**National Park Service**
**U.S. Department of the Interior**

# Kenai Fjords National Park, Alaska

## Herman Leirer (Exit Glacier) Road Flood Mitigation

## Environmental Assessment

July 2015

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National Park Service
U.S. Department of the Interior

**Kenai Fjords National Park**
Alaska

**Public Comment Period** July 17, 2015 through August 17, 2915.

**Note to Reviewers**

We welcome your comments on this document. The public comment period will extend for 30 days, through August 17, 2915. During the comment period, comments may be submitted using several methods:

1. We prefer that readers submit comments online at the project website at http://parkplanning.nps.gov/projectHome.cfm?projectId=54877.

2. You may send comments by mail, fax or email to:
Sharon Kim, Chief or Resources Management
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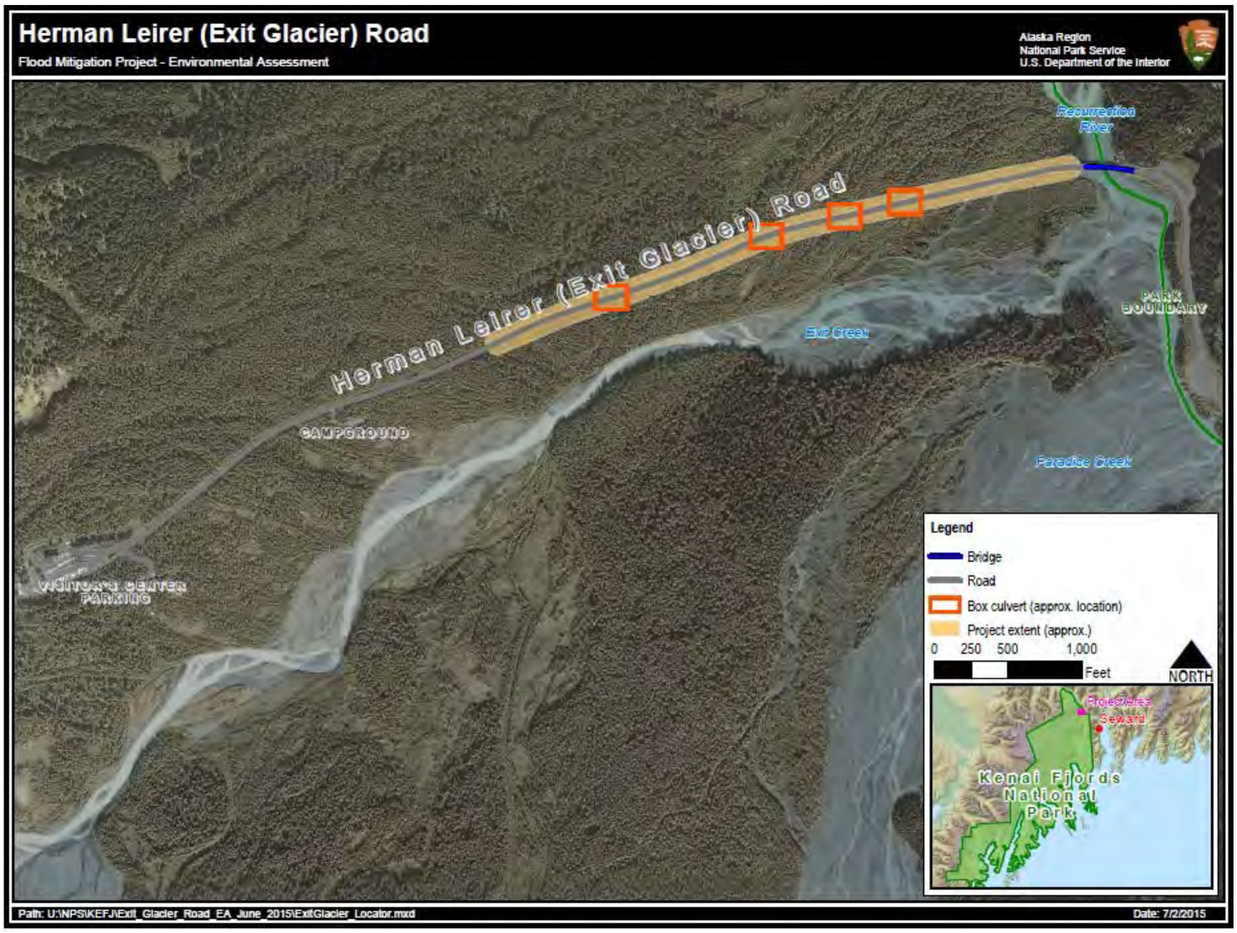
Seward, AK 99664
Fax 907-422-0571
Sharon_Kim@nps.gov

Please note: Before including your address, phone number, e-mail address, or other personal identifying information in your comment, be aware that your entire comment—including your personal identifying information—may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

## 1.0 PURPOSE AND NEED

1.1 Purpose of and Need for Action

The National Park Service (NPS), in cooperation with the Federal Highway Administration (FHWA), is considering road improvements to mitigate flooding over the Herman Leirer (Exit Glacier) Road, in Kenai Fjords National Park, in Seward, Alaska. Construction is proposed for 2016. Road improvements would be made to the Herman Leirer Road, formerly known as Exit Glacier Road, Alaska Forest Highway Route 46, or Resurrection River Road. A thorough description of the proposed action is in Chapter 2.




The purpose of the project is to maintain summer vehicular access to the Exit Glacier visitor use are, which includes an interpretive center, trails, parking lot, restrooms, and campground. The Exit Glacier area is the park's most popular and only road-accessible visitor area. It receives 140,000 visits annually.

The Exit Glacier Road is a nine-mile, dead-end road alignment that was first bulldozed as a gravel road from 1971-1980 by a private individual, Herman Leirer. It traverses the Resurrection River floodplain, wetlands, and wildlife habitat in the alluvial fan of Exit Glacier. Bridge #1390, across Resurrection River, was constructed in 1985 by NPS. The portion of the road in the Exit Creek alluvial fan was engineered, paved, and widened from 1998-2001 by NPS.

The project is needed because the road experiences sheet flooding, causing road damage and safety hazards. Road closure is imposed when the water on the road is deeper than six inches.

In October 2012, the park completed interim measures on the road to reduce road damage from flooding and to minimize road closures. The park installed road shoulder hardening with geo-fabric, riprap, and 2,200 lineal feet of temporary concrete jersey barrier wall, beginning 1,100 feet west of Resurrection River Bridge at a cost of $800,000. These interim measures resulted in successfully preventing damage to the road's southern edge during four flood events, which likely would have undermined the road's edge. The interim measures will not protect against a predicted stream avulsion event (a stream avulsion is the rapid change of a river channel and the formation of a new river channel).

Scour damage on the northern edge of the road still occurs when water flows across the road. Damage also occurs at culverts that are overwhelmed during flood events. Drivers must exercise caution in navigating the flooded roadway to access the Exit Glacier visitor use area since the floodwaters obscure the road edge and the depth of the sheet flow across the pavement can be deceiving to motorists.

Since 2012, the park has monitored the 2,200 lineal feet of concrete jersey barriers installed as a short-term measure for reducing flooding and erosion damage. The results of this monitoring were used in designing this project. The USGS conducted a hydrological and geomorphological investigation in 2013-2014.

This purpose of the project is to provide a long-term solution to the flooding of Exit Glacier Road. The justification for flood mitigation action is to:
1) Provide essential access to a primary park destination;
2) Reduce or eliminate the danger to drivers in traversing flooded roadways;
3) Reduce or eliminate financial loss by commercial users due to road closures from flooding; and
4) Eliminate the repetitive cost of repair associated with damage caused by flood events.

This EA analyzes the proposed action and the No Action alternative and their impacts on the environment. The EA has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and regulations of the Council on Environmental Quality (40 CFR 1508.9).

## 1.2 Background

### 1.2.1 Park Purpose and Significance

Kenai Fjords National Park preserves the scenic and environmental integrity of an interconnected icefield, glacier, and coastal fjord ecosystem.

The park protects the Harding Icefield and its outflowing glaciers, where the maritime climate and mountainous topography result in the formation and persistence of glacier ice. It protects wild and scenic fjords that open to the Gulf of Alaska where rich currents meet glacial outwash to sustain an abundance of marine life. It protects an outstanding example of a subsiding coastal mountain range with steep-sided fjords, drowned cirques, and jagged islands. It protects a rich diversity of terrestrial and marine life in their natural state. It provides opportunities to experience, understand, and appreciate the scenic and wild values of the Harding Icefield, its outflowing glaciers, coastal fjords, and wildlife and to comprehend environmental change in a human context.

The 2013 Foundation Statement for the park determined that the Fundamental Resources and Values of the park include providing visitors with access to Exit Glacier in order to learn about outflowing glaciers, glacier ice, and the Harding Icefield, and providing for a broad range of accessible recreational activities and opportunities.

### 1.2.2 Relationship of Proposal to Other Planning Projects

The Herman Leirer Road Multi-Modal Trail Feasibility Study EA (NPS 2013) approved the concept of a separated non-motorized trail designed and constructed for summer use by pedestrians and bicycles, and winter use by skiers and mushers. The current road project incorporates and modifies that non-motorized trail as part of the construction project for flood mitigation.

The Exit Glacier Flood Mitigation categorical exclusion in 2012 provided for the interim repair of erosion along the road and placement of cement jersey barriers to hold back high water while a more permanent solution was developed.

The Exit Glacier Area Plan EA and General Management Plan (GMP) Amendment of 2004 provided for the visitor facilities at the end of the road, and the continued summer vehicular access on the road.

The Alaska Forest Highway Route 46, Exit Glacier Road EA of 1991, in cooperation with the Federal Highway Administration, provided for improvements to the road outside of the park.

The GMP of 1984 mentioned the Exit Glacier Area Development Concept Plan of 1982, which called for replacement of the Resurrection River footbridge with a permanent two-lane vehicular bridge and improvement of 1.4 miles of road in the park. This improved access has put visitors within comfortable hiking distance – about 0.5 miles – from the toe of Exit Glacier.

## 1.3 Issues

To focus the environmental assessment, the NPS, through an interdisciplinary scoping team, selected specific issues or impact topics for further analysis and eliminated others from evaluation.

### 1.3.1 Issues Selected for Detailed Analysis

Issues selected for detailed analysis will be addressed in later chapters in this EA.

#### 1.3.1.1 Vegetation, Soils, and Wildlife Habitat

The project would directly impact vegetation, soils, and wildlife habitat as the developed footprint of the road is expanded.

#### 1.3.1.2 Floodplains

The project would directly impact the floodplain of Exit Creek. The creek runs parallel to the road, and the active alluvial fan of the creek flows under and through the road alignment. An NPS Statement of Findings is in the appendix of this EA.

#### 1.3.1.3 Wetland

The project area includes wetlands that would be affected by the road and drainage improvements. An NPS Statement of Findings is in the appendix of this EA.

#### 1.3.1.4 Visitor Use and Safety

The project would improve both visitor use and public safety.

### 1.3.2 Issues Dismissed from Detailed Analysis

Issues dismissed from detailed analysis will not be addressed after this section in this EA.

#### 1.3.2.1 Cultural Resources

The area of potential effect has been surveyed for cultural resources (Reynolds 1984). The park has completed an Assessment of Effect and determined that there would be "No Historic Properties Affected."

#### 1.3.2.2 Air Quality

The project would have an impact on air quality during construction due to fugitive dust and emissions from heavy equipment. Impacts would be local, temporary, and not significant enough to evaluate in this EA.

#### 1.3.2.3 Threatened or Endangered Species

The area of potential effect for this project has no listed threatened, endangered, or proposed species, and no designated or proposed critical habitat.

#### 1.3.2.4 Environmental Justice

The project will not significantly affect low income or minority populations as addressed by Executive Order 12898.

1.3.2.5 Socioeconomics

The project will use construction materials, equipment, and labor for several weeks. The effect on local and regional economy will not be significant enough to evaluate in this EA.

1.3.2.6 Subsistence

Subsistence uses are not permitted in the park (36 CFR 13.1302). An ANILCA 810 subsistence finding is not necessary for this project.

1.3.2.7 Wilderness

The project's area of potential effect does not include any designated or eligible wilderness. The park's GMP (NPS 1984) zoned the Exit Glacier Road corridor as a Park Development Zone (page 56) and not suitable for wilderness designation (page 61).

1.3.2.8 Climate Change

The project would have a little impact on regional or global climate change. A changing climate would likely have little impact on the life or sustainability of the project. The addition of a bicycle path could encourage the use of non-motorized transportation but would not have a measurable effect on climate change.

1.3.2.9 Natural Soundscape and Night Sky

The project would temporarily impact natural soundscapes during construction. Construction noise would be localized along the road corridor, and some increased heavy equipment traffic would also occur over the road. This short-term disturbance would be greater than the usual amount of traffic associated with vehicles on the road. The construction period would be during the summer when there are few hours of darkness and little opportunity to view the night sky at this latitude. The project would temporarily impact night sky during construction. Construction lighting would be localized along the road corridor. Lighting would be shielded and not directed off site.

1.3.2.10 Environmental Justice

Executive Order 12898 addresses environmental justice. The proposed action would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

1.4 Permits and Approvals Needed to Implement Project

The Federal Highways Administration would conduct its own environmental compliance review following that of the NPS, per its agency policy.

An Army Corps of Engineer, Clean Water Act, section 404 permit may be required for this project.  A permit will be submitted following the EA if deemed necessary.

Note that a State of Alaska Fish Habitat Permit is not needed for this project because the activity would be conducted above the ordinary high water mark of the Resurrection River, the only anadromous stream in the project area (ADF&G 2008).

# 2.0 ALTERNATIVES

## 2.1 Introduction

This chapter describes the proposed action and the *No Action* alternative. It also describes those alternatives and actions that were dismissed and will not be considered further (i.e., those not analyzed in Chapter 4).

The alternatives were developed by the NPS through an interdisciplinary team and public input. Public scoping was done, in part, through the NPS website *Planning, Environment and Public Comment* (PEPC) with an open comment period from March 10, 2015 to April 13, 2015. An internal Value Analysis (VA) study was conducted September 10-11, 2014 in Seward, Alaska.

The scope of the project was defined with the requirements that 1) vehicular access to Exit Glacier would continue, 2) the approximate horizontal alignment of road corridor would remain, and 3) acknowledgement that a bridge or causeway spanning the entire flood zone would be prohibitively expensive and would not be considered a viable solution.

As a result of the VA study, Alternative B, *Raise the Road and Install Culverts*, was selected as the best value to the government, considering area hydrology and geomorphology, costs, benefits, probable environmental impacts, probable impacts to cultural resources, legal and policy guidance, and likelihood of success. Park management concurred with the VA recommendation with additional project enhancements added during and after the VA study, including raising the roadway five feet in the effected flood area.

The VA determined that Alternative B would provide the greatest combination of benefits for the most reasonable cost. These benefits included increased protection of natural resources, increased visitor safety, ease of maintenance, and continuing park vehicular access during times of high water. This is the only action alternative carried forward. This limited range of reasonable alternatives is justified due to the nature of the project and the constraints on the scope and cost. A discussion of the alternatives that were considered and dismissed is found in Section 2.5.

During winter months, snow is not removed from the NPS portion of the road. The State of Alaska Department of Transportation and Public Facilities closes the gate at the Box Canyon Bridge (mile 1.3 of the Exit Glacier Road), as the road enters State Department of Natural Resources (DNR) lands. This effectively closes the DNR, US Forest Service (USFS), and NPS sections of road to normal motor vehicles. Snowmachine use of the road continues through the winter as snow cover allows. Non-motorized use continues year round.

Tables at the end of this chapter compare the alternatives in terms of actions taken and environmental impacts.

## 2.2 Alternative A, *No Action*

This *No Action* alternative would continue the current and on-going situation. EA Chapter 3, Affected Environment, provides a more detailed profile of the current situation. This alternative provides a baseline for evaluating changes and impacts of the proposed action. The existing road footprint in the project area is 3.4 acres.

This *No Action* alternative proposes maintaining the 2,200 feet jersey barrier wall along the south edge of the road. The barriers provide a linear visual reference for motorists using the road during an overtopping flood event. The barriers reduce the flow velocity of flood water crossing the road. Reducing the flood flow velocity reduces the extent of erosion damage to the road shoulder and pavement. Sand bags would be placed along the base of the jersey barriers as needed for further reducing sheet-flow depths and flood flow velocities on the road surface. The jersey barrier system accommodates a wide range of flood flow depths and is stable up to a water depth of two feet. The jersey barrier system is not expected to effectively eliminate water flowing across the road surface. Vehicular use of the road would continue to be prohibited when water depths on the road exceed six inches. This practice would continue as a safety precaution due to the risk of driving off the roadway into the ditch as the waters obscure the route.

Under this *No Action* alternative, the park would continue to maintain the two-lane paved road within the park from the Resurrection River Bridge to the dead end at the Exit Glacier parking lot. Routine maintenance would include the cleaning of the four pipe culverts (two feet in diameter each), striping of the road pavement, removing fallen trees and other debris, clearing shoulder vegetation, clearing drainage ditches, applying crack sealants, and applying chip seal. Continued maintenance of the existing road bank riprap and the riprap barbs in their current location and length is included in this alternative.


Aerial view of Alternative A, *No Action*

The existing road surface is two feet above the surrounding forest floor

2.3 **Alternative B, *Raise the Road and Install Culverts***, (Proposed Action and Preferred Alternative)

A segment of the park road to Exit Glacier that currently experiences routine flooding would be raised five feet. The raised height of five feet is based on the assumption that two feet of sediment will be deposited adjacent to the road embankment over the next 50 years. Up to three feet of floodwater is assumed and could be accommodated without flooding over the road.

The 2,200 feet of jersey barriers would be removed and salvaged.

The side slopes would be one foot vertical to two feet horizontal in order to provide a gentle slope to eliminate the need for guard rails. The footprint of the road would increase, but the 12 foot driving lanes would not be widened. All the increase in the road footprint would occur on the north side of the road, and the centerline would shift approximately eight feet north of the existing centerline, in order to reduce impacts to the south side of the road. Approximately 25 feet of vegetation along the entire length of the project would be removed from the north side of the road. The new total road footprint in the project area would be 6.4 to 6.8 acres. No part of the existing (3.4 acre) road footprint would be reclaimed.

New precast concrete box culverts would be installed to improve drainage at four locations. Culvert openings would be five feet tall and six feet wide each. The culverts would not have guardrails. The wingwalls at the ends of the culverts would be precast concrete.

The raised road profile would start approximately 180 feet west of the Resurrection River Bridge, extend beyond the area of highest flood risk, and continue as needed for transitioning the grade, all totaled to be approximately 5,400 feet (about one mile) west of the bridge.

The existing riprap and road embankment on the south side of the road would be left in place. The riprap would be extended up to the top edge of the new road shoulder. This addition of riprap would be about four feet thick. The north road embankment would receive riprap armoring at the box culvert headwalls, box culvert outlets, and where flow is expected along the embankment toe. Riprap armoring would help prevent erosion of the roadway from water flowing along the face of the raised road, where flow depths and flow velocities would be large enough to erode an unprotected road embankment.

The gravely-cobble road ditch bottom would tend to erode due to flow velocities, potentially undermining the riprap placed on the road embankment. To prevent this erosion, riprap barb extensions were installed along the road embankment toe. Continued maintenance of these riprap barbs in their current location and length is included in this alternative.

Routine cleaning of the four new box culverts would be done to maintain hydraulic flow capacity. The box culverts would tend to fill with sediment and debris over time or depending upon flood events.

A multi-modal, or bicycle, trail concept (NPS 2013) was approved to run parallel to the Exit Glacier Road as a 12 feet wide paved trail, separated from the road by a vegetation buffer of at least 10 feet. This bicycle path concept would be adapted to this road project, but modified to a three feet wide paved shoulder added to each side of the road for the length of the one-mile project. The driving lanes would continue to be 12 feet wide each. The three feet wide paved shoulders would not be wide enough to be considered official bicycle lanes; therefor, they would not be marked as a bicycle lane. A single white line would separate the 12 feet wide driving lane from the three feet wide shoulder.

Construction traffic delays would be minimized and access to the Exit Glacier visitor use area would be maintained throughout the entire construction operation. The project would generally keep at least one traffic lane open, with delays of up to 10 minutes per hour. During installation of the cement box culverts, however, traffic delays would be longer. Box culverts could likely be placed with two to four hour road closures. These longer closures would be announced and posted in advance, and would only occur during nighttime hours (10:00 p.m. to 6:00 a.m.). These traffic closures would eliminate the need for temporary construction bypass routes. The project would be completed within one calendar year.

The life cycle costs are estimated for 50 years.

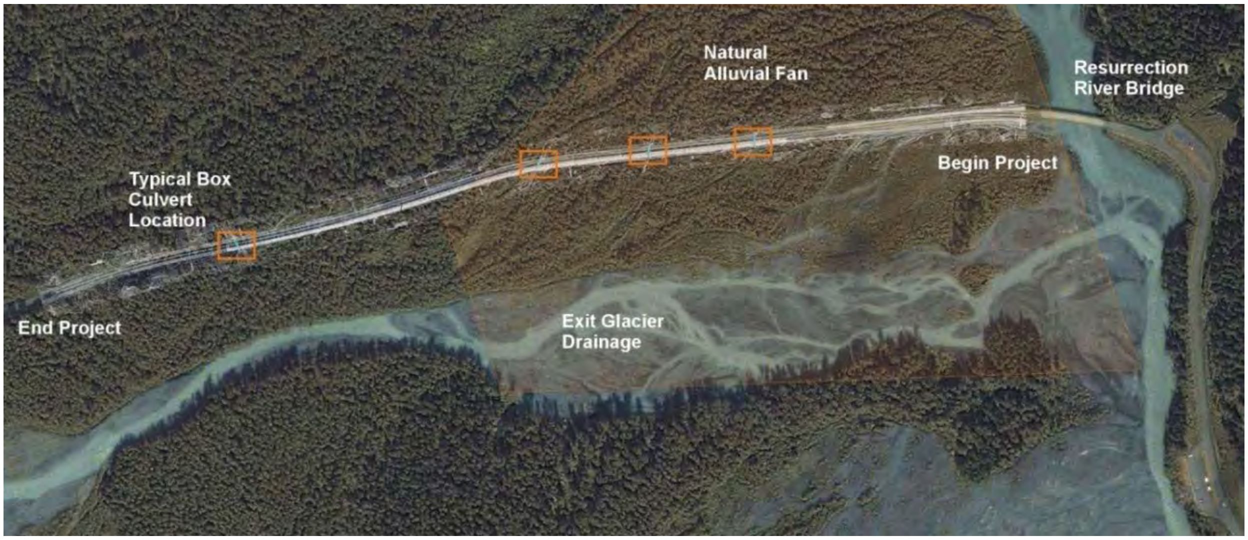
Costs estimate of Alternative B, Raise the Road and Install Culverts

| | | |
|---|---|---|
| Excavation | $98,130 | 3.8% |
| Roadway embankment | $727,440 | 28.1% |
| Place riprap | $770,000 | 29.8% |
| Aggregate base grading | $268,095 | 10.4% |
| Pavement | $531,657 | 20.5% |
| Concrete (precast wing walls) | $32,000 | 1.2% |
| 6 feet x4 feet precast box culvert | $160,000 | 6.2% |
| Total | $2,587,322 | 100.0% |

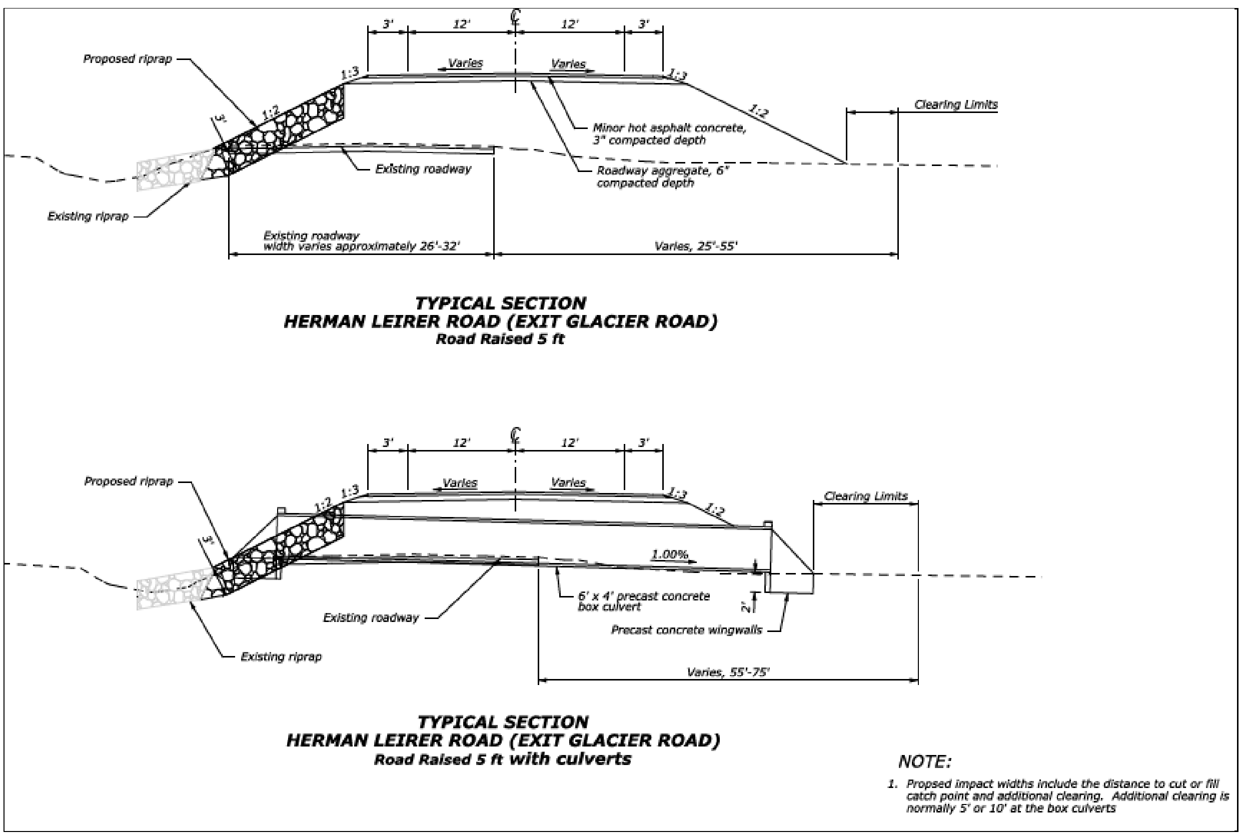
Schedule: The proposed project schedule is:

| | |
|---|---|
| May 2016 | Construction start |
| October 2016 | Substantial completion |

In order to comply with the Migratory Bird Treaty Act, the trees and woody vegetation to be removed would be cut outside of the nesting season (May 1 – July 15).




Aerial view of Alternative B: Road Raised Five Feet with Four Box Culverts




Typical section depicting five feet road raise

Typical six feet wide x five feet tall precast box culvert, cement wing walls, no guardrail

Typical six feet wide x five feet tall precast box culvert, stone wing walls, no guardrail

### 2.3.1 Mitigation Measures

The following mitigation measures are included in the proposed action. This EA, in Chapter 4, assumes the mitigation measures are included.

Migratory Birds: There would be no tree or brush cutting during nesting season, May 1 – July 15, to comply with the Migratory Bird Treaty Act.

Historic Objects: If any historic or archeological objects are discovered during excavation, the project activities in that area would stop, the NPS archeologist would be notified, and the site would be evaluated. Depending on the nature of the historic objects, the project may be delayed while a documentation and recovery is conducted, in consultation with the State Historic Preservation Officer, in order to comply with Section 106, 36 CFR Part 800 of the National Historic Preservation Act of 1966. The park superintendent would decide if and when the project activities could continue.

Night Sky: Any construction lighting would be directed to the work area and shielded from shining upwards.

Fugitive Dust: During construction, dust would be controlled by watering and covering loads.

Invasive Plants: To avoid introducing invasive plant species, certified weed-free fill would be used. All equipment would be pressure washed and thoroughly cleaned prior to arriving on the park. Seeding, if done, would use only locally collected, weed free, native seed. The park would permanently monitor the project area and treat any non-native plant populations identified.

To avoid the introduction of sediment into adjacent wetlands during construction, silt fencing and other appropriate erosion control measures would be used.

## 2.4 Environmentally Preferable Alternative

The environmentally preferable alternative is Alternative B, *Raise the Road and Install Box Culverts*, the NPS Proposed Action, and the Preferred Alternative.

This alternative would provide improvements to wetlands and habitat. It would provide more natural flow volume under the road and across the alluvial fan than the *No Action* alternative. It would provide 24 linear feet of openings for water distribution to minimally maintain wetlands, riverine, and alluvial processes on the north side of the road.

The alternative would provide a raised road that would eliminate overtopping of the road by flood waters five feet deep or less. In an avulsion of Exit Creek, this alternative would work better than the *No Action* alternative, which would withstand only two and a half feet or less flooding depths. The raised road also would minimize damage to the road.

Under Alternative B there would not be the visual intrusion of the existing jersey barrier wall of the *No Action* alternative. Culvert construction would require short-term road closures but the *No Action* alternative would require road closures over the long-term during flooding events.

Alternative A, the *No Action*, is the highest benefit to cost ratio in the VA analysis due mainly to very low initial cost of construction and low life cycle cost. It is possible that the estimated life cycle cost does not adequately take into account the continued damage that could occur to the road over a 50 year lifespan under present conditions. Alternative A, *No Action*, was not recommended by the VA team because it would not provide a solution to the existing frequent flood impacts, long-term safety protection for motorists, or access to the Exit Glacier visitor use area, or substantially meet the purpose and need of the project. It was determined that the additional cost and additional benefit of Alternative B outweighed the lower costs of Alternative A, *No Action*.

## 2.5 Alternatives and Actions Considered but Eliminated from Detailed Study

The project alternatives were developed by the NPS through an interdisciplinary team and public input. A VA study was conducted in Seward, Alaska in September 2014.

The scope of the project is defined with the following requirements and constraints:

- vehicular access to the Exit Glacier visitor use area would continue,
- the approximate road corridor would remain, and
- a bridge or causeway of the entire flood zone would be prohibitively expensive.

Some alternatives were eliminated from this EA because they were determined to be beyond the scope for the project. These alternatives included:

- Relocating all visitor use and development to the east of the Resurrection River Bridge, outside of the park, to the vicinity of the glacier view pullout area on USFS land, and convert park road to a trail. This is not consistent with the park's GMP.
- Re-route the road out of the alluvial fan and floodplain, to the north, requiring a new bridge and a new road alignment for about 1 mile.
- Convert from the current road to an elevated bridge or causeway, to allow free flow and deposition along the entire alluvial fan.

The VA study considered six alternatives. Four of these were eliminated from this EA as a result of completing the VA. The four alternatives eliminated following the VA study were:

- Raising the road profile six feet and installing four 100 feet long bridges. This alternative was eliminated from this EA because the financial costs were too great for the natural resources benefits of a more free-flowing creek and alluvial fan system.
- Raising the road profile five feet without use of bridges or culverts. This alternative was eliminated from this EA because it did not add benefits to the natural resources, that is, the natural hydrology of the alluvial fan. Raising the road profile without bridges or culverts also would create a barrier to the Exit Creek flows during high-water and would channelize the waters along the south side of the road.
- Maintaining existing road profile and installing 2,000 feet of log debris wall along edge of active channel of Exit Creek. This alternative was eliminated from this EA because it would create a barrier to the Exit Creek flows during high-water and would channelize the waters in the existing stream channel, thereby drying the rest of the alluvial fan flood plain. Survey and maintenance of this log debris wall was also considered to be an unreasonable long-term labor servicing and cost.
- Maintaining the existing road profile and install 3,850 feet of improved jersey barriers along the road's south edge. This alternative was eliminated from this EA because it would create a barrier to the Exit Creek flows during high-water, two feet above the road surface, similar to a dam. It would also channelize the waters along the south side of the road.

Table 2.1, Summary of Alternatives

| Characteristics | No Action | Proposal Action |
|---|---|---|
| Road rise | None | Five feet |
| Centerline shift | None | 12 feet north |
| Culverts | Four two feet diameter pipes | Four six feet wide x five feet high boxes |
| Flows under the road | Six feet wide total | 24 feet wide total |
| Jersey barriers | 2,200 feet wall remains | Removed and salvaged |
| Side slope | Existing | Gentle 2 horizontal:1vertical |
| Slope treatments | Maintain existing rip rap and spurs on south side | Maintain existing rip rap and spurs on south side, and add rip rap above existing |
| Driving lane paved width | 12 feet each side | 12 feet each side |
| Paved shoulder | One foot each side | Three feet each side |
| Bicycle lane | No designated bicycle lane, One foot paved shoulder available. | No designated bicycle lane, Three feet paved shoulder available |
| Treatment length | 2,200 feet existing jersey barrier wall | 5,400 feet (about one mile) raised road |
| Road flood frequency | One to three feet per year | None |
| Vehicular access to Exit Glacier visitor use area | Closure at six inches flood depth over road | No high-water closures |
| Road surface height above surrounding terrain | About two feet | About seven feet |
| Traffic delays during construction | None | Normally < 10 min delay, plus some nighttime closures < eight hours for culvert installation |
| Road damage from erosion | Continuing with each flood | Mitigated to none |
| New disturbance | None | 3.0 to 3.4 acres |
| Total footprint | 3.4 acres existing | 6.4 to 6.8 acres |
| Additional fill | None | 37,000 to 42,000 cubic yards |
| Cost estimate, initial net construction | $828,000 (cost of completed interim measures) | $3,622,251 |
| Cost estimate, annual maintenance | $12,000 | $19,500 |
| Cost estimate, life cycle (50 years annualized) | $78,000 | $186,000 |

Table 2.2, Summary of Impacts

| Impact Topic | No Action | Proposed Action |
|---|---|---|
| Wildlife habitat, vegetation, and soils | No new impacts | 3.0 to 3.4 acres of new road fill |
| Floodplains | Road prevents most of the natural flows over the active alluvial fan floodplain, allowing only eight feet of flow through pipe culverts | Project allows more natural flows over the active alluvial fan floodplain, allowing 24 feet of flow through box culverts |
| Wetland | Road blocks most wetland development on north side, allowing only eight feet through | Road blocks some wetland development on north side, allowing 24 feet through. 2.46 acres of wetland filled |
| Visitor Use and Safety | Road closures during flooding | No road closures |

# 3.0 AFFECTED ENVIRONMENT

## 3.1 Project Area

The project area includes the Exit Glacier Road from the Resurrection River Bridge about one mile west into the park. The width of direct impact varies but is about 50 feet. The analysis area encompasses the existing road footprint as well as the proposed project footprint on the north side of the road. Indirect impacts extend into the larger ecological units, such as watersheds and wetland systems.

## 3.2 Resource Impact Topic 1 – Wildlife Habitat, Soils and Vegetation

### 3.2.1 Mammals

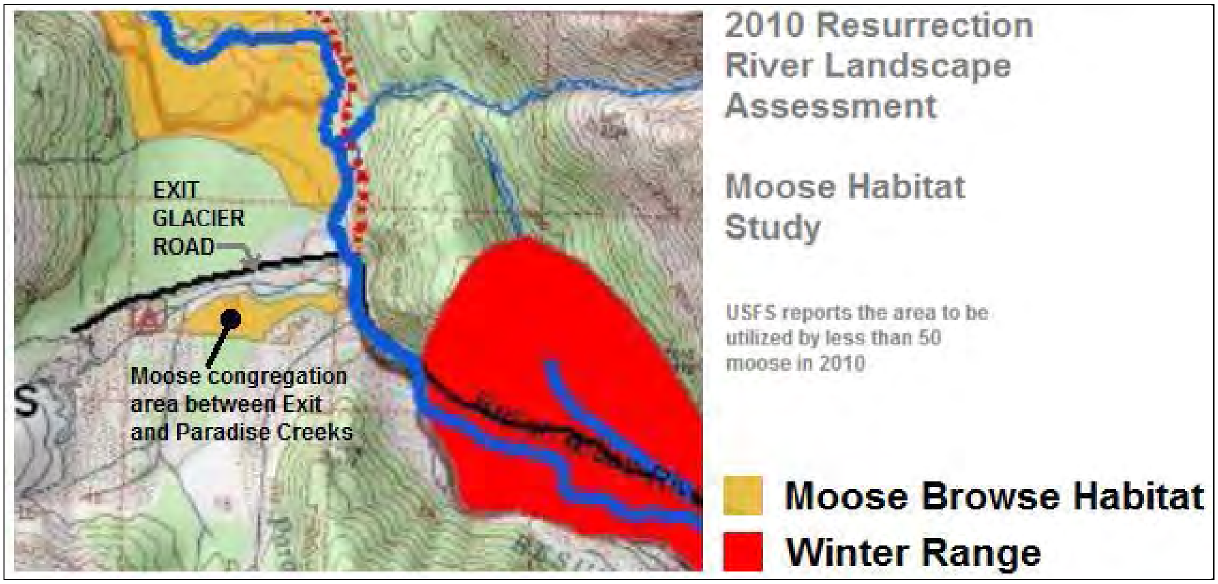
Twenty-nine species of terrestrial mammals are documented within Kenai Fjords National Park (NPS 2011) and the project area contains habitats suitable for most of these species. Among these species, the species most common are mountain goat (*Oreamnos americanus*), moose (*Alces alces*), northern river otter (*Lontra canadensis*), black bear (*Ursus americanus*), hoary marmot (*Marmota caligata*), snowshoe hare (*Lepus americanus*), porcupine (*Erethizon dorsatum*), and ermine (*Mustela ermine*) (NPS 2011).

According to the Exit Glacier Area Plan EA (NPS 2004), black bears are common in the Exit Glacier area. In early May, bears are often observed above tree line on the north side of the Exit Glacier valley foraging on emerging vegetation. There are a number of reports of black bears preying on newborn moose and goats in spring and early summer. Black bears are encountered daily during the summer and fall as they feed on berries.

Also present, but less frequently observed, are gray wolves (*Canis lupus*), coyotes (*Canis latrans*), lynx (*Lynx canadensis*), wolverine (*Gulo gulo*), American marten (*Martes americana*), American beaver (*Castor canadensis*), little brown bat (*Myotis lucifugus*), and mink (*Mustela vison*) (NPS 2011).

While there are no mammal species listed as threatened or endangered under the Endangered Species Act Section 4(a)(1) in the project area, the Kenai population of the brown bear (*Ursus arctos kenai*) is on the State of Alaska's list of Species of State Concern. Brown bears are infrequent visitors to Exit Glacier, typically passing through the valley in the spring and late fall (NPS 2004).

Moose utilize the project area for browse habitat and especially the area between Exit and Paradise creeks. Winter range habitat has been identified a mile downstream in the Resurrection River Valley. See the following figure.




3.2.2 Birds

Sixty-two bird species have been identified in the Exit Glacier area (NPS 2004). A survey of the occurrence and distribution of bird species in the Exit Glacier study area was conducted in 2000 and 2001 (NPS 2004).

Van Hemert et al. (2008) conducted a summer inventory of landbirds in Kenai Fjords National Park and described the Resurrection River Valley as follows,

> Although it covers a relatively small proportion of the park's total area, the valley hosts a high percentage of landbird species, and offers habitat resources that occur nowhere else in the park. More than half of all landbird species detected across the park were observed in the Exit Glacier and Resurrection River area, including seven species that occurred only in this limited geographic area.

Van Hemert observed two species previously undocumented in the park: Townsend's solitaire (*Myadestes townsendi*) and western screech-owl (*Otis kennicotti*). This survey also documented that shorebirds use area wetlands for breeding. Greater yellowlegs (*Tringa melanoleuca*), spotted sandpiper (*Actitis macularius*), and semipalmated plover (*Charadrius seimpalmatus*) were observed exhibiting territorial breeding behavior and two Wilson's snipe (*Gallinago delicate*) nests were found.

The Migratory Bird Treaty Act protects potential nesting sites from destruction. The Act is administered by the FWS. For the project site, the dates for not cutting vegetation are May 1 – July 15.

The species most commonly observed by Wright (2001a as cited in NPS 2004) are listed by group below.

Table 3-1 – Common Bird Species in the Exit Glacier Area

| Passerines | Raptors | Gamebirds |
| --- | --- | --- |
| Wilson's warbler (*Wilsonia pusilla*)<br>Varied thrush (*Ixoreus naevius*)<br>Hermit thrush (Catharus guttatus)<br>Fox sparrow (Passerella iliaca)<br>Ruby-crowned kinglet (*Regulus calendula*)<br>Orange-crowned warbler (*Vermivora celata*)<br>Steller's jay (Cyanocitta stelleri)<br>Black-billed magpie (*Pica hudsonia*)<br>Northwestern crow (*Corvus caurinus*)<br>Common raven (*Corvus corax*)<br>Chestnut-backed (*Poecile rufescens*)<br>Black-capped chickadee (*Poecile atricapillus*)<br>Common redpoll (*Carduelis flammea*)<br>Snow bunting (Plectrophenax nivalis)<br>White-winged cross bill (*Loxia leucoptera*)<br>Dark-eyed junco (*Junco hyemalis*) | Bald eagle (Haliaeetus leucocephalus)<br>Golden eagle (Aquila chrysaetos)<br>Northern goshawk (*Accipiter gentilis*)<br>Sharp-shinned hawk (*Accipiter striatus*)<br>Great horned owl (*Bubo virginianus*)<br>Northern saw-whet owl (*Aegolius acadius*) | Willow ptarmigan (*Lagopus lagopus*)<br>Rock ptarmigan (*Lagopus mutus*)<br>White-tailed ptarmigan (*Lagopus leucurus*)<br>Spruce grouse (Falcipennis canadensis) |

Special Status Species:  Five birds on the Alaska Species of Concern (ADF&G 2006) list may occur in the project area (Table 3-2).  The list contains any species or subspecies of fish and wildlife native to the State of Alaska that has entered a long term decline in abundance or is vulnerable to a significant decline due to low number, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance (ADF&G 2006).

Table 3-2 – State Species of Concern in the Exit Glacier Area

| Common Name | Scientific Name | Occurrence in Kenai Fjords National Park | Occurrence in Exit Glacier Area |
|---|---|---|---|
| Peregrine falcon | Falco peregrinus anatum | Rare year-round | Rare |
| Olive-sided flycatcher | Contopus cooperi | Rare in summer | Rare |
| Gray-cheeked thrush | Catharus minimus | Uncommon in spring, summer, and fall | Rare |
| Townsend's warbler | Dendroica townsendi | Common in spring, summer, and fall | Potentially breeding |
| Blackpoll warbler | Dendroica striata | Uncommon in spring, summer, and fall | Unknown |
| Sources: NPS 1997; Van Hemert et al. 2008. | | | |

Townsend's warblers have been seen in the Exit Glacier area during the breeding season (NPS 2004) and conifer habitat suitable for nesting is available.  Gray-cheeked thrush have rarely been reported in the Exit Glacier area during the breeding season; however, suitable woodland nesting habitat is available (NPS 2006).  According to the U.S. Fish and Wildlife Service (USFWS) Bald Eagle Nest Atlas (USFWS 2011) and the U.S. Forest Service (2010), there are no known bald eagle nests in the project area.

### 3.2.3 Fish

Anadromous fish studies presently underway found salmon spawning to be occurring in the Resurrection River far upstream from the affected alluvial fan (NPS fish biologist Dan Young, pers. comm.).  The proposed action would increase water flows to the northern half of the Exit Glacier alluvial fan for a more natural hydrological system.  However, further study is needed to confirm potential beneficial impact of the project to salmon rearing habitat in the alluvial fan area.

All five species of Pacific salmon use the Resurrection River for migration – Coho (Silver), King (Chinook), Sockeye (Red), Chum (Dog), and Pink (Humpback).  The Resurrection River also has Dolly Varden and Steelhead trout.

Dolly Varden have been found in Exit Creek.

### 3.2.4 Vegetation

The project area lies within the Kenai sub-region of the Coniferous Forest Biome. The vegetation communities range from alpine meadows to coastal rainforests.

Vegetation communities in the project area include:

Shrub/ Scrub: These communities are dominated by Sitka alder, black cottonwood, or Sitka willow. This community represents an early postglacial successional stage and is also subject to occasional flood disturbance. Within Kenai Fjords National Park, these communities are found along a small area on low floodplain terraces near the confluence of Exit Creek and the Resurrection River.

Deciduous Forest: This community is dominated by black cottonwood and is found on upland terraces and moraine deposits. This is the most common vegetation community on the valley floor and represents an older successional stage than the scrub community. Young Sitka spruce seedlings occurring in the understory indicate that, in time, this community will be become a closed mixed forest dominated by Sitka spruce and black cottonwood.

Mixed Forest: This community is dominated by Sitka spruce and black cottonwood and is located near the confluence of Exit Creek and the Resurrection River.

Evergreen Forest: This community represents the oldest successional stage present at Exit Glacier area and occurs on slopes above the valley floor. The overstory is dominated by Sitka spruce and western hemlock.

Rare Species: No federally listed plant species occur in Kenai Fjords National Park. However, three plant species listed as rare within the State of Alaska by the Alaska Natural Heritage Program (AKNHP) have been documented in the Exit Glacier area and could occur in the project area. These are pale poppy (*Papaver alboroseum*), bog bluegrass (*Poa leptocoma*), and Bebb's sedge (*Carex bebbii*) (NPS 2004).

Non-native Vegetation: Surveys have documented numerous non-native plant species within Kenai Fjords National Park and along Exit Glacier Road. Within the park, 16 species of non-native plants have been identified. These species include common dandelion (*Taraxacum officinale*), oxeye daisy (*Leucanthemum vulgaris*), common plantain (*Plantago major*), white clover (*Trifolium repens*), alfalfa (*Medicago sativa*), and toadflax (*Linaria vulgaris*) (Kurtz 2010; Fulton 2012). Common dandelion are the most abundant non-native plant found in the project area.

Outside of Kenai Fjords National Park, Densmore et al. (2001) found additional species of non-native plants growing along the Exit Glacier Road. These included yellow sweetclover (*Melilotus officinalis*), red clover (*Trifolium pratense*), and annual hawksbeard (*Crepis tectorum*). These plants were apparently introduced in a reseeding mix after a section of road was paved in 1999 (Bryden 2002b as cited in NPS 2004). The Alaska Exotic Plant Management

Team at Kenai Fjords National Park continues to monitor and control for invasive plants, focusing on the Exit Glacier Area.

The existing road footprint in the project area covered 3.4 acres of natural area with road fill. Vegetation was removed from the original deciduous forest, evergreen forest, mixed forest, and shrub/scrub communities. The native vegetation was replaced with road base and asphalt. These vegetation types are abundant in the surrounding area.

Soils: The major rock types within this region are interbedded slate and greywacke, granite, chert, greenstone, limestone, and conglomerates (NPS 1984). The greywacke is a medium-grained mid to dark gray sandstone. When compared to the slate of the area, the greywacke has a greater degree of resistance to erosion, enabling it to form slopes of 70 degrees or greater.

The Kenai Peninsula is generally free of permafrost (perennially frozen ground), which is known to cause substantial difficulties for construction in Alaska's interior (USFS 2010).

On lower elevation slopes, gravelly and well-drained stony loam is often found. Recent moraines are composed of stony to very gravelly tills, where older moraines contain somewhat loamy and acidic soils. The soils of the forested uplands within the area, including lands flanking Exit Creek, are gravelly, shallow, and acidic. Peat-rich soils are oftentimes found in association with these soils (USFS 2010).

3.3 Resource Impact Topic 2 – Floodplains

The project area is located within a floodplain. The floodplain is in an alluvial fan of Exit Creek near the confluence with the Resurrection River. The project area frequently floods as the banks of the Exit Creek are now well defined or stable over time.

Climate change could change the hydrology of the Exit or Paradise creeks and the assumptions upon which this flood mitigation project is based. This adds uncertainty to the project's long-term success. Moving the project outside of a floodplain area is not possible. A floodplains delineation survey has been completed for the project area.

Stream flows in Exit Creek are controlled by snowmelt, glacial melting, and rainfall, with glacial runoff as the primary control of streamflow. Peak flows generally occur in the late summer, during the peak period of glacial melting. A combination of high flows from glacial melting and runoff from fall rainstorms can cause flooding, which is most common during the months of August, September, and October (USFS 2010). Winter flows are generally low because glacial runoff ceases when temperatures drop in higher elevations. Fall rainstorms can cause dramatic fluctuations in flow, as well as very high peak flows.

Some of the nearby streams have flood control levees. In the alluvial fan system that transports large amounts of suspended and bed load sediment, these levees require constant maintenance and upkeep to perform properly. Continued aggradation of sediments on levee structures further increases the risk of high flows overtopping levees.

Eventually, a change of the main channel of Exit Creek is expected. It could be gradual or sudden. Braiding of the creek bed will redirect flows to the road, either alongside or over the road. The proposed action is designed to mitigate against a gradual change in the channel. FHWA engineers express considerable certainty that a stream avulsion will occur over the next 50 years. Exactly when is speculative, and based on the alluvial fan gradient, expected gravel aggradation rate, and avulsion resistance of the vegetated fan areas, engineers estimate a gradual avulsion in ten to 20 years. This is based on observations of Exit Creek's current configuration as well as historical photographs and satellite imagery.

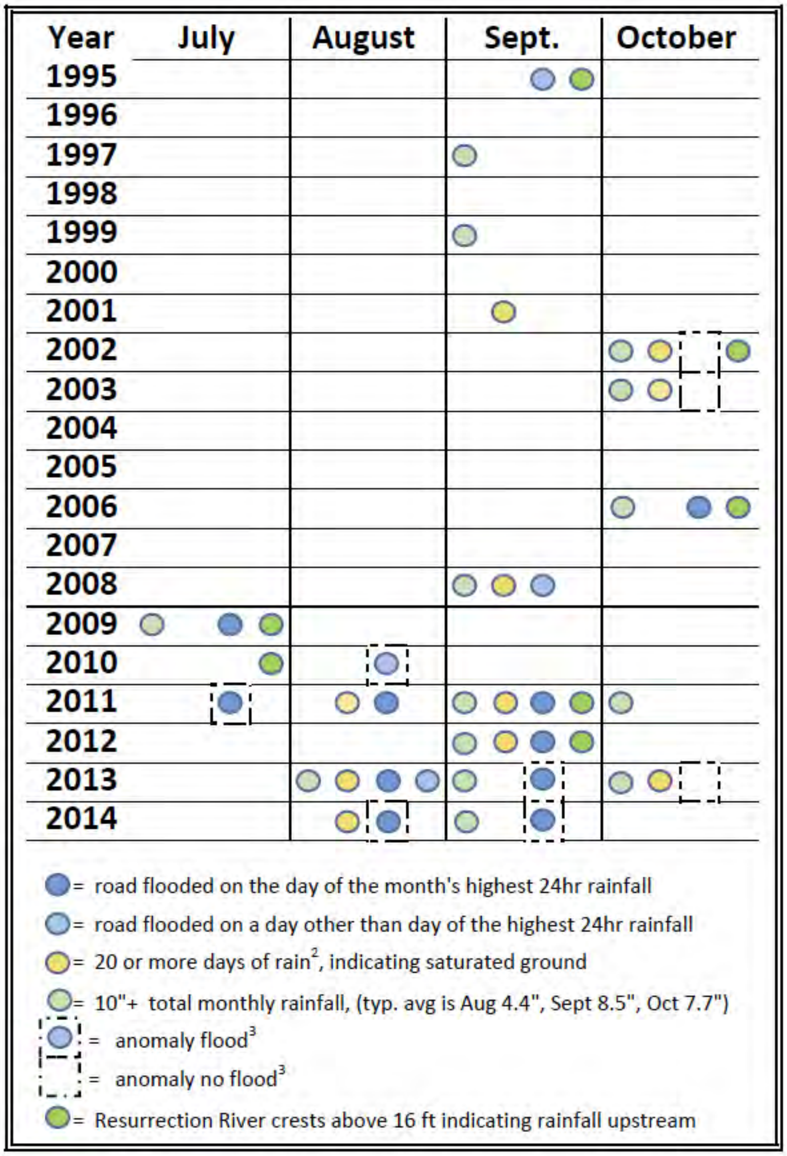
Two important factors influencing an avulsion –river bank break-out and re-channelization–of Exit Creek are: 1) the stream does not appear to move large amounts sediment in quick pulses, and 2) the stream lacks abundant large woody debris and flood flow depth needed for transporting the large woody debris. These factors suggest that the probability of a rapid catastrophic avulsion is low. The more likely scenario is for a gradual avulsion over a number of years to fully develop. Gravels will deposit, raising the level of the riverbed, causing the river to spill onto lower adjacent portions of the braded floodplain, and of the entire alluvial fan, eventually reaching the area of the park road that crosses the alluvial fan.

The project life cycle is programmed for 50 years. Cost estimates are based on the assumption of a gradual deposition and not on catastrophic avulsion of Exit Creek.

The active stream channel is currently approximately 200 feet wide, so it is reasonable to assume that in a full avulsion, the width of the damaged road area would be up to 200 feet long with a transition area on both sides of the road.

Hydrology: The storms coming off of the Gulf of Alaska provide a consistent and substantial delivery of precipitation to the Kenai Mountains. Snow is the primary source of precipitation on the vast Harding Icefield, including Exit Glacier. Freshwater storage is generally in the form of ice and snow on the Harding Icefield.

Frequency of Indicator Events and Exit Glacier Road Flood Events, 1995-2014[(1)]:




[1] Based on weather station data from Seward airport.
Based on data from Resurrection River Bridge at Exit Glacier Road, RESA2.
[2] Rainfall days = rainfall greater than 0.05 inches.
[3] Anomalies may result from rainfall on site differing from airport weather station rainfall.
Note: October flood events may not be recorded because park road is closed for season and site may not be accessible.

The table examines several “indicator” events in an effort to identify the frequency of flooding on Exit Glacier Road and to understand any correlation between total precipitation, number of precipitation days, and maximum 24-hour rainfall events.

Preliminary analysis suggests indicator events are due to:

1. Ground saturation:
   Rain occurs at the nearest weather station (i.e., Seward airport) on 20 or more days in the month of flood indicating ground saturation.

2. Flooding in upper watershed:
   The Resurrection River gauge at Exit Glacier Road shows the river at flood stage or above.
3. Higher than average rainfall quantity over 30 days:
   The total rainfall at the nearest weather station for the month of flood is ten inches or more.
4. Inundating rainfall event nearby:
   A 24-hour rainfall event at the nearest weather station measuring more than three and a half inches of rain.
5. Melting event:
   Temperatures change at nearest weather station (near sea level) in the ten-day period before flood where daily high temperature rises by more than 8°F over previous day and lasts for two or more days.

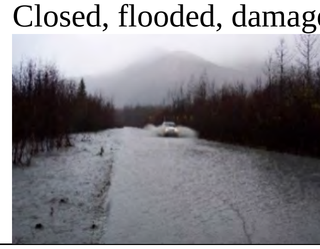
A pattern emerges that indicates Exit Glacier Road floods either: 1) when Resurrection River reaches flood stage at the Exit Glacier Road Bridge, or 2) when at least two of five indicator events coincide. The pattern does not explain one instance when the road flooded without any indicator events (August 16, 2010) or on one occasion when indicator events predicted a flood the event was not documented (October 28, 2013).

Frequency of flood events and rainfall duration in late summer has increased significantly as follows:

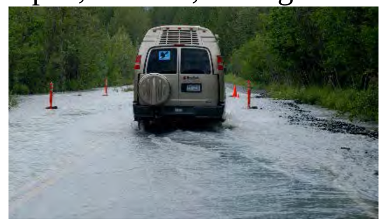
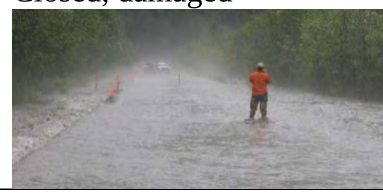
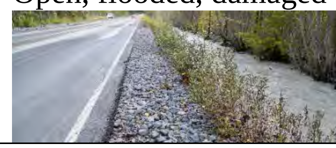
1. River flood events are occurring in the Resurrection River watershed with increasing frequency. Five of Resurrection River Bridge #1390 gauge's ten highest crests since 1995 (when the gauge was installed) have occurred since 2008.
2. Seward has experienced more than 20 days of rain per month in at least of one of the months of August, September or October in 2011, 2012, 2013, and 2014, which is more rainy days than any late summer of the last 20 years.
3. Total monthly rainfall exceeds ten inches more frequently, which is significantly above the typical monthly average for any late summer month from 1995 to 2014, (August, 4.4 inches average, September, 8.5 inches average, October, 7.7 inches average).

More recently in 2013 and 2014, Exit Glacier Road flooded with only one indicator event. A September 2014 flood occurred when the site received one to two inches of rain for three days in a row during an otherwise relatively dry month. Historically, the road does not flooded under these circumstances. An accumulation of gravel deposits in the alluvial channels next to Exit Glacier Road potentially reduced the flood capacity of the present creek channels, causing water to spread to the road during smaller rainfall events and therefore more frequently.

The following table shows the historical and recent floods, air temperatures, rainfall totals, for major events before 1995 and Exit Road Bridge river gauge readings for the top ten river crests from 1995-2012, and Park-reported flooding from 2012-present.

| **Date** | **Ten day high temps[1]** | **Four day rainfall[1]** (in inches) | **Resurrection River Bridge gauge[2]** (in feet) | **Exit Glacier Road Status** (source: NPS Photos) |
|---|---|---|---|---|
| Historical flood event 21 Aug 1966 | 55, 59, 63, 68, 65, 59, 57, 56, 54, 52, 53 | 6.05 | No bridge | No road |
| Historical flood event 6 Oct 1969 12 Oct 1969 | 56, 53, 50, 52, 52, 51, 50, 49, 45, 50, 51 | 5.94 6.45 | No bridge | No road |
| Historical flood event 12 Oct 1986 | 54, 51, 50, 51, 48, 45, 51, 48, 52, 52, 50 | 7.61 | Estimate 16 feet. Report of three feet below lowest bridge steel | (no road info) NWS Record 17 inches of rain in 24-hrs in downtown Seward |
| Historical flood event 27 Aug 1989 | 55, 75, 60, 64, 72, 61, 55, 55, 60, 55, 57 | 0.00 | N/A | (no road info) Possible snowmelt flooding in Seward during an otherwise dry month |
| Historical flood event 9 Sept 1995 20 Sept 1995 | 54, 50, 55, 52, 52, 52, 55, 59, 55, 54, 57 | 1.9 Heavy rains | 17.90 19.36 | One foot of water reported on road on 20 Sept. Heavy rainfall throughout region – not reflected in airport measurements |
| Historical flood event 23 Oct 2002 | 50, 46, 48, 46, 45, 48, 53, 50, 50, 51, 52 | 7.55 | 18.50 | Road closed. Did not flood. Closed due to river touching the Resurrection bridge. Flooding reported at Nature Center construction site. |
| 15 Sept 2006 | 55, 55, 55, 53, 52, 55, 57, 66, 64, 52, 51 | 1.86 | 15.67 | Road did not flood. |
| 9 Oct 2006 | 53, 44, 48, 48, 48, 48, 48, 45, 51, 50, 55 | 8.71 | 19.85 | Closed, flooded, damage  |

| **Date** | **Ten day high temps[1]** | **Four day rainfall[1]** **(in inches)** | **Resurrection River Bridge gauge[2]** **(in feet)** | **Exit Glacier Road Status** **(source: NPS Photos)** |
|---|---|---|---|---|
| 14 Sept 2008<br>18 Sept 2008 | 59, 54, 52, 52, 51, 53, 53, 51, 51, 50, 48 | 2.66 | 15.37 | Road did not flood on 14 Sept 2008. Road flooded on 19 Sept 2008 per USGS report. |
| 29 July 2009 | 59, 59, 54, 51, 52, 54, 55, 55, 55, 62, 61 | 5.2 | 18.76 | Closed, damaged<br> |
| 10 Oct 2009 | 50, 55, 51, 50, 48, 53, 48, 46, 50, 57, 55 | 2.88 | 18.09 | No road info or did not flood. |
| 7 Aug 2010 | 53, 57, 54, 54, 59, 57, 52, 55, 55, 53 | 1.43 | 16.62 | Road may have flooded, was not closed.<br><br>Photo dated 14 July 2010 |
| 16 Aug 2010 | 54, 55, 55, 55, 54, 57, xx, 55, 57, 62, 53 | 1.1 | >15 | Closed, damaged<br> |
| 2 Oct 2010 | 54, 55, 55, 54, 57, 48, 46, 48, 51, 51, 52 | 5.6 | >15 | Road closed announcement in Seward City News, 2 Oct 2010 |

| **Date** | **Ten day high temps**[1] | **Four day rainfall**[1] **(in inches)** | **Resurrection River Bridge gauge**[2] **(in feet)** | **Exit Glacier Road Status (source: NPS Photos)** |
|---|---|---|---|---|
| 15-18 Jul 2011 Numerous photos of flooding from travel blogs | 55, 55, 59, 61, 60, 63, 71, 72, 75, 64, 62 | 0.3 | >15 | Open, flooded, damaged  |
| 3 Aug 2011 | 55, 54, 59, 61, 68, 64, 64, 63, 57, 57, 55 | 2.64 | >15 | Closed, damaged  |
| 8 Sept 2011 | 57, 54, 54, 66, 57, 53, 53, 52, 53, 48, 53 | 5.3 | 17.99 | Open, flooded, damaged  |
| 19 Sept 2012 | 61, 62, 53, 55, 59, 50, 52, 51, 52, 51, 57 | 13.09 | 19.97 (highest on record) | Closed, damaged  |
| 12 Aug 2013 | 60, 59, 57, 57, 60, 57, 57, 55, 59, 57, 59 | 3.14 | >15 | Interim means held  |
| 29 Aug 2013 | 51, 51, 51, 51, 50, 55, 46, 46, 50, 51, 53 | 3.3 | >15 | Road flooded per USGS report. |
| 6 Sept 2013 | 68, 66, 64, 59, 66, 57, 57, 57, 57, 55, 57, 55 | 3.28 | >15 | Interim means held  |

| Date | Ten day high temps[1] | Four day rainfall[1] (in inches) | Resurrection River Bridge gauge[2] (in feet) | Exit Glacier Road Status (source: NPS Photos) |
|---|---|---|---|---|
| 13 Aug 2014 | 61, 63, 63, 62, 59, 57, 57, 64, 60, 57, 59 | 2.96 | >15 | Interim means held  |
| 14 Sept 2014 | 55, 57, 66, 66, 59, 55, 55, 57, 60, 59, 57 | 4.09 | >15 | Road open, flooded  |

Sources: [1]Seward airport weather station. [2]National Weather Service, Resurrection River at Exit Glacier Bridge (RESA2) hydrograph records (1995-present) at http://water.weather.gov/ahps/. 1999 Flood Insurance Study, Kenai Peninsula Borough, Alaska. Community Number 020012.

National Weather Service forecasts that 16 feet on the Resurrection River gauge at Exit Glacier Bridge typically precipitates minor flooding along Exit Glacier Road.

Geomorphology: Geomorphology relates to changes in the shape, depth, and length of Exit Glacier's alluvial fan. Geomorphological changes are effectively lowering the elevation of Exit Glacier Road relative to surrounding flood plain. Research presented by Janet Curran, USGS hydrologist (pers. comm. 11 Sept 2015) shows that Exit Glacier's alluvial fan is lengthening and growing deeper, as indicated by gravel deposits in the area adjacent to Exit Glacier Road (Lower Exit Creek). Water is pushing Lower Exit Creek's channels northward towards the road through an increase in gravel movement from both Upper Exit Creek and from the adjacent Paradise Creek. A comparison of Digital Elevation Models (DEM) from 2012 imagery and 2008 LIDAR data showed new deposits up to three to six feet deep in all but a few reaches of Exit Creek during this time period.

Curran indicates that continuation of increased rainfall in the Paradise/Exit watershed will continue to cause increased gravel movement by which Paradise Creek will migrate northward and could soon merge with Exit Creek, resulting in combined flows that could deposit significantly more gravel at the junction of the creeks with the Resurrection River. This slow migration of channels towards Exit Glacier Road, described by Curran as a gradual avulsion, is the design scenario that FHWA engineers used in developing six Flood Mitigation Project Alternatives. Further study of hydrological and geomorphological processes and rates of change would be needed to establish perfected design parameters for successful long term mitigation. FHWA will need to finalize a design based on the best available data to date.

## 3.4 Resource Impact Topic 3 – Wetlands

The entire project area is in an active alluvial fan. The area adjacent to the road is mostly wooded. The area is flooded intermittently. The area is a recently de-glaciated gravel surface with first generation trees without developed soils.

Wetlands delineation has not been completed for the project area, beyond the gross scale National Wetlands Inventory. Wetland mapping, however, did occur in Kenai Fjords National Park as part of a road rehabilitation project in 2012.

The wetland type in the project area is Freshwater Forested/Shrub Wetland, Classification Code PSSIA.

The project area may also contain riverine wetlands associated with Exit Creek. Riverine wetlands also serve as habitat for small mammals, large mammals, amphibians, and birds. These wetlands also provide flood control, sediment/toxicant retention, production export, and nutrient transformation.

## 3.5 Resource Impact Topic 4 – Visitor Use and Safety

Vehicular access to the Exit Glacier area is currently stopped during periods of road flooding when water over the road exceeds six inches. Driving becomes unsafe due to loss of road edge orientation, not due to risk of being washed off the road. Floods cause erosion of the road edge making the road unsafe until repaired.

# 4.0 ENVIRONMENTAL CONSEQUENCES

This chapter provides an evaluation of the potential effects or impacts of both of the alternatives on the resources described in Chapter 1. The direct, indirect, and cumulative impacts are described based on the intensity (magnitude), duration, and context (extent) of the impact. Impacts may be adverse, beneficial, or both.

## 4.1 Impacts of Alternative A, *No Action*

### 4.1.1 Impact to Wildlife Habitat, Vegetation, and Soils for Alternative A, *No Action*

There would be no new disturbance to Wildlife Habitat, Vegetation, and Soils under the *No Action* alternative.

Cumulative impacts to Wildlife Habitat, Vegetation, and Soils from past actions would continue under the *No Action*. These past actions involved direct, long-term impacts to vegetation by removing 3.4 acres of natural area with road bed. Past actions removed vegetation of deciduous forest, evergreen forest, mixed forest, and shrub/scrub vegetation along the one mile project area. The native vegetation was replaced with a footprint of road base and asphalt. These vegetation types are abundant in the surrounding area.

Regular annual maintenance and construction activities to maintain the road would continue. These include roadside vegetation clearing, trimming, cutting, and hazard tree removal. Woody vegetation would be kept well away from the paved surface. Indirect impact to vegetation includes the blocking of occasional floodwaters from passing to the north side of the road and thereby effectively drying a portion of the natural alluvial fan of Exit Creek. Such drying effects the natural vegetation mix in the north portion of the alluvial fan. There would continue to be potential for the introduction or spread of non-native plant species, above that of natural undisturbed areas. An active park program of non-native plant monitoring and treatment is ongoing and would continue indefinitely, otherwise the impacts to native species would increase. The loss of vegetation, mainly from past cumulative road construction, would in an adverse impact but would not significantly degrade the quality of area-wide vegetation resources.

Soils have been directly impacted on 3.4 acres by the past actions of road building. These impacts would continue under Alternative A. Cumulative past impacts of road construction caused this direct impact. Indirect soil impacts would continue, caused by the road blocking natural flood flows to the north portion of the Exit Creek alluvial fan. These impacts would continue to be well beyond the 3.4 acres of direct impact. Blocking flood flows would continue to prevent sediment accretion and soil formation on the north side. On the south side, blocking the natural flow regime would continue to channelize flood flows, raising water depths, slowing approaching streamflow, causing increased deposition in the deeper water. Sediment accretion over the alluvial fan on the south side of the road would eventually overtop the road level. In the south side road drainage ditch, flows would increase in speed and cause ditch erosion. In the past, this required riprap to stabilize and protect the road from erosional. Cumulative impacts to soil would be long-term. The soils resource is considered common in context. Soils are not identified in the enabling legislation for the park and are not considered rare in the park or project area.

4.1.2 Impact to Floodplains for Alternative A, *No Action*

There would be no new disturbance to Floodplains under the *No Action* alternative.

Cumulative impacts to floodplains would continue under the *No Action* alternative. The existing jersey barriers would remain and would continue to channelize flows along the south side of the road. Alternative A would continue the past, direct impacts to floodplains by the covering 3.4 acres with roadbed. It would continue to impact floodplains indirectly by maintaining the unnatural flow regime of the area, backing up flood water on the south side of the road up to two feet above its natural elevation. The road currently functions as a two feet high dam or barrier to most flow, except for that water able to get through the existing four 24-inch diameter pipe culverts. The effect would continue to be diverted flood flows and not allowing flooding of the north side of the road to part of the Exit Creek alluvial fan.

The paved road surface is itself impervious to rain and so would continue to contribute a small amount to the runoff and increased flooding. The duration of cumulative impacts would be long-term, lasting the life of the road. The context is considered common, as floodplains are not identified in the enabling legislation for the park and are not considered rare within or outside the park area.

A Statement of Finding for floodplains is found in the Appendix.

4.1.3 Impact to Wetlands for Alternative A, *No Action*

There would be no new disturbance to Wetlands under the *No Action* alternative.

Cumulative impacts to wetlands would continue under the No Action alternative. Past actions created a road footprint of 3.4 acres. Of this, 1.57 acres was wetland and would have flooded for at least few days in most years. Freshwater forested/shrub wetland was covered by the existing road, so cumulative past actions had a negative, long-term impact to wetlands.

A Statement of Finding for wetlands is found in the Appendix.

4.1.4 Impact to Visitor Use and Safety for Alternative A, *No Action*

There would be no new disturbance to Visitor Use and Safety under the *No Action* alternative.

The current *No Action* conditions would continue, with some road flooding closing the road, and representing a cumulative, long-term adverse impact to visitor use and safety from past and present activities.

4.2 Impacts of Alternative B, *Raise Road and Install Culverts*, the proposed action, the preferred alternative

4.2.1 Impact to Wildlife Habitat, Vegetation, and Soils for Alternative B, *Raise Road and Install Culverts*

4.2.1.1 Impact to Wildlife and Habitat for Alternative B, *Raise Road and Install Culverts*

Alternative B, would have a direct new impact to wildlife habitat with the loss of 3.0 to 3.4 acres. Cumulative impacts from past road construction would account for 3.4 acres. Many of the area facilities were constructed to increase visitation to the Exit Glacier Area and may have impacted certain wildlife species, such as brown bears, wolves, wolverine, and lynx that have large home ranges and a low tolerance for human disturbance (Zielinski 1995). A lack of predevelopment data, however, makes it difficult to assess whether the current scarcity of these species in the project area, relative to surrounding areas, is a direct result of park development and increases in visitation. The extent of impacts has typically been limited to the immediate vicinity of human activities (i.e., habitat removal or alteration, species displacement or mortality, noise).

New direct impacts would be north of the existing road. These would be permanent in duration. Impacts to wildlife and habitat similar to those for Alternative A would occur, but direct impacts would increase by an additional 3.0 to 3.4 acres.

The vegetation clearing could result in bird displacement. Mitigation measures for this project stipulate that there would be no tree or brush cutting during nesting season, May 1 to July 15, to comply with the Migratory Bird Treaty Act. It is unlikely that active bird nests would be destroyed or abandoned during fall vegetation clearing or that birds would suffer direct mortality. There would be some loss of nesting habitat but an abundance is available in the vicinity.

Of the five Species of Special Concern known to occur in the project area, only the Townsend’s warbler potentially breeds within the project area. The rest of the Species of Special Concern, including the brown bear, are rare or uncommon visitors. During the construction period, noise and human activity would disturb wildlife and cause some individuals to be temporarily displaced from the affected and adjacent areas. Displaced animals would likely move to adjacent areas of similar habitat, which are common throughout the vicinity. Some small mammals, such as snowshoe hare and red-backed voles, would potentially experience direct mortality during construction activities.

Anadromous fish habitat would not be significantly impacted. The natural hydraulic regime would improve over the Exit Creek alluvial fan. Exit Creek does not have anadromous fish but does have Dolly Varden. Water flowing from Exit Creek, including its newly available channels, into Resurrection Creek, where fish do occur, would be the same volume and quality.

The wildlife and habitat in the area are considered important in context, because birds are identified in the park purpose. However, wildlife and habitat potentially affected by the proposed project are not rare in the project area or in vicinity of the park.

### 4.2.1.2 Impact to Vegetation for Alternative B, *Raise Road and Install Culverts*

Alternative B would result in direct loss of vegetation due to road building. The existing past impacts total 3.4 acres, and the proposed direct impact would increase that by 3.0 to 3.4 acres, for a total direct, permanent impact to vegetation of 6.4 to 6.8 acres. Removed vegetation would be deciduous forest, evergreen forest, mixed forest, and shrub/scrub vegetation along the one mile project area. The native vegetation would be replaced with road fill and asphalt. These vegetation types are abundant in the surrounding area. Construction activities disturbing soils and causing dust will be minimized by mitigation measures stipulating that disturbed areas would be revegetated with local native plant species and dust would be controlled during construction.

There would be an increased potential for the introduction or spread of non-native plant species. As a mitigation measure, fill would be required to be weed free, and the park would permanently monitor the project area and treat any non-native plant populations identified.

Indirect beneficial impacts to vegetation would occur from the improvement of the hydrologic regime that adds flood waters to the north side of the road over the Exit Creek alluvial fan, allowing for more natural soil development.

### 4.2.1.3 Impact to Soils for Alternative B, *Raise Road and Install Culverts*

Alternative B would increase the footprint of development by about 3.0 to 3.4 acres. The park road acts as an artificial barrier to natural flow of flood waters over the north portion of the Exit Creek alluvial fan. Alternative B would improve the situation somewhat by providing more flow through four box culverts. This would improve natural deposition and soil development on both sides of the road. Impacts to soil would be permanent under the roadbed, and would be long-term and varied over the alluvial fan. Since most of the one mile project area would still lack culverts, the road would continue to function as a barrier to most soil transport and would thereby impact soil deposition and development on both sides of the road. This would be a long-term impact.

The soils resource is considered common in context, as it is not identified in the enabling legislation for the park and is not considered rare in the project area or the park vicinity.

### 4.2.2 Impact to Floodplains for Alternative B, *Raise Road and Install Culverts*

Alternative B would have some adverse, direct, long-term impact to floodplains since it would increase road's footprint by about 3.0 to 3.4 acres, which could contribute slightly to runoff and increased flooding potential. This alternative would have beneficial impact to floodplains since it would increase the flood flows under the road, from six to 24 linear feet with box culvert openings. This alternative would help to restore the natural function of the floodplain where the road crosses the Exit Creek alluvial fan. The duration of impacts would be long-term, lasting the life of the road.

The context is considered common, as floodplains are not identified in the enabling legislation for the park and are not considered rare within or outside the park area.

4.2.3 Impact to Wetlands for Alternative B, *Raise Road and Install Culverts*

Alternative B would result in some adverse, direct, long-term new impact to 2.46 acres of freshwater forested/shrub wetland due to road fill. The project would also result in much greater beneficial, indirect, long-term new impact to wetland by improving the hydrology, reducing the impact of the road as a levee, re-wetting and restoring former wetlands north of the road, and improving natural function of the alluvial fan.

Cumulative impact to wetlands from the past and continuing activity was adverse, direct, and long-term and covers 1.57 acres of former wetland.

The freshwater forested/shrub wetland resource is considered common in context, as it is not identified in the enabling legislation for the park and is not considered rare in the project area or the park vicinity.

4.2.4 Impact to Visitor Use and Safety for Alternative B, *Raise Road and Install Culverts*

There would be new beneficial, long-term impacts to Visitor Use and Safety under Alternative B. Road flooding would be eliminated, so there would be no road closures and vehicular access to the Exit Glacier area would continue uninterrupted. Drivers would not be in danger of driving off the road during a flood, and the roadway would not erode from flood waters.

## 5.0 CONSULTATION AND COORDINATION

Public scoping was conducted on this project March 10, 2015 through April 13, 2015 as part of the environmental assessment process. In addition, persons, organizations, and agencies contacted for information and assisting in identifying important issues, developing alternatives, or analyzing impacts are listed below, as are the preparers of the EA.

| | |
|---|---|
| Paul Schrooten | Transportation Program Lead, Landscape Architect, AKRO |
| Betty Chon | Project Manager, FHWA |
| Rebecca Lasell | Superintendent, KEFJ |
| Joan Darnell | Team Manager, Environmental Planning and Compliance, AKRO |
| Brooke Merrell | Regional Environmental Coordinator, AKRO |
| Dick Anderson | Lead EA Preparer, Environmental Protection Specialist, AKRO |
| Molly Cobbs | Environmental Protection Specialist, AKRO |
| Sharon Kim | Chief of Resource Management, KEFJ |
| Ken Pendleton | Landscape Architect, AKRO |
| Rebecca Shaffer | Architect, AKRO |
| Paul Burger | Geologist, AKRO |
| Bud Rice | Management Biologist, AKRO |
| Kirk Desermia | Facility Manager, KEFJ |
| Mark Baker | Flood Risk Evaluator, WASO, NPS |
| Sven Leon | Hydraulic Engineer, FHWA |
| Janet Curran | Hydrologist, USGS |
| Pete Field | Highway Engineer, FHWA |
| Corrie Veenstra | Program Manager, FHWA |
| Heather Wills | Environmental Compliance, FHWA |

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# APPENDIX

## STATEMENT OF FINDINGS

**For Executive Order 11990 (Protection of Wetlands)**
**and**
**For Executive Order 11988 (Floodplain Management)**

**Herman Leirer Road (Exit Glacier Road) Flood Mitigation Project**
**Kenai Fjords National Park, Alaska**

July 2015

Recommended:

______________________________________________________________

Superintendent, Kenai Fjords National Park                    Date

Certified for Technical Accuracy and Servicewide Consistency:

______________________________________________________________

Chief, Water Resources Division, Washington Office                    Date

Approved:

______________________________________________________________

Regional Director, Alaska Region                    Date

## Introduction

The National Park Service (NPS) is considering road improvements to mitigate flooding over the Herman Leirer Road (Exit Glacier Road) in Kenai Fjords National Park in Seward, Alaska. The road would be raised five feet and four large box culverts would be installed to allow floodwaters to pass. Construction is proposed for 2016. Road improvements would be completed on the Herman Leirer Road, also known as the Exit Glacier Road, Alaska Forest Highway Route 46, and the Resurrection River Road.

The purpose of the project is to maintain summer vehicular access to the Exit Glacier visitor use area, which includes an interpretive center, trails, parking lot, restrooms, and campground. The Exit Glacier area is the park's most popular and only road-accessible visitor area. An average of 48,840 visitors use the road during the months of May through September (average from 2010-2014; park statistics from www.irma.nps.gov).

The nine mile, dead-end Herman Leirer Road was first bulldozed as a gravel road from 1971-1980 by a private individual, Herman Leirer. It traverses the Resurrection River floodplain, wetlands, and wildlife habitat in the alluvial fan of Exit Creek. Bridge #1390, across the well-defined Resurrection River, was constructed in 1985 by NPS at mile 7.3 of the Herman Leirer Road as it enters the park. The portion of the road in the alluvial fan was engineered, paved, and widened from 1998-2001 by NPS.

The proposed road project is on the alluvial fan of Exit Creek near the confluence with the Resurrection River. The existing road was been built on the alluvial fan, and portions of Exit Creek occasionally overlap the road. The road flooding is primarily associated with channel change on the alluvial fan. The road acts as a barrier to natural flows over the alluvial fan and has changed the natural hydrology to the north. Impacts include road closures during peak tourist season and costly repairs to road damage. To restore a more natural flow of Exit Creek across its alluvial fan, the project would install four large culverts (five feet high and six feet wide each) and raise the road five feet to accommodate aggradation over time.

The size and locations of the new box are designed to match existing flood channels that were well defined on both the south and north sides of the road. The box culverts primary purpose would be to convey water to the channels north of the road to maintain the existing and relic flood scour channel habitat. The box culverts would convey a larger amount of water than the existing pipe culverts. The existing pipe culverts pass some water. The larger flow is intended to enhance the current habitat. The proposed box culverts will pass more water and be easier to maintain as the sediment levels fluctuate. Culvert size (six feet span and five feet rise) was designed primarily as minimums to what is needed for cleaning access and for accommodating some sediment transport at the inlet. The culvert spans also approximately match the flood channel widths. The box culverts are not designed to convey the entire flow from Exit Creek and Paradise Creek. Excess flow, not conveyed through the culverts, would be conveyed along the south side ditch to the Resurrection River. If the entire flow from the two creeks were to combine and flow against the road, the road embankment would redirect the flow east to the Resurrection River. A new large channel would be created paralleling the road. The road embankment would be adequately armored to prevent major damage to the road.

Flooding over the road is variable but occurs about twice a year and has caused damage along the road edge.  The road is closed to vehicles if the flow depth over the road reaches six inches because that level has been shown to obscure painted road lines and could lead to vehicles driving off the roadway.

Executive Order 11990 (Protection of Wetlands) and Executive Order 11988 (Floodplain Management) require the NPS, and other federal agencies, to evaluate the likely impacts of actions in wetlands and floodplains.  The executive order requires that short and long-term adverse impacts associated with occupancy, modification or destruction of wetlands and floodplains be avoided whenever possible.  Indirect support of development and new construction in such areas should also be avoided wherever there is a practicable alternative.

To comply with these executive orders, the NPS has developed a set of agency policies and procedures which can be found in Director's Order 77-1 and Procedural Manual 77-1 for Wetland Protection, and in Director's Order 77-2 and Procedural Manual 77-2 for Floodplain Management.  The policies and procedures related to wetlands and floodplains emphasize: exploring all practical alternatives to building on, or otherwise affecting, wetlands and floodplains; reducing impacts to wetlands and floodplains whenever possible; mitigating impacts from building in floodplains, and providing direct compensation for any unavoidable wetland impact by restoring degraded or destroyed wetlands on other NPS properties.

The purpose of this Statement of Findings (SOF) is to present the NPS rationale for its proposed road work in the floodplain and wetland area.  This SOF also documents the anticipated effects on these resources.

## A. FLOODPLAINS

Justification for Use of the Floodplain

The road is the only vehicular access to the Exit Glacier visitor use area of the park, which is the most visited part of the park with a 5-year average of 48,840 visitors using the road during the months of May through September.  Preliminary scoping limited the project to the existing road alignment (across the alluvial fan).  The option to move the road off of the floodplain was considered but rejected because the relocation and construction of a new bridge over the Resurrection River would be impractical.

Exit Glacier infrastructure including the Nature Center and trails are also located in the alluvial fan upstream and out of the current flooding zone.  Relocating these structures is not an option either due to extensive visitor use at Exit Glacier and the road is necessary to access these structures.

### Site Specific Flood Risk

The flooding interval is irregular.  The following table shows the instances of flooding of Exit Glacier Road since 1995.  The frequency of these events has increased substantially since 2009.

| Dates of Documented Road Flooding | | | |
|---|---|---|---|
| July | August | September | October |
| 7/29/09 | 8/16/10 | 9/20/95 | 10/9/06 |
| 7/8/10 | 8/3/11 | 9/18/08 | 10/2/10 |
| 7/17/11 | 8/12/13 | 9/8/11 | |
| | 8/29/13 | 9/19/12 | |
| | 8/13/14 | 9/6/13 | |
| | | 9/14/14 | |

The flood depths are not great – less than two feet over the road – and the velocities are not hazardous enough to threaten to wash away cars from the roadway. The hazard occurs when depths exceed six inches and drivers cannot see the pavement striping on the road and cannot tell where the road edge is. In such cases, drivers might accidently drive off the road and into the ditch. Therefore, the current way of dealing with road flooding is to close the road when depth reaches six inches or greater.

The time required for flooding to occur is extremely variable. Typically, the water depth adjacent to the road is observed, and when it reaches the surface of the road, warnings and constant observation follows.

It is very possible for visitors or staff to be cut off by the road flooding for several hours. The road is a dead end, and it terminates beyond the flood hazard area in a developed area with a parking area, campground, visitor center, restrooms, trail to the glacier, and overnight hiking trails. There is no food service or visitor lodging at the road end.

With the current road configuration there is opportunity for a significant safety or visitor delay situation to develop. If floodwaters rise relatively quickly – within two hours – to the point where NPS rangers close the road for safety, then there may be little opportunity to evacuate, especially since many visitors may not be near the visitor center and parking area.

A hydrology and geomorphology study of Exit Creek is underway by Janet Curran of USGS (Anchorage). These data are from her work but are preliminary and not yet published.

The forest floor has been buried in sediment, grading from cobbles near the braid plain to sand near the road. Fluvial structures (swale/ridge topography, streamlined gravel deposits) have begun to develop near the braid plain. Sitka spruce kill was observed in 2013 (suggesting recent flooding or saturated soil around spruce trees); weak green-up of upland deciduous trees was observed in 2014 (suggesting poor soil condition from flooding or saturated soils). Erosion is rare and minor; fresh sediment deposits are nearly ubiquitous throughout flooded forest areas.

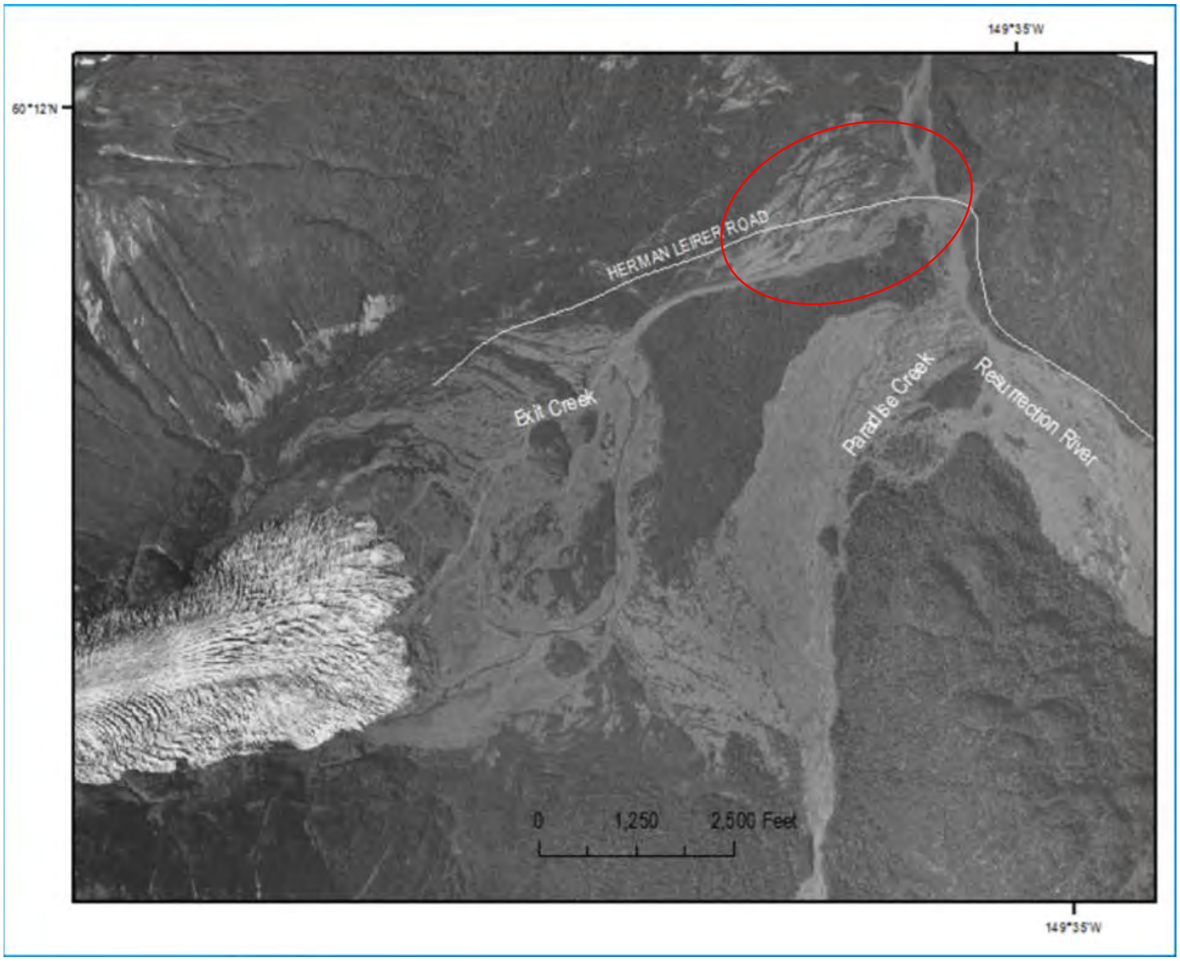
Peak stream flows (floods) in Alaska can be the result of snowmelt, glacier melt, and/or rainfall. Flooding prior to 2009 was less common and occurred late in the year. Records include a 1995 report of one foot of water over the top of the road. Since 2009, the road has flooded one to three times per year. Road floods have occurred in July, August, September, and October. Impacts include road closures during peak tourist season and costly repairs to road damage.

USGS measured Exit Creek discharge at modest non-flood summer flows twice in 2013 – 590 cubic feet per second (cfs) on 23 July 2013 and 460 cfs on 21 August 2013.

There are two main sources of Exit Creek flow – a small stream emerging from the toe of Exit Glacier and a larger flow from a canyon south of the glacier terminus. The Exit Creek channel has changed, recently and historically. The USGS used LIDAR and aerial photos to determine geomorphic setting and history back to 1950. USGS surveyed transects in 2013 to compare to 2011 transects and bank heights to assess potential for overtopping. Basic data and reconnaissance were collected by USGS in 2013, such as grain size data, discharge rates, and field-checking the entire braid plain, including the Paradise Creek crossover area.

The influence of glaciers and Paradise Creek on the Exit valley was considered. Paradise Creek shares the valley with Exit Creek. Exit and Paradise Creeks were compared by USGS. Exit valley has many moraines, while Paradise valley contains few. Paradise Creek is steeper, larger, and coarser than Exit Creek. Both creeks have built alluvial fans at the mouths of their valleys. Paradise Creek has likely flowed into Exit Creek many times in the past. Exit Creek geomorphic reaches include the outwash plain, a section confined by moraines, and a braided section on an alluvial fan. The valley that Exit Creek and Paradise Creek flow into contains a nested suite of moraines and several alluvial fans. Paradise Creek periodically influences the water and sediment budget in Exit Creek. Exit Glacier moraine positions extend far down-valley, however, Paradise Glacier moraines are not an influence in Exit valley. If Paradise Creek were to again flow into Exit Creek, the larger flows might be too large for the proposed project box culverts. However, if and when Paradise Creek will contribute direct flow into Exit Creek is unpredictable, but, potentially could happen. Design of the proposed road addresses this potential impact.

Figure SOF-1 – This 1950 aerial photo illustrates the problem. Flow direction is towards the east into the Resurrection River, then southeast. Note the red circled active alluvial fan of Exit Creek to the right of the word "ROAD." This is the project area, which is now largely vegetated, where flooding of the road occurs when high flows seek northern channels but are blocked by the road and by inadequate culverts. The proposal is to raise the road and add culverts to allow surface water to transit beneath the road to the north.




**Project Design will Mitigate the Current Road Flooding and the Existing Condition of Minimal Hydrologic Flow**

The construction of a causeway or bridge across the alluvial floodplain was considered cost prohibitive (about $20M). The project design would raise the road five feet and install four box culverts (five feet high and six feet wide each), which would improve the hydrologic function of the floodplain area at much less cost (about $4M). The new design would allow much more water to flow to the north side of the road (now accommodated by two sets of two 24 inch pipe culverts), and it would improve the natural processes of gravel deposition and channel development.

The location of the four box culverts would match existing, well developed flood channels on both the south and north side of the road. The box culverts primary purpose is to convey flow to the channels north of the road for maintaining habitat. The box culverts would convey a larger amount of water than the existing pipe culverts. The larger flow would enhance the current habitat. Culvert size of the four box culverts (five feet high and six feet wide each) was established primarily as a minimum for what would be needed for cleaning access and for accommodating some sediment deposition at the inlet. The culvert spans would also approximately match the flood channel widths.

The project design would minimize the risk to life and property by preventing road flooding and maintaining unencumbered vehicular access to the Exit Glacier area of the park.

### Floodplain Summary

The project would eliminate road flooding and improve natural processes across the project area and beyond to the alluvial fan of Exit Creek.

## B. WETLANDS

### Wetlands within the Project Area

Wetland boundaries were identified in the field by a 2012 NPS contract to Kenai Watershed Forum and confirmed in the field in 2015 by NPS staff, Paul Burger and Bud Rice.

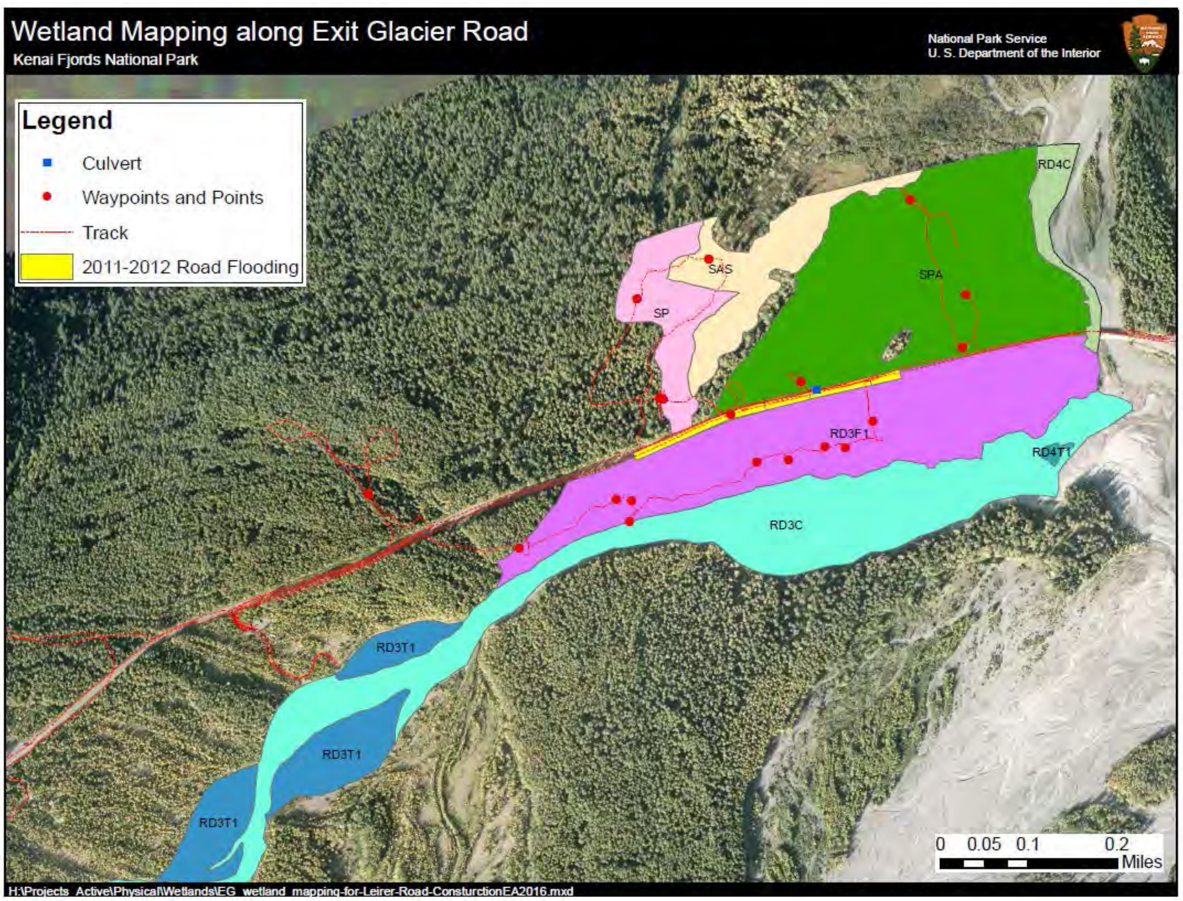



Figure SOF-2 – Wetlands and Road Flooding Area

### Wetland Overview

Wetlands around the project area are adjacent to a recent avulsion of a braid-thread of Exit Creek. The stream thread is occupying a new channel on the Exit Creek braid-plain adjacent to the Herman Leirer Road, causing the road to now flood more frequently. Stream thread avulsion is a common process on braid-plains. During conditions of high flow, larger material is transported in suspension. As the flow subsides, sufficient material drops from suspension to raise the elevation of the bed above that of the surrounding braid-plain. When this occurs, the flow in the stream thread seeks a lower elevation, and may avulse to a new position on the plain. These events are frequent, depending on glacial melt, precipitation, and sediment supply. Retreat and thinning of Exit Glacier has reduced storage capacity of the glacier and exposed more bare ground and more sediment for transport to the Exit Glacier outwash plain and floodplain during high precipitation events. The avulsion of Exit Creek toward the north has apparently raised the surrounding water table, creating expanded areas of wetland in the vicinity of the Herman Leirer Road.

The data collected in the field by Kenai Watershed Forum in 2012 were of two types: wetland determination data, and mapping data. Data forms from the Alaska Regional Supplement to the US Army Corps of Engineers (USACE) wetland delineation manual (2007) were used to record wetland determination data. A number of these points were rechecked by qualified NPS regional wetland delineators (Paul Burger and Bud Rice) on June 30, 2015 who confirmed that the 2012 delineation was still accurate.

The wetland determination data can be used to document the extent to which any site might meet the criteria established by the USACE for consideration as a wetland under their jurisdiction pursuant to section 404 of the Clean Water Act. USDA PLANTS codes for plant names were used instead of binomials. The PLANTS database (http://plants.usda.gov/dl_state.html) contains useful information as synonymy (many plant names have recently changed), authority, and wetland indicator status, and was updated in June 2012.

The following is a summary of the plant cover data with indicator status and Plant Prevalence Index, by Kenai Watershed Forum 2012

WAYPOINT 1

Plant Prevalence Index 3.06

| Taxon | Cover | Indicator Status |
|---|---|---|
| Alnus incana (L.) Moench ssp. tenuifolia (Nutt.) Breitung | 60 | FAC |
| Calamagrostis canadensis (Michx.) Beauv. | 6 | FAC |
| Equisetum arvense L. | 4 | FAC |
| Salix alaxensis (Anderss.) Coville | 4 | FAC |
| Populus balsamifera L. | 3 | FACU |
| Picea sitchensis (Bong.) Carr. | 2 | FACU |
| Pyrola asarifolia Michx. | 1 | FAC |
| Salix barclayi Anderss. | 1 | FAC |
| Salix sitchensis Sanson ex Bong. | 0.1 | FAC |
| Rubus arcticus L. | 0.1 | FAC |
| Carex disperma Dewey | 0.1 | FACW |

WAYPOINT 10

Plant Prevalence Index 3.01

| Taxon | Cover | Indicator Status |
|---|---|---|
| Alnus incana (L.) Moench ssp. tenuifolia (Nutt.) Breitung | 40 | FAC |
| Equisetum arvense L. | 30 | FAC |
| Calamagrostis canadensis (Michx.) Beauv. | 10 | FAC |
| Salix barclayi Anderss. | 5 | FAC |
| Picea sitchensis (Bong.) Carr. | 1 | FACU |
| Platanthera obtusata (Banks ex Pursh) Lindl. | 0.1 | FACW |
| Athyrium filix-femina (L.) Roth | 0.1 | FAC |
| Dryopteris expansa (K. Presl) Fraser-Jenkins & Jermy | 0.1 | FACU |
| Rubus arcticus L. | 0.1 | FAC |
| Orthilia secunda (L.) House | 0.1 | FACU |

WAYPOINT 5

Plant Prevalence Index 2.98

| Taxon | Cover | Indicator Status |
|---|---|---|
| Alnus incana (L.) Moench ssp. tenuifolia (Nutt.) Breitung | 30 | FAC |
| Salix barclayi Anderss. | 20 | FAC |
| Equisetum arvense L. | 3 | FAC |
| Carex disperma Dewey | 1 | FACW |
| Calamagrostis canadensis (Michx.) Beauv. | 1 | FAC |
| Rubus arcticus L. | 0.1 | FAC |
| Picea sitchensis (Bong.) Carr. | 0.1 | FACU |
| Tsuga mertensiana (Bong.) Carr. | 0.1 | FAC |
| Trientalis europaea L. | 0.1 | FAC |
| Dryopteris expansa (K. Presl) Fraser-Jenkins & Jermy | 0.1 | FACU |
| Parnassia palustris L. | 0.1 | FACW |
| Lycopodium annotinum L. | 0.1 | FAC |
| Pyrola asarifolia Michx. | 0.1 | FAC |
| Carex buxbaumii Wahlenb. | 0.1 | FACW |
| Eriophorum angustifolium Honckeny | 0.1 | OBL |

WAYPOINT NEW

Plant Prevalence Index 3.29

| Taxon | Cover | Indicator Status |
|---|---|---|
| Salix barclayi Anderss. | 35 | FAC |
| Alnus incana (L.) Moench ssp. tenuifolia (Nutt.) Breitung | 25 | FAC |
| Populus balsamifera L. | 25 | FACU |
| Salix sitchensis Sanson ex Bong. | 3 | FAC |
| Picea sitchensis (Bong.) Carr. | 2 | FACU |
| Salix alaxensis (Anderss.) Coville | 1 | FAC |
| Calamagrostis canadensis (Michx.) Beauv. | 0.1 | FAC |
| Equisetum arvense L. | 0.1 | FAC |
| Carex buxbaumii Wahlenb. | 0.1 | FACW |
| Carex disperma Dewey | 0.1 | FACW |

WAYPOINT WET9

Plant Prevalence Index 3.36

| Taxon | Cover | Indicator Status |
|---|---|---|
| Alnus incana (L.) Moench ssp. tenuifolia (Nutt.) Breitung | 70 | FAC |
| Equisetum arvense L. | 30 | FAC |
| Populus balsamifera L. | 30 | FACU |
| Pyrola chlorantha Sw. | 30 | FACU |
| Calamagrostis canadensis (Michx.) Beauv. | 4 | FAC |
| Oplopanax horridus Miq. | 1 | FAC |
| Trientalis europaea L. | 1 | FAC |
| Orthilia secunda (L.) House | 0.1 | FACU |
| Streptopus amplexifolius (L.) DC. | 0.1 | FAC |
| Chamerion angustifolium (L.) Holub | 0.1 | FACU |
| Galium triflorum Michx. | 0.1 | FACU |
| Athyrium filix-femina (L.) Roth | 0.1 | FAC |
| Actaea rubra (Ait.) Willd. | 0.1 | FAC |
| Platanthera obtusata (Banks ex Pursh) Lindl. | 0.1 | FACW |
| Viburnum edule (Michx.) Raf. | 0.1 | FACU |

The 2012 effort mapped 171.2 acres of wetland in the 420.3 acre Exit Glacier Development Area. This is 40% of the area mapped but covers 100% of the project area. The areas mapped as RD3T1, RD3T2 and RD4T1 may not currently meet the jurisdictional criteria developed by the USACE; however, due to the extremely dynamic nature of braid-plains in the Seward area they probably will meet those criteria at some time during the next few decades. In fact, much of the other wetland area would have been mapped as these types before the recent avulsion of Exit Creek. Additionally, the areas mapped as river channel (RD4C and RD3C) are not strictly wetland, because they are un-vegetated. However, the area mapped as SPA, SAS and SP is wetland, although the areas mapped as SPA and SP probably were not wetland before the recent change in Exit Creek. The area mapped as SAS probably has been wetland since deglaciation.

The chemistry data help document the processes responsible for driving the functions of the wetlands mapped. Two hypotheses are possible: one is that the wetlands are supported directly by hyporheic flow (the flow of the river through the porewater of the sediments in the braid-plain). The other is that river flow is hydraulically damming groundwater discharging to these sediments. It can be difficult to determine which process dominates, but in this area the strong contrast in chemistry between the water in Exit Creek (and the Resurrection River) and the surface and local groundwater supports rejection of the first hypothesis.

Specific conductance (SC) was measured of: 1) Exit Creek, 2) the Resurrection River, 3) clear water creeks flowing through the area, 4) in the surface, and 5) pore waters of the wetlands themselves. Specific conductance is related to the overall concentration of ions in the water and can provide a hint to the source of different waters if a strong contrast is present. The SC of Exit Creek was measured at five points and averages 50 µS/cm, and was also low in the Resurrection River (85.7 µS/cm) compared to the other sources where SC is much higher. A clear water creek at the base of the adjacent mountain slope had a value of 188.2 µS/cm; the average value found in streams flowing through the area was 220 µS/cm; wetland surface water averaged 226.5 µS/cm; and wetland pore water averaged 331.3 µS/cm.

This pattern of the difference in SC was especially evident at one location where clear water flowed into the turbid water of Exit Creek in a ditch along the Herman Leirer Road. There, the clear water had a SC of 237.9 µS/cm, and the turbid water of Exit Creek had a SC value of 60.9 µS/cm only 10 meters downstream (see figure below). This strong contrast in a short distance downstream implies that shallow groundwater with high SC is being hydraulically dammed by the flow of Exit Creek which supports a low SC.

Figure SOF-3 – Clear groundwater (foreground), which has discharged into a ditch, flows into the turbid water of Exit Creek at the center of the picture on 18 July 2012. The source of the clear groundwater may be either Exit Creek filtered through the sediments of the braid-plain, or local groundwater discharging from recharge in surrounding mountain slopes. The SC measured in the clear water was much higher (237.9 µS/cm) than that of Exit Creek (60.9 µS/cm) just 10 meters away, indicating that the clear water is not Exit Creek water filtered by hyporheic flow through the braid-plain sediments. – Kenai Watershed Forum 2012.

Prior to avulsing, Exit Creek was further south, allowing a broader area for dispersal of local groundwater on the north side of the creek. Because the shallow groundwater could disperse over a broader area, it was deeper, supporting fewer wetlands. Therefore, the avulsion of Exit Creek has probably led to an increase in wetland area near the road due to hydraulic damming of local groundwater rather than because creek water is infiltrating through the hyporheic zone.

The wetlands located within the proposed project area consist mostly of wooded riverine bottomlands. The immediate floodplain surrounding the streambed is classified as Riverine Upper Perennial Unconsolidated Cobble-Gravel/Vegetated (R3US). These wetlands provide poor habitat for macro-invertebrates and few fish, including very low numbers of Dolly Varden and small mammals such as voles. Moose and snowshoe hare frequent the area. Black bear are fairly common in this area, while brown bear are seen much less frequently. A number of migratory and resident bird species use these wetland and floodplain areas for breeding and foraging.

No threatened or endangered animal or plant species are found in the area.

Numerous similar glacial river systems are found in the area and region within and outside the park. The wetland acreage adversely impacted by the project, 2.46 acres, is a relatively minor part of the alluvial fan and the numerous local small stream valleys nearby.

The beneficial impacts to wetlands, from reestablishing natural surface water flows over the Exit Creek alluvial fan north of the road, are a significant improvement to the existing situation. Removing the wetlands under the road fill would have no impact on any known cultural resources, and would have a minor adverse impact on surface water quality, including sediment control and water purification, flood flow, and animal and macro-invertebrate habitat.

NPS Policy is to avoid siting projects in wetlands whenever possible. If circumstances make it impracticable to avoid wetlands, then mitigation of unavoidable impacts must be planned. A NPS wetlands no-net-loss policy requires that wetland losses be compensated for by restoration of wetlands, preferably of comparable wetland type and function and in the same watershed, if possible. Restoring the surface water flows to the north of the Exit Glacier Road is expected to create a new wetland area of about 10 acres immediately north of the road and west of the mapped wetlands. It may also increase the wetland area to 15 to 20 acres by pushing more water through the box culverts onto the north side and flooding areas currently upland. This action would also increase the function of degraded wetlands now partially starved of natural water flows to the north of the road.

**Alternatives Considered**

A series of project alternatives were considered over the years by the park, the public, and a value analysis workshop including Federal Highway Administration and USGS representation.

- Moving the road out of the Exit Creek alluvial fan was considered impractical as it would require a new bridge over Resurrection River and a new road alignment through currently undisturbed uplands.
- Elevating the road on a raised bridge or causeway was considered impractical due to the cost (about $20M).
- Raising the road profile six feet and installing four 100-feet long bridges, was determined to be too expensive ($8.8M).
- Maintain the existing road profile and install a 2,000 feet long log debris wall along the edge of the active channel, was determined to be only a short-term solution and too speculative as to effectiveness ($1.7M). The log debris wall would need to be replaced in 20 to 25 years.
- Maintain the existing road profile and install a 3,850 feet improved jersey barrier along the road's south edge, was determined to be too speculative as to effectiveness, and added no benefit to the degraded wetlands and floodplains on the north side of the road ($4.9M). Such a flood wall would allow about two feet or flood depth above the road surface to be diverted to the Resurrection River. The aesthetic impacts would be significant.

The selected alternative is a combination of raising the roadway five feet and adding four large box culverts (five feet tall by six feet wide each) to relieve flood water and to return functionality of the floodplain and degraded wetlands on the north side of the road.

## Summary of Wetland Impacts Proposed Compensation

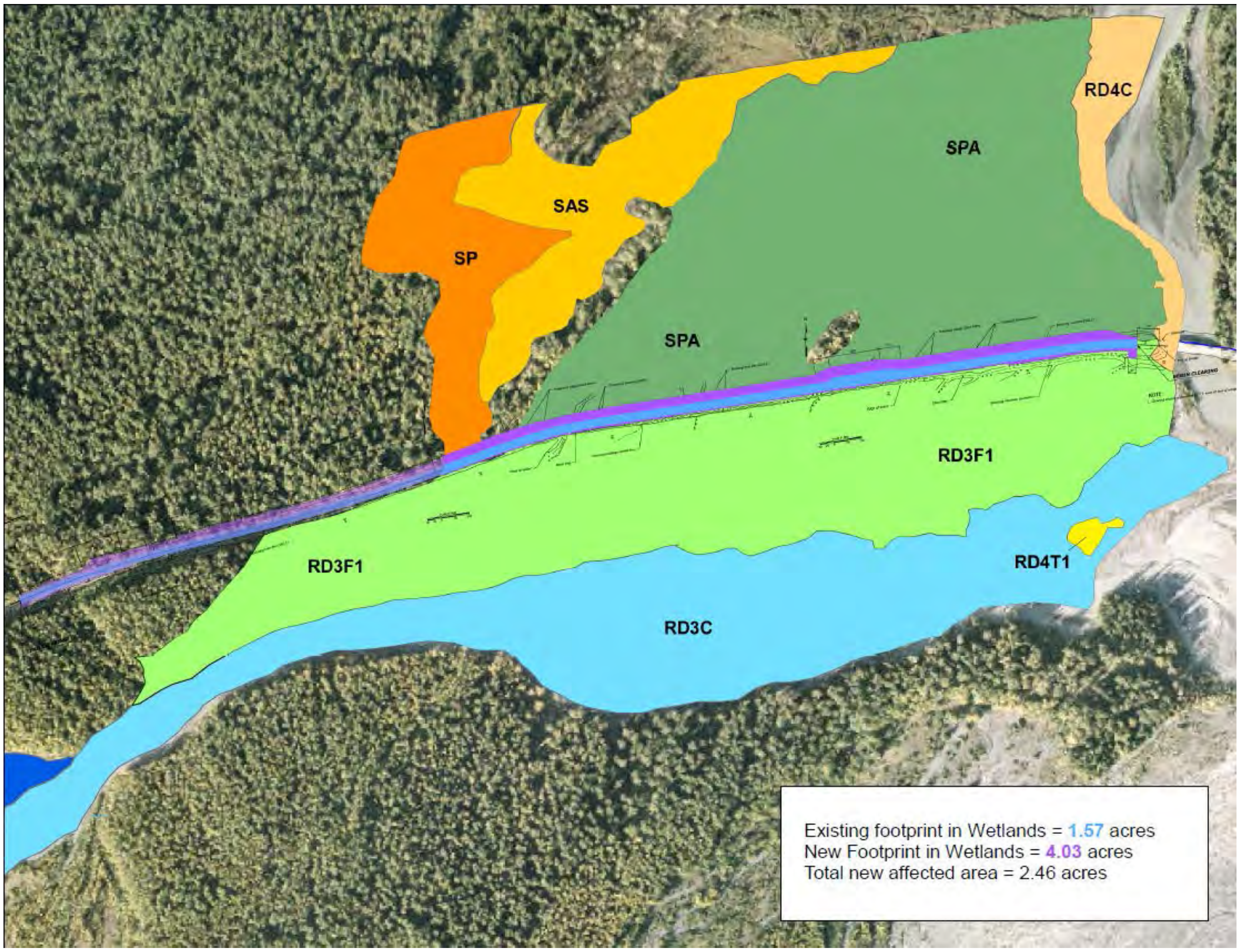



Fig SOF-4 – Wetlands and Impact Acreage

The entire project area is in the Exit Creek alluvial fan. The proposal is a road improvement project one mile long through an area with increasingly frequent flooding. The existing road footprint in wetlands is 1.57 acres. The proposed new fill in wetlands would be 2.46 acres, due to raising the roadway 5 feet which would require increasing the width of the road base prism. The new wetlands footprint (existing plus the new fill) would be 4.03 acres.

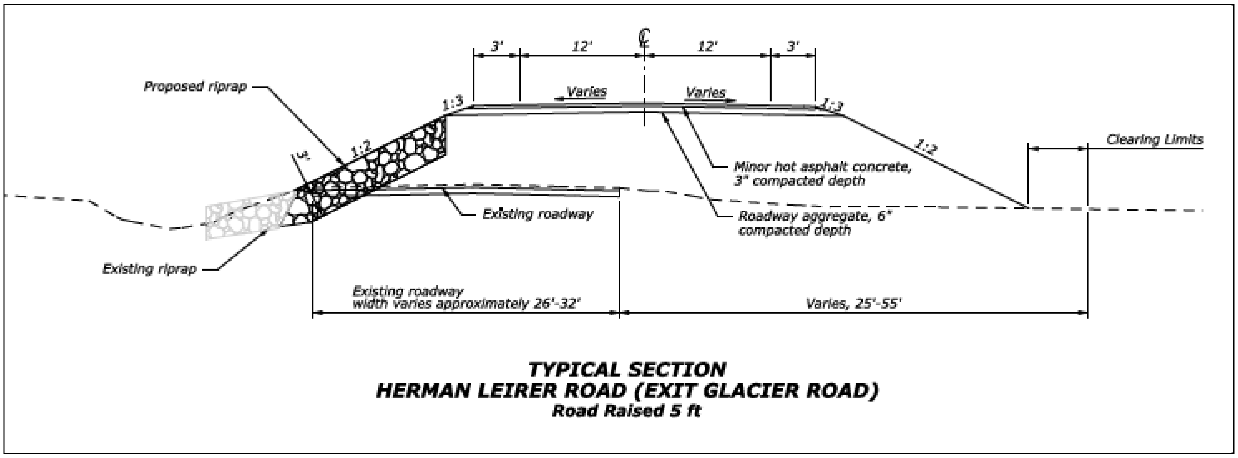



Fig SOF-5 – Typical section depicting five feet road raise.

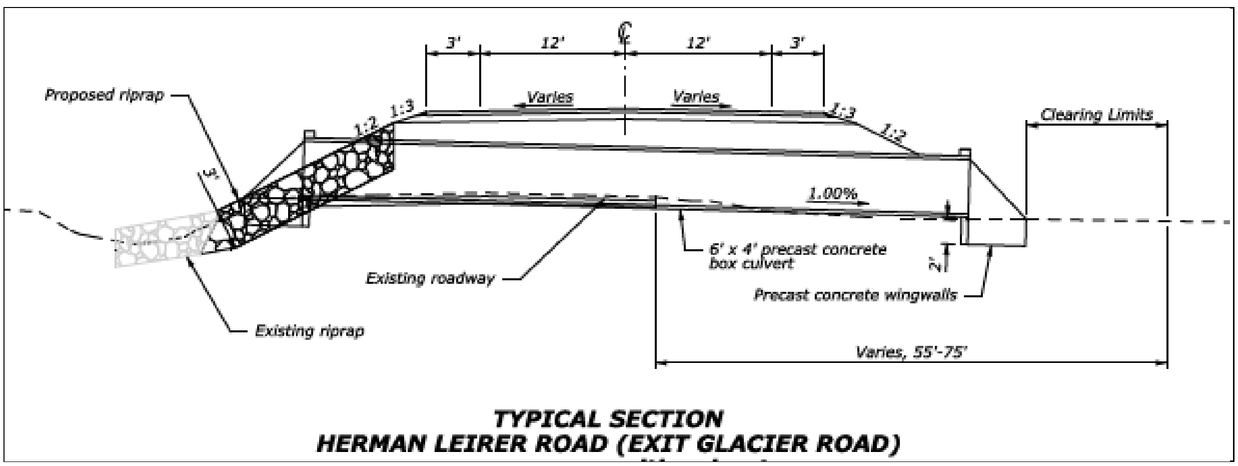



Fig SOF-6 – Typical section depicting box culvert.

A purpose of the project is to reestablish more-natural surface water flow regimes north of the road. Currently, the road forms an artificial barrier to surface flows over the alluvial fan to the north. The four existing drainage 24 inch pipe culverts are inadequate and overwhelmed during flood events, and wetlands north of the road have been degraded and diminished by this road barrier. The proposed box culverts would significantly improve the hydrologic transfer of surface water flow past the road prism. Approximately 80 acres of wetlands north of the road would be benefit from the improved hydrologic transfer, and up to 20 acres of wetland may be created as a result of the improved surface water transfer to the north of the road.

The new box culverts may serve a minor role in preventing flooding but they do not seem to be absolutely essential for the primary purpose of the project which is to maintain road access to the Exit Glacier area. This suggests that they are proposed for the primary purpose of restoring some hydrologic function to the area north of the road. Therefore, the hydrologic effect of these culverts could serve to compensate for the functional loss of the wetlands filled by the road expansion (2.46 acres).

The project benefits to the hydrology of the about 80 acres of wetlands north of the road are far greater than the adverse impacts created by the fill of 2.46 acres of wetland and therefore compensate for the impacts of the proposed fill.

**Conclusion**

The NPS concludes that there are no practicable alternatives to filling 2.46 acres of wetlands for the flood mitigation work on the Herman Leirer Road. Wetlands would be avoided to the maximum practicable extent. The wetland impacts that could not be avoided would be minimized. The braided stream's macro-invertebrate habitat and wetland vegetation habitat would be improved by the four large box culverts allowing improved stream flow to the north side alluvial fan. The NPS acknowledges that some natural as well as artificial localized wetlands processes would be adversely affected by the increased roadbed footprint. Impacts on the wetlands would be more than compensated by restoring natural riverine and palustrine wetland habitat and associated riparian habitat on the Exit Creek alluvial fan north of the road. The NPS finds that this project is consistent with Procedural Manuals #77-1 and #77-2 *Wetland Protectio*n, 2011 and *Floodplain Management*, and compliant with NPS Director's Order #s77-1 and 77-2, *Wetland Protection and Floodplain Management*.