Cantwell to Healy – Parks Highway Milepost 203-259 Planning & Environmental Linkages Study

Project No. NFHWY00492

Needs and Opportunities Assessment Report

Prepared for:

Federal Highway Administration Western Federal Lands Highway Division

In partnership with:

Alaska Department of Transportation and Public Facilities
National Park Service

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Contents

Figures

Appendices

Acronyms and Abbreviations

AADT	annual average daily traffic
ADF&G	Alaska Department of Fish and Game
AHRS	Alaska Heritage Resource Survey
DNP	Denali National Park and Preserve
DOT&PF	Alaska Department of Transportation and Public Facilities
Jacobs	Jacobs Engineering Group Inc.
M&O	maintenance and operations
MP	milepost
mph	mile(s) per hour
NPS	National Park Service
PAC	project advisory committee
PEL	Planning and Environmental Linkages
WFL	Western Federal Lands

Executive Summary

The Federal Highway Administration (FHWA) Western Federal Lands (WFL) Highway Division, Alaska Department of Transportation and Public Facilities (DOT&PF) Northern Region, and National Park Service (NPS) are working together to identify potential future transportation and access improvements along the Parks Highway corridor between Broad Pass at milepost (MP) 203 and the turnoff to Ferry at MP 259. This effort is being conducted through a Planning and Environmental Linkages[1] (PEL) study.

The Parks Highway is one of the most important corridors in Alaska for commerce, recreation, tourism, and community connection. The highway provides the most direct hard surface link from the Anchorage area in southcentral Alaska to Fairbanks in the interior. A significant feature along this corridor is Denali National Park and Preserve (DNP), for which the sole road into the park is accessed from MP 237 of the Parks Highway. While there are many other significant features along the corridor, including several communities, the Alaska Railroad, and an abundance of recreational opportunities, it is visitors and travelers associated with DNP that heavily influence the corridor.

This report reflects the results of the first phase of the PEL study, which was to identify the existing and projected corridor conditions, needs, and opportunities of the Parks Highway as it relates to users and communities of the 56-mile corridor. The PEL study team conducted several activities between March and July 2020 to identify needs and opportunities along the corridor, the results of which are summarized in the subsequent sections of this report and detailed further in the appendices. These activities included reviewing existing data and prior plans; conducting field visits; and obtaining input from the public, agencies, and stakeholders through an advisory committee. Appendix A contains a comprehensive list of the comments, issues, needs and opportunities that were submitted and identified. The other appendices contain the following:

- Review of Prior Plans for the Corridor and Region Memorandum (Appendix B)
- A summary of the first public meeting (June – July 2020 online open house) (Appendix C)
- Traffic and Safety Memorandum (Appendix D)
- Maintenance and Operations Existing Concerns and Needs Report (Appendix E)
- Recreational Facilities Memorandum (Appendix F)
- Economic Impact Assessment Memorandums (Appendix G)
- Baseline Area Drainage Analysis Memorandum (Appendix H)
- Baseline Geological and Geotechnical Assessment Memorandum (Appendix I)
- Environmental Conditions Memorandum (Appendix J)

The study team categorized the identified issues, needs, and opportunities into the following broad categories: safety, roadway conditions/maintenance, mobility, access, recreation, and other topics such as stewardship, education, and economic development. The following represents an overview of the main themes of the identified needs and opportunities.

- Improve safety
- Address roadway conditions and maintenance issues (caused by factors such as erosion, drainage, frost heaves, rockfall hazards, and slope instability)

[1] The FHWA defines PELs as “a collaborative and integrated approach to transportation decision-making that 1) considers environmental, community, and economic goals early in the transportation planning process, and 2) uses the information, analysis, and products developed during planning to inform the environmental review process.” *(Source: https://www.environment.fhwa.dot.gov/env_initiatives/PEL.aspx)*

- Reduce congestion
- Improve mobility for all transportation modes
- Balance the needs of all users (includes local residents, visitors/ tourists, through travelers, freight, non-motorized, and recreational uses)
- Separate motorized and non-motorized uses where reasonable
- Improve existing recreation access areas
- Accommodate increased recreation and tourism demands, in turn to support the economic vitality of the region
- Promote stewardship and knowledge of the intrinsic values of the area (i.e., the values associated with the highway's scenic bypass designation such as natural, recreational, scenic, historical and cultural values)
- Leverage partnerships to benefit project development and implementation

The information gleaned during this first phase will inform the next step of the PEL study process. The next phase will entail identifying and developing potential improvement options to address the identified needs and opportunities. These options will be evaluated and screened for consideration as recommendations to be moved forward for future implementation. The final PEL study will include a framework for implementing future transportation improvements along the corridor.

1. Introduction

1.1 Planning and Environmental Linkages Study Overview

The Cantwell to Healy Parks Highway milepost (MP) 203-259 Planning and Environmental Linkages (PEL) Study was initiated in 2019 with the intent to provide an opportunity to collaborate and engage local, regional, and community stakeholders in a transportation planning process to plan for future highway corridor and access improvements. The result of this planning process will yield a documented plan framework that guides future enhancements and transportation projects along the Parks Highway corridor between Broad Pass at MP 203 and the turnoff to Ferry at MP 259.

This study process includes identifying current and future conditions, needs, and opportunities of the Parks Highway as it relates to users and communities along this 56-mile corridor. A significant feature along this corridor is one of America's Crown Jewels – Denali National Park and Preserve (DNP). The sole road into DNP connects to the Parks Highway at MP 237 and approximately seven miles of the Parks Highway traverses park land.

To bring partnering agencies and the community together to collaboratively plan for future highway corridor improvements, the Alaska Department of Transportation and Public Facilities (DOT&PF) Northern Region obtained Federal Lands Access Program funding from the Federal Highway Administration Western Federal Lands (WFL) Highway Division in partnership with the National Park Service (NPS). Together, these three partnering agencies are preparing this PEL study to provide an implementation plan for future highway corridor improvement projects.

This PEL study is a planning-level process that looks at transportation issues, solutions and environmental considerations. The final PEL study results will be used by the project partners to help implement future highway corridor improvement projects. PEL studies are conducted and intended to facilitate streamlining the project development process by helping to move projects forward from the planning phase into the environmental review process, thereby better "linking" planning and environmental project phases. Analysis and decisions made in this study may be used to inform future National Environmental Policy Act processes and may be incorporated by reference.

This report summarizes the results from the first phase of the PEL study process: assessing needs and opportunities along the highway corridor. This report summarizes existing and projected future conditions and the needs and opportunities identified during outreach with key stakeholders and the public.

PEL Study Desired Outcomes

- A clear and actionable PEL study that guides future enhancements and development on the Parks Highway corridor.
- A PEL process that brings together local, regional, and community stakeholders for a comprehensive multi-modal look at recent, active, and future improvements along this corridor.

PEL Study Goals

- Collect, compile, and analyze information about the conditions and concerns along the corridor to support the identification of individual projects.
- Conduct field studies (condition reports, maintenance concerns, public concerns) and compile data already collected (crash information, deficient curves, bridge conditions) that will focus the areas of greatest attention and anticipate future needs to address.
- Develop and evaluate possible solutions to the concerns identified.
- Identify distinct projects, cost estimates, and timelines of project implementation to effectively address concerns in a timely manner.

1.2 Study Area Setting

The Parks Highway is one of the most important corridors in Alaska for commerce, recreation, tourism, and community connection. The 323-mile-long Interstate highway generally runs parallel and to the east of the Alaska Railroad mainline, both of which complement the economic development of the region and beyond. The Parks Highway serves as the primary[2] north-south roadway link, connecting the state's largest city and port in southcentral Alaska to the northern interior of Alaska and beyond to the North Slope oil and gas fields in Prudhoe Bay (Figure 1). Also known as the George Parks Highway or Alaska Route 3, the Parks Highway begins 35 miles north of Anchorage and terminates in Fairbanks. The Parks Highway is functionally classified as a rural interstate highway and is part of both the National Highway System and the Interstate Highway System.[3]

Figure 1. Study Area in State Context

Primary users of the Parks Highway corridor in the study area include local residents, travelers, freight, people accessing adjacent lands and waterways for recreation and other uses like subsistence or wildlife viewing, and tourists visiting DNP and other related attractions. Commercial trucks use this highway route year-round to deliver supplies and freight from Anchorage to Fairbanks and other surrounding communities. There is also a notable amount of cargo transported for the Trans-Alaska Pipeline and other North Slope development along this route. Truck traffic comprises nearly 20% of traffic along the study corridor.

This PEL study focuses on a 56-mile segment of the Parks Highway, beginning in Broad Pass at the Denali Borough boundary (MP 203) and extending north to the turnoff for Ferry (MP 259) (Figure 2). The corridor passes through the Alaska Range, which separates southcentral Alaska from interior Alaska.

[2] While an alternate highway route is available from Southcentral Alaska to Interior Alaska, it is longer and less direct: the Glenn Highway extends from Anchorage northeast to Glennallen, where the Richardson Highway is picked up and extends north to the Alaska Highway at Delta Junction which extends west to reach Fairbanks. This more circuitous route adds an additional 60 miles and traverses via an interstate, minor arterial, and interstate, respectively.

[3] An interstate highway is the highest classification of roadways in the United States. Interstate highways are intended to provide the highest level of mobility and the highest speeds over the longest uninterrupted distance.

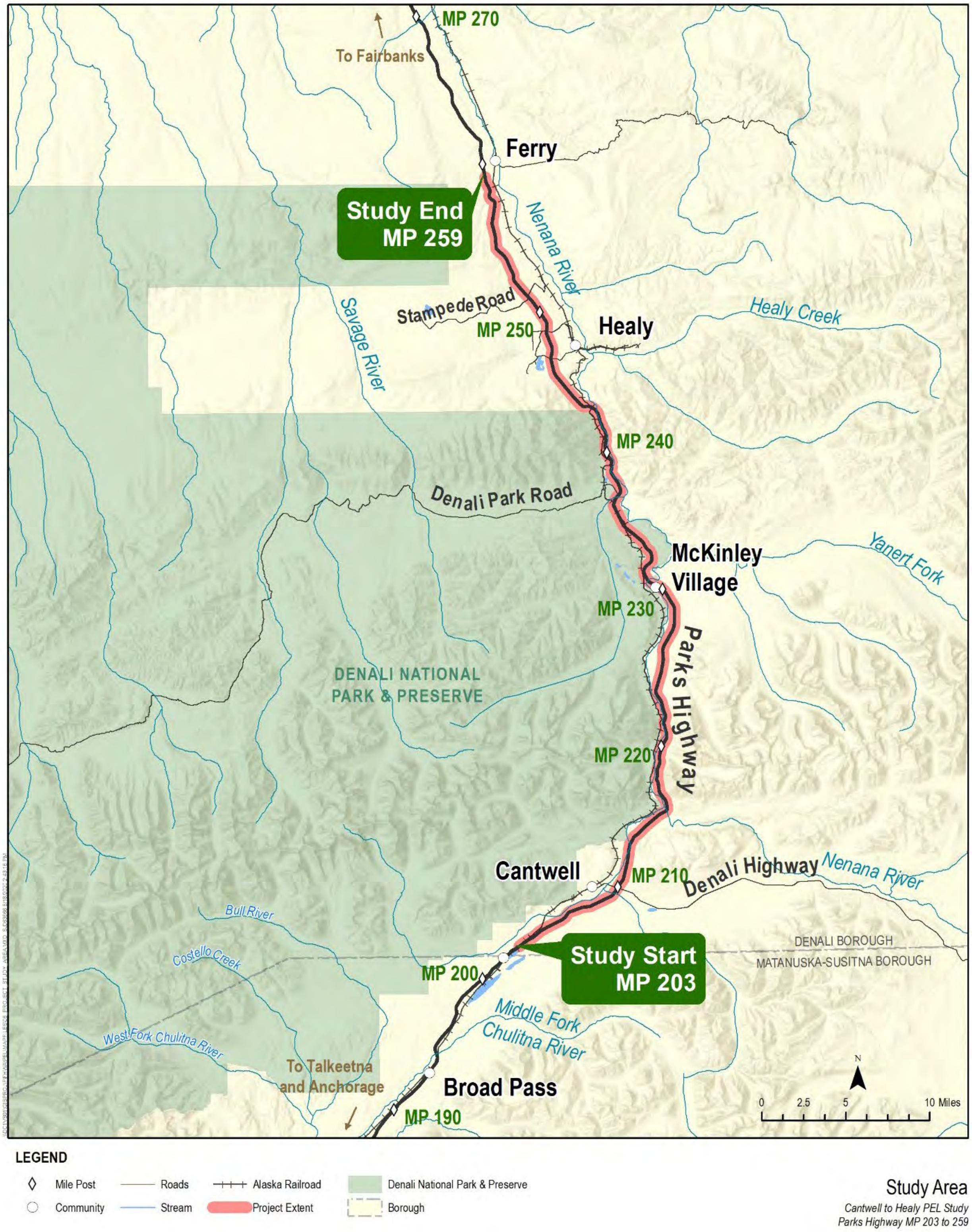


Figure 2. Study Area

The Parks Highway along with the Alaska Railroad provide intermodal access to the study area, which includes several year-round communities and other pockets of small development spread along the corridor. The corridor also contains a handful of private and public-use airports, of which the latter consists of the NPS-owned McKinley National Park Airport near the DNP entrance and State-owned Healy River Airport, located in Healy. Aircraft operations at these two airports consist mostly of general aviation and air taxis. Collectively, this infrastructure caters to the seasonal tourism and visitor industry, as well as providing access to other recreational lands and activities, local game units, private lands, native allotments, and subsistence resources.

While nearly 75 percent of the study corridor runs adjacent to the eastern boundary of DNP, there is only one roadway into DNP—the Denali Park Road—which connects to the Parks Highway at MP 237. This sole hard surface gateway into DNP has resulted in a substantial amount of seasonal tourism development and infrastructure built up along the highway corridor to the south and north of MP 237. The approximate 2-mile stretch extending north from MP 237 through Nenana Canyon is often (and some would state reluctantly) referred to as “Glitter Gulch”. During the summer, traffic along the study corridor increases substantially, nearly doubling, because of tourism associated with DNP. This increase in traffic and visitors results in safety, mobility, and congestion issues, but also fuels the region’s economy. In recent years, the study corridor has seen an increase in winter and shoulder season recreation and tourism. The NPS is currently analyzing how to accommodate for these types of increased shoulder season activities and visitation at DNP.

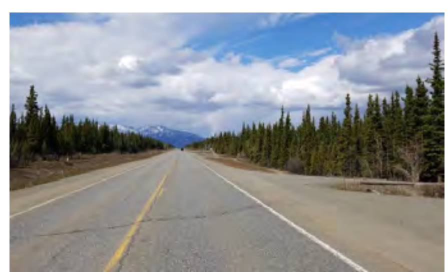
Glitter Gulch (MP 239) in early May 2020; normally bustling but the pandemic shuttered most businesses during the 2020 summer season

Originally constructed between the late 1960s and early 1970s, the Parks Highway was officially completed in 1971. It was initially called the Anchorage-Fairbanks Highway. Before 1971, the Alaska Railroad served as the primary access point to DNP from the early 1900s. Today, visitors to DNP arrive largely by the Parks Highway or the Alaska Railroad, which generally parallels the Parks Highway corridor. The opening of the Parks Highway resulted in a tremendous increase in travelers to DNP and the corridor (see DNP visitation numbers in Section 2.4.1.2 of the Economic Technical Memo #2 in Appendix G).

Accommodation and service signs, Cantwell (MP 210)

The Denali Highway is another notable roadway connecting to the Parks Highway in the southern end of the study corridor in Cantwell near MP 210. In the northern end of the study corridor, Healy Spur Road (MP 248) and Stampede Road/Lignite Road (MP 251) are other notable roadways connecting to the Parks Highway.

The Parks Highway provides access to the year-round communities of Cantwell (MP 210), McKinley Village (MP 231), Healy (MP 248), and Ferry (MP 259). The Carlo Creek area (MP 224) sees substantial seasonal visitors and tourist congestion in the summer months. These communities and pockets of development along the corridor have resulted in numerous driveways directly accessing the highway.



Several stretches along the corridor contain numerous driveways directly connecting to the highway, such as this photo depicting driveways near MP 229

The existing highway alignment generally consists of a two-lane paved highway with additional lanes periodically to accommodate passing, climbing, and turning lanes. The highway corridor traverses lands owned by the State of Alaska, NPS, Ahtna, Inc., and private property. Other corridor features include the Nenana River, which also generally parallels the highway for most of the study corridor. River rafting on the Nenana River is one of many recreational activities drawing visitors to the area. The corridor provides access to an abundance of recreational activities.

The entire 56 miles is designated as an Alaska State Scenic Byway, portions of which were designated in 1998 (MP 203-248) and in 2008 (MP 248-259). The corridor was designated a National Scenic Byway in 2009. The six intrinsic values related to scenic byways – archaeological, natural, cultural, recreational, historic, and scenic – are found in the corridor, with the natural and recreational opportunities considered "world-class".

1.3 Study Process

Figure 3 depicts the PEL study process, which is broken into the following three phases over a nearly 2-year timeframe:

- Assess needs and opportunities
- Develop improvement options
- Prepare draft/final PEL study

The project partners have placed a high priority on seeking input from stakeholders, other partners, and the public throughout the duration of the study as depicted in the process graphic.

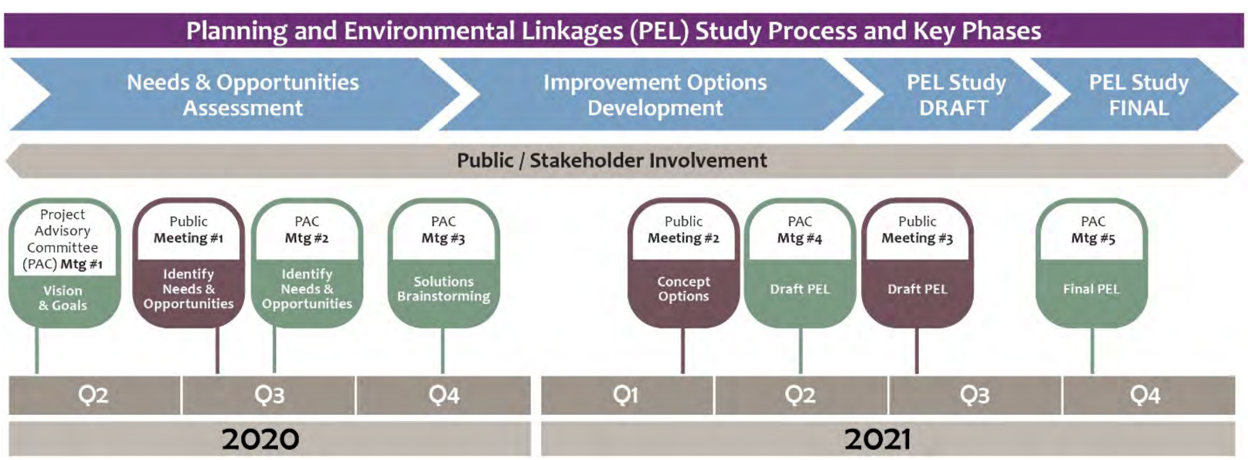


Figure 3. Cantwell to Healy PEL Study Process

This report summarizes the key results from the first phase in the study process.

2. Identified Corridor Needs and Opportunities

2.1 Methods for Identifying Needs and Opportunities

The study team—comprised of the project partners (WFL, DOT&PF, and NPS) and consultant team led by Jacobs Engineering Group Inc. (Jacobs), who was retained by WFL to assist with the PEL study —conducted the following activities between March and July 2020 to identify and assess the needs and opportunities within the study corridor:

- Reviewed existing data and prior plans for the corridor and region
- Conducted field visits
- Conducted outreach with agencies, stakeholders (through a project advisory committee [PAC]) and the public to seek input
- Prepared several memorandums documenting existing and projected future corridor conditions (Appendices B, D-J)

Based on these activities, the study team compiled a comprehensive list of identified needs and opportunities in the study corridor (see Appendix A). This list contains both general corridor-wide comments as well as comments regarding specific locations along the corridor. Supporting documents that helped to identify corridor conditions, needs, and opportunities are contained in the Appendices B-J and summarized in the following report sections 3-5.

2.2 Identified Needs and Opportunities Overview

The study team categorized all the identified needs, opportunities, and issues detailed in Appendix A into the following broad categories: safety, roadway conditions/maintenance, mobility, access, recreation, and other topics such as stewardship, education, and economic development. The following are the main themes of the identified needs and opportunities, as further detailed in the subsequent sections of this report and in the appendices.

- Improve safety
- Address roadway conditions (caused by factors such as erosion, drainage, frost heaves, rockfall hazards, and slope instability)
- Reduce congestion
- Improve mobility for all transportation modes
- Balance the needs of all users (includes local residents, visitors/ tourists, through travelers, freight, non-motorized, and recreational uses)
- Separate motorized and non-motorized uses where reasonable
- Improve existing recreation access areas
- Accommodate increased recreation and tourism demands, in turn to support the economic vitality of the region
- Promote stewardship and knowledge of the intrinsic values of the area
- Leverage partnerships to benefit project development and implementation

The word clouds in Figure 4 graphically portray the frequency with which the identified needs and opportunities by theme were reported. The larger font size reflects greater frequency.

Figure 4. Graphic Representation of Identified Needs and Opportunities Based on Category Theme and Source

3. Prior Plans for the Corridor and Region

Previously prepared plans and studies provide context for understanding the corridor conditions. These prior plans also provide insight on relevant stakeholders' organizational values and previously identified visions, goals, needs, opportunities, and proposed projects for the corridor. The study team recognizes the importance of collaborating with stakeholders and building upon and incorporating work that has been done previously, where applicable and to the extent possible. In light of prior planning efforts, the project partners decided to come together to conduct a PEL study that would leverage partnerships to more easily and efficiently move projects forward. A key benefit of conducting a PEL study is that partner agencies, communities and stakeholders are engaged together earlier in the project delivery process. Also, PELs are intended to help promote efficient and cost-effective solutions that can be more easily streamlined through project delivery and implementation because the planning and environmental phases are better linked.

The study team reviewed the following studies and plans. A detailed summary of relevant content of each report is included in Appendix B.

- Denali Park Realignment (MP 344-348) Feasibility Study (ARRC 2018)
- Denali National Park Long Range Transportation Plan (NPS 2018)
- Denali Borough Land Use and Economic Development Plan (Denali Borough 2018)
- State Rail Plan (DOT&PF 2016)
- Denali Borough Healy Transportation and Pedestrian Safety Plan (Denali Borough 2016)
- Denali Borough Comprehensive Plan (Denali Borough 2015)
- Parks Highway National Scenic Byway Master Interpretative Plan (DNR 2012)
- George Parks Highway Scenic Byway Corridor Partnership Plan (DNR 2008)
- Parks Highway Visioning Document (DOT&PF 2006)
- Tanana Basin Area Plan for State Lands (DNR 1991)

Common themes in these plans and studies include the following:

- Establish and leverage partnerships
- Improve existing and create new recreation access areas
- Improve roadway safety, including adding turning lanes
- Add pathways, particularly along the highway for mobility, connectivity, access, safety, and/or recreation
- Promote a culture of safety and mutual respect among user groups, including motorized and non-motorized
- Importance of tourism and outdoor recreation that drives communities and borough economy
- Support and expand tourism industry

Past, present, and already-planned DOT&PF projects in the study corridor are listed in the *Maintenance and Operations Existing Concerns and Needs Report* (Appendix E).

4. Public Involvement and Stakeholder Outreach

The Parks Highway is a key corridor that serves a variety of highway users and stakeholder needs and interests. Because of the COVID-19 pandemic in 2020, public and stakeholder outreach activities during the needs and opportunities assessment phase were conducted virtually.

4.1 Project Advisory Committee

At the onset of the outreach process for this PEL study, a PAC was formed to guide project development and build consensus on corridor needs and opportunities, appropriate solutions, and final project selection. The PAC includes representatives from the following stakeholder organizations:

- Ahtna, Inc.
- Alaska Railroad
- Alaska Travel Industry Association
- Denali Borough
- Denali Citizen's Council
- DOT&PF Maintenance and Operations
- DOT&PF Traffic and Safety
- NPS
- Trucking industry representative

The study team held two PAC meetings during this phase of the study. The first PAC meeting was held April 15, 2020, and included exercises related to understanding PAC organizations' shared values and respective PAC organizational vision statements and brainstorming potential goal statements for the PEL Study. The second PAC meeting was held July 21, 2020. Before the second meeting, PAC members completed a questionnaire ranking goal-related statements generated from the previous meeting as well as a potential PEL study vision statement. During PAC Meeting #2, each PAC member described their top three needs and opportunities for the corridor.

As depicted on Figure 4, the needs, issues, and opportunities identified by the PAC members were largely related to access, safety, mobility, economic activity generation, and improving recreation opportunities. PAC members identified the following top needs and opportunities:

- Improve safety conditions along the highway (e.g., address issues such as seasonal congestion, conflict points, and pedestrian crossings in dense areas)
- Improve connectivity and access between DNP and the corridor
- Eliminate the at-grade railroad crossing at MP 235
- Expand DNP frontcountry recreational opportunities (e.g., provide tourism congestion relief, spur additional economic activity)
- Improve non-motorized facilities
- Enhance facilities at pull-outs
- Maintain the scenic quality of the highway (e.g., promote stewardship of the land)
- Balance the needs of all users, which includes local residents, visitors/ tourists, through-travelers (e.g., freight), non-motorized, and recreational
- Balance corridor improvements with fiscal responsibility, given projected limited funding

4.2 Public Involvement

In an effort to ensure public safety during the COVID-19 pandemic, a month-long online open house was hosted in lieu of in-person meetings originally slated for Cantwell, Healy, and Denali National Park. The dedicated online open house period from June 25 to July 25, 2020 provided ample opportunity for the public to explore the current conditions along the corridor and to identify needs or opportunities that could be addressed by future projects. Public comments will continue to be solicited for the duration of the study.

General public notification activities during this phase included a project website[4] with an ArcGIS-based comment form to geospatially reference comments. Focused media efforts to promote the virtual open house included:

- Email invitations sent to a listserv of approximately 220 names
- Print newsletters sent to a comprehensive list of mailing addresses in the study area
- Posters displayed in public locations in Cantwell and Healy
- Updates provided in the DOT&PF Daily News Coverage emails and social media posts.

During the dedicated online open house there were 355 visitors to the open house website. Fifty people submitted responses producing approximately 110 unique comments during the advertised month-long window. Approximately half of the comments were safety related; one-quarter were related to highway condition and recreation, and the remaining one-quarter addressed other topics such as access and economic development. See Appendix C for a detailed summary of the virtual public meeting and comments. Needs and opportunities themes from the comments included:

- Requests for turning lanes, bike paths, and pedestrian pathways or cross walks
- Requests to emphasize or enforce the speed limit
- Support for eliminating the at-grade railroad crossing
- Concerns about roadway condition
- Suggestions for specific rest area locations with amenities (e.g., educational displays, viewing areas and restroom facilities)

4.3 Agency and Tribal Outreach

The DOT&PF sent a letter to local, state and federal resource agencies, Tribes and Native Corporations on June 8, 2020, soliciting input and informing them of the PEL study. Several agencies expressed their interest to stay involved in the study process and offered data regarding baseline conditions in the study area including contaminated sites and bald eagle nest locations.

[4] http://dot.alaska.gov/nreg/parkshealypel/

5. Existing and Projected Conditions

The existing and projected conditions provides the study team, stakeholders, and the public with the baseline to help determine what needs and opportunities exist in the study area, forming the foundation for why this PEL study is being conducted (i.e., goals to accomplish and projects to implement). This section provides a brief summary of all the memorandums the study team completed during this phase of the study, which are included as appendices. Refer to the appendices for more details on each topic. All corridor-wide and specific locations of identified needs, opportunities, and issues are included in the comprehensive needs and opportunities list in Appendix A.

5.1 Traffic and Safety

The *Traffic & Safety Memorandum* (July 20, 2020) (Appendix D) prepared for this study summarizes existing and projected traffic and safety conditions. Key topics addressed include the following:

- Existing and projected traffic levels
- Vehicle crash history between 2013 and 2017
- Roadway geometry
- Access management issues in developed areas along the corridor (i.e., need for turning lanes)
- Conflicting needs of roadway users (i.e., balancing mobility and providing access for travelers)
- Accommodation of motorized and non-motorized uses, including pedestrian safety particularly during the peak summer tourist season
- Eliminating two highway/rail crossings (MP 235 and 236.5)

The highway traverses along physical constraints such as the Nenana River and mountainous terrain, which results in numerous horizontal and vertical roadway curves and reduced posted speeds in those locations. (Refer to crash and geometry maps located in the Traffic & Safety memo). There are many stretches where a clear zone is not available along the highway because of rock cut slopes and guardrail protecting vehicles from the river. Road conditions are impacted by seasonal frost heaves and several areas are prone to hazards such as rockfall. Other safety concerns include the need to eliminate two highway/rail crossings.

CORRIDOR SNAPSHOT

Traffic and safety

- Corridor traffic nearly doubles during the summer
  - Annual average daily traffic (AADT): 1,100-2,000 vehicles
  - AADT: 2,200-4,300 vehicles in the peak summer
- Trucks comprise 20% of total traffic
- One-third of vehicle crashes involved wildlife
- September and January have high vehicle crash rates
- Two seasonal traffic light signals in Glitter Gulch (MP 238-239)
- Seasonal reduced speed limits in congested locations

Sampling of identified needs and opportunities

MP 231 is one of several locations where pedestrians cross the highway to access commercial facilities

Balancing the mobility needs of through-traffic with slower traffic accessing developed areas

Glitter Gulch (MP 238-239) is the major services hub for DNP tourism, as there are limited services within the park itself. Over the years, tourist support services have spread farther south and north along the Parks Highway that created pockets of higher density development: south to Carlo Creek (MP 224) and McKinley Village (MP 231) and north toward Healy (MP 248). Identified issues in these pocket areas include seasonal congestion, lack of turning lanes, and numerous driveways/ direct highway access points. Seasonal employees are increasingly housed in these further locations, which necessitates regular travel to/from the DNP entrance and these locations.

Glitter Gulch becomes congested between May and September, with facilities shuttering for the winter. Lack of adequate parking causes vehicles to encroach into the road right-of-way. This area is also constrained by the Nenana River and Canyon, further limiting the ability to accommodate new development and pushing it elsewhere along the corridor.

This memo also summarizes recent, already-constructed DOT&PF highway safety improvement projects in the corridor.

5.2 Maintenance and Operations

The DOT&PF maintenance and operations (M&O) crew prepared the *Maintenance and Operations Existing Concerns and Needs Report* (July 24, 2020) (Appendix E), which identifies and evaluates M&O needs and concerns along the corridor. Report contents includes corridor infrastructure, highway usage, existing conditions, and suggestions for future improvements. (Refer to Figures 3 and 4 in the M&O memo for a geographical depiction of the M&O concerns). Key M&O issues include the following:

- Rockslides and drainage issues around Nenana Canyon (MP 239 – 240)
- Alaska Railroad/Parks Highway at-grade crossing maintenance at MP 235
- Drainage issues resulting in damage to both the road base and road surface
- Sections of sinking roadway, some areas dropping annually
- Inadequate roadway shoulders in some locations

CORRIDOR SNAPSHOT

DOT&PF maintenance and operations

- Corridor is serviced by two DOT&PF M&O stations
  - MP 203-230: Cantwell M&O station
  - MP231-259: Healy M&O station
- DOT&PF maintains 22 bridges
  - DOT&PF currently recommends five bridges for specific bridge work
- M&O staff deal with issues such as erosion, permafrost, bedrock constraints, rockfall hazards, inadequate drainage, sinking of the roadway, parking issues, inadequate roadway shoulders, and frost heaves resulting in roadway damage

Sampling of identified needs and opportunities

The at-grade railroad crossing at MP 235 requires a lot of attention by M&O crews. This photo also illustrates a motorist unsafely pulled off onto the narrow roadway shoulder.

Rockfall, drainage, and sediment build up are continuous issues along the highway in Nenana Canyon (MP 239-240)

- Parking issues around Nenana Canyon businesses during summer from tourism traffic
- Annually returning problems with uneven and bumpy areas along the highway

Roadway damage related to frost heaves can be found throughout the study corridor as well as drainage issues. Patching roadway surface damage is one of the major M&O costs.

Another specific location requiring substantial past maintenance and costs is near MP 240, where repairs were made because of high water scour along the riverbank of the Nenana River that runs alongside the roadway.

The highway through the Nenana Canyon (MP 239 –MP 240) requires continual maintenance and safety attention that the DOT&PF M&O crews address. This section has rockslides that regularly reach the roadway, resulting in sediment buildup that causes drainage issues and accessibility issues for resolving these drainage issues.

The at-grade railroad crossing at MP 235 also requires a lot of attention by M&O crew, as it causes damage to snow removal equipment, in addition to issues associated with pavement and roadway integrity. The area at the crossing also consists of poor soil conditions.

5.3 Recreational Facilities

The *Recreational Facilities Memorandum* (July 23, 2020) (Appendix F) prepared for this study provides inventory and usage information for recreational facilities and key recreational access points along the study corridor and identifies future recreation and access improvement needs. Existing recreational facilities include DNP, campgrounds, trailheads, boat launches, and wilderness areas, as well as pull-outs that provide access to areas for dispersed recreational activities (e.g., off-trail hiking, snow machining, backcountry skiing, wildlife viewing, berry picking, hunting, and fishing). The Nenana River and other corridor waterways also provide opportunities to river raft, canoe, kayak, and fish.

DNP draws the highest concentration of recreation visitors along the Parks Highway

CORRIDOR SNAPSHOT

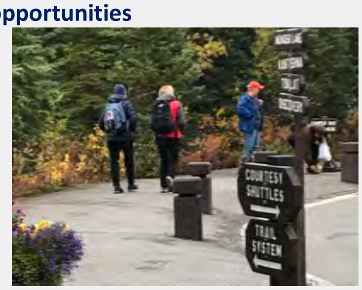
Recreational facilities *

- DNP entrance at MP 237
- 13 campgrounds / RV parks
- 30 distinct vehicle access points along the corridor, such as paved or gravel pull-outs and parking areas
- 11 public and private boat launches (in addition to other unmaintained/ informal boat pull-outs)
- 31 hiking trails/ trailheads
- 3 Alaska Fish & Game Management Subunits

** includes facilities accessed from the highway (i.e., located within DNP)*

Sampling of identified needs and opportunities

Providing safe recreation access, such as access improvements at Bison Gulch (MP 243.8)



Improving safety, connectivity and easing congestion for DNP travelers and visitors and provides access to world-class scenery and recreational resources. In the study area, there are 30 paved or gravel vehicle access points (e.g., pull-outs and parking areas) for recreational opportunities or rest for motorists. There are more than a dozen campgrounds and RV parks, numerous maintained and informal hiking trails, and several private and public boat launch points and put-ins (both developed and undeveloped).

The use of recreational sites within the corridor has grown steadily over the past several decades. The area has experienced an increase in seasonal visitation to DNP, including an increase in off-season tourism. A growing tourism industry presence and an increasing popularity among recreationists has resulted in an increased demand for recreational access. Identified needs and opportunities related to recreation include the following:

- Providing trail connectivity
- Constructing pathways separating motorized from non-motorized users
- Enhancing the safety of existing recreational access points at trailheads and roadway pull-outs
- Creating new access points in part to relieve congestion at existing areas

5.4 Economic Impact Assessment

Two memorandums were prepared for this study with the intent of developing a planning-level economic impact assessment that will be used to guide in the prioritization of the site development and regional cooperation for leveraging public lands resources. The first memorandum is a literature review of quantitative economic methods used to value the effects of travel and visitation at national parks whose characteristics are similar to DNP (Appendix G: *Commonly Accepted Methods for Estimating the Economic Value of Recreational Travel and Visitation Literature Review Memorandum* [July 2, 2020].) The second memorandum provides a characterization of the study area's (Denali Borough) existing demographics and economic activity generators, identifies future economic opportunities, and includes estimates of the total economic contribution or impact of DNP (Appendix G: *Existing Economic Activity Generators and Future Economic Opportunities Memorandum* [July 29, 2020]).

The highway study corridor falls within the boundary of the Denali Borough. The Borough characterizes its economic base as a "three-legged stool," referring to the borough's dependence on resource development, military spending, and tourism. While resource development and military spending are important in providing year-round, well paid jobs, the contribution of these two sectors is small relative to the tourism sector.

Figure 5 shows the distribution of the real 2018 annual industry income for Denali Borough and the state of Alaska. The real annual industry income generated in the borough economy by tourism-related sectors and military spending are shown separately while the income in all other sectors have been combined. This is because data on the resource development sector (i.e., the mining, oil & gas extraction sector) which forms the borough's third leg of its economic base are not separately published at the borough level. Figure 5 shows that tourism and military spending account for more than one-third (37%) of the borough's total annual industry income while these two sectors account for only 11% of the state's total annual industry income. Including the annual industry income in the resource development sector at the state level increases this percentage to 19%. Thus, this graphic demonstrates the important role that tourism plays in the borough's economy compared to this sector's role at the state level.

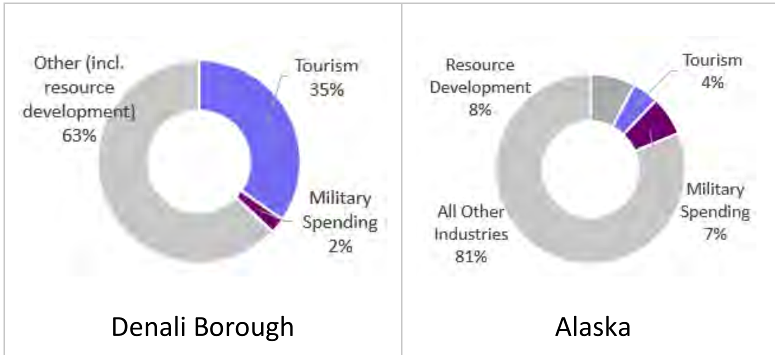


Figure 5. Distribution of Real Annual Income by Industry in 2018, Denali Borough and Alaska

Figure 6 shows the distribution of the annual industry employment in 2018 for Denali Borough and the state of Alaska. The annual industry employment in the tourism-related sectors and military spending sector are shown separately while the employment in all other sectors have been combined for the borough. This is because data on the resource development sector (i.e., the mining, oil & gas extraction sector) which forms the third leg of the borough's economic base are not separately published at the borough level. Figure 6 shows that tourism and military spending account for 52% of the borough's total annual industry employment while these two sectors account for only 16% of the state's total annual industry employment. Including the employment in the resource development sector at the state level increases this percentage to 20%. Again, this demonstrates the important role that tourism plays in the borough's economy compared to this sector's role at the state level.

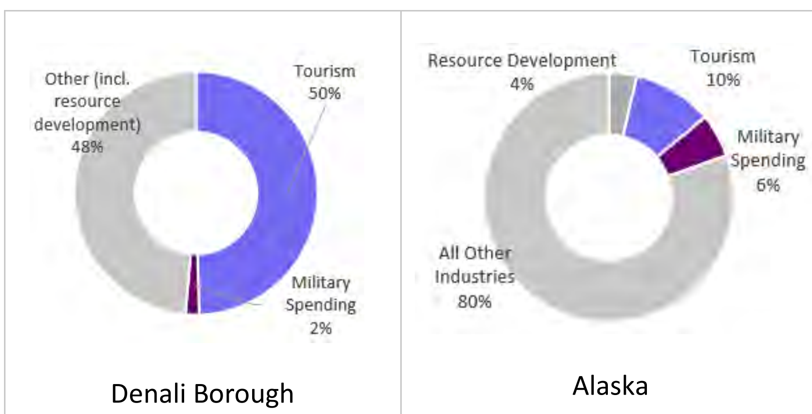


Figure 6. Annual Employment by Industry in 2018, Denali Borough and Alaska

Tourism in the borough is centered around exploring DNP and surrounding scenic and recreational areas. The economic effects of travel and visitation to DNP on the corridor and region (and state) is evidenced by DNP visitors spending more than $600 million in 2019. DNP is clearly a key economic driver in the borough. Seasonal tourism, largely from DNP visitation, provides a central role in the corridor and area's economy. The relatively isolated economy of the DNP area means that the economy of this region is heavily reliant on the tourism industry. DNP visitors spend money in the Parks Highway corridor, which in turn supports jobs, labor income, and additional economic output in the borough. While there are other economic activity generators in the Denali Borough (such as Usibelli Coal Mine and Golden Valley Electric Association), DNP visitation and associated spending are vital to the region. Currently, the

Borough's tax revenue sources are overnight accommodation (i.e., bed tax) and severance tax, which further highlights the importance of the visitor industry.

With the opening of the Parks Highway in 1971, visitation to DNP began to increase substantially compared to previous decades. Visitation doubled between 1971 and 1972, going from 44,500 visitors to 88,625. In recent years, visitation has continued to increase, going from 364,019 visitors in 2000 to 601,152 in 2019.

The Parks Highway is a vital transportation corridor that provides access to key economic generators within the borough, region and state; this includes the heavily visited DNP as well as providing a thoroughfare for trucks traveling to support the state's oil and gas fields.

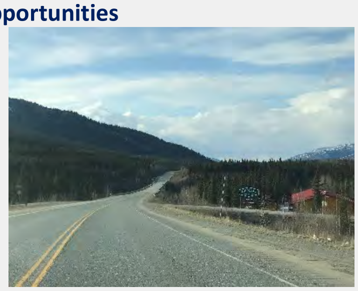
CORRIDOR SNAPSHOT

Economics

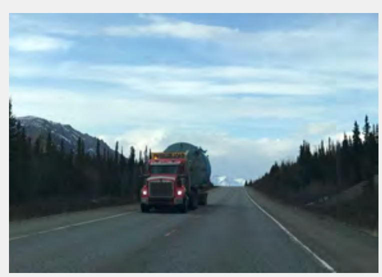
- DNP is a key economic generator
  - 600,000+ visitors to DNP spent $600+ million and supported nearly 7,500 jobs in 2019
- Services and recreation jobs in 2018:
  - 50% of total Borough industry jobs fall in two subsectors: Accommodation/Food Services and Arts/Entertainment/Recreation.
  - At the state level, these two subsectors comprise only 10% of total jobs.
- Borough unemployment is noticeably tied to DNP season:
  - 2019 summer unemployment rate: below 5%
  - 2019 winter unemployment rate: above 20%
- Winter recreation and tourism is increasing in the corridor
- The Parks Highway is one of the state's most critical freight corridors

Sampling of identified needs and opportunities

Summer is both tourist and construction season (near Healy)



A variety of needs have been identified at McKinley Village (MP 231), related to safety and recreation connectivity. Some enhancements are already planned.



The Parks Highway is a critical freight corridor, which includes supporting traffic headed to/from Prudhoe Bay

5.5 Baseline Area Drainage Conditions

Drainage issues are a fairly common problem faced by DOT&PF maintenance crews in the study corridor. The *Baseline Area Drainage Analysis Memorandum* (July 10, 2020) (Appendix H) prepared for this study looked at significant river crossings and other drainage features to identify failures related to culvert end conditions, erosion around culvert end treatments, inherent geomorphic conditions around bridge crossings, and locations where the highway embankment is adjacent to river/stream channels.

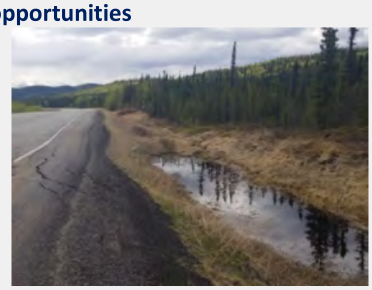
CORRIDOR SNAPSHOT

Baseline area drainage conditions

- Highway crosses more than 2 dozen significant streams
- 200+ culverts located along the highway
- Drainage issues can cause roadway damage
- Nenana River is the only navigable waterway identified in the corridor, per the U.S. Coast Guard and U.S. Army Corps of Engineers definitions

Sampling of identified needs and opportunities

The braided Nenana River pushes the main channel against the roadway corridor near MP 223



Ponding at low points adjacent to the roadway embankment near MP 258.5

More than two dozen significant stream crossings occur in the study corridor; many of these occur within an approximate 8 -mile stretch beginning at Riley Creek (MP 237) and extending through the Nenana Canyon to Antler Creek (MP 244.5). (Refer to Exhibit A in the Drainage memo for a graphical depiction of these significant crossings). The Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog[5] identifies nine crossings of anadromous fish streams in the study corridor. There are more than 200 culverts in the 56-mile corridor; this includes cross culverts conveying offsite runoff across the roadway as well as adjacent driveway culverts conveying roadside ditch drainage adjacent to the roadway.

During the drainage-specific site visit in June 2020, there were many locations observed where the roadside ditches were inundated or poorly defined, which creates ponding conditions immediately adjacent to the highway roadway embankment. General corridor observations and cited drainage issues included several locations where the roadway embankment was eroding. Ponding observed adjacent to the roadway corridor appeared to contribute to deteriorating roadway embankments and roadway structural sections. The source of ponded water was a combination of thawing subsurface ice, onsite roadway runoff, and offsite surface runoff. In some instances, the DOT&PF M&O staff have attributed poor roadway condition to drainage issues. Only a few culverts were observed as being damaged or deteriorating.

[5] https://www.adfg.alaska.gov/sf/SARR/AWC/

5.6 Baseline Geological and Geotechnical Conditions

The Parks Highway traverses several different geologic landscapes. The *Baseline Geological and Geotechnical Assessment Memorandum* (July 2020) (Appendix I) prepared for this study looked at the following geological and geotechnical hazards found in the corridor: permafrost, seasonally frozen soils, erosion, landslides, rockslides, rockfall, seismicity, liquefaction, and other potential future hazards.

The Parks Highway within the study corridor travels over discontinuous and continuous permafrost soils, across and adjacent to rivers and drainages, over rolling hills, and through steep mountainous terrain. This diverse geologic terrain poses numerous hazards to the highway including thaw-unstable soils, erosion, landslides, rockslides, and rockfalls.

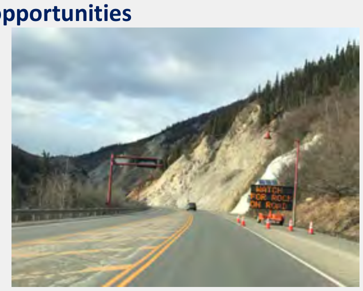
CORRIDOR SNAPSHOT

Geological and geotechnical conditions

- Several types of geological hazards:
  - Permafrost and seasonally frozen soils
  - Erosion
  - Landslides
  - Rockslides and rockfall
- Highway traverses discontinuous and continuous permafrost soils
- Significant seismic hazard exists in the region, primarily related to the Denali Fault and other associated smaller fault groups

Sampling of identified needs and opportunities

The highway is constrained by areas of slope instability and erosion by the river in the Nenana Canyon (MP 239-241)



Rockfall hazards (MP 239-241)

The most pervasive geologic hazard observed during the May 2020 site visit was roadway embankment instability, likely because of thawing permafrost under the highway alignment. This condition was present sporadically along the corridor. Embankment instability is frequently observed along with drainage problems related to settlement or loss of gradient in drainage ditches, thaw ponds that prevent the migration of water away from the embankment toe, and damaged culverts that fail to convey water through the embankment.

Other geologic hazards encountered along the alignment were areas of embankment erosion because of surface water runoff or adjacent to river cut banks, landslides, rockslides, and rockfall. Liquefaction is another hazard within the project area. The project corridor is situated near the Denali Fault system and several mapped faults cross the Parks Highway within the study area. The fault system is active and capable of generating large magnitude earthquakes.

5.7 Environmental Conditions

The *Environmental Conditions Memorandum* (July 30, 2020) (Appendix J) prepared for this study provides an overview of the environmental conditions in the corridor based on a boundary of 500 feet on either side of the highway centerline and also expanding around study area communities. This memo summarizes social, biological, and physical environmental features, which include the following: land ownership, cultural resources, land uses and transportation plans, environmental justice, noise, Section 4(f)/6(f) properties, invasive species, wetlands and waterbodies, fish and wildlife resources, water and air quality, and contaminated sites.

Much of the land in the study area is owned by the state and federal government; however, the corridor intersects 37 Native Allotments. Ahtna Inc., a regional native corporation, is a major land owner in the corridor. The Alaska Railroad is also a major land owner in the Healy vicinity.

CORRIDOR SNAPSHOT

Environmental resources

- The corridor contains:
  - 65 AHRS sites
  - Wetlands and waterbodies
  - Section 4(f) properties, including DNP and other recreational resources
  - Anadromous fish streams, including the Nenana River and several other tributaries
  - 35 contaminated sites
  - Many invasive plant species
  - No threatened or endangered species
  - No impaired waterbodies

Sampling of identified needs, opportunities or resources

Culverts at Slate Creek (MP257.8), shown here, and Little Panguingue Creek (MP 254) are identified by ADF&G as poor for overall fish passage

Riley Creek Campground, accessed from MP 237, is one of several Section 4(f) properties

There are 65 Alaska Heritage Resource Survey (AHRS) sites in the identified boundary, none of which are listed as National Historic Landmarks or in the National Register of Historic Places. Nearly half of these are concentrated between MP 235-240.

Larger waterbodies in the corridor vicinity include Otto Lake near Healy, the Chavey Lakes near Cantwell, Deneki Lakes, Horseshoe Lake near the DNP entrance, and many smaller unnamed lakes. Most of the wetlands identified in the environmental memo boundary are freshwater forested/ shrub wetlands.

6. Next Steps

The study team will take into consideration all the needs and opportunities identified during this phase of the study. The next step will be to develop and evaluate a list of solutions and potential projects, as depicted in the process and schedule graphic in Figure 3. These improvement project options will be presented to the public and stakeholders for input. The last phase of the study will include finalizing the corridor vision, needs, opportunities, solutions and prioritization of proposed projects to move forward for implementation.

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Appendix A

Comprehensive List of Identified Needs, Opportunities, and Issues in the PEL Study Corridor

Approximate Parks Highway Milepost (MP) *(if a range, southern MP extent)*	**Approximate MP range** *(if applicable)*	**Category Type of Identified Need, Concern, Issue, Hazard or Opportunity**	**General Description** [1]	**Source** [2]
	Corridor	access-numerous driveways access points	Safety concerns including numerous driveways in multiple sections of corridor	PAC
	Corridor	costs	Economically, our state cannot afford to maintain new, large pullouts and multiple passing lanes (e.g. snow removal). The State faces difficulty needing to do more with less money	PAC
	Corridor	development	development affects residents	Public
	Corridor	development-no improvements	No further development along this stretch of the Parks Highway. Too much uncontrolled development has already destroyed our natural environment. Do not add new turning lanes or parking lots.	Public
	Corridor	development-pull outs	Stop building public pullouts because they cause trash, human waste and fire danger. They are dangerous to the communities.	Public
	Corridor	drainage	Several locations where roadway shoulder conditions created concentrated flow, and did not include drainage flumes, appeared to be eroding the roadway embankment.	Drainage Memo
	Corridor	drainage-ponding	Many locations where roadside ditches were inundated or poorly defined, created ponding conditions immediately adjacent to the roadway embankment.	Drainage Memo
	Corridor	economic development	Economic development for year-round employment is needed to bring people to live closer to Cantwell. Our school community is small and in jeopardy of shutting down due to lack of employment.	Public
	Corridor	economic development, recreation/tourism, DNP congestion, trails	"One more day" economic opportunity concept: this provides congestion relief and more frontcountry opportunities.	PAC
	Corridor	education	Help the public know about Ahtna lands with signage	Public
	Corridor	hazard-rock fall	Rockfall hazard	T&S Memo
	Corridor	mobility	Consider needs associated with employees of the tourist industry. Many come from abroad and do not have cars. They rely on transportation from their employers who get them to work but not elsewhere. Some hitchhike to get around. The DNP long range transportation system dealt with that issue – a form of public transportation in the area; it's a good idea but there is no solution yet.	PAC
	Corridor	mobility/connectivity	Fostering greater connection between DNP and the entire area. Connecting the park with the communities and businesses is a huge opportunity with this study.	PAC
	Corridor	mobility-traffic flow	We need to maintain traffic flow or "non-constrictive obstacles" for large modular vehicles as we enhance and increase roadways (i.e., 18-ft high, 24-ft wide). Restricted truck flow generally occurs during summer months.	PAC
	Corridor	partnerships	This cooperative work being done as part of the PEL is a real opportunity; having so many organizations in this planning effort is a unique opportunity. This collaborative effort has great potential.	PAC
	Corridor	partnerships, access	"Work with NPS, Ahtna, the State and user groups to improve accessible "frontcountry" experiences, such as trails to and through existing/planned commercial, lodging and residential areas. Make it easy for people to get into attractive natural places – by foot, bike or in the winter by skis, dogsled or snow machine – without needing a car."	Prior Plans
	Corridor	pathway, pedestrian safety	Another concern I have is biker & pedestrian safety, as well as creating opportunities for health/active communities. In & around most of the communities covered in this study are areas of opportunities for a multi-use trail that could provide a safer place to travel & recreate than the narrow shoulder next to high speed traffic year-round, but especially in the summer.	Public
	Corridor	planning	Document existing trails in the borough and seek opportunities to reserve and improve popular trails	Prior Plans
	Corridor	planning	Support the state's efforts to identify and resolve all RS2477 routes and other transportation corridors	Prior Plans
	Corridor	planning	Prepare a Denali Recreation Region study, spanning from Talkeetna to Healy	Prior Plans
	Corridor	planning	Likes the idea of a non-motorized use plan. There may be potential Federal Lands Access Planning (FLAP) dollars to take on this planning effort.	PAC
	Corridor	planning	Review the goals and visions from prior planning processes and fold them into the plan	PAC
	Corridor	planning needs	Create a non-motorized plan for the area. The highway has wide shoulders in locations, but people may not feel comfortable using due to the high-speed traffic.	PAC
	Corridor	planning, access, trails, recreation	Ahtna is a major land owner along this corridor and half of their "selected, not yet conveyed" lands will come in the form of 17b easements. We need to map and address these parcels as well as other private properties as they could become ATV or hiking trails to reach state or federal land. Ahtna allows the public to buy permits to cross their land. There may be a new 17b easement: a horse trail at the new DOT&PF parking lot near MP 228.	PAC
	Corridor	planning, development	If the ASAP and Alaska LNG pipeline projects are going to happen, it would generate many new planning issues regarding transportation and new users.	PAC

Approximate Parks Highway Milepost (MP) *(if a range, southern MP extent)*	**Approximate MP range** *(if applicable)*	**Category Type of Identified Need, Concern, Issue, Hazard or Opportunity**	**General Description [1]**	**Source [2]**
	Corridor	recreation	Consider other users in the project area like snowmachiners and back-country skiers in winter. Seasonality is important to keep in mind.	PAC
	Corridor	recreation, access	Needs and opportunities related to hunting, fishing, sportsman's type stuff, berry pickers. This includes a broader area: people from Anchorage to Fairbanks. There may be funding opportunities through Pittman-Roberts and/or Dingell/Johnson Funds for planned improvements to access (such as boat launches).	PAC
	Corridor	recreation/tourism, congestion, safety	The need for sufficient visitor accommodations such as parking comes with the increased demand for recreational activities. Overflowing parking areas will often cause vehicles to park along the active roadway, which can result in a variety of unsafe conditions for both pedestrians and motorists.	Rec Memo
	Corridor	rest areas / facilities	Additional rest areas could be beneficial if they were done as to not impact the natural environment. Current rest areas can also be congested, particularly the ones at MP 203.5 and MP 224.	PAC
	Corridor	roadway condition	DOT&PF should look into other M&O techniques and expert research to maintain the roadway quality: consider redoing the road bed; avoid chip seal overlays that result in chipped and broken windows; mark frost heaves for drivers	Public
	Corridor	roadway condition	Seasonal frost heaves	T&S Memo
	Corridor	roadway geometry	Approximately 33.1% of the current horizontal curvature and 28.5% of the vertical curvature does not meet AASHTO design criteria for 65mph. Several horizontal curvature deficiencies (due to physical constraints of river and mountains)	T&S Memo
	Corridor	safety	Lack of clear zone due to rock cut slopes and guardrail protecting vehicles from the river	T&S Memo
	Corridor	safety	add more passing lanes	Public
	Corridor	safety	prohibit double-trailers in snowy winter conditions	Public
	Corridor	safety	Turn entire corridor from 2 to 4 lanes to prevent passing crashes/deaths	Public
	Corridor	safety, four-wheelers	Where the 4-wheeler trails are on the highway right of way, they should be platted in a safe and legal manner with regard to grade, substrate, stream crossings, and keeping the trails off private property.	Public
	Corridor	safety, pathway, multi-modal, access/connectivity	Separating user groups - bike paths, communities and connecting to the park has been a real need and want.	PAC
	Corridor	safety, pedestrians/trespass	Huge trespass issues across the railroad tracks. Informal trails were created without talking to the railroad.	PAC
	Corridor	safety-turning lanes, access management	General access management related concerns (turn lanes, frontage roads, etc.) throughout the corridor from Cantwell to Healy	T&S Memo
	Corridor	speed	Be aware of the effect of speed variances and related safety issues. For example, when speed limits decrease in communities, vehicles want to pass trucks of any size, especially near Healy. When speeds increase during inclines, trucks have trouble maintaining these speeds so vehicles want to pass them dangerously.	PAC
	Corridor	speed	Do not modify the roadway such that people can drive faster	Public
	Corridor	stewardship	Section 1311 of ANILCA established the Denali Scenic Highway which "shall consider the scenic and recreational values of the lands…" The establishment document describes the Denali Highway will run from DNP to Wrangell St Elias [McCarthy] and was envisioned to be scenic through its entirety.	PAC
	Corridor	stewardship	Maintain the scenic quality of the highway. There is an existing Scenic Byway designation for a large section of the Parks Highway. From this, many goals and visions should naturally flow.	PAC
	Corridor	stewardship	Reduce the likelihood of strip development - Strip Development was attempted along the Chulitna River, and it was thwarted. Keep the Parks Highway beautiful.	PAC
	Corridor	stewardship/ education	Need for interpretive kiosks and panels in the corridor. Likes Interpretive panels at pullouts will tell you about geographic features, history of the area, etc. One idea is to have a cohesive theme in all the panels within the corridor.	PAC
	Corridor	stewardship/ education	Add historical/geological information to pullouts. A good example of these is in the Maclaren region of the Denali Highway.	PAC
	Corridor	stewardship/ education	Kiosks and visitor information/interpretive panels could enhance the borough visitor experience. Information opportunity to display the history of Ahtna people, placing it into context with geographical, historical, and cultural context at pullouts.	PAC
	Corridor	stewardship/ education	Use the PEL process to be an opportunity to discuss the "Denali Region", not just DNP. Could be a way to tie all of that together and make it a cohesive story and there isn't one Denali but the entire area.	PAC
	Corridor	Stewardship/ education	A new highway advisory radio piece could be created that provides the history of the highways, geology of the Nenana River going through the Alaska range, and the anthropological stories.	PAC

Approximate Parks Highway Milepost (MP) *(if a range, southern MP extent)*	**Approximate MP range** *(if applicable)*	**Category Type of Identified Need, Concern, Issue, Hazard or Opportunity**	**General Description** [1]	**Source** [2]
	Corridor-south end	rest areas/ pull-outs	Create year-round rest area with bathroom facilities near the southern edge of the study area where people pull over to view the mountain.	Public
203.0	203-209.5	scenic values	Broad Pass to Jack River is one of the few areas remaining along the Parks Hwy that a traveler gets a sense of the vastness, a taste of "remote Alaska". Taking care to preserve the undeveloped nature of this stretch	Public
203.0	203-210	roadway condition	roadway condition/ repair needs: Frost heaves south of Cantwell – an idea that the road would be in better condition if it were gravel for the 10-mile section near Summit Lake and the "Leaving Mat Su Borough" sign	Public
203.0	203-215	unstable embankment corresponding with regional ponding	Between MP 203-215, surrounding topography is observed to be very flat adjacent to the roadway corridor. There are many regional low points that have accumulated surface runoff in the form of ponding throughout this section of the study corridor. Locations that have been identified as part of the Baseline Geologic and Geotechnical Assessment Memorandum as areas with unstable embankment tend to coincide with regional ponding that is abutted against the roadway embankment. The source of the ponded water is a combination of thawing subsurface ice, onsite roadway runoff and offsite surface runoff. The highest concentration of these local ponds exists between MP 208 and MP 215.	Drainage Memo
203.0	203-259	pathway	Request for separated multi-use pathway (full corridor, Broad Pass to Ferry)	Public
203.5		rest areas / facilities	Current rest areas can also be congested, particularly the ones at **MP 203.5** and MP 224.	PAC
204.5	204.5-208.5	roadway condition	Area experiences frost heaves	T&S Memo
204.5	204.5-208.5	safety, crash locations	Area where several vehicle crashes (n=13) occurred between 2013-2017 based on DOT&PF data and using a sliding spot analysis; crash factors mostly but not all attributed to wildlife collisions. Fatality occurred at MP 206.	T&S Memo
206.2	206.2 - 206.3	unstable embankment/ pavement damage	Road bumps where embankment crosses a low spot between ridges. Possibly settlement caused by compressible organics or thawing permafrost. (SW2020)	Geol Memo
207.7	207.7 - 207.9	unstable embankment/ pavement damage; drainage issues	Road bumps and ditch ponds likely caused by thaw settlement. Possibly up to a few feet of settlement based on backslope offset. (SW2020)	Geol Memo
208.0	208 - 210	roadway condition (damage)	Huge frost heaves, needs to be reconstructed.	M&O Memo
208.0	208-215	pathway	Request for separated multi-use pathway, also tying in to Denali Highway MPs 130-136	Public
208.0		safety-turning movements	Hazardous roadway configuration for turning movements	Public
208.2	208.2-209.3	unstable embankment/ pavement damage	Reoccurring frost heaves. (M&O) Bumps likely due to thaw settlement and/or heaving. Peat ground cover may suggest areas of possible shallow permafrost. (SW2020) Unstable embankment. 2016 construction may have repaired the slope – reassessment needed. Extensive shoulder patching and apparent slumps. Rolling freeze thaw distress to embankments to north and south, but of Class C variety. Condition = poor. (GAM)	Geol Memo
209.0		access-maintain for emergency services	Ensure emergency services are able to maintain access to points they need. As example, firetrucks in Cantwell fill their water at "Beaver Pond" (MP 209 across the Parks Highway from the Village burial grounds and south of Jack River). However, there are often campers in that location. If there was an emergency it could limit the time it takes the firetrucks to fill their tanks if they have to have people move first. Signage could be improved in this area in particular. That land is going to be conveyed to the State eventually.	PAC
209.5		possible stream bed degradation near bridge crossing	The Jack River showed the potential to migrate vertically as degradation and aggregation was observed within the crossing. Possible stream bed degradation is occurring on the upstream side of the Jack River Bridge (BR 0293) piers with aggregation on the downstream side.	Drainage Memo
210.0	210-230	roadway condition	roadway condition/ repair needs: frost heaves from MP 210-230	Public
210.0	210-237	pathway	Request for separated multi-use pathway (Cantwell-Denali Park Road turnoff)	Public
210.0	210-248	pathway	Request for separated multi-use pathway (Cantwell-Healy)	Public
210.0	210-251	pathway	Request for separated multi-use pathway (Cantwell-Stampede Road turnoff)	Public
210.0	210-251	speed	Speed limits, at least, seasonally should be consistently 55 mph from Cantwell to the Stampede, due to the high volume of traffic, pedestrians & driveways in between.	Public
210.0	210-251	speed	Use consistent 55mph from Cantwell to Stampede Road due to high volume of traffic, pedestrians and driveways	Public
210.0	210-259	pathway	Request for separated multi-use pathway (Cantwell-Ferry)	Public
210.0		development, tourism, stewardship, education	An opportunity for a visitor center in Healy would be beneficial as would a visitor center at **Cantwell**. In Healy, it could emphasize an early man site and other known archaeological sites as well. The Parks Highway itself has an interesting history. Cantwell Visitor Center idea – it is so beautiful there and would be awesome.	PAC

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210.0		development, tourism/ recreation	The 1996 South Side Development Concept Plan/EIS was amended 15 years later to describe this southside destination around Parks Highway milepost 134. NPS supported a NPS visitor center in the Cantwell/Broad Pass area that could function year-round with seasonal activities aiming at DNP, the Nenana River, and upper Talkeetna Mountains.	PAC
210.0		recreation-bike trails (add)	Add bike trails, specifically in Cantwell.	PAC
210.0		rest areas/ pull-outs	Create a rest area/pull out with a picnic area in Cantwell area	Public
210.0		roadway configuration, traffic	Have interchange w/ Denali Highway, or if interchange is too costly have roundabout due to congestion and increased visitors to Denali National Park	Public
210.0		safety, access/ mobility	Consider an interchange, short four-lane section and frontage roads in Cantwell	Prior Plans
210.0		safety, mobility	Consider a Cantwell bypass	Prior Plans
210.0		safety-turning lane	Desired turn lanes at Denali Highway Junction	T&S Memo
210.0		safety-turning lane	Need turning lane at Parks Highway Mile 210 Denali Highway intersection, northbound and southbound lanes	Prior Plans
210.0		safety-turning lanes / pedestrian facilities	Requests have been received for turning lanes at Parks Highway and Denali Highway intersection as well as additional pedestrian accommodations in Cantwell, due to inadequate access.	M&O Memo
210.0		safety-turning movements	Hazardous roadway configuration for turning movements	Public
210.0		speed	More speed limit signage and speed limits painted in 45 zones (Cantwell and Healy)	Public
211.0	211 - 212	unstable embankment/ pavement damage	Occasional spreading cracks along shoulders. (SW2020)	Geol Memo
212.0		hazard-landslide	Unstable soil slope. Vern Carlson (Maintenance Foreman) stated that the site was a slow-moving slide that caused the ditch to be cleaned out every three to five years depending on rainfall. They always cleaned it out before material got on the road. No special equipment was required. Condition = fair. (GAM)	Geol Memo
212.3		hazard-rock fall	Unstable rock slope. Condition = good. (GAM)	Geol Memo
212.5	212.5-213	blocked culverts, rockfall hazard, poor rock/ soil	Rock constrains the highway in several areas, including just north of **Cantwell** and through Nenana Canyon. There are maintenance concerns currently in areas that are generally composed of a poor rock. Slope failures appear to be soil and likely related to loss of shear strength because of permafrost thawing. Debris from these slope failures is blocking culverts behind concrete barrier.	Drainage Memo
212.5		hazard-rock fall	Unstable rock slope. Cobbles weathering out of sandy gravel over highly fractured rock cut. Ditch appears sufficient to keep rockfall off paved surface if maintained. Risk of impact to traffic low. Condition = good. (GAM)	Geol Memo
212.7		unstable soil slope	Erosional gully feature with potential periodic sloughing, erosion, and deposition of materials into the ditch. (SW2020)	Geol Memo
212.9		hazard-rock fall	Unstable rock slope. Differential erosion in sandy gravel slope over highly fractured rock cut. Sandy gravel releasing cobbles up to 1.5 feet. Very low risk to road if ditch is maintained. Condition = good. (GAM)	Geol Memo
213.5	213.5-216.5	safety-crash locations	Area where several vehicle crashes (n=14) occurred between 2013-2017 based on DOT&PF data and using a sliding spot analysis; crash factors include wildlife collision, loss of control navigating curve at Windy Bridge [#1243]	T&S Memo
215.6	215.6-231	access-boat launch (add)	It has been suggested that another formal boat launch could be useful between McKinley Village Bridge at MP 231 and the boat launch near the Number One Bridge (also referred to as Nenana River Bridge [BR 1243] at MP 215.6).	Rec Memo
215.6		pedestrian/bicyclists	Suggestion for new pedestrian/bike bridge: Nenana River Bridge (BR #1243), sometimes referred to as Number One Bridge. Consider a cantilever off the east side of the existing bridge.	Public
216.0		other-boat launch signage	A BLM sign at the boat access at MP 216 is knocked down and either needs to be removed or replaced. This boat launch could also benefit from a “Kids Don’t Float” life jacket loaner board and educational components.	PAC
216.4	216.4-217.1	unstable embankment/ pavement damage	Waviness and patching in the roadway. Large dip at MP 217. (SW2020)	Geol Memo
217.0		ponding; drainage issue	Near MP 217, the regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor. The typical roadway section in this area is a cut section on the east and a fill section on the west. It appears that the cut section has sloughed in multiple locations creating local low points in the roadside ditch that in turn create ponded water during rainfall events. The existing cross culverts are correctly located in the roadway profile low points. The roadside ditches are unable to convey runoff to these cross culverts due to inundation of cut slope material.	Drainage Memo
217.2	217.2-217.7	hazard-debris flow	Road cut into likely colluvial soil slope. Potential risk for future expansion if cut is extended. (SW2020) Unstable soil slope. 2016 construction may have repaired the slope – reassessment needed. Debris fan above the road – minimal material reaches the road. Smaller power lines reportedly moved across road to minimize impact from debris flows/rockfall. Condition = poor. (GAM)	Geol Memo

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217.8	217.8-218	ponding: lack of cross culverts at low points	Between MP 217 and MP 218, the regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor. Roadside ditches on the east side of the corridor convey offsite and onsite surface runoff to these low points that generally include cross culverts installed. Cross culverts do not appear to have been installed near MP 217.8 and MP 218, where the upstream side (east side of corridor) indicates a regional low point.	Drainage Memo
218.0		hazard-debris flow	Shallow failure in boulder colluvium. (SW2020) Condition = poor. (GAM)	Geol Memo
218.9	218.9-219.3	hazard-rock fall	A few boulders on river side of guardrail, possibly from above. (SW2020) Area subject to rockfall from mountain above. Large blocks rare, smaller blocks more common. Condition = fair. (GAM)	Geol Memo
219.5	219.5-225.5	safety-crash locations	Area where several vehicle crashes (n=25) occurred between 2013-2017 based on DOT&PF data and using a sliding spot analysis; crash factors include animal strikes, weather conditions, and an illegal passing maneuver in no passing zone (resulting in a fatality)	T&S Memo
220.0	220-231	speed	Slime Creek (MP 220) to McKinley Village is residential and needs traffic to slow down	Public
220.0		recreation/ access	MP 220 area is where people access the Nenana River and sees a lot of both local and commercial use.	PAC
220.0		rest areas/ pull-outs	Create year-round rest area with bathroom at Slime Creek pull out	Public
220.5		rest areas / facilities (enhance)	Pull-outs are great; we encourage them. There is a pullout at MP 220.5 that is very important for truckers to park for their mandatory 10-hour rest; it is a section of the old highway alignment. People want to get rid of this rest stop, but it needs to be preserved and it could use some facilities. The pullout is just south of the bend in the river with the overhead delineators (the truckers call that the River Hilton). This is where many of the truckers sleep primarily in the summer and when the wind isn't blowing in the winter (which is usually is in the winter – in the winter they stay in Cantwell at the Chevron). Motorhomes, etc. that stop there as well.	PAC
221.8	221.8-222	erosion	Minor erosion due to river undercutting in unprotected banks at north end of section. (SW2020) River undercutting bank approximately 60 feet from edge of pavement. If erosion continues, existing riprap on embankment may need to be improved. Condition = good. (GAM)	Geol Memo
221.8	221.8-222.1	roadway damage-drainage	A small portion of the roadway is eroding due to the Nenana River undercutting of the roadway embankment between MP 221.8 and MP 222 as identified within the Baseline Geologic and Geotechnical Assessment Memorandum. This situation appears to be happening just north of MP 222 as well.	Drainage Memo
222.0	222-224	river abuts roadway embankment; ponding	The braided nature of the Nenana River pushes the main channel against the roadway corridor. Embankment protection measures appear to be adequate along this area. This section also includes river braids that are slow moving and abut against the roadway embankment. These slow-moving braids also appear to create areas of ponding that also abut against the roadway embankment.	Drainage Memo
222.2		rest areas / facilities (enhance)	Pull-outs are great; we encourage them. This pullout is used by all types of travelers, including truckers. It could use some restroom facilities.	PAC
223.5		drainage	Near MP 223.5, the west side roadside ditch is abruptly ended at a driveway approach where no culvert exists. This forces the roadside ditch to empty onto the roadway surface prior to being redirected back into the roadside ditch on the other side of the driveway.	Drainage Memo
224.0	224-229	access-numerous driveways /congestion	Carlo Creek area: Higher density with numerous driveways accessing lodging, restaurants, tourist activities	T&S Memo
224.0	224-229	congestion	Seasonal tourist congestion during summer months	T&S Memo
224.0	224-229	pathway (lack of)	No dedicated pedestrian/ bicycle facilities; users utilize the 8-foot road shoulders	T&S Memo
224.0	224-229	speed	Public requests for implementing a seasonal speed limit through Carlo Creek area	T&S Memo
224.0	224-230	access management	Access management needed in the MP 224-230 area. Consider frontage system and turn lanes like what was done for the passing lanes in Nenana.	Public
224.0	224-231	access-numerous driveways	Especially between Carlo Creek and McKinley Village, there is an increase in businesses and hidden driveways.	PAC
224.0	224-231	safety, mobility	Consider continuous frontage road system between Carlo Creek and McKinley Village, connected to the highway at several interchanges or unsignalized, at-grade intersections	Prior Plans
224.0	224-231	speed	Lower speed from 65mph to 45mph between MP 224-231	Public
224.0	224-237	pathway	Request for separated multi-use pathway (Carlo Creek-Denali Park Road turnoff)	Public
224.0	224-251	pathway	Request for separated multi-use pathway (Carlo Creek-Stampede Road turnoff)	Public
224.0		Carlo Creek	See Traffic & Safety Memo.	M&O Memo
224.0		pedestrian/bicyclists	Suggestion for new pedestrian/bike bridge (Carlo Creek Bridge, BR 0693)	Public
224.0		rest areas / facilities	Current rest areas can also be congested, particularly the ones at MP 203.5 and **MP 224.**	PAC
224.0		safety	enhance the safety of collecting spring water at MP 224	Public
224.0		safety, pedestrian	Pedestrian crossing at Carlo Creek	T&S Memo

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224.0		speed	Speed limits at Carlo Creek	T&S Memo
224.0		speed	Speed limit needs to be reduced south of Carlo Creek	Public
224.0		speed, driveways	Would like restricted speed limit at **Carlo Creek** & McKinley village due to the amount of public use driveways, small lodging, and the gravel pit. Especially don't want passing lanes there and it is no place for higher speeds	Public
225.0	225-227	drainage-ponding	Just south of **MP 225**, a local low point has been created in the roadside ditch on the east side of the corridor where no cross culvert has been installed. This will create ponding during minor rainfall events. This situation also exists **just north of MP 225** as well as an area around MP 226 and just north of MP 227.	Drainage Memo
225.6		hazard-rock fall	Unstable rock slope. Cut slope in sandy gravel with cobbles up to 3 feet max dimension. Ditch appears of sufficient width and depth to contain rockfall if maintained. Condition = good. (GAM)	Geol Memo
225.8		hazard-rock fall	Sandy gravel with cobbles up to 2 ft max dimension. Ditch appears sufficient to contain rockfall if maintained. Condition = good. (GAM)	Geol Memo
225.9	225.9-226.2	unstable embankment/ pavement damage	Bumps and patches. Cause uncertain. (SW2020)	Geol Memo
226.2		hazard-rock fall	Raveling of sandy gravel cut face, cobbles up to 2 feet. Ditch appears to be sufficient width and depth to prevent damage to roadway if maintained. Condition = good. (GAM)	Geol Memo
228.0	228-250	bicycle lanes	There are no on-road bicycle lanes; riders currently use highway shoulder	Public
228.5		roadway condition (sinking)	The road in this location settles every year, causing the highway to sink lower into the surrounding terrain. This results in the need for yearly maintenance to be completed to minimize this damage to the active roadway.	M&O Memo
228.5		unstable embankment/ pavement damage	Road dropping, appears worst at shoulder. Requires annual maintenance. (M&O) This issue appears to be at MP 226 not 228.5 as reported by M&O. (SW2020)	Geol Memo
228.7	228.7-231.1	bicycle lanes	There are no on-road bike lanes; riders currently use highway shoulder	Public
229.0	229-232	safety, access, congestion	Busy stretch of highway with year-round residents, large seasonal summer businesses, river access, trail access	T&S Memo
229.0	229-232	speed	Speed limits at McKinley Village/ Crabbie's Crossing	T&S Memo
229.0		safety-turning movements	Hazardous roadway configuration for turning movements	Public
229.8		drainage-ponding	Near MP 229.8, a regional low point on the east side of the corridor does not appear to have an outlet which creates ponding adjacent to the roadway corridor.	Drainage Memo
230.0	230-230.7	drainage-ponding	Between MP 230 and MP 230.7, the cut slopes appear to be sloughing into the roadside ditch creating ponding situations during rainfall events. Cut slopes show moderate erosion in the form of rills along this section as well.	Drainage Memo
230.0	230-237	pathway	Request for separated multi-use pathway	Public
230.0		development (potential)	Potential for large new lodge near MP 230	T&S Memo
230.8		unstable embankment/ pavement damage; slope stability	Cracking, patching, and some bumps. There appears to be a large-scale slope issue here. Numerous tension cracks (as large rills) and scarps observed in right (looking up station) road cut and hillside behind it. Observed relatively recent drill hole with instrumentation at the top of the cut. (SW2020) M&O stated that the slope has not affected the road in all his time working out of the Healy station (1999). Slope exhibits little to no potential to affect the roadway. Condition = good. (GAM)	Geol Memo
231.0	231-237	safety, trails, access/connectivity	Removing the at-grade crossing has the potential for more east side connections. Nenana River Trail could use the old corridor to connect from MP 231 Wayside the Denali frontcountry.	PAC
231.0	231-248	pathway	Request for separated multi-use pathway (McKinley Village-Healy)	Public
231.0		costs/ funding	Lack of funding for all improvements needed at MP 231	T&S Memo
231.0		McKinley Village	See Traffic & Safety Memo.	M&O Memo
231.0		pedestrian/bicyclists	Suggestion for new pedestrian/bike bridge (Crabbie's Crossing)	Public
231.0		pedestrian/bicyclists	Suggestion for pedestrian/bike underpass between Grizzly Bear and McKinley Village; Triple Lakes & Oxbow Trailhead	Public
231.0		planning, multi-modal	Connectivity- One of the reasons the NPS is participating in the PEL Study is because of the NPS' past desire to conduct a multi-modal frontcountry study for the Denali entrance area. NPS is developing other multimodal pieces in the corridor like MP 231 Nenana River Wayside – a pedestrian bridge connecting trails like Triple Lake and Oxbow. (The Nenana River Wayside at MP 231 is going to be built in 2022; there will be an opportunity to connect with the Denali frontcountry. The NPS will keep looking for funding opportunities to make the pedestrian bridge happen.)	PAC

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231.0		rest areas/ pull-outs, recreation access	Create wayside and trailhead parking east side of highway on the north side of the bridge (near MP 231) for Triple Lakes and Oxbow Trails. Pedestrian underpass for trail access. Toilets and bearproof trash containers would be a benefit.	Public
231.0		safety, mobility	Consider turning lanes to accommodate numerous driveways in McKinley Village	Prior Plans
231.0		safety, pathway	Explore opportunities to build bike and pedestrian infrastructure along highways and major roads: McKinley Village	Prior Plans
231.0		safety, pathway, multi-modal, access/connectivity	Multimodal access and transport are a key interest. Seeing different ways for people to experience the area. Trails and bike accessibility ties into safety issues that people have brought up at **MP 231**, Glitter Gulch, Windy/Moody Bridge. These issues stem from the problem that pedestrians and users have nowhere else to go except the road [Parks Highway].	PAC
231.0		safety, pedestrians	Pedestrian crossing at Parks 231 (Crabbie's Crossing)	T&S Memo
231.0		safety, pedestrians	Pedestrian safety from hotel accommodations to nearby trailheads	T&S Memo
231.0		safety, pedestrians, recreation access	Pedestrian safety concerns near the McKinley Village bridge - the bridge project addresses safety concerns and presents a lot of opportunities. The problem is people playing an extremely dangerous game of frogger across the road. There should be a way for pedestrians to go under the road to connect to the DNP trail system (NPS Triple Lakes trail).	PAC
231.0		safety-turning lane, bridge widths	Safety - turning lanes, bridge widths- the MP 231 project is a huge need and opportunity project.	PAC
231.0		safety-turning lanes, access	Lack of turn lanes at MP 231 to businesses and to major river access point	T&S Memo
231.0		safety-turning movements	"Crabbies Crossing" (MP 231) is dangerous; it has a downhill curve prone to speeds, lots of foot traffic on a bridge and turning traffic in and out of the McKinley Village Lodge complex and Grizzly Bear Cabins/Resort.	Public
231.0		speed	A seasonal 55mph speed limit implemented in McKinley Village, until MP 231 project improvements are completed, has not resulted in a change in driver behavior.	T&S Memo
231.0		speed	Congested area at Nenana River Bridge MP 231 needs slower and enforceable speed limit	Public
231.0		speed, driveways	Would like restricted speed limit at Carlo Creek & **McKinley village** due to the amount of public use driveways, small lodging, and the gravel pit. Especially don't want passing lanes there and it is no place for higher speeds	Public
231.2		pedestrian/bicyclists	Suggestion for new pedestrian/bike bridge (Nenana River Bridge, BR 0694)	Public
231.2		stream erosion at bridge crossing	Moderate erosion in the form of rilling exists immediately under the Nenana River Bridge (BR 0694) deck on each abutment. The cause of such erosion does not seem obvious although it appears roadway runoff is being captured by the bridge seam and being conveyed under the deck along the top of the abutment. The river does not show signs of potential migration outside its existing banks. Some minor aggradation was observed on the right bank just downstream of the bridge crossing. The proposed Parks Highway MP 231 Enhancements project will replace this bridge.	Drainage Memo
231.4		recreation, access, inadequate parking	Several of the trailheads located along the study corridor such as Bison Gulch and **Triple Lakes** have inadequate parking to meet the demand for access during peak season.	Rec Memo
231.4		safety-turning lane	An area of concern I have is the lack of left hand turn lanes at use points. One of the worst examples is the left hand turn onto the Stampede Road when driving northbound. Other similar areas include the parking lot accessing the Bison Gulch Trail & **S. Boundary of Denali Nat'l Park (Triple Lakes Trailhead)**.	Public
231.6		drainage	Near MP 231.6, a local low point has been created in the roadside ditch on the west side of the corridor where no cross culvert has been installed. Most of these ponds are not connected with the ponds on the other side of the roadway corridor via a cross culvert. There does not appear to be a drainage outlet for these ponds as the surrounding topology is somewhat flat albeit generally sloping toward the Nenana River on the east side of the study corridor.	Drainage Memo
231.6		unstable embankment/ pavement condition	Isolated bump. Likely related to thaw settlement. (SW2020)	Geol Memo
232.0	232-236	roadway pavement deterioration	A field visit to this area has verified the deteriorating condition of the roadway pavement. Numerous regional offsite low points exist adjacent to the roadway corridor which has accumulated ponded water. In general, the regional topography is sloped toward the Nenana River on the west side of the corridor. The deteriorating roadway pavement and embankment has generally been observed where ponded water has abutted to the roadway embankment. The source of the ponded water is a combination of thawing subsurface ice, onsite roadway runoff and offsite surface runoff. Few cross culverts exist here, and roadside ditch low points do not match the locations where these culverts have been installed.	Drainage Memo

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232.5	232.5 - 232.8	unstable embankment/ pavement condition	Annually reoccurring bumpy section. Permafrost at approximately 32 feet based on prior drilling. Poor pavement performance. Requires annual maintenance. (M&O) Extreme area of thaw settlement and slumping of backslopes at the north end of the damage zone. (SW2020) Thaw unstable embankment section exhibits up to 12 inches of differential settlement. Condition = fair. (GAM)	Geol Memo
232.5		roadway condition (pavement condition/ roadway integrity)	This section of roadway has uneven settling, which has caused an annually returning issue for maintenance crews. According to Richard Lee, an M&O foreman for the Denali district, this location was drilled and there was an ice lens present here around 32 feet down.	M&O Memo
232.7		roadway condition (pavement condition/ roadway integrity)	This location requires annual maintenance to be complete in order to address issues with uneven settling and heaving.	M&O Memo
234.5	234.5-239.5	safety-crash locations	Area where several vehicle crashes (n=11) occurred between 2013-2017 based on DOT&PF data and using a sliding spot analysis; no crash patterns identified. One fatality.	T&S Memo
235.0	235 - 236	drainage issues / inadequate road shoulders	Drainage issues along this stretch cover a pretty significant area, spanning over ¾ of a mile in both directions from MP 235.5. The condition of the pavement in this area is reported to be way below an acceptable level, likely as a partial result of these drainage issues. This stretch of roadway requires annual maintenance work to be completed. There are also concerns regarding the road shoulder, which is said to be next to non-existent in some places.	M&O Memo
235.0	235-236	drainage	Drainage issues along this stretch cover a significant area, spanning over 0.75 miles in both directions from MP 235.5. The condition of the pavement in this area is reported to be substantially below an acceptable level, likely as a partial result of these drainage issues. (M&O)	Drainage Memo
235.0	235-236	unstable embankment/ pavement condition; drainage issues	Poor drainage and disappearing shoulder causing pavement issues. ARRC crossing at MP 235 requires annual repairs and regularly causes damage to snow removal equipment. (M&O) Bumpy road due to extreme thaw settlement. 5 to 6-foot deep thaw hole at left toe (MP 235.5) with large circular failure expression in roadway and in backslope. (SW2020) Thaw unstable embankment section exhibits up to 12 inches of differential settlement. M&O stated that several patches need to be added annually to this section. He described it as 'leap-frogging' patches. This section contains a railroad crossing. Condition = fair. (GAM)	Geol Memo
235.0		railroad crossing	One concern with this crossing is that it is always causing damage to the snow removal equipment used by M&O to clear the highway. This railroad crossing also requires a large amount of maintenance annually, with crews repairing the crossing at least once a year if not more frequently. There are reoccurring maintenance issues with the pavement and the roadway integrity at this railroad crossing as well.	M&O Memo
235.0		railroad crossing	For everyone's sake, eliminating the at-grade railroad crossing should be the #1 goal. This crossing impacts so many users (trucking, buses, cars, trains).	PAC
235.0		railroad crossing	Eliminate at-grade crossing	Public
235.0		railroad crossing, access/trail connectivity	Encouraged to hear that everyone is on-board with getting rid of the at-grade railroad crossing, moving it to the other side of the highway. NPS is 100% behind that plan. It would tie into trails on the east side of river and help foster developing the trail system.	PAC
235.0		railroad crossing, maintenance costs	Elimination of at-grade crossing at Railroad MP 345/Parks Highway MP 235. It is the most expensive crossing in the state to maintain (it eclipses the next two crossings in cost). It's on 60 feet of frozen ground and nothing will fix it besides making it go away. The Railroad has identified an alternate route that would also eliminate the grade-separated bridge further north. That bridge is oldest grade-separated railroad bridge in the state (>50 years) and has about 20 years of life left. Between those two elements, it would be less expensive to replace them than repair them. It is a challenging project to move forward because this would require the realignment to be located in a national park, but it is relevant to this PEL study.	PAC
235.0		railroad crossing, recreation	Reroute railroad to eliminate two highway-rail crossings. Convert abandoned rail to 4.2 mile trail.	Prior Plans
235.0		railroad crossing, safety	It's time to address the railroad crossing safety issue; glad to see people paying attention; there is good momentum to move this one forward. Remove at-grade railroad crossing for safety reasons	PAC
235.0		railroad crossing, safety	Poor soil conditions in area results in no truck/bus lanes being added. All traffic must stop behind commercial vehicles (including regular tour buses), increases chances of rear-end collision. Desire to eliminate rail crossing.	T&S Memo
235.0		roadway condition	roadway condition/ repair needs: Decades old frost heaves and buckled pavement north of the railroad crossing (MP 235) and near the railroad tracks	Public
236.5		railroad crossing	Overpass crosses highway, limits loads.	M&O Memo
236.9		hazard-rock fall	Rock fall slope exhibits a low to moderate potential to affect the roadway. Blocks up to 2 feet were observed on the slope face. Condition = good. (GAM). This is a road cut in a soil slope at approximately MP 236.5 based on milepost markings in the field.	Geol Memo
237.0		mobility/connectivity, lack of transit service	Lack of connections between DNP and surrounding communities and visitor accommodations	Prior Plans

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237.0	237-238	drainage	The regional topology indicates surface sloping from the west toward the Nenana River on the east side of the study corridor. A pedestrian pathway has been constructed on the west side of the roadway corridor that appears to be impeding offsite surface runoff. Flows that reach the roadway corridor are typically directed via roadside ditch toward the Nenana River toward the north. These roadside ditches have been blocked by soil in a few locations which appears to create ponding during small rainfall events.	Drainage Memo
237.0	237-239	congestion, speed	Congestion from Denali park entrance north through Nenana Canyon results in dropping the speed limit to 45mph from 65mph during summer	T&S Memo
237.0	Corridor	planning, multi-modal	Need to evaluate frontcountry circulation to improve and inform development (update NPS' 1997 DNP entrance area plan), incorporate multi-modal circulation and specific elements such as traffic counter mechanisms to understand vehicle, bicycle, and pedestrian movements	Prior Plans
237.0	Corridor	planning-community transit	Facilitate development of a community transit plan	Prior Plans
237.0	Corridor	recreation, development	"Shift future recreation demand toward "front country" activities, providing more opportunities to experience the Park at the Park's outer periphery."	Prior Plans
237.0	Corridor	recreation/tourism, DNP congestion, development, trails	Trail system connections in the frontcountry to alleviate crowding/ increase frontcountry opportunities - We've pushed the envelope in terms of the number of visitors that can visit inside DNP using buses; investing into the frontcountry trails can help to alleviate overcrowding. Having more frontcountry experiences satisfies visitor desires to get into DNP and can serve as an "one more day". This increases hotel stays, giftshops, and hotels, without over taxing the park.	PAC
237.0		culvert	Possible settlement at culvert outlet. (SW2020)	Geol Memo
237.0		drainage	Cut slope has sloughed into roadside ditch creating ponding during rainfall events	Drainage Memo
237.0		other-lack of transit service information	Lack of information about transit service operations in the DNP frontcountry	Prior Plans
237.5		unstable embankment	Thaw unstable embankment section exhibits up to 12 inches of differential settlement. (GAM)	Geol Memo
237.9		bank erosion near bridge crossing	The Nenana River near MP 237.9 appeared to be eroding the left bank (looking upstream) near the Nenana River Bridge (BR 1147) crossing.	Drainage Memo
237.9		faulting/ground displacement	Faulting related ground movements have caused damage to the highway and pedestrian bridges. Displacement rate appears to be on the order of 6 inches over the last 30 years at the north bridge abutment. (DOT&PF Bridge)	Geol Memo
238.0	238-239	access-numerous driveways access points	There are 17 driveway access points (providing access to hotels, lodges, a gas station, restaurants, outdoor recreation businesses and retail stores) along with 2 seasonally operated traffic lights within a mile stretch of road.	T&S Memo
238.0	238-239	drainage	There appears to be an inadequate number of culverts that convey collected onsite and offsite surface runoff along the roadway profile to the nearest discharge location (Junco Creek toward the north). Localized ponding occurs prior to multiple access driveways along the roadway corridor.	Drainage Memo
238.0	238-239	planning, development	Seeing more and more development at both the north and south ends of Glitter Gulch area as the land becomes more of a premium. Part of this is where seasonal workers are being housed. We're not seeing a lot of planning as to how it ties to the DNP entrance. Planning is needed at the regional level.	PAC
238.0	238-239	roadway condition	Pavement condition: frost heave damage, gouges in pavement from trailer hitches	T&S Memo
238.0	238-239	safety, traffic, congestion, parking	Congestion in Glitter Gulch, including lack of parking and on-highway parking	T&S Memo
238.0	238-246	safety, mobility	Consider travel options through Nenana Canyon, including a cut-and-cover design in the canyon or a bypass to the east around Sugar Loaf Mountain	Prior Plans
238.0	238-259	pathway (separated)	Desired separated bike/ped path from Anderson south to Glitter Gulch	T&S Memo
238.2	238.2-238.8	unstable embankment/ pavement condition; possible landslide hazard	Bumps and heaves. Previously documented area with underlying thaw unstable soils/massive ice, and potential larger scale landslide mechanism. (SW2020)	Geol Memo
238.3		unstable slope	Small cut N of Nenana River Bridge. M&O operators said that it was basically stable even though it looked like the material had been pushed back up the slope in the last 3 or 4 years. Erosional failure filling the ditch is the most likely mechanism. Additionally, highway sinking due to landslide. Recently patched with up to 1 foot of asphalt. S&W investigated landslide above highway during hotel construction, but these "settlement" areas may be local. 2016 construction may have repaired the slope – reassessment needed. Condition = fair to poor. (GAM)	Geol Memo
238.5	238.5-248	pathway	Request for separated multi-use pathway (Glitter Gulch-Healy)	Public
238.5		roadway configuration, traffic	roadway condition/ repair needs: Northern-most signal in Glitter Gulch. It either doesn't recognize/activate or give enough time for the east-west traffic so traffic backs way up into Prospector's or the Chalet.	Public

Approximate Parks Highway Milepost (MP) *(if a range, southern MP extent)*	**Approximate MP range** *(if applicable)*	**Category Type of Identified Need, Concern, Issue, Hazard or Opportunity**	**General Description** [1]	**Source** [2]
238.5		safety, parking, pedestrians/trespass	Safety concerns regarding parking in Glitter Gulch/ Nenana Canyon. There is trespass in the ROW (ex. signage). Issues include RVs parking there and people popping out into the road. Fortunately, there is no formal documented safety issue that has occurred yet, , but it is a risky behavior. Restrict trespassing from occurring in the ROW, particularly in Glitter Gulch.	PAC
238.5		safety, pathway, multi-modal, connectivity	Multimodal access and transport are a key interest. Seeing different ways for people to experience the area. Trails and bike accessibility ties into safety issues that people have brought up at MP 231, **Glitter Gulch**, Windy/Moody Bridge. These issues stem from the problem that pedestrians and users have nowhere else to go except the road [Parks Highway].	PAC
238.5		safety-turning movements	Hazardous roadway configuration for turning movements: Widening the road through Denali Canyon/Glitter Gulch (MP 238.5) to have dedicated right and left turn lanes in both directions	Public
239.0	239-239.9	hazard-rock fall; drainage issues	Nenana Canyon. Drainage issues behind jersey barriers and rock slides blocking culverts. Emergency repairs in 2013/2014. (M&O) South section of Nenana Canyon (area outside roadside barriers): M&O says that much of material that ends up on the road consists of mud composed of completely weathered rock. Potential for large slides to occur here and completely close the road. Condition = poor. North section of Nenana Canyon (section of slope behind barriers and slope to north without barriers): Rock is rotten, most material coming down sand-silt size. M&O reports barrier is effective until it fills up. Condition = fair. (GAM)	Geol Memo
239.0	239-240	blocked culverts, rockfall hazard, poor rock/ soil	Rock constrains the highway in several areas, including just north of Cantwell and through **Nenana Canyon**. There are maintenance concerns currently in areas that are generally composed of a poor rock. Slope failures appear to be soil and likely related to loss of shear strength because of permafrost thawing. Debris from these slope failures is blocking culverts behind concrete barrier.	Drainage Memo
239.0	239-240	hazard- rock fall (active) / drainage	This area is prone to active rock slides, which are a concern for M&O crews as well as the general public. When these slides occur, larger rocks can be moving with enough force to make it past protective barriers and onto the active roadway. Scott Randby, the M&O superintendent for the Denali district, said that crews will begin working in this area in the early morning hours while rocks are still frozen in place. This is to minimize the risk of getting hit by a slide directly or smashing maintenance equipment. // Drainage issues are a continual problem behind jersey barriers, with annual debris slides that will often block the culverts. These jersey barriers that were installed after the last project through Nenana Canyon cause additional maintenance problems. With the current setup, M&O crews do not have adequate access around the barriers to use their normal equipment to clean all the debris from the ditches. Instead, they have to rent an excavator to do it, which results in additional maintenance costs.	M&O Memo
239.0	239-241	hazard-rock fall	Rockfall in the Nenana Canyon	T&S Memo
239.0		culvert condition-moderate damage	Junco Creek cross culvert has been mitered to the roadway slope and looks moderately damaged. The culvert shows minor rust but is generally in good condition.	Drainage Memo
239.0		hazard-rock fall	Rough rock slide areas through the canyon	PAC
239.0		inadequate summer parking	The Nenana Canyon Businesses corridor is another location that M&O crews have identified as a problematic area. During the summer months when tourism is around its peak, parking in this area can often fill up and overflow into the Parks Highway shoulders.	M&O Memo
239.0		rockfall hazard	Add rock fall protection fence near MP 239	Public
239.5		culvert condition-damage ,drainage	Drainage issues are causing damage to the base of the road. The effect of these drainage issues on the road base are causing part of the road to begin collapsing. A sink hole or a severe dip is being created in the road surface.	Drainage Memo
240.5		drainage	Near MP 240.5, a local low point has been created in the roadside ditch on the east side of the corridor where no cross culvert has been installed. Ponding was observed at this location that could potentially create issues to the roadway embankment.	Drainage Memo
240.6		unstable embankment/ pavement condition	Small bump. Potential settlement in ditches on uphill side. (SW2020) Thaw unstable embankment section exhibits up to 12 inches of differential settlement. Condition = fair. (GAM)	Geol Memo
240.9		culvert condition	Grizzly Creek cross culvert shows moderate rust but is generally in fair condition.	Drainage Memo
240.9		hazard-rock fall	Slope exhibits moderate to high potential to affect road. Blocks up to 4 feet observed in ditch. Spring comes down one side of slope, drains through ditch under the slope. M&O stated water and material often clog ditch, require clearing every 1-2 years. Condition = fair. (GAM)	Geol Memo
241.0		drainage	Near MP 241, just north of the Grizzly Creek crossing, a small 24-inch cross culvert has been installed that conveys offsite and onsite surface runoff from the east toward the Nenana River on the west side of the corridor. It appears that the roadside ditch may be too flat, or the culvert is undersized which has created a backwater condition at the upstream side.	Drainage Memo

Approximate Parks Highway Milepost (MP) *(if a range, southern MP extent)*	**Approximate MP range** *(if applicable)*	**Category Type of Identified Need, Concern, Issue, Hazard or Opportunity**	**General Description** [1]	**Source** [2]
241.4		hazard-rock fall	Slope exhibits a high potential to affect the roadway. M&O stated that ditch needs to be cleaned out every year. M&O also pointed out a large crack that is forming in an overhanging section of rock. This crack could lead to a largescale failure. Condition = fair. (GAM)	Geol Memo
242.0		access-wildlife viewing	Another opportunity is for a sheep viewing pull-out located north of Windy Bridge. It's a great area to enjoy wildlife and enjoy wild mountain sheep.	PAC
242.0		culvert condition-deterioration	The condition of the Eagle Creek cross culvert (7111/1076) appears to be deteriorating. There is separation between the concrete bottom and the concrete spread footing on the bottom edges of the arch structure.	Drainage Memo
242.0		roadway condition (sinking)	This location has been identified to have issues with the roadway settling annually. This causes the highway to develop an uneven surface and sections of heaving, resulting in annual maintenance concerns.	M&O Memo
242.1		drainage	Near MP 242.1, the roadside ditch on the east side of the roadway corridor appears to have a low point created because of slope inundation. No cross culvert has been installed at this location.	Drainage Memo
242.1		unstable embankment/ pavement condition	Highway develops repeated dips. (M&O) Large heave/depression. Possible thawing ice wedge. (SW2020)	Geol Memo
242.8		pedestrian/bicyclists	Suggestion for new pedestrian/bike bridge (Nenana River Bridge, BR 1143); the scenery in this location is compelling. People need a safe place to take photos.	Public
242.8		safety, multi-modal, access/connectivity	Multimodal access and transport are a key interest. Seeing different ways for people to experience the area. Trails and bike accessibility ties into safety issues that people have brought up at MP 231, Glitter Gulch, **Windy/Moody Bridge [also known as Nenana River Bridge, Bridge #1143 at MP 242.8]**. These issues stem from the problem that pedestrians and users have nowhere else to go except the road [Parks Highway].	PAC
243.0		pedestrian/bicyclists	Suggestion for pedestrian/bike underpass at Bison Gulch Trailhead	Public
243.0		recreation, new access	One popular location for wildlife viewing is at MP 243 on the north side of the Moody Bridge. The steep sunny slopes of Sugarloaf Mountain regularly attract sheep as well. A designated location for motorists to pull off the highway for wildlife viewing in this vicinity does not currently exist.	Rec Memo
243.0		roadway condition	roadway condition/ repair needs: Bison Gulch trailhead MP 243	Public
243.5	243.5-245.5	safety, crash locations	Area where several vehicle crashes (n=7) occurred between 2013-2017 based on DOT&PF data and using a sliding spot analysis; no crash patterns identified	T&S Memo
243.5		roadway condition (sinking)	This location has been identified to have issues with the roadway settling annually. This causes the highway to develop an uneven surface and sections of heaving, resulting in annual maintenance concerns.	M&O Memo
243.5		unstable embankment/ pavement condition	Highway develops repeated dips. (M&O) Abrupt depression in roadcut. (SW2020) Thaw unstable embankment section exhibits up to 12 inches differential settlement yearly. M&O stated that this section needs to be paved yearly. M&O stated that the material disappears every year. There are signs that read "Bump" leading up to the section. Condition = fair. (GAM)	Geol Memo
243.8	243.8-244.1	unstable embankment	Thaw unstable embankment section exhibits up to 6 inches of differential settlement. M&O stated section requires maintenance every 2 to 3 years. Condition = fair. (GAM)	Geol Memo
243.8		recreation	Folks trying to get from the Bison Parking Lot to the obvious trail on the other side of the road.	PAC
243.8		recreation access improvement	Create parking for Bison Gulch on west side of highway	Public
243.8		recreation, access, inadequate parking	Several of the trailheads located along the study corridor such as **Bison Gulch** and Triple Lakes have inadequate parking to meet the demand for access during peak season.	Rec Memo
243.8		recreation, existing access improvements	Trails, improving Bison Gulch/ Antler Creek trailhead; may need to move this up to Antler Creek.	PAC
243.8		recreation/tourism, DNP congestion, development, trails	Trail system connections in the frontcountry to alleviate crowding/ increase frontcountry opportunities - We've pushed the envelope in terms of the number of visitors that can visit inside DNP using buses; investing into the frontcountry trails can help to alleviate overcrowding. Having more frontcountry experiences satisfies visitor desires to get into DNP and can serve as an "one more day". This increases hotel stays, giftshops, and hotels, without over taxing the park. **Same thing with Bison Gulch trail.**	PAC
243.8		safety, recreation, access, trailhead	Relocate Bison Gulch parking area to the west side of Parks Highway, closer to the trailhead to Mt. Healy.	Prior Plans
243.8		safety-turning lane	An area of concern I have is the lack of left hand turn lanes at use points. One of the worst examples is the left hand turn onto the Stampede Road when driving northbound. Other similar areas include the parking lot accessing the **Bison Gulch Trail** & S. Boundary of Denali Nat'l Park (Triple Lakes Trailhead).	Public
244.0		drainage	A small section near MP 244 appears to include low points within the roadside ditches on both sides of the roadway corridor. There is a regional low point identified as a pond that exists on the west side of the roadway corridor that appears to have no outlet.	Drainage Memo

Approximate Parks Highway Milepost (MP) *(if a range, southern MP extent)*	**Approximate MP range** *(if applicable)*	**Category Type of Identified Need, Concern, Issue, Hazard or Opportunity**	**General Description** [1]	**Source** [2]
245.0	245 - 245.9	unstable embankment/ pavement condition	Wavy road. Evidence of embankment settlement with ponded water along the toe. Thaw problems. (SW2020)	Geol Memo
245.2	245.2-245.9	drainage	Ponding was identified in the roadside ditch on the west side of the roadway corridor. The culverts appeared to be in good condition and the roadside ditches have been inundated and do not effectively convey runoff to these culverts.	Drainage Memo
246.0	246-247	speed	Perception of Healy, particularly near Otto Lake as a speed trap	T&S Memo
247.0	247-249.3	pathway	Request for separated multi-use pathway (Otto Lake Road-Dry Creek)	Public
247.0		access-numerous driveways	Need frontage road on the west side of Parks Highway, south from the Hilltop Road intersection, to minimize direct driveway access to the highway	Prior Plans
247.0		safety, pedestrian	Concerns with pedestrian crossings at Healy Spur/Hilltop	T&S Memo
247.5	247.5-252.5	safety, crash locations	Area where several vehicle crashes (n=23) occurred between 2013-2017 based on DOT&PF data and using a sliding spot analysis; crash factors mostly attributed to animal (moose) strikes, also driver error and weather conditions	T&S Memo
248.0		development, stewardship, education	An opportunity for a visitor center in **Healy** would be beneficial as would a visitor center at Cantwell. In Healy, it could emphasize an early man site and other known archaeological sites as well. The Parks Highway itself has an interesting history.	PAC
248.0		safety	Safety concerns including Healy spur road intersection	PAC
248.0		safety- four-wheelers	Accommodate four-wheelers: There needs to be a safe place for 4-wheelers to cross the highway in the Healy area where there are many 4-wheeler trails in the area.	Public
248.0		safety, pedestrian	Pedestrian crossing in Healy. DOT&PF worked with the Borough to get the flashing beacon installed previously. The area houses a lot of seasonal employees. Pedestrian crossing is a concern at Healy Spur Road.	PAC
248.0		safety, pedestrian	Many seasonal employees were moved from Nenana Canyon area to the area near the Healy Spur Road in 2014, which resulted in a sharp uptick in pedestrian crossings of the Parks Highway	T&S Memo
248.0		safety, pedestrian	DOT&PF has received mixed feedback from the installation in 2015 of a pedestrian activated rectangular rapid flashing beacon. Possible need for obtaining new pedestrian counts during peak tourism season to understand additional employee housing and other developing in the area contributing to pedestrian counts.	T&S Memo
248.0		safety, pedestrians / connectivity	Pedestrian concerns in the community of Healy.	M&O Memo
248.0		speed	More speed limit signage and speed limits painted in 45 zones (Cantwell and Healy)	Public
249.0		roadway condition	roadway condition/ repair needs: The “dip” near Dragonfly Creek ~MP 249	Public
249.2	249.2-249.3	unstable embankment/ pavement condition	Ponded water next to embankment. Possible thaw settlement or grading issue. (SW2020)	Geol Memo
249.3		safety	Healy “over flow bridge/Dry Creek Slough bridge” is a pinch point and a need to address.	PAC
249.4		pedestrian/bicyclists	Suggestion for new pedestrian/bike bridge (Dry Creek Bridge, BR 0852)	Public
249.8		safety, pathway	Explore opportunities to build bike and pedestrian infrastructure along highways and major roads: Upgrade Dry Creek Slough Bridge to include sufficient width for a separated pedestrian path, or develop a culvert	Prior Plans
251.0		safety-turning lane	Need turning lane at Parks Highway Mile 251 Stampede and Lignite Road intersection, northbound and southbound lanes	Prior Plans
251.0		safety-turning lane	An area of concern I have is the lack of left hand turn lanes at use points. One of the worst examples is the left hand turn onto the **Stampede Road** when driving northbound. As a resident of the Stampede I am routinely passed at high speeds to my right, on the shoulder of the road, often in marginal conditions. Other similar areas include the parking lot accessing the Bison Gulch Trail & S. Boundary of Denali Nat'l Park (Triple Lakes Trailhead).	Public
251.0		safety-turning lane	Desired turn lanes at Stampede/Lignite intersection	T&S Memo
251.0		safety-turning lanes	Requests have been received for turning lanes at intersection of Parks Highway with Stampede Road and Lignite Road.	M&O Memo
251.0		safety-turning movements	Hazardous roadway configuration for turning movements: Stampede/Lignite Road	Public
251.0		speed	At the Stampede Road turnoff - where people are leaving Healy, increasing their speed to 65 mph, then the road narrows. This poses safety concerns when someone wants to turn left onto Stampede Road.	PAC
251.5	251.5-252	unstable embankment /pavement condition	Roadway dips. Culverts appear to be bowed down in middle ~1 foot of 3-foot diameter culvert. Likely related to thaw settlement. (SW2020)	Geol Memo
252.3		unstable embankment /pavement condition	Small patch in pavement south of Panguingue Creek. Frost heave? (SW2020)	Geol Memo
252.5		bank erosion near bridge crossing	The Panguingue Creek shows signs of bank erosion within the bridge crossing structure (BR 0313) and immediately downstream of the crossing.	Drainage Memo

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252.5		safety	This bridge was resurfaced a few years ago, but it's located on a curve; would like to see it straightened. There's also a vertical curve south of the bridge; truckers call it Caribou Dip, since the caribou cross there. So there's wildlife crossing issues here.	PAC
253.0	253-254	roadway damage-weakening embankment	The roadside ditch on the east side of the roadway corridor has developed local low points that accumulates surface runoff into ponding that is currently abutting up to the roadway embankment. This ponding is assumed to be the source of weakening embankment identified; see also SW2020.	Drainage Memo
253.0		drainage issues	Slightly to the north of MP 253, drainage issues are causing damage to the base of the road. The effect of these drainage issues on the road base are causing part of the road to begin collapsing, creating a bit of a sink hole or severe dip in the road surface.	M&O Memo
253.0		safety-turning lane	Need turning lane at Parks Highway Mile 253, at location of proposed Healy Solid Waste Transfer Station, northbound and southbound lanes	Prior Plans
253.1		roadway damage-drainage	Installed culverts in this area are generally good. However, roadside ditch does not appear to convey the complete captured surface runoff to each culvert on the upstream side (western side of the corridor. Local low points created on the downstream side (eastern side of the corridor) appear to exacerbate the issue.	Drainage Memo
253.3	253.3-253.8	drainage issues; unstable embankment/ pavement condition	Drainage issues are causing damage to the road base, sink holes and severe dips occur. (M&O) MP 253-253.3 and MP 253.7-253.8 severe thaw settlement. MP 253.7-253.8 settlement at embankment toe. (SW2020)	Geol Memo
255.3	255.3-255.5	unstable embankment/ pavement condition	A few bumps. Large circular failure propagating through northbound lane near 255.4. Toe pond and poor drainage at culverts. (SW2020)	Geol Memo
255.9		unstable embankment/ pavement condition	Bumps (SW2020)	Geol Memo
256.0	256-259	roadway damage-weakening embankment	Regional topography shows the adjacent surface generally slopes from the west toward the Nenana River in the east. The roadside ditch on the east side of the roadway corridor has developed local low points that accumulates surface runoff into ponding that is currently abutting up to the roadway embankment. This ponding is assumed to be the source of weakening embankment (SW 2020).	Drainage Memo
256.3	256.3-256.5	drainage issues	Drainage issues are causing road damage. (M&O) Severe bumps and waves. Thaw settlement resulting in drainage issues. (SW2020)	Geol Memo
256.5		roadway condition (pavement condition/ drainage)	Maintenance crews have identified a section of roadway around MP 256.5 where the shoulder of road is failing due to damage resulting from issues with drainage. There are a large amount of longitudinal cracks forming along the road shoulder as well as along the active roadway. It has been reported that the road shoulder is beginning to fall off due to these issues.	M&O Memo
256.5		roadway damage-drainage	Road shoulder is failing due to damage caused by drainage issues. There are many cracks forming along the road shoulder as well as along the active roadway, causing the road shoulder to begin to fall off. (M&O)	Drainage Memo
257.1	257.1-257.3	unstable embankment/ pavement condition	A few bumps in small “valley” areas between road cuts. (SW2020)	Geol Memo
257.8		possible stream bed degradation near culvert	Slate Creek appears to show signs of bed degradation on the downstream side of the roadway crossing (double barrel culvert pipes 7113). The culverts show moderate rust but are generally in good condition. The creek shows a slight potential to migrate outside its existing banks as the channel is braided as it approaches the roadway crossing. The southernmost culvert shows signs of glaciation.	Drainage Memo
258.1	258.1 -259	unstable embankment/ pavement condition; slope stability; landslide hazard	Bumpy road with numerous patches and drainage issues. Large scale creeping failure of slopes above the road (MP258.3-258.6) and impacting the ROW. Small riprap “buttress” on backslope is “failing”. (SW2020) Drainage issues affecting road base. (M&O)	Geol Memo
258.5		roadway condition (pavement condition/ drainages issues)	These drainage issues are a problem affecting the base of the roadway near MP 258.5 of the Parks Highway. It is likely that these drainage problems will continue to cause structural damage to the roadway until the problems are addressed.	M&O Memo
258.5		roadway damage-drainage	DOT&PF maintenance and operations crews have reported that drainage issues are also a concern in the area near MP 258.5 of the Parks Highway. These drainage issues are a problem that is affecting the base of the roadway. (DOT&PF 2020)	Drainage Memo
259.0		safety-turning movements	Hazardous roadway configuration for turning movements: Turning east on Ferry Road	Public

[1] Acronymns: AASHTO = American Association of State Highway Transportation Officials; ANILCA = Alaska National Interest Lands Conservation Act; ASAP = Alaska Standalone Pipeline; BR = bridge; DNP = Denali National Park; DOT&PF= Alaska Department of Transportation & Public Facilities; GAM = DOT&PF Geotechnical Asset Management ; LNG = liquified natural gas; NPS = National Park Service; RS2477 = Revised Statute 2477; SW = Shannon & Wilson.

[2] Sources include: Public, Project Advisory Committee (PAC), and the following PEL Study memos: Geological/Geotechnical, Drainage, Environmental Conditions, Review of Prior Plans, Maintenance and Operations (M&O), Recreational Facilities, Traffic & Safety (T&S)

Appendix B

Review of Prior Plans for the Corridor and Region Memorandum (August 15, 2020)

Memorandum

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Subject	**Review of Prior Plans for the Corridor and Region**
Project Name	Cantwell to Healy Planning and Environmental Linkages (PEL Study) Parks Highway Mileposts 203-259
From	Leslie Robbins, AICP CEP Jacobs Planner
Date	August 15, 2020
Copies to	Federal Highway Administration Western Federal Lands, Alaska Department of Transportation and Public Facilities Northern Region, and National Park Service Alaska Region

1. Introduction

The Federal Highway Administration Western Federal Lands (WFL) in partnership with the Alaska Department of Transportation and Public Facilities (DOT&PF) and the National Park Service (NPS), are working together to identify potential future transportation and access improvements along the Parks Highway corridor (mileposts [MP] 203 and 259). The partnering agencies are conducting a Planning and Environmental Linkages (PEL) Study that will look at current and future conditions and needs of transportation and access facilities along the Parks Highway corridor as it relates to the users and communities in the areas between Cantwell and Healy.

Several technical memorandums such as this one are being prepared as part of the Needs and Opportunities Assessment phase, which is the first phase of this PEL Study process. This memorandum briefly summarizes representative (1) prior plans for the transportation corridor and region and (2) other relevant projects or proposed development.

2. Review of Representative Prior Planning Efforts for the Corridor and Region

2.1 Overview

The Parks Highway is as a key transportation corridor, serving a variety of highway users and stakeholder needs and interests. Previously-prepared plans and studies provide context for the importance of this unique corridor and insight on various stakeholders' previously-identified visions, goals, needs and opportunities for the corridor. Reviewing past efforts helps to have a greater understanding of baseline conditions related to the transportation corridor. To the extent possible, the PEL Study will incorporate and build upon the work that has been done previously.

This memorandum provides a brief summary of the following previous plans and studies:

- Denali Park Realignment (MP 344-348) Feasibility Study (Alaska Railroad Corporation [ARRC] 2018)

- Denali National Park Long Range Transportation Plan (NPS 2018)
- Denali Borough Land Use and Economic Development Plan (Denali Borough 2018)
- State Rail Plan (DOT&PF 2016)
- Denali Borough Healy Transportation and Pedestrian Safety Plan (Denali Borough 2016)
- Denali Borough Comprehensive Plan (Denali Borough 2015)
- Parks Highway National Scenic Byway Master Interpretative Plan (Alaska Department of Natural Resources [DNR] 2012)
- George Parks Highway Scenic Byway Corridor Partnership Plan (DNR 2008)
- Parks Highway Visioning Document (DOT&PF 2006)
- Tanana Basin Area Plan for State Lands (DNR 1991)

Common themes in these plans and studies include:

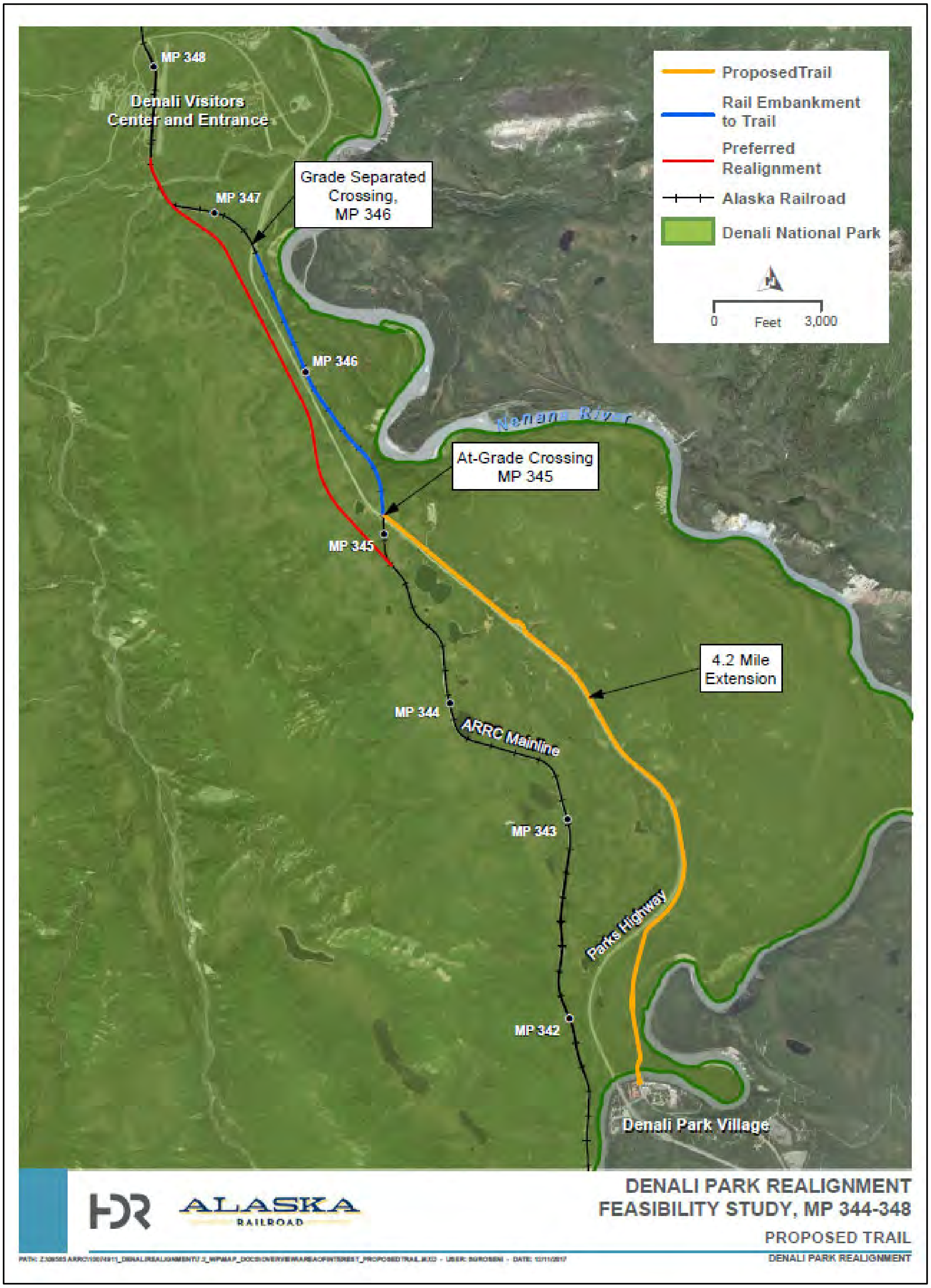
- Establishing and leveraging partnerships
- Improving existing and creating new recreation access areas
- Safety roadway improvements, including adding turning lanes at Parks Highway intersections
- Adding pathways, particularly along the highway
- Promoting a culture of safety and mutual respect amongst user groups, including motorized and non-motorized
- Importance of tourism and outdoor recreation that drives communities and borough economy
- Support and expand tourism industry

2.2 Denali Park Realignment (MP 344-348) Feasibility Study (2018)

The *Denali Park Realignment (MP 344-348) Feasibility Study* (ARRC 2018) was conducted by the ARRC to assess the feasibility of realigning the railroad track near the entrance to Denali National Park **to reduce maintenance costs, provide operational efficiency, and improve public safety by removing two highway-rail crossings on the Parks Highway**. One crossing is an at-grade crossing of the Parks Highway at MP 235 and the other is an existing already grade-separated crossing of the Parks Highway slightly further north. The rail realignment would straighten the tracks and enable future double tracking. The planning-level analysis included conceptual engineering, consideration of potential environmental resources such as wetlands and geotechnical constraints, and conceptual cost estimates.

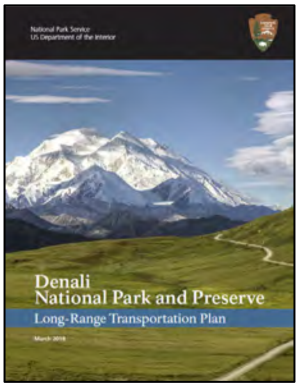
The study identified a preferred alternative amongst three options, which would realign the track west of its existing location through Denali National Park. The study cites the need for additional coordination between the ARRC and the NPS regarding land ownership and future environmental clearance, including a potential Section 4(f) analysis. The study also included a conceptual design for converting the existing ARRC track embankment that would be abandoned into a trail and connecting to a potential additional 4.2-mile trail alignment that would connect to the Denali Village area. Figure 2-1 is a figure excerpt from the study and depicts the preferred track realignment and the proposed trails, including the proposed abandoned rail to trail alignment.

Figure 2-1. Alaska Railroad Proposed Railroad Realignment and Trail near Denali National Park Entrance



Source: Excerpt from *Denali Park Realignment (MP 344-348) Feasibility Study* Figure 4-1, ARRC 2018.

2.3 Denali National Park Long Range Transportation Plan (2018)



The National Park Service prepared the *Denali National Park Long Range Transportation Plan* (LRTP) in 2018 to guide transportation decision-making within the Park for a 20-year planning horizon. The plan contains visions, goals, objectives, identification of conditions and transportation needs, funding strategies, and identification of implementation actions.

The LRTP's vision statement is:

"Protect intact the globally significant Denali National Park and Preserve ecosystems, including their cultural, aesthetic, and wilderness values, and ensure appropriate access to opportunities for inspiration, education, research, recreation, and subsistence for this and future generations."

The LRTP identified the following goals:

- Resource protection goal: Understand and protect Denali's fundamental park resources and values as they relate to the transportation system.
- Climate change goal: Plan for climate change impacts to the park's transportation system.
- User experience goal: Provide a quality, multimodal park experience for users.
- Access goal: Provide safe, efficient, and appropriate park access for all users.
- System optimization goal: Develop a long-term transportation system to appropriately satisfy current and future park needs.
- Partnership goal: Maintain formal and informal partnerships to provide a viable transportation system.

The LRTP describes the three available transit service types along the Denali Park Road, which includes tour buses, transit buses, and frontcountry courtesy buses.

Some identified needs impacting the frontcountry include:

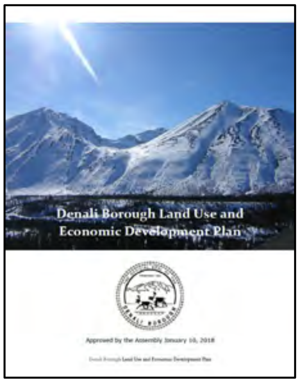
- Lack of information about transit service operations.
- Lack of connections between the park and surrounding communities and visitor accommodations.

The NPS identified several proposed implementation actions in varying priority. Relevant frontcountry and transit-related actions include:

- High priority: Evaluate frontcountry circulation to improve and inform development.
    - o The LRTP describes this action as two-fold: (1) update entrance area plan (last completed in 1997 and incorporate multimodal circulation as a key factor and (2) include specific elements such as traffic counter mechanisms to understand vehicle, bicycle, and pedestrian movements.
- Medium priority: Facilitate development of a community transit plan.
    - o The LRTP describes this action three-fold: (1) determine staff and funding resource needs; (2) commit time to initiate and complete a comprehensive stakeholder process; and (3) support non-NPS entities to apply for funding from such programs as the Federal Lands Access Program.

An appendix in the LRTP contains a list of possible foreseeable projects/plans near Denali National Park, as of August 2017. Lastly, the LRTP cites several past resource documents that contributed to the development of the LRTP, including reports such as the Denali Entrance Area Environmental Assessment (2001), Denali Transportation Needs Assessment (2006), Consolidated Denali General Management Plan (2008), and the NPS Alaska Region LRTP (2012).

2.4 Denali Borough Land Use and Economic Development Plan (2018)



The Denali Borough Assembly approved the *Denali Borough Land Use and Economic Development Plan* **on** January 10, 2018.

The plan states it was prepared in response to borough residents and land/business owners trying to find a balance between the amount of overall government involvement and the need to protect private property rights.

The plan contains guiding principles, current trends regarding population and the economy, and housing. The process included developing a vision and identifying community values and goals. The plan's three goals are related to land use, transportation, and economic/ fiscal health. Tourism and outdoor recreation are cited as driving most of the borough economy (page 21). The plan includes the goal of encouraging expansion of the tourism industry by increasing fall, winter, and spring travel.

For the land use goals, the plan references the growing recreation and tourism activity in the Borough, particularly the growing portion of these activities that will happen in "frontcountry" locations (page 11). Relevant identified land use goals include:

- Goal: Support quality, sustainable front country recreation & tourism
- Goal: Encourage clustering of commercial activity to maintain an attractive highway corridor & provide compact, convenient activity and service centers.

The plan mentions several times the opportunities associated with working actively with entities who currently operate the transportation network; this includes the DOT&PF, NPS, ARRC, and other private transportation and tourism operators. The plan states possible next steps could include working with "partners like the State and the Park Service to improve the tourism and recreation opportunities, the activities that are the foundation of the borough economy. Bringing together key transportation providers can begin productive dialogues about shared interests and goals and build or strengthen relationships between the organizations." A specific partnership-related action cited includes:

> "Work with NPS, Ahtna, the State and user groups to improve accessible "frontcountry" experiences, such as trails to and through existing/planned commercial, lodging and residential areas. Make it easy for people to get into attractive natural places – by foot, bike or in the winter by skis, dogsled or snow machine – without needing a car."

Relevant components of the transportation goal include:

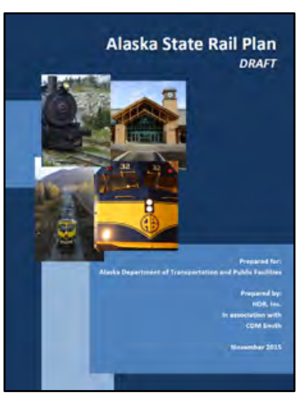
- Support effective, easy to use, connected transportation options that benefit everyone who lives in, works in or visits Denali Borough.
    - One existing transportation service is provided by Dine Denali shuttle, which provides regularly scheduled passenger service around the Park entrance area and in Healy during the summer.

- Explore opportunities to build bike and pedestrian infrastructure along highways and major roads. The plan identified the following relevant 2017 community priorities:
    - McKinley Village: new, safer pedestrian and vehicle movements – combined with a new NPS trailhead, will create a valuable new "frontcountry" gateway, to the Oxbow and Triple Lakes Trails Healy: Multiple projects
    - Multi-use pathway along Healy Spur Road, from Parks Highway to School Road.
    - Upgrade Dry Creek Slough Bridge to include sufficient width for a separated pedestrian path, or develop a culvert
    - Relocate Bison Gulch parking area to the west side of Parks Highway, closer to the trailhead to Mt. Healy.
    - Frontage road on the west side of Parks Highway, south from the Hilltop Road intersection, to minimize direct driveway access to the highway.
    - Turning lane at Parks Highway Mile 251 Stampede and Lignite Road intersection, northbound and southbound lanes.
    - Turning lane at Parks Highway Mile 253, at location of proposed Healy Solid Waste Transfer Station, northbound and southbound lanes.
    - Cantwell: Turning lane at Parks Highway Mile 210 Denali Highway intersection, northbound and southbound lanes.
- Document existing trails in the borough and seek opportunities to reserve and improve popular trails.

The plan mentioned a long-discussed vision for creating a Healy Town Center to encourage clustering of commercial activities into a liveable and compact walkable place. The plan also suggests building upon the work of the Healy Transportation and Pedestrian Safety Plan, which identified specific community projects.

Lastly, the plan references other planning efforts that have occurred in the Borough (page 15), several of which are summarized in this memo such as the Healy Transportation and Pedestrian Safety Plan and the Denali Borough's Comprehensive Plan.

2.5 State Rail Plan (2016)



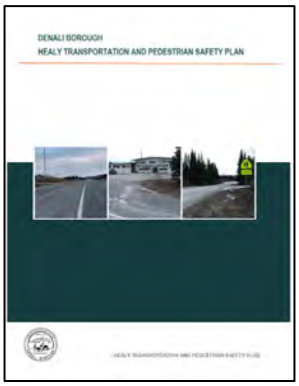
The DOT&PF completed the *State Rail Plan* in 2016 to formulate a vision for rail in Alaska and to serve as a guide for the state's rail freight and passenger transportation planning activities and project development plans over a 20-year planning horizon.

The plan describes the state's existing rail network and rail-related economic and socioeconomic impacts. The plan also included a rail vision for the state and supporting goals, and described potential capital improvements, studies, and recommended next steps. Goal 3 of the plan (Encourage Partnership and Collaboration) and a corresponding objective (Participate in local government land use planning along existing and potential transportation corridors) aligns with the ARRC's involvement as being one of the stakeholders in the project advisory committee for this PEL study.

The plan identifies the following two proposed projects that would be located within the PEL study area:

- Freight Rail – Short-term: Cantwell Intermodal Facility. The plan states the DOT&PF, the Alaska Gasline Development Corporation, and the Alaska Energy Authority have identified an interest to construct an intermodal facility near Cantwell. This would enable transfer of material from rail to truck, for which DOT&PF is interested in because of the potential development opportunity of a hard aggregate facility in the area.
- Freight Rail – Long-term: ARRC Healy Canyon Stabilization. The plan states this project comprises several elements, some of which have already been completed such as daylighting a tunnel and realigning track. The ARRC has ongoing work to stabilize the track bed along a narrow bench above the Healy Canyon.

2.6 Denali Borough Healy Transportation and Pedestrian Safety Plan (2016)



The Denali Borough completed the *Healy Transportation and Pedestrian Safety Plan* in 2016, prepared by the Healy and Pedestrian Safety Ad-Hoc Committee that had been established in 2014. The focus area included multiple local roads near Healy as well as the 4-mile stretch along the Parks Highway, between MP 247 for Otto Lake Road and MP 251.2 at the Stampede/Lignite Road intersection. The purpose of the plan is to “establish a framework **to realize improved vehicle and pedestrian safety** within the community of Healy.”

The plan identified the following **goals**:

- Overall Goal: to prevent vehicle-pedestrian related accidents and conflicts in a growing community
- Goal 1: To establish safe traffic and pedestrian routes within the community of Healy (infrastructure)
- Goal 2: Promote a culture of safety and mutual respect between motorized and non-motorized user groups (education)

The plan also identifies the goal to conduct “close collaboration between the Denali Borough, stakeholders and the DOT to identify potential opportunities for improved vehicle and pedestrian safety” through measures such as: increased signage of existing speed limits; widened road shoulders; multi-use trails; and turn pockets, among other measures.

The plan describes recent **transportation improvements** that have been made in the corridor (e.g., addition of turning lanes and passing lanes) and other **projects in progress** at the time (e.g., replacing Riley Creek bridge to accommodate turn lanes [completed in 2015] and improving pedestrian facilities and turn lanes at MP 231 of the Parks Highway).

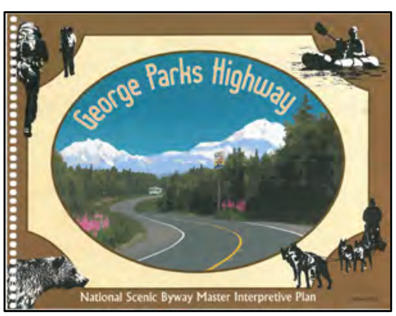
2.7 Denali Borough Comprehensive Plan (2015)

The Denali Borough adopted this *Comprehensive Plan* in 2009 and amended it on September 9, 2015. The plan's purpose is to "guide planning for the intelligent use of the borough's resources for its present and future generations."

Selected relevant goals from the plan include:

- Goal 1 for future economic expansion: Create a sustainable, diversified economic base through the development of natural resources and expansion of the tourist industry.
- Goals for transportation planning:
  - Goal 1: Continue to develop and maintain a Long Range Comprehensive Transportation Plan.
  - Goal 8: Support the state's efforts to identify and resolve all RS2477 routes and other transportation corridors.
  - Goal 10: Continue to encourage and support DOT and NPS in their efforts to develop multi-use paths along the Parks Highway through communities and in heavily used tourist areas.
  - Goal 11: Continue to encourage and support DOT and NPS in improving highway safety with the implementation of turning lanes, passing lanes, pedestrian cross-walks, traffic signals, reduced speed limits in congested areas, pedestrian bridges and tunnels.
  - Goal 12: Continue support and encourage DOT and NPS in removing the at-grade railroad crossing located at Milepost 235 on the Parks Highway.

2.8 Parks Highway National Scenic Byway Master Interpretative Plan (2012)



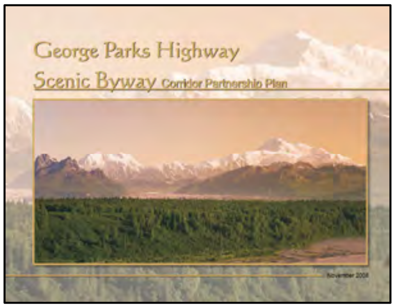
The Alaska Department of Natural Resources prepared the *Parks Highway National Scenic Byway Master Interpretative Plan* in 2012 for DOT&PF, with the intent to help Byway partners and land managers "make decisions regarding the establishment and maintenance of interpretive sites and services.

The plan contains a mission statement, goals and objectives. Goals are largely related to interpretive-related facilities, however the promotion of safe and responsible travel on the byway is one of the identified goals. The plan contains the following mission statement:

> *Enhance the experience for byway travelers by promoting a safe and comfortable journey wile presenting high-quality interpretation that reveals the George Parks Highway National Scenic Byway's intrinsic qualities.*

The plan summarizes the six intrinsic qualities as detailed in the related George Parks Highway Scenic Byway Corridor Partnership Plan (2008) prepared four years prior.

2.9 George Parks Highway Scenic Byway Corridor Partnership Plan (2008)



The Alaska Department of Natural Resources prepared the *George Parks Highway Scenic Byway Corridor Partnership Plan* in 2008 for DOT&PF, a requirement at the time for seeking National Scenic Byway or All-American Road designation. The plan recognizes the Parks Highway as being one of the most important roads in Alaska for commerce and recreation.

The Parks Byway Vision Statement found in the plan is:

> *Take a journey on the Parks Byway into the wilds of Alaska. Experience breathtaking views clear to the horizon of majestic mountains, including Denali (Mt. McKinley), North America's highest peak. The Parks Highway Scenic Byway takes you through birch and spruce forests and the Alaska Range's wide-open alpine tundra. It passes steeply-carved hillsides, broad open plains, glacier-fed rivers, and clear water streams—a landscape shaped over time by snow, ice, and other natural forces.*
>
> *The Parks Highway Scenic Byway is a place where people value their connection to the land for recreation, self-sufficiency, and continuing cultural traditions—a corridor in which the independent, frontier spirit of the people is reflected in the uniqueness of their rural communities.*

The Parks Byway Community Partnership Mission Statement found in the plan is:

> *Through cooperative planning and continued sustainable development, the Parks Byway Community Partnership is dedicated to maintaining the scenic qualities of the byway corridor and honoring the spirit of the last frontier by providing a safe, comfortable, and educational adventure to be enjoyed by every traveler. The Parks Byway Community Partnership further contributes to the communities and places of interest along the corridor by promoting tourism, supporting the local culture, and enhancing the economic base of the region.*

The plan describes the Parks Highway as exemplifying the following six intrinsic values of national significance as part of the Alaska and National Scenic Byways Program:

- Natural: tallest mountain in North America (Denali); deepest gorge in North America (Ruth); vast protected area (the United Nations Man and Biosphere Program's designation of Denali National Park and Preserve as an International Biosphere Reserve; Denali State Park and associated State Recreation areas); largest inland glaciers in Alaska; one of North America's lowest mountain passes (Broad Pass); critical fossil finds
- Recreational: wildlife watching; world-class mountaineering; limitless multi-use outdoor recreation opportunities; unparalleled hiking; world's longest wheelchair and handcycle race; dog-mushing; world-class snowmobiling; accessible aurora viewing; guided excursions
- Scenic: one of Alaska's most scenic byways; seasonal changes and fall tundra colors
- Historical: First Peoples; early explorers; the race up Mt. McKinley; creation of Denali National Park and Preserve
- Cultural: unique frontier culture
- Archaeological: sites associated with Athabascan groups

An appendix of the plan inventories these intrinsic qualities broken down at key mileposts. The plan includes a mapbook series as part of the intrinsic quality assessment. Relevant maps that cover the PEL study corridor include: Figure 2 (natural resources); Figure 4 (recreation resources); Figure 6 (scenic resources); and Figure 8 (cultural resources).

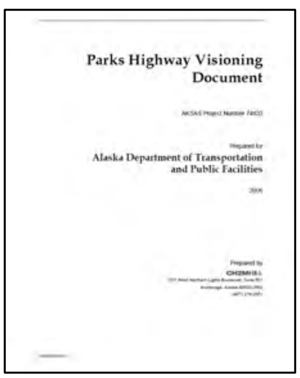
Chapters 6 and 7 of the plan discuss transportation/ safety and tourism, respectively. The plan calls the Parks Highway the backbone of the transportation system through central Alaska. Regarding tourism, one of the plan's primary goals is "to enhance the economic vitality of local communities along the byway." The plan suggests expanding tourism beyond the busy summer months between May and September.

The plan also mentions the decades-long-studied South Denali Visitor Complex which was proposed to be located atop Curry Ridge in Denali State Park. (While the location for this proposed visitor complex is located south and outside of the PEL Study corridor, this project would have implications to tourist visitation within the PEL study area).

The plan also cites the Denali State Park Management Plan (2006) as identifying the need to prepare a Denali Recreation Region Study.

The plan states one of the primary concerns heard during the public involvement outreach effort was related to the challenges associated with maintenance of current and future facilities. Other concerns the plan identifies includes: the mix of recreation and residential traffic, particularly during the traffic flow during summer; conflict of commercial through-traffic preferring higher speeds versus tourist traffic which is associated with a slower more leisurely speed.

2.10 Parks Highway Visioning Document (2006)



Parks Highway Visioning Document

Alaska Department of Transportation and Public Facilities

The DOT&PF completed the *Parks Highway Visioning Document* in 2006. The plan identifies the rapid economic expansion and population growth within the Parks Highway corridor considering DOT&PF's challenge to "preserve the highway's primary function as an interstate-level arterial while still supporting the safe and efficient flow of localized traffic at key nodes." The intent of the plan is to provide DOT&PF's vision and provide guidance to DOT&PF's decisions about forthcoming highway projects. The needs identified in the plan were based on 2030 traffic projections.

The plan contains the following vision:

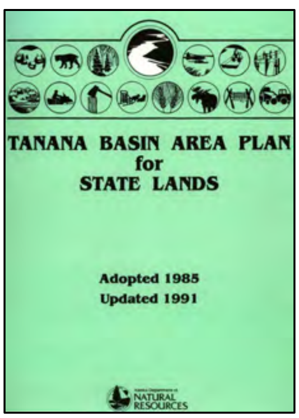
> *The Parks Highway is a vital transportation link connecting numerous communities from south central Alaska to the northern interior regions of the state. This link is important for community connection, commerce, recreation, and tourism. A high degree of mobility for through trips while accommodating local access and slower travelers should be provided in a manner that is highly compatible with the communities and the environment along the corridor. The highway should be free-flowing with enough capacity and appropriate design standards to safely support travel at highway speeds. The long-term vision is for the highway to be upgraded to include freeway-style design characteristics, such as controlled access and interchanges at major connections. Local travel, within communities along the corridor, will be improved by developing local access road systems.*

The plan describes varying highway corridor uses, including the right-of-way adjacent to the highway, which "also provides for many functions, including pullouts, rest areas, recreation access, pedestrian/ bike trails, public and commercial establishment parking, switch-over stops for truckers, raft launches, trailheads, and camping."

By segments ("planning units") along the entire Parks Highway corridor, the plan identifies needs, programmed projects, and potential future development for each segment. Of the identified planning units in the document, four units run through the PEL study area; these include Cantwell-Carlo Creek, Carol Creek-McKinley Village, McKinley Village–Nenana Canyon, and Nenana Canyon–Healy, as briefly summarized below. The plan is more than 15 years old and some of the identified needs and projects may have already been addressed or constructed.

- Cantwell – Carlo Creek: need for passing lanes and climbing lanes, possible interchange, frontage roads, possible bypass
- Carlo Creek – McKinley Village: need for passing lanes and climbing lanes, need for turning lanes to accommodate numerous driveways in McKinley Village, provide continuous frontage road system extending the full length of highway between Carlo Creek and McKinley Village
- McKinley Village – Nenana Canyon: consider travel options through Nenana Canyon, including a cut-and-cover design in the canyon or a bypass to the east around Sugar Loaf Mountain; add turning lanes and other safety improvements to the turnoff for the Denali National Park entrance
- Nenana Canyon – Healy: need for passing lanes and climbing lanes, consider an upgraded two-lane section with passing and climbing lanes with a four-lane section and frontage road or access road system in Healy

2.11 Tanana Basin Area Plan for State Lands (1991)



The DNR prepared the *Tanana Basin Area Plan for State Lands* in 1991 as an update to several past state land areas and management planning efforts. The plan "designates the uses that will occur on state lands within the Tanana Basin." The Parks Highway (and PEL Study corridor) falls within one of the Tanana Basin Planning area units: subregion 4 of the Tanana Basin Planning Area. The plan discusses this subregion in chapter 3, pages 123 through 171.

The plan characterizes this subunit as being bisected by the highway and railroad transportation corridor with many trails, roads and rivers that extend into the backcountry. Aside from the resource management intent related to agriculture, mineral development, and wood harvesting, one of the management intents is to "protect the habitat and recreational resources of the area." The overarching "management emphasis [for the management unit (Unit 4f-Parks Highway Corridor) is on recreation, protecting future agriculture development opportunities, and maintaining fish and wildlife habitat. Regarding transportation, the plan recognizes DOT&PF is examining improvements to the Parks Highway; specific improvements identified include additional lanes, climbing lanes, and shoulder widening (page 3-125). The plan mentions the Alaska Natural Gas Pipeline project and that one of the proposed routes would follow the Parks Highway – Alaska Railroad corridor.

3. Other Relevant Representative Projects or Proposed Development

While this memorandum is largely focused on briefly summarizing representative prior plans for the corridor and region, this section briefly summarizes past, current and already-planned DOT&PF projects as well as several other projects that the public and members of the Cantwell to Healy PEL Study project advisory committee mentioned as warranting consideration when looking at the corridor setting.

Table 1 summarizes recent DOT&PF construction projects along the Parks Highway that occurred within the PEL study area.

Table 1: Recent DOT&PF Construction Projects within the PEL Study Corridor

Project Name	Project Boundaries	DOT&PF Project ID	Description of Work	Construction Year
Parks Highway MP 163 - 305 Passing Lanes - Stage II	MP 197.7 - 200.1 and MP 213.1 - 215.1	62683	Constructed passing lanes on the Parks Highway from MP 197.7 - 200.1, MP 213.1 - 215.1, MP 289.5 - 291.6, and MP 294.1 - 296.2	2015/2016
Parks Highway MP 204 Summit Railroad Overcrossing	MP 204	61279	Constructed overpass for highway crossing over the railroad	2007/2008
Parks Highway MP 206 - 210	MP 206 - 210	60924	Resurface and rehabilitate the Parks Highway	2005/2006
Parks Highway Enhanced Curve Delineation	MP 215 - 219	62510	Enhanced Curve Delineation - installing curve warning signs	2015/2016
Parks Highway MP 222 - 223 Guardrail	MP 222 - 223	63485	Guardrail installation.	2011
Parks Highway MP 163 - 305 Passing Lanes - Stage III	MP 232.4 - 234.8	63515	Constructed passing lanes on the Parks Highway from MP 232.4 - 234.8	2015/2016
Parks Highway MP 235 AARC Signal Upgrades	MP 235	58989	ARRC Signal Upgrades	2016/2017
Parks Highway MP 235 Drainage Improvements	MP 235	62176 / 62914	Drainage improvements, replace culvert at MP 235	2016/2017
Parks Highway MP 237 Riley Creek Bridge Replacement	MP 237	63763	Riley Creek Bridge Replacement	2016/2017
Parks Highway MP 239 - 252 Rehabilitation	MP 239 - 252	61275	Rehabilitate and resurface the Parks Highway and construct passing lanes	2014 - 2017
Parks Highway MP 240 Repairs 2013	MP 240	62283	Emergency repairs from high water; embankment and pavement repairs, guardrails, riprap protection stockpile	2013/2014
Parks Highway MP 252-263 Rehabilitation	MP 252 - 263	63655	Rehabilitate and resurface the Parks Highway and construct passing lanes	2014/2015
Parks Highway Signing and Striping - Project A	MP 174 - 205 and MP 254.4 - 323.7	64259	Signing and Striping	2016/2017

Source: DOT&PF. 2020. Maintenance and Operations Existing Concerns and Needs Report. *Cantwell to Healy Parks Highway MP 203-259 PEL Study*. July 24, 2020.

Table 2 lists several DOT&PF-sponsored projects within the PEL study area that are currently in the planning or design phases.

Table 2: Current and Planned DOT&PF Projects within the PEL Study Corridor

Project Name	Parks Highway MPs	Project Scope	Construction Year	Notes
Healy Spur Road	Accessed from near MP 248.8	Rehabilitate Healy Spur Road in Healy. Work includes widening to add shoulders and improving drainage.	After 2023	Improvements to Healy Spur Road include widening the road to add shoulders for pedestrian access, as well as improving drainage along the roadway. Construction is currently not anticipated until 2025 or 2026.

Bison Gulch Parking Area & Trail Enhancement	MP 245	Reconstruction of the parking area onto the west side of the Parks Highway near Milepost 245. Work includes Drainage Improvements and Roadside Hardware.	2021 or 2022	The current location of the parking lot is across the Parks Highway from the Bison Gulch Trailhead.
Parks Highway MP 231 Enhancements	MP 229.7 to 232.3	Improvements will include updates to the Denali wayside, acceleration lanes near McKinley Village heading towards Anchorage, and passive on bridge pedestrian detection for approaching vehicles.	2022	Improvements to this section of roadway will include updates to the Denali wayside near the Triple Lakes and Oxbow Loop Trailheads, constructing acceleration lanes near McKinley Village heading towards Anchorage, and passive on bridge pedestrian detection for approaching vehicles.
Parks Highway MP 208 - 210 Reconstruction	MP 208 to 210	Reconstruct this section of the Parks Highway.	After 2023	There is currently a significant amount of damage to the existing roadway that has been caused by frost heaves in the area, creating pavement issues along with an uneven roadway surface. The purpose of the project is to reconstruct this section of the Parks Highway to repair this significantly damaged section of roadway.

Source: DOT&PF. 2020. Maintenance and Operations Existing Concerns and Needs Report. *Cantwell to Healy Parks Highway MP 203-259 PEL Study.* July 24, 2020.

There are other planned projects or development plans that have the potential to affect the highway corridor, as included in the following list. While not a comprehensive list, these projects were specifically mentioned during the initial outreach phase of the PEL Study process.

- Alaska Stand Alone Pipeline (ASAP) Project: This 700+ mile proposed natural gas transmission mainline would extend from the North Slope Oilfields to the Matanuska-Susitna Borough, generally paralleling the Parks Highway corridor within the PEL Study corridor. The project proponent, the Alaska Gasline Development Corporation (AGDC), has shifted focus primarily to the Alaska Liquified Natural Gas (LNG) Project, though ASAP remains as a back-up project to the State.

- Alaska LNG project: The AGDC proposes to construct an 800+ mile LNG pipeline from the North Slope oil fields to Southcentral Alaska. As with the ASAP project, the pipeline would run generally parallel to the Parks Highway/ Alaska Railroad corridor, including passing through a portion of the Denali National Park and Preserve. The lead federal agency, Federal Energy Regulatory Commission, issued a final environmental impact statement in early 2020.

- Pretty Rocks Landslide analysis along the Denali Park Road: The NPS is analyzing several locations along the Denali Park Road where landslides have the potential to impact and close the Denali

Park Road, thereby substantially impacting visitors to Denali National Park, the PEL Study corridor and region. The NPS is analyzing options to resolve the Pretty Rocks Landslide that is occurring near Polychrome Pass, at approximately MP 45 of the Denali Park Road. The Denali Park Road intersects the Parks Highway at MP 237.

- Ahtna, Incorporated intends to develop a future 150-room lodge and resort that would be accessed from Parks Highway MP 229.8.

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Appendix C

Public Meeting #1 (Online Open House) Summary

Cantwell to Healy PEL Study
Parks Highway MP 203-259
Planning & Environmental Linkages (PEL) Study

Subject	**Public Meeting #1 – Identifying Needs and Opportunities**		
Project	Cantwell to Healy Planning and Environmental Linkages Study		
Prepared by	Jacobs		
Location	Online Open House	**Date/Time**	June 25 – July 25, 2020

Public Meeting #1 Summary

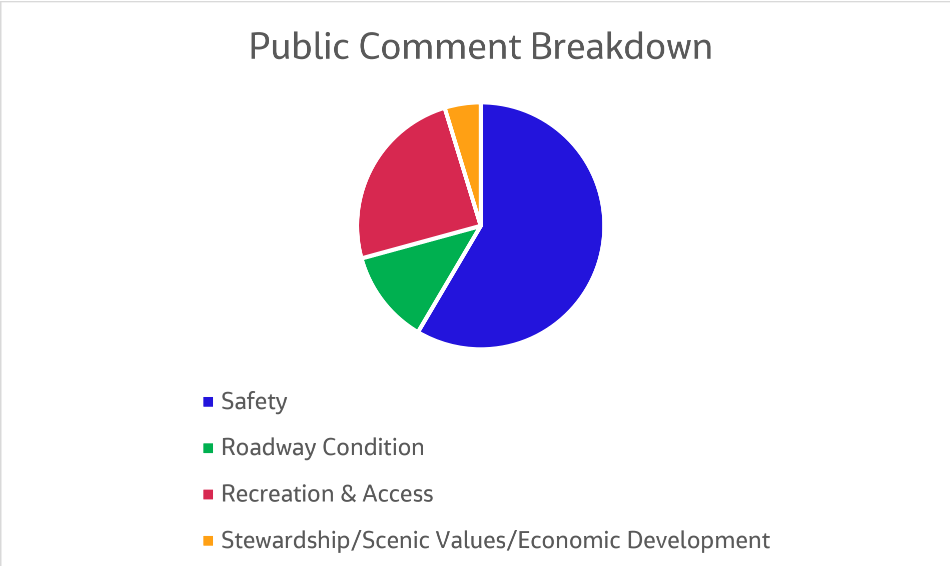
Online Open House

As part of the Needs and Opportunities phase of the *Cantwell to Healy PEL Study – Parks Highway MP 203-259* an online open house was hosted using ESRI Story Map software. This is the first of three public meetings planned for the PEL Study. The month-long online open house was hosted in lieu of a series of three in-person meetings in Cantwell, Healy and Denali National Park. (The shift from in-person to virtual format was due to the COVID-19 pandemic).
The virtual/online open house ran from June 25 – July 25, 2020. It provided the public the opportunity to read about the PEL Study and current conditions along the 56-mile corridor and use a mapping tool to identify locations of needs or opportunities that could be addressed by future projects. The contents of the Online Open House are provided in Attachment A. (This is equivalent to the "presentation" that would have been provided to the public in an open house format public meeting.)

Attendance

Although public comments are solicited from the main project website throughout the life of the study, there were 355 visitors to the open house website. Fifty people submitted responses via the website's online comment form producing 106 unique comments during the advertised month-long window.

Respondents self-categorized their comments under the themes of safety, road condition, recreation and access, or 'other'. When recoded for accuracy, more than half of the comments are safety related; one-quarter are recreation related (although the majority of these are about bike paths which is also a frequent topic under safety). The remaining one-quarter of comments are related to the following topics: roadway condition, stewardship/scenic quality and economic development.



Public Comment Summary Statements

A complete set of public comments (verbatim) is provided in Attachment B. The following is a summary of public comments during the Online Open House (mileposts are approximations):

Safety

- Requests for a **Separated Multi-use Path** for year-round mobility (including commute), recreation, healthy active communities, and economic opportunities.

  General suggestions:

  - Install a gravel trail first then pave as its popularity grows
  - A trail corridor adjacent or near the Parks Highway could be maintained in partnership with local communities, landowners, and trail organizations. There are already ad hoc trails created by various users under the GVEA powerline or the highway ditch (~MP 238).
  - Key segments between communities and employers; there were observations of seasonal workers who are at risk using the shoulder of the highway

  Segment suggestions range from:

  - Broad Pass (MP 203) to Ferry (MP 259)
  - MP 208-215, also tying into the Denali Highway MPs 130-136
  - Cantwell (MP 210) to Ferry (MP 259)
  - Cantwell (MP 210) to Stampede Road (MP 251)
  - Cantwell (MP 210) to Healy (MP 248)
  - Cantwell (MP 210) to Denali (MP 237)
  - Carlo Creek (MP 224) to Denali Park Entrance (MP 237)
  - Carlo Creek (MP 224) to Stampede Road (MP 251)

- MP 230-237
- McKinley Village (MP 231) to Healy (MP 248)
- Glitter Gulch (MP 238.5) to Healy (MP 248)
- Otto Lake Road (MP 247) to Dry Creek (MP 249.3)

- Support of **eliminating the railroad at-grade crossing at MP 235**
  - One suggestion for routing the rail to stay west of the highway, which avoids the need for the existing overpass at MP 236
  - One suggestion for creating a highway overpass

- Discussion of (on-road) **Bike Lanes**:
  - No bike lanes from MP 228.7-231.1 due to limited roadside space for expansion
  - Addition of a bicycle lane from MP 228 pullout to MP 250 where many people ride bikes on the Parks Highway shoulder
- Suggestions for new **Pedestrian/Bike Bridges**:
  - Nenana River Bridge (Bridge [BR] 1243) (sometimes referred to as #1 Bridge), MP 215.6
    - included a suggestion to cantilever off east side of existing bridge
  - Carlo Creek Bridge (BR 0693), MP 224
  - Crabbie's Crossing MP 231
  - Pedestrian/bike underpass between Grizzly Bear and McKinley Village
  - Nenana River Bridge (BR 0694), MP 231.2
  - Pedestrian/bike underpass Triple Lakes and Oxbow Trails (~MP 231)
  - Nenana River Bridge (BR 1143) (sometimes referred to as Windy Bridge), MP 242.8
  - Pedestrian/bike underpass for Bison Gulch trailhead (MP 243)
  - Dry Creek Bridge (BR 0852), MP 249.4
  - At all bridges, but especially McKinley Village
- Specific locations or road reconfiguration for **Turning**:
  - Hazardous exits at MP 208 & 210
  - Carlo Creek Bridge (MP 224) is a high traffic area with multiple driveways and it is bookended with a blind curve and hill. Making turns is dangerous because vehicles coming from the blind curve can't see that vehicle is stopped ahead & vehicles from the hill are traveling too fast. Often a car will try to pass a left-turning vehicle, resulting in an accident.
  - Businesses near MP 229
  - "Crabbie's Crossing" (MP 231) is dangerous; it has a downhill curve prone to speeds, lots of foot traffic on a bridge and turning traffic in and out of the McKinley Village Lodge complex and Grizzly Bear Cabins/Resort.
  - Triple Lakes Trailhead (MP 231)

  - Widening the road through Denali Canyon/Glitter Gulch (MP 238.5) to have dedicated right and left turn lanes in both directions
  - Stampede/Lignite Road (MP 251)
  - Turning east on Ferry Road (MP 259)

- Concerns about **Speeding** and speed limit enforcement:
  - More speed limit signage and speed limits painted in 45 zones (Cantwell and Healy)
  - Use consistent 55 mph from Cantwell to Stampede Road due to high volume of traffic, pedestrians and driveways
  - Slime Creek (MP 220) to McKinley Village is residential and needs traffic to slow down
  - Lowering from 65 mph to 45 mph between MP 224-231
  - Congested area at Nenana River Bridge MP 231 needs slower and enforceable speed limit
  - Do not modify the roadway such that people can drive faster

- Suggestions to accommodate **4-Wheelers**:
  - There needs to be a safe place for 4-wheelers to cross the highway in the Healy area where there are many 4-wheeler trails in the area.
  - Where the 4-wheeler trails are on the highway right of way, they should be platted in a safe and legal manner with regard to grade, substrate, stream crossings, and keeping the trails off private property.
- Suggestions regarding **Passing**:
  - Turn entire corridor from 2 to 4 lanes to prevent passing crashes/deaths
  - The road necessarily needs widened, but additional passing zones will improve safety.
  - More passing lanes within entire corridor
- **Other restrictions or suggestions** to improve safety:
  - Prohibit double trailers in snowy winter conditions
  - Enhance the safety of collecting spring water at MP 224 (The turnout for the fresh water spring at MP 224 is unmaintained and lists away from the road making winter access difficult without getting stuck. Big trucks go way too fast here. This spring is important to many local residents with dry cabins or with inferior well water.)
  - Access management needed in the MP 224-230 area. Consider frontage system and turn lanes like what was done for the passing lanes in Nenana.

Roadway Condition

- Specific locations along the Parks Highway that need repair:

- Frost heaves south of Cantwell – an idea that the road would be in better condition if it were gravel for the 10-mile section near Summit Lake and the "Leaving Mat-Su Borough" sign
- Frost heaves from MP 210-230
- Decades old frost heaves and buckled pavement north of the railroad crossing (MP 235) and near the railroad tracks
- Northern-most signal in Glitter Gulch. It either doesn't recognize/activate or give enough time for the east-west traffic so traffic backs way up into Prospector's or the Chalet.
- Bison Gulch trailhead MP 243
- The "dip" near Dragonfly Creek ~MP 249

- Maintenance & Operations should look at other techniques and more expert research, to maintain roadway quality:
    - Consider redoing the road bed
    - Avoid cheap chip seal overlays that result in chipped and broken windows similar to Sunshine to Trapper Creek
    - Mark frost heaves for drivers

Other (Stewardship/Education/Scenic Values/Economic Development)

- Broad Pass to Jack River is one of the few areas remaining along the Parks Hwy that a traveler gets a sense of the vastness, a taste of "remote Alaska". Taking care to preserve the undeveloped nature of this stretch.
- Help the public know about Ahtna lands with signage
- Do not add new turning lanes or parking lots
- Keep in mind that development affects residents
- Economic development for year-round employment is needed to bring people to live closer to Cantwell. Our school community is small and in jeopardy of shutting down due to lack of employment.
- Put a bridge through the narrowest part of Nenana Canyon. The river continues to erode the road and they keep blasting the beautiful rocks to move the road further from the water.
- No further development along this stretch of the Parks Highway. Too much uncontrolled development has already destroyed our natural environment.

Recreation and Access

- General support for more parking, trailheads, and bike paths
    - A multiuse trail throughout the corridor would relieve pressure on the trails within the first 3-miles of DNP
- Specific locations for improvements to existing **Rest Areas**:

   - Windy Bridge (also referred to as Nenana River Bridge, BR 1143, at MP 242.8) needs a pedestrian bridge and parking because the scenery is so compelling; people need a safe place to take photos
   - Public toilets and informational signs at all river access points
- Stop building public pullouts because they cause trash, human waste and fire danger. They are dangerous to the communities.
- Specific requests for **New Pull-out/Rest Area Facilities:**
   - A picnic area in Cantwell area
   - Year-round rest area with bathrooms near the southern edge of the study area where people pull over to view the mountain.
   - Year-round rest area with bathroom at Slime Creek pull out
   - Create wayside and trailhead parking east side of highway on the north side of the bridge (near MP 231) for Triple Lakes and Oxbow Trails. Pedestrian underpass for trail access. Toilets and bearproof trash containers would be a benefit.
   - Create parking for Bison Gulch on west side of highway

1. Attachments

A. Open House Website
B. Public Comments Verbatim

Attachment A - Online Open House Contents

Nts'e di'tae![1]

Thank you for your interest in the Parks Highway Milepost (MP) 203-259: Cantwell-Healy Planning & Environmental Linkages (PEL) Study.

The purpose of the online open house is to:

- Introduce the PEL Study and process to the public
- Seek input from the public

Read on to learn about the PEL Study and share some of your ideas on improvement needs and opportunities for the 56-mile transportation corridor. We want to hear from you! **Click here to provide comments!**

[1]Athabascan greeting "how are you?" *pronounced "In jitty da"*

This online open house will be available **June 25-July 25.**

Use the **Comment Form** to provide general input, get on our email list and identify specific issues and opportunities on our mapper.

Quick Facts

This 56-mile stretch of the Parks Highway…

* Is one of the most important roads in Alaska for commerce and recreation

* Provides access to one of America's "crown jewels" – Denali National Park

General Project Study Area Map

Click here to download a topographic map set of the study area.

The Alaska Department of Transportation and Public Facilities (DOT&PF), Federal Highway Administration (FHWA) Division of Western Federal Lands (WFL), and National Park Service (NPS) are conducting a PEL Study for the Parks Highway corridor between the mileposts (MP) of 203 to 259, beginning just north of Broad Pass at the borough boundary and extending north to the turnoff for the community of Ferry. This process will create a planning document describing the condition of the Parks Highway and the needs of the users and communities along it.

The planning document will be used by the partners (WFL, DOT&PF, and NPS) to provide a framework for implementing future highway corridor improvement projects over a 20-year planning horizon. Study partners place a high priority on input from you!

The Parks Highway in the study area serves multiple purposes. The highway is the primary road connection between Anchorage and Fairbanks, serving also as the key road connection between the Port of Anchorage and the North Slope oilfields. The highway experiences considerable tourist traffic traveling to Denali and other attractions and recreation areas in the vicinity. Denali National Park's only road-accessible entrance falls within the corridor study area and is located at milepost (MP) 237 of the Parks Highway. The area expects a 1-2% yearly increase in traffic. The highway currently experiences high volumes of commercial traffic (buses, vans, tractor trailers, and vehicles with boat trailers) as well as increased pedestrian and vehicle traffic during the tourist season (May to September). Furthermore, there are several year-round communities located within this nearly 60-mile corridor.

Desired Outcomes and Objectives

The desired outcome of the PEL Study is to bring together highway users and community and local stakeholders for a comprehensive multi-modal look at future improvements of this interstate highway corridor.

The objectives of the PEL Study are to:

• Document existing and future conditions as it relates to transportation and the environment

• Identify an overall corridor vision

• Identify needs and opportunities for the area transportation system

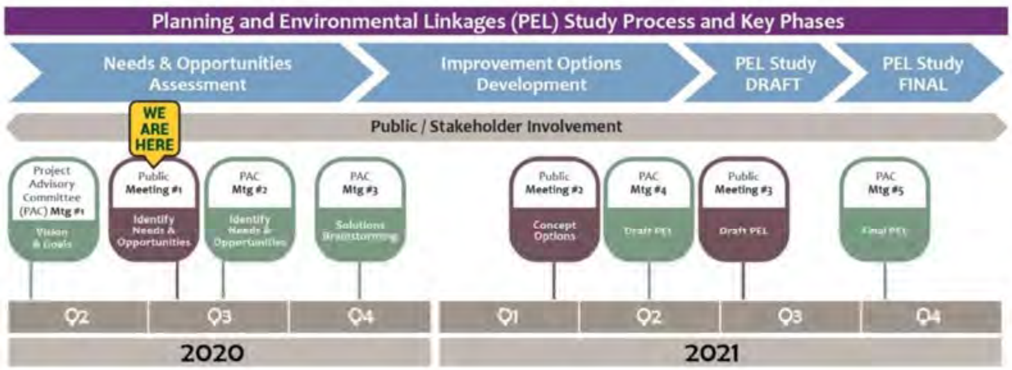
• Develop and evaluate improvement options and solutions

• Seek public and stakeholder input throughout process

• Document the process

The final PEL Study will create a shared understanding of local and regional interests between DOT&PF and Parks Highway stakeholders and give us a clear and actionable plan that prioritizes and guides future enhancements and development on the Parks Highway. In other words, it could streamline future projects!

Your input at this Online Open House is being collected as part of the **Needs and Opportunities** in the Study Area. There will be another open house when it's time for public input on the development and prioritization of **Improvement Options.** The third public meeting will be an opportunity to see all the research, prioritization and improvements chosen for consideration and implementation by the partner agencies in the future in the **PEL Study Draft**.



The PEL Study is being prepared in 3 key phases. We are currently assessing needs and opportunities and reviewing data related to traffic, safety, maintenance and operation, recreational opportunities, and environmental conditions. The outcome will be a **Needs and Opportunities Assessment Report** this fall.

Existing Studies and Plans

Numerous corridor stakeholders have previously prepared studies, plans and identified needs for this transportation corridor. This PEL study is not starting from scratch! The Study Team intends to partner with these stakeholders to leverage similar goals and needs for the corridor. Click here to view documents reviewed to date.

As a user of the Parks Highway, comment here about other needs and opportunities we should consider and if there are other studies we should review.

Establish a Corridor Vision and Goals

The PEL Study will establish a corridor vision and goals using public input. During the Project Advisory Committee (PAC) kick-off meeting held in April, PAC representatives underwent a simple word cloud visioning exercise.

Study Area Overview

The Parks Highway is the state's primary connection between the Port of Anchorage to the North Slope, serving highway users' and local communities' needs and interests. The tourism industry, centered around Denali National Park and Preserve drew 600,000+ visitors in 2019, providing revenue to the Borough through bed taxes and a seasonal economic boom for local businesses.

Alaska Railroad
The railroad crosses the Parks Highway 4 times: at-grade (MP 235) and grade-separated (MP 203, 236.5, 243).

Communities
Cantwell (pop. 190) and Healy (pop. 1,093) are at both ends of the corridor. Other communities include Denali Park/McKinley Village (pop. 186) and Ferry (pop. 27).

Roadway Corridor Characteristics
Level and mountainous terrain; 45 to 65 mph speeds; 22 bridges; 2 seasonal traffic light signals and numerous driveways.

Traffic and Safety
Annual average daily traffic 1,100 - 2,000 vehicles; 2,200-4,300 in peak summer. Trucks comprise 20% of total traffic. 1/3 of vehicle crashes involved a live animal.

Maintenance and Operations
DOT M&O staff deal with issues such as erosion, permafrost, bedrock constraints, and drainage challenges. Other issues include inadequate roadway shoulders and parking issues in some locations.

Images along the Parks Highway

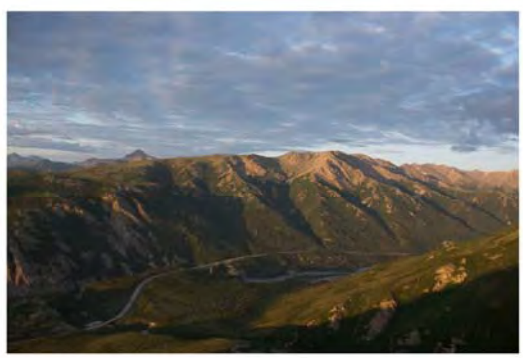
Are there areas where traffic or safety is a concern?

Add your ideas here!

Bank erosion from Nenana River adjacent to the Highway (MP 222.8) (Left). Roadway deterioration adjacent to thaw pond, likely caused by thawing permafrost (MP 256.4) (Right)

Are there other locations of Maintenance and Operations concern? Add you ideas here!

Example photos of roadway construction and rock fall hazards.



Beautiful scenery along the Parks Highway

Access and Recreation

Providing recreation access points and pull-outs is an important feature of this highway corridor. Visitation to Denali National Park grew by approximately 400% to 17,000 visitors during the 2018-2019 winter and shoulder seasons.

Vehicle Access Pull-outs
30+ vehicle access pull-out locations (paved and gravel) for recreation access, viewing, and driver relief.

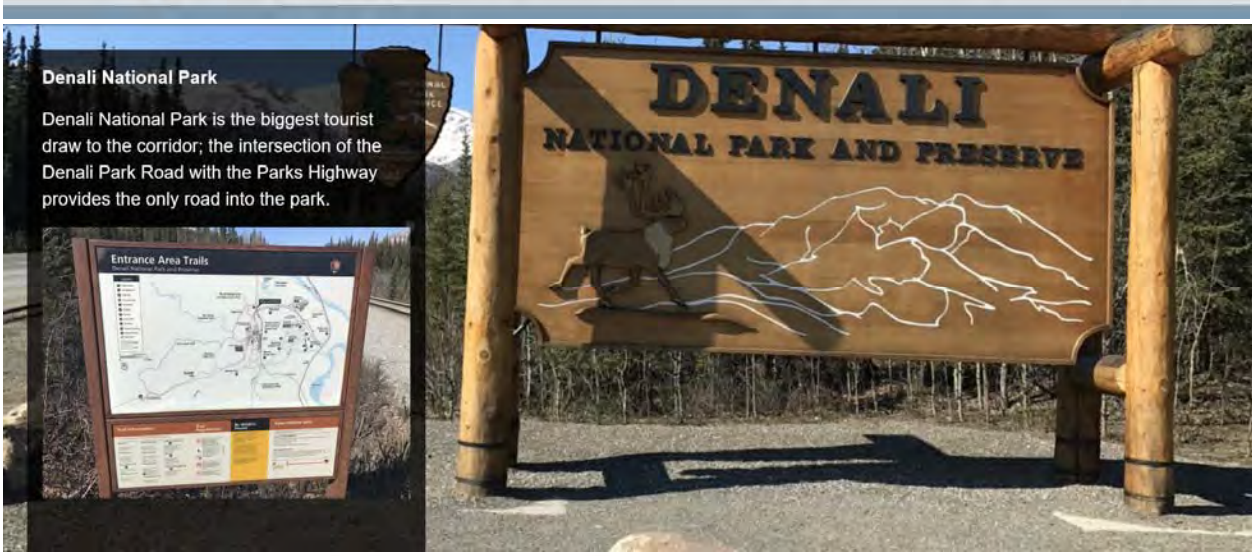
Campgrounds
6+ campgrounds along corridor and 6+ National Park Service campgrounds along the Denali Park Road.

Trailheads
6+ formal and informal trailheads off the Parks Highway and 20+ formal trails within the Denali Park boundary.

Boat Launches
The Nenana River and its tributaries provide fishing and rafting opportunities.
Launch facilities at MP 216.5, Jack River Bridge north of Cantwell at MP 209.3, and Nenana River Wayside at MP 238. Other spots are used by commercial rafting companies.

Wilderness
Part of Denali National Park is formally designated as wilderness. Opportunities include off-trail hiking, paddlesports, wildlife viewing, skiing, and mountaineering accessed via the Denali Park Road or Parks Highway.

Ahtna Lands
Ahtna is a significant land owner along the Parks Highway. When land claim settlements are complete, Ahtna's Cantwell lands will stretch from MP 192 to 230.5 (though currently, MP 198.25 to 199.75 and MP 200.5 to 207 are still public lands). Permits can be requested to cross Ahtna lands.



Bison Gulch (Left); Recreational Boat Launch (Right)

Are there other recreation locations, economic opportunities or environmental considerations the study team should evaluate?

Add your ideas here.

Thank you for visiting the Cantwell-Healy PEL Study Online Open House.

Please take a few moments by **clicking here** to provide comments about any needs and opportunities along this great corridor.

Cantwell to Healy PEL Study

Alaska DOT&PF Northern Region Project No. HHWY00482

Email us directly:
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Give a call with questions or comments: (907) 451-2275

Send us a letter:
State of Alaska DOT & PF
Cantwell to Healy PEL Study
2301 Peger Road
Fairbanks, AK 99709

U.S. Department of Transportation
Federal Highway Administration

Attachment B - Online Open House Public Comments Verbatim

Public Comments – Recreation & Access – June 25-July 25, 2020

Create parking for trailhead (Bison Gulch) on west side of Hwy
Adding a multi-use trail that extends throughout the corridor would relieve some of the pressure that trails within the first 3 miles of Denali NP experiences on busy summer weekends. This would also greatly benefit the community!
A bicycle trial from Cantwell to Healy would provide a safe recreation opportunity for almost all local residents and visitors.
Put in a bike path, please from Cantwell to Healy, covering the entire community for equitable access
I am a Cantwell resident and have live here for 21 years. While there have been some road construction projects, there is still many sections of the Parks Highway that need work. I am confident that you and the other commenters will identify these areas for this plan. I would like to suggest that a bike path be looked at from Cantwell to Healy and for a few reasons. It would benefit the local population with much needed non-motorized activities and would be a bonus for non-residents alike. It could easily start out gravel and one day be paved, if it became popular. In the winter it could be used for skiing and biking. It would connect all the small communities along the Parks Highway as well as the many small band large business along the route. With the number of visitors, we have had in the past (before the virus), this may be one way to attract more in the future.
It would be great to have a bike path that is separate from the Hwy, at least from the Village to Healy.
Multi-user path from Cantwell to Ferry. A way to combine many opportunities; economic, safety, and recreation into one would be construct a dedicated path from Cantwell to Ferry. This path would accommodate as many user groups as possible and allow for an alternative means of safe transportation for visitors and residents alike.
Recreation and Safety and Public Health: Bike path from Carlo Creek to Healy (or the entire corridor)
at all river access public toilets and informational signs
picnic area in Cantwell area,
consider expanded facilities for snow machine access near Cantwell
Please do not impede access to the spring where locals get drinking water. In fact, they pullout should be improved. It is horrible and very dangerous as it is. The spring is located at mile 224 on the east side of the road. The turnout is terrible. The turnout is unmaintained and lists away from the road making winter difficult to pull in without getting stuck in and big trucks go way too fast here. This spring is used by many local residents as there are many of us in dry cabins and others who's well water is inferior, so they gather drinking water here as well.
More parking and trail heads and bike path from Healy to Cantwell
This is a much needed-project. Building a bike path between Mile 230 and Mile 237 Parks Hwy, and adding a pedestrian bridge at Crabbe's Crossing, will improve recreation, safety, and economic opportunities.
I would love to see a bicycle path along the highway. Many Alaskan communities already have this. We see several bicyclists on the Parks Highway all summer, and many locals ride their bike to work. Esp between the Village and Glitter Gulch.
Build no more public pullout along the road. They just cause more trash, human waste, and fire danger from campfire to our local residence. It's dangerous to our communities.

Economic development for year-round employment to bring people to live closer to Cantwell. Our school community is small and in jeopardy of shutting down. The community of Cantwell does not have much in terms of employment and thus not many families live in the area.
A walking/bike trail for community members to utilize would be fantastic.
maybe some pullouts with restrooms for summertime use
A bike path along the Parks Highway from at least the DNP road south to McKinley Village or farther south to Carlo Creek and even better also from the Park to Healy would be a huge asset and a safety measure for the Denali Borough, its residents & tourists.
A bike/walking path along the Parks Hwy north and south of the Park entrance would get a huge amount of use and provide safety for those biking or walking along the highway
Would love to see either paved or gravel bike and pedestrian path to extend as far along the length of the study area as possible. It's a huge opportunity for connectivity and human powered recreation, will increase safety for cyclists passing through.
Create wayside and trailhead parking east side of highway on the north side of the bridge (near MP 231) for Triple Lakes and Oxbow Trails. Pedestrian underpass for trail access. Toilets and bearproof trash containers would be a benefit.
Bike path between Cantwell and Healy. This is a scenic byway and many people bike on the highway between these two towns.
The addition of a bicycle lane from mile 228 pullout to mile marker 250. This is a heavily visited tourism area and many people ride their bikes on the shoulders of the busy Parks Highway.
Add a rest area with bathrooms near the southern edge of the study area where people pull over to view the mountain. Recommend keeping open for winter tourism as well as summer.
Suggest the addition of one more rest area with bathroom at Slime Creek pull out. Recommend it stay open for winter tourism
bike/pedestrian trails

Public Comments – Roadway Condition – June 25-July 25, 2020

The "dip" near Dragonfly Creek (~MP 239) needs to get fixed
There appears to be an issue with the northern-most signal in glitter gulch when it is in operation. It either doesn't recognize/activate or give enough time for the east-west traffic and traffic backs way up into Prospector's or the Chalet.
On the highway itself, the frost heaves are a danger.
The frost heaves south of Cantwell are absolutely terrible. The road would be in better condition if it were gravel for the 10-mile section near summit lake and the "Leaving Mat Su Borough" sign
Fix the road bed and the surface right. It is in such bad condition, because it was never properly done. Don't need any turning lanes or parking lots. Just fix the road surface correctly.
The decades old "frost heaves" and buckled pavement north of the railroad crossing (between the railroad and the Park entrance) need more regular maintenance. There is no reason to do endless repaving projects that just fall apart within months. Just repair it more often.
No more cheap chip seal overlays that result in chipped and broken windows similar to Sunshine to Trapper Creek.
Several frost heaves from 210 to 230.
Parks highway in Denali Park needs replaced near the railroad tracks.
The glitter gulch area has the canyon area that still has falling rocks all the [cut off]
The frost heaves are unmarked and very dangerous for all that travel. I am not sure how to change or prevent this. I am so disappointed in all the dot road work jobs anymore. More expert research is needed for our roads to replace and repair.
frost heave damage

Public Comments – Safety – June 25-July 25, 2020

Bike and pedestrian safety by making a bike path or lane for bike traffic from Cantwell to Stampede. This would encourage bike commuters and also make the highway safe for residents to bike to stay healthy year-round.
There should be a multi-use or pedestrian path (for walking, biking, or other means of travel than a car) paralleling/adjacent to the road along the populated and high-traffic areas of the corridor.
Ideally, this would be a single continuous path along the entire corridor from Healy to Carlo Creek (and possibly a separate path through the populated areas in Cantwell area), but that likely isn't logistically or financially feasible.
An alternative would be multiple pedestrian paths that at least connect parts of each community to one another. Nearly every time drive I drive through Healy or the McKinley Village, I see people walking or biking on the shoulder of the road because there isn't a safe or reasonable alternative if you are not in a vehicle. From the Denali Park entrance through Glitter Gulch, I almost never see this because people clearly prefer to use the walkway that already exists. Not having a pathway poses a significant safety hazard, and (as I'm sure some members of the working group for the PEL study are aware) at least one community member was killed in a hit and run collision while riding her bike along the highway to work in 2014. Since Princess increased the seasonal employees housed in Healy and businesses like Three Bears, 49th State Brewery, and others have developed, I would estimate the number of pedestrians on the road in town has increased tenfold, and it's only a matter of time until someone is hit by a vehicle. There has also been a huge increase in pedestrians along the highway from Healy to Glitter Gulch, as most seasonal employees don't have cars and still want/need to get to these areas by means other than the employee shuttle Princess provides. There is little to no shoulder along this section of the highway, so these people are often walking right next to or on the road. It's only a matter of time until another tragic (preventable) accident occurs.
Nearly every other community in Alaska along the road system has a path like this, most of the time extending even to the furthest outskirts of the population center. It's an embarrassment and a serious oversight that the communities in the Denali area, one of the most significant tourist destinations and busiest sections of highway in the state, do not.
Pedestrian, biker & snowmobiler safety would be greater improved with a trail corridor adjacent or near-to to the Parks Hwy. Trail could be maintained in partnership with local communities and land owners and trails organizations. There are already ad hoc trails in many sections either under the GVEA powerline or in the highway ditch created by various users.
Support a bike path from Cantwell to Healy.
Maybe a turning lane for the businesses near mile 229.
Turning lanes for Grizzly Bear and McKinley Village area.
Please build a bike path from mile 208 thru mile 215 and include mile 130 of Denali highway thru mile 136.
Please give serious consideration to bike paths and/or bike lanes for future parks highway development between Healy and Cantwell.

Crabbies crossing is an accident-prone spot. Seeing Semi trucks pulling doubles downhill at 70 mph! Downhill on a curve with lots of foot traffic on a bridge. It's a traffic pinch point with vehicles pulling in and out of the Village and Grizzly Bear.
This stretch of the Parks Highway needs a bike path or bike lane from Cantwell to Healy to improve safety for local bike commuters and recreational riders. A bike path from Cantwell to Healy would increase recreational opportunities by providing a safe alternative to the current practice of riding on the dangerous road during the season with the highest traffic. I have personally jumped off my bike and ran for the ditch when a truck nearly collided with a RV while trying to pass another vehicle
I would love to see a multi-use pedestrian/bike path that runs along the entire corridor from Broad Pass to Ferry
Add widened shoulder or right turn lane for people travelling north turning east onto Ferry Rd
Grade separated crossing at the railroad crossing at MP 235 is needed
There needs to be better separation of the pedestrian facilities from the vehicles. It is a very common problem for vehicles to use the separated path to drive down (like several times a day on a normal summer) and causes much concern for the local workers who are often on foot.
Bike safety, many people already commuting by bike, many more could with bike lanes and bridges. Pedestrian/bike bridges at #1 Bridge and Windy Bridge
The bridge over the Nenana River at Mile 215 needs a pedestrian /cyclist bridge. It is scary as hell for cycle tourists to climb the bridge northbound. Maybe this could be cantilevered off of the east side of bridge.
Speed limit from Stampede to Carlo Creek should not exceed 55 mph
bike/ped lanes and all bridges (especially McKinley Village)
turn lane at Stampede Rd
reroute AK Railroad to eliminate at-grade crossing
During the tourist season, there is a lot of pedestrian traffic along the highway between the Otto Lake Road and Dry Creek. Pedestrian path needed here, perhaps on both sides of the highway. Pedestrian lane on the bridge at Mile 249.4 would be desirable.
There needs to be a safe place for 4-wheelers to cross the highway in the Healy area. There are many 4-wheeler trails in the area. Where the 4-wheeler trails are on the highway right of way, they should be platted in a safe and legal manner with regard to grade, substrate, stream crossings, and keeping the trails off private property.
As a resident and business owner living at 227 Parks Hwy, I suggest lower the speed limit from 65mph to 45mph between mile 231 and 224.
A parallel-to-the-road bike path between Denali and Healy would be well used in the summer and increase bike traffic between Healy and Denali. It would continue to improve the appeal of Healy as a destination, as well as Denali (Glitter Gulch included).
Riding a bicycle on the road between Healy and Denali is hazardous.
Double lanes both ways with lots of pullouts

Make it a 4-lane road, 2 lanes each way. So many accidents and deaths would be prevented as people would not need to pass and the center line would be crossed so much less. It would be a safer roadway for all.
Pedestrian bridge over the Nenana River, and an under-highway passage for bikers and hikers between Grizzly Bear and Village.
The Windy Bridge north of Glitter Gulch needs a pedestrian bridge. The scenery is too compelling. People need a place to park and safely view the canyon and take photos.
The Nenana River Bridge at mile 231 is a congested area with multiple driveways and frequent pedestrian use and it is bookended with blind hills on both sides. Turning vehicles cause vehicles from behind to pass on a bridge, which often has people on it, and a freight truck coming from the other direction. A pedestrian bridge is needed. Much slower speed limit and enforceable speed limit needed.
Pedestrian frequently cross the Carlo Creek Bridge. A pedestrian bridge would be nice.
Carlo Creek Bridge is a high traffic area with multiple driveways, and it is bookended with a blind curve and hill. Making turns is dangerous because vehicles coming from the blind curve can't see that vehicle is stopped ahead & vehicles from the hill are traveling too fast. Often a car will try to pass a left-turning vehicle, resulting in an accident.
Additional passing zones. I do not think the road necessarily needs widened, but additional passing zones will improve safety.
Overpass at Railroad crossing, or 4 lane the crossing for busses and HazMat
Mile 208 to 210 needs replaced several hazardous exits that need fixed.
More passing lanes on entire area
Widening of the road through the Denali canyon (Glitter Gulch) to have dedicated right turn and left turn lanes in both directions
Prohibit double semi-trailers in snowy winter conditions.
No bike lanes mile 228.7-231.1 due to limited roadside space for expansion.
The biggest thing the stretch from Cantwell to McKinley Village needs is a way to slow down traffic. Whatever you do, don't make it so that people can go faster, because they will. Make the speed limit 55 and enforce it. What I'd like to say to you is after living here 38 years (at MP 227.2) I have just one comment. Whatever happens, don’t make the road so that people can drive faster, because they will. Please establish a 55 mph speed limit and adequate signage promoting slowing down. And enforce it. I can’t tell you how many times I have almost been T-boned by some impatient southbound driver suddenly trying to pass multiple cars that are slowing down for me as I try to turn left into my driveway. I know it’s a main highway but from Slime Creek to McKinley Village it is a residential area.
Of course, we need a bike lane, of course there are beautiful sites where people want to pull over for photos that need a pull out, of course it will all be changed if they put the LNG line down this section. But none of this should be done without reflecting the fact that people live along this stretch of highway.
At mile 224 there is a spring where I, and many others get drinking water as I live in a dry cabin. The pullout there is horrible with people and truckers blasting along. How can we slow people down

outside of making car manufacturers quit making behemoth vehicles that can't go slow. MAKE THE SPEED LIMIT SLOWER FOR THIS SECTION, PLEASE!
More passing lanes
separate bike route from Healy to Cantwell (to provide access from both communities to Denali National Park).
More speed limit signage and speed limits painted in 45 zones (Cantwell and Healy) and overpass at RR Crossing @ mi 235
Eliminate the railroad crossing near MP 235 for improved safety. If the train tracks could be rerouted to stay on the west side of the highway, that would be the best (removes need for overpass at MP 236).
Bison Gulch trailhead parking (near MP 243) could really use a pedestrian underpass from the parking lot to the trail for safety. This is also a place where the road seems to be in bad condition every year.
Bike/pedestrian path, parallel to and separate from the highway! Area most needed is MP 224 (Carlo Creek) to MP 237 (park entrance); secondary is MP 239 (Glitter Gulch) to Healy. Safer for bike commuters, would be big draw for recreational tourism.
Intersection at McKinley Village (Grizzly Bear Campground/Denali Park Village turnoffs) is dangerous in the summer season. Slower speed limit through this section, turning lanes for intersection, pedestrian underpass, pedestrian bridge or lane on bridge.
Bridge for roadway or train tracks, so summer tourism buses do not have to stop
Turning lane or something similar needed at the entrance to the McKinley Village Lodge and Grizzly Bear Resort. Summer tourists cross the highway unsafely, so a pedestrian walkway is also needed.
The spring thaws cause some sections of the road to become a safety hazard every single year.
Add a pedestrian bridge or walkway to allow safe movement of visitors over the Nenana River Bridge near the Denali Park Village and Grizzly Bear Resort.
The intersection of Parks Hwy and Stampede/Lignite Road needs a left turn lane.
Turning lanes, passing lanes
An area of concern I have is the lack of left-hand turn lanes at use points. One of the worst examples is the left hand turn onto the Stampede Road when driving northbound. As a resident of the Stampede I am routinely passed at high speeds to my right, on the shoulder of the road, often in marginal conditions. Other similar areas include the parking lot accessing the Bison Gulch Trail & S. Boundary of Denali Nat'l Park (Triple Lakes Trailhead).
Another concern I have is biker & pedestrian safety, as well as creating opportunities for health/active communities. In & around most of the communities covered in this study are areas of opportunities for a multi-use trail that could provide a safer place to travel & recreate than the narrow shoulder next to high speed traffic year-round, but especially in the summer.
Speed limits, at least, seasonally should be consistently 55 mph from Cantwell to the Stampede, due to the high volume of traffic, pedestrians & driveways in between.
Access management needed in the MP 224-230 area. Consider frontage system and turn lanes like what was done for the passing lanes in Nenana.

Public Comments – Economic Development & Stewardship – June 25-July 25, 2020

Broad Pass is one of the few areas remaining along the Parks Hwy that a traveler gets a sense of the vastness, a taste of “remote Alaska”. Taking care to preserve the undeveloped nature of the Broad Pass to Jack River stretch.
Economic development for year-round employment to bring people to live closer to Cantwell. Our school community is small and in jeopardy of shutting down. The community of Cantwell does not have much in terms of employment and thus not many families live in the area.
Put a bridge through the narrowest part of the canyon. The river continues to erode the road and they keep blasting the beautiful rocks to move the road further from the water.
I do not support any further development along this stretch of the Parks Highway! Too much uncontrolled development has already destroyed our natural environment.
help the public know about AHTNA lands with signage for visitors to the area

Appendix D

Traffic and Safety Memorandum (July 20, 2020)

PARKS HIGHWAY MP 203 – 259
PEL STUDY

Cantwell to Healy
PEL Study
Parks Highway MP 203-259
Planning & Environmental Linkages (PEL) Study

Traffic & Safety Memo

Project No. NFHWY00492

July 20, 2020

Acronyms

AADT – Average Annual Daily Traffic

AASHTO – American Association of State Highway and Transportation Officials

ADF&G – Alaska Department of Fish and Game

AKRR – Alaska Railroad

BIC – Backcountry Information Center

BLM – Bureau of Land Management

CCS – Continuous Counting Site

CDS – Coordinate Data Set

DNR – Department of Natural Resources

DNP&P – Denali National Park and Preserve

DOT&PF - Department of Transportation and Public Facilities

FHWA - Federal Highway Administration

GMU – Game Management Units

HSIP – Highway Safety Improvement Program

IHS – Interstate Highway System

MADT – Monthly Average Daily Traffic

M&O – Maintenance and Operations

MPH – Miles Per Hour

NHS – National Highway System

NPS - National Park Service

PAC – Project Advisory Committee

PDO – Property Damage Only

PEL – Planning and Environmental Linkages

PHB – pedestrian hybrid beacon

RRFB – rectangular rapid flashing beacon

SVROR – Survivor

WFL – Western Federal Lands

Introduction

The Northern Region State of Alaska Department of Transportation and Public Facilities (DOT&PF) in conjunction with the Western Federal Lands (WFL) is conducting a Planning and Environmental Linkages (PEL) study along the Parks Highway from milepost (MP) 203 to 259. The purpose of the study is to develop a realistic implementation plan of projects that will address the issues and concerns identified by stake-holders.

The Parks Highway is classified as an interstate route. It is the primary highway connection between Anchorage and Fairbanks (Alaska's two most populated cities), and is the key highway connection between the Port of Anchorage and the North Slope oilfields. The Alaska Railroad has 4 crossings within the corridor, 3 are grade separated (MP 203, 236.5, 243) the other is at grade (MP 235). Between the Railroad and trucking industry the vast majority of all goods headed north pass through the corridor.

It also serves tourist traffic seeking to enjoy Denali National Park & Preserve (DNP&P), as well as numerous other Denali themed tourist attractions along the route. Summer months find the route saturated with motorhomes, tour buses, pedestrians, and wildlife. With the tourism industry being a significant economic driver for Alaska it is vital that the analysis include factors to facilitate use of the highway by tourists and tourism businesses.

As part of the PEL various traffic conditions will be analyzed to identify locations that are of most concern to maintain safety, efficiency, and functionality of the corridor for all modes of transportation. See section 2 for a more details. Between trucking, tourism, and local traffic (moose included), all modes are represented.

An overview map of the project corridor is shown in Figure 1

Figure 1 - Parks PEL Study Corridor Location

Existing Traffic Conditions

Figure 2 shows the annual average daily traffic (AADT) for the past 10 years and the projected 2040 traffic. A 1.35% growth rate for projecting out the 2040 AADT values was based on a Continuous Counting Site (CCS) south of Nenana that has historical data going back over 40 years. That growth rate was applied to an average of the last 4/5 years of AADTs to produce rounded 2040 values. Percent of traffic that are trucks was collected for MP 185-210 in 2017 at 18.27% and for MP 240-249 in 2018 at 17.71%.The truck directional split along the corridor is 50/50. Any data missing is due to not collecting data on that specific year.

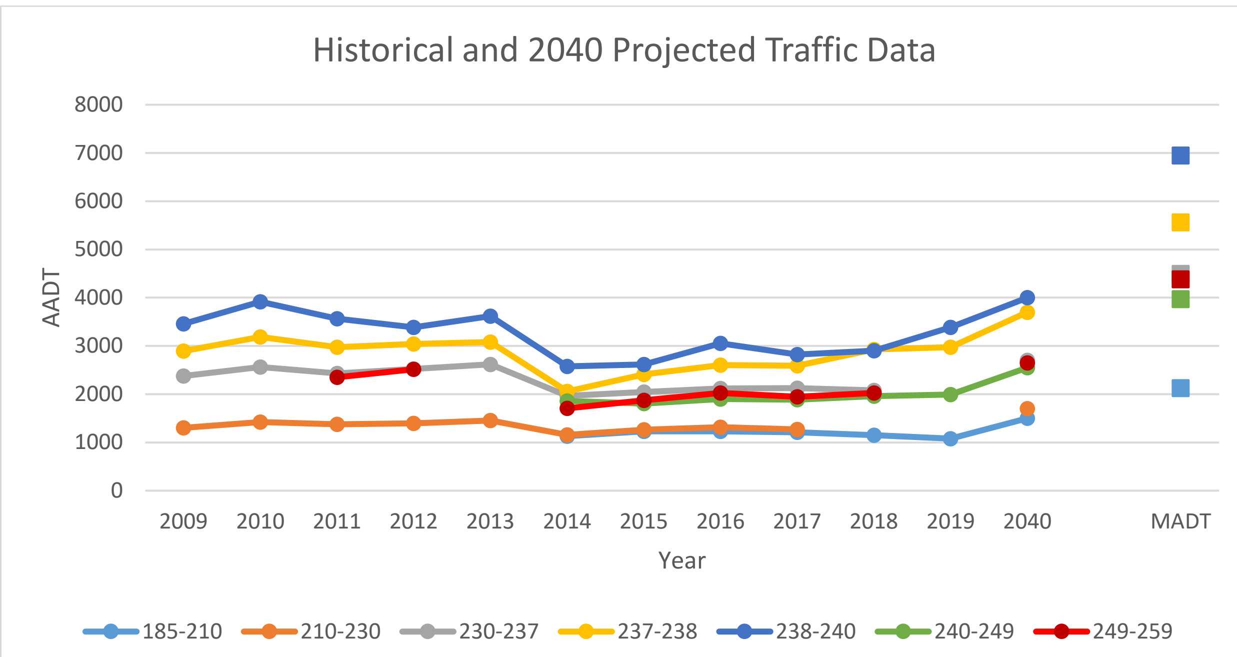


Figure 2 - Historical and Projected Traffic Data

The decrease in 2014 is due to a change in software used to model the traffic more accurately. Traffic counting devices record data when driven over but by themselves are incapable of knowing what kind of vehicle passed by. Software is needed to process and interpret the readings. The general trends on both sides of year 2014 are similar indicating a consistent trend even though calculated numbers seem different. It is noteworthy that MP 237-240 not only has the highest AADT but also a strong positive trend over the last 5 years.

A better way to see the impact that the summer months have in the corridor is shown using the Monthly Average Daily Traffic, MADT. All sections of road experience almost double the amount of traffic in the month counted as compared to the AADT. All data for MADT was collected during peak months, June to August. See appendix A for raw MADT data.

Crash History

Crash History from 2013 to 2017 was reviewed. Note that 2017 data is not complete and there could be crashes not yet available from that data set. During this timeframe, there were 3 fatal crashes, 7 serious injury crashes, 25 minor injury crashes and 119 property damage only crashes for a total of 154 in the study area. See Figure 6 and Figure 7 for maps depicting crash locations/severity. Raw crash data area attached. Of these crashes, 18 involved commercial vehicles, 2 involved motorcycles and none involved bicycles or pedestrians. Of the crashes, 119 were single vehicle crashes and 35 were multi vehicle crashes. Twelve of the crashes involved drugs and/or alcohol. As shown in Figure 3 nearly one third of the 154 crashes involved a live animal. Crashes by first harmful event are shown in Figure 3.

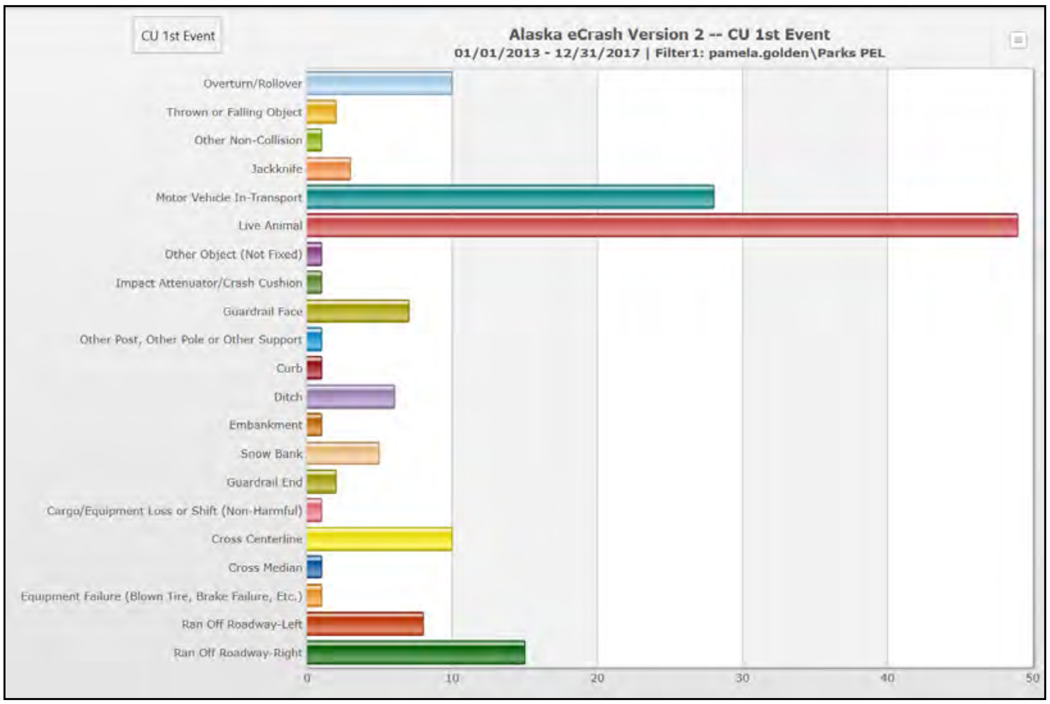


Figure 3 - Crash Data by First Harmful Event

There are approximately twice as many crashes when the road is wet, snow covered, or icy than when it is dry. September, January and December have the most crashes, while March thru May has the least. Weekend crash rates are slightly higher than crash rates on weekdays.

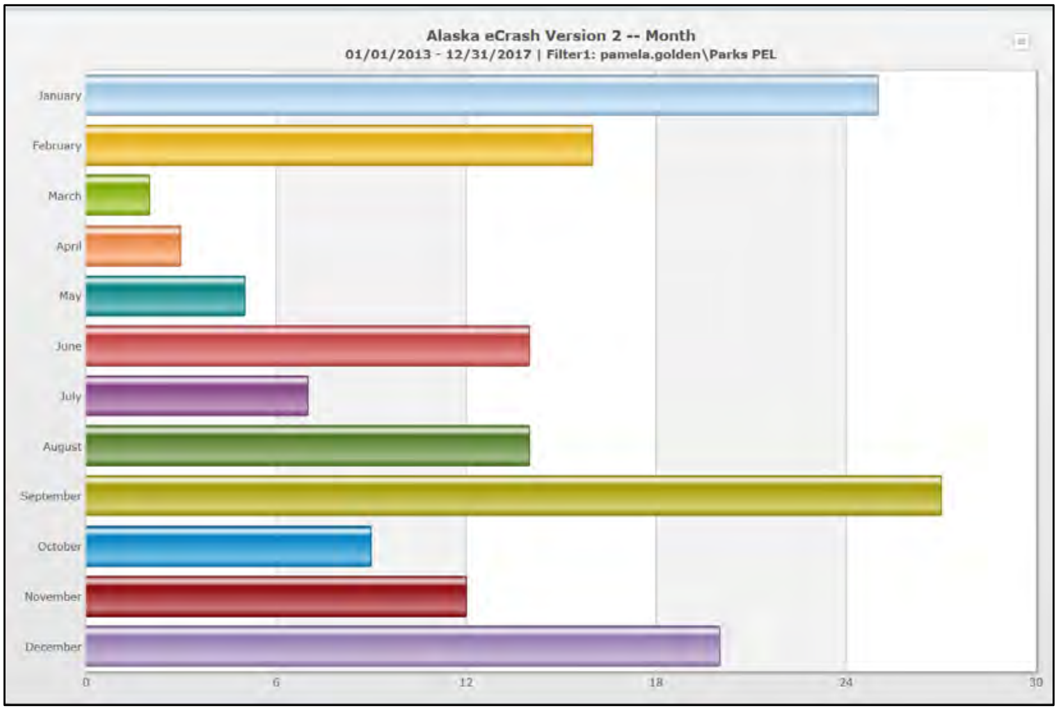


Figure 4 - Crash Data by Month

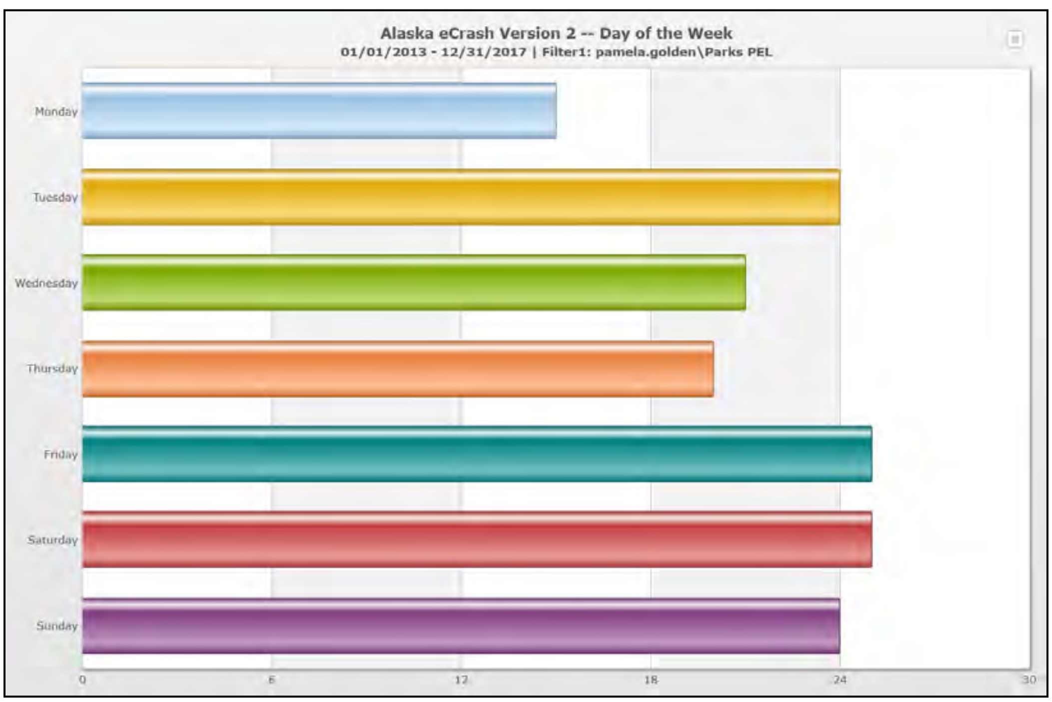


Figure 5 - Crash Data by Day of the Week

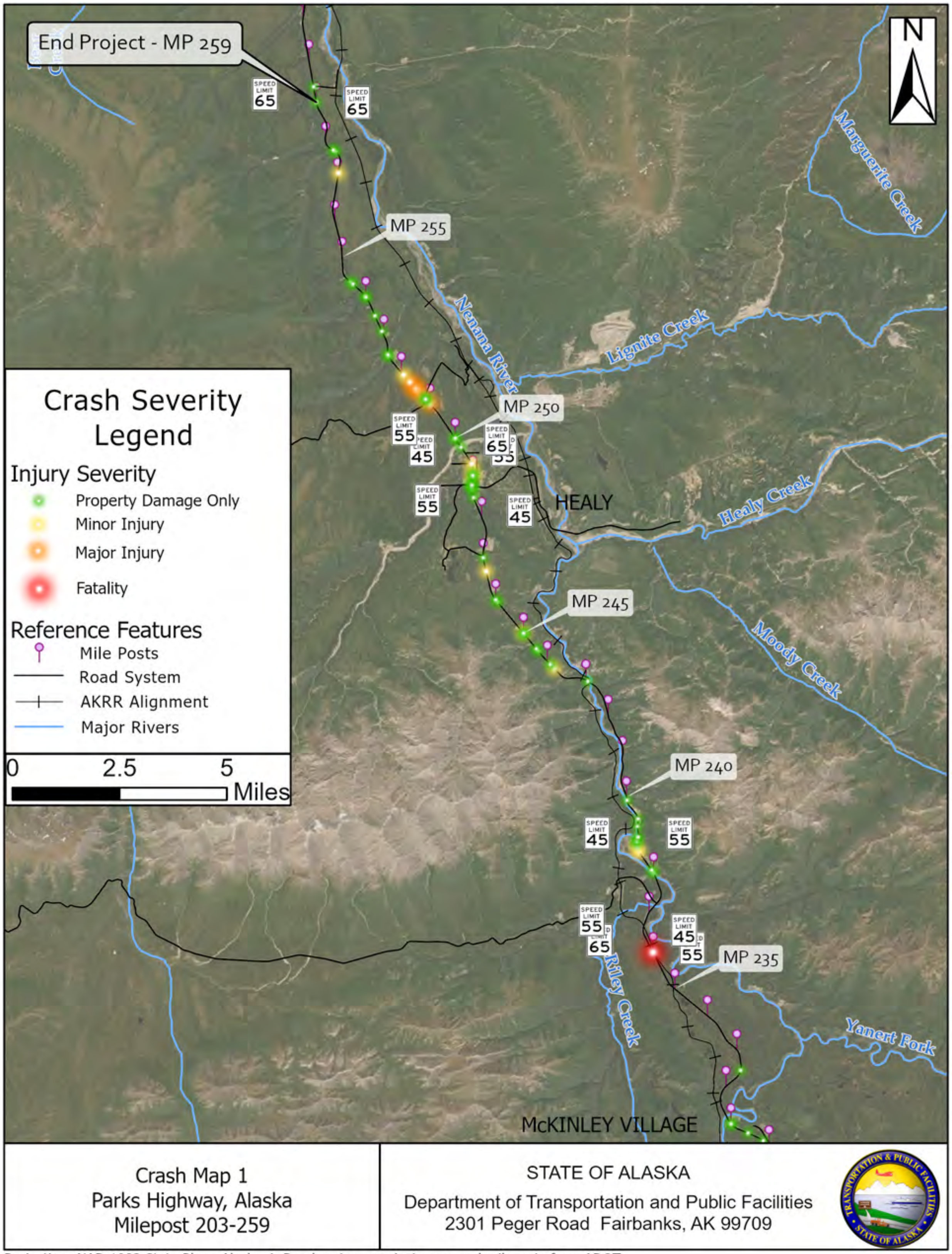
Crash rates were not calculated for the corridor because statewide rates have not been calculated since the 2012 data was completed. Changes in crash reporting format went into effect in 2013, so comparisons between this data set and the rates through 2012 would not be meaningful.

A sliding spot analysis was performed to target areas with injury and/or fatal crashes to see how those correlated to each other and to property damage crashes. Six locations in the corridor had at least 2 minor or major injury crashes or 1 fatal crash within one mile. The sliding spot method identifies overlapping miles that meet this criteria. Note that mileposts are approximate as crash data is recorded by milepoint. Individual crash narratives within these segments were reviewed to identify crash patterns.

Table 1 - Crash Data Narratives

From Milepost	To Milepost	Total Crashes	Fatal Crashes	Major Injury Crashes	Minor Injury Crashes	Property Damage Crashes	Notes
204.5	208.5	13	1	2	2	8	5 crashes, all PDO were moose or caribou related. The remaining crashes were SVROR. The fatality was a SVROR on a dry summer day and the deceased was ejected (not wearing a seat belt). The curve at MP 206 is the location of both the fatality and a SVROR PDO. It is signed with a 55 mph advisory speed and also experiences seasonal frost heave.
213.5	216.5	14	0	0	4	10*	Crashes in this segment are primarily either moose collisions or loss of control navigating the sharp curve at Nenana River at Windy Bridge (#1243). The HSIP project discussed in the next section was constructed in the middle of this timeframe. Only one crash was reported in the curve following the enhanced delineation, and is a PDO south of the bridge.

							*appears there is a duplicated crash in this data set; have inquired with state crash data manager
219.5	225.5	25	1	4	1	19	Animal strikes, SVROR on icy/snowy roads and rear ending of turning vehicles are the three crash patterns from this stretch of roadway. The fatal crash was a SVROR, and the serious injury crash was a result of an illegal passing maneuver in a no pass zone. The minor injury crashes are from animal collisions (2), a SVROR (1) and a rear end of a turning vehicle
234.5	239.5	11	1	0	2	8	While there are several crashes in this segment, there are no crash patterns.
243.5	245.5	7	0	0	2	5*	No crash patterns in this segment *appears there is a duplicated crash in this data set; have inquired with state crash data manager
247.5	252.5	23	0	4	4	15	Moose account for the majority of collisions in this segment. Three SVROR resulting from falling asleep also occurred in this segment, accounting for 2 major injury and 1 minor injury crash. Loss of control in icy conditions accounted for the other 2 serious injury crashes.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 6 - Crash Severity Northern End

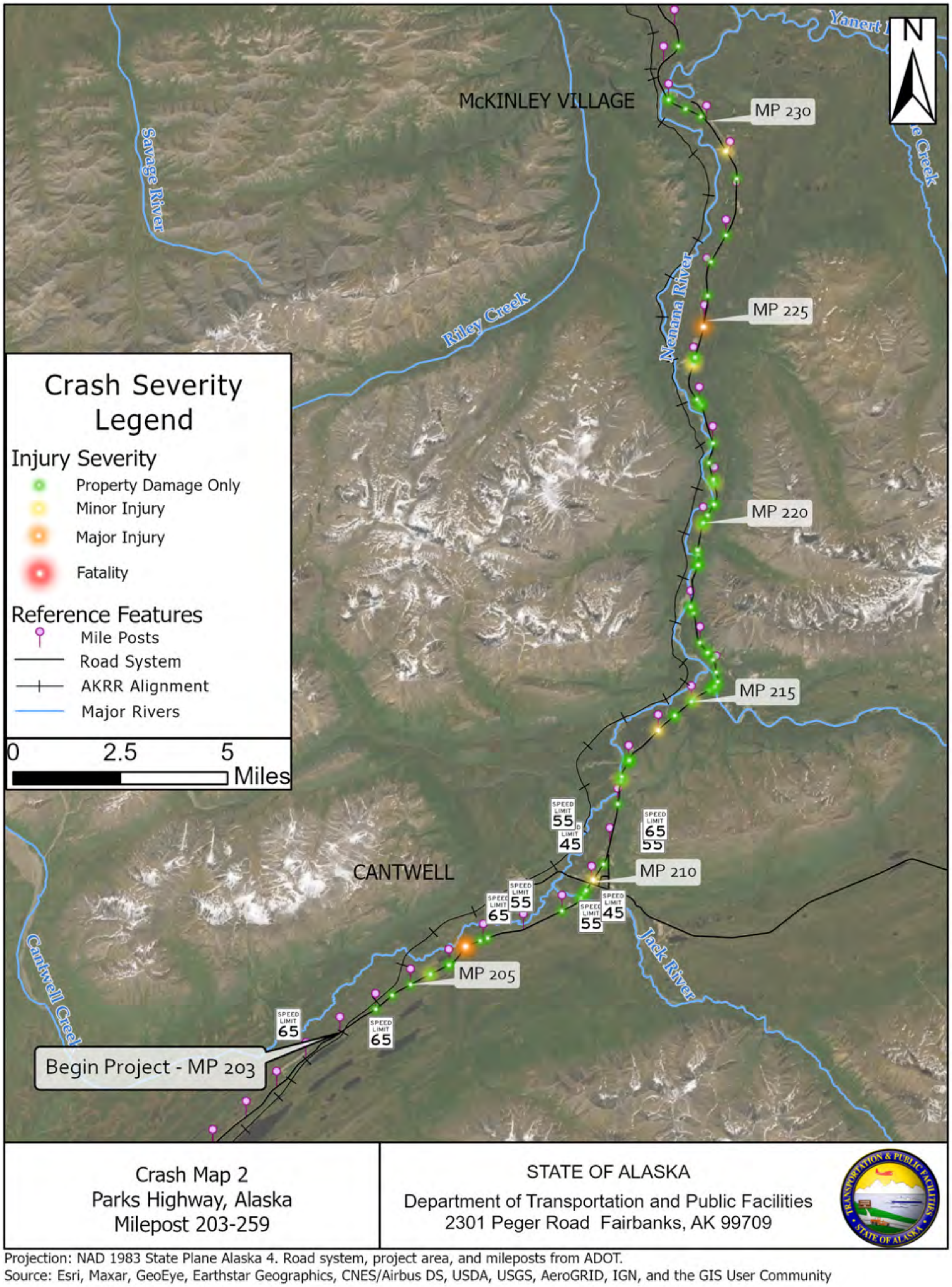
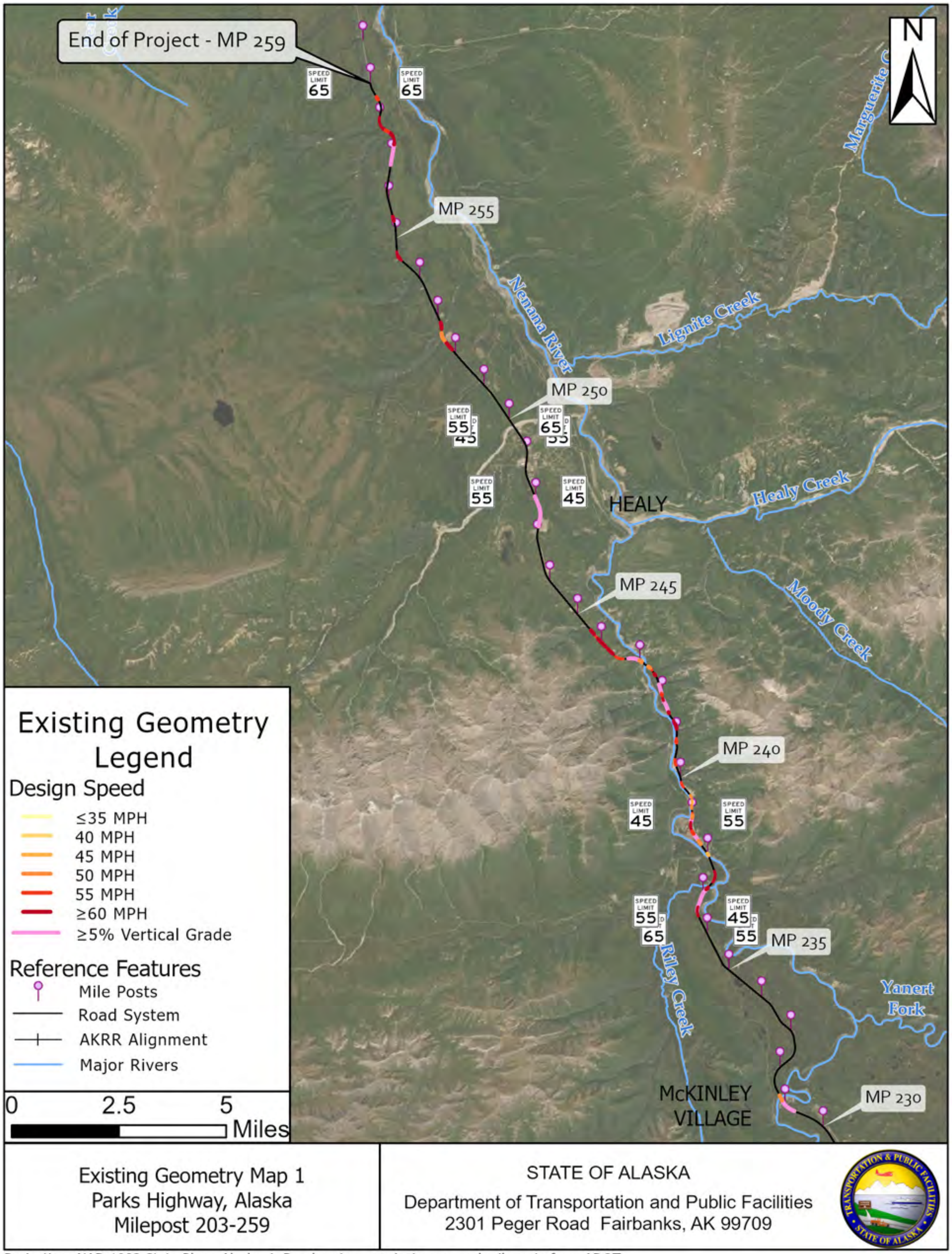


Figure 7 - Crash Severity Southern End

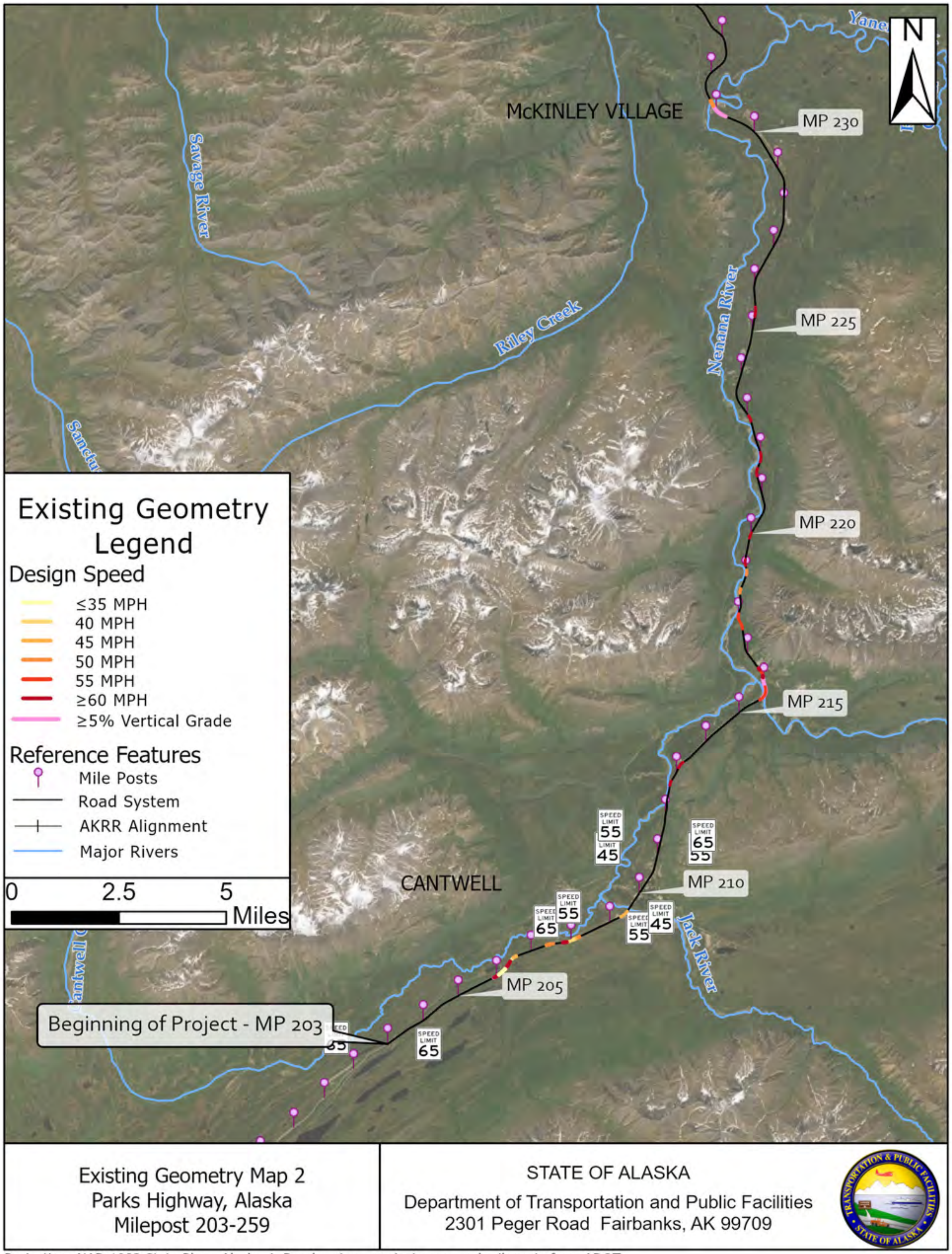
Existing Geometric and Safety Conditions

The study area is approximately 56 miles long with over 200 lane miles. Posted speed limits range from 45mph to 65mph. Approximately 33.1% of the current horizontal curvature and 28.5% of the vertical curvature does not meet AASHTO design criteria for 65mph. The standard roadway typical is 12 ft lanes with 8 ft shoulders, see figure 3 for details. There are passing lanes located at MP 214-215. There are 22 bridges located within the corridor, discussed in the M&O Needs Memo.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 8 - Existing Geometry Northern End



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

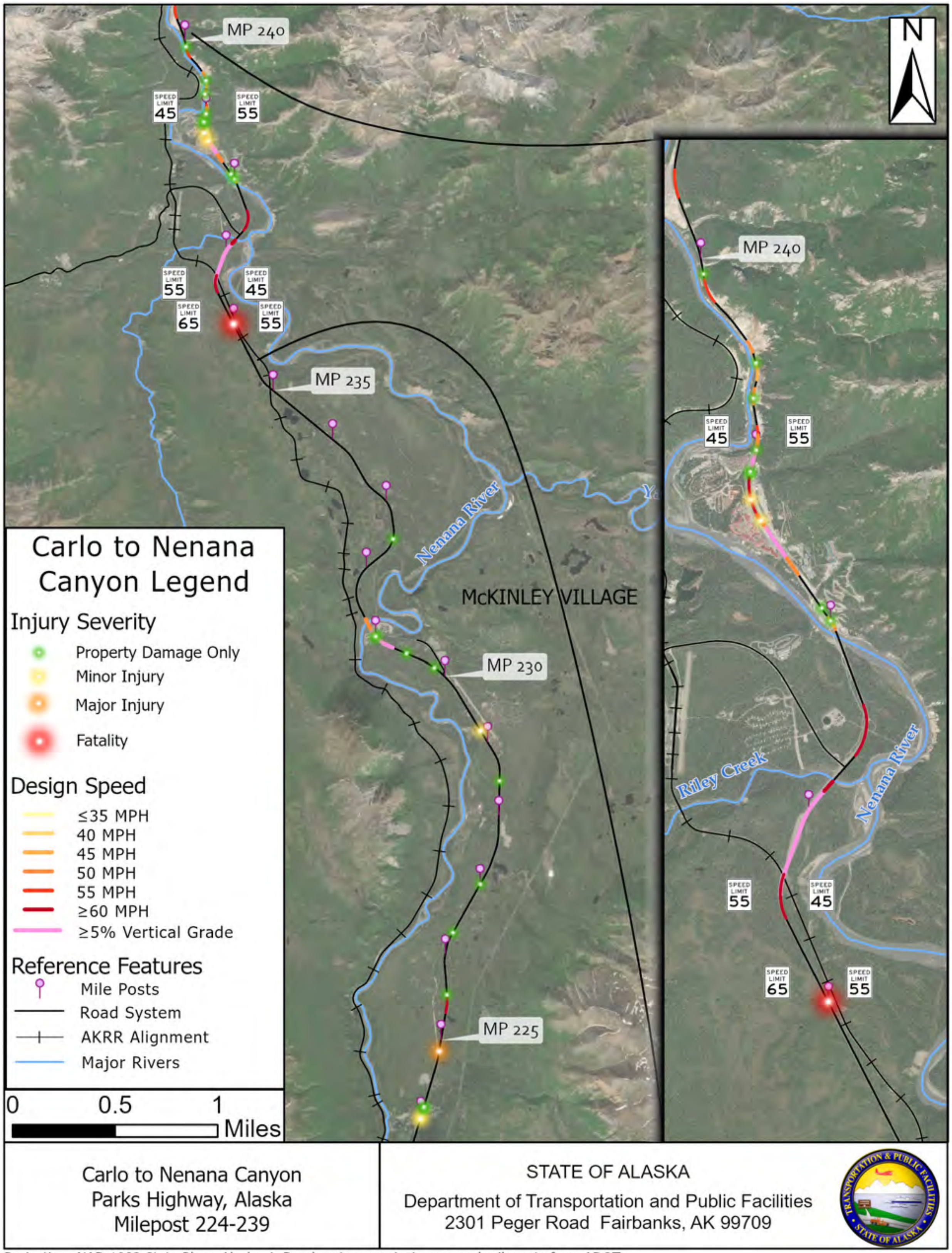
Figure 9 - Existing Geometry Southern End

The beginning of project is just north of Broad Pass on level to rolling terrain. Road conditions are impacted by seasonal frost heaves. Heading north from Cantwell the road hugs the mountains to the East and the Nenana River to the West. This section of road is prone to rockfalls and the alignment has several deficient horizontal curves due to the physical constraints of the river and mountains. There are many stretches where clear zone is not available due to rock cut slopes and guardrail protecting vehicles from the river.

Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 10 - Cantwell

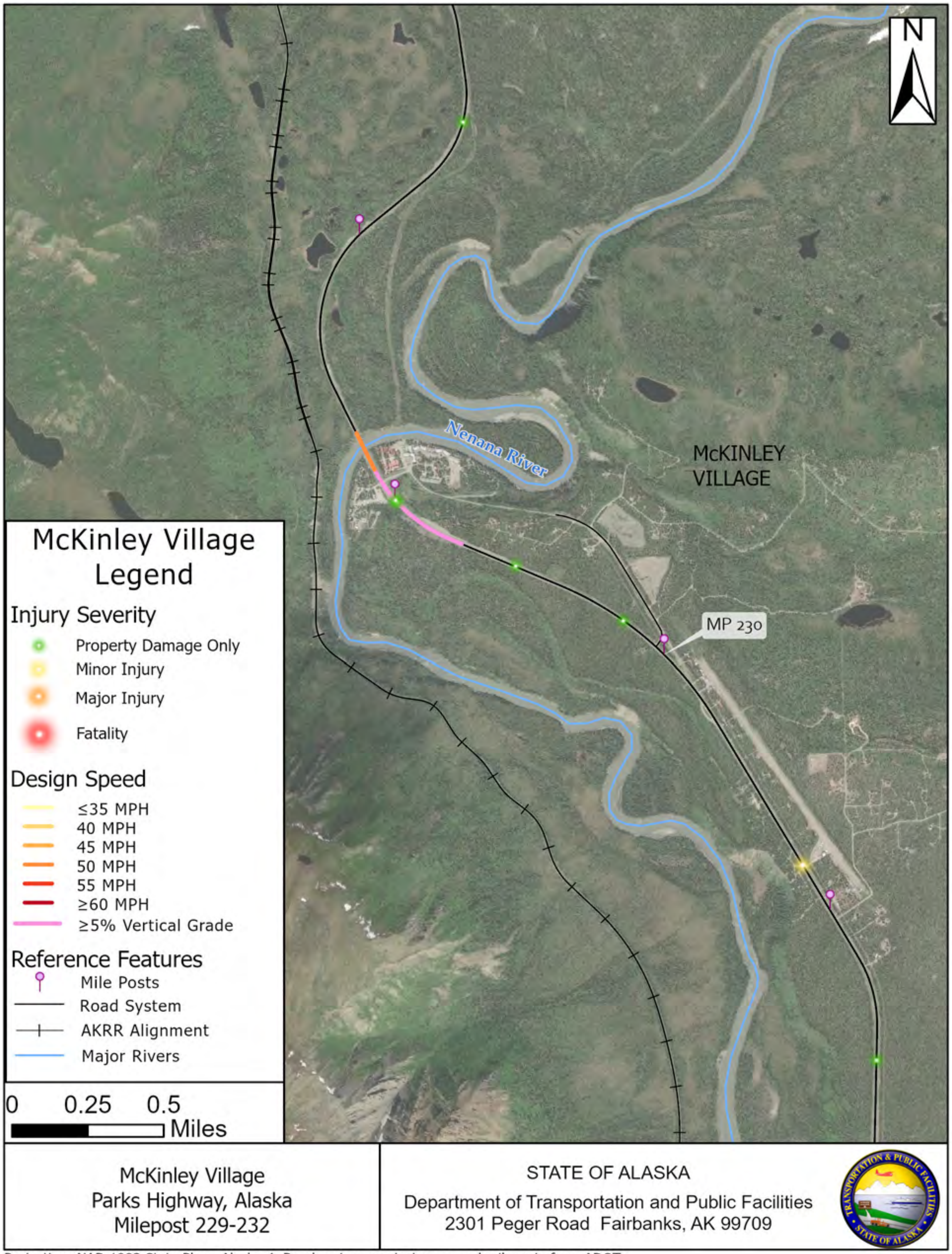
Carlo Creek to the Nenana Canyon (MP 224-239) consists of higher density developments supporting Denali National Park related businesses including lodging, restaurants, and tour operators. These areas currently do not have any access management provisions along the Parks Highway, resulting in numerous direct access points onto the Parks Highway. There are typically no dedicated pedestrian and bicycle facilities, those users utilize the 8-ft road shoulders. Terrain is predominantly level to rolling and the majority of horizontal and vertical geometry meets design standards for the posted speeds. During the summer months (typically Memorial Day to Labor Day) this area becomes inundated with turning traffic and pedestrians, creating conflicts with Interstate through traffic.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 11 - Carlo Creek to Nenana Canyon

The McKinley Village area from MP 229-232 has year round residents, large seasonal businesses, river access and trail access. The Nenana River Bridge near MP 231 has many pedestrian crossings of hotel guests on the south side of the bridge and trail access on the north side of the bridge, in addition to being at the bottom of two road grades that exceed 65 mph design standards. There is much local concern for the potential of a severe crash involving pedestrians at this location. Additionally, two large hotels are located just south of the bridge along with a major river access point for rafters. No turn lanes into these businesses are present, and there are occasional crashes at the driveways. There is a project in design to help address the concerns but funding issues have limited the size of the project, so not all areas of concern can be addressed. The final design with reduced scope will include a wayside by ox bow and the triple lakes trails, acceleration lanes by McKinley Village heading towards Anchorage and passive on bridge pedestrian detection for approaching vehicles. The project is schedule for construction in the spring of 2022.



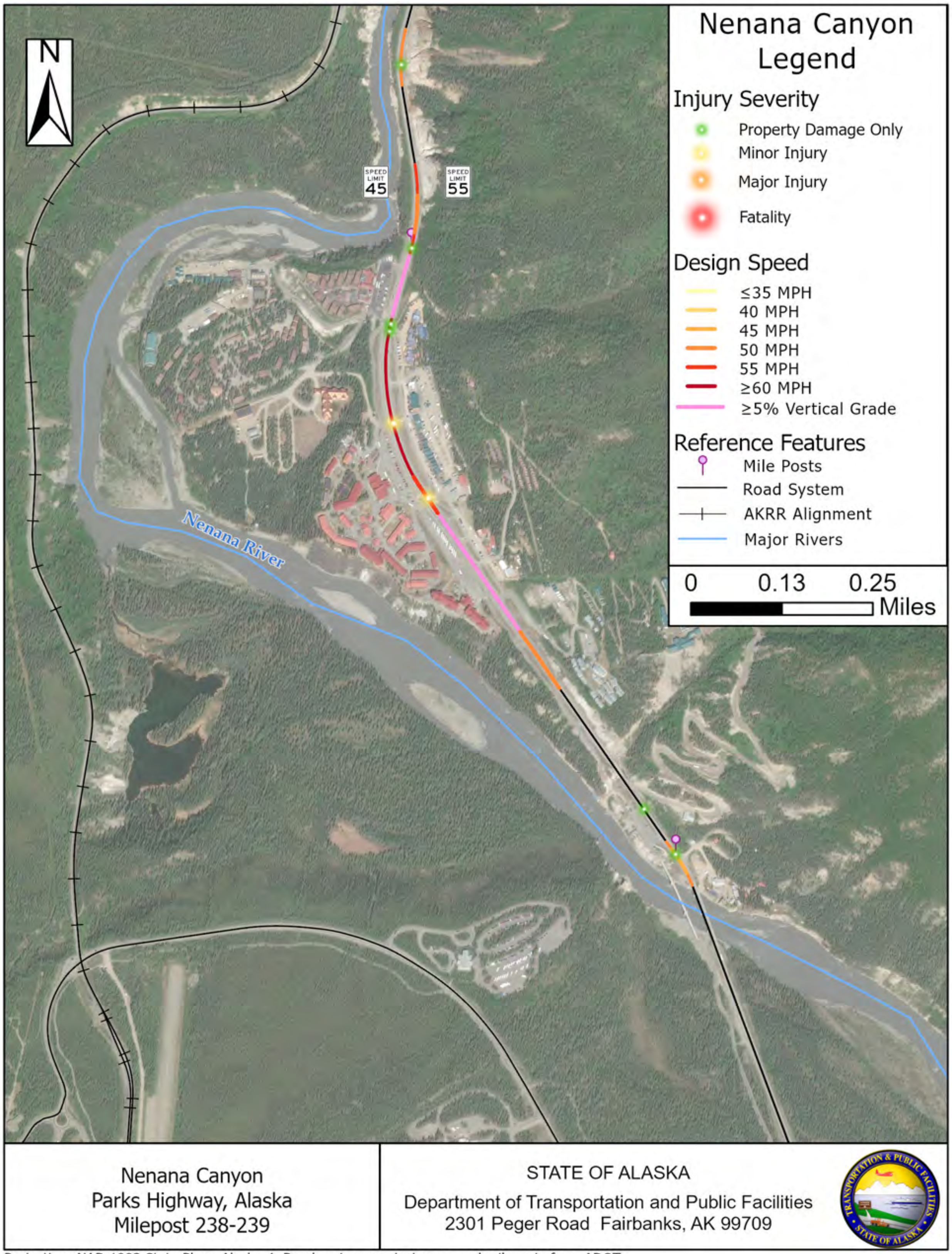
Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 12 - McKinley Village

There is an at-grade AKRR crossing at MP 235 that is continually shifting due to poor soil conditions in the area. Additionally, there are no truck/bus lanes at this location due to the ground conditions, so all traffic must stop behind a commercial vehicle (including the regular tour buses), increasing the chances for a rear end collision. The AKRR has a plan to relocate their track to stay on the West side of the highway which would eliminate this and the bridge crossing at MP 236.6, (ARRC 2018 Denali Park Realignment Feasibility Study). The relocation would be on National Park land, likely requiring congressional approval.

There is a seasonal 45 mph speed limit in place beginning just south of the Denali Park entrance, in the winter the posted speed is 55 mph. The Denali Park Road entrance is located at MP 237 immediately north of the Riley Creek Bridge. The intersection was reconstructed in 2015 to include a northbound left turn lane. There is also a southbound right turn lane.

The Glitter Gulch area (MP 238-239) is unique both within the study area and along the entire Parks Highway. This area is the major hub for much of the Denali Park summer tourism and springs to life in early May and shuts down by the end of September. It is home to hotels, lodges, a gas station, restaurants, outdoor recreation businesses and retail stores. There are 17 driveway access points along with 2 seasonally operated traffic lights within a mile stretch of road. Parking at the various shops and hotels is limited and many people, particularly those with motorhomes and trailers, choose to park along the shoulders of the highway. This creates congestion along the highway as vehicles complete their parallel parking maneuvers on the highway and presents a safety concern when pedestrians exit their vehicles and wish to cross the road. The road itself also suffers from frost heave damage, and it is normal to see gouges in the pavement from trailer hitches. M&O forces will be doing pavement work in the area in summer 2020. See the M&O Needs Memo for more details on this area and the issues faced.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

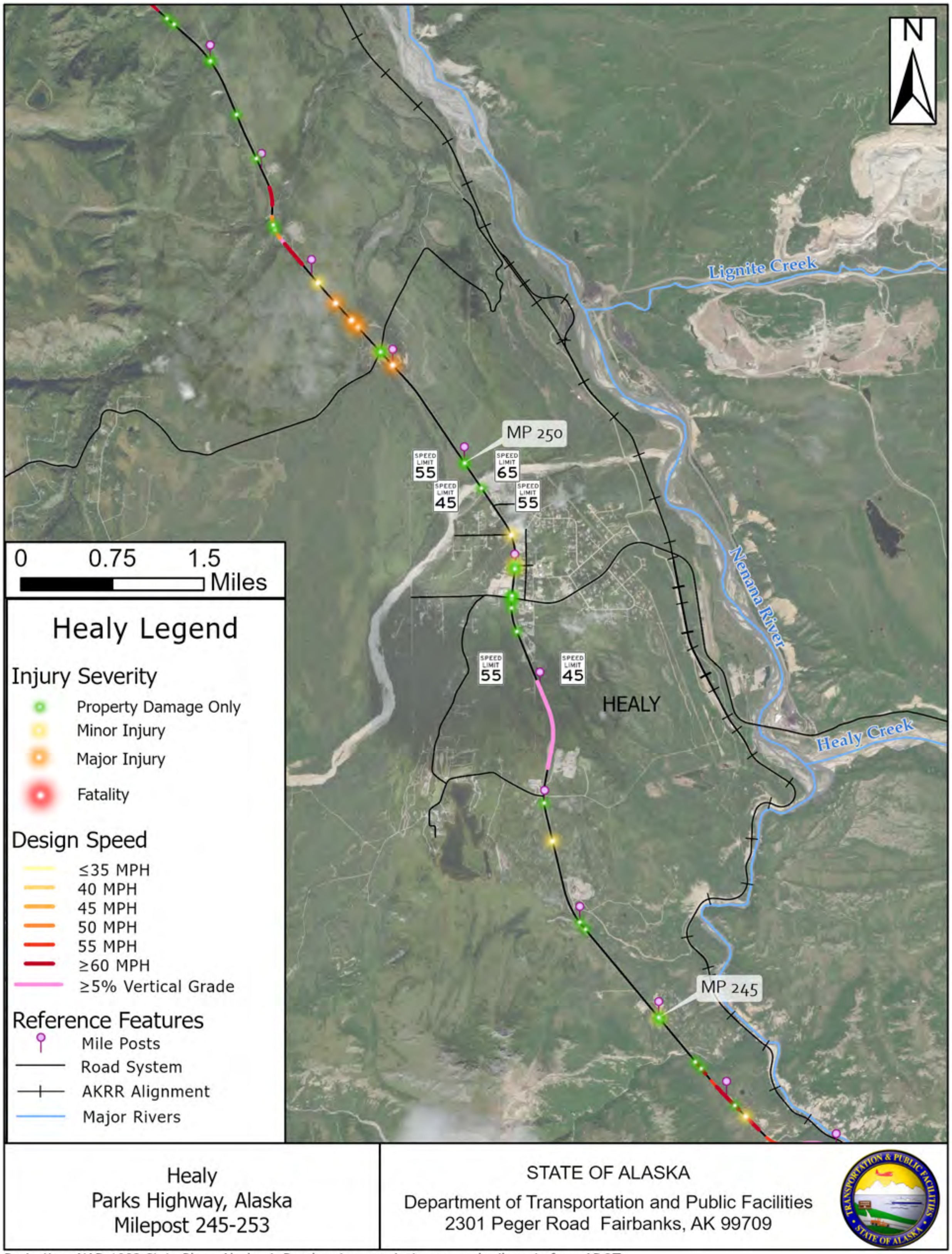
Figure 13 - Nenana Canyon/Glitter Gulch

Right as you leave at MP 239 you enter the Nenana Canyon. This mile and a half stretch is bound tightly by rock slopes to the east and the river to the west. Scaling of the rock face was completed in 2018 however rockfall still occurs in the area. Rock blockers are installed between the base of the rock face and the roadway in stretches of the canyon to limit the size and amount of rock that makes it to the roadway. This is a popular area for photography of the river and river rafters and vehicles often park on the shoulder to take photographs. For more detail on rockfall concerns, see the M&O Needs memo and Baseline Geological & Geotechnical memo.

Leaving the canyon crosses Moody Bridge. There is a small parking area for maintenance where people park to get under the bridge on the catwalk. Just beyond that on the East side of the road is a small parking area for the Bison Gulch Trailhead which is located on the West side of the road. This causes people to cross the highway on foot on both a horizontal and vertical curve with poor sight visibility. A project with the Denali Borough and DOT&PF is in design to relocate the parking lot.

Headed north as you enter Healy there is a long hill at 6% grade. Southbound traffic has two lanes to accommodate slow moving truck traffic. The highway is in good condition and geometrically sound through Healy. There are concerns regarding pedestrian traffic at the intersection with Healy Spur Road that are discussed below. There are multiple projects currently in planning for the local roads in Healy that will help provide safer connectivity for all transportation modes.

From Healy to the end of the study area the road experiences frost heaving and some areas of rockfall. In some cases the heaves are severe enough to cause gouging in the pavement from tail hitches similar to Nenana Canyon. The majority of the road between MP 256.8 and 258 includes advisory speed signs. Along with the speed reductions there are limited opportunities to pass in this section.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 14 - Healy

Operations

Speed Limits

The speed limit on the majority of the Parks Highway between Wasilla and Fairbanks was raised to 65 mph in 1992. 45 mph speed limits are in effect for the Cantwell and Healy communities year round. A 55 mph speed limit is in effect during winter months from just south of Denali NP to Healy. During summer months, the speed limit at the Park entrance through the Nenana Canyon (Glitter Gulch) area drops to 45 mph to accommodate tourism related congestion.

Starting in 2018, a seasonal 55 mph speed limit was implemented in the McKinley Village until improvements are made at the Parks 231 bridge. Follow up speed studies have found little to no change in driver behavior from the seasonal change in the regulatory speed limit. This is consistent with decades of before and after speed studies throughout Alaska that have shown that speed limit changes only effect a 2-3 mph change in operational speed, unless they are strictly enforced.

There have been several requests to implement a seasonal speed limit in the Carlo Creek area. Speed readings have been obtained multiple times since 2014. Speed data along with a review of roadside development and uses suggests that a speed limit adjustment for the Carlo Creek area is not warranted.

Traffic Signals

There are two seasonally operational signals in the Nenana Canyon. They are generally put into operation in early May and turned off mid-September when the summer tourism season winds down. In addition to providing gaps for vehicles to enter the highway, they accommodate heavy pedestrian crossings between the seasonal hotels and parking on the west side of the road and the primarily retail and food seasonal establishments on the east side of the road.

Signal warrants were investigated in 2014 for the intersection of Healy Spur Road and the Parks Highway. Many seasonal employees were moved from the Nenana Canyon area to this area around that time, resulting in a sharp uptick in pedestrian crossings of the Parks Highway at this location. Warranting conditions for a pedestrian hybrid beacon (PHB) were met, but signal warrants were not. General consensus at the time was that a PHB would be unexpected in this setting, particularly due to their not being in widespread use in Alaska. Instead, a pedestrian activated rectangular rapid flashing beacon (RRFB) was installed in 2015. We have received mixed feedback on the installation. It may be prudent to get new counts at this intersection once tourism returns to normal as it is our understanding that additional employee housing and other development may happen at this location.

Areas of Known Public Concern

Issues brought to the attention of Traffic and Safety over the past 8 years by the public include:

- MP 210 - Desired turn lanes at Denali Highway Junction
- MP 230 - Potential for large new lodge near MP 230
- MP 224, 229-232 - Speed limits at Carlo Creek (addressed above) and McKinley Village/Crabbie's Crossing
- MP 231 - Pedestrian crossings at Carlo Creek and Parks 231 (Crabbie's Crossing)
- MP 235 - Desire to eliminate Parks 235 rail crossing
- MP 238-239 - Congestion in Glitter Gulch, including lack of parking and on-highway parking
- MP 239-241 Rockfall in the Nenana Canyon
- MP 246-247 Perception of Healy, particularly near Otto Lake as a speed trap
- MP 247 Concerns with pedestrian crossings at Healy Spur/Hilltop
- MP 251 Desired turn lanes at Stampede/Lignite intersection
- Desired separated bike/ped path from Anderson south to Glitter Gulch
- General access management related concerns (turn lanes, frontage roads, etc.) throughout the corridor from Cantwell to Healy

Concerns about natural gas line, particularly in Nenana Canyon

HSIP Project History in the Corridor

Several Highway Safety Improvement Program projects have constructed in the project area in the past 5 years.

- In 2015, curve delineation was upgraded and enhanced between MP 215 and 219, leading into and including the Nenana River bridge at Windy.
- In fall 2016, all remaining curves north of Milepost 174 on the Parks Highway were marked with appropriate curve and advisory speed plaques conforming to the 2012 Alaska Traffic Manual. Pass and no-pass striping were also updated at that time to conform to current standards.
- ARRC received HSIP funds in 2018 to upgrade the signal system power source, cantilevers and signal gate masts at the Parks 235/ARRC 345 rail crossing.
- Guardrail on the Parks Highway was inventoried in 2017. Any needed upgrades will be incorporated into a future HSIP guardrail project in the next few years.

Appendix A

Table 2 - AADT Data

Mile Post Range	Annual Average Daily Traffic (AADT)											Projected 2040 AADT
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
185-210						1131	1229	1227	1211	1153	1079	1500
210-230	1306	1422	1374	1394	1454	1157	1265	1318	1268			1700
230-237	2378	2563	2429	2525	2619	1966	2044	2120	2127	2076		2700
237-238	2892	3185	2976	3041	3080	2058	2411	2604	2588	2929	2974	3700
238-240	3460	3914	3562	3383	3615	2577	2613	3052	2821	2903	3384	4000
240-249						1860	1805	1902	1889	1959	1994	2550
249-259			2350	2516		1706	1876	2024	1947	2027		2650

Table 3 - MADT Data

Mile Post Range	MADT	MADT Month
185-210	2124	Jul-19
210-230	N/A	N/A
230-237	4491	Aug-18
237-238	5560	Jun-19
238-240	6941	Jun-19
240-249	3965	Jul-19
249-259	4380	Aug-18

Appendix E

Maintenance and Operations Existing Concerns and Needs Report (July 24, 2020)

PARKS HIGHWAY MP 203 – 259 PEL STUDY

Cantwell to Healy PEL Study

Parks Highway MP 203-259
Planning & Environmental Linkages (PEL) Study

Maintenance and Operations Existing Concerns and Needs Report

TRANSPORTATION & PUBLIC FACILITIES
STATE OF ALASKA

Project No. NFHWY00492

July 24, 2020

Executive Summary

The primary purpose of this document, called the Maintenance and Operations Existing Concerns and Needs Report is to identify and evaluate the needs and areas of concern of the Maintenance and Operations crews. Because these crews work to maintain the Parks Highway year round, this input should provide valuable insight to identifying the areas that could benefit most from improvement. These areas of concern were identified using an interactive survey, which allowed crews to identify and describe the issues faced, pinpoint the location on a map using GPS, and attach photos to visually depict the problematic locations.

Based on the survey, M&O has concerns relating to the following:

- Rock slides and drainage issues around Nenana Canyon, MP 239 - 240.
- Alaska Railroad crossing maintenance at MP 235.
- Drainage issues resulting in damage to both the road base and surface.
- Sections of sinking roadway along study corridor.
- Inadequate roadway shoulders in some locations.
- Parking issues around Nenana Canyon Businesses during summer from tourism traffic.
- Annually returning problems with uneven and bumpy areas.
- Areas where the roadway is dropping annually.

As part of the FHWA mandated bridge inspection program, the Department's Bridge Section prepares work candidates for bridges throughout the state. Bridge work recommendations in this area include:

- Nenana River Bridge near Park Station #1147 – reset the abutment on the Fairbanks end in a few years
- Kingfisher Creek Bridge #697 – deck overlay
- Iceworm Gulch Bridge #1146 – abutment spall repairs
- Hornet Creek Bridge #1145 – abutment spall repairs
- Antler Creek Bridge #1141 – deck overlay

This document concludes with a summary of the major concerns highlighted by maintenance crews with the existing conditions of the Parks Highway along the PEL Study corridor. This information is intended to help inform the PEL study team of these concerns, which may help influence the scope of future projects along the Parks Highway PEL Study corridor.

Table of Contents

List of Tables

List of Figures

Acronyms

AADT – Average Annual Daily Traffic

AASHTO - American Association of State Highway and Transportation Officials

BSM - Bridges and Structures Manual

CCS - Continuous Counting Stations

CDS - State Coordinate Data Set

DNR - Department of Natural Resources

DOT&PF - Department of Transportation and Public Facilities

FHWA - Federal Highway Administration

FO - Functionally Obsolete

HMA – Hot Mix Asphalt

IHS - Interstate Highway System

M&O – Maintenance and Operations

MP – Milepost

ND - Not Deficient

NHS - National Highway System

NPS – National Park Service

PAC – Project Advisory Committee

PEL - Planning and Environmental Linkages

RIP - Roadway Information Portal

SD - Structurally Deficient

SR - Sufficiency Rating

WFL - Western Federal Lands

1.0 Introduction

1.1 Study Overview

The State of Alaska Department of Transportation and Public Facilities (DOT&PF) Northern Region in partnership with the Federal Highway Administration (FHWA), Western Federal Lands (WFL), and the National Park Service (NPS) is conducting a Planning and Environmental Linkages (PEL) study for the Parks Highway. The PEL study corridor includes the communities of Cantwell and Healy (MP 203 to MP 259) as well as the Parks Highway intersection with the access road for Denali National Park and Preserve. This study will create a planning document studying the current and future conditions and needs of the Parks Highway as it relates to highway infrastructure, the users, and surrounding communities. The final PEL study results will be used by the project partners to help implement future highway corridor improvement projects. A high priority is placed on the needs and input from stakeholders, partners, and the public when making decisions related to the Parks Highway.

This document, called the *Maintenance and Operations Existing Concerns and Needs Report* will primarily identify and evaluate the needs and areas of concern of the Maintenance and Operations (M&O) crews. Because these crews work to maintain the Parks Highway year-round, this input should provide valuable insight to identifying the areas that could benefit most from improvement. A discussion of the identified maintenance issues and areas of concern along the PEL study corridor from MP 203 through MP 259 of the Parks Highway is included in this document. Background information on the Parks Highway covering the corridor infrastructure, usage, existing conditions, and opportunities for future improvements is included as well.

1.2 Study Location

The location of the PEL study corridor is between MP 203 and MP 259 of the Parks Highway, which passes through the communities of Cantwell and Healy as well as the community of McKinley Village. The study area begins slightly north of Broad Pass and continues north until the turnoff for the community of Ferry, covering a total of 56 miles.

Figure 1 – Parks PEL Study Corridor Location

1.3 Study Methods and Content

The current needs and concerns of the M&O crews that maintain this section of highway were compiled primarily using an interactive survey which allowed maintenance crews to identify and document the location, general description, and severity of the concern. By utilizing the Survey123 application through ArcGIS, the survey was filled out by M&O staff using a smartphone in the field. These areas of concern will be discussed in greater detail in the Existing Conditions Analysis section later in this memo, along with other known problematic conditions along the Parks Highway PEL study corridor. These locations that were identified by maintenance crews using Survey123 have been collected gradually over the period from 4/15/2020 through 5/14/2020.

The survey asks a few basic questions, such as the name of the recorder, date that the concern was logged, and the project that the concern best relates to. Once the basic information has been recorded, the survey asks to select the general concern from a list or to choose other and type in a response. Utilizing the smartphones GPS capabilities, these individual points of interest could be tagged to their respective coordinate location either via GPS or visually on an interactive map. Each area of concern was then describe further in detail by the recorder with the option to assign a 1 to 5 rating for the severity of the issue to highlight high priority areas. Photos were also attached to the survey results to give a visual along with the description.

Based on the survey, M&O has concerns relating to the following:

- Rock slides and drainage issues around Nenana Canyon, MP 239 - 240
- Alaska Railroad crossing maintenance at MP 235
- Drainage issues resulting in damage to both the road base and surface
- Sections of sinking roadway along study corridor
- Inadequate roadway shoulders in some locations
- Parking issues around Nenana Canyon businesses during summer from tourism traffic
- Annually returning problems with heaving and uneven road surfaces
- Areas where the roadway is settling annually

2.0 Background Information

2.1 Highway Infrastructure History

The Parks Highway (State Coordinate Data Set (CDS) route number 170000) is a part of both the National Highway System (NHS) and the Interstate Highway System (IHS). Originally constructed between the late 1960's and early 1970's, the highway was officially completed in 1971. This highway provides the primary ground route from Fairbanks to Anchorage. Commercial trucks use this route year-round to deliver supplies and freight from Anchorage to Fairbanks and other surrounding communities. There is also a notable amount of cargo transported for the Trans-Alaska Pipeline along this route. During the summer months, traffic along the Parks highway increases significantly due to tourism, especially around Denali National Park and Preserve.

Originally, the segment between MP 203 and 259 was constructed with a standard typical section giving one 12-foot lane in each direction and an 8 foot shoulder traveling in each direction. The total width of the roadway is approximately 44 feet, with geosynthetic limits that extend an additional 2 feet beyond the shoulder on either side. Some sections of the Parks Highway have a typical section containing a 10 foot shoulder on one side of the road. It is anticipated that there will be between a 1 to 2 percent yearly increases in traffic through this area. For more information on the route usage, see the Traffic and Safety Memo for a more detailed and in-depth discussion.

2.2 Maintenance Districts

The Parks Highway is currently serviced by two separate M&O stations within the PEL study boundaries. Both stations are a part of the Denali Maintenance district. The Southern section of the project from MP 203 through MP 230 is maintained by the Cantwell M&O station, with their service starting technically around MP 194. The Northern portion starting from MP 230 through MP 259 transitions to the maintenance responsibility of the Healy M&O station. A map of the service area boundaries for these M&O stations is shown in *Figure 2*.

The DOT&PF gives a priority ranking for winter maintenance of their roadways, assigning a priority level between 1 (highest priority) and 5 (lowest priority) based on the volume, speed, and uses for each state maintained road. Currently, the Parks Highway has a winter maintenance priority of 2 for the section of the Parks Highway covered by the PEL study. Priority level 2 is often assigned to major highways and arterials connecting communities, which is an accurate description of the Parks Highway. Despite not being the highest possible priority level, this is still the highest maintenance priority of all roads within the surrounding area. According to the DOT&PF Winter Maintenance Priority Map, it may take up to 18 hours after a winter storm to fully clear the road for this priority level.

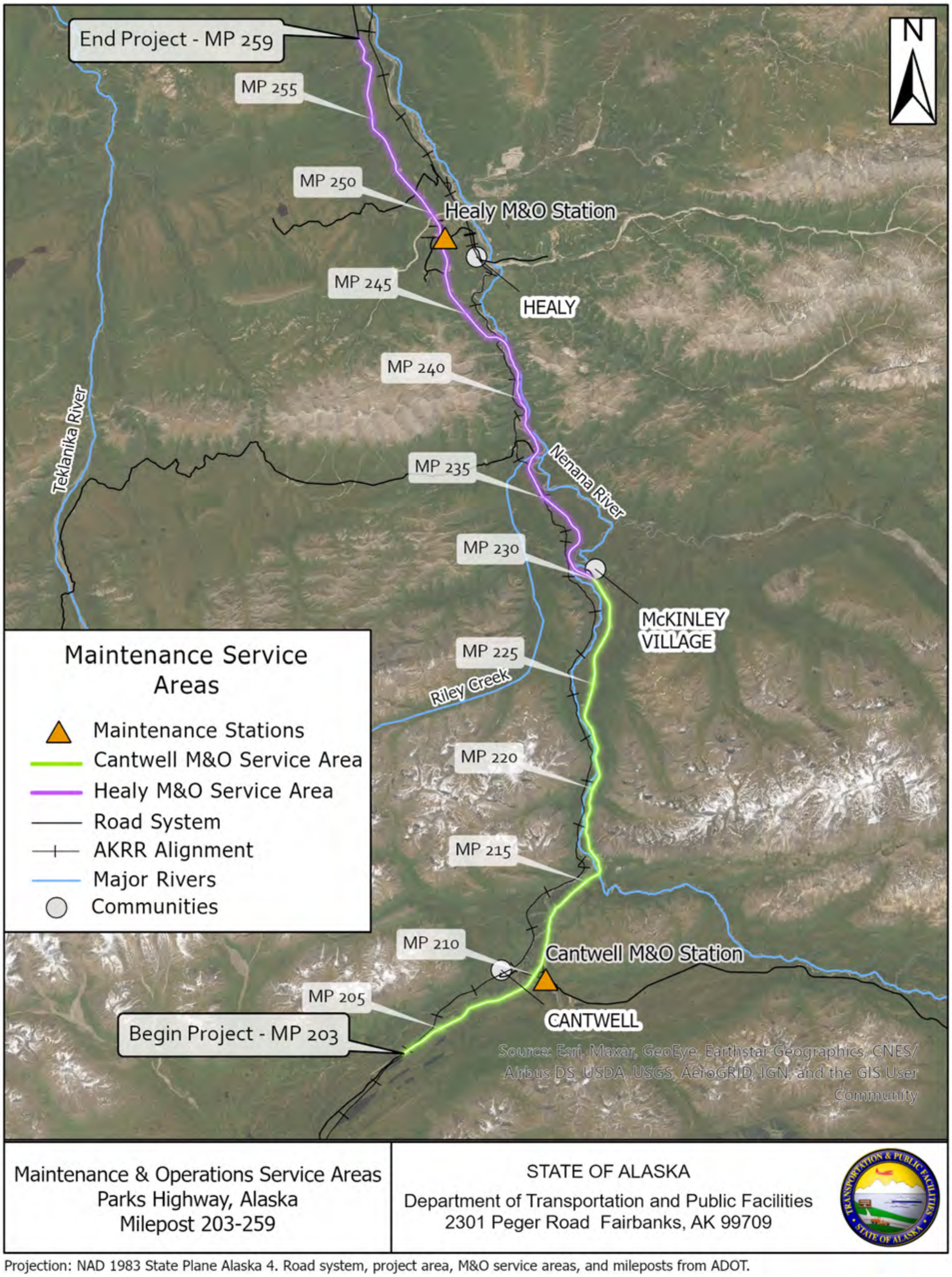


Figure 2 - Maintenance and Operations Station Service Area Boundaries

2.3 Bridge Inventory

There are a total of 22 unique bridges along the Parks Highway within the boundaries of the study corridor. Information regarding the condition of these bridges and their ratings is included from routine bridge inspection reports conducted by DOT&PF bridge design teams in 2018. The report provides geometric details, materials, age, condition and other information about the bridge. Using a formula provided by FHWA, the Sufficiency Rating (SR) is calculated as a number between 0 and 100, with 100 as the best case scenario and 0 as the worst.

A bridge may also be classified as Structurally Deficient (SD), Functionally Obsolete (FO) or Not Deficient (ND) based upon the condition factors, load rating, geometry, and other factors. To be classified as SD, a bridge condition factor of 4 or less is required for the deck, superstructure or substructure. The SR and SD/FO/ND values are used to generate a prioritized list of bridge needs. The formula for the prioritization is included in the DOT&PF *Bridges and Structures Manual* (BSM). Refer to FHWA publication *Specifications for the National Bridge Inventory Bridge Elements* and the American Association of State Highway and Transportation Officials (AASHTO) publication *Manual for Bridge Evaluation* for further detail on definitions and explanations of the bridge terminology. The bridges within the corridor are outlined in greater detail in *Table 1.*

Bridge Name	Bridge Number	Parks Highway MP	Condition - Deck 58	Condition - Super 59	Condition -Sub 60	Condition - Channel Protection 61	Condition - Culvert 62	Sufficiency Rating	Structurally Deficient / Functionally Obsolete	Year Built
Summit Overhead	#2084	MP 203.2	8 - Very Good	8 - Very Good	7 - Good	n/a	n/a	81.6	ND	2006
Pass Creek Bridge	#0293	MP 208.2	7 - Good	6 - Satisfactory	6 - Satisfactory	8 - Protected	n/a	67.5	ND	1965
Jack River Bridge	#0302	MP 209.6	6 - Satisfactory	7 - Good	6 - Satisfactory	7 - Minor Repairs Needed	n/a	67.5	ND	1965
Windy Bridge at Nenana River	#1243	MP 215.8	7 - Good	6 - Satisfactory	6 - Satisfactory	7 - Minor Repairs Needed	n/a	73.8	ND	1974 , Rehabilitated in 2006
Carlo Creek Bridge	#0693	MP 224.1	6 - Satisfactory	7 - Good	7 - Good	7 - Minor Repairs Needed	n/a	78.5	ND	1973
Nenana River Park Boundary	#0694	MP 231.3	7 - Good	6 - Satisfactory	6 - Satisfactory	6 - Bank Slumping	n/a	72.8	ND	1973, Rehabilitated in 2006
Railroad Underpass	#0696	MP 236.8	5 - Fair	5 - Fair	7 - Good	n/a	n/a	-2.0	NA	1968
Riley Creek Bridge	#0695	MP 237.3	9 - Excellent	9 - Excellent	8 - Very Good	9 - No Deficiencies	n/a	79.0	ND	2015
Nenana River Park Station	#1147	MP 238.0	7 - Good	6 - Satisfactory	5 - Fair	6 - Bank Slumping	n/a	61.4	ND	1970
Kingfisher Creek Bridge	#0697	MP 238.2	5 - Fair	6 - Satisfactory	6 - Satisfactory	8 - Protected	n/a	75.5	ND	1971
Iceworm Gulch Bridge	#1146	MP 240.1	7 - Good	7 - Good	5 - Fair	7 - Minor Repairs Needed	n/a	69.0	ND	1971
Hornet Creek Bridge	#1145	MP 240.3	6 - Satisfactory	7 - Good	5 - Fair	8 - Protected	n/a	69.0	ND	1971
Fox Creek Bridge	#1144	MP 241.2	6 - Satisfactory	7 - Good	6 - Satisfactory	8 - Protected	n/a	80.0	ND	1971
Eagle Creek Culvert	#7111	MP 242.0	n/a	n/a	n/a	8 - Protected	6	39.0	NA	1971
Dragonfly Creek Bridge	#1075	MP 242.3	6 - Satisfactory	7 - Good	6 - Satisfactory	8 - Protected	n/a	80.0	ND	1971
Moody Bridge at Nenana River	#1143	MP 242.9	6 - Satisfactory	6 - Satisfactory	6 - Satisfactory	8 - Protected	n/a	65.7	ND	1970
Bison Gulch Bridge	#1142	MP 243.6	6 - Satisfactory	7 - Good	6 - Satisfactory	7 - Minor Repairs Needed	n/a	71.8	ND	1969
Antler Creek Bridge	#1141	MP 244.6	5 - Fair	7 - Good	6 - Satisfactory	8 - Protected	n/a	70.8	ND	1969
Dry Creek Overflow Bridge	#0852	MP 249.3	6 - Satisfactory	7 - Good	6 - Satisfactory	8 - Protected	n/a	73.0	ND	1965
Dry Creek Bridge	#0851	MP 249.8	6 - Satisfactory	7 - Good	6 - Satisfactory	7 - Minor Repairs Needed	n/a	69.3	ND	1965
Panguingue Creek Bridge	#0313	MP 252.6	7 - Good	6 - Satisfactory	6 - Satisfactory	8 - Protected	n/a	74.0	ND	1965
Slate Creek Culvert	#7113	MP 257.9	n/a	n/a	n/a	8 - Protected	8	39.0	NA	1961

Table 1 - Existing (2018) Conditions Summary of Bridges on the Parks Highway

2.4 Past Construction Projects

A summary of recent construction projects along the Parks Highway that occurred within the study area is shown below in *Table 2*.

Project Name	Project Boundaries	Project ID	Description of Work	Construction Year
Parks Highway MP 163 - 305 Passing Lanes - Stage II	MP 197.7 - 200.1 and MP 213.1 - 215.1	62683	Constructed passing lanes on the Parks Highway from MP 197.7 - 200.1, MP 213.1 - 215.1, MP 289.5 - 291.6, and MP 294.1 - 296.2.	2015/2016
Parks Highway MP 204 Summit Railroad Overcrossing	MP 204	61279	Constructed overpass for highway crossing over the railroad.	2007/2008
Parks Highway MP 206 - 210	MP 206 - 210	60924	Resurface and rehabilitate the Parks Highway.	2005/2006
Parks Highway Enhanced Curve Delineation	MP 215 - 219	62510	Enhanced Curve Delineation - installing curve warning signs.	2015/2016
Parks Highway MP 222 - 223 Gaurdrail	MP 222 - 223	63485	Guardrail installation.	2011
Parks Highway MP 163 - 305 Passing Lanes - Stage III	MP 232.4 - 234.8	63515	Constructed passing lanes on the Parks Highway from MP 232.4 - 234.8.	2015/2016
Parks Highway MP 235 AARC Signal Upgrades	MP 235	58989	AARC Signal Upgrades.	2016/2017
Parks Highway MP 235 Drainage Improvements	MP 235	62176 / 62914	Drainage improvements, replace culvert at MP 235.	2016/2017
Parks Highway MP 237 Riley Creek Bridge Replacement	MP 237	63763	Riley Creek Bridge Replacement.	2016/2017
Parks Highway MP 239 - 252 Rehabilitation	MP 239 - 252	61275	Rehabilitate and resurface the Parks Highway and construct passing lanes.	2014 - 2017
Parks Highway MP 240 Repairs 2013	MP 240	62283	Emergency repairs from high water; embankment and pavement repairs, guardrails, riprap protection stockpile.	2013/2014
Parks Highway MP 252-263 Rehabilitation	MP 252 - 263	63655	Rehabilitate and resurface the Parks Highway and construct passing lanes.	2014/2015
Parks Highway Signing and Striping - Project A	MP 174 - 205 and MP 254.4 - 323.7	64259	Signing and Striping.	2016/2017

Table 2 - Recent Construction Projects within the PEL Study Corridor

2.5 Current Design Projects

Existing within the study area, there are a number of DOT sponsored projects that are currently in planning or design. These projects are identified and described in greater detail in *Table 3.* When the final Parks Highway PEL study has been completed, it will help provide a solid foundation for nominating future transportation improvements within the corridor for funding. Once solutions that address the areas of greatest concern have been identified and evaluated, numerous future projects are likely to emerge.

Project Name	Parks Highway Mileposts	Project Scope	Construction Year	Notes
Healy Spur Road	Accessed from near MP 248.8	Rehabilitate Healy Spur Road in Healy. Work includes widening to add shoulders and improving drainage.	After 2023	Improvements to Healy Spur Road include widening the road to add shoulders for pedestrian access, as well as improving drainage along the roadway. Construction is currently not anticipated until 2025 or 2026.
Bison Gulch Parking Area & Trail Enhancement	MP 245	Reconstruction of the parking area onto the west side of the Parks Highway near Milepost 245. Work includes Drainage Improvements and Roadside Hardware.	2021 or 2022	The current location of the parking lot is across the Parks Highway from the Bison Gulch Trailhead.
Parks Highway MP 231 Enhancements	MP 229.7 to 232.3	Improvements will include updates to the Denali wayside, acceleration lanes near McKinley Village heading towards Anchorage, and passive on bridge pedestrian detection for approaching vehicles.	2022	Improvements to this section of roadway will include updates to the Denali wayside near the Triple Lakes and Oxbow Loop Trailheads, constructing acceleration lanes near McKinley Village heading towards Anchorage, and passive on bridge pedestrian detection for approaching vehicles.
Parks Highway MP 208 - 210 Reconstruction	MP 208 to 210	Reconstruct this section of the Parks Highway.	After 2023	There is currently a significant amount of damage to the existing roadway that has been caused by frost heaves in the area, creating pavement issues along with an uneven roadway surface. The purpose of the project is to reconstruct this section of the Parks Highway to repair this significantly damaged section of roadway.

Table 3 - Current DOT Projects within the PEL Study Corridor

3.0 Existing Conditions Analysis

For the existing conditions analysis, maintenance concerns with the current existing conditions are identified along the Parks Highway within the study area. These concerns have been outlined and described from south to north, starting at MP 203 and continuing north through MP 259. This will provide a look at the maintenance issues and areas of concern as they would appear when traveling the highway. The order of these locations does not reflect the severity of the issues, which will be discussed later in the memo. Concerns that were identified by M&O crews using the Survey123 application discussed previously in *Section 1.3* each have a minimum of one picture of the existing conditions accompanying them. The concerns that have been identified along the corridor are outlined in detail in *Table 4*.

While there are a considerable amount of maintenance concerns identified by M&O crews within the study area, it is important to consider other factors when analyzing the existing conditions. There exists several additional areas of concern that are significant enough to examine and review further when evaluating the existing conditions of the corridor. Many of these concerns with the existing conditions of the Parks Highway were identified and documented during a site visit meeting in 2019 over September 24th and 25th. More in-depth discussions of many of these additional concerns will be included in the *Traffic and Safety Memo*.

Parks Highway MP	Maintenance Station	Type of Concern	Figure Number(s)	Location Number	Notes
MP 208 - 210	Cantwell M&O Station	Roadway Damage	n/a	1	Huge frost heaves, needs to be reconstructed.
MP 210	Cantwell M&O Station	Turning Lanes / Pedestrian	n/a	2	Requests have been received for turning lanes at Parks Highway and Denali Highway intersection as well as additional pedestrian accommodations in Cantwell, due to inadequate access.
MP 224	Cantwell M&O Station	Carlo Creek	n/a	3	See Traffic & Safety Memo.
MP 228.5	Cantwell M&O Station	Roadway Sinking	*Figure 5*	4	The road in this location settles every year, causing the highway to sink lower into the surrounding terrain. This results in the need for yearly maintenance to be completed to minimize this damage to the active roadway.
MP 231	Healy M&O Station	McKinley Village	n/a	5	See Traffic & Safety Memo.
MP 232.5	Healy M&O Station	Pavement / Roadway Integrity	*Figure 6* and *Figure 7*	6	This section of roadway has uneven settling, which has caused an annually returning issue for maintenance crews. According to Richard Lee, an M&O foreman for the Denali district, this location was drilled and there was an ice lens present here around 32 feet down.
MP 232.7	Healy M&O Station	Pavement / Roadway Integrity	*Figure 8*	7	This location requires annual maintenance to be complete in order to address issues with uneven settling and heaving.
MP 235	Healy M&O Station	Railroad Crossing	*Figure 9, Figure 10,* and *Figure 11*	8	One concern with this crossing is that it is always causing damage to the snow removal equipment used by M&O to clear the highway. This railroad crossing also requires a large amount of maintenance annually, with crews repairing the crossing at least once a year if not more frequently. There are reoccurring maintenance issues with the pavement and the roadway integrity at this railroad crossing as well.
MP 235 - 236	Healy M&O Station	Drainage Issues / Road Shoulders	*Figure 12, Figure 13,* and *Figure 14*	9	Drainage issues along this stretch cover a pretty significant area, spanning over ¾ of a mile in both directions from MP 235.5. The condition of the pavement in this area is reported to be way below an acceptable level, likely as a partial result of these drainage issues. This stretch of roadway requires annual maintenance work to be completed. There are also concerns regarding the road shoulder, which is said to be next to non-existent in some places.
MP 236.5	Healy M&O Station	Railroad Crossing	n/a	10	Overpass crosses highway, limits loads.

Parks Highway MP	Maintenance Station	Type of Concern	Figure Number(s)	Location Number	Notes
MP 239	Healy M&O Station	Inadequate Summer Parking	*Figure 15*	11	The Nenana Canyon Businesses corridor is another location that M&O crews have identified as a problematic area. During the summer months when tourism is around its peak, parking in this area can often fill up and overflow into the Parks Highway shoulders.
MP 239 - 240	Healy M&O Station	Active Rock Slides / Drainage	*Figure 16, Figure 17,* and *Figure 18*	12	This area is prone to active rock slides, which are a concern for M&O crews as well as the general public. When these slides occur, larger rocks can be moving with enough force to make it past protective barriers and onto the active roadway. Scott Randby, the M&O superintendent for the Denali district, said that crews will begin working in this area in the early morning hours while rocks are still frozen in place. This is to minimize the risk of getting hit by a slide directly or smashing maintenance equipment. Drainage issues are a continual problem behind jersey barriers, with annual debris slides that will often block the culverts. These jersey barriers that were installed after the last project through Nenana Canyon cause additional maintenance problems. With the current setup, M&O crews do not have adequate access around the barriers to use their normal equipment to clean all the debris from the ditches. Instead, they have to rent an excavator to do it, which results in additional maintenance costs.
MP 242	Healy M&O Station	Roadway Sinking	*Figure 19 (left)*	13	This location has been identified to have issues with the roadway settling annually. This causes the highway to develop an uneven surface and sections of heaving, resulting in annual maintenance concerns.
MP 243.5	Healy M&O Station	Roadway Sinking	*Figure 19 (right)*	14	This location has been identified to have issues with the roadway settling annually. This causes the highway to develop an uneven surface and sections of heaving, resulting in annual maintenance concerns.
MP 248	Healy M&O Station	Pedestrian Safety / Connectivity	n/a	15	Pedestrian concerns in the community of Healy.
MP 251	Healy M&O Station	Turning Lanes	n/a	16	Requests have been received for turning lanes at intersection of Parks Highway with Stampede Road and Lignite Road.
MP 253	Healy M&O Station	Drainage Issues	*Figure 20*	17	Slightly to the north of MP 253, drainage issues are causing damage to the base of the road. The effect of these drainage issues on the road base are causing part of the road to begin collapsing, creating a bit of a sink hole or severe dip in the road surface.

Parks Highway MP	Maintenance Station	Type of Concern	Figure Number(s)	Location Number	Notes
MP 256.5	Healy M&O Station	Pavement / Drainage	*Figure 21*	18	Maintenance crews have identified a section of roadway around MP 256.5 where the shoulder of road is failing due to damage resulting from issues with drainage. There are a large amount of longitudinal cracks forming along the road shoulder as well as along the active roadway. It has been reported that the road shoulder is beginning to fall off due to these issues.
MP 258.5	Healy M&O Station	Drainage Issues	*Figure 22*	19	These drainage issues are a problem affecting the base of the roadway near MP 258.5 of the Parks Highway. It is likely that these drainage problems will continue to cause structural damage to the roadway until the problems are addressed.

Table 4 - Summary of Identified Concerns from M&O Crews and Site Visit

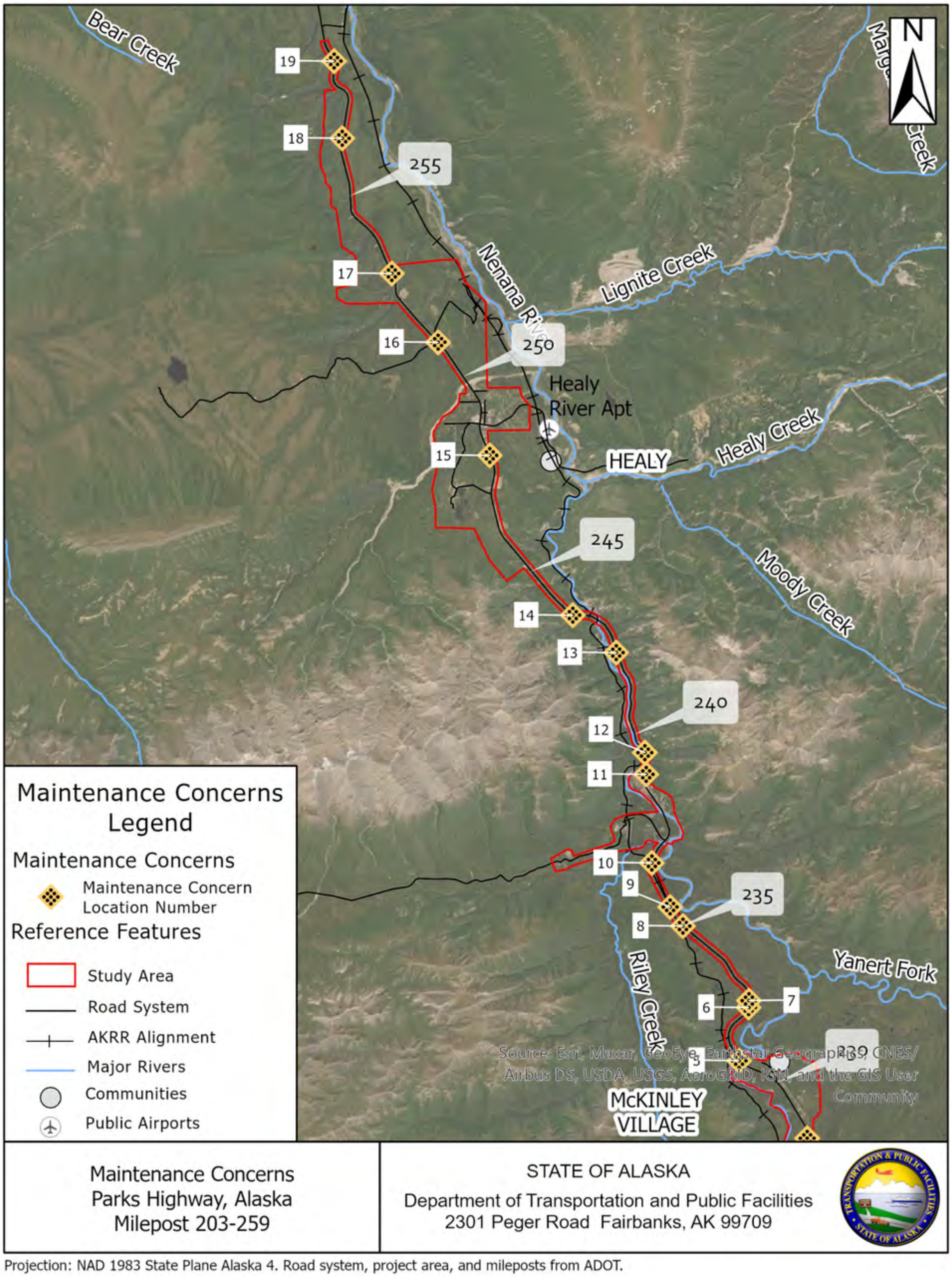
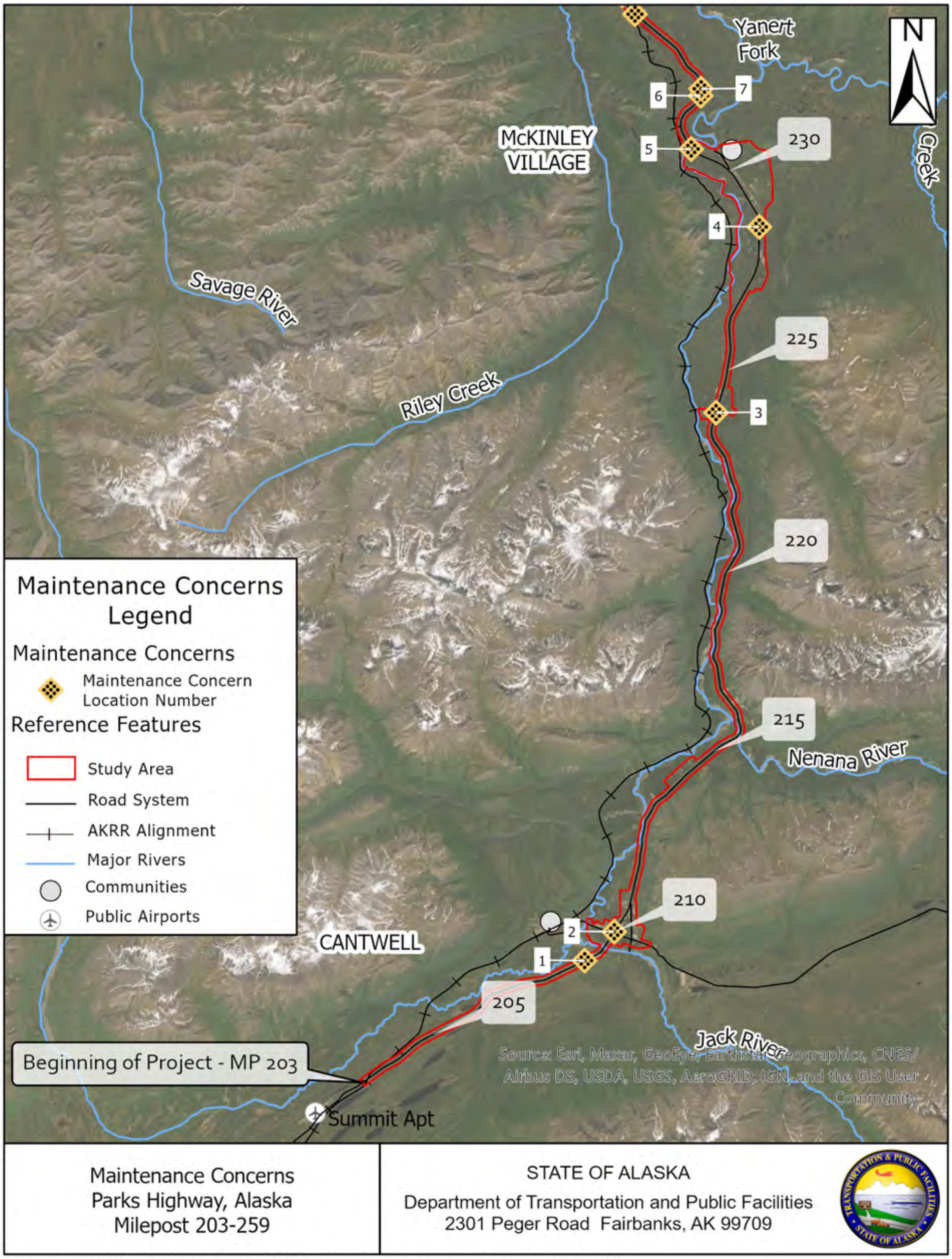


Figure 3 - Map of Identified Maintenance Concerns within the Northern half of the Corridor



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.

Figure 4 - Map of Identified Maintenance Concerns within the Southern half of the Corridor

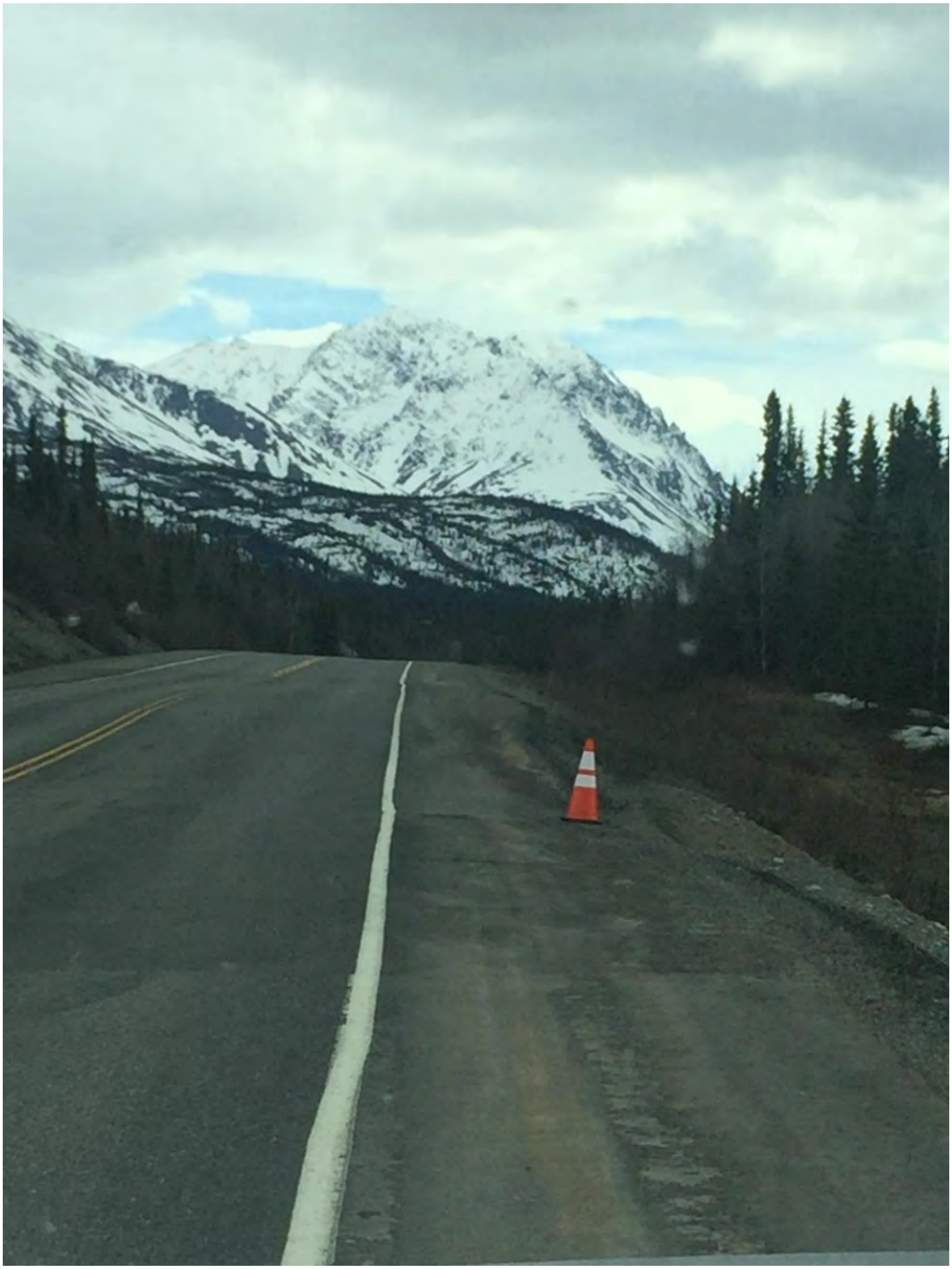


Figure 5 – Section near MP 228.5, where the road is settling

Figure 6 – Annually reoccurring bumps around MP 232.5, likely caused by an ice lens

Figure 7 - Additional photo of bumpy section near MP 232.5

Figure 8 - Annual maintenance for pavement and roadway integrity issues near MP 232.7

Figure 9 – Problematic Railroad Crossing at MP 235 of the Parks Highway

Figure 10 - Surface patches along railroad crossing

Figure 11 - Additional photo of roadway damage at railroad crossing

Figure 12 – Drainage issues and damaged pavement around MP 235.5

Figure 13 – Section of highway that requires annual repairs around MP 235.5

Figure 14 – Additional photo of section requiring annual maintenance due to drainage issues

Figure 15 – Northern side of Nenana Canyon Businesses, summer parking concerns

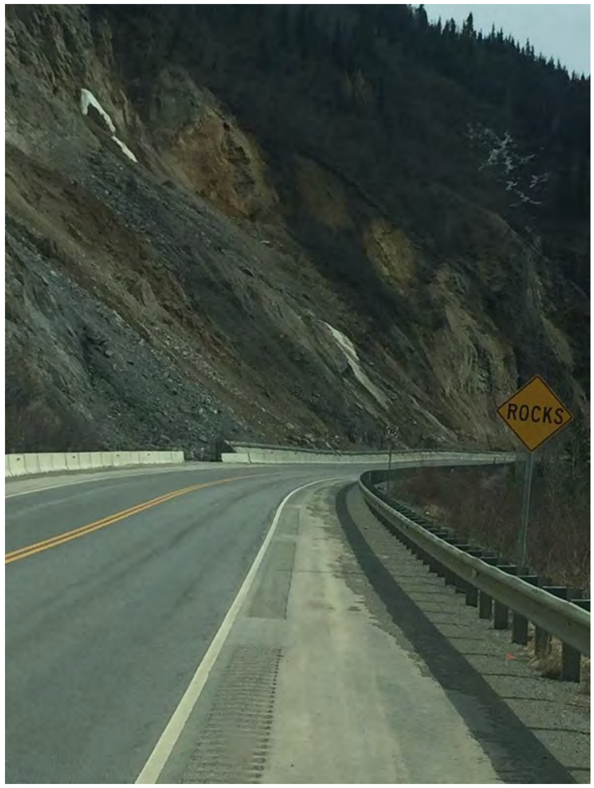


Figure 16 – Entering Nenana Canyon from the North

Figure 17 – Larger rockslide that has traveled onto the Parks Highway in Nenana Canyon

Figure 18 – Drainage issues from slide debris behind the jersey barriers

Figure 19 – Sinking roadway around MP 242 (left) and MP 243.5 (right) of the Parks Highway

Figure 20 – Damage to road caused by drainage issues north of MP 253

Figure 21 - Road shoulder failing due to drainage issues around MP 256.5

Figure 22 – Drainage issues effecting the road base near MP 258.5

4.0 Maintenance Costs and Future Needs

One major cost to M&O crews along the Parks Highway is patching the surface of damaged sections of roadway. These patches were applied using primarily hot mix asphalt (HMA) paving. Between 2012 and 2019, maintenance on these surface patches cost DOT&PF over 1 million dollars over these seven years, with an approximate final cost of $1,307,248.85. This approximate cost was obtained from back-calculating previously completed work along the Parks Highway. This value is not too far from the average costs for a typical highway, but is very high when compared to other sections of the Parks Highway. The need for surface patches on Alaskan roads is inevitable, but it may be possible to reduce the future maintenance costs with improvements to the Parks Highway.

There are some sections that had significantly higher costs than the surrounding areas during certain years. For example, the segment from MP 200 through 210 had an approximate total cost of over $250,000 in 2012. The reason for this significantly high cost is because M&O did a major overlay of this section of roadway, rather than just spot patching. A major overlay likely inflated the yearly cost to a degree, but overall reduced the need for work needed for this section in future years. This section also is known to have issues related to major frost heaves, and a construction project to reconstruct a section of the Parks Highway is currently in the works and described in more detail previously in *Table 3*. A summary for the approximate total costs of this maintenance work for each 10-mile increment of the highway is outlined in *Table 5* and broken down graphically by year in *Figure 23.*

Parks Highway Segment	**Approximate Total Cost**	**Notes**
MP 200 - MP 210	$ 431,192.00	Over $250,000 in 2012 alone.
MP 210 - MP 220	$ 163,544.30	
MP 220 - MP 230	$ 254,192.20	Nearly $120,000 in 2017 alone.
MP 230 - MP 240	$ 247,026.00	
MP 240 - MP 250	$ 115,536.00	Nearly $100,000 in 2013 alone.
MP 250 - MP 260	$ 95,758.35	

Table 5 - Summary of Identified Concerns from M&O Crews and Site Visit

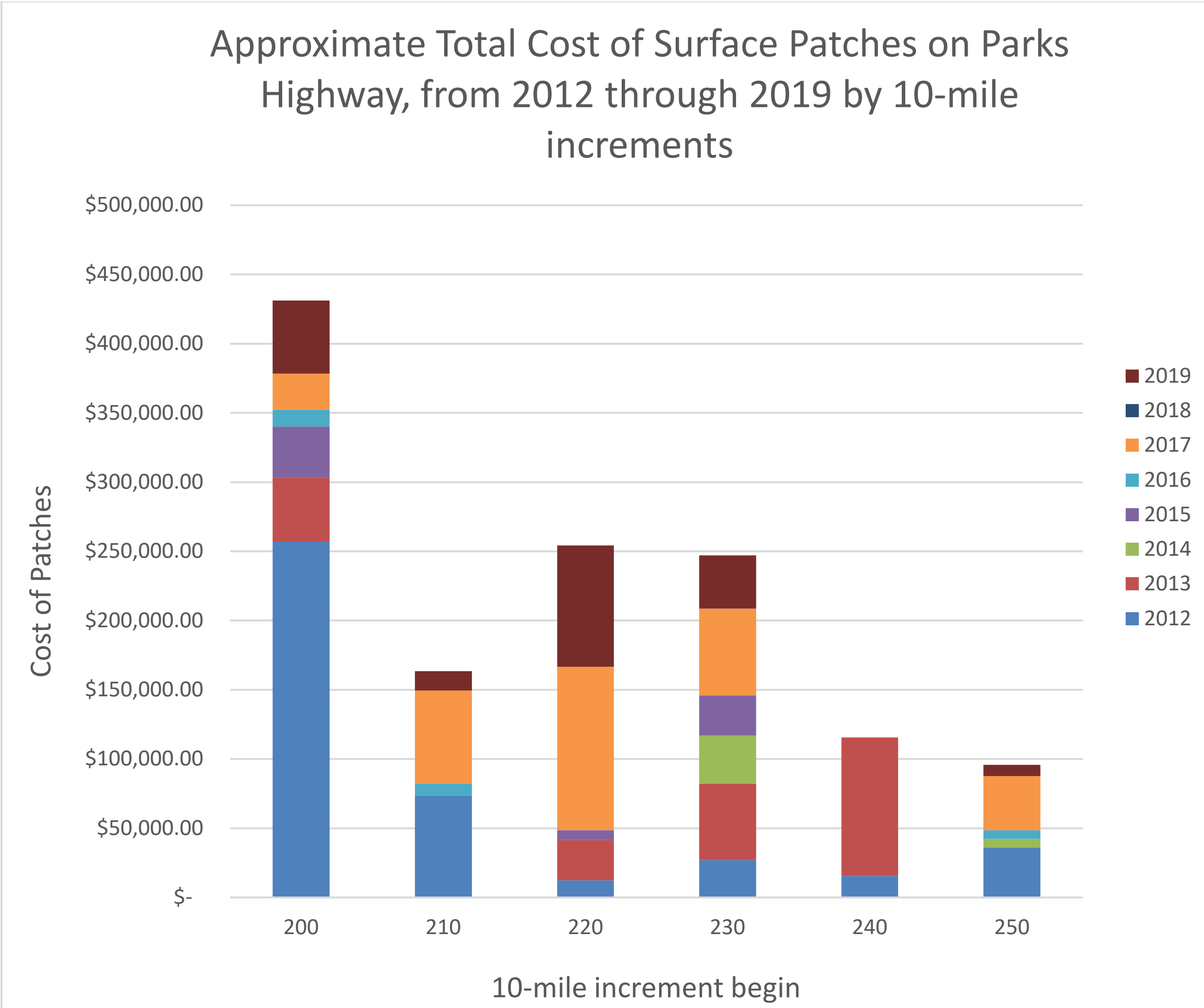


Figure 23 – Total Cost of Surface Patches from 2012 to 2019

Another location that has required a significant amount of past maintenance on the Parks Highway is at around MP 240. In 2013, a construction project for these repairs titled *Parks Highway MP 240 Repairs 2013* was completed to make emergency repairs to this section. These repairs were necessary due to high water scour along the riverbank of the Nenana River that runs alongside the roadway. The work included repairs to the roadway embankment and pavement, guardrail repairs, and riprap bank protection and stockpiling to prevent similar damage from occurring again. By the end of the project, the total cost of completing these emergency repairs was over $700,000.

5.0 Conclusion, Summary, and Recommendations

The Parks Highway is a vital route for transportation between Alaska's two largest cities, Fairbanks and Anchorage. The PEL study corridor is an important sections of this route, containing the communities of Cantwell and Healy along with the access road for Denali National Park and Preserve. The input from M&O is very crucial to identifying the problematic areas and concerns along the corridor, since maintenance crews are working year-round to maintain the highway and are familiar with the existing conditions.

The *Maintenance and Operations Needs and Concerns Survey* has greatly contributed to identifying problematic areas along the Parks Highway PEL study corridor. These areas that have been identified either create a potential safety hazard to the traveling public, require significant amounts of maintenance, or have existing conditions that are actively causing damage to the highway. It is inevitable that the roadway will require some level of regular maintenance to keep the Parks Highway in a safe and acceptable condition. Given the current conditions, many of the locations identified by M&O as areas of concern will continue to require future maintenance until the root cause of the problems are addressed.

One section of the Parks Highway that has been highlighted by M&O crews as a continual maintenance issue and safety concern is the corridor that passes through Nenana Canyon, from about MP 239 through MP 240. This section is known to have rocks slides that regularly reach the active roadway, resulting sediment buildup that causes drainage issues, and accessibility issues for resolving these drainage issues. These larger rock slides that reach the roadway are known to cause damage to vehicles traveling through the canyon. With the large number of maintenance concerns identified in the area, this canyon would be a good section to consider when planning for future projects.

Another location that appears to create a significant amount of issues is the at-grade Alaska Railroad crossing at MP 235. This crossing requires a large amount of maintenance and attention from M&O crews, needing repairs at least once a year if not more frequently. It also is known to regularly cause damage to snow removal equipment used by maintenance crews to clear the highway during winter months. Removing this crossing would create the benefit of reduced maintenance costs, both in repairing damaged equipment and the roadway around the crossing itself. Since there has already been a study completed on rerouting both of the railroad crossings in this corridor, it would be good to keep this location in mind when planning for future projects.

Drainage issues seem to be a fairly common problem faced by maintenance crews along the Parks Highway as well. These problems with inadequate drainage will result in continual damage to the foundation of the roadway, shoulders, and the road surface. Areas identified by M&O that are affected by these drainage problems include a section spanning between MP 235 through past MP 236, MP 253, MP 256.5, and MP 258.5. One possible solution may be to install either larger or additional culverts in the areas where drainage issues have been identified. This area and its geological conditions are discussed more thoroughly in the *Baseline Geological and Geotechnical Assessment Memo*. By incorporating drainage improvements at these problematic areas into future projects in the corridor, these maintenance concerns could be easily addressed and resolved.

There are number of locations throughout the 56-mile study corridor with reoccurring issues regarding pavement integrity that have been identified by M&O. There are also several locations that have reoccurring issues with the roadway sinking, resulting in uneven and potentially unsafe conditions. These locations are summarized previously in the *Summary of Maintenance Needs and Concerns* section in *Table 4*. When planning for future projects in PEL corridor, these areas would be good to consider including as well due to the reoccurring nature of these problems.

The purpose of the *Maintenance and Operations Existing Concerns and Needs Report* is primarily to provide information to the PEL study team. The input received from M&O will be used by the study team to help evaluate possible solutions to these identified areas of concern. This information will be used along with the input from a variety of other stakeholders to analyze the needs of all parties, and eventually to develop future improvement projects along the Parks Highway.

Appendix F

Recreational Facilities Memorandum (July 23, 2020)

PARKS HIGHWAY MP 203 – 259
PEL STUDY

Cantwell to Healy
PEL Study
Parks Highway MP 203-259
Planning & Environmental Linkages (PEL) Study

Recreational Facilities Memorandum

Project No. NFHWY00492

July 23, 2020

Table of Contents

List of Tables

List of Figures

Acronyms

ADF&G – Alaska Department of Fish and Game

AKRR – Alaska Railroad

BLM – Bureau of Land Management

CDS – Coordinate Data Set

DNR – Department of Natural Resources

DNP&P – Denali National Park and Preserve

DOT&PF – Department of Transportation and Public Facilities

FHWA – Federal Highway Administration

GMU – Game Management Units

IHS – Interstate Highway System

M&O – Maintenance and Operations

NHS – National Highway System

NPS – National Park Service

PAC – Project Advisory Committee

PEL – Planning and Environmental Linkages

STIP – Statewide Transportation Improvement Program

WFL – Western Federal Lands

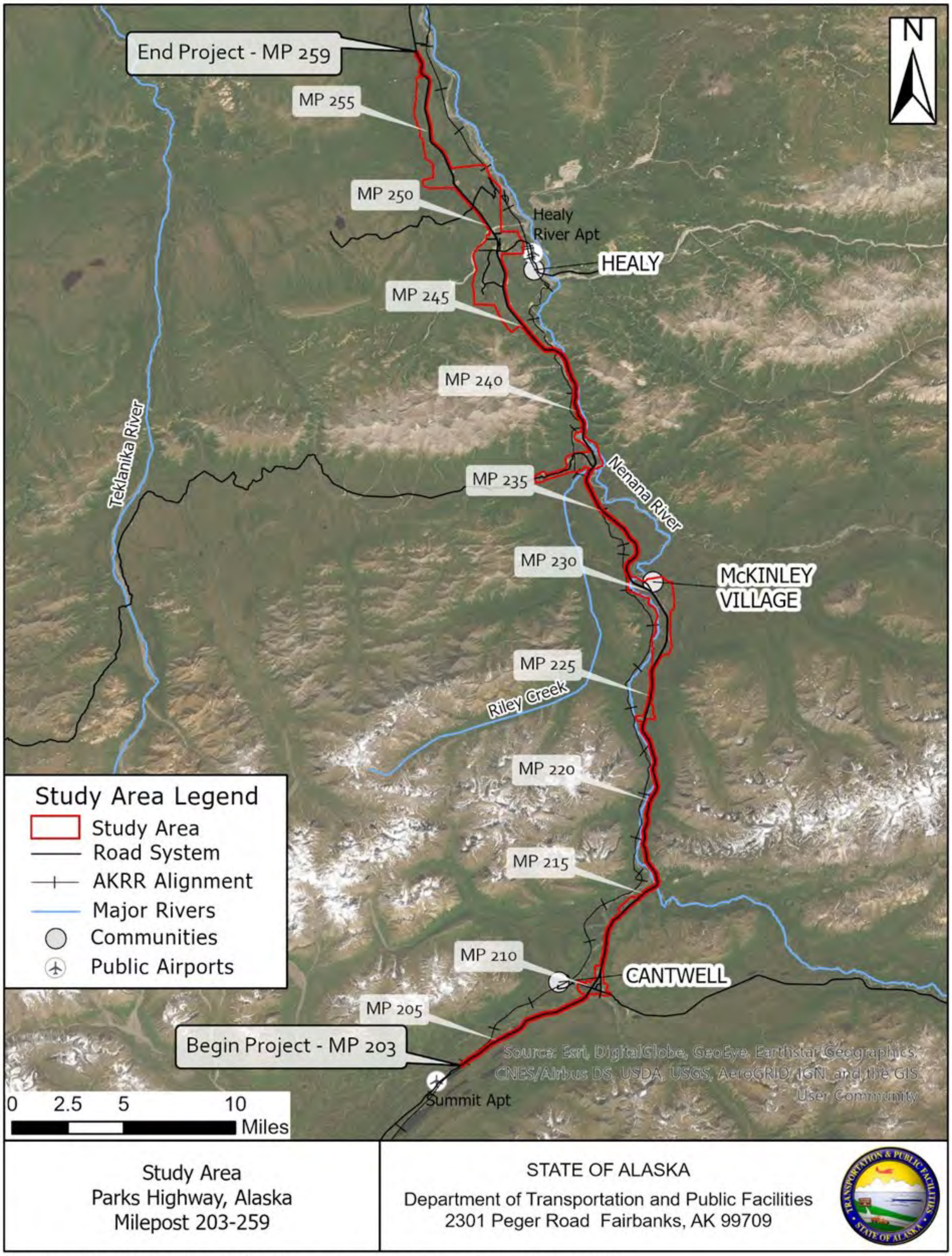
1.0 Introduction

The State of Alaska Department of Transportation and Public Facilities (DOT&PF) Northern Region in partnership with the Federal Highway Administration (FHWA) Western Federal Lands (WFL) and the National Park Service (NPS) is conducting a Planning and Environmental Linkages (PEL) study for the Parks Highway. The PEL study corridor includes the communities of Cantwell and Healy (MP 203 to MP 259) as well as the Parks Highway intersection with the access road for Denali National Park and Preserve. A map of the Parks Highway PEL study corridor boundaries is shown below in *Figure 1*. This study will create a planning document studying the current and future conditions and needs of the Parks Highway as it relates to highway infrastructure, the users, and surrounding communities. The final PEL study results will be used by the project partners to help implement future highway corridor improvement projects. A high priority is placed on the needs and input from stakeholders, partners, and the public when making decisions related to the Parks Highway.

This Recreational Facilities Memorandum will focus primarily on providing an overview of the existing recreational sites along the Parks Highway in the study area. The study area is the Parks Highway corridor from MP 203 to MP 259. The primary topics identified and discussed in this document include:

- Background information on the Parks Highway PEL Study corridor;
- Campgrounds and RV parks accessible from within PEL Study boundaries;
- Hiking and backpacking trailheads located within the study area;
- Boat launches and river access points for the Nenana River;
- Other recreational facilities and access points;
- Recreational facilities within Denali National Park;
- Subsistence hunting and fishing and the significance to local communities; and
- Wilderness Areas and recreational facilities within them.

The document concludes with a discussion of existing future improvement plans within the study area. This information is intended to inform decision makers of the recreational facilities that are located along the Parks Highway that would be useful to consider when planning for future projects within the corridor.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.

Figure 1 – Parks PEL Study Corridor Location.

2.0 Background Information

The Parks Highway (State Coordinate Data Set (CDS) route number 170000) is a part of both the National Highway System (NHS) and the Interstate Highway System (IHS). Originally constructed between the late 1960s and early 1970s, the highway was officially completed in 1971. This highway provides the primary ground route from Fairbanks to Anchorage. Commercial trucks use this route year-round to deliver supplies and freight from Anchorage to Fairbanks and other surrounding communities. There is also a notable amount of cargo transported for the Trans-Alaska Pipeline and North Slope oil and gas fields along this route. During the summer months, traffic along the Parks highway increases significantly due to tourism, especially around Denali National Park and Preserve. The area had also seen an increase in winter recreation and tourism in recent years.

The PEL study area corridor covers a total of 56 miles of the Parks Highway, spanning from just north of Broad Pass and extending to the turnoff to Ferry. It is anticipated that there will be between a 1% to 2% yearly increases in traffic through this area. With the only road access to Denali National Park and Preserve in the middle of the study area at MP 237, this area receives a high volume of commercial traffic such as tour busses and vans, especially during tour season in the summer months. Besides the traffic related to tourism, the Parks Highway provides the primary route for both cargo and personal vehicle travel between Alaska's two largest cities, Fairbanks and Anchorage.

One of the primary goals of a PEL study is to collaborate ideas and have discussions that address the needs and wants of all local and corridor stakeholders. These stakeholders include a variety of groups, including DOT&PF, Federal Highway Administration (FHWA), Western Federal Lands (WFL), Department of Natural Resources (DNR), Denali Borough, Denali National Park and Preserve (DNP&P), environmental groups, Alaska Railroad (AKRR), trucking industry, Native groups, tourism businesses, local business, local communities, and members of the public.

A project advisory committee (PAC) will be established with representatives from all relevant parties, with the intent of providing guidance and input for the duration of the study. Many of the current and future needs for the communities and stakeholders will be identified through collaborative discussions of needs, concerns, and ideas. Once all sides have addressed their concerns, work will begin to decide how to best proceed so that all parties of stakeholders are satisfied with the outcome.

3.0 Recreational Facilities

3.1 Denali National Park and Preserve

Developed recreational facilities in Denali National Park are concentrated along the Denali Park Road, which begins at MP 237.3 of the Parks Highway. In addition to the campgrounds and trails described in *Section 3.2* and *Section 3.3* of this document, the park offers recreational facilities such as day use areas, visitor centers, and options for enjoying the Park Road itself.

During summer months, the Denali Park Road is accessible to private vehicle traffic as far west as the Savage River, approximately 15 miles west of the park entrance. West of the Savage River, private vehicle traffic is restricted and visitors use the concessioner-operated tour and transit buses. These buses provide wildlife viewing opportunities as well as access to camping, hiking, and other recreational opportunities in the park. Although summer vehicle access is restricted to buses west of the Savage River, visitors can hike or bike along any segment of the Denali Park Road.

Rest stops and day use areas along the Park Road provide restrooms, scenic views, informational signs, and some offer picnic facilities. The Riley Creek day use area is near the park entrance, and is a picnic area and trailhead for entrance area trails. The Mountain Vista and Savage River areas, between mile 12 and 15 of the Denali Park Road, are accessible to private vehicles and provide trailhead access, restrooms, and picnic facilities. Other rest areas must be accessed via the park bus system, and primarily provide restroom facilities. These rest areas include Primrose (mile 16), Teklanika (mile 30), and Toklat (mile 53).

There are two visitor centers inside park boundaries. The Denali Visitor Center is on the Denali Park Road in the entrance area and the Eielson Visitor Center is at mile 66 of the Denali Park Road. Both visitor centers offer educational displays, access to trails, and are staffed with NPS personnel who provide information and interpretive programs. Backcountry permits are available at the Denali Visitor Center for overnight use of backcountry areas of the park.

These recreational facilities provide access to and support for the limitless recreational opportunities in the park that do not require other infrastructure. These opportunities include off-trail hiking and backpacking, paddlesports, and mountaineering.

3.2 Campgrounds

Camping is a very popular recreational activity that attracts a large number of visitors annually for both tent and RV camping experiences. Located along the 56-mile PEL study corridor of the Parks Highway, there are a total of 13 campgrounds and RV parks. About a third of these camping facilities are on the Parks Highway itself, with 4 locations directly off the highway and the remaining 9 located off of smaller access roads. Of these 9 campgrounds, 6 are located within the boundaries of Denali National Park and are accessed using the Park Road. These campgrounds and RV Parks are listed from south to north, and are summarized in *Table 1*.

Campground Name	Parks MP	Location	Ownership	Campsites	Fire Pits	Picnic Tables	Restroom Facilities	Disability Accessible	Electric	Water	Water Hookups	Showers	Laundry	Dump Station	Wi-Fi	Nearby Recreational Activities
Cantwell RV Park	209.9	Cantwell Station Road - 0.3 miles	Private	70	X		X	X	X	X	X	X	X	X	X	Hiking trails, berry picking, and wildlife viewing
Brushkana Creek Campground	209.9	Denali Highway - about 30 miles	BLM	22	X	X	X			X						Hiking trails, fishing, sheltered picnic area, and scenic views
Denali Grizzly Bear Resort and Campground	231.1	Parks Highway	Private	100	X	X	X		X	X	X	X	X	X	30 minutes free	Close to Denali National Park, hiking trails, river rafting, and other tours
Riley Creek RV and Campground	237.3	Denali Park Road - 0.1 miles	DNP&P	142	X	X	X	X		X				X		Several trailheads are nearby, accessible by private vehicles.
Savage River RV and Campground	237.3	Denali Park Road - 13 miles	DNP&P	32	X	X	X	X		X						Several trailheads are nearby, accessible by private vehicles.
Sanctuary Campground	237.3	Denali Park Road - 22 miles	DNP&P	7			X									Covered picnic area, Sanctuary River banks, and off-trail hiking.
Teklanika RV and Campground	237.3	Denali Park Road - 29 miles	DNP&P	53	X	X	X	X		X						Minimum stay of 3 nights for private vehicles.
Igloo Campground	237.3	Denali Park Road - 35 miles	DNP&P	7		X	X									Covered picnic area and off-trail hiking nearby.
Wonder Lake Campground	237.3	Denali Park Road - 85 miles	DNP&P	28		X	X	Semi-accessible		X						Covered picnic shelters, access to Wonder Lake, on-trail and off-trail hiking opportunities.
Denali Rainbow Village RV Park and Motel	238.6	Parks Highway	Private	55	X	X	X		X	X	X		X	X	X	Located within the Nenana Canyon Businesses, with a variety of nearby recreational opportunities.
Denali RV Park and Motel	245.1	Parks Highway	Private	82			X		X	X	X	X	X		X	Outdoor cooking areas, numerous hiking trails, and scenic views.
Midnight Sun RV Park and Campground	248.5	Parks Highway	Private	50 +	X	X	X		X	X	X	X	X		X	Convenience store and automotive repair shop on location, and 49th State Brewery 100 yards away.
Waugaman Village RV Park	248.8	Healy Spur Road - 3.8 miles	Private	18			X		X	X	X	X	X	X		Hiking, boating, fishing, wildlife viewing, zip line tours, and wildlife viewing.

Table 1 - Summary of Campgrounds and RV Parks along Parks Highway PEL corridor

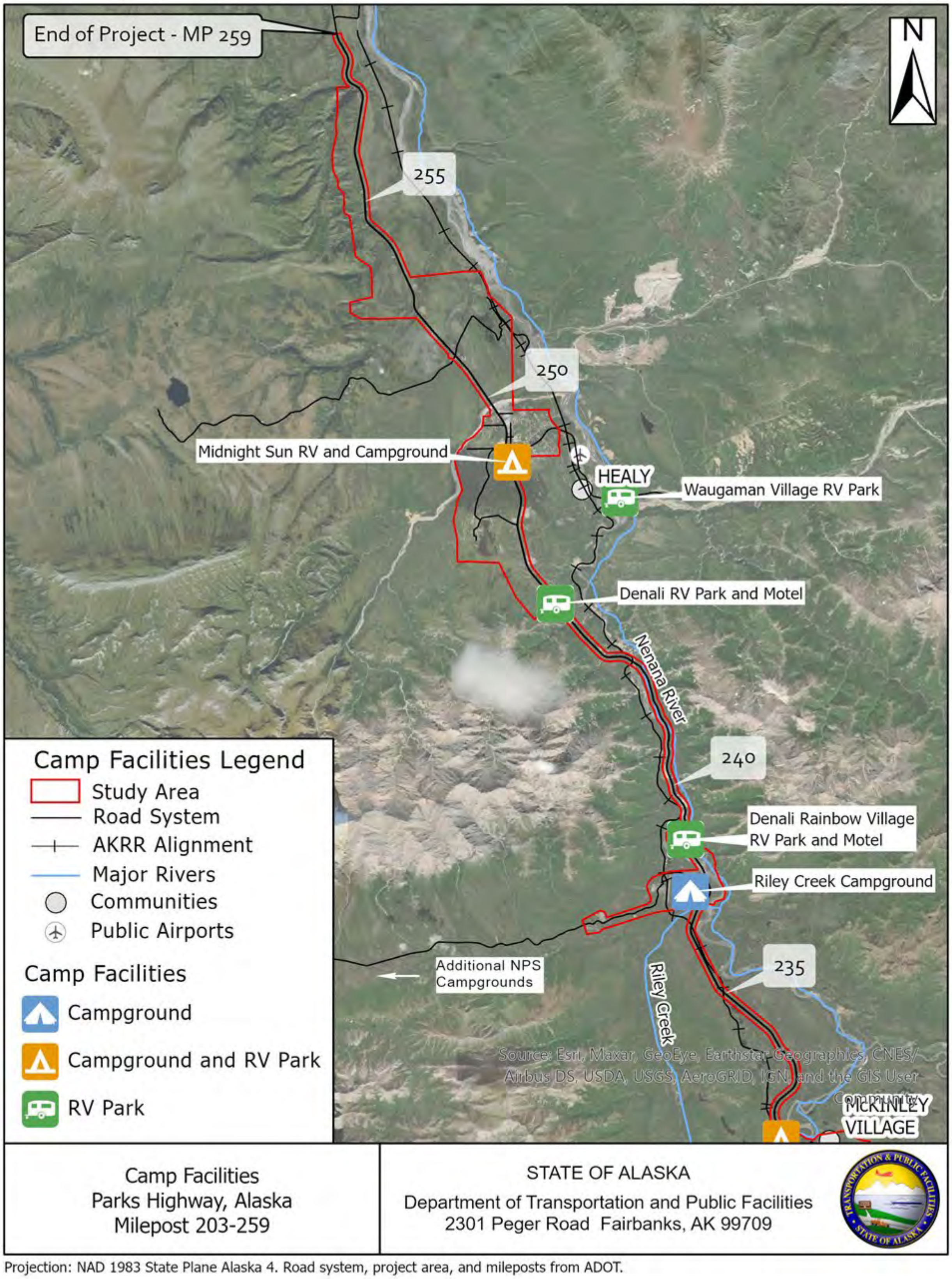


Figure 2 – Campgrounds and RV Parks in the Northern half of the PEL study Corridor.

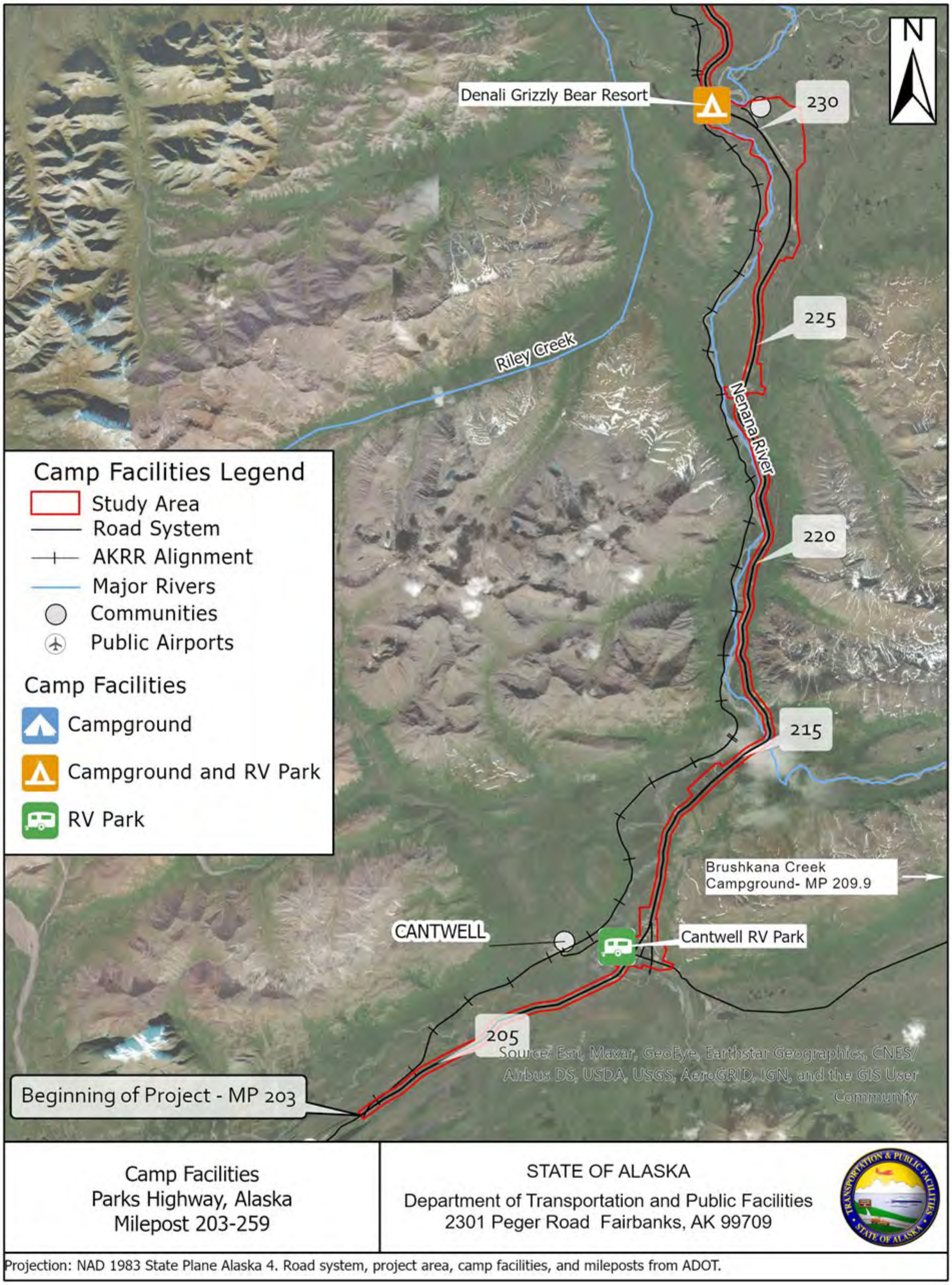


Figure 3 – Campgrounds and RV Parks in the Southern half of the PEL study Corridor.

3.3 Trailheads

One of the most popular and abundant recreational activities along the Parks Highway is hiking, both on maintained and unmaintained hiking trails. The study team identified 31 hiking trails within the PEL study corridor. Of these hiking trails, 7 are along the Parks Highway directly while the remaining 24 are on smaller access roads that intersect with the highway. Backcountry and off-trail hiking is also a popular activity in designated areas that are not explicitly covered in this summary of more structured trails. The hiking locations that have been identified are outlined starting from the south end of the corridor at MP 203 of the Parks Highway and heading north through MP 259.

<u>Wolf Point Trailhead</u>: (Accessed from near MP 209.9)

Wolf Point Trail is an unmaintained trail located roughly 5 miles down the Denali Highway, which intersects with the Parks Highway in Cantwell at MP 209.9. This off road vehicle trail is approximately 2.9 miles point to point, for a round trip of about 5.8 miles. With slightly over 1000 feet of elevation gain, Wolf Point Trail has been rated as a moderate hike. The trail is estimated to take about two hours each way, and features a river along with scenic views. The Bureau of Land Management (BLM) has also called this trail Jack Creek Trail.

<u>Windy Creek Trailhead</u>: (Accessed from near MP 210)

The Windy Creek Trail has been rated as a relatively easy hike, with about 400 feet of elevation gain total. This unmaintained trail is approximately a 2.5 mile hike in each direction, making for a round trip of a little over 5 miles. Backcountry camping and backpacking is allowed in the area of Denali National Park accessed by this trail with a backcountry permit from the backcountry desk, located in the Denali National Park entrance area.

The Windy Creek Trail crosses private land and is not maintained within Denali National Park. This a 17 (B) easement trail which provides access to State of Alaska and BLM managed lands. The easement is 25 feet in width and users must stay within the easement until reaching public lands, approximately two miles in from the start of the trailhead. The best way to reach Windy Creek is by following a marked public easement trail that starts near the Northwest corner of Cantwell. Cantwell is located a little over 25 miles south of the entrance to Denali National Park, at around MP 210 of the Parks Highway.

Carlo Creek Trailhead: (Located at MP 224.5)

The Carlo Creek Trail is an unmaintained trail that follows alongside Carlo Creek and crosses private lands within a 17 (B) easement to provide access to public lands. The easement is 25 feet wide and trail users must stay within the easement until reaching public lands, which are approximately 1.5 miles from the start of the trailhead. The Carlo Creek trail provides access to scenic views of the surrounding valley and is located at MP 224.5 of the Parks Highway.

Slime Creek Trailhead: (Located around MP 223)

The Slime Creek Trail is an unmaintained trail that follows alongside Slime Creek, which runs through the State of Alaska Yanert controlled use area. This trailhead is located on the east side of the Parks Highway near MP 223, approximately 24.3 miles south of Healy. This trail is a lesser known local trail, so there is little information available on the length of this informal hiking trail.

Yanert River Trailhead: (Located at MP 222.2)

Located at approximately MP 222.2 of the Parks Highway, there exists another unmaintained trailhead with access the Yanert Valley via the “Horse Trail”. This trail is accessed from a double ended pullout with a large parking area for horse trailer parking that is located the on east side of the highway. This is a popular horse trail and is located within the State of Alaska Yanert Controlled Use Area, and is sometimes referred to as “Pyramid Mountain Trailhead” as well since this mountain sits in the center of the valley. This 17 (B) easement trail is 25 feet wide and crosses across private land to provide recreational access to public use lands. All trail users must stay within the easement until reaching public lands, which are approximately 2 miles from the start of the trailhead.

Triple Lakes Trailhead: (Located at MP 231.4)

The Triple Lakes Trail is the longest hiking trail in Denali National Park, with a total round trip distance of 18.5 miles and slightly more than 9 miles for one direction. This trail is moderately trafficked and has been rated as difficult, considering an elevation gain of over 1000 feet with the high point in the middle of the trail. Estimated travel time for this trail is between 4 to 5 hours each way. This trail has two points of access, with the Northern access point located inside Denali National Park close to the Denali Visitor Center. Parking for access to the Southern trailhead is located at MP 231.4 of the Parks Highway near McKinley Village. There are currently plans to improve and expand this parking area for the Triple Lakes Trail, which is expected to begin in the 2022 construction year.

Trailheads within Denali National Park: (Accessed from near MP 237.3)

According to the National Park Service (NPS) website, there are a total of 21 official trails that are located within Denali National Park. Of these trails, 17 are easily accessible by private vehicles within the front country area of the park. Hiking off trail is also a popular recreational activity for many park visitors, and is encouraged following Leave No Trace principles by the NPS. Most of these trails can be accessed from the Denali Park Road, which begins at MP 237.3 of the Parks Highway. More detailed information on the accessibility of Denali Park Road is available in *Section 3.1*. A map showing the hiking trails that are located near the park entrance has been provided by the NPS and is shown in *Figure 4.*

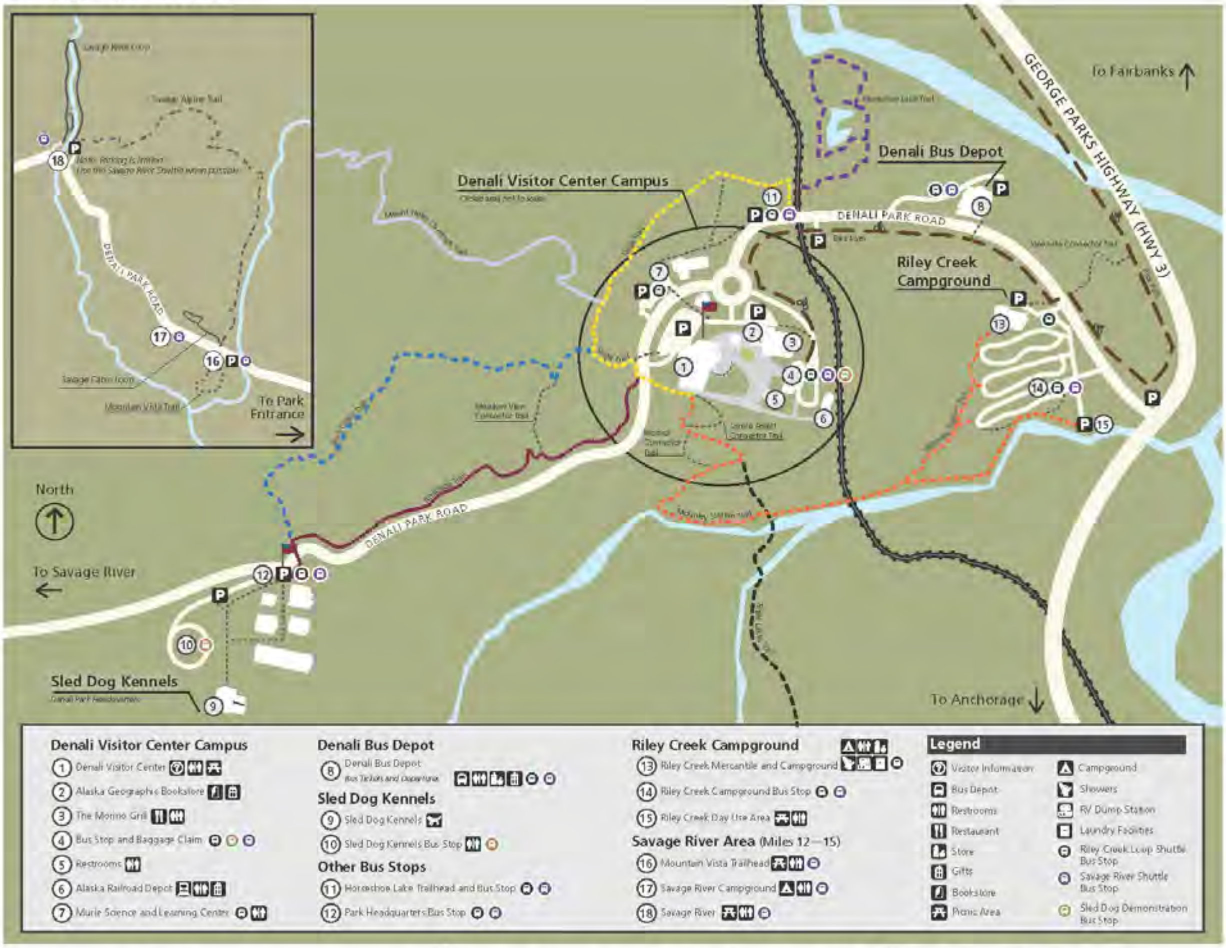
- Bike Path: Travels along the Denali Park Road between the entrance and the visitor center, about 1.7 miles each way.
- Horseshoe Lake Trail: Popular trail that travels entirely around Horseshoe Lake, 2 mile round trip with an estimated travel time of 2 hours.
- Jonesville Trail: Shortcut from Riley Creek Campground to Nenana Canyon Businesses, approximately 0.3 miles each way.
- McKinley Station Trail: Travels from the visitor center to the train station and passes under the Alaska Railroad trestle, approximately 1.6 miles each way.
- Meadow View Trail: Short and narrow trail that connects Rock Creek Trail with Roadside Trail, about 0.3 miles each way.
- Morino Trail: Short trail through spruce forest, about 0.2 miles each way.
- Mount Healy Overlook Trail: A steep trail located off of the Taiga Trail that goes part way up Mt. Healy, about 2.7 miles each way to the overlook.
- Oxbow Loop Trail: Follows along near the Nenana River and eventually drops down to a gravel bar, approximately a 1.5 mile round trip. Accessed from MP 231.4 of the Parks Highway.
- Parks Highway Bike Trail: Paved path that follows along the Parks Highway between roughly MP 237 and MP 238, about 1 mile each way.
- Roadside Trail: Travels from the visitor center to park headquarters and sled dog kennels, roughly 1.8 miles each way.
- Rock Creek Trail: Similar route to Roadside Trail through the forest, much quieter and about 2.4 miles each way.
- Spruce Forest Trail: A short trail through spruce forest, 0.2 miles each way and approximately 20 minutes for a round trip.
- Taiga Trail: Short forested trail that connects the visitor center with Horseshoe Lake, about 0.9 miles each way.
- Triple Lakes Trail: Longest trail at Denali National Park, about 9.5 miles each way and connects to Southern parking area about 7 miles from the park entrance.
- Mountain Vista Trail: Located about 13 miles into the park, this short loop is a 0.6 mile round trip that takes around 30 minutes.

- Savage Alpine Trail: Strenuous trail that connects between Savage River and Mountain Vista areas, approximately 4 miles each way.
- Savage River Loop: Located at Mile 15 of the Denali Park Road, this 2 mile loop takes around 90 minutes to complete.
- Tundra Loop: Accessible from the Eielson Visitor Center at Mile 66 of the Denali Park Road, this loop is a 0.3 mile round trip through the alpine tundra.
- Thorofare Ridge Trail: From the Eielson Visitor Center, this trail takes switchbacks up the ridge for a scenic view, and is about 0.8 miles each way.
- Gorge Creek Trail: Descends about 600 feet and provides access to off trail hiking and backcountry camping, and is roughly a 2 mile round trip.
- McKinley River Bar Trail: Located close to Wonder Lake Campground, this trail leads to the McKinley River and is about 2.4 miles each way.

Denali National Park and Preserve

National Park Service
U.S. Department of the Interior

Featured Trails



Frontcountry Trails

Trail	Difficulty	Elevation	Distance*
Horseshoe Lake Trail	Moderate	250 ft (*76 m*)	3.2 miles (*5.1 km*) Round-trip
Mt. Healy Overlook Trail	Strenuous	1,700 ft (*518 m*)	2.7 miles (*4.3 km*) One-way
Taiga Trail	Moderate	75 ft (*23 m*)	~1 mile (*1.5 km*) One-way
McKinley Station Trail	Moderate	100 ft (*30 m*)	1.6 miles (*2.6 km*) One-way
Rock Creek Trail	Moderate	400 ft (*122 m*)	2.4 miles (*3.8 km*) One-way
Roadside Trail	Moderate	350 ft (*106 m*)	1.8 miles (*2.9 km*) One-way
Bike Path	Easy	150 ft (*45 m*)	1.7 miles (*2.7 km*) One-way
Triple Lakes Trail	Strenuous	1,000 ft (*305 m*)	9.5 miles (*15.3 km*) One-way
Spruce Forest Trail	Easy	Negligible	0.15 miles (*.24 km*) Round-trip

**Distances are measured from the Denali Visitor Center*

Savage River Area Trails (Miles 12—15)

Trail	Difficulty	Elevation	Distance
Savage Alpine Trail	Strenuous	1,500 ft (*457m*)	4 miles (*6.4 km*) One-way
Mountain Vista Trail	Easy	50 ft (*15m*)	0.6 miles (*1 km*) Round-trip
Savage Cabin Loop	Easy	50 ft (*15 m*)	0.8 mile (*1.3 km*) Round-trip
Savage River Loop	Moderate	Negligible	2 miles (*3.2 km*) Round-trip

To reach the Savage River area, drive your own vehicle or use the free Savage River Shuttle—see **go.nps.gov/DenaliCourtesy** *for schedules and dates of operation.*

Please note, access to Savage River is variable in spring and fall, depending on snow conditions.

Hikers should be prepared for encounters with moose, bears, or wolves.

- *Carry bear spray and know how to use it.*
- *Be prepared to run from moose, but never run from a wolf or bear.*
- *Stay 25 yards away from all wildlife, except bears—stay 300 yards away from bears.*
- *See* **go.nps.gov/DenaliSafety** *for detailed information on wildlife safety and on staying safe in a wilderness environment.*

Figure 4 – Map of Trailheads Located near the Entrance of Denali National Park.

Sugar Loaf Ridge Trailhead: (Accessed from near MP 238)

The Sugar Loaf Ridge Trail has been rated as a difficult hike, taking a steep route up Sugar Loaf Ridge with nearly 2700 feet of elevation gain before reaching the top. This unmaintained trail is about a 4.3 mile round trip, with an estimated travel time between 4 to 6 hours due to the steepness. While lightly trafficked, this trail leads to fantastic views of Denali and Nenana Canyon from the top of Sugar Loaf Ridge. The trail begins within Nenana Canyon Businesses corridor, which is located around MP 238 of the Parks Highway. The most popular access point for this trail begins near the Grande Denali Lodge, although no public parking is available at the lodge itself.

Dragonfly Creek Trailhead: (Located at MP 242.3)

The Dragonfly Creek Trail is an unmaintained 1.6 mile out and back trail that follows along closely to Dragonfly Creek. This trail has been rated as a relatively easy hike, with an estimated travel time of about an hour. While lightly traveled and more backcountry when compared to many other hiking locations in the area, this trail leads to waterfalls, a rock climbing area, and views over the Nenana River. A parking lot for access is located near Dragonfly Creek Bridge at MP 242.3 of the Parks Highway.

Bison Gulch Trailhead: (Located at MP 243.8)

The Bison Gulch trail is a steep route up a ridge paralleling Bison Gulch. This unmaintained route can be followed for an approximately 6.9 mile round trip, and there is an elevation gain of over 4000 feet to reach the top from the base trailhead. Estimated travel time is between 5 to 7 hours for a round trip. This trail is rather strenuous and exposed, it has been rated as a difficult hike. A parking area for the Bison Gulch Trailhead is located at MP 243.8 of the Parks Highway, close to the Bison Gulch Bridge. There are currently plans to relocate this parking area to the same side of the highway as the Bison Gulch Trailhead, which is expected to begin during the 2021 construction year.

Antler Creek Trailhead: (Located at MP 244.4)

Slightly north of Bison Gulch, there exists another unmaintained trailhead that climbs the same massif with excellent views of the area. This trail is less step of a climb than Bison Gulch, but there is currently less parking available to this trail than for Bison Gulch. Access to this trailhead is located at approximately MP 244.4 on the south end of the Antler Creek Bridge.

Stampede Trailhead: (Accessed from near MP 251.1)

Stampede Trail is an unmaintained trail located about 8 miles down Stampede Road, which intersects with the Parks Highway near Healy at MP 251.1. This trail is a strenuous and potentially dangerous hike that would likely require multiple days to complete in full. There are over 4200 feet of elevation gain along this approximately 38.2 mile out and back trail. Stampede trail begins at the end of Stampede Road and goes west all the way to the head waters of the Sushana River, crossing several other rivers along the way including the dangerous Teklanika River.

3.4 Boat Launches

Nenana River Access:

Approximately 140 miles long, the Nenana River flows somewhat parallel to the Parks Highway for a majority of the PEL study corridor and eventually feeds into the Tanana River. Boat launches provide recreational access to the Nenana River, which can allow for a variety of waterfront activities. While obviously used by larger motorized boats, these boat launch facilities also accommodate recreational activities such as river rafting, canoeing, and kayaking.

Located about 20 miles down the Denali Highway from the junction in Cantwell, there is a former public formal river put-in on the Nenana River. This site is now undeveloped, but is still used by visitors for river access. The river from this point flows away from the road corridor, rejoining at the Cantwell's Number One Bridge Public Launch below. This river access point on the Denali Highway could benefit from future improvement projects to create a maintained access location.

There are a few other access points for the Nenana River along the Parks Highway that are used as put-in and take-out points for rafts, canoes, and kayaks. The first of these access points is at the Jack River Bridge, which is located just south of Cantwell at MP 209.3 of the Parks Highway. Based on the *George Parks Highway Scenic Byway* document, there is also a 0.4 mile long access road to the Nenana River at MP 215.3 that can be used for river access. Jet boat tours have been offered from this location in the past.

Based on information from the Alaska Department of Fish and Game's website, there is a public use boat launch facility available at MP 216.5 of the Parks Highway. This launch facility is relatively easy to access compared to some of the undeveloped access points, and is also located near the Number One Bridge. The next access point is located along the highway around MP 220, although this location is more undeveloped, with trailers parked on a grassy shoulder-like area. This launch starts one of the most popular sections of the Nenana River for recreational usage. This section runs through the McKinley Village Bridge, where the exit point for this popular section is on the south side of the bridge near MP 231.

The river access point near the McKinley Village Bridge at MP 231 is a more developed and paved public use boat launch. This launch is used by both commercial raft companies and the general public and is located near Denali Park Village. It has been suggested that another formal boat launch could be useful between this one and the boat launch near the Number One Bridge. The float between this put in and the Nenana Canyon take out is often called the "Scenic Float" by rafting companies, with primarily Class 2 and Class 3 rapids.

Closer to Nenana Canyon Businesses and Denali National Park, there is a boat launch available for access to the Nenana River at the Nenana River Wayside around MP 238 of the Parks Highway. Located nearby is the whitewater rafting tour company Nenana Raft Adventures, which offers recreational rafting trips ranging anywhere from two hours to two weeks. The most popular river trip starts at MP 238 and goes through the Nenana Canyon, taking out at the end of the Healy Spur Road in Healy. Other whitewater rafting tour companies are nearby in Nenana Canyon Businesses, including Alaska Raft Adventures and Denali Raft Adventures.

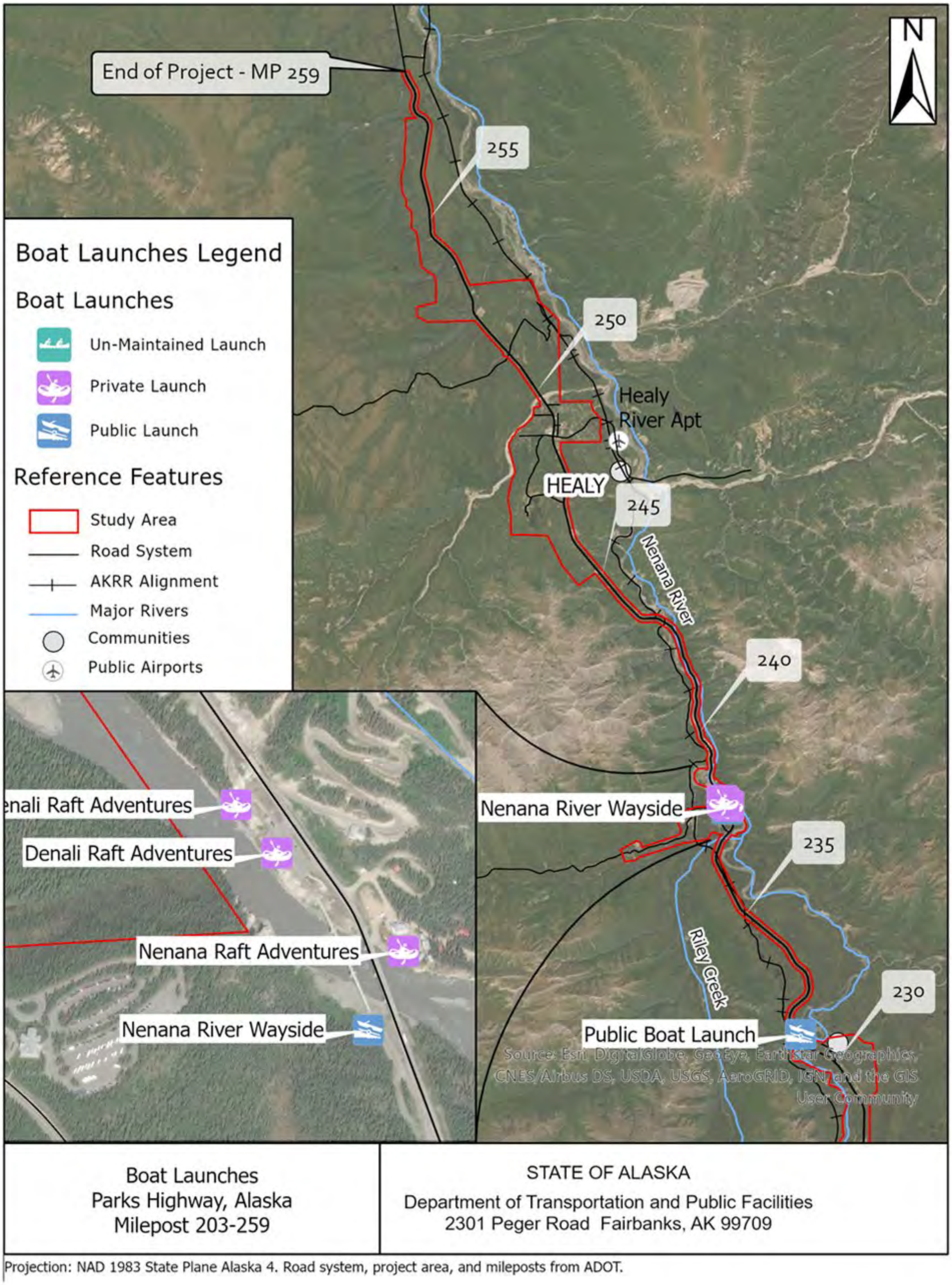
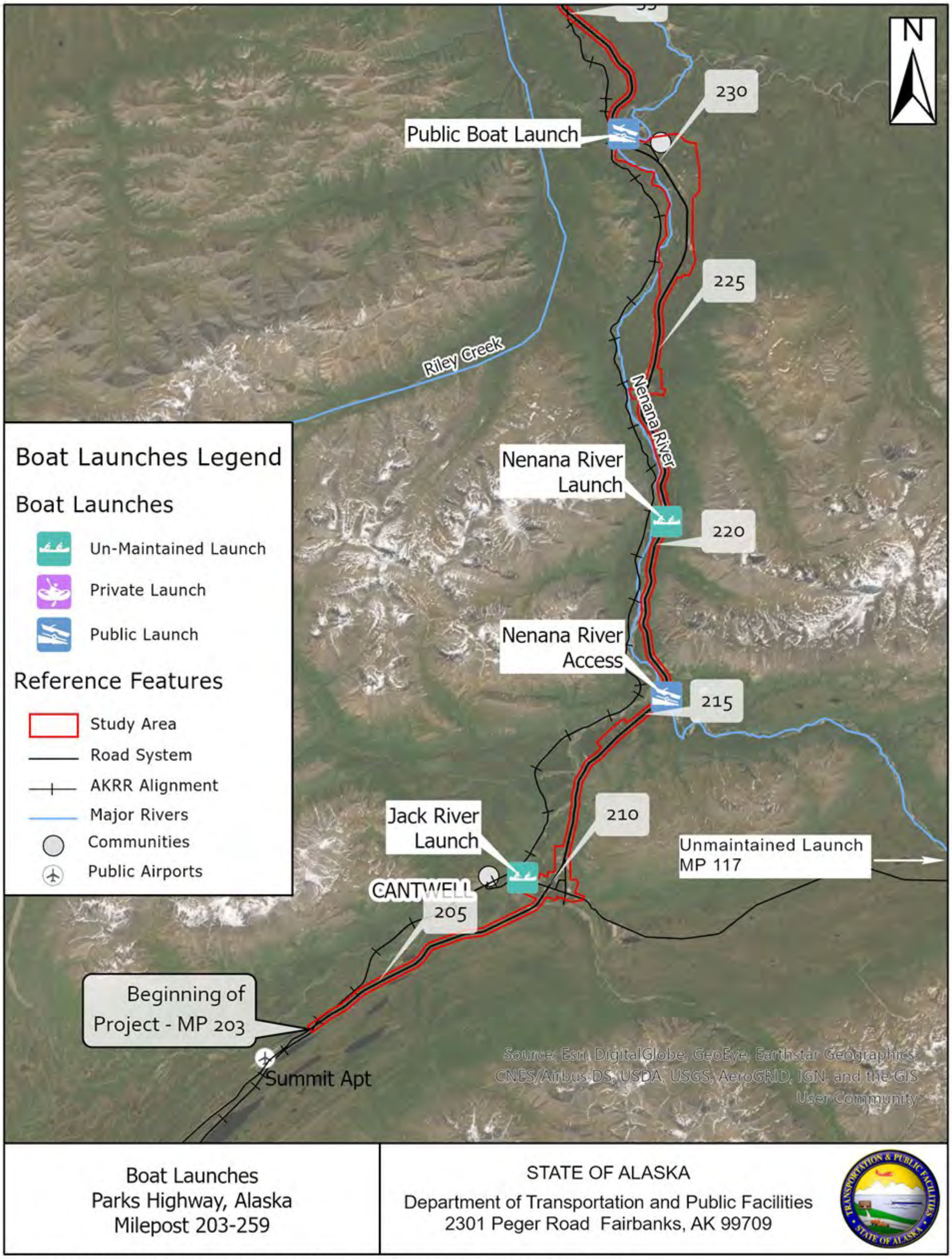


Figure 5 – River Access Locations in the Northern half of the PEL study Corridor.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.

Figure 6 – River Access Locations in the Southern half of the PEL study Corridor.

3.5 Hunting and Fishing

In Alaska, hunting and fishing are both popular activities and are regulated through a variety of different licenses and permits. Permits for both recreational and subsistence hunting and fishing are available through the Alaska Department of Fish and Game (ADF&G). These activities can be authorized within designated areas, and can be limited to particular seasons depending on the type of game. Subsistence hunting plays a key role in the lives of many residents, described by ADF&G as being "central to the customs and traditions of many cultural groups in Alaska." Subsistence hunting and fishing are critical to the nourishment, food security, and economic stability of many rural Alaskans. As a result of its significance to Alaskan communities, the regulations are different and often less strict for subsistence harvests.

The project area provides access to three game management units (GMU): 13E, 20A, and 20C. Within 20A are four controlled or management areas: the Yanert Controlled Use Area, Wood River Controlled Use Area, Healy-Lignite Management Area, and Ferry Trail Management Area. A map of the boundaries of the different units is shown in *Figure 7*. Hunting within these three GMU's is regulated by ADF&G and are restricted to particular open seasons for different types of game. Harvest data from the 2017 hunting season within these three GMUs is shown in *Figure 8* using information that is available through ADF&G. This figure shows the number of animals harvested of each species along with the number of unsuccessful hunters for each of the three GMUs. Individual GMUs can have different open seasons and harvest limits for the same types of game. Detailed information on the current open seasons, harvest limits, and special instructions for hunting within each GMU is available on the ADF&G website.

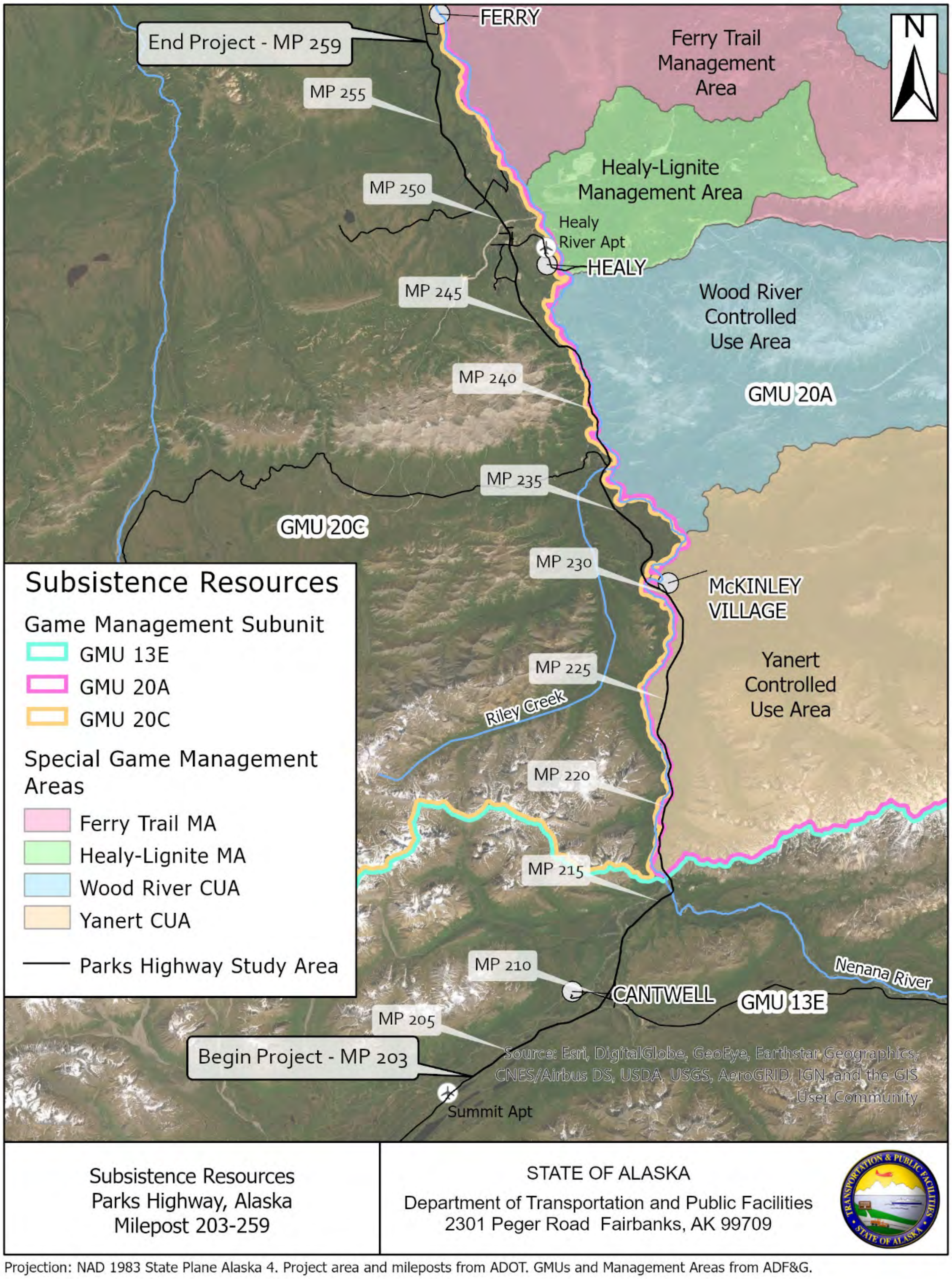


Figure 7 – Map of Game Management Unit Boundaries.

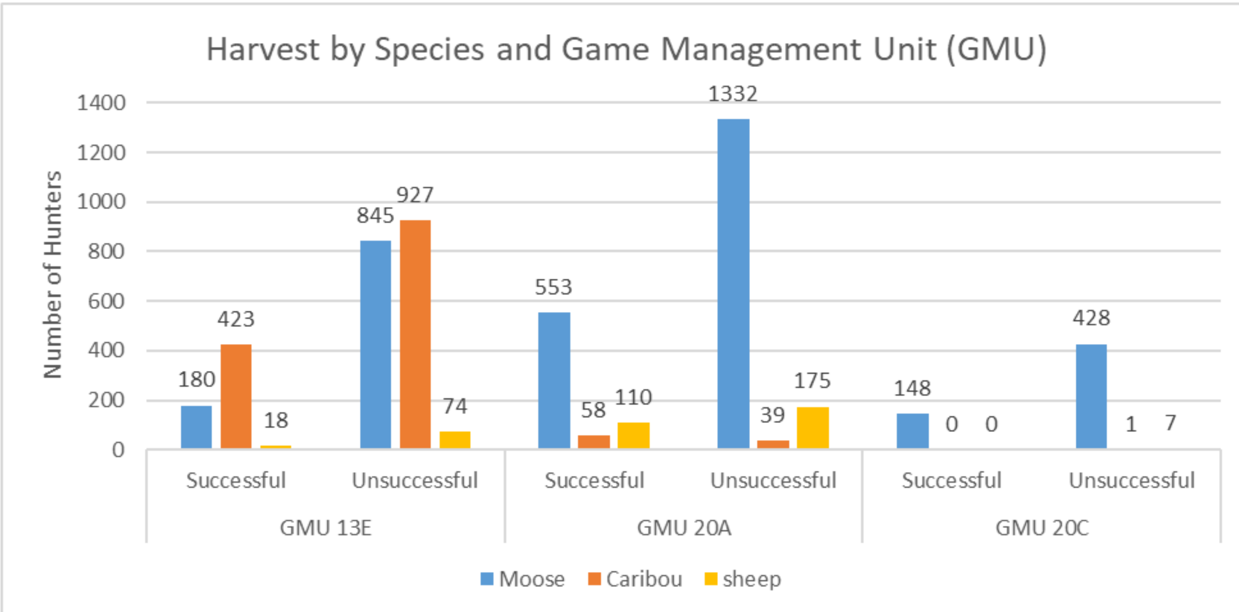


Figure 8 – Harvest by Species, Game Management Unit, and Success.

Many of the communities that make up the project area rely heavily on subsistence harvest as a major food source. These communities harvest large quantities of land mammals and fish as well as smaller quantities of birds, eggs, and marine invertebrates. For the years 2012, 2014, and 2015, ADF&G conducted a survey on the harvest within the communities of Cantwell, Denali Park, Ferry, and Healy. These surveys produced valuable data on the community demographics and harvest statistics. *Table 2* depicts the pounds of subsistence resource harvested by each community and the total harvested along the Parks Highway PEL corridor. This shows how significant a portion of the diet in these communities is made up of subsistence resources. Due to the varying size of communities, a standardized metric is represented in *Figure 9*. The figure shows the pounds of subsistence resources harvested per capita for each community. Although not all of these resources were harvested directly within the study area, they demonstrate the necessity of ensuring access to and from the communities during subsistence gathering seasons.

Community	Population Size	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Land Mammals (lbs.)	Vegetation (lbs.)
Cantwell	196	2,978.3	1,274.5	14,294.3	1,010.8
Denali Park	172	4,413.9	1,494.1	1,651.3	2,038.0
Ferry	41	2,610.9	434.7	691.7	607.2
Healy	1,006	9,362.4	5,341.7	34,538.0	1,920.8
Total	1,415	19,365.5	8,545.0	51,175.3	5,576.8

Table 2 - Amount of Subsistence Resource Harvested by Community and in Total.

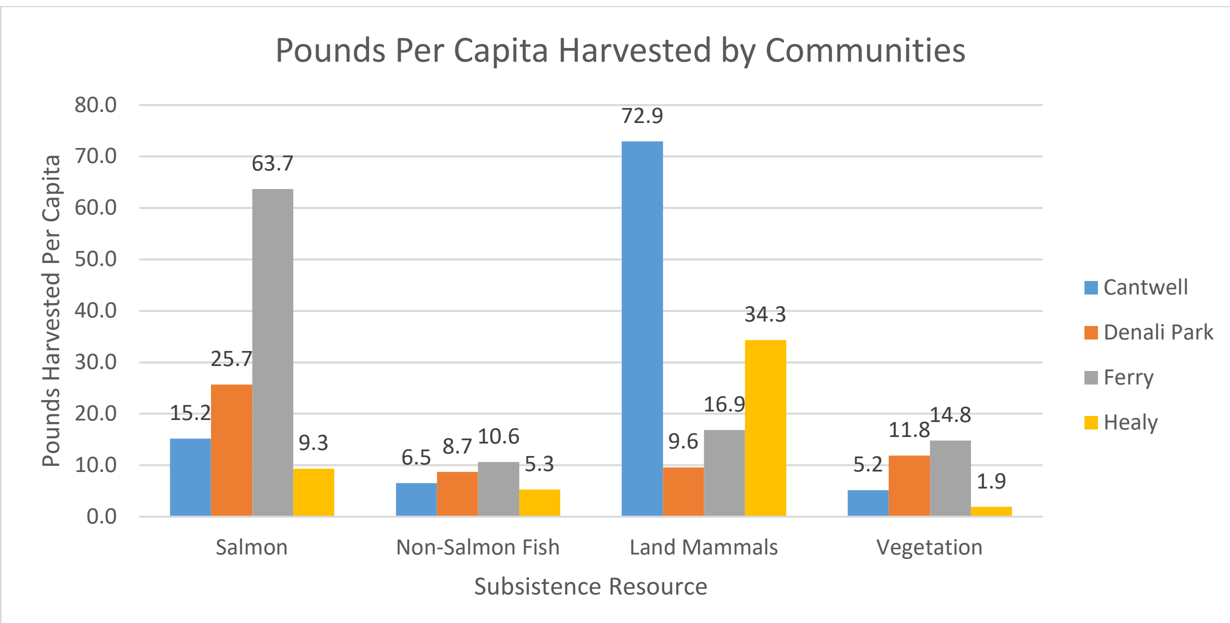


Figure 9 - Pounds of Subsistence Resource Harvested Per Capita by Key Communities within the Study Corridor.

According to the ADF&G 2020 Northern Alaska Sport Fishing Regulations Summary, the project area falls within the Lower Tanana River Drainage area. This area has multiple streams and stocked lakes available for subsistence and recreational fishing. Harvestable fish species include King Salmon, Chum Salmon, Coho Salmon, Arctic Char, Dolly Varden, Lake Trout, Arctic Grayling, Northern Pike, Whitefish, Sheefish, and Burbot.

3.6 Wilderness Areas

As described previously in *Section 3.1*, recreational facilities in Denali National Park, such as trails, campgrounds, rest areas, and visitor centers are concentrated on the Denali Park Road. This road nearly bisects the approximately 2 million acres of the Denali Wilderness. This is a formally designated wilderness area where motorized use, commercial operations, and development are restricted. This area is managed to preserve its wilderness character, including its functioning as a natural ecosystem, its lack of development, its lack of human intervention, and its ability to provide solitude and unconfined recreation.

The wilderness recreation opportunities possible within the Denali Wilderness include off-trail hiking, backpacking, paddlesports, wildlife viewing, skiing, and mountaineering. The Denali Wilderness is large and undeveloped enough to afford opportunities for extended expeditions, a relatively rare opportunity in NPS units outside of Alaska. Overnight use of most backcountry areas across the park require a free backcountry permit, which is available in the park entrance area. Wilderness recreation on a day-use basis is generally unrestricted.

The remaining approximately 4 million acres within Denali National Park and Preserve are not formally designated as wilderness, but share many qualities of wilderness character with the 2 million acres of designated wilderness in the park. These 4 million undesignated acres are eligible for eventual formal designation as wilderness, must be managed as wilderness, and provide similar recreational opportunities as the 2 million acres of designated wilderness in the park.

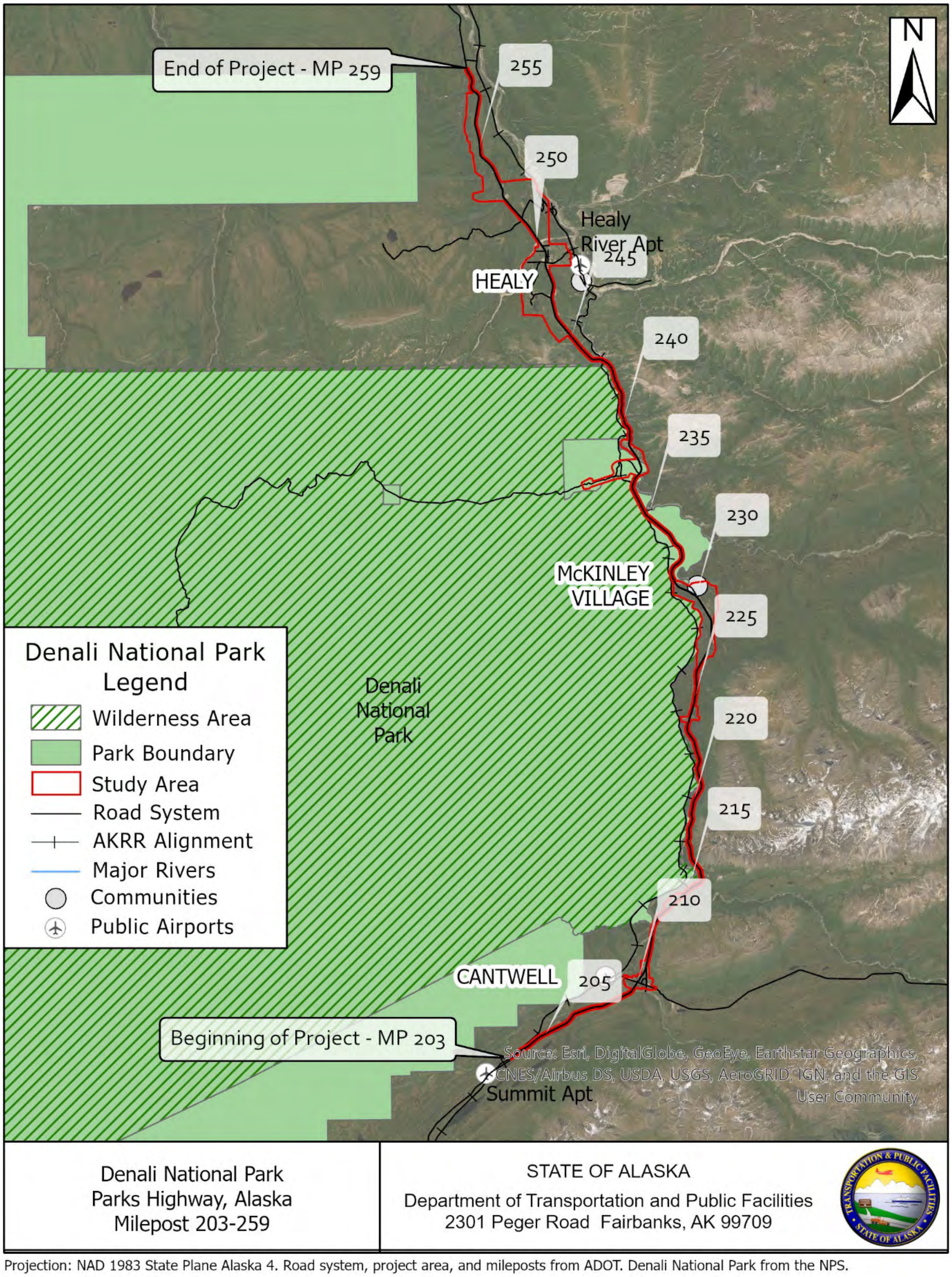


Figure 10 – Wilderness Area Boundaries on Parks Highway along PEL Study Corridor.

3.7 Other Recreational Facilities

With the vast amount of undeveloped and unpopulated wilderness along the Parks Highway, there are a variety of additional facilities that support recreational activities. Accessibility is an important factor to consider when determining the areas that are likely to attract recreational visitors. While major attractions like hiking trails and campgrounds are easier to account for, less structured activities such as backcountry backpacking, skiing, and mountaineering can be more difficult to pinpoint. To help account for these types of activities, *Table 3* shows a summary of all pull-offs and parking lots that are located along the PEL study corridor. These pull-off and parking lots also provide recreational access points for off-road vehicles such as ATV and snow machines.

Parks Highway MP	Description	Notes
MP 203.5	Paved pull-off	
MP 208	Parking	Pass Creek Bridge, access to Eldridge Glacier
MP 211.5	Paved pull-off	Double-ended paved pull-off
MP 213.8	Paved pull-off	Double-ended paved pull-off
MP 215.3	Road	0.4 miles to Nenana River, used by truckers
MP 216.5	Paved pull-off	
MP 218.5	Paved pull-off	
MP 219.7	Paved pull-off	Double-ended paved pull-off
MP 220.5	Paved pull-off	
MP 222.2	Paved pull-off	
MP 229.7	Paved pull-off	Double-ended paved pull-off
MP 231.4	Parking	Parking lot for Triple Lakes Trailhead
MP 231.5	Gravel pull-off	
MP 233.1	Gravel pull-off	
MP 234.2	Paved pull-off	Double-ended paved pull-off
MP 237.7	Paved pull-off	
MP 238	Parking	Nenana River Bridge waysite
MP 240.3	Parking	Hornet Creek Bridge, double-ended parking
MP 241.1	Gravel pull-off	Access to Fox Creek
MP 241.6	Gravel pull-off	
MP 242.3	Parking	Dragonfly Creek Bridge
MP 242.7	Paved pull-off	Double-ended paved pull-off
MP 243.8	Parking	Bison Gulch Bridge
MP 243.9	Gravel pull-off	
MP 244	Gravel pull-off	
MP 245	Parking	Antler Creek gravel pit
MP 246.3	Gravel pull-off	
MP 246.9	Paved pull-off	
MP 249.8	Parking	Dry Creek Bridge, berry picking in Fall
MP 252.4	Parking	Panguingue Creek

Table 3 – Vehicle Access Locations on Parks Highway along PEL Study Corridor.

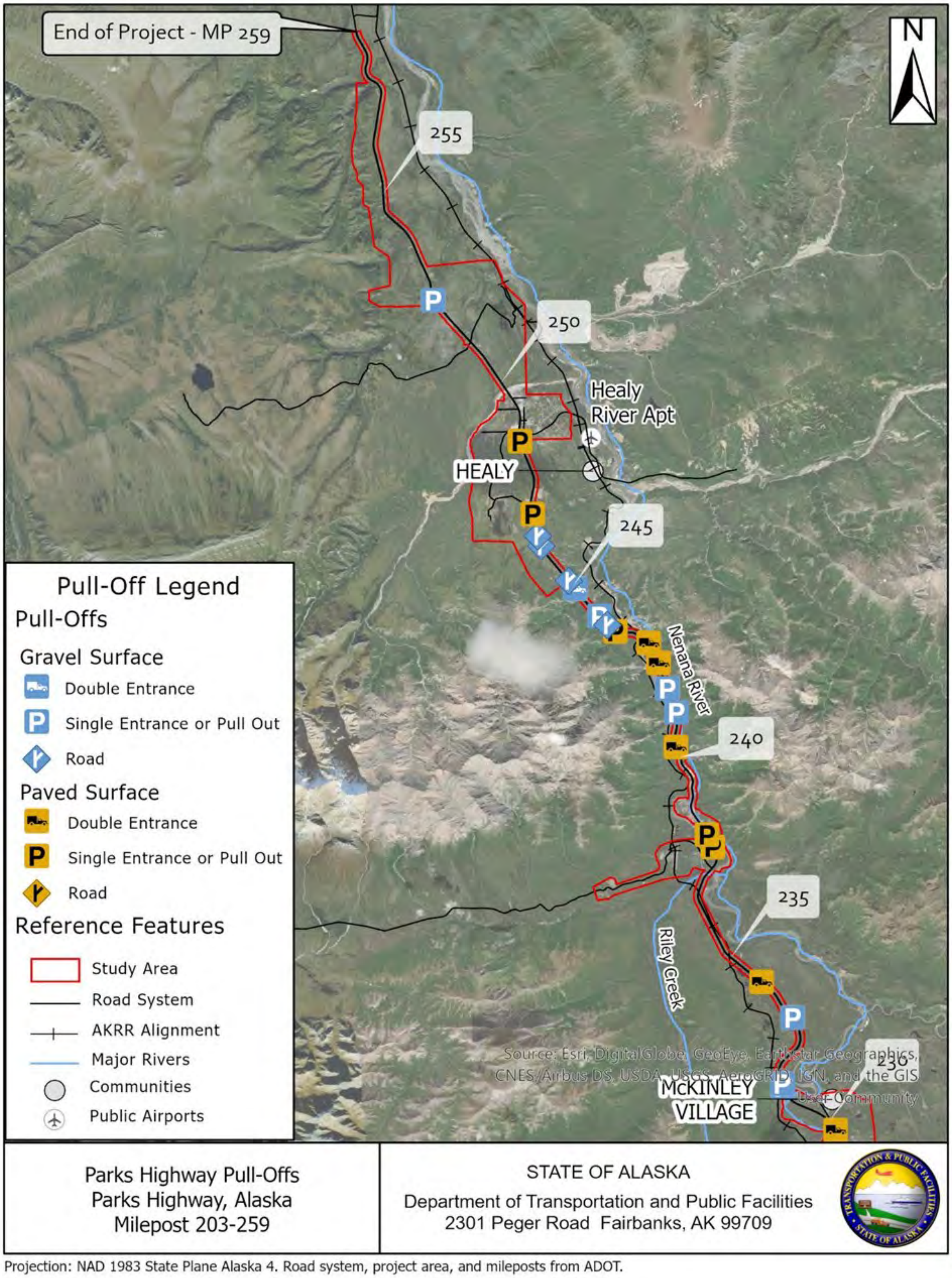
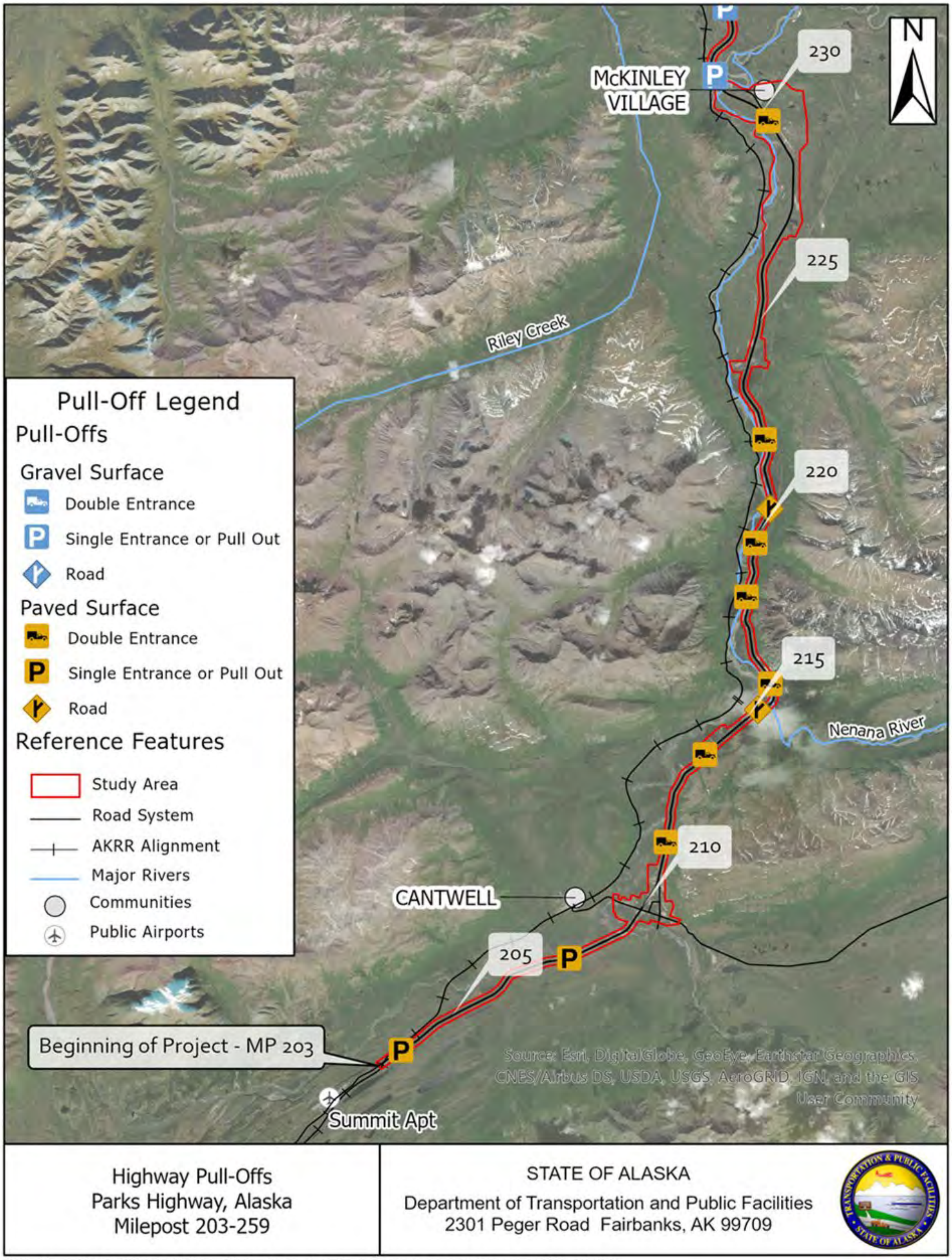


Figure 11 – Pull-offs on Parks Highway along Northern half of the PEL Study Corridor.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.

Figure 12 – Pull-offs on Parks Highway along Southern half of the PEL Study Corridor.

Wildlife viewing is another attraction along the Parks Highway PEL study corridor that draws visitors to the area year round. There is a large amount of wildlife present in the area, such as grizzly and black bears, moose, caribou, wolves, and foxes. Wildlife is present along the PEL study corridor throughout the year, but is especially abundant near Denali National Park. One popular location for wildlife viewing is at MP 243 on the north side of the Moody Bridge. The viewing of wild mountain sheep, known as Dall sheep, is possible at this location as the Dall sheep frequent the steep slopes along the canyon. The steep sunny slopes of Sugarloaf Mountain regularly attract sheep as well. A designated location for motorists to pull off the highway and view these magnificent creatures does not currently exist.

While tourism in Alaska peaks during the summer months, recreation still occurs during the winter months in the study area. Many recreational visitors will access areas throughout the PEL study corridor for backcountry crust skiing. Another popular recreational activity that is available primarily when temperatures are below freezing is ice climbing. There are several popular ice climbing locations along the Parks Highway that fall within the PEL study corridor. These ice climbing sites attract recreational climbers during the winter months and are described briefly in *Table 4*.

Ice Climbing Location	Parks Highway MP	Description
Panorama Peak Ice Climbs	MP 219	Located a few miles North of Cantwell, just east of the Parks Highway near MP 219.
Denali National Park	MP 237.3	Ice climbing opportunities within the park, located at MP 237.3 of the Parks Highway.
Fox Creek Ice Climbs	MP 241.1	Located at MP 241.1 of the Parks Highway, with roughly 50 meters of moderately difficult climbing.
Dragonfly Creek Ice Climbs	MP 242.3	Located at MP 242.3 of the Parks Highway, with 40 to 50 meters of climbing surface spanning two pillars.
Johnny Cash Falls Ice Climbs	MP 250	These falls are located just north of Dry Creek Bridge in Healy, near MP 250 of the Parks Highway.

Table 4 – Ice Climbing Locations on Parks Highway along the PEL Study Corridor.

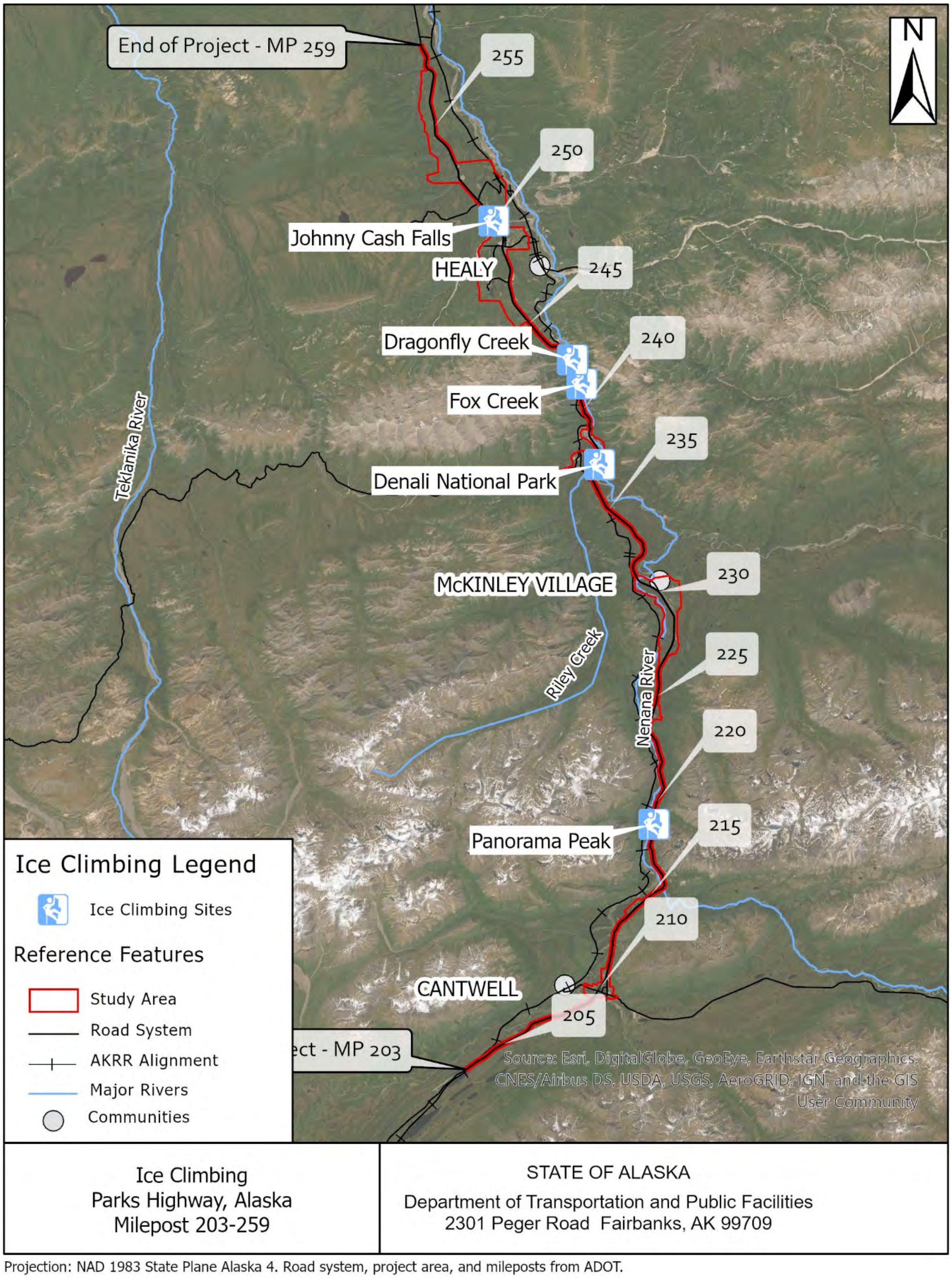


Figure 13 - Ice Climbing Locations on Parks Highway along the PEL Study Corridor.

4.0 Recreational Usage and Future Improvements

The usage of recreational sites within the Parks Highway PEL study area has been steadily growing over the past couple of decades. A combination of increases in the tourism industry and the amount of the population participating in recreational activities has resulted in this increased demand for recreational access. The amount of visitors at Denali National Park and Preserve, the most famous recreational area within the study corridor, has nearly doubled since the beginning of the century. Visitation numbers for the park have increased from 364,019 visitors in 2000 to a total of 601,152 visitors in 2019. The need for sufficient visitor accommodations such as parking comes with this increased demand for recreational activities. Overflowing parking areas will often cause vehicles to park along the active roadway, which can result in a variety of unsafe conditions for both pedestrians and motorists.

Figure 14 - Yearly Recreational Visitors at Denali National Park from 2000 to 2019.

There are currently recreational facility improvement projects under development within the corridor of the PEL study. One project is located around MP 243 of the Parks Highway near Bison Gulch, which involves relocating the parking lot that provides access to Bison Gulch and the Bison Gulch Trailhead. Due to the current location of the parking lot, which is across the highway from the trailhead, there are pedestrian concerns in this area. By moving the parking lot to the same side of the highway as the trail, pedestrian activity along and across the highway should decrease substantially. Construction of the new Bison Gulch trailhead and parking area is currently expected to begin in 2021.

The Denali Park Realignment (MP 344-348) Feasibility Study was conducted by the ARRC in 2018 to assess the feasibility of realigning the railroad track near the entrance to Denali National Park. ARRC refers to the crossing as Milepost 345 on their mainline, while it is slightly north of Milepost 235 of the Parks Highway's alignment. The purpose of this study was to identify options to reduce maintenance costs, provide operational efficiency, and improve public safety by removing two highway-rail crossings on the Parks Highway. The study included a conceptual design for converting the existing ARRC track embankment that would be abandoned into a trail and connecting to a potential additional 4.2-mile trail alignment that would connect to the Denali Village area.

An additional recreational development in the study area is in the vicinity of MP 231. This area near a bridge over the Nenana River already provides river access and acts as a trailhead for the Oxbow and Triple Lakes Trails within Denali National Park and Preserve. There are no dedicated pedestrian access or formal parking areas which complicates trail access. The NPS and DOT&PF have collaborated on plans to improve pedestrian safety in the area and provide a dedicated trailhead parking area and rest stop. The NPS has also long discussed the possibility of additional trail development in the MP 231 area. Based on the 2020 – 2023 Alaska Statewide Transportation Improvement Program (STIP), this project has received funding and is currently planned to go into construction in 2022.

5.0 Conclusion

The Parks Highway is a vital route for transportation between Alaska's two largest cities, Fairbanks and Anchorage. As recreational usage of the Parks Highway continues to grow in popularity, there exists the need for certain updates to accommodate the increased demand. For example, several of the trailheads located along the study corridor such as Bison Gulch and Triple Lakes have inadequate parking to meet the demand for access during peak season.

It is important to consider these recreational sites such as campgrounds, trailheads, and boat launches when planning for future projects within the PEL study corridor. While peak season for tourism and visitors in during the summer months, recreation along the Parks Highway attract visitors year round. As discussed previously in *Section 4.0*, there has been a significant increase in the amount of annual visitors to Denali National Park over the previous two decades. With the access road located within the study corridor, this results in an increased usage of the Parks Highway to provide transportation to and from the park for these visitors.

The purpose of the *Recreational Facilities Memo* is primarily to provide information on recreational facilities to the PEL study team and PAC members. This information will be used along with the input from a variety of other stakeholders to analyze the needs of all parties, and eventually to develop future improvement projects along the Parks Highway.

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https://parks-highway-mp-203-259-pel-akdot.hub.arcgis.com/

http://dot.alaska.gov/nreg/parkshealypel/

Map provided by National Park Service:

https://www.nps.gov/dena/planyourvisit/upload/trail-map-letter-size.pdf

Appendix G

Economic Impact Assessment Memorandums:

Commonly Accepted Methods for Estimating the Economic Value of Recreational Travel and Visitation Literature Review **(July 2, 2020)**

Existing Economic Activity Generators and Future Economic Opportunities **(July 29, 2020)**

Cantwell to Healy
PEL Study

Memorandum

Jacobs Engineering Group Inc.
949 East 36th Avenue, Suite 500
Anchorage, AK 99508
www.jacobs.com

Subject	**Commonly Accepted Methods for Estimating the Economic Value of Recreation Travel and Visitation: Literature Review**
Project Name	Cantwell to Healy Planning and Environmental Linkages (PEL Study) Parks Highway Mileposts 203-259
From	Fatuma Yusuf, Ph.D., Jacobs economist and Tara Callear Jacobs planner
Date	July 2, 2020
Copies to	Federal Highway Administration Western Federal Lands, Alaska DOT&PF Northern Region, and National Park Service Alaska Region

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1. Introduction

The Federal Highway Administration Western Federal Lands in partnership with the Alaska Department of Transportation and Public Facilities (DOT&PF) and the National Park Service (NPS), are working together to identify potential future transportation and access improvements along the Parks Highway corridor (mileposts 203 and 259) between Cantwell and Healy.

The partnering agencies are conducting a Planning and Environmental Linkages (PEL) Study that will look at current and future conditions and needs of transportation and access facilities along the Parks Highway corridor as it relates to the users and communities in the areas between Cantwell and Healy.

As part of the PEL Study, it was desired to determine and quantify the economic value of the corridor, which is assumed to rely heavily on travel and visitation to Denali National Park and Preserve (DNP). An econometric analysis of the value of travel and visitation to DNP could provide estimates that could then be used to estimate the direct economic value of the corridor. Such analysis requires data on the visitors' total expenditures associated with their travel to DNP. However, developing, pilot testing, refining, and implementing a survey to collect the needed data requires significant investment in time and resources and once the data has been collected, the analysis can also require significant investment in time and resources.

Although primary research would produce the most thorough and defensible analysis, the constraints on time and budget make the use of either secondary data (i.e., existing DNP-specific data collected for other purposes which has limited information on visitor user values) or benefit transfers (i.e., existing visitor use value estimates for other parks) more feasible options. Therefore, in lieu of doing a full-scale econometric analysis, a literature review was conducted with the intent to provide the study team with comparable visitor use values. The articles reviewed focus on the methods and findings from other national parks with similar characteristics and opportunities to DNP. Discussed in this review are the limitations to the generalizability of these studies in the context of the "Denali Experience", due to the particularly unique recreation opportunities and experiences that is offers, such as:

- Witnessing the tallest mountain in North America
- Experiencing safe and close-up wildlife encounters (mega fauna)
- Interacting with intact subarctic ecosystems
- Learning about Interior Alaska cultural experiences (e.g., exhibits and interpretation)
- Accessing remote wilderness by bus (i.e., unique opportunities for solitude)

As detailed in this review, the generalizability of existing studies is further limited by the fact that visitation to the park is largely by non-Alaskan residents and is comprised of a high percentage of group tourism instead of independent travelers. Additionally, because of the distance involved in getting to Alaska, many of these visitors are one-time or infrequent visitors and, thus, there are few spur-of-the-moment or drop-in visitors. The relatively isolated economy of the DNP area means that the economy of this region is heavily reliant on the tourism industry.

Several technical memorandums such as this one are being prepared as part of the Needs and Opportunities Assessment phase. This technical memorandum, one of two related to economic assessment of the corridor, contains a literature review of commonly accepted methods for estimating the economic value of recreation and visitation. These methods are described in Section 2. Section 3 summarizes the findings from the literature reviewed on commonly used economic methods to estimate recreation value. A detailed review of the literature follows in Section 4.

The second economic assessment memorandum will include an analysis of the total economic contribution/impact of DNP and the identification of existing economic generators and future economic opportunities. The total economic contribution/impact of DNP includes the direct economic benefits of visitation.

2. Description of Economic Valuation Methods Used for Recreation

Economic benefits associated with recreation are typically evaluated using one of the following three methods:

- Travel Cost Method
- Contingent Valuation Method
- Benefit Transfer

Travel cost method and contingent valuation method are economic survey methods based on individuals having directly revealed their preference for the recreation activity (or opportunity) through their purchases in the market place or by revealing their preference in response to a hypothetical question. Benefit transfer method relies on values that are derived from the application of the first two methods.

2.1 Economic Survey Methods

2.1.1 Travel Cost Method

The travel cost method (TCM) is used to estimate the value of recreational benefits. The basic premise of TCM is that the time and travel cost expenses that visitors incur to visit a site represent the “price” of access to the site. Thus, individuals’ willingness to pay (WTP) to visit the site can be estimated based on the number of trips made at different travel costs.

2.1.2 Contingent Valuation Method

The contingent valuation method (CVM) is another well-established method used to estimate economic values for many resources, particularly those with non-use values or non-market values. With this method, individuals are surveyed on how much they would be willing to spend for specific resource. In some cases, respondents are asked for the amount of compensation they would be willing to accept to give up specific resources. It is called contingent valuation because they are asked to state their WTP, contingent on a specific hypothetical scenario and description of the resource.

2.1.3 Benefit Transfer Method

The benefit transfer method does not specifically measure benefits of resources. Instead, this method is used to transfer values developed by other studies for similar sites to the resource site currently being evaluated. For example, values for recreational fishing at a particular site may be estimated by applying measures of recreational fishing values from a study conducted at another site. Thus, the basic goal of this method is to estimate benefits for one context by adapting, or transferring, an estimate of benefits from some other context. The method aggregates the data from the TCM and CVM. It is often used when it is too expensive or there is too little time available to conduct an original valuation study, yet some measure of benefits is needed. The benefit transfer method is most reliable when the original site and the current study site are similar in terms of factors such as quality, location, and population characteristics; when the proposed change is very similar for the two sites; and when the original valuation study was carefully conducted and used sound valuation techniques.

3. Specific articles reviewed

This section summarizes the review of the literature as it pertains to the economic valuation methods (discussed in Section 2) commonly used in non-market valuation of public goods, specifically recreation. The articles selected are those that have used econometric or other economic methods to value travel and visitation at national parks whose characteristics and opportunities are as similar to DNP's as possible. When estimates of recreation benefit values are included in an article, these values are summarized and then some additional analysis was conducted to derive visitation values to DNP. Specifically, the values presented in original dollar year estimates in the articles were converted into 2019 dollar values and applied to DNP visitation numbers. A summary of all the values that were presented in the articles is provided at the end of this technical memorandum.

3.1 Rosenberger and Loomis (2001): "Benefit transfer of outdoor recreation use values: A technical document supporting the Forest Service Strategic Plan" (2000 revision)

Primary research provides content- and context-specific estimates of recreation value; however, "when circumstances such as insufficient funding or time make primary research infeasible, benefit transfer provides a means by which the value of recreation at an unstudied site can be estimated using information about recreation values at other sites." Rosenberger and Loomis (2001) defined benefit transfer in the context of recreation use valuation as the application of data from a study site to a policy site. A study site is defined as a place for which recreation value data collected through primary research exists, and a policy site as a place for which there is little or no data available on the economic value of recreation. Benefit transfer provides content-and context-relevant estimates of recreation value for policy sites.

This article provides (1) a review of literature on recreation use values, (2) guidelines on conducting benefit transfer, (3) a review of benefit transfer approaches, and (4) a meta-analysis of the recreation use value literature for use in benefit transfers.

The article also provides guidance for use in judging the relevance and credibility of transferring specific measures. Necessary conditions for and limitations to effective benefit transfers include issues concerning policy site needs, the quality of study site data, and the correspondence between the study site and the policy site. Several factors are identified that can limit the accuracy of value estimation using benefit transfer, such as data issues, methodological issues, site correspondence issues, temporal issues, and spatial issues. A decision tree is also presented to guide researchers through a framework on how to obtain measures of recreation use value.

The researchers estimated forecasted average values for 21 recreation activities using a meta-analysis benefit transfer function. These estimates were developed for each of the Forest Service assessment regions (i.e., Northeast, Southeast, Intermountain, Pacific Coast, and Alaska). Of the activities applicable to DNP shown for the Alaska region, which includes general recreation, camping, hiking, and wildlife viewing activities, the authors estimated these activities to have an average annual consumer surplus of $29.95 per person in 1996 dollars. Consumer surplus is the difference between the price that consumers pay and the price that they are willing to pay and it represents the benefit that consumers realize from consumption over and above the price of a good or service.

3.2 Kaval and Loomis (2003): "Updated Outdoor Recreation Use Values with Emphasis on National Park Recreation"

Like Rosenberger and Loomis (2001), this report provides some basic guidance for conducting benefit transfers. This report is intended to be used as a guide to the empirical estimates available. A database on outdoor recreation use values was compiled from four existing literature reviews that include data spanning from 1967 to 2003 (Sorg and Loomis 1984; Walsh et al. 1988; McNair 1993; Loomis 2005), including a fifth literature review conducted for the purpose of this report. The main coding categories included reference citations to the research, benefit measure(s) reported, methodology used, recreation activity investigated, recreation site characteristics, and user or sample population characteristics. A total of 1,239 estimates obtained from 593 studies were compiled for 30 separate outdoor recreation activities. Average values per visitor day were reported for each activity roughly by U.S. Census region (Alaska, Intermountain, Northeast, Pacific Coast, and Southeast). An additional category of Multiple Area Studies was included that captured studies that spanned geographies. Basic guidelines on performing benefit transfers in the context of recreation use valuation were provided.

Summary statistic on average consumer surplus values by activity and region per person per day (1967-2003) was presented in 1996 U.S. dollars (USD) by census region. The following table summarizes the eight activities evaluated from the 26 studies that were reported for Alaska.

Table 1: Summary Statistics on Average Consumer Surplus Values by Activity per Person per Day in Alaska, 1967-2003

Activity	Studies Observed	Mean Consumer Surplus (1996 USD)
Fishing	4	51.66
Rafting/Canoeing	1	15.13
General Recreation	1	12.37

Table 1: Summary Statistics on Average Consumer Surplus Values by Activity per Person per Day in Alaska, 1967-2003

Activity	Studies Observed	Mean Consumer Surplus (1996 USD)
Hiking	1	12.93
Hunting	7	54.73
Pleasure Driving	3	7.01
Sightseeing/Snorkeling	1	13.20
Wildlife Viewing	8	41.11
Totals	**26**	-

3.3 Loomis (2006): "A Comparison of the Effect of Multiple Destination Trips on Recreation Benefits as Estimated by Travel Cost and Contingent Valuation Methods"

Loomis (2006) used primary research data to investigate the empirical magnitude of multiple-destination/purpose trip bias in the TCM, and the performance of an empirical solution for that method. The Snake River in Jackson Hole, Wyoming, south of Grand Teton National Park, was selected as the case study. For this study area, Loomis reported that ignoring the multiple-destination/purpose trip distinction does result in a substantial difference in per trip values for the TCM. The Parsons and Wilson's (1997) TCM demand model of multiple-destination trips was used to calculate separate estimates of consumer surplus for each of these two trip types; an especially attractive feature for small sample sizes.

This study also compared CVM-derived values for single- versus multiple-destination trips, using data on visits to the case study area. The dichotomous choice contingent valuation method was employed using higher trip costs as a payment vehicle. The dichotomous choice WTP question format was applied, rather than asking about the maximum amount respondents would pay. For the case study, the net WTP of the multiple-destination users represents the majority of total site benefits. This is true whether estimated by the TCM or CVM. Thus, omitting multiple-destination users from benefit estimation would result in a substantial underestimate of total site recreation benefits for the Snake River south of Grand Teton National Park.

3.4 Heberling and Templeton (2009): "Estimating the Economic Value of National Parks with Count Data Models Using On-Site, Secondary Data: The Case of the Great Sand Dunes National Park and Preserve"

Heberling and Templeton (2009) applied the TCM and provided an approach that follows the standard estimation of travel cost models using count data. The model explains the number of trips taken to a recreation site during a defined previous time period as a function of the cost associated with making the trips to the park from their home. Secondary data were obtained from the Visitors Services Project (VSP), an existing dataset collected by the NPS and the University of Idaho. This was the first study to demonstrate the feasibility of using VSP data to estimate economic value. Typical use of the VSP data is focused on visitor satisfaction. Although the questions fall short in asking about assigned values (Turner 2002), Heberling and Templeton argue that the data is still usable for certain research questions and that it could be duplicated for other available VSP data sets.

The VSP data were transformed and augmented before estimating the model. Because of the inherent limitations of the VSP data set, trips were multiplied by group size to correct for the high rate of one-time visitation. Travel costs were not asked in the VSP; therefore, roundtrip costs and entrance fees were estimated to determine travel costs using respondents' zip codes combined with zonal information, which were then multiplied by the U.S. roundtrip reimbursement rate. It was assumed that all travelers face the same cost per kilometer because no information was available on how visitors traveled to the national park. The authors noted that additional variation could be created by making an assumption about distance traveled, type of transportation used, and entrance fees. Travelers' income was not in the VSP data set; therefore, the mean household income was calculated by zip code from the U.S. Census. The remaining variables were based directly on VSP responses. Adjustments were made using dummy variables to correct for the TCM assumption of a single purpose trip. A dummy variable was also created for days spent at Great Sand Dunes (GSD) based on VSP responses. Other questions related to substitute sites, travel time, mode of transportation, and changes in quality or park services were not asked in the VSP survey and, therefore, are not included in the model.

Because all respondents are actual visitors to the park (on-site), their number of visits in past 12 months is always greater than zero, therefore transformation was necessary. Respondents who visit frequently are more likely to be sampled and, if left uncorrected, would create inference problems and lead to overstated welfare estimates. The estimate of annual consumer surplus per visitor for GSD as the primary destination is approximately $89 (in 2002 USD). The consumer surplus per year related to multi-destination trips and unplanned trips is much larger, $256 and $238, respectively.

Two limitations of the TCM were discussed: (1) opportunity cost of travel time is not included because of multicollinearity and difficulty of determining modes of transportation and (2) travel costs to substitute sites were not included because of bias consumer surplus and lack of data (difficult to estimate). Heberling and Templeton point out that, without the opportunity cost of time and substitute sites, ''empirically, the results can be considered fairly realistic, because the two effects work in the opposite direction'' (Ovaskainen et al. 2001).

3.5 Neher et al. (2013): "Valuation of National Park System visitation: the efficient use of count data models, meta-analysis, and secondary visitor survey data"

Neher et al. (2013) is an extension of the Heberling and Templeton (2009) study, and its focus is to estimate total annual WTP associated with recreational visitation to NPS sites. Models were estimated using 58 different park surveys used within a meta regression analysis model to predict average and total WTP for NPS visitation system-wide. The 58 park surveys with adequate count model data represent a generally good cross section of the NPS system and are well distributed across the regions of the NPS system (Alaska was not represented in the sample). Overall, visitor data from 16 percent of park units in the NPS system were included in the analysis. Explanatory variables for the meta-regression analysis included readily available identifiers for park location, park type, and a measure of complementarity (the percent of Federal land in the state surrounding the park unit). Explanatory variables were collected for the 58 park units, as well as for the remainder of park units in the NPS system (for the subsequent out-of-sample prediction of WTP values).

The article addressed lack of variability, a common issue found in individual travel cost model estimation. Preliminary model specification showed that 18 percent of park unit datasets estimated had insufficient variability in the dependent variable to estimate statistically significant travel cost parameters. Neher et al. followed the same convention as Heberling and Templeton (2009) and, in doing so, estimated travel cost parameters for all 58 park models that were statistically significant.

Three limitations of using data not collected specifically for travel cost modeling were discussed: (1) general lack of information on household/individual income, (2) lack of information about mode of travel and travel costs, and (3) under representation of some users because of grab sampling during only a few weeks during peak season. Because of these limitations, this research opted to omit explanatory variables related to (1) the value of travel time, (2) the price and qualities of substitute sites, and (3) multi-destination trips. Including the value of travel time in TCM is an unsettled area of research (Amoako- Tuffour and Martínez-Espiñeira 2012) as it unambiguously increases estimated welfare measures; therefore, this explanatory variable was omitted from this model. As for substitute sites, the difficulty in identifying and constructing a substitute variable is not unique to this study (Rosenthal 1987). The authors reported that, because inclusion of a variable for the price and/or quality of substitutes is important to avoid overstating WTP, their study initially explored including a constructed substitute variable based on the number of NPS units within the individual visitors' home states. This approach was not successful in estimating statistically significant substitute parameters of the theoretically expected sign; therefore, variables for substitute prices were omitted. Lastly, not all park units collect VSP data on whether a trip is multi- or single-destination. It was also reported that treating multi-site trips as though they were single-purpose will "systematically bias consumer surplus estimates upward *(*Martínez-Espiñeira and Amoako-Tuffour 2009).

Neher et al. estimated 58 new models of visitor WTP associated with recreational use of a wide spectrum of NPS units nationwide. These value estimates were used within a meta-regression analysis framework to predict mean WTP visitor values for the remaining NPS units with no survey data sufficient for WTP model estimation. Estimated WTP per NPS visit in 2011 averaged $102 system-wide and ranged across park units from $67 to $288. Total 2011 visitor WTP for the NPS system is estimated at $28.5 billion, with a 95 percent confidence interval of $19.7 to $43.1 billion. Additional values reported for sites mentioned as case studies in other literature reviewed herein are as follows for 2011: WTP per person per trip in USD for GSD and Yellowstone National Park (YNP) were $108.37 and $141.89, respectively.

One choice in parameters used in this study that sets it apart from Heberling and Templeton and had a strong impact on final WTP estimates is the choice of a travel cost value per mile. There is currently little consensus in the literature on the most appropriate construction of the travel cost variable, as the choices made in constructing the travel cost variable are highly influential.

3.6 Benson et al. (2013): "Who visits a national park and what do they get out of it?: A joint visitor cluster analysis and travel cost model for Yellowstone National Park"

This study also uses VSP data and builds upon Heberling and Templeton (2009); however, Benson et al. (2013) goes a step further to investigate how benefits vary by type of visitors who participate in different activities while at the park. This accounts for the heterogeneity of the visitors and how this heterogeneity likely influences the benefit they receive from their trip (Turner 2002). Visitor clusters were developed based on activities the visitors engaged in and were incorporated into a TCM to determine the economic value. In addition to the clusters, taste and preference variables were included in the TCM in order to evaluate the statistical and economic significances of the visitor profile variables and their effect on demand and benefit received. The four categories of taste and preference variables included (1) individual demographics such as age, race, ethnicity, disability, and education; (2) the size of the respondent's visitor group; (3) closely related goods, as proxied by spending inside the region on other goods; and (4) income.

Unlike Heberling and Templeton and Neher et al. (2013), this study deals with the multi-destination problem by excluding respondents for whom YNP was not their primary destination. And Benson et al. (2013) estimated the travel cost price variable at both one-third and one-fourth of the wage rate to test for sensitivity to opportunity cost specification. Using VSP data collected at YNP in the summer of 2006, the average benefit was estimated across all visitor cluster groups at between $235 and $276 per person per trip; whereas per trip benefits varied substantially across clusters. Economic value varied from $90 to $103 for the “value picnickers,” to $185–$263 for the “backcountry enthusiasts,” $189–$278 for the “do it all adventurists,” $204–$303 for the “windshield tourists,” and $323–$714 for the “creature comfort” cluster group. All estimates are in 2006 dollars.

4. Literature Review Findings and Application to Denali National Park and Preserve

4.1 Literature Review Findings

The six articles in this literature review were published between 2001 and 2013 and used data spanning multiple decades, between 1967 and 2011. The studies utilized both primary research and secondary data sources for estimating the travel costs of recreationists. The relevance and credibility of each are discussed in this section.

Rosenberger and Loomis (2001) and Kaval and Loomis (2003) both explored the use of the benefit transfer method to value recreation benefits, which uses secondary data. Rosenberger and Loomis provided a thorough critique of the benefit transfer method and identified factors limiting its use. Kaval and Loomis attempted to account for the limitations identified in the Rosenberger and Loomis and estimated the recreation value for various activities by separating the data from their studies into regions and activities. If the benefit transfer method were to be applied in DNP, both would provide useful guidance to maximize the credibility of the results.

Loomis (2006) also used secondary data from existing studies for both the TCM and CVM. The article evaluated the effect of multiple-destination trip itineraries on estimating recreation benefits and investigated a way to get around the inherent bias in values out of TCM when the data include multiple-destination users and further confirmed the results by comparing them to CVM derived values. This is a problem for the TCM because it will yield a biased estimate of the recreation benefits. Both Heberling and Templeton (2009) and Neher et al. (2013) deal with the multiple-destination trip problem by identifying the multiple-destination visitors in the sample and dropping them from the data set for the purposes of estimating the benefits per person (Smith & Kopp, 1980). However, this could lead to a biased estimate of total recreation site benefits if the multiple-destination visitors have substantially different benefits than single-destination visitors. Several solutions to this problem have been explored in the literature and are reviewed in Loomis (2006). This has implications for DNP because it is unique in that many of the visitors visit more than one national park while traveling throughout Alaska.

Heberling and Templeton (2009), Neher et al. (2013), and Benson et al. (2013) all evaluated the useful value of the VSP count data collected by the NPS for YNP. Although these data are not collected specifically for estimating travel cost, these studies demonstrated the feasibility of transforming and augmenting the count data for this purpose. Like DNP, YNP is particularly remote. The first national park in the world, YNP is a unique treasure known for its wildlife and its many geothermal features, especially Old Faithful geyser. These unique features might increase the generalizability of these findings to DNP.

Heberling and Templeton (2009) evaluated the economic value of national parks using visitor count data from GSD in Colorado. Like DNP, GSD is an especially unique treasure (largest sand dunes in North America) with a high rate of one-time/infrequent visitation, a predominance of group travel (only 7 percent traveling alone), and many visitors participating in multi-destination trips. Unlike DNP, GSD is in the contiguous 48 states and is relatively closer to population centers (i.e., not isolated economy). Heberling and Templeton argue that the data is still usable for certain research questions and that it could be duplicated for other available VSP data sets. Based on the similarities between DNP and GSD, it is possible this model could be used to estimate the visitation value of DNP as well.

Unlike Heberling and Templeton (2009), Neher et al. (2013) did not use the case study approach, but rather used visitor count data from 58 different park surveys to estimate 58 travel cost models. Whereas, Benson et al. (2013) also used existing data, but went a step further to analyze demographic characteristics of NPS visitors, as well as the value of activities that visitors participated in. Neher et al. (2013) suggested the use of data from a subset of NPS visitor surveys which include detailed questions on visitor travel in order to identify the most appropriate mileage cost parameter to use to construct travel cost variables. In the case of DNP, data appropriate for this purpose was collected in 2016 as part of the Collaborative Visitor Transportation Survey (Fix P.J. et al. 2018), which was collected to inform Federal Land Management Agencies on long-term transportation developments to provide access to public lands in Alaska.

The conclusion from the literature review is that there are limitations to using secondary data to extrapolate travel costs from other NPS sites because of the particularly unique nature of DNP as a travel destination. Although the benefit transfer method may be a cost-effective method, unique site characteristics decrease the generalizability, and therefore the validity and reliability of the TCM and CVM as applied in other studies focused on resources that are less comparable. The modes of travel and the travel itineraries of the average visitor to Alaska may be beyond comparison with other NPS destinations (e.g., GSD or YNP). Finally, although the value of the types of activities that individual visitors engage in at DNP might be transferable, the Denali Experience for many is something that is by many considered priceless.

4.2 Application to Denali National Park and Preserve

Recreation benefit values is measured by either consumer surplus or WTP. The recreation benefit values discussed in the articles reviewed may not wholly be applicable to recreation at DNP due to the uniqueness of the park. Nonetheless, to assign an economic value to DNP visitation, we have extrapolated the values identified in the articles and derived a value for DNP, as summarized in Table 2 and described below.

Five of the six articles reviewed contained recreation benefit values; Loomis 2006 did not include such values. To derive and estimate a total direct economic benefit of recreation visits at DNP, either the per person consumer surplus value or the per person WTP value in each of the articles (adjusted to 2019 dollars) was multiplied by the total annual recreation visitors to DNP in 2019 (n = 601,152[1]). These estimates are summarized in Table 2 and represent the estimated annual direct economic benefit associated with recreation at DNP. These values do not include indirect or induced economic values.

[1] 2019 DNP visitation numbers provided by Jennifer Johnston, DNP Outdoor Recreation Planner to Fatuma Yusuf, Jacobs economist, in email correspondence dated May 12, 2020

Table 2: Summary of Derived Total Annual Direct Recreation Benefits in DNP in 2019

Article	Type of Estimate (Consumer Surplus or WTP)	Per Visitor Value (Original Estimate from article)	Year of Original Per Visitor Value Estimate (from article)	Per Visitor Value (2019$ Estimate)	Estimated Total Annual Direct Recreation Benefits (Millions 2019 USD)[1]
Rosenberg and Loomis	Consumer Surplus	$29.95	1996	$46	$27.7
Kaval and Loomis	Consumer Surplus	$7, $12, $13, $41	1996	$11, $19, $20, $63	$31.2
Heberling and Templeton	Consumer Surplus	$89 (GSD)	2002	$123 (GSD)	$73.9
Neher et al.	WTP	$142 (YNP)	2011	$162 (YNP)	$97.4
Benson et al.	Consumer Surplus	$235 -$276	2006	$293 -$344	$176.1 - $206.8

[1] Total annual recreation benefit = Per visitor value (2019$) * 2019 DNP Recreation Visitors

The per visitor original estimates shown for Kaval and Loomis are those from Table 1; however, of the activities that were listed in Table 1 only four are assumed to be relevant to DNP. These four activities and their estimated value include: General Recreation ($12), Hiking ($13), Pleasure Driving ($7) and Wildlife Viewing ($41). Of the total 601,152 recreation visitors to DNP in 2019, Pleasure Driving was assumed to represent a very small percentage of visitors: estimated at 3,600 visitors. The 3,600 visitors are assumed to represent the annual fall lottery for which the NPS allows private vehicles to drive the park road. Of the remaining activities, the majority (75%) is assumed to be associated with Wildlife Viewing followed by General Recreation at 15% and Hiking at 10%. Multiplying these annual recreation visitor numbers by the average consumer surplus value per person in 2019 dollars results in a total annual economic benefit (direct) of $31.2 million.

Using the annual average consumer surplus estimates from Heberling and Templeton and Benson et al., derived total direct annual economic benefits associated with the 2019 DNP visitation levels are estimated at about $74 million and between $176 million and $207 million, respectively. Although Neher et al. presented several estimates of WTP, in this instance we've chosen to use the value assigned for YNP ($162). YNP has characteristics that are similar (e.g., uniqueness) to DNP when compared to GSD or any other park in the NPS system. As shown in Table 2, multiplying this value by the DNP visitation numbers results in a total annual economic benefit (direct) of nearly $98 million.

The extrapolation exercise described in this section suggests a total annual direct recreation economic value of 2019 DNP visitors could range between $28 million and $207 million. However, these numbers do not capture the total economic value of DNP. To estimate the total economic value or total economic contribution of DNP to Denali Borough's economy, the direct economic benefits would need to be used as inputs into an input-output regional economic model such as the IMPLAN model (IMPLAN Group LLC) to estimate the secondary economic benefits/impacts. The direct and secondary economic benefits would together represent the total economic contribution.

The estimates presented in Table 2 and discussed above are likely to under-represent the actual direct economic benefits of DNP. However, in the absence of data that has been specifically developed for DNP, these estimates give us an idea of the importance of DNP to both Denali Borough's economy and Alaska's economy.

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Memorandum

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Subject	**Existing Economic Activity Generators and Future Economic Opportunities**
Project Name	Cantwell to Healy Planning and Environmental Linkages (PEL Study) Parks Highway Mileposts 203-259
From	Fatuma Yusuf, Ph.D., Jacobs economist
Date	July 29, 2020
Copies to	Federal Highway Administration Western Federal Lands, Alaska DOT&PF Northern Region, and National Park Service Alaska Region

1. Introduction

The Federal Highway Administration Western Federal Lands in partnership with the Alaska Department of Transportation and Public Facilities (DOT&PF) and the National Park Service (NPS), are working together to identify potential future transportation and access improvements along the Parks Highway corridor (mileposts [MPs] 203 and 259).

The partnering agencies are conducting a Planning and Environmental Linkages (PEL) Study that will look at current and future conditions and needs of transportation and access facilities along the Parks Highway corridor as it relates to the users and communities in the areas between Cantwell and Healy.

As part of the PEL Study, it was desired to develop a planning-level economic impact assessment that will be used to guide in the prioritization of the site development and regional cooperation for leveraging public lands resources. The economic assessment consists of two parts:

1) A literature review of quantitative economic methods used to value the effects of travel and visitation at national parks whose characteristics are similar to Denali National Park and Preserve (DNP)
2) A characterization of the study area's (Denali Borough) existing demographics and economic activities and identification of future economic development opportunities

This technical memorandum, the second of the two related to economic assessment, describes the existing demographics and economic data including economic activity generators, as presented in Section 2. Section 3 identifies future economic generators from planning documents and studies. It also includes estimates of the total economic contribution or impact of DNP. Section 4 summarizes the findings.

2. Existing Demographics and Economics

Numerous federal and state data sets were reviewed to characterize the study area's economics. This includes, but is not limited to, the following key sources:

- Data from the U.S. Census Bureau (USCB) and the Alaska Department of Labor and Workforce Development (ADOLWD) were used to describe historical and current trends in population, median household incomes and poverty rates within the Denali Borough, the State of Alaska, and the United States (U.S.).
- Data from the U.S. Bureau of Labor Statistics (BLS) and the ADOLWD were used to describe the historical and current trends in labor force characteristics of the Denali Borough, the State of Alaska, and the U.S.
- Data from the U.S. Bureau of Economic Analysis (BEA) were used to characterize the historical and current trends in per capita income, employment by industry, and earnings by industry in the analysis area.
- Data from the Alaska Department of Commerce, Community and Economic Development (ADCCED) on bed tax revenues.
- Data from the NPS website on visitation to DNP in addition to visitation data from ADCCED.

Finally, to facilitate the evaluation of trends on income and tax data that are typically reported in current year, all the income and tax data were converted to real dollars, in 2019 dollars, using the gross domestic product implicit price deflator (BEA 2020a).

2.1 Population

The annual year-round population of Denali Borough has fluctuated very little over the past 20 years; it declined slightly by an average annual rate of 0.4 percent between 2000 and 2010 and increased slightly by an average annual growth rate of 0.2 percent between 2010 and 2019. Table 1 shows both the State of Alaska and the U.S. had higher growth rates during these two periods as well as the during the entire 19-year period.

Table1. Historical Population of Denali Borough Compared to the State of Alaska and the U.S. – 2000, 2010, and 2019

Area	2000	2010	2019	Average Annual Growth Rate (%)		
				2000-2010	2010-2019	2000-2019
Denali Borough	1,893	1,826	1,860	-0.4%	0.2%	-0.1%
State of Alaska	626,932	710,231	731,007	1.3%	0.3%	0.8%
United States	281,421,906	308,745,538	328,239,523	0.9%	0.7%	0.8%

Source: ADOLWD 2020a; USCB 2000, 2020a

ADOLWD provides population projections at 5-year intervals for regions, boroughs and census areas within the state. Based on the 2019 population estimate of 1,860, ADOLWD projects that Denali Borough's population will decline to 1,819 in 2020 before rebounding by 31 in 2025. The population in the borough and the state are projected to grow at an average growth of 0.2 percent and 0.4 percent, respectively, between 2025 and 2045. (ADOLWD 2020b)

The population in Denali Borough typically triples during the summer season when seasonal workers move to the area to provide labor to the tourism industry (Denali Borough 2018); and although some of these seasonal workers are interested in living in the borough permanently, the lack of adequate housing options and sustainable incomes prevents them from calling Denali Borough their permanent home.

2.2 Employment

Two estimates of employment are typically used to describe employment in an area: total civilian labor force and employment by industry. Civilian labor force data reflect the employment status of individuals by place of residence and include self-employed, employees on unpaid leave of absence, unpaid family workers, and household workers. Employment by industry data reflect jobs by place of work and exclude the self-employed, unpaid family workers, employees on leave of absence, and household workers. Individuals with more than one job are counted only once in civilian labor force data, and they are counted in each job in the employment by industry data.

Table 2 shows the civilian labor force characteristics for the borough, the state, and the country. The civilian labor force (composed of civilian employment and civilian unemployment) in the borough declined from 2000 to 2019, with the largest decline occurring in the 2000-2010 period. Civilian labor force increased between 2000 and 2010 in both the state and country and continued to increase in the country while declining in the state between 2010 and 2019. Annual unemployment rate was higher in the borough compared to the state and country during all the periods shown in Table 2, notably in 2010 at nearly 12 percent. However, as shown in Figure 1, the unemployment rate in the borough has been lower than that at the state during some of the years (e.g., 2005 through 2008) and was lower than the country's unemployment in 2009.

Table 2. Historical Labor Force Characteristics in the Denali Borough, the State of Alaska, and the U.S. – 2000, 2010, and 2019

Area	Civilian Labor Force			Unemployment Rate (%)		
	2000	2010	2019	2000	2010	2019
Denali Borough	1,342	1,011	1,038	7.3	11.9	8.5
State of Alaska	319,511	361,913	347,779	6.4	7.9	6.1
United States	142,583,000	153,889,000	163,539,000	4	9.6	3.7

Source: ADOLWD 2020c; BLS 2020a, 2020b

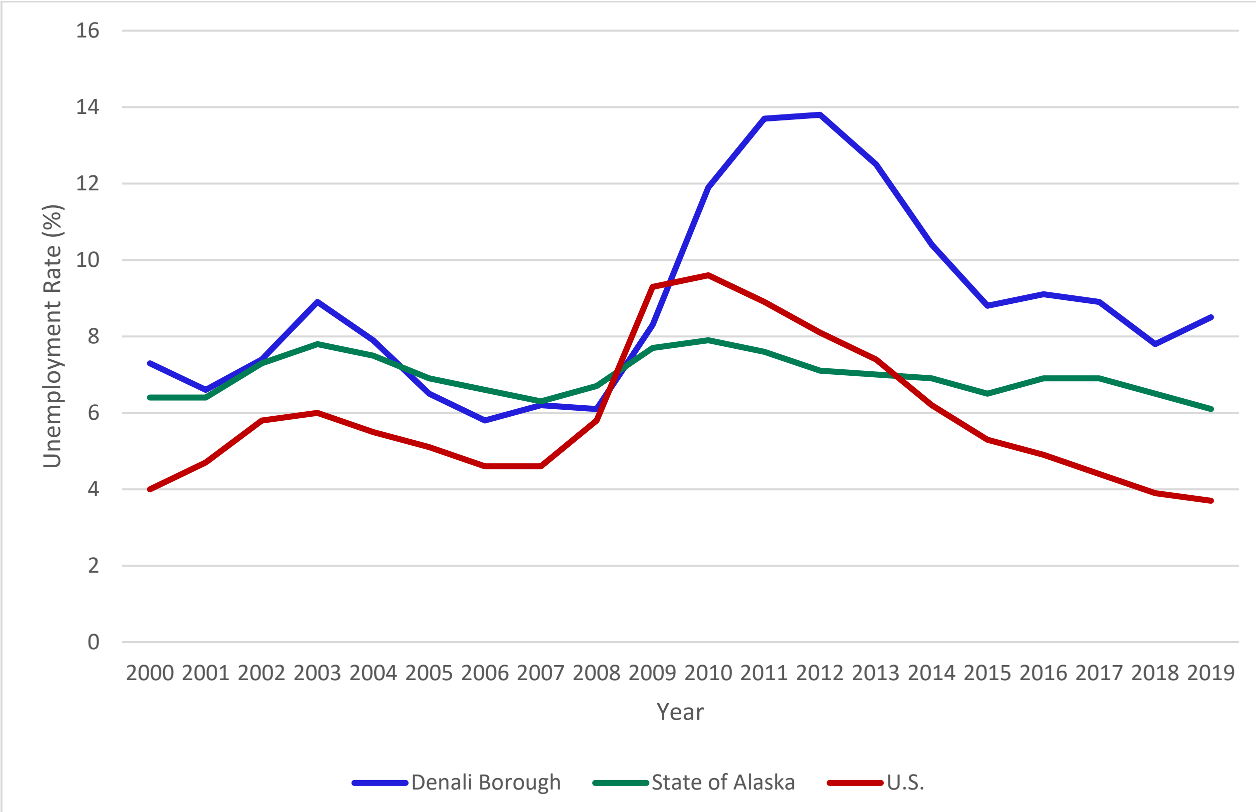

Figure 1. Historical Annual Unemployment Rates (%) in the Denali Borough, the State of Alaska, and the U.S. – 2000-2019

Source: ADOLWD 2020c; BLS 2020a, 2020b

While the annual unemployment rate shown in Figure 1 can give us a picture of where the economy is with respect to the civilian labor force when averaged over the entire year, it does not capture the cyclical nature of labor force needs within specific industries or areas. In the case of Denali Borough, employment follows seasonal patterns, with higher labor force and thus lower unemployment rates during the summer months and the reverse during the winter months. Figure 2 demonstrates the cyclical nature of employment and unemployment during 2019. In 2019, borough unemployment dipped below 5 percent in the summer months compared to more than 20 percent during winter months.

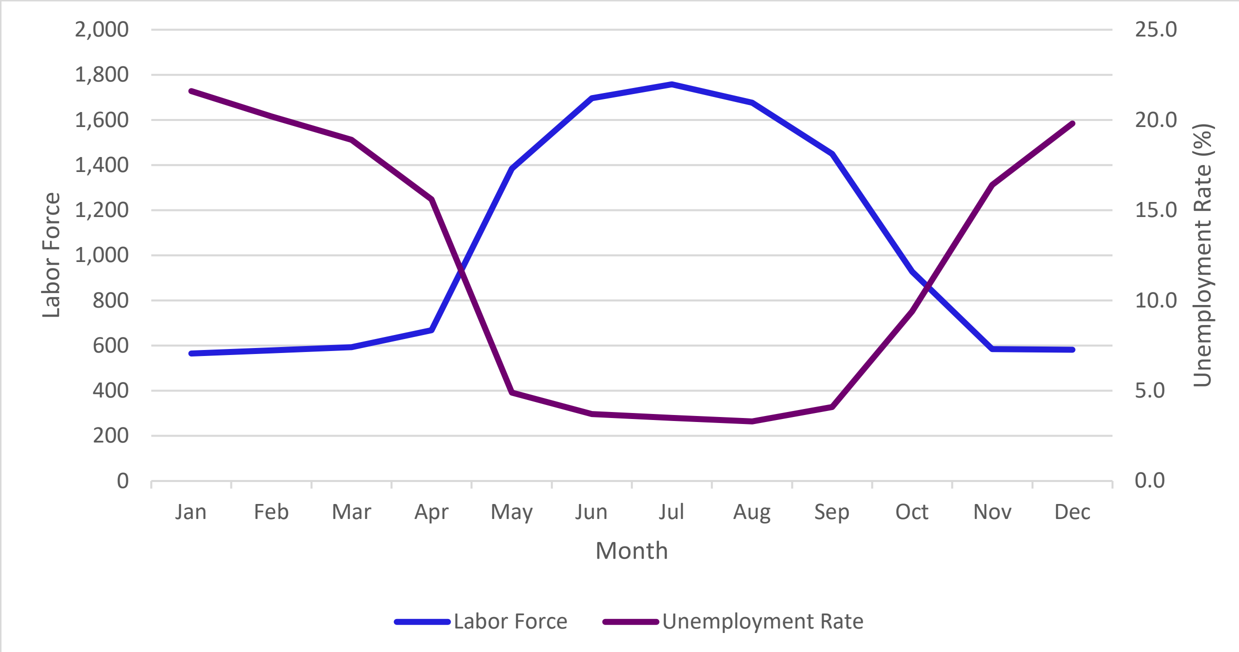

Figure 2. Monthly Labor Force and Unemployment Rates (%) in the Denali Borough – 2019
Source: BLS 2020b

The BEA reports annual full and part-time employment by industry data at the state and county (borough in the case of Alaska) level. Some industries did not report data for some of the years to avoid disclosure of confidential information or because the data was not available. However, employment estimates for those industries are included in higher-level totals reported in this memorandum. The same limitations exist with the income by industry data presented in the next section regarding incomes.

At-a-Glance Denali Borough Employment

In 2018, the following two subsectors comprised 50 percent of total Borough industry jobs: Accommodation/Food Services and Arts/Entertainment/Recreation.

Compare this to the state, in which these two subsectors comprise 10 percent of total jobs.

Because of compatibility issues between the pre-2001 data, which used the Standard Industrial Classification Code to classify industry sectors and the post-2001 data which uses the North American Industry Classification System (NAICS) Code, the employment industry data shown in Table 3 starts in 2001. The average annual employment by industry for the Denali Borough is concentrated in the services and government sectors. These two sectors account for about two-thirds of all jobs in the borough. Of the four subsectors that fall within the Services sector as shown in Table 3, the accommodation and food services subsector has the highest employment accounting for nearly 40 percent of Services sector jobs (BEA 2020b). In 2001, an estimated 780 jobs out of 2,129 (or 37 percent of total employment) were in the accommodation and food services subsector. That number increased to 1,089 out of 2,498 in 2018, which is about 44 percent of the total employment. The next highest contributor is the arts, entertainment and recreation subsector, and based on the available data (for 2001 and 2010), this subsector contributed about 6 percent and 10 percent, respectively, of the total service sector employment. The accommodation and food services and the arts, entertainment and recreation subsectors are the two subsectors in the services sector most identified with recreation and tourism. Combined, these two subsectors accounted for about 95 percent and 90 percent in 2001 and 2018, respectively, of the total service sector jobs. With respect to total jobs, these two subsectors accounted for about 50 percent of total employment. Based on the available data it looks like the contribution from these two subsectors to the total employment is increasing. This implies that the borough's reliance on service sector jobs is increasing as evidenced by the average annual growth rates of employment in these subsectors of 2 percent and 6.6 percent during the 2001-2018 period. However, without the 2010 data for both subsectors, this cannot be determined conclusively.

The contribution of government sector employment to the borough's total employment has been declining: it was 23 percent in 2001, 19 percent in 2010, and 16 percent in 2018. Most of this decrease in government sector jobs has been driven by declining employment in the federal government, particularly in military employment which decreased by an average annual rate of 6 percent between 2001 and 2018. Between 2001 and 2010, military employment in the borough declined by more than 100 jobs before bouncing back slightly between 2010 and 2018. Federal government jobs declined by about 3 percent in average annual terms between 2001 and 2010 and by about 1 percent between 2010 and 2018. In 2001, employment in the federal and state governments accounted for three out of four government jobs, but with the decline in federal government jobs, these two subsectors now account for two out of every three government jobs. Local government employment grew at an average annual rate of 0.5 percent and 0.8 percent during the 2001-2010 and 2010-2018 periods, respectively. Over the 2001-2018 period, local government employment grew at an average annual rate of 0.7 percent.

Table 3. Full- and Part-time Employment Numbers by Industry, Denali Borough, Alaska – 2001, 2010, and 2018

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018
Agriculture[1]	6	6	8	0.0%	3.7%	1.7%
Mining, Quarrying, and Oil and Gas Extraction	(D)	(D)	(D)	NA	NA	NA
Construction	17	(D)	45	NA	NA	5.9%
Manufacturing	20	23	(D)	1.6%	NA	NA
Wholesale Trade	6	7	12	1.7%	7.0%	4.2%
Retail Trade	87	(D)	148	NA	NA	3.2%
Transportation, Warehousing, and Utilities[2]	(D)	121	(D)	NA	NA	NA
Information	(D)	5	(D)	NA	NA	NA
FIRE[3]	19	(D)	(D)	NA	NA	NA
Services[4]	873	*88*[5]	1,378	NA	NA	2.7%
Accommodation and Food Services	780	(D)	1,089	NA	NA	2.0%
Arts, Entertainment, and Recreation	51	(D)	150	NA	NA	6.6%
Health Care and Social Assistance	27	25	38	-0.9%	5.4%	2.0%
All Other Services	(D)	(D)	92	NA	NA	NA
Government	486	415	402	-1.7%	-0.4%	-1.1%
Federal Government	343	263	243	-2.9%	-1.0%	-2.0%
Federal Civilian	212	248	198	1.8%	-2.8%	-0.4%

Table 3. Full- and Part-time Employment Numbers by Industry, Denali Borough, Alaska – 2001, 2010, and 2018

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018
Military	131	15	45	-21.4%	14.7%	-6.1%
State Government	20	23	21	1.6%	-1.1%	0.3%
Local Government	123	129	138	0.5%	0.8%	0.7%
Total Employment[6]	**2,129**	**2,188**	**2,498**	**0.3%**	**1.7%**	0.9%

Source: BEA 2020b

[1] Includes earnings in forestry, fishing, and related activities.

[2] The estimates associated with transportation are characterized by (D) in 2001 and 2018 while those associated with utilities are characterized by (D) in all 3 years shown. These estimates are not included in the totals shown for this sector.

[3] FIRE is a combination of the sectors: finance, insurance, real estate, rental, and leasing.

[4] Totals shown for this sector exclude estimates for several of the subsectors whose estimates were characterized by (D) in each of the 3 years shown in the table.

[5] Total missing estimates for the accommodation and food services subsector which accounts for 37% and 45% of totals shown for the service sector in 2001 and 2018. This subsector was marked (D) in 2001 and 2018.

[6] Totals for each year may not add up to the total shown. This is because of some of the earnings estimates within some of the sectors being marked (D).

Data are marked with (D) to avoid disclosure of confidential information. However, the estimates are included in the totals.

NA = Not applicable because all or some underlying data are characterized as (D).

Table 4 presents similar data to the previous table but on the state level; this includes the annual full- and part-time employment by industry in Alaska for 2001, 2010, and 2018. The transportation, warehousing and utilities; services; government; and construction sectors accounted for about 60 percent of the total employment in Alaska in each of the years shown in the table (BEA 2020b). The accommodation and food services subsector accounts for about 7 percent of total jobs in the state compared to the 40 percent in the borough. About six in ten government jobs within the state are in the federal and state government while the remaining four in ten jobs are in local government. Employment in the federal government grew (at an average annual rate of 1.7 percent) between 2001 and 2010 and declined (at an average annual rate of 1.1 percent) during the 2010-2018 period. Over the 2001-2018 period, employment in the federal government grew at an average annual rate of 0.3 percent. Military employment accounted for the majority of the job growth between 2001 and 2010 while federal civilian employment accounted for most of the decline in federal government employment between 2010 and 2018. State government employment followed the same trend by growing between 2001 and 2010 and declining in the 2010-2018 period. Local government showed continued growth during both periods; however, the growth during the latter period was much smaller.

Table 4. Full- and Part-time Employment Numbers by Industry, Alaska – 2001, 2010, and 2018

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018
Agriculture[1]	775	13,135	11,637	NA	-1.5%	17.3%
Mining, Quarrying, and Oil and Gas Extraction	(D)	17,782	16,586	NA	-0.9%	NA
Construction	22,339	24,026	23,613	0.8%	-0.2%	0.3%
Manufacturing	14,326	14,940	15,628	0.5%	0.6%	0.5%
Wholesale Trade	7,184	7,211	7,198	0.0%	0.0%	0.0%
Retail Trade	42,401	43,647	45,302	0.3%	0.5%	0.4%
Transportation, Warehousing, and Utilities	24,234	24,706	29,264	0.2%	2.1%	1.1%
Information	8,144	7,418	6,828	-1.0%	-1.0%	-1.0%
FIRE[2]	21,470	26,673	29,112	2.4%	1.1%	1.8%
Services[3]	113,262	156,182	171,143	3.6%	1.2%	2.5%
Accommodation and Food Services	28,158	31,365	36,131	1.2%	1.8%	1.5%
Arts, Entertainment, and Recreation	8,632	10,067	11,242	1.7%	1.4%	1.6%
Health Care and Social Assistance	33,873	46,365	53,035	3.5%	1.7%	2.7%
All Other Services	42,599	68,385	70,735	5.4%	0.4%	3.0%
Government	97,328	108,184	102,867	1.2%	-0.6%	0.3%
Federal Government	38,386	44,590	40,676	1.7%	-1.1%	0.3%
Federal Civilian	16,375	17,588	14,893	0.8%	-2.1%	-0.6%
Military	22,011	27,002	25,783	2.3%	-0.6%	0.9%
State Government	23,082	25,352	23,581	1.0%	-0.9%	0.1%
Local Government	35,860	38,242	38,610	0.7%	0.1%	0.4%
Total Employment[4]	**394,565**	**443,904**	**459,178**	1.3%	0.4%	0.9%

Source: BEA 2020b

[1] Includes employment in forestry, fishing, and related activities. The estimates associated with forestry, fishing and related activities are characterized by (D) in 2001, thus the number shown excludes these numbers.

[2] FIRE is a combination of the sectors: finance, insurance, real estate, rental, and leasing.

[3] Total missing estimates for the others services subsector. This subsector is marked (D) in 2001 and accounts for about 4% of totals shown for the service sector in 2001.

[4] Totals for each year may not add up to the total shown. This is because of some of the earnings estimates within some of the sectors being marked (D).

Table 4. Full- and Part-time Employment Numbers by Industry, Alaska – 2001, 2010, and 2018

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018

Data are marked with (D) to avoid disclosure of confidential information. However, the estimates are included in the totals.

NA = Not applicable because all or some underlying data are characterized as (D).

2.3 Income

Three measures of income are presented in this memorandum. These three measures, which are discussed separately in the following subsections, are median household income, per capita income, and income by industry. Additionally, poverty rates are also included in this discussion.

2.3.1 Median Household Income

Table 5 shows the real median household incomes (in 2019 dollars) for the Denali Borough, the state and the country. Between 2000 and 2010, real median household incomes declined at an average annual rate of 0.7 percent in Denali Borough and 0.3 percent in the country while remaining unchanged in the state. The Great Recession could partially be responsible for the lower median household incomes in 2010 (Federal Reserve Bank 2013). Post 2010, real median household incomes in both the borough and the country grew at slightly higher rates (0.7 percent) than the state (0.1 percent). Over the 2000-2018 period, real median income in the borough declined by an average annual rate of 0.1% while it grew by an average annual rate of 0.1% in both the state and the country.

Table 5. Real Median Household Incomes Denali Borough Compared to State of Alaska and the U.S. – 2000, 2010, and 2018 (in 2019 dollars)

Area	2000	2010	2018	Average Annual Growth Rate (%)		
				2000-2010	2010-2018	2000-2018
Denali Borough	$75,077.06	$70,086.27	$74,183.72	-0.7%	0.7%	-0.1%
State of Alaska	$72,737.93	$72,903.33	$73,628.40	0.0%	0.1%	0.1%
United States	$59,383.38	$57,496.85	$60,875.73	-0.3%	0.7%	0.1%

Source: USCB 2020b; BEA 2020c

2.3.2 Per Capita Income

Figure 3 shows the real per capita income (in 2019 dollars) for the Denali Borough and Alaska. The borough's real per capita income is higher than the state's per capita income, and the difference between the two is greater after 2009. This suggests that the borough was somewhat sheltered from the effects of the Great Recession and the regional recession that followed the decline in oil prices, a major revenue source for the state, in 2014.

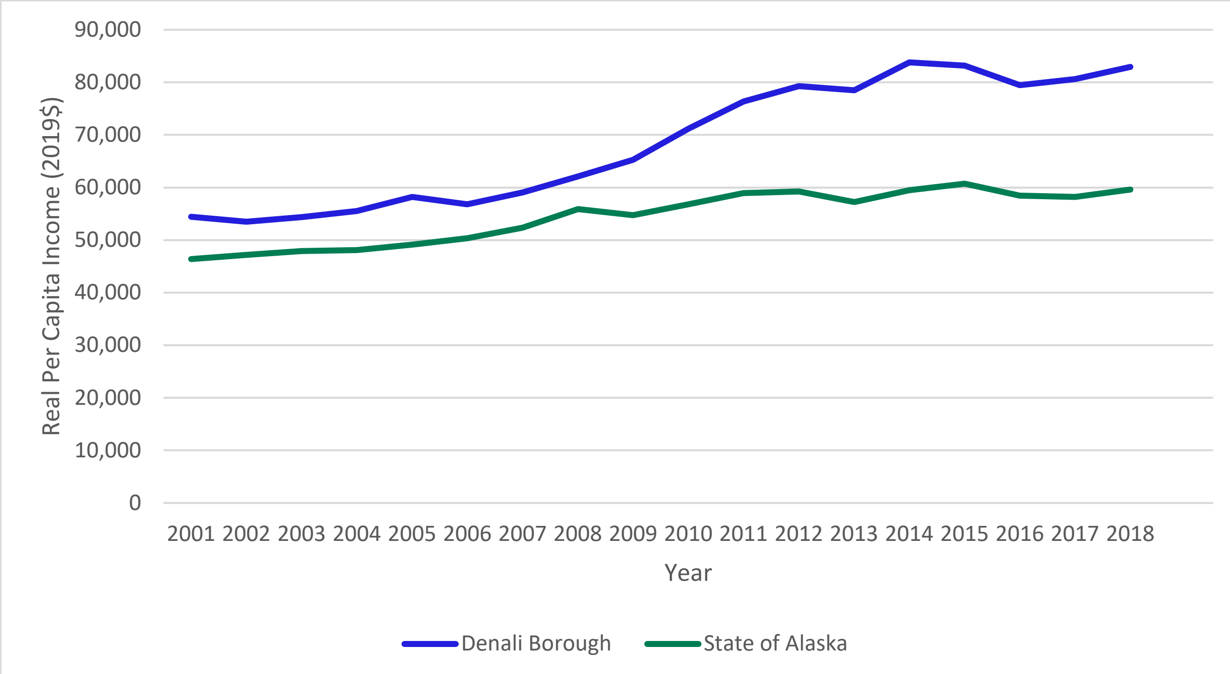

Figure 3. Real Per Capita Income in the Denali Borough and State of Alaska – 2001-2018 (in 2019 dollars)

Source: BEA 2020a, 2020c

2.3.3 Poverty Rates

Poverty rates in 2000, 2010, and 2018 for the borough, state, and nation are summarized in Table 6. Denali Borough had the lowest poverty rates for all 3 years shown in Table 6. Despite the lower comparable rates, the borough's poverty rates have been increasing. The borough's poverty rate increased by an average annual rate of 1.6 percent and 2.6 percent during the 2000-2010 and 2010-2018 periods, respectively. The nation's poverty rate grew during the 2001-2010 period before declining during the 2010-2018 period. Over the 2000-2018 period, poverty rates increased by an average annual rate of 2.0 percent, 1.5 percent and 0.8 percent, in the borough, state and nation, respectively.

Table 6. Poverty Rates, Denali Borough Compared to State of Alaska and the U.S. – 2000, 2010, and 2018

Area	2000	2010	2018	Average Annual Growth Rate (%)		
				2000-2010	2010-2018	2000-2018
Denali Borough	4.8	5.6	6.9	1.6%	2.6%	2.0%
State of Alaska	8.5	11.0	11.1	2.6%	0.1%	1.5%
United States	11.3	15.3	13.1	3.1%	-1.9%	0.8%

Source: USCB 2020b

2.3.4 Earnings by Industry

Real annual earnings (in 2019 dollars) by industry for the Denali Borough and Alaska in 2001, 2010, and 2018 are presented in Tables 7 and 8. Real earnings by industry in the Denali Borough grew at a slightly slower rate after 2010. Earnings in the services and government sectors accounted for about half to two-thirds of the total real industry earnings in the borough. These two sectors are also the sectors that contribute the largest number of jobs in the borough (Table 3). Earnings in the government sector accounted for about a quarter of the borough's total industry earnings in each of the 3 years shown in the table and, within the government sector, about 70 percent of the earnings were from the federal government. A majority of these federal government sector earnings are associated with the federal civilian subsector. Earnings in the federal civilian subsector grew at 3.4 percent annually between 2001 and 2010 and declined by about 2 percent between 2010-2018. Over the 2001-2018 period, earnings in the federal civilian subsector grew at an average annual rate of about 1 percent. Earnings in the military subsector declined by an average annual rate of about 21 percent during the 2001-2010 period before bouncing back during the 2010-2018 period when earnings grew at an average annual rate of about 18 percent. Over the 2001-2018 period, earnings in the military subsector declined at an average annual rate of about 5 percent.

Within the services sector in the borough, the highest contribution to real industry earnings is from the accommodation and food services subsector. Based on the available data, earnings in this subsector accounted for 92 percent in 2001 and 84 percent in 2018 of all service sector earnings (BEA 2020c). The next highest contributor is the arts, entertainment and recreation subsector, and based on the available data (for 2001 and 2018), this subsector contributed about 6 percent of the total service sector earnings. Thus, these two subsectors that are most identified with recreation and tourism accounted for about 97 percent and 81 percent in 2001 and 2018, respectively. Based on the available data, these two subsectors grew at average annual rates of 3.5 percent and 7.1 percent respectively, between 2001 and 2018.

Alaska's real earnings by industry is primarily driven by the services and government sectors (Table 8). Earnings in these two sectors accounted for about 50 percent to 60 percent of total real earnings within the state. These two sectors are also among the sectors contributing the largest number of jobs in the state (Table 4). Earnings in the government sector accounted for about 30 percent of total industry earnings within the state and, within the government sector, federal government earnings accounted for about 40 percent. The proportion of earnings from the civilian federal subsector declined slightly from 54 percent in 2001 to about 46 percent in 2018, while that from the military increased from about 46 percent in 2001 to about 54 percent in 2018. Average annual growth rate in military subsector earnings (6.9 percent) was about three times that in the federal civilian subsector (2.4 percent) during the 2001-2010 period. Both the military and federal civilian subsectors experienced negative earnings growth during the 2010-2018 period.

Unlike the borough and based on the available data, the state's real earnings from the accommodation and food services subsector was lower; it was about 17 percent, 12 percent, and about 13 percent in 2001, 2010, and 2018, respectively, of the total service sector earnings (BEA 2020c). Based on the available data, the combined contribution from the accommodation and food services and the arts, entertainment and recreation subsectors was 20 percent in 2001, 14 percent in 2010 and 15 percent in 2018 of the overall service sector earnings. In terms of annual growth rates, the accommodation and food services and the arts, entertainment and recreation subsectors grew at 1.4 percent and 3.9 percent respectively, between 2001 and 2018. These growth rates are significantly lower than those observed in the borough during the same period, i.e., 3.5 percent and 7.1 percent, respectively.

Table 7. Real Earnings by Industry, Denali Borough, Alaska (thousands in 2019 dollars)

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018
Agriculture[1]	6	156	90	NA	-6.6%	17.9%
Mining, Quarrying, and Oil and Gas Extraction	(D)	(D)	(D)	NA	NA	NA
Construction	385	(D)	2,620	NA	NA	11.9%
Manufacturing	257	383	(D)	4.5%	NA	NA
Wholesale Trade	141	43	727	NA	NA	10.1%
Retail Trade	2,556	(D)	3,827	NA	NA	2.4%
Transportation, Warehousing, and Utilities[2]	(D)	6,565	(D)	NA	NA	NA
Information	(D)	147	(D)	NA	NA	NA
FIRE[3]	72	(D)	(D)	NA	NA	NA
Services[4]	29,864	1,759	66,413	NA	NA	4.8%
Accommodation and Food Services	27,512	(D)	49,146	NA	NA	3.5%
Arts, Entertainment, and Recreation	1,500	(D)	4,786	NA	NA	7.1%
Health Care and Social Assistance	739	765	1,176	0.4%	5.5%	2.8%
All Other Services	113	994	11,306	NA	NA	NA
Government	35,570	35,991	37,147	0.1%	0.4%	0.3%
Federal Government	26,540	25,217	24,635	-0.6%	-0.3%	-0.4%
Federal Civilian	17,968	24,183	20,806	3.4%	-1.9%	0.9%
Military	8,572	1,034	3,828	-20.9%	17.8%	-4.6%
State Government	2,328	2,687	2,637	1.6%	-0.2%	0.7%
Local Government	6,702	8,087	9,876	2.1%	2.5%	2.3%
Total Industry Earnings[5]	**119,709**	**139,117**	**155,599**	**1.7%**	**1.4%**	1.6%

Source: BEA 2020a, 2020c

[1] Includes earnings in forestry, fishing, and related activities. The estimates associated with forestry, fishing and related activities are characterized by (D) in 2001.

[2] The estimates associated with transportation are characterized by (D) in 2001 and 2018, while those associated with utilities are characterized by (D) in all 3 years shown. These estimates are not included in the totals shown for this sector.

[3] FIRE is a combination of the sectors: finance, insurance, real estate, rental, and leasing.

[4] Totals shown for this sector exclude estimates for one or more subsector whose estimates were characterized by (D) in each of the 3 years shown in the table. In 2010, estimates for the accommodation and food services

Table 7. Real Earnings by Industry, Denali Borough, Alaska (thousands in 2019 dollars)

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018

subsector; and the art, entertainment, and recreation subsector, were not available, thus the low total for the service sector estimate shown in the table.

[5] Totals for each year may not add up to the total shown. This is because of some of the earnings estimates within some of the sectors being marked (D).

Data are marked with (D) to avoid disclosure of confidential information. However, the estimates are included in the totals.

NA = Not applicable because all or some underlying data are characterized as (D).

Table 8. Real Earnings by Industry, Alaska (thousands in 2019 dollars)

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018
Agriculture[1]	27,686	478,140	452,270	NA	-0.7%	17.9%
Mining, Quarrying, and Oil and Gas Extraction	(D)	2,496,421	2,384,723	NA	-0.6%	NA
Construction	1,912,697	2,625,265	2,160,777	3.6%	-2.4%	0.7%
Manufacturing	736,313	830,123	942,227	1.3%	1.6%	1.5%
Wholesale Trade	465,894	497,985	520,405	0.7%	0.6%	0.7%
Retail Trade	1,907,179	1,775,692	1,664,499	-0.8%	-0.8%	-0.8%
Transportation, Warehousing, and Utilities	1,771,756	2,166,658	2,372,286	2.3%	1.1%	1.7%
Information	566,274	492,133	530,206	-1.5%	0.9%	-0.4%
FIRE[2]	1,039,376	1,488,636	1,227,452	4.1%	-2.4%	1.0%
Services[3]	5,231,922	8,437,948	9,180,182	5.5%	1.1%	3.4%
Accommodation and Food Services	895,332	1,038,021	1,143,578	1.7%	1.2%	1.4%
Arts, Entertainment, and Recreation	125,261	177,549	238,103	4.0%	3.7%	3.9%
Health Care and Social Assistance	1,926,561	3,089,745	3,879,578	5.4%	2.9%	4.2%
All Other Services	2,284,768	4,132,633	3,918,924	NA	-0.7%	3.2%
Government	7,279,432	9,707,915	9,635,008	3.3%	-0.1%	1.7%
Federal Government	2,839,218	4,283,464	3,830,052	4.7%	-1.4%	1.8%
Federal Civilian	1,541,813	1,913,670	1,745,339	2.4%	-1.1%	0.7%

Table 8. Real Earnings by Industry, Alaska (thousands in 2019 dollars)

Industry Sector	2001	2010	2018	Average Annual Growth Rates (%)		
				2001-2010	2010-2018	2001-2018
Military	1,297,405	2,369,795	2,084,713	6.9%	-1.6%	2.8%
State Government	1,879,578	2,366,516	2,320,425	2.6%	-0.2%	1.2%
Local Government	2,560,636	3,057,935	3,484,531	2.0%	1.6%	1.8%
Total Industry Earnings[4]	**23,566,888**	**30,996,915**	**31,070,035**	**3.1%**	**0.0%**	1.6%

Source: BEA 2020a, 2020c

[1] Includes earnings in forestry, fishing, and related activities. The estimates associated with forestry, fishing and related activities are characterized by (D) in 2001.

[2] FIRE is a combination of the sectors: finance, insurance, real estate, rental, and leasing.

[3] Total shown for this sector in 2001 excludes estimates for one subsector whose estimates were characterized by (D). These estimates for this subsector are included in the totals shown for all other services in 2010 and 2018 but are missing from the 2001 total.

[4] Totals for each year may not add up to the total shown. This is because of some of the earnings estimates within some of the sectors being marked (D).

Data are marked with (D) to avoid disclosure of confidential information. However, the estimates are included in the totals.

NA = Not applicable because all or some underlying data are characterized as (D).

2.4 Economic Activity Generators

The *Denali Borough Land Use and Economic Development Plan* (Denali Borough 2018) characterizes the borough's economic base as a "three-legged stool," referring to the borough's dependence on resource development, military spending, and tourism. While resource development and military spending are important in providing year-round, well paid jobs, the contribution of these two sectors is small relative to the tourism sector. Subsections 2.2 and 2.3.4 present data on the government sector and provide a discussion of the contribution of this sector to the borough's economy. The discussion also contrasts the importance of the government sector to borough's economy with its importance to the Alaskan economy. The BEA database does not publish data specific to the resource development sector (i.e., mining, quarrying, oil and gas extraction) for the borough to avoid disclosure of confidential information. Thus, the importance of this sector to the borough's economic base is determined through information from other sources such as specific documents or studies of the borough. These are discussed in subsection 2.4.2. The following subsections discuss each of these three contributing sectors and quantify the contribution of each to the borough's economy from sources other than the BEA sources that are presented in Subsections 2.2 and 2.3.

2.4.1 Tourism

Tourism in the borough is centered around exploring DNP and surrounding scenic and recreational areas. While the data and discussion presented in the Subsection 2.2, Employment, and Subsection 2.3.4, Earnings by Industry, demonstrate the aggregate contribution of the tourism industry to both the borough's and Alaska's economies, understanding the underlying data and how these data have changed over the past decade or two helps inform the predictions on future contribution of this sector to the borough's economy.

2.4.1.1 General Visitation Trends

The Alaska tourism industry is multi-faceted and includes a substantial number of visitors traveling to Alaska's 15 NPS units, which includes DNP; an article written for the NPS Alaska Park Science publication indicated summer 2001 tourism visitation data showed more than half of the total amount spent by tourists in Alaska comes from people who visit Denali (NPS 2017).

The Alaska Visitor Statistics Program (AVSP) is a statewide visitor study periodically commissioned by the ADCCED. The study provides "essential information on one of Alaska's major economic engines: out-of-state visitors" (ADCCED 2017a). The most recent study (AVSP 7) was completed in 2016 and provides information on visitor volume and results from a visitor survey. The visitor survey, which was administered to a sample of out-of-state visitors at major exit points, provides information on "trip purpose, transportation modes used, length of stay, destination, lodging, activities, expenditures, satisfaction, trip planning, and demographics".

The AVSP indicated approximately 1.85 million nonresident visitors to Alaska during summer 2016, of which 55 percent arrived as part of the cruise ship industry. The visitor survey indicated that 31 percent of day or overnight visitors to Denali traveled to Alaska by a combination of highway and ferry, about 26 percent used air transportation and 20 percent came on cruise ships in 2016. The average length of stay in Alaska for vacation or pleasure visitors was estimated at 8.7 nights. (ADCCED 2017a)

2.4.1.2 Denali National Park and Preserve Visitation

The Denali Park Road, the sole roadway into DNP, intersects the Parks Highway at MP 237. Visitors to DNP arrive largely by the Parks Highway or the Alaska Railroad. The Parks Highway is the sole roadway that provides access to DNP.

Figure 4 shows the trend in the annual recreation visitors to DNP over the past 20 years. Although visitation numbers declined during some of the years from what they were in the immediately preceding year, the overall trend has been upward, characterized by an average annual growth rate of 2.7 percent over the 20-year period. The lowest number of visitors (311,335) was in 2002, while the highest (642,809) was in 2017. The decline in visitation in 2008 and 2009 is most likely related to the effects of the Great Recession on nonresident visitors (either from other parts of the U.S. or the world) to the park (ADCCED 2017a; ADOLWD 2010).

Figure 4. Denali National Park and Preserve Annual Recreation Visitors – 2000-2019

Source: NPS 2020a

Historic visitation to DNP extending back even earlier to 1922 is depicted in Figure 5, as extracted from the NPS' long-range transportation plan prepared in 2018 for DNP. With the opening of the Parks Highway in 1971, visitation to DNP began to increase. DNP visitation and associated spending is clearly the key economic driver in the borough. The Parks Highway is critical to DNP visitation, as evidenced in Figure 5 that depicts the visitation increase when the Parks Highway opened.

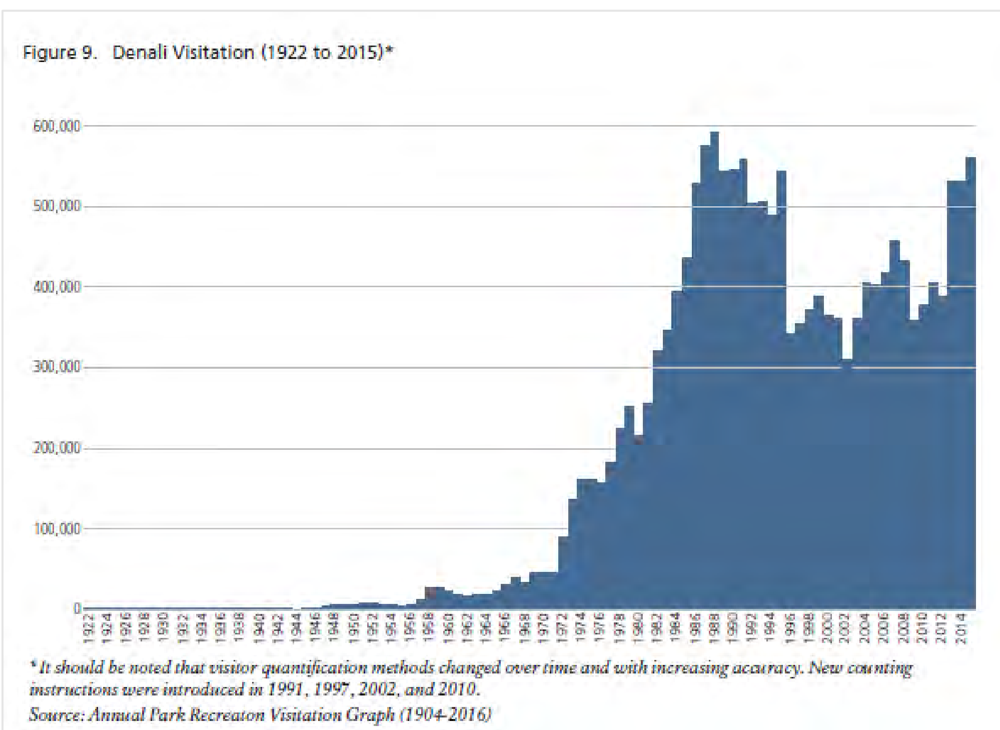

Figure 5. Denali National Park and Preserve Historic Annual Visitation – 1922-2015

Source: NPS 2018

Figure 6 shows the trend in monthly recreation visitors to the DNP over the past 20 years. In general, visitation has been trending upwards for most months for each of the past 20 years. The highest visitation is during the summer months of June, July and August. The next busiest months are September followed by May. Visitation is typically lower during the late fall through early spring though even these months have seen an uptick in the number of recreation visitors.

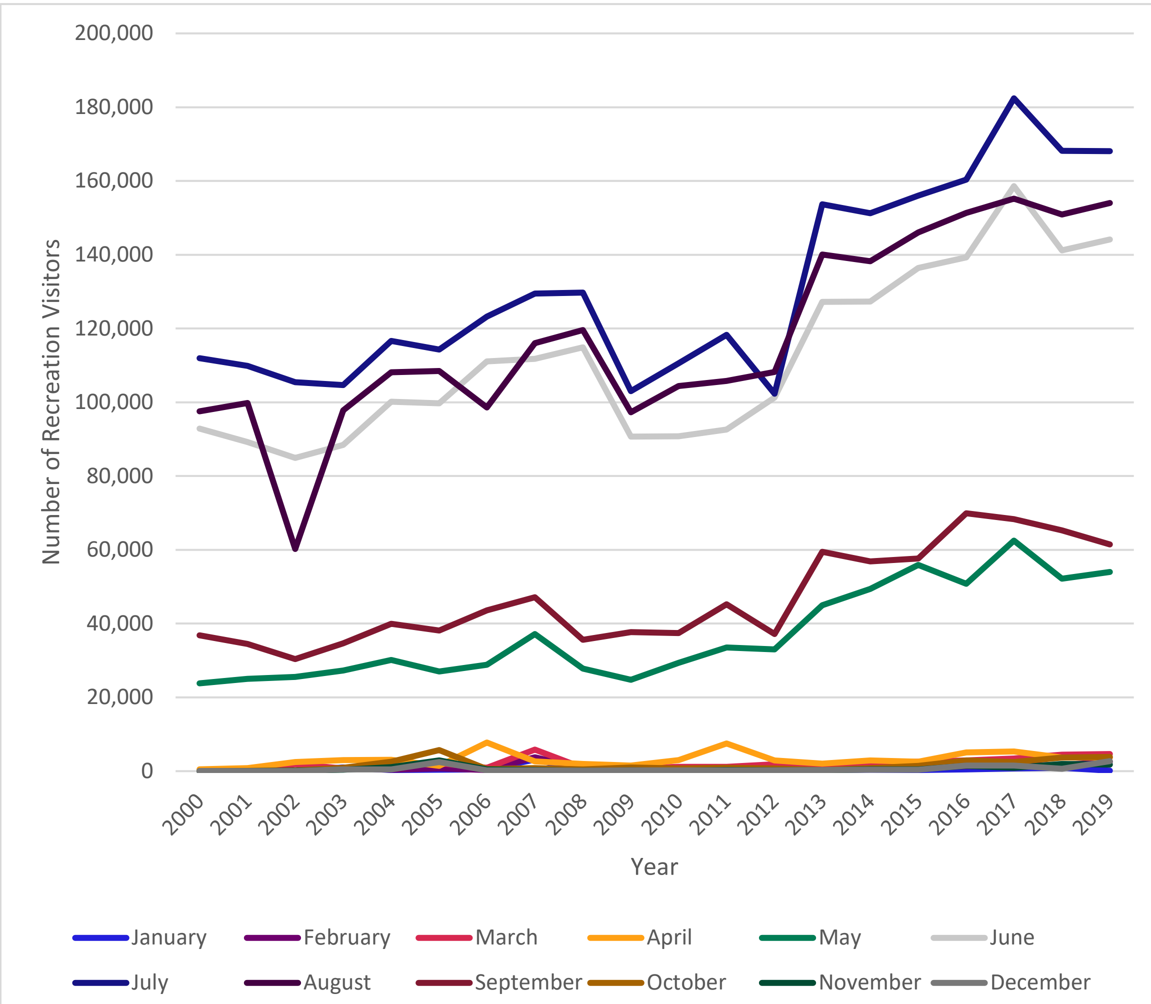

Figure 6. Monthly Recreation Visitors to Denali National Park and Preserve – 2000-2019
Source: NPS 2020a

The study corridor has also seen an increase in winter recreation and tourism in recent years. From fall 2012 to spring 2019, visitation to DNP between October and April grew by approximately 400 percent to 17,296 visitors during the 2018-2019 winter and shoulder seasons (NPS 2020b). The increase in visitation during winter and shoulder seasons has resulted in the creation of new business opportunities in the area around DNP such as snow machine tours, cross country skiing, and aurora viewing (Denali Borough 2018).

Figure 7 summarizes the total annual recreation fees and concession franchise fee (CFF) revenues (in 2019 dollars) for DNP between 2013 and 2019. The recreation fee revenues are generated from park entrance fees, while the CFF is the money that the park collects as a percentage of the commercial activity that takes place in the park. The park collects approximately 13 percent of the revenue from primary commercial operator/transportation system providers and between 3 percent and 13 percent from smaller contractors (e.g., guided hunting, flightseeing). About 77 percent of the recreation fee revenues and 80 percent of the CFF revenues are allocated to DNP; the remaining 23 percent and 20 percent of these revenues are distributed across the NPS system. For all years shown in the figure, CFF revenues are higher than the recreation fees revenues. The recreation fee and CFF revenues peaked at about $3.9 million and $5.4 million, respectively, in 2018. Because the proportion of these fees that are allocated to the park is fixed, the trend in the fee available to DNP mirrors that for the total recreation fee and CFF revenues.

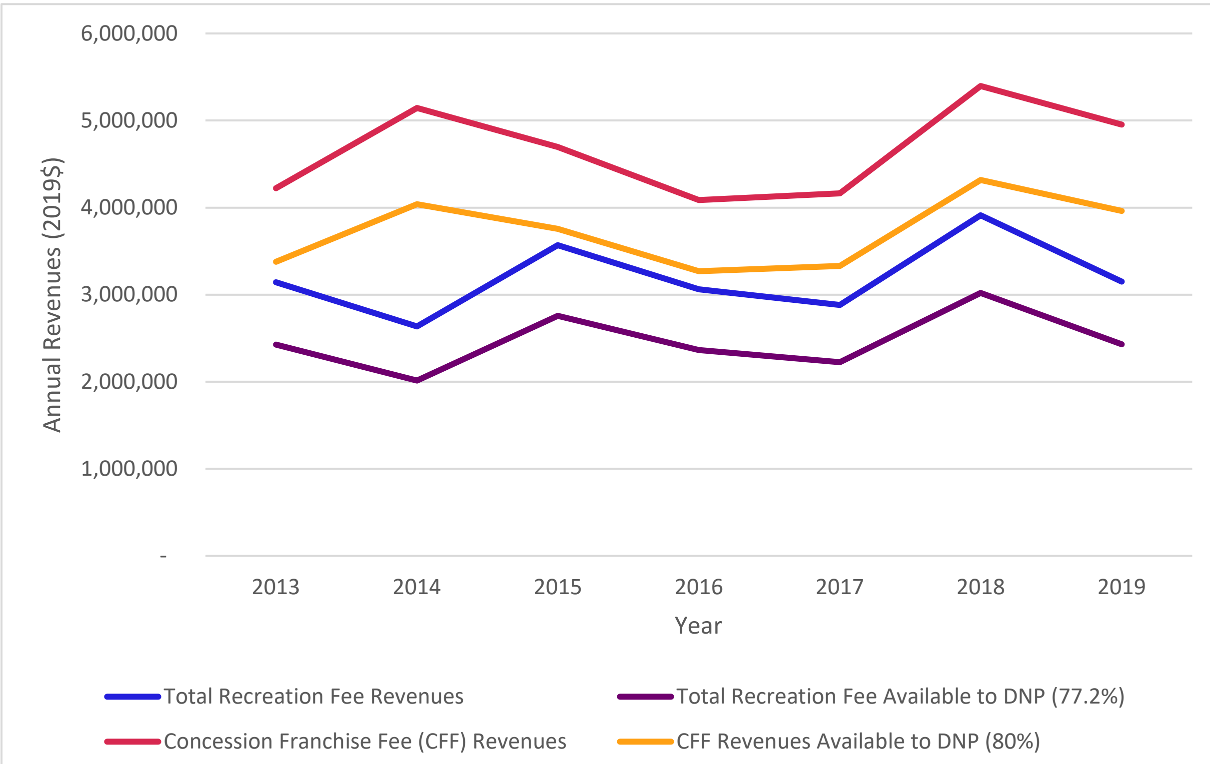

Figure 7. Total Annual Recreation Fees and Concession Franchise Fee Revenues – 2019 dollars
Source: Johnston pers. comm. 2020; BEA 2020a

2.4.2 Other Economic Activity Generators in the Borough

Healy, the borough seat, is a key economic driver in the borough. While McKinley Park is the closest year-round community to DNP, the community of Healy is the closest of the larger year-round communities in the borough (population approximately 1,000), located near MP 248 of the Parks Highway. Healy is home to approximately half of borough residents, and therefore sees a lot of economic activity in the borough. Of the approximately 300 employees of DNP, more than two-thirds are seasonal workers (Denali Borough 2018). These seasonal workers that support the summer tourist season at DNP and associated businesses in the Nenana Canyon are increasingly living in the Healy area. Accommodations located in the Nenana Canyon business area are limited during the summer and are largely devoted to tourists. One Alaska-based tour company (Premier Alaska Tours) that has been operating in Alaska for more than 25 years recently purchased land in Healy to construct a hotel, maintenance facility, and employee housing. Usibelli Coal Mine is located near Healy and employs 120 people, operating year-round (Denali Borough 2018). The Golden Valley Electric Association is another employer providing stable employment in the Healy area; it provides 40 jobs (60 at peak operation) in Healy and several other jobs at their Eva Creek Wind power operation (Denali Borough 2018).

Other year-round communities of McKinley Park and Cantwell (both populations approximately 200 each) provide jobs to borough residents and are closer to the park than Healy. The Clear Air Force Station, located near Anderson, provides approximately 300 permanent jobs, though how many of these jobs are held by Denali Borough residents is unknown; this facility is located further north and beyond the northern extent of the planning study area.

The borough serves as a transportation corridor for freight trucks driving between southcentral Alaska and Fairbanks and beyond to the North Slope oilfields. The Parks Highway is the only north-south roadway corridor through the borough. While the Alaska Railroad also traverses the borough, the Parks Highway is the main link between Anchorage and Fairbanks and serves a large volume of daily truck movements (DNR 2008). The Parks Highway plays an important role in the transportation needs of the state's oil and gas industry. The oil and gas industry is vital to the state's economy, as it both historically and currently funds the majority of the state's operating budget—72 percent of Alaska's unrestricted revenue in fiscal year (FY) 2016—as well as providing more than 100,000 jobs in Alaska, representing nearly one-third of all wage and salary jobs in the state (McDowell 2017). The alternative transportation corridor to the North Slope oilfields when the Parks Highway is not available would be the Glenn and Richardson Highways. This route is longer and less direct than the Parks Highway.

The Denali Highway connects Cantwell and Paxton while the Alaska Railroad connects the borough to the Railbelt at DNP and Usibelli Coal Mine. These roadway and rail systems generate economic activity through the transportation of visitors to and through the borough and the hauling of goods.

Finally, unlike the tourists who visit the borough primarily during certain months of the year, Alaska residents travel to the borough for recreation purposes year-round, thus contributing to the economy of the borough.

2.5 Local Tax Revenues

Denali Borough does not assess sales tax on goods and services purchased within the borough nor does it assess property tax on real property. Currently, the borough's tax revenues sources are the overnight accommodation tax (i.e., bed tax) and severance tax. In 2019, Borough residents voted to add a 5 percent tax on alcohol and marijuana sales and to increase the bed tax by 0.5 percent from the 7 percent it has been over the last 24 years (Fairbanks Daily Newsminer 2019). However, at the time of this analysis, these additional taxes had not been implemented.

The bed tax is assessed on rental accommodations such as rooms, RV spaces, homes or cabins, and tent spaces within the borough. Figure 8 shows the trend in the annual bed tax revenues in Denali Borough in 2019 dollars between 2000 and 2019 (ADCCED 2020). Because the bed tax is associated with visitation by non-residents, most of whom are assumed to rent a space, the trend in bed tax closely follows that shown for recreation visitors (Figure 4). However, this is not an exact match, because the trend in visitors captures those who may visit the park for a day and not stay overnight in the area. The data on visitors also includes campers who stay overnight in the park.

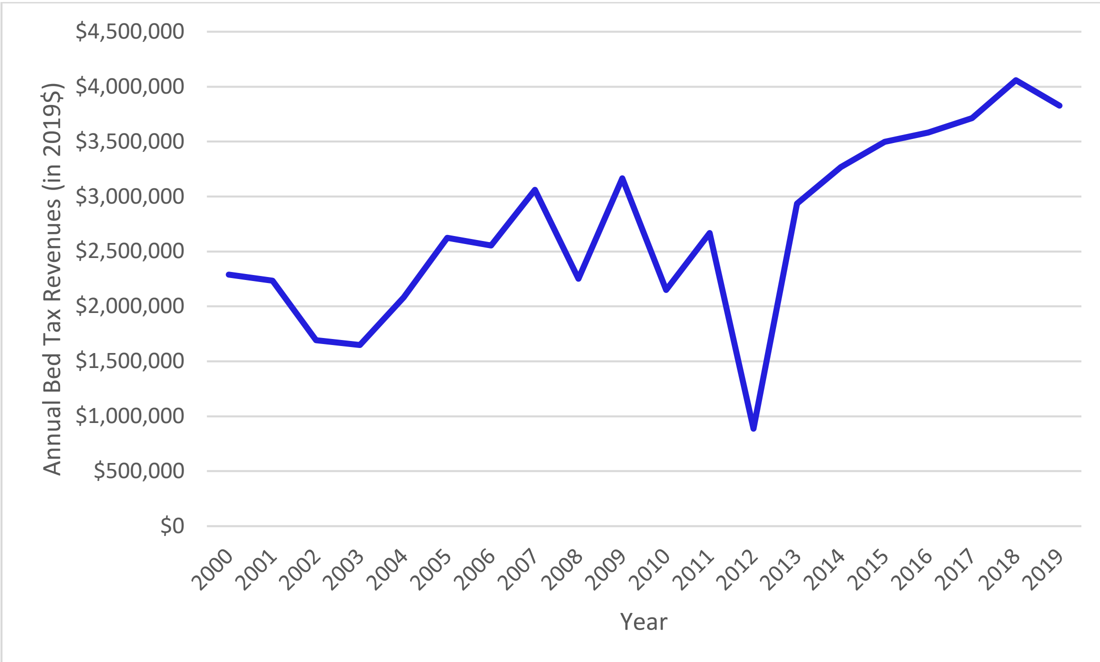

Figure 8. Real Annual Bed Tax Revenues, Denali Borough – 2000-2019 (in 2019 dollars)
Source: ADCCED 2020

3. Future Economic Generators

Future economic generators are those identified through either explicitly stated economic development goals from planning documents or those identified through other documents or studies.

3.1 Future Economic Generators from Economic Development Goals

This section documents the economic activity generators in Denali Borough that have been identified through a review of existing planning documents and policies both at the local and state level. Because tourism and recreation are Denali Borough's largest economic sector (Denali Borough 2017), the economic generators identified and included in this analysis are primarily those that enhance this sector. Among these are those that encourage visitation to the area during the winter and shoulder season, as well as those that improve transportation and accessibility. Additionally, other economic generators not necessarily linked to tourism are also identified.

3.1.1 Denali Borough

The *Denali Borough Comprehensive Plan (*the 2015 Plan*),* which was adopted in 2009 and subsequently amended in 2015, identifies the primary planning objective to be the maintenance of the unique qualities of life in Denali Borough and the provision of a vision for the future that includes the 'intelligent use of the borough's resources for its present and future generations' (Denali Borough 2015). The 2015 Plan identifies tourism, government, mining, power generation, and the Clear Air Force Station as the economic base for the borough. To diversify its economic base and promote economic expansion, the borough developed the following goals for future economic expansion:

- Goal 1 – Create a sustainable, diversified economic base through the development of natural resources and expansion of the tourist industry.

- Goal 2 – Identify and promote development, including federal, state, and borough facilities and private industry to bring new and increased opportunities to the Denali Borough.
- Goal 3 – Fully utilize Denali Borough lands through development of a management plan.
- Goal 4 – Promote the generation of power from renewable resources.
- Goal 5 – Encourage the development and expansion of the communication infrastructure within the Denali Borough.
- Goal 6 – Develop metrics to evaluate the effectiveness of the Denali Borough's economic development efforts.
- Goal 7 – Support the building of a bridge across the Nenana River at Ferry to provide year-round access from the Parks Highway to the Eva Creek Wind Farm and existing mining facilities.
- Goal 8 – Promote affordable housing for seasonal and temporary workers in the construction and tourism industry.
- Goal 9 – Encourage the opening and operation of the Healy Unit II Power Plant.

In addition to these economic expansion goals, the 2015 Plan (Denali Borough 2015) includes specific transportation goals that have an impact on the economic development of the borough. Among the 12 transportation planning goals, the following relate specifically to improving access for residents and tourists:

- Goal 2 – Expand public transportation.
- Goal 4 – Pursue an area north of Healy for future use of a regional airport that would be capable to handling life flight and commuter aircraft from Anchorage and Fairbanks to increase public safety and access for residents and tourists.
- Goal 10 – Continue to encourage and support DOT&PF and NPS in their efforts to develop multi-use paths along the Parks Highway through communities and in heavily used tourist areas.
- Goal 11 – Continue to encourage and support DOT&PF and NPS in improving highway safety with the implementation of turning lanes, passing lanes, pedestrian cross-walks, traffic signals, reduced speed limits in congested areas, pedestrian bridges, and tunnels.
- Goal 12 – Continue to encourage and support DOT&PF and NPS in removing the at-grade railroad crossing located at MP 235 on Parks Highway.

Finally, the 2015 Plan (Denali Borough 2015) calls for the management of borough-owned lands to "enhance the sustainable health and diversity of the local economy, and to support opportunities for borough residents to seek economic security." One of the borough's land use goals calls for the support of quality, sustainable front country recreation and tourism. This goal was developed in response to global trends that show that tourists are increasingly showing a preference for the types of activities (e.g., an all-day hike followed by a good meal, shower, and a dry bed) that are available in the front country. The NPS refers to "front country" in DNP as any area of the park not classified as backcountry, including the park entrance area and the Park Road corridor.

The *Denali Borough Land Use and Economic Development Plan* (the 2018 Plan), which was approved by the Assembly in 2018 (Denali Borough 2018), expands on some of the goals identified in the 2015 Plan (Denali Borough 2015). The 2018 Plan states that "an increasing number of visitors are coming to enjoy Denali Borough during winter and shoulder seasons, creating new opportunities such as snow machine tours, cross country skiing, and aurora viewing." Thus, the 2018 Plan calls for the expansion of the tourism industry through the encouragement of increased fall, winter, and spring travel. It also calls for the encouragement of local commercial development as well as the expansion of housing supply to address the existing shortage and meet future labor force needs.

3.1.2 Denali National Park and Preserve

The *Denali National Park and Preserve Resource Stewardship Strategy 2008-2027 Summary* (NPS n.d.) summarizes the Resource Stewardship Strategy developed for the park between 2004 and 2007. It serves as a 20-year road map for resources within the park. Although the focus of the document is to identify and assess current conditions of the resources and develop strategies for the protection of these resources, it nonetheless acknowledges the need for the development of an economic impact model. The purpose of the economic impact model is to demonstrate the impact of DNP on local and regional jobs and income. The *2019 National Park Visitor Spending Effects* (NPS 2020c) study estimates that the 601,152 visitors to the park in 2019 spent a total $612.7 million and supported a total of 7,490 jobs. The total jobs include both those directly employed in the tourism sector and the secondary jobs created in the area because of the multiplier effect. The study does not state if the total jobs include both part-time and full-time.

At-a-Glance DNP Economic Value

For 2019, estimates indicate 600,000+ visitors to DNP spent $600+ million and supported nearly 7,500 jobs.

3.1.3 State of Alaska

The State of Alaska's 2017 comprehensive economic development strategy calls for the improvement of transportation, energy and technological foundations of the state (ADCCED 2017b). The specific objectives of this strategy that are relevant to the corridor are improving broadband access and improving and developing intermodal hubs and ports. Improving broadband access will improve internet connectivity for both residents and visitors to Denali Borough, while improving intermodal hubs will lead to improved transportation.

3.2 Other Future Economic Generators

The planning documents discussed in Subsection 3.1 as well as the 2008 *George Parks Highway Scenic Byway Corridor Partnership Plan* (DNR 2008) call for the expansion of tourism beyond the summer season as a way to increase the economic contribution of tourism and recreation to the continued and future economic development of Denali Borough. The economic contribution is expected to be through direct visitor spending and increased bed tax as a result of increased visitation levels. In addition to the tourism-based economic generators, the borough may also experience future economic growth related to state and federal spending as well as resource development.

3.2.1 Visitation and Visitor Spending

The AVSP study (ADCCED 2017a) estimated that travelers spent, on average per person, a total of $1,575 (in 2016 dollars) in Alaska during their visit to DNP. This estimate does not include the transportation costs to and from Alaska. Of the $1,575 (or $1,672 in 2019 dollars) spent in Alaska, about $244 (or $259 in 2019 dollars) per person per day were spent in the local (Denali) area. Assuming the following, the total visitor spending in the Denali area would be between $161.3 million and $778.8 million in 2019 dollars:

- Visitation levels range from a low of 311,335 (the 2002 levels) and a high of 601,152 (the 2019 levels)
- Each of these visitors spends a minimum of 2 and a maximum of 5 nights (or about 25 percent and 70 percent, respectively) of the average 8.7 nights identified for vacation or pleasure visitors in the AVSP study (ADCCED 2017a)

The lower estimate of $161.3 million assumes that visitation was at the 2002 levels of 311,335 total visitors and visitors spent the minimum of 2 nights in the Denali area. The higher estimate of $778.8 million is based on the higher visitation levels of 601,152 (in 2019) and the maximum of 5 nights in the Denali area. Both estimates use the same rate per person of $259 per day.

The $612.7 million estimate from the 2019 NPS study (NPS 2020c) falls within this range. Actual estimates are likely to be somewhere in between these two estimates. However, visitation levels have been growing at an annual rate of 2.7 percent over the past 20 years (Section 2.4.1.2, Visitation) so it is likely that the upper estimate could be exceeded in the future. Additionally, the estimates could be higher if the borough's goal of increasing fall, winter, and spring travel is realized.

The fact that tourism contributes so much to the borough's economy is a function of the uniqueness of DNP. The employment estimate of 7,490 jobs out of the 2019 NPS study (NPS 2020c) includes both the direct employment in the tourism sector as well as the secondary employment in other sectors. It's worth noting there are some limitations to the 2019 NPS study that may not fully capture precisely the economic value and importance of DNP. The 2019 NPS study relies on survey data across all of Alaska and bases the Denali-specific economic contribution on visitors' responses to survey questions at four exit points; this could mean the actual economic contribution may be underrepresented and more generalized in that study. Additionally, the Visitor Spending Effects model in the 2019 NPS study used to develop the estimates identified with DNP are based on visitor spending at Katmai National Park and Preserve and Southeast Alaska, thus not capturing the uniqueness associated with DNP. A potential improvement on this study to better capture the economic contribution of DNP visitors would be one that targeted all visitors (from within Alaska and outside the state) to DNP and gathered trip expenditure data specific to DNP. This trip expenditure data would capture the expenditures associated with all the recreation activities within the DNP as well as outside the DNP but within the borough. The DNP direct visitor expenditures and the direct visitor expenditures outside the DNP but within the borough could then be run through a regional economic impact model such as the IMPLAN model (IMPLAN Group LLC) to estimate the secondary (indirect and induced) employment and income that would be generated within the borough as a result of the direct expenditures associated with the tourism sector. In addition to DNP/corridor visitation expenditures related to the tourism sector, assuming direct estimates are available for the other sectors (e.g., freight truck, resource development, state, and federal spending), the same model could be used to estimate the secondary employment and incomes that would be generated within the borough. The direct and secondary estimates combine to represent the total economic contribution of each of these sectors. Running an economic impact model was the beyond the scope of this effort. However, existing documentation regarding visitation and visitor spending was reviewed, and the retrieved data demonstrates the economic contribution of DNP (and to a lesser degree other economic generators) to the corridor and region.

3.2.2 Bed Tax

About one new hotel opens in Denali Borough every year (Denali Borough 2017). Assuming the construction and opening of a new hotel per year continues and visitation levels continue to increase, the borough's bed tax revenues will be higher in the future. Additionally, the 0.5 percent in additional bed tax is expected to be implemented in 2021 (Fairbanks Daily Newsminer 2019b), the borough's bed tax revenues will also increase.

3.2.3 Other Economic Generators

The borough's 2018 Plan (Denali Borough 2018) identified future economic development from increased federal and state government spending as well as the private development of a liquefied natural gas pipeline by Alaska Gasline Development Corporation. The liquefied natural gas pipeline "would likely pass through the borough, creating construction jobs and potentially substantial new local revenues" (Denali Borough 2018). The increased federal government spending would be that associated with the continued expansion of the missile defense role for Clear Air Force Station as well as the continued federal support for park maintenance budgets. Changes in state funding for schools and roads could also potentially contribute to future economic growth in the borough.

3.3 Impact of COVID-19

The projected future increase in visitation and the associated increase in visitation spending and bed tax revenues does not consider unforeseen circumstances', such as the current ongoing COVID-19 pandemic, impact on visitation to Alaska in general and to DNP in particular. At the time of this analysis, most of the U.S. and rest of the world is coming out of a several weeks to months of lockdowns necessitated by the COVID-19 pandemic. These lockdowns have had a detrimental effect on local, state, national, and international economies. In early May 2020, Carnival Corporation, which includes its subsidiaries Princess Cruises and Holland America Line, canceled all cruise ship voyages to Alaska for 2020. In turn, land and rail tours were canceled in addition to five Princess lodges not being opened, which includes two hotels just outside of the DNP entrance not opening (Fairbanks Daily Newsminer 2020). Although Alaska is currently (as of July 2020) allowing visitors from outside the state, there are restrictions (State of Alaska 2020) on these visitors which coupled with the fear of contracting SARS-CoV2 (the virus causing COVID-19) is likely to result in reduced visitation. The reduction in visitation levels would be expected to continue until a vaccine is available, which is likely to be sometime in 2021. Even if a vaccine becomes available before summer of 2021, it may not be widely available. Furthermore, the recession triggered by the lockdowns is likely to result in reduced disposable incomes, which will also likely lead to reductions in visitors to DNP. In the long run and after the economy recovers, visitation levels would be expected to return to pre-COVID19 levels.

The COVID-19 pandemic's detrimental impact on local, state, and national economies is likely to result in reductions in government tax revenues in FY 2020 through FY 2021 or until a vaccine is widely available. Decreased tax revenues could result in either postponement or a scaling down of planned government-supported projects in the borough. The current and projected COVID-19-induced recession is also likely to result in postponement of any private development; however, low interest rates (Federal Reserve 2020) could lead to some private development proceeding during the pandemic as the cost of borrowing is low.

4. Summary

The analysis of the existing economic generators and the identification of future economic generators in the study highway corridor relies heavily on secondary sources of data including government databases as well as studies that include DNP. These data sources depict employment (including the seasonal nature of employment in the borough), economic information related to relevant industry sector earnings (i.e., largely tied to the services industry), and DNP visitation data, all of which clearly demonstrate the economic importance this transportation corridor plays by providing access to DNP and the region.

The existing economy of Denali Borough is heavily tied to the tourism industry which forms one of the "three legs" of the borough's economic base. Resource development (i.e., mining, quarrying, oil and gas extraction) and military spending are the other two legs of the "three legs". While both resource development and military spending are expected to continue to contribute to the borough's economy in the future, tourism is expected to continue to be the be the biggest contributor. DNP is the largest economic and tourism generator in the transportation corridor, as evidenced by readily-available data related to employment, visitation, and visitor spending.

The tourism industry is centered around exploring DNP and the surrounding scenic and recreational areas. In 2018, the two subsectors identified with the tourism industry - Accommodation/Food Services and Arts/Entertainment/Recreation – accounted for 50 percent of total jobs and 35 percent of total industry earnings in the borough. In comparison, at the state level, these two subsectors accounted for substantially smaller portions of the industry: 10 percent of total jobs and 4 percent of total industry earnings in 2018. Thus, the tourism industry is a larger contributor and hence more important to the borough's economy compared to its contribution to Alaska's economy. In 2019, the approximately 600,000 visitors to DNP spent more than $600 million and supported nearly 7,500 jobs. With the increase in visitation (both during the summer and during the winter and shoulder seasons) and barring any disruptions (e.g., current COVID-19 pandemic, economic recession) that have long-term impacts, the contribution of the tourism industry to the borough's economy is expected to continue to grow. Improvements in transportation and access along the Parks Highway corridor included in the Cantwell to Healy PEL study coupled with the proposed transportation improvements identified in the borough planning documents will facilitate this growth.

Currently, the resource development contributor to the borough's economy is the Usibelli Coal Mine which employs 120 people in its year-round operations. The improvements in transportation and access along the Parks Highway corridor included in the Cantwell to Healy PEL study would facilitate the implementation of the borough's goal of promoting renewable energy development and thus diversifying its economic base.

The oil and gas industry is vital to state's economy as it both historically and currently funds the majority of the state's operating budget—72 percent of Alaska's unrestricted revenue in fiscal year (FY) 2016—as well as providing more than 100,000 jobs in Alaska, representing nearly one-third of all wage and salary jobs in the state (McDowell 2017). Because the borough serves as the key transportation corridor for freight trucks driving between southcentral Alaska and Fairbanks and beyond to the North Slope oilfields, improvements in the Parks Highway corridor would continue to support this vital industry.

The Parks Highway is a vital transportation corridor that provides access to key economic generators within the borough, region and state; this includes the heavily-visited DNP as well as providing a thoroughfare for trucks traveling to support the state's oil and gas fields. By maintaining and improving this transportation link, projects coming out of the Cantwell-Healy PEL study will continue to help drive the economic base of the region, borough and state.

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Appendix H

Baseline Area Drainage Analysis Memorandum (July 10, 2020)

Memorandum

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Subject	**Baseline Area Drainage Analysis**
Project Name	Cantwell to Healy Planning and Environmental Linkages (PEL Study) Parks Highway Mileposts 203-259
From	Jacobs Engineering Group Inc. (Iosefa Matagi, Jacobs, senior water resources engineer)
Date	July 10, 2020
Copies to	Federal Highway Administration Western Federal Lands, Alaska DOT&PF Northern Region, and National Park Service Alaska Region

1. Introduction

The Federal Highway Administration (FHWA) Western Federal Lands (WFL) in partnership with the Alaska Department of Transportation and Public Facilities (DOT&PF) and the National Park Service (NPS), are working together to identify potential future transportation and access improvements along a specific section of the Parks Highway corridor (between mileposts [MP] 203 and 259) between Cantwell and Healy.

The Parks Highway (State Coordinate Data Set route number 170000) is a part of both the National Highway System and the Interstate Highway System. Originally constructed between the late 1960s and early 1970s, the highway was officially completed in 1971. This highway provides the primary ground route from Fairbanks to Anchorage. Commercial trucks use this route year-round to deliver supplies and freight from Anchorage to Fairbanks and other surrounding communities. There is also a notable amount of cargo transported for the Trans-Alaska Pipeline along this route. During the summer months, traffic along the Parks Highway increases significantly because of tourism, especially around Denali National Park and Preserve (DNP).

The study area corridor covers a total of 56 miles of the Parks Highway, spanning from just north of Broad Pass to the turnoff to the town of Ferry. It is anticipated that there will be between a 1 and 2 percent yearly increase in traffic through this area. With the only road access to DNP in the middle of the corridor study area at MP 237, this area receives a high volume of commercial traffic such as tour busses and vans, especially during tour season in the summer months. Besides the traffic related to tourism, the Parks Highway provides the primary route for both cargo and personal vehicle travel between Alaska's two largest cities, Fairbanks and Anchorage.

The partnering agencies are conducting a Planning and Environmental Linkages (PEL) study that will look at current and future conditions and needs of transportation and access facilities along this section of the Parks Highway corridor as it relates to the users and communities in the areas between Cantwell and Healy. One of the primary goals of a PEL study is to collaborate ideas and have discussions that address the needs and wants of all local and commercial stakeholders. These stakeholders include a variety of groups, including DOT&PF, WFL, NPS, Department of Natural Resources, Denali Borough, environmental groups, Alaska Railroad, trucking industry, Native groups, tourism businesses, local businesses, local communities, and members of the public. As part of the Needs and Opportunities phase, several technical memorandums are being prepared.

The purpose of this technical memorandum is to quantify and present a baseline area drainage analysis that will collect existing condition information from field visits, as-builts, local information, and other available sources. This baseline area drainage analysis will include the following:

- Drainage basin delineation within the project corridor, to include the Nenana River (at specific bridge crossings and other hydraulically significant areas) and sub-basins for contributing tributaries that have been identified within the project
- Flood frequency peak flow determination for the primary (Nenana River) and tributary waterways
- Field review of the project corridor to assess baseline conditions of roadways and other elements in relation to Nenana River and tributaries
- Geomorphic stability evaluation of primary and tributary waterways in context of Parks Highway, with specific emphasis on existing bridge and culvert structures and highway embankments where adjacent to river/stream channels
- Identification of fish passage issues that are present in the project area using readily available information

Figure 1 shows the project study corridor and adjacent topographic features.

1.1 General Baseline Area Drainage Conditions

Significant offsite cross drainage evaluated throughout the study corridor generally appear in good conveyance condition. Although no hydraulic analysis was completed, bridges and culverts appear to be adequately sized for general rainfall runoff events.

Although an in-depth geomorphological analysis was not completed for these cross drainages, general stream stability appears to be in good condition with a few exceptions. The Jack River showed the potential to migrate vertically as degradation and aggregation was observed within the crossing. The Nenana River near MP 237.9 appeared to be eroding the left bank (looking upstream) near the crossing. The Panguingue Creek showed signs of bank erosion within the bridge crossing structure and immediately downstream of the crossing. Slate Creek appeared to show signs of bed degradation on the downstream side of the roadway crossing.

The DOT&PF maintenance division has identified multiple locations where they have concluded drainage to be an issue related to poor roadway conditions. Field verification of these locations have confirmed issues with drainage conveyance of offsite and onsite surface runoff. Ponding observed adjacent to the roadway corridor appears to contribute to deteriorating roadway embankments and roadway structural sections.

General baseline conditions were observed to be moderate. Many locations where roadside ditches were inundated or poorly defined, created ponding conditions immediately adjacent to the roadway embankment. Roadway runoff conditions were good with few exceptions. Several locations where roadway shoulder conditions created concentrated flow, and did not include drainage flumes, appeared to be eroding the roadway embankment.

FIGURE 1
Vicinity Map
Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS

2. Existing Conditions and Facilities

As-built plan sets obtained from the DOT&PF cover most of the study corridor (from the southern limit to approximately MP 253). These as-builts were used to identify the existing facilities along the relevant portion of the study corridor. An existing culvert GIS shapefile obtained from the DOT&PF shows all the existing cross culverts throughout the study corridor. A combination of the as-built plan sets, the DOT&PF culvert GIS shapefile, and field verification were utilized in locating and assessing existing cross culverts along the study corridor.

In the southern portion of the study corridor, the Parks Highway is located parallel with Cantwell Creek. The creek is on the western side of the roadway and flows toward the north. Smaller drainages, including Pass Creek, cross the project corridor and join Cantwell Creek on the western side of the roadway. Continuing north along the project corridor, near MP 210, the Jack River crosses the roadway and joins with Cantwell Creek on the western side of the roadway. The Jack River then continues to flow north, parallel with the roadway.

Continuing north, near MP 216, the Nenana River crosses the roadway corridor and joins with the Jack River on the western side of the roadway continuing parallel with the roadway as the Nenana River. Between MP 216 and MP 231, the Nenana River flows north, on the western side of the project corridor where much smaller drainages, including Slime and Carlo Creeks, cross the roadway and join the Nenana River.

Between MP 231 and MP 238, the Nenana River flows north, on the eastern side of the project corridor where much smaller drainages, including Riley Creek, cross the roadway and join the Nenana River. Yanert Fork also joins with the Nenana River near MP 238 before the Nenana River crosses the project corridor. Between MP 238 and MP 243, the Nenana River exists on the western side of the project corridor and joins with smaller drainages that include; Kingfisher, Junco, Hornet, Grizzly, Fox, Eagle, Dragonfly, and Coyote Creeks as well as Iceworm Gulch.

Continuing north, near MP 243, the Nenana River crosses the project corridor from the west side to the eastern side. Between MP 243 and the northern limit of the study, the Nenana River flows north, on the eastern side of the project corridor where much smaller drainages that include; Antler, Dry, Panguingue, Little Panguingue and Slate Creeks cross the roadway and join the Nenana River.

More than 200 culverts exist along the study corridor and were included in a culvert inventory list. These culverts are identified as cross culverts conveying offsite runoff across the roadway as well as adjacent driveway culverts conveying roadside ditch drainage adjacent to the roadway.

Significant stream and offsite roadway drainage crossings were identified:

- Where a United States Geological Survey (USGS) topographic perennial stream was located on the relevant Quad Map,
- Where the Alaska Department of Fish and Game (ADF&G) had identified the stream as anadromous,
- At all bridge crossings.
- Crossing structure sizes of 48-inch-diameter culvert or larger were also singled out from the existing cross culvert inventory.

2.1 Existing Significant Crossings

An overview Location Map (Exhibit A) can be found in **Attachment A**. Exhibit A shows the location of the significant crossings and the two USGS gages.

A field visit focusing on each significant crossing as well as other existing drainage features and their respective physical condition was conducted between June 29-July 2, 2020. This visit was conducted to potentially identify failures related to culvert end conditions, erosion around culvert end treatments, inherent geomorphic conditions around bridge crossings and locations where the highway embankment is adjacent to river/stream channels. Identification of existing offsite and onsite drainage issues is discussed later in this section of the technical memorandum.

Below is a brief description of the significant crossings that are included in this study. These descriptions will be described from south to north starting at the first significant crossing near MP 208 and continuing north through MP 258. As depicted on Exhibit A, a substantial number of these crossings occur within an approximate eight mile stretch that includes the Nenana Canyon.

2.1.1 Pass Creek

Near MP 208, Pass Creek crosses under the Parks Highway roadway corridor within a single-span bridge structure (BR 0293).

Figure 2. Pass Creek Bridge (BR 0293) Upstream Looking Downstream

The bridge abutments are armored with moderately sized riprap and the stream does not show signs for potential migration outside its existing banks.

Figure 3. Looking Upstream, Left and Right Abutments

2.1.2 Jack River

Near MP 209.5, the Jack River crosses the Parks Highway from the east, under an existing single-span bridge structure (BR 0302). The Jack River then combines with Cantwell Creek and flows north, parallel and adjacent to the Parks Highway.

Figure 4. Jack River Bridge (BR 0293) Downstream Looking Upstream

The bridge abutments are armored with moderately sized riprap and the stream is braided during low flows which presents the opportunity that the main channel could possibly migrate within its own river banks. Possible stream bed degradation is occurring on the upstream side of the piers with aggregation on the downstream side.

Figure 5. Looking Downstream, Left Abutment: Looking Upstream, Right Pier

2.1.3 Nenana River

Near MP 215.6, the Nenana River crosses the Parks Highway from the east, under an existing dual-span bridge structure (BR 1243). The Nenana River then combines with the Jack River and continues to flow north, parallel and adjacent to the Parks Highway. For the next 10 miles, the Parks Highway and the Nenana River continue north and are situated at the bottom of a narrow canyon.

Figure 6. Nenana River Bridge (BR 1243) Downstream Looking Upstream

The bridge abutments are armored with moderately sized riprap and the river does not show signs of potential migration outside its existing banks.

Figure 7. Looking Upstream, Left and Right Abutment

2.1.4 Slime Creek

Near MP 220, Slime Creek crosses the Parks Highway from the east within 72--inch, double-barrel culvert pipes and one vertically offset 48-inch culvert pipe that acts as an overflow for larger storm events.

Figure 8. Slime Creek Cross Culverts, Upstream Side Looking North

As Slime Creek approaches the upstream side of the highway, it meanders abruptly toward the left prior to entering the cross culverts. The outer bank of this meander is heavily armored with riprap and vegetation and does not show any signs of degradation. (**Figure 8**) Moderate rusting along the bottom of this culvert was observed. The downstream side of the crossing appears stable with heavily vegetated banks.

Figure 9. Downstream Looking Downstream: Upstream Looking Upstream

2.1.5 Carlo Creek

Near MP 224, Carlo Creek crosses the Parks Highway from the east within a single-span bridge structure (BR 0693).

Figure 10. Carlo Creek Bridge (BR 0693), Upstream Looking Downstream

The bridge abutments are armored with moderately sized riprap and the creek does not show signs of potential migration outside its existing banks.

Figure 11. Looking Upstream, Left and Right Abutment

2.1.6 Nenana River

Near MP 231.2, the Nenana River crosses the Parks Highway from the western side to the eastern side within a three-span bridge structure (BR 0694). The Nenana River then combines with Yanert Fork and continues to flow north, parallel and adjacent to the Parks Highway on the eastern side. At the location of this Nenana River crossing, the Parks Highway MP 231 Enhancements project is currently proposed to replace the existing 358-foot-long, three-span bridge with a 462-foot-long, three-span bridge structure. This project proposes a new bridge replacement as well as pedestrian underpass improvements.

Figure 12. Nenana River Bridge (BR 0694), Downstream Looking Upstream

The bridge abutments are armored with mildly sized riprap only on the upstream and downstream sides. Moderate erosion in the form of rilling exists immediately under the bridge deck on each abutment. The cause of such erosion does not seem obvious although it appears roadway runoff is being captured by the bridge seam and being conveyed under the deck along the top of the abutment. The river does not show signs of potential migration outside its existing banks. Some minor aggradation was observed on the right bank just downstream of the bridge crossing.

Figure 13. Looking Upstream, At Left Abutment, Looking Upstream from Left Abutment

2.1.7 Riley Creek

Near MP 237.2, after Hines Creek and Riley Creek combine, Riley Creek crosses the Parks Highway from the west within a dual-span bridge structure (BR 0695).

Figure 14. Riley Creek Bridge (BR 0695), Upstream Looking Downstream at Right Abutment

The bridge abutments are armored with moderately sized riprap and the creek does not show signs of potential migration outside its existing banks. Overflows appear to be directed under the left side of the bridge.

Figure 15. Riley Creek Looking Downstream, At Left Abutment, Looking Upstream from Left Abutment

2.1.8 Nenana River

Near MP 237.9, the Nenana River, once again, crosses the Parks Highway from the east towards the west within a four-span bridge structure (BR 1147). As the Parks Highway continues north, it begins to enter the Nenana Canyon from the south. The Nenana River flows toward the north, parallel with the Parks Highway, and is located on the western side of the roadway. Mountain surface runoff from the east is collected in gulches and conveyed under the Parks Highway roadway via culverts.

Figure 16. Nenana River Bridge (BR 1147), Downstream Looking Upstream

The bridge abutments are armored with mildly sized riprap. Looking upstream, the left abutment appears to be constructed on possible bedrock. The right abutment is mildly armored with riprap. The river does not show signs of potential migration outside its existing banks as these banks are very steep. Aggradation has been observed near the center of the channel just upstream of the crossing that is creating a mild braid and appears to be eroding the river bank on the left near the developed parcels. This can be noted in **Figure 17** just upstream of the left abutment. Immediately downstream of this bridge crossing, a pedestrian bridge (BR 2060) exists that does not show potential for river bank degradation.

Figure 17. Looking Upstream, At Left Abutment and Right Abutment

2.1.9 Kingfisher Creek

Near MP 238.2, Kingfisher Creek crosses the Parks Highway from the east within a single-span bridge structure (BR 0697).

Figure 18. Kingfisher Creek Bridge (BR 0697), Downstream Looking Upstream

The bridge abutments are armored with moderately sized riprap and the creek does not show signs of potential migration outside its existing banks. The Creek is very steep, and the bed is made up of large cobbles and rock that don't appear to be aggregating. Minor flows from roadside ditches appear to be maintained on the upstream side of the crossing and no signs of bank erosion were observed.

Figure 19. Looking Upstream, At Left Abutment and Right Abutment

2.1.10 Junco Creek

Near MP 239, Junco Creek crosses the Parks Highway from the east within a 72-inch culvert structure.

Figure 20. Junco Creek Cross Culvert, Upstream Looking Downstream

The upstream culvert end treatment has been mitered to the roadway slope and looks moderately damaged. The culvert shows minor rust but is generally in good condition. The creek does not show signs of potential migration outside its existing banks as these banks are heavily vegetated.

2.1.11 Iceworm Gulch

Near MP 240, Iceworm Gulch crosses the Parks Highway from the east within a single-span bridge structure (BR 1146).

Figure 21. Iceworm Gulch Bridge (BR 1146), Upstream Looking Downstream

The bridge abutments are armored with moderately sized riprap and the creek does not show signs of potential migration outside its existing banks as the banks are relatively steep. The channel bed consists of cobles and rock and the channel is relatively steep. The channel banks are made up of a smaller material that does pose the potential for erosion though none were observed.

Figure 22. Looking Upstream

2.1.12 Hornet Creek

Near MP 240.2, Hornet Creek crosses the Parks Highway from the east within a single-span bridge structure (BR 1145).

Figure 23. Hornet Creek Bridge (BR 1145), Downstream Looking Upstream

The bridge abutments are armored with moderately sized riprap and the creek does not show signs of potential migration outside its existing banks as the banks are relatively steep. The channel bed consists of cobles and rock and the channel is relatively steep.

Figure 24. Looking Upstream, Left Abutment and Right Abutment

2.1.13 Grizzly Creek

Near MP 240.9, Grizzly Creek crosses the Parks Highway from the east within a single 72-inch culvert pipe.

Figure 25. Grizzly Creek Cross Culvert, Upstream Side Looking North

The upstream and downstream culvert end treatments have been mitered to the roadway slope and appears relatively intact. The culvert shows moderate rust but is generally in fair condition. The creek does not show signs of potential migration outside its existing banks as these banks are heavily vegetated.

2.1.14 Fox Creek

Near MP 241.2, Fox Creek crosses the Parks Highway from the east within a single-span bridge structure (BR 1144).

Figure 26. Fox Creek Bridge (BR 1144), Upstream Looking Downstream

The bridge abutments are armored with moderately sized riprap and the creek does not show signs of potential migration outside its existing banks as the banks are relatively steep and somewhat vegetated. The channel bed consists of cobles and rock and the channel is relatively steep. As indicated in the field photos, overflows tend to freeze and glaciate over the right abutment.

Figure 27. Looking Upstream, Left and Right Abutment

2.1.15 Eagle Creek

Near MP 242, Eagle Creek crosses the Parks Highway from the east within a major 12-foot by 13-foot arch culvert structure with a concrete bottom (7111/1076).

Figure 28. Eagle Creek Cross Culvert (7111/1076), Upstream Looking Downstream

The condition of the existing cross culvert appears to be deteriorating. There is separation between the concrete bottom and the concrete spread footing on the bottom edges of the arch structure.

The upstream and downstream culvert end treatments include headwalls that appear to be in good condition. The creek is aggregating near the downstream portion of the crossing indicating the steep nature of the culvert relative to the slope of the creek. The does not show signs of potential migration outside its existing banks as the banks are relatively steep and vegetated. The channel bed consists of cobbles and rock.

Figure 29. From Downstream Side Looking Upstream and Downstream

2.1.16 Dragonfly Creek

Near MP 242.4, Dragonfly Creek crosses the Parks Highway from the east within a single-span bridge structure (BR 1075).

Figure 30. Dragonfly Creek Bridge (BR 1075), Downstream Looking Upstream

The bridge abutments are armored with moderately sized riprap and the creek does not show signs of potential migration outside its existing banks as the banks are relatively steep. The channel bed consists of cobles and rock and the channel is relatively steep.

Figure 31. Looking Upstream, Left and Right Abutment

2.1.17 Coyote Creek

Near MP 242.6, Coyote Creek crosses the Parks Highway from the east within a 108-inch culvert structure.

Figure 32. Coyote Creek Cross Culvert, Upstream Side Looking North

There did not appear to be end treatments on this culvert. The culvert shows moderate rust but is generally in good condition. The creek does not show signs of potential migration outside its existing banks as these banks are heavily vegetated.

2.1.18 Nenana River

Near MP 242.8, the Nenana River once again crosses the Parks Highway from the west toward the east within an elevated, four-span, steel bridge structure (BR 1143). The furthest span to the north allows the railroad to pass under the highway. At this point, the roadway runs parallel with the Nenana River on the east side.

Figure 33. Nenana River Bridge (BR 1143), Downstream Looking Upstream and North

The bridge abutments are armored with mildly sized riprap. Looking downstream, the left and right abutments appear to be constructed on possible bedrock. The river does not show signs of potential migration outside its existing banks as these banks are very steep and the river exists within a deep gorge. Erosion is observed to exist on the left bank where the river is abutting to the railroad embankment.

Figure 34. Looking Downstream, Left Pier and Right Abutment

2.1.19 Bison Gulch

Near MP 243.6, Bison Gulch crosses the Parks Highway from the west within a single-span bridge structure (BR 1142).

Figure 35. Bison Gulch Bridge (BR 1142), Downstream Looking Upstream and East

The bridge abutments do not appear to be armored yet the creek does not show signs of potential migration outside its existing banks as the banks are relatively steep. There is a potential for the creek to erode the abutment walls. The channel bed consists of cobles, rock and large boulders and the channel is relatively steep. There appears to be aggradation around the upstream side of the pier and degradation around the downstream side of the pier.

Figure 36. Looking Downstream, Left and Right Abutment

2.1.20 Antler Creek

Near MP 244.6, Antler Creek crosses the Parks Highway from the east within a single-span bridge structure (BR 1141). At this point, the Parks Highway begins to exit Nenana Canyon.

Figure 37. Antler Creek Bridge (BR 1141), Downstream Looking Upstream and East

The bridge abutments do not appear to be armored. Moderate erosion in the form of rilling exists immediately under the bridge deck on each abutment. The cause of such erosion does not seem obvious. The river does not show signs of potential migration outside its existing banks. The creek bed is made up of smaller cobbles and gravel and is relatively steep. There is potential for this river to create significant erosion of the abutments and its own banks during larger runoff events.

2.1.21 Dry Creek

Near MP 249.3, the Dry Creek overflow crosses the Parks Highway from the west within a triple-span bridge structure (BR 0852).

Figure 38. Dry Creek Overflow Bridge (BR 0852), Downstream Looking Upstream and Northwest

The bridge abutments are armored with moderately sized riprap that appears to be intact. The creek does not show signs of potential migration outside its existing banks as these banks are very steep. This overflow also appears to contain very few runoff events. The channel bed is made up of small cobbles and gravel.

Figure 39. Looking Downstream, Left and Right Abutment

2.1.22 Dry Creek

Near MP 249.8, Dry Creek crosses the Parks Highway from the west within a five-span bridge structure (BR 0851).

Figure 40. Dry Creek Bridge (BR 0851), Downstream Looking Upstream and South

The bridge abutments are armored with moderately sized riprap that appears to be intact. The creek does not show signs of potential migration outside its existing banks as these banks are very steep. The channel bed is made up of small cobbles and large gravel.

Figure 41. Looking Upstream, Left and Right Abutment

2.1.23 Panguingue Creek

Near MP 252.5, Panguingue Creek crosses the Parks Highway from the west within a single-span bridge structure (BR 0313).

Figure 42. Panguingue Bridge (BR 0313), Downstream Looking Upstream and South

The bridge abutments are armored with moderately sized riprap as well as solidified concrete sacks that are somewhat intact although mildly crumbling. The creek does not show signs of potential migration outside its existing banks as these banks are very steep. The creek is braided through the bridge structure during low flows giving it the potential to create a main channel in various locations along the channel bed throughout the seasons. The channel bed is made up of cobbles and rocks. The banks are vegetated, and some erosion was observed on the downstream right side of the channel bank where vegetation is starting to fall into the creek.

Figure 43. Looking Upstream, Left Abutment: Looking Downstream, Right Abutment

2.1.24 Little Panguingue Creek

Near MP 254, Little Panguingue Creek crosses the Parks Highway from the west within a 130-inch culvert structure (7112).

Figure 44. Little Panguingue Creek Cross Culvert, Downstream Looking Upstream

The upstream and downstream culvert end treatments have been mitered to the roadway slope and appears relatively intact. The culvert shows moderate rust but is generally in good condition. The creek does not show signs of potential migration outside its existing banks as these banks are heavily vegetated. The creek appears to be degrading on the outlet side of the culvert as it is elevated above the channel bottom. The channel bed is made up of large boulders and cobbles.

2.1.25 Slate Creek

Near MP 257.8, Slate Creek crosses the Parks Highway from the west within 144-inch, double barrel culvert pipes (7113).

Figure 45. Slate Creek Cross Culverts, Downstream Side Looking Upstream

The upstream and downstream culvert end treatments have been mitered to the roadway slope with cutoff walls. Each end treatment appears relatively intact. The culverts show moderate rust but are generally in good condition. The creek does show a slight potential to migrate outside its existing banks as the channel is braided as it approaches the roadway crossing. The channel banks are heavily vegetated. The creek appears to be degrading on the outlet side of the culvert as it is elevated above the channel bottom. The channel bed is made up of cobbles and smaller gravel. The southernmost culvert shows signs of glaciation.

Figure 46. Looking Upstream from Roadway

2.2 Storm Water Management and Geomorphic Evaluation

2.2.1 Stormwater Management

Existing onsite storm water management is limited to roadway sheet flow runoff directly down slopes into toe ditches within a roadway fill typical section. Roadside ditches in cut slope typical sections convey roadway runoff and cut slope surface runoff where applicable. These toe and roadside ditches also collect offsite surface runoff to ultimately discharge into the larger adjacent rivers via gradually sloping terrain. These ditches were not designed to comply with stormwater treatment criteria but provide minimal treatment to stormwater runoff with regards to trash capture.

2.2.2 Geomorphic Evaluation

Local streams ice over in the winter, and during prolonged freezing conditions, ice formations may block a stream's main channel, diverting flow onto the overbanks or over the ice cover. Backwater increases and aufeis may result at site-specific locations; however, flow is generally under the ice cover as flows typically decrease during the freezing months.

Formal bank migration studies have not been conducted for this study; however, bank stability appears to be mediocre throughout the project reach based on visual observations and the types of bank vegetation present. Existing onsite drainage patterns consist of roadway sheet flow directly down fill slopes. Runoff is subsequently concentrated and directed into existing topography and to the adjacent rivers. In cut slope situations, onsite and offsite runoff is combined and collected in roadside ditches and conveyed via the roadway profile to nearby toe of slope ditches and ultimately directed under the roadway and into the existing topography toward the adjacent rivers.

Each significant crossing was evaluated with relation to bank stability adjacent to the existing crossing structure. Section 2.1 within this technical memorandum summarizes any potential future stream migration near each existing significant crossing.

2.3 Waterbodies

Waterbodies in the corridor vicinity include lakes and rivers. Lakes include Otto Lake near Healy, the Chavey Lakes near Cantwell, the Deneki Lakes as well as Horseshoe Lake near McKinley Village, and many smaller unnamed lakes. Larger lakes are identified on Exhibit A and most of the smaller lakes exist within small ponds adjacent to the roadway corridor.

Major rivers in the area that are categorized as a navigable waterway include only the Nenana River, which is both a United States Coast Guard Navigable Waterway and a United States Army Corp of Engineers Navigable Waterway. (HIF 2020 and USACE 2012)

A search of the Federal Emergency Management Agency database found that there are no delineated 100-year floodplains or regulatory floodways within the study area.

2.4 Existing Drainage Conditions

Regional and local geology, seismicity, and known/anticipated geologic hazards have been identified within the *Baseline Geological and Geotechnical Assessment Memorandum* completed as a part of this PEL Study by Shannon and Wilson (S&W). General observations identify that current erosion concerns are where the highway exists on the outside edge of a river bend (cut bank). Drainage issues throughout the corridor are causing damage at the base of the highway. Massive ice exists at nearly every instance of significant roadway settlement or embankment failure. The frost action around the roadway reduces the bearing capacity of the pavement. Permafrost appears to be a problem throughout the entire corridor except in locations where the roadway is adjacent and at a similar elevation to the Nenana River. (S&W, 2020)

2.4.1 DOT&PF Maintenance Concerns

Maintenance concerns related to drainage are outlined in the PEL study as a separate technical memorandum prepared by DOT&PF, *Maintenance and Operations Existing Concerns and Needs Report* (DOT&PF 2020). Highlights related to drainage are summarized in the following paragraphs.

An area of concern that the DOT&PF maintenance and operation crews has identified is the section of roadway near MP 235 through MP 236. Drainage issues along this stretch cover a significant area, spanning over 0.75 miles in both directions from the location pictured in **Figure 47**, which was taken around MP 235.5. The condition of the pavement in this area is reported to be substantially below an acceptable level, likely as a partial result of these drainage issues. (DOT&PF 2020)

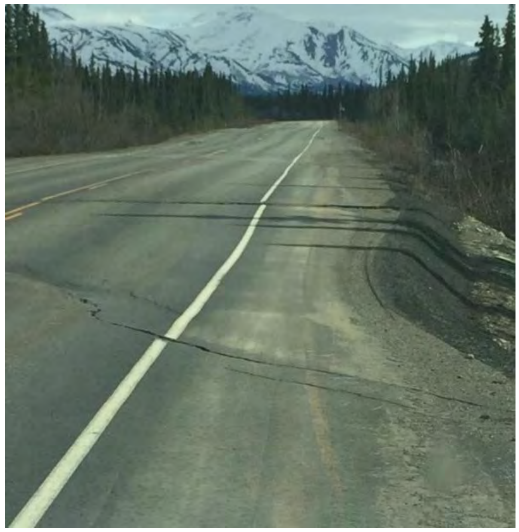

Figure 47. MP 235.5
Source: DOT&PF 2020

A field visit to this area has verified the deteriorating condition of the roadway pavement. Between MP 232 and MP 236, numerous regional offsite low points exist adjacent to the roadway corridor which has accumulated ponded water. In general, the regional topography is sloped toward the Nenana River on the west side of the corridor. The deteriorating roadway pavement and embankment has generally been observed where ponded water has abutted to the roadway embankment. The source of the ponded water is a combination of thawing subsurface ice, onsite roadway runoff and offsite surface runoff. Few cross culverts exist here, and roadside ditch low points do not match the locations where these culverts have been installed.

Rock constrains the highway in several areas, including just north of Cantwell and through Nenana Canyon. There are maintenance concerns currently in areas that are generally composed of a poor rock. Slope failures appear to be soil and likely related to loss of shear strength because of permafrost thawing. Debris from these slope failures is blocking culverts behind concrete barrier. **Figure 48** illustrates the drainage issues from slide debris behind concrete barriers.

Figure 48. Drainage issues from slide debris behind concrete barriers
Source: DOT&PF 2020

A field visit to this area has confirmed the destruction and blockage of cross culverts in this area.

Figure 49. Damaged Culvert End Condition near MP 239.5 on the East Side

Slightly to the north of MP 253, drainage issues are causing damage to the base of the road. The effect of these drainage issues on the road base are causing part of the road to begin collapsing. A sink hole or a severe dip is being created in the road surface.

A field visit has verified roadway damage at this location. Regional topography shows the adjacent surface generally slopes from the west toward the Nenana River in the east. The roadside ditch on the east side of the roadway corridor has developed local low points that accumulates surface runoff into ponding that is currently abutting up to the roadway embankment. This ponding is assumed to be the source of weakening embankment identified, as part of the Baseline Geologic and Geotechnical Assessment Memorandum, between MP 253 and MP 254.

Culverts that have been installed in this area are in good condition. The roadside ditches do not appear to convey the complete captured surface runoff to each culvert on the upstream side (western side of the corridor). Local low points created on the downstream side (eastern side of the corridor) appear to exacerbate the issue.

Figure 50. Upstream End of Culvert (West Looking East): Downstream End of Culvert

Maintenance crews have identified a section of roadway around MP 256.5 where the road shoulder is failing because of damage caused by issues with drainage. There are many cracks forming along the road shoulder as well as along the active roadway, causing the road shoulder to begin to fall off. DOT&PF maintenance and operations crews have reported that drainage issues are also a concern in the area near MP 258.5 of the Parks Highway. These drainage issues are a problem that is affecting the base of the roadway. (DOT&PF 2020)

A field visit has verified roadway damage at this location. Regional topography shows the adjacent surface generally slopes from the west toward the Nenana River in the east. The roadside ditch on the east side of the roadway corridor has developed local low points that accumulates surface runoff into ponding that is currently abutting up to the roadway embankment. This ponding is assumed to be the source of weakening embankment identified, as part of the *Baseline Geologic and Geotechnical Assessment Memorandum*, between MP 256 and MP 259.

Culverts that have been installed in this area are in good condition. The roadside ditches do not appear to convey the complete captured surface runoff to each culvert on the upstream side (western side of the corridor). There appears to be an adequate number of cross culverts and that conveyance to these culverts is being impeded.

Figure 51. Ponding Observed on the Upstream Side (West Side) Near MP 256.5

Source: S&W 2020

Figure 52. Ponding Observed on the Upstream Side (West Side) Near MP 258.5

Source: DOT&PF 2020

The following are the main areas of concern that have been established by DOT&PF maintenance crews:

- Drainage issues and inadequate shoulder sections, spanning from MP 235 to 236
- Nenana Canyon rockslides and drainage issues, MP 239 to 240
- Drainage issues damaging roadway at MP 253, MP 256.5, and MP 258.5

2.4.2 Drainage Field Observations

Between the southern limit of the study corridor and MP 215, the surrounding topography is observed to be very flat adjacent to the roadway corridor. There are many regional low points that have accumulated surface runoff in the form of ponding throughout this section of the study corridor. Locations that have been identified as part of the *Baseline Geologic and Geotechnical Assessment Memorandum* as areas with unstable embankment tend to coincide with regional ponding that is abutted against the roadway embankment. The source of the ponded water is a combination of thawing subsurface ice, onsite roadway runoff and offsite surface runoff. The highest concentration of these local ponds exists between MP 208 and MP 215.

Figure 53. Ponding Observed on the East Side Near MP 208

Near MP 217, the regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor. The typical roadway section in this area is a cut section on the east and a fill section on the west. It appears that the cut section has sloughed in multiple locations creating local low points in the roadside ditch that in turn create ponded water during rainfall events. The existing cross culverts are correctly located in the roadway profile low points. The roadside ditches are unable to convey runoff to these cross culverts due to inundation of cut slope material.

Between MP 217 and MP 218, the regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor. Roadside ditches on the east side of the corridor convey offsite and onsite surface runoff to these low points that generally include cross culverts installed. Cross culverts do not appear to have been installed near MP 217.8 and MP 218, where the upstream side (east side of corridor) indicates a regional low point.

The Nenana River flows north, adjacent to the west side of the roadway corridor between MP 218 and MP 223.5. The roadway embankment includes moderate riprap protection along this stretch. A small portion of the roadway is eroding due to the Nenana River undercutting of the roadway embankment between MP 221.8 and MP 222 as identified within the Baseline Geologic and Geotechnical Assessment Memorandum. This situation appears to be happening just north of MP 223 as well.

Figure 54. Erosion Just North of MP 223 Looking South (Upstream of the Nenana River)

Just north of MP 222, a permanent pond exists adjacent to the east side of the roadway corridor and abuts against the roadway embankment. This pond includes a 48-inch culvert pipe with headwall end treatments that directly discharges into the Nenana River. The Nenana River creates a tailwater condition that keeps this pond full. See **Figure 55**.

Figure 55. Culvert Just North of MP 222, Downstream Looking South, Upstream Looking North

In the section between MP 222 and MP 224, the braided nature of the Nenana River pushes the main channel against the roadway corridor. Embankment protection measures appear to be adequate along this area. This section also includes river braids that are slow moving and abut against the roadway embankment. These slow-moving braids also appear to create areas of ponding that also abut against the roadway embankment. The regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor. There appear to be adequate cross culverts draining the offsite surface runoff from the east.

A roadway high point was observed just south of MP 225. Roadside ditches convey offsite and onsite surface runoff along the roadway profile toward existing cross culverts and natural drainages in this area. Typically, driveway approaches include culverts to allow roadside ditches to convey along the roadway profile. Near MP 223.5, the west side roadside ditch is abruptly ended at a driveway approach where no culvert exists. This forces the roadside ditch to empty onto the roadway surface prior to being redirected back into the roadside ditch on the other side of the driveway. This instance occurs elsewhere along the study corridor but on an infrequent basis.

Just south of MP 225, a local low point has been created in the roadside ditch on the east side of the corridor where no cross culvert has been installed. This will create ponding during minor rainfall events. This situation also exists just north of MP 225 as well as an area around MP 226 and just north of MP 227. The regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor.

With the same regional topology, the area between MP 226.5 and MP 227 includes some regional low points that don't necessarily abut against the roadway embankment. These ponds (known as the Deneki Lakes) exist adjacent to the roadway corridor on the east side and roadside ditches have been graded to drain to them. The west side of the corridor drains away from the roadway.

A roadway low point was observed just south of MP 228. Roadside ditches convey offsite and onsite surface runoff along the roadway profile toward this low point. The regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor. Between MP 228 and a roadway high point at MP 230 through MP 231, only one cross culvert was observed to be installed. Throughout this section, only driveway approach culverts exist conveying roadside ditch flows along the roadway corridor. At MP 228 and near MP 229.8, a regional low point on the east side of the corridor does not appear to have an outlet which creates ponding adjacent to the roadway corridor.

Between MP 230 and MP 230.7, the cut slopes appear to be sloughing into the roadside ditch creating ponding situations during rainfall events. Cut slopes show moderate erosion in the form of rills along this section as well.

Near MP 231.6, a local low point has been created in the roadside ditch on the west side of the corridor where no cross culvert has been installed. Regional low points in the form of ponds exist adjacent to the roadway corridor in this region (MP 231.5 through MP 235). Most of these ponds are not connected with the ponds on the other side of the roadway corridor via a cross culvert. There does not appear to be a drainage outlet for these ponds as the surrounding topology is somewhat flat albeit generally sloping toward the Nenana River on the east side of the study corridor.

Near MP 234.8, cross culverts that have been installed in this area are in good condition. The roadside ditches do not appear to convey the complete captured surface runoff to each culvert on the upstream side (western side of the corridor). This situation continues between MP 235 and MP 236. The regional topology indicates surface sloping from the west toward the Nenana River on the east side of the study corridor.

Near MP 237, the cut slope has sloughed into the roadside ditch creating ponding during rainfall events.

Between MP 237 and MP 238, the regional topology indicates surface sloping from the west toward the Nenana River on the east side of the study corridor. A pedestrian pathway has been constructed on the west side of the roadway corridor that appears to be impeding offsite surface runoff. Flows that reach the roadway corridor are typically directed via roadside ditch toward the Nenana River toward the north. These roadside ditches have been blocked by soil in a few locations which appears to create ponding during small rainfall events.

Between MP 238 and MP 239, the roadway typical section includes a vegetated median with pedestrian pathways on both sides of the roadway. This section of roadway includes roadside ditches between the mainline roadway and the pedestrian pathways on each side of the corridor. There appears to be an inadequate number of culverts that convey collected onsite and offsite surface runoff along the roadway profile to the nearest discharge location (Junco Creek toward the north). Localized ponding occurs prior to multiple access driveways along the roadway corridor. The vegetated median cross section includes a ditch which collects onsite roadway runoff and conveys this runoff along the roadway profile toward Junco Creek. At intersections, this vegetated median ditch terminates at storm drain inlets in multiple location along this area. Existing storm drain systems then outlet these flows into the roadside ditches located on the west side of the roadway corridor.

Figure 56. Storm Drain Median Inlet Near MP 238.6

Between MP 239 and MP 243, the Nenana River flows directly adjacent to the west side of the roadway corridor. Near MP 240.5, a local low point has been created in the roadside ditch on the east side of the corridor where no cross culvert has been installed. Ponding was observed at this location that could potentially create issues to the roadway embankment.

Near MP 241, just north of the Grizzly Creek crossing, a small 24-inch cross culvert has been installed that conveys offsite and onsite surface runoff from the east toward the Nenana River on the west side of the corridor. It appears that the roadside ditch may be too flat, or the culvert is undersized which has created a backwater condition at the upstream side.

Figure 57. Upstream Side of Culvert Looking South Near MP 241

Near MP 242.1, the roadside ditch on the east side of the roadway corridor appears to have a low point created because of slope inundation. No cross culvert has been installed at this location. The regional topology indicates surface sloping from the east toward the Nenana River on the west side of the study corridor.

Figure 58. Roadside Ditch Low Point on the West Side Near MP 242.1

A small section near MP 244 appears to include low points within the roadside ditches on both sides of the roadway corridor. The regional topology indicates surface sloping from the west toward the Nenana River on the east side of the study corridor. There is a regional low point identified as a pond that exists on the west side of the roadway corridor that appears to have no outlet.

Figure 59. Roadside Ditch Low Point on the West Side Near MP 244

Between MP 245.2 and MP 245.9, the regional topology indicates surface sloping from the west toward the Nenana River on the east side of the study corridor. Ponding was identified in the roadside ditch on the west side of the roadway corridor. The culverts appeared to be in good condition and the roadside ditches have been inundated and do not effectively convey runoff to these culverts.

Near MP 247.5, the roadway typical section is indicative of a roadway in cut. The roadside ditch on the west side of the roadway corridor appears to be inundated by a significant amount of the roadway cut material.

Near MP 248.4, the regional topology indicates surface sloping from the west toward the Nenana River on the east side of the study corridor. This location has a 48-inch cross culvert installed conveying surface runoff flows from the west toward the Nenana River on the east side of the roadway corridor. This culvert appears to be in poor condition with a broken back near the center (directly under the roadway). This has created a situation where upstream headwater is unable to drain and ponding occurs.

Figure 60. Culvert at MP 248.4: From Upstream Looking Downstream: From Downstream Looking Upstream

Within the town of Healy, near MP 248.7 just south of the intersection with Hilltop Road, there appears to be a localized detention pond created as a part of the development of the parcel on the southwest corner of the intersection. The regional topology indicates surface sloping from the west toward the Nenana River on the east side of the study corridor. On the northwest corner of this same intersection, there appears to be several inadequate driveway approach culverts and at the roadside ditch terminus with the intersection, there is no culvert to convey roadside ditch flows from the north to the south side of Hilltop Road. The roadway typical cross section through the town of Healy (MP 248.5 through MP 249.5) includes a pedestrian pathway on each side of a mainline roadway.

Near just south of MP 251, regional ponding was observed adjacent to the roadway corridor. A cross culvert has been installed at this location, but the ponding occurs further away from the roadway embankment such that only overflow flows will be able to be conveyed within it. Similarly, between MP 253.5 and MP 253.8, low points along the roadside ditch on the west side of the roadway corridor are present. Culverts have been installed along this section, the roadside ditches have been inundated and do not effectively convey runoff to these culverts.

In several locations along the study corridor, simple roadway embankment erosion was observed where roadway runoff was unintentionally concentrated on the shoulder prior to being able to flow down the roadway embankment. This occurred more frequently where guardrail was present.

Figure 61. Shoulder Erosion Near MP 252.5 Looking South Towards the Panguingue Creek Crossing

Several locations along the corridor include batter board where guardrail is present. There would then typically include a flume (metal or riprap) to convey concentrated flows from openings in the batter board to the bottom of the roadway embankment. These are typically placed near bridges where concentrated flow is unavoidable but were also observed where steep embankments warranted guardrail.

Figure 62. Typical Riprap Flume Looking Toward Slate Creek: Typical Metal Flume on Southbound Side of the Kingfisher Creek Crossing

Erosion within roadside ditches appeared to be minimal as riprap was effectively used where slopes became steep.

Figure 63. Typical Riprap Roadside Ditch Looking Toward Riley Creek

2.5 Fish Passage

The U.S. Fish and Wildlife Service created the National Fish Passage Program to work with transportation agencies to improve road stream crossings to a level that promotes safe and adequate fish passage. Anadromous and resident fish populations depend on reliable passage through drainage structures when migrating to spawning, rearing, and over-wintering grounds. Barriers to fish passage can be a significant factor in fish population decline. (DOT&PF/ADF&G 2001)

To identify fish passage issues that are present in the study area, several readily available datasets were reviewed. These include the following:

- The DOT&PF has completed an environmental conditions memorandum that has identified fish and wildlife resources along the study corridor (DOT&PF 2020).
- The ADF&G maintains an Anadromous Waters Catalog (AWC) that is important for spawning, rearing or migration of anadromous fishes and an accompanying Atlas to the Catalog. The AWC is a numerically-ordered list of the water bodies with documented use by anadromous fish for these purposes. The Atlas to the Catalog shows, cartographically, the location, name and number of these specified water bodies, the anadromous fish species using these water bodies, and the fish life history phases for which the water bodies are used (to the extent known) (ADF&G 2020). The AWC can be accessed online through the ADF&G's Interactive Mapper application.
- Essential Fish Habitat (EFH) in Alaska is identified in Fishery Management Plans developed by the North Pacific Fishery Management Council (NOAA 2020). EFH maps are available online via the Alaska EFH Mapper ArcGIS Web Application.
- The ADF&G maintains a Fish Passage Inventory Database (FPID) that contains data on over 2,500 stream crossings assessed for fish passage by the ADF&G since 2001 (ADF&G 2020). This database of fish passage roadway culvert crossings throughout the state of Alaska can be accessed online through the ADF&G's Fish Resource Monitor interactive mapping application.

The ADF&G's AWC mapper identified several anadromous streams in the project area including the Nenana River and some of its small tributaries: Moody Creek, Healy Creek, Lignite Springs, K-Dog Creek, an unnamed stream, Panguingue Creek, and Little Panguingue Creek. (DOT&PF 2020)

The ADF&G's FPID mapper identified two locations where fish passage has been evaluated and included in the database. These include:

- 40500307: Slate Creek and,
- 40500308: Little Panguingue Creek

The Little Panguingue Creek and the Slate Creek crossing was observed to have a poor culvert outfall height as well as a poor culvert gradient. This resulted in each crossing to have an overall fish passage rating designation of red as indicated in the FPID. A red rating means that the crossing is assumed to be inadequate for juvenile salmonid and weak swimming fish passage. The FPID includes only those culverts that have been assessed as a part of the national fish passage program. This database is not intended to be comprehensive of all stream crossings in the study corridor.

Exhibit A within **Attachment A** includes the presentation of data acquired from the AWC mapper and the FPID mapper which identifies anadromous streams and fish passage assessed culverts along the study corridor, respectively.

A search of the National Oceanic and Atmospheric Administration (NOAA) EFH mapper database did not identify any EFH locations in the corridor area.

Table 1 shows the locations along the study corridor that currently have either an assessment from the ADF&G regarding fish passage obtained from the FPID, or streams with anadromous fish from the AWC. Only those locations where anadromous streams and resident fish streams that cross the study corridor are presented here.

Table 1. Fish Passage Crossing Locations

MP	Crossing Name	Structure	Size (in)	Fish
216	Nenana River	Double Span	n/a	Anadromous
220	Slime Creek	Culvert	72	Resident
231	Nenana River	Triple Span	n/a	Anadromous
238	Nenana River	Four Span	n/a	Anadromous
243	Nenana River	Four Span	n/a	Anadromous
251	Un-named	Culvert	36	Anadromous
252.6	Panguingue Creek	Single Span	n/a	Resident/Anadromous
254	Little Panguingue Creek	Culvert	120	Anadromous
257.8	Slate Creek	Culvert	120	Anadromous

Source: ADF&G 2020

3. Hydrologic Analysis

A hydrologic analysis was performed on each significant drainage crossing along the project corridor. This analysis determines peak flow values used in the hydraulic design of cross culverts and ditches. Hydrology map overviews and more detailed hydrology maps, including a delineation of drainage basins and key sub-basins for contributing tributaries to the Nenana River, can be found in **Attachment B**.

3.1 Hydrologic Methodology and Criteria

Appendix A in the *Alaska Highway Drainage Manual* (DOT&PF 2006) and Table 1120-1 of the *Alaska Highway Preconstruction Manual* (DOT&PF 2019) outlines the required design frequency for drainage crossings of highway corridors. **Table 2** is a summary of the criteria outlined in these two manuals.

Table 2. Design Flood Event Criteria

Type of Structure	Design Frequency	Exceedance Probability
Culverts on Primary Highways	50 years	2%
Bridges on All Highways	50 years	2%

Source: DOT&PF 2019, DOT&PF 2006

The *Alaska Highway Drainage Manual* (DOT&PF 2006) allows the use of various hydrologic methods depending on basin size and available data. For analyses that require a peak runoff value to be used in culvert and bridge crossing designs, USGS stream gage data was used. The USGS Scientific Investigations Report 2016-5024 presents statistical analysis, including a Log-Pearson Type III (LP3) analysis, performed on all USGS gages within the state of Alaska. The report also presents regional regression equations for developing peak runoff values for delineated watersheds.

Drainage crossings were identified based on the significance of each drainage crossing of the roadway corridor. Significant drainage crossings were identified based on a crossing structure size of a 48-inch-diameter culvert or larger and all bridge crossings. This threshold meets criteria outlined in the *Alaska Highway Preconstruction Manual* section 450.9.7 and 1120.5.1 (DOT&PF 2019). Significant streams were also identified where USGS topographic perennial streams were located as well as any streams that the ADF&G had identified as anadromous streams.

DOT&PF has recommended the incorporation of nonstationary conditions within the hydrologic and hydraulic analysis related to FHWA guidelines within the *Highways in the River Environment-Floodplains, Extreme Events, Risk and Resilience* (HEC-17) (FHWA 2016).

3.1.1 Crossings with USGS Stream Gages

Where USGS stream gages exist, a weighted average of the stream gage peak flow estimate obtained by the LP3 analysis, and a peak flow estimate obtained from the regional regression equations, was conducted in accordance with the methodologies outlined in the USGS Scientific Investigations Report 2016-5024.

3.1.2 Crossings without USGS Stream Gages

If a delineated watershed was near a USGS stream gage but did not have a gage, an improved peak flow estimate was obtained from the regression equation for the ungaged site, weighted with the weighted peak flow estimate from the gaged site and a drainage area-based multiplier. This multiplier and the methodology required to perform this weighted analysis at any ungaged site is presented in the USGS Scientific Investigations Report 2016-5024. This methodology is also only valid for sites that are near a

USGS stream gage. A site is considered near if it is within 50 to 150 percent of the drainage area of the gaged site.

If the ungaged site is not considered near a gaged site, the weighting procedure gives full weight to the regional regression analysis outlined in the USGS Scientific Investigations Report 2016-5024.

3.2 Drainage Area

From MP 203 to about MP 210, the topography is generally rolling with a roughly northeast-southwest trending patterns of ridges and valleys. From MP 210 to about MP 244, the topography generally consists of hilly to rugged mountains separated by glacial and post-glacial valleys. From MP 244 to the northern limit of the study corridor, the topology generally consists of rolling to moderately rugged hills separated by areas of relatively flat, typically poorly draining bogs. (S&W 2020)

Elevations range from 1,100 feet (Dry Creek crossing) to 12,339 (Mt Deborah) feet within the drainage basins that produce surface water to the Nenana River. Surface water runoff generally flows from the higher elevations toward the lower drainage paths via streams and rivers. Concentrated surface water runoff will typically cross under the project roadway corridor via culverts or bridges.

The USGS quadrangle maps ("Healy" and "Fairbanks") were consulted to delineate drainage runoff areas for offsite drainage crossings (USGS 2016; USGS 2013). USGS elevation data derived from these quad maps were obtained from the USGS National Map[1] and processed in ArcGIS Version 10.6, a geographic information system software program created by the Environmental Systems Research Institute, commonly referred to as ESRI. Processing scripts (ArcHydro) created for ArcGIS were used to ensure the raw elevation data was conditioned to create a drainage grid. This process is called digital elevation model reconditioning and uses algorithms to match grid elevation data to streamline data obtained from the National Hydrography Dataset in the USGS National Map (USGS 2020).

Contours created from these digital elevation models aided in the delineation of drainage basin boundaries used for offsite hydrology. Contours from the actual quad map imaging were also consulted and aided in verifying drainage boundaries.

3.3 Rainfall Characteristics

All drainage systems for the roadway corridor are sized to meet the design criteria for this project using appropriate rainfall data for the area.

Mean annual precipitation from the PRISM precipitation dataset, developed by the PRISM Climate Group and published for Alaska by Gibson (2009), was selected as a variable in flood frequency regression equations for the study in the USGS Scientific Investigations Report 2016-5024. LP3 analysis completed in the USGS study utilize the PRISM data as the precipitation variable. All regression equations developed within the USGS Report also use this precipitation data to minimize variations in parameter usage.

Table 1 in the USGS Scientific Investigations Report 2016-5024 has presented the basin average mean annual precipitation data for every USGS gage site in the state of Alaska.

[1] https://www.usgs.gov/core-science-systems/ngp/tnm-delivery/

3.4 Log-Pearson III

Flood-frequency estimates for stream gages are computed by fitting the base-10 logarithms of the series of annual peak flows to a known statistical distribution. The flood magnitude and frequency estimates for this study were computed using the LP3 distribution as recommended in Bulletin 17B (Interagency Advisory Committee on Water Data 1982). The fitting of this distribution requires calculating the three statistics—the mean, standard deviation, and skew of the logs of annual peak flows, which describe the midpoint, slope, and curvature of the peak-flow frequency curve, respectively. (USGS 2016)

USGS stream gage statistics and an LP3 fitting for each gage is presented in the USGS Scientific Investigations Report 2016-5024 Table 4, *Flood-frequency statistics for stream gages in Alaska and conterminous basins in Canada with at least 10 years of record through water year 2012*. This data was obtained for use in the Cantwell to Healy PEL corridor study.

3.5 Regional Regression

The USGS Scientific Investigations Report 2016-5024 outlines a methodology using exploratory regression analysis by beginning to illustrate ordinary least-squares regression as a simple form of multiple-linear regression that assumes that the peak flow values at stream gages are independent and that each stream gage record has similar variance, which is influenced by the length of records.

Streamflow data are naturally correlated spatially and temporally, making the assumptions of ordinary least-squares regression incompletely satisfied. A more sophisticated technique, generalized least-squares analysis, improves the equations by accounting for time-sampling error, which is a function of record length, and cross-correlation of annual peak flows between stream gages. If two stream gages are near each other and flooding is caused by regional rainstorms or other basin climate conditions, the annual series of peak flow will be largely correlated at both stream gages and cannot be considered independent information for the purposes of the regression. (USGS 2016)

The final regional regression equations were derived and presented in the USGS Scientific Investigations Report 2016-5024 Table 7, *Regional regression equations for estimating annual exceedance-probability discharges for unregulated streams in Alaska and conterminous basins in Canada.* These equations were used in the Cantwell to Healy PEL study.

3.6 Weighted Averaging

Weighted averaging that uses USGS stream gage data, regional regression analysis, and nearby ungaged sites was conducted to present a more conservative and accurate depiction of annual exceedance probability peak flows for each delineated drainage basin.

3.6.1 Weighted Averaging <u>with</u> USGS Gage Data

Flood frequency estimates at stream gages can be improved by computing a weighted average of the stream gage estimate obtained by LP3 analysis of peak flows, here referred to as the station estimate, and the estimate from the regression equation. Optimal weighted flow estimates can be obtained if the variance for each of the two estimates is known or can be estimated accurately. (USGS 2016)

The USGS Scientific Investigations Report 2016-5024 includes within its Table 4, values from each USGS stream gage derived through the LP3 methodology, regional regression methodology, and a weighted average between the two.

3.6.2 Weighted Averaging without USGS Gage Data

For ungaged sites near a gaged site on the same stream, an improved estimate can be obtained from the regression estimate for the ungaged site, weighted with an estimate based on the weighted estimate for the gaged site and a drainage area-based multiplier. The sites are considered near if the drainage area of the ungaged site is within 50 to 150 percent of the drainage area of a gaged site. (USGS 2016)

Methodology for completing a weighted average for a site without a USGS stream gage can be found in the USGS Scientific Investigations Report 2016-5024. This corridor study uses a computational spreadsheet to evaluate drainage basins that meet criteria to include weighted averaging with a nearby gaged site or evaluate a peak flow estimate utilizing regional regressions only.

4. Hydraulic Analysis

Hydraulic analysis on all identified stream crossings was not conducted as a part of this corridor study. As outlined in the *Alaska Highway Preconstruction Manual* (DOT&PF 2019), hydrologic and hydraulic analysis must be conducted on all bridge crossing designs as well as any culvert crossings 48 inches in diameter or larger. The analysis should evaluate the failure caused by hydrostatic and hydrodynamic forces, erosion, saturated soils, or plugging by debris.

The minimum diameter for round cross-drainage culverts is 24 inches, as stated in the *Alaska Highway Preconstruction Manual* (DOT&PF 2019). Throughout the project corridor, where icing becomes a potential issue, the DOT&PF recommends a minimum size of 36 inches in diameter.

DOT&PF recommends a culvert and storm drain system with a service life of 30 to 75 years.

5. Summary

5.1 Peak Flow Analysis

A hydrologic and hydraulic analysis is required for culvert structures 48 inches and larger or bridge structures, as defined in the *Alaska Highway Preconstruction Manual* (DOT&PF 2019). These significant crossings were determined by using as-built plan sets obtained from the DOT&PF covering the entire corridor. In the future, the existing significant crossings will need a hydraulic analysis to evaluate the failure caused by hydrostatic and hydrodynamic forces, erosion, saturated soils, or plugging by debris.

For USGS gaged streams, a weighted average of the stream gage peak flow estimate obtained by the LP3 analysis and a peak flow estimate obtained from the regional regression equations is presented.

For ungaged crossings that are near a gaged site, an improved peak flow was obtained from the regression equation. The ungaged crossing is weighted with the weighted peak flow estimate from the gaged site and a drainage area-based multiplier.

For any ungaged crossing that is considered not near a gaged site, the regression equation was used.

Results from the hydrologic analysis on the identified crossings in the corridor can be found in **Table 3**. This table presents resulting peak flow values for the 50-year storm event for each identified crossing.

Table 3. Hydrologic Summary

MP	Crossing Name	Gaged/ Ungaged	Structure	Size (in)	Drainage Area (sq. mi.)	50-Year Peak Flow Rate (cfs)
208	Pass Creek	Ungaged	Single-span		29.3	1361
209.5	Jack River	Ungaged	Single-span		189.0	5439
216	Nenana River	Gaged	Double-span		707.0	42300
220	Slime Creek	Ungaged	Culvert	72	7.1	473
224	Carlo Creek	Ungaged	Single-span		19.4	1001
231	Nenana River	Ungaged	Three-span		1171.4	22983
237	Riley Creek	Ungaged	Dual-span		104.8	3509
238	Nenana River	Ungaged	Four-span		1738.2	37433
238.1	Kingfisher Creek	Ungaged	Single-span		0.6	74
239	Junco Creek	Ungaged	Culvert	72	0.6	80
240	Iceworm Gulch	Ungaged	Single-span		1.6	160
240.4	Hornet Creek	Ungaged	Single-span		2.2	200
240.9	Grizzly Creek	Ungaged	Culvert	72	0.7	88
241.2	Fox Creek	Ungaged	Single-span		0.6	75
242	Eagle Creek	Ungaged	Culvert	146	0.6	73
242.4	Dragonfly Creek	Ungaged	Single-span		0.8	96
242.6	Coyote Creek	Ungaged	Culvert	108	0.8	93
243	Nenana River	Ungaged	Four Span		1746.8	37671
243.5	Bison Gulch	Ungaged	Single-span		1.1	120
244.5	Antler Creek	Ungaged	Single-span		1.4	144
250	Dry Creek + Overflow	Ungaged	Dual-span		37.8	1645
252.6	Panguingue Creek	Ungaged	Single-span		17.1	912
254	Little Panguingue Creek	Ungaged	Culvert	120	3.6	286
257.8	Slate Creek	Ungaged	Culvert	120	10.3	627

cfs = cubic feet per second
sq. mi. = square mile
in = inches

5.2 Future Analysis

Identification of additional crossings that need hydrologic and hydraulic analysis should be considered for future solutions related to maintenance and operation concerns.

Implementation of the methodology outlined in HEC-17 (FHWA 2016) regarding a framework that applies to the statistical hydrologic methodology completed as a part of this technical memorandum should be considered. This framework ensures the inclusion of a nonstationary condition analysis related to climate change. It is recommended that a minimum Level 2 procedure outlined in HEC-17 be conducted. This Level 2 procedure considers uncertainty within the use of historical data to identify an appropriate range of conditions to aid in a more resilient design of drainage facilities.

At Level 2, the design team estimates the design discharge based on historical data and qualitatively considers future changes in land use and climate as in Level 1. In addition, the design team quantitatively estimates a range of discharges (confidence limits) based on historical data to evaluate plan/project performance. (FHWA 2016)

Fish passage criteria will need to be identified to provide a tiered approach outlined in the memorandum of agreement between the DOT&PF and the ADF&G to designing and installing fish passage roadway culverts throughout the project corridor. Current culvert crossings would also need to be evaluated and assessed to identify poor fish passage parameters and included in the FPID in the future.

Erosion could be a future problem for the highway at most locations where the river is near or in contact with a slope that supports the highway. At the locations where the highway is on the outside edge of the cut bank, erosion from the river could cause slope failure in the future.

Drainage issues seem to be a fairly common problem faced by maintenance crews along the Parks Highway. These problems with inadequate drainage will result in continual damage to the foundation of the roadway, shoulders, and the road surface. Future analysis to identify locations where a combination of larger culverts, additional culvert crossings, and enhanced roadside ditch grading to alleviate current drainage issues is recommended.

6. References

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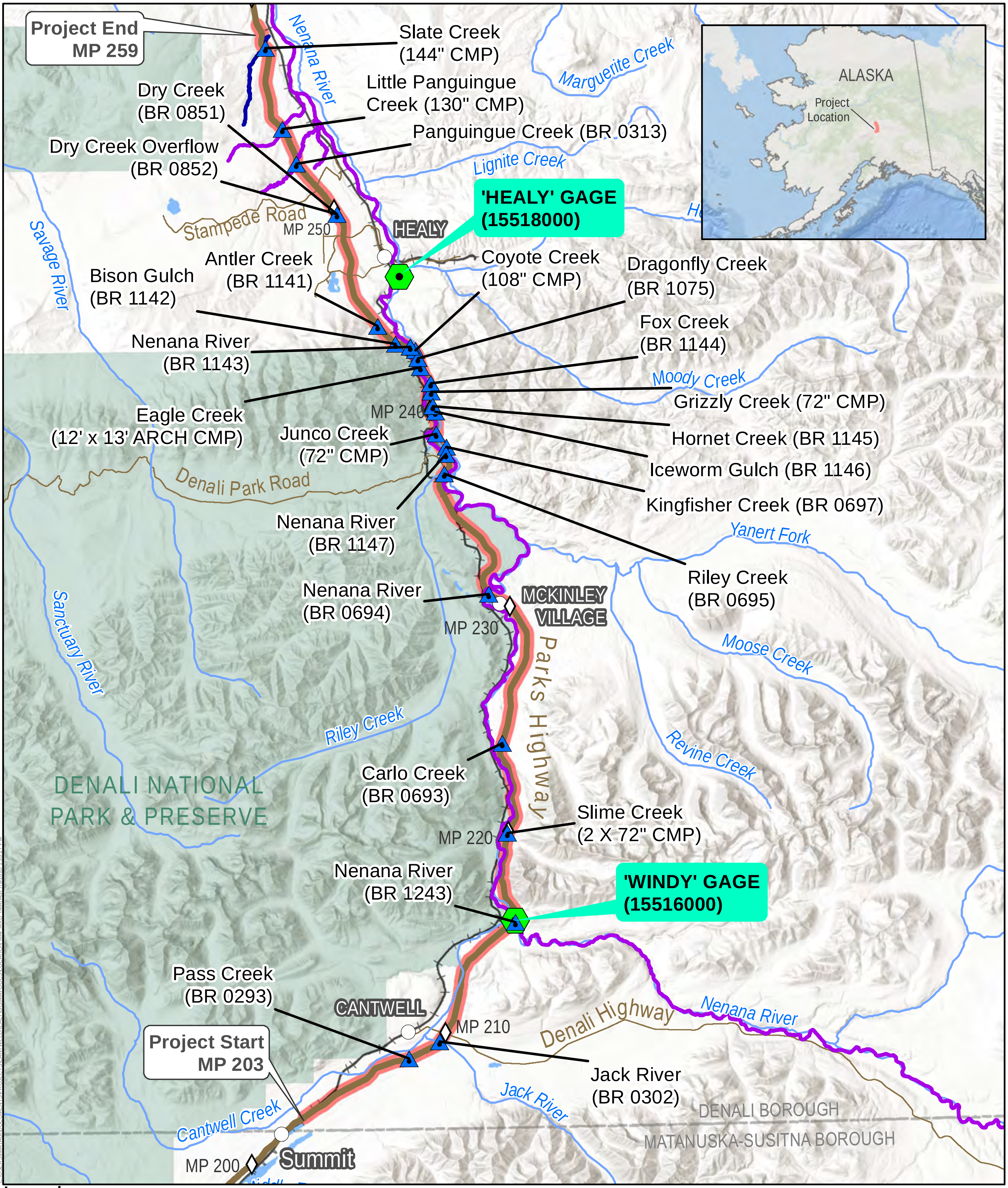
Attachment A
Location Map and
Anadromous Stream and Fish Passage Data



Legend

- Significant Crossings
- Mile Post
- USGS Gages
- Cities
- Streams
- Roads
- Alaska Railroad
- Project Extent
- Ponds/Lakes
- Denali National Park & Preserve
- Borough
- Fish Passage Streams (FPID)
- Andromous Streams (AWC)

N

0 2.5 5 10 Miles

Exhibit A
Location Map
Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS

Fish Passage Site 40500308

Coordinates (dec. deg.): 63.93483°, -149.10238°
Legal Description: F011S008W27
Region: Interior
Road Name: Parks Highway

Datum: WGS84
Quad Name / ITM: Healy D-5
AWC Stream #:
Stream Name: Unnamed

Elevation:

Site Comments: None

Survey CNT07-PAR07

Survey Date: Jul 27, 2006

Observers: Dave Ryland, Kyle Negri

Overall Fish Passage Rating: Red

Tidal: No
Backwatered: No

Step Pools:
Construction Year:

Site Observations:

1. Outfall height red
2. Culvert gradient red

Comments: None

Culvert Measurements

ID: 1 **Structure Type:** Circular pipe (Corrugated steel) **Fish Passage Rating:** Red

Length(ft): 146.7
Inlet Type: Mitered
Outlet Type: Mitered
Corrugation Depth(in.): 2.0
Corrugation Width(in.): 6.0
Condition Rating(1-5): 3
Approach Angle: 19.0
Sedimentation At Inlet:
Inlet Substrate: None
Outlet Substrate: None

	Inlet	Outlet
Width(ft):	9.4	9.5
Height(ft):	10.5	10.4
Apron Length(ft):		
Water Depth(ft):		0.35
Rustline Height(ft):	1.1	
Substrate Depth(ft):	0.0	0.0

Backwatered?:
Baffles Present: No
Embedded?: No
Outfall Height: 2.56
Outfall Type:
Constriction Ratio: 0.89
Culvert Gradient: 2.95%
Max Slope:
Max Slope Length:

Culvert Observations:

1. Outfall height red
2. Culvert gradient red

Stream Measurements

Stream Substrates	Upstream	Downstream
Dominant:	Cobble	Cobble
Subdominant:	Gravel	Gravel

Stream Slope(deg.):
Stream Flow Stage:

Stream Width Type	Distance From Crossing (ft)	Stream Width (ft)
Downstream bank full	113.0	12.00
Downstream bank full	165.0	13.30
Downstream ordinary high water	113.0	9.80
Downstream ordinary high water	165.0	11.70
Upstream bank full	55.0	11.90
Upstream bank full	136.0	13.60
Upstream bank full	225.0	10.90
Upstream ordinary high water	55.0	7.60
Upstream ordinary high water	136.0	12.20
Upstream ordinary high water	225.0	11.60

Elevations

Locator ID	Culvert Number	River Distance (ft)[1]	Distance From Crossing (ft)[2]	Relative Elevation (ft)
D/S Grade Ctrl (Thalweg)		0.00	165.0	63.49
D/S Grade Ctrl (Thalweg)		52.00	113.0	64.52
D/S Grade Ctrl (Thalweg)		124.00	41.0	67.28
OHW Left Bank		139.00	26.0	67.95
Bankfull Left Bank		139.00	26.0	68.21
OHW Right Bank		139.00	26.0	67.88
Bankfull Right Bank		139.00	26.0	68.15
D/S Tailcrest or 1st Thalweg		139.00	26.0	67.35
D/S Water Surface Elev		139.00	26.0	67.84
Outlet Pool Water Elev		165.00	0.0	67.83
Outlet Invert	1	165.00	0.0	70.04
Inlet Culvert Invert	1	311.00	0.0	74.38
U/S Thalweg		317.00	6.0	74.77
U/S Thalweg		330.00	19.0	75.35
U/S Thalweg (Tailcrest)		338.00	27.0	75.83
U/S Grade Ctrl (Thalweg)		366.00	55.0	76.36
U/S Grade Ctrl (Thalweg)		447.00	136.0	80.48

Notes:

1. River distance is measured continuously throughout the survey reach along the thalweg of the stream.
2. Measured from each end of the crossing along the thalweg of the stream.

Fish Sampling Efforts

No fish sampling occurred during this survey.

Fish Observations

No fish observations occurred during this survey.

Photos

Questions or comments about this report can be directed to dfg.dsf.webmaster@alaska.gov

Fish Passage Site 40500307

Coordinates (dec. deg.): 63.98364°, -149.12519°
Legal Description: F011S008W04
Region: Interior
Road Name: Parks Highway

Datum: WGS84
Quad Name / ITM: Healy D-5
AWC Stream #:
Stream Name: Unnamed

Elevation:

Site Comments: None

Survey CNT07-PAR06

Survey Date: Jul 26, 2006

Observers: Dave Ryland, Kyle Negri

Overall Fish Passage Rating: Red

Tidal: No
Backwatered: No

Step Pools:
Construction Year:

Site Observations:

1. Outfall height red
2. Culvert gradient red

Comments: None

Culvert Measurements

ID: 1 **Structure Type:** Circular pipe (Corrugated steel) **Fish Passage Rating:** Red

Length(ft): 130.8
Inlet Type: Mitered
Outlet Type: Mitered
Corrugation Depth(in.): 2.0
Corrugation Width(in.): 6.0
Condition Rating(1-5): 3
Approach Angle: 20.0
Sedimentation At Inlet:
Inlet Substrate: None
Outlet Substrate: None

	Inlet	Outlet
Width(ft):	10.8	10.3
Height(ft):	12.2	12.4
Apron Length(ft):		
Water Depth(ft):		0.28
Rustline Height(ft):	1.2	
Substrate Depth(ft):	0.0	0.0

Backwatered?:
Baffles Present: No
Embedded?: No
Outfall Height: 0.87
Outfall Type:
Constriction Ratio: 1.36
Culvert Gradient: 2.53%
Max Slope:
Max Slope Length:

Culvert Observations:

1. Outfall height red
2. Culvert gradient red

ID: 2 **Structure Type:** Circular pipe (Corrugated steel) **Fish Passage Rating:** Red

Length(ft): 130.9
Inlet Type: Mitered
Outlet Type: Mitered
Corrugation Depth(in.): 2.0
Corrugation Width(in.): 6.0
Condition Rating(1-5): 3
Approach Angle: 20.0
Sedimentation At Inlet:
Inlet Substrate:
Outlet Substrate:

	Inlet	Outlet
Width(ft):	10.5	10.3
Height(ft):	12.3	12.4
Apron Length(ft):		
Water Depth(ft):		0.25
Rustline Height(ft):	1.3	
Substrate Depth(ft):	0.0	0.0

Backwatered?:
Baffles Present: No
Embedded?: No
Outfall Height: 0.87
Outfall Type:
Constriction Ratio: 1.36
Culvert Gradient: 2.47%
Max Slope:
Max Slope Length:

Culvert Observations:

1. Outfall height red
2. Culvert gradient red

Stream Measurements

Stream Substrates	Upstream	Downstream
Dominant:	Cobble	Cobble
Subdominant:	Cobble	Gravel

Stream Slope(deg.):
Stream Flow Stage:

Stream Width Type	Distance From Crossing (ft)	Stream Width (ft)
Downstream bank full	100.0	26.80
Downstream bank full	237.0	27.40
Downstream ordinary high water	100.0	21.60
Downstream ordinary high water	237.0	23.00
Upstream bank full	104.0	15.50
Upstream bank full	151.0	15.40
Upstream bank full	198.0	13.00
Upstream ordinary high water	104.0	12.40
Upstream ordinary high water	151.0	11.10
Upstream ordinary high water	198.0	9.70

Elevations

Locator ID	Culvert Number	River Distance (ft)[1]	Distance From Crossing (ft)[2]	Relative Elevation (ft)
Misc. (concrete headwall at inlet pipe 1)				74.70
Misc. (concrete headwall at outlet pipe 1)				71.36
D/S Grade Ctrl (Thalweg)		0.00	190.0	64.53
D/S Grade Ctrl (Thalweg)		90.00	100.0	66.37
D/S Grade Ctrl (Thalweg)		139.00	51.0	68.14
D/S Tailcrest or 1st Thalweg		159.00	31.0	68.02
OHW Left Bank		159.00	31.0	69.37
Bankfull Left Bank		159.00	31.0	70.63
OHW Right Bank		159.00	31.0	69.41
Bankfull Right Bank		159.00	31.0	70.75
D/S Thalweg		183.00	7.0	66.60
Outlet Pool Water Elev		190.00	0.0	68.87
Outlet Invert	1	190.00	0.0	69.46
Outlet Invert	2	190.00	0.0	69.49
Road Elev		255.00		102.16
Inlet Culvert Invert	1	320.00	0.0	72.77
Inlet Culvert Invert	2	320.00	0.0	72.73
U/S Grade Ctrl (Thalweg)		333.00	13.0	74.17
U/S Grade Ctrl (Thalweg)		372.00	52.0	74.64
U/S Grade Ctrl (Thalweg)		381.00	61.0	75.09
U/S Grade Ctrl (Thalweg)		435.00	115.0	76.33
U/S Grade Ctrl (Thalweg)		518.00	198.0	79.58

Notes:

1. River distance is measured continuously throughout the survey reach along the thalweg of the stream.
2. Measured from each end of the crossing along the thalweg of the stream.

Fish Sampling Efforts

No fish sampling occurred during this survey.

Fish Observations

No fish observations occurred during this survey.

Photos



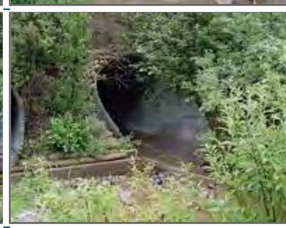




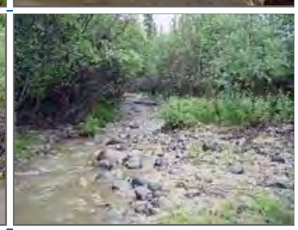






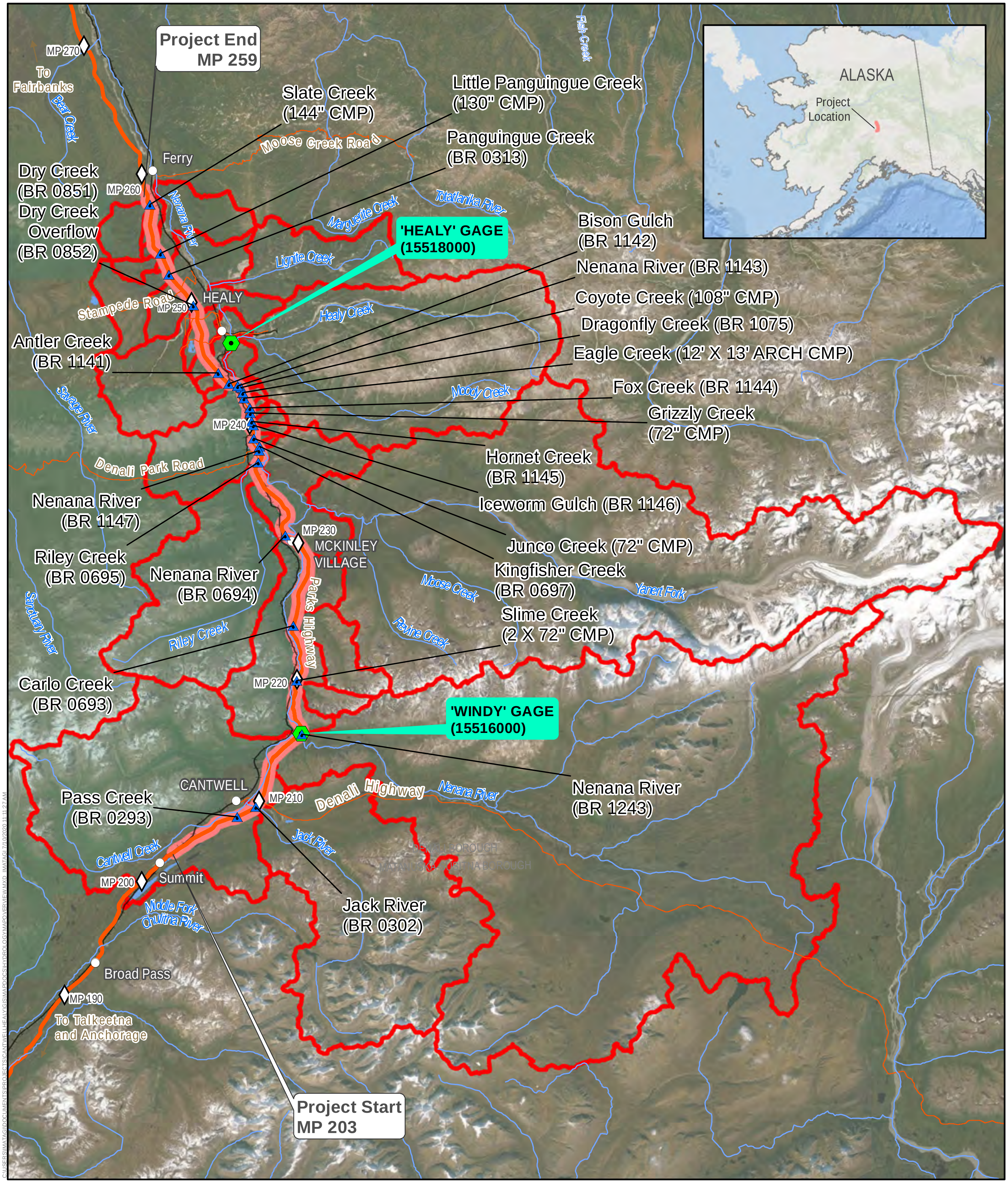






Questions or comments about this report can be directed to dfg.dsf.webmaster@alaska.gov

Attachment B
Hydrology Maps, and Statistical Analysis



Legend

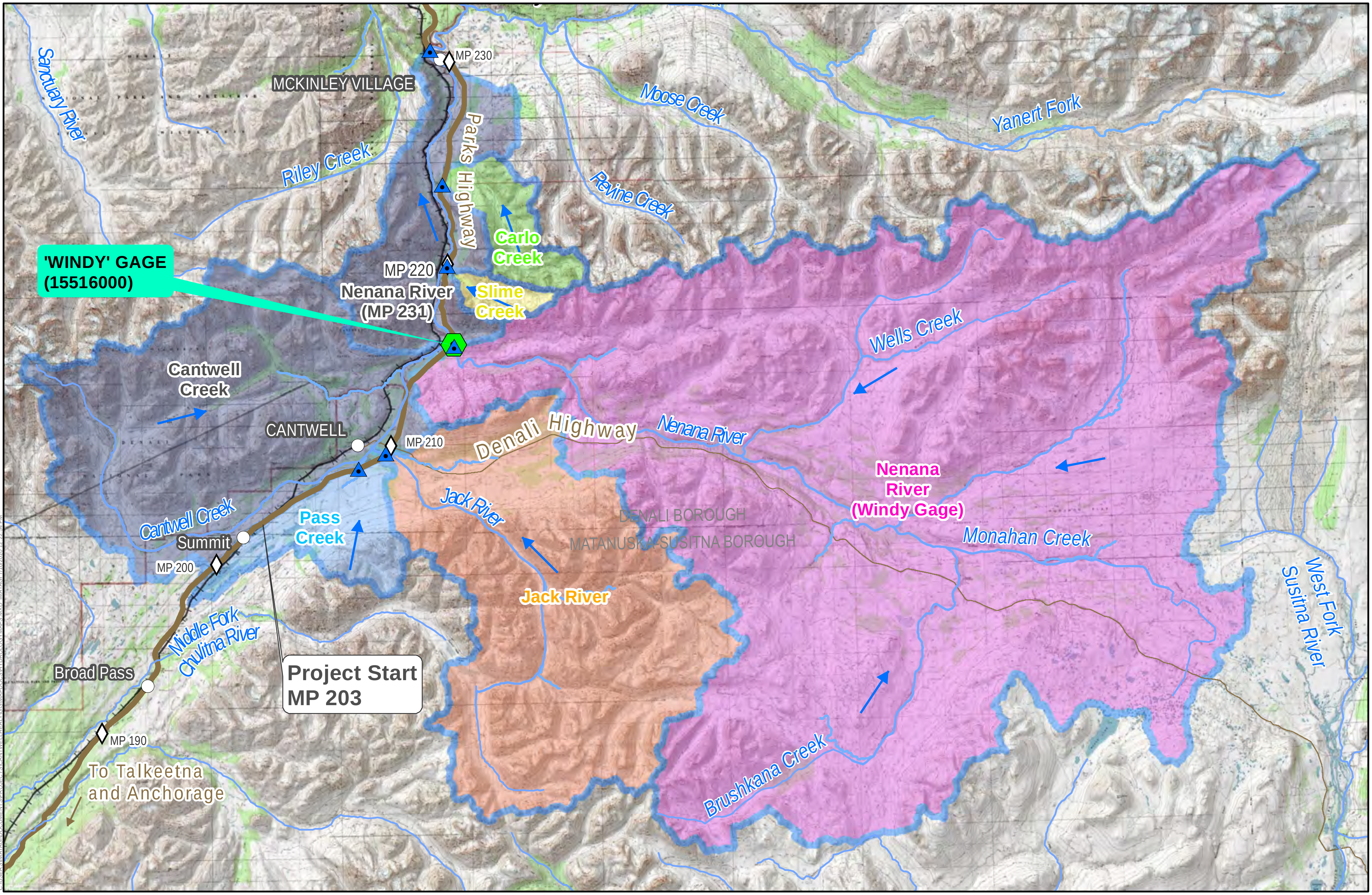
- Mile Post
- Cities
- Alaska Railroad
- Project Extent
- Ponds/Lakes
- Roads
- Denali National Park & Preserve
- Borough
- Streams
- Significant Crossings
- USGS Gages
- Drainage Basins

N

0 2.5 5 10 Miles

Exhibit B1
Hydrology Map Overview
Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS



Legend

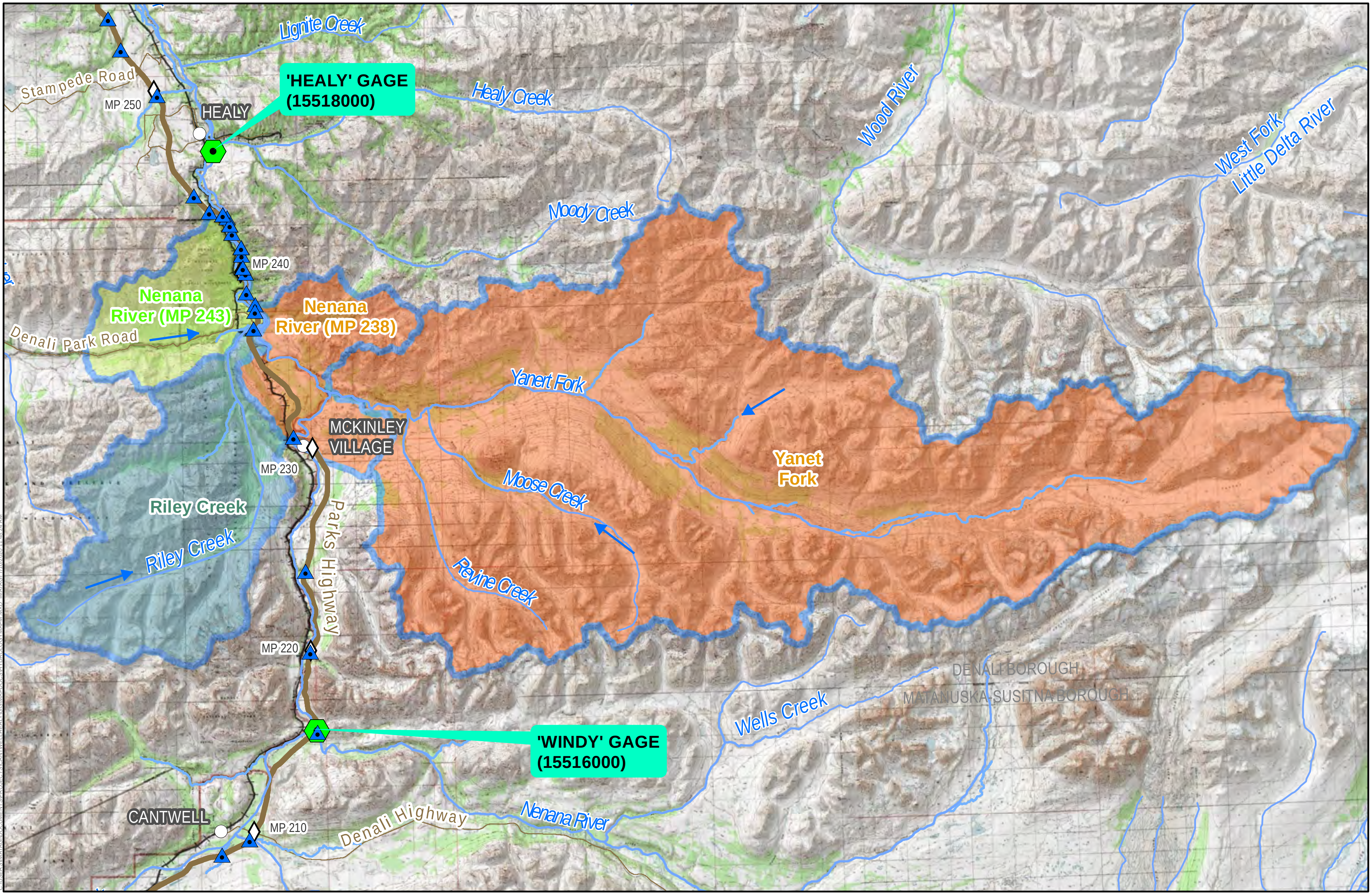
Significant Crossings	Streams	**Drainage Basins**	Nenana River (MP 231)
Mile Post	Roads	Cantwell Creek	Nenana River (Windy Gage)
USGS Gages	Alaska Railroad	Carlo Creek	Pass Creek
Cities		Jack River	Slime Creek

0 2.5 5 10 Miles

N

Exhibit B2
Hydrology Map South
Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS



Legend

Significant Crossings
Mile Post
USGS Gages
Cities
Streams
Roads
Alaska Railroad

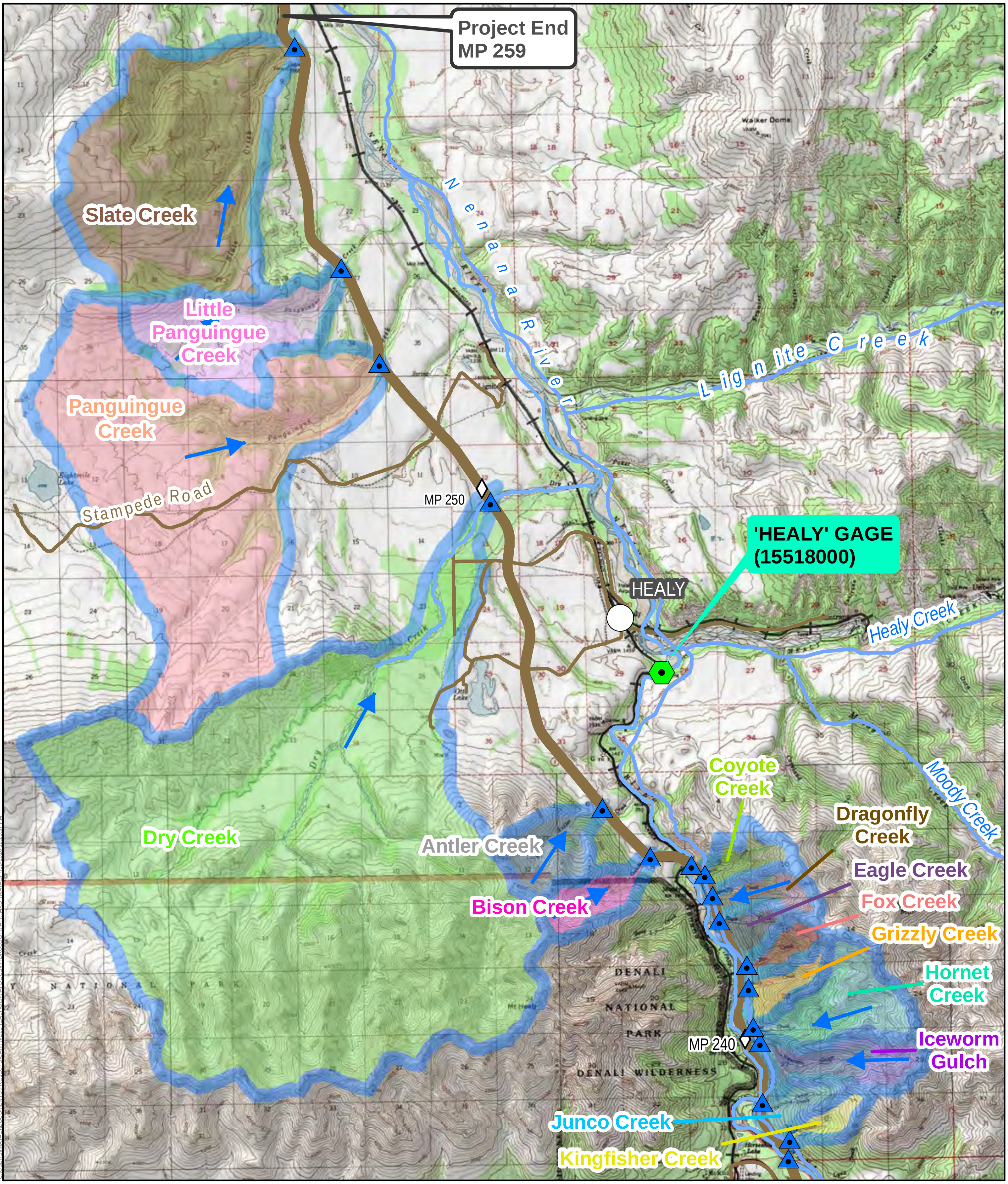
Drainage Basins

Nenana River (MP 238)
Nenana River (MP 243)
Riley Creek
Yanert Fork

N
0 2.5 5 10 Miles

Exhibit B3
Hydrology Map Middle
Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS



Legend

Significant Crossings	Cities	**Drainage Basins**					
Mile Post	Streams	Antler Creek	Dragonfly Creek	Grizzly Creek	Kingfisher Creek		
USGS Gages	Roads	Bison Creek	Dry Creek	Hornet Creek	Little Panguingue Creek		
	Alaska Railroad	Coyote Creek	Eagle Creek	Iceworm Gulch	Panguingue Creek		
			Fox Creek	Junco Creek	Slate Creek		

N

0 0.5 1 Miles

Exhibit B4
Hydrology Map North

Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS

JACOBS

SUBJECT:
George Parks Highway - Cantwell to Healy PEL Study

Nenana River USGS Gage Data

Gage Summary Data

CALC'D BY: **BP**
REV'D BY: **IM**
DATE: **6/2/2020**
PROJECT NUMBER **W3X71248**

Healy Data:

Drainage Area	1,910	sqmi
Mean Annual Precipitation	25	in

Windy Data:

Drainage Area	707	sqmi
Mean Annual Precipitation	25	in

		Healy						**Windy**					
		Flood Frequency Statistics			**Variance Estimates**			**Flood Frequency Statistics**			**Variance Estimates**		
Percent Annual Exceedance Probability	**Recurrence Interval (year)**	**LPIII**	**Reg**	**Wtd**	**LPIII**	**Reg**	**Wtd**	**LPIII**	**Reg**	**Wtd**	**LPIII**	**Reg**	**Wtd**
50	2	20,600	14,100	20,500	0.0008	0.0770	0.0008	6,540	6,140	6,540	0.0005	0.0760	0.0005
20	5	27,500	19,100	27,300	0.0011	0.0740	0.0011	8,240	8,690	8,240	0.0007	0.0730	0.0007
10	10	32,200	22,700	31,900	0.0016	0.0740	0.0016	9,370	10,500	9,380	0.0010	0.0760	0.0010
4	25	38,300	27,100	37,900	0.0025	0.0770	0.0024	10,800	12,800	10,900	0.0018	0.0760	0.0018
2	50	42,900	30,300	42,300	0.0036	0.0800	0.0034	11,900	14,500	12,000	0.0025	0.0760	0.0024
1	100	47,700	33,600	46,800	0.0049	0.0830	0.0046	13,000	16,200	13,200	0.0035	0.0760	0.0033
0.5	200	52,700	36,900	51,400	0.0066	0.0890	0.0061	14,200	17,900	14,400	0.0047	0.0760	0.0044
0.2	500	59,500	41,300	57,600	0.0092	0.0970	0.0084	15,700	20,300	16,100	0.0066	0.0760	0.0061

Source: United States Geological Survey (USGS). 2016. *Estimating Flood Magnitude and Frequency at Gaged and Ungaged Sites on Streams in Alaska and the Conterminous Basins in Canada, Based on Data Through Water Year 2012* . Scientific Investigations Report 2016-5024.

JACOBS		CALC'D BY: BP
SUBJECT: George Parks Highway - Cantwell to Healy PEL Study		REV'D BY: IM
Significant Crossing Ungaged Weighted Analysis		DATE: 6/2/2020
		PROJECT NUMBER W3X71248

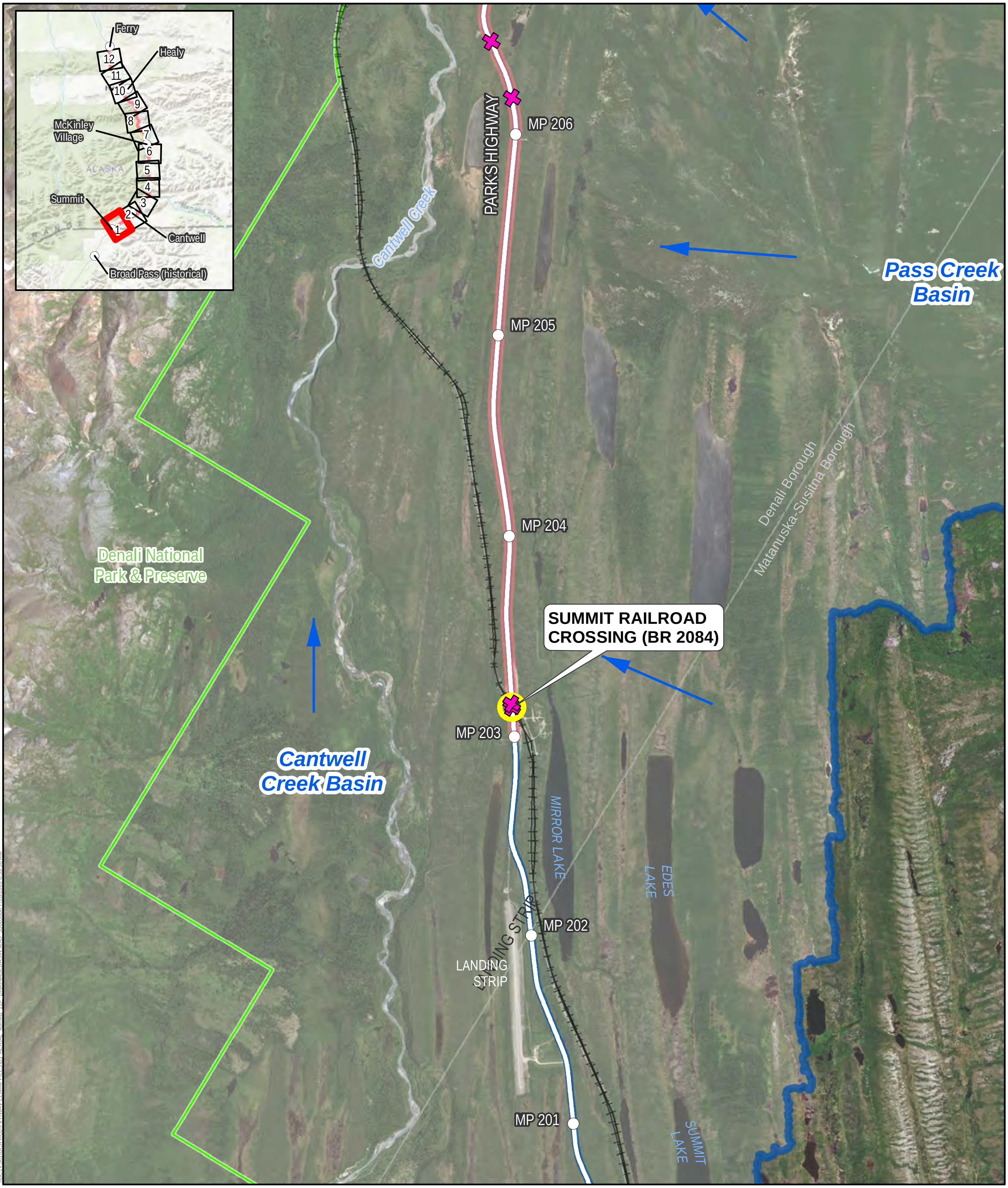
Mean Annual Precipitation	25	
Drainage Area Exponent (50-year)	0.743	
Drainage Area Healy	1,910	sqmi
Drainage Area Windy	707	sqmi
Gaged Q50 Healy	42,300	cfs
Gaged Q50 Windy	12,000	cfs

MP	Crossing Name	Drainage Area (sqmi)	Area Ratio (must be between 0.5 and 1.5)	Q (u)g	Q (u) (reg)	Delta Area	Q (u) (wtd)	100-Year Peak Flow Rate (CFS)
208	Pass Creek	29.291592	0.015335912	1898.115374	1361.312	1880.71	840.9734904	1361
209.5	Jack River	188.957757	0.098930763	7583.532743	5438.845	1721.04	3718.507779	5439
220	Slime Creek	7.066533	0.003699755	659.9224825	473.2907	1902.93	288.0399881	473
224	Carlo Creek	19.368942	0.010140807	1395.893414	1001.123	1890.63	614.3587363	1001
231	Nenana Rive	1171.442536	0.613320699	29416.58616	21097.32	738.56	22982.81263	22983
237	Riley Creek	104.753541	0.054844786	4892.354617	3508.755	1805.25	2276.921385	3509
238	Nenana Rive	1738.197931	0.910051273	39439.03703	28285.34	171.80	37432.51516	37433
238.1	ngfisher Cre	0.579385	0.000303343	102.900442	73.79931	1909.42	44.71584185	74
239	Junco Creel	0.642532	0.000336404	111.1215738	79.69544	1909.36	48.29044895	80
240	eworm Gul	1.641718	0.000859538	223.0999153	160.0053	1908.36	97.01924001	160
240.4	Hornet Cree	2.216471	0.001160456	278.8428296	199.9837	1907.78	121.3075664	200
240.9	Grizzly Cree	0.733721	0.000384147	122.6371561	87.95432	1909.27	53.29812321	88
241.2	Fox Creek	0.594233	0.000311117	104.8533844	75.19995	1909.41	45.56496261	75
242	Eagle Creek	0.573874	0.000300458	102.1723239	73.27711	1909.43	44.39926815	73
242.4	agonfly Cre	0.826878	0.00043292	134.0267737	96.12285	1909.17	58.25174983	96
242.6	Coyote Cree	0.785752	0.000411388	129.0415878	92.54752	1909.21	56.08347835	93
243	Nenana Rive	1746.792495	0.914551045	39583.8356	28389.19	163.21	37670.6936	37671
243.5	Bison Gulch	1.111513	0.000581944	166.9733204	119.7518	1908.89	72.58530623	120
244.5	Antler Creel	1.429285	0.000748317	201.2731625	144.3514	1908.57	87.51479972	144
250	Dry Creek	37.80036	0.019790764	2294.098473	1645.308	1872.20	1022.197147	1645
252.6	nguingue Cr	17.081588	0.00894324	1271.455193	911.8768	1892.92	558.7299144	912
254	Panguingue	3.590331	0.001879754	399.0226061	286.1756	1906.41	173.7528236	286
257.8	Slate Creek	10.309155	0.005397463	873.6899017	626.6029	1899.69	382.1831899	627

50-year Event Regression Equation
8.79*(DRNAREA)^0.743(PRECPRISOO)^0.787

Source: United States Geological Survey (USGS). 2016. *Estimating Flood Magnitude and Frequency at Gaged and Ungaged Sites on Streams in Alaska and the Conterminous Basins in Canada, Based on Data Through Water Year 2012* . Scientific Investigations Report 2016-5024.

Attachment C
Drainage Feature Maps



LEGEND

- Bridge
- Surface Flow Arrows
- Roads
- Mile Post

Culvert (Size)

- < 48 inches
- >= 48 Inches
- Project Extent

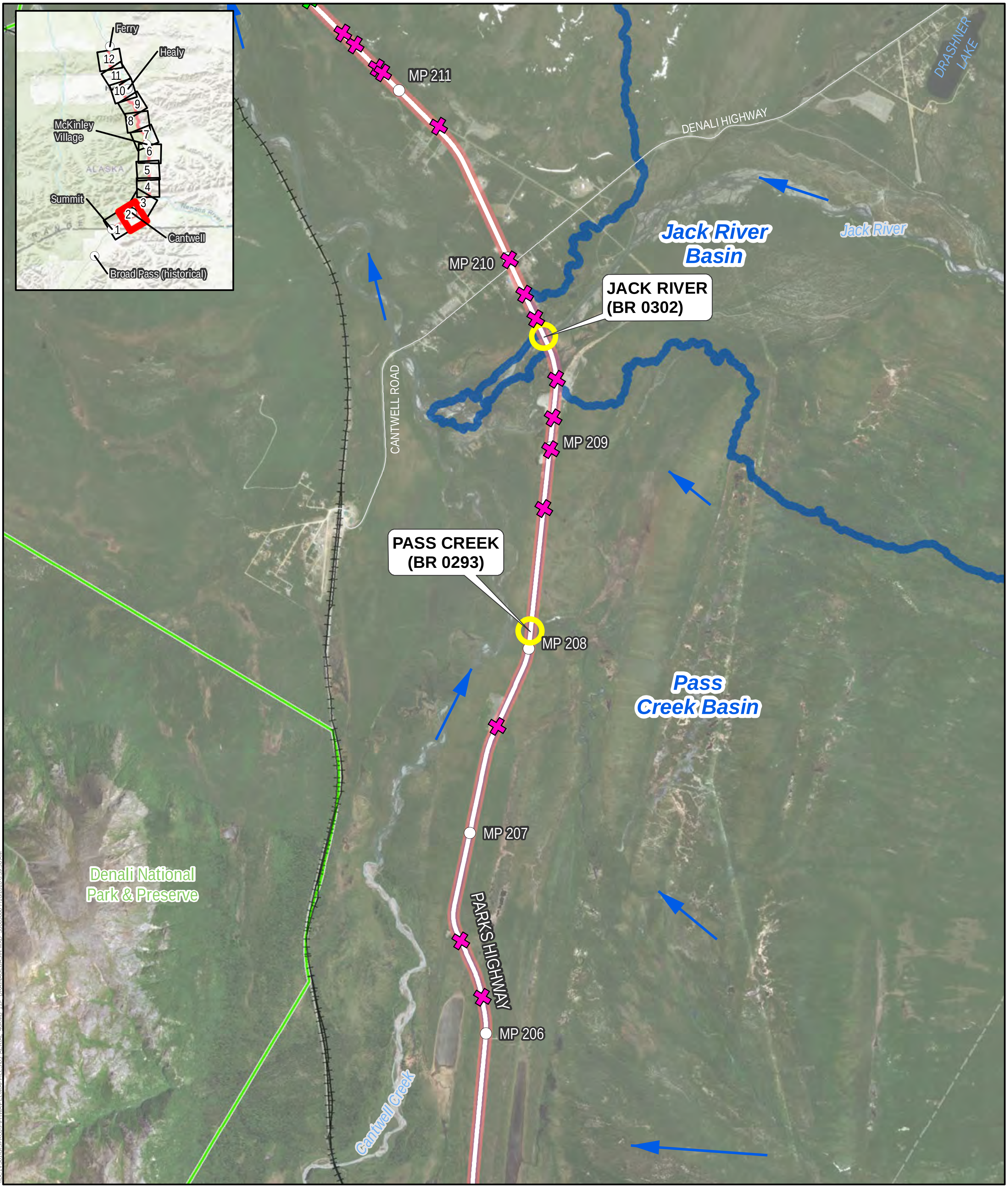
- Denali National Park & Preserve
- Borough
- Drainage Basins

0 0.5 1 Miles

EXHIBIT C1 of 12
Drainage Feature Maps

Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS



LEGEND

- Bridge
- Surface Flow Arrows
- Roads
- Mile Post

Culvert (Size)

- < 48 inches
- >= 48 Inches
- Project Extent

- Denali National Park & Preserve
- Borough
- Drainage Basins

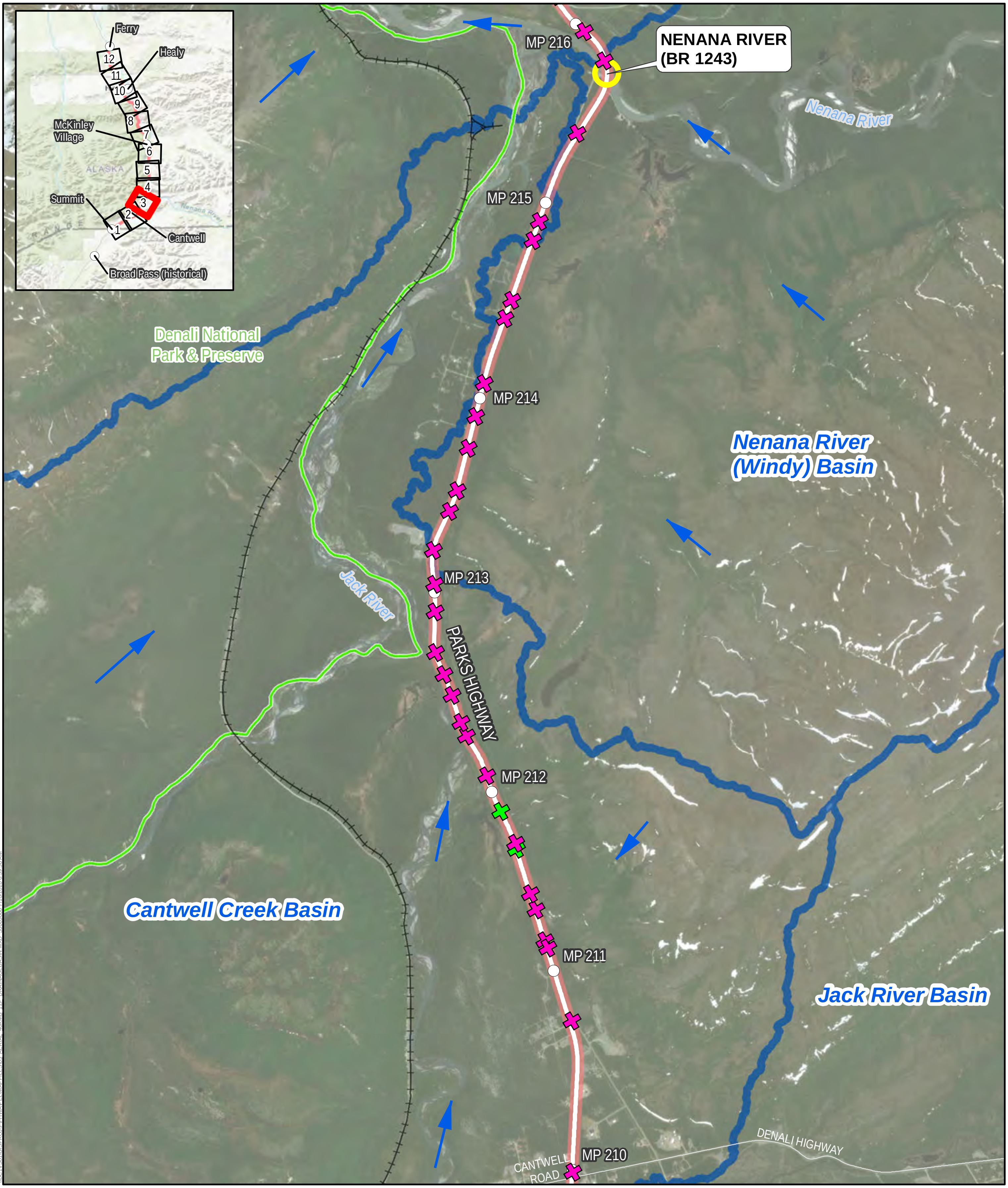
N

0 0.5 1 Miles

EXHIBIT C2 of 12
Drainage Feature Maps

Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS



LEGEND

Bridge

Surface Flow Arrows

Roads

Mile Post

Culvert (Size)

< 48 inches

>= 48 Inches

Project Extent

Denali National Park & Preserve

Borough

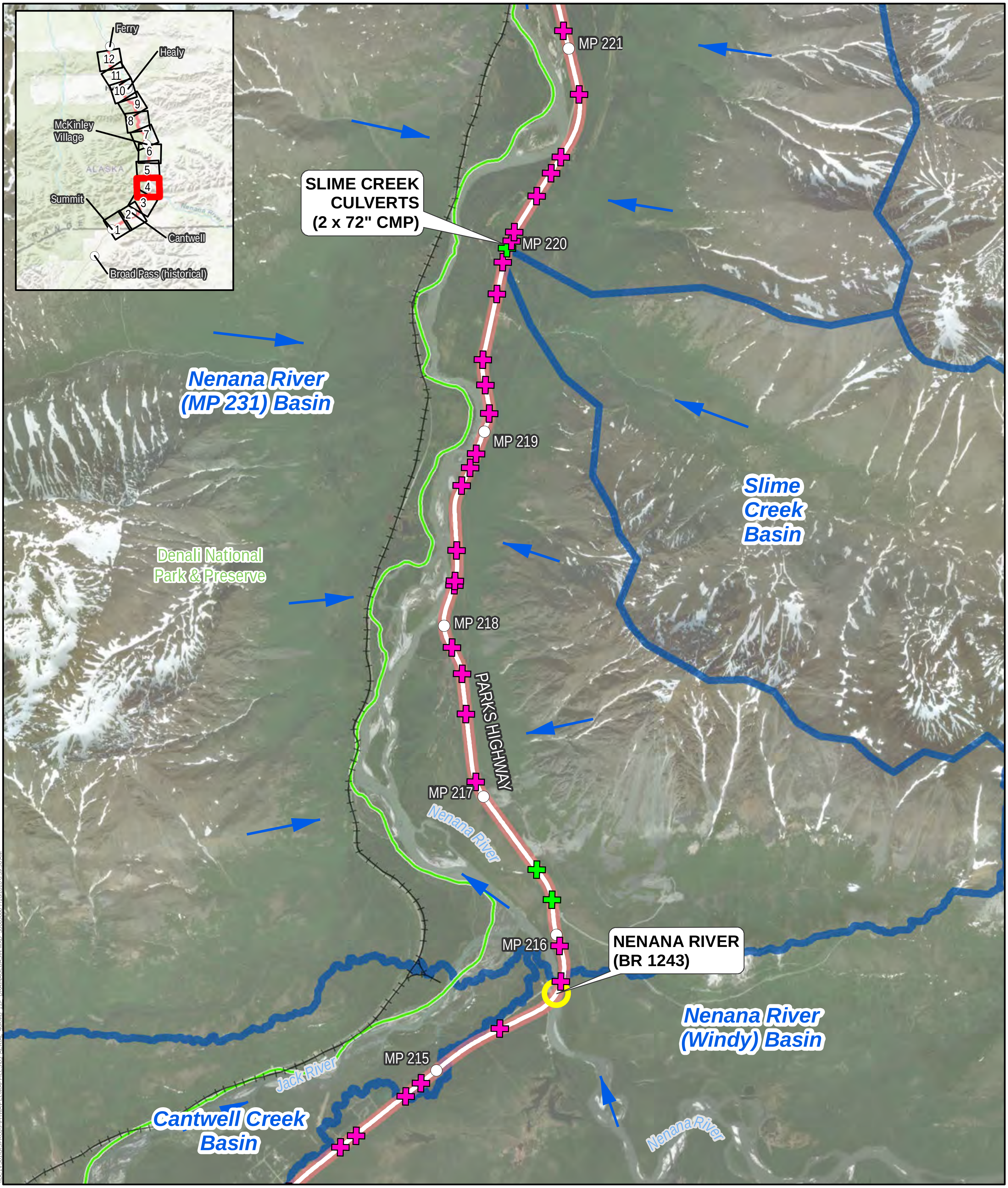
Drainage Basins

0 0.5 1 Miles

EXHIBIT C3 of 12
Drainage
Feature Maps

Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS



LEGEND

Bridge

Surface Flow Arrows

Roads

Mile Post

Culvert (Size)

< 48 inches

>= 48 Inches

Project Extent

Denali National Park & Preserve

Borough

Drainage Basins

N

0 0.5 1 Miles

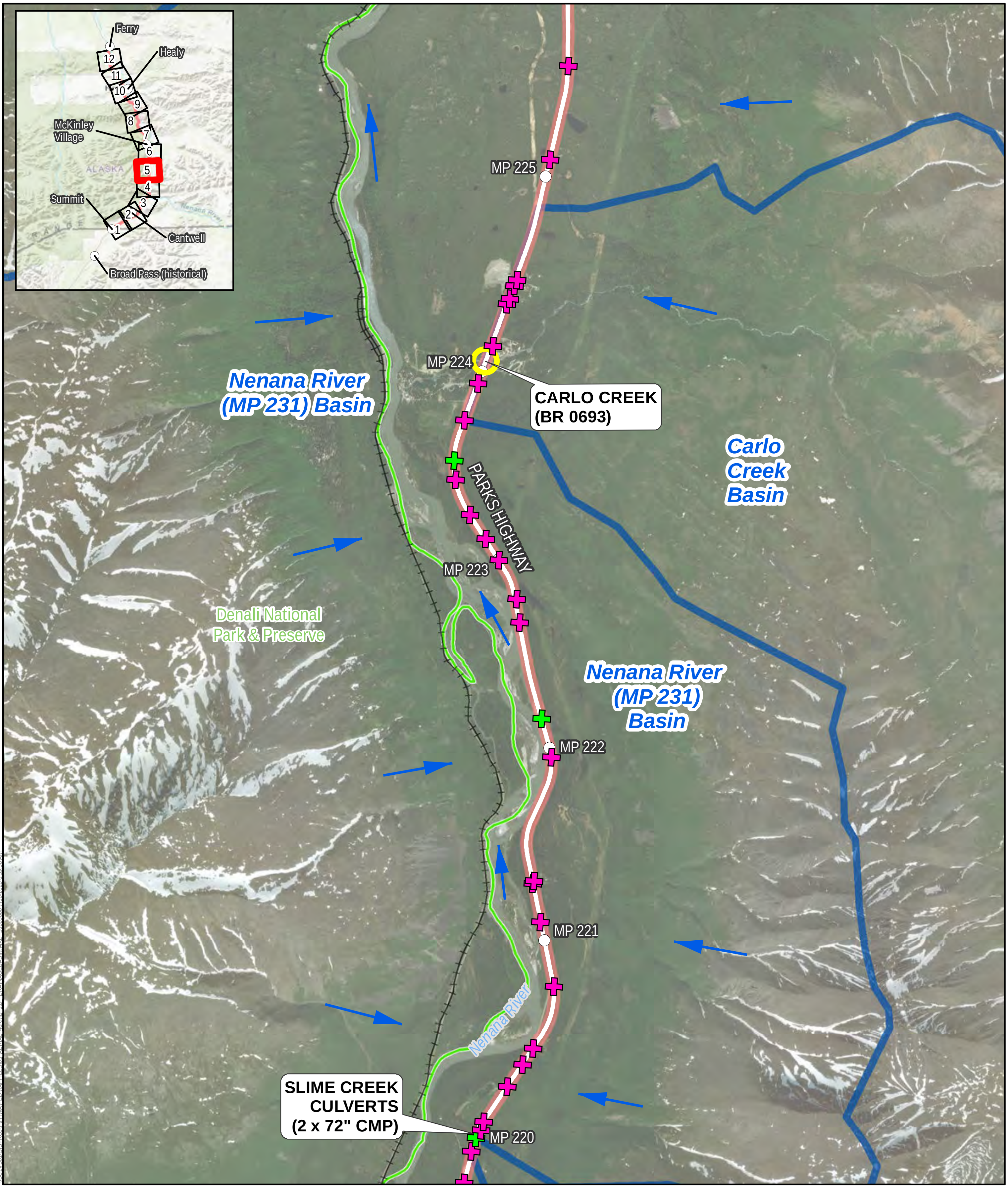
EXHIBIT C4 of 12

Drainage Feature Maps

Cantwell to Healy PEL Study

Parks Highway MP 203 to 259

JACOBS



LEGEND

- Bridge
- Surface Flow Arrows
- Roads
- Mile Post

Culvert (Size)

- < 48 inches
- >= 48 Inches
- Project Extent

- Denali National Park & Preserve
- Borough
- Drainage Basins

N

0 0.5 1 Miles

EXHIBIT C5 of 12
Drainage
Feature Maps

Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS

LEGEND

Bridge

Surface Flow Arrows

Roads

Mile Post

Culvert (Size)

< 48 inches

>= 48 Inches

Project Extent

Denali National Park & Preserve

Borough

Drainage Basins

N

0 0.5 1 Miles

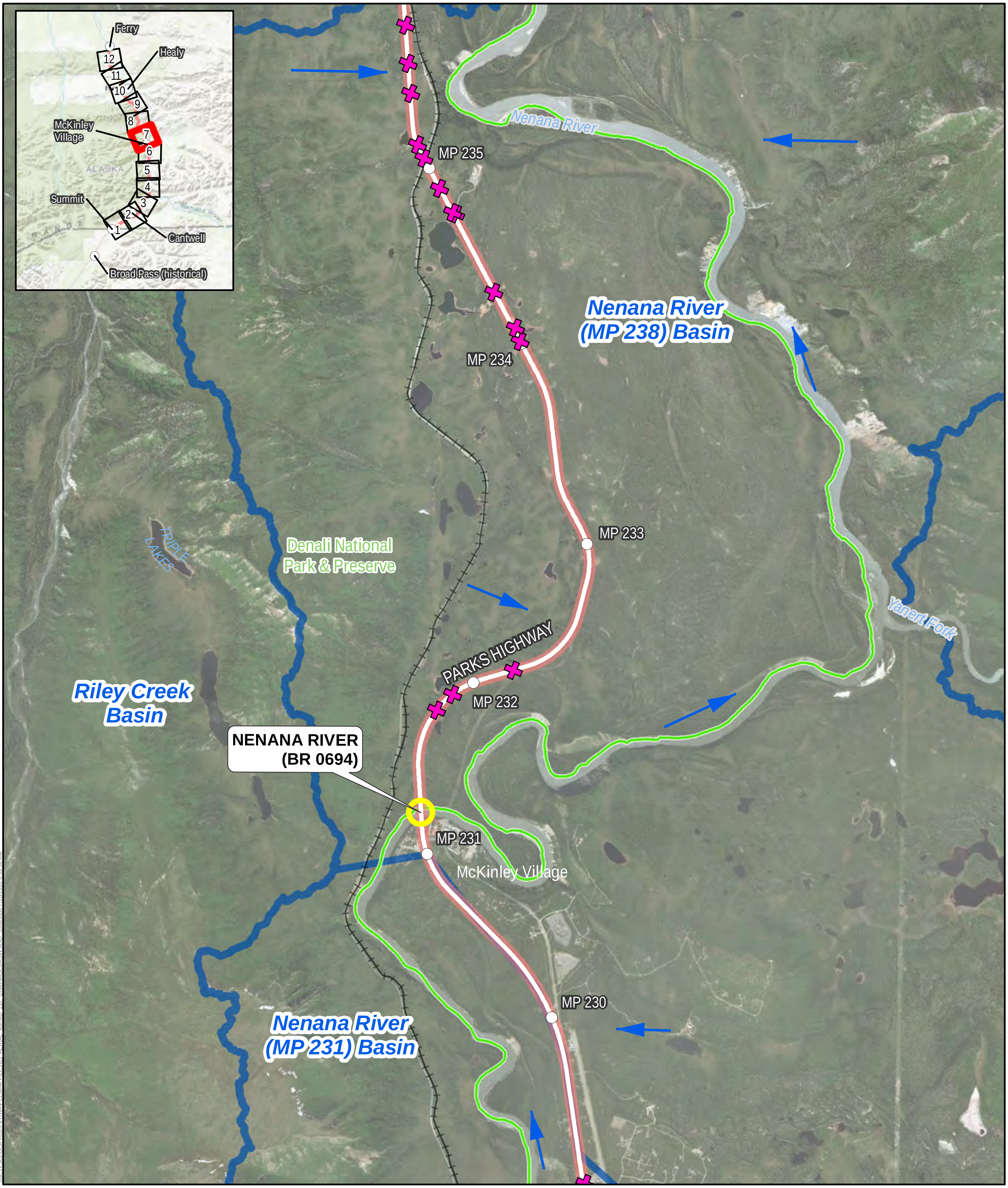
EXHIBIT C6 of 12

Drainage Feature Maps

Cantwell to Healy PEL Study

Parks Highway MP 203 to 259

JACOBS



LEGEND

Bridge

Surface Flow Arrows

Roads

Mile Post

Culvert (Size)

< 48 inches

>= 48 Inches

Project Extent

Denali National Park & Preserve

Borough

Drainage Basins

N

0 0.5 1 Miles

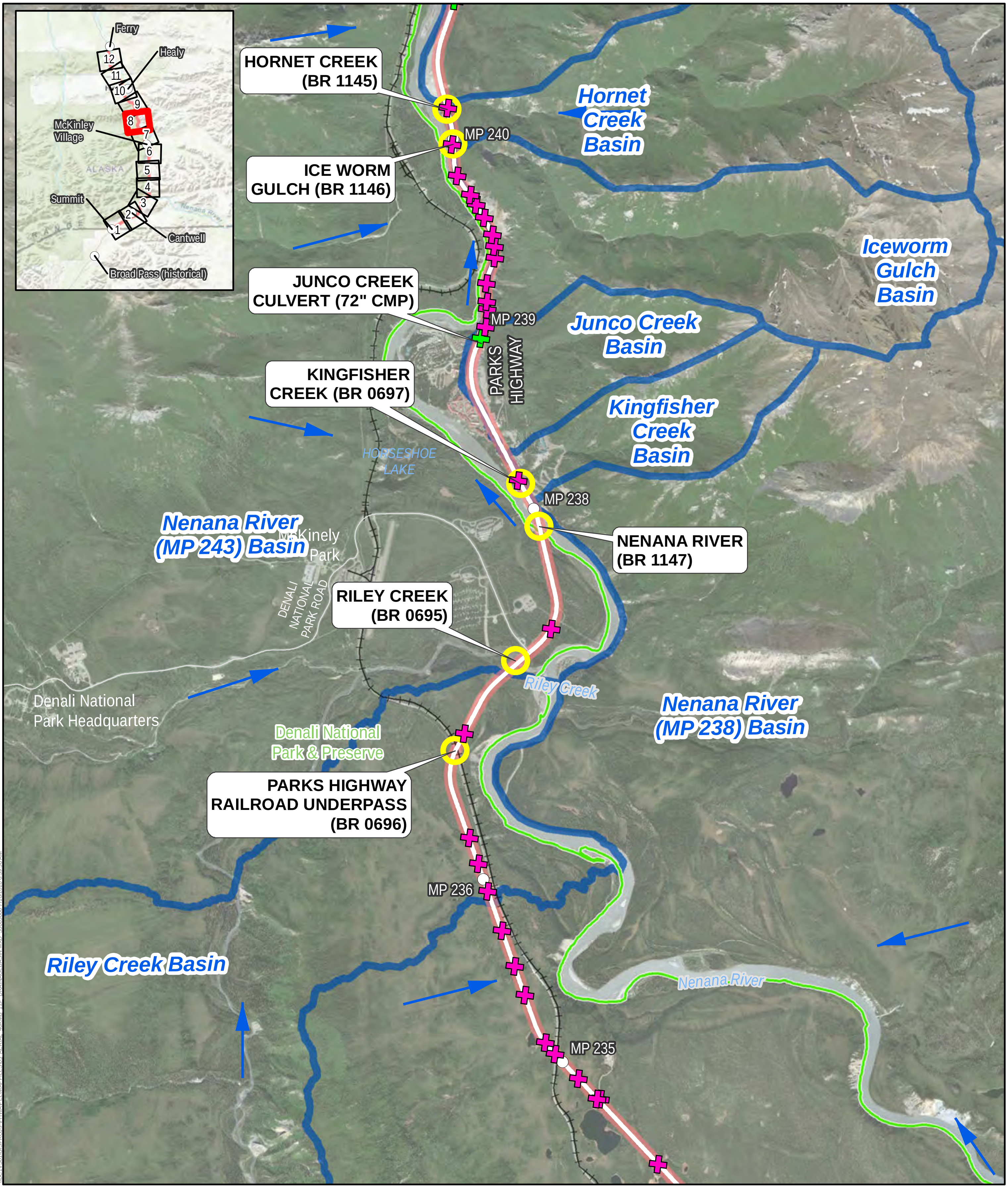
EXHIBIT C7 of 12

Drainage Feature Maps

Cantwell to Healy PEL Study

Parks Highway MP 203 to 259

JACOBS



LEGEND

- Bridge
- Surface Flow Arrows
- Roads
- Mile Post

Culvert (Size)

- < 48 inches
- >= 48 Inches
- Project Extent

- Denali National Park & Preserve
- Borough
- Drainage Basins

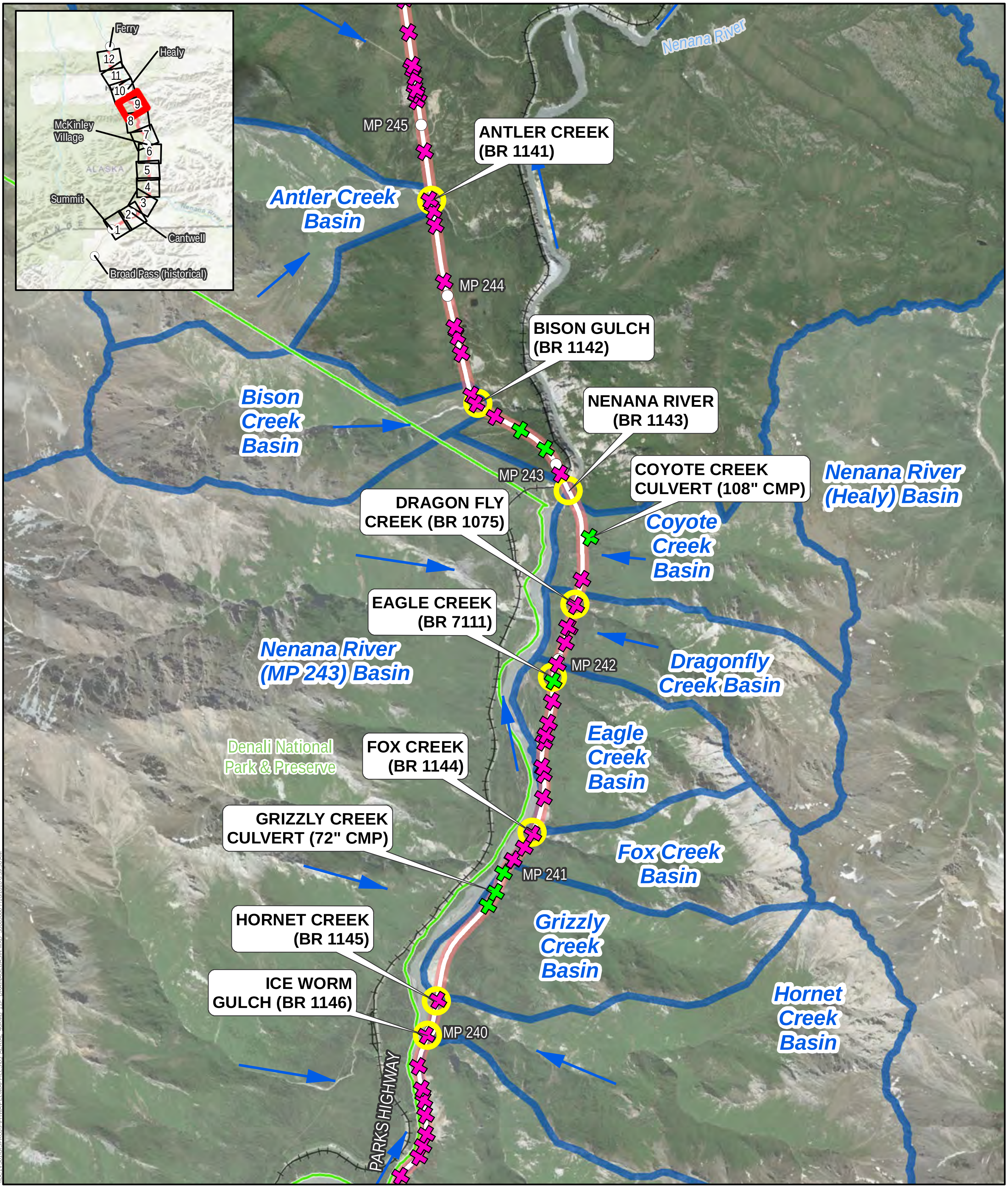
N

0 0.5 1 Miles

EXHIBIT C8 of 12
Drainage
Feature Maps

Cantwell to Healy PEL Study
Parks Highway MP 203 to 259

JACOBS



LEGEND

Bridge

Surface Flow Arrows

Roads

Mile Post

Culvert (Size)

< 48 inches

>= 48 Inches

Project Extent

Denali National Park & Preserve

Borough

Drainage Basins

N

0 0.5 1 Miles

EXHIBIT C9 of 12

Drainage Feature Maps

Cantwell to Healy PEL Study

Parks Highway MP 203 to 259

JACOBS

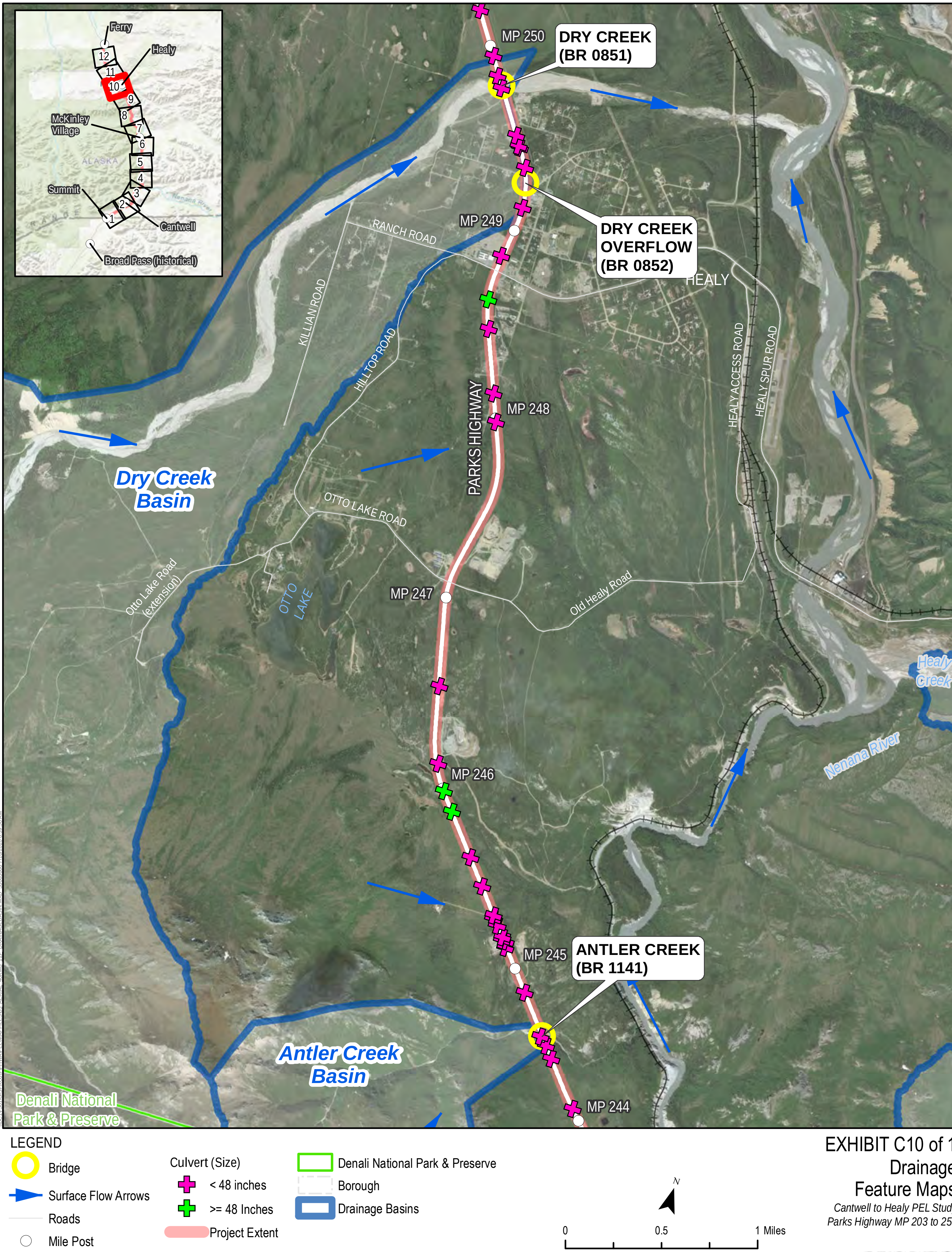


EXHIBIT C10 of 12

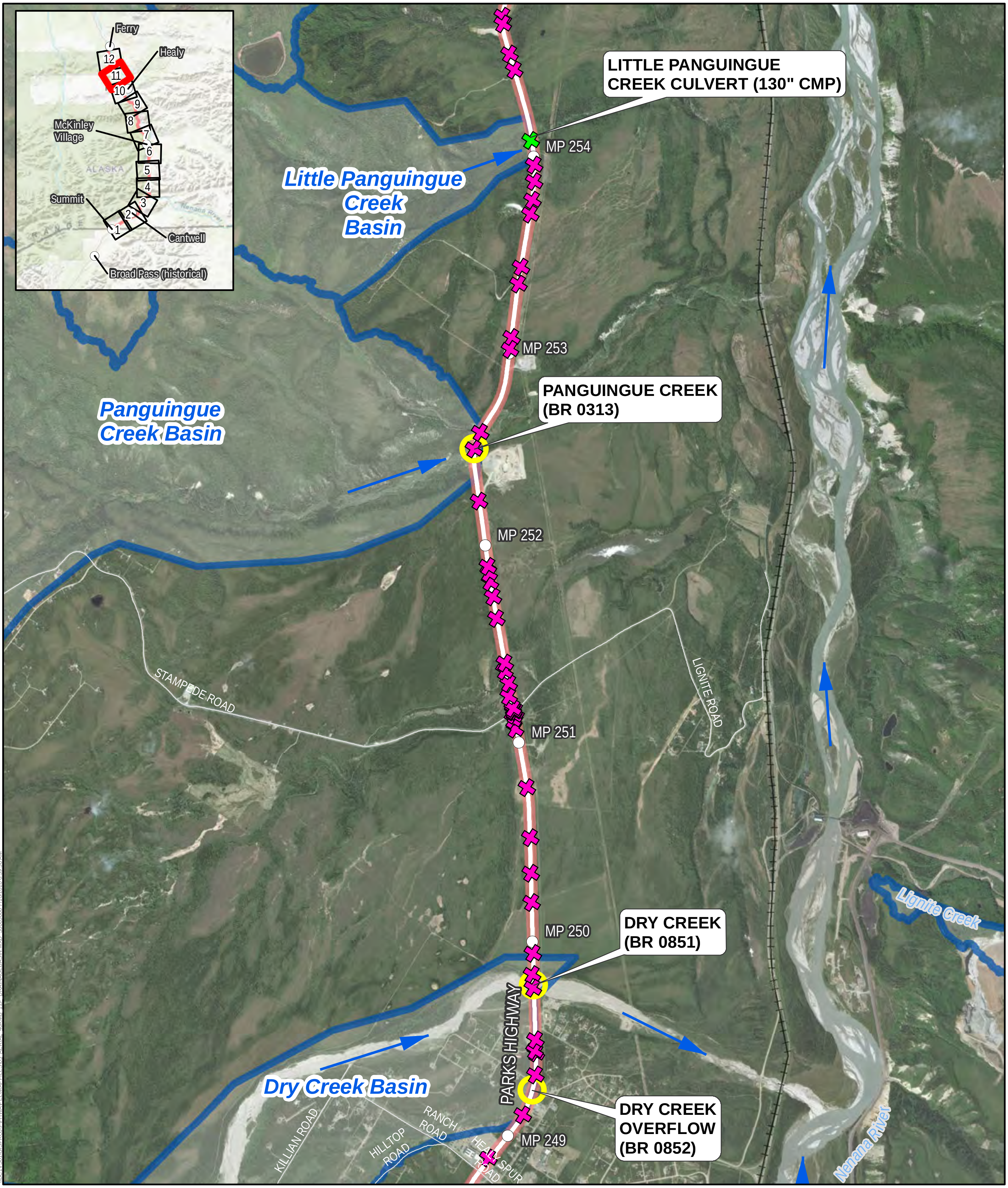
Drainage

Feature Maps

Cantwell to Healy PEL Study

Parks Highway MP 203 to 259

JACOBS



LEGEND

- Bridge
- Surface Flow Arrows
- Roads
- Mile Post

Culvert (Size)

- < 48 inches
- >= 48 Inches
- Project Extent

- Denali National Park & Preserve
- Borough
- Drainage Basins

N

0 0.5 1 Miles

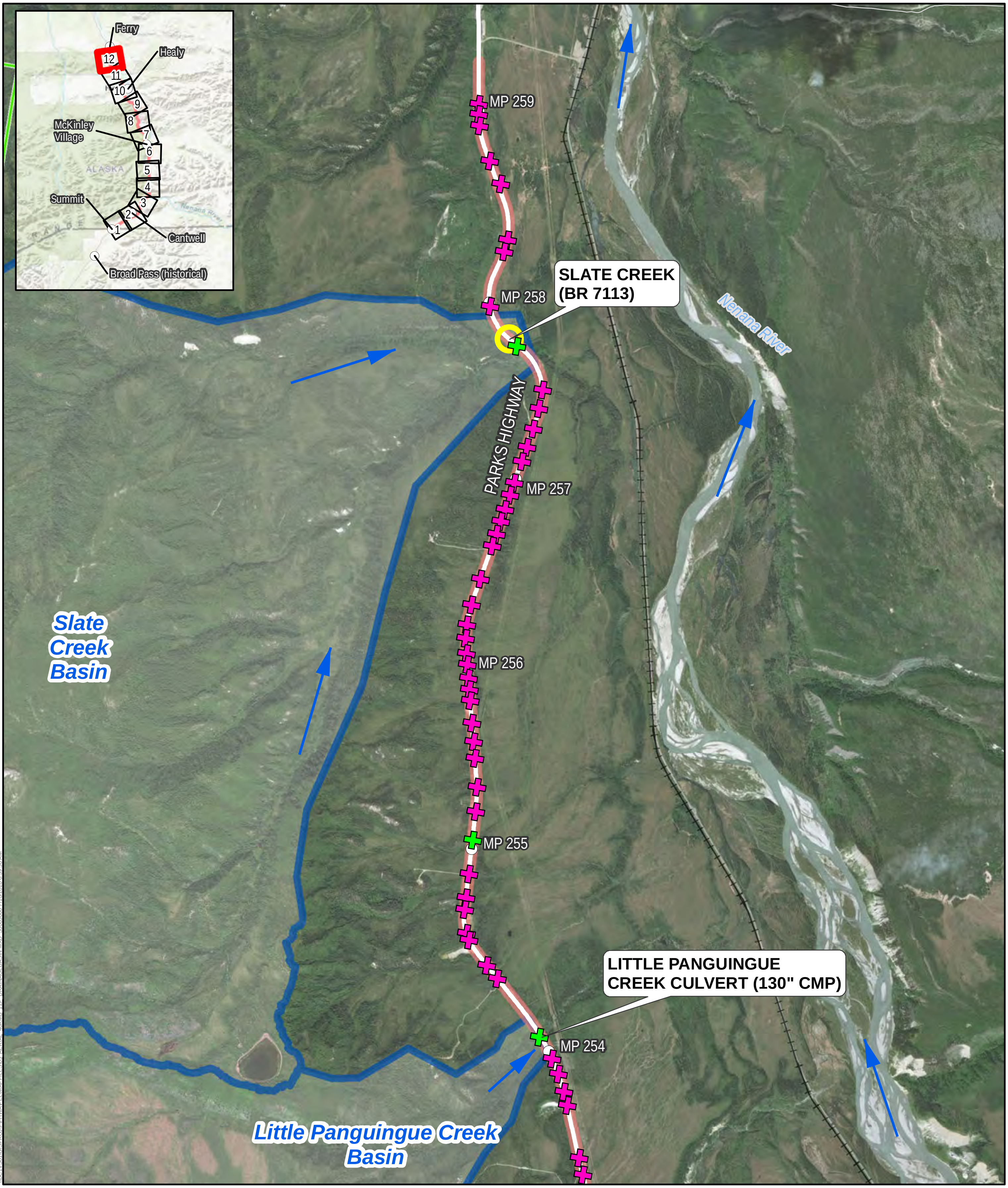
EXHIBIT C11 of 12

Drainage Feature Maps

Cantwell to Healy PEL Study

Parks Highway MP 203 to 259

JACOBS



LEGEND

Bridge

Surface Flow Arrows

Roads

Mile Post

Culvert (Size)

< 48 inches

>= 48 Inches

Project Extent

Denali National Park & Preserve

Borough

Drainage Basins

N

0 0.5 1 Miles

EXHIBIT C12 of 12

Drainage Feature Maps

Cantwell to Healy PEL Study

Parks Highway MP 203 to 259

JACOBS

Appendix I

Baseline Geological and Geotechnical Assessment Memorandum (July 2020)

SUBMITTED TO:
Jacobs
949 E 36th Avenue, Suite 500
Anchorage, Alaska 99508

BY:
Shannon & Wilson, Inc.
5430 Fairbanks Street, Suite 3
Anchorage, Alaska 99518

(907)561-2120
www.shannonwilson.com
AECC 125

BASELINE GEOLOGICAL AND GEOTECHNICAL ASSESSMENT MEMORANDUM

Cantwell to Healy PEL Study

MILEPOST 203 – 259
PARKS HIGHWAY, ALASKA

SHANNON & WILSON

July 2020

Shannon & Wilson No: 105047-001

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Submitted To: Jacobs
949 E 36th Avenue, Suite 500
Anchorage, Alaska 99508
Attn: Ms. Leslie Robbins, AICP CEP

Subject: BASELINE GEOLOGICAL AND GEOTECHNICAL ASSESSMENT MEMORANDUM, CANTWELL TO HEALY PEL STUDY, MILEPOST 203 – 259 PARKS HIGHWAY, ALASKA

Shannon & Wilson prepared this report and participated in this project as a subconsultant to Jacobs. Our scope of services was specified in Professional Services Agreement Number 148014232 with Naoko Anzai of Jacobs dated April 2, 2020. This Baseline Geological and Geotechnical Assessment Memorandum is based on the results of our research and field reconnaissance and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.

STATE OF ALASKA
49 TH
Thomas M. Keatts
CE-112603
7/4/20
REGISTERED PROFESSIONAL ENGINEER

Thomas Keatts, PE
Senior Engineer II

KLB:TMK/rdc/skd

EXECUTIVE SUMMARY

This report presents the results of our Baseline Geological and Geotechnical Assessment for the Needs and Opportunities Assessment portion of the Parks Highway Cantwell to Healy Planning and Environmental Linkages Study. The assessment was based on a combination of document review and research, and field reconnaissance observations. In general, the assessment includes:

- A description of the physical conditions in the areas including climate, topography, vegetation and permafrost and seasonal frost characteristics,
- a description of the regional geology and seismicity along with more detailed descriptions of the local geology and existing highway construction and condition which has been grouped and described by milepost,
- a description of the geologic hazards previously documented and/or observed in the field,
- a description of historical areas of concern that were documented by the local Alaska Department of Transportation & Public Facilities (DOT&PF) Maintenance and Operations (M&O), and the DOT&PF Geotechnical Asset Management (GAM) database, and were also observed during field reconnaissance or confirmed through the Fugro and DOT&PF IVision Roadware tool,
- and a description of geotechnical challenges and conceptual mitigation possibilities.

During our field reconnaissance we generally observed a highway in variable condition with approximately half of the alignment showing significant rehabilitation within the last decade. The alignment traverses several different geologic landscapes with the condition of the pavement and the observed hazards generally correlating well with the age of the pavement and the geologic conditions in the area.

The most pervasive hazard observed along the alignment is embankment instability likely due to thawing permafrost under the highway alignment. This condition is present sporadically along the alignment within most of the geologic units except for areas where the highway is within the floodplain or thaw bulb of a river. Embankment instability is frequently observed along with drainage problems related to settlement or loss of gradient in drainage ditches, thaw ponds which prevent the migration of water away from the embankment toe, and damaged culverts which fail to convey water through the embankment.

Other hazards encountered along the alignment are areas of embankment erosion due to surface water runoff or adjacent to river cut banks, landslides, rockslides and rockfall. Liquefaction is another hazard within the project area. While no signs of historical liquefaction were observed, the conditions for liquefaction, specifically loose saturated sands are present in areas along the alignment and the area is susceptible to large magnitude earthquakes.

Practical mitigation possibilities are challenging for many of these observed hazards, and specific mitigation techniques in nearly all cases will be dependent on the results of subsurface explorations in the area.

CONTENTS

Exhibits

Figures

Appendices

CONTENTS

1 INTRODUCTION

The purpose of this baseline geological and geotechnical assessment is to summarize existing available geologic and geotechnical information and field observations into a single document which details the geological and geotechnical conditions along the existing alignment, current and potential future geological and geotechnical hazards, highlights future design challenges along the alignment, and provides conceptual level mitigation possibilities. To accomplish this, we reviewed available existing data provided by Jacobs and Western Federal Lands (WFL), data from the Alaska Department of Transportation and Public Facilities (DOT&PF) and published geologic maps. The material reviewed is included in the bibliography at the end of this report. Sources were not necessarily reviewed in their entirety but were reviewed for information we believe to be within the scope of this study. A field reconnaissance effort was also conducted to observe the alignment and document observations related to the present roadway condition, problem areas, and observable geologic and geotechnical hazards.

Presented in this report is a narrative of:

- the physical conditions in the area including climate, topography, vegetation and permafrost and seasonal frost characteristics,
- descriptions of the regional geology and seismicity along with more detailed descriptions of the local geology and existing highway construction and condition which have been grouped and described by milepost,
- a description of the geologic hazards previously documented and/or observed in the field, descriptions of historical areas of concern that were documented by the DOT&PF Maintenance and Operations (M&O), the DOT&PF Geotechnical Asset Management (GAM) database, and/or were observed during field reconnaissance or confirmed through the Fugro and DOT&PF IVision Roadware tool,
- and a description of geotechnical challenges and conceptual mitigation possibilities.

This report is intended for use by the project engineering staff, WFL and their representatives.

2 PROJECT DESCRIPTION

The overall project consists of a Planning and Environmental Linkages (PEL) Study for the Parks Highway between MP 203 and MP 259 in the Denali Borough, Alaska. This Baseline Geological and Geotechnical Assessment Memo is a portion of the Needs and Opportunities Assessment, which is used to determine future highway needs and opportunities for improvement within the project extents, based on input from various user groups.

The existing highway alignment generally consists of a two-lane paved highway with additional lanes periodically to accommodate passing, climbing, and turning lanes. The highway is generally not access limited and includes numerous cross streets and driveways as well as frequent pullouts. The highway runs through several small towns along the alignment including Cantwell, McKinley Park, and Healy, and passes the entrance to Denali National Park and the commercial park entrance known as Glitter Gulch. The general location of the project area is show on the Vicinity Map, presented as Figure 1. A more detailed Site Plan showing the project area with relevant site features is presented as Figure 2 (12 sheets).

We understand that future highway improvements may include highway capacity improvements, safety improvements including passing, climbing and turning lanes, highway geometry and line of site improvements, pedestrian paths, separated grade railroad crossings, bridge replacements or expansions, and pavement and embankment rehabilitation and preservation projects.

The southern end of the project is at MP 203 in Broad Pass, approximately 7 miles south of Cantwell, Alaska. The project corridor follows the existing highway alignment north through the Alaska Range, passing the towns of Cantwell, McKinley Park, the Denali National Park entrance, and Healy to MP 259, approximately 10 miles north of Healy, Alaska. The project corridor extends approximately ½ mile on either side of the existing highway centerline.

We understand that the purpose of this memo is to summarize the existing geologic and geotechnical conditions and hazards within the project limits based on provided and publicly available data. We also conducted site reconnaissance to observe general surface conditions, help verify and identify problem areas along the alignment, and support development of conceptual level mitigation possibilities. Subsurface explorations were not included within the scope of this effort, our analysis of the existing hazards is based on professional judgement, the data reviewed, and our observations. Design level mitigation should be based on future explorations once individual projects have been identified.

3 GEOLOGIC SETTING AND CLIMATE

The project corridor travels through the Alaska Range, which separates south-central Alaska from interior Alaska. The geology along the corridor is influenced by mega-scale geologic processes, tectonics, multiple periods of glaciation, and recent alluvial and fluvial processes. The geography of the region is generally characterized by a central zone of mountainous terrain which is flanked on the north and south by foothills and rolling topography. The geology of the area is dominated by earlier cycles of regional tectonic movement and instability, and later glacial, glaciofluvial, and ongoing tectonic activity. This section describes the general geologic setting, including regional geology, tectonics and seismicity, and other site characteristics that may be pertinent to project design, such as climatology, seasonal frost, perennially frozen ground (ie. permafrost), and vegetation.

3.1 Regional Geology

The project area spans three physiographic divisions defined by Wahrhaftig (1965), including the Cook Inlet-Susitna Lowland, Alaska Range (Central and Eastern Parts), and Northern Foothills. While continental-scale geologic processes are used to describe the overall physiographic regions of Alaska, these subdivisions provide rough boundaries for and broadly describe the geography and complex underlying geologic processes that can be used to gain a general understanding of the landform geomorphology along the highway study section.

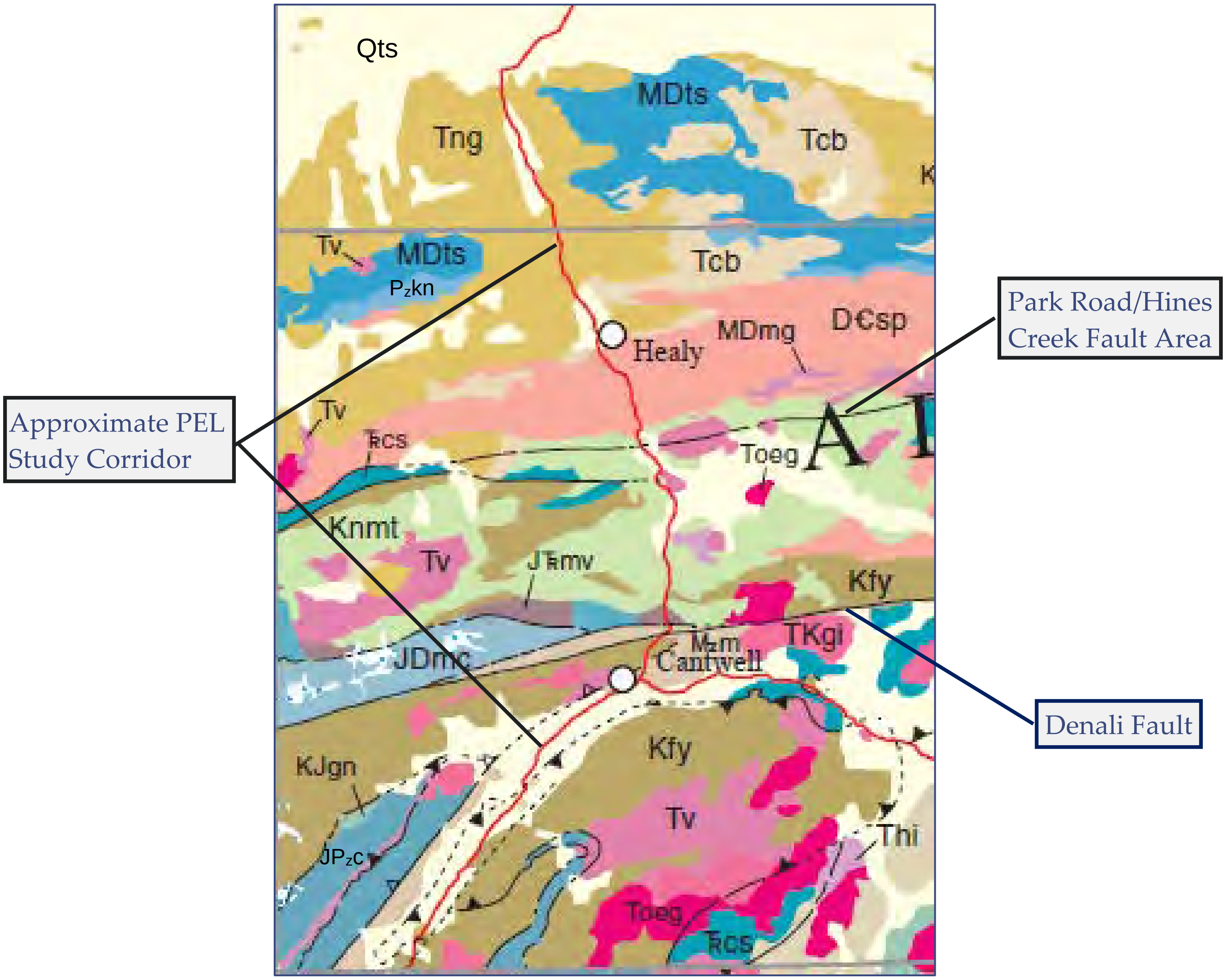
From MP 203 to about MP 210, the highway is situated within the Broad Pass Depression of the Cook Inlet-Susitna Lowland physiographic providence. In the project area, the topography is generally rolling with a roughly northeast-southwest trending pattern of ridges and valleys reminiscent of the most recent glacial period. The near surface geology in this division is generally represented by glacial landforms consisting of plains of glacial drift, eskers, and moraines. Bedrock is generally obscured by unconsolidated glacial and post-glacial soil deposits along the project corridor.

From MP 210 to about MP 244, the highway is situated within the central and eastern Alaska Range physiographic province. The topography through this area generally consists of hilly to rugged mountains separated by glacial and post-glacial valleys. Elevations in the valley bottoms typically range between about 1,500 feet at the north end of the project and 2,000 feet at the southern end with mountain peaks rising serval thousand feet above the valley bottoms on either side of the corridor. The Nenana River intersects the highway corridor near MP 215.7 and flows north through a pass in the Alaska Range providing the route along which the highway follows through the otherwise mountainous terrain. The geology in this physiographic division is complex and ranges from exposed bedrock, various overlapping glacial deposits, and recent colluvial, fluvial, and floodplain deposits. Structurally, the area consists of east-west trending bedrock formations that are in fault contact. South of the Park Road Fault, bedrock generally consists of Cretaceous-aged conglomerate, sandstone, shale, and argillite of the Cantwell Formation. These rocks are interbedded with volcanic rocks and intruded by occasional dikes, sills, and laccoliths. North of the Park Road Fault, bedrock generally consists of pre-Cambrian, primarily quartzose and pelitic, schist known as the Birch Creek Schist.

From MP 244 to the end of the study section at MP 259, the highway is situated within the Northern Foothills physiographic province. This division marks a transition between the Alaska Range and the Tanana-Kuskokwim Lowland of "interior" Alaska. Landforms generally consist of rolling to moderately rugged hills separated by areas of relatively flat, typically poorly drained bogs. Bedrock geology along the highway corridor generally consists of a moderately indurated sandstone, and conglomerate of the Nenana Gravel formation. The Nenana Gravel is generally overlain by more recent sand and gravel alluvium, eolian deposits (loess), and organic soils. The area is thought to have been unglaciated during the Pleistocene glaciations in the Alaska Range that have influenced the landforms in the physiographic regions to the south, except for the valley bottoms which were periodically widened by advancing glacial lobes. The maximum extent of the glacial advance in the Nenana River valley is thought to have occurred during the early Pleistocene Browne glaciation, and extending to the northern edge of the Northern Foothills, just south of Rex, approximately 13 miles north of the northern limits of this project.

At least four periods of glaciation which occurred during the Pleistocene Epoch (~10,000 to 1.6 million years ago) have been mapped in the Eastern and Central Alaska Range, leaving extensive deposits that are visible in the high cut banks of the Nenana River and across valley bottoms (Wahrhaftig, 1958). Deposits of the youngest glacial advances are the best preserved and comprise the near-surface soils over much of the project area. More recent deposits of alluvium washed from the high mountain areas adjacent to the Nenana River valley and colluvium exist throughout the area.

Exhibit 3-1: Regional Geologic Map



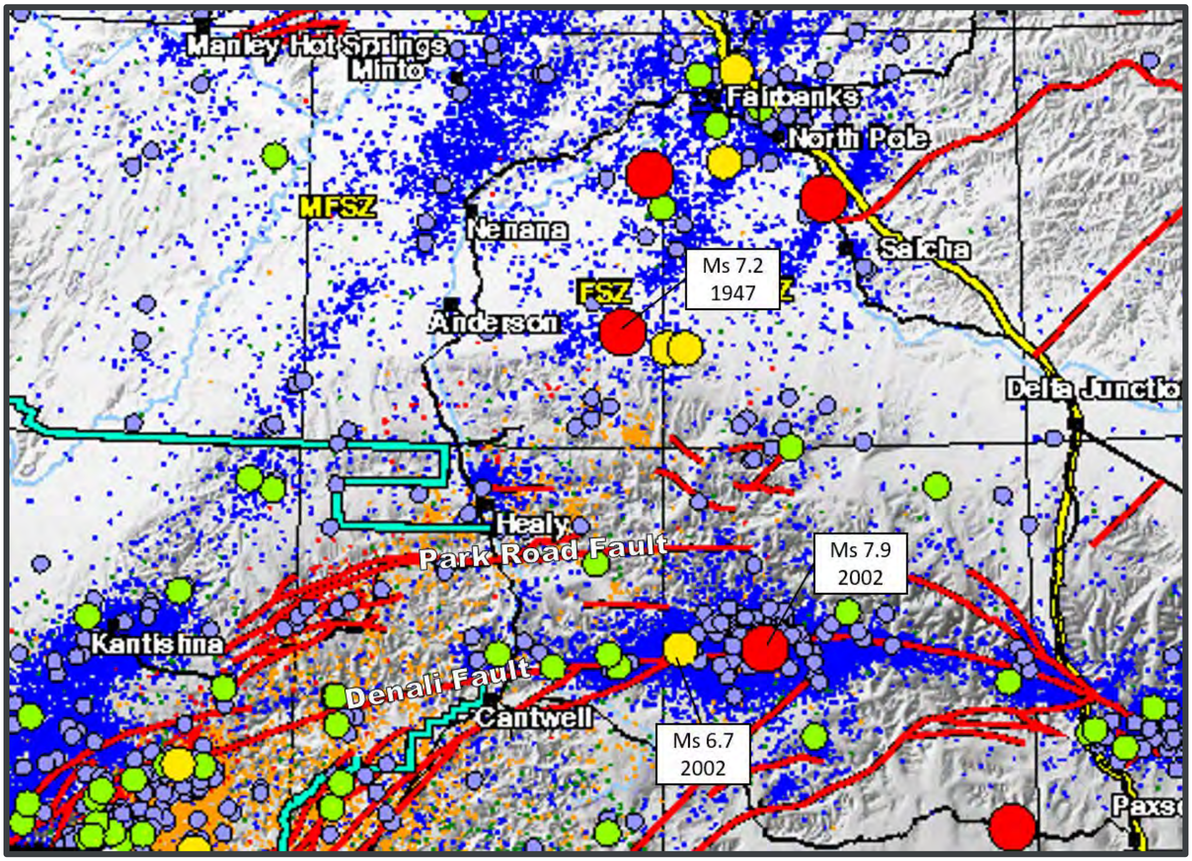
Map Units: DCsp – Schist and Phyllite of the Alaska Range, JDmc – Mystic structural complex, undivided, JPzc – Chulitna sequence, undivided (sedimentary with occasional volcanics), JTRmv – Tatina River Volcanics, Kfy - Flysch, KJgn – Gravina-Nuzotin unit (volcanics), Knmt – Nonmarine to shelf Sedimentary rocks, MDmg – Granitic rocks and orthogneiss, MDts – Totatlanika Schist, Pzkn – Klondike Schist, Keevy Peak Formation, and similar rocks, Qts – Uncosolidated and poorly consolidated surficial deposits, Tcb – Coal bearing sedimentary rocks, Thi – Hypabyssal intrusions, Tkgi – Granitic rocks of southern and interior Alaska, Tng – Nenana gravel, Toeg – Granitic rocks in southern Alaska, Tv – Volcanic rocks, undivided, TRcs – Calcareous sedimentary rocks. Taken from *Geologic Map of Alaska*, (Wilson et al, 2015).

3.2 Tectonics and Seismicity

The interior of Alaska has been subjected to numerous moderate earthquakes and occasional strong shocks during the region's 200-year recorded history. This seismicity is the result of interaction between the Pacific and North American plates over 300 miles to the south. The northwestward movement of the Pacific plate relative to the North American Plate results in a transform boundary with associated right-lateral strike-slip faults parallel to the continental margin along southeast Alaska, a convergent, plate-boundary subduction along the western portion of the Gulf of Alaska and the Aleutians, and a transition zone between the transform and subduction zone in the central portion of the Gulf of Alaska.

The project corridor is situated near the Denali Fault system and several mapped faults cross the Parks Highway within the study area. We postulate that many smaller active faults and tectonic lineaments also exist in relation to the zone of main fault activity along the Denali Fault. Brief descriptions and approximate locations of these faults are discussed in the appropriate subsections of Section 6 below. As demonstrated by the November 3, 2002 magnitude (MW) 7.9 Denali fault earthquake, these systems are active and capable of generating large earthquakes. The 2002 Denali fault earthquake was felt widely throughout central and southern Alaska. The highest recorded peak horizontal ground acceleration of this event was 0.35 times the gravitational coefficient (g) at Pump Station 10 along the Richardson highway, which is less than 2 miles from the rupture. The peak ground acceleration recorded on bedrock at the University of Alaska campus in Fairbanks was 0.09g. Exhibit 3-2 below presents the locations of the major faults and earthquakes in Interior Alaska.

Exhibit 3-2: Historical Seismicity and Faulting



Adapted from AEIC, Interior Alaska Seismicity, 1904 to January 2005.

3.3 Climatology

The project corridor climate is predominantly continental. In general, the subarctic, continental climate zone experiences average annual temperatures at or below freezing. As a result, permafrost conditions are commonly encountered. The continental climate zone tends to be relatively dry. Microclimates exist within the zone where atypical conditions exist, especially near the mountainous areas in and around the Alaska Range.

Based on modeling conducted by the Scenarios Network for Alaska & Arctic Planning (SNAP) at the University of Alaska Fairbanks, the annual average temperature along the alignment is anticipated to rise over the next 30 years. Modeled temperature increases vary by location along the project alignment and based on the modeled assumptions for global emissions. In general, anticipated increase in mean annual temperature may be on the order of 5 to 8 degrees Fahrenheit over historical mean annual temperatures for data prior to 2009. Temperature increases of this magnitude would raise the mean annual average temperature (MAAT) above freezing over much of the project area. The historical MAAT in the project area ranges from approximately 26 to 29 degrees Fahrenheit.

Exhibit 3-3: Climate Data for McKinley Park

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Max. Temperature (˚F)	9.2	16.3	24.8	38.8	53.6	64.2	66.3	61.4	50.7	32.4	17.3	11.2
Average Min. Temperature (˚F)	-7.8	-4.1	0.4	15.8	29.9	39.7	43.4	39.9	30.6	14.5	0.9	-5.6
Average Total Precipitation (in.)	0.68	0.60	0.46	0.37	0.80	2.32	3.14	2.57	1.54	0.92	0.83	0.90
Average Total Snowfall (in.)	10.3	10.2	7.7	5.1	2.9	0.3	0	0	4.2	12.3	13.1	13.4

NOTES:

1 Climate data for McKinley Park, from Western Regional Climate Center

˚F = degrees Fahrenheit

in. = inches

3.4 Seasonal Frost and Perennially Frozen Soils

With average wintertime temperatures well below freezing, seasonal frost penetration into the subsurface is expected. The thickness of the "active layer," or that portion of the ground at or near the surface which undergoes an annual freeze-thaw cycle, is largely dependent upon the location, ground cover, subsurface conditions, depth to groundwater and seasonal snow depth. Frost penetrates most deeply beneath well-drained road surfaces that are kept clear of snow and particularly around large diameter drainage structures that allow cold air to circulate beneath the road surface. At these locations, we estimate that frost may penetrate up to 8 to 12 feet below the ground surface. Away from the road surfaces and in areas where there is significant organic cover and lack of snow removal, we estimate that frost penetration is likely shallower, on the order of 2 to 4 feet.

According to the Permafrost Characteristics of Alaska (PCA) map by the University of Alaska Fairbanks Institute of Northern Engineering (Jorgenson, et al. 2008), the project alignment is split between areas underlain by 'discontinuous' permafrost and areas with continuous permafrost. Permafrost is defined as ground that has remained at a temperature of 32° F or less for two or more years. The PCA map defines discontinuous and continuous areas of permafrost as having a permafrost distribution of 50 to 90 percent and greater than 90 percent, respectively. The base of the permafrost varies considerably but is generally between approximately 100 and 200 feet below the ground surface near the project area.

3.5 Local Vegetation

The highway corridor is situated within valleys and surrounded by rugged, mountainous topography. Between about 2,200 and 2,500 feet in elevation within these valleys, vegetation generally consists of moderately dense forests of white and black spruce, birch, cottonwood, willow, and other shrubs, except in low-lying and poorly-drained areas that do not appear to support much tree growth and instead are covered by extensive areas of muskeg deposits or bogs. Between about 2,500 feet and 4,000 feet in elevation, tree cover is sparse and the vegetation transitions to shorter brush, lichens, and grasses. Only sparse patches of stunted brush, moss, and lichens exist above about 4,000 feet. South of Cantwell, through Broad Pass, the vegetation consists predominantly of willow, and other scrub brush with only sparse tree cover. Other groundcover consists of lichens, grasses and wildflowers.

4 FIELD RECONNAISSANCE

Two experienced representatives from S&W's Anchorage office geotechnical group conducted surface reconnaissance along the alignment May 18 through 21, 2020. Tthe survey included driving the entire alignment and observing the highway and surrounding terrain. During the field visit we verified and ground truthed previously documented maintenance concerns and documented new or previously unreported instances of embankment and slope instability, erosion, drainage concerns and other geologic and geotechnical hazards. The field observations focused primarily on significant isolated hazards as opposed to the general pavement condition. The pavement condition as of 2014 was documented in our Parks Highway Pavement Evaluation Report (2014). Nearly half of the alignment, from MP 239 to MP 259 has been rehabilitated since 2014.

A significant amount of time was spent photographing damaged areas of the roadway, most commonly due to settlement and embankment instability, and less frequently related to erosional concerns, non-embankment slope and rock stability issues, and rockfall. The location of selected photographs from our field reconnaissance are presented on the Site Plan, Figure 2 (12 sheets). The selected photos are included in our Photo Report, presented as Figure 3 (14 sheets).

General observations of the alignment from our reconnaissance effort are discussed by milepost groupings in Section 5.0 below. General descriptions of the geologic and geotechnical hazards observed are described in Section 6.0, and specific damage types and locations are tabulated in Section 7.0.

5 DETAILED GEOLOGY AND EXISTING GEOTECHNICAL CONDITIONS

The following subsections divide the project into multiple segments on the basis of similar expected geologic and geotechnical conditions interpreted through our review of existing geologic data and surface observations by our representatives during our May 2020 site visit. The segments are indicated by approximate highway milepost (MP) at the beginning and end of each segment, according to milepost markers along the highway and odometer readings recorded during our site visit. We have assumed these markers are roughly equivalent to the marker locations included in the DOT&PF spatial dataset that was used to indicate the highway mileposts shown on the various maps included in this memorandum. While we have attempted to verify that the approximate locations are correct, some minor variations between the mileposts described below, the maps included in this memorandum, and actual ground locations should be expected.

It is important to note that the subdivisions described in this report are generalized and the anticipated subsurface conditions described in the following descriptions are primarily based on interpretations based on observations of the ground surface and existing geologic mapping. Detailed descriptions and discussions of the pavement and roadway conditions are beyond the scope of this report. However, the following subsections include generalized discussions regarding roadway performance to provide the reader with a general sense of the pavement and subgrade conditions for each segment and how those conditions may relate to geotechnical issues discussed in various sections of this report. Many factors such as age, maintenance history, techniques and materials used in construction, design deficiencies, and others could influence roadway performance. As such, the statements in this report generally do not fully consider all of the factors that may influence interpretations and conclusions regarding roadway performance and these statements should be considered as subjective and relative to existing conditions, unless specifically stated otherwise. General locations by milepost and site descriptions for each subdivision are presented below and shown on the maps included as Figure 2 (12 sheets).

5.1 MP 203.2 to MP 209.3

This section of the road is primarily located along the top of southeast to northwest trending ridgelines through Broad Pass and ending at the south side of the Jack River floodplain. These ridgelines are interpreted as glacial landforms that formed beneath the glacial ice as it flowed down-valley, with the ridgelines generally oriented parallel to the primary direction of glacial movement. Other ridge-like features, such as eskers and moraines, are also related to glacial processes and may be found in the area. At MP 206.2 and 208.1 the roadway crosses through similarly trending depressions that separate the ridgelines. The overall topography is rolling with gentle to moderate slopes. This section includes a bridge crossing at Pass Creek (MP 208.1).

The ground surface in undeveloped areas adjacent to the roadway is generally vegetated with an organic mat and moderately dense stands of small shrubs. North of MP 208.2 the ground cover becomes primarily muskeg/peat with only occasional, sparse stands of trees and shrubs. Given the geologic environment, we anticipate that soils in this area will consist of several feet of organics over variable deposits of glacial origin, which may include till (unsorted deposits with nearly equal fractions of sand, gravel, and fines), fine-grained soils, pockets of well-sorted sand and gravel, other glaciofluvial deposits, and recent stream and pond deposits. Organic surface soils are likely less than several feet thick except in depressions or other low-lying areas where considerably thicker (up to 10 to 15 feet) organic deposits may be present. Permafrost may be nearly continuous under much of the area.

The road through this section is generally constructed on top of embankments ranging from 2 to 4 feet high above the surrounding ground, except where the road crosses depressions between ridgelines or drainages, where embankments may extend up to about 15 feet high. Road cuts, where present, are typically less than 5 to 10 feet high, with the largest cuts typically observed where the road transitions from cut to fill at drainage or valley crossings. In general, the roadway appears to be in relatively fair condition given its age except as noted below and included in Exhibit 7-1. Several bumpy sections were observed where the road crosses depressions between MP 203 and MP 208.1 and persistent surface waviness was observed between MP 208.1 and MP 209. The bumps appear to be the result of settlement likely caused by melting of thaw unstable permafrost.

5.2 MP 209.3 to MP 223.5

This section of the road travels through relatively flat floodplains adjacent to the Jack and Nenana Rivers, starting just south of the Jack River bridge and ending just south of Carlo Creek. From MP 211.5 to 213.2 and 215.8 to 219.5 the roadway climbs above the floodplain areas and traverses the lower slopes of the hills and mountains east of the Jack and Nenana Rivers. In the floodplain areas, the topography is relatively flat to slightly hummocky with occasional depressions apparently marking remnant stream meanders. Sporadic areas of standing water were observed during our site visit. The ponding generally appears to be associated with abandoned stream channels and small depressions, although it is unclear whether the water was ponded due to underlying seasonal frost, given the time of year of our site visit, or if the ponds are related to a shallow water table, or some other expression of geologic conditions. This section includes bridge crossings at the Jack River (MP 209.4) and

Nenana River (MP 215.7). According to the USGS Quaternary Faults and Folds Database, the road crosses the Denali Fault between approximate MP 214 and 215.7.

The ground surface in undeveloped areas adjacent to the roadway is generally vegetated with moderately dense stands of spruce and other trees. Soil deposits in the floodplain areas are anticipated to consist of geologically recent stream deposits of poorly graded sand and gravel alluvium with lenses and pockets of fine-grained materials. Glacial deposits of till, sand, gravel, and fine-grained soils may be present on the lower hillsides above the floodplain areas. Organic surface soils, likely up to several feet thick generally cover the ground surface. These soils may be considerably thicker (up to 10 to 15 feet) in some depressions or other low-lying areas. Bedrock is expected at relatively shallow depths in hilly areas along this section, primarily between MP 211.5 to 213.2 and 215.8 to 219.5. Permafrost may occur in sporadic pockets in the floodplain areas and in greater amounts on undeveloped, vegetated hillsides.

The roadway through this section is generally constructed on top of embankments ranging from about 2 to 4 feet above the surrounding ground. From MP 211.5 to 213.2 and 215.8 to 219.5, where the roadway travels along the lower slopes of hillsides adjacent to the floodplain area, the uphill side of the roadway typically consisted of soil and rock cut slopes up to about 40 feet high; while the downslope side of the road was supported on embankments of varying heights, but sometimes up to about 40 feet high. Cut slopes were in fair condition except for occasional shallow raveling and rockfall in certain areas. In general, the roadway is in overall fair condition through this section except for some waviness and patching that was observed between about MP 216.4 and 217.1 and as noted in Section 7.0.

5.3 MP 223.5 to MP 237.9

This section of the road generally travels through rolling uplands adjacent to the Nenana River, and includes the area from just south of Carlo Creek to the southern abutment of the Nenana River bridge just north of the Denali National Park entrance. The topography in the area is gently rolling to relatively flat and displays characteristic landforms related to past glaciations and recent fluvial activity. In the rolling terrain, the hills typically extend less than 100 feet above adjacent depressions and valleys. This section includes one major bridge crossing at the Nenana River, roughly MP 231.2. Two smaller bridge crossings are included at Carlo Creek (MP 224.1) and Riley Creek (MP 237.2). According to the USGS Quaternary Faults and Folds Database, the road crosses the Park Road fault (aka. Hines Creek strand of the Denali Fault) near Riley Creek. The fault is an east-west trending, active strand of the Denali Fault.

The ground surface in undeveloped areas adjacent to the roadway is generally vegetated with organic soils and sparse to moderately dense stands of small shrubs and mature trees. Given the geologic environment and based on surficial geologic mapping by Wahrhaftig (1958), we anticipate that soils in this area will consist of several feet of organics over various glacial and glaciofluvial deposits which may include till-like materials, unsorted moraine deposits, and relatively clean outwash sands and gravel. Pockets of fine-grained soils may also be present in isolated pockets. Organic surface soils may be considerably thicker (up to 10 to 15 feet) in depressions or other low-lying areas. Permafrost is likely present under well vegetated and boggy areas and north facing slopes throughout much of the area.

Due to hilly and hummocky topography throughout this segment, the roadway through this section is supported on a variable subgrade that regularly transitions between cuts and fill/embankment sections to accommodate geometric design. The tallest embankments, sometimes up to 20 to 30 feet high, typically occur where the roadway travels across narrow valleys or depressions between ridges. In general, the roadway appears to be performing relatively well except as noted below and included in Exhibit 7-1. Notable areas of embankment and pavement distress that were observed during our site visit occur from approximate MP 224.5 to 224.7, MP 225.9 to 226.2, MP 230.8 to 231, MP 231.6, MP 232.5 to 232.6, MP 235 to 236. This distress generally consisted of bumps and waves that are thought to be associated with settlement related to thawing of thaw unstable permafrost. A large-scale slope instability was observed in the slopes above the distressed area between MP 230.8 and 231. Observations of the southwest-facing portion of the road cut and hillside adjacent to the cut suggest that a relatively large block of land may be experiencing creeping movement toward the Nenana River valley to the north. Given the anticipated geologic conditions in this area, it is likely this zone of instability will continue to impact the road and adjacent right-of way; however, additional studies would be needed to define the extent of the hazard.

5.4 MP 237.9 to MP 245.7

This section of road begins at the southern end of the Nenana River bridge crossing, just north of the Denali National Park entrance. In this section, the road generally travels north along the Nenana River through the Nenana Canyon commercial area, the Nenana Canyon, and includes a short section north of the Nenana Canyon. Without major realignment, the roadway is largely constrained geographically to its current alignment by steep, mountainous terrain on both sides and the Nenana River gorge. The topography in the area is generally very steep with mountain peaks rising rapidly from the Nenana River gorge to elevations up to several thousand feet above the gorge floor. The valley floor, which includes the Nenana River gorge and adjacent elevated terraces is generally on the order of

1/4 to 1/3-mile wide. This section includes several bridge crossings, including crossings at the Nenana River (MP 237.9 and MP 242.5), Bison Gulch (MP 243.5), Antler Creek (MP 244.6), and several smaller bridge crossings.

Geologic conditions are expected to be highly variable through this section due to a complex glacial history, past and ongoing tectonic activity, and geologically recent erosional and depositional processes. In general, the subsurface conditions include glacial moraine and outwash deposits, glacial lake clays, recent alluvial and colluvial deposits, and bedrock. Ground cover in undeveloped areas ranges from sparse, in areas of steep topography, to brush covered. Moderately dense stands of spruce and other trees may be present in valley floors and on the lower portions of the mountain slopes. Organic surface soils up to several feet thick may also be present in more gentle terrain. Considerably thicker deposits of peat (up to 10 to 15 feet) may also be present in depressions or other low-lying areas. Permafrost is likely present under well vegetated and boggy areas and primarily north facing slopes throughout much of this segment. Based on previous mapping by others, most of the bedrock in the project area consist of quartzose and pelitic schist of the Birch Creek formation. The rock is typically highly foliated and intensely deformed. Previous studies by others have suggested the schist has highly variable strength properties, but is generally relatively weak, and is susceptible to relatively rapid weathering when exposed to the environment by construction activities or natural mass wasting processes.

The roadway through this section is generally constructed on variable subgrade conditions ranging from rock and soil cuts where the road traverses sloping ground and hillsides to relatively short embankments (typically 2 to 6 feet high) in places where the road travels through areas of relatively gentle topography. Several areas of embankment and pavement distress were observed through this section during our May 2020 site visit and are reported in the draft DOT&PF M&O Memorandum for this Study. This distress generally occurs as frost heaving or settlement that is likely related to thawing of thaw-unstable permafrost. Occasional areas of embankment distress may be related to other types of ground movements (ie. slumps, sloughs, and landslides) caused by thaw weakening of embankment support soils. Particular areas displaying these types of distress were noted during our site visit in the Denali Park commercial area from MP 238 to 239, MP 242.1, MP 243.5, and around MP 243.8. Brief descriptions of each area of distress are included in Exhibit 7-1.

Numerous areas of slope instability exist along the road corridor in the Nenana Canyon area (about MP 239 to MP 241.4), as identified in previous studies and the draft M&O Memorandum. Detailed discussions of individual areas of instability, slope conditions, and potential failure mechanisms are beyond the scope of this document and project specific studies will need to be performed to support individual projects as they are designed.

Therefore, the following includes only a generalized description of the issues to orient the reader with potential challenges for design of future projects. The instability primarily occurs in the rock slopes above and to the east of the highway and includes erosion, rockfall from relatively shallow sloughing and raveling of the loose and weathered rock surface, and more deep-seated failures that involve larger wedges of rock mass. Bedrock in the canyon area generally consists of highly foliated, extremely deformed, and moderately to highly weathered, quartz-mica schist, except near MP 239.3, where an exposed dike of a greenish-black, fine-grained intrusive rock exists. In general, foliation planes appear to strike perpendicular to the roadway and dip steeply to the south; however, this general trend is highly variable due to intense deformation and folding. The rock is moderately to highly jointed with several intersecting joint sets. A prominent, near-vertical joint set, striking roughly parallel to the roadway, was observed in numerous locations in the canyon area during our site visit. While generally shallow, rockfall and moderately sized landslides related to failures along this joint set appear to be common.

5.5 MP 245.7 to MP 259

This section of the road begins south of Healy and continues through the end of the project at MP 259. The section traverses near the base of northeast facing slopes on the west side of the Nenana River valley. Landforms in the area are suggestive of terrace topography formed by deposition of multiple phases of outwash alluvium and later downcutting by the Nenana River. This section includes a multi-span bridge crossing at Dry Creek (MP 249.4) and a smaller bridge crossing at Panguingue Creek. According to the USGS Quaternary Faults and Folds Database, the road crosses the Healy Creek Fault near MP 251.2 (Stampede/Lignite Road intersection) and the moderately constrained Stampede Fault near Little Panguingue Creek (MP 254.1). The Healy Creek fault is an east-west trending, north-dipping reverse fault, approximately 10 miles north of the project area in the Northern Foothills of the Alaska Range. The fault has evidence of multiple late Pleistocene displacements.

According to geologic mapping by Wahrhaftig (1958), the soils making up the terrace plateaus generally consist of glacial moraine and outwash materials deposited during several periods of early Pleistocene glacial advance and retreat. Pockets of fine-grained soils may also be present in isolated areas. The low foothills west of the road are made up of moderately consolidated conglomerate and sandstone bedrock of the Tertiary Nenana Gravel formation, with minor outcroppings of an older Tertiary coal-bearing formation and the Totatlanika Schist mapped in lower, incised portions of some stream crossings. These soils and rock are typically overlain by recent organic soil and peat that may range from 1 to 3 feet thick in moderately sloped topography up to 10 to 15 feet thick in flatter, poorly drained areas. In general, the ground surface in sloped topography is vegetated by brush and moderately dense stands of birch and mature spruce, birch, and other trees; and peat, shrubs, and grasses with sparse tree cover in flatter, low-lying and poorly drained areas. Organic surface soils may be considerably thicker (up to 10 to 15 feet) in depressions or other low-lying areas. Permafrost is likely present throughout much of this segment, particularly under well vegetated and boggy areas and north facing slopes.

The roadway through this section is primarily constructed on embankments approximately 3 to 15 feet high above the surrounding grade. The tallest embankments typically occur where the roadway traverses the lower slopes of the northeast facing hills, from north of Stampede Road to the end of the project. Cut slopes are present at transitions into drainage crossings and along short sections for geometric design. From MP 245.1 to about MP 251.5 the roadway appears to be performing relatively well. Notable areas of embankment and pavement distress were observed during our site visit from approximate MP 251.5 to 251.9, MP 252.6, MP 253 to 253.3, MP 253.7 to 253.8, MP253.3 to 255.5, MP 255.9, MP 256.3 to 256.4, MP 257.2, 258.3 to 259 and as included in Section 7.0. In general, this distress consisted of bumps and waves typically associated with settlement related to thawing of thaw unstable permafrost. A large-scale slope instability appears to exist on the hillside above the roadway near MP 258.3. The instability is best viewed in hillshade images of the area and appears to impact about 2,000 feet of the road ROW and extending west about 1,300 feet to the ridgeline above the road. The entrained mass appears to be moving toward the roadway in a creeping, or solifluction-type failure. Given the anticipated geologic conditions in this area, it is likely this zone of instability may continue to impact the ROW; however, additional studies would be needed to define the extent of the hazard.

6 GEOLOGICAL AND GEOTECHNICAL HAZARDS

The Parks Highway within the project extents travels over discontinuous and continuous permafrost soils, across and adjacent to rivers and drainages, over rolling hills, and through steep mountainous terrain. This diverse geologic terrain poses numerous hazards to the highway including thaw unstable soils, erosion, landslides, rockslides, and rockfalls. In addition to these hazards, significant seismic hazard exists in the region primarily related to the Denali Fault and associated smaller fault groups. This seismicity attributes an additional hazard related to ground displacement, and potential liquefaction of susceptible soils (loose saturated sands, some gravels, and non-plastic silts). The sections below describe the observed hazards and locations of the existing hazards along the alignment. Potential new or exacerbated hazards related to changes or expansion of the highway alignment, or due to changes in climate are also discussed.

6.1 Permafrost and Seasonally Frozen Soils

The Parks Highway is underlain by discontinuous or continuous permafrost for most of the project extent except for locations where the highway travels within the floodplain thaw bulb of the Jack and Nenana Rivers. In general, the thawing of permafrost soils beneath the highway results in a loss of subgrade support, and settlement as ice lenses and/or massive ice thaw. The magnitude of the strength loss and rate/magnitude of settlement is dependent upon the volumetric ice content, the rate and depth of thaw, the ability for the thawed soil to drain, the compressibility of the organic and mineral soils, and the loading applied above the thaw front. The rate of thaw is dependent upon the climatic conditions, ground cover, and the thermal properties of the mineral and organic soil and ice mass.

The result of thawing permafrost along the highway was observed in several areas and was expressed in various ways. Somewhat uniform settlement of the embankment into the native soils was observed based on over steepened embankment slopes and thaw ponds at the toe of embankments. This type of thaw settlement creates drainage problems including ponded water which can't drain away from the embankment, low points or reverse grades within drainage ditches, and damage to roadway culverts. While settlement, loss of subgrade support, and saturated support soils can cause embankment instability and an increased rate of pavement fatigue, the pavement in these areas where settlement was uniform was still relatively smooth. Uniform settlement of the embankment was observed where fill embankments were present between MP 206 and 209, MP 234.5 to MP 236.3, MP 243.6 to MP 247.5, and MP 250 to MP 259.

Isolated or more severe differential settlement of the roadway and embankment slope failures were observed in several locations and are likely the result of thawing of higher volumetric ice content soils (massive ice lenses or buried ice). These isolated areas of thaw occurred sporadically along much of the alignment and more frequently in areas where the highway embankment crossed depressions in hilly terrain, and within cut slopes, particularly on the north end of cut slopes. The result of the thaw of massive ice resulted in over steepened embankments and disappearing shoulders, longitudinal and circular pavement cracking, and settlement within the roadway. The settlement was typically abrupt with a several inches of vertical displacement over a distance of a few feet. Where isolated areas occurred in cut slopes raveling of the cut slopes was also observed along with trees leaning over cut slopes where root support had been compromised. The isolated areas frequently extended into the adjacent drainage ditch causing low spots within the drainage area and ponding water, as well as damaging drainage structures when present. Selected areas of isolated instability are shown on the Site Plan on Figure 2 (12 sheets), and a more comprehensive list of instabilities are tabulated in Section 7.0. Permafrost may also be responsible for larger scale landslide features along the alignment. These areas are discussed in Section 6.3 below.

Seasonal frost along the project area exists along the entire alignment. Hazards related to seasonal frost generally include frost heaves, and loss of subgrade support during spring thaw. Most of the highway alignment travels either along embankments, over outwash or terrace gravels, or over bedrock. The roadway is typically elevated on an embankment or is somewhat isolated from water by relatively deep drainage ditches. The roadway is also typically supported by reasonably thick structural fills. During our field visit we did not observe areas we believe to be the result of frost heaves, although some may exist seasonally. Some degree of loss of subgrade support likely exists along most of the alignment and is likely worse in areas where drainage is poor. In general, the highway appears to perform relatively well in response to seasonal frost.

6.2 Erosion

The Parks Highway crosses and travels adjacent to several rivers and drainages that are fed by numerous perennial tributaries and intermittent drainages. Erosion is a potential concern any time the roadway embankment crosses a drainage or is adjacent to a river. During our site visit we observed that embankments and bridge abutments were typically armored with rip rap to prevent erosion where the road is near drainages. This appeared to be working well in most areas and erosion was not listed as a significant concern based on the draft M&O memorandum. The primary area we observed where active erosion is taking place is near MP 222, where the river is approximately 60 feet away from the highway and is not armored against erosion. If this area is left unprotected it will likely continue to progress toward the highway.

In addition to natural drainages, damage from erosion also occurs from surface water draining off the roadway. Small areas of erosional damage occur throughout the project area with greater erosional damage occurring where the roadway crown has been compromised, typically due to thaw settlement. Areas with thaw settlement can channelize the surface water and create preferential drainage paths leading to embankment erosion.

6.3 Landslides

Landslides are present along the Parks Highway and are characterized as either shallow sloughing type failures which typically occur in road cuts or as larger deep failures which occur above, below or encompass a portion of the highway. Sloughing type failures occur in several of the soil road cuts and can cause clogging of the drainage ditch below. These sloughing type failures are typically the result of cuts which stand near the angle of repose of the soil, or where seeps or thawing permafrost contribute to slope instability.

Larger landslide features occur in areas along the alignment adjacent to mountainous terrain such as near MP 217.5 where unstable colluvial slopes exist, and near MP 230.8 and MP 258.3 where large scale slope failures appear to be happening in terrace deposits. The slides at MP 230.8 may be related to thawing of permafrost soils or due to undermining of the toe of the slope due to development along the Nenana River or erosion by the river. The slide area appears to be moving away from the roadway and has not significantly impacted the roadway based on the draft M&O memo. However, pavement in this area is generally in poor condition. The slide near MP 258.3 appears to be a large-scale landslide likely related to melting permafrost soils and may be an example of a creep or solifluction type failure. The toe of this failure has been buttressed with rip rap at the highway, however, the buttress is likely not contributing significantly to stabilizing the larger slope failure. Water was observed draining out of the buttress rock during our site visit, it is unknown if the source of the water is related to a spring, or thaw of seasonal or permafrost soils.

6.4 Rockslides and Rockfall

The Parks Highway passes below rock cuts and travels over bedrock in several areas. The exposed rock along the highway consists of various sedimentary and metamorphic rock types which are commonly weak and highly weathered. Rockfall, and rockslides along the highway are a persistent concern for maintenance and are frequently exacerbated by rainfall events. Rockfall occurs in two forms, it can originate in rock cuts adjacent to the roadway, or from mountain cliffs relatively far from the roadway. Rockfall frequently clogs drainage ditches which must be cleaned by maintenance periodically and less frequently impacts the road creating a driving hazard. Typically, rockfall debris is relatively small in diameter (6-inches or less), but rocks as large as 10-feet in diameter have been reported along the corridor. Rockfall hazard locations are shown on the Site Plan as Figure 2 (12 sheets) and are tabulated in Section 7.0.

Rockslides occur both above and below the highway within the project limits and are generally slow moving. The predominant rockslide concerns are within Glitter Gulch (MP 239 to 240) where the roadway undulations are likely the result of thawing permafrost but may be coupled with unstable rock and/or soil below, and within Nenana Canyon (MP 240 to 241). Nenana Canyon has several unstable rock masses which are monitored by DOT&PF and have been well documented. Most of the canyon area contains mechanical rockfall barriers such as concrete barriers along the highway shoulder, a widened ditch line, and rock bolts and wire mesh along portions of the slope above. Even with the existing mitigation, rockfall is a persistent issue and requires frequent maintenance by M&O. Rockslide hazard locations are shown on the Site Plan as Figure 2 (12 sheets) and are tabulated in Section 7.0.

6.5 Seismicity and Liquefaction

The Parks Highway within the project extents is in a seismically active zone and crosses several active faults, most notably the Denali Fault. The Denali Fault is capable of producing large magnitude earthquakes including the magnitude 7.9 Denali Earthquake in 2002. While surface rupture did not occur along the Parks Highway in 2002, the earthquake did result in many landslides and rockslides throughout the Alaska Range, and produced shaking capable of liquefying susceptible soils. Surface rupture could occur in future earthquakes along this fault system.

Even without surface rupture, displacement of soil and rock across fault boundaries is possible. Problems have occurred along the project corridor near the Nenana River Crossing at MP 237.9. Displacements in the soil/rock at the abutments have been on the order of 6 inches over a period of 30 years. Damage has been documented on both the highway and pedestrian bridges.

Liquefaction is a concern in areas of the alignment where thawed, saturated, loose sands, gravels, and non-plastic silts are present. Relatively clean sands and gravels are common throughout the project area, particularly in areas of glacial outwash and alluvial deposits. Liquefaction susceptibility may be highest near river crossings where soils are expected to be saturated and thawed. Thin liquefiable layers may exist throughout the project where saturated soils exist near the thaw front of unstable permafrost soils. Liquefaction of subgrade soils can lead to landslides, lateral spreading, and loss of bearing support below highway embankments.

6.6 Potential Future Hazards

The existing hazards along the Parks Highway corridor have been relatively well documented, however, changes to the highway may result in new hazards. We understand that future projects may expand the highway, add pedestrian paths, or modify the highway geometry. Any improvements that change the highway footprint or grade could potentially lead to new hazards. It should also be noted that additional hazards may occur due to warming of the climate and hazards may be present which have not yet caused visible damage to the roadway.

Undisturbed areas within the project limits are generally in equilibrium with the existing climate and ground cover conditions and are changing at a relatively slow rate with the changing climate. Disturbing the native organic mat and soils near the ground surface is likely to increase the rate of thaw in these areas and may create new thaw problems. Significant changes to roadway cuts may also change the thaw conditions by bringing the roadway closer to the thawing front. The potential for, or severity of new permafrost hazards may be decreased by keeping future improvements within the currently cleared Right-of-Way limits to the extent possible.

Pedestrian paths have been discussed in the documents we reviewed. It is worth noting that pedestrian paths are frequently traveled by bicycles which may not tolerate some types of damage as well as vehicles do. Many of the hazards associated with permafrost thaw result in relatively abrupt differential settlement and relatively large pavement cracks. Several of the cracks observed during our site visit would be serious safety hazards to a cyclist and may require more immediate maintenance than similar damage within the highway.

In addition to thaw settlement, as the top of the permafrost in discontinuous permafrost areas continues to recede deeper, areas with thick organic deposits may become more compressible. Changes to the highway in areas of depressions may have long term settlement hazards or may require surcharging which could increase construction time.

Any area where new soil or rock cuts occur could potentially cause new slope instabilities or rockfall concerns. In several areas, the highway is constrained between a river and mountainous terrain, expansion of the highway in these areas will be challenging.

7 HISTORICAL AREAS OF CONCERN

We used observations made during our May 2020 site visit, the draft M&O Memorandum, and the DOT&PF Geotechnical Asset Management database to develop the table in the following exhibit which attempts to highlight historical and existing areas of concern documented at the time of this report. Minimal editing of the source data was performed, and in several instances, the same general issue or hazard may be highlighted in multiple rows as an attempt to maintain data fidelity since the information was collected by multiple data sources at different times. It is our intent to provide a somewhat comprehensive tabulation of significant problem areas in this table. However, we recognize that additional areas of concern may exist or could develop between the time of this report and the date of end use. Therefore, we recommend conducting additional research and studies during design of future projects, particularly where a project crosses previously undeveloped area or includes an existing area of significant concern. Areas of concern are shown graphically on the maps in Figure 2 (12 sheets).

Exhibit 7-1: Historical Areas of Concern by Milepost

Approximate Milepost	Hazard Type	General Description (data source is shown in parentheses following description[1])
206.2-206.3	Unstable Embankment/ Pavement damage	Road bumps where embankment crosses a low spot between ridges. Possibly settlement caused by compressible organics or thawing permafrost. (SW2020)
207.7-207.9	Unstable Embankment/ Pavement damage; Drainage issues	Road bumps and ditch ponds likely caused by thaw settlement. Possibly up to a few feet of settlement based on backslope offset. (SW2020)
208.2-209.3	Unstable Embankment/ Pavement damage	Reoccurring frost heaves. (M&O) Bumps likely due to thaw settlement and/or heaving. Peat ground cover may suggest areas of possible shallow permafrost. (SW2020) Unstable embankment. 2016 construction may have repaired the slope – reassessment needed. Extensive shoulder patching and apparent slumps. Rolling freeze thaw distress to embankments to north and south, but of Class C variety. Condition = poor. (GAM)
211-212	Unstable Embankment/ Pavement damage	Occasional spreading cracks along shoulders. (SW2020)
212	Landslide hazard	Unstable soil slope. Vern Carlson (Maintenance Foreman) stated that the site was a slow-moving slide that caused the ditch to be cleaned out every three to five years depending on rainfall. They always cleaned it out before material got on the road. No special equipment was required. Condition = fair. (GAM)
212.3	Rock fall hazard	Unstable rock slope. Condition = good. (GAM)
212.5	Rock fall hazard	Unstable rock slope. Cobbles weathering out of sandy gravel over highly fractured rock cut. Ditch appears sufficient to keep rockfall off paved surface if maintained. Risk of impact to traffic low. Condition = good. (GAM)
212.7	Unstable soil slope	Erosional gully feature with potential periodic sloughing, erosion, and deposition of materials into the ditch. (SW2020)
212.9	Rock fall hazard	Unstable rock slope. Differential erosion in sandy gravel slope over highly fractured rock cut. Sandy gravel releasing cobbles up to 1.5 feet. Very low risk to road if ditch is maintained. Condition = good. (GAM)
216.4-217.1	Unstable Embankment/ Pavement damage	Waviness and patching in the roadway. Large dip at MP 217. (SW2020)
217.2-217.7	Debris flow hazard	Road cut into likely colluvial soil slope. Potential risk for future expansion if cut is extended. (SW2020) Unstable soil slope. 2016 construction may have repaired the slope – reassessment needed. Debris fan above the road – minimal material reaches the road. Smaller power lines reportedly moved across road to minimize impact from debris flows/rockfall. Condition = poor. (GAM)

Approximate Milepost	Hazard Type	General Description (data source is shown in parentheses following description[1])
218	Debris flow hazard	Shallow failure in boulder colluvium. (SW2020) Condition = poor. (GAM)
218.9-219.3	Rock fall hazard	A few boulders on river side of guardrail, possibly from above. (SW2020) Area subject to rockfall from mountain above. Large blocks rare, smaller blocks more common. Condition = fair. (GAM)
221.8-222	Erosion	Minor erosion due to river undercutting in unprotected banks at north end of section. (SW2020) River undercutting bank approximately 60 feet from edge of pavement. If erosion continues, existing riprap on embankment may need to be improved. Condition = good. (GAM)
225.6	Rock fall hazard	Unstable rock slope. Cut slope in sandy gravel with cobbles up to 3 feet max dimension. Ditch appears of sufficient width and depth to contain rockfall if maintained. Condition = good. (GAM)
225.8	Rock fall hazard	Sandy gravel with cobbles up to 2 ft max dimension. Ditch appears sufficient to contain rockfall if maintained. Condition = good. (GAM)
225.9-226.2	Unstable Embankment/ Pavement damage	Bumps and patches. Cause uncertain. (SW2020)
226.2	Rock fall hazard	Raveling of sandy gravel cut face, cobbles up to 2 feet. Ditch appears to be sufficient width and depth to prevent damage to roadway if maintained. Condition = good. (GAM)
228.5	Unstable Embankment/ Pavement damage	Road dropping, appears worst at shoulder. Requires annual maintenance. (M&O) This issue appears to be at MP 226 not 228.5 as reported by M&O. (SW2020)
230.8	Unstable Embankment/ Pavement damage; Slope stability	Cracking, patching, and some bumps. There appears to be a large-scale slope issue here. Numerous tension cracks (as large rills) and scarps observed in right (looking up station) road cut and hillside behind it. Observed relatively recent drill hole with instrumentation at the top of the cut. (SW2020) M&O stated that the slope has not affected the road in all his time working out of the Healy station (1999). Slope exhibits little to no potential to affect the roadway. Condition = good. (GAM)
231.6	Unstable Embankment/ Pavement condition	Isolated bump. Likely related to thaw settlement. (SW2020)
232.5 - 232.8	Unstable Embankment/ Pavement condition	Annually reoccurring bumpy section. Permafrost at approximately 32 feet based on prior drilling. Poor pavement performance. Requires annual maintenance. (M&O) Extreme area of thaw settlement and slumping of backslopes at the north end of the damage zone. (SW2020) Thaw unstable embankment section exhibits up to 12 inches of differential settlement. Condition = fair. (GAM)

Approximate Milepost	Hazard Type	General Description (data source is shown in parentheses following description[1])
235-236	Unstable Embankment/ Pavement condition; Drainage issues	Poor drainage and disappearing shoulder causing pavement issues. ARRC crossing at MP 235 requires annual repairs and regularly causes damage to snow removal equipment. (M&O) Bumpy road due to extreme thaw settlement. 5 to 6-foot deep thaw hole at left toe (MP 235.5) with large circular failure expression in roadway and in backslope. (SW2020) Thaw unstable embankment section exhibits up to 12 inches of differential settlement. M&O stated that several patches need to be added annually to this section. He described it as 'leap-frogging' patches. This section contains a railroad crossing. Condition = fair. (GAM)
236.9	Rock fall hazard	Rock fall slope exhibits a low to moderate potential to affect the roadway. Blocks up to 2 feet were observed on the slope face. Condition = good. (GAM). This is a road cut in a soil slope at approximately MP 236.5 based on milepost markings in the field.
237	Culvert	Possible settlement at culvert outlet. (SW2020)
237.5	Unstable Embankment	Thaw unstable embankment section exhibits up to 12 inches of differential settlement. (GAM)
237.9	Faulting/Ground Displacement	Faulting related ground movements have caused damage to the highway and pedestrian bridges. Displacement rate appears to be on the order of 6 inches over the last 30 years at the north bridge abutment. (DOT&PF Bridge)
238.2-238.8	Unstable Embankment/ Pavement condition; Possible landslide hazard	Bumps and heaves. Previously documented area with underlying thaw unstable soils/massive ice, and potential larger scale landslide mechanism. (SW2020)
238.3	Unstable slope	Small cut N of Nenana River Bridge. M&O operators said that it was basically stable even though it looked like the material had been pushed back up the slope in the last 3 or 4 years. Erosional failure filling the ditch is the most likely mechanism. Additionally, highway sinking due to landslide. Recently patched with up to 1 foot of asphalt. S&W investigated landslide above highway during hotel construction, but these "settlement" areas may be local. 2016 construction may have repaired the slope – reassessment needed. Condition = fair to poor. (GAM)
239-239.9	Rock fall hazard; Drainage issues	Nenana Canyon. Drainage issues behind jersey barriers and rock slides blocking culverts. Emergency repairs in 2013/2014. (M&O) South section of Nenana Canyon (area outside roadside barriers): M&O says that much of material that ends up on the road consists of mud composed of completely weathered rock. Potential for large slides to occur here and completely close the road. Condition = poor. North section of Nenana Canyon (section of slope behind barriers and slope to north without barriers): Rock is rotten, most material coming down sand-silt size. M&O reports barrier is effective until it fills up. Condition = fair. (GAM)
240.6	Unstable Embankment/ Pavement condition	Small bump. Potential settlement in ditches on uphill side. (SW2020) Thaw unstable embankment section exhibits up to 12 inches of differential settlement. Condition = fair. (GAM)

Approximate Milepost	Hazard Type	General Description (data source is shown in parentheses following description[1])
240.9	Rock fall hazard	Slope exhibits moderate to high potential to affect road. Blocks up to 4 feet observed in ditch. Spring comes down one side of slope, drains through ditch under the slope. M&O stated water and material often clog ditch, require clearing every 1-2 years. Condition = fair. (GAM)
241.4	Rock fall hazard	Slope exhibits a high potential to affect the roadway. M&O stated that ditch needs to be cleaned out every year. M&O also pointed out a large crack that is forming in an overhanging section of rock. This crack could lead to a largescale failure. Condition = fair. (GAM)
242.1	Unstable Embankment/ Pavement condition	Highway develops repeated dips. (M&O) Large heave/depression. Possible thawing ice wedge. (SW2020)
243.5	Unstable Embankment/ Pavement condition	Highway develops repeated dips. (M&O) Abrupt depression in roadcut. (SW2020) Thaw unstable embankment section exhibits up to 12 inches differential settlement yearly. M&O stated that this section needs to be paved yearly. M&O stated that the material disappears every year. There are signs that read "Bump" leading up to the section. Condition = fair. (GAM)
243.8-244.1	Unstable Embankment	Thaw unstable embankment section exhibits up to 6 inches of differential settlement. M&O stated section requires maintenance every 2 to 3 years. Condition = fair. (GAM)
245-245.9	Unstable Embankment/ Pavement condition	Wavy road. Evidence of embankment settlement with ponded water along the toe. Thaw problems. (SW2020)
249.2-249.3	Unstable Embankment/ Pavement condition	Ponded water next to embankment. Possible thaw settlement or grading issue. (SW2020)
251.5-252	Unstable Embankment /Pavement condition	Roadway dips. Culverts appear to be bowed down in middle ~1 foot of 3-foot diameter culvert. Likely related to thaw settlement. (SW2020)
252.3	Unstable Embankment/ Pavement condition	Small patch in pavement south of Panguingue Creek. Frost heave? (SW2020)
253.3-253.8	Drainage issues; Unstable Embankment/ Pavement condition	Drainage issues are causing damage to the road base, sink holes and severe dips occur. (M&O) MP 253-253.3 and MP 253.7-253.8 severe thaw settlement. MP 253.7-253.8 settlement at embankment toe. (SW2020)
255.3-255.5	Unstable Embankment/ Pavement condition	A few bumps. Large circular failure propagating through northbound lane near 255.4. Toe pond and poor drainage at culverts. (SW2020)
255.9	Unstable Embankment/ Pavement condition	Bumps (SW2020)
256.3-256.5	Drainage issues	Drainage issues are causing road damage. (M&O) Severe bumps and waves. Thaw settlement resulting in drainage issues. (SW2020)

Approximate Milepost	Hazard Type	General Description (data source is shown in parentheses following description[1])
257.1-257.3	Unstable Embankment/ Pavement condition	A few bumps in small “valley” areas between road cuts. (SW2020)
258.1 -259	Unstable Embankment/ Pavement condition; Slope stability; Landslide hazard	Bumpy road with numerous patches and drainage issues. Large scale creeping failure of slopes above the road (MP258.3-258.6) and impacting the ROW. Small riprap “buttress” on backslope is “failing”. (SW2020) Drainage issues affecting road base. (M&O)

NOTES:

1 Information Sources: SW2020 – S&W observations during May 2020 site visit; GAM – taken from the DOT&PF Geotechnical Asset Management Database; M&O – Adapted from DOT&PF draft M&O Memorandum; DOT&PF Bridge – from report provided by DOT&PF Bridge.

8 GEOTECHNICAL CHALLENGES AND MITIGATION POSSIBILITIES

Many hazards exist along the Parks Highway within the project limits. Unfortunately, mitigation is impractical or cost prohibitive for many of the observed hazards. However, conceptual mitigation possibilities are discussed in broad terms below. No mitigation project should be based upon the concepts discussed below without a site-specific study and in most cases a project specific geotechnical exploration program. The list of mitigation possibilities below should not be considered an exhaustive list as other mitigation approaches may become evident as more is understood about specific problem areas.

8.1 Permafrost Mitigation

Permafrost hazards are generally mitigated in one of three ways, preserve the permafrost by passively or actively cooling the subgrade soils, slow the thaw of permafrost by increasing the insulating characteristics of the highway above the frozen ground, or thaw and drain the permafrost to remove the hazard. For large linear projects such as highways in discontinuous permafrost it is typically cost prohibitive to preserve the permafrost and the addition of horizontal thermosyphons and/or insulation may introduce new hazards such as growing new ice lenses or exacerbating icing issues on the roadway.

Thawing the permafrost is possible in some locations and may be appropriate in isolated areas with massive ice. The applicability of thawing the permafrost will be dependent on the subgrade soils, the lateral and vertical extents of the massive ice, and the condition of the soils adjacent to the thawed area. Actively thawing permafrost soils is becoming more common under building footprints but is not common below roadways.

Typically, the most practical mitigation for permafrost distress involves slowing the rate of thaw of the permafrost and reinforcing the subgrade soils to more effectively bridge over the thawing subgrade. Subgrade thaw can be slowed by increasing the insulating characteristics of the soil above the thawing front. This can be done by increasing the thickness and/or width of the roadway embankment, through the addition of insulation into the road embankment, or by constructing air cooled embankments (ACE). Slowing thaw does not remove the hazard, but it may decrease the frequency of maintenance, and in conjunction with geogrid or woven geotextile fabric reinforcement, is likely to smooth the transition in areas that experience thaw related settlement.

Drainage issues which are frequently caused by thaw related settlement may not have a practical long term fix. However, frequent maintenance to fill in thaw ponds at the toe of the embankment and re-establish grades within drainage ditches can help preserve the life of the embankment and pavement. Culverts may also be strategically positioned in areas with better settlement performance and can be oversized or placed with a cambered profile to accommodate settlement.

8.2 Erosion Mitigation

The existing erosional features observed along the project alignment appear to be associated with river features that parallel or intersect the Parks Highway. Given the topography through which the alignment traverses, the river features tend to be high energy and have a relatively high sediment load. We did not observe areas where significant erosional processes appear to be posing an immediate threat to the roadway, however, given the dynamic environment, river erosion may become an issue in the future. The most significant threats would be associated with embankment undercutting, scour around bridge foundation elements, and transport of material around or through drainage culverts.

Existing erosional issues along the highway caused by rivers have been mitigated using shoreline protection including armoring with rip rap revetment. This method appears to be effective and barring changes to river flow paths and roadway alignment or footprint adjustments. Improvement projects along the alignment should consider changes to the geometry of the alignment and how those changes may be impacted by river erosion. Hydraulic studies should also include evaluation for climate change and potential future river channel meander changes that could change the dynamic of the interaction between the rivers and the alignment. If hydraulic evaluations suggest that locations exist where armor rock is not appropriate for protecting the highway, structural solutions such as sheet pile or secant pile walls could be used to prevent erosion. The design of these structures, similar to bridge foundations, should be designed to accommodate scour effects over time. Erosion threats can also be addressed by realignment, but in many cases, realignment may increase the possibility of other geohazards (cut slope instabilities, permafrost hazards, etc.) where horizontal constraints are restrictive.

Several areas were identified along the road where the embankment experiences erosion due to surface water. These were largely located in areas where embankment settlement is occurring which focuses surface runoff in localized areas. These effects can be mitigated by addressing the cause of the embankment settlement if practical, or with maintenance to re-establish the roadway crown or to divert the water to an area that is less readily erodible. Course and less erodible surface aggregate may also be used on the embankment slopes in these areas to discourage transport of fill soils down the embankment slope.

8.3 Landslide Mitigation

Landslides that could impact the project alignment are varied in horizontal and vertical extent. Improvement projects along the corridor should consider known landslide features and explore potential unknown features through aerial photography review, topographic analysis, and detailed site reconnaissance. Because the corridor largely follows a valley bottom, landslide threats to the roadway are most likely to come from destabilization or mobilization of slide masses from above. Active and dormant landslide features can be destabilized through earthwork activities associated with constructing improvement projects and such effects should be evaluated and accommodated during the design phase. Changes to drainage and thermal degradation of permafrost soils (natural or manmade) and seismic loading can also have a destabilizing effect on landslide features

In general, project features that can most effectively mitigate landslide instability include improved drainage of groundwater and surface water, slope flattening/unloading the crest of the slope, and buttressing/loading the toe. Practical mitigation for smaller landslides along the alignment are possible within several of the road cut areas by incorporating horizontal drains to decrease the pore pressure within the cut slopes or flattening the slopes. In areas where landslides would result in a focused flow of debris, structural debris catchment systems could be installed to retain mobilized debris before it encroaches on the roadway.

Larger scale failures such as the failures at MP 230.8 and 258.3 likely do not have a practical hazard mitigation solution because of the horizontal and vertical extents of the features. In areas where mitigating the hazard through design is not practical, it may be practical to mitigate the risk of landslides by installing slope deformation monitoring instrumentation that is monitored by an automated remote alarm system. Such a system can alert DOT&PF personnel and close the appropriate road section if movement is detected, thereby mitigating the risk of a landslide impacting the traveling public. Larger landslide feature risks may also be accommodated through realignment; however, careful consideration should be given to this alternative as moving the roadway may expose it to other hazard risks.

8.4 Rockfall and Rockslide Mitigation

Rockfall hazards generally have practical mitigation possibilities. Frequently widening of the ditch line is enough to contain rockfall and prevent it from entering the roadway. Removing the rockfall hazard by rock scaling or blasting can also be a practical approach depending on the size of the hazard. Mechanical rockfall arresting systems such as those employed within Nenana Canyon (rockfall barriers and wire mesh) may be used to prevent larger rockfalls from initiating, or from entering the roadway. It should be noted that rockfall on an exposed rock face will likely be an ongoing issue unless the face of the rock slope is protected with a designed, anchored mesh or shotcrete face. Given the size of the rock slopes along the alignment and rock conditions, it is unlikely that these approaches would be effective in the long term. Rockfall hazards are most likely to be effectively mitigated through a combination of improved catchment and an ongoing, regular monitoring/scaling maintenance program.

Rockslide mitigation is dependent upon the mechanics of the rockslide, the competency of the rock, and controlling structure in the rock mass. Large rockslide features and kinematically unstable areas in a rock mass are subject to the same challenges as described in large landslide areas. Mitigation techniques such as mechanical stabilization, slope flattening, and buttressing may be effective techniques in competent rock or if the topography allows. Removal of the rock mass may also be practical if the instability is isolated and overall slope geometry allows. Mitigation techniques for Nenana Canyon have been studied in depth but a cost-effective practical mitigation to the problem has not yet been determined.

8.5 Seismic Hazard Mitigation

Some seismic hazards can be mitigated in a practical manner while many of the hazards, such as surface rupture have no practical geotechnical mitigation techniques. Ground displacements related to faulting including long term creep movement and short-term surface rupture may be accommodated in structural design for engineered structures such as bridges and retaining walls. The risk or quantity of landslides can be lessened by stabilizing slopes which are already statically unstable. Liquefaction concerns under embankments are not likely to be practical unless the concern is isolated to a reasonably small area. If isolated areas are identified adding lateral confinement to embankments with geogrid or woven geotextile fabric reinforcement may help mitigate spreading of the embankment caused by liquefaction. Liquefaction at structures such as bridges can be mitigated through foundation design when structures are replaced if a liquefaction hazard is identified.

9 CLOSURE AND LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein. The conclusions contained in this report are based on information provided from the observed site conditions and other conditions described herein. The analyses and conclusions contained in this report are based on site conditions as they presently exist. It is assumed that the reviewed data and information are representative of the conditions throughout the corridor.

This report includes observations and recommendations and is intended to provide planning level information only. The recommendations contained herein are not sufficient for final design of any projects along the corridor. Individual projects should be designed per standard DOT&PF procedures.

Unanticipated conditions are commonly encountered and cannot fully be determined by merely reviewing information and making surficial observations. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Please read the Important Information section at the back of this report to reduce your project risks.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information obtained or derived from such electronic files shall be at the user’s sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact us.

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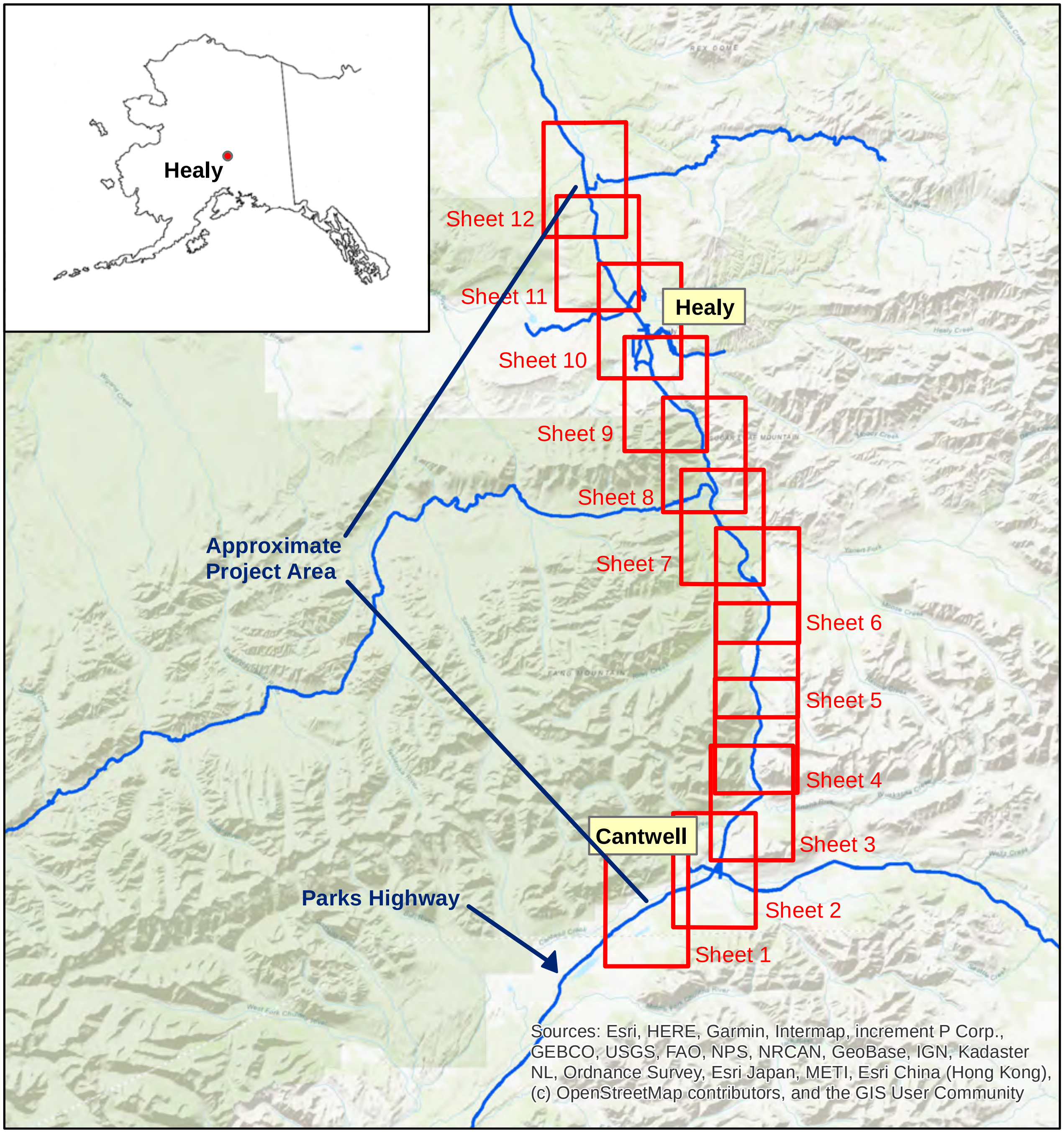

Map adapted from files provided by the Alaska Department of Natural Resources

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Miles

Cantwell to Healy PEL Study
Parks Highway, Alaska

VICINITY MAP

July 2020 105047-001

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FIG. 1

Path: T:\105047\SiteMap.mxd

LEGEND

- Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 205 - 207

July 2020

105047-001

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FIG. 2
Sheet 1 of 12

Path: T:\105047\SiteMap.mxd

LEGEND

- ☆ Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

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Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 207 - 213

July 2020 105047-001

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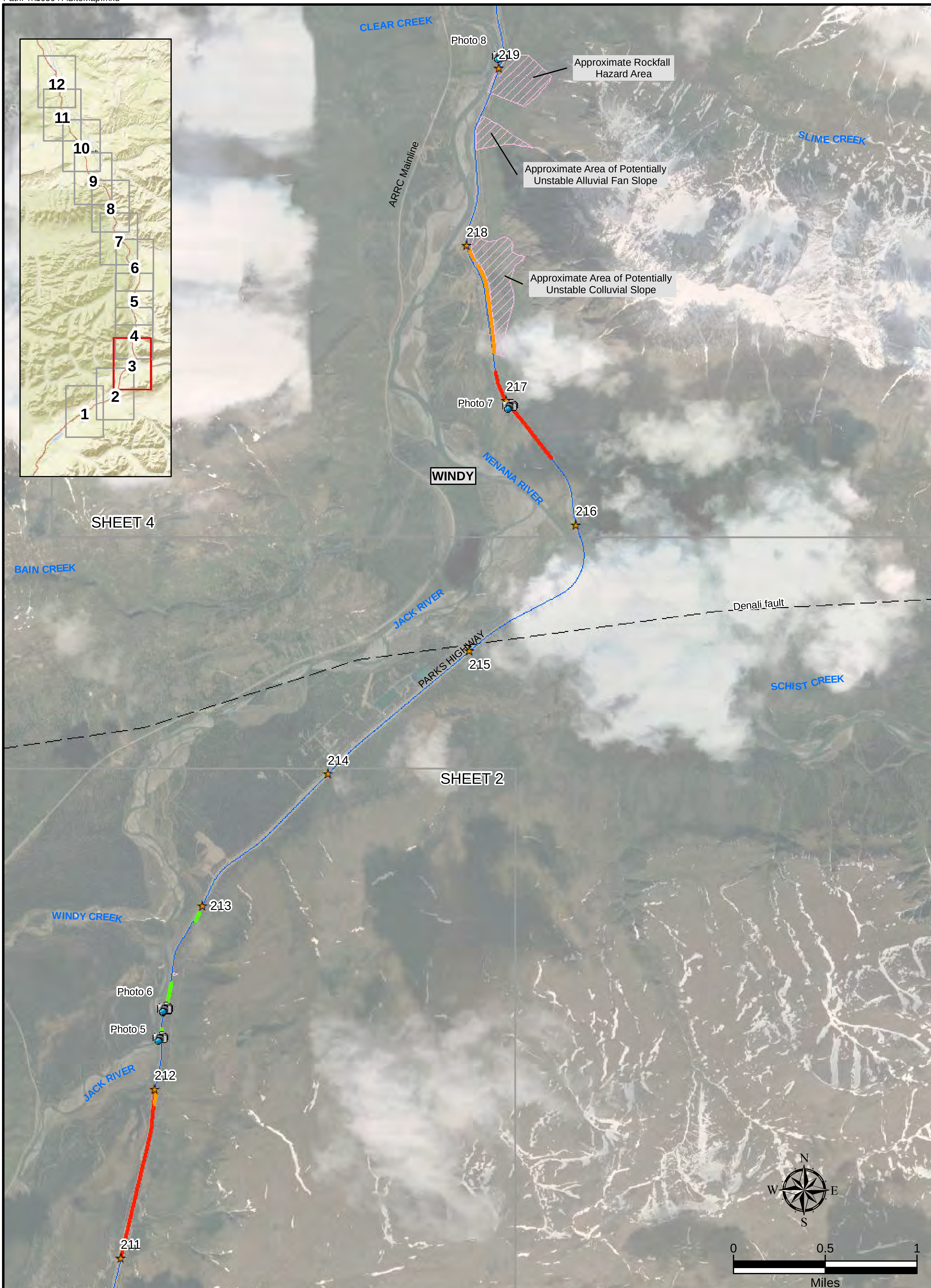
FIG. 2
Sheet 2 of 12

Path: T:\105047\SiteMap.mxd



LEGEND

- ☆ Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

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Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 213 - 218

July 2020 | 105047-001

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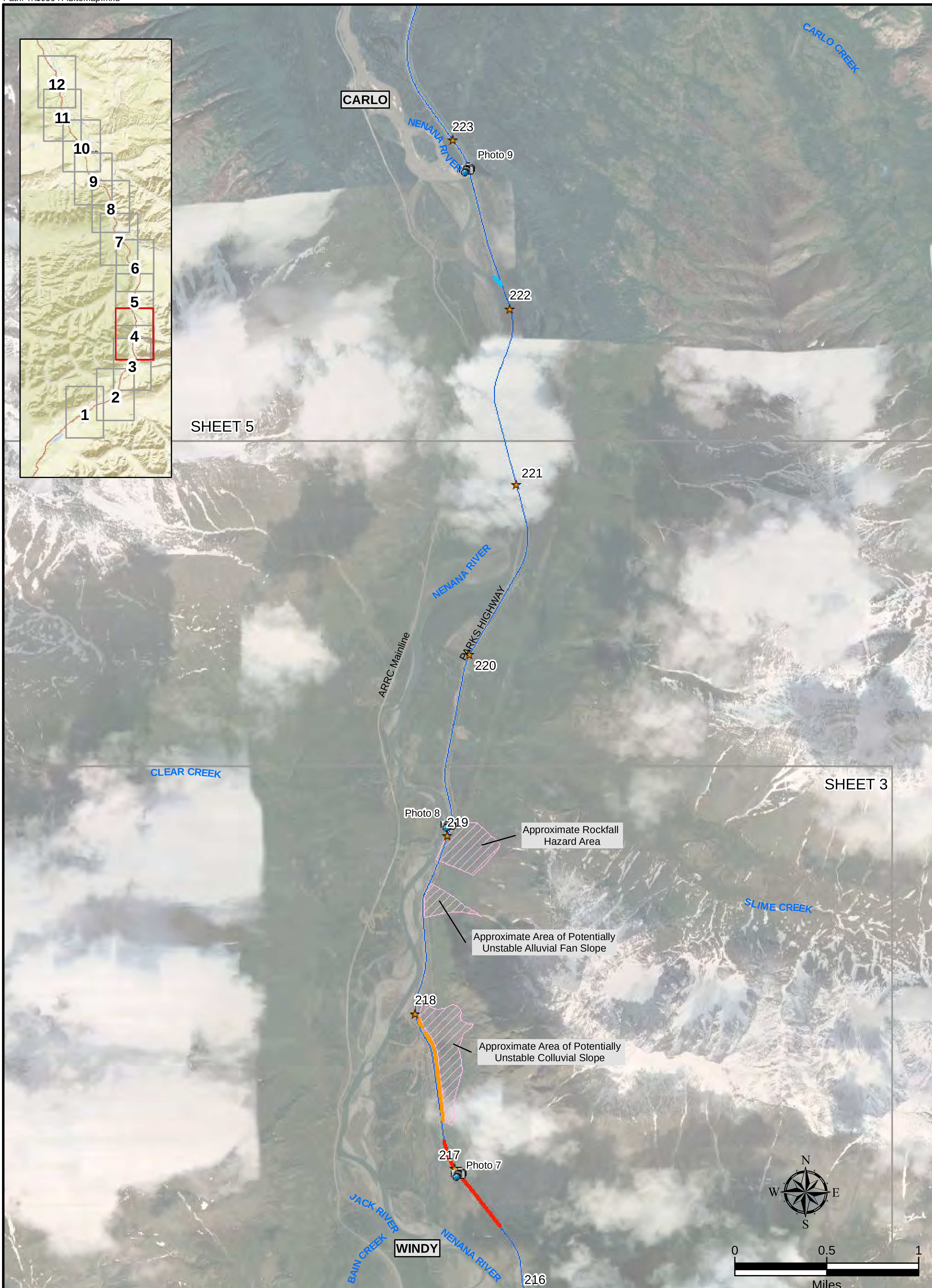
FIG. 2
Sheet 3 of 12

Path: T:\105047\SiteMap.mxd



LEGEND

- ☆ Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

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Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 218 - 223

July 2020 | 105047-001

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FIG. 2
Sheet 4 of 12

Path: T:\105047\SiteMap.mxd

LEGEND

- Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 223 - 228

July 2020

105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 5 of 12

Path: T:\105047\SiteMap.mxd

LEGEND

Milepost	**Areas of Concern**		Area of Potential Instability Observed by Shannon & Wilson, May 2020
Road Centerlines	Unstable Embankment		
Quaternary Faults	Unstable Cut in Soil Slope		
Photograph Location (See Figure 3)	Unstable Cut in Rock Slope		
	Landslide Instability		
	Erosion		

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 228 - 233

July 2020

105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 6 of 12

Path: T:\105047\SiteMap.mxd

LEGEND

- ☆ Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 233 - 238

July 2020

105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 7 of 12

Path: T:\105047\SiteMap.mxd

LEGEND

- ★ Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 238 - 243

July 2020 | 105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 8 of 12

Path: T:\105047\SiteMap.mxd

LEGEND

- Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 243 - 248

July 2020 | 105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 9 of 12

Path: T:\105047\SiteMap.mxd

LEGEND

- ☆ Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 248 - 252

July 2020

105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 10 of 12

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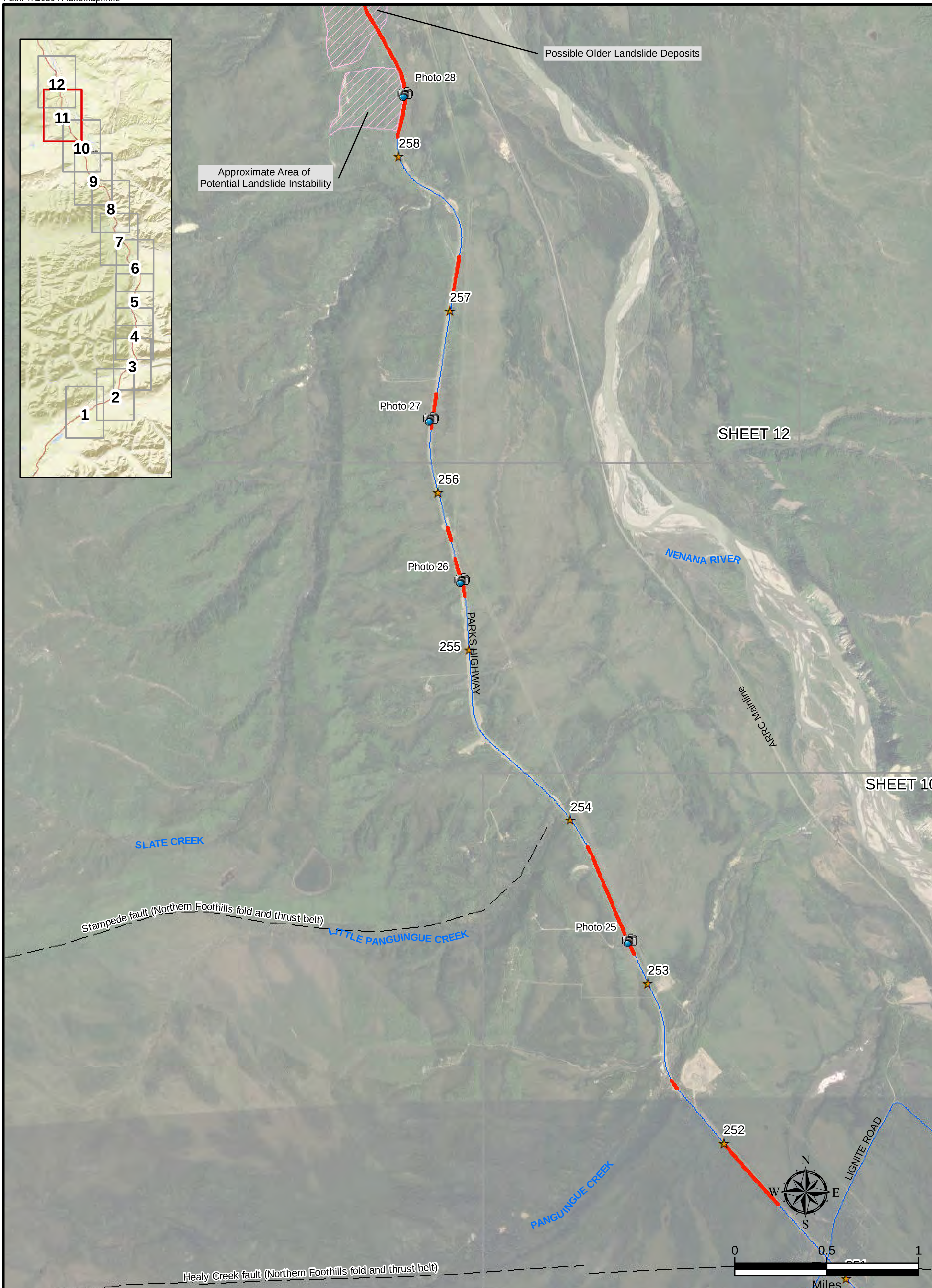

LEGEND

- Milepost
- Road Centerlines
- Quaternary Faults
- Photograph Location (See Figure 3)

Areas of Concern

- Unstable Embankment
- Unstable Cut in Soil Slope
- Unstable Cut in Rock Slope
- Landslide Instability
- Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 252 - 258

July 2020

105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 11 of 12

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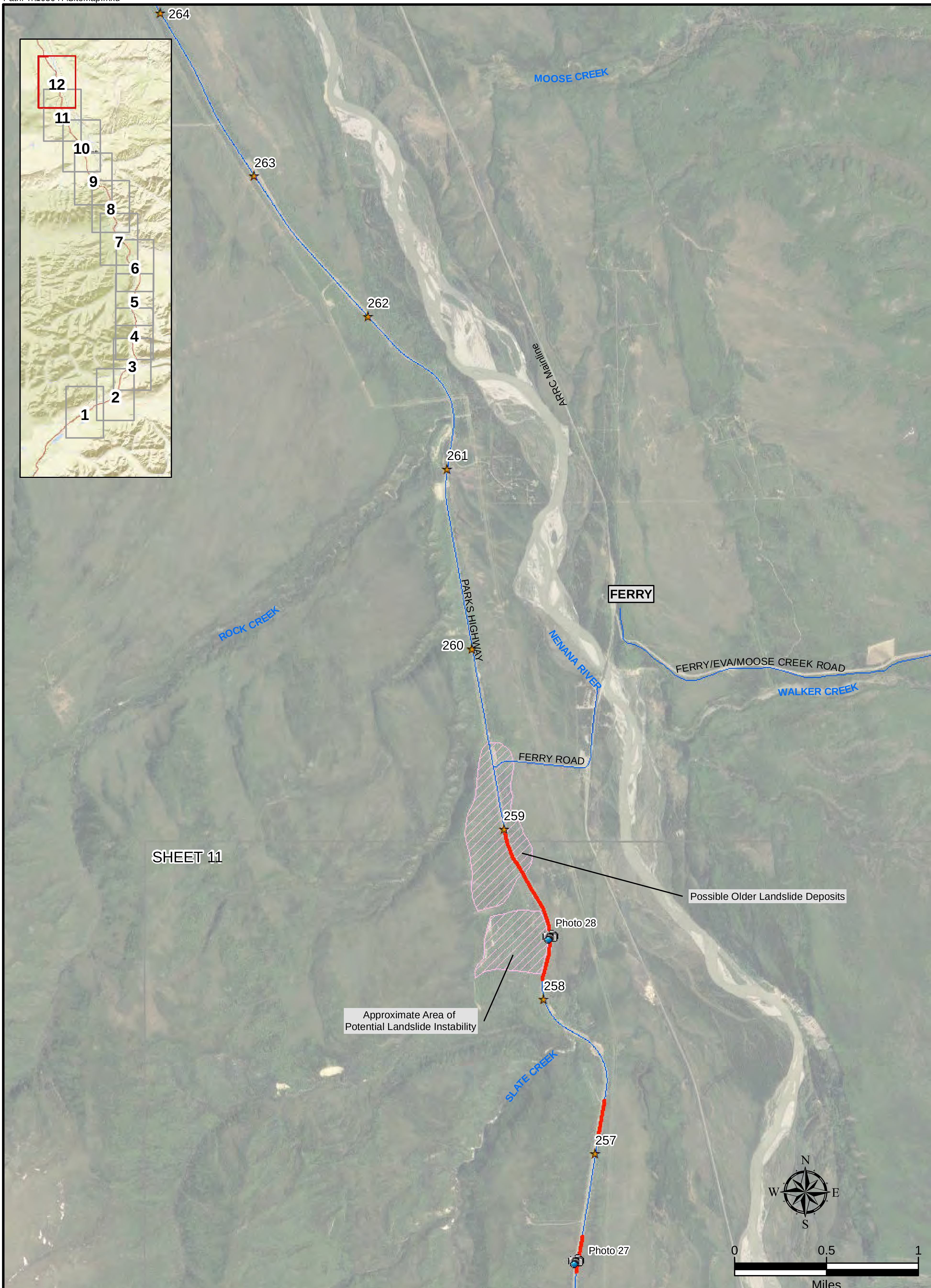


LEGEND

Milepost
Road Centerlines
Quaternary Faults
Photograph Location (See Figure 3)

Areas of Concern
Unstable Embankment
Unstable Cut in Soil Slope
Unstable Cut in Rock Slope
Landslide Instability
Erosion

Area of Potential Instability Observed by Shannon & Wilson, May 2020

NOTES

1. Basemap adapted from GIS layers provided by ADOT TGIS, ADNR, USGS, and ESRI,OpenStreetMap.
2. Extents of Areas of Concern (AOC)shown are for illustrative purposes only and should be considered approximate. See report text for additional discussion regarding AOC's. Additional areas of concern may exist within the project area.

Cantwell to Healy PEL Study
Parks Highway, Alaska

SITE MAP:
MP 258 - 259

July 2020 105047-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 12 of 12

Photo 1: MP 206.2 to 206.3

Road bumps where embankment crosses a low spot between ridges.
Settlement likely caused by compressible organics and thawing permafrost.

Photo 2: MP 208.2 to 209.3

Thaw ponds at toe of embankment slope. Thickened asphalt due to repeated patching.

Photo 3: MP 208.2 to 209.3

Longitudinal crack down roadway due to embankment shoulder rotation. Thaw pond at toe of embankment.

Photo 4: MP 208.2 to 209.3

Reoccurring frost heaves. (M&O) Bumps likely due to thaw settlement and/or heaving. Peat ground cover may suggest areas of possible shallow permafrost. (SW2020)

Photo 5: MP 212.3

Potential rockfall hazard.

Photo 6: MP 212

Unstable soil and rock slope. Vern Carlson (Maintenance Foreman) stated that the site was a slow-moving slide that caused the ditch to be cleaned out every three to five years depending on rainfall.

Photo 7: MP 217

Waviness and patching in the roadway. Large dip at MP 217. (SW2020)

Photo 8: MP 219

Existing erosion protection along the Nenana River.

Photo 9: MP 221.8 to 222

Minor erosion due to river undercutting in unprotected banks at north end of section. (SW2020)

Photo 10: MP 228.9

Frequent driveways along this section of highway.

Photo 11: MP 230.8

Possible scarp lines in road cut. Relative movement of slide is obliquely away from highway.

Photo 12: MP 232.5 to 232.8

Annually reccurring bumpy section. Permafrost at approximately 32 feet based on prior drilling.
Poor pavement performance. Requires annual maintenance. (M&O)
Extreme area of thaw settlement and slumping of backslopes at the north end of the damage zone. (SW2020)

Photo 13: MP 235

Example of embankment erosion due to surface runoff in area where pavement settlement has occurred.

Photo 14: MP 235.5

Bumpy road due to extreme thaw settlement. 5 to 6-foot deep thaw hole at left toe with large circular failure expression in roadway and in backslope. (SW2020)

Photo 15: MP 238.3

Unstable cut slope likley related to thawing permafrost.

Photo 16: MP 238.2 to 238.3

Bumps and heaves. Previously documented area with underlying thaw unstable soils/massive ice, and potential larger scale landslide mechanism. (SW2020)

Photo 17: MP 239 to 240

The Nenana River flowing through Nenana Canyon.

Photo 18: MP 239.2

Widened ditch with concrete traffic barrier. Some rockfall debris in ditch.

Photo 19: MP 239.3

Rock outcropped identified by Landslide Technology as an actively moving block.

Photo 20: MP 239.6

Nenana Canyon rockslide and rockfall area with robust concrete barrier protection.

Photo 21: MP 239.7

End of rockfall barrier with ditch section that requires frequent clearing by M&O.

Photo 22: MP 242.1

Highway develops repeated dips. (M&O)
Large heave/depression. Possible thawing ice wedge. (SW2020)

Photo 23: MP 243.5

Highway develops repeated dips. (M&O)
Abrupt depression in roadcut. (SW2020)

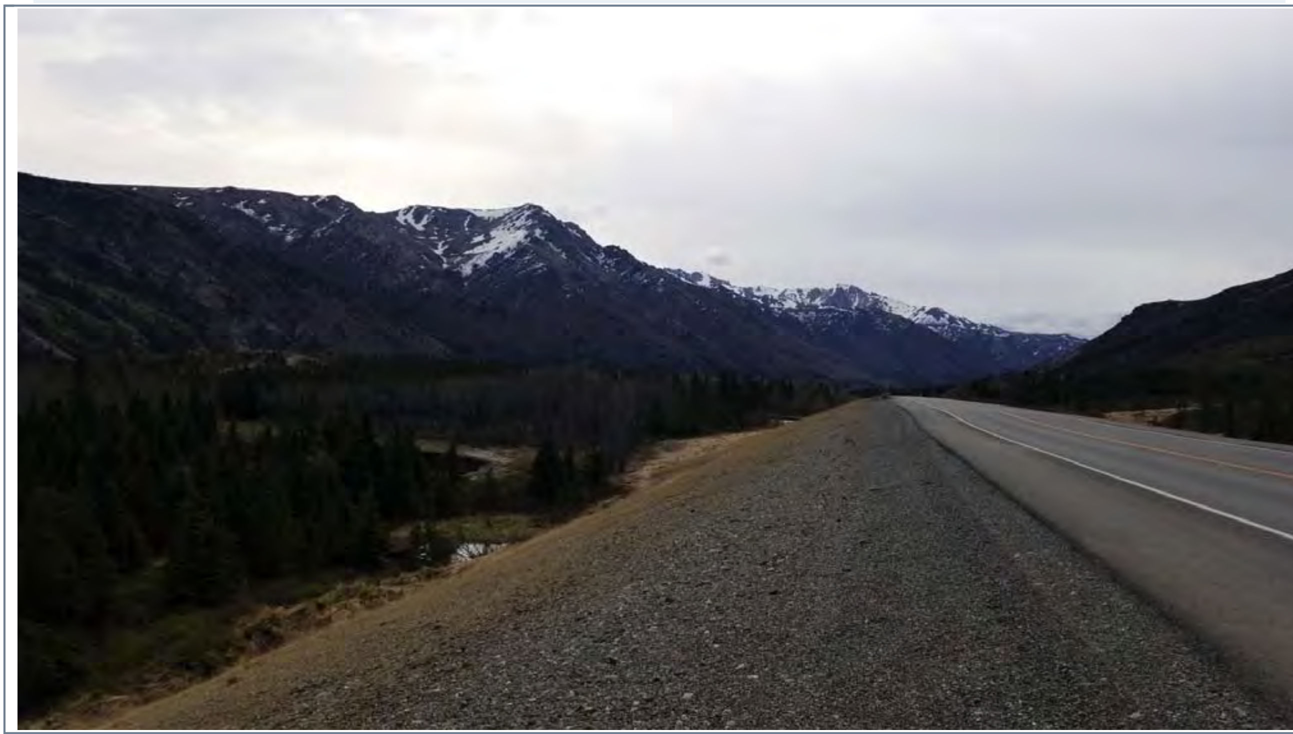


Photo 24: MP 243.8 to 244.1

Thaw unstable embankment section exhibits up to 6 inches of differential settlement.
M&O stated section requires maintenance every 2 to 3 years.
Several thaw ponds visible at toe of slope and beyond. Condition = fair. (GAM)

Photo 25: MP 253.3 to 253.8

Drainage issues are causing damage to the road base, sink holes and severe dips occur. (M&O)
MP 253-253.3 and MP 253.7-253.8 severe thaw settlement. MP 253.7-253.8 settlement at embankment toe. (SW2020)

Photo 26: MP 255.3 to 255.5

A few bumps. Large circular failure propagating through northbound lane near 255.4.
Toe pond and poor drainage at culverts. (SW2020)

Photo 27: MP 256.3 to 256.5

Drainage issues are causing road damage. (M&O)
Severe bumps and waves. Thaw settlement resulting in drainage issues. (SW2020)

Photo 28: MP 258.3

Bumpy road with numerous patches and drainage issues. Large scale creeping failure of slopes above the road (MP258.3-258.6) and impacting the ROW. Small riprap "buttress" on backslope is "failing". (SW2020)
Drainage issues affecting road base. (M&O)

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining

IMPORTANT INFORMATION

your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

Appendix J

Environmental Conditions Memorandum (July 30, 2020)

PARKS HIGHWAY MP 203 – 259 PEL STUDY

Cantwell to Healy
PEL Study
Parks Highway MP 203-259
Planning & Environmental Linkages (PEL) Study

Environmental Conditions Memo

Project No. NFHWY00492

July 30, 2020

Table of Contents

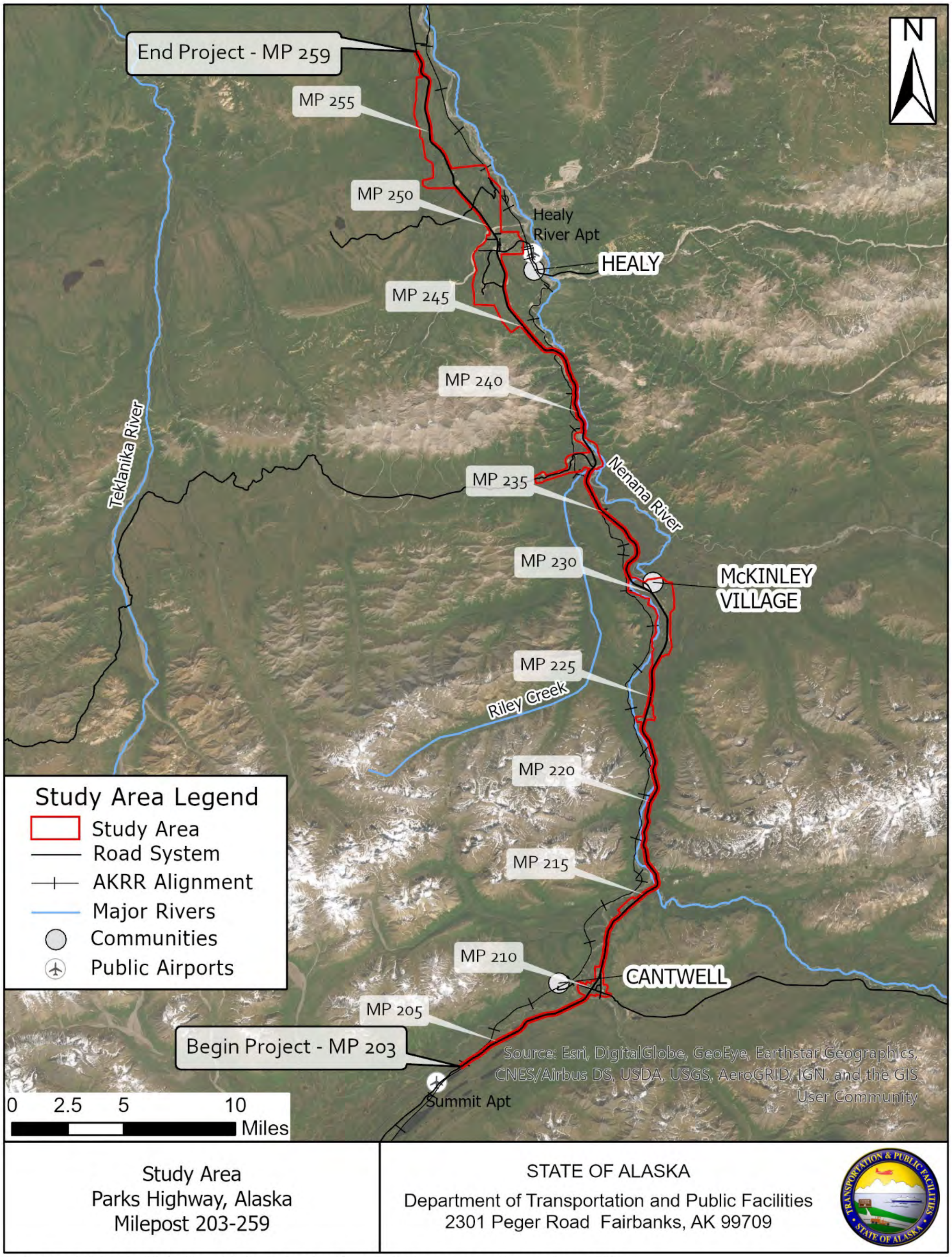
Table of Figures

Table of Tables

Introduction

The Parks Highway connects Fairbanks and Anchorage with 323 miles of roadway. It facilitates personal, tourist, and commercial travel as well as freight transit. It provides access to communities, recreational lands, local game units, private and native allotments, and subsistence resources. This PEL project focuses on the 56 miles of corridor between Mileposts 203 through 259. It includes bridge crossings, railroad crossings, and several communities. The Alaska Railroad has 65 miles of alignment through this corridor. Important roads are accessed via the Parks Highway within the project area, including the Denali Highway, Denali Park Road, Healy Spur Road, Stampede Road, and Lignite Road. Within the project area, the Parks Highway grants access to the communities of Cantwell, McKinley Village, Healy, and Ferry. There are 2 airports serving the communities in the corridor. The corridor contains land owned by the State of Alaska, Denali National Park & Preserve, BLM, and private property.

The study area includes 500 feet on either side of the current Parks Highway centerline. Around communities the study area expands to encompass areas of high density property parcels. We do this because future projects to the Parks Highway may have impacts on transportation networks within communities. Expanding the study area in communities to include connected transportation facilities, and near-by properties will help the study team better understand the impacts of potential projects in these communities. Throughout the course of the PEL study, the project study area may be expanded or reduced based on the results of initial public scoping and needs assessment. See Figure 1 for the approximate study area, or study corridor. The proposed study area is 73567,356 acres in total.



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT.

Figure 1: Parks Highway PEL Study Area

Land Ownership

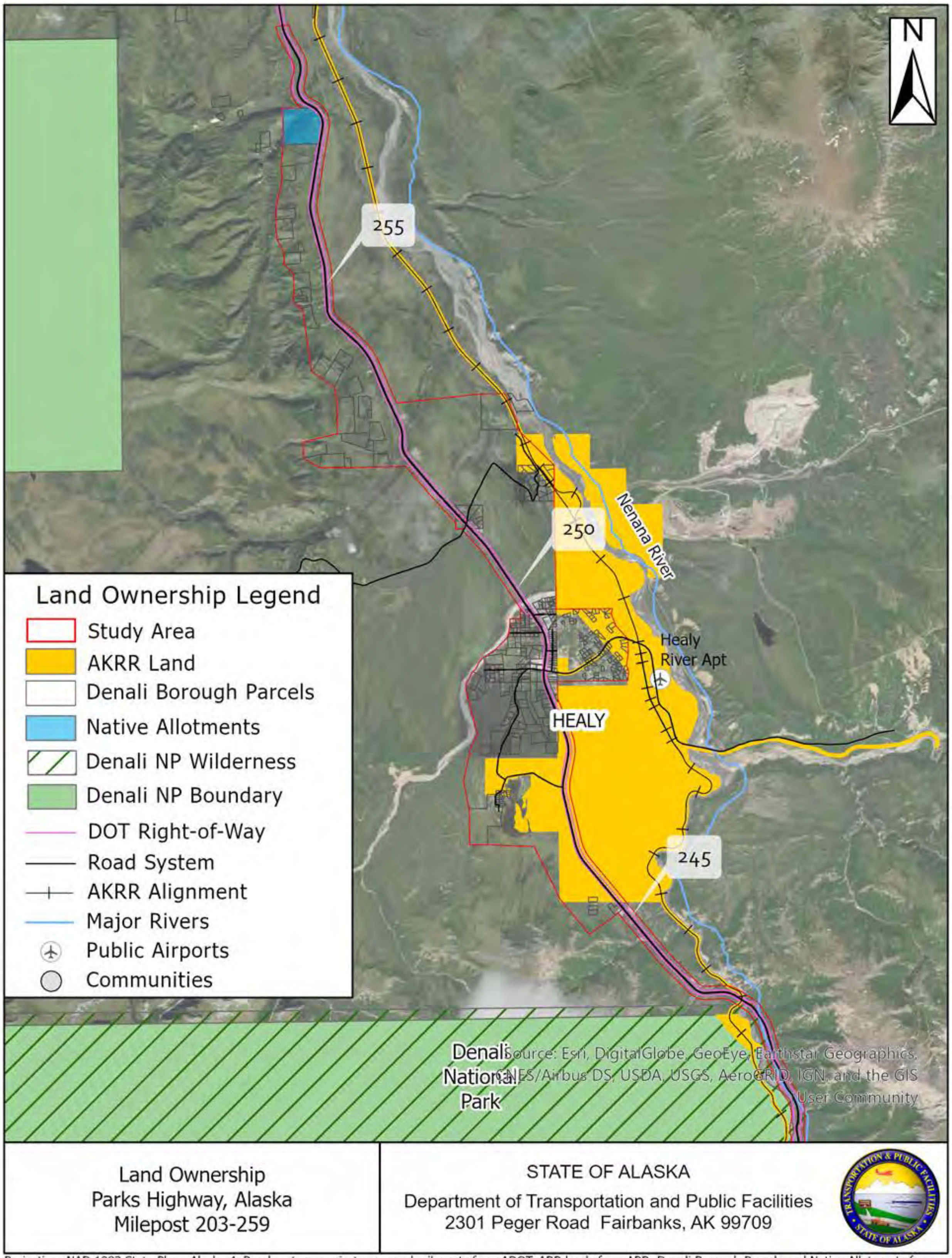
Within the study corridor, approximately 40 miles of roadway running along and through Denali National Park & Preserve (DNP&P). Denali National Park includes the Denali National Park Road and many related tourist-type businesses. Although the study area includes the beginning of the Denali National Park Road, the entirety is not included in this study. According to the National Park Service (NPS) the Park was established as "Mount McKinley National Park" on February 26, 1917. It encompassed 2,146,000 acres, which was nearly tripled in size on December 2, 1980 when the Park was renamed "Denali National Park and Preserve." Today DNP&P includes 6,057,030 acres with a perimeter 606 miles long. Its infrastructure includes 6 campgrounds for a total of 274 sites. In addition, it includes 35.5 miles of official trails and 92 miles of Denali Park Road. In 2017 the Park accommodated 642,809 visitors, nearly double what it saw in the year 2000. To meet this crowd, the Park was staffed by 772 volunteers and 266 employees. In 2017 the effects of visitor spending totaled $632 million with economic output coming to $924 million. The Project area has the potential to affect approximately 623 acres of Denali National Park and Preserve land. Economic impact information was not available for the years 2018 or 2019, but Park visitation for those years was 594,660 and 601,152 persons, respectively.

Within the corridor, the project intersects 37 Native Allotments, covering approximately 764 acres. Although much of the land in the project area is owned by state or federal government, there are several parcels owned by individuals, native corporations, and businesses (ADNR, 2006). There are 919 parcels identified within the study corridor. These include lands owned by private individuals, LLCs, INCs, LTDs, Trusts, and Trustees. 44 of the parcels belong to Ahtna Incorporated, an Alaska Native Regional Corporation established under the Alaska Native Claims Settlement Act (ANSCA) of 1971 (Ahtna 2020). Table 1 summarizes the number and acreage of parcels within the study area and what type of ownership they are under.

Property Owner Type	**Number of Parcels**	**Acreage**
Private	783	6,665
Native Allotments	136	650
Denali Nat. Park	N/A	1,726
AKRR	N/A	1,456
Total	**919**	

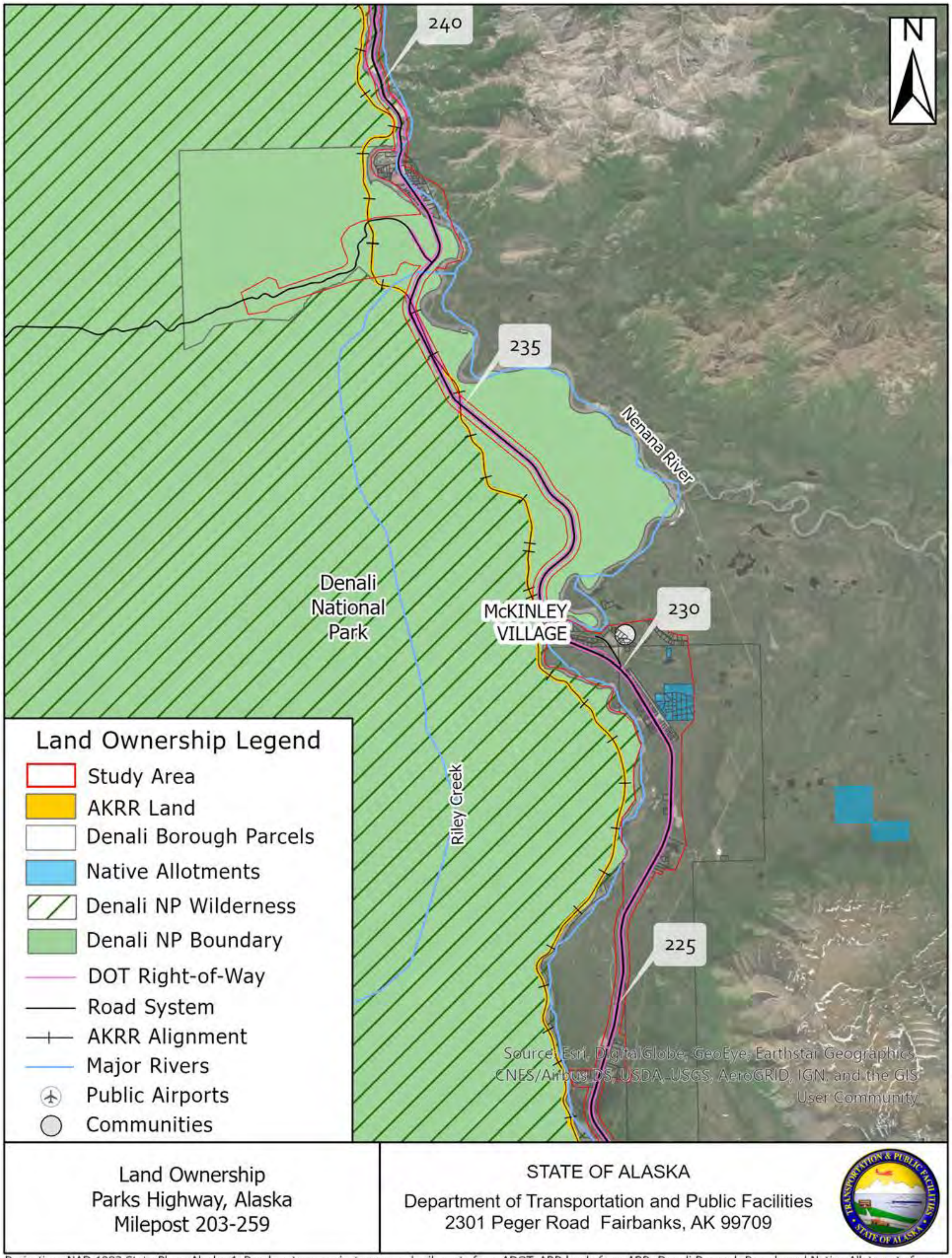
Table 1: Parks Highway PEL Land Ownership

The Parks Highway parallels the Alaska Railroad (AKRR) through the project area. The study area corridor contains approximately 65 track miles. The railroad crosses the Parks Highway in 4 locations within the study area. These crossings occur at mile posts 203, 235, 236.3, and 243. According to data obtained from the Alaska Railroad Corporation (2019) there is approximately 1,455 acres of land owned by AKRR within the corridor, much of which is located around Healy.



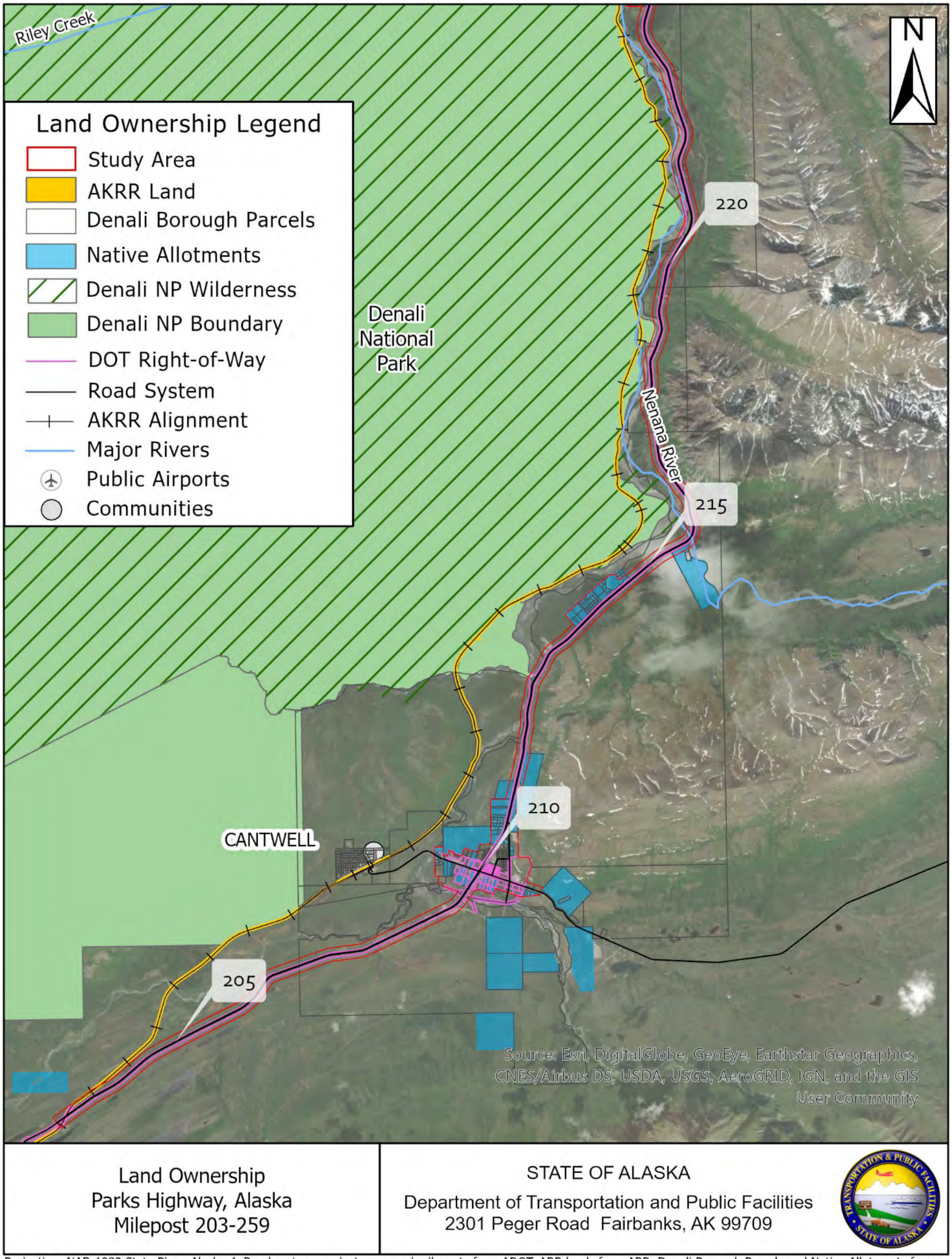
Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT. ARR lands from ARR. Denali Borough Parcels and Native Allotments from AKDNR. Denali National Park from NPS.

Figure 2: Land Ownership Map 1 of 3



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT. ARR lands from ARR. Denali Borough Parcels and Native Allotments from AKDNR. Denali National Park from NPS.

Figure 3: Land Ownership Map 2 of 3



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT. ARR lands from ARR. Denali Borough Parcels and Native Allotments from AKDNR. Denali National Park from NPS.

Figure 4: Land Ownership Map 3 of 3

Cultural Resources

According to the Alaska Office of History and Archaeology (OHA) and their Alaska Heritage Resource Survey (AHRS) mapper, there are 65 AHRS sites within the corridor area. Refer to Table 3 for the number of AHRS sites within each five mile stretch of the project area. None of these AHRS sites were listed as National Historic Landmarks or in the National Register of Historic Places.

Milepost	Number of AHRS Sites
203-205	0
205-210	3
210-215	1
215-220	1
220-225	4
225-230	1
230-235	1
235-240	28
240-245	7
245-250	8
250-255	10
255-259	1

Table 2: Cultural and Historical Resource Sites by 5 mile increments

Wetlands and Waterbodies

According to the United State Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) mapper, the corridor area encompasses approximately 4,881 acres of wetlands. Table 4 shows a breakdown of how many acres there are of each of the major wetland classifications. Figure 8 and Figure 9 show the locations of wetland features in relation to the study area.

Wetland Type	**Area**
Freshwater Emergent Wetland	151
Freshwater Forested/ Shrub Wetland	4,031
Freshwater Pond	82
Lake	128
Riverine	489
Total	**4,881**

Table 3: Wetland acreage by major wetland classification

Waterbodies in the corridor vicinity include many lakes and rivers. Lakes include Otto Lake in Healy, Chavey Lakes, Deneki Lakes, Horseshoe Lake, and many smaller unnamed lakes. The major river in the area is the Nenana River, a United States Coast Guard (USCG) Navigable Waterway as well as a United States Army Corp of Engineers (USACE) Navigable Waterway. Smaller rivers and creeks in the area include Jack River and Riley Creek. A search of the Federal Emergency Management Agency (FEMA) database found that there are no mapped 100-year floodplains or regulatory floodways within the study area.

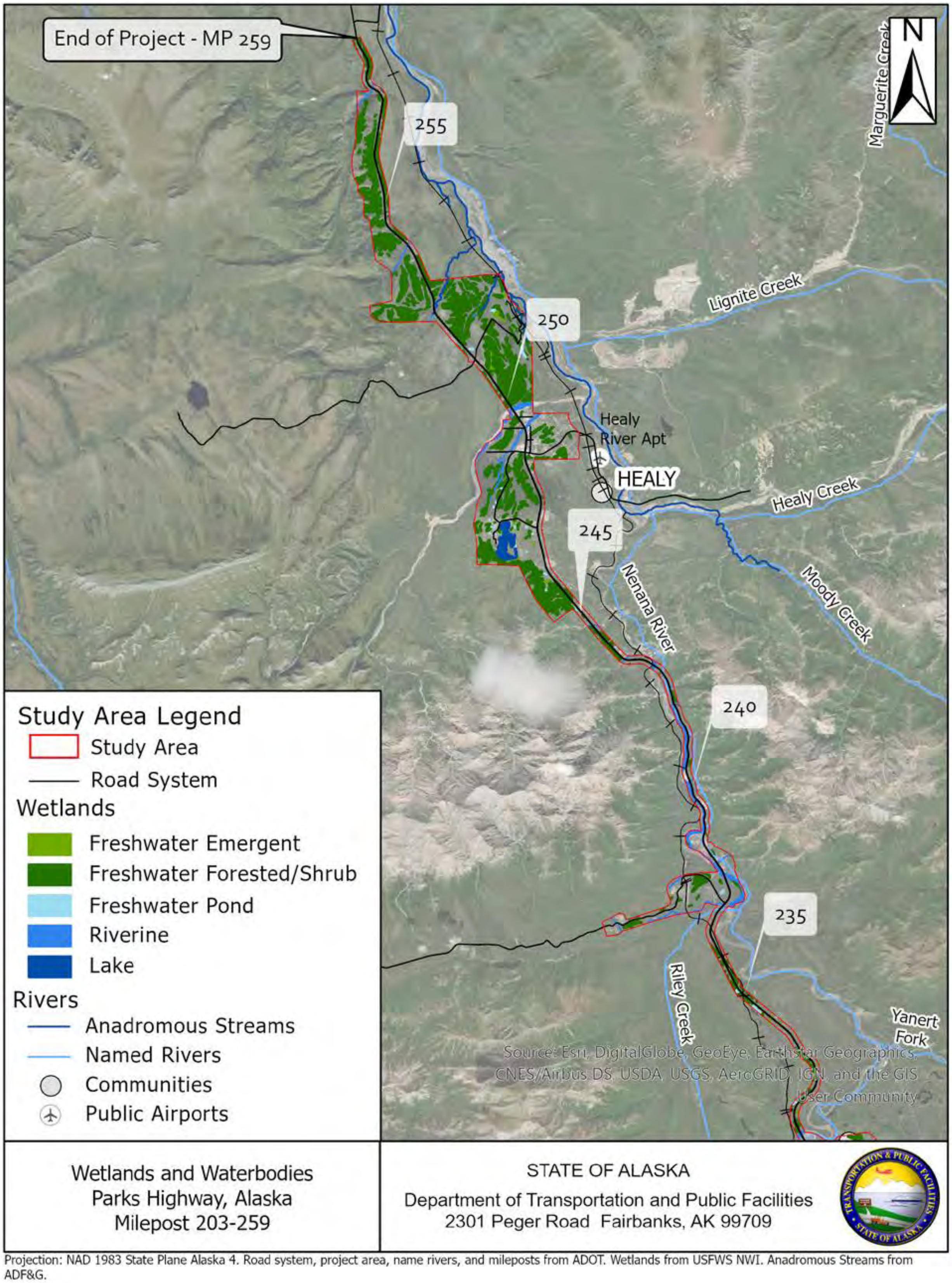
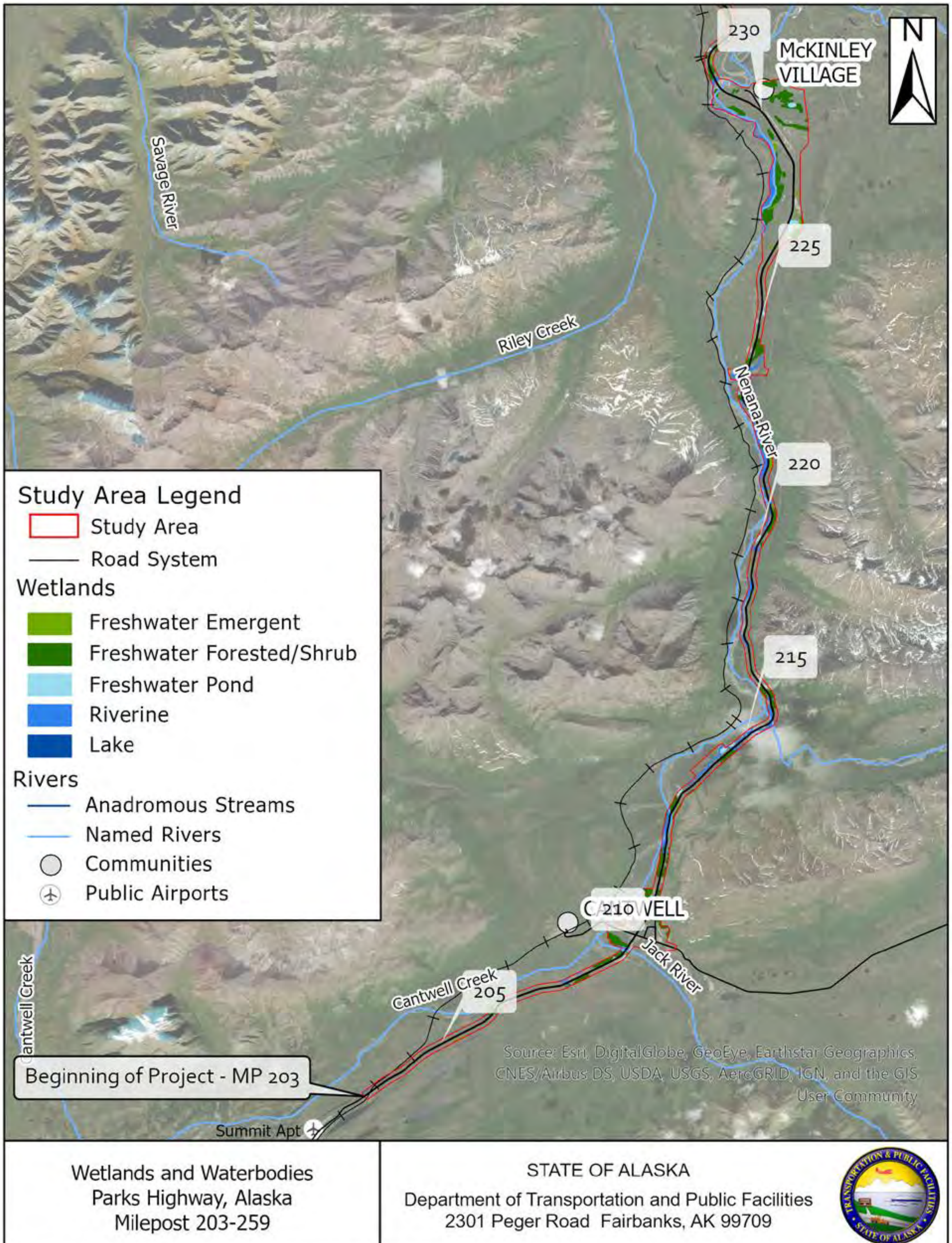


Figure 5: Wetlands and Waterbodies Map 1



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, name rivers, and mileposts from ADOT. Wetlands from USFWS NWI. Anadromous Streams from ADF&G.

Figure 6: Wetlands and Waterbodies Map 2

Fish and Wildlife Resources

The corridor area contains no threatened or endangered species according to the USFWS Information for Planning and Consultation (IPac) database. It did show that there are several bird species of concern in the area. The Bald Eagle (*Haliaeetus leucocephalus*) and Golden Eagle (*Aquila chrysaetos*) are not birds of conservation concern, but are considered vulnerable species. The American Golden-plover (*Pluvialis dominica*), Lesser Yellowlegs (*Tringa flavipes*), Olive-sided Flycatcher (*Contopus cooperi*), Rusty Blackbird (*Euphagus carolinus*), and Whimbrel (*Numenius phaeopus*) are considered birds of conservation concern across their ranges which include the corridor area.

A search of the National Oceanic and Atmospheric Administration (NOAA) Essential Fish Habitat (EFH) mapper database did not identify any EFH locations in the corridor area. The ADF&G Anadromous Waters Catalogue (AWC) mapper identified a number of anadromous streams in the project area including the Nenana River and some of its small tributaries: Moody Creek, Healy Creek, Lignite Springs, K-Dog Creek, an unnamed stream, Panguingue Creek, and Little Panguingue Creek (Table 5).

Stream Name	AWC Number	Fish Species and Life Stage
Nenana River	334-40-11000-2490-3200	Chum Salmon- Present
		Coho Salmon- Present
		Chinook Salmon- Present
Moody Creek	334-40-1100-2490-3200-4091-5102	Chum Salmon- Spawning, Present
Healy Creek	334-40-1100-2490-3200-4091	Chum Salmon- Present
Lignite Springs	334-40-1100-2490-3200-4086	Coho Salmon- Spawning
K-Dog Creek	334-40-1100-2490-3200-4086-5010	Coho Salmon- Spawning
Unnamed Stream	334-40-1100-2490-3200-4079	Coho Salmon- Spawning, Rearing
Panguingue Creek	334-40-1100-2490-3200-4075	Coho Salmon- Spawning, Rearing
Little Panguingue Creek	334-40-1100-2490-3200-4071	Coho Salmon- Spawning

Table 4: Anadromous Fish Streams including stream name, number, and fish species

Land Use and Transportation Plans

The project area falls under the Yukon Tanana Area Plan for land use[1]. It is within the Interior Alaska Transportation Plan[2]. The proposed project is in agreement with the goals described in both the Yukon Tanana Area Plan and the Interior Alaska Transportation Plan.

[1] Yukon Tanana Area Plan: http://dnr.alaska.gov/mlw/planning/areaplans/ytap/
[2] Interior Alaska Transportation Plan: http://www.dot.state.ak.us/stwdplng/areaplans/area_regional/iatp.shtml

Water Quality

The Alaska Department of Environmental Conservation (ADEC) Impaired Waters mapper showed no impaired water bodies within the study corridor. There are some community water systems, non-transient non-community water systems, and non-community water systems within the project corridor. Each of these has an identified drinking water protection area around it. Figure 10 and Figure 11 show where these sites are in relation to the study corridor.

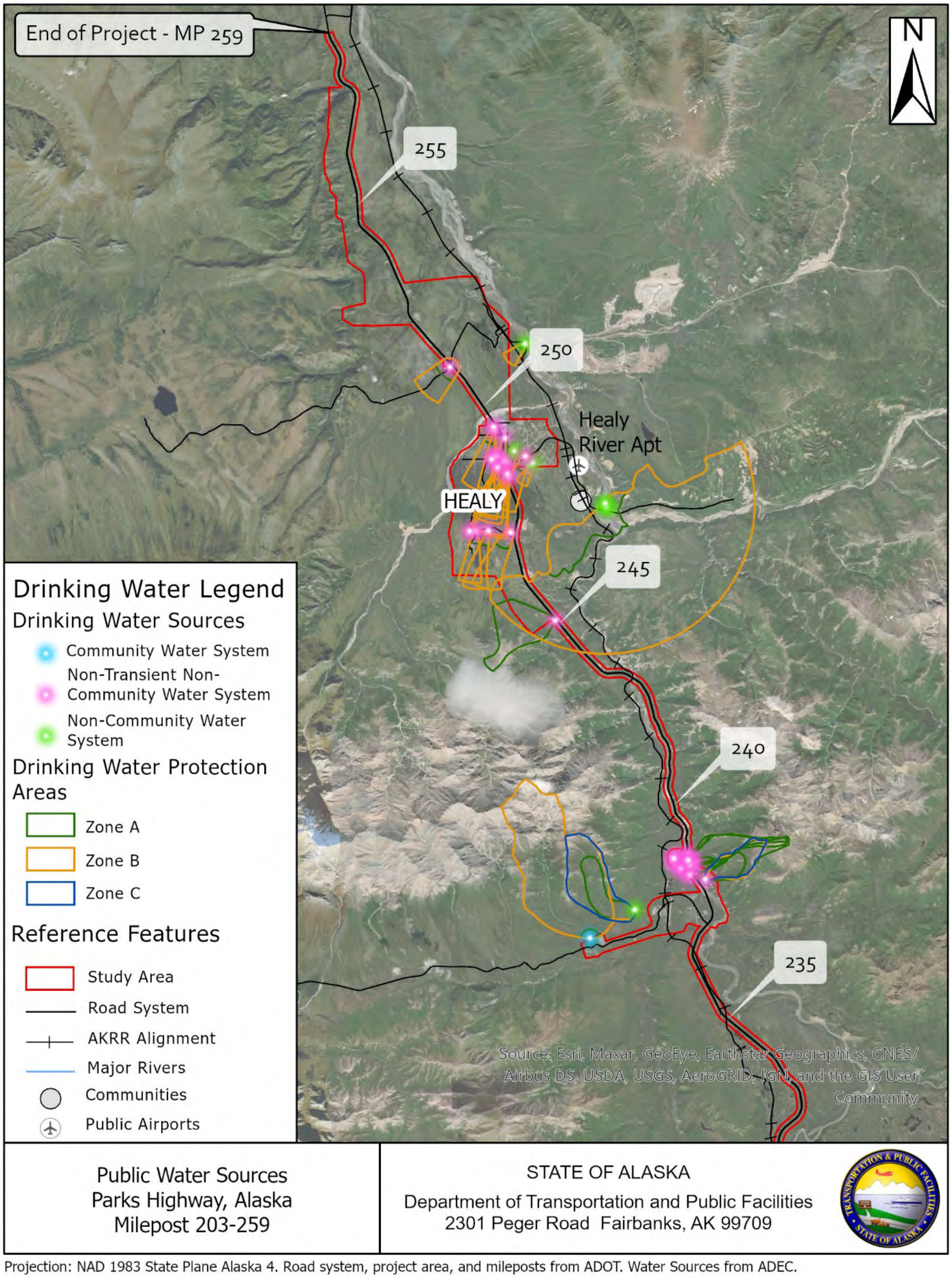
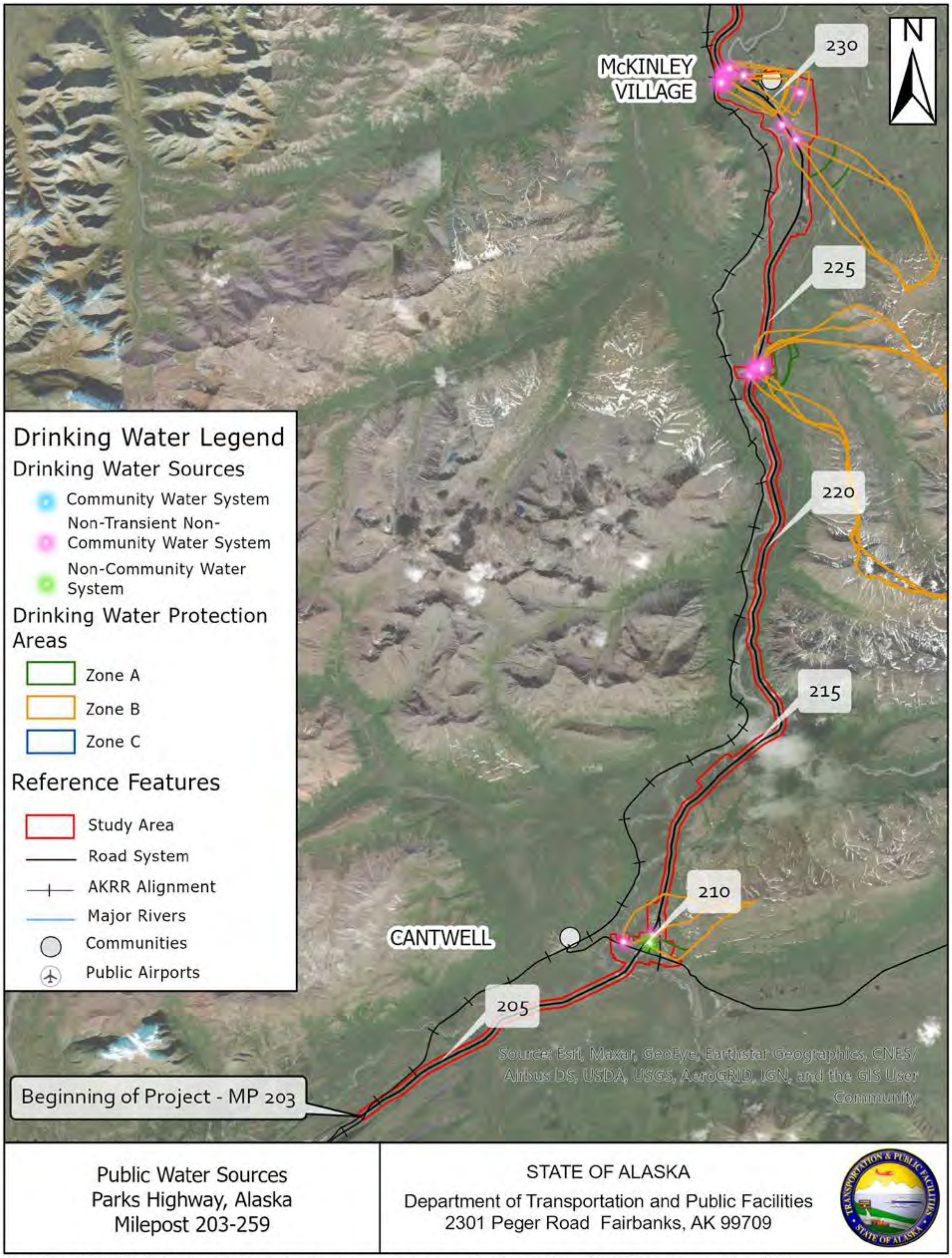


Figure 7: Public Water Sources, Map 1



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT. Water Sources from ADEC.

Figure 8: Public Water Sources, Map 2

Contaminated Sites

The Alaska Department of Environmental Conservation's (ADEC) Contaminated Sites database showed 35 contaminated sites in the project corridor. There were no identified groundwater plumes in the project corridor. Table 6 summarizes the ADEC contaminated sites by their status. Table 7 lists each ADEC contaminated site, its hazard ID, name, and status. Figure 10 and Figure 11 show the locations of the contaminated sites in relation to the project area.

Site Status	Number of Sites
Cleanup Complete	17
Cleanup Complete - Institutional Controls	12
Open	6

Table 5: Alaska DEC Contaminated Sites Summary Table

Hazard ID	Site Name	Status
11	NPS Denali Nat'l Park Hotel Oil Spill	Open
1073	Healy Small Tracts Subdivision	Open
1594	Residence - NHN Carbon Way	Cleanup Complete
1604	NPS Denali Nat'l Park HQ Boiler Bldg 54	Cleanup Complete - Institutional Controls
3668	AT&T Alascom McKinley Village	Cleanup Complete
3818	NPS Denali Nat'l Park HQ Bldg. 51	Cleanup Complete - Institutional Controls
3949	NPS Denali Nat'l Park HQ Bldg 12-13	Cleanup Complete
3950	NPS Denali Nat'l Park HQ Bldg. 111	Cleanup Complete - Institutional Controls
3951	NPS Denali Nat'l Park C-Camp Fuel Distribution	Cleanup Complete - Institutional Controls
3958	NPS Denali Nat'l Park HQ Bldg. 21	Cleanup Complete
3963	NPS Denali Nat'l Park C-Camp Auto Shop UIC	Cleanup Complete
4029	USPS Cantwell Post Office	Open
4107	NPS Denali Nat'l Park Bldg 107	Cleanup Complete - Institutional Controls
4547	NPS Denali Nat'l Park DENA Dorm UHOT	Open
22890	ADOTPF - Cantwell Maintenance Station	Cleanup Complete
23137	NPS Denali Nat'l Park C-Camp Auto Shop UST Spills	Cleanup Complete - Institutional Controls
24249	Tesoro - Tsesyu -Parks Hwy.	Cleanup Complete
24359	NPS Denali Nat'l Park, C-Camp Auto Shop	Cleanup Complete
24455	McKinley Mercantile	Cleanup Complete
24568	Larrys Healy Service	Cleanup Complete
24574	Reindeer Mountain Lodge	Cleanup Complete
24615	Tesoro - Lynx Creek -Parks Hwy	Cleanup Complete
24780	NPS McKinley Park Airstrip - Denali National Park	Cleanup Complete
25019	Healy Mountain View Liquor & Grocery	Cleanup Complete - Institutional Controls
25022	MCKINLEY VILLAGE LODGE	Cleanup Complete
25023	Evans Construction	Cleanup Complete
25142	ADOTPF - Healy Maintenance Facility	Cleanup Complete
25281	NPS Denali Nat'l Park HQ Bldg 27	Cleanup Complete - Institutional Controls
25282	NPS Denali Nat'l Park HQ Bldg 28	Cleanup Complete - Institutional Controls
25283	NPS Denali Nat'l Park HQ Bldg 34	Cleanup Complete - Institutional Controls
25540	NPS Denali Nat'l Park C-Camp Emergency Services Bldg / Former Auto Shop	Cleanup Complete - Institutional Controls
26057	NPS Denali Nat'l Park Bus Barn	Cleanup Complete - Institutional Controls
26142	Nenana Heating Services Truck Rollover - MP 134.5 Denali Highway	Cleanup Complete
26345	ADOT&PF Cantwell Maintenance Station Class V Injection Well	Open
26568	ADOT&PF Healy Maintenance Station Class V Injection Well	Open

Table 6: Alaska DEC Contaminated Sites

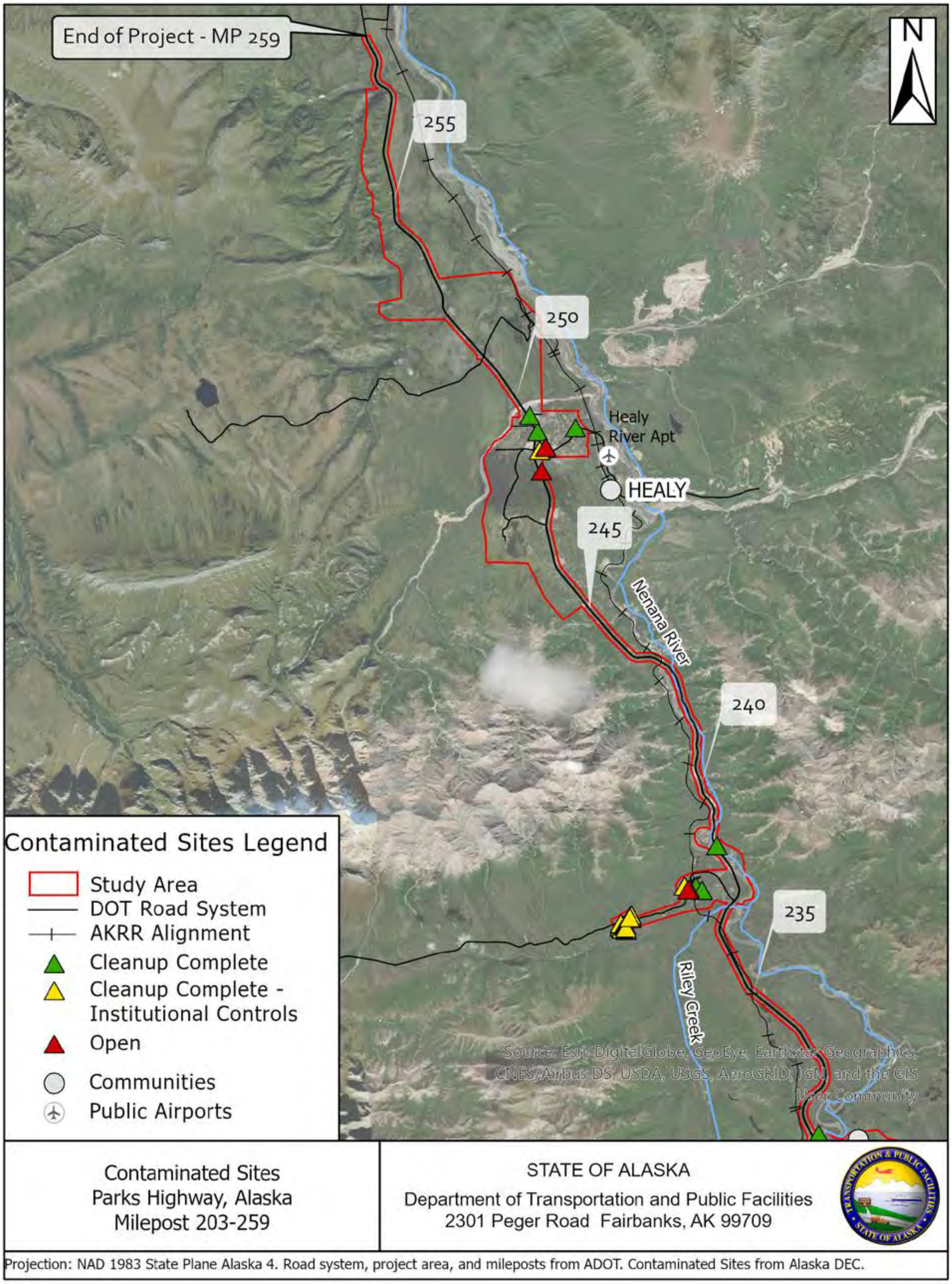
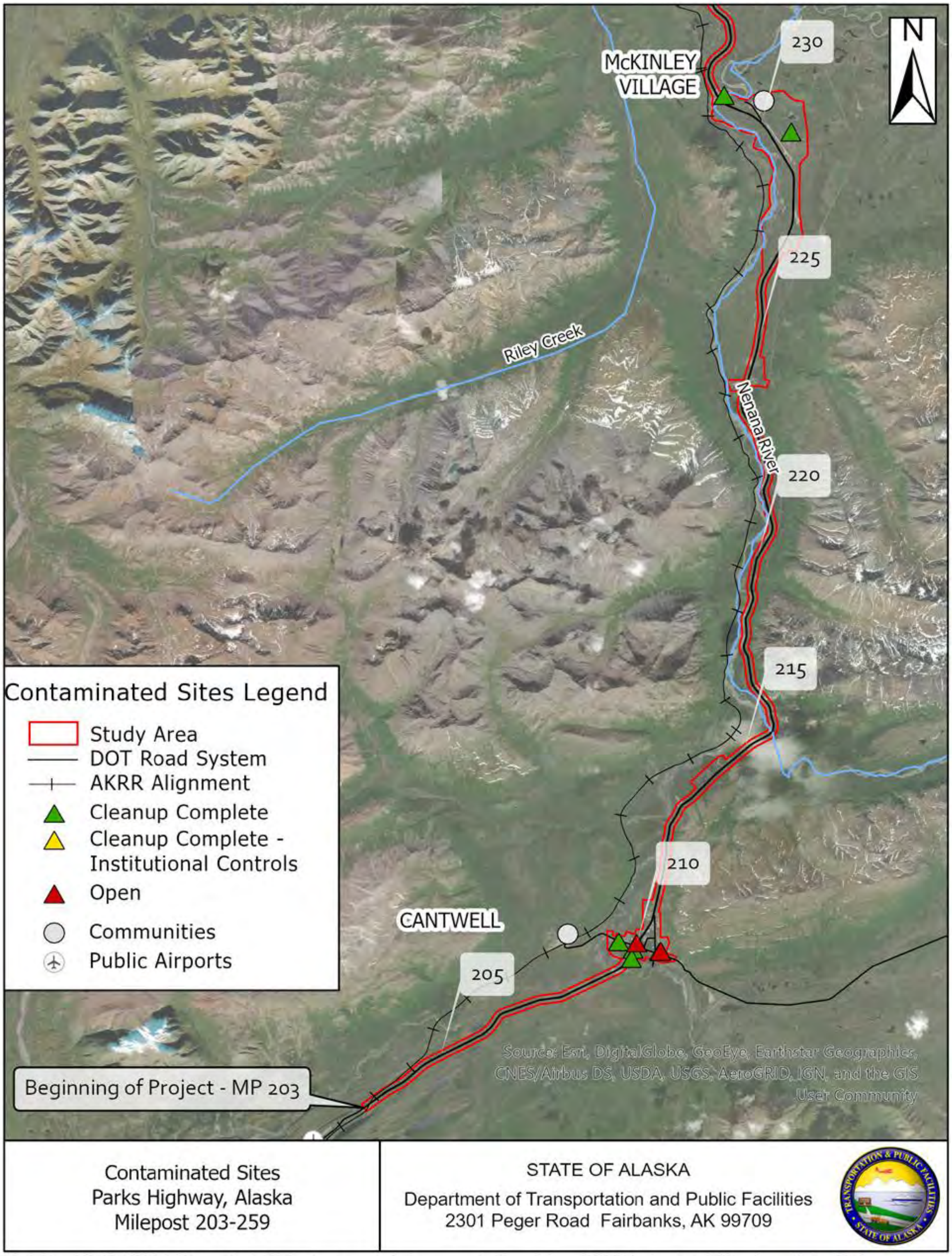


Figure 9: Contaminated Sites, Map 1



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT. Contaminated Sites from Alaska DEC.

Figure 10: Contaminated Sites, Map 2

Environmental Justice

A search of the EPA's EJScreen database found the following statistics relating to demographics within the study area. This search identified Minority Populations at 17% for the study area and 38% for the state average. Low Income Populations are 37% for the study area, and 25% for the state average. This study and future projects are designed to benefit the residents along the roadway corridor, so there are not adverse impacts likely to apply.

Air Quality

The Parks PEL study area is not located within an air quality maintenance or non-attainment area for CO, PM- 2.5, or PM- 10. There are no State or Federal air quality conformity requirements within the environmental process.

Noise

The Categorical Exclusion document breaks noise impacts into categories A through E. Noise category land uses of lands within or adjacent to the study area include:

"Category A: Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose."

"Category B: Residential. *This includes undeveloped lands permitted for this category."*

"Category C (exterior): Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings. *This includes undeveloped lands permitted for this category."*

"Category D (interior): Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios."

"*Category E:* Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not listed above*. This includes undeveloped lands permitted for this category."*

Noise analyses rely heavily on the details of the project being built. A more thorough analysis will be completed as the study team identified potential projects during the development of the PEL.

Section 4(f)/6(f)

Known Section 4(f) properties within the study area include Denali National Park & Preserve, Tri-Valley School, Otto Lake Park, Bison Gulch Trailhead, Horseshoe Lake Trail, Rock Creek Trail, Mount Healy Overlook Trail, Riley Creek Campground, Triple Lakes Trailhead/Kantishna Wilderness Trail, and Cantwell School.

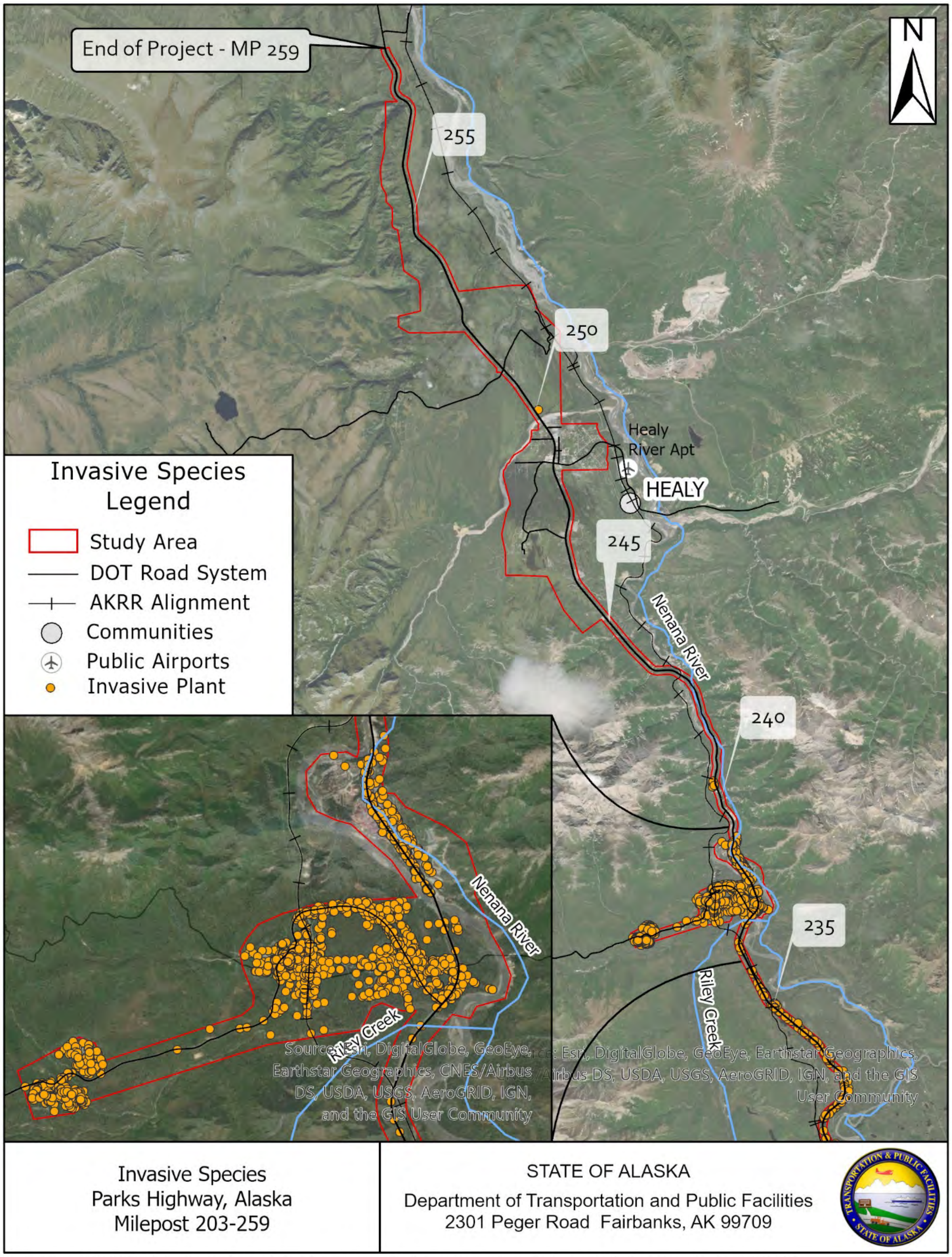
Section 6(f) properties have not yet been identified. We will contact the Alaska Department of Natural Resources (DNR) for verification of all 4(f) properties and identification of 6(f) properties within the study area.

Invasive Species

The University of Alaska Anchorage (UAA) Alaska Exotic Plant Information Clearinghouse (AKEPIC) mapper identified many invasive plant species within the project area. Invasive species thrive in areas of disturbed soil, and their seeds are often spread via vehicular traffic. As a result, mitigation and minimization measures will be taken to prevent further spread of invasive species during future construction projects.

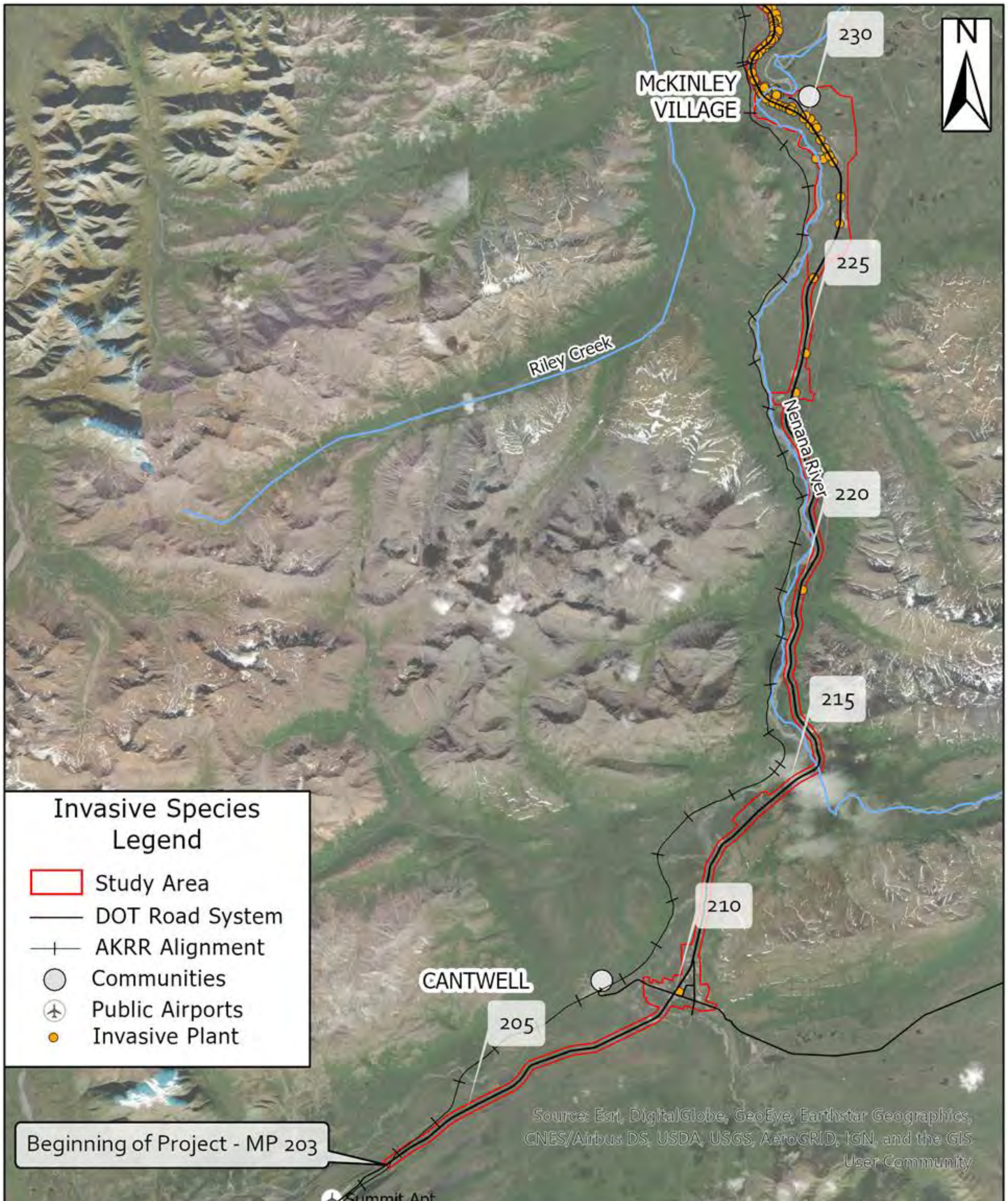
Scientific Name	Common Name	Infested Area (acres)	Invasiveness Ranking
Aegopodium podagraria L.	bishop's goutweed	0.16	57
Bromus inermis Leyss.	smooth brome	3.34	62
Capsella bursa-pastoris (L.) Medik.	shepherd's purse	1.22	40
Caragana arborescens Lam.	Siberian peashrub	0.09	74
Chenopodium album L.	lambsquarters	3.90	37
Crepis tectorum L.	narrowleaf hawksbeard	119.23	56
Descurainia sophia (L.) Webb ex Prantl	herb sophia	0.64	41
Elymus sibiricus L.	Siberian wildrye	1.00	53
Hieracium umbellatum L.	narrowleaf hawkweed	0.94	51
Hordeum jubatum L.	foxtail barley	58.47	63
Lappula squarrosaM(Retz.) Dumort.	European stickseed	0.15	44
Lepidium densiflorum Schrad.	common pepperweed	2.47	25
Lepidium ramosissimum A. Nels.	manybranched pepperweed	Less than 0.01	None
Leucanthemum vulgare Lam.	oxeye daisy	0.40	61
Linaria vulgaris P. Mill.	butter and eggs	1.85	69
Lupinus polyphyllus Lindl. ssp. polyphyllus	bigleaf lupine	0.04	71
Matricaria discoidea DC.	pineappleweed	11.24	32
Melilotus albus Medik.	white sweetclover	18.13	81
Melilotus officinalis (L.) Lam.	yellow sweetclover	0.51	69
Myosotis scorpioides L.	true forget-me-not	Less than 0.01	54
Phleum pratense L.	timothy	0.52	54
Plantago major L.	common plantain	18.93	44
Poa annua L.	annual bluegrass	2.50	46
Poa pratensis L. ssp. irrigata (Lindm.) H. Lindb. or Poa pratensis L. ssp. pratensis	spreading bluegrass or Kentucky bluegrass	1.00	52
Polygonum aviculare L.	prostrate knotweed	0.67	45
Ranunculus repens L.	creeping buttercup	Less than 0.01	54
Sonchus arvensiseL.	field sowthistle	Less than 0.01	73
Sonchus oleraceus L.	common sowthistle	Less than 0.01	46
Sorbus aucuparia L.	European mountain ash	Less than 0.01	59
Stellaria media (L.) Vill.	common chickweed	0.31	42
Taraxacum officinale F.H. Wigg.	common dandelion	125.45	58
Trifolium hybridum L.	alsike clover	1.45	57
Trifolium pratense L.	red clover	1.55	53
Trifolium repens L.	white clover	14.06	59
Tripleurospermum inodorum (L.) Sch. Bip.	scentless false mayweed	4.13	48
Triticum aestivum L.	common wheat	0.04	None
Vicia cracca L. ssp. cracca	bird vetch	1.83	73

Table 7: Invasive species



Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT. Invasive sites from AKEPIC.

Figure 11: Invasive Species Map 1



Invasive Species
Parks Highway, Alaska
Milepost 203-259

STATE OF ALASKA
Department of Transportation and Public Facilities
2301 Peger Road Fairbanks, AK 99709

Projection: NAD 1983 State Plane Alaska 4. Road system, project area, and mileposts from ADOT. Invasive sites from AKEPIC.

Figure 12: Invasive Species Map 2

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