INTERIOR ALASKA
Transportation Plan

TRANSPORTATION RESILIENCY TECHNICAL MEMORANDUM 4

Identifying and Prioritizing Risks to Interior Alaska's Transportation Infrastructure

June 2024

TABLE OF CONTENTS

FIGURES

TABLES

ACRONYMS

AAC	Alaska Admin Code
AURA	Arctic Urban Risks and Adaptions
BRIC	Building Resilient Infrastructure and Communities
BRIC DTA	Building Resilient Infrastructure and Communities Direct Technical Assistance
CFR	Code of Federal Regulations
DCRA	Alaska Division of Community and Regional Affairs
DNR, DFFP	Alaska Department of Natural Resources, Division of Forestry and Fire Protection
DOT&PF	Alaska Department of Transportation and Public Facilities
FBX	Fairbanks
FEMA	Federal Emergency Management Agency
FNSB	Fairbanks North Star Borough
GHG	Green House Gases
HMP	Hazard Mitigation Plan
IATP	Interior Alaska Transportation Plan
IARC	International Arctic Research Center
IIJA	Infrastructure Investment and Jobs Act
LRTP	Long Range Transportation Plan
Mat-Su	Matanuska-Susitna
MAGT	Mean and Annual Ground Temp
MP	Mile Point
NFIP	National Flood Insurance Program
NRI	National Risk Index
SE FBX	Southeast Fairbanks
SHMP	State Hazard Mitigation Plan
SNAP	Scenarios Network for Alaska + Arctic Planning
STIP	Statewide Transportation Improvement Plan
THMP	Tribal Hazard Mitigation Plan
TRAAK	Trails and Recreational Access for Alaska Program
UAF	University of Alaska Fairbanks
USDOT	United States Department of Transportation

DEFINITIONS

Aufeis A mass of sheet-like layered ice that forms from successive flows of ground or river water during freezing temperatures.

Climate A combined average of the experienced conditions in a location over an extended period. The American Geosciences Institute has identified the two most important factors in identifying climate of an area as temperature and precipitation[1]. Much like meteorologists, climatologists have been able to use climate models to create forecasts that project climate. Although, unlike weather predictions, these climate models and forecasts look multiple years into the future.

Cryosphere The parts of the Earth's surface and the subsurface where water is still in solid form. These cold areas are a pertinent part in regulating the Earth's climate and are the first places that scientists observe to identify signs of climate change.

Erosion A surface process that removes soil, rock, or dissolved material from one location and transports it to another. Erosion often occurs gradually over time but in times such as flooding, this process may occur rapidly.

Existing Permafrost Related Problems Identification of problems based on existing documents such as community hazard mitigation plans.

Fault The zone where there is a fracture in the rocks of the Earth's crust allowing space for the two pieces to slide past one another.

FEMA Mitigation Grant Funding Competitive grant funding opportunities administered by the Federal Emergency Management Agency (FEMA) providing capital for eligible mitigation measures that reduce disaster losses.

Flash Flooding Rapid flooding in low-laying areas.

Frost Susceptibility The level of permeability in ground material, loose soils such as sand have a high susceptibility and run a greater chance of developing damage to the infrastructure above.

Ground Failure The result of soil, ice, or rock losing stability and resulting in a collapse, typically with a downward movement.

Hazard An environmental phenomenon that has the potential to affect societies and the human environment.

IIJA Often referred to or known as the Bipartisan Infrastructure Law, the Infrastructure Investment and Jobs Act, or IIJA, focuses on funding investments while acknowledging and addressing the climate crisis in the United States.

Manufactured Disaster Disasters that have an element of human intent, negligence, or error involving a failure of a human-made system, as opposed to natural disasters resulting from natural hazards. These disasters are commonly seen as avoidable when the right systems are in place.

Massive Ice Occurrence The occurrence of large ice bodies near the ground's surface, this occurrence can leave infrastructure and communities vulnerable to experiencing thermokarst sinkholes and extreme thaw settlement even in areas that experience very low permafrost temperatures.

Mitigation Strategies Planning, programs, or actions to reduce, limit, or eliminate the risk generated by a hazard.

Permafrost Any ground that remains at 32° Fahrenheit (F) or 0° Celsius (C) or colder for at least two years straight. Permafrost is an integral part of the Interior Alaska region ecosystem that assists in keeping soils damp and cool, which slows decomposition and growth. This slowing of decomposition and growth creates an entrapment of greenhouse gases, preventing them from being released into the atmosphere.

Permafrost Occurrences When used by SNAP to describe the risk to communities, this refers to current permafrost and the type that is occurring. The SNAP Permafrost Risk Assessment is discussed in section 3.3

These permafrost types include:

- Isolated – Areas with mostly unfrozen soils and patches of isolated permafrost.

- Discontinuous – Distribution of permafrost is uneven and intermittent among unfrozen soils. Contains many open and/or closed taliks.
- Continuous – Taliks exist but only under large and deep waterbodies.

Permafrost Temperature Measures and documents the mean and annual ground temperature (MAGT).

- Mean – MAGT Greater Than negative five degrees Celsius (-5°C)
- Cool – MAGT Equal to negative five degrees Celsius to negative two degrees Celsius (-5°C to -2°C)
- Warm – MAGT Equal to negative two degrees Celsius and zero degrees Celsius (-2°C to 0°C)

Resilience Using the context of risk management, resilience is a system's ability to continue functionality at what is deemed an acceptable level of efficiency in the wake of disruptive or unexpected conditions. [1]

For **Transportation Resilience**, this definition varies on the level of scope:

Individual Level: the ability to continue to get around when faced with a broken-down vehicle, injury, disability, or loss of income.

Community Level: accessibility remains for public transit opportunities and traffic is able to continue despite impacts from accidents, emergencies, seasonal construction, or disasters.

Design Level: transportation systems are designed with built in features to withstand extreme levels of demand as well as critical, unexpected problems.

Strategy Level: the transportation system is created to accommodate future growth and changes that may occur to future usage or access.

Resiliency See definition for **Resilience.**

Repeat Historical Occurrences How often the hazard event has occurred and has been documented in the community.

Risk A function of the nature and magnitude of a threat/hazard, the vulnerabilities to that threat/hazard, and the consequences that could result.

Risk Level Identifies the risk level for communities based on permafrost data. Risk level is assigned based on the following values:

- 0: No Permafrost
- 5 – 8: Low Risk Level
- 9 – 11: Medium Risk Level
- 12 – 15: High Risk Level

Riverine Erosion Water flow or movement of ice formations causing the wearing away of rock and soil along a riverbed or embankment.

Seismic Activity Data determining how often, what type, and how large earthquakes being experienced in an area are.

Slope A feature of terrain that describes the gradient.

Scenarios Network for Alaska + Arctic Planning (SNAP) Community Permafrost Data Hub A database that houses data information that serves as a single access point for communities to view permafrost vulnerabilities.

Subduction The sideways and downward movement of the edge of a plate on the earth's crust into the mantle beneath another plate.

Threat A natural, technological, or human-caused occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, and/or property.

Transportation System The facility and elements needed for the movement of passengers and goods.

Weather The status of the atmosphere at any given time at any given location. Weather is a dynamic concept that can change quickly without warning. Meteorologists have been able to use weather models to create forecasts that can predict weather for a few days at a time with varying certainty; these models are just as dynamic.

Wildfire Large fires that spread over woodland or brush.

Wind Erosion Wind picking up and carrying soil and debris, seen in the Tanana River area of the Interior Alaska planning area.

1.0 INTRODUCTION

1.1 Purpose of the Memorandum

This memorandum identifies potential hazards and associated risks to regional infrastructure throughout the Interior Alaska Transportation Plan (IATP) area. To assess the hazards in the IATP area, an overview of the current level of community resilience to risk with focused input from community, government, and business representatives informs how the Alaska Department of Transportation and Public Facilities (DOT&PF)'s planning efforts are used. The regional Long Range Transportation Planning (LRTP) process integrates with hazard mitigation planning at a state and local level to drive infrastructure risk mitigation efforts and contribute to community resiliency throughout the IATP area.

This memorandum also provides potential mitigation strategies that strive to promote resiliency for both communities and infrastructure. These strategies can be implemented on a community, program, or project basis. At any scale, the highest risk hazards should be identified to prioritize projects and programs focused on increasing and promoting resilient transportation within the IATP area.

At the time of writing, a DOT&PF Statewide Resiliency Plan has been initiated and is undergoing preliminary research. It is the intention of the planning team to ensure that this resiliency and risk analysis for the IATP area will provide insight and information that will assist in the efforts to finalize a Statewide Resiliency Plan.

The identification of risk and related resiliency factors includes analysis of community profiles from the Federal Emergency Management Agency (FEMA) National Risk Index (NRI), climate and permafrost information from the Scenarios Network for Alaska + Arctic Planning (SNAP) in coordination with the University of Alaska Fairbanks (UAF) International Arctic Research Center (IARC), the State of Alaska Hazard Mitigation Plan (SHMP), select community hazard mitigation plans (HMP), tribal hazard mitigation plans(THMP), and the IATP Working Group [1] [2] [3].

The tools, data, community input, and analysis provided in this memorandum serve as way to guide future planning discussions, policies, projects, funding, and development at a community level. The hazards and identified risks impact the potential for the IATP area's transportation infrastructure to function at the full intended design capacity before, during, and after a hazardous event. Identification of hazards and impacts create the ability to evaluate and analyze the ways in which community, program, or project-based mitigation strategies can be identified, prioritized, and implemented to better serve the needs of the planning area and promote resiliency.

1.2 Planning Area Defined

The IATP area has two international border crossings between Alaska and Canada, 1,250 miles of National Highways, 770 miles of Alaska State Highways, and 62 airports. The planning area shares a border with the North Slope Borough to the north (part of the Northwest Alaska Transportation Plan area), and Canada to the east. The western boundary follows the Dalton Highway from mile point (MP) 232 to MP 57 and then follows a segment of the Yukon River to the west of the Tanana River where it turns south to Lake Minchumina, before heading east to the George Parks Highway at MP 163.2 and continuing to the Susitna River. The boundary turns south, crosses the Glenn Highway at MP 188.4, and continues south before turning east and intersecting with the Richardson Highway at MP 69 continuing east to the Canadian border. Figure 1 identifies the IATP area along with key roadways, communities, and geographic features.

Included in the boundary of this planning area is approximately 132,223 square miles of land, containing forests, mountains, rivers, and lowlands. The main rivers within the area are the Yukon, Tanana, Copper, and Koyukuk Rivers. The mountain ranges making up the area are the Brooks Range, Ogilvie Mountains, Yukon-Tanana Uplands, the Kuskokwim Mountains, the Wrangell Mountains, and the Alaska Range.

These ranges and their peaks play a key role in the formation of the IATP area transportation system. Additionally, four major faults, or locations where two tectonic plates come into contact and slide past each other, have been identified in the area. These are the Kobuk, Tintina, Castle Mountain, and Denali Fault. This varied topography influences the types and number of hazards that are found across the area.

Figure 1. Interior Alaska Transportation Plan Area

1.3 Infrastructure Risk & Community Resiliency

Resiliency has become a key issue in the IATP area, particularly considering recent spring flooding events experienced in the communities of Yukon Flats, Circle, Kuspuk, Crooked Creek, Copper River, the City and Native Village of Eagle, and Glennallen. Many of these community disasters were a result of ice jams and snowmelt on the Yukon and Kuskokwim Rivers, leading to state disaster declarations for these communities. This allows for the identification of affected communities and grants eligibility for future reimbursement for any eligible emergency protective measures, while also activating the State of Alaska's Public and Individual Assistance Disaster Recovery Programs [4]. Each of these hazard events impacted both DOT&PF's physical infrastructure and daily system operations, as well as resulted in emergency response to quickly repair, and in some cases, replace damaged infrastructure.

Planning for and building resilient communities is not a new concept for Alaska and the communities in the IATP area. Generations of Alaskans have been implementing the core fundamentals of resiliency in their values to ensure the survival of their culture, customs, and communities [5]. The lasting presence of Alaska Natives in the existing communities and the focus on community resilience have resulted in innovations such as:

- Efficient and eco-friendly forms of transportation with the ability to traverse through arctic conditions. (Snowmachines, dog sleds)
- Innovations in metallurgy (tools, weapons, jewelry).
- Use of physics of light, sound, water, and materials to increase success in hunting in arctic landscapes.
- Creation of tools and devices to assist in resilient survival.

Communities are encouraged at all levels to be prepared to withstand and recover from a wide range of hazards. Resiliency and elasticity, or the ability to 'bounce back' from an event, is not limited to businesses, communities, or governments. Resiliency is important to be considered and applied to systems that allow business, communities, and governments to get from one location to the next.

Without resilient infrastructure and systems, a resilient community is a community on its own. The goal for communities and infrastructure located within the IATP area is to reach a functional level of resiliency, preparedness, and hazard mitigation. This goal requires routine maintenance of planning documents and inspections to verify any major changes that would impact the community's level of resiliency.

1.4 Current Regional Climate

Weather in the IATP area has the greatest temperature variation of any region in Alaska, varying as much as 30 degrees in a single day. The climate of the area in the summer months has dry temperatures averaging mid-70 degrees Fahrenheit and can reach 100 degrees Fahrenheit on the warmest days. Winters tend to have temperatures that stay at or below 0 degrees Fahrenheit and can see snowfall up to 100 inches or more in more mountainous areas. Within the IATP area, there are three main climate zones: arctic in the north, continental in the central region, and transitional in the south-central Interior region. Each of these climate zones have their own characteristics that influence the geography of the land, weather patterns, and hazard events experienced.

1.5 Changing Climate

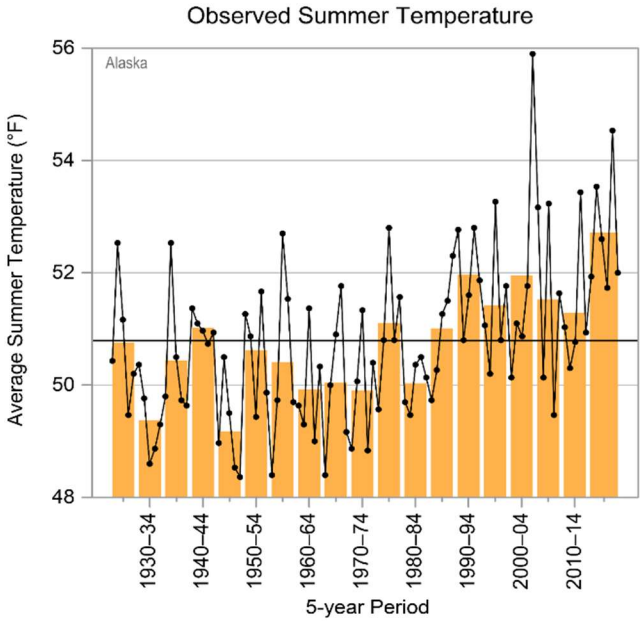

Figure 2. Interior Planning Area Observed Summer Temperatures 1925 to 2020, ACRA, NOAA, CISESS 2022)

Alaska has been warming at a rate twice as fast as the global average since the middle of the 20th century. Figure 2 shows the average temperature during the summer months of June through August over five-year periods from 1925 to 2020. The black dots show annual values, while the gold bars show averages over the selected five-year periods. The black line across Figure 2 show the long-term average identified as 50.8 degrees Fahrenheit. There is a distinct increase in summer temperatures identified on Figure 2 in the years following 1990, with a peak average around 55 degrees Fahrenheit around 2004 [7] [8].

Figure 3 shows the average temperature during the winter months of December through February over five-year periods from 1925 to 2020. The black dots show annual values while the gold bars show averages over the selected five-year periods. The black line shows the long-term average, identified as 4.4 degrees Fahrenheit. Although the averages in Figure 3 seem to have not experienced much of an increase or decline over the years, the annual values have seen an elevated trend since the mid-1990's [7] [8].

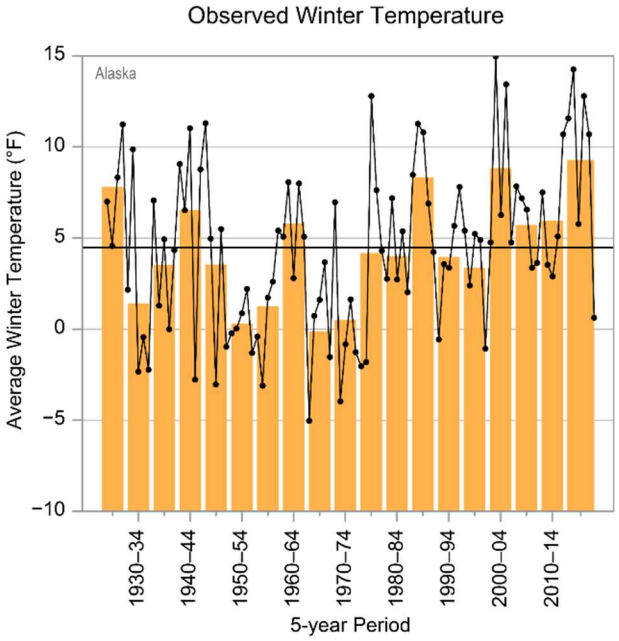

Figure 3. Interior Planning Area Observed Winter Temperatures 1925 to 2020, (ACRA, NOAA, CISESS 2022)

1.6 Common Hazards in the Interior Planning Area

FEMA defines a threat as a natural, technological, or human-caused occurrence, individual, entity, or action that has or indicates the potential to harm life, information, operations, the environment, and/or property. A hazard is defined as an environmental phenomenon having the potential to affect societies and the human environment. For this memorandum, the term hazard will be used in place of threat. This is due to all identified events being categorized as environmental phenomena. The defined terms of threat and hazard relate to how risk is defined as a function of the nature, magnitude, vulnerabilities, and the consequences that could result from a threat/hazard [9].

1.6.1 Flooding and Erosion

Flooding and erosion are often associated with coastal communities, but communities within the IATP area are also at risk to these hazards. The issues associated with flooding and erosion for communities are often recurrent while requiring continued observation and preparation. In recent years, changes in the environment and climate have resulted in increased flooding and erosion within the IATP area, including permafrost degradation.

Flooding is defined as the general and temporary condition of partial or complete inundation of two or more acres of areas land that are typically dry. This condition is the result of overflow, unusual and rapid accumulation or runoff of surface water, mud or landslides, or the collapse of land due to erosion. Flooding is a natural phenomenon, but when development is in proximity it becomes a hazard to life and structure.

Riverine flooding in the IATP area is often caused by water overflowing the side of the riverbank due to rainfall or runoff, flash flooding, alluvial fan, and ice jams. Other types of flooding occur from fluctuating lake levels, glacial lake overflow, groundwater, and aufeis.

Erosion occurs from water, ice, or wind and results in the removal of soil, rock, or any other dissolved material from one location to another. While it most often occurs over a lengthy period of time, in instances of flash flooding, erosion will happen rapidly and cause land to disappear without warning. The IATP area experiences riverine erosion and wind erosion.

Erosion vs. Ground Failure

The difference between ground failure and erosion is the location and length of time it takes for the event to occur. Erosion is often seen on riverbanks caused by wind occurring over long periods of time. Ground failure events are defined as rapid events happening without warning and result from another hazard (such as flash flooding) that increases the flow of loose material.

1.6.2 Permafrost Degradation

There are three main cryospheric hazards that impact the IATP area: glaciers, avalanches, and permafrost. Of these hazards, permafrost degradation is not defined by FEMA as a nationwide hazard, as it is only found in Alaska. Glaciers and avalanches are included as nationwide hazards and are addressed in the flooding and erosion and ground failure sections, respectively.

Permafrost is found in approximately 85 percent of Alaska's soil and can be found most densely in Arctic Alaska, north of the IATP area and the Brooks Range. Moving south, permafrost begins to thin but remains present within the IATP area. Permafrost has unique structural importance within Alaska, and permafrost thaw has caused several environmental hazards, which are discussed in further detail below.

1.6.3 Earthquake

Alaska has been identified as one of the most active states for seismic activity due to the subduction of the Pacific tectonic plate beneath the North American plate at the Alaska-Aleutian subduction zone. This subduction zone experiences frequent major movement that has resulted in deformation. There is no way to predict where in the state the next "big one" will occur or how large it will be.

The IATP area has not experienced a major earthquake since 2002, but as a state, Alaska experiences approximately one hundred earthquakes per day. The extent of these earthquakes can be seen in Figure 4, which was produced by the University of Alaska Fairbanks, Earthquake Center, and depicts seismic activity throughout the

whole state over the course of 2022[10]. These daily earthquakes often happen in remote, unpopulated locations, but demonstrate the seismic activity the state experiences.

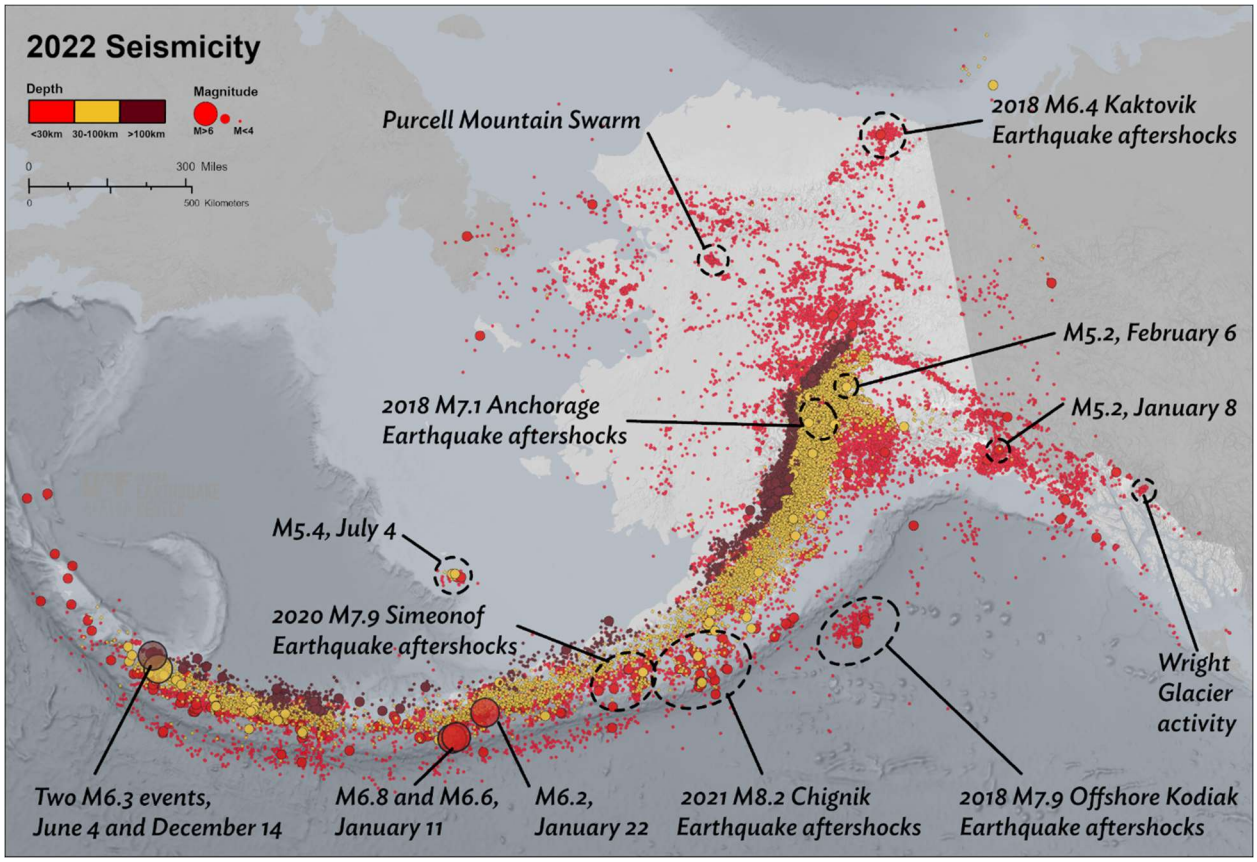

Figure 4. 2022 Seismicity Year in Review, University of Alaska Fairbanks Earthquake Center

1.6.4 Ground Failure

Ground failure has been added to the list of hazards through input from the Working Group, and includes hazards such as landslides, avalanches, mudslides, and rockslides in a single category. Table 1 identifies the several types of ground failure and their causes.

Ground failures are often seen when there is an increased slope to the land. Ground failure is unique in that as a hazard, it is typically a byproduct of another hazard. The type of slide is dependent on the type of material moving and the mechanics of it moving.

Table 1. Slide Type and Cause

SLIDE TYPE	CAUSE
Landslide	Earthquake, human activity, ground water, wildfires, steep slope, Permafrost degradation
Avalanche	earthquake, human activity, Permafrost degradation
Mudslide	Heavy rain, human activity, ground water, wildfires, steep slope
Rockslide	Heavy rain, human activity, ground water, steep slope, wildfires

1.6.5 Wildfire

Wildfires can ignite and spread quickly while being fueled by the natural vegetation found in the environment. These fires can be caused by both human activities and natural phenomena. Figure 5 depicts the seasonal fire phases within Alaska; included in the graph are acres burned and environmental influence responsible for impacting the spread by driving the wildfire. These drivers are identified as wind, duff, drought, and diurnal effect), all of which can be exacerbated or mitigated based on infrastructural or programmatic changes. [11].

Many communities in the IATP area are impacted by wildfires due to seasonal effects, such as dry summers with long daylight hours. April marks the start of fire season in the IATP area and much of Alaska, vegetation is green and begins to become lush while the ground and soil remains frozen. The fires ignited during this time tend to be caused by recreational activities, but typically cannot travel far due to the wet ground conditions. However, due to the cause of these wildfires, the fires are commonly close to communities' infrastructure. With the ability for strong winds to carry flames and embers, these communities' infrastructure remains at risk [11].

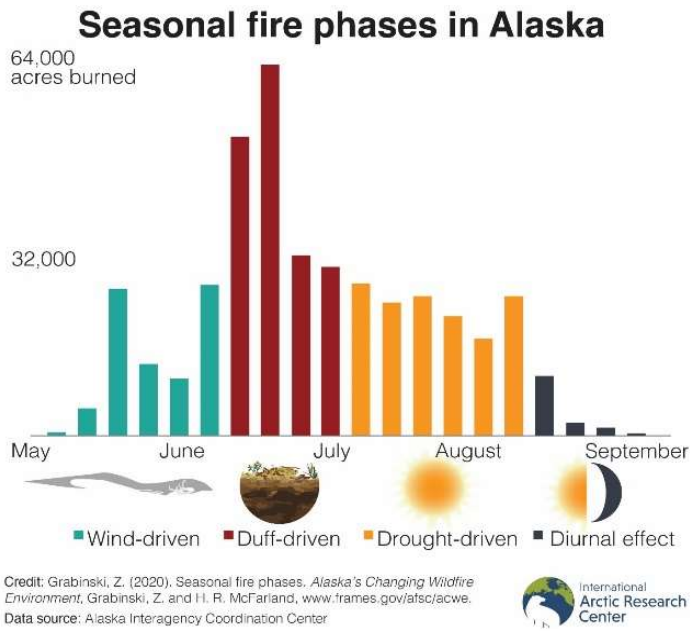

Figure 5. Seasonal Fire Phases and Environmental Drivers, International Arctic Research Center 2020

June and July are peak fire season, as well as the time of year with the most daylight hours. The IATP area can experience up to 24 hours per day. Long days with sun exposure dries vegetation on the ground and creates an ideal environment for a wildfire hazard. Fires during this time of year are most often caused by lightning strikes. For the remainder of the summer season, the risk of wildfire occurrences continues based on the amount of precipitation. If the summer has been particularly dry and hot, the chances of experiencing a wildfire increase, while a cooler wetter summer decreases the risk of continued wildfire hazards [11].

Wildfires occurring internationally and nationally in places such as Russia, Canada, Washington, and California can cause dense smoke. This dense smoke within the state and the IATP area can lead to visibility hazards when operating motor vehicles or human health hazards associated with poor air quality, such as asthma. Dense smoke is also a byproduct of wildfires occurring in Alaska and could become a hazard to the surrounding areas.

1.7 Hazard Mitigation Strategies

Being unable to control natural phenomena, experts within the field have come to together to develop potential mitigation strategies. These strategies can be based in planning practices and work to provide community education and preparedness, infrastructure inspections and repairs, and even community relocation as a last resort option. Under the Disaster Mitigation Act of 2000 community hazard mitigation planning is a requirement for communities to be eligible to receive FEMA disaster mitigation funding [12].

1.7.1 Protect in Place

“Protect in place” is a mitigation strategy that focuses on keeping the hazard at a manageable level. These practices can include providing community outreach and education on preparedness, environmental restoration or addition of hardening efforts, safety committees and policy boards, and implementation of management plans. Protect in place mitigation strategies require the identification of hazards and at-risk locations, collaboration, and community outreach [13].

1.7.2 Accommodate

“Accommodate” is a mitigation strategy that focuses on ways to enhance community and infrastructure while without actively managing a hazard but limiting potential damage. This mitigation strategy is implemented with engineering practices that stabilize, maintain, and prepare for what could happen. Accommodating hazards requires funding for infrastructure inspections, staffing to carry out tasks such as inspections, design, implementation of safe and effective designs, construction, and agency and community collaboration [13].

1.7.3 Managed Retreat

“Managed retreat” is a last resort mitigation strategy seen most often in communities that experience hazards repeatedly. This mitigation strategy requires collaboration with FEMA, and communities must have an HMP with a managed retreat plan [13]. HMPs work to permanently move a community or infrastructure away from the hazard after exhausting all other efforts. HMPs are often developed to support a whole community moving at once, not just a single piece of infrastructure moving.

2.0 CURRENT RESILIENCY PLANNING EFFORTS

Resiliency in transportation planning is required by federal legislation. States are given the opportunity to set legislative guidance for resilience through transportation planning efforts. As mentioned, a Statewide DOT&PF Resiliency Plan is currently underway and will provide a more coherent framework for the current resiliency planning efforts in the state of Alaska.

The Alaska Administrative Code (AAC) currently does not include specific resiliency objectives, but rather includes a broader consideration for various objectives in the statewide planning process to include resiliency as a critical component of planning. 17 AAC 05.125 includes objective (5) which states that the statewide transportation planning process will consider the "preservation of existing transportation systems [14]". While the LRTP and STIP play pivotal roles in increasing the safety of the state's transportation system, ensuring proper maintenance of the transportation system, promoting economic growth, and enhancing resilience and sustainability in Alaska's systems and communities.

Federal legislation for transportation planning is established in Title 23 Part 450 of the Code of Federal Regulations (CFR). This includes 23 CFR 450.206(a)(9) which addresses the inclusion of resiliency within transportation planning. This regulation expresses that statewide transportation planning should improve the resilience and reliability of the transportation system and reduce or mitigate stormwater impact of surface transportation [15].

The United States Department of Transportation (USDOT), FEMA, and the State of Alaska have initiated several plans and programs to promote resiliency. These plans develop policy for regional long-range resiliency planning as well as create criteria-based documentation to aid in project selection.

2.1 Infrastructure Investment and Jobs Act

The Infrastructure Investment and Jobs Act (IIJA), commonly referred to as the Bipartisan Infrastructure Law (BIL), focuses on funding investments while acknowledging and addressing climate change in the United States. Among the infrastructure investments supported by IIJA, investments focused on the reduction of greenhouse gas (GHG) emissions and promoting an increase in the overall resilience of transportation infrastructure in the United States are at the forefront of this legislation [16].

2.2 Alaska Long Range Transportation Planning

Alaska's Statewide LRTP is created under federal mandate 23 CFR 450.216 and AAC 17. The statewide transportation planning process serves as a guide for the to help establish transportation funding policy within the state of Alaska [17]. At the time of writing, *Alaska's 2050 Long Range Transportation Policy Plan Update – Alaska Moves* is in a public review draft form. This draft LRTP includes resiliency as a goal for Alaskans to "assess risk and invest in solutions to develop a transportation agency and system that will adapt to and recover from the effects of climate change, natural disasters, and other disruptions." Two focus areas of resiliency in the LRTP are agency resiliency, which focuses on a resilient workforce, and resilient infrastructure, which focuses on resilient transportation infrastructure, facilities, and plans [18].

The older *2036 Long Range Transportation Policy Plan Update – Let's Keep Moving 2036*includes a focus on improvements to the transportation system and addition of redundancy to address safety and security risks. Some of the policies included focus on working with federal, local, and state agencies to provide safe, secure, and resilient transportation systems and emergency preparedness for all modes with an improved resiliency for events such as earthquakes, climate change, and manufactured disaster [19].

2.3 Hazard Mitigation Planning

Hazard mitigation planning is provided for under 44 CFR 206.401whichworks to identify and profile hazards, provide an analysis of the people and facilities at risk, and assist in the development of actions to reduce and/or eliminate hazard risks [20]. These plans are pertinent to maintaining statewide and local eligibility for certain FEMA mitigation grant funding opportunities for mitigation planning. The elements required to be included in hazard mitigation plans are defined by FEMA in their Local Mitigation Planning Policy Guide. This guide is informed by 44 CFR 201.6(c)(2)(i) [21] [22].

2.3.1 State Hazard Mitigation Plan

The SHMP assists in identifying the planning process for HMPs based on criteria provided by FEMA, prior to identifying all hazards found within Alaska. With Alaska being a large state, with many diverse climates and ecosystems, there are many hazards identified within the SHMP. These hazards include:

- Cryosphere and Permafrost Degradation
- Earthquake
- Flooding and Erosion
- Ground Failure
- Tsunami and Seiche
- Volcano
- Severe Weather
- Wildland Fire and Community Fire
- High Hazard Potential Dams

The capabilities and assistance through hazard mitigation laws, regulations, policies, and programs available throughout Alaska are also identified within this SHMP, creating a single location to view information. The SHMP has identified obstacles, challenges, and solutions to hazard mitigation capabilities, such as the lack of coordinated code adoption statewide or the lack of participation in the National Flood Insurance Program.

The SHMP serves as a framework for the types of mitigation strategies that can be developed for communities for identified hazards. It is focused on providing communities and planning entities with the information, tools, and resources needed to conduct local hazard and mitigation planning.

2.3.2 Community Hazard Mitigation Plans

Communities throughout the IATP area have developed local HMPs, or for Native Villages/Tribes, Tribal Hazard Mitigation Plans (THMPs). Local HMPs and THMPs, like the SHMP, are required to be updated every five years to be considered compliant with FEMA-guiding legislation. HMPs and THMPs should, at a minimum, include:

- Identification of the planning area
- Completion of a risk assessment, including:
  - Identification and description of hazards
  - Identification of community assets
  - Analysis of potential hazard impacts to community and assets
  - Summary of vulnerability
- Review of community mitigation capabilities.

- Development of a mitigation strategy, including:
  - Mitigation goals
  - Mitigation actions
  - Prioritization of actions
  - Implementation plan
- Strategies to keep the plan current.

Approximately half of the 62 communities in the IATP area have a hazard mitigation plan, although 12 of the plans have not been updated within the last five years. Currently, six of these communities meet the required elements to be eligible for funding and recognition as current by FEMA, and the remaining plans are either overdue for an update or do not include required plan elements. Without an established or updated local HMP, a community may be ineligible to receive funding in the event of a hazard event and may be unprepared to mitigate hazards of particular concern to those communities. Table 2 provides an overview of the HMPs within the IATP area, the communities included in the plan, and the last known update to the plan.

Table 2. Hazard Mitigation Plans, their communities, and last Updates within the IATP Area

HAZARD MITIGATION PLAN TITLE	COMMUNITIES INCLUDED	LAST UPDATE
The City of Nenana Hazard Mitigation Plan	City of Nenana	2010
Native Village of Tanacross Hazard Mitigation Plan	Native Village of Tanacross	2013
Matanuska-Susitna Borough Hazard Mitigation Plan	Lake Louise	2013
City of Eagle Native Village of Eagle Hazard Mitigation Plan	City of Eagle and Native Village of Eagle	2014
Native Village of Circle Hazard Mitigation Plan	Circle Village	2014
Native Village of Chitina Hazard Mitigation Plan	Native Village of Chitina	2015
Copper Center Hazard Mitigation Plan/Village of Kluti-Kaah Hazard Mitigation Plan	Native Village of Kluti-Kaah (Copper Center) and some aspects of Wrangell-St. Elias National Park	2015
City of Fort Yukon, Alaska Hazard Mitigation Plan	City of Fort Yukon	2017
Tanana Hazard Mitigation Plan	City of Tanana and Tanana Tribal Council	2017
Delta Junction and Deltana Local Hazard Mitigation Plan	Delta Junction and Deltana Region (Big Delta, Whitestone, Healy Lake, and Fort Greely)	2017
Community of Tok, Alaska Hazard Mitigation Plan	Tok and Tetlin	2018
Native Village of Venetie Tribal Hazard Mitigation Plan	Native Village of Venetie and Arctic Village	2018
Glennallen and Native Village of Tazlina Multi-Jurisdictional Hazard Mitigation Plan	Glennallen and Native Village of Tazlina	2019
Denali Borough and City of Anderson Multi-Jurisdictional Hazard Mitigation Plan	Denali Borough (Cantwell, Ferry, Healy, and McKinley Village) and the City of Anderson	2020
Fairbanks North Star Borough – FNSB Hazard Mitigation Plan	Fairbanks, North Pole, Fort Wainwright, Eielson Airforce Base	2021
Gulkana Village Tribal Hazard Mitigation Plan	Tribal Planning Area of Gulkana	2023
Native Village of Gakona Tribal Hazard Mitigation Plan	Tribal Planning Area of Gakona	2023
Northway Village Tribal Hazard Mitigation Plan	Northway Junction, Northway Native Village, and Northway Airport	2023

Of the 62 communities in the planning area, 32 communities within the planning area are currently without an established HMP. Identified by census designated place (CDP), these communities include Chisana, Chistochina, Kenny Lake, McCarthy, Mendeltna, Mentasta Lake, Nabesna, Nelchina, Paxson, Silver Springs Slana, Tolsona,

Tonsina, Willow Creek, Alcan Border, Chicken, Dot Lake, Dot Lake Village, Tetlin, Beaver, Birch Creek, Central, Chalkyitsik, Coldfoot, Four Mile Road, Lake Minchumina, Livengood, Manley Hot Springs, Minto, Rampart, and Stevens Village.

Funding is available to establish a HMP through FEMA's Hazard Mitigation Grant Program. This program provides funding to qualified state, local, tribal, and territorial government to develop HMPs and have opportunities to rebuild in ways that reduce or mitigate future losses due to disaster. This grant funding is available to communities following a presidentially declared disaster. An additional option for funding through FEMA that does not require a community to have recently experienced a disaster includes Building Resilient Infrastructure and Communities (BRIC). BRIC funding focuses on shifting reactive emergency response to proactive emergency response and is the appropriate funding source for communities seeking assistance to update their HMP. These funding sources are competitive processes and require communities seeking assistance to complete applications detailing their purpose and need for funding [23].

In addition to funding assistance, technical assistance is offered through Building Resilient Infrastructure and Communities Direct Technical Assistance (BRIC DTA). This technical assistance program focuses efforts to support local and tribal communities that may not have the needed resources to carry out a resilience planning project. Communities receiving assistance under BRIC DTA may or may not be receiving monetary funding from FEMA, while all activities under BRIC DTA are non-financial support services, such as climate risk assessment, community engagement, partnership building, mitigation planning, and assistance applying to and finding grant opportunities [24].

2.3.3 State and Federal Resilience Programs

On federal and state levels, several resilience focused programs have been created and are available for reference and implementation in Alaska's communities. The functionality of these programs ranges from managing and distributing funding to providing technical tools, training, and education. These resilience-based programs not only focus on the overarching theme of resilience but also address other areas, such as mitigation, sustainability, and climate.

State programs support Alaskan communities to conduct hazard mitigation, education, and planning. State agencies providing programs include the Division of Community and Regional Affairs (DCRA), DOT&PF, and Department of Natural Resources Division of Forestry and Fire Protection (DNR, DFFP), while the efforts of the federal programs provided by agencies and programs such as FEMA, USDOT, and IIJA focus on providing competitive grant funding opportunities.

The identification of these programs, the agency responsible, a brief description, and their area(s) of focus are included in Table 3:

Table 3. Federal and State Resilience Based Programs

PROGRAM	ENTITY	DESCRIPTION	FOCUS AREA(S)			
			RESILIENCE	MITIGATION	SUSTAINABILITY	CLIMATE
Community Resilience Programs	DCRA	Provides tools, training, and funding to educate, prepare, respond, and recover, with a focus on risk assessment, planning, and implementation.	✓	✓		
Village Inter-Agency Planning Groups	DCRA	Establishes Planning Groups that involve multiple agencies, including those within threatened communities, to collaborate on establishing strategies and solutions, while reducing duplication of efforts, and increasing engagement.	✓	✓		
Alaska Climate Change Impact Mitigation Program	State of Alaska	Established in 2008 and completed in 2016, this program created materials that remain available and valuable. This program supplied technical assistance and funding to communities experiencing immediate impacts from natural hazards resulting from environmental climate changes. The program assisted in developing planned mitigation approaches using hazard impact assessment and community adaption planning grants.		✓		✓
Firewise	DNR, DFFP	Focuses on community-based practices for preparing communities and homes to be compatible with the area's ecosystem to withstand wildfires. Three communities are currently regarded as Firewise communities, two of which are within the IATP planning area: Kennicott/McCarthy and Ester Lump.	✓	✓		

PROGRAM	ENTITY	DESCRIPTION	FOCUS AREA(S)			
			RESILIENCE	MITIGATION	SUSTAINABILITY	CLIMATE
Carbon Reduction Program	IIJA	Supplies funding for projects designed to reduce transportation emissions (strictly defined as carbon dioxide emissions from on-road highway sources).			✓	✓
Congestion Mitigation and Air Quality Improvement	USDOT	Supplies funding for transportation projects and programs that aid in meeting the Clean Air Act.			✓	✓
Promoting Resilient Operations for Transformative, Efficient, and Cost Saving Transportation (PROTECT) Formula Program	IIJA	Provides funding for projects that focus on creating surface transportation that is resilient to natural hazards through planning, resilience improvements, community resilience, evacuation routes, and at-risk costal infrastructure.	✓	✓		
Hazard Mitigation Grant Program	FEMA	Funding provided to state, local, tribal, and territorial governments for purposes such as developing hazard mitigation plans and opportunities to rebuild in ways that reduce or mitigate future loses in the community.	✓	✓		
Building Resilient Infrastructure and Communities (BRIC)	FEMA	Provides funding to state, local, tribal, and territorial governments to undertake hazard mitigation projects that reduce the risks faced from disasters and other natural hazards. BRIC focuses on supporting communities by being a flexible, consistent program that builds capabilities and capacities, encourages, and promotes innovation, promotes partnerships and collaborations, and creates the possibility of large-scale projects.	✓	✓		

3.0 RISK TO INFRASTRUCTURE RESILIENCE ASSESSMENT

The risk assessment considers hazards specific to the IATP area that may impact the resilience of transportation infrastructure. This assessment uses data-driven risk assessment tools from FEMA and SNAP, as well as the input from the IATP Working Group, which includes stakeholders throughout the IATP area. The assessment concludes with a matrix outlining each community's anticipated FEMA hazard(s) and associated risk level, the assigned permafrost risk level, facilities identified to be at risk, the overall recommended mitigation strategy, and whether the risk has been identified in a community or state hazard mitigation plan.

3.1 FEMA Hazards Risk Assessment

3.1.1 FEMA Hazards: Wildfire, Flooding, Cold Wave, Avalanche, Earthquake, Winter Weather, and Ice Storm

The FEMA National Risk Index is an online interactive mapping tool that depicts the 18 most common natural hazards and their risk throughout the United States. The risk index tool provides data on risk index, expected annual loss, social vulnerability, and community resilience, which are the components of assessing a community's resilience to hazards [1]. For the IATP area, the FEMA hazards assessed include wildfire, flooding, cold wave, avalanche, earthquake, winter weather, and ice storm hazards, but does not currently include all hazards found within the Interior planning area, namely permafrost. These hazards are addressed with Alaska's SNAP models in **Section 3.3.**

The FEMA National Risk Index is a representation of the combined elements of **Expected Annual Loss** (EAL) due to an event and the **Community Risk Factor**, as shown in Figure 6. Each element contains data associated with the natural hazard occurrence related to economic loss (for expected annual loss) and overall community vulnerability and resilience (for Community Risk Factor).

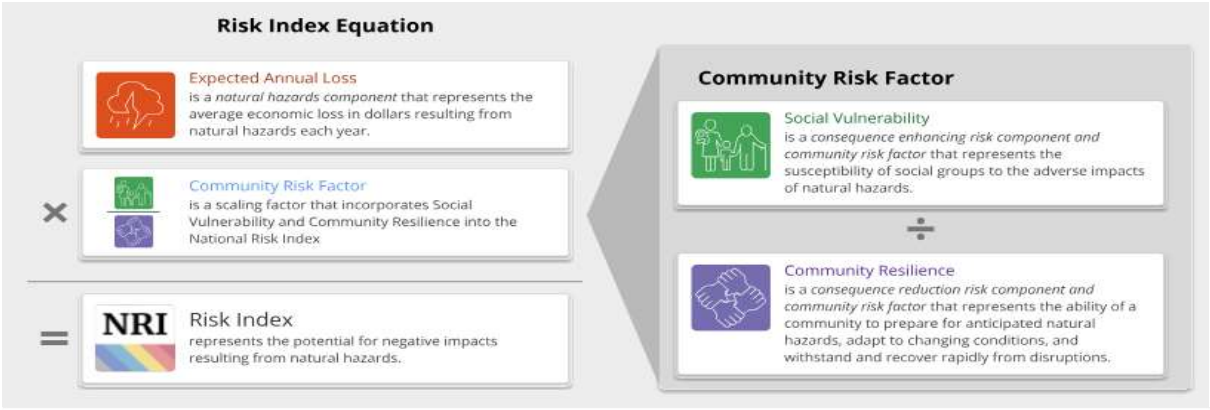

Figure 6. FEMA NRI Definitions for Risk Index Equation and Community Risk Factors

Expected Annual Loss is calculated from three criteria reduced to a representative number. Figure 7 outlines how loss is estimated due to a natural hazard consequence factor ("Exposure"), the probability of the event each year ("Annualized Frequency"), and the estimated percentage of exposed infrastructure value expected to be lost due to the natural hazard occurrence ("Historic Loss Ratio").

- **Exposure** – Represents the value of buildings, population, or agriculture that would be exposed to a natural hazard. These are often referred to as assets. Used in calculating expected annual loss.
- **Annualized Frequency** – Represents the expected frequency or probability of a natural hazard occurring per year. Used in calculating expected annual loss.
- **Historic Loss Ratio** – Represents the estimated percentage of exposed building value, population, or agriculture (assets) value expected to be lost due to a natural hazard occurrence. Used in calculating expected annual loss.

Figure 7. Expected Annual Loss Factors

The **Community Risk Factor** incorporates Social Vulnerability and Community Resilience to create a scaling factor into the National Risk Index.

Social Vulnerability – Represents the susceptibility of social groups to the adverse impacts of natural hazards.

Community Resilience – Represents the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover from disruptions.

Risk Index – The potential for negative impacts resulting from natural hazards.

Risk Value – A value used to measure risk within the National Risk Index. Used to generate all Risk Index percentiles and ratings [1].

3.2 FEMA Risk & Resiliency Assessment by Community

The FEMA Risk Index Score and associated resiliency assessment for each community are compiled in the following tables. The assessments are detailed to the census tracts level to assess risk levels and estimated resiliency levels for each individual community located within the IATP area boundary.

Each community is assigned scores between 0 and 100 based on their level of risk for each hazard, the overall risk, social vulnerability, and community resiliency. These scores are compared to communities of the same type (i.e., tracts compared to tracts, counties compared to counties) and then given a category label as "very high," "relatively high," "relatively moderate," "relatively low," or "very low" [1].

Table 4 outlines the national and state averages for FEMA Risk Index score and category and the associated social vulnerability and community resilience to provide a baseline to compare the individual borough, census area, or census tract information provided for each community in the planning area.

Table 4. National and State Averages for FEMA Risk Index, Social Vulnerability, and Community Resilience

INDEX AVERAGE CATEGORY	RISK INDEX SCORE / CATEGORY		SOCIAL VULNERABILITY		COMMUNITY RESILIENCE	
National	45.05	Very Low Risk	86.57	Very High	3.21	Very Low
Alaska	80.00	Relatively Moderate Risk	83.30	Relatively High	6.70	Relatively Low

Appendix 2 contains in depth NRI information for each identified IATP area subregion.

3.3 Permafrost Risk Assessment by Community

SNAP has created and implemented tools to assist Alaskan communities, including many in the IATP area, identify their vulnerability to permafrost. Part of SNAP's research involves collecting and analyzing data pertaining to permafrost and permafrost degradation in rural Alaska through the SNAP Community Permafrost Data Hub. The data hub allows for SNAP to create, score, and assign each of the rural communities identified with risk levels. The risk level assignment is based on the following scoring and evaluations:

- Risk level – The sum of ranking for each identified category.
- Massive ice occurrence.
- Thaw susceptibility.
- Existing permafrost related problems.
- Permafrost occurrences.
- Permafrost temperature.

The table identifying the scoring and evaluations for the communities identified within the IATP area can be found in Appendix 3. SNAP identified 24 communities within the IATP area, which are included in detail in Appendix 3, from which to collect permafrost data. Of the communities in the planning area, Circle has been identified as having a high permafrost risk level. Other communities identified have been assigned risk levels of either medium or low. Many factors influencing the overall risk level are community dependent, while there is a commonality of warm permafrost temperatures in many of the communities identified. This overall warming permafrost temperature plays an important role in the cryosphere changes being observed.

3.4 Resiliency Working Group Risk Assessment

On Wednesday, August 16, 2023, a working group meeting was held via video conference. The meeting provided attendees an update on the IATP process and outlined the purpose of the working group meeting: identify the most prominent risks within the IATP area and identify key infrastructure locations at risk. A summary of the Resiliency Working Group is found in Appendix 1.

Attendees were grouped according to representative geography. These geographic groupings were based on the working group's representative attendees and identified in Figure 8, Interior Alaska Transportation Plan Workgroup Group Sub-Region Map. The geographic groupings included Yukon Flats, Upper Tanana, Copper River, Middle Yukon / Fairbanks, and the Denali Borough. The sub-regions are general locations; the boundaries shown on Figure 8 cover the IATP area, not necessarily any census-designated or otherwise governmental boundary.

During the breakout discussions, attendees identified hazards, locations, and infrastructure in their communities that are at risk while also providing input on the associated risk level and suggested mitigation strategies. Hazards identified included FEMA-recognized hazards (Flooding, Wildfire, Earthquake and Erosion), as well as permafrost. The groups shared knowledge to identify the location of infrastructure at risk to a hazard event, level of risk to the identified infrastructure, priority, and recommended mitigation strategy. Table 5 outlines the at-risk infrastructure perceived as a high risk and/or high priority to the sub-region and recommended mitigation actions for DOT&PF and partner agencies tasked with infrastructure management and maintenance.

Figure 8. Interior Alaska Transportation Plan Working Group Sub-Region Map

Table 5. Community Working Group Identified High Risk and/or High Priority Actions

SUB-REGION	HAZARD	AT-RISK INFRASTRUCTURE IDENTIFIED	RECOMMENDED ACTION
Yukon Flats	Wildfire	Roads, Utility/Communication Infrastructure	Appropriate clearing to protect right-of-way to mitigate fire destruction of infrastructure.
	Flooding	Roads, equipment, structures.	Improve policy and collaboration with community leadership.
	Erosion	Homes, structures.	
	Earthquake	Homes, structures, roads, utilities.	
	Permafrost	Roads	Align design, construction, and maintenance standards to mitigate the impact.
Upper Tanana	Wildfire	Any infrastructure impacted blocks evacuation from communities with limited access (Examples: Dot Lake and Sand Lake).	Provide appropriately customized information to community.
	Flooding	Johnson River Bridge Robertson River Bridge	Replace Bridges to withstand flooding events.
Copper River	Flooding (continues to occur annually)	Flooding locations: O'Brien and Hidden Creek near the Edgerton Highway, Glennallen, Copper River.	Continue to monitor and replace infrastructure in response to historical flooding challenges.
	Erosion	Access road to Copper River, McCarthy Road to Kennecott (one access in/out). This includes landslides.	Repair / replace roadway segments experiencing failure.
	Wildfires	Limited access via road or air for evacuation.	Additional access and/or improved evacuation routes (road or air).
Middle Yukon/Fairbanks	Wildfire	Roads, Utility/Communication Infrastructure	Appropriate clearing to protect right-of-way to mitigate fire destruction of infrastructure.
	Flooding, Erosion, Permafrost	Homes, roadways	Plan and prepare for appropriate mitigation of flooding, erosion due to climate change.
	Earthquake	Deficient bridges with possible subsurface structure.	Replace bridges with seismic retrofits as needed.
Denali Borough	Wildfires, Flooding/Ice Jams	Dry Creek Infrastructure, Community of Anderson Dyke.	Community Programs, Awareness, and on-going collaboration with state and federal agencies to address maintenance needs (Anderson Dyke).

3.5 Piecing It Together

Likely hazards and community risk factors using information from the FEMA National Risk Index, available community based HMPs, SNAP, and input from the IATP Working Group creates an overview of the planning area's most at-risk communities and infrastructure. A summary of the risks to the IATP area's infrastructure is found in this section by considering the risk index, historical occurrence, social vulnerability, and community resilience levels of each community by census track or borough census area. The summary also includes input by local community members through the IATP working group during a workshop focused on community infrastructure resiliency.

From a regional perspective, most of the IATP area shows "very high" or "relatively high" risk in the areas of Social Vulnerability and Community Resilience. Table 6 provides a regional overview of the FEMA Risk Index Categories by each census-designation (tract, borough, or area), noting opportunities for improvement for all communities within the IATP area. For detailed FEMA Risk Index Category Rankings detailed by local communities, Appendix 2 includes the full assessment details for each census tract or area included in Table 6.

The overview scores in Table 6 are representative of scoring factors such as repeat historical occurrences of flooding, winter weather, and avalanche as common in communities having the topography to support land movement. Additional hazards identified as being a higher risk due to their historical occurrences include wildfires and earthquakes.

Table 6. Regional FEMA Risk Index Category Ratings

	YUKON FLATS/MIDDLE YUKON/FAIRBANKS SUBREGIONS				UPPER TANANA SUBREGION		DENALI SUBREGION	COPPER RIVER SUBREGION	
	Y-K Census Tract 1	Y-K Census Tract 2	Y-K Census Tract 4	Fairbanks North Star Borough	SE FBX Census Tract 1	SE Census Tract 2	Denali Borough Census Area	Copper River Census Area	Mat-Su Census Tract 2
Risk Index	Relatively Moderate Risk	Relatively Moderate Risk	Relatively Low Risk	Relatively Low Risk	Relatively High Risk	Very High Risk	Relatively Moderate Risk	Relatively Low Risk	Relatively High Risk
Social Vulnerability	Very High	Very High	Very High	Relatively Moderate	Relatively High	Relatively High	Relatively Moderate	Relatively High	Relatively Moderate
Community Resilience	Very Low	Very Low	Very Low	Relatively Moderate	Very Low	Very Low	Very Low	Relatively Moderate	Very Low

It should be noted that the FEMA Risk Index assessment data does not include evaluation due to instances of major flooding events caused by snow melt or ice jams. Using information from community members provided at the working group, additional communities at risk due to these type of flooding events were able to be identified. These communities include Eagle, Eagle Village, and Glennallen.

While the aspect of social vulnerability and community resilience was not addressed directly in the working group, these concepts occurred naturally during discussion between attendees. Concerns addressing social vulnerability and community resilience include the quantity and availability of evacuation routes (including air), interagency coordination, policy implementation and planning, community education and preparedness, state and local government officials' education on hazards, and medical facility/medication surplus access.

The following sections and their accompanying tables take a deeper look into the information obtained via FEMA's National Risk Index, SNAP's Permafrost Risk Levels, the IATP Resiliency Working Group, and a desktop analysis using geographic information systems (GIS) to identify facilities in proximity to identified hazards. These tables identify the specific at-risk facilities for communities and mitigation strategies that can be used to address vulnerabilities.

3.6 Yukon Flats and Middle Yukon/Fairbanks Subregion

YUKON FLATS

Table 7. Yukon-Koyukuk Census Tract 1 Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

YUKON-KOYUKUK CENSUS TRACT 1					
LOCATION	**IDENTIFIED HAZARDS**	**FEMA RISK INDEX CATEGORY FOR THE COMMUNITY FOR ALL HAZARDS**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Arctic Village	Wildfire Flooding Permafrost	Relatively Moderate	Medium	Arctic Village Airport Mountain Street Airport Street Village Center	Protect in Place
Venetie	Flooding Wildfire	Relatively Moderate	Low	Venetie Airport Fort Yukon Trail and Landfill Access Road (responsible for providing access to Airport)	Protect in Place
Beaver	Flooding Wildfire	Relatively Moderate	Medium	Government Road Beaver Airport Landfill Access Road	Protect in Place
Fort Yukon	Flooding Wildfire Permafrost	Relatively Moderate	Medium	Fort Yukon Airport Fort Yukon Long Range Radar Site FAA Site Road First Avenue	Protect in Place

YUKON-KOYUKUK CENSUS TRACT 1					
LOCATION	**IDENTIFIED HAZARDS**	**FEMA RISK INDEX CATEGORY FOR THE COMMUNITY FOR ALL HAZARDS**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Chalkyitsik	Flooding Wildfire	Relatively Moderate	Low	Fishhook Drive Kutchin Street Gravel Pit Road Ridge Road	Protect in Place
Birch Creek	Flooding Wildfire	Relatively Moderate	Low	Landfill Road Fort Yukon Trail Birch Creek Airport	Protect in Place
Circle	Flooding Wildfire Permafrost	Relatively Moderate	High	River Street (Steese Highway) Circle City Airport Steese Expressway Town Center	Protect in Place/Accommodate
Central	Flooding Wildfire	Relatively Moderate	No Risk Level Assigned	Steese Expressway Montana Creek M&O Station Crooked Creek Bridge Circle Hot Springs Road Deadwood Creek Bridge	Protect in Place

YUKON FLATS/MIDDLE YUKON

Table 8. Yukon-Koyukuk Census Tract 2 Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

YUKON-KOYUKUK CENSUS TRACT 2					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Stevens Village	Flooding Wildfire Permafrost	Relatively Moderate	Medium	Harding Road Airport Road Stevens Village Airport	Protect in Place
Livengood	Wildfire	Relatively Moderate	No Risk Level Assigned	Livengood Airport Livengood Camp Airport Livengood M&O Station Elliott Highway Dalton Highway	Protect in Place
Rampart	Flooding Wildfire Permafrost	Relatively Moderate	Medium	1st Avenue 6th Avenue 2nd Avenue Rampart Airport Minook Creek Road	Protect in Place/Accommodate
Minto	Flooding Wildfire	Relatively Moderate	Low	Minto Road Minto Al Wright Airport	Protect in Place

YUKON-KOYUKUK CENSUS TRACT 2					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Nenana	Flooding Wildfire Ground Failure	Relatively Moderate	Low	Alaska Native Veterans Honor Bridge Shirly Deminetieff Memorial Bridge Parks Highway Totchaket Road 10th Street Cemetery Road Port of Nenana Airport Service Road Nenana Municipal Airport	Protect in Place/Accommodate
Manley Hot Springs	Flooding Wildfire	Relatively Moderate	Medium	Elliott Highway (Near the Tanana River)	Protect in Place
Tanana	Flooding Wildfire Permafrost	Relatively Moderate	Medium	Ralph M Calhoun Airport All Roadways along Tanana River White Alice Road Tanana Road (Elliott Highway)	Protect in Place/Accommodate

MIDDLE YUKON/FAIRBANKS

Table 9. Fairbanks North Star Borough Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

FAIRBANKS NORTH STAR BOROUGH HAZARDS					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Chena Hot Springs Road	Permafrost Riverine Flooding	Relatively Low Risk	No Risk Level Assigned	Roadway Flat Creek Bridge Little Chena River Bridge	Protect in Place/ Accommodate
Goldstream Road	Permafrost	Relatively Low Risk	No Risk Level Assigned	Roadway	Protect in Place/ Accommodate
Ballaine Road	Permafrost Earthquake	Relatively Low Risk	No Risk Level Assigned	Roadway Goldstream Creek Bridge	Protect in Place/ Accommodate
Elliot Hwy	Permafrost Flooding	Relatively Low Risk	No Risk Level Assigned	Roadway Washington Creek Bridge	Protect in Place/ Accommodate

3.7 Upper Tanana Subregion

Table 10. Southeast Fairbanks Census Tract 1 Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

SOUTHEAST FAIRBANKS CENSUS TRACT 1					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Eagle/Eagle Village	Avalanche Flooding	Relatively High Risk	Medium	Taylor Highway Eagle Airport American Creek	Protect in Place
Northway	Flooding Wildfire Erosion Permafrost	Relatively High Risk	Low	Fish Camp Creek Bridge Northway Airport Alaska Highway Northway Road All Facilities Near Nabesna River Population Center	Protect in Place/Accommodate
Tanacross	Flooding Wildfire Permafrost	Relatively High Risk	Medium	Tanacross Airport Alaska Highway Richardson Highway	Protect in Place
Tok	Wildfire	Relatively High Risk	No Risk Level Assigned	Alaska Highway Tok Junction Airport	Protect in Place
Tetlin	Wildfire	Relatively High Risk	Low	Tetlin Airport	Protect in Place
Dot Lake/Dot Village	Wildfire	Relatively High Risk	No Risk Level Assigned	Alaska Highway	Protect in Place
Dry Creek	Wildfire	Relatively High Risk	No Risk Level Assigned	Alaska Highway Dry Creek Road	Protect in Place

Table 11. Southeast Fairbanks Census Tract 4 Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

SOUTHEAST FAIRBANKS CENSUS TRACT 4					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Healy Lake	Flooding Wildfire	Very High Risk	No Risk Level Assigned	Landfill Access Road	Protect in Place
Fort Greely	Wildfire Flooding	Very High Risk	No Risk Level Assigned	Alaska Highway Meadows Road	Protect in Place
Delta Junction/ Deltana/ Big Delta	Ground Failure Flooding	Very High Risk	No Risk Level Assigned	Delta Junction Airport Alaska Highway Richardson Highway Tanana River Big Delta Bridge Delta Junction M&O Station	Protect in Place

3.8 Denali Borough Subregion

Table 12. Denali Borough Census Area Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

DENALI BOROUGH CENSUS AREA					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Anderson	Flooding Wildfire Earthquake	Relatively Moderate Risk	No Risk Level Assigned	Anderson Road	Protect in Place
Clear	Flooding Wildfire Earthquake	Relatively Moderate Risk	No Risk Level Assigned	Bear Creek Bridge	Accommodate
Healy	Wildfire Flooding Earthquake	Relatively Moderate Risk	No Risk Level Assigned	Healy River Airport Dry Creek Bridge Stampede Road Panguinegue Creek Bridge	Protect in Place
Ferry	Flooding Wildfire Earthquake	Relatively Moderate Risk	No Risk Level Assigned	Ferry/Eva/Moose Creek Road	
North of McKinley/Denali Park Area	Wildfire Ground failure Earthquake	Relatively Moderate Risk	No Risk Level Assigned	Kantishna Airport Denali National Parks Road Alaska Railroad Parks Highway Railroad Underpass	Accommodate by updating infrastructure and design
Cantwell	Wildfire Earthquake	Relatively Moderate Risk	No Risk Level Assigned	Parks Highway Jack River Bridge	Protect in Place

3.9 Copper River Census Area

Table 13. Copper River Census Area Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

COPPER RIVER CENSUS AREA					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Whole Census Area	Wildfire	See all communities in the Census Area	No Risk Level Assigned	All Transportation Facilities	Protect in Place, provide additional maintenance opportunities, additional road access spots, improve evacuation routes, and increase air transportation facilities
Slana	Flooding - Low	Relatively Low Risk	No Risk Level Assigned	Tok Cutoff Highway Nabesna Road	Protect in Place
Chistochina	Flooding - Low	Relatively Low Risk	Low	Chistochina Airport	Protect in Place
Gulkana	Flooding - Low	Relatively Low Risk	Medium	Richardson Highway Gulkana Airport	Protect in Place
Glennallen	Flooding	Relatively Low Risk*	No Risk Level Assigned	Glenn Highway Richardson Highway Glenn Highway Crossing	Protect in Place

COPPER RIVER CENSUS AREA					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK CATEGORY**	**SNAP ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Copper Center Area	Flooding – Low Erosion	See all communities in the Census Area	Low	Richardson Highway Copper Center Airport Brenwick-Craig Road Edgerton Highway/McCarthy Road Tazlina M&O Station Tazlina River Bridge Klutina River Bridge Old Richardson Highway	Protect in Place
Chitina	Permafrost Flooding - Low	Relatively Low Risk	Medium	Edgerton Highway/ McCarthy Road Copper River Spur	Protect in Place
Tonsina/ Chisnana	Flooding - Low Wildfire	Relatively Low Risk	No Risk Level Assigned	Chisana Airport	Protect in Place
McCarthey	Flooding - Low Erosion Wildfire	Relatively Low Risk	No Risk Level Assigned	Edgerton Highway/McCarthy Road May Creek Airport McCarthy Airport	Protect in Place/Accommodate

*Hazards for Glennallen Alaska are identified as relatively low risk; this includes flooding events. Although, flooding in Glennallen has become common place in recent years. Many of the flooding events in Glennallen are not documented as FEMA categorized events as they are the result of situations such as log and ice jams, which FEMA does not track.

Table 14. Matanuska-Susitna Borough Hazards, FEMA NRI, SNAP Risk, Facilities at Risk, and Mitigation Strategies

MATANUSKA-SUSITNA BOROUGH CENSUS TRACT 2					
LOCATION	**IDENTIFIED HAZARD(S)**	**FEMA RISK INDEX CATEGORY**	**ASSIGNED PERMAFROST RISK LEVEL**	**FACILITIES AT RISK**	**MITIGATION STRATEGY(S)**
Lake Louise	Avalanche Earthquake	Relatively High Risk	No Risk Level Assigned	Richardson Highway Glenn Highway Lake Louise Airport	Protect in Place/Accommodate

4.0 RECOMMENDATIONS

4.1 Non-Infrastructure Community-Based Resiliency Efforts

Engaging the local population in a planning process to mitigate disasters will result in better understanding of the potential hazard, historical events, and how the community can best respond to an event until additional help can be deployed. Additionally, HMPs provide an organized method for communities to engage in preparing for events through education and organization, while simultaneously having the minimum requirements met for funding eligibility. This planning process will help to empower the local community, provide clear steps in the event of hazard occurrence, and guide prioritization of infrastructure rehabilitation and repair post event. For DOT&PF, on-going and focused engagement as a partner by encouraging and collaborating when possible in HMP development and implementation might include:

- Make sure DOT&PF facilities are accounted for in state, local, and tribal HMPs.
- Lead creation of hazard mitigation plans where communities have no local government.
- Work with local organizations to promote community education on local hazards.
- Facilitate and maintain interagency coordination and community communications for emergency response.
- Invest in the production of rock (rip rap) in areas of high flooding or erosion risk as a preparedness measure not as a response.

During the working group discussion on resiliency and risk, attendees were grouped by geographic regions to identify the location of infrastructure at risk to a hazard event, level of risk to the identified infrastructure, priority, recommended mitigation strategy, and any potential actionable ideas by the breakout group (Appendix 1). The breakout groups identified specific infrastructure, as well as discussed non-infrastructure solutions to better prepare and share knowledge about how to improve community resiliency. The key recommendations identified by the working group attendees included:

- Improve policy regarding preparation for hazard events.
- Include all infrastructure in hazard event planning: homes and local buildings used by all and possibly used for dual purpose during hazard events (grocery stores, libraries, etc.).
- Improve collaboration between government agencies, support organizations, and members of the community through defined communication strategies during hazard events and on-going knowledge-sharing for continuous improvement to response and updating preparation efforts.

4.2 Establish Infrastructure Risk Mitigation Strategies

In a brief working group session, specific infrastructure, location, and level of priority for those community member representatives were quickly established. This preliminary effort is an opportunity to begin prioritizing community infrastructure and the appropriate mitigation strategy, including:

1. Protect in Place: Focuses on engineering solutions that keep the threat at a manageable level while staying in-place (Short to Mid-Term).
2. Accommodate: Enhances the infrastructure in a way that allows the threat to continue but keeps extreme damage from happening (Mid to Long-Term).
3. Managed Retreat: Requires moving infrastructure away from the threat completely, often after attempting other mitigation efforts (Long-Term).

Each mitigation strategy type is an opportunity for DOT&PF to lead the next steps to improve the resiliency of the community through infrastructure improvement.

4.3 Develop Evaluation Criteria for a Resiliency Action Program

As resiliency continues to be a key strategy for DOT&PF's service to Alaskan communities, it is crucial to partner with the local community when determining how a resiliency program should be implemented, including the evaluation criteria to determine actions that will support resiliency of Alaskan's communities. No matter the selected mitigation strategy, evaluating at-risk infrastructure to determine a prioritized program for improvement will help guide next steps in DOT&PF's resiliency efforts.

For all communities within the IATP area, recommended evaluation criteria for prioritizing at-risk infrastructure mitigation should consider:

- Access to the road system.
- One entry/exit access point.
- One transportation mode access point.
- Communities that do not have up-to-date emergency communication systems.
- Improvements to emergency evacuation points.
- Improvements to emergency evacuation aviation facilities for off-road and remote communities.

DOT&PF's infrastructure resiliency efforts are built into current planning that coincide with various state departments, federal agencies, and local government processes. These efforts include HMPs, THMPs, educational outreach, and on-going mitigation strategy implementation. Continued partnerships with community-based programs, focused risk mitigation strategies appropriate to the community's infrastructure risk levels, and consideration of resiliency in statewide action programs are the key elements in executing an effective resiliency strategy for DOT&PF infrastructure.

5.0 REFERENCES

- FEMA (2023). *National Risk Index*.[GIS] Retrieved from: https://hazards.fema.gov/nri/
- Scenarios Network for Alaska + Arctic Planning, UAF. (2023).*Tools + Data*.[Webpage] Retrieved from: https://uaf-snap.org/climate-tools/
- Alaska Division of Homeland Security and Emergency Management. (2023). *State Hazard Mitigation Plan (SHMP).[Web Document]* Retrieved from: https://ready.alaska.gov/Mitigation/SHMP
- FEMA. (2023, August). *FEMA Disaster Assistance Teams Visiting Glennallen.* Retrieved from: https://www.fema.gov/event/fema-disaster-assistance-teams-visiting-glennallen
- Alaska Federation of Natives. (2018, December). Retrieved from nativefederation.org: https://www.nativefederation.org/wp-content/uploads/2018/12/AFN-AKDayResilience-December2018-ONLINE.pdf
- Western Regional Climate Center. (1929-2016). *Interior Alaska Climate Summary.* Retrieved from wrcc.dri.edu: https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak2968
- NOAA. (2022). *National Center for Environmental Information State Climate Summaries.*
- ACRC. (2022). *Alaska State Climate Center, Fairbanks*.[Data] Retrieved from: http://akclimate.org/climate-change-in-alaska/
- FEMA. (2023). *FEMA Hazard Definitions*. Retrieved from: fema.org.
- University of Alaska Fairbanks Earthquake Center. (2023, May 30). *2022 Seismicity Year in Review*. Retrieved from: https://earthquake.alaska.edu/2022-seismicity-year-review
- Grabinski, Z. (2020). *Alaska Changing WIldfire Environment*. Retrieved from: https://uaf-iarc.org/alaskas-changing-wildfire-environment/#:~:text=Finally%2C%20as%20the%20season%20winds,mid%2DJune%20to%20early%20July
- Disaster Mitigation Act of 2000 (106th Congress 2000).
- Alaska Administrative Code 17. (n.d.). Retrieved from: https://casetext.com/regulation/alaska-administrative-code/title-17-transportation-and-public-facilities/chapter-05-administration/section-17-aac-05120-statewide-transportation-planning-process
- CFR Title 23. (n.d.). *Code of Federal Regulations*. Retrieved from: https://www.ecfr.gov/current/title-23/chapter-I/subchapter-E/part-450?toc=1
- CFR Title 23 Part 450.206(a)(9). (n.d.). Retrieved from: https://www.ecfr.gov/current/title-23/chapter-I/subchapter-E/part-450/subpart-B/section-450.206
- FHWA. (2023). *Bipartisan Infrastructure Law*. Retrieved: from fhwa.dot.gov: https://www.fhwa.dot.gov/bipartisan-infrastructure-law/climate.cfm
- CFR Title 23 Part 450.216. (n.d.). Retrieved from: https://www.ecfr.gov/current/title-23/chapter-I/subchapter-E/part-450/subpart-B/section-450.216
- Alaska DOT&PF. (2022). *Alaska's 2050 Long Range Transportation Policy Plan Update - Alaska Moves.*
- Alaska DOT&PF. (2016). *Alaska's 2036 Long Range Transportation Policy Plan Update - Let's Keep Moving 2036.*
- 44 CRF 206.401. (n.d.). *National Archives*. Retrieved from: https://www.ecfr.gov/current/title-44/chapter-I/subchapter-D/part-206/subpart-N
- FEMA. (2022). *State Mitigation Planning Policy Guide.* Retrieved from: https://www.fema.gov/sites/default/files/documents/fema_state-mitigation-planning-policy-guide_042022.pdf
- 44 CFR 201.6. (n.d.). Retrieved from: https://www.ecfr.gov/current/title-44/chapter-I/subchapter-D/part-201/section-201.6
- FEMA. (2023). *Summary of FEMA Hazard Mitigation Assistance (HMA) Programs*. Retrieved from: https://www.fema.gov/fact-sheet/summary-fema-hazard-mitigation-assistance-hma-programs
- FEMA. (2023). *BRIC Direct Technical Assistance*. Retrieved from: https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/direct-technical-assistance

APPENDIX 1: RESILIENCY WORKING GROUP MEETING SUMMARY

Working Group Meeting No. 3

Wednesday, August 16, 2023, 10:00 a.m. – 12:00 p.m., via Zoom

Meeting Objective

To provide working group members with an update on the Interior Alaska Transportation Plan (IATP) and discuss resiliency as it is associated with transportation infrastructure within the IATP planning area. The goal is to identify the most prominent risks within the identified planning area and identify key infrastructure locations that are at risk.

Attendees

Name	Organization
Sara Lucey, Project Manager	Department of Transportation and Public Facilities
Brett Nelson, Environmental Manager	Department of Transportation and Public Facilities
Yvonne Adams, Regional Planner	Department of Transportation and Public Facilities
Randi Bailey, Fairbanks Area Planner	Department of Transportation and Public Facilities
Adison Spafford, Commissioner's Office	Department of Transportation and Public Facilities
Jessica Smith, Project Manager	DOWL
Jessica Herceg, Assistant Project Manager	DOWL
Morgan McCammon, Project Communications Lead	DOWL
Jovie Garcia, Project Communications Support	DOWL
Talli Vittetoe, Project Communications Support	DOWL
Kendal Ramage, Transportation Planner	DOWL
Kate Silber, Land Use Planner	DOWL
Joy Huntington, Public Involvement Lead	Uqaqti Consulting
Lindsay Johnson, Public Involvement Support	Uqaqti Consulting
Megan Flory, Community and Sustainability Planner	RESPEC
Marie Schmidt, Environmental Analyst	RESPEC
Jackson Fox, Executive Director	Fairbanks Area Surface Transportation Planning
Erin Shine, Staff	Senator Bishop's Office
Billy Connor, Director	University of Alaska Fairbanks Arctic Infrastructure Development Center
Clay Walker, Mayor	Denali Borough
Don Galligan, Transportation Planner	Fairbanks North Star Borough

Cary Fremin, Director of Health and Social Services	Village of Dot Lake
Sarah Obed, Lands and Natural Resources	Doyon, Limited
Cheyenne Dibert, Government and Rural Affairs Coordinator	Doyon, Limited
Cheyenna Kuplack, Communications Manager	Doyon, Limited
Fred Dahl, Chitina EPA/IGAP Director	Native Village of Chitina
Marina Evans, Transportation Manager	Tanana Chiefs Conference
Melanie Herbert, Executive Director	Gwichyaa Zhee Gwich'in (Fort Yukon) Tribal Government

Agenda

10:00 am	Welcome, Land Acknowledgement, Introductions, Housekeeping	Joy Huntington / Sara Lucey
10:10 am	What is Resiliency in Alaska's Interior Planning Area Transportation?	Joy Huntington / Sara Lucey
10:20 am	Risks to Infrastructure in IATP Planning Area	Kendal Ramage
10:30 am	Resiliency Mitigation Strategies	Jessica Smith
10:40 am	Breakout Group Discussions	Joy Huntington
11:30 am	Reconvene as a Large Group to Discuss	Joy Huntington
11:50 am	Action Items and Next Steps	Joy Huntington

Acronyms

Department of Transportation and Public Facilities	DOT&PF
Fairbanks North Star Borough	FNSB
Bureau of Land Management	BLM
Interior Alaska Transportation Plan	IATP

Summary

Joy Huntington, Uqaqti Consulting, welcomed participants, introductions from the project team and participants, reviewed general housekeeping items for Zoom, shared the land acknowledgement, and presented an update on the project schedule.

Joy presented an overview of transportation resiliency in Alaska and welcomed Sarah Lucey, Department of Transportation and Public Facilities (DOT&PF) Project Manager, to share her perspective on resiliency. Sarah discussed that transportation resiliency in Interior Alaska is a strategic investment area for the Commissioner and a frequent topic of discussion at DOT&PF. There is the need to plan resiliency and mitigation strategies for the next twenty years.

Adison Spafford, Commissioner's Office, asked participants to think about resiliency from and Alaskan perspective and commented that this effort would feed into the statewide resiliency plan. She expressed the need for resiliency plans to be realistic, especially for rural Alaska. She added that the Commissioner's Office has access to a legislative liaison and asked that participants consider topics within resiliency that need to be addressed in the next legislative session.

Joy opened the discussion to participants by asking "What does resilient transportation infrastructure in Interior Alaska look like?"

Clay Walker, Mayor of the Denali Borough, responded that resiliency is both organizational and institutional and added that plans need to be in place for emergencies, as well as appropriate physical infrastructure. What advanced planning have your done as an organizational, ready? In terms of infrastructure, engineering, and design, referencing the earthquake 20-years ago, the pipeline was engineered to withstand the 8+ earthquake. Increase the resiliency of infrastructures.

Sarah Obed, Doyon Limited, responded that community communication is important, especially for requesting repairs on roads and infrastructure and when/where it will be scheduled/happen. She emphasized that with position turnover, there needs to be clear guidelines on who oversees various regions within the Interior. She provided an example, Elliott Highway – who's overseeing the region, area, the quality, and attention to road work, ensuring communication is open between DOT&PF and the community.

Adison mentioned FEMA, assisting with funding on repairs. She suggested a policy discussion and is interested in the participants input.

Cary Fremin, Dot Lake Village, responded that communication is especially important in these situations. Each community is so unique and that community needs are different from each other. Listen to what the communities have to say. Sometimes over-communication is the key, especially in emergency situations, make sure that everyone is on the same page. Sometimes it seems like State and Government Agencies are very siloed and they don't communicate very well to each other which trickles down and doesn't communicate to the communities either. Be more transparent and over-communicate when a situation arises.

Yvonne Adams, DOT&PF Regional Planner (originally from Ruby), shared an example of a fire incident outside of Ruby, where the Bureau of Land Management (BLM) contacted her needing to borrow specialized equipment to help fight the fire. It took a lot of effort, work, and you must be flexible in these situations. There was a lot of communication between her department, BLM, and the tribe. If you don't help each other, you won't survive, there's has to be a willingness to be community and tribal minded in the sense of looking out for each other – be a team player.

Kendal Ramage, DOWL Transportation Planner, discussed the 'Risks to Interior Alaska's Transportation Infrastructure.' The project team identified some of the top hazards that exist in the Interior. She provided a basic overview for the following risks:

FLOODING

- Occurs in the spring and summer seasons.
- Rivers and water bodies can't handle the increased amount of water and spill over into infrastructure. Richardson Highway Bear Creek Washout.
- Recent flooding in Glennallen area.

WILDFIRES

- Summers continue to get hotter and drier.
- The heat/fire causes destruction to the infrastructure.
- Fire and thick smoke cause visual impairments to drivers on the road, whether or not the fire is local.
- Wildfire rages cross dirt road of interior Kobe Ag, July of 2022.

PERMAFROST

- Unique to the Alaska climate.
- Freeze/thaw cycle: Ice under roadways and other existing infrastructure undergoes freeze / thaw cycles. Roads become bumpy and creates rutting in the roads.
- Costly to fix, repaving and depending on how deep the permafrost.

EARTHQUAKES

- Seismic activity is frequent in Alaska and infrastructure can become damaged and needs to be planned and ready for.
- Earthquakes creates hazards, avalanches, mudslides, landslides, snow/ice, etc.
- Pipelines in the 2002 Denali Fault Earthquake experienced minor damage because of improved infrastructure.

EROSION

- Dalton Highway wash out is currently happening.
- Rivers continue to get closer to roadways.
- Dredging is a mitigation operation to assist in removing silt from river erosion.

Jessica Smith, DOWL Project Manager, discussed the three Resiliency Mitigation Strategies and Strategies Not Requiring Relocation, responding to risks and how would we approach diverse types of emergency situations:

1. Protect in Place: Focuses on engineering solutions that keep the threat at a manageable level. Prepare for an event and ready to stay where we are (Short to Mid-Term)
2. Accommodate: Enhances the infrastructure in a way that allows the threat to continue but keeps extreme damage from happening. (Mid to Long-Term)
3. Managed Retreat: Requires moving infrastructure away from the threat completely often after attempting other mitigation efforts. (Long-Term)

Breakout Group Discussion & Summaries

Attendees were grouped in a "breakout group" according to representative geography. The geography groupings included:

- Yukon Flats
- Upper Tanana
- Copper River
- Middle Yukon / Fairbanks
- Denali Borough

Each break out group included a facilitator and note taker from the project team. The objective of the breakout was to give smaller groups the opportunity to discuss specific risks to the infrastructure in each respective geographic region.

The breakout groups identified the location of infrastructure at risk to a hazard event, level of risk to the identified infrastructure, priority, recommended mitigation strategy, and any potential actionable ideas by the breakout group. The following summary tables include summaries of the breakout groups' discussions and decisions.

YUKON FLATS: HAZARD AND INFRASTRUCTURE RISK AND PRIORITY IDENTIFICATION					
IDENTIFY HAZARD	**RISK LEVEL**	**IDENTIFY INFRASTRUCTURE**	**PRIORITY LEVEL**	**MITIGATION STRATEGY**	**POTENTIAL ACTION**
Wildfire Wildfire - Closer to the communities	Medium	Roads – Fire could jump road, visibility. Communications, utilities	Medium High	Protect in place Managed retreat/protect in place	For all areas, be proactive and promote better policy and coordination with community leadership.
Flooding	High	Roads, equipment, structures	High	Protect in place	Proactively engage in improving policy and fostering collaboration with community leaders
Erosion	Medium	Homes, structures	High	Accommodate	For all areas, we need to be proactive and promote better policy and coordination with community leadership.
Earthquake	Low	Homes, structures, roads, utilities	High	Protect in place	Proactively engage in improving policy and fostering collaboration with community leaders
Permafrost	Medium/High	Roads	Medium	Accommodate	Take initiative to enhance policy development and collaboration with community leaders.

UPPER TANANA: HAZARD AND INFRASTRUCTURE RISK AND PRIORITY IDENTIFICATION					
IDENTIFY HAZARD	**RISK LEVEL**	**IDENTIFY INFRASTRUCTURE**	**PRIORITY LEVEL**	**MITIGATION STRATEGY**	**POTENTIAL ACTION**
Wildfire – Dot Lake, Sand Lake	High	Blocks access to Tok, major medical center, no other access around.	High	Close contact with Forestry, weather, and wind information. Structured and appropriate community communication - few homes have phones.	Small camp monitoring fires.
Flooding	Undecided	Johnson River and Roberson River Bridges – would be cut off from health care and goods/services if inaccessible	High	Accommodate	Replace older bridges.
Emergency Communication Systems	Undecided	Unknown	Undecided	Unknown	Track lessons learned; Share as much information as possible

COPPER RIVER: HAZARD AND INFRASTRUCTURE RISK AND PRIORITY IDENTIFICATION					
IDENTIFY HAZARD	**RISK LEVEL**	**IDENTIFY INFRASTRUCTURE**	**PRIORITY LEVEL**	**MITIGATION STRATEGY**	**POTENTIAL ACTION**
Flooding O'Brien and Hidden Creek near the Edgerton Highway Glennallen Copper River	Medium to high risk – flooding occurs annually, but not to the extent experienced this past year.	Recent culverts were added to protect existing infrastructure.	High priority	Protect in Place Accommodate	Undecided.
Erosion Copper `River McCarthy Road to Kennecott	Low to medium risk	Highway comes close to the river in several locations and creates undercutting and severe drainage problems. Weak points in the asphalt due to annual freeze/ that cycles.	High priority – one highway in and out of communities.	Protect in Place Accommodate	Undecided.
Wildfires	High risk	Limited emergency transportation access via road or air. Poor air quality due to smoke.	Low to medium priority	Protect in Place	Additional maintenance opportunities. Additional road access spots. Improved evacuation routes. Air transportation facilities.

MIDDLE YUKON / FAIRBANKS: HAZARD AND INFRASTRUCTURE RISK AND PRIORITY IDENTIFICATION					
IDENTIFY HAZARD	**RISK LEVEL**	**IDENTIFY INFRASTRUCTURE**	**PRIORITY LEVEL**	**MITIGATION STRATEGY**	**POTENTIAL ACTION**
Wildfire (random), all throughout Interior. Climate change, lightning strikes, challenges with access to the large-remote areas, high winds	High	Active fires on Elliott and Richardson Hwy, main highways. Structure protection – overhead powerlines, communications (cut off). Yearly fires in the Anderson areas.	High	Accommodate	Bury power/communication lines, underground, less risk to the fires. Actively clearing the brush to wider area – fire break to prevent jumping the hwy. Develop an evacuation plan/strategy – where to go, what to do
Earthquake	High	Deficient bridges that may not hold earthquakes. Anything built on fill – review/develop construction methods on fill sites.	High	Accommodate	Replace bridge, earthquake seismic retrofits
Bridges	High	Yearly construction on bridges – repairing cracks on major bridges.	High	Accommodate	Assessment and Maintenance
Flooding	High	Circle area damage. Impacts to housing.	High	Accommodate	Plan and prepare in the rural villages. Review the standards for flooding elevation (2-3 ft).
Permafrost	High	Building homes – needs assistance with where/how to build these homes. Roadways – continue to be built in these areas, cannot get away from it. I.e., Chena Hot Springs Rd, Old Steese Hwy	High	Accommodate	Plan and prepare in the rural villages. Doyon supports planning groups – Climate change and mitigation programs to help prevent. DOTPF yearly overlays asphalt in the dips.

MIDDLE YUKON / FAIRBANKS: HAZARD AND INFRASTRUCTURE RISK AND PRIORITY IDENTIFICATION					
IDENTIFY HAZARD	**RISK LEVEL**	**IDENTIFY INFRASTRUCTURE**	**PRIORITY LEVEL**	**MITIGATION STRATEGY**	**POTENTIAL ACTION**
		(yearly frost heaves, summer dips)			
Erosion	High	Riverbanks	Undecided	Accommodate Protect in Place	Plan and prepare in the rural villages

DENALI BOROUGH: HAZARD AND INFRASTRUCTURE RISK AND PRIORITY IDENTIFICATION					
IDENTIFY HAZARD	**RISK LEVEL**	**IDENTIFY INFRASTRUCTURE**	**PRIORITY LEVEL**	**MITIGATION STRATEGY**	**POTENTIAL ACTION**
LANDSLIDE @ Nenana River/Canyon	Medium/High	HWY/Rail	Undecided.	Unknown.	Unknown.
MUDSLIDE	Medium/High	Unknown.	Undecided.	Unknown.	Unknown.
AVALANCHE	Undecided.	Power	Undecided.	Unknown.	Unknown.
Earthquake	Medium	Glitter Gulch Bridge	High	Accommodate	Infrastructure and Design
Flooding	High	Dry Creek Infrastructure	Undecided.	Accommodate	Gravel extraction
Ice Jams, Anderson	High	Community of Anderson Dyke	Undecided.	Protect in Place	M&O Asset Management?
Wildfires	Medium/High	Unknown.	Undecided.	Protect in Place	Community programs? Awareness? Collaboration with federal

APPENDIX 2: FEMA NATIONAL RISK INDEX

YUKON FLATS AND MIDDLE YUKON/FAIRBANKS SUBREGION

YUKON FLATS

Yukon-Koyukuk Census Tract 1 – 02290000100 (Arctic Village, Venetie, Beaver, Fort Yukon, Chalkyitsik, Birch Creek, Circle, Central)

Yukon-Koyukuk Census Tract 1

COMMUNITIES INCLUDED: Arctic Village, Venetie, Beaver, Fort Yukon, Chalkyitsik, Birch Creek, Circle, Central						
Social Vulnerability: Very High Community Resilience: Very Low Community Risk Factors: 1.76						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Flooding	$373,638	$659,259	1.5 events	36	1996-2019 (24 years)	97.4
Wildfire	$276,823	$488,439	0.722% chance	N/A	2021 Dataset	98.1
Cold Wave	$123,543	$217,983	.9 events	15	2005-2021 (16 years)	99.4
Avalanche	$61,612	$108,710	0 events	1	1960-2019 (60 years)	38.9
Earthquake	$15,136	$26,706	.266% chance	N/A	2021 Dataset	64.3
Winter Weather	$2,065	$3,644	4.2 events	69	2005-2021 (16 years)	68
Ice Storm	$140	$246	0 events	1	1946-2014 (67 years)	8.9

Risk Index

The risk index for Y-K Census Tract 1 identified from the FEMA NRI report generated in 2023 was 81.24 which FEMA considers a "relatively moderate" risk index. This overall risk index considers the risk index assigned for all identified hazards for Y-K Census Tract 1.

Social Vulnerability

Census Tract 1 in the Y-K census area is identified as having a social vulnerability score of 88.99 which is categorized as very high susceptibility to facing adverse impacts following a natural hazard.

Community Resilience

Y-K Census Tract 1 received a community resilience score of 0.95, which indicates a very low ability to prepare, adapt, and rebound from changing conditions. This community resilience score is lower than 97 percent of census tracts across Alaska.

YUKON FLATS/MIDDLE YUKON

Census Tract 2 — 02290000200 — Coldfoot, Steven Village, Livengood, Rampart, Minto, Nenana, Four Mile Road, Manley Hot Springs, Tanana

Yukon-Koyukuk Census Tract 2

COMMUNITIES INCLUDED: Coldfoot, Stevens Village, Livengood, Rampart, Minto, Nenana, Four Mile Road, Manley Hot Springs, Tanana						
Social Vulnerability: Very High Community Resilience: Very Low Community Risk Factors: 1.76						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Flooding	$845,612	$1,487,760	1.5 events	36	1996-2019 (24 years)	98.9
Wildfire	$247,947	$435,720	0.832% chance	N/A	2021 Dataset	97.9
Avalanche	$61,612	$108,271	0 events	1	1960-2019 (60 years)	38.7
Earthquake	$60,461	$106,248	0.531% chance	N/A	2021 Dataset	78.2
Cold Wave	$37,616	$66,103	.6 events	10	2005-2021 (16 years)	96.1
Winter Weather	$3,191	$5,608	4.9 events	80	2005-2021 (16 years)	76.2
Ice Storm	$191	$336	0	1	1946-2014 (67 years)	11.6

Risk Index

The risk index for Y-K Census Tract 2 identified from the FEMA NRI report generated in 2023 was 88.9, which FEMA considers as relatively moderate. This identified risk index considers the risk index scores assigned to all identified hazards within the census tract.

Social Vulnerability

Census Tract 2 in the Y-K census area is identified as having a social vulnerability score of 88.67, which is categorized as very high susceptibility to facing adverse impacts following a natural hazard.

Community Resilience

Y-K Census Tract 2 is identified as having a very low ability to prepare, adapt, and rebound from changing conditions by having a community resilience score identified as 0.95. This community resilience score is lower that 99 percent of community resilience scores for census tracts across the U.S. and 97 percent of census tracts across Alaska.

MIDDLE YUKON/FAIRBANKS

Fairbanks North Star Borough (Fairbanks, North Pole, For Wainwright, Eielson)

Fairbanks North Star Borough

COMMUNITIES INCLUDED: Fairbanks, North Pole, Fort Wainwright, Eielson AFB						
Social Vulnerability: Relatively Moderate Community Resilience: Relatively Moderate Community Risk Factors: 1.08						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Wildfire	$11,056,562	$10,895,490	0.997% chance	N/A	2021 Dataset	97.9
Earthquake	$8,551,433	$10,338,607	0.632% chance	N/A	2021 Dataset	95
Cold Wave	$1,119,510	$1,251,367	0.2 events	3	2005-2021 (16 years)	94.6
Flooding	$603,367	$631,564	1.1 events	27	1996-2019 (24 years)	56.3
Ice Storm	$9,558	$10,829	0 events	1	1946-2014 (67 years)	19.6
Winter Weather	$2,646	$2,955	3.4 events	55	2005-2021 (16 years)	4.7

Risk Index

The risk index for Fairbanks North Star Borough (FNSB) identified from the FEMA NRI report generated in 2023 was 82.4 which FEMA considers as “relatively low risk.” This overall risk index considers the risk index scores assigned for all identified hazards for FNSB.

Social Vulnerability

FNSB is identified as having a social vulnerability score of 52.64 which is categorized as relatively moderate susceptibility to facing adverse impacts following a natural hazard.

Community Resilience

FNSB received a community resilience score of 51.69 which is categorized as relatively moderate. This reflects FNSB being relatively moderate in their ability to prepare, adapt, and rebound to changing conditions.

UPPER TANANA SUBREGION

The Southeast Fairbanks Census Area (SE FBX) is identified as 022400 and is composed of multiple Census Tracts, two of which contain communities identified within the limits of the IATP area. These Census Tracts were identified as Census Tract 1 and Census Tract 4 and are represented by 02240000100 and 02240000400. Although both Census Tracts are within the same regional Census Area, they are represented by different risk indexes, EALs, social vulnerabilities, and community resilience scores.

SE FBX Census Tract 1 – 02240000100 (Eagle, Eagle Village, Chicken, Northway, Alcan Boarder, Tetlin, Tok, Tanacross, Dot Lake, Dot Lake Village, Dry Creek)

Southeast Fairbanks Census Tract 1

COMMUNITIES INCLUDED: Eagle, Eagle Village, Chicken, Northway, Alcan Boarder, Tetlin, Tok, Tanacross, Dot Lake, Dot Lake Village, Dry Creek						
Social Vulnerability: Relatively High Community Resilience: Very Low Community Risk Factors: 1.42						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Wildfire	$1,602,113	$2,273,191	1.28% chance	N/A	2021 Dataset	99.7
Avalanche	$485,151	$688,366	0.1 events	6	1960-2019 (60 years)	80
Earthquake	$47,745	$67,745	0.560% chance	N/A	2021 Dataset	74.8
Cold Wave	$7,087	$10,056	0.3 events	4	2005-2021 (16 years)	76.8
Ice Storm	$173	$245	0 events	0	1946-2014 (67 years)	8.9
Winter Weather	$49	$70	3.4 events	55	2005-2021 (16 years)	20.8

Risk Index

The risk index for SE FBX Census Tract 1 identified from the FEMA NRI report generated in 2023 was 93.4, which FEMA categorizes as “relatively high risk.” This overall risk index considers the risk index assigned for all identified hazards for SE FBX Census Tract 1.

Social Vulnerability

SE FBX Census Tract 1 is identified as having a social vulnerability score of 72.57 which is categorized as “relatively high susceptibility” to facing adverse impacts following a natural hazard.

Community Resilience

SE FBX Census Tract 1 received a community resilience score of 6.8, which indicates a very low ability to prepare, adapt, and rebound from changing conditions.

Census Tract 4 — 02240000400 — Healy Lake, Deltana, Fort Greely, Delta Junction, Big Delta, Whitestone

Southeast Fairbanks Census Tract 4

COMMUNITIES INCLUDED: Healy Lake, Deltana, Fort Greely, Delta Junction, Big Delta, Whitestone						
Social Vulnerability: Relatively High Community Resilience: Very Low Community Risk Factors: 1.42						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Wildfire	$2,797,342	$3,977,719	0.533% chance	N/A	2021 Dataset	99.9
Avalanche	$485,151	$689,867	0.1 events	6	1960-2019 (60 years)	80.2
Earthquake	$439,165	$624,476	0.886% chance	N/A	2021 Dataset	88
Flooding	$233,017	$331,342	0.7 events	17	1996-2019 (24 years)	94.6
Cold Wave	$12,111	$17,221	0.3 events	5	2005-2021 (16 years)	83.8
Ice Storm	$391	$557	0 events	0	1946-2014 (67 years)	17.4
Winter Weather	$79	$112	3.9 events	63	2005-2021 (16 years)	22.7

Risk Index

The risk index for SE FBX Census Tract 4 identified from the FEMA NRI report generated in 2023 is 98.1, which FEMA categorizes as “very high risk.” This overall risk index considers the risk index assigned for all identified hazards for SE FBX Census Tract 4.

Social Vulnerability

SE FBX Census Tract 4 is identified as having a social vulnerability score of 72.8, which is categorized as “relatively high susceptibility” to facing adverse impacts following a natural hazard.

Community Resilience

SE FBX Census Tract 4 received a community resilience score of 6.8, which indicates a “very low” ability to prepare, adapt, and rebound from changing conditions.

DENALI BOROUGH SUBREGION

The Denali Borough is its own Census Area that contains a single Census Tract identified as 02068000100. This Census Tract represents Anderson, Healy, Ferry, Denali Park, and Cantwell.

Denali Borough Census Area

COMMUNITIES INCLUDED: Anderson, Healy, Ferry, Denali Park, Cantwell						
Social Vulnerability: Relatively Moderate Community Resilience: Very Low Community Risk Factors: 1.09						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Avalanche	$758,667	$824,561	0.2 events	10	1960-2019 (60 years)	82.5
Wildfire	$557,069	$605,453	0.529% chance	N/A	2021 Dataset	98.5
Earthquake	$332,497	$361,375	1.20% chance	N/A	2021 Dataset	84.9
Cold Wave	$4,389	$4,770	0.2 events	3	2005-2021 (16 years)	67.1
Ice Storm	$153	$166	0 events	0	1946-2014 (67 years)	6.3
Winter Weather	$35	$39	3.2 events	51	2005-2021 (16 years)	19

Risk Index

The risk index for the Denali Borough census area identified from the FEMA NRI report generated in 2023 is 85.1, which FEMA categorizes as “relatively moderate risk.” This overall risk index considers the risk index assigned for all identified hazards for the Denali Borough census area.

Social Vulnerability

The Denali Borough census area is identified as having a social vulnerability score of 41.7, which is categorized as “relatively moderate susceptibility” to facing adverse impacts following a natural hazard.

This social vulnerability score of 41.7 is the highest seen across all areas analyzed within the IATP area. Some factors that contribute to boosting this score include mitigation programs in place, the existing HMP, and active and educated community.

Community Resilience

The Denali Borough census area received a community resilience score of 11.8, which indicates a very low ability to prepare, adapt, and rebound from changing conditions.

Census Tract 4 – 02290000400 – Lake Minchumina

Yukon-Koyukuk Census Tract 4

COMMUNITIES INCLUDED: Lake Minchumina						
Social Vulnerability: Very High Community Resilience: Very Low Community Risk Factors: 1.83						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Wildfire	$158,697	$290,677	0.812% chance	N/A	2021 Dataset	97
Flooding	$117,263	$214,784	1.5 events	36	1996-2019 (24 years)	91.9
Avalanche	$61,612	$112,851	0 events	1	1960-2019 (60 years)	39.8
Earthquake	$12,387	$22,689	0.582% chance	N/A	2021 Dataset	61.5
Cold Wave	$5,356	$9,810	0 events	0	2005-2021 (16 years)	76.5
Winter Weather	$3,058	$5,651	6.1 events	99	2005-2021 (16 years)	76.3
Ice Storm	$135	$247	0 events	0	1946-2014 (67 years)	8.9

Risk Index

The risk index for Y-K Census Tract 4 identified from the FEMA NRI report generated in 2023 was 57.4, which FEMA considers as “relatively low risk”. This overall risk index considers the risk index assigned for all identified hazards for Y-K Census Tract 4.

Social Vulnerability

Census Tract 4 in the Y-K census area is identified as having a very high susceptibility to facing adverse impacts following a natural hazard. Although the social vulnerability category assigned is equal to that of Y-K Census Tracts 1 and 2, this social vulnerability score (92.04) is higher than those identified in both Census Tracts 1 and 2 for the same Census Area.

Community Resilience

Census Tract 4 in the Yukon-Koyukuk Census Area is identified as having a very low ability to prepare, adapt, and rebound from changing conditions by having a community resilience score identified as 0.95. This community resilience score is lower that 99 percent of community resilience scores for Census Tracts across the U.S. and 97 percent of Census Tracts across Alaska.

COPPER RIVER SUBREGION

A single Census Tract within the Copper River Census Area contains all of Copper River Census Area and communities identified within the IATP study area. This Census Tract is Census Tract 1 identified as 02066000100.

Copper River Census Area

COMMUNITIES INCLUDED: Paxson, Mentasta Lake, Slana, Chistochina, Nebesna, Gakona, Glennallen, Tolsona, Mendeltna, Nelchina, Tazlina, Copper Center, Silver Springs, Willow Creek, Kenny Lake, Tonsina, Chitina, Chisnana, McCarthey						
Social Vulnerability: Relatively High Community Resilience: Relatively Moderate Community Risk Factors: 1.27						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (Per Year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Earthquake	$255,829	$324,972	.905% chance	N/A	2021 Dataset	84.3
Wildfire	$94,825	$120,453	.076% chance	N/A	2021 Dataset	94.4
Avalanche	$36,967	$46,958	0 events	0	1960-2019 (60 years)	8
Volcanic Activity	$28,373	$36,042	0 events	1	9310BC – 2022 (11331 years)	54
Winter Weather	$1,915	$2,433	1 event	16	2005-2016 (16 years)	59.7
Ice Storm	$460	$584	0 events	0	1946-2014 (67 years)	18.1

Risk Index

The risk index for the Copper River census area identified from the FEMA NRI report generated in 2023 is 50, which FEMA categorizes as “relatively low risk.” This overall risk index considers the risk index assigned for all identified hazards for the Copper River census area.

Social Vulnerability

The Copper River census area is identified as having a social vulnerability score of 66.2, which is categorized as “relatively high susceptibility” to facing adverse impacts following a natural hazard.

Community Resilience

The Copper River Census Area was identified as having a community resilience score of 58.9, which is identified as being “relatively moderate” in the ability to prepare, adapt, and rebound from changing conditions.

Matanuska-Susitna Borough

A single community, identified as Lake Louise, within the IATP study area exists within the Matanuska-Susitna (Mat-Su) Borough. This community is found within Census Tract 2, identified as 02170000102. This Census Tract contains other communities such as Talkeetna, which borders Denali State Park and is not included within the IATP area. For consistency and due to the size of the community of Lake Louise, viewing the National Risk Index scores through the lens of the Census Tract was most beneficial.

Matanuska-Susitna Census Tract 2

COMMUNITIES INCLUDED: Lake Louise						
Social Vulnerability: Relatively Moderate Community Resilience: Very Low Community Risk Factors: 1.14						
Hazard	**Expected Annual Loss**	**Risk Value**	**Estimated Annualized Frequency (per year)**	**Historical Occurrence**	**Period of Record Provided**	**Risk Index Score**
Avalanche	$1,823,094	$2,083,478	0.4 events	25	1960-2019 (60 years)	94.9
Earthquake	$712,008	$814,843	1.11% chance	N/A	Based on 2021 Data	89.7
Flooding	$237,590	$271,524	0.3 events	7	1996-2019 (24 years)	93.5
Wildfire	$71,396	$81,593	0.051% chance	N/A	Based on 2021 Data	93.1
Ice Storm	$317	$363	0 events	0	1946-2014 (67 years)	12.4
Winter Weather	$77	$87	2.2 events	35	2005-2021 (16 years)	21.7

Risk Index

The risk index for Mat-Su Census Tract 2 identified from the FEMA NRI report generated in 2023 is 94.2, which FEMA categorizes as “relatively high risk.” This overall risk index considers the risk index assigned for all identified hazards for Mat-Su Census Tract 2.

Social Vulnerability

Mat-Su Census Tract 2 is identified as having a social vulnerability score of 47 which is categorized as “relatively moderate susceptibility” to facing adverse impacts following a natural hazard.

Community Resilience

Mat-Su Census Tract 2 received a community resilience score of 4.4, which indicates a very low ability to prepare, adapt, and rebound from changing conditions.

APPENDIX 3: SNAP PERMAFROST RISK ASSESSMENT TABLE

SNAP conducted permafrost risk assessments for communities in rural Alaska, many of which are found within the IATP area. The following definitions are important in understanding the identified SNAP permafrost risks for the identified communities – located in table on the next page.

SNAP Permafrost Risk Levels for Specified IATP Area Communities

Community	Massive Ice	Thaw Susceptibility	Existing Problems	Occurrence	Temp.	Rating	Assigned Permafrost Risk Level
Chistochina	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Isolated (1)	Warm (3)	7	Low
Chitina	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	10	Medium
Copper Center	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Isolated (1)	Warm (3)	7	Low
Gakona	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Isolated (1)	Warm (3)	7	Low
Gulkana	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	10	Medium
Mentasta Lake	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Isolated (1)	Warm (3)	7	Low
Tazlina	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Isolated (1)	Warm (3)	7	Low
Eagle	Sparse: Ice wedges & buried ice (2)	Medium (2)	Moderate (2)	Discontinuous (2)	Cool (2)	10	Medium
Northway	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Discontinuous (2)	Warm (3)	8	Low
Tanacross	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	10	Medium
Tetlin	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Discontinuous (2)	Warm (3)	8	Low
Arctic Village	Sparse: Ice wedges & buried ice (2)	Medium (2)	Moderate (2)	Continuous (3)	Cool (2)	11	Medium
Beaver	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	10	Medium
Birch Creek	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Discontinuous (2)	Warm (3)	8	Low
Chalkyitsik	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Discontinuous (2)	Warm (3)	8	Low
Circle	Sparse: Ice wedges & buried ice (2)	High (3)	Moderate (2)	Continuous (3)	Warm (3)	13	High
Fort Yukon	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	10	Medium
Minto	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Isolated (1)	Warm (3)	7	Low
Manley Hot Springs	Sparse: Ice wedges & buried ice (2)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	11	Medium
Nenana	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Isolated (1)	Warm (3)	7	Low
Rampart	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Continuous (3)	Warm (3)	11	Medium
Stevens Village	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	10	Medium
Tanana	Absent: No massive ice (1)	Medium (2)	Moderate (2)	Discontinuous (2)	Warm (3)	10	Medium
Venetie	Absent: No massive ice (1)	Low (1)	Minimal or Minor (1)	Discontinuous (2)	Warm (3)	8	Low