their relevance to changing situations in the city, as well as changes in state or federal policy and to ensure that mitigation continues to address current and expected conditions. The Community and Economic Development Director will review the hazard analysis information to determine if this information should be updated and/or modified, give any new available data or changes in status.

Continued Plan Development

The plan will continue to be developed as resources become available. Additional hazards not currently covered in the plan, including technological and manmade hazards, will be added, if funding becomes available during the next five-year update cycle.

The plan will be updated every 5 years or after a Federally Declared Disaster, if required to do so by DHS&EM.

The Community and Economic Development Director will be responsible for updating and maintaining the plan by adding additional hazards and completing vulnerability assessments for existing hazard chapters.

The following table lists the schedule for completion of these tasks, provided that funds are available to do so:

Table 2. Continued Plan Development

Hazard	Status	Hazard Identification Completion Date	Vulnerability Assessment Completion Date
Floods	Completed	2006	2006
Erosion	Completed	2006	2006
Severe Weather	Completed	2006	2006
Wildland Fire	Completed	2006	2006
Earthquake	Completed	2006	2006
Tsunami/Seiche	Completed	2006	2006
Avalanche	Completed	2006	2006
Economic	Future Addition	2009	2011
Technological	Future Addition	2009	2011
Public Health Crisis	Future Addition	2009	2011
Homeland Security	Future Addition	2009	2011

Continued Public Involvement

The following methods will be used for continued public involvement.

City website: http://www.ci.valdez.ak.us.

Places where the hazard plan will be kept:
City Community and Economic Development
City Fire Department

City Public Works Department
City Clerk's Office
City Library

Risk Assessment Methodology

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, property damage, and disruption to local and regional economies, environmental damage and disruption, and the amount of public and private funds spent to assist with recovery.

Mitigation efforts begin with a comprehensive risk assessment. A risk assessment measures the potential loss from a disaster event caused by an existing hazard by evaluating the vulnerability of people, buildings, and infrastructure. It identifies the characteristics and potential consequences of hazards and their impact on community assets.

A risk assessment typically consists of three components; hazards identification, vulnerability assessment and risk analysis.

1. *Hazards Identification* - The first step in conducting a risk assessment is to identify and profile hazards and their possible effects on the jurisdiction. This information can be found in Chapter 3: Hazards.

2. *Vulnerability Assessment* – Step two is to identify the jurisdiction's vulnerability; the people, infrastructure and property that are likely to be affected. It includes everyone who enters the jurisdiction including employees, commuters, shoppers, tourists, and others.

Populations with special needs such as children, the elderly, and the disabled should be considered; as should facilities such as the hospital, health clinic, senior housing and schools because of their additional vulnerability to hazards.

Inventorying the jurisdiction's assets to determine the number of buildings, their value, and population in hazard areas can also help determine vulnerability. A jurisdiction with many high-value buildings in a high-hazard zone will be extremely vulnerable to financial devastation brought on by a disaster event.

Identifying hazard prone critical facilities is vital because they are necessary during response and recovery phases. Critical facilities include:

- Essential facilities, which are necessary for the health and welfare of an area and are essential during response to a disaster, including hospitals, fire stations, police stations, and other emergency facilities;

- Transportation systems such as highways, airways and waterways;

- Utilities, water treatment plants, communications systems, power facilities;
- High potential loss facilities such as bulk fuel storage facilities; and
- Hazardous materials sites.

Other items to identify include economic elements, areas that require special considerations, historic, cultural and natural resource areas and other jurisdiction-determined important facilities.

3. *Risk Analysis* – The next step is to calculate the potential losses to determine which hazard will have the greatest impact on the jurisdiction. Hazards should be considered in terms of their frequency of occurrence and potential impact on the jurisdiction. For instance, a possible hazard may pose a devastating impact on a community but have an extremely low likelihood of occurrence. Such a hazard must take lower priority than a hazard with only moderate impact but a very high likelihood of occurrence.

For example, there might be several schools exposed to one hazard but one school may be exposed to four different hazards. A multi-hazard approach will identify such high-risk areas and indicate where mitigation efforts should be concentrated.

Currently there are insufficient funds and data with which to conduct an accurate risk analysis for all the hazards affecting Valdez. However, risk analysis information will be added as it is completed.

Vulnerability Assessment Methodology

The purpose of a vulnerability assessment is to identify the assets of a community that are susceptible to damage should a hazard incident occur.

Critical facilities are described in the Community Profiles Section of this hazard plan. A vulnerability matrix table of critical facilities as affected by each hazard is provided in Chapter 3 of this document.

Facilities were designated as critical if they are: (1) vulnerable due to the type of occupant (children, disabled or elderly for example); (2) critical to the community's ability to function (roads, power generation facilities, water treatment facilities, etc.); (3) have a historic value to the community (museum, cemetery); or (4) critical to the community in the event of a hazard occurring (emergency shelter, etc.).

This hazard plan includes an inventory of critical facilities from the records and land use map.

Federal Requirement for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201.6 (c) (2) include a requirement for a risk assessment. This risk assessment requirement is intended to provide information that will help the community identify and prioritize mitigation activities that will prevent or reduce losses from the identified hazards. The federal criteria for risk assessments and information on how the Valdez LHMP meets those criteria are outlined below:

Table 3. Federal Requirements

Section 322 Requirement	How is this addressed?
Identifying Hazards	Valdez city staff and community members identified natural hazards at community meetings, which were used in developing the Plan.
Profiling Hazard Events	The hazard-specific sections of the Valdez LHMP provide documentation for all natural hazards that may affect the City. Where information was available, the Plan lists relevant historical hazard events.
Assessing Vulnerability: Identifying Assets and Estimating Potential Losses of Critical Facilities	Vulnerability assessments for floods/erosion, severe weather, wildland fire, earthquakes, avalanches and tsunamis have been completed and are contained within the hazard chapter. Additional vulnerability assessments will be added as they are funded and completed.
Assessing Vulnerability: Analyzing Development Trends	The Community Profile Section and Chapter 3 include a description of development in Valdez.

Economic Analysis

FEMA and DHS&EM require that the city perform a benefit/cost analysis of mitigation projects when applying for grant funds for actual project. This section briefly outlines what a cost/benefit analysis entails and provides information on where to obtain information when the city applies for project specific grants.

Only mitigation options with essentially no cost can be accurately assessed at this time. The data necessary to conduct an accurate cost-benefit analysis of mitigation actions that require significant investments, such as engineering analysis or project design is not currently available, but will be added as resources allow further study.

Chapter 4, Mitigation Strategy, outlines Valdez's overall strategy to reduce its vulnerability to the effects of the hazards studied. Currently the planning effort is limited to the *natural* hazards determined to be of the most concern; flooding/erosion, severe weather earthquake, avalanche and tsunamis. Future additions could include *manmade* hazards such as technology, public health crisis or homeland security.

The City of Valdez will use the following FEMA required factors to prioritize mitigation project items should funding become available.

1. Extent the project reduces risk to life.

2. Extent to which benefits are maximized when compared to the costs of the project.

3. Project protects critical facilities or critical city functionality.
   A. Hazard probability.
   B. Hazard severity.

Please see specific projects, with baseline cost estimates in Chapter 4.

Valdez will prioritize projects and prepare mitigation grant applications as mitigation funding becomes available and as applicable to grant funding guidelines.

Benefit-cost analysis will be conducted as projects are submitted to DHS&EM for consideration.

FEMA 2006 Guidelines for Benefit-Cost Analysis

The following section is reproduced from a document prepared by FEMA, which demonstrates on how to perform a Benefit –Cost Analysis. The complete guidelines document, a benefit-cost analysis document and benefit-cost analysis technical assistance is available online http://www.fema.gov/government/grant/bca.

The purpose of the FEMA document is to provide information about how to perform Benefit-Cost Analysis (BCA) and provide proper documentation. BCA is the method by which the future benefits of a mitigation project are determined and compared to its cost. The end result is a Benefit-Cost Ratio (BCR), which is derived from a project's total net benefits divided by its total cost. The BCR is a numerical expression of the cost-effectiveness of a project. Composite BCRs of 1.0 or greater have more benefits than costs, and are therefore cost-effective.

Facilitating BCA

Although the preparation of a BCA is a technical process, FEMA has developed software, written materials, and training that simplifies the process of preparing BCAs. FEMA has a suite of BCA software for a range of major natural hazards: earthquake, fire (wildland/urban interface fires), flood (riverine, coastal A-Zone, Coastal V-Zone), Hurricane Wind (and Typhoon), and Tornado.

Sometimes there is not enough technical data available to use the BCA software mentioned above. When this happens, or for other common, smaller-scale hazards or more localized hazards, BCAs can be done with the Frequency Damage Method (i.e., the Riverine Limited Data module), which is applicable to any natural hazard as long as a relationship can be established between how often natural hazard events occur and how much damage and losses occur as a result of the event. This approach can be used for coastal storms, windstorms, freezing, mud/landslides, severe ice storms, snow, tsunami, and volcano hazards.

Applicants and Sub-Applicants must use FEMA-approved methodologies and software to demonstrate the cost-effectiveness of their projects. This will ensure that the calculations and methods are standardized, facilitating the evaluation process. Alternative BCA software may also be used, but only if the FEMA Regional Office and FEMA Headquarters approve the software.

To assist Applicants and Sub-applicants, FEMA has prepared the *FEMA Mitigation BCA Toolkit* CD. This CD includes all of the FEMA BCA software, technical manuals, BC training courses, Data-Documentation Templates, and other supporting documentation and guidance. The *Mitigation BCA Toolkit* CD is available free from FEMA Regional Offices or via the BC Help line at bchelpline@dhs.gov or toll free number at (866) 222-3580.

The BC Help line is also available to provide BCA software, technical manuals, and other BCA reference materials as well as to provide technical support for BCA.

For further technical assistance, Applicants or Sub-Applicants may contact their State Mitigation Office, the FEMA Regional Office, or the BC Help line. FEMA and the BC Help line provide technical assistance regarding the preparation of a BCA.

Identifying Cost-Effective Mitigation Projects

Applicants and Sub-Applicants are encouraged to consider the idea of "risk" when identifying and analyzing mitigation projects. Risk is simply the threat to the built environment (buildings and infrastructure) and people (casualties) expressed in terms of dollars. Risk depends both on the frequency and severity of natural hazards and on the vulnerability of the built environment and people. The highest risk situations have a combination of high hazard, high vulnerability, and high value of inventory (buildings, infrastructure, people) exposed to the hazard. This concept of risk is illustrated in the figure below (using structures as an example):

Figure 1. FEMA Cost-Benefit Analysis Hazard & Risk

HAZARD & RISK

Hazard Event (Frequency and Severity)	X	Property Exposed to the Hazard	=	Hazard Risk Dollars (S)
Probability of	X	Value and Vulnerability of	=	Severity of the Hazard Threat to the

Damaging Hazard Events	Property Exposed to the Hazard	Built Environment

While it is generally true that high-risk situations have the highest potential benefits, the cost-effectiveness of mitigation projects also depends directly on how much they cost and how effectively the proposed activity mitigates current hazard damages. The project BCR is a *comparison* of benefits to costs. Even in situations where risk appears relatively small, such as a rural culvert washing out every year, an inexpensive mitigation project may be highly cost-effective. Projects that mitigate “big” risk are not necessarily more cost effective.

Chapter 2: Community Profile

Community Overview

Current Population:	4,4354 (2006 State Demographer estimate)
Pronunciation:	val-DEEZ
Incorporation Type:	Home Rule City
Borough Located In:	Unorganized
Census Area:	Valdez/Cordova Census Area

Location

Valdez is located on the north shore of Port Valdez, a deep-water fjord in Prince William Sound. It lies 305 road miles east of Anchorage, and 364 road miles south of Fairbanks. It is the southern terminus of the Trans-Alaska oil pipeline. It lies at approximately 61.130830° North Latitude and -146.34833° West Longitude. (Sec. 32, T008S, R006W, Copper River Meridian.) Valdez is located in the Valdez Recording District. The area encompasses 222.0 sq. miles of land and 55.1 sq. miles of water.

Population

The state demographer estimated the 2006 population of Valdez at 4,354 people.

History and Culture

The Port of Valdez was named in 1790 by Senor Fidalgo for the celebrated Spanish naval officer Antonio Valdez y Basan. Due to its ice-free port, a town developed in 1898 as a debarkation point for men seeking a route to the Klondike gold fields. Valdez soon became the supply center of its own gold mining region, and incorporated as a City in 1901. Tsunamis generated by the 1964 earthquake hit the original city, killing several residents and destroying the waterfront. The community was rebuilt in a more sheltered location nearby. During the 1970's, construction of the Trans-Alaska oil pipeline terminal and other cargo transportation facilities brought rapid growth to Valdez.

The Richardson Highway was Alaska's first road, connecting Fairbanks in the Interior with tidewater at Valdez. It began as a trail for the gold stampeders of 1898, was later converted to a wagon road, and in 1913 was driven by an enterprising Alaskan named Bobby Sheldon in a Model T Ford. It has been open to vehicle traffic for more than 60 years.

Today's Richardson Highway (Alaska Route 4) is a modern, paved, two-lane highway open all year to vehicle traffic. The highway follows the routes of Captain William R. Abercrombie of the 2nd U.S. Infantry Abercrombie and General Wilds P. Richardson, first president of the Alaska Road Commission for whom the highway is named. The Richardson Highway travels up through Keystone Canyon, cresting the Chugach Mountains at 2,771-foot Thompson Pass. North from its junction with the Glenn

Highway, the Richardson crosses the Alaska Range at 3,000-foot Isabel Pass, before descending into Delta Junction, where it joins the Alaska Highway into Fairbanks. The ARC updated the road to automobile standards in the 1920s and continued to improve the road with new bridges, widening and rerouting, finally hard-surfacing the highway in 1957.

Valdez prospered as a commercial center, especially after gold and copper were discovered nearby. As with many other areas along the Gulf Coast, damage caused by the 1964 earthquake severely disrupted Valdez. In fact, much of the town was destroyed by an underwater landslide and subsequent sea wave. City fathers decided to move the town four miles west to a safer site.

Government and Population

Table 4. Community Information

Community Information	Contact Information and Type
Current Population:	4,296 (2006 State Demographer certified population)
Pronunciation:	val-DEEZ
Incorporation Type:	Home Rule City City of Valdez P.O. Box 307 Valdez, Alaska 99686 Phone: (907) 835-4313 Email: csmith@ci.valdez.ak.us Website: http://www.ci.valdez.ak.us
Borough Located In:	Unorganized
Native Tribe:	Valdez Native Tribe
Census Area:	Valdez/Cordova
School District:	Valdez City Schools

Community Assets

This section outlines the resources, facilities, and infrastructure that, if damaged, could significantly impact public safety, economic conditions, and environmental integrity of Valdez.

Critical Facilities: Those facilities and infrastructure necessary for emergency response efforts.

- Valdez Container Terminal
- Alyeska Oil Terminal
- Valdez Airport

Essential Facilities: Those facilities and infrastructure that supplement response efforts.

- Designated Shelters
- City Hall Buildings
- Bulk Fuel Storage Tank Farm

Critical Infrastructure: Infrastructure that provides services to Valdez.

- Telephone lines
- Power lines
- Transportation networks
- Wastewater collection
- Water wells

Vulnerable Populations: Locations serving population that have special needs or require special consideration.

- Schools
- Valdez Senior Center and Housing
- Hospital
- Assisted Care Facilities

Cultural and Historical Assets: Those facilities that augment or help define community character, and, if lost, would represent a significant loss for the community.

- Valdez Community Center
- Museum Valdez Museum & Archives

Community Resources

This section outlines the resources available to Valdez for mitigation and mitigation related funding and training.

Federal Resources

The federal government requires local governments to have a hazard mitigation plan in place to be eligible for funding opportunities through FEMA, such as through the Pre-Disaster Mitigation Assistance Program and the Hazard Mitigation Grant Program. 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 the FEMA Publication Warehouse (1-800-480-2520) and are briefly described below:

- **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 mirror the four major phases of hazard mitigation planning used in the development of the Newtok Hazard Mitigation Plan. 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 Disaster Mitigation Act (DMA) 2000 requirements (http://www.fema.gov/fima/planhowto.shtm).

- **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.

- **Mitigation Resources for Success CD.** FEMA 372, September 2001. This CD contains a wealth of information about mitigation and is useful for state and local government planners and other stakeholders in the mitigation process. It provides mitigation case studies, success stories, information about Federal mitigation programs, suggestions for mitigation measures to homes and businesses, appropriate relevant mitigation publications, and contact information.

- **A Guide to Federal Aid in Disasters.** FEMA 262, April 1995. When disasters exceed the capabilities of state and local governments, the President's disaster assistance program (administered by FEMA) is the primary source of federal assistance. This handbook discusses the procedures and processes for obtaining this assistance, and provides a brief overview of each program.

- **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 Newtok businesses.

- **Department of Agriculture.** Assistance provided includes: Emergency Conservation Program, Non-Insured Assistance, Emergency Watershed Protection, Rural Housing Service, Rural Utilities Service, and Rural Business and Cooperative Service.

- **Department of Energy, Office of Energy Efficiency and Renewable Energy, Weatherization Assistance Program.** 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.

- **Department of Housing and Urban Development, 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.

- **Department of Housing and Urban Development, Community Development Block Grants.** Administered by the Alaska DCCED, Division of Community Advocacy. 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.

- **Department of Labor, 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.

- **Federal Financial Institutions.** Member banks of the Federal Deposit Insurance Corporation (FDIC) or Federal Home Loan Bank Board (FHLBB) may be permitted to waive early withdrawal penalties for Certificates of Deposit and Individual Retirement Accounts.

- **Internal Revenue Service, Tax Relief.** Provides extensions to current year's tax return, allows deductions for disaster losses, and allows amendment of previous tax returns to reflect loss back to three years.

- **United States Small Business Administration (SBA).** May provide low-interest disaster loans to individuals and businesses that have suffered a loss due to a disaster. Requests for SBA loan assistance should be submitted to the Alaska DHS&EM.

The following are websites that provide focused access to valuable planning resources for communities interested in sustainable development activities.

- **Federal Emergency Management Agency,** 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,** http://www.planning.org – is 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,** http://ibhs.org – an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters. Online resources provide information on natural hazards, community land use, and ways citizens can protect their property from damage.

State Resources

- **Alaska DHS&EM** is responsible for coordinating all aspects of emergency management for the State of Alaska. Public education is one of its identified main categories for mitigation efforts.

  Improving hazard mitigation technical assistance for local governments is high priority item for the State of Alaska. Providing hazard mitigation training, current hazard information, and the facilitation of communication with other agencies would encourage local hazard mitigation efforts. DHS&EM provides resources for mitigation planning on their website at http://www.ak-prepared.com.

- **DCCED, Division of Community Advocacy:** Provides training and technical assistance on all aspects of the National Flood Insurance Program (NFIP) and flood mitigation.

- **Division of Senior Services:** Provides special outreach services for seniors, including food, shelter, and clothing.

- **Division of Insurance:** Provides assistance in obtaining copies of policies and provides information regarding filing claims.

- **Department of Military and Veteran’s Affairs:** Provides damage appraisals and settlements for Veterans Administration (VA)-insured homes, and assists with filing for survivor benefits.

Other Funding Sources and Resources

- **Real Estate Business.** Real estate disclosure is required by state law for properties within flood plains.

Regulatory Tools (ordinances, codes, plans)	Local Authority
Building code	Yes
Zoning ordinance	Yes
Subdivision ordinance or regulations	Yes
Special purpose ordinances (floodplain management, stormwater management, hillside or steep slope ordinances, wildfire ordinances, hazard setback requirements)	Yes
Growth management ordinances (also called "smart growth" or anti-sprawl programs)	No
Site plan review requirements	Yes
Comprehensive plan	Yes
A capital improvements plan	Yes
An economic development plan	Yes
An emergency response plan	Yes
A post-disaster recovery plan	No
Real estate disclosure requirements	Yes

- **American Red Cross.** Provides for the critical needs of individuals such as food, clothing, shelter, and supplemental medical needs. Provides recovery needs such as 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.

Local Resources

Valdez has a variety of planning and land management tools that will allow it to implement hazard mitigation activities. The resources available in these areas have been assessed by the City, and are summarized in the following tables:

Table 5. Legal and Technical Capability

Table 6. Fiscal Capability

Financial Resources	Accessible or Eligible to Use (Yes or No)
Community Development Block Grants (CDBG)	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for sewer/sewer	Yes
Impact fees for homebuyers or developers for new developments/homes	No
Incur debt through general obligation bonds	Yes
Incur debt through special tax and revenue bonds	Yes
Incur debt through private activity bonds	No
Withhold spending in hazard-prone areas	No

Table 7. Administrative and Technical Capability

Staff/Personnel Resources	Y/N	Department/Agency and Positions
City Manager	Yes	Administration, 2 additional staff members
Community and Economic Development Director	Yes	Community and Economic Development (CED) - 2 additional staff members
Fire Chief/Fire Department	Yes	Chief and 10 Firefighters, 63 Volunteer Firefighters, EMS, Haz Mat
City Clerk	Yes	City Clerk Department
Public Works Director	Yes	Street Maintenance, Vehicle Maintenance, Solid Waste, and Water/Wastewater Treatment, 20 employees
Librarian	Yes	Valdez Consortium Library, a combined public/college library
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Yes	Public Works Dept.
Planners or Engineer(s) with an understanding of natural and/or human-caused hazards	Yes	Fire Chief, Community and Economic Development Director, Planning Tech.
Floodplain manager	Yes	CED, Planning Tech.
Surveyors	Yes	Public Works Dept.
Emergency manager	Yes	City Manager Fire Chief, Police Chief
Grant writers	Yes	Administration, CED
Environmental Advisory Council	Yes	Regional Citizens Advisory Council

Chapter 3: Hazards

DHS&EM Matrices

Table 8. Hazard Matrix

Valdez/Cordova Census Area					
Flood	**Wildland Fire**	**Earthquake**	**Volcano**	**Avalanche**	**Tsunami & Seiche**
Y-H	Y –M	Y-M	U	Y-H	Y-M
Severe Weather	**Landslides**	**Erosion**	**Drought**	**Technological**	**Economic**
Y-H	Y-H	Y-H	U	Y-L	U

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 : L= Low: Hazard is present with a low probability of occurrence, event has a 1 in 10 years chance of occurring.
M : M= Hazard is present with a moderate probability of occurrence; event has a 1 in 3 years of occurring.
H: H= Hazard is present with a high probability of occurrence, 1 in 1 year.

Source: Alaska State All-Hazards Plan, 2007

Table 9. Previous Occurrences of Hazards 1978 – Present

Valdez/Cordova Census Area					
Flood	**Wildland Fire**	**Earthquake**	**Volcano**	**Avalanche**	**Tsunami & Seiche**
6 - L	0	2 - L	0	1 - L	2 – L
Severe Weather	**Ground Failure**	**Erosion**	**Drought**	**Technological**	**Economic**
2 - L	1 – L	0	0	0	0

Extent **Z** - Zero - Used for historical information. An event occurred but may not have caused damage or loss.
L - Limited – Minimal through maximum impact to part of community. *Falls short of the definition for total extent*.
T - Total – Impact encompasses the entire community.
Number: Number of occurrences

Source: Alaska State All-Hazards Plan, 2007

Identification of Assets and Vulnerability

The Hazard Vulnerability Matrix below lists the City of Valdez facilities, utilities and transportation systems. The dollar values listed below are from the December 31, 2005 Financial Report for the city. The list is provided to identify city assets and provide an indication of each asset's vulnerability to natural hazards.

All structures that were located in the avalanche zone were relocated, demonstrating the city's proactive approach to hazard mitigation.

Table 10. City of Valdez Asset and Hazard Vulnerability Matrix – Structures and Infrastructure

Facility	Acquire Date	Life Span	2006 Dollar Value	Flood/ Erosion	Severe Weather	Wildland Fire	Earth-quake	Tsunami
City Hall New	1979	100	289,403		X		X	
City Hall Old	1964	100	44,783		X		X	
City Council Chambers	1967	100	43,974		X		X	
Jail	1979	100	140,921		X		X	
Police Admin	1979	100	93,947		X		X	
Fire Hall	1979	100	108,016		X		X	
Fire Station 4	1983	100	72,675		X		X	
Fire Station 3	1983	100	41,522		X		X	
Fire Station 2	1969	100	24,500		X		X	
Law Enforcement	1979	100	35,102		X		X	
Animal Control	1977	100	45,683		X		X	
Library	1979	100	469,701		X		X	
Civic Center	1982	100	3,601,699		X		X	
Teen Center	1983	100	422,749		X		X	
Recreation Hall	1975	100	120,131		X		X	
Senior Center	1980	100	1,024,822		X		X	
Teen Ctr remodel	2003	75	30,093		X		X	
Library Climate Ctrl	2003	40	239,621		X		X	
Robe River RR	2003	10	21,425	X	X		X	
Cottonwood RR	2003	10	56,425		X		X	
Dock point RR	2004	10	83,368		X		X	
Alpine Woods RR	2004	10	23,595	X	X	X	X	
Civic Center Painting	2005	20	222,541		X		X	
Camps, etc	1985	30	1,996,830		X	X	X	
Pool	2001	30	3,107,164		X		X	
Ball Fields	1983	100	47,558		X		X	
Civic center parking lot	2003	100	91,358		X		X	
Ice Rink portable	2003	10	2,802		X		X	
Unfer field drainage	2003	100	13,726		X		X	
Black Gold park strip	2003	100	43,160		X		X	

Facility	Acquire Date	Life Span	2006 Value	**Flood/ Erosion**	**Severe Weather**	**Wildland Fire**	**Earth-quake**	**Tsunami**
Alpine Woods park	2003	40	39,033	X	X	X	X	
Crooked Ck deck view	2003	25	14,648	X	X	X	X	
Richardson bike trail	2003	5	136,787	X	X	X	X	
Salcha way	2004	5	104,819		X		X	
King Pond	2004	25	204,280		X		X	
Maint Shop 2	1981	100	402,271		X		X	
Maint Shop 1	1981	100	103,503		X		X	
Baler	1991	100	775,137		X		X	
Warehouse #1	1967	100	795,066		X		X	
Warehouse #2	1967	100	121,580		X		X	
Fire Station 3&4	2003	100	51,582		X		X	
Baler doors	2003	15	79,311		X		X	
Shop HVAC	2003	40	80,624		X		X	
Senior Ctr windows	2003	25	23,408		X		X	
Senior Ctr HVAC	2003	40	82,196		X		X	
Mobile park bus shelter	2003	20	10,200		X		X	
Senior Center Roof	2005	50	2,049		X		X	
Bailer Water Fire Improvements	2005	20	18,997		X		X	
Maint Shop 2	1981	100	402,271		X		X	
City Dock Office	1967	100	5,907	X	X		X	X
Scale House	1967	100	9,117	X	X		X	X
City Dock, etc	1965	50	202,697	X	X		X	X
Grain Silos	1982	50	217,721	X	X	X	X	X
Container Dock	1982	50	26,000,000	X	X	X	X	X
VCT Causeway and Dock Lights	2005	50	69,521	X	X	X	X	X
Harbor Building # 1	1969	100	9,068	X	X		X	X
Harbor Building # 2	1969	100	520,257	X	X		X	X
Harbor Building #3	1969	100	10,251	X	X		X	X
SBH HVAC	2005	15	5,040	X	X		X	X
A float	2000	30	728,333	X	X		X	X
D float	1966	39	-	X	X		X	X
E float	1966	39	-	X	X		X	X
E. Laydown	2001	30	169,931	X	X		X	X
F float	1978	30	11,094	X	X		X	X
Fishermen Dock	1989	50	780,087	X	X		X	X
G float	1978	30	8,875	X	X		X	X
H float	1985	30	178,340	X	X		X	X
Boardwalks, plazas, etc	1985	30	11,094	X	X		X	X
I float	1985	30	178,340	X	X		X	X
J float	1985	30	178,340	X	X		X	X
K float	1985	30	178,340	X	X		X	X

Facility	Acquire Date	Life Span	2006 Value	Flood/ Erosion	Severe Weather	Wildland Fire	Earth-quake	Tsunami
Launch ramp	1986	30	120,000	X	X		X	X
Boat lift dock	1982	30	81,667	X	X		X	X
M float	1985	30	495,880	X	X		X	X
Kobuck Park	2001	30	150,069	X	X		X	X
Tour Bt Dock	1987	28	199,143	X	X		X	X
Upland Boat Yard	2001	30	480,000	X	X		X	X
Fish Clean station	2000	30	283,915	X	X		X	X
Small Boat Harbor	2003	30	1,641,728	X	X		X	X
Pump Station 1	1983	100	808,106	X	X		X	X
Pump Station 2	1983	100	5,706	X	X		X	X
Pump Station 3	1983	100	7,420	X	X		X	X
Pump Station 4	1983	100	540,880	X	X		X	X
Mineral Creek Pump	1983	100	556,512	X	X		X	
Robe River Pump	1983	100	545,245	X	X		X	
Senior Center Pump	2003	100	1,106,496		X		X	
Sewer Plant	1979	100	65,593		X		X	
Pump 1 Aer. Building	1979	100	4,715		X		X	
Lift Stat 1	1979	100	5,994		X		X	
Lift Stat 2	1979	100	3,710		X		X	
Lift Stat 3	1979	100	3,710		X		X	
Lift Stat 4	1979	100	3,286		X		X	
Basic Infras. Harbor	1979	50	6,908,830		X		X	
Robe River Sewer line extension	2003	50	7,854	X	X	X	X	
Loop water design	2003	50	2,858,780	X	X		X	
Airport	1982	100	2005 Value 1,732,500		X	X	X	
Access Control	2006	10	2005 Value 33,373		X	X	X	
Fire suppression	2003	75	2005 Value 142,081		X	X	X	
Museum	1977	100	2005 Value 210213		X		X	
Jr High & High School	1965	100	2,067,875		X		X	
Herm Hutch	1979	100	4,510,625		X		X	
HH Utility	1979	100	10,488		X		X	
Admin Bldg	1979	100	355,964		X		X	
School conditions	2003	100	56,947		X		X	
Middle Sch improv	2003	50	56,138		X		X	
Jr High survey	2003	40	41,978		X		X	
School plumbing	2003	40	26,148		X		X	
Roof repair	2004	20	1,244,319		X		X	
HH Roof Replace	2005	50	21,074		X		X	
HS Park ADA	2005	70	29,079		X		X	
Gilson Med.	1995	100	859,564		X		X	
Hospital Construction	2005	100	25,313,411		X		X	

The following table is also from the City financial report dated December 31, 2005. It is included here to document the value of the city streets in Valdez. Vulnerability to each natural hazard is not applicable since streets are not in a fixed location.

Table 11. City of Valdez Dollar Value of Streets

STREETS			
Road Type	Linear Feet	Cost Ft	Total Dollar Value
Gravel Only	39,640	85	3,369,400
Asphalt Curb & Sidewalk	51,129	348	17,792,892
Asphalt No Curb/sidewalk	20,724	224	4,642,176
Asphalt Curb No Sidewalk	8,252	348	2,533,364
Asphalt Sidewalk No Curb	7,401	265	1,961,265
	127,146		30,299,097

Valdez's Vulnerability to Identified Hazards:

In summary the natural hazards of flood/erosion, severe weather (high winds and snowfall specifically) and earthquake could potentially impact any part of Valdez.

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.

A severe weather event would create an area wide impact and could damage structures and potentially isolate Valdez from the rest of the state.

Earthquake damage would be area-wide with potential damage to critical infrastructure up to and including the complete abandonment of key facilities. Priority would have to be given critical infrastructure to include: public safety facilities, health care facilities, shelters and potential shelters, and finally public utilities.

Avalanche and landslide danger is limited primarily to the identified avalanche zones and steep slope areas. Tsunami damage would impact the structures and infrastructure within one mile of the coastline.

Wildland fire would directly impact the critical facilities list on Table 10, but since Valdez is heavily forested, wildland fire vulnerability is area wide. A serious wildland fire could potentially isolate Valdez from the rest of the state.

Section 1. Floods and Erosion

Hazard Description and Characterization

Types of Flooding in Valdez

Flood hazards in Valdez include storm surges, voluminous rainfall, snow and glacier melt and release of glacier-dammed lakes.

Storm Surge Flooding

Storm surges are relatively long-term, local increases in water level resulting from offshore storms. Maximum hazard results when such a surge coincides with a maximum tide.

Rainfall, Snowmelt, Glacier Melt Flooding

Floods occur in rivers as a result of a large input of water to the drainage basin in the form of rainfall, snowmelt, glacier melt, or a combination of these inputs. In the Valdez area, as well as most coastal areas of Southcentral and Southeast Alaska, the floods due to snowmelt are typically lower in magnitude than those due to rainstorms in late summer or fall. Glacier melt is typically largest in late summer, increasing the potential magnitude of late summer rainfall floods in glacial streams.

Flood and Erosion Hazards

Deposition

Deposition is the accumulation of soil, silt, and other particles on a river bottom or delta. Deposition leads to the destruction of fish habitat and presents a challenge for navigational purposes. Deposition also reduces channel capacity, resulting in increased flooding or bank erosion.

Erosion

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.

Stream bank erosion involves the removal of material from the stream bank. When bank erosion is excessive, it becomes a concern because it results in loss of streamside vegetation, loss of fish habitat, and loss of land and property. This also can cause undermining of bridge supports.

Contaminated water

Floodwaters pose a health hazard by picking up contaminants and disease as they travel. Outhouses (although rare in Valdez) sewers, septic tanks, and dog yards are all potential sources of disease transported by floodwaters. Individual wells in Valdez could be contaminated during flood events. The private well systems must be tested and disinfected after a flood. Lack of a water source is a significant concern for flood victims, especially if the flood has been extensive enough to contaminate the public water supply. In such a case, outside bottled water is at times the only source of clean water.

Local Flood and Erosion Hazard Identification

Riverine and glacier-dammed outburst flooding have historically occurred on Valdez Glacier Stream, Lowe River and Mineral Creek. All activities within the floodway and floodway fringe are subject to the Valdez Flood Plain Management Ordinance. Gravel extraction within the floodway and floodway fringe, if conducted improperly, could cause the Valdez Glacier Stream to seek a new channel. Downstream damage from such an occurrence could be substantial.

The main riverine flows in the developed and developable areas of Valdez come from three sources: Valdez Glacier Stream, Mineral Creek, and Lowe River. In addition, development has occurred adjacent to Robe River, and has been planned adjacent to Corbin and Slater Creeks. The flood boundaries of these and the other waterways have been indicated on the attached flood plain map. Floodways extending beyond the limits of the Valdez Flood Study area (Keystone Canyon, Upper Mineral Creek) have not been mapped.

The City of Valdez is exposed to the hazard of combined storm surge/high tide flooding due to winter storms in the Gulf of Alaska. Factors affecting storm surges include coastline topography and climatologically characteristics, such as atmospheric pressure, speed and direction of the storm center relative to the coastline, and the stage of frontal development. Storm surges at Valdez may be affected by local conditions such as the dissipative effect of flow through Valdez Narrows or the potential effects of local winds amplifying or damping the water level of the storm surge.

Estimated combined storm surge and tide elevation in Port Valdez with a 100-year recurrence interval is 10.6 feet above sea level. Such flooding can occur along the entire Port Valdez shoreline. Because of the steep terrain, the area affected by the hazard is generally small. The relatively flat land of the river deltas allows for greater flooding.

The primary factors that affect the magnitude of riverine flooding include the size of the drainage basin contributing flow to the river; the amount and distribution of the precipitation that falls on the basin; the size and location of lakes, wetlands, or other water storage basins within the drainage basin; and the size and location of glaciers within the drainage basin. Frequent river flooding should be expected in the unvegetated flood plains of all the rivers in the area. Less frequent flooding occurs in overbank areas adjacent to the rivers. Glacier-damned lake release can cause significant flooding. The glacier-dammed lakes form when a stream is blocked by a glacier. Flooding occurs when lake water develops an escape route through, under, or over the glacier dam. The escape route enlarges, allowing the lake to drain rapidly.

Little is known about factors affecting flooding from glacier-dammed lakes. Some potential factors include the mechanism by which the lake releases, the volume of water in the lake, and the route through which the lake water travels before reaching the area subject to flooding. The frequency of glacier-dammed lake releases is likely related to the time necessary for the lake to fill and for a drainage channel to become blocked, and the position and movement of the damning glacier.

Estimates of flood discharges resulting from glacier-damned releases combined with potential concurrent rainstorm floods in the basins of Valdez Glacier Stream and Lowe River are 46,000 cubic feet per second (cfs) and 59,900 cfs, respectively.

The City of Valdez participates in the National Flood Insurance Program (NFIP). The function of the National Flood Insurance Program is to provide flood insurance to homes and businesses located in floodplains at a reasonable cost. In trade, the City of Valdez regulates new development and substantial improvement to existing structures in the floodplain. The program is based upon mapping areas of flood risk, and requiring local implementation to reduce flood damage primarily through requiring the elevation of structures above the base (100-year) flood elevations. Flood Insurance Rate Map (FIRM) Zones are explained in the following table.

Table 12. FIRM Zones

Firm Zone	***Explanation***
A	Areas of 100-year flood; base flood elevations and flood hazard not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet, average depths of inundation are shown but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.
C	Areas of minimal flooding.
D	Areas of undetermined, but possible, flood hazards.

Flood hazard high velocity zones (zones with an A in the table above) in the community encompass only a few areas within the Valdez city limits. These areas are Alpine Woods, two lots in Robe River and some undeveloped land.

In 1984 Woodward-Clyde Consultants prepared *ALPINE WOODS ESTATES DETAILED FLOOD EVALUATION* for the City of Valdez. The report makes the following finding, which reproduced from that study.

Flooding of the Alpine Woods Estates is primarily a function of flood discharge, channel shifting and logjams. When the main channel of the Lowe River is near the subdivision, flooding may occur in the subdivision at relatively low discharges. For example, the May 1983 flow of 3200 cfs was sufficient to cause localized flooding. However, the 1982 flood flow of 15.000 cfs was less than one-third of the 1981 peak flows of 49,000 cfs. No flooding was observed in the 1981 flood because the main channel was on the far side of the floodplain. Should the main river channels shift and remain on the far side of the floodplain, the subdivision could be trouble-free for many years. Such changes are, unfortunately, impossible to predict.

The 1989 *Evaluation of Stream Stability in the Valdez, Alaska Area*. Prepared by GEOMAX, P.C. for the City of Valdez details in engineering terms the flood potentials of Lowe River, Valdez Glacier Creek and Mineral Creek. Brief excerpts from that report, edited only for ease of reading, follow.

It was observed that Lowe River was almost universally pulled to areas where riprapping or rock structures had been placed in the floodplain. This was first observed where the bank had been riprapped upstream from the small secondary road crossing. From there, the river moves across the floodplain to a riprapped section of the Alaska pipeline. The channel then is drawn back across the floodplain to the rock structures, which have been placed in front of the Alpine Woods Subdivision. Next the stream continues northwesterly until it reaches the riprapped section of the highway. Downstream from this location the channel seems to generally follow its old path until it reaches the bridge crossing for the highway, which connects Valdez with the oil terminal. The channel is drawn to riprap or Jetties on both Glacier Creek and Mineral Creek in a similar fashion.

The following specific site descriptions for Lowe River will begin at the mouth of Keystone Canyon and continue downstream. The river develops very high velocity as its flows through Keystone Canyon. Because of the steep gradient the river displays an erosive pattern. As soon as the river leaves the canyon however, the grade flattens abruptly and the pattern immediately changes to a braided condition after it flows underneath the secondary road bridge. Extreme scouring has occurred along the riprap and threatens to cause damage to both the riprap and the downstream bridge. A possible solution would be the use of barbs in this area to keep the stream from attacking the riprap and bridge abutments. This treatment also would be desirable along the riprap projects along the Alaska pipeline.

Valdez Glacier Stream in the vicinity of the Richardson Highway Bridge has serious instability problems. There is a large dike extending northeasterly along a secondary road, which joins the highway. The stream has been pulled to the road by turbulence along the riprap. The stream then makes a perpendicular bend paralleling the highway before it passes underneath the Richardson Highway Bridge. This portion or stream has numerous places where the riprap has already railed by toe scour. The stream is folded in on the bridge and makes an extreme right angle entry under the bridge, which has caused a gravel bar to form along the inside or the bend. This deposition seriously reduces the capacity of the already undersized bridge opening. Higher velocities and turbulences develop on the outside or the bend as a result. Loss or bridge capacity is critical because Glacier Creek is subject to periodic surge release flooding. Measures should be taken to maintain adequate bridge capacity so that the highway will not be jeopardized. Again, the use of bank barbs might be the most cost effective method or reestablishing a more typical braided flow through this reach, thereby improving the bridge entry.

Mineral Creek entering into Valdez harbor has produced a typical fan-delta with one modification. There is a significant bedrock outcrop, which lies off the mouth of Mineral Creek in the bay. At the present time the fan delta has entirely filled the area between the mouth of the Mineral Creek Canyon and this bedrock outcrop. The new Valdez townsite lies between the bedrock outcrop and the mouth of Mineral Creek on a portion of the fandelta. Before development occurred, Mineral Creek moved laterally filling the area on both sides of the bedrock outcrop. Presently a diking system has been installed which keeps Mineral Creek confined to the northwestern part or the fan-delta. For some time there has been a bridge crossing Mineral Creek near the mouth or the canyon, but recently a new, larger bridge was built well out on the fan delta. This bridge allows access to the western half of the fan delta. It is clear that strong developmental pressures are occurring which could result in more construction of houses and increased density in this area.

In summary it must be stressed that the State of Alaska possesses extreme geological conditions not found in other states, which require special analysis to ensure that long-term stability is obtained. Alaska is now coming of age and it is time for a more considered and long-term view of development. The general public must be informed of the risks and provided with the development of a sound future so that they may participate in the development of a sound future for the state and area. (GEOMAX)

Table 13. Land Use Types Located in the High Velocity Flood Zones

Land Use Type	Number of Uses
Residential	< 50 homes
Commercial	< 10 commercial business
Public	0 public structures, some utilities

Source: Valdez CED Department

The following table compares the Valdez community NFIP with state figures.

Table 14. NFIP Statistics

Emergency Program Date Identified	**Regular Program Entry Date**	**Map Revision Date**	**NFIP Community Number**	**CRS Rating Number**	**Total # of Current Policies (07/31/06)**
5/12/1975	9/3/1980	12/1/1983	020094	9	26
Total Premiums	**Total Loss Dollars Paid**	**Average Value of Loss**	**AK State # of Current Policies**	**AK State Total Premiums**	**AK Total Loss Dollars Paid**
$13,127	$34,859	$11,620	2,559	$1.6 million	$3.4 million
Valdez Average Premium	**AK State Average Premium**	**Repetitive Loss Claims**	**Dates of Rep. Losses**	**Total Rep. Loss**	**Average Rep. Loss**
$504	$629	1 property – 3 losses	1994 1986 1981	$34,859	$11,620

Valdez Floodplain Coordinator	Carol Smith P.O. Box 307 Valdez, AK 99686 Phone:(907) 835-3427 Email: csmith@ci.valdez.ak.us
State of AK Floodplain Coordinator	Taunnie Boothby, Floodplain Management Program Coordinator Department of Commerce, Community & Economic Development Division of Community Advocacy 550 W. 7th Avenue, Suite 1640 Anchorage, AK 99501 (907) 269-4567 (907) 269-4563 (fax) Website: http://www.commerce.state.ak.us/dca/nfip/nfip.htm

Source: DCCED, DCA, Floodplain Management

Previous Occurrences of Flooding/Erosion

There have many instances of Lowe River, Valdez Glacier Creek and Mineral Creek flooding. The following list the most significant and events that have been recorded.

Alpine Woods Subdivision is the only subdivision within the high velocity flood zone and often has localized flooding.

96-180 Southcentral Fall Floods declared September 21, 1995 by Governor Knowles, FEMA declared (DR-1072) on October 13, 1996: On September 21, 1995, the Governor declared a disaster as a result of heavy rainfall in Southcentral Alaska an 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 Valdez, 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.

00-191 Central Gulf Coast Storm declared February 4, 2000 by Governor Murkowski, 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.

October 10 –13, 2006

The City of Valdez suffered a major flooding event October 10 – 13, 2006, the following press releases, situation reports and a newspaper graphically describe the event.

DHS&EM Situation Report, October 11, 2006

Valdez:
- The Whittier tunnel will have extended hours of operation.
- Daily Ferry service was established between Whittier and Valdez. Dot Website: http://www.dot.state.ak.us/
- Trans Alaska Pipeline has restarted at 1:40pm, 10 October following an unscheduled shutdown due to communication failure with 5 Remote Gate Valves (RGV).
- Valdez Marine Terminal ferrying employees by boat.
- Allison Creek Bridge is opened for emergency traffic.
- Richardson Highway closed from Milepost 12 to Milepost 79 and Copper River Hwy MP 13 to MP 48.8; extensive damage in multiple locations. It is unknown at this time when it will reopen to traffic, possible 7-10 days out. Stranded travelers are staying at local lodges and DOT highway camps. Valdez is isolated – no road access.
- Valdez airport is open.
- Schools are open.
- Water levels are dropping and residents are returning to their homes.
- No one is staying in the local shelter.
- Approximately 60 to 80 homes were damaged by floodwaters.

CITY OF VALDEZ, ALASKA
PRESS RELEASE
OCTOBER 11, 2006
0900 HRS

The Valdez Fire Department and Public Works Department have reported that flood waters in Alpine Woods subdivision have receded. The evacuation order for Alpine Woods has been cancelled. Residents are advised that they can return to their homes. The City of Valdez and Alaska Department of Transportation will continue to monitor the area and assess any damage to roadways and public infrastructure in the area. Residents should use caution when traveling on access roads due to water damage and erosion.

Residents in the Alpine Woods area should continue to boil water used for drinking, cooking, hand or dish washing for at least 2 minutes. For information on disinfecting, where to have your water tested, or your sewer system monitored to detect damage, call DEC's Wasilla Office at 907-376-1850.

Alaska Department of Transportation reports that bridge inspectors should be arriving in Valdez within the next few days to perform inspections of damage to bridges in Keystone Canyon. The Richardson Highway remains closed into Valdez.

Sheri Pierce, PIO
City of Valdez

The National Weather Service in Anchorage has extended the flood warning for small streams in the northeastern Prince William Sound area of Alaska, including the city of Valdez, until 8 am Wednesday. At 11:30 am the flood warning for the Valdez area has been extended until 8 am Wednesday. Moderate to heavy rain has continued to fall in the Prince William Sound area this morning. Flooding has been reported near 10 mile and water and rock and mudslides have resulted in the closure of the Richardson Highway through Keystone Canyon. The rain is expected to diminish in intensity later this afternoon and this should result in receding water levels.

Anchorage Daily News (Alaska)
October 11, 2006
Section: Main
Edition: Final
Page: A10

Record rainfall, mudslides and snowmelt are hammering Valdez, where breached levees Tuesday prompted the evacuation of some 200 residents, and others remained stranded after officials closed nearly 70 miles of the Richardson Highway. The wet, windy, unseasonably warm weather has walloped Southcentral communities like Valdez, Seward, and Cordova for days. In the Matanuska-Susitna Borough, officials said while water rose along some troublesome creeks and rivers, no waterway reached flood stage. The Richardson closure stranded at least six travelers at a highway maintenance station at Thompson Pass. At least eight others holed up at Rendezvous Lodge farther north, where state officials measured about 6 inches of rainfall in 24 hours.

Waters outside Valdez Alpine Woods subdivision slopped over the Lowe River Dike. The city told people to get out, as the Red Cross set up a shelter at George Gilson Junior High School. Storms cut off at least 10 homes in Heiden View, a smaller subdivision north of the city, where Matt Kinney runs the Thompson Pass Mountain Chalet.

“ The creeks here look like turbine jets," Kinney said. "When I walk out my door, it's thunderous. I'm looking out at probably 20 waterfalls coming down from 6,000 feet."

Valdez sits on the north shore of Port Valdez in Prince William Sound. It's a 305-mile drive from Anchorage, and the southern terminus of the trans-Alaska oil pipeline. Its 4,400 residents can leave only by airplane, the state ferry or the Richardson.

That road took a beating the past few days. The National Weather Service said 6.5 inches of rain fell Sunday and Monday at Valdez -- 4.6 inches Monday alone, breaking the city's 24-hour record. Spots along the closed section of highway -- from 12 miles northwest of Valdez to milepost 79 -- recorded even greater accumulations.

The Alaska Department of Transportation decided to close that stretch late Monday, with entire sections slathered over with mud and debris and uprooted trees, or drowned beneath standing water. Floods washed away Mineral Creek Bridge, which leads to a subdivision west of town. Bridges on the Richardson Highway at Keystone Canyon were also damaged or in danger including one that was moved five feet, according to Shannon McCarthy, spokeswoman for the DOT's northern region.

Road repairs won't happen soon, she said. "We're not talking about a matter of hours. We're definitely talking about a matter of days."

The city depends largely on trucks to haul supplies like groceries to its stores, so the marine highway system is beefing up ferry routes. The boat trip from Whittier to Valdez takes about five hours.

Marine highway officials Tuesday also got the OK to open the Whittier Tunnel as needed, to swiftly get supplies through, said Mike Chambers, a DOT spokesman.

Flooding hit Valdez just as the Alaska Travel Industry Association kicked off its annual conference, with hundreds of visitors and speakers expected, said Dave Worrell, ATIA's communications director. Getting there was a challenge. Era Aviation canceled all flights to the city Monday and turned one around Tuesday because of problems with weather and ground navigation equipment, said Paul Landis, Era president.

Era is adding flights to get people in and out of Valdez, Landis said.

Worrell left Anchorage Sunday, and enjoyed a beautiful drive to Valdez. Colleagues weren't so lucky, he said. One bus came within 50 miles of Valdez early Tuesday morning when road crews turned it around.

People live along the highway, McCarthy said, "And we don't know what the full extent is of people stranded. ... This is kind of an old fashioned rescue."

Valdez is similarly drenched. The city recorded 22 inches of rain in two days, and Mayor Tim Joyce declared a local disaster for the second time in two months due to flooding.

The town of about 2,300 sits at the southeastern end of Prince William Sound, 52 air miles southeast of Valdez.

" We had high waters in August that covered our city airport, washed out roads, and ... this flood this time is probably a foot and a half deeper than that," Joyce said. "Our main river and lake system in town is called Eyak Lake and Eyak River, and it's up to 50 or 100-year flood levels."

The same areas devastated by the August floods -- and since repaired -- are washed out again, Joyce said. The entire 48.8 mile Copper River Highway that runs northeast from Valdez is closed, cutting Valdez off from its landfill and its hydropower plant.

The city airport's runway is awash with 3 feet of water, Joyce said. Homes near 6 mile by Eyak Lake are flooded.

" Those people are all on well water, so their wells have been contaminated," Joyce said. "Their septic tanks and fuel tanks have all flooded. We have diesel seeping out of underground fuel tanks. There's going to be some serious repairs done."

So far, displaced residents have found shelter with friends.

“ A lot of people were just recovering from the other flood," Joyce said. "It's been kind of a double whammy for some of those folks.” (AND, October 11, 2006)

Flood/Erosion Vulnerability

Tables at the beginning of Chapter illustrate the dollar amount of facilities located with flood/erosion areas. While Alpine Woods Subdivision is the only area in Valdez located within the high velocity flood zone Valdez is located on the water and therefore the Port and Harbor facilities and areas near the shore are always vulnerable to flooding/erosion.

Flood/Erosion Mitigation

Goals

Goal 1.   Reduce flood damage.

Support elevation, flood proofing, buyout or relocation of structures that are in danger of flooding or are located on eroding banks.

Goal 2.   Prevent future flood damage.

Continue to enforce the National Flood Insurance Program through City ordinances and regulations. Discourage development in areas subject to flood/erosion damage.

Goal 3:   Increase public awareness

Increase public knowledgeable about mitigation opportunities, floodplain functions, emergency service procedures, and potential hazards.

Projects

After receiving public input, it is the recommendation of this plan that the City of Valdez, along with other local, State and Federal entities look at the following projects for flood/erosion mitigation. Please see Chapter 4 Mitigation Strategy for more detail on the projects.

- Riprap Valdez Glacier Stream

Continue replacing and riprapping Valdez Glacier Stream. Please see photos in the Appendix.

- Rechannelization of Valdez Glacier Stream

Continue efforts to rechannel Valdez Glacier Stream to undeveloped areas.

- Dike Repair and Expansion - Alpine Woods Subdivision

Improve and expand the subdivision dike to protect again Lowe River.

- Mineral Creek Flood Management Diking System Maintenance

The diking system at Mineral Creek is in need of maintenance.

- Gravel Extraction – Valdez Glacier Creek and Mineral Creek

Gravel extraction of these creeks to steer the waterbodies away from developed areas has a proven track of record of mitigating potential flooding/erosion events.

- Structure Elevation and/or Relocation

A list of homes, commercial structures and critical facilities that are in danger of flooding and in erosion danger should be identified and mitigation projects for elevating and/or relocating the structures determined.

- Valdez Maps

Accurate flood maps should be prepared that delineate areas of flooding and upland areas.

- Public Education

Increase public knowledgeable about mitigation opportunities, floodplain functions, emergency service procedures, and potential hazards. This would include advising property owners, potential property owners, and visitors about the hazards. In addition, dissemination of a brochure or flyer on flood hazards in Valdez could be developed and distributed to all households.

Section 2. Severe Weather

Hazard Description and Characterization

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. High winds 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. 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.

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 northern villages.

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 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.

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.

Local Severe Weather Hazard Identification

Table 15. Valdez Weather Summary

WEATHER IN VALDEZ, ALASKA (temp. & precipitation)

PERIOD	MIN	MEAN	MAX	REC. HIGH	REC. LOW	PRECIP.
JANUARY	15.0	20.5	25.9	46 (1991)	-20 (1972)	5.6
FEBRUARY	18.1	24.1	30.0	52 (1991)	-5 (1999)	5.13
MARCH	22.4	29.2	35.9	51 (1974)	-6 (1972)	4.7
APRIL	29.9	37.1	44.2	62 (1995)	05 (1972)	3.16
MAY	37.8	45.2	52.5	78 (1993)	21 (1972)	3.83
JUNE	44.4	51.8	59.1	86 (1997)	31 (1972)	3.08
JULY	47.5	54.9	62.3	85 (1979)	33 (1972)	3.84
AUGUST	46.2	53.5	60.8	82 (1994)	32 (1984)	5.96
SEPTEMBER	40.4	47.2	54.1	73 (1997)	25 (1983)	8.37
OCTOBER	32.7	38.1	43.4	58 (1995)	08 (1975)	8.07
NOVEMBER	22.4	27.4	32.4	50 (1997)	01 (1989)	5.5
DECEMBER	18.0	22.9	27.8	52 (1983)	-06 (1989)	6.8

Source: Valdez Convention and Visitors Bureau

Summer Average Temp: 53.5 | High: 60.8 | Low: 46.1
Winter Average Temp: 22.5 | High: 27.9 | Low: 17.1

Average Annual Precipitation: 64.04 inches
Average Annual Snowfall (in city): 325.6 inches
Average Snowfall in Thompson Pass: over 600 inches
Record Snowfall (in city): 556.7 inches (1989/90)
Record Snowfall in Thompson Pass: over 900 inches
Record High Temperature: 26 days above 70 degrees (1997)

Source: Valdez Convention and Visitors Bureau

Heavy Snow

Valdez is known for heavy snowfall, the Valdez Convention and Visitors Bureau posted their snowfall for the winter of 2006/2007 at 257 inches or 21 feet of snow. Heavy snowfall can lead to isolation in the winter due to the only road out of town being closed at Thompson Pass

Heavy snow, generally more than 12 inches of accumulation in less than 24 hours, can immobilize even experienced, weather savvy Valdez by bringing transportation to a halt. Until the snow can be removed, the airport and the one highway out of town Richardson Highway 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 accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

High Winds

Another major weather factor in the community is high winds. The wind chill factor can bring temperatures down to -50°F, which can lead to frozen pipes and dangerous conditions for outdoor activities. While most home and business owners are prepared for the heavy winds and low temperatures, construction practices must be followed to protect against the high winds.

Previous Occurrence of Severe Weather

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.

Severe Weather Hazard Vulnerability

The entire community is obviously vulnerable to severe weather. The citizens of Valdez are vulnerable to bitter cold weather, heavy snowfall and high winds. Valdez is known in Alaska for its self-efficiency and hardy behavior in the face of often inclement weather. Citizens must be able to survive without outside assistance several times throughout most winters.

Please see the tables at the beginning of this chapter, which illustrate the city structures, infrastructure, and transportation systems, which are vulnerable.

Severe Weather Mitigation

Goals

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.

Goal 3: Develop practical measures to warn in the event of a severe weather event.

Projects

- Research and consider instituting the National Weather Service program of *“Storm Ready”*.

Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to tsunamis. 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.

To be officially Storm Ready, a community must:

1. Establish a 24-hour warning point and emergency operations center.
2. Have more than one way to receive severe weather forecasts and warnings and to alert the public.
3. Create a system that monitors local weather conditions.
4. Promote the importance of public readiness through community seminars.
5. Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.
6. Demonstrate a capability to disseminate warnings.

Specific Storm Ready guidelines, examples, and applications also may be found on the Internet at: www.nws.noaa.gov/stormready

- Conduct special awareness activities, such as Winter Weather Awareness Week, Flood 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.

Section 3. Earthquake

Hazard Description and Characterization

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. Primary waves are the first ones felt, often as a sharp jolt. 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 course 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 include slumps and debris slides on steep slopes.

Local Earthquake Hazard Identification

Information and data in the following section was prepared by Denise Schanbeck and was taken from the 1992 Coastal Management Plan, Alaska Department of Natural Resources Public Data File 87-29, and the Mineral Creek Site Investigation of 1982.

There are eleven major active fault systems within 150 miles of Port Valdez that are capable of producing earthquakes strong enough to affect Valdez. The dominant earthquake source is the plate boundary that underlies the region around Valdez at a depth of about 12 km.

Table 16. Active Fault Systems Near Port of Valdez

FAULT SYSTEM	Fault Length (mi)	Nearest Approach to Site (mi)	Maximum Probable Magnitude (M)
Denali	1,600	150	8.5
Castle Mountain	350	90	8.0
Knik	135	90	7.5
Aleutian Megathrust	1,800	25	8.6
FAULT SYSTEM	**Fault Length (mi)**	**Nearest Approach to Site (mi)**	**Maximum Probable Magnitude (M)**

Patton Bay & Hanning Bay	60	90	7.4
Chugach – St. Elias	200	80	8.3
Ragged Mountain	20	80	6.9
Galena Bay	22	18	6.9
Jack Bay	32	14	7.1
Whalen Bay	12	22	6.6
Fairweather	650	150	8.5

The following tables were obtained from the University of Alaska, Fairbanks, and Alaska Earthquake Information Center website at: http://www.giseis.alaska.edu/Seis/

Figure 2. AEIS Earthquake Active Faults

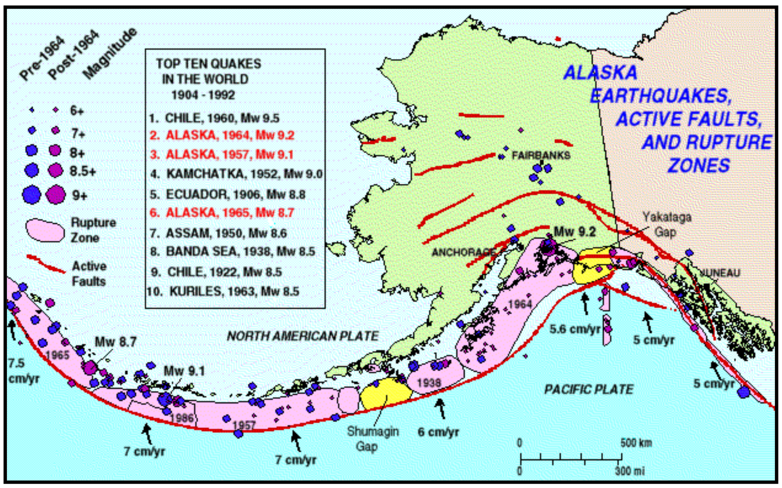
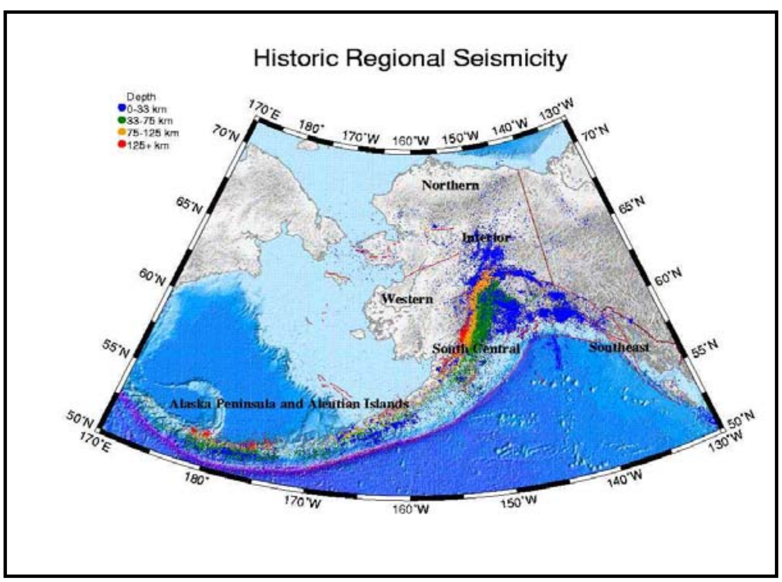


Figure 3. AEIS Historic Regional Seismicity



Previous Occurrences of Earthquakes

Six earthquakes are reported to have seriously affected Port Valdez since 1899. During each of these earthquakes, events indicating submarine slides or possible liquefaction of the bottom sediments of Port Valdez were reported. “Seismic sea waves” (seiching) were also reported during four of these earthquakes. The following is a brief summary of the effects of these events at Port Valdez (Coulter and Migliaccio, 1966).

September 3, 1899 - A magnitude 8.3 earthquake occurred near Yakutat Bay (60° N 142° W). Strong ground shaking and “earthquake water waves” were reported in Valdez. It was also reported that a ship, which was anchored in 40 feet of water at the mouth of the Lowe River in 1898, was unable to reach bottom with 200 feet of cable at the same location after the 1899 earthquake. If these reports are factual, a massive submarine slide must have occurred in the deltaic sediments at the mouth of the Lowe River. The distance from Port Valdez to the reported epicenter of the 1899 event (165 miles) is such that bedrock accelerations were probably on the order of 0.05 g’s, and rich with low frequency vibrations. Moreover, the depth of the sediments and their probable density leads one to believe the amplitude of shaking experienced by the soil deposit was also quite small. However, due to the magnitude of this earthquake, the duration of shaking was probably on the order of several tens of seconds. Seismic excitation of this nature is more apt to induce liquefaction in loose fine sand deposits such as those found at the mouth of the Lowe River, rather than slope failure due to over-stressing associated with inertial forces generated in the rather flat slope. It is probable that excess pore pressures gradually increased in the fine-grain non-cohesive sediments during this event until the soil’s effective shear strength was reduced below that required for stability of the slope, thus precipitating a massive sub-aqueous flow slide.

February 14, 1908 – The second reported earthquake to significantly affect the Port Valdez occurred just north of Port Fidalgo (61°N 146.25°W). No magnitude has been assigned to this event; however, Modified Mercalli Intensity of VI is attributed to the assigned epicenter. Again, violent ground shaking and sea waves were reported at Valdez. Additionally, the submarine communications cables linking Valdez and Sitka, and Valdez and Seward were broken and buried in several places along the bottom of Port Valdez. No evidence of submarine slides was reported; therefore, faulting was thought to be the culprit. However, no manifestations of faulting could be detected anywhere on shore. It is very unlikely that faulting could have occurred across narrow Port Valdez, and not left a trace along the shore; therefore, a more probable explanation for burial of several sections of the cable is liquefaction of the sediments in Port Valdez. Liquefaction within these sediments is probable for the same reasons stated for the 1899 earthquake. The effects on the cables due to liquefaction would be much like those reported. That is, a complete loss of bearing (shear strength) due to liquefaction of the sediments supporting the cables would cause the cables to sink below the mud line. If only isolated areas along the continuously supported cable lost all bearing capacity, the cables would sag and stretch between the remaining sections supported in competent soil, would break, and would be buried by the surrounding sediments as they sunk into the “liquefied” soil. Furthermore, another phenomenon directly attributable to the submarine cables is a sub-aqueous flow slide in the soft upper sea bottom sediments. Flow slides within gently sloping sea bottom sediments have been reported during previous earthquakes in other regions of the world. “Flow slides”, as the term implies, occur when saturated soil attains the consistency of a very thick viscous fluid with very little, if any, shear strength, and actually flows down slope. Flow slides have been known to occur in very flat slopes, and to have traveled overland great distances. Some slides of this nature have progressed down slope very slowly such that people could literally move out of their path on foot, and some have traveled at speeds in excess of 100 mph. It is quite possible that shallow flow slides could have been trigged in the sediments of Port Valdez b earthquake induced liquefaction, and could have traveled along the sea bottom for enough to break and bury the submarine communications lines sometime after strong ground shaking ceased. It is also possible that the topographic effects of slides of that nature could go undetected during routine bathymetric surveys. Therefore, it is more probable that liquefaction of the fine sands within Port Valdez was the cause of the cable breaks rather than sub-aqueous faulting.

September 21, 1911 – A magnitude 6.5 earthquake and three aftershocks occurred between Seward and Whittier (60.5°N 149.0°W). Moderate ground motion was reported at Valdez, and minor talus slides were observed on Valdez Glacier. However, no cracking or distress of the glacier was observed. The submarine cables were again severed as in the 1908 event; however, the separation of the cables did not take place until “several seconds” after the earthquake stopped. The severing and burial of the cables was again attributed to faulting at the bottom of Port Valdez; however, no faulting was observed on shore. The fact that the cables were not broken until some moments after shaking subsided almost forces one to reject faulting as a cause of the cable breaks, and accept some manifestation of liquefaction as the applicable phenomenon. The strongest evidence is that liquefaction quite often is manifested <u>after</u> ground shaking ceases, yet surface faulting must always be accompanied by near-field ground shaking. Non-liquefaction-induced sub-aqueous slides could have been the cause of cable burial; however, the probability is remote because the slope of the bottom fjord was only 50 feet to the mile (<1%) in the location where the cable was buried. It is very unlikely that accelerations at the mud line of the sediments associated with the magnitude and epicenter distance of this earthquake could have generated appreciable down slope movement of the sediments near enough to affect the cable.

January 31, 1912 – The fourth earthquake, not as well documented, is known to have affected Port Valdez. The earthquake has been assigned a magnitude 7.25 and epicentral location at 61°N 147.5°W (40 miles west of Valdez). Once again the submarine cables were broken in Port Valdez.

February 23, 1925 – The fifth earthquake occurred, west of Glennallen and Copper Center. No magnitude determinations were made for this event, but a Modified Mecalli Intensity of VII was assigned at the epicentral location (NOAA). Strong ground shaking caused structural damage to buildings and the dock at Valdez. Power Lines were broken, and the submarine cables were severed once more. Seiching in Port Valdez also caused extensive damage to the boardwalk along Water Street.

March 27, 1964 The magnitude of this quake measured 8.4 - 8.6 on the Richter scale and was reported as a 9.2 Moment Magnitude (Mw). The massive shock waves ripped streets apart, damaged homes and destroyed buildings in town. Two docks in town were completely destroyed. $15 million dollars in damage was reported.

The most distinctive phenomenon in Port Valdez caused by this earthquake was a massive submarine slid involving approximately 98 million cubic yards of soil at the face of the Valdez Glacier Stream / Lowe River outwash delta. The slide destroyed the harbor facilities, and many near-shore facilities. Several people were killed by the collapse of the docks and the incoming sea waves generated by the slide. The loss of material at the face of the outwash delta also contributed to a seaward ground stretching and subsidence of part of the shore area to an elevation below high tide level.

Figure 4. Alaskan Hotel at Old Town 3/27/1964

Several subordinate phenomena were imitated by the massive slide at the face of the outwash delta. A wave with a reported height of 30 to 40 feet was generated within Port Valdez. The wave transversed the length of the embayment several times at the approximate first mode period of the "basin". The run up of these waves caused further damage in Valdez beyond that associated with ground shaking. Subsidence, and ground cracking and stretching linked to mass soil loss at the face of the delta also contributed heavily to the destruction within the city. Utilities ('life lines") were especially hard hit b this form of ground failure.

The true cause of the submarine slide, which contributed so heavily to the destruction of old Valdez, and which precipitated ground failure and general seaward progression of the landmass immediate to the pre-quake shoreline, is not precisely known. However, both liquefaction of sand layers and lenses, and failure of sensitive fine grain soil (silt, clay) could have produced similar effects as those that were reported to have occurred. According to aerial photo interpretation and published results of ground reconnaissance performed by members of the U.S. geological Survey soon after the 1964 earthquake, most of the surface distress was generally limited to an area within 5,000 feet of the pre-quake shoreline. The exception to these limits was the area southwest of Knife Ridge along the dike (Dike Road) south of Valdez Glacier Stream. In that area ground cracking and evidence of liquefaction were noted as far as 8,000 feet inland from the pre-quake shoreline.

Surface features accompanying some of the fissures and cracks on the outwash delta were indicative of liquefaction at depth. Sand and occasional gravel particles were ejected as far 100 feet along extensive fissures. Graben-like depressions between fissures were also noted in areas of no reported ground stretching, indicating that the loss of ejected material at depth resulted in localized surface depressions of up to 12 inches deep. Test borings made by the Alaska Highway Department indicated that the soil fabric in the affected areas was generally more course than that which is usually considered to be sensitive to liquefaction. The fact that the ground surface was frozen, and therefore, impermeable when the earthquake struck may have been the important contributing factor which made the critical difference, and allowed a relatively permeable soil to “liquefy”. It is, of course, also recognized that the 1964 seismic event was unique in its own right. That is, it was extremely violent and of unusually long duration (4 to 6 minutes). All of these unusual factors may have combined under just the right circumstances to cause the reported ground failures in and about old Valdez.

The Valdez that exists today is a town rebuilt a four miles west of the original Old Town. Valdez today, sits near the mouth of Mineral Creek. The geologists recommended the Mineral Creek site because it sits on bedrock rather than on silty, water-drenched soil. 52 buildings were moved and the other structures were burned and the ground razed.

The geologic instability of Old Town, which was constructed in the flood plain of Valdez Glacier, was noticed in 1899 by Edward Gillete. Gillete was an engineer working with Capt. W.R. Abercrombie.

> "Where the small town of Valdez has been hastily built there is danger at any time of having the buildings swept into the Bay by swift and quickly changing channels formed by the numerous streams flowing from uncertain and ever changing parts of the Valdez Glacier situated some four miles north of town," Gillete wrote.

The drainage of Valdez Glacier not only put the town at flood risk, the water-saturated silt, fine sand, and gravel created an unstable foundation that proved disastrous when the big earthquake hit.

Saturated, fine-grain soils often feel as solid as concrete until violently shaken. In a process called liquefaction, solid ground suddenly acts as a liquid when earthquake movement alters the delicate structure of fine-grained soils that are buttressed by water. Liquefaction of the underlying soil of the Old Valdez waterfront caused an underwater landslide. The rapid sluffing of 97 million cubic yards of soils under the ocean surface caused a giant wave. The wave, estimated to be at least 30 feet high, slammed into the Valdez waterfront. As the wave bounced off the other side of the bay, Old Town was pummeled repeatedly. According to a plaque now standing on a house foundation at the Old Town site, 32 people died as a result of the underwater landslide and resulting waves. (Alaska Science Forum, Ned Rozell)

It took from two to four years for the new Valdez to become home for Valdez residents. Approximately 62 buildings were moved from the old Valdez to the new town site. Homeowners paid a fee of $400 for lots because the Corps of Engineers, along with Urban Renewal funds, replaced public facilities.

For its efforts in rebuilding the new Valdez the city was voted an All America City in 1965. Valdez was once again named an All America City in 1982 for its diversified economic growth, which has stabilized today encompassing the oil industry, fishing, and tourism. (Valdez Vacation Guide 2004)

Earthquake Hazard Vulnerability

Please see Hazard Vulnerability Assessment Matrix and description at the beginning of this chapter.

Earthquake Mitigation

Goal

Goal 1: Obtain funding to protect existing critical infrastructure from earthquake damage.

Projects

- If funding is available, perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Valdez.
- Identify buildings and facilities that must be able to remain operable during and following an earthquake event.
- Contract a structural engineering firm to assess the identified buildings and facilities to determine their structural integrity and strategy to improve their earthquake resistance.

Section 4. Tsunami and Seiche Hazard

The City of Valdez developed the following Tsunami/Seiche Mitigation Plan in March 2005, which was reviewed and approved by the DHS&EM. Denise Schanbeck of the Fire Department wrote the plan. It is included here in its entirety.

Hazard Description and Characterization

A ***tsunami*** is a series of ocean waves generated by any rapid large-scale disturbance of the seawater. These waves can travel at speeds of up to 600 miles per hour in the open ocean. Most tsunamis are generated by earthquakes, but they may also be caused by volcanic eruptions, landslides (above or under sea in origin), undersea slumps, or meteor impacts.

Tsunami damage is a direct result of three factors:

1. *Inundation* (the extent to which the water covers the land)
2. *Wave action* that will impact structures and moving objects that become projectiles.
3. *Coastal erosion*

A ***seiche*** is a wave that oscillates in partially or totally enclosed bodies of water. They can last from a few minutes to a few hours as a result of an earthquake, underwater landslide, atmospheric disturbance or avalanche. The resulting effect is similar to bathtub water sloshing repeatedly from side to side. The reverberating water continually causes damage until the activity subsides. The factors for effective warning are similar to a local tsunami, in that the onset of the first wave can be a few minutes, giving virtually no time for warning.

Types of Tsunamis

Tsunamis are categorized in one of two ways:

- Distant-source tsunamis
- Locally generated tsunamis

This distinction is made based on the time it takes the tsunami to leave the source disturbance and reach land.

A ***distant-source tsunami*** (Tele-tsunami) is the term for a tsunami observed at places 600 miles or more from their source of origin. Distant tsunamis are more likely to occur in the Pacific Ocean and are capable of traveling across the entire ocean in less than one day. Since distant-source tsunami make such long trips with a relatively constant speed, experts can predict their arrival with a fair degree of accuracy. This allows time for warnings and evacuation.

A ***locally generated tsunami*** is a term for a tsunami that is generated near the coast, thus the first waves may reach the shore within minutes of the event. This gives little or no time for warning or evacuation.

Previous Occurrences of Tsunamis/Seiches

September 3, 1899 - At the time of the Yakutat earthquake, at Valdez the shaking was reportedly so strong "that men were made dizzy and could not stand, houses and forests were disturbed, and there were earthquake water waves in Port Valdez" (Tarr and Martin, 1912, pg. 66).

There is also a fugitive report that a ship which had anchored off the mouth of the Lowe River in 40 feet of water in 1898 was unable to reach bottom with 200 feet of cable in the same spot late in the fall of 1899. (Effects of the Earthquake of March 27, 1964 at Valdez, Alaska - A Geological Survey Professional Paper 542 C written by Henry W. Coulter and Ralph R. Migliaccio, pg. C7)

February 14, 1908 - It was variously reported by eyewitnesses that at 1:41 a.m. local time an earthquake that lasted from 3 seconds to about 2 minutes occurred. Several witnesses who were former residents of San Francisco stated that it seemed to be as violent as any of the shocks felt there April 18, 1906.

It is also noted that the submarine cable in the Port of Valdez was broken. In a report by Grant and Higgins (1913, p. 12), the following statement concerning the 1908 quake: (It seems quite probable that slumping is taking place occasionally along the seaward edge of the delta. On February14, 1908, an earthquake of considerable magnitude visited this district and broke in several places both the Seattle-Valdez and the Valdez-Seward cables, which run east and west through Port Valdez. Accompanying the earthquake there seems to have been a slumping of the delta front, which buried sections of the cables. The cause of the earthquake is not known, but it is thought to have been minor faulting, for one of the cables was broken in deep water on the flat bottom of the fiord 11 miles from Valdez.)

It was further stated that the steamer Northwestern, which was approaching the dock at Valdez, encountered a "tidal wave" and "felt as though the ship struck on the bottom". (Effects of the Earthquake of March 27, 1964 at Valdez, Alaska - A Geological Survey Professional Paper 542 C written by Henry W. Coulter and Ralph R. Migliaccio, pgs C7 and C8)

September 21, 1911 - A series of four earthquakes between 7 and 8:30 p.m. The first was at 7:01 p.m. and lasted 20 seconds. The second happened at 7:13 and lasted between 5 and 10 seconds. The third occurred at 7:28 and lasted 3 to 5 seconds. The fourth and final came at 8:38 and lasted about 2 seconds. (Tarr and Martin, 1912, pg. 100)

Once again, it is noted that the submarine cables in the Port of Valdez were broken. The report by Tarr and Martin (1912, pg. 100), states the following: (During this earthquake the submarine cable from Valdez to Sitka was broken just north of Fort Liscum, at a point 3 3/16 miles west of the dock at Valdez, near latitude 61°06'08" N., and longitude 146°19'23" W., and was buried for 1,650 feet. This is almost exactly at one of the points where the cable was broken during the earthquake of February 14, 1908, when twice as great a length of cable was buried near this break. The water here is 700 to 750 feet deep and the slope of the fiord bottom is less than 50 feet to the mile. The break at this same point on 1911 seems to verify our suggestion made in 1908 (p. 98) that a fault exists there.)

A.J. Burr, a former Valdez resident states: "* * * that was the first time that we had ever observed Valdez Bay so literally covered with dead fish as a result of the concussions in the water that in most of the patches the dead fish were so thick it was difficult to see much of the water" (written communication., July 29, 1964). (Effects of the Earthquake of March 27, 1964 at Valdez, Alaska - A Geological Survey Professional Paper 542 C written by Henry W. Coulter and Ralph R. Migliaccio, pgs C8 and C9)

January 31, 1912 - An earthquake occurred at 8:11 p.m. and though there are no eyewitness accounts of tsunami waves, it is documented again that submarine cables were broken in the Port of Valdez. (Effects of the Earthquake of March 27, 1964 at Valdez, Alaska –A Geological Survey Professional Paper 542 C written by Henry W. Coulter and Ralph R. Migliaccio, pg. C9)

February 23, 1925 – An earthquake occurred at 1:55 p.m. Many electric lines were broken, and the front wall of the vacant Valdez Brewery collapsed. More significantly a part of the dock collapsed; an unusual wave accompanying the tremors tore up a section of the boardwalk along Water Street, and the submarine cables were again broken. (Gov. William A. Egan, oral communication., August, 1964) (Effects of the Earthquake of March 27, 1964 at Valdez, Alaska –A Geological Survey Professional Paper 542 C written by Henry W. Coulter and Ralph R. Migliaccio, pg. C9)

March 27, 1964 – An earthquake of magnitude 9.2 occurred in Prince William Sound. The first tremors were felt in Valdez at approximately 5:36 p.m. The shocks lasted from 3 to 5 minutes and were reported to have been accompanied by a low-pitched rumbling sound. The single most disastrous event caused by the earthquake at Valdez was the submarine landslide, which occurred on the waterfront. There were two other landslides reported near the Shoup Bay area. These slides and their concomitant waves were responsible for the loss of 30 lives.

Exact details of the wave sequence at Valdez have been difficult to determine; however, four major waves have been distinguished. During the first two waves, most eyewitnesses state, the turbulence in the harbor area generated a mist or haze that obscured the bay beyond the shoreline.

The first major wave at Valdez closely followed the submarine slide. Without doubt, it was caused by the sudden transfer of approximately 98 million cubic yards of unconsolidated deposits from the face of the delta out into the bay. This first wave, estimated to have been from 30 to 40 feet high, surged onto the Valdez waterfront with destructive violence.

The second wave major wave to strike the waterfront at Valdez arrived approximately 10 minutes after the strong ground motion ceased; it has been described as a violent surging wave only slightly smaller than the first.

The seismic energy plus the submarine landslides seem to have generated a complex multimodal seiche in Port Valdez that persisted until early the following morning.

At approximately 11:45 p.m. and 1:45 a.m., just before and just after high tide, waves three and four, described as rapidly moving tidal bores, advanced into the town. These two waves are presumed to have been the result of long-period seiche waves with high tide. (Effects of the Earthquake of March 27, 1964 at Valdez, Alaska –A Geological Survey Professional Paper 542 C written by Henry W. Coulter and Ralph R. Migliaccio, pg. C14)

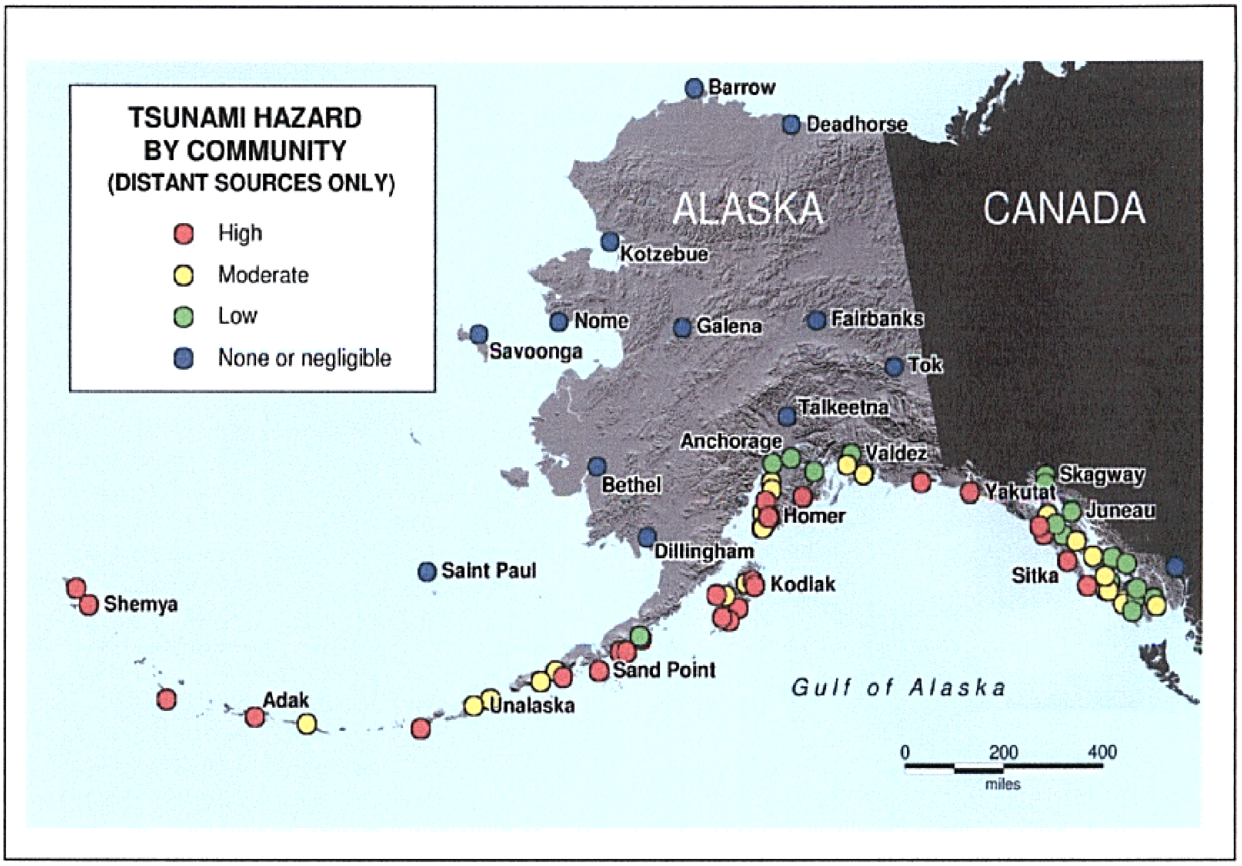
Tsunami/Seiche Hazard Assessment

Tsunamis are natural phenomenon that are a series of traveling ocean waves generated by disturbances associated with earthquakes, volcanoes, or landslides in oceanic and coastal regions. In Valdez, the most serious threat is from locally generated tsunamis and/or seiches originating in the Port of Valdez. These waves have reached heights of 170 feet. Because they are generated immediately offshore, they may strike the coast before a warning could be issued.

Any tsunami greater than one meter in height may cause a variety of incidents such as industrial/technological emergencies (e.g. fires, explosions, and hazardous materials incidents); disruption of vital services such as water, sewer, power, gas and transportation; and damage to or disruption of port and harbor facilities. The Trans Alaska Pipeline Marine Terminal is located in the Port of Valdez and could be impacted.

The geological findings following the 1964 event resulted in the town site being moved to a new location four miles northwest. The new town site sits on the Mineral Creek fan – a more stable area that also has some natural protection from sea waves. At this time the amount of protection is unknown as no major event has occurred since the move, and inundation mapping has not been completed. Included in these findings was the suggestion of a fault underneath the Port of Valdez. This has not been studied to determine or rule out its existence.

Figure 5. Tsunami Hazard by Community



Source: Alaska State Hazard Mitigation Plan, 2004

The adopted Valdez Emergency Operations Plan (EOP) defines the evacuation areas in Valdez as all areas below the 100-foot elevation, or one-mile distance from the water's edge. This is determined from general tsunami safety information and is not linked to actual inundation mapping. The National Hazard Mitigation Program (NTHMP) has identified Valdez as a participant in the tsunami inundation-mapping project, which will help refine these evacuation areas. Geophysicists working with the NTHMP will use sophisticated modeling systems to construct bathymetric and topographic models and perform simulations based on events of various sizes and intensities. The outcome of this project will be more accurate inundation maps for the Valdez area. This information will also be used to ensure evacuation routes are safe. Unfortunately it may be ten years before Valdez is studied.

In Valdez, the most serious threat is from a locally generated tsunami/seiche originating in the Port of Valdez. These waves have reached heights of 170 feet. Because they are generated immediately offshore, they may strike the coast before a warning could be issued. With this in mind, this summary is based on a locally generated tsunami/seiche, as it poses the greatest threat.

Vulnerability Assessment

Vulnerability: Currently, all coastal areas below 100 ft. elevation and/or within one mile of the waters edge. Tsunami inundation mapping may lead to a revision of vulnerable areas.

Property That May Be Affected: Port and harbor facilities, public works facilities, structures, vehicles, equipment, transportation facilities such as docks, float systems, and roads.

Environment That May Be Affected: Wetlands with inclusive flora and fauna, coastal vegetation.

Unusual Conditions: Locations containing Hazardous Materials including the Trans Alaska Pipeline Marine Terminal, and multiple fish processing facilities containing by example but not exclusively the following hazardous materials: Ammonia, Freon, Crude Oil, etc. Psychological impacts due to major loss of life and traumatic injuries.

Sheltering for displaced populations. (*The Trans Alaska Pipeline Marine Terminal sets on the Port of Valdez, which if impacted could affect the economy of the entire United States, most notably the West Coast to which it supplies 60% of the coasts oil.)*

Tsunami/Seiche Mitigation

Tsunami Hazard Mitigation Successes

Relocation of Town Site

Following the March 27, 1964 event, the town site was relocated four miles northwest. The new town site sits on the Mineral Creek fan – a more stable area that also has some natural protection from sea waves. At this time the amount of protection is unknown as no major event has occurred since the move, and inundation mapping has not been completed.

Tsunami Warning System

The West Coast/Alaska Tsunami Warning Center (WC/ATWC) in Palmer, Alaska issues tsunami warnings to Valdez and other areas in Alaska, British Colombia, Washington, Oregon and California. The Palmer ATWC uses satellite telemetry, seismic and sea level data, and other information to track seismic activity and potential tsunamis in the Pacific basin. When a large earthquake occurs, geophysicist at the ATWC determine its epicenter and magnitude, and if this data meets certain known criteria for the possible generation of a tsunami, the ATWC will issue a TSUNAMI WARNING for a limited area near the epicenter. A tsunami warning message (issued through the City of Valdez

Police Dispatch) includes predicted tsunami arrival times at selected coastal areas and requires that those areas prepare for the possibility of immediate flooding from the tsunami. A TSUNAMI WATCH is issued to areas adjacent to the warning area alerting them to the possibility of a tsunami threat. Upon issuing the watch and warning threats, the ATWC geophysicist will confirm whether or not a tsunami has been generated by examining additional data, and based on this information will issue regular updates to the affected areas. In the event of a tsunami watch or warning in Valdez, City of Valdez Police Dispatch will follow the call-out procedures outlined in the Warning Annex of the Emergency Operations Plan.

A tsunami warning signal system has been installed throughout the populated areas to alert the public of a tsunami warning or watch for Valdez. These warning signals are tested every Friday at 5:00 p.m. The tsunami-warning signal for the City of Valdez is a wavering tone for a 3 minute repeating period. This signal indicates that according to the best available information a tsunami wave is coming. Whenever this signal is sounded (except Friday at 5:00 p.m.) local residents should follow the evacuation procedures outlined in the Warning Annex of the Emergency Operations Plan.

Goals

Goal 1. Increased Public Education about Tsunamis and Seiches.

Goal 2. Tsunami Ready Community Designation.

Goal 3. Develop accurate inundation maps for the Port of Valdez.

Goal 4. Update Valdez Emergency Operations Plan.

Projects

- Participation in the Tsunami Awareness Program.

Residents and visitors will be educated about the threat of tsunamis to the City of Valdez, as well as being informed about tsunami evacuation areas, routes and safe areas. Community members will be encouraged to develop a Family Disaster Plan and an Emergency Survival Kit for their home and vehicles.

- Tsunami Ready Community Designation

Participate in the NWS/WC&ATWC Tsunami Ready Program. The City of Valdez is actively pursuing “Tsunami Ready Certification”. The Tsunami Ready Community program promotes tsunami hazard preparedness as an active collaboration among Federal, State, and local emergency management agencies, the public, and the NWS tsunami warning system. This collaboration supports better and more consistent tsunami awareness and mitigation efforts among communities at risk. The main goal is improvement of public safety during tsunami emergencies.

- Inundation Mapping

Obtain tsunami inundation maps for the Port of Valdez. As stated earlier the National Hazard Mitigation Program (NTHMP) has identified Valdez as a participant in the tsunami inundation-mapping project, which will help refine evacuation areas. Without these maps, communities must rely on historical or estimated information for land use and evacuation route planning. Inundation maps will provide more accurate and precise information. Our goal is to ensure that emergency management has the most up to date and accurate information needed for planning and zoning.

- Update Valdez Emergency Operations Plan

Update Emergency Operations Plan as mapping and other geological information becomes available. Though this is an ongoing project our next update is due to be completed in the summer of 2006.

Section 5. Avalanche and Landslides

Hazard Description and Characterization

Information and data for this section was taken from the following sources.

Avalanche Hazard Evaluation & Mitigation Recommendations for Town Mountain and Duck Flats Avalanche Areas. Prepared by Doug Fesler and Jill Fredston, Alaska Mountain Safety Center, Inc. for the City of Valdez. May 1, 2000

Avalanche Hazard Phase 2 Report, Supplemental Avalanche Dynamics Analysis and Mitigation Design for the Porcupine Street Avalanche Area. Prepared by: Doug Fesler and Jill Fredston, Alaska Mountain Safety Center, Inc. for the City of Valdez. September 19, 2000

The climate of a region strongly influences both the amount of snow found in the area's avalanches paths and the type of snow pack structure. These, in turn, affect the characteristics (e.g., the run out distance, velocities, and impact pressures) of the avalanches, which are likely to occur. Valdez has primarily a maritime snow climate. This means the region is typically wet and warm. Because of its coastal location, Valdez is subject to prolonged storms and frequent cloud cover. Snow accumulations of great depth are likely and winter rains are common. Valdez can receive exceptionally heavy amounts of precipitation in short periods of time. During the winter of 1989-1990, total snowfall measured 561" (14.2m), with 47.5" (1.2m) measured in a single day in January 1990. The maximum snow depth at sea level, also recorded in January 1990, was 107" 2.7 meters.

Avalanches affecting lower elevations in the Valdez area (although there are marked annual variances) can typically be expected to occur between November and May, with the greatest potential for larger avalanches between January and April. From available historical records, February appears a prime month. Generally, in a maritime snow climate, the overall snow pack is often relatively strong with short-lived periods of instability associated primarily with storm events or spring warming. Even relatively small amounts of rain or cold, dry snow pack can lead to widespread instability. A snow pack that received consistent rain is less sensitive to additional rain. Glide cracks are common in maritime snow packs, particularly during deep snow pack years. Prone to develop mostly on steep, smooth, lubricated slopes, glide cracks are tensile failures, which can lead to slab avalanches releasing to the ground weeks, or even months after the glide crack forms.

It is important to note that maritime snow climates are often subject to pronounced changes in snow pack conditions with elevation due to differences in temperature, precipitation, and wind. This is especially true at northern latitudes. At higher elevations in the Valdez area, it is common to find colder temperatures, drier snow, and greater deposition of new and wind-loaded snow than at sea level. Colder conditions, more typical of a "continental" type climate, can be conductive to the formation of weak poorly bonded layers. The importance of this is that these weak layers can persist for long periods of time and become deeply buried under successive layers of heavier, more typically "maritime" snow. The result, often months later, can be large, deep slab releases. Even in a maritime climate, it I possible to have relatively dry, cold snow layers at all elevations, a factor that allows avalanches to easily accelerate and entrain additional snow in their descent.

The time required for a large avalanche, which descends in a bounding, wave-like manner, to flow past a given point in the tract is estimated to be roughly 10-20 seconds, depending upon topography and snow conditions. Typically, the dynamic impact pressures reach a level two to five times as high as the norm, with subsequent peaks somewhat less. Each peak may last only one-tenth of a second, while the power blast itself (i.e., the leading edge of the avalanche) may precede the core by only a fraction of a second or by many seconds depending upon the topography, the consistency of the snow pack, and the character of the climate. Generally, however, the elapsed time from initial to maximum impact is less than a second. Such large, dry snow avalanches typically tend to descend in a straight line, regardless of small terrain barriers, and are capable of exerting tremendous thrust pressures, horizontally, vertically, and laterally.

In general, colder, drier snow avalanches will tend to travel longer distances, obtain greater velocities, and cover larger areas than will warmer, wetter avalanche events of similar initial size in a given path. This is not to imply that wetter slides, which involve denser snow than dry slides, are lacking in force or scope. Under the right conditions of low surface adhesion, wet slides are able to travel long distances and alter their direction of travel by 90° or more.

Even moderate-sized avalanches are capable of producing impact loads 10 to 20 times greater than the typical lateral loading capacity of wood framed structures. For example, an avalanche traveling at a speed of approximately 65 mph (30 m/s) with a flow density of approximately 100 kg/m (typical dry Powder snow) could exert a lateral pressure of 940 lbs/ft. By comparison, a force of 40-80 lbs/ft is sufficient to break windows in houses while forces ranging from 400-600 lbs/ft are capable of breaking mature trees and destroying wood frame structures. The problem of avalanche impact is exacerbated when structures are built broadside to the direction of the flow.

A landslide is a natural event that causes damage when human activities interface with slides areas. Landslides 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. Erosion that removes material from the base of a slope can also cause naturally triggered landslides. Human activities such as road construction, excavation, and mining can also cause landslides.

Landslides are a significant hazard in Valdez because of the climate, topography, and the presence of other hazards such as earthquakes that might increase the likelihood of a landslide. The possibility of additional hazards caused by landslides compounds the hazard; landslides can trigger tsunamis and flash floods.

Previous Occurrence of Avalanches and Landslides

The historical record of avalanches affecting the Valdez area are incomplete (i.e., avalanches have occurred for which no records exist) and of short duration.

During late January and early February 2002, a series of avalanches originating from Town Mountain above Valdez hit two houses (with one seriously damaged), covered the northern portion of Valdez High School’s east parking lot, and nearly hit the northeast corner of the school’s gymnasium. As an outgrowth of those events and other close calls in recent years, the City of Valdez commissioned an avalanche study by the Alaska Mountain Safety Center (AMSC) of the High School, Porcupine Street/Robe River Drive, and the Duck Flats areas.

Avalanche/Landslides Mitigation

Goals

Goal 1. Reduce Valdez’s vulnerability to avalanche and landslide hazards in terms of threat to life and property.

Goal 2. Have comprehensive information regarding avalanche and landslide hazards and unstable soils throughout Valdez’s developed area, including areas that will be developed in the future.

Goal 3. Increase public awareness of avalanche and landslide dangers and hazard zones.

Projects

- Prohibit new construction in avalanche zones.

Construction in avalanche zones means bigger losses in the future should an avalanche occur. New construction in hazard zones should be discouraged or prohibited, even if structures are not intended for habitation.

- Utilize appropriate methods of structural avalanche control.

Containment structures, depending on their design, can prevent snow loads from releasing and forming an avalanche, and/or protect structures by diverting or containing avalanche debris. Such structures include snow fences, diversion/containment structures, snow nets, and reforestation.

- Enact buyout of homes in avalanche paths.

A buyout could be implemented to reduce the number of people living in avalanche zones. Update existing structures within avalanche zone to avalanche impact standards. Structures that already exist can be made safer with structural reinforcements.

- Prohibit removal of vegetation in areas prone to landslides.

Removal of vegetation from slopes can compromise the integrity of the soil and lead to landslides. Requests to remove vegetation should be handled through a permit process that involves an assessment of the area for landslide hazard.

- Conduct additional study of unstable soils and avalanche or landslide prone areas.

Specifically those areas that have not yet been studied and might present additional dangers in the form of underwater landslides, or landslides that may cause tsunamis.

- Public disclosure of risk linked to deed or title of property and require owners to notify renters of hazard prior to occupancy.

Many residents, especially renters, are not aware of the locations of landslide zones or the potential dangers inherent in living within them .

- Install warning signage in mapped landslide zones.

- Continue to educate public about avalanche and landslide hazards. Information can be disseminated to the public through the City web site, press releases, media ads, and other methods.

Section 6. Wildland Fire

Hazard Description and Characterization

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 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.

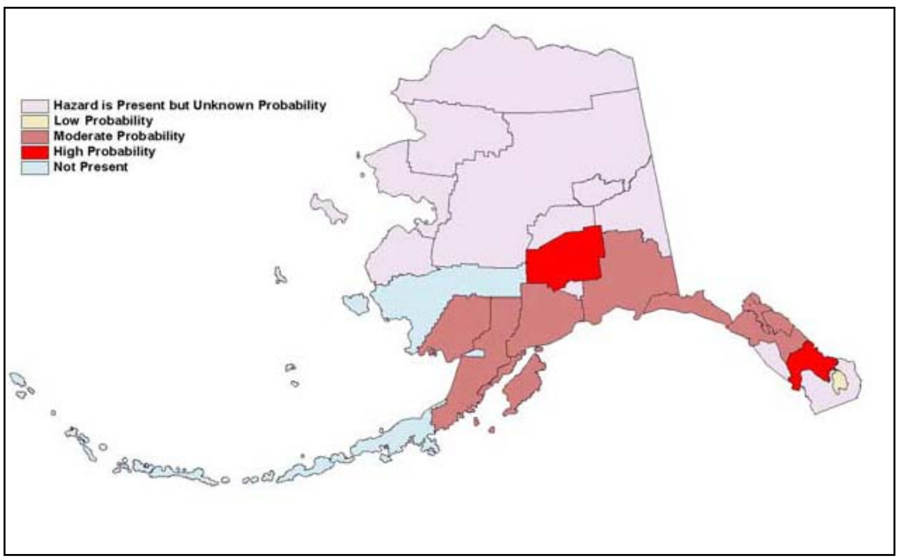
Wildland fire risk is increasing in Alaska due to the spruce bark beetle infestation. The beetles lay eggs under the bark of a tree. When the larvae emerge, they eat the tree's phloem, which is what the tree uses to transport nutrients from its roots to its needles. If enough phloem is lost, the tree will die. The dead trees dry out and become highly flammable.

Local Wildland Fire Hazard Identification

Though Valdez has a moderate probability of occurrence, it is listed as a critical protection area by the Alaska Interagency Fire Management Plan. Please see map and explanation on the following pages.

The following map from the Alaska State Hazard Plan depicts Valdez as being in a moderate probability area of the state.

Figure 6. Alaska Hazard Plan - Fire Risk Map



Valdez is located in a full protection area of the state protection option areas. Full protection is suppression action provided on a wildland fire that threatens uninhabited private property, high-valued natural resource areas, and other high-valued areas such as identified cultural and historical sites. The suppression objective is to control the fire at the smallest acreage reasonably possible. The allocation of suppression resources to fires receiving the full protection option is second in priority only to fires threatening a critical protection area.

Wildland Fire Hazard Vulnerability

Please see Hazard Vulnerability Assessment Matrix and description at the beginning of this chapter.

Previous Occurrence of Wildland Fire

There has been no recorded evidence of wildland fire in Valdez.

Wildland Fire Mitigation

Goals

Goal 1: Establish building regulations to mitigate against fire damage.

Goal 2: Conduct outreach activities to encourage the use of Fire Wise development techniques.

Goal 3: Encourage the evaluation of emergency plans with respect to wildland fire assessment.

Goal 4: Acquire information on the danger of wildland fires and how best to prepare.

Projects

- Continue to support the fire department with adequate firefighting equipment and training.

- Promote Fire Wise building design, siting, and materials for construction.

The Alaska Fire Wise Program is designed to educate people about wildland fire risks and mitigation opportunities. It is part of a national program that is operated in the State by the Alaska Wildfire Coordinating Group (AWCG).

- Continue to enforce building codes and requirements for new construction.

- Enhance public awareness of potential risk to life and personal property. Encourage mitigation measures in the immediate vicinity of their property.

Chapter 4: Mitigation Strategy

Benefit - Cost Review

This chapter of the plan outlines Valdez's overall strategy to reduce its vulnerability to the effects of the hazards studied. Currently the planning effort is limited to the hazards determined to be of the most concern; flooding, erosion, severe weather and earthquake; however the mitigation strategy will be regularly updated as additional hazard information is added and new information becomes available.

The projects listed on Table 12, Benefit and Costs Listing, were prioritized using a listing of benefits and costs review method as described in the FEMA *How-To-Guide Benefit-Cost Review in Mitigation Planning* (FEMA 386-5).

Due to monetary as well as other limitations, it is often impossible to implement all mitigation actions. Therefore, the most cost-effective actions for implementation will be pursued for funding first, not only to use resources efficiently, but also to make a realistic start toward mitigating risks.

The City of Valdez considered the following factors in prioritizing the mitigation projects. Due to the dollar value associated with both life-safety and critical facilities, the prioritization strategy represents a special emphasis on benefit-cost review because the factors of life-safety and critical facilities steered the prioritization towards projects with likely good benefit-cost ratios.

1. Extent to which benefits are maximized when compared to the costs of the projects, the Benefit Cost Ratio must be 1.0 or greater.

2. Extent the project reduces risk to life-safety.

3. Project protects critical facilities or critical city functionality.

    A. Hazard probability.

    B. Hazard severity.

Other criteria that was used to developing the benefits – costs listing depicted in Table 12:

1. Vulnerability before and after Mitigation

Number of people affected by the hazard, areawide, or specific properties.
Areas affected (acreage) by the hazard
Number of properties affected by the hazard
Loss of use

Loss of life (number of people)
Injury (number of people)

1. List of Benefits

Risk reduction (immediate or medium time frame)
Other community goals or objectives achieved
Easy to implement
Funding available
Politically or socially acceptable

2. Costs

Construction cost
Programming cost
Long time frame to implement
Public or political opposition
Adverse environmental effects

This method supports the principle of benefit-cost review by using a process that demonstrates a special emphasis on maximization of benefits over costs. Projects that demonstrate benefits over costs and that can start immediately were given the highest priority. Projects that the costs somewhat exceed immediate benefit and that can start within five years (or before the next update) were given a description of medium priority, with a timeframe of one to five years. Projects that are very costly without known benefits, probably cannot be pursued during this plan cycle, but are important to keep as an action were given the lowest priority and designated as long term.

The Valdez Planning Commission will hold another round of public meetings on the LHMP Update. The plan is subject to final Valdez City Council approval after pre-approval is obtained by DHS&EM.

After the LHMP Update has been approved, the projects must be evaluated using a Benefit-Cost Analysis (BCA) during the funding cycle for disaster mitigation funds from DHS&EM and FEMA.

A description of the BCA process follows, briefly, BCA is the method by which the future benefits of a mitigation project are determined and compared to its cost. The result is a Benefit-Cost Ratio, which is derived from a project's total net benefits divided by its total cost. The BCR is a numerical expression of the cost-effectiveness of a project. Composite BCRs of 1.0 or greater have more benefits than costs, and are therefore cost-effective.

Benefit-Cost Review vs. Benefit-Cost Analysis (FEMA 386-5) states in part:
Benefit-Cost Review for mitigation planning differs from the benefit cost analysis (BCA) used for specific projects. BCA is a method for determining the potential positive effects of a mitigation action and comparing them to the cost of the action. To assess and demonstrate the cost-effectiveness of mitigation actions, FEMA has developed a suite of BCA software, including hazard-specific modules. The analysis determines whether a mitigation project is technically cost-effective. The principle behind the BCA is that the benefit of an action is a reduction in future damages.

DMA 2000 does not require hazard mitigation plans to include BCA's for specific projects, but does require that a BCR be conducted in prioritizing projects.

Benefit-Cost Analysis

The following section is reproduced from a document prepared by FEMA, which demonstrates on how to perform a Benefit –Cost Analysis. The complete guidelines document, a benefit-cost analysis document and benefit-cost analysis technical assistance is available online http://www.fema.gov/government/grant/bca.

Facilitating BCA

Although the preparation of a BCA is a technical process, FEMA has developed software, written materials, and training that simplifies the process of preparing BCAs. FEMA has a suite of BCA software for a range of major natural hazards: earthquake, fire (wildland/urban interface fires), flood (riverine, coastal A-Zone, Coastal V-Zone), Hurricane Wind (and Typhoon), and Tornado.

Sometimes there is not enough technical data available to use the BCA software mentioned above. When this happens, or for other common, smaller-scale hazards or more localized hazards, BCAs can be done with the Frequency Damage Method (i.e., the Riverine Limited Data module), which is applicable to any natural hazard as long as a relationship can be established between how often natural hazard events occur and how much damage and losses occur as a result of the event. This approach can be used for coastal storms, windstorms, freezing, mud/landslides, severe ice storms, snow, tsunami, and volcano hazards.

Applicants and Sub-Applicants must use FEMA-approved methodologies and software to demonstrate the cost-effectiveness of their projects. This will ensure that the calculations and methods are standardized, facilitating the evaluation process. Alternative BCA software may also be used, but only if the FEMA Regional Office and FEMA Headquarters approve the software.

To assist Applicants and Sub-applicants, FEMA has prepared the *FEMA Mitigation BCA Toolkit* CD. This CD includes all of the FEMA BCA software, technical manuals, BC training courses, Data-Documentation Templates, and other supporting documentation and guidance.

The *Mitigation BCA Toolkit* CD is available free from FEMA Regional Offices or via the BC Helpline (at bchelpline@dhs.gov or toll free number at (866) 222-3580.

HAZARD EVENT (Frequency & Severity)	**X**	PROPERTY EXPOSED TO THE HAZARD	**=**	HAZARD RISK Dollars ($$)
Probability of Damaging Hazard Events		Value & Vulnerability of Property Exposed to the Hazard		Severity of the Hazard Threat to the Built Environment

The BC Helpline is also available to provide BCA software, technical manuals, and other BCA reference materials as well as to provide technical support for BCA.

For further technical assistance, Applicants or Sub-Applicants may contact their State Mitigation Office, the FEMA Regional Office, or the BC Helpline. FEMA and the BC Helpline provide technical assistance regarding the preparation of a BCA.

Table 17. Benefit Cost Review Listing

* Priorities: High = Clearly a life/safety project, or benefits clearly exceed the cost or can be implemented
0 – 1 year.
Medium = More study required to designate as a life/safety project, or benefits may exceed the cost, or can be implemented in 1 – 5 years.
Low = More study required to designate as a life/safety project, or not known if benefits exceed the costs, or long-term project, implementation will not occur for over 5 years.

** PDMG Pre-Disaster Mitigation Grant
*** HMGP Hazard Mitigation Grant Program
****FMA Flood Mitigation Assistance (Program

Mitigation Projects	Benefits (pros)	Costs (cons)	High
Flood/Erosion (FLD)			
FLD-1. Riprap Valdez Glacier Stream	Life/Safety issue Potential PDMG**	Dollar cost unknown >$100,000 Engineering study needed. Funding source not identified 1 - 5 years implementation	Medium
FLD. 2. Rechannelization of Valdez Glacier Stream	Life/Safety issue Potential PDMG**	Engineering Needed >$100,000 1 – 5 years implementation	Medium
FLD 3. Dike Repair and Expansion - Alpine Woods Subdivision	Potential HMGP*** or PDMG** Benefit to Alpine Woods Ongoing project	>$100,000	High
FLD 4. Mineral Creek Flood Management Diking System Maintenance	Benefit to Mineral Creek area Ongoing project Funding potential from FEMA and USCOE. Property damage reduction	>$100,000	High
FLD 5. Gravel Extraction – Valdez Glacier Creek and Mineral Creek	Benefit to Mineral Creek area and Valdez Glacier Creek area. Large amount of area. Ongoing project Funding potential from FEMA and USCOE. Property damage reduction	>$100,000	High
FLD-6. Structure Elevation and/or Relocation	Life/Safety project Benefit to government facilities and private properties. Potential PDMG**, HMGP***, FMA****	Dollar cost unknown, >$50k 1 – 5 year implementation	Medium

FLD-7. Updated FIRM Valdez Maps	FEMA, PDMG**, HMGP*** and State DCRA funding available. USCOE facilitated project. Can be started immediately.	Expensive, at least $100,000	High
FLD-8. Public Education	DCRA funding may be available. Could be done yearly. Inexpensive <$1,000City	Not clear if there would be community interest or participation.	Medium
FLD 9. Install upgraded streamflow and rainfall measuring gauges	Life/Safety project Benefit to government facilities and private properties. Potential PDMG**, HMGP***, FMA****	Dollar cost unknown, >$10k 1 – 5 year implementation	Medium
FLD 10. Apply for grants/funds to implement riverbank protection methods.	Life/Safety project Benefit to government facilities and private properties. Potential PDMG**, HMGP***, FMA****	Dollar cost unknown, >$50k 1 – 5 year implementation	Medium
FLD 11. Pursue obtaining a CRS rating to lower flood insurance rates.	High capability by city to do on an annual basis Will reduce NFIP insurance for entire community. <$1,000/year	Staff time.	High
FLD 12. Continue to obtain flood insurance for all City structures, and continue compliance with NFIP.	High capability by city to do on an annual basis. Public benefit to have public buildings insured through NFIP. Inexpensive, approx.$3,000/year.	Staff time	High
FLD 13. Require that all new structures be constructed according to NFIP requirements and set back from the river shoreline to lessen future erosion concerns and costs.	High capability by city to do on an annual basis. Public benefit to have public buildings insured through NFIP. Inexpensive, approx.$3,000/year.	Staff time	High
Severe Weather (SW)			
SW-1. Research and consider instituting the National Weather Service program of *"Storm Ready"*.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be implemented annually	Staff time	High

SW-2. Conduct special awareness activities, such as Winter Weather Awareness Week, Flood Awareness Week, etc.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
SW-3. Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
SW-4. Encourage weather resistant building construction materials and practices.	Risk and damage reduction. Benefit to entire community.	Would require ordinance change. Potential for increased staff time. Research into feasibility necessary. Political and public support not determined. 1 – 5 year implementation	Medium
Wildland Fire (WF)			
WF-1. Continue to support the local fire department with adequate firefighting equipment and training.	Life/Safety issue Risk reduction Benefit to entire community State assistance available Annual project.	Dollar cost not determined. Staff time to research grants	High
Project WF-2. Promote Fire Wise building design, siting, and materials for construction.	Life/Safety issue Risk reduction Benefit to entire community, Annual project. State assistance available	Dollar cost not determined. Staff time to research grants	High
WF-3: Continue to enforce development of building codes and requirements for new construction.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be implemented annually	Staff time	High
WF-4: Enhance public awareness of potential risk to life and personal property. Encourage mitigation measures in the immediate vicinity of their property.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be implemented annually	Staff time	High

Earthquake (E)			
E-1. If funding is available, perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Valdez.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
E-2. Identify buildings and facilities that must be able to remain operable during and following an earthquake event.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
E-3. Contract a structural engineering firm to assess the identified bldgs and facilities.	Benefit to entire community Risk reduction	Feasibility and need analysis needed. 1 – 5 years	Medium
Tsunami/Seiche (T/S)			
Project T/S-1: Continued Participation in the Tsunami Awareness Program.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
Project T/S-2. Continued Participation in the Tsunami Ready Community Designation	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
Project T/S-3. Inundation Mapping	FEMA, PDMG, HMGP and State DCRA funding available. USCOE facilitated project. 1 – 5 year project.	Expensive, at least $100,000	Medium
Project T/S-4. Update Valdez Emergency Operations Plan	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available 1 – 5 years, or as needed.	Staff time	Medium
Avalanche/Landslide (A/L)			

Project A/L-1. Prohibit new construction in avalanche zones.	Life/Safety issue/Risk reduction Benefit to entire community No direct cost to implement State assistance available 1 – 5 years to adopt ordinance.	Political Support not determined. Private property issues. Staff time.	Medium
A/L-2. Utilize appropriate methods of structural avalanche control.	Life/Safety issue/Risk reduction Benefit to entire community Federal or State assistance available	Engineering and structural design needed. Dollar cost not determined. Long timeframe to implement,5+ years.	Low
A/L-3. Enact buyout of homes in avalanche paths.	Life/Safety issue/Risk reduction Benefit to entire community PDMG or HMPG projects.	Political Support not determined. Private property issues. Staff time. Expensive, >$100k. Long timeframe 5+ years.	Low
A/L-4. Prohibit removal of vegetation in areas prone to landslides.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an ongoing project	Staff time	High
Project A/L-5. Public disclosure of risk linked to deed or title of property and require owners to notify renters of hazard prior to occupancy.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an ongoing project.	Political Support not determined. Private property issues. Staff time.	High
Project A/L-6. Install warning signage in mapped landslide zones.	Life/Safety issue/Risk reduction Benefit to entire community Federal and State assistance available	Mapped landslide zones do not exist at this time. 5+ years to implement	Low
Project A/L-7. Continue to educate public about avalanche and landslide hazards.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High

Mitigation Project Plan Table

Table 18. Mitigation Project Plan

* Priorities: High = Clearly a life/safety project, or benefits clearly exceed the cost or can be implemented 0 – 1 year.
Medium = More study required to designate as a life/safety project, or benefits may exceed the cost, or can be implemented in 1 – 5 years.
Low = More study required to designate as a life/safety project, or not known if benefits exceed the costs, or long-term project, implementation will not occur for over 5 years.

** PDMG Pre-Disaster Mitigation Grant
*** HMGP Hazard Mitigation Grant Program
******FMA Flood Mitigation Assistance (Program**

Mitigation Projects	Responsible Agency	Cost	Funding Sources	Priority
Flood/Erosion (FLD)				
FLD-1. Riprap Valdez Glacier Stream	FEMA DHS&EM USCOE	>$100,000	PDMG*	Medium
FLD. 2. Rechannelization of Valdez Glacier Stream	FEMA DHS&EM USCOE	>$100,000	PDMG	Medium
FLD 3. Dike Repair and Expansion - Alpine Woods Subdivision	FEMA DHS&EM USCOE	>$100,000	PDMG	High
FLD 4. Mineral Creek Flood Management Diking System Maintenance	FEMA DHS&EM USCOE	>$100,000	PDMG	High
FLD 5. Gravel Extraction – Valdez Glacier Creek and Mineral Creek	FEMA DHS&EM USCOE	>$100,000	PDMG	High
Project FLD-6. Structure Elevation and/or Relocation	FEMA DHS&EM	N/A	PDMG	Medium
Project FLD-7. Valdez Maps	FEMA	>$100,000	PDMG	High
Project FLD-8. Public Education	City DHS&EM	Staff Time	City	Medium
Project FLD 9. Install new streamflow and rainfall measuring gauges	FEMA DHS&EM	$10,000	PDMG	Medium
Project FLD 10. Apply for grants/funds to implement riverbank protection methods.	City	Staff Time	PDMG	Medium
Project FLD 11. Pursue obtaining a CRS rating to lower	City	Staff Time	City	High

Mitigation Projects	Responsible Agency	Cost	Funding Sources	Priority
flood insurance rates.				
Project FLD 12. Continue to obtain flood insurance for all City structures, and continue compliance with NFIP.	City	$1,500	City	High
Project FLD 13. Require that all new structures be constructed according to NFIP requirements and set back from the river shoreline to lessen future erosion concerns and costs.	City	Staff Time	City Budget	High
Severe Weather (SW)				
SW-1. Research and consider instituting the National Weather Service program of *"Storm Ready"*.	City	Staff Time	City	High
SW-2. Conduct special awareness activities, such as Winter Weather Awareness Week, Flood Awareness Week, etc.	City DCCED DHS&EM	Staff Time	City DCCED DHS&EM	Medium
SW-3. Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability	City	Staff Time	NOAA	High
SW-4. Encourage weather resistant building construction materials and practices.	City	Staff Time	City	High
Earthquake (E)				
E=1. If funding is available, perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Valdez.	City DHS&EM	To be determined	State Grants	High
E-2. Identify buildings and facilities that must be able to remain operable during and following an earthquake	City DHS&EM DCCED	Staff Time	State Grants	High

Mitigation Projects	Responsible Agency	Cost	Funding Sources	Priority
event.				
E-3. Contract a structural engineering firm to assess the identified bldgs and facilities.	City DHS&EM	>$10,000	PDMG	High
Tsunami/Seiche (T/S)				
Project T/S-1: Continued Participation in the Tsunami Awareness Program.	City DHS&EM	Staff Time	PDMG	High
Project T/S-2. Continued Participation Tsunami Ready Community Designation	City DHS&EM	Staff Time	PDMG	High
Project T/S-3. Inundation Mapping	City DHS&EM	>$100,000	PDMG	Medium
Project T/S-4. Update Valdez Emergency Operations Plan	City DHS&EM	Staff Time	PDMG	Medium
Avalanche/Landslide (A/L)				
Project A/L-1. Prohibit new construction in avalanche zones.	City	Staff Time	City Budget	Medium
A/L-2. Utilize appropriate methods of structural avalanche control.	FEMA	>$25,000	PDMG	Low
A/L-3. Enact buyout of homes in avalanche paths. reinforcements.	FEMA	>$25,000	PDMG	Low
A/L-4. Prohibit removal of vegetation in areas prone to landslides.	City	Staff Time	City Budget	High
Project A/L-5. Public disclosure of risk linked to deed or title of property and require owners to notify renters of hazard prior to occupancy.	City	Staff Time	City Budget	High
Project A/L-6. Install warning signage in mapped landslide zones.	DHS&EM FEMA City	<$10,000	PDMG	High
Project A/L-7. Continue to educate public about avalanche and landslide	City	Staff Time	City Budget	High

Mitigation Projects	Responsible Agency	Cost	Funding Sources	Priority
hazards.				
Wildland Fire (WF)				
WF-1. Continue to support the local fire department with adequate firefighting equipment and training.	City	Staff Time	City Budget	High
Project WF-2. Promote Fire Wise building design, siting, and materials for construction.	City	Staff Time	City Budget	High
WF-3: Continue to enforce development of building codes and requirements for new construction.	City	Staff Time	City Budget	High
WF-4: Enhance public awareness of potential risk to life and personal property. Encourage mitigation measures in the immediate vicinity of their property.	City	Staff Time	City Budget	High

Glossary of Terms

A-Zones Are found on all Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary and Floodway Maps (FBFMs).

Acquisition Local governments can acquire lands in high hazard areas through conservation easements, purchase of development rights, or outright purchase of property.

Alluvial Fan 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)

Alluvial Fan Flooding 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.

Asset 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.

Avalanche Is a mass of snow and ice falling suddenly down a mountain slope and often taking with it earth, rocks, trees, and rubble of every description.

Base Flood Is 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.

Base Flood Elevation (BFE) Is 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.

Base Floodplain Is the area that has a one percent chance of flooding (being inundated by flood waters) in any given year.

Building Is 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.

Building Code 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.

Community 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.

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 points. A community's points can earn people in their community a discount on their flood insurance premiums.

Critical Facilities 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.

Designated Floodway 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.

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 or drilling operations or of equipment or materials.

Digitize 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

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 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 recovery.

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.

Flood Disaster Assistance 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.

Flood Elevation Is the 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.

Flood Hazard is the potential for inundation and involves the risk of life, health, property, and natural value. Two reference bases 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).

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.

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.

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.

Floodplain Management 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.

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.

Flood Zones Are zones on the Flood Insurance Rate Map (FIRM) in which a Flood Insurance Study has established the risk premium insurance rates.

Flood Zone Symbols
A Area of special flood hazard without water surface elevations determined.
A1-30, AE Area of special flood hazard with water surface elevations determined.
AO Area of special flood hazard having shallow water depths and/or unpredictable flow paths between one and three feet.
A-99 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.
AH 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.
B, X Area of moderate flood hazard.
C, X Area of minimal hazard.
D Area of undetermined but possible flood hazard.

Geographic Information System A computer software application that relates physical features of the earth to a database that can be used for mapping and analysis.

Governing Body The legislative body of a municipality that is the assembly of a borough or the council of a city.

Hazard 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.

Hazard Event A specific occurrence of a particular type of hazard.

Hazard Identification The process of identifying hazards that threaten an area.

Hazard Mitigation 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)

Hazard Mitigation Grant Program 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.

Hazard Profile 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.

Hazard and Vulnerability Analysis 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.

Mitigate To cause something to became 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.

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.

One Hundred (100)-Year The flood elevation that has a one-percent chance of occurring in any given year. It is also known as the Base Flood.

Planning The act or process of making or carrying out plans; the establishment of goals, policies, and procedures for a social or economic unit.

Repetitive Loss Property 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.

Risk 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.

Riverine Relating to, formed by, or resembling rivers (including tributaries), streams, creeks, brooks, etc.

Riverine Flooding Flooding related to or caused by a river, stream, or tributary overflowing its banks due to excessive rainfall, snowmelt or ice.

Runoff 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).

Seiche 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.

Seismicity Describes the likelihood of an area being subject to earthquakes.

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.

Topography The contour of the land surface. The technique of graphically representing the exact physical features of a place or region on a map.

Tribal Government 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.

Tsunami 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 landslide 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.

Vulnerability Describes how exposed or susceptible to damage an asset it. 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.

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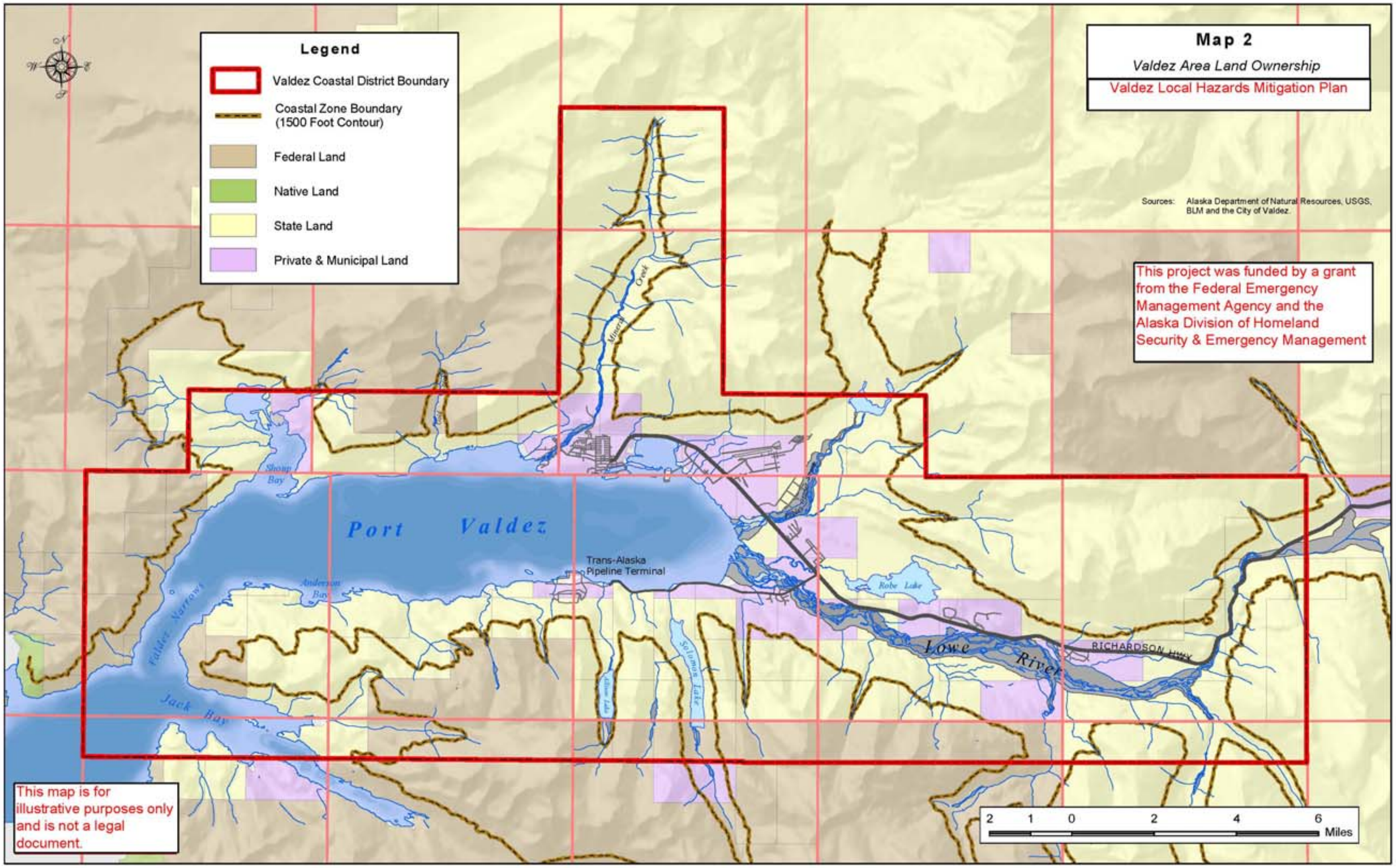
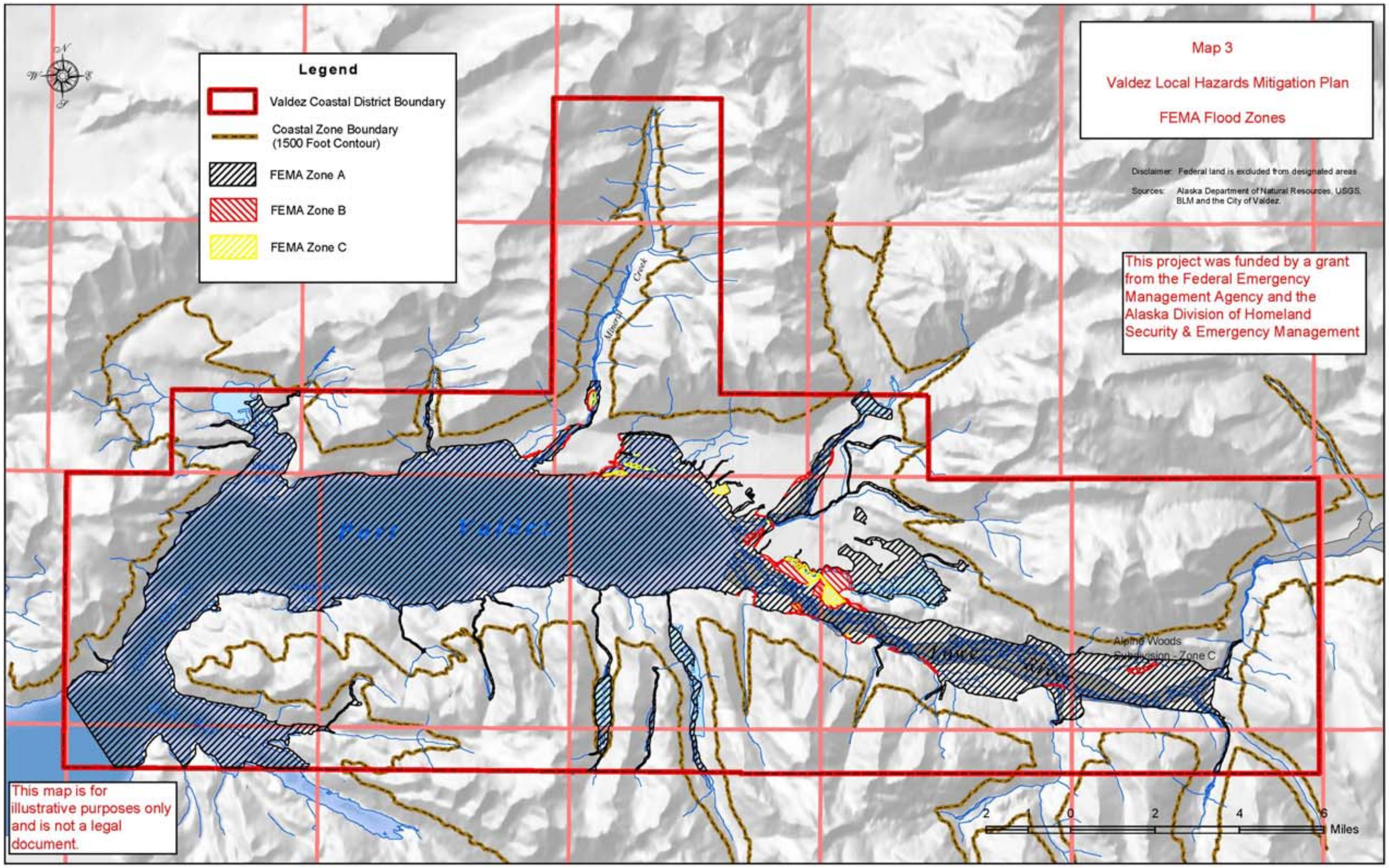
Appendix

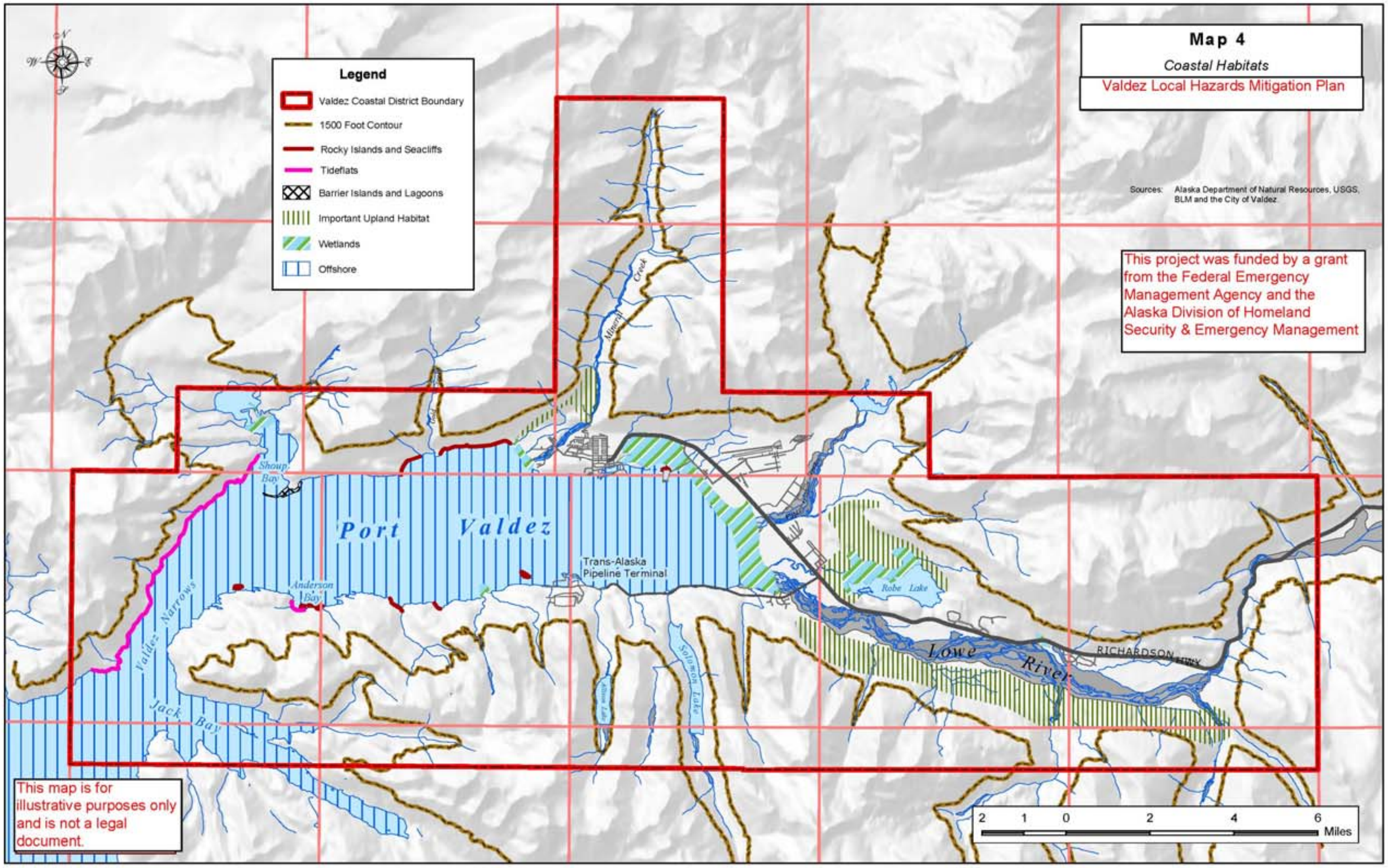
List of Maps

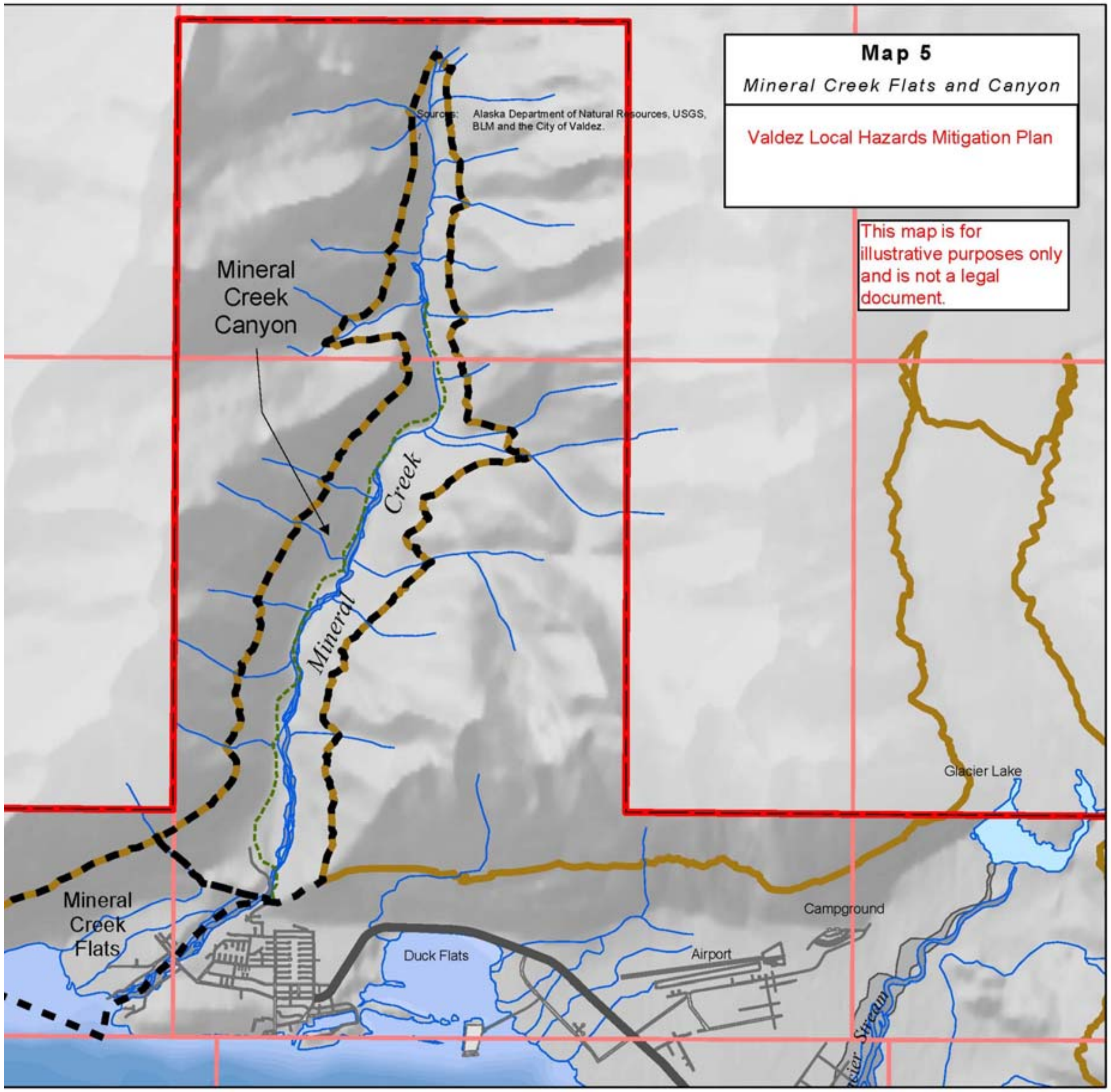
Groups of Pictures

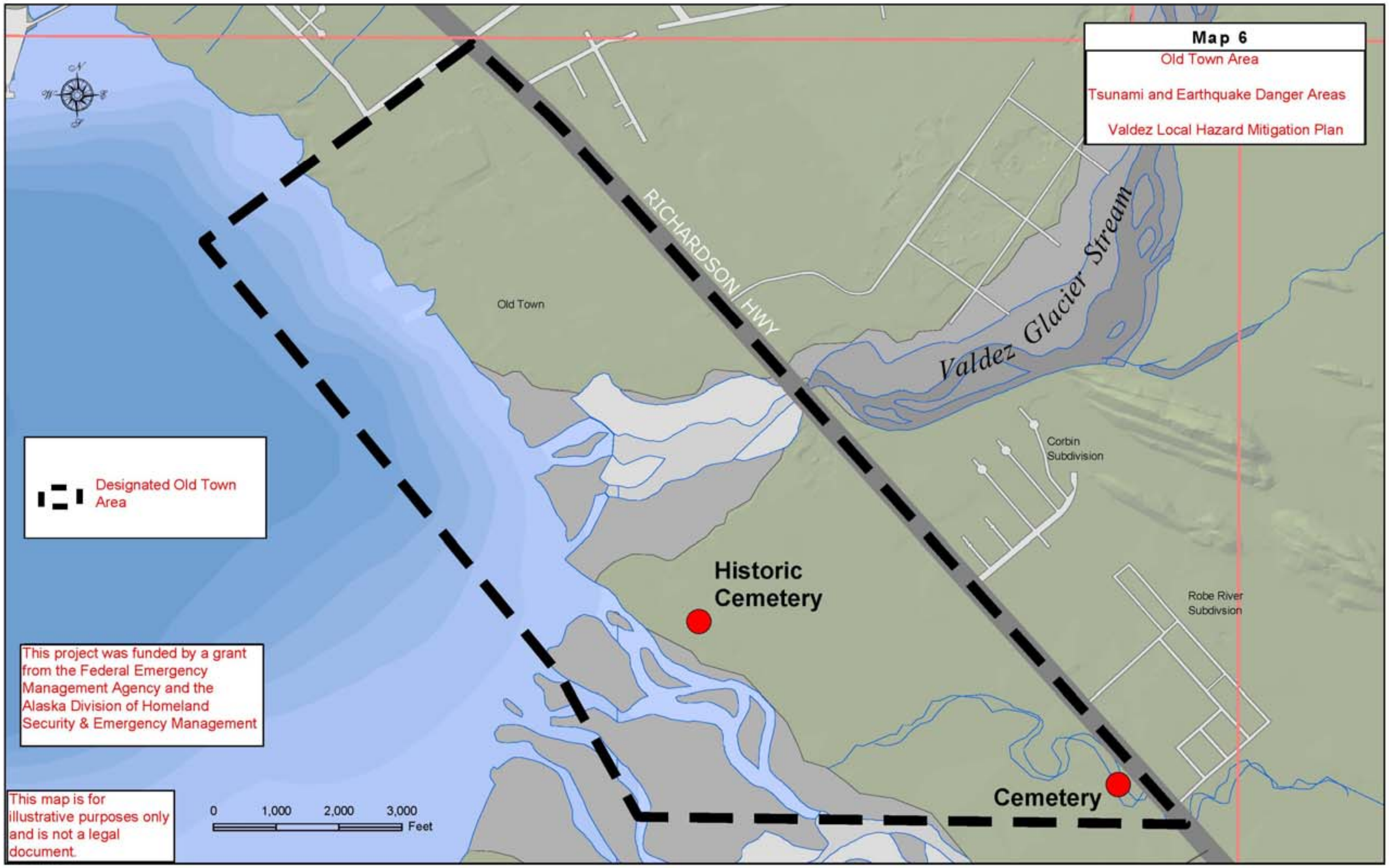

Map 1
Location Map
Valdez Local Hazards Mitigation Plan
Arctic Ocean
Fairbanks
Valdez
Anchorage
Juneau
Bristol Bay
Gulf of Alaska
0
125
250
500
Miles

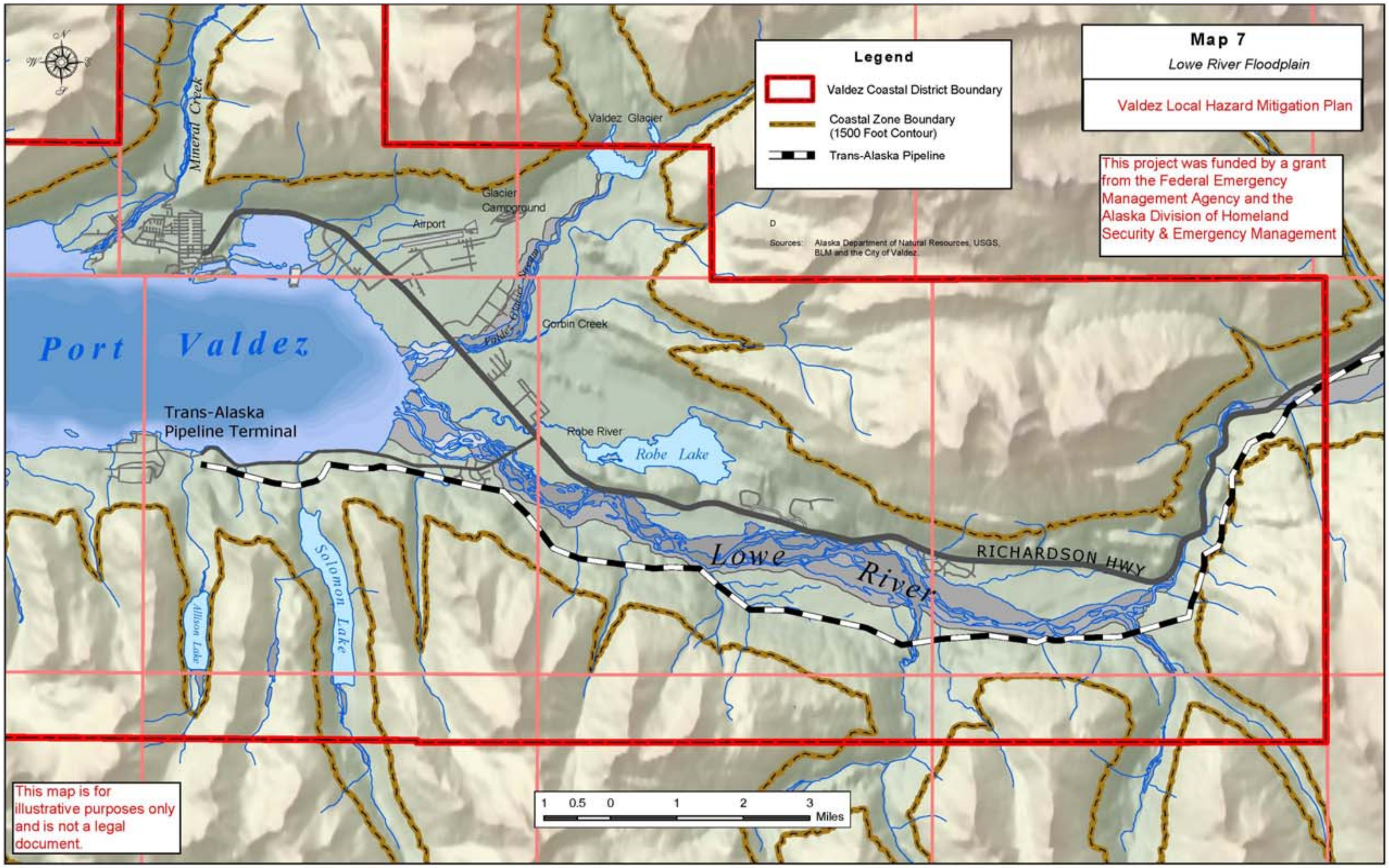

Legend
Valdez Coastal District Boundary
Coastal Zone Boundary (1500 Foot Contour)
Federal Land
Native Land
State Land
Private & Municipal Land
Map 2
Valdez Area Land Ownership
Valdez Local Hazards Mitigation Plan
Sources: Alaska Department of Natural Resources, USGS, BLM and the City of Valdez.
This project was funded by a grant from the Federal Emergency Management Agency and the Alaska Division of Homeland Security & Emergency Management
Port Valdez
Trans-Alaska Pipeline Terminal
Lowe River
RICHARDSON HWY
Valdez Narrows
Jack Bay
Robe Lake
Solomon Lake
This map is for illustrative purposes only and is not a legal document.
2 1 0 2 4 6 Miles

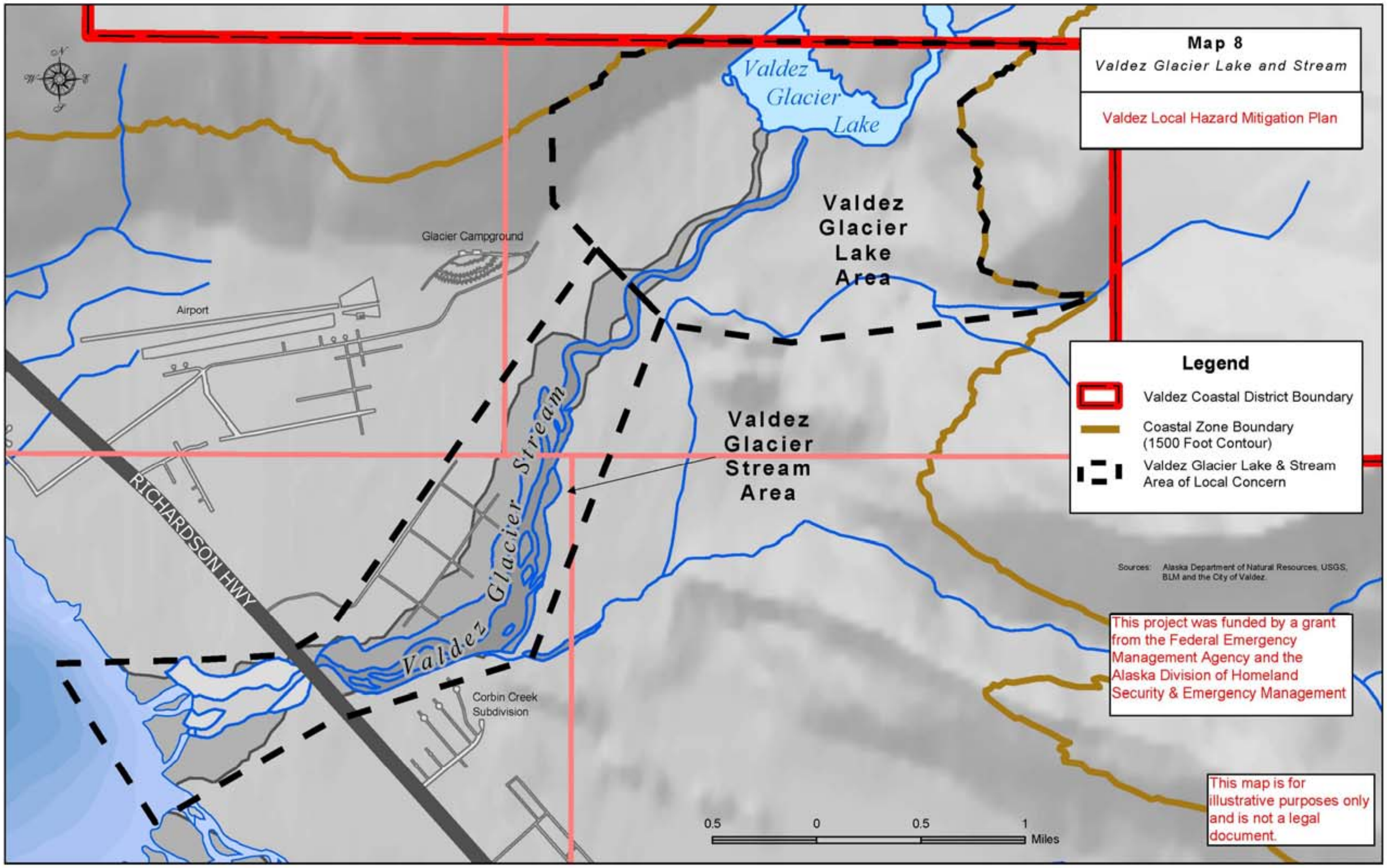

Map 3
Valdez Local Hazards Mitigation Plan
FEMA Flood Zones
Legend
Valdez Coastal District Boundary
Coastal Zone Boundary
(1500 Foot Contour)
FEMA Zone A
FEMA Zone B
FEMA Zone C
Disclaimer: Federal land is excluded from designated areas
Sources: Alaska Department of Natural Resources, USGS, BLM and the City of Valdez.
This project was funded by a grant from the Federal Emergency Management Agency and the Alaska Division of Homeland Security & Emergency Management
Port Valdez
Mineral Creek
Alpine Woods
Subdivision - Zone C
2 1 0 2 4 6
Miles
This map is for illustrative purposes only and is not a legal document.

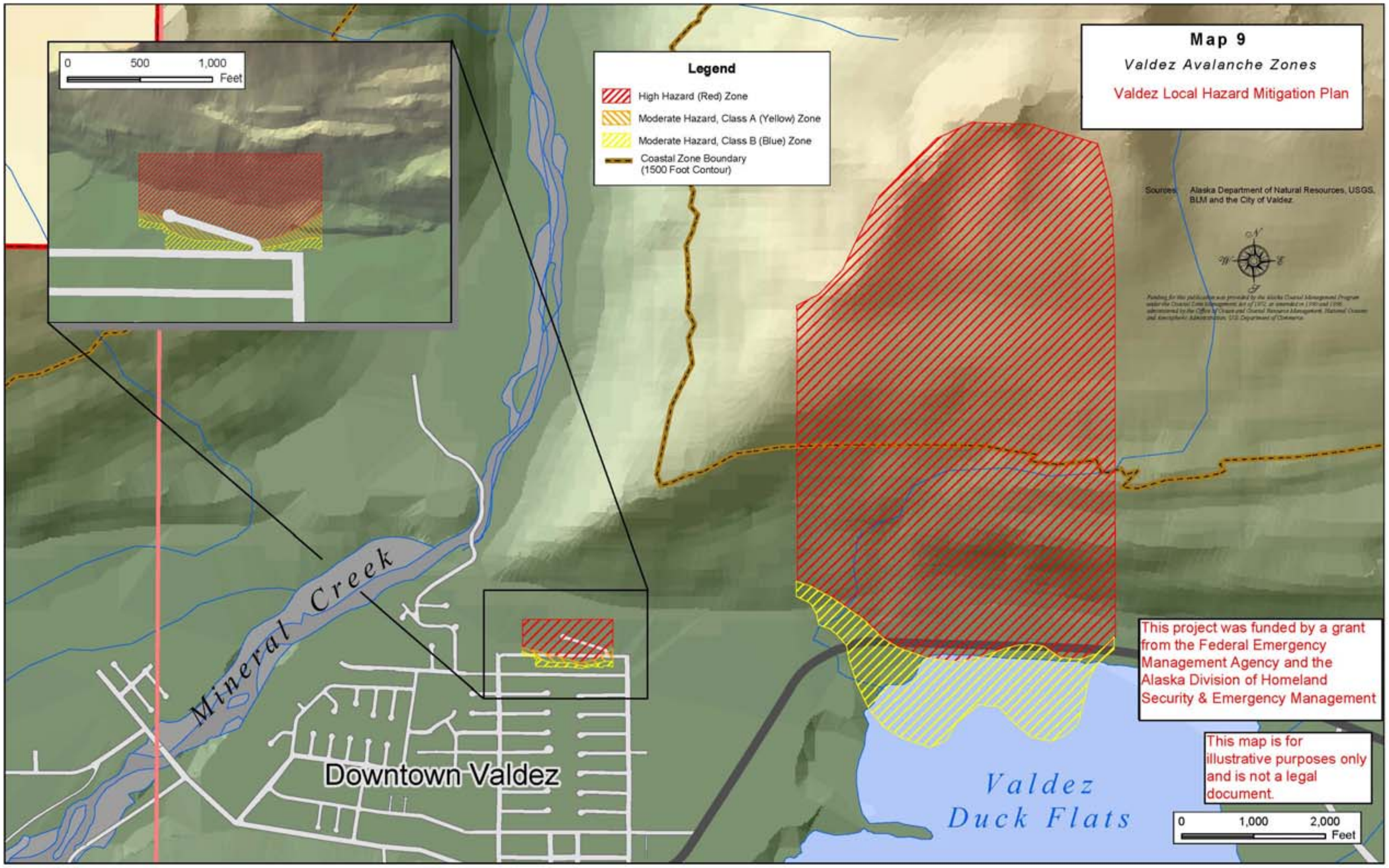

Map 4
Coastal Habitats
Valdez Local Hazards Mitigation Plan
Legend
Valdez Coastal District Boundary
1500 Foot Contour
Rocky Islands and Seacliffs
Tideflats
Barrier Islands and Lagoons
Important Upland Habitat
Wetlands
Offshore
Sources: Alaska Department of Natural Resources, USGS, BLM and the City of Valdez
This project was funded by a grant from the Federal Emergency Management Agency and the Alaska Division of Homeland Security & Emergency Management
Port Valdez
Trans-Alaska Pipeline Terminal
Shoup Bay
Anderson Bay
Valdez Narrows
Jack Bay
Mineral Creek
Robe Lake
Solomon Lake
Lowe River
RICHARDSON HWY
This map is for illustrative purposes only and is not a legal document.
2 1 0 2 4 6
Miles


Map 5
Mineral Creek Flats and Canyon
Valdez Local Hazards Mitigation Plan
This map is for illustrative purposes only and is not a legal document.
Sources: Alaska Department of Natural Resources, USGS, BLM and the City of Valdez.
Mineral Creek Canyon
Mineral Creek
Mineral Creek Flats
Duck Flats
Airport
Campground
Glacier Lake


Map 6
Old Town Area
Tsunami and Earthquake Danger Areas
Valdez Local Hazard Mitigation Plan
RICHARDSON HWY
Valdez Glacier Stream
Old Town
Corbin Subdivision
Robe River Subdivision
Historic Cemetery
Cemetery
Designated Old Town Area
This project was funded by a grant from the Federal Emergency Management Agency and the Alaska Division of Homeland Security & Emergency Management
This map is for illustrative purposes only and is not a legal document.
0 1,000 2,000 3,000 Feet


Map 7
Lowe River Floodplain
Valdez Local Hazard Mitigation Plan
Legend
Valdez Coastal District Boundary
Coastal Zone Boundary
(1500 Foot Contour)
Trans-Alaska Pipeline
Sources: Alaska Department of Natural Resources, USGS, BLM and the City of Valdez.
This project was funded by a grant from the Federal Emergency Management Agency and the Alaska Division of Homeland Security & Emergency Management
This map is for illustrative purposes only and is not a legal document.
Mineral Creek
Valdez Glacier
Glacier Campground
Airport
Corbin Creek
Port Valdez
Trans-Alaska Pipeline Terminal
Robe River
Robe Lake
Lowe River
RICHARDSON HWY
Solomon Lake
Allison Lake
1 0.5 0 1 2 3
Miles


Map 8
Valdez Glacier Lake and Stream
Valdez Local Hazard Mitigation Plan
Valdez Glacier Lake
Valdez Glacier Lake Area
Valdez Glacier Stream Area
Valdez Glacier Stream
Glacier Campground
Airport
RICHARDSON HWY
Corbin Creek Subdivision
Legend
Valdez Coastal District Boundary
Coastal Zone Boundary (1500 Foot Contour)
Valdez Glacier Lake & Stream Area of Local Concern
Sources: Alaska Department of Natural Resources, USGS, BLM and the City of Valdez.
This project was funded by a grant from the Federal Emergency Management Agency and the Alaska Division of Homeland Security & Emergency Management
This map is for illustrative purposes only and is not a legal document.
0.5 0 0.5 1
Miles


Map 9
Valdez Avalanche Zones
Valdez Local Hazard Mitigation Plan
Legend
High Hazard (Red) Zone
Moderate Hazard, Class A (Yellow) Zone
Moderate Hazard, Class B (Blue) Zone
Coastal Zone Boundary
(1500 Foot Contour)
Sources: Alaska Department of Natural Resources, USGS, BLM and the City of Valdez
N
W
E
S
0 500 1,000 Feet
Mineral Creek
Downtown Valdez
Valdez Duck Flats
This project was funded by a grant from the Federal Emergency Management Agency and the Alaska Division of Homeland Security & Emergency Management
This map is for illustrative purposes only and is not a legal document.
0 1,000 2,000 Feet

Engineering Department
212 Chenega
P.O. Box 307
Valdez, AK 99686
(907) 835-3404 phone
(907) 834-3420 fax

<table>
<tr><td>FIELD REPORT</td><td>DATE: 10-30-06</td><td colspan="3">PROJECT NO:</td></tr>
<tr><td rowspan="3">TO:
Rick Wade- Nordic Village Supply
Bob Thompson – PW/Eng
Greg Loclwood – Eng
John Hozey - CM</td><td colspan="4">PROJECT: Alpine Woods Dike Construction</td></tr>
<tr><td colspan="4">LOCATION: Alpine Woods Subdivision</td></tr>
<tr><td colspan="4">CONTRACTOR: Nordic Village Supply</td></tr>
<tr><td rowspan="2">AT SITE:
Rick Wade, 2 workers</td><td rowspan="2">WEATHER: Partly sunny</td><td>TEMP</td><td>°at</td><td>AM</td></tr>
<tr><td>TEMP</td><td>°at</td><td>PM</td></tr>
</table>

10-24

1. Met with Rick Wade and toured the new levees.
2. New dike constructed along the south edge of the airstrip turns left to head north to the creek. The levee runs 371' east to west and 285' north to south. It is approximately 12' wide at the top and 4 ½' to 5 ½' tall.
3. A second levee is tied in to the eastern most portion of the City dike system. The new dike runs in a northeasterly direction and terminates at the creek that flows through the back of the Wade's property. This dike is 130' long, 11' wide at the top and 4 ½' to 5 ½' tall.
4. An earthen berm was constructed on the north side of the creek. It is 101' long, 4' wide at the top and approximately 3' tall
5. Erosion to several areas of the access road behind the existing City dikes was visible.
6. Photographed the area to the east of Nordic where a section of forest was cleared around the creek to divert water during the flood event. A rough road has now been established into this area.
7. Photographed the area on the west end of the gravel pit where flood waters were directed to flow back into the Lowe River.

10-26

1. Rip rap was placed on the end of the 130' dike extension.
2. Stockpiled rip rap behind the existing City dike is too small to be used as class III material.
3. Dozer working the east end of the airstrip clearing brush.

10-30

1. Total of 90 lineal feet of rip rap toe'd in and placed mid way up the face of the 130' dike extension.
2. Total of 44 lineal feet of rip rap placed along the 101' earthen berm.
3. Total of 155 lineal feet of rip rap toe'd in and placed mid way up the face of the 285' section of dike on the east end of the air strip.
4. Dozer and loader working to clear brush and overburden away from the airstrip dike.
5. Logs and debris cleared away to make a diversion channel at the west end of the gravel pit and partially along the face of the 2000 dike.
6. Area of woods at the west end of the gravel pit cleared as part of the diversion channel to direct future flood waters back into the river.

SIGNED:	Scott Benda	**PAGE 1 of 2**
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285' dike at the end of the airstrip.

130' extension to existing dike.

Rip rap on the 130' extension.

101' earthen berm

Diversion channel

371' levee along the south edge of the Airstrip

SIGNED:	Scott Benda	PAGE 2 of 2
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1985 Alpine Woods Flood Aerial Photos

Right bank of Lowe river at Alpine Woods Subdivision. Aspen Way upper left. Southwest end of improved Whispering Spruce Drive center.

8-5-85

Right bank of Lowe River at Alpine Woods Subdivision.
Whispering Spruce Drive/Richardson Highway intersection upper center.

8-5-85

Right bank of Lowe river at Alpine Woods Subdivision. Aspen Way upper left. Southwest end of improved Whispering Spruce Drive center.

8-5-85

Valdez Glacier and Lake
June 22, 2004

Valdez Glacier and Lake
June 22, 2004




Valdez Glacier and Lake
June 22, 2004




Valdez Glacier - Civil Air Patrol Pictures
July 12, 2006

Valdez Glacier - east of second bench, this lake has dumped recently
N 61° 13.266' W 146° 08.930' 3047 ft E 07/12/06 19:27:59

Valdez Glacier - Lake 2870 east of second bench
N 61° 13.393' W 146° 03.974' 3809 ft 07/12/06 19:30:56

Valdez Galcier accumulation area - north side of Abercrombie Mtn
N 61° 16.240' W 146° 09.509' 4765 ft 07/12/06 19:37:13

Valdez Galcier accumulation area
N 61° 16.789' W 146° 07.346' 5016 ft 07/12/06 19:38:14

Mineral Creek - Civil Air Patrol Pictures
July 12, 2006

Looking down Mineral Creek
N 61° 15.802' W 146° 18.721' 6461 ft S 07/12/06 19:49:29

Mineral Creek Glacier
N 61° 16.154' W 146° 17.450' 6521 ft 07/12/06 19:50:40

Mineral Creek Glacier - ice fall
N 61° 16.157' W 146° 17.669' 6531 ft 07/12/06 19:50:45

Mineral Creek - stamp mill in lower left center
N 61° 13.275' W 146° 17.733' 6168 ft 07/12/06 19:53:14

Snow Removal
January 2004


Valdez October 10 – 13, 2006 Flood Event




Valdez October 10 – 13, 2006 Flood Event