Draft
City of Dillingham
and
Curyung Tribal Council
MULTI-JURISDICTIONAL
HAZARD MITIGATION PLAN

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November 2021

Prepared for:

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List of Acronyms and Abbreviations

ºF	degrees Fahrenheit
ANTHC	Alaska Native Tribal Health Consortium
BEA	Baseline Erosion Assessment
BRIC	Building Resilient Infrastructure and Communities
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
City	City of Dillingham
DCCED	Department of Community, Commercial, and Economic Development
DCRA	Division of Community and Regional Affairs
DGGS	Division of Geological and Geophysical Surveys
DHS&EM	State of Alaska, Department of Homeland Security and Emergency Management
DHS	Department of Homeland Security
DMA 2000	Disaster Mitigation Act of 2000
DNR	Department of Natural Resources
DOF	Department of Forestry
FEMA	Federal Emergency Management Agency
FHAs	Flood Hazard Areas
FIRMs	Flood Insurance Rate Maps
ft	Feet
FMA	Flood Mitigation Assistance
FY	Fiscal Year
g	Gravity
GAO	Government Accountability Office
GIS	Geographic Information Systems
HAZUS-MH	Hazards U.S. – Multi-Hazard
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
IGAP	Indian General Assistance Program
M	Magnitude

MAP	Mitigation Action Plan Strategy
MJHMP	Multi-Jurisdictional Hazard Mitigation Plan
MHHW	Mean higher high water
MMI	Modified Mercalli Intensity
Mph	Miles per Hour
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PDM	Pre-Disaster Mitigation
PGA	Peak Ground Acceleration
PSHAs	Probabilistic Seismic Hazard Analyses
REAA	Rural Education Attendance Area
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic and Environmental
Tribe	Curyung Tribal Council
U.S.	Unites States
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USFA	U.S. Fire Administration
USGS	U.S. Geological Survey

1.0 Introduction

This section provides a brief introduction to hazard mitigation planning, the grants associated with these requirements, and a description of this Multi-Jurisdictional Hazard Mitigation Plan (MJHMP). This MJHMP is an Update of the 2016 Hazard Mitigation Plan (HMP) for the City of Dillingham (City) and a new HMP developed for the Curyung Tribal Council (Tribe). As part of this planning process, the 2021 HMP is a MJHMP that includes both the City and Tribe as jurisdictions.

1.1 HAZARD MITIGATION PLANNING

Hazard mitigation, as defined in Title 44 of the Code of Federal Regulations (CFR), Part §201.4, is "any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards." Many areas have expanded this definition to also include human-caused hazards. As such, hazard mitigation is any work done to minimize the impacts of any type of hazard event before it occurs. It aims to reduce losses from future disasters. Hazard mitigation is a process in which hazards are identified and profiled, people and facilities at risk are analyzed, and mitigation actions are developed. Implementation of the mitigation actions, which include long-term strategies that may consist of planning, policy changes, programs, projects, and other activities, is the end result of this process. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage reconstruction and repeated damage. As such, State, Local, and Tribal governments are encouraged to take advantage of funding provided by Federal Hazard Mitigation Assistance (HMA) programs.

1.2 PLANNING REQUIREMENTS

1.2.1 Local and Tribal Mitigation Plans

On October 30, 2000, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390) which amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Title 42 of the United States Code [USC] 5121 et seq.) by repealing the act's previous mitigation planning section (409) and replacing it with a new mitigation planning section (322). Section 322 directs State, Local, and Tribal entities to closely coordinate mitigation planning and implementation efforts. Additionally, it establishes the HMP requirement for the Federal Emergency Management Agency's (FEMA) HMA.

On October 2, 2015, FEMA published the Mitigation Planning Final Rule in the Federal Register, [Docket ID: FEMA-2015-0012], 44 CFR Part 201, effective November 2, 2015. Planning requirements for Local and Tribal entities are described in detail in Sections §201.6 and §201.7. Locally- and Tribally- adopted and State- and FEMA-approved HMPs qualify jurisdictions for several HMA grant programs. This MJHMP for the City and Tribe complies with Title 44 CFR Sections §201.6 and §201.7 and applicable FEMA guidance documents as well as the 2018 State of Alaska HMP.

Section 322 of the Stafford Act (42 USC 5165) as amended by P.L. 106-390 provides for State, Local, and Tribal governments to undertake a risk-based approach to reducing risks from natural hazards through mitigation planning. The National Flood Insurance Act of 1968 (42 USC 4001 et seq.) as amended, further reinforced the need and requirement for HMPs, linking Flood Mitigation Assistance (FMA) programs to State, Local, and Tribal HMPs. This change also required participating National Flood Insurance Program (NFIP) communities' risk assessments and mitigation strategies to identify and address repetitively flood damaged properties.

1.3 GRANT PROGRAMS WITH MITIGATION PLAN REQUIREMENTS

FEMA HMA grant programs provide funding to State, Local, and Tribal entities that have a FEMA-approved State, Local, or Tribal HMP. Two of the grants are authorized under the Stafford Act and DMA 2000, while the remaining three are authorized under the National Flood Insurance Act and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act. As of June 19, 2008, the grant programs were segregated. The Hazard Mitigation Grant Program (HMGP) is a competitive, disaster-funded grant program whereas the other Unified Mitigation Assistance Programs (Pre-Disaster Mitigation [PDM] and FMA, although competitive) rely on specific pre-disaster grant funding sources, sharing several common elements. As a result of amendments by the Disaster Relief and Recovery Act of 2018, the PDM program is being replaced with the new Building Resilient Infrastructure and Communities (BRIC) program.

"The Department of Homeland Security (DHS) FEMA HMA grant programs present a critical opportunity to protect individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds. The HMA programs provide PDM/BRIC grants annually to State, Local, and Tribal communities. The statutory origins of the programs differ, but all share the common goal of reducing the loss of life and property due to natural hazards. The PDM/BRIC program is authorized by the Stafford Act and focuses on mitigation project and planning activities that address multiple natural hazards, although these activities may also address hazards caused by manmade events. The FMA program is authorized by the National Flood Insurance Act and focuses on reducing claims against the NFIP" (FEMA, 2019h).

1.3.1 Hazard Mitigation Assistance Unified Programs

The HMGP provides grants to State, Local, and Tribal entities to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Projects must provide a long-term solution to a problem; for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. FEMA may provide a State, City, or Village with up to 20% of the total aggregate disaster damage costs to fund HMGP project or planning grants. The cost-share for this grant is 75% Federal/25% non-Federal.

The PDM/BRIC grant program provides funds to State, Local, and Tribal entities for hazard mitigation planning and mitigation project implementation prior to a disaster event. PDM grants are awarded on a nationally-competitive basis. Like HMGP funding, a PDM/BRIC project's potential savings must be more than the cost of implementing the project. In addition, funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The total amount of PDM/BRIC funding available is appropriated by Congress on an annual basis. In Fiscal Years (FY) 2018 and 2019, PDM program funding totaled approximately $235 and $250 million each year. The cost-share for this grant is 75% Federal/25% non-Federal.

The goal of the FMA grant program is to reduce or eliminate flood insurance claims under the NFIP. Particular emphasis for this program is placed on mitigating repetitive loss properties. The primary source of funding for this program is the National Flood Insurance Fund. Grant funding is available for three types of grants, including Planning, Project, and Technical Assistance. Project grants, which use the majority of the program's total funding, are awarded to State, Local, and Tribal entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP. In FY 2018, FMA funding totaled $160 million. In FY 2019, FMA funding totaled $210 million. The cost-share for this grant is 75% Federal/25% non-Federal.

> The City of Dillingham is an NFIP participating community and is eligible for FMA-associated grant funding opportunities.

1.4 MJHMP Description

The remainder of this MJHMP consists of the following sections and appendices:

Community Description

Section 2 provides a general history and background of the Dillingham community, including historical trends for population, and the demographic and economic conditions that have shaped the area. Location figures of the Dillingham area with relation to the various surrounding water bodies are included in Section 5 with hazard areas identified.

Planning Process

Section 3 describes the planning process and identifies the Planning Team members, the meetings held as part of the planning process, the LeMay Engineering & Consulting, Inc. planners, and the key stakeholders within the Dillingham jurisdictional area. In addition, this section documents public outreach activities (Appendix C) and the review and incorporation of relevant plans, reports, and other appropriate information.

Section 3 also describes the Planning Team's formal plan maintenance process to ensure that the MJHMP Update remains an active and applicable document. This process includes monitoring, evaluating, and updating the MJHMP Update (Appendix E); implementation of the mitigation process through existing planning mechanisms; and continued public involvement.

Prerequisites

Section 4 addresses the prerequisites of plan adoption, which include adoption by the Dillingham City Council and the Curyung Tribal Council. The adoption resolutions are included in Appendix B.

Hazard Analysis

Section 5 describes the process through which the Planning Team identified, screened, and selected the hazards to be profiled in this MJHMP Update. The hazard analysis includes the characteristics, history, location, extent, impact, and recurrence probability for each hazard. In addition, historical and hazard location figures are included when applicable.

Vulnerability Analysis

Section 6 identifies potentially vulnerable assets—people, residential and nonresidential buildings, and critical facilities and infrastructure—in the Dillingham community. The resulting information identifies the full range of hazards that the City and Tribe could face and potential social impacts, damages, and economic losses. Trends in land use and development are also discussed.

Mitigation Strategy

Section 7 defines the mitigation strategy which provides a blueprint for reducing the potential losses identified in the vulnerability analysis. The Planning Team developed a list of mitigation goals and potential actions to address the risks facing Dillingham. Mitigation actions include preventive actions, property protection techniques, natural resource protection strategies, structural projects, emergency services, and public information and awareness activities. This section also provides the community's capacity in terms of regulatory tools, and staff and financial resources.

References

Section 8 lists the reference materials used to prepare this MJHMP Update.

Appendix A

Appendix A provides the FEMA Local Mitigation Plan Review Tool for the City of Dillingham and the FEMA Tribal Mitigation Plan Review Tool for the Curyung Tribal Council; both review tools document compliance of this MJHMP with FEMA criteria.

Appendix B

Appendix B provides the adoption resolutions for the City and Tribe as well as the final approval letters from FEMA for this 2021 MJHMP Update.

Appendix C

Appendix C provides public outreach information, including newsletters, meeting sign-in sheets and agendas, and public comments.

Appendix D

Appendix D contains the Benefit-Cost Analysis Fact Sheet used to prioritize mitigation actions.

Appendix E

Appendix E provides plan maintenance documents, such as an annual review sheet, a progress report form, and a community survey.

Appendix F

Appendix F identifies potential funding sources.

2.0 Community Description

This section describes the location, geography, climate, history; demographics; and economy of the Dillingham community.

2.1 LOCATION, GEOGRAPHY, CLIMATE, AND HISTORY

Location and Geography

Dillingham is located at the extreme northern end of Nushagak Bay in northern Bristol Bay, at the confluence of the Wood and Nushagak Rivers. It lies 327 miles southwest of Anchorage and is located at approximately 59.0406 North Latitude and -158.4656 West Longitude (Figure 1). Dillingham is located in the Dillingham Census Area. The area encompasses 36.84 square (sq.) miles of land and 397.94 sq. mile of water (Department of Community, Commerce, and Economic Development [DCCED], Division of Community and Regional Affairs [DCRA], 2021).

Figure 1. Dillingham Location Map

The community sits at the edge of rolling tundra, with ridges of spruce and birch trees. Rivers ox bow through the land, and pristine lakes and streams abound. To the north, rugged mountains criss-cross the horizon. Dillingham is surrounded by 1.6 million acres of Wood-

Tikchik State Park, the largest state park in the United States (U.S.). The Park is known for its spectacular stair-step lakes, connected by short rivers. The Togiak National Wildlife Refuge is only accessible by plane or boat. The refuge comprises 6,600 sq. miles of tundra wetlands, rivers, jagged peaks, glacial valleys, as well as rugged sea cliffs and beaches.

Consistent with its geological history, the topography of Dillingham is a mix of wet lowlands, gentle hills, and moraine deposits. There are a few areas with slopes too steep for development. Steep coastal bluffs occur at several locations along the Nushagak River below the core town site, most notably at the end of Squaw Creek Road, extending through Kanakanak Beach and adjacent to the Bristol Bay Area Health Corporation facility. Other steep bluffs occur beyond the end of Wood River Road, along the western bank of the Wood River. These steep-sided waterfront slopes are erosion-prone, offer poor access, and limit the feasible sites for development of marine transportation facilities. Apart from these areas, slopes present severe limitations for development on some of the steeper back-slopes of hills and some of the steep slopes that run along drainages. Forested areas of moderate slope generally reflect favorable surface drainage.

Dillingham was once covered by glaciers, and the topography of the area is characteristic of areas where deposition by continental glaciers occurred. The landscape consists of rolling hills with many irregularly shaped moraine knolls and ridges separated by flat, wetlands and muskeg. The upland moraine hills are covered with a thick layer of silty, wind-laid material called loess – a mixture of silt blown from unvegetated floodplains and hills adjacent to the melting glaciers, and volcanic ash from the Aleutian Range to the east and south. Beneath this mantel of loess, the substratum is mostly coarse-grained sand and gravel.

Climate

Dillingham falls within the transitional climate zone, characterized by tundra interspersed with boreal forests, and weather patterns of long, cold winters and shorter, warm summers. Heavy fog is common in July and August. Winds of up to 60-70 miles per hour (mph) may occur at any time of the year and are common from August through December, roughly coinciding with the peak Pacific typhoon season. The Nushagak River is ice-free from mid-May through late October. Annual precipitation totals approximately 25 inches, with 83 inches of snow annually.

History

The area around Dillingham was inhabited by both Yup'ik and Athabascans. It became a trade center when Russians erected the Alexandrovski Redoubt Post in 1818. Local Native groups and Natives from the Kuskokwim Region, the Alaska Peninsula, and Cook Inlet mixed as they came to visit or live at the post. The community was known as Nushagak by 1837, when a Russian Orthodox mission was established. In 1881, the U.S. Signal Corps established a meteorological station at Nushagak. In 1884, the first salmon cannery in the Bristol Bay region was constructed by Arctic Packing Co., east of the site of modern-day Dillingham. Ten more were established within the next 17 years. The Post Office at Snag Point and town were named after U.S. Senator Paul Dillingham in 1904, who had toured Alaska extensively with his Senate subcommittee during 1903. The 1918-19 influenza epidemic struck the region and left no more than 500 survivors. A hospital and orphanage were established in Kanakanak after the epidemic, six miles from the present-day community. The Dillingham townsite was first surveyed in 1947. The City was incorporated in 1963.

Traditionally a Yup'ik area with Russian influences, Dillingham is now a highly-integrated population of non-natives and Alaska Natives. The outstanding commercial fishing opportunities in the Bristol Bay area are the focus of the local culture.

2.2 DEMOGRAPHICS

The 2020 certified DCCED population of Dillingham is 2,226. The population grows to nearly double during the summer commercial fishing and tourism months. Figure 2 shows the historic population for Dillingham.

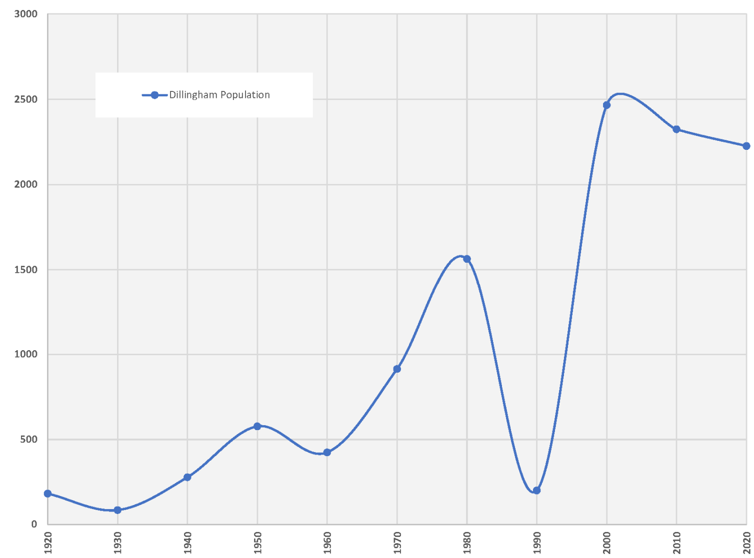


Figure 2. Historic Population Estimates for Dillingham

The 2010 U.S. Census recorded 2,329 residents, of which the median age was 33.1, indicating an overall young population.

2.3 ECONOMY

Dillingham is the economic, transportation, and public service center for western Bristol Bay. Commercial fishing, fish processing, and support of the fishing industry are the community's primary industrial activities. The majority of Dillingham's economy is driven by commercial fishing during the summer. Peter Pan Seafoods & Icicle Seafoods operates processing plants onshore in Dillingham. Six other major processors, Ocean Beauty, Trident, and Leader Creek, Copper River, Ekuk Fisheries, Alaska's Best, Silver Bay and Red Salmon, coordinated their operations on floating processors in the fishing district.

Dillingham can only be reached by air and sea. The State-owned airport provides a 6,404-feet (ft) long by 150 ft wide paved runway and flight service station. Regular jet service is available from Anchorage. A seaplane base is available three miles west at Shannon's Pond and a heliport is available at Kanakanak Hospital. In 2007, four freight airlines served Dillingham; thirteen charter services served smaller communities from Dillingham; and two passenger airlines connected southwest Alaska residents from Bristol Bay and points south and west to King Salmon and Anchorage. The City operates a Small Boat Harbor during the summer, an all-tide dock boat harbor and boat launch facilities. Two private companies provide boat haul-out and storage services. Two barge lines make scheduled trips from Seattle. There is a 23-mile State of Alaska-maintained paved road to Aleknagik; constructed in 1960 and paved to the City limits in 1998.

According to the 2019 American Community Survey, the median household income in Dillingham was $90,289. Approximately 109 individuals were estimated to be living below the poverty level. The potential work force (those aged 16 years or older) in Dillingham was estimated to be 1,655; of which 1,207 were actively employed. In 2019, the unemployment rate was 6.3%.

3.0 Planning Process

This section provides an overview of the planning process; identifies the Planning Team members and key stakeholders; documents public outreach efforts; and summarizes the review and incorporation of existing plans, studies, and reports used to develop this 2021 MJHMP Update. Outreach support documents and meeting information regarding the Planning Team and public outreach efforts are provided in Appendix C.

The requirements for the planning process, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements
1. REGULATION CHECKLIST
Local Planning Process **§201.6(b)** and **§201.7(b):** An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include Elements A in the Plan.
ELEMENT A. Planning Process
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? **[Requirements §201.6(c)(1)** and **§201.7(c)(1)]** A2 for City and A3 for Tribe. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? **[Requirements §201.6(b)(2)** and **§201.7(c)(1)(ii)]** A3 for City and A2 for Tribe. Does the Plan document how the public was involved in the planning process during the drafting stage? **[Requirements §201.6(b)(1)** and **§201.7(c)(1)(i)]** A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? **[Requirements §201.6(b)(3)** and **§201.7(c)(1)(iii)]** A5 for City and A7 for Tribe. Is there discussion of how the City and Tribe will continue public participation in the plan maintenance process? **[Requirements §201.6(c)(4)(iii)** and **§201.7(c)(4)(iv)]** A5 for Tribe. Does the plan include a discussion on how the planning process was integrated to the extent possible with other ongoing Tribal planning efforts as well as other FEMA programs and initiatives? **[Requirement §201.7(c)(1)(iv)]** A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating, and updating the mitigation plan within a 5-year cycle?) **[Requirements §201.6(c)(4)(i)** and **§201.7(c)(4)(i)]**
Source: FEMA, 2015.

3.1 OVERVIEW OF PLANNING PROCESS

During the 2021 planning process, the City of Dillingham and the Curyung Tribal Council updated their 2016 HMP with assistance from the State of Alaska, Division of Homeland

Security and Emergency Management (DHS&EM). Updates to the 2021 Multi-Jurisdiction HMP included:

1. A review of the local hazards facing the City and Tribe.
2. An assessment of the progress made towards minimizing or eliminating those hazards from the 2016 HMP.
3. A revised hazard vulnerability assessment that updates the City information and adds the Tribal information.
4. Revised community demographic and economic information.

The Planning Team reviewed their roles in the planning process, such as: advocating community participation, creating opportunities for public participation, and gathering and organizing information. The Planning Team identified applicable City and Tribal resources and capabilities. They also discussed hazards affecting the community (Section 5).

The Planning Team asked participants to review hazards affecting the City and Tribe, assess risks to residential and critical facilities, and assist the Team with reviewing and prioritizing mitigation actions.

The following five-step process took place from April 2021 through November 2021:

1. Organize resources: Members of the Planning Team identified information resources, such as local experts and various organizations capable of providing the technical expertise and historical information necessary for a thorough MJHMP Update.
2. Monitor, evaluate, and update the City HMP: The City portion of the Planning Team evaluated their implementation process to ensure compatibility with community needs and involved the Tribe in assessing how well the implementation process worked, making changes for an even better process starting in 2026.
3. Assess risks: The Planning Team reviewed the hazards specific to the community and the associated risk assessments to include the vulnerability analysis for each jurisdiction.
4. Assess capabilities: The Planning Team reviewed current administrative and technical, legal and regulatory, and fiscal capabilities to determine whether existing provisions and requirements adequately address relevant hazards.
5. Update the mitigation strategy: The Planning Team updated 2016 City mitigation goals and actions. Subsequently, the City identified completed projects, and both jurisdictions jointly developed mitigation goals, actions, and prioritized future projects into a combined Mitigation Action Plan (MAP) strategy.

3.2 HAZARD MITIGATION PLANNING TEAM

Table 1 identifies the Hazard Mitigation Planning Team. Table 2 summarizes Planning Team meetings.

Table 1. Hazard Mitigation Planning Team

Name	Title	Organization	Key Input	Contact Information
Thomas Tilden	First Chief	Curyung Tribal Council	Planning Team member, data input, and MJHMP Update review.	907-842-2384
Jonathan Larson	Second Chief			
Teresa Seybert	Third Chief			
Gayla Hoseth	Member Chiefs			
Carol Luckhurst				
Robin Samuelsen				
Kimberly Williams				
Courtenay Carty	Tribal Administrator			tribaladmin@curyung.com
Shalise Schroeder	Tribal Clerk			tribalclerk@curyung.com
Alice Ruby	Mayor	City of Dillingham	Planning Team member, data input, and MJHMP Update review.	mayor@dillinghamak.us 907-842-5272
Chris Hladick	City Manager			manager@dillinghamak.us 907-842-5148
Chris Napoli	City Council Members			chris.napoli@dillinghamak.us 907-842-1514
Bill Rodawalt				bill.rodawalt@dillinghamak.us 907-843-0947
Aksel Buholm				aksel.buholm@dillinghamak.us
Curt Armstrong				curt.armstrong@dillinghamak.us 907-842-5928
Andy Anderson				andy.anderson@dillinghamak.us 907-842-1243
Gregg Marxmiller				gregg.marxmiller@dillinghamak.us
Cynthia Rogers	Director of Planning & Grants Management			planner@dillinghamak.us 907-842-3785
Kaleb Westfall	Planning Commission Members			907-842-5211
Jason Lamson				
Gregg Marxmiller				
Susan Isaacs				
Jessica Denslinger				
Elizabeth Clark				
R.M.	No other information provided.			
Adelheid Herrmann	Shareholder	Bristol Bay Native Corporation	Meeting attendee	Information not provided
Jennifer LeMay, PE, PMP	Senior Planner	LeMay Engineering & Consulting, Inc.	HMP development, lead writer, project coordinator.	907-350-6061
Patrick LeMay, PE	Planner		HMP development.	907-250-9038
Rick Dembroski	PDM/BRIC Program Manager	DHS&EM	HMP review.	907-428-7015
Terry Murphy	State Hazard Mitigation Officer		HMP review.	907-428-7085

Table 2. Planning Team Meetings

Date	Type	Subject	Summation
April 14, 2021	Initial Communications	HMP Development and Update Process	Team began learning the update process.
May 12, 2021	MJHMP Kickoff Meeting	Community Awareness	Team discussed community hazards and identified critical facilities.
September 1, 2021	Hazard Mitigation Plan Workshop	Community Awareness	Participants discussed why a hazard mitigation plan is needed and what funding streams are available for mitigation projects.
September 8, 2021	Planning Commission	Community Awareness	Participants discussed why a hazard mitigation plan is needed and what funding streams are available for mitigation projects.
November 29-December 10, 2021	Review and Outreach – Distribution of the Draft MJHMP Update for a two-week public comment period	Hazards and Goals	Team reviewed their hazards and goals, other plans, and reviewed the Draft MJHMP Update.
December __, 2021	Public Meeting – Plan Summary and Review	Project Review & Prioritization	Team reviewed and prioritized their projects to meet their goals. Team and community provided comments.
December 13, 2021	Incorporation of Public Review Comments	Draft Plan Review	Final plan review session.

3.3 PUBLIC INVOLVEMENT PROCESS

Table 2 above summarizes the public involvement process. An invitation was extended to individuals and entities via a joint public notice inviting the public to a hazard mitigation workshop. The workshop was held on September 1, 2021 via Zoom with 10 participants representing the City and Tribe. During the meeting, Patrick LeMay, PE led the attending participants through a hazard identification and screening exercise. The attendees developed a list of hazards which have the potential to impact the community: flood/erosion, severe weather, changes in the cryosphere, earthquakes, ground failure, volcanoes and ashfall, and wildland/conflagration fire. On September 8, 2021 via teleconference, Patrick LeMay, PE led the attending participants at the Planning Commission through an overview of the hazard mitigation planning process and summarized funding streams available for mitigation projects. Nine participants representing the City participated.

After the community asset data was collected by the Planning Team, a risk assessment was completed that illustrated the assets that were exposed and vulnerable to specific hazards.

Mitigation actions were also developed and prioritized.

A newsletter was developed and posted at the City Office, Tribal Office, U.S. Post Office, and other visible bulletin boards within the community of Dillingham on November 29, 2021, announcing the availability of the Draft MJHMP Update and kicking off the two-week public comment period.

On December x, 2021, the Dillingham Planning Team held another public meeting and received further input on the Draft MJHMP Update. Jennifer LeMay provided a summary of the Draft MJHMP Update in a PowerPoint© presentation and led the attending public through the mitigation actions. The Planning Team and public were very helpful in finetuning the mitigation actions and providing comments on the Draft MJHMP Update. Public comments were incorporated into the Draft MJHMP Update (see Appendix C).

3.4 INCORPORATION OF EXISTING PLANS

During the planning process, the Planning Team reviewed and incorporated information from existing plans into this Draft 2021 MJHMP Update. Table 3 summarizes existing plans that were used. Section 8 provides a complete list of references.

Table 3. Incorporated Planning Documents

Existing Plans, Studies, Reports & Ordinances	Contents Summary
State of Alaska, DCCED/DCRA *Community Profile*, 2021	This website provided historical and demographic information.
Climate Change and Health Effects in the Bristol Bay Region of Alaska, Project Synthesis Report, April 30, 2014	The Alaska Native Tribal Health Consortium (ANTHC) Center for Environmentally Threatened Communities assessed climate change through the lens of public health with a focus of the potential effects on disease, injury, food and water security, and mental health. Climate sensitive health effects, some positive some negative, were identified from each category.
State of Alaska DHS&EM *HMP*, October 2018	This HMP defined statewide hazards and potential risks.
State of Alaska DHS&EM *Disaster Cost Index*, June 2021	This index identified State Disaster Declarations for Alaska.
State of Alaska, Department of Natural Resources, Division of Geological and Geophysical Survey (DGGS) *Shoreline Change, 1952-2018, Dillingham, Alaska*, 2020.	The change in shorelines during this time period were delineated from historical photographs collected between 1952 and 2018.
Denali Commission, *Statewide Threat Assessment*, 2019	This assessment identified Dillingham as being ranked 42nd out of 187 rural communities that were ranked in regards to their combined infrastructure threats to erosion, flooding, and thawing permafrost. Dillingham was ranked 12th out of 58 rankings for threat of erosion, and 49th out of 65 rankings for threat of flood. Dillingham was determined not to have a threat from

	melting permafrost.
City of Dillingham Hazard Mitigation Plan, 2016	This plan addressed Dillingham's impact to potential hazards, summarized vulnerability, and developed mitigation actions to implement as a preventative measure.
City of Dillingham, 1st Annual Assessment of City Services, 2021	This plan addresses Dillingham's capabilities.
U.S. Army Corps of Engineers (USACE), Alaska *Baseline Erosion Assessment*, 2009	This assessment defined erosion impacts for Dillingham.
Dillingham Comprehensive Plan Part 3, 2013-2018	This plan addressed Dillingham's housing trends, goals, and initiatives.

3.5 PLAN MAINTENANCE

This subsection describes a formal HMP maintenance process ensuring the HMP and its updates remain an active and applicable document. It explains the Planning Team's coordination of efforts ensuring an efficient improvement and revision process.

The following three process steps are addressed in detail here:

1. Implement mitigation actions through existing planning mechanisms.
2. Continue public involvement.
3. Monitor, review, evaluate, and update the HMP.

3.5.1 Incorporating Existing Planning Mechanisms

The Planning Team will incorporate planning mechanisms into their HMP by undertaking the following activities:

- Review the community-specific regulatory tools to facilitate mitigation strategy integration as defined in the capability assessment section (Section 7.1 tables).
- Involve City and Village organizations when researching information.
- When the 2022 Community Development Plan is updated, incorporate HMP actions into relevant planning mechanisms.
- Update or amend existing planning mechanisms as necessary.
- Implementing HMP goals and actions may require updating or amending specific planning mechanisms.

Planners are encouraged to integrate components of this HMP into their own plans.

3.5.2 Continued Public Involvement

The City and Tribe are dedicated to involving the public directly in the continual reshaping and updating of the HMP. A paper copy of the HMP and any proposed changes will be available at both the City and Tribal Offices. This HMP will also be stored on the State of Alaska DCCED/DCRA's plans website under Dillingham for public reference.

The Planning Team will continue to raise community awareness about the HMP and the hazards that affect Dillingham. See Appendix E for a community survey. Any public comments or community surveys received regarding the HMP will be collected by the City Planner or Tribal Administrator, included in the annual report, and considered during future HMP updates.

Through community outreach activities, the Planning Team will continue to raise awareness about their HMP. Outreach activities could include attendance and provision of materials at City- and Tribal- sponsored events, outreach programs, and public mailings.

3.5.3 Monitoring, Reviewing, Evaluating, and Updating the HMP

This subsection addresses activities ensuring improvements and revisions occur in an efficient and coordinated manner.

The following three activities form the process:

1. Update the HMP to reflect revisions to goals, actions, and priorities.
2. Submit a plan update at the end of the five-year life cycle for State- and FEMA-approval.
3. Continue implementing mitigation initiatives.

3.5.3.1 Monitoring the HMP

The HMP was prepared as a collaborative effort. To maintain momentum and build upon hazard mitigation planning efforts, the Planning Team will continue their involvement in monitoring, evaluating, and updating the HMP. Each authority identified in Table 27 will be responsible for implementing the MAP strategy. The City Planner or Tribal Administrator will serve as the primary points of contact and will coordinate local efforts to monitor, evaluate, and revise the HMP.

3.5.3.2 Reviewing the HMP

The City and Curyung Tribal Councils will review their success for achieving the HMP's mitigation goals and implementing the MAP strategy's projects during the annual review process.

During each annual review, each agency or authority administering a mitigation project will submit a progress report (Appendix E) to the Planning Team. The report will include the current status of the mitigation project, including any project changes, impediments (including strategies to overcome them), and a comparison of the project to the corresponding goal identified in the HMP.

3.5.3.3 Evaluating the HMP

The City Planner or Tribal Administrator will initiate the annual review two months prior to the planning meeting date. The findings from the review will be presented at the annual Planning Team meeting. Each review, as shown on the annual review worksheet in Appendix E, will include an evaluation of the following:

- Efforts to involve City and Tribal authorities, outside agencies, stakeholders, and residents.
- Changes in risk for each identified and newly considered all-natural hazards.
- Impact upon land development activities and related programs.
- MAP Strategy implementation progress.
- HMP local resource implementation for HMP identified activities.

3.5.3.4 Updating the HMP

In addition to the annual review, the Planning Team will update the HMP every five years. The following section explains how the HMP will be reviewed and evaluated.

DMA 2000 Requirements
Reviewing, Evaluating, and Implementing the Plan **§201.6(d)(3)** and **§201.7(d)(3):** A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit if for approval within 5 years in order to continue to be eligible for mitigation project grant funding.
ELEMENT D. Planning Process (Continued)
D1. Was the Plan revised to reflect changes in development? **[Requirements §201.6(d)(3)** and **§201.7(d)(3)]** D2. Was the Plan revised to reflect progress in local mitigation effort? **[Requirements §201.6(d)(3)** and **§201.7(c)(4)(iii)]** D3. Was the Plan revised to reflect changes in priorities? **[Requirements §201.6(d)(3)** and **§201.7(d)(3)]**
Source: FEMA, 2015.

The City and Curyung Tribal Councils will review the HMP annually per Section 3.5.3 and update the HMP every five years, or when changes to hazards, actions, or priorities are made. The Planning Team will solicit community involvement through the distribution of annual review community surveys. The annual surveys (Appendix E) document the Community's insights into potential changes to hazards, actions, and resource allocations.

No later than the beginning of the fourth year following HMP adoption, the Planning Team will undertake the following activities:

- Request grant assistance from DHS&EM to update the HMP (it can take up to one year to obtain and one year to update the plan).
- Require each authority administering a mitigation project to submit a comprehensive progress report to the Planning Team.
- Develop a chart to identify those HMP sections needing improvement.

- Determine the current status of the mitigation actions (projects) in progress.
- Identify completed, deleted, or delayed projects. For statuses other than “completed”, include a reason for the designation.
- Document changes to priorities.
- Assess the impact of completed projects.
- Identify any barriers preventing the implementation of mitigation projects such as financial, legal, or political restrictions, and develop strategies to overcome them.
    - Thoroughly analyze and update their risks to natural hazards.
    - Prepare a “new” MAP Strategy for the Dillingham community.
- Prepare a draft of the updated HMP.
- Submit the updated Draft HMP to DHS&EM and FEMA for review and approval.

3.5.3.5 Formal State and FEMA HMP Review

Completed HMPs do not qualify the City and Curyung Tribal Councils for mitigation grant program eligibility until they have been reviewed and adopted by the City and Tribal Councils, and received final FEMA-approval.

The City and Curyung Tribal Councils will submit the Draft HMP to DHS&EM for initial review and preliminary approval. Upon preliminary approval, DHS&EM will forward the HMP to FEMA for their review and conditional approval. Conditional approval is granted prior to passage of the City and Curyung Tribal Council HMP Adoption Resolutions. Upon receipt of the Adoption Resolutions, FEMA will grant final approval and return the approved HMP Update to the City and Curyung Tribal Councils (Appendix B).

4.0 Plan Adoption

4.1 ADOPTION BY LOCAL GOVERNING BODIES AND SUPPORTING DOCUMENTATION

The DMA 2000 requirements for the adoption of this HMP by the local governing bodies are described below.

DMA 2000 Requirements
Local and Tribal Plan Adoptions **§201.6(c)(5)** and **§201.7(c)(5** and **6):** [The plan shall include…] Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, Tribal Council). For multi- jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.
1. REGULATION CHECKLIST
ELEMENT E. Plan Adoption
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? E2. For multi-jurisdictional Plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? E3. Does the Plan include assurances that the Tribal government will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002, and will amend its plan whenever necessary to reflect changes in Tribal or Federal laws and statutes?
Source: FEMA, 2015.

The City of Dillingham and the Curyung Tribal Council are represented in this 2021 MJHMP Update that meets the requirements in Section 322 of DMA 2000 and Sections 44 CFR §201.6 and §201.7. The Tribal Council will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 2 CFR Parts 200 and 3002, and will amend this HMP whenever necessary to reflect changes in Tribal or Federal laws and statutes as required. The Dillingham City Council adopted this MJHMP Update on _____, 2021, and the Curyung Tribal Council adopted this MJHMP Update on _____, 2021. A scanned copy of Dillingham's formal adoptions and FEMA's pending and final approval letters are included in Appendix B.

5.0 Hazard Profiles

This section identifies and profiles the hazards with the potential to impact the community.

5.1 OVERVIEW OF A HAZARD ANALYSIS

A hazard analysis includes the identification, screening, and profiling of each hazard. Hazard identification is the process of recognizing the natural events threatening a populated area. A natural phenomenon, such as a volcanic eruption, must have an element of human involvement to be deemed a natural hazard. Human, Economic, Technological, and Terrorism-related hazards are beyond the scope of this MJHMP Update. All-natural hazards potentially impacting Dillingham are considered, and those found unlikely to occur or where the risk of damage is very low, are eliminated from consideration.

Hazard profiling is the act of describing hazards in terms of their characteristics, history, breadth, magnitude, frequency, location, extent, and recurrence probability. Hazards are identified through historical and anecdotal information, and reviews of existing plans and studies. Hazards are mapped to determine their geographic extent and define their boundaries.

5.2 HAZARD IDENTIFICATION AND SCREENING

The DMA 2000 requirements for hazard identification are described below.

DMA 2000 Requirements
Identifying Hazards **§201.6(c)(2)(i)** and **§201.7(c)(2)(i):** The risk assessment shall include a] description of the type, location and extent of all-natural hazards that can affect the jurisdictions. The Plan shall include information on previous occurrences of hazard events and on the recurrence probability of future hazard events for each jurisdiction. **§201.6(c)(2)(ii)** and **§201.7(c)(2)(ii):** Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction and planning area? **§201.6(c)(2)(ii):** Does the Plan address NFIP-insured structures within the jurisdiction that have been repetitively damaged by floods?
1. REGULATION CHECKLIST
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT
B1. Does the Plan include a description of the type, location, and extent of all-natural hazards that can affect each jurisdiction? B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? B4. Does the Plan address NFIP-insured structures that have been repetitively damaged by floods?
Source: FEMA, 2015.

During the September 1, 2021 workshop, the Planning Team reviewed the natural hazards profiled in the 2016 HMP. All hazards were considered, even if any particular one had not occurred within the past five years. The Planning Team evaluated hazards based on a range of factors, including their prior history, relative risk, mitigation potential, and availability of information. Table 4 contains hazards that were screened for this 2021 MJHMP Update.

Table 4. Identification and Screening of Hazards

Hazard Type	Should It Be Profiled?	Explanation
Changes to the Cryosphere	Yes	Dillingham experiences harsh weather and flooding conditions that could worsen due to changes in the cryosphere. Permafrost is isolated.
Earthquake	Yes	Dillingham is within close proximity to named and un-named earthquake faults (i.e. within 300 miles of the Alaska-Aleutian seismic zone).
Flood/Erosion	Yes	Coastal storm surge and riverine ice jam flooding and high wind events occur regularly which exacerbates high water flow shoreline, bluff, and surface runoff scour (erosion).
Ground Failure	Yes	Minor ground failure events (landslides and subsidence) could occur within the community.
Severe Weather	Yes	Severe weather including heavy snow, ice storms, and extremely high winds are regular seasonally occurring events.
Tsunami & Seiche	No	This hazard does not pose an immediate threat to the community.
Volcano	Yes	There is historic evidence of volcano-activity that may impact the Dillingham area. Volcanic ash combined with high winds can disrupt cargo and utility service delivery to area residents.
Wildland/Urban Interface Fire/Conflagration Fire	Yes	The relatively flat terrain, vegetation fuels, and changes in the cryosphere-influenced weather conditions are favorable for wildland fire propagation throughout the area as well as within close proximity to the community core. Urban fire (conflagration) in high density areas of downtown Dillingham is a concern.

5.3 HAZARD PROFILE

The Planning Team reviewed their local hazards using the following criteria:

- Characteristics (Type);
- History (Previous Occurrences);
- Location;

- Extent (to include breadth, magnitude, and severity);
- Impact (Section 5 provides general impacts associated with each hazard. Section 6 provides detailed impacts and a vulnerability summary of potential hazards to Dillingham's residents and critical facilities); and
- Recurrence probability.

The hazards profiled for the community of Dillingham are presented throughout the remainder of Section 5.3. The presentation order does not signify their importance or risk level.

5.3.1 Cryosphere

5.3.1.1 Hazard Characteristic

The "cryosphere" is defined as those portions of Earth's surface and subsurface where water is in solid form, including sea, lake, and river ice, snow cover, glaciers, ice caps and ice sheets, and frozen ground (e.g., permafrost) (Figure 3). The components of the cryosphere play an important role in climate. Snow and ice reflect heat from the sun, helping to regulate the Earth's temperature. They also hold Earth's important water resources, and therefore, regulate sea levels and water availability in the spring and summer. The cryosphere is one of the first places where scientists are able to identify global climate change.

Related hazards to the cryosphere include flood/erosion and isolated permafrost which all have the potential to affect the Dillingham community.

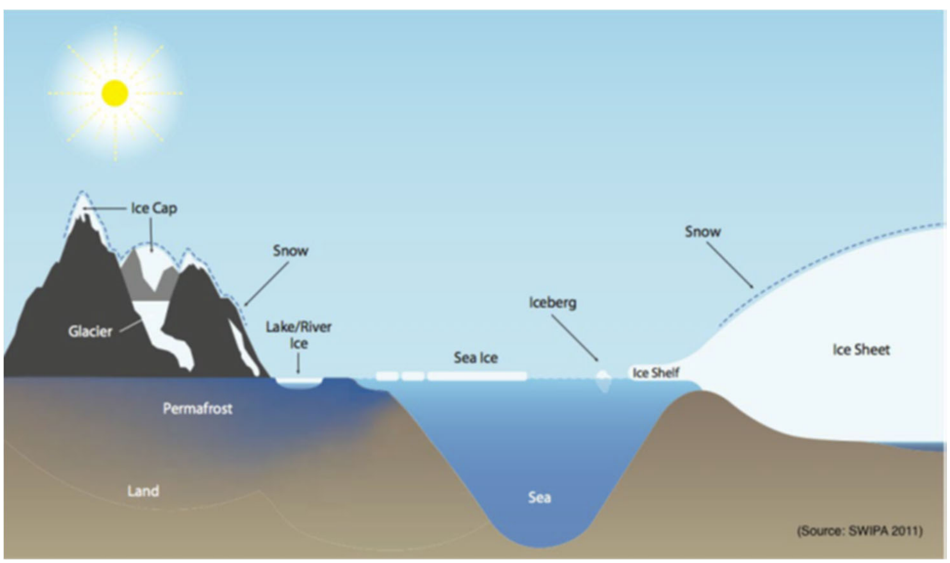


Figure 3. Cryosphere Components Diagram

Source: DHS&EM, 2018

Hazards of the cryosphere can be subdivided into four major groups:

- Glaciers;

- Permafrost and periglacial features;
- Sea ice; and
- Snow avalanche.

Of these four major groups, only permafrost applies to the Dillingham community.

Permafrost is caused by the effects of changing perennially frozen soil, rock, or sediment and the landscape processes that result from extreme seasonal freezing and thawing (Figure 4). Permafrost is found in nearly 85% of Alaska and is thickest and most extensive in Arctic Alaska north of the Brooks Range. It is present virtually everywhere and extends as much as 2,000 feet (ft) below the surface of the Arctic Coastal Plain. Southward from the Brooks Range, permafrost becomes increasingly thinner and more discontinuous, broken by pockets of unfrozen ground until it becomes virtually absent in Southeast Alaska, with the exception of pockets of high-elevation alpine permafrost.

Permafrost, defined as ground with a temperature that remains at or below freezing (32°F) for two or more consecutive years, can include rock, soil, organic matter, unfrozen water, air, and ice. Regions with permafrost are typically categorized by % of surface area underlain by permafrost (Figure 4): continuous (>90%), discontinuous (50-90%), sporadic (10-50%), and isolated (<10%) permafrost. Dillingham is located in an area of isolated permafrost. The thickness of the active layer is largely dependent upon soil type, ground cover, and snow depth.

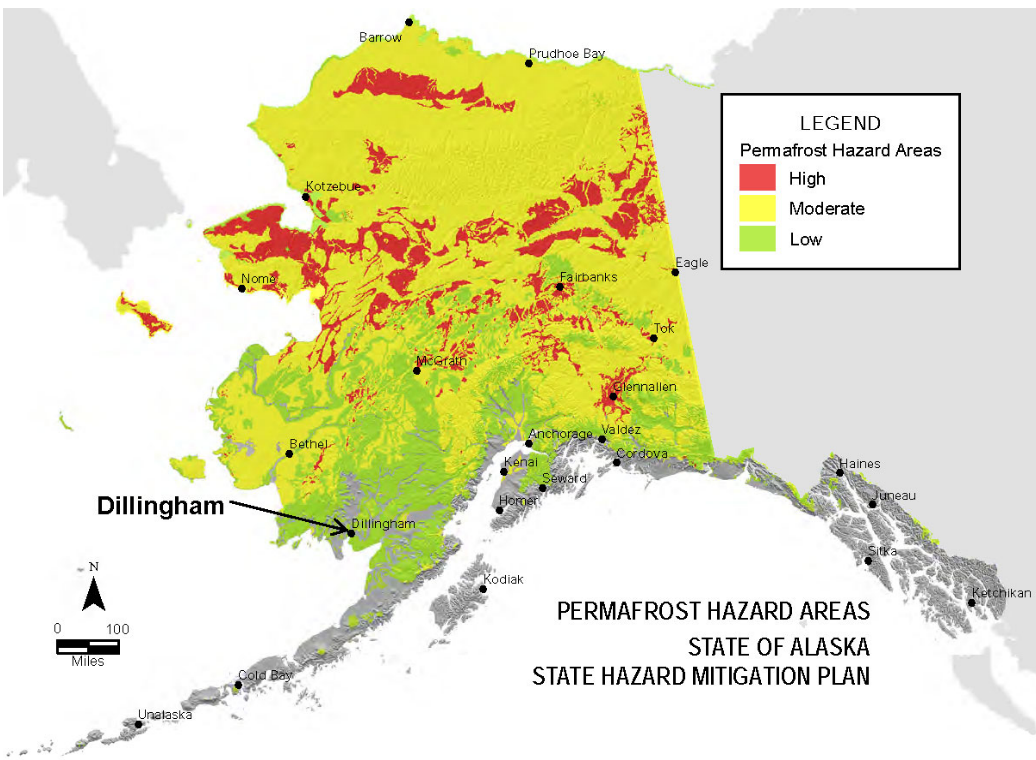


Figure 4. Permafrost Hazard Areas Distribution Map

Source: DHS&EM, 2018

Permafrost provides a stable foundation for structures and infrastructure in cold-climate regions as long as the temperature of the frozen ground is well below freezing. A major hazard of warming and thawing permafrost is that ground ice degrades, and the soil surface collapses. Fluctuations in temperature over the seasons also cause the ground to move as the upper layers freeze (i.e., ice lens formation) and thaw (i.e., loss of ice). Segregated ice lenses may form under wet conditions as the ground freezes, especially in fine-grained soils such as silt or clay. Upon thawing, ground ice can cause an excess of liquid water that cannot be stored in the soil and needs to flow out of the soil as gravity consolidates the soil after thawing.

Permafrost temperatures throughout Alaska are showing warming trends (Figure 5); as permafrost approaches the freezing point (32°F), it becomes increasingly unstable and prone to collapse. Unstable permafrost requires very little to trigger to initiate degradation.

Ice content is the measure of frozen water in a given volume of permafrost (Figure 6). Because permafrost by definition is any earth material that remains below freezing for more than two consecutive years, permafrost composition is highly variable, ranging from solid rock to soils that are composed almost entirely of ice.

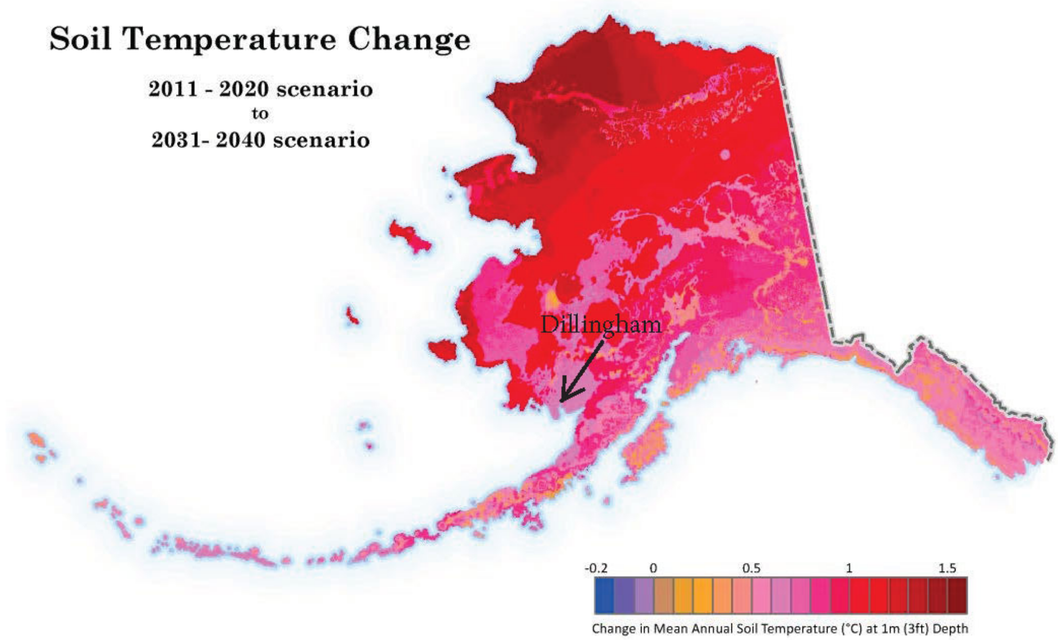


Figure 5. Display of Modeled Soil Temperature Potential Changes

Source: DHS&EM, 2018

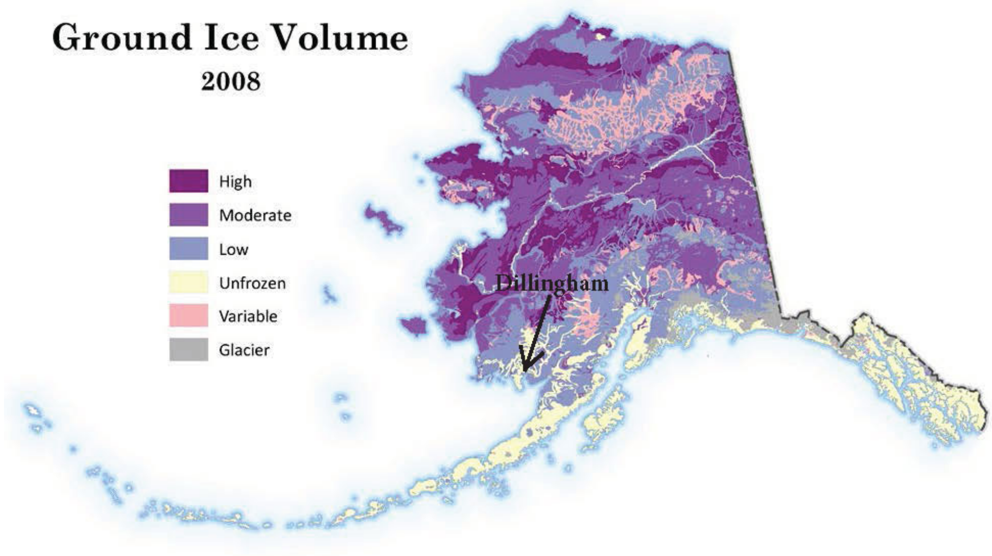


Figure 6. Map Showing Ground Ice Volume of Permafrost in Alaska

Source: DHS&EM, 2018

5.3.1.2 Climate Factors

Climate has a major effect on cryosphere hazards because these hazards are so closely linked to snow, ice, and permafrost. Changes in climate can modify natural processes and increase the magnitude and recurrence frequency of certain geologic hazards (e.g., floods, erosion, and permafrost thaw), which if not properly addressed, could have a damaging effect on Alaska's communities and infrastructure, as well as on the livelihoods and lifestyles of Alaskans.

During the last several decades, Alaska has warmed twice as fast as the rest of the U.S. Permafrost is at an increased risk of thawing as a result of climate change. The major climatic factor leading to warming and thawing permafrost is an increase in air temperature. Another important factor is the potential increase in snow depth predicted by the majority of climate models. Snow insulates permafrost from low winter temperatures, which leads to an increase in ground temperatures and diminishes permafrost stability. When soils are warm, permafrost becomes unstable and is sensitive to catastrophic collapse in conjunction with flooding and erosion. Even in non-ice-rich soils, process-driven models show more material is available for erosion and transport when the soil is thawed, which leads to increased exposure of underlying or adjacent frozen material to thermal and physical stressors.

Human-induced ground warming can often degrade permafrost much faster than natural degradation caused by a warming climate. Permafrost degradation can be caused by constructing warm structures on the ground surface, allowing heat transfer to the underlying ground. Under this scenario, improperly designed and constructed structures can settle as the ground subsides, resulting in loss of the structure or expensive repairs. Permafrost is also degraded by damaging the insulating vegetative ground cover, allowing the summer thaw to extend deeper into the soil, causing subsidence of permafrost.

5.3.1.3 Cryosphere Hazard History

There is no written or oral record defining permafrost impacts.

5.3.1.4 Location, Extent, Impact, and Recurrence Probability

Location

Cryosphere hazards can impact any place in Alaska where water occurs seasonally or permanently in solid form, including permafrost and snow cover in Dillingham. The Dillingham community is located on isolated permafrost. An increase in surface temperatures will potentially affect the subsurface depth of the permafrost. Release of frozen moisture will cause the land to sink, and surface water to drain. All existing foundations, gravel pad and piling, will experience disruption with a loss of permafrost.

According to a permafrost map completed by the Institute of Northern Engineering, University of Alaska Fairbanks, and comments received from the Planning Team, the Dillingham area is underlain by isolated permafrost (Figure 7).

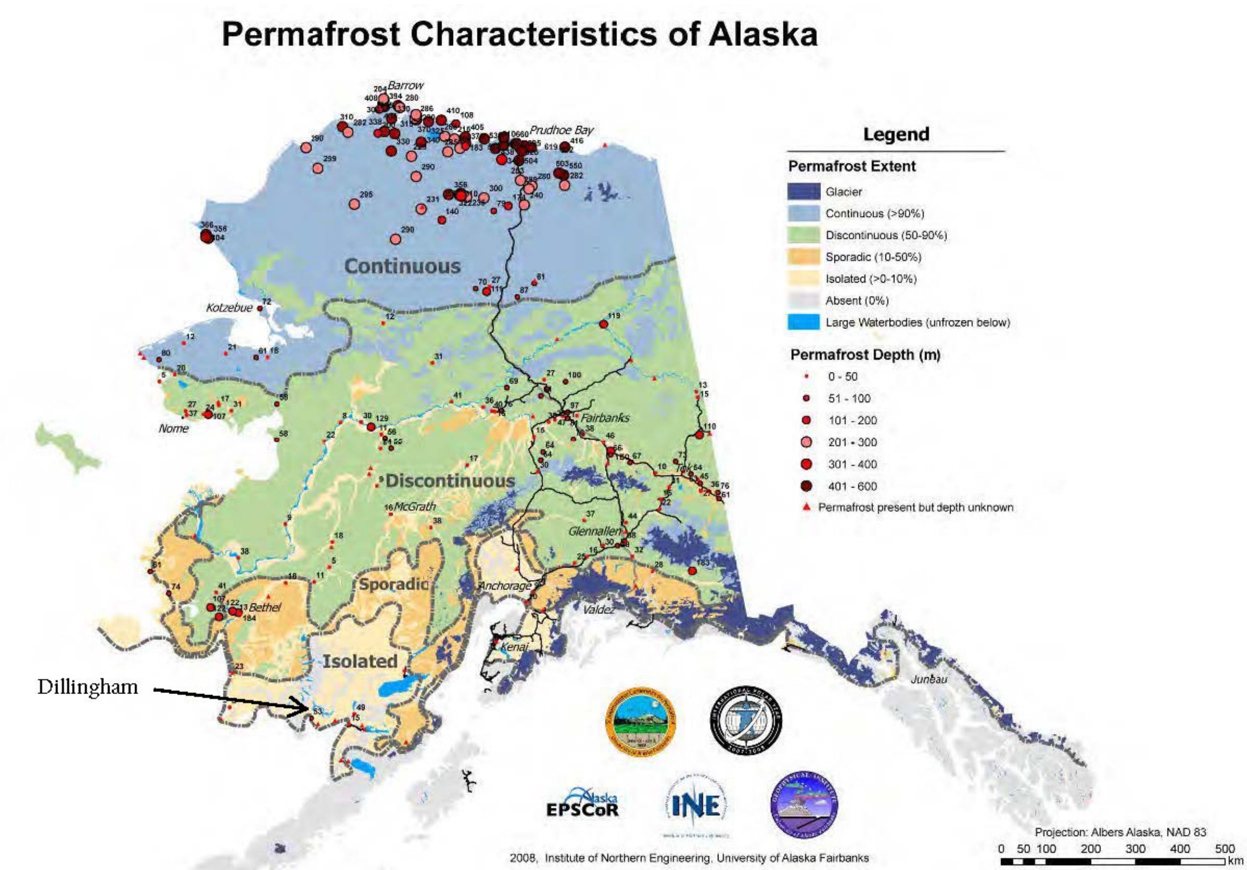


Figure 7. Permafrost Map of Alaska

Extent

Permafrost is found beneath nearly 85% of Alaska. Thawing causes ground subsidence, flooding, and erosion. The damage magnitude could range from minor with some repairs required and little to no damage to transportation, infrastructure, or the economy to major if a critical facility (such as the airport) were damaged and transportation was affected. Dillingham has had very little issue with permafrost damage.

Impact

Permafrost impacts include a full range of damage from comparatively minor bending or buckling of manmade features due to heterogeneous movement, to complete destruction of infrastructure and buildings due to catastrophic ground failure. Permafrost has generated comparatively slow ongoing phenomena in the past, but warming climate is expected to increase the breadth, magnitude, and frequency of damaging permafrost collapse.

Impacts associated with degrading permafrost include surface subsidence, infrastructure, structure, and/or road damage. Permafrost does not pose a sudden and catastrophic hazard, but improperly designed and constructed structures can settle as the ground subsides, resulting in loss of the structure or expensive repairs. Permafrost restricts use of the ground surface, and affects the location and design of roads, buildings, communities, pipelines, airfields, and bridges. To avoid costly damage to these facilities, careful planning and design in the location and construction of facilities is warranted.

Recurrence Probability

Changes to the cryosphere in Dillingham are occurring and will continue to be monitored. It is "likely" that events will occur which means that an event has up to one in three years (1/3=33%) chance of occurring, and the history of events is greater than 20% but less than or equal to 33% likely each year.

5.3.2 Earthquake

5.3.2.1 Characteristics

An earthquake is a sudden motion or trembling caused by a release of strain accumulated within or along the edge of the earth's tectonic plates. The effects of an earthquake can be felt far beyond the epicenter. Earthquakes usually occur without warning, and after only a few seconds can cause massive damage and extensive casualties. The immediately perceived effect of earthquakes is ground motion.

Ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. An earthquake causes seismic waves travelling through the earth's interior and surface waves along the earth's surface. There are two basic types of seismic waves: body waves and surface waves: The first jolt felt during an earthquake is the push-pull body wave, or P (primary) wave. P waves are compression waves moving through the earth. The second wave felt is another type of body wave, called an S (secondary) wave. S waves, also known as shear waves, are slower than P waves and are similar in character to sound waves. The rolling motion felt along the surface is an R or Raleigh wave. R waves move continuously forward, although the individual particles move in an elliptical path, similar to water waves. L (Love) waves, like R waves, are continuously forward travelling surface waves, but the individual particles move side to side, perpendicular to the direction of travel. Surface waves are responsible for much of the ground motion experienced during an earthquake.

In addition to ground motion, several secondary natural hazards occur from earthquakes:

- **Surface Faulting** is the differential ground movement of a fault at the earth's surface. Displacement along faults varies but may be significant (e.g., over 20 ft), as may the length of the surface rupture (e.g., over 200 miles). Surface faulting may severely damage linear structures.
- **Liquefaction** occurs when seismic waves pass through saturated granular soil, distorting its granular structure, and causing the empty spaces between granules to collapse. The increase in pore water pressure will cause the soil to behave like a fluid and deform. There are three telltale signs indicating liquefaction has taken place:
    1. Lateral spread, horizontal movements commonly 10 to 15 ft, possibly reaching over 100 ft in length.
    2. Debris flows, massive flows of soil, typically hundreds of ft, possibly reaching over 12 miles in length.
    3. Loss of bearing strength, soil deformations causing structures to settle or tip.
- **Landslides** occur as a result of horizontal seismic inertia forces induced by ground shaking. The most common earthquake-induced landslides are rock falls, rockslides, and soil slides.

The severity of an earthquake is expressed in terms of intensity and magnitude. Intensity is determined from the effects on people and their environment. It varies depending upon the location with respect to the earthquake epicenter, which is the point on the earth's surface that is directly above the spot, (focus), where the earthquake occurred. The intensity generally increases with the amount of energy released and decreases with distance from the epicenter. The scale most often used in the U.S. to measure intensity is the Modified Mercalli Intensity (MMI) Scale. As shown in Table 5, the MMI Scale consists of 12 increasing levels of intensity that range from imperceptible to catastrophic destruction. Peak ground acceleration (PGA) is also used to measure earthquake intensity by quantifying how hard the earth shakes in a given location. PGA can be measured as acceleration due to gravity (g) (MMI, 2012).

Magnitude (M) is the measure of the earthquake's strength. It is related to the amount of seismic energy released at the earthquake's hypocenter, the actual location of the energy released inside the earth. It is based on the amplitude of the earthquake waves recorded on instruments, known as the Richter magnitude test scales, which have a common calibration (see Table 5).

Table 5. Magnitude/Intensity/Ground-Shaking Comparisons

<table>
<tr><th>Magnitude</th><th>Intensity</th><th>PGA (% g)</th><th>Perceived Shaking</th></tr>
<tr><td rowspan="2">0 – 4.3</td><td>I</td><td><0.17</td><td>Not Felt</td></tr>
<tr><td>II-III</td><td>0.17 – 1.4</td><td>Weak</td></tr>
<tr><td rowspan="2">4.3 – 4.8</td><td>IV</td><td>1.4 – 3.9</td><td>Light</td></tr>
<tr><td>V</td><td>3.9 – 9.2</td><td>Moderate</td></tr>
<tr><td rowspan="2">4.8 – 6.2</td><td>VI</td><td>9.2 – 18</td><td>Strong</td></tr>
<tr><td>VII</td><td>18 – 34</td><td>Very Strong</td></tr>
<tr><td rowspan="3">6.2 – 7.3</td><td>VIII</td><td>34 – 65</td><td>Severe</td></tr>
<tr><td>IX</td><td>65 – 124</td><td>Violent</td></tr>
<tr><td>X</td><td rowspan="3">124 +</td><td rowspan="3">Extreme</td></tr>
<tr><td rowspan="2">7.3 – 8.9</td><td>XI</td></tr>
<tr><td>XII</td></tr>
</table>

5.3.2.2 History

On Good Friday, March 27, 1964, North America's strongest recorded earthquake, with a moment magnitude of 9.2, rocked central Alaska. No damage occurred in Dillingham. Dillingham felt minor shaking. Earthquakes felt in the Dillingham area have not exceeded M6.6 in the past 41 years, and damage has never been reported due to an earthquake event. Table 6 lists earthquakes exceeding M4.0 that have occurred within 150 miles of Dillingham.

Table 6. Earthquake History

Time	Latitude	Longitude	Depth	Magnitude
2016-07-23T09:59:01.409Z	58.4734	-156.457	203.6	5.5
2013-07-18T03:52:58.400Z	58.1814	-156.368	13.9	4.6
2010-06-13T13:43:03.489Z	58.1201	-157.049	14.9	4.9
2003-02-27T15:35:31.943Z	58.3561	-156.653	199	5.3
1998-05-18T18:56:52.340Z	57.913	-156.794	-3	4.6
1998-05-11T19:30:59.350Z	57.9302	-156.805	-3	4.6
1998-05-09T06:59:48.480Z	57.9272	-156.827	-3	4.7
1998-05-09T04:58:33.870Z	57.985	-156.93	-3	4.9
1998-05-09T03:55:51.890Z	57.983	-156.963	-3	5.4
1998-05-09T00:30:12.990Z	57.8933	-156.823	-3	5.4
1990-05-01T16:12:20.405Z	58.5212	-156.542	252	6.6
1984-11-19T00:44:27.220Z	58.567	-156.702	205.7	4.6

1984-05-21T18:47:03.170Z	58.22	-156.298	161	4.6
1983-04-20T10:18:32.970Z	59.023	-155.972	208.7	4.5
1977-03-28T03:37:54.400Z	58.123	-156.769	61	4.5
1976-03-06T12:21:56.900Z	58.24	-157.103	155	4.5
1974-05-24T22:30:02.000Z	58.112	-156.832	126	4.5

5.3.2.3 Location, Extent, Impact, and Recurrence Probability

Location

Dillingham is located in close proximity to several earthquake faults as depicted in a clip of the Division of Geological and Geophysical Survey's 1994 Neotectonics Map of Alaska (Figure 8).

- Denali Fault-Togiak-Tikchik
- Denali Fault-Holitna
- Ataskaksovluk-Holokuk Fault Zone (yellow lines)
- Bruin Bay Fault-Becharof-Inlakin
- Lake Clark Fault to Dillingham's north east (blue lines)
- Many unnamed faults (smaller black lines)

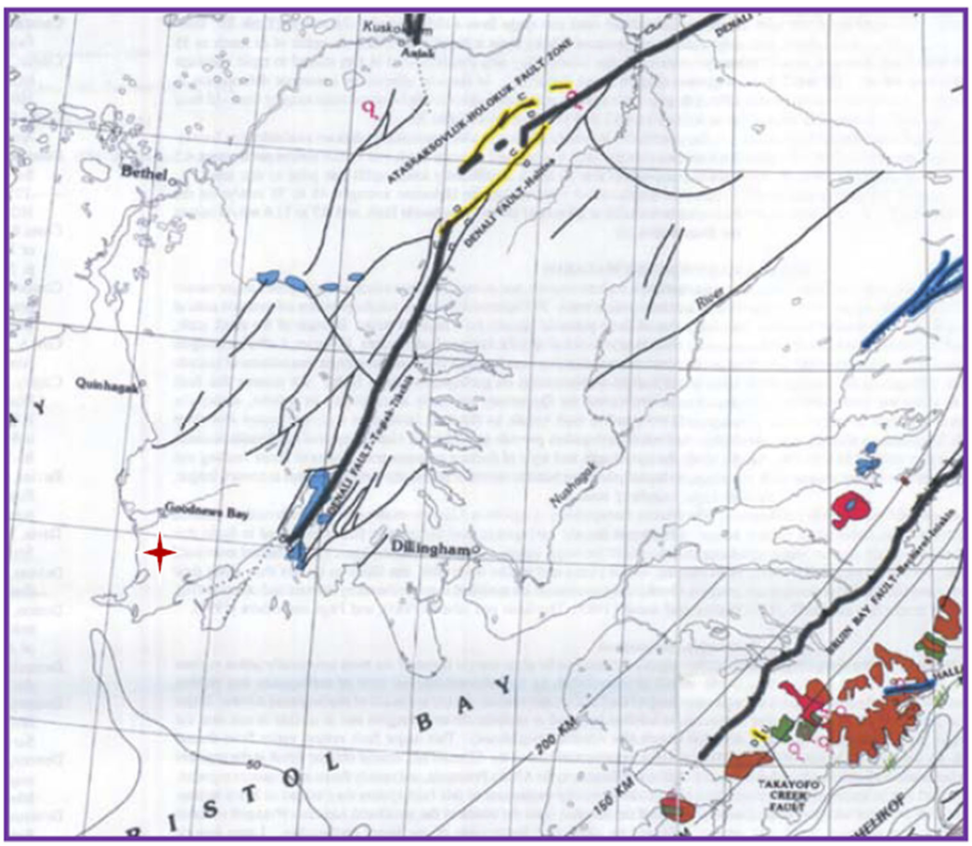


Figure 8. Active and Potentially Active Faults

Extent

Only a few documented earthquakes of magnitude 6.0 or greater have been recorded in western Alaska, of which the 1958 Huslia earthquake (M 7.3) was the largest. This shock reportedly produced extensive failure in surficial unconsolidated deposits. The second largest (M 6.9) occurred in the Chukchi Sea in 1928. In general, the seismicity in western Alaska in the M 2.0 to 5.0 range appears to be widespread and confined to relatively shallow crustal depths.

Impact

Impacts to the community such as significant ground movement that may result in infrastructure damage are not expected. Minor shaking may be seen or felt based on past events. Impacts to current and future populations, residences, critical facilities, and infrastructure are anticipated to remain the same.

Recurrence Probability

Dillingham has no official record of significant earthquake activity resulting in damage or injuries. Ground accelerations are described at different spectral wavelengths to describe the types of shaking that affect different building styles; for example, spectral wavelengths of 0.2-second affects short, rigid buildings whereas one-second wavelengths affect multi-story structures. It is classified as "Unlikely" that an earthquake would be centered in an area around Dillingham. This means that the event has up to one in ten years' chance of occurring (1/10=10%).

Because earthquakes are impossible to predict, scientists must use a unique approach in describing the hazards posed by earthquakes. Probabilistic Seismic Hazard Analyses (PSHAs) describe earthquake shaking levels and the likelihood that they will occur in Alaska. PSHAs are based on known, mapped geologic faults throughout Alaska and all background seismicity from unknown faults. The result is a visual representation of the PGA that has a certain percent chance of being exceeded in a given amount of time (usually 50 years). Figure 9 indicates that the U.S. Geological Survey (USGS) earthquake probability model places the probability of an earthquake with a likelihood of experiencing strong shaking (0.10g to 0.12g PGA) in Dillingham with a 2% probability in 50 years, based on the USGS Alaska hazard model. A 2% probability in 50 years is the rare, large earthquake, and statistically, it happens on average every 2,500 years.

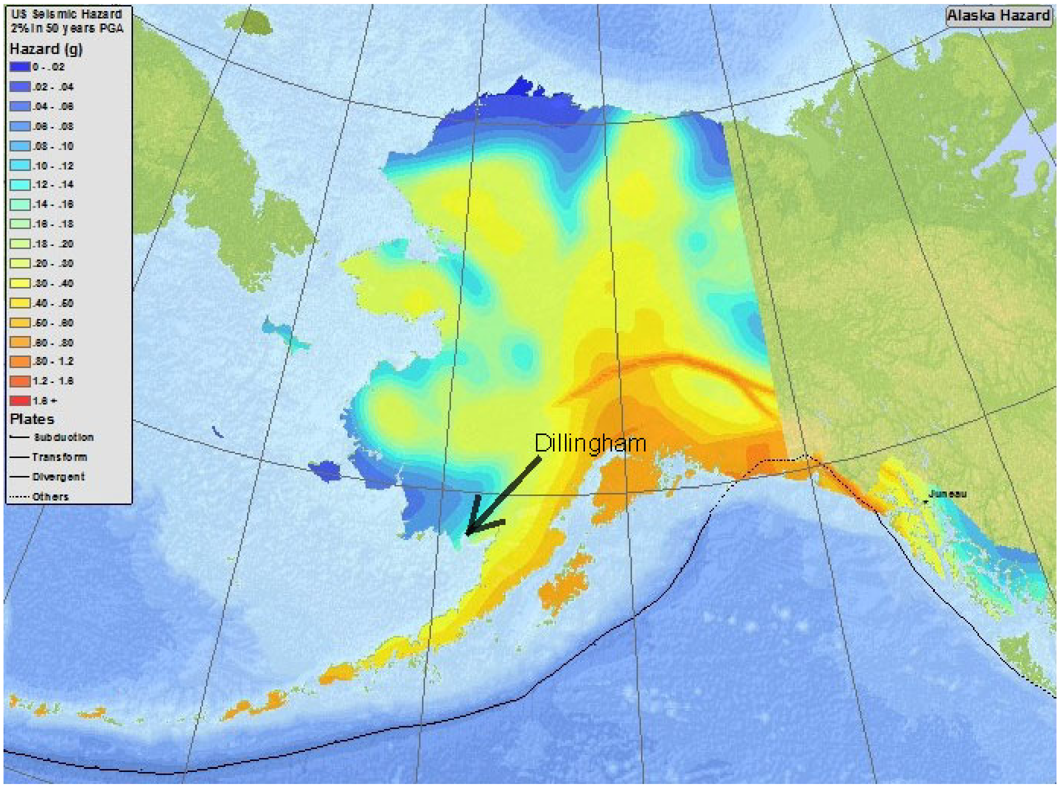


Figure 9. Dillingham Earthquake Probability

5.3.3 Flooding and Erosion

5.3.3.1 Characteristics

Approximately 6,600 miles of Alaska's coastline and many low-lying areas along Alaska's riverbanks are subject to severe flooding and erosion. The U.S. Government Accountability Office (GAO) reported in 2003 that flooding and erosion affect 184 out of 213 (86%) of Alaska Native villages because of rising temperatures. The 2009 BEA utilized criteria to determine whether communities experienced erosion as a "Priority Action" community, a "Monitor Conditions" community, or a "Minimal Erosion" community. Dillingham was classified as a "Priority Action" community (USACE, 2009).

Many of the problems are long-standing, although studies indicate that increased flooding and erosion are being caused in part by changing climate (DHS&EM, 2018). Flooding and erosion occur together in Dillingham because of increased water currents that get raised above the normal riverbank.

Flooding is the accumulation of water where usually none occurs or the overflow of excess water from a stream, river, lake, reservoir, glacier, or coastal body of water onto adjacent floodplains. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected.

Four primary types of flooding occur in the community of Dillingham: rainfall-runoff, snowmelt, ice jam, and storm surge.

Rainfall-Runoff flooding occurs in late summer and early fall. The rainfall intensity, duration, distribution, and geomorphic characteristics of the watershed all play a role in determining the magnitude of the flood. This type of flood event generally results from weather systems that have associated prolonged rainfall.

Snowmelt floods typically occur from April through June. Snowpack depths, spring weather patterns, and geomorphic characteristics of the watershed determine the magnitude of flooding.

Ice jam floods occur after an ice jam develops on a river or stream and blocks the path of flowing water. The depth of the ice jam snowpack and break-up weather patterns upriver influence the volume of water entering the river drainage. When an ice jam occurs, water collects upstream from the jam, flooding an area by creating a lake-like effect, analogous to a dam. Once the jam is breached, there is usually a rapid draining of the water from behind the jam. Not only does the downstream water level rise significantly once the jam is breached, but there is substantial current which can cause erosion and extensive damage. Additionally, the rising water causes the ice to float and the increased velocities move the ice further downstream. The motion of large solid blocks of ice is often very destructive. In Dillingham, the highest risk to ice jams and snow melt flooding occurs in early summer, also referred to as breakup season.

Additionally, for Dillingham, flooding has originated from a coastal storm surge and is linked to high winds and coastal storms in the fall. Storm surge or coastal floods occur when the sea is driven inland above the high-tide level onto land that is normally dry. Often, heavy surf conditions driven by high winds accompany a storm surge adding to the destructive flooding water's force. The conditions that cause coastal floods can also cause significant shoreline erosion as the flood waters undercut bluffs. Communities that are situated on low-lying coastal lands with gradually sloping bathymetry near the shore and exposure to strong winds with a long fetch over the water are particularly susceptible to coastal flooding. Dillingham is influenced by Bristol Bay.

Erosion is a process that involves the gradual wearing away, transportation, and movement of land. However, not all erosion is gradual. It can occur quite quickly as the result of a flash flood, coastal storm, or other event. Most of the geomorphic change that occurs in a river system is in response to a peak flow event. Erosion is a natural process, but its effects can be exacerbated by human activity.

Erosion rarely causes death or injury. However, erosion causes the destruction of property, development, and infrastructure. In Alaska, coastal erosion is the most destructive, and riverine erosion a close second.

Coastal erosion (also called coastal scour or tidal, bluff, and beach erosion) is land loss impacts to beach, shoreline, or bluff material. Coastal erosion occurs over the area roughly from the top of the bluff out into the near-shore region to about the 30 ft water depth. It is measured as the rate of change in the position or horizontal displacement of a shoreline over a period of time. Bluff recession is the most visible aspect because of the dramatic change it causes to the landscape.

Rivers constantly alter their course, changing shape and depth, trying to find a balance between the sediment transport capacity of the water and the sediment supply. This process, called riverine erosion, is usually seen as the wearing away of riverbanks and riverbeds over a period of time.

Riverine erosion is often initiated by high sediment loads or heavy rainfall. This generates high volume and velocity run-off which concentrates in the lower drainages within the river's catchment area. Erosion occurs when the force of the flowing water exceeds the resistance of the riverbank material. The water continues to increase its sediment load as it flows downstream. Eventually, the river deposits its sediment in slower moving sections such as dams or reservoirs. The river may eventually change course or develop a new channel. In less stable braided channel reaches, erosion and deposition are constant issues. In more stable meandering channels, erosion episodes may infrequently occur.

Dillingham sits on the Wood River which is greatly affected by ocean currents and surges. The multi-year impact of waves, tidal current, coastal storms, storm surges, and flooding causes severe coastal erosion. The fall storm season has the greatest impact. In winter, bottom shore-fast ice inhibits the vulnerability. Climate change will potentially increase the threat of erosion due to the associated rising sea levels and loss of permafrost.

Riverine erosion is the wearing away of river beds and deposition of material. Rivers constantly alter their course, changing shape and depth, balancing the sediment transport capacity of the water and the sediment supply. The constant erosion and deposition of material affects channel navigation and accessibility. Maintaining a navigable waterway is essential to the community as the annual supply of fuel and other bulk supplies are shipped by barge. Summer commercial and subsistence fishing, as well as intra-village transportation are dependent upon the use of privately-owned boats.

Impacts from erosion include loss of land and any development on that land. Erosion can cause increased sedimentation of river deltas and hinder channel navigation—affecting marine transport. Other impacts include reduction in water quality due to high sediment loads, loss of native aquatic habitats, damage to public utilities (fuel headers and electric and water/wastewater utilities), and economic impacts associated with the costs of trying to prevent or control erosion sites.

People in Alaska are losing the ground beneath their feet because of erosion. Riverine erosion is a major threat to Dillingham as it threatens the embankment, structures, and the subsistence livelihood of residents. Not only do thawing permafrost and high river flow rates (such as during breakup) contribute to increased erosive scour, climate change has accelerated the normal process along Alaska’s rivers; warmer temperatures degrade the permafrost that helped bind together the soil, and heavier rains produce more floods and swollen rivers that wash away the soil (DHS&EM, 2018).

5.3.3.2 History

The following is a list of previous flood events in Dillingham:

- 1929 – A coastal flood, concurrent with high tides, was classified as the community's worst historical flood. It flooded Dillingham's lower areas to an elevation of 30 ft (10 ft above mean higher high water [MHHW]). The greatest impact of this storm was that vessels anchored in Wood River were blown up onto the flooded flats to the northeast where they remained stranded (from a conversation with Hjalmar and Peter Olson, who reported that the hulls were visible there when they were children).

  According to Hjalmar and Peter Olson, later storms also damaged anchored vessels, leading to a push to create a small boat harbor on Scandinavian Creek. They did not recall damage from flooding to have been significant.

- 1962 – Storms also damaged anchored vessels, leading to development of the small boat harbor on Scandinavian Creek
- 1980 – Severe erosion and damage to the municipal dock and cold storage facilities occurred due to a coastal storm surge.
- 1981 – A coastal storm surge caused some wave action damage to the City dock, but no significant flooding was reported.
- 1993 – A series of storms of in the fall caused severe damage to Snag Point and eroded the bluff there, exposing portions of the City's sewer system, including a manhole.
- 2005 – A storm in August caused minimal flooding in the vicinity of the small boat harbor and Bristol Alliance Fuels tank-farm. Wave action significantly eroded unprotected portions of the harbor entrance, and waves breaking over the sea-walls damaged vehicles parked at the harbor and a small building at Bristol Alliance. No significant damage was reported as a result of flooding, even though the tank farm access road and parking lot, as well as parts of the harbor parking lot, were temporarily covered with nearly two feet of standing water. This storm heavily damaged Peter Pan Cannery docks and significantly eroded unprotected portions of the harbor entrance. Erosion flanked the east end of the harbor seawall and removed a large amount of gravel from behind the sheet-pile and from the berm of the southeast dredge waste containment area.
- 2008 – An October 4 storm eroded the east bank of the harbor with an average of five ft. The unprotected west side of the harbor mouth continues to erode, particularly during storms.

Erosion may be exacerbated by climate cycles such as El Niño (strongly negative Southern Oscillation Index [SOI]) and La Nina (strongly positive SOI). Based on averages from 1967 through 2002, historical data show higher than average mean sea levels during both the 1982/1983 and 1997/1998 El Niño cycles. When large waves combine with high tides, they can reach higher elevations, which contribute to significantly higher rates of coastal erosion. Higher sea levels also can lead to significant beach and bluff erosion. Dillingham is also experiencing dramatic erosion along the Wood River, adjacent to the Sewer Lagoon. See Figures 10 fand 11 for historical and predicted shoreline changes in Dillingham.

5.3.3.3 Location, Extent, Impact, and Recurrence Probability

Location

Highly localized flooding has occurred around creeks within the Dillingham area as a result of blocked culverts and/or beaver dams, particularly in times of high run off. Additionally, very high tides frequently combine with onshore winds to cause temporary flooding along low-lying portions of the main road, impeding traffic.

Spring snowmelt causes flooding on the north side of the core town site. Septic systems in this area have been known to flood and back up when the ground is frozen and it rains or warms enough for snow to melt. Hank Boggs, former Maintenance Foreman for the shelter for victims of violence, said that the facility had to replace their septic system because of this problem. He indicated the septic overflowed and sewage reached the nearby City Public Works shop. Ramon Roque, former Public Works Director, stated that every spring they have to pump out the septic to keep it from flooding. The septic for the Boggs-owned duplex in that area has had problems annually as long as he's owned it. At least one additional residence has had flooded septic systems because of snow melt induced flooding.

The flood prone area is less than a half mile from the City's main well. The Alaska Rural Water Association ranked the well's contamination susceptibility as High. This indicates that while the well has low contamination susceptibility, the aquifer has very highly susceptibility to contamination.

There are three homes at the end of Kleepuk Hill Road which is the only means of ingress or egress to the main road system, the hospital, and stores. Every spring, the road becomes nearly impassible because of localized flooding from melting snow and ice on the surrounding tundra.

The bridge and adjacent bike path over Scandinavian Creek are the only ingress and egress to and from Dillingham's core town site and the HUD housing complex. This area contains the community's highest population density. The bridge and path are threatened by flooding when high tides combine with a wind drive storm surge. Water repeatedly covers the bridge during such events.

Typical annual storms are causing land to erode along the west bank of Dillingham Harbor. The waves enter the harbor and continually erode the west bank. The east bank has been protected by a USACE project. Erosion at the west side of the harbor entrance is also fueled by wave action in conjunction with high tides. Currently, the west bank of Dillingham Harbor is eroding at an average rate of 11 feet per year. If left unchecked, the continued erosion would lead to a significant decrease of harbor protection. In addition to reduced bank protection for the harbor, floats, and commercial fishing fleet, land as well as the majority of the fuel supply for the area would be lost (USACE, 2009).

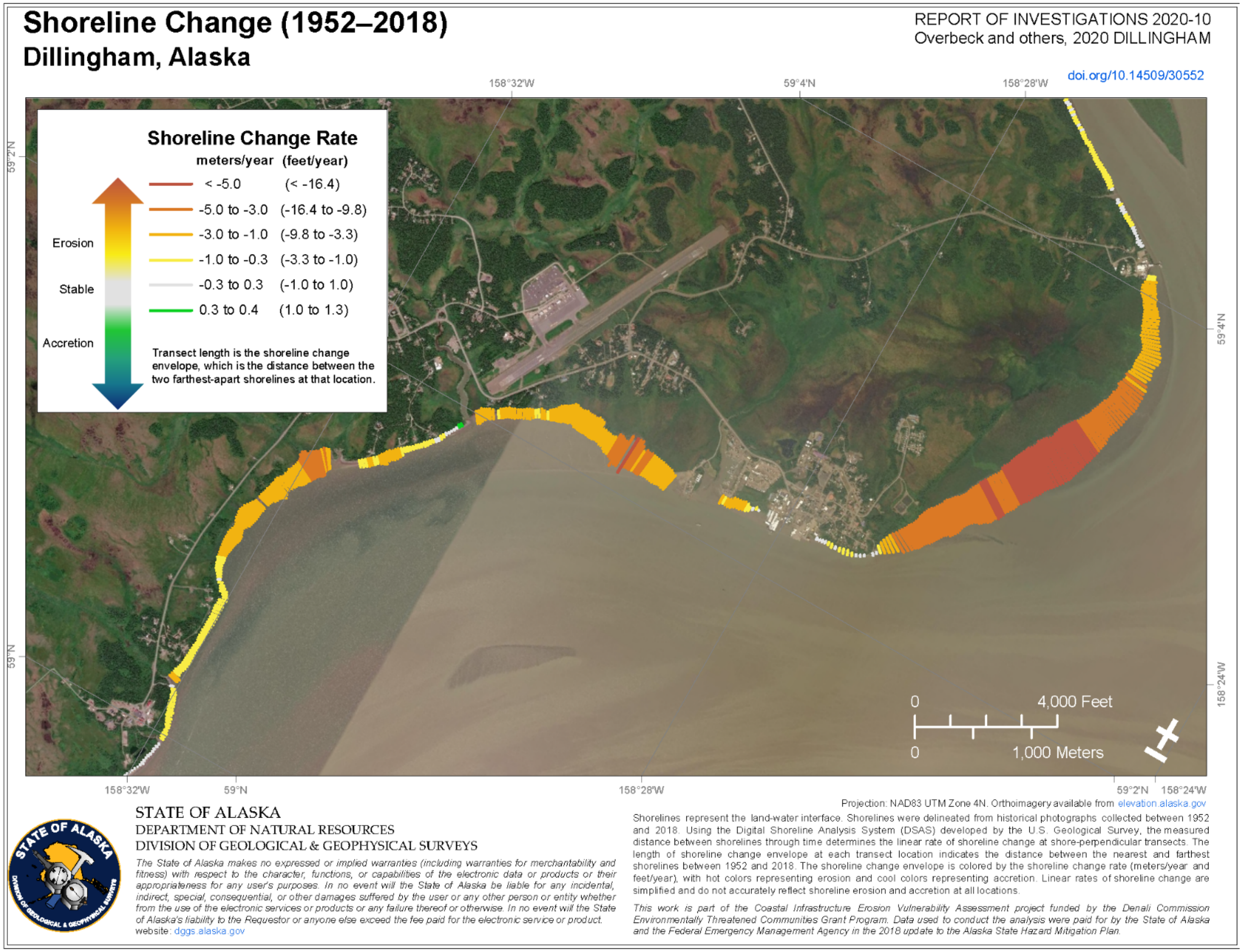


Figure 10. Shoreline Changes in Dillingham

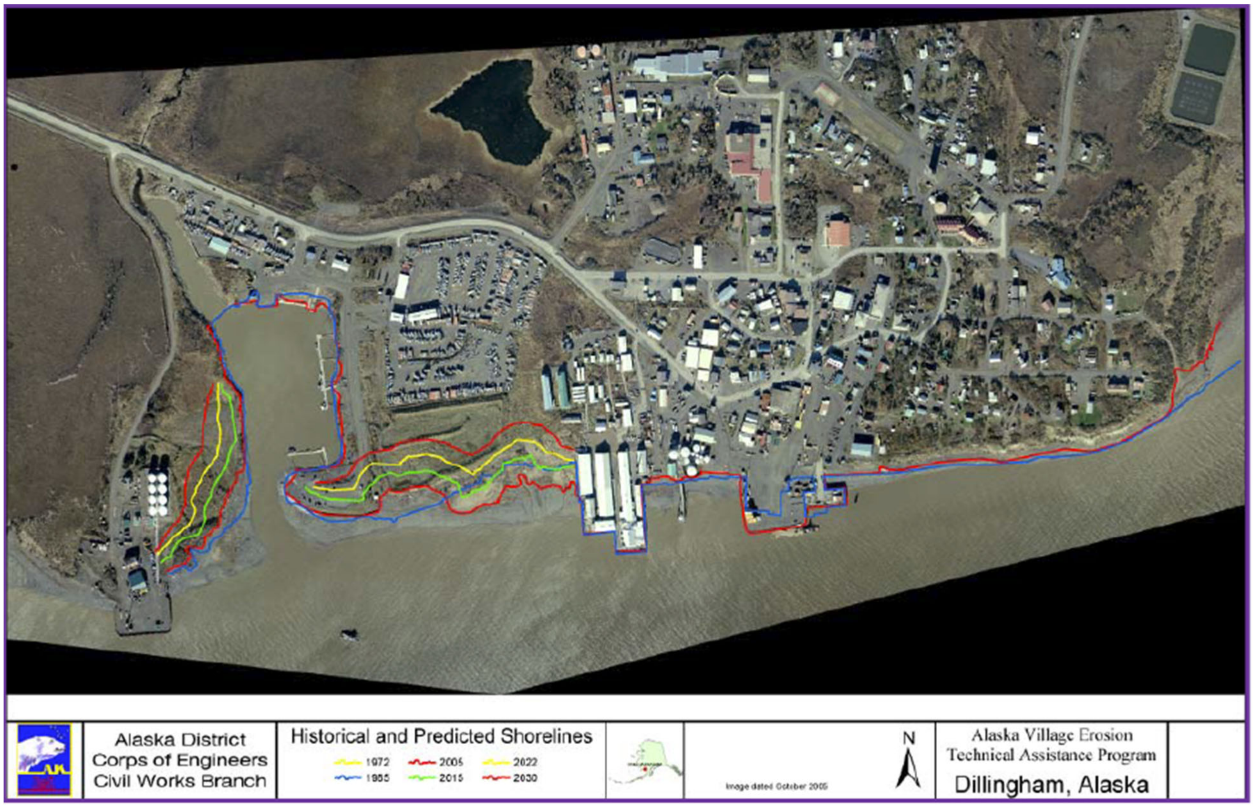


Figure 11. Historical and Predicted Shorelines

The most readily available information for Dillingham is FEMA's Flood Insurance Rate Maps (FIRMs). The FIRMs show 100-year floodplain boundaries for identified flood hazards. These areas are also referred to as Special Flood Hazard Areas (FHAs) and are the basis for flood insurance and floodplain management requirements. The FIRMs also show floodplain boundaries for the 500-year flood, which is the flood having a 0.2 percent chance of occurrence in any given year. The City of Dillingham's original FIRMs were created in 1982.

The FIRMs and Flood Insurance Studies for the City of Dillingham show identified Special Flood Hazard Areas for the following flooding sources:

- Wood River
- Nushagak River
- Squaw Creek
- Snake River
- Scandinavian Creek

Figure 12 illustrates the 100-Year and 500-Year flood hazard areas for the Dillingham area.

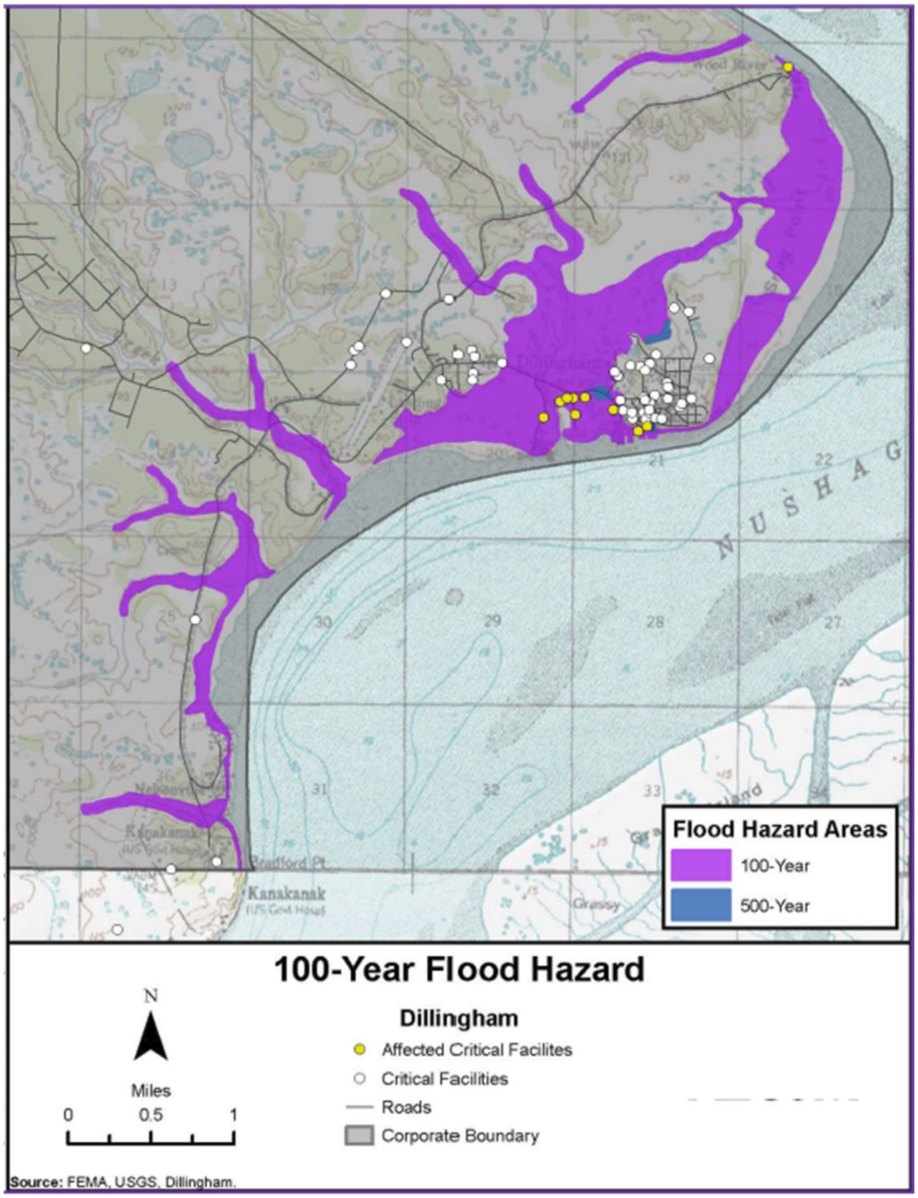


Figure 12. Flood Hazard Areas

Extent

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. The following factors contribute to riverine flooding severity:

- Rainfall intensity and duration.
- Watershed conditions, including terrain steepness, soil types, amount, vegetation type, and development density.

- The attenuating feature existence in the watershed, including natural features such as swamps and lakes and human-built features.
- Flow velocity.
- Availability of sediment for transport, and the bed and embankment watercourse erodibility.
- City location related to the base flood elevation as indicated with their certified high-water mark.

Dillingham is also experiencing dramatic erosion along the Wood River, adjacent to the Sewer Lagoon. See Figure 10 for the extent of erosion of the shoreline.

Previous efforts to control riverbank erosion near the small boat harbor consisted of timber plank and pile bulkheads built in 1983 by the City at Snag Point, about ¾ mile east of the small boat harbor; 1,600 feet of sheet-pile bulkhead built by the USACE at Snag Point between 1995 and 1998; and about 600 feet of sheet-pile bulkhead built by the USACE immediately east of the harbor entrance in 1999. In addition, Bristol Alliance Fuels installed a sheet-pile wall to protect their mooring facilities. In 2004-2005, the older timber plank and pile bulkheads built in 1983 were replaced with open cell sheet pile. The City moved the east side float arm bases inland, resulting in increased risk to vessels moored in the harbor. The floats themselves are no longer positioned over the dredged portion of the harbor. As of 2009, more than $6 million had been spent in efforts to control erosion (USACE, 2009).

The FIRMs indicate that an area totaling 2.36 sq. miles within the City of Dillingham is within the 100-year floodplain with an additional 0.012 square miles is within the 500-year floodplain (Figure 12). While most of the floodplains are located within relatively undeveloped areas, infrastructure and other nonresidential and residential development susceptible to flooding include:

The majority of Dillingham infrastructure is located along the Wood River, Scandinavian Creek, Squaw Creek, Nushagak River, and Snake River and is subject to flooding and erosion. Areas susceptible to flooding include:

- Scandinavian Creek Bridge;
- Small Boat Harbor;
- Nushagak Electric Power Plant;
- City Dock;
- Bristol Alliance Bulk Fuel Facility;
- Tank Farm Access Road;
- Tank Farm Parking Lot;
- Harbor Parking Lot;

- Kanakanak Road;
- Harbor Office & Animal Shelter;
- LFS;
- Squaw Creek Bridge;
- Kleepuk Hill Road;
- Women's Shelter; and
- City of Dillingham Public Works Department.

Impact

Nationwide, floods result in more deaths than any other natural hazard. Physical damage from floods includes the following:

- Structure flood inundation, causing water damage to structural elements and contents.
- High water flow storm surge floods scour (erode) coastal embankments, coastal protection barriers, and result in infrastructure and residential property losses. Additional impacts can include roadway embankment collapse, foundations exposure, and damaging impacts.
- Damage to structures, roads, bridges, culverts, and other features from high-velocity flow and debris carried by floodwaters. Such debris may also accumulate on bridge piers and in culverts, decreasing water conveyance and increasing loads which may cause feature overtopping or backwater damages.
- Sewage, hazardous or toxic materials release, materials transport from wastewater treatment plant or sewage lagoon inundation, storage tank damages, and/or severed pipeline damages can be catastrophic to rural remote communities.

Floods also result in economic losses through business and government facility closure, communications, utility (such as water and sewer), and transportation services disruptions. Floods result in excessive expenditures for emergency response, and generally disrupt the normal function of a community.

Impacts and problems also related to flooding are deposition as well as embankment, coastal erosion, and/or wind. Deposition is the accumulation of soil, silt, and other particles on a river bottom or delta. Deposition leads to the destruction of fish habitat, presents a challenge for navigational purposes, and prevents access to historical boat and barge landing areas. Deposition also reduces channel capacity, resulting in increased flooding or bank erosion. Embankment erosion involves material removal from the stream or river banks, coastal bluffs, and dune areas. When bank erosion is excessive, it becomes a concern because it results in loss of embankment vegetation, fish habitat, and land, property, and essential infrastructure.

Recurrence Probability

Dillingham has historically experienced flood and erosion events. Based on previous occurrences and FEMA FIRMs, it is “Likely” with a one in five years (1/5=20%) chance of a flood occurring within the mapped floodplain. The history of events is greater than 10% but less than or equal to 20% likely per year.

5.3.4 Severe Weather

5.3.4.1 Characteristics

Winter weather includes heavy snows, ice storms, extreme cold, and high winds.

Heavy Snow generally means:

• Snowfall accumulating to four inches or more in depth in 12 hours or less.

• Snowfall accumulating to six inches or more in depth in 24 hours or less.

Snow Squalls are periods of moderate to heavy snowfall, intense, but of limited duration, accompanied by strong, gusty surface winds and possibly lightning.

A **Snow Shower** is a short duration of moderate snowfall.

Snow Flurries are an intermittent light snowfall of short duration with no measurable accumulation.

Blowing Snow is wind-driven snow that reduces surface visibility. Blowing snow can be falling snow or snow that already has accumulated but is picked up and blown by strong winds.

Drifting Snow is an uneven distribution of snowfall and snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.

A **Blizzard** means that the following conditions are expected to prevail for a period of three hours or longer:

• Sustained wind or frequent gusts to 35 mph or greater.

• Considerable falling and / or blowing snow, reducing visibility to less than 1/4 mile.

Freezing Rain occurs when rain or drizzle freezes on surfaces. Excessive accumulation may immobilize a community and hamper rescue efforts.

Extreme Cold 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 less than -40ºF. Excessive cold may accompany winter storms or high barometric pressure and clear skies.

Ice Storms describe occasions when damaging accumulations of ice are expected during a freezing rain event. 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.

5.3.4.2 History

DHS&EM's Disaster Cost Index records the following severe weather disaster events which impacted the area (DHS&EM, 2021). Storms that were included in Section 5.3.3.2 are not included in this list if their main consequence was coastal surge/flooding-related.

10. Bristol Bay, September 2, 1980: *Following a storm which generated high winds and heavy sea waves, causing damage to the equipment of numerous commercial fishermen, canneries and approximately 15 to 20 private houses, the Governor proclaimed a Disaster Emergency extending from Dillingham to Port Heiden. The State provided both public assistance to communities and grants to individuals and families; the SBA provided disaster loans to residents of the area. In addition, the State provided temporary housing assistance to one of the residents who were forced to relocate due to damage to his home.*

106. Broadcast Emergency (KYUK/KDGL), February 22, 1990: *Radio Station KYUK in Bethel, Alaska, a public radio station and the EBS station for a large portion of Western Alaska, experienced a failure in its transmission antenna. Concurrently, KDLG, the public radio station and EBS station for the Dillingham operational area, lost its source of emergency power. The Governor's declaration of disaster enabled these stations to immediately repair these shortfalls in their capability to serve as stations on the Emergency Broadcast System network.*

(New numbering system began in 1995 to begin with event year).

00-191 Central Gulf Coast Storm declared February 4, 2000 by Governor Murkowski, then FEMA-declared (DR-1316) on February 17, 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 on December 21, 1999. On February 17, 2000, President Bill Clinton determined the event 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 existed in the 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 project worksheets (PWs), totaled $12.8 million. Hazard Mitigation totaled $2 million. The total for this disaster was $15.66 million.*

06-214 2005 Bristol Bay Storm (AK-06-214) declared October 03, 2005 by Governor Murkowski: *On August 23, 2005, a strong storm with high winds combined with high tides produced storm surges of 2 to 3 feet above the high tide levels and caused* *widespread coastal flooding in the upper Bristol Bay area. Public infrastructure, commercial property, and personal property damages were reported in the City of Clark's Point, the nearby unincorporated community of Ekuk, and the City of Togiak. Damages were also reported in Lake and Peninsula Borough, Bristol Bay Borough and the City of Dillingham. Lake and Peninsula Borough, Bristol Bay Borough and the City of Dillingham elected not to declare local disasters and are not seeking assistance. Clark's Point and Togiak have each signed local disaster declarations and are asking for state Individual Assistance and Public Assistance in response and recovery from this storm. Individual Assistance totaled $131,890 for 39 applicants (w/admin =$157,465). Public Assistance totaled $157K (final amount was 77,111 + 29,427 admin=$106,539) for 3 applicants and 11 PW's. The total for this disaster is $326K. (final total $264,004). Administrative closeout on Jan 18, 2008. Formal closeout letter to DMVA/DAS was Nov 6, 2008. (RBS, Nov 7, 008)*

Table 7 identifies severe weather events from the National Weather Service (NWS) database for the Dillingham area. Not all events happened in Dillingham, but are included from a regional perspective.

Table 7. Severe Weather Events

AK Zone	MONTH	YEAR	EVENT TYPE	DESCRIPTION
161	December	2000	Winter Storm	A strengthening low 120 miles south of Amchitka moved by Adak as a 956 millibar (mb) center. The low then curved north to 180 miles north of Adak where it became nearly stationary and slowly began to weaken. The front with the low crossed the central Aleutians, lying in a long arc from Amchitka to 60 miles south of Saint Matthew Island to near Port Moller. Atka first gusted in excess of 60 mph. Frontal passage occurred right around this time. Post frontal winds (on the east side of the low) reached 73 mph from the southeast. Two ships north northwest of Amchitka reported sustained northerly winds in the 55 to 65 mph range on the west side of the storm.
161	April	2001	Winter Storm	A moderate front moving into the area from the south southwest was preceded by locally strong east winds. East winds peaked at 60 mph at Iliamna. Gusts reached 67 mph at Augustine Island.
161	March	2002	Extreme Cold/Wind Chill	A moderate frontal system approaching the southwest coast of Alaska, was preceded by

				locally strong southeast winds, local blizzard conditions, and a mix of rain and snow. Local freezing rain was reported across the area.
161	September	2002	High Wind/Coastal Flood	A significant Bering Sea storm moved into Norton Sound. Strong southerly winds preceded the associated front, while strong westerly winds were observed along the 'back side' of the low. Strong onshore winds combined with maximum astronomical tides to produce the potential for coastal flooding. According to a report from Togiak on 9/13, one boat washed out to the beach (caused by the wind). The boat's anchor snapped. According to the NWS office in King Salmon, the Village Public Safety Officer (VPSO) in the community estimated "tide...10 ft above normal". It appeared that most significant water encroachment was on the "morning (Friday) tide". In Dillingham, officials suggested that the coastal flood was a minimal one ("very mild") and that they did not sustain any damage. The high tide and wind were mentioned as periods of concern. At Napakiak, one commercial fishing net was lost and the river reportedly overflowed its banks by 2-3 feet. Southerly winds across the area were gusting from 35 mph to locally near 55 mph Thursday.
161	January	2003	Blizzard/Cold/High Winds	A strong low in the north Pacific moved toward the western Aleutians at 970 mbs. A moderate front extended from the western center in a long arc into the western Gulf of Alaska. The front continued to connect both lows, then extend in an eastward arc into the Gulf of Alaska. Very cold, modified arctic air was in place across the entire Bering Sea and Aleutians prior to the onset of strong winds and precipitation. Snowfall first began with light intensities. Snow intensities then increased markedly as the front approached. As the front moved into areas, snow turned to rain. Easterly winds also increased significantly in advance of the front, whipping falling and ground based loose snow into a blizzard. Peak gusts reached 78 mph in advance of the front at the Dutch Harbor airport. The change in precipitation state

				from frozen to liquid abruptly ended the blizzard conditions. In the Bristol Bay zone, a blizzard was reported along the western capes.
161	January	2004	High Winds	Gusty north wind to 48 mph in the Bristol Bay community of Dillingham blew airline freight "igloo" containers into two parked aircraft, causing an estimated $40,000 in damage.
161	February	2005	High Winds	An intense storm moved into the Eastern Aleutians, February 17th and 18th. Strong east and southeast wind gusted to 75 mph on the Bristol Bay coast at Cape Newenham and to 82 mph in Dutch Harbor as the low approached the region Thursday night and Friday.
161	October	2005	High Winds/Storm Surge	An intense Bering Sea storm produced west wind gusting to 90 mph across the Pribilof Islands. The storm bottomed out at 962 mb as it moved northeast into the northern Bering Sea. The combination of the strong wind and long fetch produced a surge that coincided with high tides. Flooding occurred in the Bristol Bay area north to Kipnuk along the Kuskokwim Delta. In advance of the front, the strong pressure gradient produced a typically high wind along Turnagain Arm with peak gusts reaching 82 mph.
161	September	2006	Surge	The remnants of super typhoon Ioke moved into the Bering Sea September 7th and 8th. This storm produced strong west wind across the Bering Sea that produced seas in excess of 30 ft. This surge coincided with very high astronomical tides along the Bristol Bay coast and the coast of the Kuskokwim Delta. The combination of the storm surge and the very high tides produced minor coastal flooding along the Bristol Bay coast and the Kuskokwim Delta coast.
161	January	2007	High Winds	An intense north Pacific storm moved to the central Aleutians with a secondary storm center south of the Alaska Peninsula. High Wind swept through southwest and south central Alaska and along the central Aleutians and Alaska Peninsula. Snow over the central Aleutians combined with the wind resulted in a blizzard for that region. Wide spread power outages plagued the Kuskokwim Delat with this storm along with roofs being blown off two houses,

				two houses shifted on their foundation and there was minor tidal overflow along Kuskokwim Bay. Unconfirmed wind gusts were reported to 127 mph at Sand Point on the Alaska Peninsula with this storm.
161	January	2008	High Winds	An intense storm moved across the Aleutians into the Bering Sea, producing hurricane force wind along the Aleutians, then blizzard conditions across the Pribilof Islands.
161	February	2009	High Winds	An intense hurricane force storm moved across the Aleutians into the eastern Bering Sea February 24th and 25th. This storm produced hurricane force wind as it moved through the region. This storm produced blizzard conditions along the Bering Sea coast from Bristol Bay north across the Kuskokwim Delta. Wind gusts were reported in excess of 100 mph in the Pribilof Islands and in Bristol Bay. Extensive damage occurred to many homes and buildings. This storm also produced a storm surge in the Bristol Bay region near Dillingham, Clarks Point, and Ekuk.
161	April	2011	High Winds	A large intense Bering Sea storm impacted Alaska from the Aleutian Islands to south central Alaska April 5th through the 7th. Wind gusts reached 94 mph along Turnagain Arm and ranged from 72 to 78 mph along the Aleutian Islands, Alaska Peninsula, and Pribilof Islands. This storm also produced blizzard conditions across the Pribilof Islands to the Bering Sea coast and Bristol Bay coast.
161	February	2012	Heavy Snow	A large intense north Pacific storm moved into the eastern Bering Sea the weekend of February 25th. This storm produced heavy snow and blizzard conditions across much of south central Alaska and blizzard conditions along the Bering Sea coast and across the Pribilof Islands.
161	March	2012	Blizzard	A large intense Bering Sea storm pushed its associated front through the eastern Bering Sea into southwest Alaska and the Gulf of Alaska. Strong wind and snow in advance of the front produced blizzard conditions along the Bering Sea Coast. As the front progressed east, strong wind and snow resulted in blizzard conditions.

161	March	2013	Cold/Wind Chill	On the afternoon of Wednesday, March 6th, there was a 960 mb low with occluded front centered about 400 miles south of Dutch Harbor. This low continued to strengthen some as it progressed northward reaching a peak of 954 mb just south of the Alaska Peninsula on the morning of March 7th. This storm then started to weaken as it moved into Bristol Bay and then inland on March 8th. This storm brought high winds as well as blizzard conditions to parts of Southwest Alaska and the Alaska Peninsula.
161	December	2014	Storm Surge/Tide	On December 27, a low-pressure system west of Emmonak at 995 millibars was moving northwest toward Saint Lawrence Island and deepening. A cold front was moving east-northeast toward the Yukon-Kuskokwim delta. A strong pressure gradient was noted between the trough, which extended into the Gulf of Alaska, and a 1055 mb high sitting over the northern Yukon territory of Canada.
161	December	2014	Strong Wind	A low-pressure system formed south of the Alaska Peninsula along a front from another low in the Bering Sea. This system moved northward into Bristol Bay, rapidly intensifying to 952 mb as it did so. The associated front brought unusually high winds to the Aleutian Range, Bristol Bay, and the Southcentral Region. Wind damage was reported across the area.
161	February	2017	High Wind	A low-pressure system developed over the Northern Pacific Ocean and tracked northward toward the Alaska Peninsula. Snowfall overspread the Bristol Bay area, but the main impacts were felt along the Alaska and Aleutian Ranges where snowfall upsloped along the higher terrain.
161	December	2018	Blizzard	A low-pressure system moving southeastward off the Kamchatka Peninsula rapidly intensified over the Bering Sea, reaching a central pressure of 944 mb by the time it crossed the Aleutian Islands. This system had a second, equally strong, low center that developed in its wake, continuing stormy conditions across the Aleutians as the first low moved onshore. The two low pressure systems brought widespread

				blizzards and high winds to the Aleutians, the Southwest Mainland, and Southcentral Alaska.
161	January	2020	Blizzard	A low-pressure system developed south of the Aleutian Chain and then moved northward along the Alaska Peninsula and up Cook Inlet. A strong high-pressure system behind it brought a large amount of cold air behind the low. This created the perfect scenario for snow and high winds along the Alaska Peninsula and northward through the Cook Inlet area. Snow and blizzard conditions began in December 2019 and continued into January 2020.

5.3.4.3 Location, Extent, Impact, and Recurrence Probability

Location

The entire community of Dillingham is vulnerable to the effects of a severe winter storm.

Extent

The entire Dillingham area is equally vulnerable to severe weather effects and experiences severe storm conditions with moderate snow depths; wind speeds exceeding 90 mph; and extreme low temperatures that reach -60ºF.

Impact

The intensity, location, and the land's topography influence a severe weather event's impact within a community. Hurricane force winds, rain, snow, and storm surges can be expected to impact the entire Dillingham area.

Heavy snow can immobilize the community by bringing transportation to a halt. Until the snow can be removed, the airport and roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage light aircraft and sink small boats. A quick thaw after a heavy snow can cause substantial flooding. The cost of snow removal, repairing damages, and the loss of business can have severe economic impacts.

Injuries and deaths related to heavy snow usually occur as a result of vehicle and or snow machine accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Extreme cold can also bring transportation to a halt. Aircraft may be grounded due to extreme cold and ice fog conditions, cutting off access as well as the flow of supplies. Long cold spells can cause rivers to freeze, disrupting shipping and increasing the likelihood of ice jams and associated flooding.

Extreme cold also interferes with the proper functioning of the community's infrastructure by causing fuel to congeal in storage tanks and supply lines, stopping electric generation. Without electricity, heaters and furnaces do not work, causing water and sewer pipes to freeze or rupture. If extreme cold conditions are combined with low or no snow cover, the ground's frost depth can increase, disturbing buried pipes. The greatest danger from extreme cold is its effect on people. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, and carbon monoxide poisoning is possible as people use supplemental heating devices.

Recurrence Probability

Severe winter storms occur annually along the western coast of Alaska; therefore, the probability of a severe winter storm impacting Dillingham is highly likely which equates to a one in one year (1/1=100%) chance of occurring as the history of events is greater than 20% but less than or equal to 33% likely per year.

5.3.5 Ground Failure

5.3.5.1 Hazard Characteristics

Ground failure results when rock and soil deform or move downhill under the influence of gravity. “Mass wasting” and “mass movement” are terms used for events that include downslope movement from the originating location. Topography (i.e., slope), geologic setting, lithology (i.e., rock or sediment type), vegetation, and water content are important factors that influence the movement type (i.e., style) and speed as well as the amount and type of damage that may result from failure. Ground failure can occur due to natural processes, human activities, or a combination of the two.

Ground Failure Types

Landslide is a catch-all term that describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these. “Landslide” is often used interchangeably with “slope failure” or “mass movement.” Anything that alters the slope gradient, vegetation cover, surface drainage, or groundwater infiltration can potentially destabilize vulnerable slopes and lead to landslides. In Alaska, degrading permafrost, steep slopes, heavy rain, retreating glaciers, and ground shaking from earthquakes are some of the important natural mechanisms that can trigger devastating landslides. By changing the controls on slope stability, human activity can increase landslide risk. Typically, this increased risk results from undercutting the base of a slope (e.g., with a road-cut), loading the top of a slope with debris, changing water levels by diverting flow onto a slope or removing trees that tie up moisture, or by weakening the slope by killing vegetation.

In general, landslides are classified based on the type of material being transported and the mechanics of material movement. Transported materials include rock, soil (fine-grained material), and debris (coarse-grained materials). The materials may move by falling, toppling, sliding, spreading, or flowing.

Landslides are often complex, involving multiple movements and material types, and they may begin as one mass movement type and evolve into another as materials collect and continue to move downslope. The most common landslide types can be categorized as listed in Table 8 and displayed in Figure 13.

Table 8. Landslide Types

• Rotational Landslide	• Topple	• Creep
• Translational Landslide	• Debris Flow	• Lateral Spread
• Directed Blast	• Debris Avalanche	
• Rockfall	• Earthflow	

A **Rotational Landslide** is a landslide in which earthen material slides on a failure surface or thin failure zone that curves upward. The slide movement is more-or-less rotational about an axis that is parallel to the slope contour. Rotational landslides generally occur on steep slopes (greater than 20 degrees).

A **Translational Landslide** moves downslope along a relatively planar failure surface, and has little rotational movement or backward tilting. Translational landslides commonly occur along geologic discontinuities, such as faults, joints, bedding surfaces, or at the contact between rock and soil. If the failure surface slope is steep, these slides can have considerable run-out distances.

Block Slides occur when material remains relatively coherent as it moves downslope, with little or no internal deformation. The sliding surface may be curved or planar.

A **Rockfall** is an abrupt, downward rock movement that detaches from a steep slope or cliff. Falling material may bounce or break on impact and then continue to roll downslope. Rockfalls can occur where natural processes (such as weathering and erosion) or human activities (such as digging or blasting) have resulted in an over-steepened slope.

A **Topple** describes the forward rotation of a mass of soil or rock about a pivot point that separates it from adjacent material. Toppling can be caused by natural processes, for example, stress from the weight of upslope material, or freeze-thaw action in cracks or fractures. Columnar-jointed rocks are notably susceptible to toppling.

Debris Flow is a rapid mass movement in which a saturated slurry of loose soil, rock, organic matter, air, and water flows downslope. Debris flows are commonly composed of a large proportion of silt- and sand-sized material, and are either triggered by landslides of other types or intense surface-water flow, due to heavy precipitation or rapid snowmelt, that erodes and mobilizes loose soil or rock on steep slopes. This landslide type is prevalent in areas with steep canyons and gullies, de-vegetated areas, and in volcanic regions with weak soils. Debris flows may develop from other types of landslides (such as rotational or translational) as they increase in velocity and the internal mass loses cohesion and/or gains water.

Debris Avalanches are very fast-moving debris flows. Debris avalanches occur in steep terrain from collapse of weathered slopes, or when bedrock disintegrates during a rotational or translational landslide as material moves downslope at high velocity.

Earthflows occur on moderately steep slopes, usually under saturated conditions, when earth materials lose shear strength and behave like a liquid. The flows are elongate and commonly occur in fine-grained soil (e.g., marine clay [quick clay] or silt), but granular materials or weathered bedrock with high clay content are also susceptible. Earthflows grow in size through a process known as "head scarp retrogression," which is erosion of the upper portion of a failure surface, and may evolve from slides or lateral spreads as they move downslope. Earthflows can destroy large areas and flow for several miles.

Soil Creep is a slow earthflow that is characterized by almost imperceptibly slow, steady, downslope movement of the uppermost few feet of soil or rock. Creep can pull apart or crack highways and other manmade structures. Creep is indicated by curved tree trunks, bent fences or retaining walls, tilted poles or fences, and small soil ripples or ridges. Creep may be seasonal, where movement within the soil is affected by changes in moisture or temperature, or it may be continuous. In some cases, creep may progressively increase and produce other landslide types.

Solifluction is soil creep resulting from alternating cycles of freezing and thawing. It occurs when fine-grained soil thaws, becomes oversaturated due to poor drainage, and then begins to flow. If sufficient water is present, debris flows may develop.

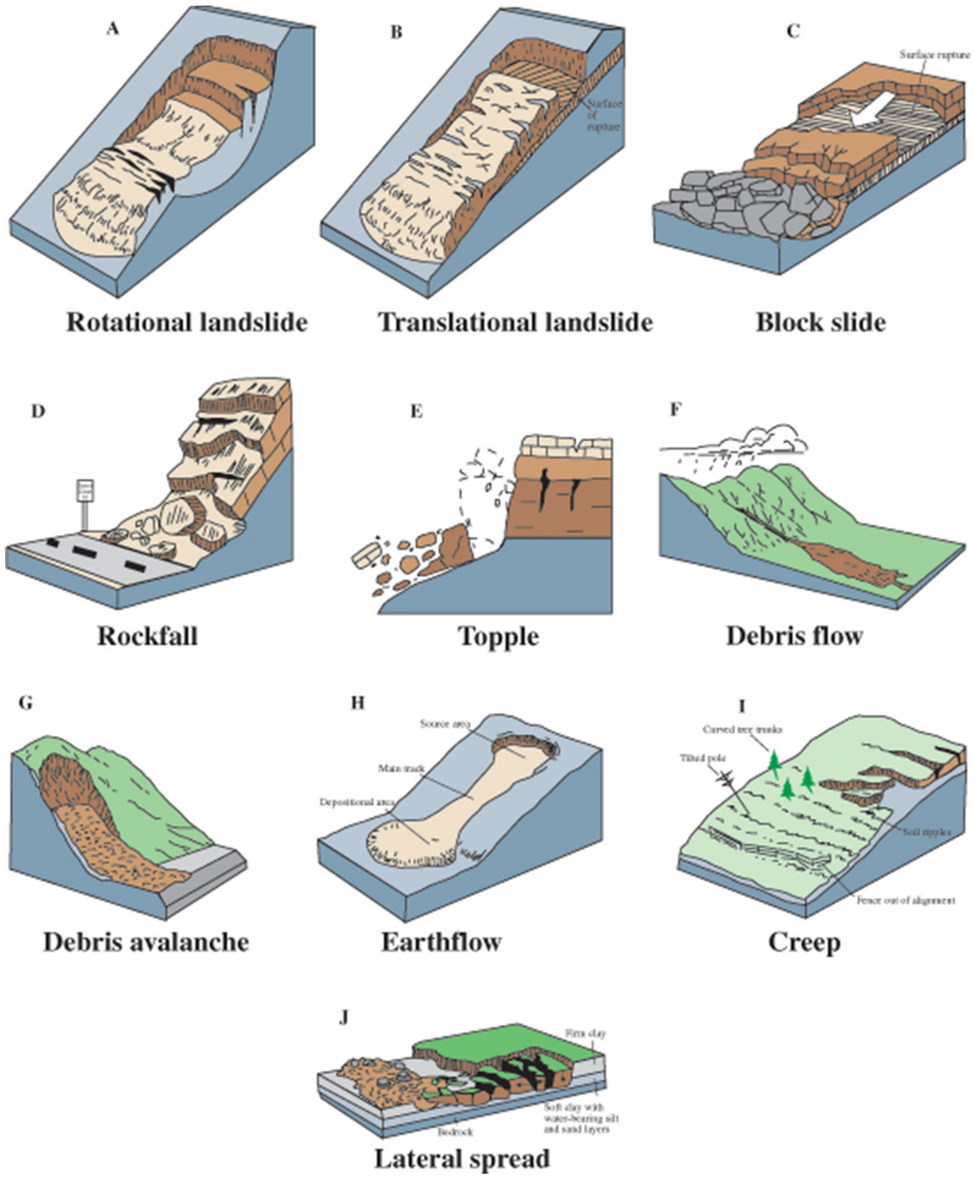
Lateral Spread is the extension or disruption of a normally coherent upper rock or soil layer on top of a softer, weaker layer that has liquefied or flowed. During an event, the stronger upper unit may subside into the weaker lower unit, or material from the lower unit may be squeezed into the upper unit. This mass-movement type generally occurs on flat or very gentle slopes.

A **Slump** is a form of mass wasting that occurs when a coherent mass of loosely consolidated materials or rock layers moves a short distance down a slope. Slumps often occur as material drops off an eroding surface, for example, on the cutbanks of rivers or along undercut coastal bluffs.

Subsidence is any sinking or settling of the earth's surface, often due to removal of subsurface material. Its causes include underground mining; groundwater and petroleum extraction or movement; and degassing and other changes in hydrothermal systems. In Alaska, sediment compaction, thawing ice-rich permafrost, and earthquakes are common subsidence causes.

Tectonic subsidence is the type of subsidence that occurs when the ground surface is lowered by the sinking of the Earth's crust as crustal plates move.

Figure 13. Diagram – Most Common Types of Landslides



5.3.5.1 Climate Factors

Studies show that changing climate conditions can increase the frequency of fast-moving, catastrophic landslides. Alaska's warming surface temperatures are impacting slope stability and increasing a variety of ground failure risks. Warming climate has caused many areas to become unstable, and future warming will increase landslide risk.

Population growth and the expansion of settlements and lifelines over potentially hazardous areas are increasing the likelihood of landslide impacts. Increased permafrost thaw causes thermokarst and subsidence due to loss of ground ice. Additionally, increased water from thawing amplifies the potential for ground failure slides, flows, and creep.

5.3.5.2 Related Hazards

Ground failure is associated with many other hazards because these hazards can directly initiate mass movement or destabilize slopes, making them more susceptible to failure. For example,

- Flooding can add weight to a surface (through water and sediment), causing it to be overloaded and unstable.
- Erosion can remove material at the base of a steep slope, resulting in loss of lateral support.
- Thawing permafrost can weaken rock and soil, leading to ground failure, or leave voids in the ground, resulting in subsidence.
- Shaking from earthquakes commonly initiates a variety of ground failures.

5.3.5.3 Hazard History

Some of the most dramatic ground failure events in Alaska were associated with the 1964 Great Alaska Earthquake, which triggered a wide variety of falls, slides, flows, and lateral spreads throughout Southcentral Alaska.

The 1964 Great Alaska Earthquake also caused extensive subsidence. The subsidence zone covered about 110,000 square miles, including the north and west parts of Prince William Sound, the west part of the Chugach Mountains, most of the Kenai Peninsula, and almost all of the Kodiak Island group. In some areas, subsidence exceeded seven feet. Part of the Seward area is about 3.5 feet lower than before the earthquake, and portions of Whittier subsided more than five feet. The Village of Portage, at the head of Turnagain Arm of Cook Inlet, subsided six feet, partly due to tectonic subsidence and partly due to sediment compaction during the earthquake.

5.3.5.4 Location

There are various ground failure locations throughout Dillingham. Sources include City planning documents, USACE, USGS, as well as other agencies' developed plans and studies. Land subsidence such as melting permafrost and floodwater soil saturation are the most common ground failure impacts (City, 2016).

5.3.5.5 Extent

The damage magnitude could range from minor with some repairs required and little to no damage to transportation, infrastructure, or the economy to major if a critical facility (such as the airport) were damaged and transportation was affected.

Based on research and the Planning Team's knowledge of past ground failure and various degradation events, the extent of "isolated" ground failure impacts in the Dillingham area are considered "Limited". Impacts would not occur quickly but over time with warning signs. Therefore, this hazard would not likely to cause injuries or death, neither would it shutdown critical facilities and services.

5.3.5.6 Impact

Impacts associated with ground failure include surface subsidence or upheaval, and infrastructure, building, and/or road damage. Ground failure can pose a sudden and catastrophic hazard in the event of a large landslide. Most ground failure damage from non-landslide causes occurs from improperly designed and constructed buildings that settle as the ground subsides, resulting in structure loss or expensive repairs. Ground failure may also impact buildings, roads, docks, and the airport, not only causing damage, but also impacting passenger and cargo delivery.

5.3.5.7 Recurrence Probability

The Planning Team determined the recurrence probability for ground failure as “Unlikely” which equates to once in the next 1-10 years (1/10=10 percent) chance of occurring as the history of events is less than 10% likely per year.

5.3.6 Wildfires

5.3.6.1 Characteristics

A wildland fire is a type of wildfire that spreads through consumption of vegetation. It often begins unnoticed, spreads quickly, and is usually signaled by dense smoke that may be visible from miles around. Wildland fires can be caused by human activities (such as arson or campfires) or by natural events such as lightning. Wildland fires often occur in forests or other areas with ample vegetation. A conflagration fire involves man-made structures.

The following three factors contribute significantly to fire behavior and can be used to identify fire hazard areas.

Topography describes slope increases, which influences the rate of wildland fire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildland fire behavior. However, ridgetops may mark the end of wildland fire spread since fire spreads more slowly or may even be unable to spread downhill.

Fuel is the type and condition of vegetation and plays a significant role in the occurrence and spread of fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the “fuel load”). The ratio of living to dead plant matter is also important. The risk of fire is increased significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases. The fuel load continuity, both horizontally and vertically, is also an important factor.

Weather is the most variable factor affecting fire behavior. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme fire activity. By contrast, cooling and higher humidity often signal reduced fire occurrence and easier containment.

If not promptly controlled, fires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy improved properties. In addition to affecting people, fires may severely affect livestock and pets. Such events may require emergency water/food, evacuation, and shelter.

Conflagration fires are very difficult to control. Complicating factors are wind, temperature, slope, proximity of structures, and community firefighting capability, as well as building construction and contents. Additional factors facing response efforts are hazardous substance releases, structure collapse, water service interruptions, unorganized evacuations, and loss of emergency shelters. Historical national conflagration examples include the Chicago City Fire of 1871 and the San Francisco City Fire following the 1906 earthquake. In 2018, the deadliest and most destructive wildfire and conflagration fire in California encompassed 20,000 acres, killed 85 people, and almost completely incinerated the town of Paradise. The fire was sparked by transmission lines owned by Pacific Gas & Electric. Dry vegetation and high winds caused extreme rates of spread.

Many wildland firefighters are neither equipped nor trained for conflagration fires. When wildland firefighters encounter structure, vehicle, dump or other non-vegetative fires during the performance of their wildland fire suppression duties, firefighting efforts are often limited to wildland areas.

5.3.6.2 History

Previous wildland fires have been documented in close proximity to Dillingham's limits. In recent years, favorable winds occurred so that no evacuations were needed.

There have been approximately 84 historical fires started by environmental events and human actions. The most frequent human cause has been children playing with fire, out-of-control trash, debris or brush burning, and camp or cooking fires. Lightning fires from thunderstorms are becoming more frequent fire initiators; however, lightning strikes within community limits are rare and there is no record of an urban fire being caused by such an event.

Wildfires in Dillingham's urban/wildland interface have involved grass and brush and had very limited damage extent. Most of these have occurred during warm dry spring seasons; between break-up and green-up. Most property loss occurred to outbuildings, vehicles or other non-residential – non-critical facilities, surrounded by dry grass ignited before the firefighter arrival.

Table 9 and Figure 14 identify wildland fires that have occurred within 50 miles of Dillingham in the past 80 years.

Table 9. Wildland Fires near Dillingham

Fire Year	Fire Name/Number	Acres Burned
1941	Stuyahok	5,000
1942	Aleknagik	12,000
1943	Koggiung-Naknek	192,000
1945	Dillingham	45,000

1945	Naknek	100,000
1952	Kvichak	10,000
1953	Naknek Fire	200
1957	Dillingham	5,000
1959	Lower Nushagak	750
1980	Okstakuk	1,164
1991	Twin	12,400
1997	Koggiling #2	140
1997	Kok 35	185
1997	Tuklung	250
1997	Naknek – South	300
1997	Kluk Creek	1,000
1997	704362	2,400
2012	Snake River	16,566
2015	Copenhagen Creek	5166
2015	504710	3,342
2019	Ongivinuk River	2,540

Source: Alaska Fire Service, 2020

5.3.6.3 Location, Extent, Impact, and Recurrence Probability

Location

Under certain conditions wildland fires may occur in any area with fuel surrounding the Dillingham area. Since fuels data is not readily available, for the purposes of this plan, all areas outside City limits are considered to be vulnerable to wildland fire impacts.

Dillingham lies on the coast. Its primary climatic influence is maritime, though the arctic climate of the Interior also has an effect. Average summer temperatures range from 37 to 66 ℉. Average winter temperatures range from 4 to 30 ℉. Annual precipitation is 26 inches, and annual snowfall is 65 inches.

The terrain consists of low wooded hills and ridges interspersed with tundra. Most tundra is peat bog, but some hills are covered with drier upland tundra. The forest consists of mixed spruce and birch, with some cotton wood, alder, scrub willow and other species.

At times, warm weather with low relative humidity lasts long enough to dry out light fuels and create a moderate likelihood of grass fires in open areas. Occasionally, brush fires of very limited scope occur.

Winter snowpack usually leaves the forest floor damp and therefore not subject to lurking fire in spruce duff. Similarly, ground in open areas is usually damp or sodden beneath the surface. Following winters with little or no snow, forest floors and upland tundra have some potential for harboring “underground” fires.

Extent

Fuel, weather, and topography influence wildland fire behavior. Fuel (e.g., slash, dry undergrowth, flammable vegetation) determines how much energy the fire releases, how quickly the fire spreads, and how much effort is needed to contain the fire. Weather is the most variable factor. High temperatures and low humidity encourage fire activity while low temperatures and high humidity retard fire spread. Wind affects the speed and direction of fire spread. Topography directs the movement of air, which also affects fire behavior. When the terrain funnels air, as happens in a canyon, it can lead to faster spreading. Fire also spreads up slope faster than down slope.

Impact

Impacts of a wildland fire to Dillingham could grow into an emergency or disaster if not properly controlled. Even a small fire can threaten lives and resources and destroy property. In addition to impacting people, wildland fires may severely impact livestock and pets. Such events may require emergency watering and feeding, evacuation and alternative shelter.

Indirect impacts of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thus increasing flood potential, harming aquatic life, and degrading water quality.

Recurrence Probability

Dillingham's weather is generally too cool and damp to create conditions for extensive wildland fires. During unusually hot and dry summers, grass fires in open areas become likely, with the possibility of extension into forest edges. Such fires are self-limiting, in that they do not produce enough energy to spread significantly into shady mixed-growth woods.

These local conditions may change as the planet's climate changes. If average summer temperatures increase and snow pack decreases, the likelihood and severity of wildfires may increase.

An important issue related to the wildland or tundra fire probability in the interface fire is increased development along the community's perimeter, accumulation of hazardous wildfire fuels, and the uncertainty of weather patterns that may accompany climate change. These three combined elements are reason for concern and heightened mitigation management of each community's wildland interface areas, natural areas, and open spaces.

More spruce trees are dying due to spruce bark beetle infestation. As the trees die, they dry, and fall to the forest floor. This situation provides highly flammable fuel for future wildland fires. Currently, much of the fallen beetle-killed spruce is harvested by locals, which helps to reduce the potential fuel for wildland fire.

Climate change and flammable vegetation species susceptibility to wildland fires throughout Alaska's forests and tundra locations is increasing. Therefore, based on Dillingham's wildland fire history, it is "Likely" a wildland fire event will occur within the next three years. The event has up to 1 in 3 years (1/3=33%) chance of occurring and the history of events is greater than 20% but less than or equal to 33% likely each year.

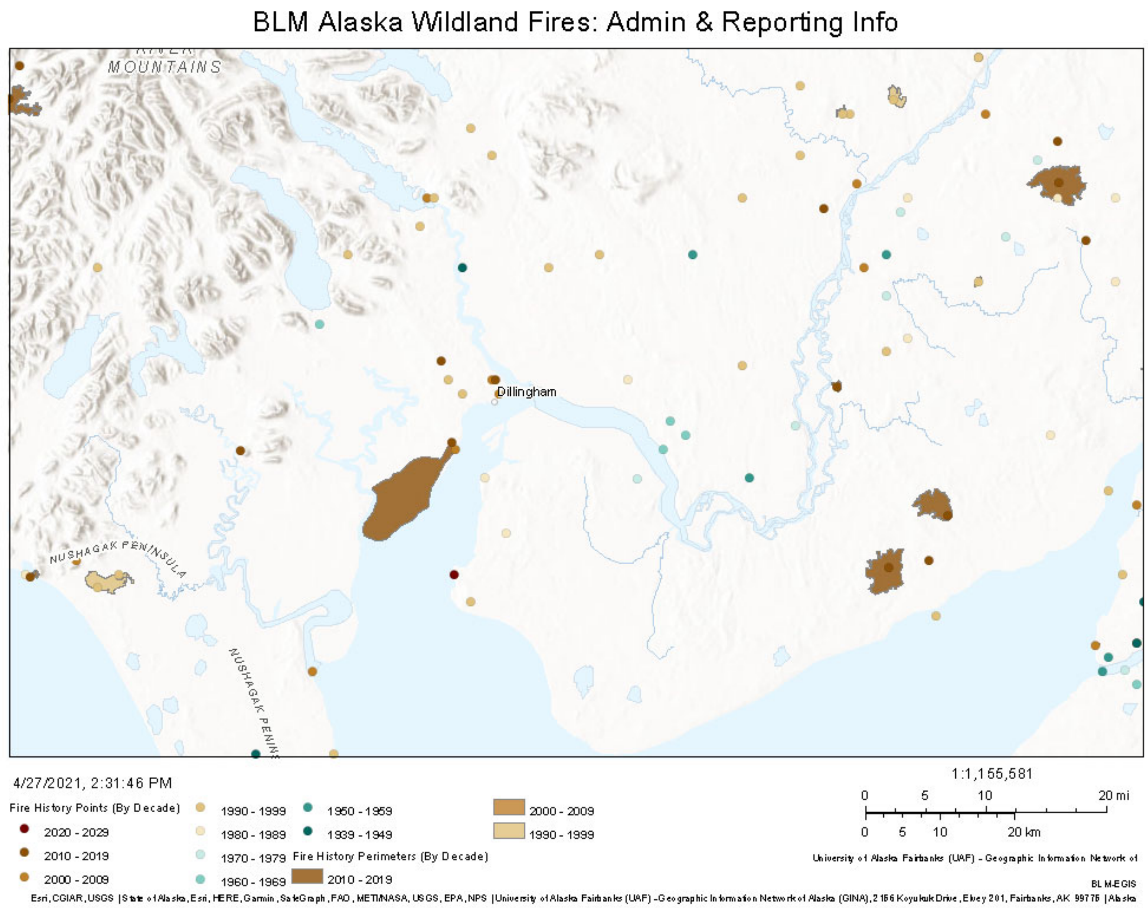


Figure 14. Dillingham Fire History Map

Source: Alaska Fire Service, 2020

5.3.7 Volcanoes and Ashfalls

5.3.7.1 Hazard Characteristics

Alaska is home to 41 historically active volcanoes stretching across the entire southern portion of the State from the Wrangell Mountains to the far Western Aleutians. An average of one to two eruptions per year occurs in Alaska. In 1912, the largest eruption of the 20th century occurred at Novarupta and Mount Katmai, located in what is now Katmai National Park and Preserve on the Alaska Peninsula.

Volcanic ash, also called tephra, is fine fragments of solidified lava and rock crystals ejected into the air by a volcanic explosion. The fragments range in size, with the larger falling nearer the source. Ash is a problem near the source because of its high temperatures (may cause fires), burial (the weight can cause structural collapses; for example, it was 100 miles from Novarupta to Kodiak where structures collapsed), and impact of falling fragments. Further away, the primary hazard to humans is damage to machinery (including airplanes in flight), decreased visibility, and inhaling the fine ash (long-term inhalation can lead to lung cancer), but lightning in large ash clouds can also pose a hazard. In Alaska, this is a major problem as many of the major flight routes are near historically active volcanoes. Ash accumulation may also interfere with the distribution of electricity due to shorting of transformers and other electrical components (ash is an excellent conductor of electricity).

The largest volcanic eruption of the 20th century occurred at Novarupta Volcano in June 1912. The eruption started by generating an ash cloud that grew to thousands of miles wide during the three-day event. Within four hours of the eruption, ash started falling on Kodiak, darkening the City. It became hard to breathe because of the ash and sulfur dioxide gas. The water became undrinkable and unable to support aquatic life. Roofs collapsed under the weight of the ash. Some buildings were destroyed by ash avalanches while others burned after being struck by lightning from the ash cloud. Similar conditions could be found all over the area. Some villages ended up being abandoned, including Katmai and Savonoski Villages. The ash and acid rain also negatively affected animal and plant life. Large animals were blinded, and many starved because their food was eliminated.

5.3.7.2 History

The Alaska Volcano Observatory (AVO) has volcano hazard identification and assessment responsibility for Alaska's active volcanic centers. The AVO monitors active volcanoes several times each day using Advanced Very High-Resolution Radiometers and satellite imagery.

DHS&EM's Disaster Cost Index records the following volcanic eruption disaster events:

> *<u>103. Mt. Redoubt Volcano, December 20, 1989:</u> When Mt. Redoubt erupted in December 1989, posing a threat to the Kenai Peninsula Borough, Mat-Su Borough, and the Municipality of Anchorage, and interrupting air travel, the Governor declared a Disaster Emergency. The Declaration provided funding to upgrade and operate a 24-hr. monitoring and warning capability.*
>
> *<u>104. KPB-Mt. Redoubt, January 11, 1990:</u> The Kenai Peninsula Borough, most directly affected by Mt. Redoubt, experienced extraordinary costs in upgrading air quality in schools and other public facilities throughout successive volcanic eruptions. The Borough also sustained costs of maintaining 24-hr. operations during critical periods. The Governor's declaration of Disaster Emergency supported these activities.*
>
> *<u>161. Mt. Spurr, September 21, 1992:</u> Frequent eruptions and the possibility of further eruptions has caused health hazards and property damage within the local governments of the Municipality of Anchorage, Kenai Peninsula Borough and Mat-Su Borough. These eruptions caused physical damage to observation and warning equipment. Funds to replace equipment for AVO.*

More recent eruptions occurred on Augustine Volcano in 1986 and again in 2006. During both eruptions, repeated ash plumes rose to 30,000 feet above sea level or higher, disrupting air traffic and dusting Cook Inlet communities with ash. A lava dome formed in the summit crater towards the end of each of these eruptions.

Redoubt Volcano erupted in 1989-1990 and mudflows or lahars caused temporary closure of the Drift River Oil Terminal. A 747-jet aircraft, temporarily lost power in all four engines when it entered the Redoubt ash plume over the Talkeetna Mountains. Fortunately, the flight crew was able to restart their engines about 4,000 feet (1,219 meters) above ground, and the plane landed safely in Anchorage.

Recent volcano eruption impacts demonstrate modern community vulnerability to volcanic ash dispersal and travel distance.

5.3.7.3 Location, Extent, Impact, and Recurrence Probability

Location

Most of Alaska's volcanoes are located along the 2,500- kilometer-long (1,550-mile-long) Aleutian Arc, which extends westward to Kamchatka and forms the northern portion of the Pacific "Ring of Fire" (AVO). Dillingham is at risk for a volcanic event. Figure 15 illustrates the number of actives volcanoes in and around Dillingham.

Extent

Extreme ashfalls, such as those documented previously for the Novarupta 1912 eruption, could happen again. There have been at least seven deposits of volcanic ash within 500 miles of Anchorage younger than 6,000 years that approach or exceed the volume of ash ejected by Novarupta in 1912. Such events have occurred at less than 1,000-year intervals, which suggests a probability of about 5% in a 50-year time period.

There is also a substantially higher probability of smaller-scale ashfalls in Alaskan communities from the numerous active volcanoes on the Alaska Peninsula or the Aleutian Arc from volcanoes further away, depending on the wind direction at the time of an eruption. For any given eruption, the depth of ash deposited at any given location depends on the total volume of ash ejected, the wind direction, and the distance between the volcano and a given location.

Extreme ashfall events, similar to the 1912 event, would have similar extreme consequences including building damage up to and including collapses, disruption of travel (air, sea, land), disruption of water, electric power and communications, and health and environmental impacts. Smaller ashfall events would result in little or no building damage, but would still have significant impacts, including:

- Respiratory problems for at-risk populations such as young children, people with respiratory problems and the elderly;
- Disruption of air, marine, and land traffic;
- Clean-up and ash removal from roofs, gutters, sidewalks, roads, vehicles, mechanical systems and ductwork, engines, and mechanical equipment;
- Clogging of filters and possible severe damage to vehicle engines, furnaces, heat pumps, air conditioners, commercial and public buildings combined heating, ventilation, and air conditioning (HVAC) systems and other engines and mechanical equipment;

- Disruption of public water supplies drawn from surface waters, including degradation of water quality (high turbidity) and increased maintenance requirements at water treatment plants;
- Disruption/clogging of storm water drainage systems;
- Disruption of electric power from ash-induced short circuits in distribution lines, transmission lines, and substations; and
- Disruption of communications.

A major factor in determining ashfall is wind direction. Kodiak was located directly downwind of the main eruption of Novarupta, which is why it was so deeply buried. Additionally, if there is a large ashfall, wind could blow and redistribute ashfall several times which would be a prolonged hazard. Ash resuspension continues to be a problem near Katmai even a century after Novarupta.

Impact

An ash fall event would undoubtedly be devastating to Dillingham by straining its resources as well as transportation (air and ocean); especially if other hub communities are also significantly affected by a volcanic eruption. Residents would likely experience respiratory problems from airborne ash, personal injury, and potential residential displacement or lack of shelter with general property damage (electronics and unprotected machinery), structural damage from ash loading, state/regional transportation interruptions, loss of commerce, as well as water supply contamination.

These impacts can range from inconvenience – a few days with no transportation capability; to disastrous – heavy, debilitating ash fall throughout the state, forcing Dillingham residents to be completely self-sufficient.

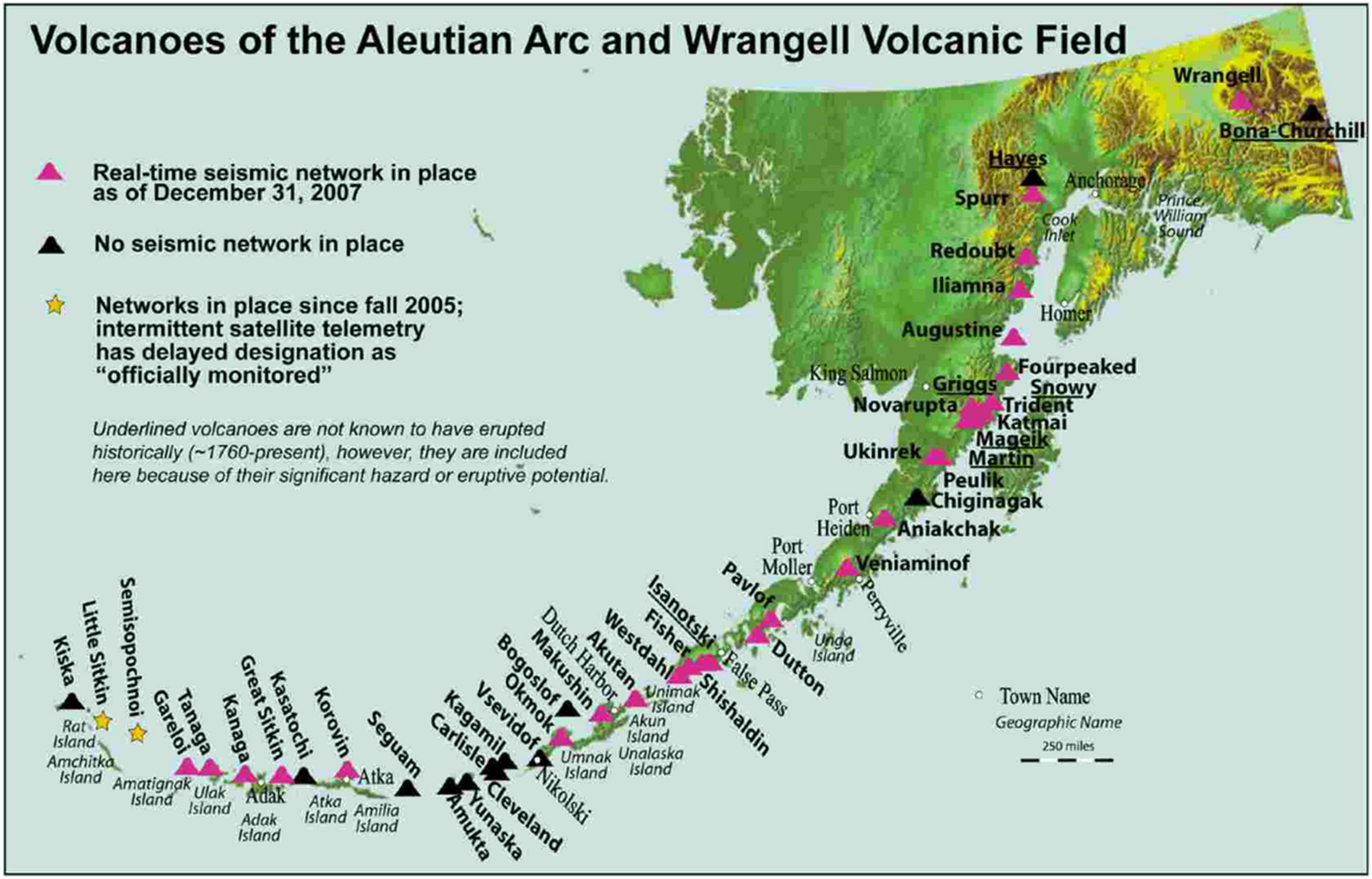
The actual impact to the Dillingham would depend in large part on the weather, especially wind patterns, at the time of the eruption. Changes in wind speed and direction could remove the chance of an ash fall on the Dillingham, however it could also cause a disaster.

Recurrence Probability

Geologists can make general forecasts of long-term activity associated with individual volcanoes by carefully analyzing past activity, but these are on the order of trends and likelihood, rather than specific events or timelines. Short-range forecasts are often possible with greater accuracy. Several signs of increasing activity can indicate that an eruption will follow within weeks or months. Magma moving upward into a volcano often causes a significant increase in small, localized earthquakes, and measurable carbon dioxide and compounds of sulfur and chlorine emissions increases. Shifts in magma depth and location can cause ground level elevation changes that can be detected through ground instrumentation or remote sensing.

It is classified as "Unlikely" that an earthquake would be centered in an area around Dillingham. This means that the event has up to one in ten years' chance of occurring (1/10=10%).

Figure 15. Volcanoes of the Aleutian Arc



6.0 Vulnerability Analysis

6.1 VULNERABILITY ANALYSIS OVERVIEW

According to recommendations stipulated in DMA 2000, a risk assessment and vulnerability analysis should include the following elements:

- A summary of the community's vulnerability to each hazard that addresses the impact of each hazard on the community.
- Identification of the types and numbers of repetitive loss properties in the hazard areas.
- Identification of the types and numbers of existing vulnerable buildings, infrastructure, and critical facilities and, if possible, the types and numbers of vulnerable future development.
- Estimation of potential dollar losses to vulnerable structures.
- Documentation of the methodology used to prepare the estimate.

A vulnerability analysis is divided into eight steps:

1. Asset Inventory;
2. Asset Exposure Analysis;
3. Repetitive Loss Properties;
4. Land Use and Development Trends;
5. Vulnerability Analysis Methodology;
6. Data Limitations;
7. Vulnerability Exposure Analysis; and
8. Future Development.

DMA 2000 Recommendations
Assessing Risk and Vulnerability, and Analyzing Development Trends **§201.6(c)(2)(ii)** and **§201.7(c)(2)(ii):** The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described. This description shall include an overall summary of each hazard and its impact on the community. The plan should describe vulnerability in terms of: **§201.6(c)(2)(ii)(A)** and **§201.7(c)(2)(ii)(A):** The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; **§201.6(c)(2)(ii)(B)** and **§201.7(c)(2)(ii)(B):** An estimate of the potential dollar losses to vulnerable structures identified in … this section and a description of the methodology used to prepare the estimate. **§201.6(c)(2)(ii)(C)** and **§201.7(c)(2)(ii)(C):** Providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions. **§201.7(c)(2)(ii)(D):** Cultural and sacred sites that are significant, even if they cannot be valued in monetary

terms.
1. REGULATION CHECKLIST
ELEMENT B. Risk Assessment, Assessing Vulnerability, Analyzing Development Trends
B3 for City. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? B3 for Tribe. Does the plan include a description of each hazard's impact as well as an overall summary of the vulnerability of the Tribal planning area? B4 for City. Does the Plan address NFIP-insured structures within each jurisdiction that have been repetitively damaged by floods? C2 for City. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements as appropriate?
Source: FEMA, 2015.

Table 10 lists Dillingham's infrastructures' hazard vulnerability.

Table 10. Vulnerability Overview

Hazard	Percent of Jurisdiction's Geographic area	Percent of Population	Percent of Building Stock	Percent of Critical Facilities and Utilities
Flood/Erosion	10%	3%	7%	5%
Severe Weather	20%	20%	20%	20%
Changes in the Cryosphere	10%	10%	10%	10%
Earthquakes	10%	10%	10%	10%
Ground Failure	5%	10%	3%	10%
Volcano	10%	10%	10%	10%
Fires	20%	10%	10%	5%

6.2 Land Use and Development

6.2.1 Land Use

Land use is predominately residential with limited area for commercial services and community (or institutional) facilities. Suitable developable vacant land is in short supply within the boundaries of the City, and open space and various hydrological bodies surround the community. The Tribe does not own any land. One area of town is classified as airport land use.

Current land use is shown on Figure 16. The City of Dillingham has platting authority as a First-Class City under Alaska Statutes. All subdivisions' governance, which are not restricted by Native allotments, must be brought before the Planning Commission.

The City of Dillingham and Choggiung Ltd. are coordinating efforts to develop a land use plan for parcels conveyed to the City for public use under the Alaska Native Claims Settlement Act. The community's comprehensive plan is a living document under continuous review and revision.

Dillingham is densely populated with mixed-uses including urban-residential, commercial, light industrial, and public facilities. The small boat harbor and "all-tide" dock anchor the primary base activities and subsequent land use patterns. Fishing-related businesses and services are in the core town site. Development northwest, northeast, and south of the core townsite is primarily rural residential.

Around 90% of Dillingham homes are fully plumbed. City water is supplied from three deep wells. Water is treated, stored in tanks (capacity is 1,250,000 gallons), and distributed. Approximately 40% of homes are served by the City's piped water system; 60% use individual wells. Most of the core townsite is served by a piped sewage system; waste is treated in a sewage lagoon. However, the majority of residents (75%) have septic systems.

The City is implementing its 2015 Water and Sewer Master Plan which included improving the existing water source and infrastructure in the core town site. Improvements included identifying and developing a new water source near the airport; and tying it to the existing system. Ultimately, the plan aims to tie most of the town into the City's water and sewer system.

Other future development includes:

- Downtown & Lake Road Fire Stations Improvements
- Downtown Streets Rehabilitation
- Harvey Samuelsen Community Center
- Small Boat Harbor Improvements
- Wood River Boat Ramp
- Renovate Senior Center & Library
- Community Pavilion
- Expand Dillingham Jail
- Bayside Drive Sewer System
- Confined Disposal Facility

The 2013-2018 Comprehensive Plan Part 3 provided a clear description of the City's capacity to regulate or control land usage:

> ***"Introduction***
>
> *Many of the goals identified through this planning process have been high*

community priorities in the past. These include goals improving downtown, expanding the economy, improving housing, protecting the natural environment, and dedicating land for future industrial, commercial and other uses. While there has been progress towards these goals,in many cases the City will need to use new methods and resources for these goals to be achieved.

Currently, Dillingham has few of the land use planning and regulatory tools used by mostsmall communities in Alaska. For example, the City has few controls over the location of new uses. The City does not require a review process for major new uses, and it has very limited standards for development on individual properties.[1]

Some residents are content with the current lack of land use controls; others are concernedthat without some guidance, development could harm the community. Examples given include damage to the natural environment and increased costs to the City to build and maintain public infrastructure. Respecting both these views, this plan proposes

incremental steps to improve the community's capacity to guide future growth. The initialsteps will equip the community with a few basic land management tools. Even these steps will be taken slowly, to provide both landowners and City staff time to test any new policies,and to find an acceptable balance between no rules and the right, limited set of practical,enforceable rules.

[1] In some Dillingham subdivisions, Codes, Covenants and Restrictions (CCR's) are used to guide certain activities and uses, with varying degrees of success. The main challenge with CCR's is the difficulty of enforcement, particularly if the homeowners' association responsible for enforcement is not constantlyvigilant. The City has a requirement for a land use permit (see the discussion under Goal 8)" (CP 2010).

Part 3 further stressed the need for developing "Advisory Guidelines" designed to provide a land use development philosophy to educate land owners enabling them to use land as needed, but to look beyond their personal use; but to consider their neighbors and to maintain a healthy community. They defined this as "Conditional Use" in the plan's objectives:

"Objective 8D: Develop and widely publicize Good Neighbor Advisory Land Use Guidelines. Theseguidelines are suggested guidelines and are not legal requirements. Guidelines should address thefollowing:

Water Quality & Erosion

1. *Land uses adjoining water bodies should be designed to minimize impacts on water quality by, for example, minimizing the removal of natural vegetation along the edge of lakes, streams and wetlands to keep runoff from driveways, oil and gas, silt, and septic effluents out of the watershed, to reduce bank erosion and provide habitat for wildlife.*

What is a Conditional Use?

A conditional use is a category of use identified in a zoning code.

Most Alaska communities and boroughshave a conditional use process, with thespecific goal of guiding land uses that have potential for significant off-site impacts, such as adult oriented businesses, or autowrecking yards.

Elements of a conditional use process typically include:

A. *A list of uses that require such a permit (which can vary by location),*
B. *A list of general conditions for consideration in the approval of specified uses (e.g. standards for traffic or safety impacts),*
C. *A review process, typically including a public hearing, where the specific conditions of approval are tied to the planned use.*

2. *Where appropriate, use drainage swales, holding basins and similar practices to ensure that runoff from developed areas does not degrade water quality in adjoining water bodies.*
3. *Maintain sufficient setbacks of buildings from streams, lakes, wetlands and other waterbodies to have minimal environmental and visual impact on the adjoining waterway or wetland.*
4. *Establish buffer zones as needed to reduce the sensory impact on residential areas androads.*
5. *Septic systems (see Objective 7B above).*
6. *Development should not disrupt drainage patterns (for example, by diverting orblocking a small stream). The general form of natural contours should be retained.*

Natural Vegetation/Site Disturbance

7. *Encourage the retention of existing natural vegetation and replant disturbed areas. Hazards and Sensitive Areas" (CP 2018).*

Figure 17 depicts Dillingham's land ownership categories which designates government oversight. Each governing body may guide land acquisition as well as authorized usage.

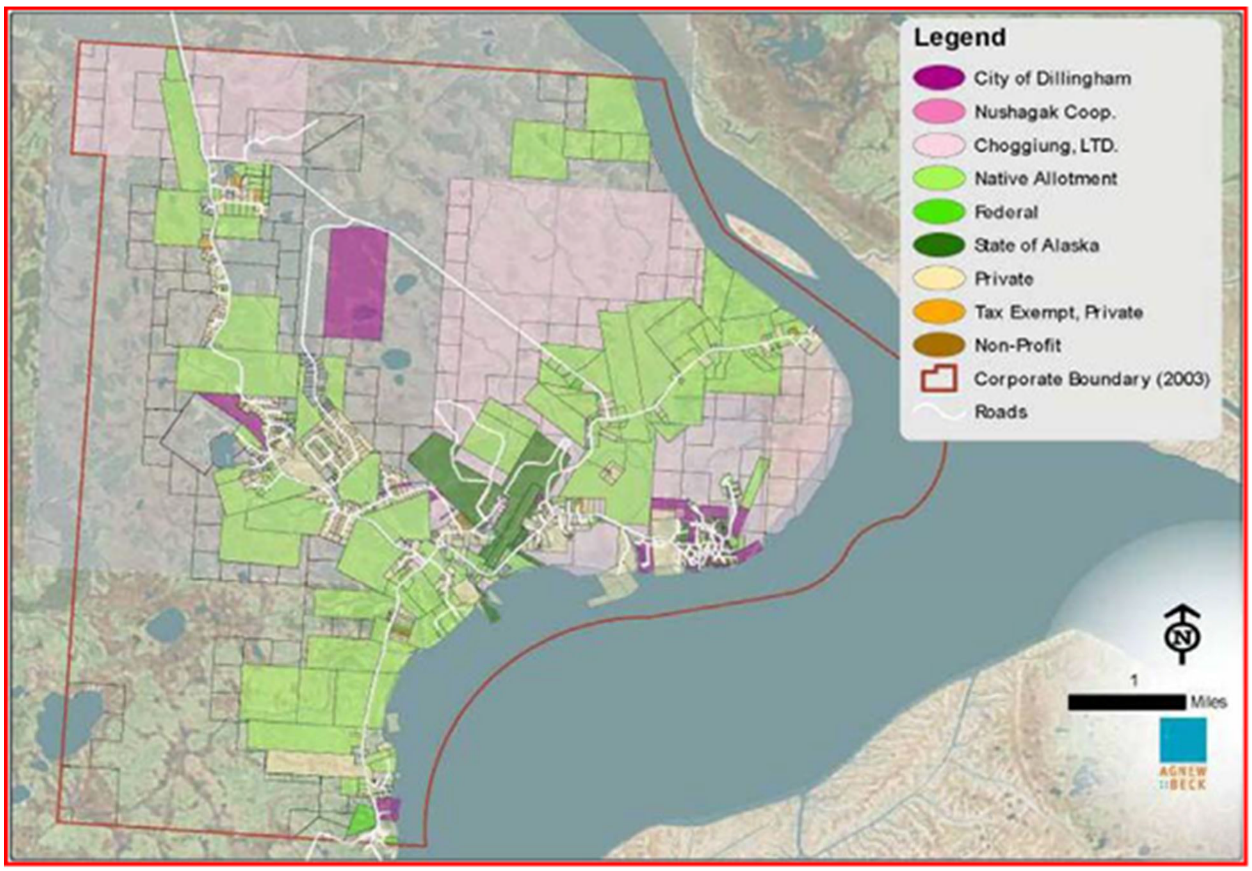


Figure 16. Dillingham Land Use Map

6.3 ASSET ANALYSIS

6.3.1 Asset Inventory

Asset inventory is the first step of a vulnerability analysis. Assets that may be affected by hazard events include population (for community-wide hazards), residential buildings (where data is available), and critical facilities and infrastructure.

6.3.1.1 Population and Building Stock

Population data for Dillingham were obtained from the 2010 U.S. Census and the DCCED. The U.S. Census reports the total population for 2010 as 2,324 while the DCCED data reported a population of 2,226 (Table 11).

Table 11. Estimated Population and Building Inventory

Population		Residential Buildings	
2010 Census	**DCCED 2020 Data**	**Total Building Count**	**Total Value of Buildings[1]**
2,324	2,226	1,047	Census: $261,226,500 City: $314,100,000 Tribe: $1,000,000

Sources: U.S. Census 2010; listed average estimated residential structure value at $249,500.
The Project Team determined that the average structural replacement value of all single-family residential buildings is $300,000.

A total of 1,047 single-family residential buildings were considered in this analysis. The Dillingham Planning Team stated that the U.S. Census generally understates residential replacement values because replacement materials acquisition, barge or airplane delivery, and construction in rural Alaska costs far exceed U.S. Census structure estimates.

The U.S. Census estimates the average residential structure value is $249,500 however, the Planning Team estimates that actual housing costs are closer to $300,000 with an additional 50% added for contents value to all residential, commercial, and public infrastructure costs. Table 12 displays a viable comparative difference between U.S. Census and Planning Team estimates.

6.3.1.2 Critical Facilities and Infrastructure

A critical facility is defined as a facility that provides essential products and services to the general public, such as preserving the quality of life in Dillingham and fulfilling important public safety, emergency response, and disaster recovery functions. The critical facilities profiled in this plan include the following:

- Government facilities, such as City and Tribal administrative offices, departments, or agencies
- Emergency response facilities, including police department and firefighting equipment
- Educational facilities, including K-12

- Care facilities, such as medical clinics, congregate living health, residential and continuing care, and retirement facilities
- Community gathering places, such as community and youth centers
- Utilities, such as electric generation, communications, water and waste water treatment, sewage lagoons, landfills.

The Planning Team determined that legacy 2016 HMP critical facilities and infrastructure values (Table 12) have not changed since 2016. The majority of the data was carried forward as representative sample values for planning purposes and will be used throughout the remainder of Section Six.

Table 12. Dillingham Critical Facilities

Facility ID	Occupancy Class	Facility Name	Contents Value ($)	Structure Value ($)
2	Government	Airport Firehouse	2,700,000	1,800,000
3		ADF&G	1,425,000	50,000
6		City Hall	2,593,470	1,728,980
8		DLG Dept. of Public Safety	2,817,771	1,878,514
9		DLG Airport	13,109,321	8,739,547
14		Downtown Fire Station	2,773,176	1,848,784
22		Lake Road Fire Station	3,000,000	2,000,000
32		US Post Office	1,627,500	1,085,000
33		SAFE Shelter & Offices	1,125,000	750,000
34		Dillingham Senior Center	2,383,100	1,588,733
36		ADOT Shop	1,910,499	1,273,666
37		City of DLG Public Works Shop	547,500	365,000
39		SWRSD Offices	120,000	80,000
44		Curyung Tribal Council Building	945,000	630,000
		Ekuk Tribal Council Building	Unknown	Unknown
49		Bristol Bay Housing Authority	3,000,000	2,000,000
50		Alaska State Trooper Post	180,000	120,000
52		Kongigatuk Building (FWS, LIO)	933,000	622,000
63		AMHTA Behavioral Health Facility	5,569,262	3,712,841
64		Dillingham Coastal Trail	2,791,500	1,861,000
68		Dillingham Animal Shelter	180,000	120,000
69		Marrulut-eniit "Granma's House"	1,988,805	1,325,870
70		Dillingham Public Health Clinic	360,000	240,000
71		Dillingham Bingo Hall – Youth Center	103,248	68,832
72		Dillingham Boat Harbor Office	184,965	123,310
82		Kleepuk Hill Road	Unknown	Unknown
86		Scandinavian Creek Bridge	Unknown	Unknown
89		Squaw Creek Bridge	Unknown	Unknown
90		Kanakanak Road	Unknown	Unknown
91		VORDME	750,000	500,000
92		SACOM	1,500,000	1,000,000
93		Dillingham FAA - Flight ServiceStation	Unknown	Unknown
10	Educational	Dillingham High School	11,250,000	7,500,000
11		Dillingham Elementary School	11,250,000	7,500,000
12		Territorial School Building	85,937	57,291
24		Dillingham Public Library &Sam Fox Museum	1,639,368	1,092,912
		Dillingham Adventist School	Unknown	Unknown
43		UAF Bristol Bay Campus	5,625,000	3,750,000
66		BBNA Head Start	30,000	4,300,000

Facility ID	Occupancy Class	Facility Name	Contents Value ($)	Structure Value ($)
5	Religious/Non-Profit	First Avenue Cemetery	20,000	20,000
53		Wood River Cemetery	20,000	20,000
61		Second Ave. West Cemetery	20,000	20,000
73		Russian Orthodox Church	Unknown	Unknown
74		Catholic Church	Unknown	Unknown
75		Seventh Day Adventist Church Buildings	310,200	310,200
76		Moravian Church	Unknown	Unknown
77		Assembly of God	Unknown	Unknown
78		Baptist Church	128,000	128,000
79		Trinity Lutheran Church	Unknown	Unknown
80		Dillingham Bible Fellowship	Unknown	Unknown
81		Evergreen Memorial Cemetery	20,000	20,000
83		Russian Orthodox Church Cemetery	20,000	20,000
84		Kanakanak Cemetery	20,000	Unknown
1	Commercial	A.C. Store	1,143,901	819,100
		Bigfoot Grocery Warehouse	Unknown	Unknown
13		Dillingham Dock Office	45,239	30,159
18		Kanakanak Hospital Compound	109,800,000	73,200,000
21		L&M Supplies	489,560	867,600
23		Bristol Express	62,158	96,600
25		N&N Market	1,042,792	67,800
26		NAPA Auto Parts	151,295	370,400
28		Neqleq Variety	60,936	165,000
30		Peter Pan Seafoods	943,568	4,524,700
40		Squaw Creek Boat Movers	75,000	50,000
		Icicle Seafoods – Wood River	Unknown	Unknown
51		Wells Fargo	42,162	549,100
65		BBNA Building	500,000	2,150,000
87		Spruce Kitchen Restaurant	27,503	44,800
88		Alaska Net Supply	21,752	42,600
16	Industrial	Harbor Land	150,000	100,000
17		Harbor Building	177,158	118,105
31		Port of DLG office	128,979	85,986
38		Small Boat Harbor	Unknown	Unknown
41		T dock	5,579,510	3,719,673
42		All Tide dock	8,925,000	5,950,000
48		Wood River Boat Launch	229,896	153,264
54		Kanakanak Beach	Unknown	Unknown
		Snag Point Bulk Head	Unknown	Unknown
67		Landfill	10,212,450	6,808,300
85		PAF Boatyard	75,429	643,000
4	Utilities	Bristol Alliance Fuels	2,951,179	2,799,300
7		Delta Western Tank Farm	1,106,027	1,268,100
15		Harbor Bath House	Unknown	500,000
19		KDLG Studio	Unknown	400,000
20		KDLG Tower and Transmitter	Unknown	600,000
29		Nushagak Electric Plant	7,609,452	Unknown

Facility ID	Occupancy Class	Facility Name	Contents Value ($)	Structure Value ($)
29		Nushagak Cooperatives Buildings	Unknown	4,879,262
29		Nushagak Telephone Infrastructure	4,623,050	Unknown
35		Sewer Building	Unknown	562,483
		City Sewer Lagoon	Unknown	565,093 6
45		Water Tank	Unknown	440,199
46		Water Tank	Unknown	565,093
47		Water Treatment Facility	Unknown	26,000
55		Sewage Lift Station - 1 Airport	Unknown	26,000
56		Sewage Lift Station - 2 Tubbs apts	Unknown	26,000
57		Sewage Lift Station - 3 Tennysons	Unknown	26,000
58		Sewage Lift Station - 4 Smalls	Unknown	
59		Sewage Lift Station - 5 harbor	Unknown	
60		Sewage Lift Station - 6 dock	Unknown	
62		Sewage Lift Station - 7 HUD	Unknown	

Table 13 provides Dillingham's total building stock values summarized by occupancy class.

Table 13. Dillingham Building Stock by Occupancy Class

Structure Type	Number	Structure Estimated Values ($)	HAZUS ContentsValue (%)	HAZUS Contents Value($)
Residential	1,047	391,839,750	50%	195,919,875
Government	31	36,412,077	150%	54,618,116
Commercial	14	83,177,859	150%	124,766,789
Industrial	10	17,778,328	150%	26,667,492
Religious/Non-Profit	14	558,200	100%	558,200
Education	6	24,200,203	150%	36,300,305
Utilities	19	12,777,530	**	16,289,708
Total	**194**	**$566,743,947**		**$455,120,485**

*** HAZUS-MH does not provide estimates for utility contents - actual data was used where available Native allotments and associated values for structures are not recorded by the City of Dillingham. Estimates forthose structures and contents will be identified in future plan updates as data becomes available.*

Table 14 identifies Dillingham's critical facilities.

Table 14. Dillingham Critical Facilities

Facility Type	Estimated No. ofOccupants	Facilities	Latitude	Longitude	Estimated Value	Earthquake	Flood/Erosion	Ground Failure	Cryosphere	Severe Weather	Volcanic Ash	Wildland Fire
Government	25	Dillingham City Hall	59.03948	-158.46292	$4,322,450	X		X	X	X	X	X
	25	Curyung Tribal Offices	59.04048	-158.46385	$1,575,000	X		X	X	X	X	X
	10	Ekluk Tribal Council Office	Undefined	Undefined	Undefined	X			X	X	X	X
	15	Bristol Bay HousingAuthority (HUD)	59.04826	-158.45656	$5,000,000	X		X	X	X	X	X
	25	Kongigatuk Building (FWS& Legislative Info Office)	59.04027	-158.45766	$1,555,000	X		X	X	X	X	X
	15	Alaska Dept of Fish &Game (ADF&G) Office	59.04263	-158.46852	$2,375,000	X		X	X	X	X	X
	25	Post Office	59.04098	-158.46215	$2,712,500	X		X	X	X	X	X
Emergency Response	2	Airport Firehouse	59.0447	-158.51282	$4,500,000	X		X	X	X	X	X
	20	DLG Dept. of Public Safety	59.04056	-158.46803	$4,696,285	X		X	X	X	X	X
	7	Downtown Fire Station	59.03967	-158.46753	$4,621,960	X		X	X	X	X	X
	7	Lake Road Fire Station	59.04469	-158.55812	$5,000,000	X		X	X	X	X	X
	20	Alaska State TrooperBuilding	59.04263	-158.46853	$300,000	X		X	X	X	X	X
	0	Dillingham Harbor Office Building	Undefined	Undefined	$308,275	X			X	X	X	X
Education	30	Southwestern Regional Schools (SWRS) Offices	59.04263	-158.46854	$200,000	X		X	X	X	X	X
	294	Dillingham Middle/High School (6 to 12)	59.04349	-158.46462	$18,750,000	X		X	X	X	X	X
	279	Dillingham Elementary School (K thru 5)	59.04355	-158.46633	$18,750,000	X		X	X	X	X	X
	5	Territorial School Bldg.	Undefined	Undefined	$143,228	X			X	X	X	X
	20	Library	59.04079	-158.46403	$2,732,280	X		X	X	X	X	X
	40	University of Alaska Fairbanks (UAF)	59.04315	-158.46389	$9,375,000	X		X	X	X	X	X
	50	Valerie Larson Family Resource Center	59.04423	-158.49271	$4,330,000	X		X	X	X	X	X
Medical Care	100	Kanakanak Hospital and Primary Care Clinic	59.00007	-158.53532	$183,000,000	X		X	X	X	X	X
	20	AMHTA Behavioral health Facility	58.9994	-158.54319	$9,282,103	X		X	X	X	X	X
	10	Marrulut Eniit Assisted Living Facility	59.04069	-158.45621	$3,314,675	X		X	X	X	X	X
	5	Dillingham Health Clinic	59.03917	-158.46228	$600,000	X		X	X	X	X	X
	15	Nitaput Child Advocacy Center	Undefined	Undefined	Undefined	X			X	X	X	X
	10	Dental Clinic	Undefined	Undefined	Undefined	X			X	X	X	X
	20	Community Health Center	Undefined	Undefined	Undefined	X			X	X	X	X
	20	Safe & Fear Free Shelter (SAFE)	59.04457	-158.46213	$1,875,000	X		X	X	X	X	X
Community	2	Church Russian Orthodox	59.04916	-158.49686	Undefined	X		X	X	X	X	X
	2	Church Catholic	59.0496	-158.50746	Undefined	X		X	X	X	X	X
	30	Church Seventh Day Adventist Buildings	59.04283	-158.49288	$620,400	X		X	X	X	X	X
	2	Church Moravian	59.04001	-158.458	$0	X		X	X	X	X	X
	5	Church Assembly of God	59.02122	-158.53926	Undefined	X		X	X	X	X	X
	4	Church Baptist	59.04282	-158.4929	$256,000	X		X	X	X	X	X
	5	Church Trinity Lutheran	59.03973	-158.45752	Undefined	X		X	X	X	X	X
	4	Church Dillingham Bible Fellowship	59.0395	-158.464	Undefined	X		X	X	X	X	X
	2	Church Latter Day Saints	59.039424	158.526401	Undefined	X		X	X	X	X	X
	20	Alaska Commercial Store (A.C.)	59.03946	-158.46629	$819,100	X		X	X	X	X	X
	60	Peter Pan Seafoods	59.03969	-158.46922	$5,468,268	X	X	X	X	X	X	X
	20	Senior Center	59.04378	-158.463	$3,971,833	X		X	X	X	X	X
	0	Youth Center	59.04071	-158.45974	$172,080	X		X	X	X	X	X
	5	Harbor Bath House	Undefined	Undefined	$500,000	X			X	X	X	X
	2	Animal Shelter	59.0407	-158.47589	$300,000	X	X	X	X	X	X	X
	0	Cemetery, Evergreen Memorial	Undefined	Undefined	$40,000	X			X	X	X	X
	0	Cemetery, First Avenue	59.03895	-158.461	$40,000	X		X	X	X	X	X
	0	Cemetery, Kanakanak	Undefined	Undefined	$40,000	X			X	X	X	X
	0	Cemetery Olsonville	Undefined	Undefined	$40,000	X			X	X	X	X

Facility Type	Estimated No. ofOccupants	Facilities	Latitude	Longitude	Estimated Value	Earthquake	Flood/Erosion	Ground Failure	Cryosphere	Severe Weather	Volcanic Ash	Wildland Fire
	0	Cemetery, Russian Orthodox Church	Undefined	Undefined	$40,000	X			X	X	X	X
	0	Cemetery, Second Avenue West	Undefined	Undefined	$40,000	X			X	X	X	X
	0	Cemetery, Wood River	Undefined	Undefined	$40,000	X			X	X	X	X
	0	Roads	N/A	N/A	Cost of $5,854,800 per mile: $250,000,000				X			
	0	Scandinavian Creek Bridge	Undefined	Undefined	Undefined			X	X	X	X	X
Bridge	0	Squaw Creek Bridge	Undefined	Undefined	Undefined			X	X	X	X	X
	0	Dock Office	59.03829	-158.46347	$75,398	X	X	X	X	X	X	X
	0	DLG Airport	59.04544	-158.50394	$21,848,868		X	X	X	X	X	X
	7	DOT Maintenance Shop	59.04345	-158.51338	$3,184,165		X	X	X	X	X	X
	12	DLG Public Works Shop	59.03973	-158.46306	$912,500		X	X	X	X	X	X
	3	Flight Service Station	Undefined	Undefined	Undefined			X	X	X	X	X
	2	Harbor Master's Office	59.03944	-158.46298	$295,263		X	X	X	X	X	X
	3	Port of DLG office (PollockWarehouse)	Undefined	Undefined	$214,965			X	X	X	X	X
	0	Small Boat Harbor	59.04036	-158.47816	Undefined	X	X	X	X	X	X	X
	0	T dock	Undefined	Undefined	$9,299,183			X	X	X	X	X
Transportation	0	All Tide dock	Undefined	Undefined	$14,875,000			X	X	X	X	X
	0	Wood River Boat Launch	59.06946	-158.43992	$383,160	X	X	X	X	X	X	X
	0	PAF Boatyard	59.04439	-158.49543	$718,429		X	X	X	X	X	X
	2	Nushagak Electric Plant	59.04303	-158.46865	$7,609,452		X	X	X	X	X	X
	2	Water Treatment Facility	59.04171	-158.45971	$565,093		X	X	X	X	X	X
	0	Water Tank	59.04161	-158.45975	$565,093		X	X	X	X	X	X
	0	Water Tank	59.04208	-158.46008	$440,199		X	X	X	X	X	X
	4	Bristol Alliance Fuels	59.03901	-158.4809	$5,750,479	X	X	X	X	X	X	X
	4	Delta Western Tank Farm	59.03893	-158.46586	$2,374,127		X	X	X	X	X	X
	2	Wastewater Treatment Plant	Undefined	Undefined	$2,000,000			X	X	X	X	X
	0	Snag Point Bulk Head	Undefined	Undefined	Undefined		X	X	X	X	X	X
	0	Sewer Building & adjacent Sewer Lagoon	59.04419	-158.45279	Undefined		X	X	X	X	X	X
	0	Sewage Lift Station - 1 Airport	59.04508	-158.51181	$85,000		X	X	X	X	X	X
	0	Sewage Lift Station - 2 Tubbs Apartments	59.0422	-158.49794	$85,000		X	X	X	X	X	X
Utilities	0	Sewage Lift Station - 3 Tennysons	59.04219	-158.49288	$85,000		X	X	X	X	X	X
	0	Sewage Lift Station - 4 Smalls	59.04372	-158.48841	$85,000		X	X	X	X	X	X
	0	Sewage Lift Station - 5 Harbor	59.04067	-158.47677	$85,000	X	X	X	X	X	X	X
	0	Sewage Lift Station - 6 Dock	59.03786	-158.46511	$85,000	X	X	X	X	X	X	X
	0	Sewage Lift Station - 7 HUD	59.04859	-158.45851	$85,000		X	X	X	X	X	X
	5	Landfill	59.09821	-158.54638	$17,020,750		X	X	X	X	X	X
	30	Nushagak Telephone & Electric Buildings	59.0424	-158.46875	$4,879,262		X	X	X	X	X	X
	0	Nushagak Telephone Infrastructure	Undefined	Undefined	$4,623,050			X	X	X	X	X
	0	VORDME	58.99419	-158.55202	$1,250,000		X	X	X	X	X	X
	0	SACOM	Undefined	Undefined	$2,500,000			X	X	X	X	X
	7	KDLG Studio	59.04312	-158.46387	$400,000		X	X	X	X	X	X
	0	KDLG Tower and Transmitter	Undefined	Undefined	$600,000			X	X	X	X	X
				$667,177,914								

6.4 REPTETITIVE LOSS PROPERTIES

DMA 2000 Requirements
Addressing Risk and Vulnerability to NFIP-Insured Structures **§201.6(c)(2)(ii):** The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008 must also address NFIP insured structures that have been repetitively damaged by floods. The plan should describe vulnerability in terms of: **§201.6(c)(2)(ii)(A):** The plan should describe vulnerability in terms of] the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; **§201.6(c)(2)(ii)(B):** The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate; **§201.6(c)(2)(ii)(C):** The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions. **§201.6(c)(3)(ii):** The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.
1. REGULATION CHECKLIST
ELEMENT B. NFIP Insured Structures
B4. Does the Plan address NFIP-insured structures within the jurisdiction that have been repetitively damaged by floods? C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate?
Source: FEMA, 2015.

The City of Dillingham has been an active NFIP participant since August 7, 1975 and has not experienced any repetitive flood claims since NFIP program inception. The City will continue to track comprehensive property loss information as it occurs to fulfill NFIP requirements.

6.5 VULNERABILITY ANALYSIS METHODOLOGY

A conservative exposure-level analysis was conducted to assess the risks of the identified hazards. This analysis is a simplified assessment of the potential effects of the hazards on values at risk without consideration of probability or level of damage.

The legacy 2008 HMP's vulnerability assessment methodology used a two-pronged effort. First, the Project Team used the State's Critical Facility Inventory and locally-obtained GPS coordinate data to identify critical facility locations in relation to potential hazard's threat exposure and vulnerability. Second, this data was used to develop a vulnerability assessment for those hazards where GIS-based hazard mapping information was available.

Replacement structure and contents values were developed for physical assets. These value estimates were provided by the Planning Team. For each physical asset located within a hazard area, exposure was calculated by assuming the worst-case scenario (that is, the asset would be completely destroyed and would have to be replaced). Finally, the aggregate exposure, in terms of replacement value or insurance coverage, for each category of structure or facility was estimated. A similar analysis was used to evaluate the proportion of the population at risk. However, the analysis simply represents the number of people at risk; no estimate of the number of potential injuries or deaths was prepared.

6.6 DATA LIMITATIONS

The vulnerability estimates provided herein use the best data currently available, and the methodologies applied result in a risk approximation. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their effects on the built environment as well as the use of approximations and simplifications that are necessary for a comprehensive analysis.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings, and critical facilities and infrastructure to the identified hazards. It was beyond the scope of this MJHMP Update to develop a more detailed or comprehensive assessment of risk (including annualized losses, people injured or killed, shelter requirements, loss of facility/system function, and economic losses).

6.7 VULNERABILITY EXPOSURE ANALYSIS

The City of Dillingham has a stand-alone GIS database. The results of this MJHMP's GIS based exposure analysis/loss estimations for Dillingham are summarized in Tables 15 and 16, and Section 6.7 provides an exposure analysis narrative summary for each identified hazard obtain from a combination of GIS analysis and from Planning Team subject-matter-experts.

Table 15. Potential Hazard Exposure Analysis – Critical Facilities

Hazard Type	Hazard Classification	Assessment Methodology	Government		EmergencyResponse		Educational		Medical		Community	
			# Bldgs/ # Occ	Value($)	# Bldgs/ # Occ	Value($)	# Bldgs/ # Occ	Value($)	# Bldgs/ # Occ	Value($)	Bldgs/ # Occ	Value($)
Changes in the Cryosphere	Low	* Descriptive	--	--	--	--	--	--	--	--	--	--
Earthquake	Low	0-8% (g)	7/140	17,539,950	6/56	19,426,520	7/718	54,280,508	10/233	198,071,778	32/286	19,464,739
Flood/Erosion	Moderate	500-year floodzone	--	--	--	--	--	--	--	--		
	High	100-year floodzone	--	--	--	--	--	--	--	--	4/77	6,354,315
GroundFailure	Low	0-14 degrees (°)	6/130	17,539,950	5/56	19,118,245	6/713	54,137,280	5/155	198,071,778	24/271	18,652,436
Severe Weather	* Descriptive	* Descriptive	7/140	17,539,950	6/56	19,426,520	6/56	19,426,520	7/718	198,071,778	32/286	19,464,739
Volcanoes	Low	* Descriptive	--	--	--	--	--	--	--	--	--	--
Fire	Low	Low fuel rank	2/50	4,287,500	5/56	9,121,960	2/319	28,125,000	2/25	2,475,000	9/87	4,818,241
	Moderate	Moderate fuelrank	4/80	13,252,450	3/47	9,996,285	4/394	26,012,280	3/130	195,596,778	15/82	13,834,195
	High	High fuel rank	--	--	--	--	--	--	--	--	--	--

Table 16. Potential Hazard Exposure Analysis – Critical Infrastructure

Hazard Type	Hazard Area	Methodology	Highway		Bridges		Transportation Facilities		Utilities	
			Miles	Value($)	No.	Value ($)	# Bldgs/ #Occ	Value($)	# Bldgs/ #Occ	Value ($)
Changes in the Cryosphere	Low	* Descriptive	--	--	--	--	--	--	--	--
Earthquake	Low	0-8% (g)	42.7	250,500,000	2	Undefined	12/28	52,006,931	22/54	51,734,988
Flood/Erosion	Moderate	)0-year floodzone	Undefined(3 roads)	Undefined	--	--	--	--	--	--
	High	)0-year floodzone	Undefined (12 roads)	Undefined	--	--	3/1	658,558	3/4	5,920,479
Ground Failure	Low	0-14 degrees	1 road	Undefined	--	--	8/21	27,617,783	18/49	42,011,938
Severe Weather	* Descriptive	* Descriptive	42.7	250,000,000	2	Undefined	12/28	52,006,931	22/54	51,734,988
Volcanoes	Low	* Descriptive	--	--	--	--	--	--	--	--
Fire	Low	Low fuel rank	--	--	--	--	6/19	26,604,091	6/45	13,573,868
	Moderate	Moderate fuelrank	42.7	250,000,000	--	--	2/2	1,013,692	12/9	28,438,070
	High	High fuel rank	--	--	--	--	--	--	--	--

6.8 EXPOSURE ANALYSIS – HAZARD NARRATIVE SUMMARIES

Earthquake

Dillingham and surrounding area can expect to experience "Negligible" earthquake ground movement that may result in infrastructure damage. Intense shaking may be seen or felt based on past events. Although all structures are exposed to earthquakes, buildings within Dilingham constructed with wood have slightly less vulnerability to the effects of earthquakes than those with masonry.

Based on earthquake probability (PGA) maps produced by the USGS, it is "Unlikely" the Dillingham area would experience significant earthquake impacts as a result of its distant proximity to known earthquake faults.

The recurrence probability is categorized as "Unlikely" because the Community is located within a low probability earthquake hazard zone. Impacts to the community such as "significant" ground movement may result in infrastructure damage and personal injury.

Impacts to future populations, residential structures, critical facilities, and infrastructure are anticipated at the same historical impact level.

Flood/Erosion

Typical flood impacts associated include structures and contents water damage, roadbed, embankment, and coastal erosion, boat strandings, areas of standing water in roadways. Flood events may also damage or displace fuel tanks, power lines, or other infrastructure. Buildings on slab foundations, not located on raised foundations, and/or not constructed with materials designed to withstand flooding events (e.g., cross vents to allow water pass-through an open area under the main floor of a building) are more vulnerable to flood impacts.

Several Dillingham residential parcels and critical facilities are exposed to flood impacts. The following are located within the 1 percent chance of occurrence (100-year) floodplain:

- Approximately six people on two residential parcels (approximate value $600,000)
- 77 people in four community facilities (approximate value $6,354,315)
- Undefined road system miles for 2nd Avenue East, D Street West, Airport Road, Birch Lane, Denny Way, Dimond Willow Drive, Ekuk Circle, Harbor Road, Kleepuk Hill Road, Lupine Drive, Main Street West, North Pacific Court, and Wood River Road (approximate value undefined)
- One person in three transportation facilities (approximate value $658,558)
- Four people in three utility facilities (approximate value $5,920,479)

The following are located within the 0.02 percent chance of occurrence (500-year) floodplain:

- 123 people on 41 residential parcels (approximate value $12,300,000)
- Undefined road system miles for 1st Avenue West, Kanakanak House Road, and Kenny Wren Road (approximate value undefined)

Impacts to future populations, residential structures, critical facilities, and infrastructure may increase due to the effects of changes in the cryosphere.

Ground Failure

Impacts associated with ground failure include surface subsidence, infrastructure, structure, and/or road damage. Buildings that are built on slab foundations and/or not constructed with materials designed to accommodate the ground movement associated with building on permafrost and other land subsidence and impacts are more vulnerable damage.

The potential ground failure impacts from landslides and subsidence can be widespread. Potential debris flows and landslides can impact transportation, utility systems, and water and waste treatment infrastructure along with public, private, and business structures located adjacent to steep slopes, along riverine embankments, or within alluvial fans or natural drainages. Response and recovery efforts will likely vary from minor cleanup to more extensive utility system rebuilding. Utility disruptions are usually local and terrain dependent. Damages may require reestablishing electrical, communication, and gas pipeline connections occurring from specific breakage points. Initial debris clearing from emergency routes and high traffic areas may be required. Water and wastewater utilities may need treatment to quickly improve water quality by reducing excessive water turbidity and reestablishing waste disposal capability.

USGS elevation datasets were used to determine the ground failure hazard areas within Dillingham. Risk was assigned based on slope angle. A slope angle less than 14 degrees was assigned a low risk, a slope angle between 14 and 32 degrees was assigned a medium risk, and a slope angle greater than 32 degrees was assigned a high risk.

Ground failure hazards periodically cause structure and infrastructure displacement due to ground shifting, sinking, and upheaval.

There have been periodic landslides and other ground failure incidents in Dillingham.

Impacts to future populations, residential structures, critical facilities, and infrastructure are anticipated at the same impact level.

Severe Weather

Impacts associated with severe weather events includes roof collapse, trees and power lines falling, damage to light aircraft and sinking small boats, injury and death resulting from snow machine or vehicle accidents, overexertion while shoveling all due to heavy snow. A quick thaw after a heavy snow can also cause substantial flooding. Impacts from extreme cold include hypothermia, halting transportation from fog and ice, congealed fuel, frozen pipes, utility disruptions, frozen pipes, and carbon monoxide poisoning. Additional impacts may occur from secondary weather hazards or complex storms such as extreme high winds combined with freezing rain, high seas, and storm surge. Buildings that are older and/or not constructed with materials designed to withstand heavy snow and wind (e.g., hurricane ties on crossbeams) are more vulnerable to the severe weather damage.

Impacts to future populations, residential structures, critical facilities, and infrastructure are anticipated at an increased rate due to changes in the cryosphere.

Volcanic Ash

Volcanic ash impacts can threaten community member's health and as well as infrastructure such as overloading community roof resulting in collapse. Any air aspirated machinery would need to be shut-down to prevent total destruction from the abrasive nature of volcanic ash.

Volcanic ash can also contaminate water supplies with excessive turbidity and wastewater treatment plants overpowering treatment capabilities.

Impacts to future populations, residential structures, critical facilities, and infrastructure are anticipated at the same impact level.

Wildfire

Impacts associated with a wildland fire event include the potential for loss of life and property. It can also impact livestock and pets and destroy forest resources and contaminate water supplies. Buildings closer to the outer edge of town, those with a lot of vegetation surrounding the structure, and those constructed with wood are some of the buildings that are more vulnerable to the impacts of wildland fire.

According to the 2016 HMP and the Planning Team's subject-matter-experts, there are wildland fire areas within Dillingham's boundaries. However very few fires have occurred within or interfaced with the City area during the legacy HMP's implementation. There is a potential for wildland fire to interface with the population center of the City if the summer is unseasonably dry.

Impacts to future populations, residential structures, critical facilities, and infrastructure are anticipated at an increased rate due to changes in the cryosphere.

6.9 LAND USE AND DEVELOPMENT TRENDS

6.9.1 Dillingham Land Use

The requirements for land use and development trends, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements
Plan Review and Updates **§201.6(d)(3)** and **§201.7(d)(3)]:** Local and Tribal governments must review and revise their plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities.
1. REGULATION CHECKLIST
ELEMENT D. HMP Updates
D1. Was the plan revised to reflect changes in development? D2. Was the plan revised to reflect progress in tribal mitigation efforts? (Plan Update for Tribe) D3. Was the plan revised to reflect changes in priorities?
Source: FEMA, 2015.

Land use in Dillingham is predominantly residential with some areas of commercial services, light industrial, and institutional. Suitable developable vacant land is in short supply within the boundaries of Dillingham, and open space and various hydrological bodies surround the community.

Light industrial land in Dillingham is grouped into occupancy classes such as government, utilities, and educational facilities. Industrial land uses are generally kept a safe distance from residential development due to pollution or other potentially hazardous or dangerous byproducts that can develop and occur with industrial activity.

6.9.2 Land Development Trends

The Planning Team stated that there have been no significant changes in development since 2016.

7.0 Mitigation Strategy

This section outlines the six-step process for preparing a mitigation strategy including:

1. Identifying each jurisdiction's existing authorities for implementing mitigation action initiatives;
2. NFIP Participation;
3. Developing Mitigation Goals;
4. Identifying Mitigation Actions;
5. Evaluating Mitigation Actions; and
6. Implementing MAP Strategies.

DMA 2000 Requirements
Identification and Analysis of Mitigation Actions **§201.6(c)(3):** Does the plan document each jurisdiction's existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing policies and programs? **§201.6(c)(3)(ii):** Does the plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? **§201.7(c)(3)** and **§201.7(c)(3)(iv):** Does the plan include a discussion of the Tribal government's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of tribal laws and regulations related to hazard mitigation as well as to development in hazard-prone areas? **§201.7(c)(3)(iv)** and **§201.7(c)(3)(v):** Does the plan include a discussion of Tribal funding sources for hazard mitigation projects and current and potential sources of Federal, tribal, or private funding to implement mitigation actions? **§201.6(c)(3)(ii)** and **§201.7(c)(3)(i):** Does the Mitigation Strategy include goals to reduce or avoid long-term vulnerabilities to the identified hazards? **§201.6(c)(3):** [The plan shall include the following:] A mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs, and resources, and its ability to expand on and improve these existing tools. **§201.6(c)(3)(ii)** and **§201.7(c)(3)(iv):** [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. **§201.6(c)(3)(iii** and **iv)** and **§201.7(c)(3)(iii):** [The hazard mitigation strategy shall include an] action plan, describing how the action identified will be prioritized, implemented, and administered by the local and tribal jurisdictions. **§201.6(c)(4)(ii)** and **§201.7(c)(4)(iii):** [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvements, when appropriate. **§201.6(c)(4)(ii)** and **§201.7(c)(4)(ii** and **v):** [The plan shall include a] process by which local governments will incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvements, when appropriate.
ELEMENT C. Mitigation Strategy
C1 City. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs?

C1 Tribe. Does the plan include a discussion of the Tribal government's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of tribal laws and regulations related to hazard mitigation as well as to development in hazard-prone areas?
C2 City. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? *(Addressed in Section 6.4)*
C2 Tribe. Does the plan include a discussion of Tribal funding sources for hazard mitigation projects and identify current and potential sources of Federal, Tribal, or private funding to implement mitigation activities?
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards?
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure?
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction?
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate?
C7 Tribe. Does the plan describe a system for reviewing progress on achieving goals as well as activities and projects identified in the mitigation strategy, including monitoring implementation of mitigation measures and project closeouts?
Source: FEMA, 2015

7.1 CITY of DILLINGHAM CAPABILITY ASSESSMENT

The capability assessment reviews the technical and fiscal resources available to the community.

This subsection outlines the resources available to Dillingham for mitigation, mitigation related funding, and training. Tables 17, 18, and 19 delineate the City's and Tribe's regulatory tools, technical specialists, and financial resources available for project management. Additional funding resources are identified in Appendix G.

Table 17. Regulatory Tools

Regulatory Tools (ordinances, codes, plans)	Existing?	Comments (Year of most recent update; problems administering it, etc.)
Comprehensive Plan, Part 3, 2018	Yes	Explains the City's land use initiatives and natural hazard impacts
Land Use Plan, 2010	Yes	Explains the City's land use goals, regulations, and initiatives
Tribal Land Use Plan	Yes	Describes the Tribe's community development goals and initiatives
Emergency Response Plan	Yes	Provides hazard response activities and priorities; Population education initiatives
Wildland Fire Protection Plan	No	
Building code, 2010	Yes	Delineates public infrastructure initiatives and identifies capital improvement goals
Zoning ordinances, 2018	Yes	Comprehensive Plan
Subdivision ordinances or regulations, 2018	Yes	Comprehensive Plan
Special purpose ordinances,	Yes	Dillingham Municipal Code: Chapter 15.04-Floodplain

2010		Regulations, and other special use area ordinances

Local Resources

The City and Tribe have a number of planning and land management tools that will allow them to implement hazard mitigation activities. The resources available in these areas have been assessed by the Planning Team and are summarized below.

Table 18. Technical Specialists for Hazard Mitigation

Staff/Personnel Resources	Y/N	Department/Agency and Position
Planner or engineer with knowledge of land development and land management practices	Yes	The City has staff with this knowledge.
Engineer or professional trained in construction practices related to buildings and/or infrastructure	Yes	The City has staff with this knowledge.
Planner or engineer with an understanding of natural and/or human-caused hazards	Yes	The City has staff with this knowledge.
Floodplain Manager	Yes	City Planner and Floodplain Manager
Surveyors	No	The City can contract for the capability.
Staff with education or expertise to assess the jurisdiction's vulnerability to hazards	Yes	The City has staff with this knowledge.
Personnel skilled in Geospatial Information System (GIS) and/or Hazards Us-Multi Hazard (Hazus-MH) software	Yes	The City has staff with this knowledge.
Scientists familiar with the hazards of the jurisdiction	Yes	City and Tribe can work with U.S. Fish & Wildlife Service (USFWS) and Fish & Game (ADF&G), and the Alaska Department of Transportation and Public Facilities and other agency specialists as needed.
Emergency Manager	Yes	The City Mayor or Fire Chief as applicable
Finance (Grant writers)	Yes	City Accountants & Planner as applicable; Tribal Administrator

Table 19. Financial Resources Available for Hazard Mitigation

Financial Resource	Accessible or Eligible to Use for Mitigation Activities
General funds	City can exercise this authority with voter approval
Payment in Lieu of Taxes (PILT)	Provides City operating support funding
Municipal Energy Assistance Program (MEAP)	Provides City operating support funding
Community Development Block Grants (CDBG)	
Indian Community Development Block Grants (ICDBG)	
City can exercise this authority with voter approval	
Capital Improvement Project Funding	City can exercise this authority with voter approval
Authority to levy taxes for specific purposes	Can exercise this authority with voter approval
Incur debt through general obligation bonds	Can exercise this authority with voter approval

Incur debt through special tax and revenue bonds	Can exercise this authority with voter approval
Incur debt through private activity bonds	Can exercise this authority with voter approval
Hazard Mitigation Grant Program (HMGP)	FEMA funding which is available to local communities after a Presidentially-declared disaster. It can be used to fund both pre- and post-disaster mitigation plans and projects.
BRIC grant program	FEMA funding which available on an annual basis. This grant can only be used to fund pre-disaster mitigation plans and projects only
Flood Mitigation Assistance (FMA) grant program	FEMA funding which is available on an annual basis. This grant can be used to mitigate repetitively flooded structures and infrastructure to protect repetitive flood structures. Dillingham qualifies for this funding source because they are active NFIP participants.
United State Fire Administration (USFA) Grants	The purpose of these grants is to assist state, regional, national, or local organizations to address fire prevention and safety. The primary goal is to reach high-risk target groups including children, seniors and firefighters.
Fire Mitigation Fees	Finance future fire protection facilities and fire capital expenditures required because of new development within Special Districts.

7.2 DEVELOPING MITIGATION GOALS

The exposure analysis results were used as a basis for developing the mitigation goals and actions. Mitigation goals are defined as general guidelines that describe what a community wants to achieve in terms of hazard and loss prevention.

After reviewing the City's 2016 HMP, the Planning Team redefined by combining or rewriting their goal statements to better represent their multi-hazard (MH), community-wide vision. They are contained within Table 20 to reduce or avoid long-term vulnerabilities to their identified hazards. Among the changes are three categories:

- MH 1: Provide outreach activities to educate and promote recognizing and mitigating natural and manmade hazards that affect Dillingham.
- MH 2: Cross-reference mitigation goals and actions with other City and Tribal planning mechanisms and projects.
- MH 3: Develop construction activities that reduce possibility of losses from natural hazards that affect Dillingham.

Table 20. Mitigation Goals

No.	Goal Description
MH 1	Provide **outreach** activities to educate and promote recognizing and mitigating natural and manmade hazards that affect the City of Dillingham (City) and the Curyung Tribe (Tribe).
MH 2	**Cross-reference** mitigation goals and actions with other City/Tribal planning mechanisms and projects.
MH 3	Develop **construction activities** that reduce possibility of losses from all natural and manmade hazards that affect the City/Tribe.
EQ 4	Reduce structural vulnerability to earthquake (EQ) damage.

FL 5	Reduce flood and erosion (FL) damage and loss possibility.
GF 6	Reduce ground failure (GF) damage and loss possibility.
SW 7	Reduce structural vulnerability to severe weather (SW) damage.
VO 8	Reduce vulnerability, damage, or loss of structures from volcanic (VO) debris impacts
WF 9	Reduce structural vulnerability to tundra/wildland fire (WF) damage.

7.3 IDENTIFYING MITIGATION ACTIONS

Mitigation actions are activities, measures, or projects implemented to achieve the goals of a mitigation plan. Mitigation actions are grouped into three broad categories: property protection, public education and awareness, and structural projects. The Planning Team reviewed their mitigation actions for this MJHMP Update (Table 21). The Planning Team placed particular emphasis on projects and programs that reduce the effects of hazards on both new and existing buildings and infrastructure as well as facilities located in potential flood zones in compliance with NFIP requirements.

Table 21. Mitigation Goals and Related Actions

Goals		Status		Actions
No.	Description	Completed, Deferred, or Ongoing	Explain Project Status	Description
MH 1	*Promote recognition and mitigation of allnatural hazardsthat affect Dillingham.*	Ongoing	No available funding – seeking funding	Update public emergency notification procedures and develop an outreach program for potential hazard impactsto identified events
MH 2	*Promote cross-referencing mitigation goals and actions with other Dillingham planning mechanisms andprojects.*	Ongoing		
MH 3	*Reduce possibilityof losses from all natural hazards that affect the City and Tribe.*	Ongoing		
EQ4	*Reduce vulnerability, damage, or lossof structures from earthquakedamage*	Deferred	Lack time, staff, and funding resources	5B: Implement Uniform International and State Building Codes to ensure that all future development meets all requirements for seismic protection and fire protection
FL 5	*Reduce vulnerability, damage, or lossof structures from erosion.*	*Ongoing*	*Seeking funding*	***CP-Obj. 1A, 1.:*** *Continue to work with the US Army Corps of Engineers, to map and evaluate the location and degreeof erosion issues along the Dillingham waterfront.*
		Ongoing	*Seeking funding*	***CP-Obj. 1A, 1.:*** *Sedimentation: remove sedimentation fromthe small boat harbor, with a renewed contract every five years.*
		Ongoing	*Undefined*	***CP-Obj. 1A, 3.:*** *City should request that USACE go back toon-land dredge spoils disposal versus pumping the sedimentback into the bay.*
		Ongoing	*Seeking funding*	***CP-Obj. 3A, 5.:*** *Stabilize the eroding bank in the vicinity ofthe recreation area.*
		Deferred	*Seeking funding*	***CP-Obj. 3A, 1.:*** *Map and evaluate the location and degreeof erosion issues along the Dillingham waterfront, with specific emphasis on the Sewer Lagoon, Small Boat Harbor,Snag Point Bulkhead, and Kanakanak Beach.*
		Deferred	*Seeking*	***CP-Obj. 3A, 3.:*** *Develop and implement practical erosion*

Goals		Status		Actions
No.	Description	Completed, Deferred, or Ongoing	Explain Project Status	Description
			funding	*mitigation plans.*
		Ongoing	*Seeking funding*	*1A: Construct breakwater and seawalls in Dillingham harbor* **CP-Obj. 1A, 1.:** Construct West side revetment andbreakwater, proposed by USACE
		Deferred	*Seeking funding*	*1C: Construction the extension of the North Shore Bulkhead (construct west and east seawalls)*
		Ongoing	*Seeking funding*	*1D: Replace riprap removed by storms at the north end ofthe Snag Point sheet-pile bulkhead*
		Ongoing	*Seeking funding*	*2A: Public education regarding City of Dillingham participation in NFIP and use and availability of floodinsurance*
		Ongoing	*Seeking funding*	*2C: Support updates to the FEMA Flood Insurance RateMaps*
		Ongoing	*Seeking funding*	*2D: Update and enforce floodplain management ordinances*
		Ongoing	*Seeking funding*	*2F: Educate residents about safe well and sewer/septic installation*
GF 6	*Reduce vulnerability, damage, or lossof structures from flooding.*	None selected as this is a minor threat to the community		
SW 7	*Reduce vulnerability,damage, or loss of structuresfrom groundfailure.*	*Ongoing*	*Seeking funding*	*7B: Conduct community alert tests for NOAA warning tones (contact NOAA, City Police and Fire Departments, and Volunteer Fire Departments to coordinate test)*
		Ongoing	*Seeking funding*	*7C: Provide two annual weather safety talks*
		Ongoing	*Seeking funding*	*8B: Complete MOU with KDLG regarding communication inthe event of an emergency*
VO 8	*Reduce vulnerability, damage, or loss of structures from volcanic ashor debris impacts*	None selected as this is deemed a minor threat to the community		
WF 9	*Reduce vulnerability, damage, or lossof structures from wildland ortundra fires.*	*Deferred*	*Combined projects Seeking funding*	*2G: Develop new water source in Neqleq Subdivision* *4B: Tie new water source in Neqleq Subdivision to the restof the city water system*
		Deferred	*Combined projects Seeking funding*	*4E: Purchase underground water supply tanks in specified locations* *4F: Install underground water supply tanks*
		Ongoing	*Seeking funding*	*4I: Public Education “info-mercials” on local radio*

7.4 EVALUATING AND PRIORITIZING MITIGATION ACTIONS

The Planning Team evaluated and prioritized each local hazard and corresponding mitigation action for the 2016 HMP. Priorities remain the same. The selected mitigation actions are included in the Mitigation Action Plan (MAP). The MAP represents mitigation projects and programs to be implemented through the cooperation of the community. The Tribe has no laws, regulations, policies, and programs that pertain to hazard mitigation.

The Planning Team reviewed the simplified social, technical, administrative, political, legal, economic, and environmental (STAPLEE) evaluation criteria (shown in Table 22) and the

Benefit-Cost Analysis Fact Sheet (Appendix E) considering the opportunities and constraints of each mitigation action. Each action considered for implementation is accompanied by a qualitative statement addressing the benefits, costs, and, where available, a technical feasibility study. A detailed cost-benefit analysis is anticipated as part of the project application process.

Table 22. Evaluation Criteria for Mitigation Actions

Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE)

Evaluation Category	Discussion "It is important to consider…"	Considerations
Social	The public support for the overall mitigation strategy and specific mitigation actions.	Community acceptance Adversely affects population
Technical	If the mitigation action is technically feasible and if it is the whole or partial solution.	Technical feasibility Long-term solutions Secondary impacts
Administrative	If the community has the appropriate personnel and administrative capabilities or if outside help is necessary.	Staffing Funding allocation Maintenance/operations
Political	Public perceptions related to the environment, economic development, safety, and emergency management.	Political support Local champion Public support
Legal	Whether the community has the legal authority to implement the action, or whether the community must pass new regulations.	Local, State, and Federal authority Potential legal challenge
Economic	If current or future funding sources may be applied. If the costs seem reasonable for the size of the project. If enough information is available to complete a FEMA Benefit- Cost Analysis.	Benefit/cost of action Contributes to other economic goals Outside funding required FEMA Benefit-Cost Analysis
Environmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community.	Effect on local flora and fauna Consistent with community environmental goals Consistent with Local, State, and Federal laws

Table 23 contains statuses, priorities, responsible agencies, potential funding sources, and timelines for mitigation actions selected to be implemented.

7.5 IMPLEMENTING A MITIGATION ACTION PLAN

Table 23. Mitigation Action Priority Matrix

Goal/ Action ID	Description	Priority (High, Medium, Low)	Responsible Department	Potential Funding Source(s)	Timeframe	**Benefit-Costs** (BC) / **Technical Feasibility** (T/F)
Multi-Hazard (MH) 1.1	Identify and pursue funding opportunities to implement mitigation actions.	High	City Planner, Tribal Administrator	City, Tribe, FEMA, DHS&EM, BRIC, HMGP, USACE	Ongoing	B/C: Rural life requires this as an ongoing activity; it is essential for communities as there are limited fundsavailable to accomplish effective mitigation actions. TF: This activity is ongoing, demonstrating its feasibility.
MH 1.2	Public education regarding City of Dillingham participation in NFIP and use and availability of flood insurance.	High	City Planner	City	Ongoing	B/C: NFIP participation while one of FEMA's highest priorities also enables communities with an effective programfocus on repetitive flood loss propertiesand other priority flood locations and projects. TF: City is currently a member, and residents enjoy lower cost insurance.Continuation is relatively simple.
MH 1.3	Educate residents about safe well, and sewer, and septic installations through the Land Use Permit process.	Medium	City Planner	City	Ongoing	B/C: This low-cost mitigation outreach program will help build and support area-wide capacity to enable the public to prepare for, respond to, and recover from disasters. T/F: Continuation is relatively simple.
MH 1.4	Public Education "info-mercials" on local radio and Facebook.	Medium	City Planner	City, Tribe	Ongoing	B/C: This low-cost mitigation outreach program will help build and support area-wide capacity to enable the public to prepare for, respond to, and recover from disasters. T/F: Continuation is relatively simple.
MH 1.5	Provide two annual weather safety talks.	Low	City Planner, Tribal Administrator	City, Tribe	Ongoing	B/C: A sustained mitigation outreach program has minimal cost and will help build and support area-wide capacity. This type of activity enables the public to prepare for, respond to, and recover from disasters. TF: This low-cost activity can be combined with recurring City and Tribal Council meetings where hazard specific information can be presented in small increments.
MH 1.6	Promote FireWise building design, siting, and materials use for construction	High	Fire Chief	City	Ongoing	B/C: Sustained mitigation outreach programs have minimal cost and will help build and support community capacity enabling the public to appropriately prepare for, respond

						to, and recover from disasters. TF: This project is technically feasible.
MH 2.1	Support updates to the FEMA Flood Insurance Rate Maps.	High	City Planner	FEMA	Ongoing	B/C: Additional floodplain management activities (i.e.: public outreach material, enhanced floodplain mapping, etc.) can be identified and implemented throughout the area, allowing resources to be shared. TF: The City has contacted FEMA to inquire about updating the FIRM.
MH 2.2	Update and enforce floodplain management ordinances.	High	City Planner	City	DMC 15.04, Floodplain Regulations was updated through Ordinance 2021-07. Enforcement is ongoing.	B/C: Additional floodplain management activities (i.e.: public outreach material, enhanced floodplain mapping, etc.) can be identified and implemented throughout the area, allowing resources and specific hazard data to be shared between City departments and local agencies involved in development. TF: This is technically feasible using existing City resources.
MH 2.3	Conduct community alert tests for NOAA warning tones (contact NOAA, City Police and Fire Departments, and Volunteer Fire Departments to coordinate test).	High	Volunteer Fire Chief, Police Chief	City	Ongoing Monthly	B/C: This low-cost mitigation outreach program supports the area-wide capacity to enable the public to prepare for, respond to, and recover from disasters. TF: Low to no cost makes this a very feasible project to successfully educate large populations. Some work needs to be done to make the alerts more audible.
MH 2.4	Complete MOU with KDLG regarding communication in the event of an emergency.	High	Department of Public Safety Chief	City	2026	B/C: As part of the Storm Readiness Program, the MOU with KDLG will facilitate the implementation of this national mitigation program. This is a cost-effective and established way to help build and support local capacity to enable the public to prepare for, respond to, and recover from severe storm events. TF: This is technically feasible using existing City resources.
MH 2.5	Design an evacuation plan for the core town site.	This project was completed as part of the Emergency Operations Plan Update in 2018 and will be deleted in the 2026 Update.				
MH 3.1	Develop new water source in Neqleq Subdivision.	High	City Public Works Director	City, Denali Commission, NRCS, USDA	Ongoing	B/C: This program will help mitigate urban conflagration and wildland fire hazards around vulnerable populations. Protecting vulnerable populations from a disaster is a FEMA goal. TF: This is technically feasible.
MH 3.2	Tie new water source in Neqleq Subdivision to the	High	City Public Works Director	Assistance to Firefighters Grant (AFG)	Ongoing	See MH3.1.

	rest of the City's water system.			Program's Fire Prevention and Safety Grant, BRIC, or HMGP funding		
MH 3.3	Purchase and install underground water supply tanks in specified locations.	Medium	City Public Works Director	AFG Program's Fire Prevention and Safety Grant, BRIC or HMGP funding	3-5 years	See MH3.1. A 5,000-gallon tank has been installed at the Lake Road Fire Station.
Flood (FL) 5.1	Construct breakwater and seawalls in Dillingham harbor. Construct West side revetment and breakwater, proposed by USACE.	High	City Harbormaster	USACE	Ongoing	B/C: This effort will prevent future damage and losses due to severe storm induced erosion loss. T/F: Historical work has proven this project is technically feasible. The community needs the USACE to prioritize and fund the project.
FL 5.2	Extend seawall in front of the harbor east toward the Peter Pan dock. Construct East side ("City dock" side) revetment armoring the outside of the harbor & providing beach access, proposed by USACE.	High	City Harbormaster	USACE	Portions of this have been completed.	B/C: This effort will prevent future damage and losses due to severe storm induced erosive scour loss. T/F: Historical work has proven this project is technically feasible. The community needs the USACE to prioritize and fund the project.
FL 5.3	Renew contract every five years to remove sedimentation from the small boat harbor.	Medium	City Manager	City, ANA, NRCS, Denali Commission, DCRA, USACE	Ongoing	B/C: Sedimentation is a continual threat to community harbor navigation. It is essential to have a recurring sedimentation removal program to prevent excessive build-up. T/F: Historical work has proven this project is technically feasible.
FL 5.4	Request that USACE go back to on-land dredge spoils disposal versus pumping the sediment back into the bay.	Medium	City Manager	City, ANA, NRCS, Denali Commission, DCRA, USACE	Ongoing	B/C: Sedimentation is a continual threat to community harbor navigation. It is essential to have a recurring sedimentation removal program to prevent excessive build-up. T/F: Historical work has proven this project is technically feasible. Removing dredged material from one location and moving to another within the same water body threatens to have adverse impacts at that or other downstream locations. The community needs the USACE to prioritize and fund the project.
FL 5.5	Stabilize the eroding bank in the vicinity of the recreation area.	This project was completed and will be deleted in the 2026 Update.				
FL 5.6	Map and evaluate the location and degree of erosion issues along the	This project was completed by DGGS and will be deleted in the 2026 Update.				

	Dillingham waterfront.					
FL 5.7	Develop and implement practical erosion mitigation plans.	High	City Planner	City, HMA, ANA, NRCS, USACE	Ongoing	B/C: Improving embankment and slope stability will greatly reduce potential infrastructure and residential losses. Project costs would outweigh replacement costs of lost facilities. TF: This is technically feasible. Specialized skills may need to be contracted-out with materials and equipment barged in depending on the method selected.
FL 5.8	Construct the extension of the North Shore Bulkhead (construct west and east seawalls).	High	City Manager and Harbormaster	USACE	2026	B/C: This effort will prevent future damage and losses due to severe storm induced erosion loss. TF: This is technically feasible. Specialized skills may need to be contracted-out by funding agencies with materials and equipment barged in depending on the method selected.
FL 5.9	Replace riprap removed by storms at the north end of the Snag Point sheet-pile bulkhead.	High	City Harbormaster	USACE	Ongoing	B/C: This effort will prevent future damage and losses due to severe storm induced erosion loss. TF: This is technically feasible. Specialized skills may need to be contracted-out by funding agencies with materials and equipment barged in depending on the method selected.

8.0 References

AICC (Alaska Interagency Coordination Center), 2020. Available: http://fire.ak.blm.gov/aicc.php.

City, 2016. *City of Dillingham Hazard Mitigation Plan*.

DCCED, 2021. DCCED, *Community Profile* 2021. Available: www.commerce.alaska.gov/web/dcra/.

Denali Commission, 2019. *Statewide Threat Assessment*. (April 2019).

DHS&EM (Division of Homeland Security and Emergency Management), 2018. Alaska State Hazard Mitigation Plan, 2018.

DHS&EM. 2021. Disaster Cost Index 2021.

FEMA-a, (Federal Emergency Management Agency), "Local Mitigation Plan Review Guide – September 30, 2011."

FEMA-b, "Mitigation Planning How-To Guides, 2013."

FEMA-c, "Local Mitigation Planning Handbook." Updated January 1, 2015.

FEMA-d, "Local Mitigation Assistance Guidance and Addendum, February 27, 2015.

FEMA-e, "Mitigation Planning Fact Sheet, February 27, 2015.

FEMA-f, "Hazard Mitigation Assistance Cost Share Guide, May 2016.

FEMA-g, "Flood Frequently Asked Questions."

FEMA-h, "Flood Facts."

FEMA-i, "Community Status Book Report."

FEMA-j, "Flood Map Service Center Portal."

FEMA-k, "Tribal Plan Review Guide."

MMI. 2012. Modified Mercalli Intensity Scale. Michigan Technical University.

USACE (United States Army Corps of Engineers), 2009. *Alaska Baseline Erosion Assessment: Study Findings and Technical Report*.