Environmental Resources Section

Public Notice

Alaska District
U.S. Army Corps of Engineers

Date MAY 27 2015 Identification No. ER-15-11
Please refer to the identification number when replying.

Salmon Creek Section 205 Flood Risk Management Project
Draft Integrated Feasibility Study, Environmental Assessment, and
Draft Finding of No Significant Impact
Seward, Alaska

The purpose of this notice is to notify the public of a change to the Alaska District, U.S. Army Corps of Engineers' (Corps) project identified in a previous public notice (ER-15-04, March 25, 2015) for construction of a channel training structure along Salmon Creek near Seward, Alaska, to provide flood risk management to the neighboring communities.

Based on comments received during public review of the earlier notice, the Corps intends to: (1) access the project site via Romack Court instead of Orlander Avenue; (2) move the construction of a 6,000-square-foot parking area from directly behind the constructed channel training structure to the entrance of the project access road; and (3) place a gate immediately after the parking area to prevent full-size vehicles from accessing Salmon Creek. Recreation-based vehicular traffic such as ATVs and snowmachines will still be allowed to access the area commensurate with U.S. Forest Service managed uses for the area. No changes are being made to the other project features, i.e., constructing a 1,500-foot-long armored berm, a 3,225-foot-long access road, and a 1,500-foot-long gravel trail. The project features will facilitate flood protection and the public's recreational use of the area. This project is expected to cost approximately $3.28 million.

More detailed information on the proposed action and anticipated environmental effects are discussed in the project's "Draft Integrated Feasibility Report, Environmental Assessment and Draft Finding of No Significant Impact". The report is available for your review and comment on the Corps' website at: http://www.poa.usace.army.mil. Click on the "Reports and Studies" button and look under "Documents Available for Review, Civil Works."

The public comment period will close 30 days from the date of this notice. Comments may be submitted to the address below or via email. Comments received by this date will become part of the official record. No public meeting is scheduled for this action. If you believe a meeting should be held, please send a written request to the address below during the 30-day review period explaining why you believe a meeting is necessary. A Finding of No Significant Impact is expected to be signed upon review of comments received and resolution of significant concerns.

Please submit written comments to:

U.S. Army Corps of Engineers, Alaska District
ATTN: CEPOA-PM-C-ER (Noah)
P.O. Box 6898
Joint Base Elmendorf-Richardson, Alaska 99506-0898

Please send electronic comments to: SalmonCreekPOA@usace.army.mil.

Notice is also hereby given that the Corps will be applying for State Water Quality certification from the Alaska Department of Environmental Conservation (ADEC). ADEC may certify there is a reasonable assurance this proposed action and any discharge that might result will comply with the Clean Water Act, Alaska Water Quality Standards, and other applicable State laws. ADEC's certification may authorize a mixing zone and/or a short-term variance under 18 AAC 70. ADEC may also deny or waive certification.

Any person desiring to comment on this proposed action with respect to water quality certification may submit written comments to ADEC at the address below within 30 days from the date on this public notice.

Alaska Department of Environmental Conservation
WQM/401 Certification
555 Cordova Street
Anchorage, AK 99501-2617
Telephone: (907) 269-7564
FAX (907) 269-7508

Requests for additional information and questions about the proposed project may be sent to me at: Michael.D.Noah@usace.army.mil. I may also be reached at (907) 753-2677.

Michael D. Noah
Chief, Environmental Resources Section

US Army Corps of Engineers

Draft Interim Integrated Feasibility Report,
Environmental Assessment
and Draft Finding of No Significant Impact

Salmon Creek Flood Risk Management Section 205

Seward, Alaska, Alaska District, Pacific Ocean Division

May 2015
Status: DRAFT

Prepared by
United States Army Corps of Engineers
Alaska District

May 2015

DRAFT
Finding of No Significant Impact

In accordance with the National Environmental Policy Act of 1969 (NEPA), as amended, the Alaska District, U.S. Army Corps of Engineers (Corps) has tentatively selected the following action for construction and assessed its potential environmental effects:

Flood Risk Management Improvements (Section 205)
Salmon Creek (Seward), Alaska

The non-Federal partner currently maintains a temporary berm constructed during high flow events to confine upper Salmon Creek at Seward, Alaska to its main channel. Without a structure in place, the stream would exit its banks and flow directly into the Bear Lake Subdivision. The Corps examined the feasibility and environmental effects of implementing flood risk management measures along upper Salmon Creek. The tentatively selected plan (Alternative L3) maximizes net national economic development benefits while minimizing effects on the environment. Major construction features include:

- Shaping in-situ material to provide the core of an engineered 1,500-foot-long berm;
- Placement of a 1.5-foot-thick layer of filter rock and a 3-foot-thick layer of armor rock on top of the core material to complete the berm;
- Upgrading 3,225 feet of mud trail with gravel to access the project site for construction, operation, and maintenance purposes;
- Constructing a 1,500-foot-long gravel trail and 6,000-square-foot gravel parking area to facilitate the public's recreational usage of the area.

The Corps determined that the flood risk management project will have no adverse effect on species protected under the Endangered Species Act or the Marine Mammals Protection Act, or on essential fish habitat. The Corps also determined that the action will have no adverse effect on cultural or historical resources, with concurrence from the State Historic Preservation Officer under the National Historic Preservation Act. The Corps' proposed action will not, in association with past, present or anticipated future actions cause appreciable cumulative impacts.

After evaluating the anticipated environmental, economic, and social effects, it is my determination that the proposed project does not constitute a major Federal action significantly affecting human health or the environment. Therefore, preparation of an Environmental Impact Statement is not required.

_____ _____

Christopher D. Lestochi Date
Colonel, U.S. Army Corps of Engineers
District Commander

Executive Summary

This report examines the need for construction of flood risk management measures along the upper reaches of Salmon Creek near Seward, Alaska and determines the feasibility of Federal participation in the potential improvements.

Flood-related problems on this stretch of stream derive from the alluvial nature of the area in which streams meander through a wide footprint, often selecting relic channels during high flow events, flooding structures and depositing material. Currently, Seward Bear Creek Flood Service Area, a subsidiary of the Kenai Peninsula Borough, is charged with conducting flood-fighting activities along this and other area streams. During high flow events, bulldozers push river-run material into a temporary berm to act as a channel training structure, confining flows from Salmon Creek to its main channel.

This study evaluated a number of alternatives based on economic, engineering, environmental, and other factors. Alternative L3 maximizes the net National Economic Development benefits and has been selected as the National Economic Development Plan. The non-Federal partner (Kenai Peninsula Borough) supports this plan, which is carried forward as the Recommended Plan. The Recommended Plan provides an armored revetment, approximately 1,500 feet in length, which will provide flood risk management to the area. Construction will require the upgrade of 3,225 feet of mud trail to accommodate equipment. Minor recreation features will be included to facilitate the public's enjoyment of the area after construction has been completed. The Recommended Plan has a construction cost of approximately $3.28 million (2015 price levels). The annual investment cost of the project, including the cost of operation and maintenance, is $139,000 with annual National Economic Development benefits of $436,000. The project's benefits to cost ratio is 3.14 with net annual benefits of $297,000.

The local sponsor, Kenai Peninsula Borough, will be required to pay the non-Federal share of 35 percent of the costs assigned to flood risk management features of the project as specified by the Flood Control Act of 1948, as amended, and also will be required to pay 50 percent of the costs assigned to recreation features of the project as specified by The Flood Control Act of 1944, as amended. The estimated non-Federal share of construction is $1.16 million, which includes $1.13 million for flood risk management measures and $22,000 for recreation features. The non-Federal partner will also be responsible for operation and maintenance of the project. The Federal share of the project is $2.16 million, which includes $2.14 million for flood risk management measures and $22,000 for recreation features.

Pertinent Data

Recommended Plan			
Revetment		**Other Features**	
Length	1,500 feet	Access Road Length	3,225 feet
Crest Width	12 feet	Access Road Width	12-24 feet
Core Material	4,030 cubic yards	Access Road Gravel Quantity	17,200 cubic yards
Filter Stone	2,040 cubic yards		
Armor Stone	7,310 cubic yards	Parking Area	6,000 square feet
		Parking Area Dimensions	200'x 30'
		Parking Area Quantity	670 cubic yards
		Multi-Use Gravel Trail Length	1,500 feet
		Multi-Use Gravel Trail Width	8 feet
		Multi-Use Gravel Trail Quantity	1,245 cubic yards

Item	Amount
Total Certified Design and Construction Costs	$3,281,000
Annual Operation and Maintenance	$9,850
Total Annual National Economic Development Cost (50 years, 3.375%)	$139,000
Annual Benefits	$451,000
Average Net Annual Benefits	**$297,000**
Benefit to Cost Ratio	**3.14**

Note: Totals may not sum due to rounding.

Conversion Table for SI (Metric) Units		
Multiply	By	To Obtain
Cubic Yards (cy)	0.7646	Cubic Meters
Acre (ac)	0.4049	Hectare
Feet	0.3048	Meters
Feet Per Second	0.3048	Meters Per Second
Inches	2.5400	Centimeters
Knots (international)	0.5144	Meters Per Second
Miles (U.S. Statute)	1.6093	Kilometers
Miles (Nautical)	1.8520	Kilometers
Miles Per Hour	1.6093	Kilometers Per Hour
Pounds (mass) (lb)	0.4536	Kilograms

*To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: C = (5/9)(F-32)

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1.0 INTRODUCTION

1.1 Authority

This feasibility study is being conducted under authority granted by Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended.

1.2 Scope of the Study

This study examines the feasibility and environmental effects of implementing flood risk management measures along upper Salmon Creek at Seward, Alaska. The City of Seward is located on the southern coast of the Kenai Peninsula, approximately 75 air miles south-southwest of Anchorage. The project area is shown below in Figure 1. The non-Federal partner for the feasibility study is the Kenai Peninsula Borough. The study area is in the Alaska Congressional District, which has the following congressional delegation: Senator Lisa Murkowski (R); Senator Dan Sullivan (R); and, Representative Don Young (R).

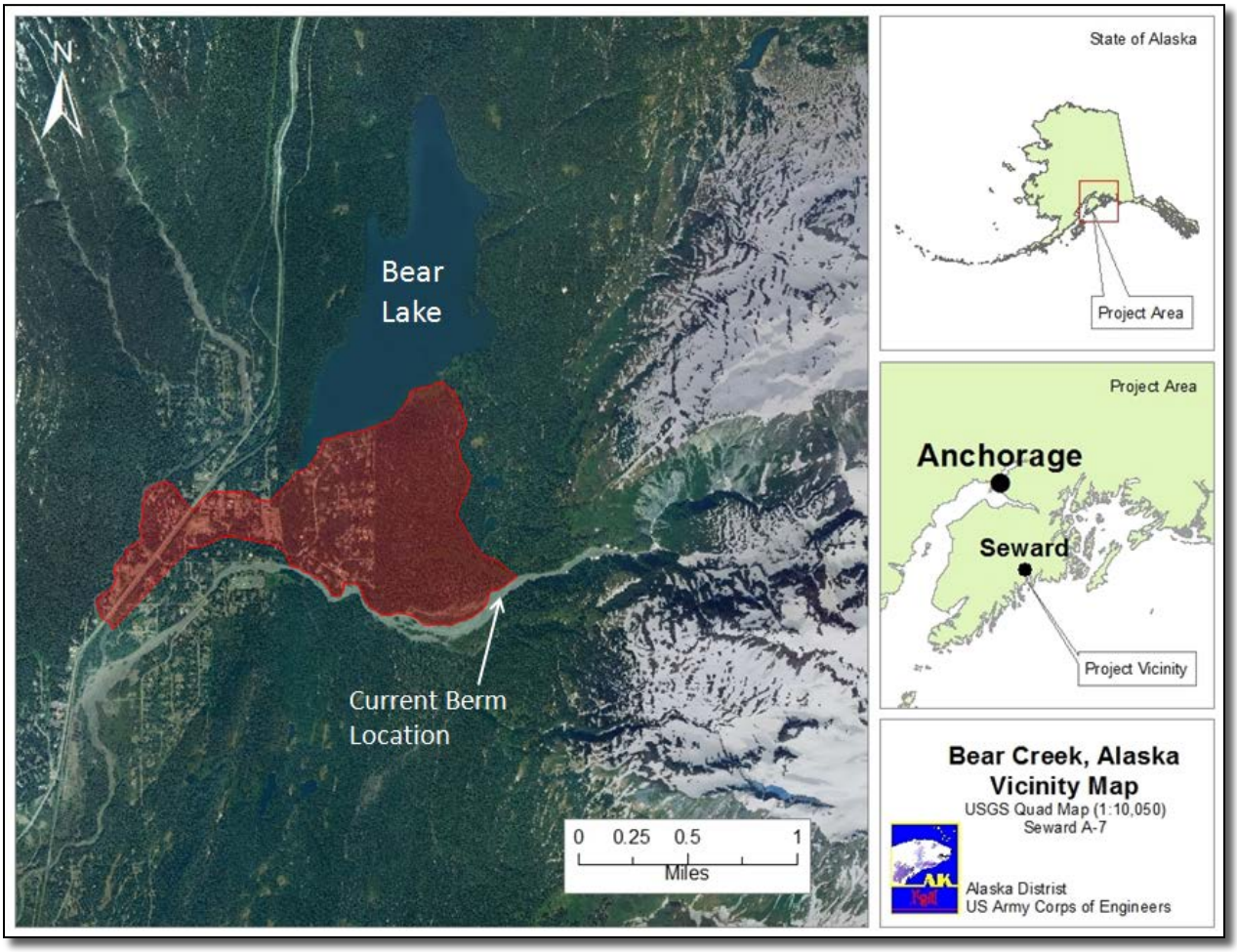

Figure 1: Study Area (area protected by berm in red)

U.S. Army Corps of Engineer Regulation 1105-2-100, "*Planning Guidance Notebook*" defines the contents of feasibility reports for flood risk management measures. Engineer Regulation 200-2-2, "*Procedures for Implementing NEPA*", directs the contents of environmental assessments. This document presents the information required by both regulations as an integrated feasibility report and environmental assessment. It also complies with the requirements of the Council on Environmental Quality regulations for implementing the National Environmental Policy Act of 1969 (42 United States Code 4321 et seq.).

This draft Integrated Feasibility Report and Environmental Assessment documents the studies and coordination conducted to determine whether the Federal Government should participate in flood risk measures along Salmon Creek at Seward, Alaska. Studies of potential flood risk management measures considered a wide range of alternatives and the environmental consequences of those alternatives, but focused mainly on actions that would provide efficient and effective management of flood risk to the surrounding community. Flood risk management is a high priority mission for the Corps, and flood risks due to high flows along Salmon Creek generate sufficient National Economic Development benefits to allow the U.S. Army Corps of Engineers to recommend a project to Congress. The Corps of Engineers can only recommend to Congress flood risk management measures cost-shared by non-Federal partners. The Kenai Peninsula Borough has stated its intention to cost-share in Federally-constructed flood risk management measures along Salmon Creek. This partnership of Federal and non-Federal interests in flood risk management measures helps ensure that those measures will effectively serve both local and national needs.

1.3 Study Participants and Coordination

The Alaska District, U.S. Army Corps of Engineers was primarily responsible for conducting studies for flood risk management measures at Seward. The studies that provide the basis for this report were conducted with the assistance of many individuals and agencies, including the Kenai Peninsula Borough, the United States Forest Service, the State of Alaska Historic Preservation Officer, the State of Alaska Department of Fish and Game, the State of Alaska Department of Environmental Conservation, the State of Alaska Department of Natural Resources, and many members of the interested public who contributed information and constructive criticism to improve the quality of this report.

1.4 Related Studies and Reports

2007 – Northwest Hydraulic Consultants. "Hydrology for Floodplain Insurance Restudy of City of Seward, Kenai Peninsula Borough, Alaska – EMS-2001-CO-0067, Task Order #28". This study evaluated hydrology within the various floodplains of the greater Seward area.

2010 – Northwest Hydraulic Consultants. "Preliminary DFIRMs for the Seward Area". This study provided draft flood inundation risk maps for the greater Seward area.

2011 – U.S. Army Corps of Engineers, "Seward Planning Assistance to States Flood Risk Management". This study evaluated flood risks in all watersheds of concern in the greater Seward area.

2.0 PLANNING CRITERIA/PURPOSE AND NEED FOR THE PROPOSED ACTION*

2.1 Problem Statement/Purpose and Need

The majority of the Seward area is subject to some degree of flooding due to the many creeks that drain the area. The area is characterized by multiple alluvial plains bordered by steep mountains. Each of the many creeks (shown in Figure 2) drains steep, small watersheds that are subject to flash-floods during high-precipitation events. The City of Seward, the Kenai Peninsula Borough, and local residents all conduct flood fighting activities on the creeks that pose the highest threats to people, structures, and infrastructure.

Salmon Creek is a glacier-fed stream characterized by a steep gradient channel contained within a narrow valley that opens onto a broad alluvial fan. The stream bed consists mainly of coarse gravel and cobbles with some sand and fine-grained soils. The creek flows out of a mountain canyon to the east of the study area and meanders approximately 6 miles to its confluence with the Resurrection River just upstream of its mouth at Resurrection Bay. The primary problem this study will address is risk of inundation due to sediment deposition and high flows along the far upper reaches of Salmon Creek. The upper reaches of Salmon Creek are referred to locally as "Kwechak Creek." However, in this report, it will be referred to as "Salmon Creek." In the reach examined by this study, the flow with a 0.1 annual chance of exceedance is approximately 1,190 cubic feet per second and has an upstream drainage area of approximately 6.9 square miles. At its mouth, Salmon Creek has a flow with a 0.1 annual chance of exceedance of approximately 2,640 cubic feet per second and drains a watershed of approximately 36 square miles.[1,2]

The non-Federal partner currently maintains a temporary berm constructed during high flow events to confine the stream to its main channel. The berm is constructed by bulldozers that push river-run material up into a continuous alignment along the bank. Without a structure in place, the stream would exit its banks and seek to recapture a relic channel to the east of Bear Lake Subdivision. This relic channel flows directly into Bear Lake Subdivision. If flows through the relic channel reached Bear Lake Subdivision, structures would be inundated and a great deal of sediment would be deposited, necessitating a large clean-up effort. The flow through the relic channel would deposit into Bear Creek, increasing flows through that stream, and inundating structures downstream of Bear Lake Subdivision.

Due to the historically rural and undeveloped nature of the area, detailed records of past flood events are not available. Data about past floods is mostly anecdotal in nature and provided by long-time residents of the area. According to a previous study, the creek has flooded 10 times since 1946, with the worst flooding occurring in 1986 when remnants from Typhoon Carmen dropped 18 inches of precipitation in the Seward area over the course of 3 days.[3] During this

[1] "Preliminary DFIRMs for the Seward Area, Northwest Hydraulic Consultants, 28 January 2010
[2] "Hydrology for Floodplain Insurance Restudy of City of Seward, Kenai Peninsula Borough, Alaska – EMS-2001-CO-0067, Task Order #28, Northwest Hydraulic Consultants, 30 November, 2007
[3] "Planning Assistance to States Flood Risk Management", United States Army Corps of Engineers, November 2011

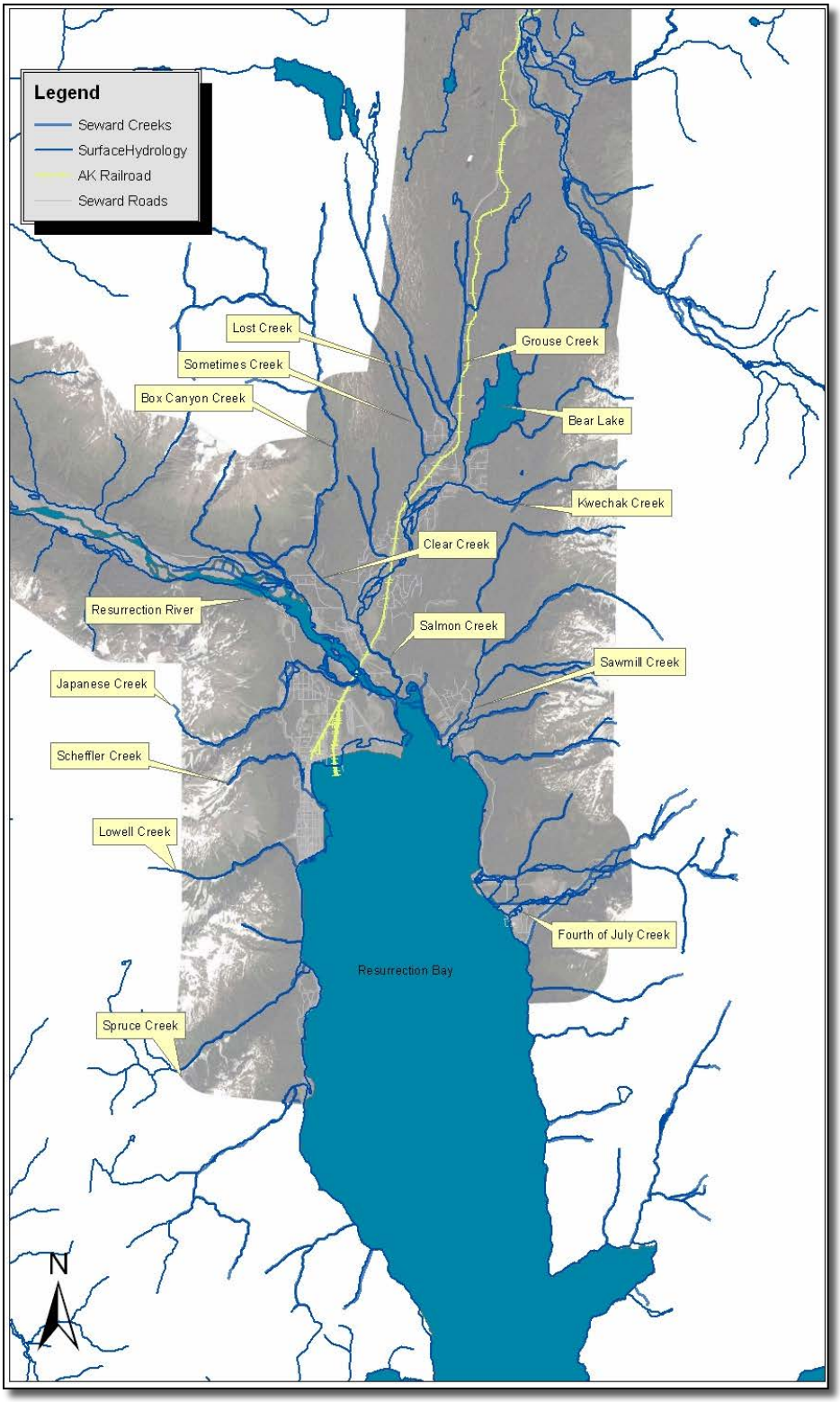

Figure 2: Seward Watersheds

event, severe flood and damages were reported in the Bear Lake area. Other major events occurred in 1995, 2002, and 2006. Local consensus is that absent ongoing action by the non-

Federal partner, the area downstream of the existing temporary berm would be inundated on a regular and on-going basis.

Figure 3: Existing Temporary Berm

2.2 Opportunities and Constraints

Opportunities are instances in which the implementation of a plan has the potential to positively address an issue or impact a resource without being formulated specifically for that resource or issue. Constraints are restrictions that limit the planning process over and above those instituted specifically by laws, policies, and guidance.

2.2.1 Opportunities

Provide for the enhancement of existing recreational opportunities, where justified.

2.2.2 Constraints (Factors to avoid)

Any structural alternatives should not increase inundation of structures downstream of the study area through changes in stream hydraulics and hydrology.

2.3 Objectives

2.3.1 National Objectives

The Federal objective of water and land resources planning is to contribute to National Economic Development in a manner consistent with protecting the nation's environment. National Economic Development features increase the net value of goods and services provided to the

economy of the nation as a whole. Only benefits contributing to National Economic Development may be claimed for Federal economic justification of a project. For Salmon Creek, these features may be structural measures such as levees or floodwalls, non-structural measures such as elevations or relocations, and to the extent allowed by policy, recreational features.

Water resource planning must be consistent with National Economic Development objectives and must consider engineering, economic, environmental, and social factors. The following objectives are guidelines for developing alternative plans and are used to evaluate those plans.

2.3.1.1 Federal Engineering Objectives

There is no minimum level of performance or protection required by Corps of Engineers projects (Engineer Regulation 1105-2-100). However, residual risk presented by varying levels of protection must be adequately analyzed and communicated. Generally, the engineering solution selected will be the one that presents the greatest level of net National Economic Development benefits with an acceptable level of environmental impacts.

2.3.1.2 Federal Economic Objectives

Principles and guidelines of Federal water resources planning require identification of a plan that would produce the greatest contribution to National Economic Development. The National Economic Development plan is defined as the environmentally acceptable plan providing the greatest net benefits. Net benefits are determined by subtracting annual costs from annual benefits. Corps of Engineers policy requires recommendation of the National Economic Development plan unless there is adequate justification to do otherwise.

All alternatives that would meet project needs must be presented and should be described in quantitative terms if possible. Benefits attributed to a plan must be expressed in terms of a time value of money and must exceed equivalent economic costs for the project. To be economically feasible, each separate portion or purpose of the plan must provide benefits at least equal to its cost. The scope of development must be such that benefits exceed project costs to the maximum extent possible. The economic evaluation of alternative plans is on a common basis of 2015 prices, a project life of 50 years, and the Federal fiscal year 2015 discount rate of 3.375 percent.

2.3.2 Study Objectives

Study-specific objectives consist of the following:

- Decrease the risk of inundation along upper Salmon Creek and associated inundation along Bear Creek over the 50-year period of analysis;
- Decrease the sponsor's flood fighting expenditures along Salmon Creek over the 50-year period of analysis; and
- Provide for associated recreational opportunities where justified.

2.4 Criteria

2.4.1 National Evaluation Criteria

Federal Principles and Guidelines establish four criteria for evaluation of water resources projects. Those criteria and their definitions are listed below.

2.4.1.1 Acceptability

Acceptability is defined as "the viability and appropriateness of an alternative from the perspective of the Nation's general public and consistency with existing Federal laws, authorities, and public policies. It does not include local or regional preferences for particular solutions or political expediency."

2.4.1.2 Completeness

Completeness is defined as "the extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. It does not necessarily mean that alternative actions need to be large in scope or scale."

2.4.1.3 Effectiveness

Effectiveness is defined as "the extent to which an alternative alleviates the specified problems and achieves the specified opportunities."

2.4.1.4 Efficiency

Efficiency is defined as "the extent to which an alternative alleviates the specified problems and realizes the specified opportunities at the least cost."

2.4.2 Study Specific Evaluation Criteria

A project that effectively serves both Federal and non-Federal interests must be sited, planned, and operated so that it safely and efficiently meets user needs. The following goals and objectives, based on the needs described in Section 2.3, are related to providing a solution that is safe, usable, and maintainable.

2.4.2.1 Safety

The alternative should be safe for recreational users. Recreational features should be safe from natural hazards such as high flows, avalanches, and landslides.

2.4.2.2 Compatibility

The selected site and alternative should be physically and aesthetically compatible with surrounding land uses.

2.4.2.3 Accessibility

The site and alternative should be reasonably accessible to allow for adequate operation and maintenance activities to take place throughout the life of the project.

2.4.2.4 Supportability

Any implemented plan should be financially supportable by the non-Federal partner in order to ensure that operation and maintenance is able to be completed in an ongoing and timely manner.

3.0 BASELINE CONDITIONS/AFFECTED ENVIRONMENT*

3.1 Community and People

3.1.1 History

Seward is named after former U.S. Secretary of State William H. Seward, who negotiated America's purchase of Alaska from Russia. It was first settled in the 1890s and became an incorporated city in 1912. The Alaska Railroad was constructed between 1915 and 1923 with Seward sited at the railroad's southern terminus, allowing the city to act as an ocean terminus and supply center. Seward was largely destroyed by tsunamis resulting from the 1964 Good Friday Earthquake, which registered 9.2 on the moment magnitude scale. Today, Seward is an important supply center as the southern terminus of the Alaska Railroad, which is used to export coal from Interior Alaska to the Far East. While there is no federally-recognized tribe, the Qutekcak people are active within the community and are petitioning for Federal recognition.

3.1.2 Demographics

In 2013 the State of Alaska Department of Labor and Workforce Development estimated Seward's population to be 2,487. However, there are multiple census-designated places outside Seward's city limits that are still located within the greater Seward area. The population of the greater Seward area is shown in Table 1. The project site is within the Bear Creek Census Designated Place (CDP).

Table 1: Area Population

Area	2013 Estimated Population
Bear Creek CDP	2,100
Crown Point CDP	75
Lowell Point CDP	75
Moose Pass CDP	249
Primrose CDP	74
City of Seward	2,487
Total:	**5,060**

The population is approximately 68 percent White, 27 percent American Indian or Alaska Native, 3 percent African American, 2 percent Asian, and 8 percent two or more races in combination. Other small groups (less than 1 percent) include Pacific Islanders. The population is 62 percent male and 38 percent female. The median age of the population is 40 years.

3.1.3 Land Use

The land surrounding the project site is generally categorized as mature forest along the north bank of Salmon Creek with steep mountain slopes to the south. The creek flows through a steep mountain canyon just upstream of the project site and meanders through a 300-foot-wide outwash plain downstream of the project.

Residents utilize the area around Bear Lake for recreational activities such as cross-country skiing, dog sledding, equestrian riding, hiking, camping, target shooting, and motorized activities (all-terrain vehicle and snowmachine). Opportunities along Salmon Creek are somewhat limited due to a lack of access. Access to Salmon Creek is provided by a four-wheel-drive accessible mud trail that may not be passable during some conditions. The creek bed is listed as a Nordic

ski trail. However, the nearest parking area with access to the trail system is in Bear Lake Subdivision at the terminus of Tiehacker Road.[4]

As shown in Figure 4, the Kenai Peninsula Borough owns the land the current berm is sited on, with the United States Forest Service owning the land upstream of the berm and the State of Alaska owning the lands downstream of the berm but upstream of private land starting at the eastern boundary of Bear Lake Subdivision. Lands downstream of the State of Alaska land are privately owned through the downstream end of the study area.

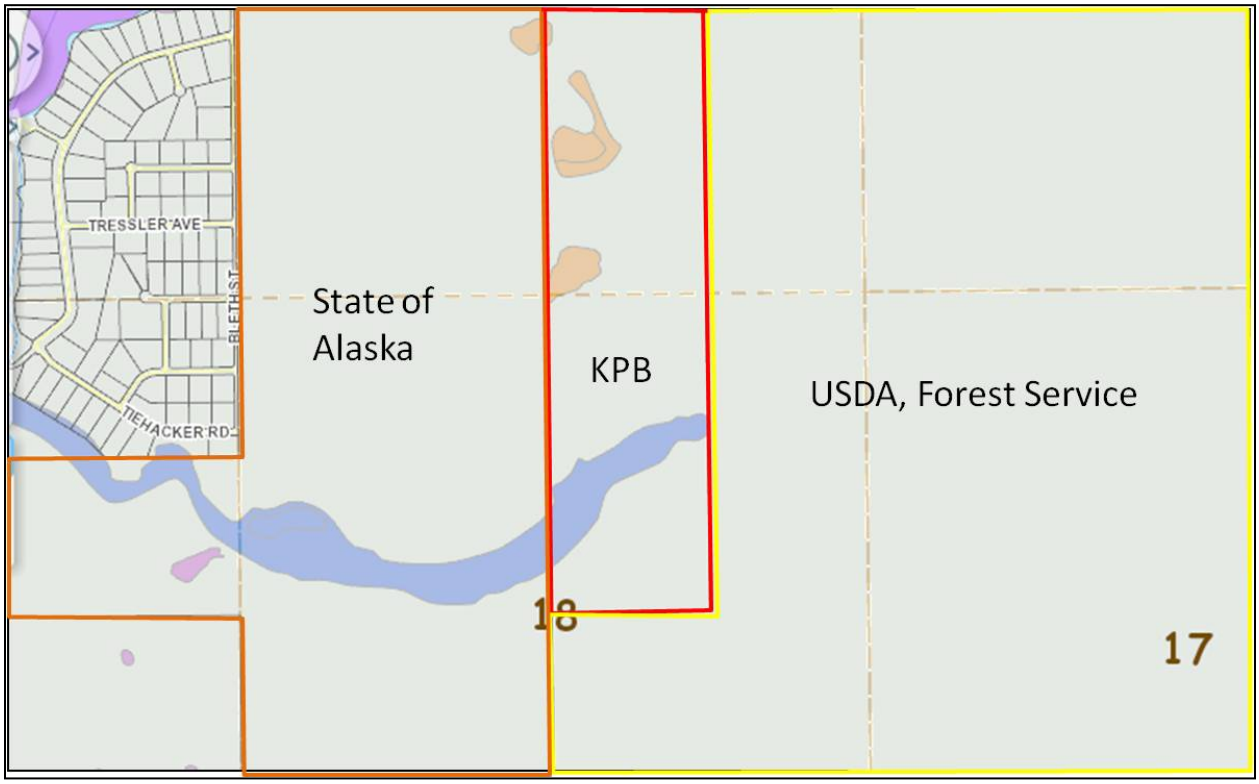

Figure 4. Land Ownership

In addition to the interests shown in Figure 4, the U.S. Forest Service has been granted an easement with a 1,000-foot-wide buffer through the State of Alaska land as part of the Iditarod National Historic Trail system.[5] While this portion of the trail is not historic from a regulatory standpoint, it retains the "historic" portion of its name as a segment of a larger trail system, portions of which are historic in nature.[6]

3.2 Physical Environment

Seward is on the eastern shore of the Kenai Peninsula, 65 miles south-southeast of Anchorage. The project site is located at 60°10.763'N and 149°20.651'W.

[4] http://www.sewardnordicskiclub.org/page26/assets/Iditarod%20south%20pdf.pdf
[5] State of Alaska Department of Natural Resources (2004). Final Finding and Decision ADL 228890 Grant of Public Easement Iditarod National Historic Trail Seward to Girdwood.
[6] United States Department of Agriculture Forest Service, Chugach National Forest Glacier and Seward Ranger Districts (September 2009). Cultural Resources Survey Results Iditarod Trail Surveys (2002-2006) Seward to Ingram Creek.

3.2.1 Climate

Seward experiences a maritime climate with average winter temperatures ranging from +17 degrees Fahrenheit to +38 degrees Fahrenheit and average summer temperatures ranging from +49 degrees Fahrenheit to +63 degrees Fahrenheit. The area receives an average of 66 inches of rain and 80 inches of snowfall annually.

3.2.2 Hydrology

In general, the area's creeks drain small, steep watersheds and exhibit flows that can increase rapidly depending on the length and severity of precipitation events. A glacier makes up a portion of the headwaters of Salmon Creek. Just downstream of the glacier there is exposed rock with very little soil or vegetation. Glacial runoff during the summer contributes a large portion of the stream's total flow. Therefore, winter flows are far below those seen during the summer. The streambank experiences a significant buildup of snow and ice during the winter months due to the large amount of precipitation that falls in the Seward area. During this time, all of the ground in the outwash plain can be covered by multiple feet of snow. Depending on temperature fluctuations, ice crusts can form on the top of the snow cover.

3.2.3 Geology/Topography

The area was shaped by glaciation, which accounts for the fjord-like landscape with characteristically steep mountains. The valleys between the mountains are relatively small watersheds drained by small streams.

3.2.4 Soils/Sediments

The area generally consists of overlapping alluvial plains surrounded by steep mountains. The area's underlying bedrock is typically made of phyllite and greywacke overlain with deposits of loose silt, sands, and gravels with some clay cobbles and boulders. The valley floors are composed of fine sediments such as glacial till, fluvial deposits, and marine deposition.[7]

3.2.5 Geomorphology

As described in Section 2.1, sediments in Salmon Creek range from fine-grained soils to coarse gravels and cobbles. The stream flows on a steep gradient through the study area. During high flows, the stream mobilizes the larger sediments, carrying them downstream and depositing them in areas of lower energy. There is evidence to suggest that Salmon Creek has previously flowed through a number of alignments between its current channel and Bear Lake. During uncontrolled higher flows, the stream would be expected to exit its banks and recapture a relic channel to the north between its current channel and Bear Lake. As the stream exited the channelized portion of the relic channel and spread out into Bear Lake Subdivision, it would drop its sediment load, raising the ground level and eventually redirecting flows throughout the subdivision.

3.2.6 Water Quality

Salmon Creek is mostly fed by glacial melt supplemented by runoff from precipitation events. The stream has high turbidity year-round due to the fine nature of the sediments it carries. No residential or municipal water sources are in the project area.

[7] City of Seward, 1979

3.2.7 Air Quality

Air quality in the project area is good due to a number of factors. The site is isolated and therefore there are few emissions sources. There is fairly continuous air movement through the valley supplemented by nearby marine air movements that also contribute to the good air quality of the area. The primary sources of air pollution are related to automobiles and residential heat sources such as fuel oil and wood stoves. Wood stoves fueled with wet wood are of particular concern because they contribute to fine particle pollution.[8] Other concerns are blown dust, wildfires, and volcanic eruptions.

3.2.8 Noise

Main noise sources in the area are related to human recreational activities such as motorized recreation and dog sledding.

3.2.9 Hazardous, Toxic, and Radioactive Waste (HTRW)

Due to the area's mostly pristine nature lacking a history of sustained, concentrated human use beyond that for low-impact recreational use, it is considered unlikely that any HTRW is present in the area.

3.3 Biological Resources

3.3.1 Terrestrial Species and Habitat

The project site is a highly disturbed depositional area with no vegetation to offer food or cover for terrestrial species. While it is possible for ground-nesting birds such as terns or plovers to use the gravel deposits as nesting habitat, this has not been observed. Due to the presence of more favorable nearby habitat, it is likely that these species would choose to nest elsewhere.

Outside of the immediate project area, there is a mix of wetlands and uplands with diverse vegetation types that provide habitat for over 200 species commonly found on the Kenai Peninsula.[9,10] The uplands beneath 1,500 feet of elevation generally consist of old-growth hemlock and spruce and are mostly undisturbed by fire or parasites.

These forests provide potential nesting habitat for goshawks, raptors, and migratory fowl. The area provides cover and denning areas for large mammals and travel corridors for moose, bear, wolverines, and wolves. It also provides winter foraging areas for mountain goats. Gaps in the canopy support stands of mountain hemlock (*Tsuga mertensiana*), devil's club (*Oplopanax horridus*), and blueberries which provide forage areas for bears. Limited mature mixed hardwood areas support populations of thrushes and warblers.[11]

3.3.1.1 Vegetation

The immediate project area is a highly disturbed deposition area with very little vegetation present. Opportunistic species such as Alder and Devil's Club grow at the margins of the deposition area with trace numbers of ferns and mosses. Based upon an investigation of the

[8] State of Alaska, 2013
[9] State of Alaska, Air Monitoring
[10] United States Department of Agriculture, 2011
[11] United States Department of Agriculture, 2011

site's vegetation, the immediate project area does not meet the qualifications necessary to be considered a jurisdictional wetland.

Construction of an access road will entail improvement of an existing trail that currently runs through areas where the vegetation is similar to uplands described in Section 3.3.1.

3.3.1.2 Birds

Birds in the area are typical of those found in Southcentral Alaska including Arctic terns (*Sterna* paradisaea), bald eagles (*Haliaeetus* leucophalus), fox sparrows (*Passerella* iliaca), lesser yellowlegs (*Tringa* flavipes), olive-sided flycatchers (*Contopus* cooperi), rufous hummingbirds (*Selasphorus* rufus), short-billed dowitchers (*Limnodromus* griseus), and short-eared owls (*Asio* flammeus) in addition to species of warblers (*Parulidae*), thrushes (*Turdidae*), and other raptors.

3.3.2 Aquatic Resources

3.3.2.1 Invertebrates

The highly dynamic nature of the stream precludes colonization of the area by these organisms. Any colonies that may become established would likely be removed from the area during subsequent high flow events.

3.3.2.2 Vegetation

The immediate project area does not contain significant amounts of aquatic vegetation. This is mostly due to its highly depositional and disturbed nature which does not allow for in-stream colonization by even highly-opportunistic species.

3.3.2.3 Fish and Essential Fish Habitat

Salmon Creek as a whole supports resident Dolly Varden (*Salvelinus malma malma*), cutthroat trout (*Oncorhynchus clarkii*), rainbow trout (*O. mykiss*), and other fish that may be present in the water at the project site. The lower reaches of Salmon Creek support anadromous fish. However, the upper reach of the stream that makes up the study area does not support anadromous fish runs; therefore, it is not considered essential fish habitat.

3.3.3 Federal and State Threatened and Endangered Species

The area does not contain any Endangered Species Act-listed plant species or state-listed sensitive plant species. The Endangered Species Act-listed Kittlitz's murrelet (*Brachyramphus* brevirostris) is known to be present in the Seward area but is not likely to be present in the project area due to the site's great distance from preferred marine feeding areas near tidewater glaciers.[12]

3.4 Socio-Economic Conditions

3.4.1 Employment and Income

According to the Alaska Department of Labor and Workforce Development, 59 percent of resident workers were employed during 2012, (the last year for which statistics are available). The largest industry is Trade, Transportation, and Utilities with significant employment in

[12] United States Fish and Wildlife Service, 2014

Education and Health Services, Leisure and Hospitality, and State and Local Government. A great number of workers are employed through commercial fishing and businesses that support that industry.

Mean per capita income in Seward is approximately $27,300 with a median household income of $42,600 and a median family income of $65,400. Approximately 6 percent of local residents have incomes lower than the Federal poverty threshold.[13]

3.4.2 Existing Infrastructure and Facilities

Currently, during high flow events, Seward Bear Creek Flood Service Area, a subsidiary of the Kenai Peninsula Borough, conducts flood fighting activities along Salmon Creek. These efforts generally consist of multiple bulldozers entering the creek bed and pushing up river run material to form a temporary protective berm. This berm is highly erodible and the flood fighting activities must take place for the entirety of the high flow event. Flood fighting takes place from sunrise to sunset and is effective for high flow events up to a 0.1 annual chance of exceedance.

Bear Lake Subdivision is located just downstream of the current berm site. Infrastructure within that subdivision includes 99 lots containing 203 structures including residences, sheds, detached carports and garages, greenhouses, machine shops, etc. The subdivision contains 11 separate roads that total 2.6 miles in length and various other utilities supporting the residences.

Development in the downstream reaches of Bear Creek is mostly residential with some light commercial activity such as cabin rentals and mini-storage.

3.4.3 Cultural and Subsistence Activities

Present day Seward is primarily non-Native but there is still a strong cultural tie to the outdoors including both food gathering activities such as fishing, hunting, and berry picking as well as non-food gathering activities such as hiking, camping, skiing, and motorized recreation activities.

3.5 Historical and Archeological Resources

A letter to the State of Alaska Historic Preservation Officer defined the Area of Potential Effect for this project as a 1,400-foot-long, 30-foot-wide section of the creek's eastern embankment, as well as the placement of a gravel road and a staging area. There are no cultural resources within the Area of Potential Effect.

Due to the highly alluvial nature of the project area, it is highly unlikely that there are any historical or archaeological resources present. Soils and sediments in the area consist of a relatively thin layer of riverine deposits on top of shallow bedrock. Historically, high flows would likely have transported any existent artifacts downstream with the alluvial material. The road and parking area are being constructed in highly disturbed areas that are unlikely to contain historical or archaeological resources.

The Alaska State Historic Preservation Officer has concurred with this assessment.[14]

[13] Alaska Division of Community and Regional Affairs, 2014
[14] State of Alaska, October 07, 2014

4.0 FUTURE WITHOUT PROJECT CONDITIONS

4.1 Physical Environment

The area consists of sparse residential development in Bear Lake Subdivision with some commercial and industrial use along Bear Creek where it meets the Seward Highway. It is unlikely that the basic nature of the area will change over the planning period of analysis.

Short observational records in Alaska make it difficult to separate climate change from natural multi-decadal variability. There are also quality problems, especially for measurements of precipitation and discharge. While there is evidence of a statewide average temperature increase of approximately 3 degrees Fahrenheit over the last 60 years, there are few spatially coherent trends in precipitation in Alaska.[15] Thus, an increase or decrease in precipitation and resulting changes in stream discharge for this study area are considered unlikely.

4.2 Economic/Political Conditions

The State of Alaska Department of Labor and Workforce Development projects the Kenai Peninsula Borough as a whole to gain approximately 9,000 residents over the next 30 years. The degree to which this increase occurs specifically in the greater Seward area is dependent upon a number of factors. The city's relative proximity to Anchorage, access to marine recreation, and rural lifestyle while maintaining common services and conveniences makes it an attractive location for some future development. However, a significantly large increase in development and population is not expected.

Table 2: State of Alaska Population Projections for the Kenai Peninsula Borough

Year	Population	Increase
2012	56,756	N/A
2017	59,225	2,469
2022	61,391	2,166
2027	63,116	1,725
2032	64,321	1,205
2037	65,098	777
2042	65,647	549

Because of this relatively stable environment, the prevailing economic and political conditions are not expected to change significantly over the period of analysis.

4.3 Planned Development

Currently, 20 of the 99 lots in Bear Lake Subdivision remain undeveloped. It is reasonable to assume that a number of these lots will be developed to some degree over the period of analysis as Seward is a desirable destination for tourists and for second homes. There is also the potential for future development along Bear Creek.

The plot of land currently owned by the State of Alaska has been targeted for transfer to the Kenai Peninsula Borough as part of the Borough's municipal entitlement. It is likely that once

[15] McAfee, et al.

the land has been transferred, the area will be targeted for residential development. However, the transfer process is lengthy and the non-Federal partner estimates that this process will take up to 10 years to complete. Given the rural-residential nature of the area and the fact that Bear Lake Subdivision is not fully developed, it is difficult to determine what the level of development will be over the 50-year period of analysis. In order to be conservative in estimates of project benefits, there is not assumed development in Bear Lake Subdivision within the planning period of analysis.

In addition, there is no reason to believe that significant development will take place along Bear Creek over the 50-year period of analysis. Due to the steep terrain and relatively developed nature of the area, there is little available developable land.

4.4 Future Without-Project Scenarios

In the future, the area will remain subject to inundation and sediment deposition during events exceeding a 0.1 annual chance of exceedance as events larger than this overwhelm local flood fighting activities. During those larger events, Salmon Creek will break out of its banks and flow into a relic channel, inundating parts of Bear Lake Subdivision before entering Bear Creek. Elevated water levels in Bear Creek will cause inundation within that watershed. For events at or smaller than events with a 0.1 annual chance of exceedance, the non-Federal partner will continue to spend its limited funding on flood fighting activities.

4.5 Biological Environment

The basic nature of the area is not expected to significantly change over the 50-year period of analysis. The area should continue to receive significant precipitation, supporting existing forest growth and terrestrial habitat in areas that remain undeveloped. Given that the stream is partially glacial-fed, constant flow levels will depend on the rate of glacial retreat. However, there is insufficient evidence at this time to suggest a significant change in base flow due to glacial retreat and how any change will influence habitat quantity and quality.

4.6 Summary of Without-Project Conditions

The Without Project Condition forms the basis for impacts under the No Action Alternative. Given the nature of the area, it is unlikely that the future without project condition will differ greatly from the existing condition. The existing environmental resources discussed above will persist with no expected significant changes in stream flow, amount or quality of habitat, or diversity or populations of present species. The stream will continue to be highly depositional with highly disturbed banks. A large increase in human population or development in not projected within the study area over the 50-year planning period of analysis.

5.0 FORMULATION AND EVALUATION OF ALTERNATIVE PLANS*

5.1 Plan Formulation Rationale

Plan formulation is the process of building alternative plans that meet planning objectives and avoid planning constraints. Alternatives are a set of one or more management measures functioning together to address one or more planning objectives. A management measure is a feature or activity that can be implemented at a specific geographic location to address one or more planning objectives. A feature is a "structural" element that requires construction or assembly on-site whereas an activity is defined as a "nonstructural" action. Each alternative plan shall be formulated in consideration of criteria stated in Section 2.4.

5.2 Management Measures

A list of management measures is listed below. After going through a screening process based on listed criteria, each of the listed measures was carried forward for consideration.

5.2.1 Structural Measures

Structural measures are generally those measures that reduce the probability of inundation within the floodplain. These measures can include levees, floodwalls, dams, and channel training structures such as engineered berms and revetments.

5.2.2 Non-structural Measures

Non-structural measures are those measures that reduce the consequences of inundation by altering structures within the floodplain to make them less susceptible to damages related to flood events. These measures can include, but are not limited to: structure elevation, relocations, buyouts, and flood proofing.

5.2.3 Mitigation Features

Mitigation Features include avoidance of impacts, minimization of impacts that cannot be avoided, and compensatory mitigation of impacts after avoidance and minimization, if required. Given the nature of the area and the project, it is likely that mitigation will be conducted through the avoidance and minimization measures, primarily the enactment of best construction practices to avoid disturbance to fish passage.

5.3 Initial Array of Alternatives

5.3.1 No Action Alternative

The No Action Alternative would not construct any flood risk management measures at Seward, Alaska. Public concerns, issues, and environmental welfare would remain unchanged unless a non-Federal entity elected to construct measures. The identified purpose and need would not be met. The area downstream of the existing berm would continue to be subject to periodic flooding and the non-Federal partner would continue to engage in flood fighting activities during high-flow events.

5.3.2 Structural Alternatives

Given that a structural measure of some sort is currently in place, consideration of more permanent structural measures is appropriate. In this case, multiple alignments of structural

measures were considered. Once the proper alignment has been chosen, multiple alternatives will be considered.

5.3.2.1 Alignment 1

Alignment 1 is a permanent, engineered revetment approximately 1,500 feet in length that closely mirrors the alignment of the temporary flood-fighting berm constructed by the non-Federal partner during high flow events. The revetment would be constructed in a manner that would encourage self-scouring, allowing flows to move sediment downstream to a wider floodplain. This design feature would lower operation and maintenance costs and ensure that Salmon Creek would not recapture its relic channel. Due to the rudimentary nature of current site access, this alignment would require the current access trail to be upgraded to a two-lane gravel road stretching from the eastern terminus of Orlander Avenue to the project site. This alignment is expected to be highly effective in preventing Salmon Creek from entering its relic channels and causing flooding within the study area.

5.3.2.2 Alignment 2

Alignment 2 is a permanent, engineered revetment approximately 1,600 feet in length that generally follows the alignment of the current temporary berm constructed by the non-Federal partner during high flow events. The revetment would be setback to allow for greater meandering of the stream during high flow events and increased deposition within the outwash plain. This alignment would allow for greater floodplain functionality. There is the potential that this berm would require smaller armoring stone and require less frequent operation and maintenance costs than Alignment 1 by allowing for a longer period of deposition to take place before material is hauled out of the area. Due to the rudimentary nature of current site access, this alignment would require the current access trail to be upgraded to a two-lane gravel road stretching from the eastern terminus of Orlander Avenue to the project site. This alignment is expected to be highly effective in preventing Salmon Creek from entering its relic channel and causing flooding within the study area.

5.3.2.3 Alignment 3

Alignment 3 is a permanent, engineered revetment approximately 4,250 feet in length. The revetment would stretch eastward for 340 feet from Salmon Creek south of Tiehacker Road before turning northward and following the eastward edge of Bear Lake Subdivision to the southern shore of Bear Lake. This alignment would not require an upgrade of the current access trail and would allow for greater floodplain function. However, because of the increase in length of the revetment, this alignment would cost approximately three times as much as Alignment 1. Because this alignment would provide fewer benefits than Alignments 1 and 2 at a greater cost, it was not carried forward for further consideration.

5.3.3 Nonstructural Alternatives

5.3.3.1 Buyouts and Relocations

Relocations and buyouts were considered but ruled out. There is little developable land within the greater Seward area and much of it is subject to flooding. Therefore, it is likely that implementing a relocation strategy would simply transfer flood risk to another watershed in the greater Seward area.

5.3.3.2 Elevations

This measure would include raising the elevation of residences within the floodplain. This would reduce structural and content damages to residences during flood events. However, the non-Federal partner would continue flood fighting activities, and there would be no reduction in damages to ancillary structures such as detached garages, sheds, machine shops, etc.

5.3.3.3 Flood Proofing

This measure would flood proof residences within the flood plain so that inundation would not cause damage to these structures. There are two different types of flood proofing. Dry flood proofing seeks to make the exterior of a structure impermeable to flood waters, protecting the structure and contents during inundation events. Wet flood proofing modifies the structure to allow for water to pass through the structure without the structure or contents being damaged. This is most effective in structures with basements where appliances in the basements can be elevated to another level and the basement modified to allow water passage. If this were the selected alternative, the non-Federal partner would continue flood fighting activities, and there would be no reduction in damages to ancillary structures such as detached garages, sheds, machine shops, etc.

5.3.4 Recreation Measures

The Flood Control Act of 1944, as amended, The Federal Water Project Recreation Act of 1964, as amended, The Water Resources Development Act of 1986, as amended, and Engineer Regulation 1105-2-100, Appendix E, Section VII allow for formulation of recreation measures in concert with flood risk management projects such that the cost of recreation measures are less than 10 percent of construction costs and less than 50 percent of the total benefits used to justify the project. Simply stated, there must be an amount of flood risk management benefits that equals at least 50 percent of the costs to construct the project.

Recreation measures can be as simple as providing parking for people to enjoy access to a natural site or as complicated as a lake behind a dam. Corps policy dictates that when recreation is a project purpose, that multiple scales of recreation development should be formulated and evaluated.

5.3.5 Screening of Initial Array of Alternatives

5.3.5.1 Structural Alternatives

Alignment 3 was eliminated based upon the efficiency criteria since it would have provided a similar level of protection as Alignments 1 and 2 at approximately three times the construction cost. Alignment 2 was considered based upon its ability to possibly delay operation and maintenance hauling of material out of the floodplain. However, when analyzed, Alignment 2 would have higher construction and operation and maintenance costs than Alignment 1. Additionally, due to stream flow conditions the rock size used during construction would have been the same as those used in Alignment 1. Alignment 2 would provide a similar level of benefits as Alignment 1. However, Alignment 2 would cost approximately $250,000 more to construct and would have higher operation, and maintenance costs, (in the form of deposition shaping and hauling), than Alignment 1. Because Alignment 2 fails to meet the efficiency criteria (provides the same protection as Alternative 1 at a greater cost), it is eliminated from further consideration.

5.3.5.2 Nonstructural Alternatives

Even if a non-structural alternative was to be implemented, the non-Federal partner would still engage in flood-fighting activities for flow events with a 0.1 annual chance of exceedance. For events that overwhelm flood-fighting activities, there would continue to be significant cleanup costs and residual damages to vehicles.

Buyouts and relocations would likely transfer risk to another place in the Seward area since much of the area is prone to flooding. As shown in Figure 2, the majority of developable land in the area sits within one of the various floodplains. Even if suitable land was available, it is unlikely that the 379 structures within the study area, (including Bear Lake Subdivision and structures along Bear Creek), could be relocated. It is also highly unlikely that the relocations could be accomplished at a cost less than the construction of a structural alternative. A 2013 Alaska District Continuing Authorities Program Section 103 feasibility study showed that relocations of residential structures approximately 1,500 square feet in size costs approximately $112,000 per structure less costs of the real estate at the destination.[16] At this cost, relocation of the structures would cost in excess of $42 million prior to the acquisition of any real estate needed to accomplish the relocations. This cost is far more than what is allowed under Section 205 and would not be an efficient flood risk management solution. Because of these considerations, nonstructural measures as a whole were eliminated from consideration.

5.3.6 Summary of Initial Screening of Alternatives

Alignment 1 is carried forward for further consideration as a general concept and will be developed to protect against different flow heights. The No Action alternative is carried forward as well.

6.0 COMPARISON AND SELECTION OF PLANS*

The alternatives were designed to meet the planning objectives and criteria and were evaluated based on environmental, economic, and engineering considerations. The physical characteristics of the alternatives are shown in Table 3. Interest during construction was added to the initial cost to account for the opportunity cost incurred during the time after the funds have been spent, but before the benefits begin to accrue. Preconstruction, engineering, and design is assumed to take 9 months and construction is assumed to take 3 months, subject to funding and resource availability.

Table 3: Comparison of Alternatives: Physical Characteristics

Feature/Alternative	No Action	Alternative L1	Alternative L2	Alternative L3
Annual Chance of Exceedance	0.1	0.02	0.01	0.002
Length (feet)	0	1,500	1,500	1,500
Armor Rock (cubic yards)	0	5,480	6,580	7,310
Filter Rock (cubic yards)	0	1,530	1,840	2,040
Core Rock (cubic yards)	0	3,030	3,630	4,030

[16] Golovin Section 103 Coastal Storm Damage Reduction Study, 2013.

6.1 Detailed Alternative Plans Descriptions

6.1.1 Without-Project Conditions (No-Action Alternative)

Without flood risk management measures at Salmon Creek, the risk of inundation in Bear Lake Subdivision and downstream areas along Bear Creek will persist. Bear Lake Subdivision is not yet fully developed as there are currently 20 undeveloped lots, or approximately 20 percent of the lots within Bear Lake Subdivision. This is a desirable location and it can reasonably be assumed that some of these undeveloped lots will be developed to some degree over the study period, which means damages from inundation will continue to rise, though to what degree is uncertain. An ordinance is in place for this area that regulates the first finished floor elevation. However, this ordinance does not reduce damages that would occur to future outbuildings and vehicles. The non-Federal partner will continue to conduct flood-fighting operations during high flow events with an annual chance of exceedance of 0.1. Flow events with levels greater than that will continue to cause damages throughout the study area. The No Action Alternative would see the without-project condition persist throughout the 50-year period of analysis.

6.1.2 With-Project Conditions

6.1.2.1 Structural Alternatives

Given that Alignment 1 was chosen for project siting, revetments of varying heights (referred to as L1, L2, and L3) were formulated to provide protection against three flow events with respective annual chances of exceedance of 0.02, 0.01, and 0.002. These levels were chosen based on their ability to provide flood risk management to the area. The non-Federal partner effectively flood fights to the 0.1 event. Constructing a revetment to that level would not provide additional flood risk management above what exists in the without-project condition. Alternatives that would protect against flows with annual chances of exceedance between 0.1 and 0.02 would be subject to frequent overtopping and would not be effective flood risk management solutions. In addition, alternatives that would provide protection against events with an annual chance of exceedance less than 0.002 were not considered at the written request of the non-Federal partner.[17]

A typical section of these revetments is shown in Figure 5. The alternatives are discussed in detail in the following sections. In all cases, the revetment would have a 12-foot-wide crest, 2 to 1 side slopes, a 1.5-foot-thick filter layer composed of Grade 1 stone, and a 3-foot-thick armor stone layer composed of Grade 3 riprap. The filter stone would have a size of R-20, or less than 100 pounds. The riprap would have a size of R-300, or less than 700 pounds.

[17] Written Correspondence, Seward Bear Creek Flood Service Area, 20 November 2014 fulfilling the requirements of Engineer Regulation 1105-2-100, Chapter 3, Section 3-3, Paragraph b, subparagraph (11)

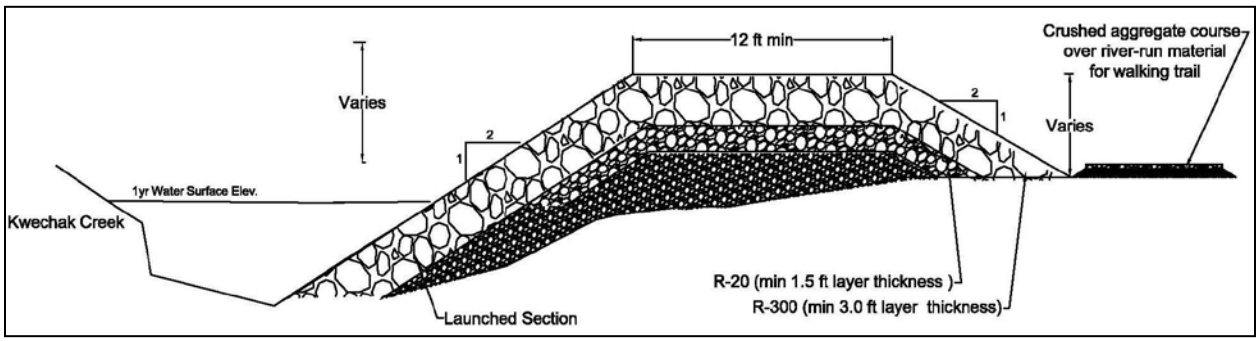

Figure 5: Designed Revetment Typical Sections (Height Varies by Alternative)

6.1.2.1.1 Alternative: L1

Alternative L1 is a revetment approximately 1,500 feet in length that would provide protection against flows with an annual chance of exceedance of 0.02. The revetment would be 3 feet tall on the land side and 8 feet tall on the river side with a 12-foot crest width. The revetment would utilize 3,025 cubic yards of in-situ river-run material for core material, 1,530 cubic yards of filter stone, and 5,480 cubic yards of armor rock. In-situ material would be shaped then overlain with a 1.5-foot-thick filter stone layer and 3-foot-thick armor rock layer. A parking lot capable of accommodating 20 vehicles would be constructed on the land side of the revetment and a multi-use gravel trail would run the length of the revetment to facilitate recreational use of the area. Initial cost estimates returned a fully funded design and construction cost of $2.83 million.

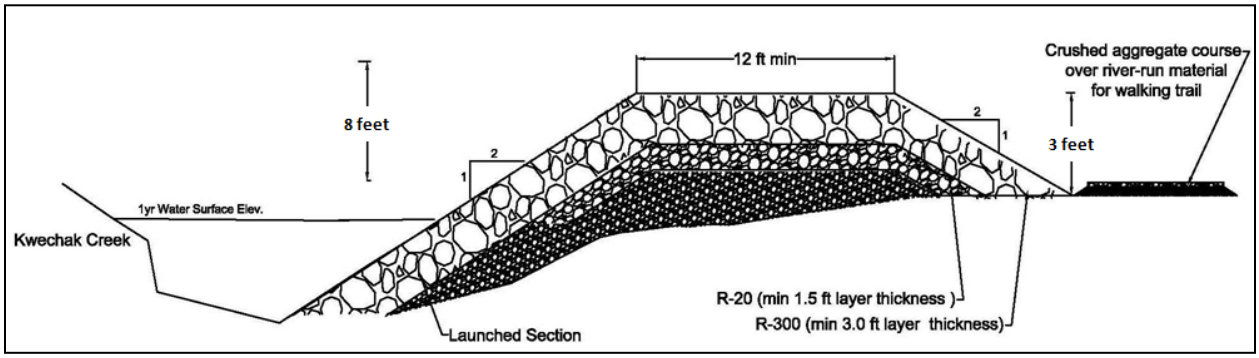

Figure 6: Alternative L1 Cross Section

Construction of this alternative would eliminate the non-Federal partner's flood-fighting activities at the site and inundation of the affected area for flows with an annual chance of exceedance equal to or less than approximately 0.02. This alternative would provide enhanced recreation opportunities to this area.

6.1.2.1.2 Alternative: L2

Alternative L2 is a revetment approximately 1,500 feet in length that would provide protection against flows with an annual chance of exceedance of 0.01. The revetment would be 4 feet tall on the land side and 10 feet tall on the river side with a 12-foot crest width. The revetment would utilize 3,630 cubic yards of in-situ river-run material for core material, 1,840 cubic yards of filter stone, and 6,580 cubic yards of armor rock. In-situ material would be shaped then overlain with a 1.5-foot-thick filter stone layer and a 3-foot-thick armor rock layer. A parking lot capable of accommodating 20 vehicles would be constructed on the landside of the revetment

and a multi-use gravel trail would run the length of the revetment to facilitate recreational use of the area. Initial cost estimates returned a fully funded design and construction cost of $3.20 million.

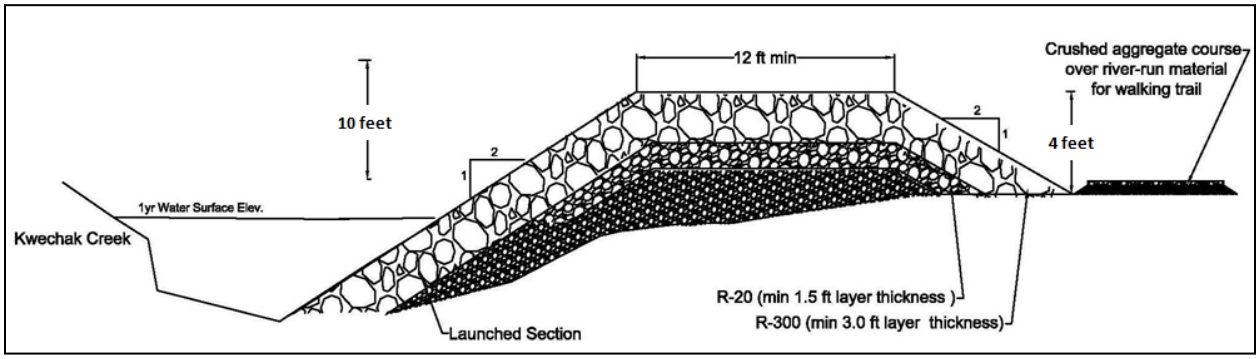

Figure 7: Alternative L2 Cross Section

Construction of this alternative would eliminate the non-Federal partner's flood-fighting activities at the site and inundation of the affected area for flows with an annual chance of exceedance equal to or less than approximately 0.01. This alternative would provide enhanced recreation opportunities to this area.

6.1.2.1.3 Alternative: L3

Alternative L3 is a revetment approximately 1,500 feet in length that would provide protection against flows with an annual chance of exceedance of 0.002. The revetment would be 4 feet tall on the land side and 12 feet tall on the river side with a 12-foot crest width. The revetment would utilize 4,030 cubic yards of in-situ river-run material for core material, 2,040 cubic yards of filter stone, and 7,300 cubic yards of armor rock. In-situ material would be shaped then overlain with a 1.5-foot-thick filter stone layer and a 3-foot-thick armor rock layer. A parking lot capable of accommodating 20 vehicles would be constructed on the land side of the revetment and a multi-use gravel trail would run the length of the revetment to facilitate recreational use of the area. Initial cost estimates returned a fully funded design and construction cost of $3.44 million.

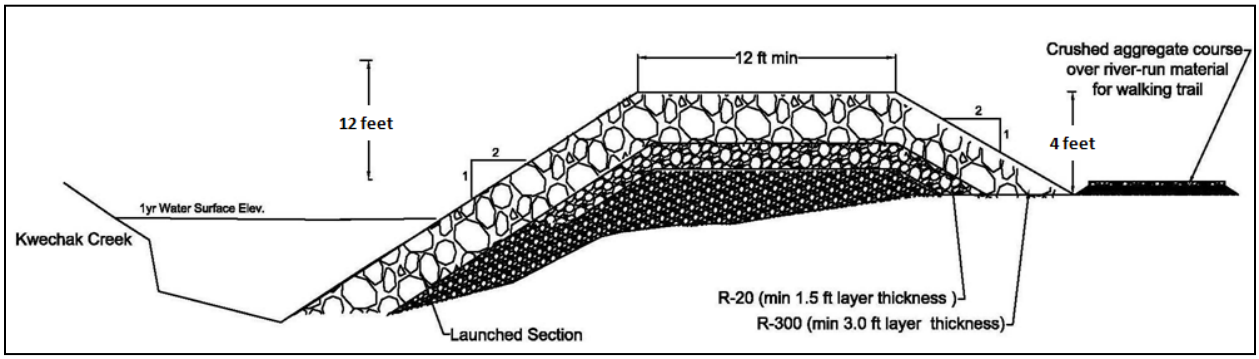

Figure 8: Alternative L3 Cross Section

Construction of this alternative would eliminate the non-Federal partner's flood-fighting activities at the site and inundation of the affected area for flows with an annual chance of exceedance equal to or less than approximately 0.002. This alternative would provide enhanced recreation opportunities to this area.

6.1.2.2 Recreation Features

There is an opportunity to include recreation features in all three of the above alternatives. Corps policy dictates that when recreation is a project purpose, that multiple scales of recreation development should be formulated and evaluated. For this study, a base plan of a 1,500-foot-long multi-use gravel trail and a 20-space parking area was formulated. A 1,500-foot-long trail would mirror the length of the armored berm. The 20-space parking area is consistent with what the U.S. Forest Service agreed to construct at a trail access point nearby at Nash Road. From this base plan, other plans were evaluated including the addition of other recreation facilities and scaling the base facilities.

The majority of the recreation benefits that would accrue to this project are related to site access. Merely providing access to the area provides the recreation opportunities that make up a majority of the expected potential increase in Unit Day Value associated with this project. Therefore, the base plan of a 20-space parking area and associated multi-use trail provide the majority of benefits available. Additional features such as covered pavilions or camping areas are not expected to yield a significant increase in benefits, can be very expensive to construct in a manner that would make them resistant to degradation, and would place a larger long-term burden upon the non-Federal partner in operation and maintenance costs. Because of the likelihood that additional facilities would not provide a significant amount of benefits to the project while potentially significantly increasing the cost of recreation-specific features, the team made a risk-based decision to retain the base plan over plans with additional recreation-specific facilities.

Furthermore, the 20-space parking area was considered the minimum size needed to provide safe access to the multi-use trail as anything smaller would likely lead to a fair amount of congestion. However, a guiding tenet of using the capacity method to estimate visitation (discussed below in Section 6.3.3) is the assumption that sufficient demand is available to meet the marginal supply provided by the project. The 20-space parking area provides a reasonable amount of additional supply that is likely to be met by existing surplus demand. Larger parking lots would run the risk of providing more supply than could be met and may lead to overstatement of recreation benefits. Because of this, the team made a risk-based decision to retain the base plan over plans with a larger parking facility. The 20-space area provides a reasonable amount of supply that is likely to be filled by existing surplus demand and provides a reasonable amount of benefits to the project.

Given that the base recreation plan provides the majority of likely available benefits at the lowest available cost while providing a reasonable amount of supply that is likely to be filled by existing surplus demand, it was selected for inclusion in all three alternatives moving forward.

6.2 Alternative Plan Costs

6.2.1 Construction and Investment Costs

Construction and investment costs account for the total costs of materials and labor needed to construct the project as well as the value of foregone investment opportunities while construction is taking place. For this analysis, construction is anticipated to last 3 months during the summer

of 2016 and interest during construction is calculated using the Federal fiscal year 2015 discount rate of 3.375 percent. These costs are shown in Table 4.

Table 4: Initial Construction and Investment Costs, by Alternative

Category	No Action	Alternative L1	Alternative L2	Alternative L3
Mobilization-Demobilization	$0	$192,072	$192,072	$192,072
Core	$0	$67,592	$81,110	$90,115
Filter	$0	$ 165,912	$199,116	$221,252
Armor	$0	$944,099	$1,132,953	$1,258,913
Survey	$0	$70,437	$70,437	$70,437
Access Road	$0	$149,192	$149,192	$149,192
Parking Area	$0	$12,164	$12,164	$12,164
Multi-Use Trail	$0	$19,946	$19,946	$19,946
Plans & Permits	$0	$50,000	$50,000	$50,000
Subtotal: Direct Costs	$0	$1,671,413	$1,906,990	$2,064,091
Contingency	$0	$451,282	$514,887	$557,305
Construction Management	$0	$192,953	$220,149	$238,285
Present Value of OMRR&R	$0	$214,394	$222,921	$228,608
LERRD Administrative Cost	$0	$36,000	$36,000	$36,000
Subtotal: Indirect Costs	$0	$894,629	$993,956	$1,060,197
First Construction Costs	$0	$2,567,000	$2,901,000	$3,124,000
Design Costs	$0	$256,700	$290,100	$312,400
Interest During Construction	$0	$11,700	$13,200	$14,200
Total Project Cost	$0	$2,835,500	$3,204,400	$3,450,700

Note: All calculations utilize 2015 price levels and the Federal fiscal year 2015 discount rate of 3.375 percent. Costs for avoidance and minimization mitigation measures have been incorporated into the direct costs for construction. Totals may not sum due to rounding.

6.2.2 Operations and Maintenance Costs

Operations and Maintenance costs are assumed to occur due to two activities: annual maintenance of the gravel course atop the multi-use trail, parking lot, and access road, and periodic replacement of a portion of the armor stone. For all alternatives, it was assumed that 5 percent of the road construction costs would be required on an annual basis to properly maintain the access road, which is needed to facilitate operations and maintenance of the revetment and recreational use of the area. In addition, it was assumed that 2.5 percent of the armor rock in the revetment would need to be replaced every 10 years to maintain the project's level of performance. These costs are shown below in Table 5.

Table 5: O&M Costs, By Alternative

Category	No Action	Alternative L1	Alternative L2	Alternative L3
Annual Road Maintenance	$0	$7,460	$7,460	$7,460
10-year Armor Rock Maintenance	$0	$23,600	$28,300	$31,500
Total Lifecycle O&M Costs	$0	$459,900	$478,816	$491,412
Present Value of O&M Costs	$0	$214,400	$222,920	$228,610
Average Annual O&M Costs	$0	$8,935	$9,290	$9,530

Note: All calculations utilize 2015 price levels and the Federal fiscal year 2015 discount rate of 3.375 percent. Operation and Maintenance costs were based on best professional judgment.

6.2.3 Total Average Annual Equivalent Costs

Using the information in the preceding sections, the total average annual equivalent costs for each alternative were calculated. These are shown below in Table 6.

Table 6: Average Annual Costs, by Alternative

Category	No Action	Alternative L1	Alternative L2	Alternative L3
Total Lifecycle Costs	$0	$3,079,978	$3,460,200	$3,713,800
Present Value of Total Lifecycle Costs	$0	$2,748,900	$3,107,000	$3,345,800
Average Annual Costs	$0	$115,000	$129,000	$139,000

Note: All calculations utilize 2015 price levels and the Federal fiscal year 2015 discount rate of 3.375 percent.

6.3 With-Project Benefits

Each alternative provides a specific level of relief from existing and future flood damages. The differences between the expected levels of damages absent Federal action (the without-project condition) and those that will occur under the various with-project conditions are benefits that accrue to the project and form the basis for selecting a recommended plan.

6.3.1 Flood Damages Alleviated

Foregone flood damages were calculated utilizing HEC-FDA, a certified model for estimating eliminated flood damages, and therefore, flood-related benefits in the various with-project conditions. Because of the steep nature of the terrain drained by this stream, the study area was divided into 25 basins housing 379 structures to account for water surface elevation changes as they relate to the topography of the area. Figure 9 shows the basins and structures input into the HEC-FDA model.

Water surface elevations at various flow levels were calculated for each of the basins. These water surface elevations were compared to the first floor elevations of each structure within the various basins to determine damages that would occur during various flooding events. These calculations are shown in detail in the Economics appendix (Appendix A), with a summary shown below in Table 7.

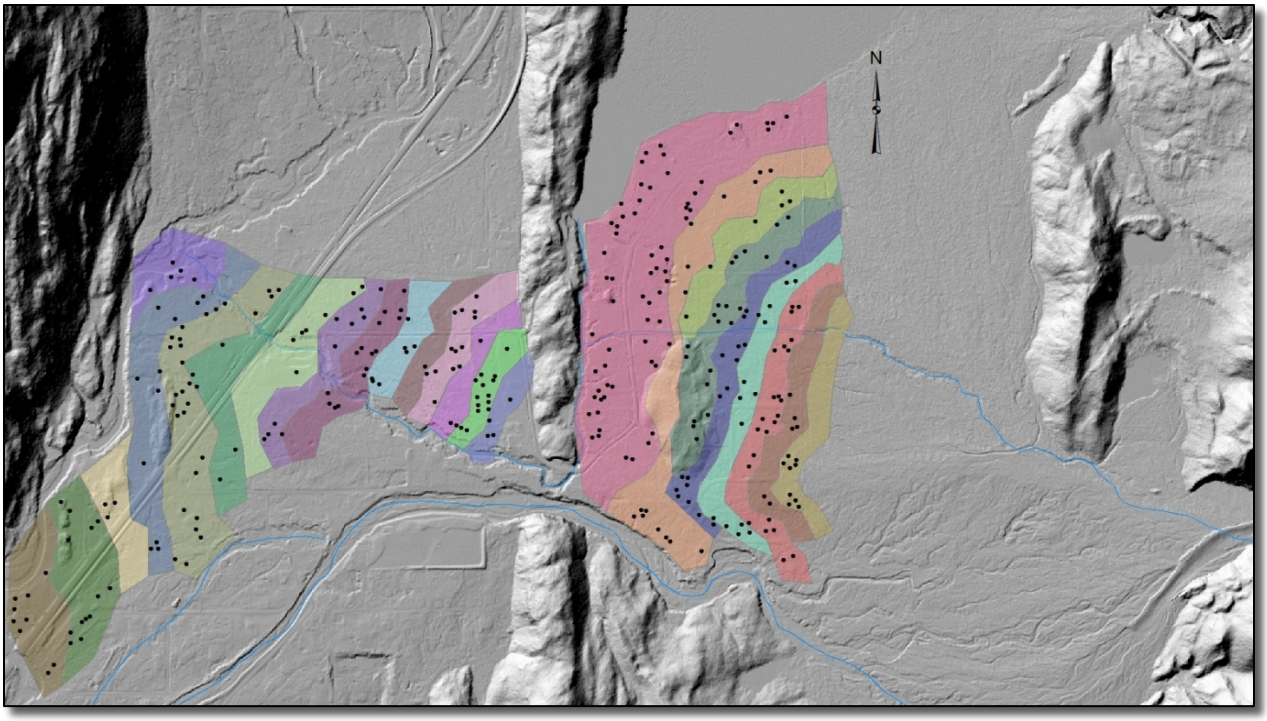

Figure 9: HEC-FDA basins and structures

Table 7: Flood Related Benefits, by Alternative

Alternative	Expected Annual Damage		
	Total Without Project	Total With Project	Damage Reduced (Benefits)
No Action	$190,040	$190,040	$0
Alternative L1	$190,040	$95,310	$95,090
Alternative L2	$190,040	$73,460	$116,930
Alternative L3	$190,040	$32,550	$157,850

Note: All calculations utilize 2015 price levels and the Federal fiscal year 2015 discount rate of 3.375 percent.

6.3.2 Flood Fighting Expenditures Alleviated

In the various with-project conditions, the amount of flood fighting that the non-Federal sponsor conducts has the potential to be reduced or eliminated. These forgone expenditures are a National Economic Development benefit that will accrue to the various structural proposals. Given that the non-Federal partner is responsible for flood-fighting activities, they have maintained detailed records about the expenditures related to their flood fighting activities and were able to give an accurate estimate of their annual activities of approximately $15,000.

6.3.3 Recreation

6.3.3.1 Recreation Demand

The Alaska Statewide Comprehensive Outdoor Recreation Plan divides the state into three administrative areas including Southeast, Railbelt, and Rural. The Seward area is located in the Railbelt region. The plan did not quantify surplus demand for additional recreation facilities in this region. However, qualitatively, it states that in respect to facilities, “shortages in this region

are, for the most part, characterized by the inability to keep up with growing resident and non-resident demand".[18] One of the plan's recommended strategies was to continue developing recreational trails to meet existing and growing demand. The recreation facilities included in this project would address this need.

The Seward area is a recreational destination for many residents of Southcentral Alaska as well as visitors from outside of the area. Multiple salmon streams, world class halibut fishing, unparalleled wildlife viewing opportunities, access to state and National parks, the Seward Small Boat Harbor, the southern terminus of the Alaska Railroad, and the Alaska Sea Life Center Research Aquarium all draw visitors to the area.

6.3.3.2 Recreation Benefits

Multiple laws and regulations allow for formulation of recreation measures in concert with flood risk management projects such that the cost of recreation measures are less than 10 percent of construction costs and less than 50 percent of the total benefits used to justify the project. Simply stated, there must be an amount of flood risk management benefits that equals at least 50 percent of the costs to construct the project.

Recreation benefits can be calculated in a number of ways. However, the most simple and efficient method for this study is calculation of the change in Unit Day Value, or the increase in value of the recreation experience in the study area as a result of a project being constructed. This change in value is then multiplied by the number of annual visitations in order to calculate the annual benefit.

6.3.3.2.1 Unit Day Value

The benefits for recreation development for the Salmon Creek Section 205 project have been estimated using Economic Guidance Memorandum 15-03 entitled "Unit Day Values for Recreation for Fiscal Year 2015." The Average Annual Recreation Value is calculated from the determined Unit Day Value and the Annualized Visitation for both the existing conditions and proposed alternative. The Average Annual Recreation Benefits is the difference between the Average Annual Recreation Value for existing conditions and Average Annual Recreation Value for the facility improvements.

The Unit Day Value is converted from the assigned point value for the existing site. The assigned point value is determined using judgment factors for each of the five criteria. All of the activities at Salmon Creek are considered to be "General Recreation." Economic Guidance Memorandum 15-03 lists guidelines for calculating point values for recreation sites. The Unit Day Value calculation takes into account five facets of the recreation experience in order to derive an estimate of existing and future value. Each of the five categories is discussed briefly below with a more detailed description available in the Recreation Appendix. The following sections describe the expected change in Unit Day Value as a result of construction of a parking lot and multi-use gravel trail along the landside of the revetment.

[18] State of Alaska, Alaska's Outdoor Legacy, Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2009-2014", September 2009

6.3.3.2.1.1 Recreation Experience

Recreation Experience is defined as the number of activities that a visitor can participate in during a visit to the facility. There are 30 total points available for this category and range from as low as 0 points for "two general activities" to a high of 30 points for "numerous high quality value activities; some general activities."

The current site (without-project condition) received 5 points for Recreation Experience. The area currently offers opportunities for several outdoor activities such as hiking, camping, skiing, dog sledding, and snowmachining. The with-project condition received 10 points for Recreation Experience indicating several general activities will be available at the site. Construction of the new measures would allow for multiple new general activities to take place at the site.

6.3.3.2.1.2 Availability of Opportunity

Availability of Opportunity is defined as the availability of other recreation facilities and is meant to help gauge the increase in total local stock of available similar recreation facilities. There are up to 18 points available for this category and range from as low as 0 points for "several within 1 hour of travel time, a few within 30 minutes of travel time" to a high of 18 points for "none within 2 hours of travel time."

The current site (without-project condition) received 0 points for Availability of Opportunity. There are abundant opportunities for hiking, camping, skiing, and snowmachining within the area. The with-project condition received 3 points for Availability of Opportunity indicating several sites available within 1 hour of travel time and a few within 30 minutes of travel time. There are abundant opportunities for hiking, camping, skiing, and snowmachining in the area. However, there are limited dedicated facilities for trail-specific walking and biking.

6.3.3.2.1.3 Carrying Capacity

Carrying Capacity is a measure of the facilities available at a site that increase the value of a day of recreation. There are 14 points available for this category and range from as low as 0 points for "minimum facility for development for public health and safety" to a high of 14 points for "ultimate facilities to achieve intent of selected alternative."

The current site (without-project condition) received 0 points for Carrying Capacity since there are currently no facilities in the area. The with-project condition received 8 points for Carrying Capacity. The identified facilities are adequate to conduct activities without deterioration of the resource or activity experience. Through offering a well-constructed parking area and path, it is less likely that the area will suffer from degradation than if these measures were not included and people utilized the area through going off-trail for motorized and non-motorized activities.

6.3.3.2.1.4 Accessibility

Accessibility is a measure of the ease with which visitors can access the site. There are 18 points available for this category and range from as low as 0 points for "limited access by any means to site or within site" to a high of 18 points for "good access, high standard road to site; good access within site."

The current site (without-project condition) received 1 point for Accessibility. Current access is provided by a two-track trail that requires a four wheel drive vehicle for passage and may be

impassable during certain conditions for most vehicles. The with-project condition received 11 points for Accessibility indicating good access and good roads to the site with fair access within the site. Construction of the project necessitated construction of an access road for construction, operation, and maintenance activities. This road would also serve to provide access to the site for recreational users.

6.3.3.2.1.5 Environmental Quality

Environmental Quality is a measure of the aesthetic factors present within a site. There are 20 points available for this category and range from as low as 0 points for "low aesthetic factors that significantly lower quality" to a high of 20 points for "outstanding aesthetic quality; no factors exist that lower quality."

The current site (without-project condition) received 10 points for Environmental Quality. It is a backcountry area with no development visible from the site except for the existing berm and deposition area, which are not particularly aesthetically pleasing. The with-project condition received 16 points for Environmental Quality, indicating an outstanding aesthetic quality with no factors that exist to lower that quality. Upgrading the existing berm to a more permanent and engineered revetment would actually increase the aesthetics of the area by eliminating the current berm and track marks from continuous heavy equipment activity. There would still be no development within sight of the berm.

6.3.3.2.1.6 Unit Day Value Summary

The total number of Unit Day Value points assigned to the project area increased from 16 points in the without-project condition to 48 points in the with-project condition mainly because of upgraded access to the site and an increase in aesthetic quality provided by eliminating evidence of continuous heavy machinery use. This corresponds to an increase in the Unit Day Value from $4.64 to $7.32, an increase of $2.68.

6.3.3.3 Visitation

Once the Unit Day Value has been calculated, it is multiplied by the number of annual expected additional visitations at the site to derive the total annual recreation benefit. There is very little information about current visitation numbers to the project area. There area does not lie within an established park or recreation area. In addition, existing recreation is informal with very little organization. Because of these factors, estimating a current number of visitations to the site is problematic. The most realistic estimate for current visitation to this site is to locate the nearest formal recreation area with similar facilities. The nearest site with limited vehicular access, water present on the site, and limited camping opportunities was Caines Head State Recreation Area south of Seward. In 2013, (the most recent year for which data was available), Caines Head received 16,529 visitations.[19]

There are multiple methods for estimating visitation at a site. Given the area's high recreation usage and the lack of available data for visitation, the capacity method was used to estimate the annual number of visitations. Guidance states that this method should be limited to situations where there is obvious demand for additional facilities, the project is small in nature, and the recreation is related to facility usage (trail-usage for walking and biking) rather than resource-

[19] State of Alaska Department of Natural Resources 2013 attendance for Caines Head State Recreation Area

based (such as fishing and hunting). Guidance on calculating visitations using the capacity method is given in IWR Report 74-R-1 and IWR Report 86-R-4. It should be noted that these calculations utilize nationally-derived formulas for estimating usage.

The capacity method is a two-step process. The first step is to estimate an average "design day load." From this, the second-step estimates assumed daily use. The daily use is then annualized to produce the capacity, and therefore, visitation, (which are assumed to be equal under the capacity method). For Salmon Creek, the limiting factor was assumed to be parking availability given the site's relative distance from other facilities and development. Using guidance, a design day load of 60 was calculated by assuming 20 parking spaces, 1 vehicle per space, turnover factor of 2.0 (per guidance), and 1.5 people per vehicle.

Design Day Load	=	Parking Spaces	*	Turnover Rate	*	People Per Car
60	=	20	*	2	*	1.5

From there, other assumptions were used to calculate total expected visitation. The required factors include the amount of recreation that takes place during peak season weekends. Given known visitation rate during the peak season of June and July for the closest comparable recreation facility (Lowell Point State Recreation Site, 2013), it is estimated that 47 percent of use will occur over the course of 9 weekend days (per guidance). The calculation for estimated visitation based on guidance in IWR Report 86-R-4 is:

Average Daily Use	=	Design Day Load	*	Average Number of Weekend Days in Peak Season	*	Proportion of Peak Season Use Expected on Weekends	*	Proportion of Annual Use Expected During Peak Season
127	=	60	*	9	*	0.50	*	0.47

These calculations rendered an Average Daily Use number of 127 visitations. This translates into an expected annual visitation of 46,419 visits (127 x 365). This total is considered to be fairly conservative. Guidance states that an assumption of 3.4 persons per car should be used in calculating the design day load. However, given the nature of the area and the types of recreation that are expected to take place, a number of 1.5 persons per car was used as it is more likely to reflect actual usage. In addition, while guidance states that the proportion of use expected in the peak season is typically between 0.50 and 0.60, data from the closest similar facility showed a peak season use of 0.47, so this number was used instead. Finally, this site can be expected to see a double-peak of usage. Summer activities will see peak usage in the nine weekends from the beginning of June through the first week of August with another peak coming during winter use in the December to February timeframe. In an effort to be conservative, only the nine summer weekends were used to calculate expected visitation.

The total number of visitations is reasonable in nature. The nearest comparable facility experienced total visitations of 65,361 in 2013.[20] The expected visitations to this facility are approximately 29 percent less.

6.3.3.4 Recreation Benefits Summary

Average Annual Recreation Benefits are derived by subtracting the Average Annual Recreation Values for the existing condition from the with-project condition. This calculation is shown below in Table 8. The difference in these values is the Average Annual Recreation Benefit.

Table 8: Average Annual Recreation Benefit Calculation

Item	Annual Visitations	Unit Day Value	Value
Without-Project Average Annual Recreation Value	16,529	$4.64	$ 76,695
With-Project Average Annual Recreation Value	46,419	$7.32	$339,787
Average Annual Recreation Benefit			**$263,093**

6.4 Net Benefits of Alternative Plans

If the No Action Alternative was to be implemented, flood risk would remain at current levels. The non-Federal partner would continue to engage in annual or semi-annual flood fighting for events with a 0.1 annual chance of exceedance.

Each of the with-action alternatives would accrue the same amount of benefits related to recreation and foregone flood fighting since the recreation facilities would not differ between the alternatives and they all would protect to a level greater than what the non-Federal partner can provide through flood-fighting activities. The main difference in the with-action alternatives is related to the degree to which they prevent flooding damages to structures within the affected area. The amount of benefits provided by each alternative is shown below in Table 9.

Table 9: Summary of Net Annual Benefits, by Alternative

Annual Benefit Category	No Action		Alternative L1		Alternative L2		Alternative L3	
	Total	%	Total	%	Total	%	Total	%
Flood Damage Reduction	$0	N/A	$ 95,090	25%	$116,930	30%	$157,800	36%
Foregone Flood-Fighting	$0	N/A	$ 15,000	4%	$ 15,000	4%	$ 15,000	3%
Recreation	$0	N/A	$263,100	70%	$263,100	67%	$263,100	60%
Total	$0	N/A	$373,000	100%	$395,000	100%	$436,000	100%

Note: Totals may not sum due to rounding.

6.5 Summary of Accounts and Plan Comparison

A comparison of National Economic Development costs and benefits associated with the various alternatives is shown in Table 10.

As shown in Table 10, net annual benefits are increasing, and no alternative greater than Alternative L3 shows a lesser amount of net annual benefits. However, given the size and projected cost of Alternative L3, the non-Federal partner provided a letter on 21 November 2014 identifying a financial constraint and requesting that alternatives protecting against flows with

[20] State of Alaska Department of Natural Resources 2013 attendance for Lowell Point State Recreation Site

Table 10: Comparison of Alternatives: Costs and Benefits

Item	Alternative			
	No Action	**L1**	**L2**	**L3**
Initial Construction Cost	$0	$2,351,648	$2,678,026	$2,895,680
Annual Operation and Maintenance	$0	$8,935	$9,290	$9,528
Design Cost	$0	$256,700	$290,100	$312,400
Interest During Construction	$0	$11,700	$13,200	$14,200
Subtotal: National Economic Development Investment Cost	$0	$2,620,000	$2,981,400	$3,222,400
Total Annual National Economic Development Cost (50 years, 3.375%)	$0	$115,000	$129,000	$139,000
Annual Benefits	$0	$373,000	$395,000	$436,000
Average Net Annual Benefits	$0	$258,000	$266,000	**$297,000**
Benefit to Cost Ratio	N/A	3.24	3.06	**3.14**
Rank by Average Net Annual Benefits	4	3	2	**1**

Note: Totals may not sum due to rounding.

less than a 0.002 annual chance of exceedance not be investigated. Therefore, in accordance with Engineer Regulation 1105-2-100, Appendix E, Section b., Paragraph (5), the requirement to formulate larger plans was suspended.

7.0 TENTATIVELY SELECTED PLAN*

7.1 Description of Tentatively Selected Plan

The tentatively selected plan is Alternative L3. This plan maximized net National Economic Development benefits and was selected as the National Economic Development plan. The plan is the largest acceptable project to the non-Federal partner and was selected as the Recommended Plan. Major construction items include:

- Upgrading the existing access trail to a two-lane gravel access road in order to facilitate construction, operation, and maintenance of the project;
- Shaping in-situ material to provide the core of the engineered berm;
- Placement of a 1.5-foot-thick layer of filter rock and a 3-foot-thick layer of armor rock on top of the core material to complete the berm; and,
- Placing and compacting gravel on the parking area and multi-use trail.

Construction of this structure would confine flows with an annual chance of exceedance equal to or greater than 0.002 to the current channel downstream of the project, alleviating associated flooding in downstream areas. This project would result in lowered operation and maintenance costs for the non-Federal partner and would enhance the public's ability to recreate in the area. The structure is not expected to have significant upstream or downstream impacts. The portion of Salmon Creek upstream of the project is very steep and completely confined to a steep-sided canyon. While some flow path changes may be expected to occur downstream as a result of this project, any changes are expected to be less than significant and will likely resemble meandering

that would have naturally occurred in the absence of Federal action simply due to the alluvial nature of the stream.

7.1.1 Plan Components

The recommended plan contains three major components, which are discussed below. A site plan showing the locations of these components is shown in Figure 10.

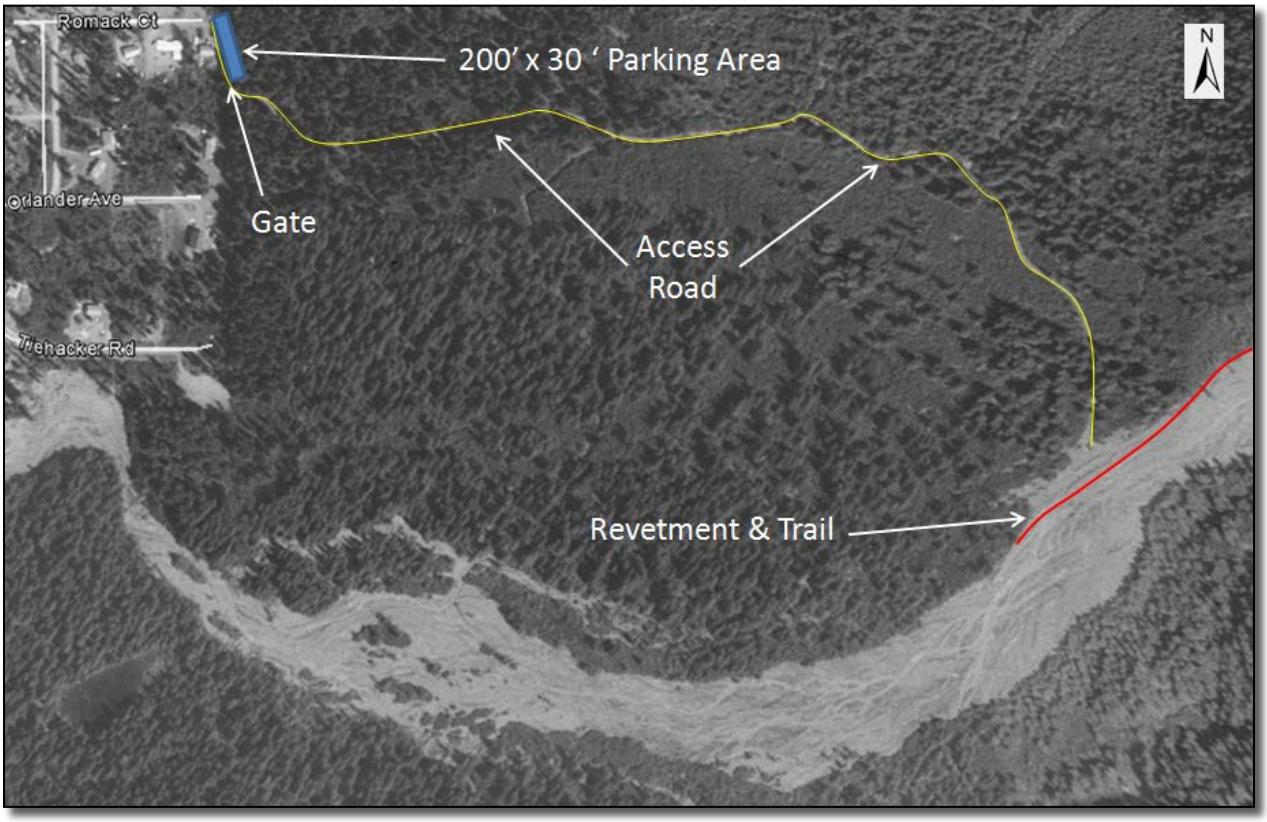

Figure 10: Site Plan of Recommended Plan

7.1.1.1 Revetment Construction

Construction of the revetment requires the shaping of in-situ material to form the core material of the berm, with filter and armor rock being placed in layers on top of the core. Construction of this component would take place during the summer in order to avoid the fall rainy season, thereby decreasing the likelihood and/or duration of any in-water work.

7.1.1.2 Access Upgrade and Recreation Facilities

Construction of the access road would entail upgrading the existing two-track, four wheel drive-only trail extending from Romack Court to a one-lane gravel road with turnouts. The primary purpose of this upgrade is for construction, operation, and maintenance of the revetment and secondarily for recreation access. While the access road could have tied-in to Romack Court, Orlander Avenue, or Tiehacker Road, meetings with stakeholders showed a preference for tying the access road into Romack Court over other nearby alternatives. This location takes advantage

of the existing access trail, minimizes clearing of vegetation, and according to local accounts, Romack Court is currently used by all-terrain vehicle users for access to the existing trail system.

The existing access trail crosses the Forest Service's easement and is co-located with the Forest Service's trail for approximately one-quarter mile. Preliminary discussions with the Forest Service during the planning phase revealed that upgrading that portion of their trail to a one-lane gravel road is acceptable as long as the road is only open to full-size vehicles performing maintenance on the berm. This arrangement provides a benefit to the trail as it upgrades approximately one-quarter of mud trail to gravel surfacing, facilitating recreational usage when maintenance in transit to and from the berm.

The access road would be approximately 3,225 feet long and 12 feet wide with turnouts every one-quarter mile to facilitate passing of vehicles during construction.[21] This alignment and width minimizes the number of trees that would need to be cleared during construction. The road would be gated in order to prohibit full-size vehicular access with the exception of Kenai Peninsula Borough vehicles transiting the area in order to perform maintenance on the revetment and law enforcement vehicles patrolling the area.

Construction of the trail includes leveling in-situ material and placement and compaction of gravel on top of the leveled in-situ material. Construction of the parking area will involve clearing of vegetation and placement and compaction of gravel. The parking area will be a 200-foot-wide by 30-foot-wide area on the eastern side of the access road near the beginning of the road at the eastern terminus of Romack Court. This configuration provides perpendicular pull-in parking space for 20 vehicles.

The siting of the parking area takes into account stakeholder feedback received from the State of Alaska Department of Natural Resources, the U.S. Forest Service, the Kenai Peninsula Borough, and residents of Bear Lake neighborhood during the planning process.

The Alaska Department of Natural Resources and U.S. Forest Service preferred that full-size vehicular traffic be prohibited from crossing the Forest Service buffer and easement while simultaneously maintaining access for all-terrain vehicles and snowmachines, which are managed uses for this section of the Forest Service's trail. This is easily accomplished by placing the parking area prior to the Forest Service's easement and buffer and gating the road.

Residents favored placing the parking area near the neighborhood to encourage monitoring of activities by visitors. There are currently a number of nuisance activities that take place along the creek. Law enforcement is unable to effectively patrol the creek bed due to the rudimentary access provided by the existing mud trail. Residents were concerned that siting the parking lot closer to the creek would exacerbate these issues. By placing the parking area in a location that is more easily monitored by residents and law enforcement, the nuisance activities may decrease. Kenai Peninsula Borough favored placing the access near the neighborhood and gating the road. This allows for the permanent road to be maintained to a 12-foot-width, decreasing long-term operation and maintenance costs.

[21] In accordance with Engineer Manual 1130-3-130

7.1.2 Implementation of Recommended Plan

7.1.2.1 Implementation Costs

7.1.2.1.1 Design Costs

Major design activities include geotechnical borings to verify subsurface conditions, survey activities, ongoing environmental coordination, project management, contracting, and construction-level design of the armored berm, roadbed and alignment, parking area, and trail.

Table 11: Estimated Design Costs

Discipline	Amount
Project Management	$25,000
Environmental	$35,000
Contracting	$50,000
Survey	$50,000
Geotechnical	$75,000
Hydraulics & Hydrology	$100,000
Total:	**$335,000**

7.1.2.1.2 Construction Costs

After application of cost-risk analysis a certified cost estimate was calculated and is shown below in Table 12. Decreases from initial estimates are related to lower final contingencies due to a decrease in uncertainty surrounding material sources and construction methods.

Table 12: Certified Cost Estimate, by WBS Structure

WBS Structure	Item	Certified Cost
08	Access Road	$289,000
11	Revetment	$2,212,000
14	Recreation Features	$37,000
11	Mobilization & Demobilization	$220,000
Construction Subtotal		**$2,758,000**
01	LERRDs	$36,000
30	Design	$334,000
31	Construction Management	$182,000
Total		**$3,310,000**

Note: Totals may not sum due to rounding

7.1.2.1.3 Cost Sharing

The Federal government will provide 65 percent of funds required for design and construction of flood risk management measures and 50 percent of funds required for design and construction of recreation measures associated with the recommended project. The non-Federal partner will provide 35 percent of funds required for design and construction of flood risk management measures and 50 percent of funds required for design and construction of recreation measures associated with the recommended project. The non-Federal partner will be required to provide 100 percent of all funds associated with operation and maintenance of the project once construction has been completed. An estimate of total cost allocation is provided in Table 13.

Table 13: Cost Allocation

Item	Total Cost	Federal Share	%	Non-Federal Share	%
Flood Risk Management Features	$2,720,000	$1,768,000	65	$952,000	35
Recreation Facilities	$37,000	$18,500	50	$18,500	50
Construction Estimate Total	$2,757,000	$1,786,500		$970,500	
LERRD	$36,000	$9,600	NA	$26,400	NA
Planning, Engineering & Design (Flood Risk Management Features)	$330,500	$214,800	65	$115,700	35
Planning, Engineering & Design (Recreation Facilities)	$4,500	$2,250	50	$2,250	50
Construction Management	$182,000	$117,900	65	$64,100	35
TOTAL PROJECT COST	$3,310,000	$2,131,110		$1,178,890	
Adjustment for LERRD Credit		+$26,400		-$26,400	
FINAL COST ALLOCATION	**$3,310,000**	**$2,157,510**		**$1,152,490**	

Note: May not sum due to rounding.

7.1.2.2 Construction

7.1.2.2.1 Federal

The Corps will be responsible for construction of the access road, revetment, parking area, and multi-use gravel trail.

7.1.2.2.2 Non-Federal

The Kenai Peninsula Borough will be responsible for acquiring all lands, easements, and rights-of-way, and performing any relocations and disposals prior to construction.

7.1.2.3 Financial Analysis

The sponsor has appropriated the full balance of their expected share of design and construction costs toward these efforts in anticipation of the completion of the feasibility phase. They are able to fully fund their portion of the anticipated project costs upon execution of a Design and Implementation Agreement.

7.1.2.4 Operations and Maintenance

The Kenai Peninsula Borough will be responsible for the operation and adequate maintenance of the constructed project.

7.1.2.5 Mitigation

All recommended mitigation measures will be implemented as discussed.

7.1.2.6 Implementation Schedule

The schedule shown in Table 14 details major activities to be accomplished during the design and implementation phase and assumes funding and resource availability. A lack of either funding or resources may cause significant changes to this schedule.

Table 14: Design and Implementation Schedule

Item	Date
Complete Feasibility Phase	May 2015
Submit Final Decision Document	June 2015
Decision Document Approval	July 2015
Initiate Design and Implementation Phase	July 2015
PPA approval by Pacific Ocean Division	August 2015
Execute Project Partnership Agreement	September 2015
Construction Contract Award	June 2016
Project Completion	September 2016

7.2 Integration of Environmental Operating Principles

The following environmental operating principles have been integrated into the planning process:

Foster sustainability as a way of life throughout the organization: This project contributes to a more sustainable waterway. The without-project condition sees annual maintenance activities within the waterway as bulldozers enter the channel to push river-run material into a temporary berm. By constructing a permanent structure, the need for these unsustainable activities will be eliminated.

Proactively consider environmental consequences of all Corps activities and act accordingly: Environmental consequences were considered throughout the planning process and every effort has been made to avoid, minimize, or mitigate all anticipated impacts. These actions include best practices during construction to avoid fish entrapment and designing the revetment in order to avoid impairing the passage and movement of fish.

Create mutually supporting economic and environmentally sustainable solutions: The recommended plan is the National Economic Development plan and therefore provides the maximum amount of benefits to the nation. The project was formulated in a way that makes it lasting, requiring very little in maintenance, and avoids long term environmental impacts wherever possible.

Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps which may impact human and natural environments: A full environmental assessment was conducted as required by the National Environmental Policy Act. In addition, the principles of avoidance, minimization, and mitigation were enacted to the extent possible.

Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs: For this study, a systems approach was utilized to examine the interaction between in-channel flows and the associated floodplain. A vegetation characterization was performed in the forest behind the berm to determine whether there were significant environmental benefits that would accrue if a project was constructed near the existing subdivision rather than at the selected site. While this assessment did not render any

positive benefits to an alternate action, the environment was considered throughout the formulation process.

Leverage scientific, economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner: The Corps worked closely with the Seward Bear Creek Flood Service Area, a subsidiary of The Kenai Peninsula Borough throughout this study. The Seward Bear Creek Flood Service Area has an abundance of institutional knowledge about the environment surrounding the stream. In addition, the Corps utilized the knowledge of a biologist from the Alaska District's Regulatory Division Kenai field office to help determine the possible environmental benefits of allowing the forest behind the berm to flood on occasion.

Employ an open, transparent process that respects the views of individuals and groups interested in Corps activities: The Corps made every effort to be responsive to stakeholder concerns. Public input was solicited and used for both environmental and economic analysis purposes. A charette was held with officials from various public agencies at the beginning of the feasibility phase. The non-Federal partner holds monthly public meeting to discuss various issues, including those related to Salmon Creek. In addition, the Corps and non-Federal partner contributed to a story about the project that was run in a local newspaper in November 2014. The Corps made repeated attempts to reach out to the local cross-country ski club to solicit information about their use of the area, but no comments were received.

7.3 Real Estate Considerations

This project lies within Section 18, Township 1 North, Range 1 East, Seward Meridian. The Kenai Peninsula Borough owns all of the land within the footprint of the revetment, multi-use gravel trail, and a minority portion of the access road. The parking area and majority of the access road alignment is located on lands owned by the State of Alaska. The Kenai Peninsula Borough is planning to acquire these lands via the municipal entitlement process, but this transfer will not likely be completed prior to construction. Therefore, an easement will be required for the parking area and portion of the access road that lies on State lands between the eastern border of Bear Lake Subdivision and the western border of the lands owned by the Kenai Peninsula Borough. Approximate Real Estate Requirements are shown in Table 15.

Table 15: Real Estate Requirements

Feature	Owner	Acres	Interest	Status
Access Road & Parking Area	State of Alaska	3.24 acres	Easement	Not Complete
Access Road	Kenai Peninsula Borough	1.78 acres	Fee	Complete
Revetment	Kenai Peninsula Borough	1.92 acres	Fee	Complete
Total Project Boundary		6.80 acres		

7.4 Summary of Accounts

7.4.1 National Economic Development

The recommended plan is the National Economic Development plan and provides the greatest amount of net annual benefits to the nation. It is the most effective plan at reducing damages and providing recreation along Salmon Creek.

7.4.2 Regional Economic Development

Economic benefits that accrue to the region but not necessarily the nation include the shifting of recreation from other areas into the study area. The Kenai Peninsula Borough has a strong demand for recreation facilities and many of its facilities are overused. Recreation activities that are currently taking place outside of the study area may shift into the study area to utilize the constructed facilities, bringing with them long term seasonal indirect expenditures in the form of patronage of local retail and service providers.

7.4.3 Environmental Quality

Qualitative enhancements to the environment include a reduction in fossil fuel usage and emissions due to a reduction in bulldozer operations within the stream during high flow events. This project contributes to the overall health of the watershed by eliminating the need for heavy machinery to operate within the stream in this stretch of Salmon Creek.

7.4.4 Other Social Effects

The project contributes to the human environment by encouraging outdoor recreation activities. This, in turn contributes to healthy lifestyles. The project increases peace of mind within the community as it relieves the constant fear of flooding during high flow events.

7.5 Risk and Uncertainty

In any planning decision, it is important to take into account the risk and uncertainty that is invariably present. For this study, there are a number of risk and uncertainty categories that were identified and evaluated during the planning process including flood damages, flow conditions, material prices, recreational usage, etc. Further information on these calculations can be found in the various appendices.

7.5.1 Estimation of Benefits

7.5.1.1 Flood-Related Benefits

Estimating flood damages involves many inputs including water surface elevations, structure first floor elevations, and depreciated replacement values of structures. There is an inherent uncertainty that comes with deriving a single number (average annual flood damages) from a model requiring so many inputs. Therefore, HEC-FDA outputs include a percentage chance that indicated values are exceeded by actual values. Table 16 shows these calculations. There is a 75 percent chance that actual damages reduced are higher than $63,890. There is a 50 percent chance that actual damages reduced are higher than $159,580. There is a 25 percent chance that damages reduced are higher than $249,670. Annual flood benefits assumed to accrue to the recommended plan are $157,850, or approximately equal to the value at which there is an equal chance of actual damages being higher or lower than the stated value.

Table 16: Probability of Flood Damage Reduction Exceedance

Probability	Damages
.75	$63,890
.50	$159,580
.25	$249,670

7.5.1.2 Recreation-Related Benefits

There is an inherent uncertainty to assigning Unit Day Value and estimating visitation to recreation facilities. However, the Unit Day Value points system accounts for a certain amount of uncertainty by assigning values in 10-point increments (Table 17).

Table 17: Federal Fiscal Year 2015 UDV Values

Point Values	General Recreation Values
0	$3.91
10	**$4.64**
20	$5.13
30	$5.86
40	**$7.32**
50	$8.30
60	$9.03
70	$9.52
80	$10.50
90	$11.23
100	$11.72

For Salmon Creek, the without-project condition points were 16. Therefore, it was assigned a Points Value of $4.64, equal to 10 points instead of 20. The with-project condition points were 48. Therefore, it was assigned a Points Value of $7.32, equal to 40 points instead of 50. This conservative approach to assigning points values accounts for some of the uncertainty inherent in this calculation.

There is also uncertainty in the calculation of visitation. Guidance acknowledges the uncertainty involved in using the Capacity Method of visitation estimation and limits its use to certain project types where the project is small in nature, the recreation is based on facility availability instead of resource availability, and the project is located in an area certain to have excess demand to utilize new facilities. The study area and project type meet all of these criteria. All calculations were performed in accordance with policy and guidance including Engineer Regulation 1105-2-100, Institute for Water Resources Report 74-R-1, and Institute for Water Resources Report 86-R-4 and vetted through a known recreation expert within the Corps.[22]

In addition, the estimated visitation number is approximately 27 percent lower than the last reported annual visitation number at the nearest similar facility (Lowell Point State Recreation Site). This provides a reality check on the estimated number of visitations expected to occur at Salmon Creek in the with-project condition.

The likelihood of an error in estimating visitation is considered medium due to the inherent uncertainty of the inputs. However, the consequence is considered low for a few reasons. First, the capacity method is highly applicable to projects such as this and was formulated in order to account for known uncertainty. Second, there are sufficient flood-related benefits such that the project would not be justified solely based upon the inclusion of recreation benefits.

[22] Written and telephonic correspondence, Matt Rea, various dates throughout 2014

7.5.1.3 Sensitivity Analysis

In addition to this analysis, an analysis was performed to determine the percentage reduction that could occur within each benefit category (holding the other categories constant) before the project would no longer be justified. The results of this analysis are shown in Table 18.

Table 18: Benefits Sensitivity Analysis

Category	Net Annual	Available Reduction	Available % Reduction
Net Annual Costs	$139,000	N/A	N/A
Foregone Flood Fighting Benefits	$15,000	$15,000	100%
Recreation Benefits	$263,100	$263,100	100%
Inundation Reduction Benefits	$157,850	$103,350	66%

Note: Per ER1105-2-100, Appendix E, Section VII, Paragraph E-47, Flood Risk Management Benefits (in this case Inundation Reduction Benefits plus Foregone Flood Fighting Benefits) must make up at least 50 percent of the benefits used to justify the project. Without this policy in place, Inundation Reduction Benefits could be reduced by 100 percent and the project would still be justified. Benefits in this table are average annual benefits.

7.5.2 Flow Conditions

Flooding along Salmon Creek is alluvial in nature and therefore it is often difficult to determine the exact flows that will take place if the stream was to exit its channel. Imagery of the area was used to assess elevation changes between the main channel of Salmon Creek and the relic channel it would follow if it exited its main channel. From this information, an estimate of total flow to exit the main channel was calculated using best professional judgment. This was addressed to some degree by flow uncertainty calculations performed within HEC-FDA.

The likelihood of some error in the calculation of flow conditions is considered to be medium. However, the consequence of any error is expected to be low. There is a known flooding issue in the area, the depths are relatively low for the most-inundated areas, and the model used to calculate benefits assumes a certain amount of flow uncertainty in its calculations. Therefore, minor changes in actual flow conditions would not significantly affect the project's viability.

7.5.3 Residual Risk

The recommended plan protects against flows with a 0.002 annual chance of exceedance. Under conditions with a lower annual chance of exceedance, this structure could be overtopped with some flow proceeding into the relic channel. However, given the nature of the area, atmospheric conditions during such an event would contribute to increased flow levels in all area streams, likely leading to flooding that would not be exacerbated by minor overtopping of the structure. The structure has been designed to protect against scour due to overtopping. Therefore, catastrophic failure during overtopping is unlikely to occur.

The cumulative long-term risks of exceedance for set time periods over the planning period of analysis are shown below in Table 19. The chance of the tentatively selected plan being exceeded over the planning period of analysis is approximately 0.095 and should have the capability to contain historic floods.

Table 19: Long Term Risk of Exceedance

Period	Chance of Exceedance
10 years	0.020
30 years	0.058
50 years	0.095

The majority of the damages avoided by construction of the tentatively selected plan occur by restricting flows to Salmon Creek that would otherwise enter a relic channel and flood Bear Lake Subdivision. In all reaches related to this area, conditional non-exceedance probabilities exceeded 0.999.

8.0 ENVIRONMENTAL CONSEQUENCES*

The environmental consequences of Alternatives L1, L2, and L3 were evaluated in comparison to the no action alternative. While this consequence analysis focuses on the Tentatively Selected Plan, the impacts of the other alternatives are similar to the Tentatively Selected Plan unless otherwise noted.

8.1 Physical Environment

8.1.1 Water Quality

8.1.1.1 No Action Plan

Large construction equipment will continue to enter the streambed during emergency berm-building operations. This activity will contribute to elevated levels of turbidity and suspended sediment. However, the effects may be negligible due to the normally high levels of turbidity and suspended sediment in this stream.

8.1.1.2 Tentatively Selected Plan

There will be temporary increases in turbidity and suspended sediment during construction, but there is not expected to be any long-term impact on the stream's water quality. There are no municipal water supplies in the area that would be negatively affected by construction. Impacts to the waters of the United States are expected to be less than significant.

8.1.2 Air Quality

8.1.2.1 No Action Plan

Air quality will continue to be temporarily degraded during emergency berm building activities due to the presence of construction equipment actively altering the stream bank's configuration.

8.1.2.2 Tentatively Selected Plan

Air quality may be affected during the construction period due to resultant suspended particulates from equipment movement and material placement as well as emissions from equipment. Any degraded air quality conditions that may be caused by the project are believed to be transient, highly localized, and likely to entirely dissipate at the end of the construction

phase. The Corps and its contractors will comply with all applicable air quality regulations and policies of the landowner, local authorities, and the State and Federal governments. Any increase in vehicular traffic related to utilization of the area for recreation purposes should not be sufficiently large enough to cause a permanent degradation of resident air quality. Impacts to air quality are expected to be less than significant.

8.1.3 Aesthetic Quality

8.1.3.1 No Action Plan

The area will continue to be undeveloped with old growth forest to the north of the creek and a steep, mountainous bank to the south. The stream bank will remain scarred from continuous re-working by heavy construction equipment.

8.1.3.2 Tentatively Selected Plan

Aesthetic quality is expected to be neutral to positive after construction is complete. While a permanent manmade structure is being constructed, it is similar in nature to the existing condition and is likely an aesthetic improvement over such. Construction of the project will negate the need for heavy equipment to maintain a presence within the streambed, leading to less scarring and tracking of the area. Any impacts to aesthetics are expected to be less than significant.

8.1.4 Noise

8.1.4.1 No Action Plan

Existing recreational activities will continue to generate a wide variety of noise. During the winter, dogsleds, cross-country skiers, and snowmachines generate noise. During the summer, day hikers and target shooters generate noise.

8.1.4.2 Tentatively Selected Plan

There is expected to be an increase in visitation due to construction of the ancillary recreation facilities establishing road access to the area. The increased human activity in the area will be mostly dispersed with people moving up and down the streambank. The only other expected increase in noise will be an increase in vehicular traffic on local roads between the Seward Highway and the project's parking lot. Any adverse changes in noise are expected to be less than significant.

8.1.5 Human Activity

8.1.5.1 No Action Plan

Human activity will continue at current levels into the foreseeable future.

8.1.5.2 Tentatively Selected Plan

In the with-project condition, there is expected to be a greater human presence in the project area due to the construction and utilization of access and recreational features. There is the potential for some degradation due to off-trail activities. However, the area will likely be visited by established user groups who are long-term users of the greater area and therefore have an interest in maintaining the somewhat pristine nature of the area. The bulk of new activities at the site are expected to be skiing, walking, dog mushing, and snow machining, which are all activities that

are best served by utilizing established trails or the creek bed. The non-Federal partner can encourage responsible use of the area through proper signage and site control.

8.2 Biological Resources

8.2.1 Terrestrial Habitat

8.2.1.1 No Action Plan

There is not expected to be any significant change in terrestrial habitat under the No Action Plan, as no future development projects are proposed for the area.

8.2.1.2 Tentatively Selected Plan

There will be a minor impact to some terrestrial habitat due to the construction of the two-lane access road. These impacts were minimized by utilizing existing four wheel drive trails for the majority of the road's alignment. The one-lane mud trail will be upgraded to a 24-foot-wide road approximately 3,225 feet in length resulting in the removal of 0.9 acre of terrestrial habitat. Any impacts to terrestrial species will be temporary in nature. Due to the abundant nature of similar habitat in the area, terrestrial species will likely choose to relocate to adjacent areas containing similar habitat during construction activities and return permanently once construction is complete.

The number of trees felled during construction of the access road will not significantly impact terrestrial habitat. It is likely that felled trees will either be transported to a landfill or offered to the public for use as firewood. There will be no loss of specialized bird habitat due to construction of the project and no mitigation is proposed for the loss of terrestrial habitat. Any impacts to terrestrial habitat are expected to be less than significant.

8.2.2 Federal and State Threatened and Endangered Species

8.2.2.1 No Action Plan

There are not expected to be any significant changes in either the presence or habitat of listed species under the No Action Plan.

8.2.2.2 Tentatively Selected Plan

While the U.S. Fish and Wildlife Service's managed species, the Kittlitz's murrelet is known to be present in the Seward/Resurrection Bay area; the project area does not provide its preferred habitat. Therefore, Tentatively Selected Plan alternatives will have no effect on the Kittlitz's murrelet or any other Federally-listed, threatened, or endangered species, or designated critical habitat.

8.2.3 Fishery Resources and Essential Fish Habitat

8.2.3.1 No Action Plan

The No Action Plan will have no effect on Salmon Creek's fishery resources and essential fish habitat downstream of the project area.

8.2.3.2 Tentatively Selected Plan

Berm construction will not impact either anadromous fish or their essential fish habitat because the project site is upstream from reaches of Salmon Creek that support anadromous fish. However, the Alaska Department of Fish and Game requires any removal of gravel and river-run rock be removed in shallow, even lifts to avoid the creation of fish entrapment basins and all depressions and potholes created by material removal be leveled to avoid fish entrapment.

8.3 Coastal Zone Resource Management

Complying with State of Alaska environmental statutes has historically centered on complying with the State's coastal zone management authorities; however, the State of Alaska withdrew from the voluntary National Coastal Zone Management Program (http://coastalmanagement.noaa.gov/programs/czm.html) on July 1, 2011. Subsequently, within the State of Alaska, the Federal consistency requirements under the Coastal Zone Management Act do not apply to Federal agencies, those seeking forms of Federal authorization, and state and local government entities applying for Federal assistance. However, the Corps is still responsible for complying with State of Alaska environmental statutes, e.g. Alaska Department of Fish and Game (ADF&G) Fish Habitat Permit and Special Area Permit and the ADEC issuance of a Clean Water Act-related "Certificate of Reasonable Assurance," and a Solid Waste Disposal permit. Comments and concerns received from the Alaska Department of Fish and Game in Permit Number FH 14-V-0347 are in this document.

8.4 Historical and Archeological Resources

There are no known cultural resources or historic properties listed or eligible for listing under the National Register of Historic Places within the area of potential effect. Ground disturbing activities proposed for this undertaking are mostly limited to the previously disturbed floodplain and modified streambank with some ground disturbance along the existing four wheel drive trail. Therefore, the Corps has determined that no historic properties are affected and the proposed action will have a less than significant effect on historic and archaeological resources. As expressed in a letter dated 10 October 2014, the Alaska State Historic Preservation Officer has concurred with the Corps' assessment that there are no known cultural resources in the project area and the likelihood of encountering or affecting cultural resources is minimal. Therefore, the impact on cultural resources is expected to be the same under both the No Action Plan and the Tentatively Selected Plan. Impacts to cultural resources are expected to be less than significant.

8.5 Environmental Justice and Protection of Children

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations", requires Federal agencies to identify and address any disproportionately high and adverse human health effects of its programs and activities on minority and low-income populations. As discussed, 32 percent of the area's population is of minority descent and 6 percent of the population falls below the Federal poverty line. This project is expected to provide proportionate benefits to the population as a whole. The impact on these populations is expected less than significant and is expected to be the same under both the No Action Plan and the Tentatively Selected Plan.

8.6 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts associated with this project. All impacts associated with this project are expected to be less than significant and temporary in nature. Therefore, unavoidable adverse impacts are expected to be the same under both the No Action Plan and the Tentatively Selected Plan.

8.7 Cumulative and Long-term Impacts

Federal law (33 Code of Federal Regulations 230 et seq.) and Engineer Regulation 200-2-2, "*Procedures for Implementing NEPA,*" require that National Environmental Policy Act documents assess cumulative effects, which are the impact on the environment resulting from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions. Construction of the Tentatively Selected Plan is not expected to have any cumulative or long-term adverse impacts and may actually enhance the health of the stream as it will eliminate the need for heavy equipment operations within the stream that would continue to occur under the No Action Plan.

8.8 Summary of Mitigation Measures

8.8.1 No Action Plan

There would be no mitigation measures associated with the No Action Plan.

8.8.2 Tentatively Selected Plan

Mitigation measures associated with this project include avoidance and minimization actions to ensure the safe movement of fish during and after construction. During construction, material will be moved and shaped in a way that avoids creating fish entrapment basins. The berm structure will be designed to avoid any impacts to fish movement. Construction will take place during the typical low-flow season, theoretically negating the need for in-water work.

8.9 Plan Selection

After thorough consideration of the ecological effects of both the No Action Plan and Tentatively Selection Plan and the overall project benefits (flood control, recreation, etc), the Tentatively Selected Plan was selected as the Recommended Plan. Any adverse effects resulting from implementation of the Recommended Plan will be temporary and less than significant.

9.0 PUBLIC AND AGENCY INVOLVEMENT*

9.1 Public/Scoping Meetings

A charette was held at the Seward City Fire Hall on 31 July 2013. The meeting was attended by representatives from the City of Seward, the Kenai Peninsula Borough, the Seward Bear Creek Flood Service Area, and the Corps. At this meeting, the study process, problems, opportunities, constraints, and potential impacts were discussed.

The Seward Bear Creek Flood Service Area holds regularly scheduled public meetings twice per month. This project was discussed multiple times throughout the study period. The Seward Bear Creek Flood Service Area and Corps of Engineers, Alaska District held a public meeting at

Kenai Peninsula Borough offices in Seward, Alaska on 1 May 2015. Public participation and input were solicited at these meetings.

In addition to these meetings, there has been outreach to local stakeholder groups such as the Seward Nordic Ski Club. Local newspapers have published multiple stories regarding the project over the course of the study.

9.2 Federal and State Agency Coordination

Coordination with all required state and Federal agencies has been sought. The project has received concurrence from the State of Alaska Historic Preservation Officer that impacts to cultural resources are not likely. Coordination with the State of Alaska Department of Fish and Game resulted in the implementation of construction best practices to avoid fish entrapment and the avoidance of impacts to fish passage. The State of Alaska Department of Natural Resources and U.S. Forest Service provided welcome feedback on the optimal placement and alignment of project access features. To date, no other agencies, other than those listed, provided input.

9.3 Status of Environmental Compliance (Compliance Table)

9.3.1 Relationship to Environmental Laws and Compliance

The following sections detail the status of compliance with project-applicable laws.

9.3.1.1 National Environmental Policy Act of 1969 (42 United States Code 4321 et seq.)

This Act requires that environmental consequences and project alternatives be considered before a decision is made to implement a Federal project. The National Environmental Policy Act established the requirements for preparation of an Environmental Impact Statement for projects potentially having significant environmental impacts and an Environmental Assessment for projects with no significant environmental impacts. This Environmental Assessment has been prepared to address impacts and propose avoidance and minimization steps for the proposed project, as discussed in the Council on Environmental Quality regulations on implementing National Environmental Policy Act (40 Code of Federal Regulations 1500 et seq.). This document presents sufficient information regarding the generic impacts of the proposed construction activities to guide future studies and is intended to satisfy all National Environmental Policy Act requirements.

In accordance with National Environmental Policy Act and Corps regulations and policies, the Environmental Assessment and unsigned Finding of No Significant Impact will be released for public and agency review, and the Environmental Assessment will be made available on the Alaska District website to the interested public prior to the implementation of this proposed action.

9.3.1.2 Clean Water Act of 1972 (33 United States Code 1251 et seq.)

The objective of the Federal Water Pollution Control Act of 1972, as amended by the Clean Water Act (Public Law 92-500, 33 U.S.C. 1251 et seq.), is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

Various sections of the Clean Water Act regulate the discharge of pollutants and wastes into aquatic and marine environments. The specific sections of the Clean Water Act that apply to the proposed project are Section 404, addressing the discharge of fill material to the waters of the United States, and Section 401, which requires certification that the permitted project complies with the State Water Quality Standards for actions within State waters. The major Federal action invoking this regulation is the proposed placement of rock below the ordinary high water line of Salmon Creek.

Although the enforcement agency for Section 404 is normally the Corps, the Corps does not issue permits to itself. Instead, the Corps has prepared a 404(b)(1) evaluation to determine Federal consistency with Section 404 of the Clean Water Act. The 404(b)(1) evaluation for this project (Appendix B) has been completed and submitted to the State of Alaska Department of Environmental Conservation. If the State concurs with the Corps determination that there is reasonable assurance that the proposed project would meet and maintain State water quality standards, a Section 401 water quality certificate will be issued. State water quality certification will be obtained prior to finalization of the Environmental Assessment and signing of the Finding of No Significant Impact.

9.3.1.3 Rivers and Harbors Act of 1899 (33 United States Code 403 et seq.)

Section 10 of this Act prohibits the obstruction or alteration of navigable waters of the United States without a permit from the Corps. Generally, navigable waters are those waters of the United States subject to the ebb and flow of the tide shoreward to the mean high water mark, and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. Salmon Creek does not meet the definition of a navigable waterway as defined by 33 Code of Federal Regulations Part 328, so the Rivers and Harbors Act of 1899 does not apply.

9.3.1.4 Endangered Species Act of 1973 (16 United States Code 1531 et seq.)

The Endangered Species Act protects threatened and endangered species by requiring federal agencies, in consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. The law also prohibits any action that causes a "taking" of any listed species of endangered fish or wildlife. Since Endangered Species Act-listed species are not normally found in the project area, and no critical habitat occurs within the project area, the proposed project will have no effect on any Federally-listed threatened or endangered species.

9.3.1.5 Fish and Wildlife Coordination Act (16 United States Code 661 et seq.)

The Fish and Wildlife Coordination Act requires the Corps to consult with the United States Fish and Wildlife Service whenever the waters of any stream or other body of water are proposed to be impounded, diverted, or otherwise modified. No comments or recommendations have yet been received by the U.S. Fish and Wildlife Service.

9.3.1.6 Magnuson-Stevens Fishery Conservation and Management Act Fishery Conservation Reauthorization Act of 2006, as amended, (16 United States Code 1801 et seq.)

The Magnuson-Stevens Fishery Conservation and Management Act provides for the conservation and management of all fishery resources between 3 and 200 nautical miles offshore. The 1996 amendments to this act require regional fisheries management councils, with assistance from the National Marine Fisheries Service, to delineate Essential Fish Habitat in Fishery Management Plans for all managed species. Essential Fish Habitat is defined as an area that consists of "waters and substrate necessary for spawning, breeding, feeding or growth to maturity" for certain fish species. Federal action agencies that carry out activities that may adversely impact Essential Fish Habitat are required to consult with the National Marine Fisheries Service regarding potential adverse effects of their actions on Essential Fish Habitat.

The Corps has conducted an assessment of Essential Fish Habitat for the proposed project using information provided on-line by the National Marine Fisheries Service, and it has been determined that this project will have no effect on Essential Fish Habitat. No future coordination with the National Marine Fisheries Service is expected at this time. Should the scope of the project change then coordination will resume at that time.

9.3.1.7 Marine Mammal Protection Act of 1972, as amended (16 United States Code 1361 et seq.)

The Marine Mammal Protection Act provides protection to marine mammals in both State waters (within 3 nautical miles from the coastline) and the ocean waters beyond. As specified in the Marine Mammal Protection Act, the United States Fish and Wildlife Service is responsible for the management of polar bears, walrus, and sea otters; the National Marine Fisheries Service is responsible for all other marine mammals.

The project area does not occur in any marine waters. Therefore the Marine Mammal Protection Act does not apply to this action.

9.3.1.8 Migratory Bird Treaty Act of 1918, as amended (16 United States Code 703 et seq.)

The essential provision of the Migratory Bird Treaty Act makes it unlawful, except as permitted by regulations, "to pursue, hunt, take, capture, kill…any migratory bird, any part, nest or egg," or any product of any bird species protected by the convention. Significant populations of migratory birds are not expected to be present in the project area. Should this change, the Corps will coordinate with Unites States Fish and Wildlife Service to minimize any risk posed to migratory birds by the project.

9.3.1.9 National Historic Preservation Act of 1966, as amended (16 United States Code 470 et seq.)

The purpose of the National Historic Preservation Act is to preserve and protect historic and prehistoric resources that may be damaged, destroyed, or made less available by a project. Under this Act, Federal agencies are required to identify cultural or historic resources that may be affected by a project and to consult with the State Historic Preservation Officer when a Federal action may affect cultural resources.

As discussed in Section 8.5, the Corps has determined that no historic properties will be affected by this project. The Corps, Alaska District received a stamped letter dated 10 October 2014 from the State of Alaska Historic Preservation Office concurring with the Corps' determination that no historic properties or cultural resources are likely to be affected by the project.

If previously unknown cultural resources are identified during project implementation, all activity will cease until requirements of 36 Code of Federal Regulations 800.11, *Discovery of Properties During Implementation of an Undertaking*, are met.

9.3.1.10 Executive Order 11988, Floodplain Management

Kenai Peninsula Borough municipal code 21.06.050, B, 1, a. states that all new structures in the area must be constructed with a first floor elevation at or above the base flood elevation. Therefore, any new construction behind the revetment will be done so in a flood-responsible manner.

The construction of the recommended project is not expected to increase or encourage construction within the floodplain above what would have occurred in the without-project condition and therefore the project is in compliance with Executive Order 11988.

9.3.1.11 Clean Air Act of 1963, as amended (42 United States Code 85 et seq.)

Seward is not located in either a maintenance or non-attainment area for any pollutant under the Clean Air Act. A study for PM_{10} particulate matter was conducted between January 2011 and May 2012. This study found that Seward does not exceed current Federal threshold levels for that pollutant. Activities due to construction, operation, maintenance, and recreational use of the recommended project include: surface disturbances, construction equipment movement, and on and off-road vehicle traffic including some government vehicle traffic used during inspections of the completed project. None of these activities are expected to produce any pollutants in quantities that would exceed Federal thresholds.

9.3.1.12 Executive Order 13112, Invasive Species

The non-native plants that are present in the area are not expected to supplant native species and rise to the level of being considered invasive. Invasive plant species are relatively rare in this area with some non-native plants occurring in areas of human-caused disturbance. Since the project area is already utilized by humans, it is unlikely that the presence of non-native species would significantly increase under the with-project condition, even with the attendant rise in recreational use.

Table 20 summarizes the project's compliance with relevant Federal statutory authorities.

9.1 Views of the Non-Federal Partner

The non-Federal partner supports the findings of this study and has allocated funds toward the design and construction of the proposed project. In addition, the public is supportive of the project due to the reduction in government costs associated with flood fighting, the reduction in direct flood risks, and the increase in recreation resources.

Table 20: Summary of Relevant Federal Statutory Authorities

Federal Statutory Authority	Compliance Status
Archaeological and Historic Act of 1974	Full Compliance
Clean Air Act, as amended	Full Compliance
Clean Water Act of 1977, as amended	Full Compliance
Coastal Zone Management Act of 1982	N/A
Endangered Species Act of 1973, as amended*	Full Compliance
Fish and Wildlife Coordination Act, as amended	Full Compliance
Marine Mammal Protection Act	Full Compliance
Marine Protection, Research, and Sanctuaries Act of 1972	Full Compliance
Migratory Bird Treaty Act of 1918*	Full Compliance
Magnuson-Stevens Fishery Conservation and Management Act*	Full Compliance
National Environmental Policy Act of 1969, as amended*	Full Compliance
National Historic Preservation Act of 1966, as amended*	Full Compliance
Protection of Wetlands (Executive Order 11990)	Full Compliance
Rivers and Harbors Act of 1899	Full Compliance

*- Full compliance will be attained upon completion of the public review process and/or further coordination with responsible agencies
Note: This list is not exhaustive.

10.0 PREPARERS OF THE ENVIRONMENTAL ASSESSMENT*

This integrated feasibility report and environmental assessment was prepared by Tatton Suter (Planner) and Jason Norris (Project Manager) of the Civil Works Planning Section, Alaska District, U.S. Army Corps of Engineers, and Chris Floyd (Biologist), Wayne Crayton (Biologist), Diane Walters (Editor) and Mike Noah (Section Chief) of the Civil Works Environmental Resources Section, Alaska District, U.S. Army Corps of Engineers.

11.0 CONCLUSIONS AND RECOMMENDATIONS*

11.1 Conclusions

The proposed construction of a new revetment as discussed in this document would have minor but largely controllable short term impacts. However, in the long term it would help improve the overall quality of the human environment. This assessment supports the conclusion that the proposed project does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, a finding of no significant impact will be prepared.

11.2 Recommendations

I recommend that the flood risk management measures at Seward, Alaska be constructed generally in accordance with the plan herein, and with such modifications thereof as at the discretion of the Chief of Engineers may be advisable at an estimated total Federal cost of $2,160,000 and $0 annually for Federal maintenance.

Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total flood risk management costs as further specified below:
    1. Provide, during the design and implementation phase, a contribution of funds equal to 5 percent of total flood risk management costs;
    2. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the flood risk management features;
    3. Provide, during the design and implementation phase, any additional funds necessary to make its total contribution equal to at least 35 percent of total flood risk management costs;

b. Provide 50 percent of total recreation costs as further specified below:
    1. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;
    2. Provide, during the design and implementation phase, any funds necessary to make its total contribution equal to 50 percent of total recreation costs;

c. Provide, during the design and implementation phase, 100 percent of the total recreation costs that exceed an amount equal to 10 percent of the Federal share of total flood risk management costs;

d. Provide, during the design and implementation phase, 100 percent of all costs of planning, design, and construction for the project that exceed $10,000,000;

e. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefor, to meet any of the non-Federal obligations for the project unless the Federal agency providing the funds verifies in writing that the funds are authorized to be used to carry out the project;

f. Not less than once each year, inform affected interests of the extent of protection afforded by the flood risk management features;

g. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

h. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project partnership agreement, and to implement such plan not later than one year after completion of construction of the flood risk management features;

i. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood risk management features;

j. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the flood risk management features afford, hinder operation and maintenance of the project, or interfere with the project's proper function;

k. Keep the recreation features, and access roads, parking areas, and other associated public use facilities, open and available to all on equal terms;

l. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 Code of Federal Regulations (CFR) Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

m. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

n. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

o. Hold and save the United States free from all damages arising from the design, construction, operation, maintenance, repair, rehabilitation, and replacement of the

project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

p. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20;

q. Comply with all the requirements of applicable Federal laws and implementing regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; the Age Discrimination Act of 1975 (42 U.S.C. 6102); the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and Army Regulation 600-7 issued pursuant thereto; and 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (labor standards originally enacted as the Davis-Bacon Act, the Contract Work Hours and Safety Standards Act, and the Copeland Anti-Kick Act);

r. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

s. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

t. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA;

u. Provide, during the design and implementation phase, a percentage of all costs that exceed $100,000 for data recovery activities associated with historic preservation for the project as follows: 35 percent of such costs that are attributable to the flood risk management features and 50 percent of such costs that are attributable to the recreation features; and

v. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

The recommendations for implementation of flood risk management and recreation measures at Seward, Alaska reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect the program and budgeting priorities inherent in the local and State programs or the formulation of a national civil works water resources program. Consequently, the recommendations may be changed at higher review levels of the executive branch outside Alaska before they are used to support funding.

Date: _____

_____
Christopher D. Lestochi
Colonel, U.S. Army Corps of Engineers
District Commander

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APPENDIX A
ECONOMICS

Salmon Creek Section, Seward, Alaska 205 Flood Risk Management Economic Analysis using Hydrologic Engineering Center – Flood Damage Analysis (HEC-FDA) model

February 13, 2015

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Introduction

General. This document presents the results of the flood risk management structural damages and benefits calculated using the Corps certified Hydrologic Engineering Analysis Flood Damage Analysis Version 1.2.5a model for Salmon Creek, AK Section 205 evaluation. The expected annual damage and benefits were calculated for without project conditions and for three structural alternatives. The appendix was prepared in accordance with Engineering Regulation (ER) 1105-2-100, Planning Guidance Notebook, and ER 1105-2-101, Planning Guidance, Risk Analysis for Flood Damage Reduction Studies. The National Economic Development Procedures Manual for Flood Risk Management and Coastal Storm Risk Management, prepared by the Water Resources Support Center, Institute for Water Resources, was also used as a reference, along with the Users Manual for the Hydrologic Engineering Center Flood Damage Analysis Model (HEC-FDA).

The economic report consists of a description of the methodology used to determine the National Economic Development (NED) flood risk management damages and benefits using the HEC-FDA model. The damages and costs were calculated using October 2014 price levels and converted to expected annual values using the current FY 2015 Federal discount rate of 3.375 percent and a period of analysis of 50 years. The year 2016 was identified as the base year for each of the project alternatives as the basis for plan comparison. The engineering and economic inputs determined for the base year are used to represent each year over the 50-year period of analysis. This report does not address the calculation of NED emergency costs, recreation benefits, or the annualization of project costs. These aspects of the economic analysis are discussed in the Draft Interim Integrated Feasibility Report and Environmental Assessment Report.

Project Description and Location. Salmon Creek is an alluvial stream located in Seward, approximately 70 miles south of Anchorage. Kenai Peninsula Borough (KPB), the non-Federal cost-sharing partner, currently maintains a temporary embankment that is approximately 1,500 feet in length on the right bank of Kwechak Creek, a tributary of Salmon Creek. The embankment is monitored by KPB representatives during rain events and has required emergency stabilization work to be performed to stop the stream from exiting its banks and recapturing a relic channel to the east of Bear Lake Subdivision. This relic channel flows directly into Bear Lake Subdivision. If the embankment is not maintained, there is a high risk of inundation and property damages into the Bear Creek Subdivision. The objective of a project is to provide an embankment that would require little maintenance and reduce the risk of floods and property damages.

The study area was subdivided into 25 hydrologic or study area reaches along three streams, Bear Creek, Relic and Kwechak Creek. Within the 24 of the 25 study area reaches, a total of 379 residential and non-residential structures were evaluated for calculation of damages and benefits. One reach did not contain any structures.

Project Alternatives. Four alternatives were considered as part of the evaluation. Water surface elevations (WSEs) were provided at each cross-section within the three streams for the following conditions:
1. Without Project – Kwechak Creek out of bank flow at the 10-year event and no additional embankment built or maintained;
2. 50-yr Embankment – the embankment is built at the 50-year water surface elevation;
3. 100-yr Embankment – the embankment is built at the 100-year water surface elevation;
4. 500-yr Embankment – the embankment is built at the 500-year water surface elevation

All embankment options are intended to lower the risk of flooding and property damages from Kwechak Creek overbank flows toward Bear Lake and Bear Creek. The designed embankment structure is not intended as a certified levee.

Economic and Engineering Inputs to the HEC-FDA Model

HEC-FDA Model Description. The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5a Corps-certified model was used to calculate expected annual damages and benefits over the period of analysis. The economic and engineering inputs necessary for the model to calculate damages include structure inventory, content-to-structure value ratios, vehicles, first-floor elevations, and depth-damage relationships, ground elevations, and stage-probability relationships.

The uncertainty surrounding each of the economic and engineering variables was also entered into the model. Either a normal probability distribution, with a mean value and a standard deviation, or a triangular probability distribution, with a most likely, a maximum and a minimum value, was entered into the model to quantify the uncertainty associated with the key economic variables. A normal probability distribution was entered into the model to quantify the uncertainty surrounding the ground elevations. The number of years that stages were recorded at a given gage was entered for each study area reach to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships.

Development of Structure Inventory. Field surveys were conducted in 2014 to develop a residential and non-residential structure inventory for the economic analysis. The square footage of the structures was determined along with characteristics of the structures. The structural characteristics included the occupancy type, the average age of the structure and the condition of the structure. A depreciated replacement value for each occupancy type (one story homes with and without basements, two story homes with and without basements, split level homes with and without basements and mobile home) in the area was calculated using the Marshal and Swift Residential Estimator Valuation computer program. The depreciated replacement value per square foot was calculated and then applied to the square foot values for each individual structure in order to determine a total depreciated replacement value for each structure in 2014 price levels. An average standard deviation, which is expressed as a percentage of the mean structure value, totaling 11.4 percent was used to represent the uncertainty surrounding the structure values for each residential category.

First-Floor Elevations of Structures. Aerial photography was superimposed over a GIS shape file layer for the purpose of identifying the location and ground elevations of residential structures. Visual inspection was used to determine the height above ground. The error implicit in using the LIDAR data to estimate the ground elevation of each of the structures is normally distributed with a mean of zero and a standard deviation of 0.6 feet. The standard deviation of 0.6 feet was used to represent the uncertainty surrounding the first floor elevation of the structures.

Content to-Structure Value Ratios and Depth-Damage Relationships. The content-to-structure value ratio (CSVR) and structure and content depth-damage relationships used for one-story residential without and with basement, two-story residential without and with basement, and split level without and with basement, are taken from EGM, 01-03, generic depth-damage relationships, dated 4 December 2000. The EGM used a CSVR of 1.0 for the CSVR for each type of structure. The mobile home depth-damage relationships developed by the New Orleans District for the Morganza to the Gulf of Mexico, LA evaluation were used for mobile homes and storage structures in the evaluation. The probability distributions representing the uncertainty surrounding the depth damage relationships were incorporated into the damage analysis.

Stage-Probability Relationships. Stage-probability relationships were provided for the without and for 3 with-project conditions for 25 reaches along three streams within the study area. Water surface profiles were provided for eight annual chance exceedance (ACE) events: .99% (1-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), 1% (100-year), 0.5% (200-year), and the 0.02% (500-year). A 15-year equivalent record length was used to quantify the uncertainty surrounding the stage-probability relationships for each study area reach. Based on this equivalent record length, the HEC-FDA model calculated the confidence limits surrounding the stage-probability function for each study area reach and project alternative. The uncertainty surrounding the stages is used in the model to determine the uncertainty surrounding the damage and benefit results through use of Monte Carlo simulation. As an example, Table 1 shows the confidence limits surrounding the stage-probability relationship for study area reach 9, which is station 18, in the HEC-FDA model.

Top of Levee Elevations. A top of levee elevation was entered into the HEC-FDA model for each study area reach under the without- and with-project conditions. Under the without-project conditions, a top of levee elevation equal to the stage associated with the 10% (10-year) ACE was entered for each study area reach. For each of the three with-project alternatives, a top of levee elevation was entered equal to the stage associated with the 2% (50-year) ACE event, the 1% (100-year) event, and the 0.02% (500-year) event, respectively. The without project stage-probability relationships were used for all of the project alternatives along with the top of levee elevations in the HEC-FDA model. The model truncates all damages below the top of levee elevation entered for each study area reach in the model.

National Economic Development (NED) Flood Damage and Benefit Calculations

HEC-FDA Model Calculations. The HEC-FDA model was utilized to evaluate flood damages using risk-based analysis. Damages were reported at the index location for each of the 25 basins for which engineering data was available and a structure inventory had been developed. A range of possible values, with a maximum and a minimum value for each economic variable (first-floor elevation, structure and content values, and depth-damage relationships), was entered into the HEC-FDA model to calculate the uncertainty or error surrounding the elevation-damage, or stage-damage, relationships. The model also used the number of years that stages were recorded at a given gage to determine the hydrologic uncertainty surrounding the stage-probability relationships.

The possible occurrences of each variable were derived through the use of Monte Carlo simulation, which used randomly selected numbers to simulate the values of the selected variables from within the established ranges and distributions. For each variable, a sampling technique was used to select from within the range of possible values. With each sample, or iteration, a different value was selected. The number of iterations performed affects the simulation execution time and the quality and accuracy of the results. This process was conducted simultaneously for each economic and hydrologic variable. The resulting mean value and probability distributions formed a comprehensive picture of all possible outcomes. For this evaluation, 1,000 iterations were performed to calculate the stage-damage relationships with uncertainty in the HEC-FDA model.

Without and With-Project Expected Annual Damages. The model used Monte Carlo simulation to sample from the stage-probability curve with uncertainty. For each of the iterations within the simulation, stages were simultaneously selected for the entire range of probability events. The sum of all damage values divided by the number of iterations run by the model yielded the expected value, or mean damage value, with confidence bands for each probability event. The probability-damage relationships are integrated by weighting the damages corresponding to each magnitude of flooding (stage) by the percentage chance of exceedance (probability). From these weighted damages, the model determined the expected annual damages (EAD) with confidence bands (uncertainty). Tables 2, 3, and 4 show the expected annual without-project damages, with-project damages, and expected annual benefits in 2014 price levels for each of the project alternatives by study area reach. The tables also show the expected annual damage reduced and the probability damaged reduced exceeds the indicated value for the 0.25, 0.50, and 0.75 percentiles. Table 5 provides a summary of the expected annual damages and benefits for each of the project alternatives.

Risk Analysis

Benefit Exceedance Probability Relationship. The HEC-FDA model used the uncertainty surrounding the economic and engineering inputs to generate results that can be used to assess the performance of the authorized project. Table 4 shows the expected annual benefits at the 75, 50, and 25 percentiles for each of the project alternatives. These percentiles reflect the

percentage chance that the benefits will be greater than or equal to the annual costs. This is indicative of the percent chance that the expected annual benefits will exceed the annual costs and that the benefit-to-cost ratio is greater than one and the net benefits are positive. Section 7.5.1 of the Draft Interim Integrated Feasibility Report and Environmental Assessment Report shows the chances that the expected annual benefits exceed expected annual costs for the recommended plan.

The HEC-FDA model calculated a target annual exceedance probability stage with a median and expected value that reflected the likelihood that the target stage will be exceeded in a given year. The target stage is set to where 5 percent residual damages at the 0.01 (100-year) ACE event under without project conditions was used to show significant damages at the target stage for each study area reach. The median value was calculated using point estimates, while the expected value was calculated using Monte Carlo simulation. The results also show the long-term risk or the probability of a target stage being exceeded over 10-year, 30-year, and 50-year periods. Finally, the model results show the conditional non-exceedance probability or the likelihood that a target stage will not be exceeded by the 10% ACE (10 year), the 4% ACE (25-year), the 2% ACE (50-year), the 1% ACE (100-year), the 0.4% ACE (250-year), and the 0.2% ACE (500-year). Tables 6, 7, 8, and 9 show the project performance results for the without-project conditions, and for each of the three project alternatives, respectively. The Hydraulics and Hydrology Appendix also displays the project performance results for the study area reach containing the embankment or levee under without-project and with-project conditions.

Report Summary

Summary. This report summarizes the use of the HEC-FDA model to calculate the expected annual flood damages and benefits for the without project condition and the three structural alternatives. The HEC-FDA model results for the project alternatives were used along with the calculation of emergency cost savings and recreation benefits to derive the total expected annual damages and benefits for the three project alternatives. The calculation of the total annual benefits is discussed in Section 6.3 of the Draft Interim Integrated Feasibility Report and Environmental Assessment Report. The calculation of the annual project costs for the three alternatives using the current interest rate and a 50-year period of analysis is discussed in Section 6.2. The total annual benefits were compared to total annual costs for the three alternatives. The alternative with the highest net benefits is considered the National Economic Development (NED) plan. The results of the NED analysis can be found in Sections 6.4 and 6.5 of the Draft Interim Integrated Feasibility Report and Environmental Assessment Report.

Table 1
Without and With Project Alternatives
Stage-Probability Confidence Limits For Reach 9 in HEC-FDA Model
15-Year Equivalent Record Length
Salmon Creek, Steward, Alaska Section 205

Exceedance Probability	Stage (ft.)	Confidence Limit Curves Stage (ft.)			
		-2 SD	-1 SD	+1 SD	+2 SD
0.9990	253.95	253.95	253.94	253.95	253.96
0.9900	254.20	254.17	254.19	254.21	254.23
0.9500	254.23	254.20	254.22	254.24	254.26
0.9000	254.24	254.22	254.23	254.26	254.27
0.8000	254.26	254.23	254.25	254.28	254.29
0.7000	254.28	254.22	254.25	254.30	254.33
0.5000	254.30	254.06	254.18	254.42	254.54
0.3000	254.61	253.95	254.26	254.96	255.31
0.2000	254.80	253.95	254.34	255.26	255.73
0.1000	255.86	254.37	255.12	256.60	257.35
0.0400	256.58	254.71	255.65	257.51	258.44
0.0200	257.04	254.93	255.99	258.09	259.15
0.0100	257.31	255.06	256.19	258.43	259.56
0.0040	257.64	255.22	256.43	258.85	260.06
0.0020	257.95	255.36	256.66	259.24	260.54
0.0010	258.24	255.50	256.87	259.62	260.99

Table 2
Without Project and Alternative 1 - 50-year Overtopping
Expected Annual Damage Reduced and Probability Damage Reduced Exceeds Indicated Values
Salmon Creek, Seward, Alaska Section 205
(1,000s if dollars)

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
				Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
Bear Creek		10	Reach 10	0.33	0.17	0.16	0.02	0.07	0.27
		11	Reach 11	0.00	0.00	0.00	0.00	0.00	0.00
		12	Reach 12	0.00	0.00	0.00	0.00	0.00	0.00
		13	Reach 13	0.09	0.05	0.04	0.00	0.02	0.07
		14	Reach 14	0.00	0.00	0.00	0.00	0.00	0.00
		15	Reach 15	0.00	0.00	0.00	0.00	0.00	0.00
		16	Reach 16	1.06	0.66	0.40	0.05	0.33	0.69
		17	Reach 17	1.24	0.66	0.58	0.09	0.46	1.03
		18	Reach 18	0.53	0.31	0.22	0.02	0.19	0.42
		19	Reach 19	0.01	0.01	0.00	0.00	0.00	0.00
		20	Reach 20	5.30	2.55	2.74	1.53	3.69	3.97
		21	Reach 21	5.05	2.35	2.70	1.50	3.48	3.94
		22	Reach 22	0.66	0.43	0.22	0.03	0.10	0.45
	Total for stream: Bear Cre			14.26	7.20	7.06	3.25	8.34	10.83
Kwechak		23	Reach 23	0.15	0.12	0.02	0.00	0.01	0.03
		24	Reach 24	5.13	1.88	3.25	1.75	3.31	4.67
		25	Reach 25	0.19	0.17	0.02	0.01	0.01	0.02
	Total for stream: Kwechal			5.47	2.17	3.29	1.76	3.33	4.72
Relic		1	Reach 1	13.48	4.42	9.06	4.79	7.96	12.47
		2	Reach 2	9.11	3.49	5.62	2.21	4.53	8.42
		3	Reach 3	53.48	24.59	28.89	20.97	37.68	43.28
		4	Reach 4	21.77	12.26	9.51	6.26	16.00	12.49
		5	Reach 5	16.02	10.47	5.55	2.19	9.71	6.37
		6	Reach 6	12.83	7.82	5.01	2.60	9.47	4.99
		7	Reach 7	9.31	4.73	4.58	2.55	5.76	7.01
		8	Reach 8	9.93	6.40	3.53	1.83	2.85	5.41
		9	Reach 9	24.73	11.75	12.98	8.20	15.18	19.34
	Total for stream: Relic			170.66	85.93	84.73	51.58	109.15	119.79

Table 3
Without Project and Alternative 2 - 100-year Overtopping
Expected Annual Damage Reduced and Probability Damage Reduced Exceeds Indicated Values
Salmon Creek, Seward, Alaska Section 205
(1,000s if dollars)

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
				Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
Bear Creek		10	Reach 10	0.33	0.10	0.23	0.03	0.09	0.37
		11	Reach 11	0.00	0.00	0.00	0.00	0.00	0.00
		12	Reach 12	0.00	0.00	0.00	0.00	0.00	0.00
		13	Reach 13	0.09	0.04	0.05	0.01	0.02	0.09
		14	Reach 14	0.00	0.00	0.00	0.00	0.00	0.00
		15	Reach 15	0.00	0.00	0.00	0.00	0.00	0.00
		16	Reach 16	1.06	0.50	0.56	0.07	0.40	0.93
		17	Reach 17	1.24	0.41	0.84	0.11	0.54	1.39
		18	Reach 18	0.53	0.28	0.25	0.03	0.20	0.49
		19	Reach 19	0.01	0.00	0.00	0.00	0.00	0.00
		20	Reach 20	5.30	1.67	3.63	1.65	4.35	5.74
		21	Reach 21	5.05	1.49	3.56	1.64	4.09	5.56
		22	Reach 22	0.66	0.34	0.32	0.05	0.12	0.61
	Total for stream: Bear Cre			14.26	4.83	9.44	3.58	9.80	15.19
Kwechak		23	Reach 23	0.15	0.11	0.04	0.01	0.02	0.05
		24	Reach 24	5.13	0.75	4.38	2.27	3.98	6.11
		25	Reach 25	0.19	0.16	0.03	0.01	0.02	0.05
	Total for stream: Kwechal			5.47	1.01	4.45	2.29	4.02	6.21
Relic		1	Reach 1	13.48	3.18	10.30	5.09	9.26	14.25
		2	Reach 2	9.11	1.95	7.16	2.64	5.58	10.59
		3	Reach 3	53.48	19.87	33.61	22.01	43.29	51.39
		4	Reach 4	21.77	9.87	11.90	6.70	18.31	19.39
		5	Reach 5	16.02	8.70	7.32	2.31	11.37	11.64
		6	Reach 6	12.83	6.16	6.67	2.69	10.99	10.32
		7	Reach 7	9.31	3.53	5.78	2.69	6.77	9.21
		8	Reach 8	9.93	5.12	4.81	2.05	4.47	6.88
		9	Reach 9	24.73	9.24	15.50	8.38	17.82	23.30
	Total for stream: Relic			170.66	67.62	103.04	54.55	127.86	156.98

Table 4
Without Project and Alternative 3 - 500-year Overtopping
Expected Annual Damage Reduced and Probability Damage Reduced Exceeds Indicated Values
Salmon Creek, Seward, Alaska Section 205
(1,000s if dollars)

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
				Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
Bear Creek		10	Reach 10	0.33	0.07	0.27	0.04	0.09	0.42
		11	Reach 11	0.00	0.00	0.00	0.00	0.00	0.00
		12	Reach 12	0.00	0.00	0.00	0.00	0.00	0.00
		13	Reach 13	0.09	0.01	0.08	0.01	0.02	0.11
		14	Reach 14	0.00	0.00	0.00	0.00	0.00	0.00
		15	Reach 15	0.00	0.00	0.00	0.00	0.00	0.00
		16	Reach 16	1.06	0.22	0.84	0.10	0.45	1.28
		17	Reach 17	1.24	0.18	1.07	0.14	0.57	1.66
		18	Reach 18	0.53	0.11	0.42	0.05	0.22	0.74
		19	Reach 19	0.01	0.00	0.01	0.00	0.00	0.01
		20	Reach 20	5.30	0.54	4.76	1.73	4.76	7.43
		21	Reach 21	5.05	0.52	4.54	1.72	4.50	6.97
		22	Reach 22	0.66	0.13	0.52	0.07	0.16	0.79
	Total for stream: Bear Cre			14.26	1.77	12.49	3.86	10.77	19.41
Kwechak		23	Reach 23	0.15	0.08	0.07	0.01	0.03	0.10
		24	Reach 24	5.13	0.30	4.84	2.47	4.45	6.79
		25	Reach 25	0.19	0.11	0.08	0.03	0.05	0.10
	Total for stream: Kwechal			5.47	0.49	4.98	2.51	4.53	6.98
Relic		1	Reach 1	13.48	1.21	12.27	5.34	10.47	17.66
		2	Reach 2	9.11	0.69	8.42	2.87	6.34	12.45
		3	Reach 3	53.48	9.31	44.17	22.66	48.04	69.09
		4	Reach 4	21.77	4.12	17.65	7.07	20.31	29.91
		5	Reach 5	16.02	4.93	11.09	2.52	12.54	20.29
		6	Reach 6	12.83	3.70	9.13	2.82	11.95	16.14
		7	Reach 7	9.31	1.56	7.75	2.81	7.62	12.36
		8	Reach 8	9.93	0.00	9.93	2.73	6.84	14.32
		9	Reach 9	24.73	4.75	19.98	8.68	20.17	31.06
	Total for stream: Relic			170.66	30.29	140.38	57.51	144.28	223.28

Table 5
Summary of Expected Annual Without Project Damages and Damages Reduced by Alternative
Expected Annual Damage Reduced and Probability Damaged Reduced Exceeds Indicated Values
Salmon Creek, Seward, Alaska Section 205
(1000's of dollars)

Plan Name	Plan Description	Expected Annual Damage			Probability Damage Reduced Exceeds Indicated Values		
		Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
Without	Without project condition	190.40	190.40	0.00	0.00	0.00	0.00
With 50	Plan added during impor	190.40	95.31	95.09	56.59	120.82	135.35
With 100	Plan added during impor	190.40	73.46	116.93	60.42	141.68	178.38
With 500	Plan added during impor	190.40	32.55	157.85	63.89	159.58	249.67

Table 6
Project Performance
Without Project
Salmon Creek, Seward, Alaska Section 205

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	30	50	10%	4%	2%	1%	.4%	.2%
Relic		1	Reach 1	levee	0.1000	0.1182	0.7157	0.9770	0.9981	0.4952	0.1580	0.0705	0.0422	0.0222	0.0124
		2	Reach 2	levee	0.1000	0.1276	0.7448	0.9834	0.9989	0.4967	0.1890	0.0961	0.0386	0.0222	0.0090
		3	Reach 3	levee	0.1000	0.0931	0.6236	0.9467	0.9924	0.4961	0.1979	0.0576	0.0249	0.0042	0.0006
		4	Reach 4	levee	0.1000	0.0874	0.5993	0.9357	0.9897	0.4952	0.2787	0.1506	0.0823	0.0166	0.0026
		5	Reach 5	levee	0.1000	0.0854	0.5906	0.9314	0.9885	0.4967	0.3259	0.2327	0.1712	0.1059	0.0682
		6	Reach 6	levee	0.1000	0.0834	0.5814	0.9267	0.9872	0.4946	0.3230	0.2251	0.1516	0.1004	0.0623
		7	Reach 7	levee	0.1000	0.0950	0.6317	0.9500	0.9932	0.4946	0.2476	0.1437	0.0882	0.0471	0.0251
		8	Reach 8	levee	0.0400	0.0525	0.4171	0.8020	0.9327	0.8347	0.4974	0.2332	0.1638	0.1041	0.0667
		9	Reach 9	levee	0.1000	0.0970	0.6397	0.9532	0.9939	0.4938	0.2047	0.1022	0.0656	0.0371	0.0210
Bear Creek		10	Reach 10	levee	0.1000	0.0949	0.6309	0.9497	0.9931	0.5010	0.1814	0.0648	0.0101	0.0068	0.0029
		11	Reach 11	levee	0.1000	0.0939	0.6268	0.9480	0.9928	0.5006	0.2106	0.0910	0.0194	0.0134	0.0047
		12	Reach 12	levee	0.1000	0.0937	0.6261	0.9477	0.9927	0.5006	0.2949	0.1997	0.1350	0.0672	0.0198
		13	Reach 13	levee	0.1000	0.0948	0.6306	0.9496	0.9931	0.5011	0.2550	0.1446	0.0773	0.0393	0.0108
		14	Reach 14	levee	0.1000	0.0890	0.6061	0.9389	0.9905	0.5006	0.2896	0.1882	0.1173	0.0706	0.0286
		15	Reach 15	levee	0.1000	0.0977	0.6422	0.9542	0.9941	0.4993	0.2383	0.1272	0.0623	0.0309	0.0090
		16	Reach 16	levee	0.1000	0.0953	0.6327	0.9504	0.9933	0.4990	0.2513	0.1415	0.0758	0.0389	0.0119
		17	Reach 17	levee	0.1000	0.0907	0.6135	0.9423	0.9914	0.4997	0.2679	0.1588	0.0633	0.0356	0.0114
		18	Reach 18	levee	0.1000	0.0854	0.5903	0.9312	0.9885	0.4998	0.3124	0.2111	0.1754	0.1020	0.0380
		19	Reach 19	levee	0.1000	0.0918	0.6183	0.9444	0.9919	0.5004	0.2668	0.1555	0.0786	0.0427	0.0131
		20	Reach 20	levee	0.1000	0.0916	0.6175	0.9440	0.9918	0.4952	0.2701	0.1695	0.0921	0.0532	0.0188
		21	Reach 21	levee	0.1000	0.0934	0.6247	0.9472	0.9926	0.4952	0.2591	0.1590	0.0831	0.0476	0.0198
		22	Reach 22	levee	0.1000	0.0891	0.6067	0.9392	0.9906	0.5011	0.2914	0.1850	0.1074	0.0596	0.0133
Kwechak		23	Reach 23	levee	0.1000	0.1074	0.6788	0.9669	0.9966	0.5003	0.1225	0.0525	0.0193	0.0079	0.0061
		24	Reach 24	levee	0.1000	0.1040	0.6666	0.9629	0.9959	0.4974	0.1676	0.0850	0.0160	0.0077	0.0042
		25	Reach 25	levee	0.1000	0.1135	0.7003	0.9731	0.9976	0.4978	0.0997	0.0410	0.0150	0.0039	0.0019

Table 7
Project Performance
Alternative 1 - 50-Year Overtopping
Salmon Creek, Seward, Alaska Section 205

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	30	50	10%	4%	2%	1%	.4%	.2%
Relic		1	Reach 1	levee	0.0200	0.0274	0.2426	0.5654	0.7507	0.9780	0.7412	0.4996	0.3633	0.2336	0.1459
		2	Reach 2	levee	0.0200	0.0321	0.2785	0.6244	0.8045	0.9572	0.7137	0.4999	0.2686	0.1761	0.0827
		3	Reach 3	levee	0.0200	0.0355	0.3034	0.6619	0.8359	0.8760	0.7058	0.4998	0.3895	0.2130	0.1048
		4	Reach 4	levee	0.0200	0.0436	0.3596	0.7374	0.8923	0.7945	0.6427	0.4998	0.3860	0.1887	0.0756
		5	Reach 5	levee	0.0200	0.0455	0.3725	0.7530	0.9027	0.7653	0.6095	0.4990	0.4100	0.2962	0.2177
		6	Reach 6	levee	0.0200	0.0452	0.3701	0.7501	0.9009	0.7619	0.6113	0.4998	0.3922	0.3024	0.2220
		7	Reach 7	levee	0.0200	0.0369	0.3132	0.6761	0.8472	0.8774	0.6662	0.4998	0.3741	0.2484	0.1623
		8	Reach 8	levee	0.0200	0.0258	0.2300	0.5435	0.7294	0.9703	0.7879	0.4994	0.3888	0.2755	0.1932
		9	Reach 9	levee	0.0200	0.0317	0.2755	0.6197	0.8003	0.9299	0.7011	0.4998	0.3886	0.2734	0.1870
Bear Creek		10	Reach 10	levee	0.0200	0.0324	0.2805	0.6275	0.8071	0.9274	0.7214	0.5004	0.2250	0.1866	0.1217
		11	Reach 11	levee	0.0200	0.0351	0.3007	0.6580	0.8327	0.9010	0.6981	0.5006	0.2380	0.1914	0.1082
		12	Reach 12	levee	0.0200	0.0423	0.3511	0.7268	0.8849	0.8259	0.6333	0.5006	0.3827	0.2277	0.0862
		13	Reach 13	levee	0.0200	0.0379	0.3203	0.6860	0.8550	0.8687	0.6645	0.5005	0.3484	0.2293	0.0976
		14	Reach 14	levee	0.0200	0.0413	0.3439	0.7176	0.8784	0.8244	0.6373	0.5006	0.3709	0.2624	0.1407
		15	Reach 15	levee	0.0200	0.0364	0.3099	0.6713	0.8434	0.8908	0.6767	0.4993	0.3345	0.2185	0.0949
		16	Reach 16	levee	0.0200	0.0375	0.3176	0.6822	0.8520	0.8735	0.6669	0.5006	0.3486	0.2301	0.1037
		17	Reach 17	levee	0.0200	0.0397	0.3330	0.7032	0.8680	0.8504	0.6544	0.5003	0.2881	0.2004	0.0931
		18	Reach 18	levee	0.0200	0.0429	0.3549	0.7315	0.8882	0.7890	0.6234	0.5006	0.4490	0.3181	0.1649
		19	Reach 19	levee	0.0200	0.0391	0.3290	0.6979	0.8640	0.8527	0.6568	0.5008	0.3385	0.2330	0.1066
		20	Reach 20	levee	0.0200	0.0395	0.3318	0.7017	0.8668	0.8478	0.6490	0.4999	0.3404	0.2339	0.1117
		21	Reach 21	levee	0.0200	0.0382	0.3228	0.6895	0.8576	0.8652	0.6572	0.4999	0.3306	0.2239	0.1188
		22	Reach 22	levee	0.0200	0.0417	0.3471	0.7217	0.8814	0.8197	0.6383	0.5004	0.3611	0.2480	0.0905
Kwechak		23	Reach 23	levee	0.0200	0.0262	0.2331	0.5490	0.7347	0.9962	0.7741	0.5004	0.2365	0.1030	0.0795
		24	Reach 24	levee	0.0200	0.0311	0.2712	0.6129	0.7944	0.9798	0.7263	0.4946	0.1213	0.0539	0.0267
		25	Reach 25	levee	0.0200	0.0256	0.2287	0.5411	0.7270	0.9991	0.7960	0.4995	0.2223	0.0509	0.0171

Table 8
Project Performance
Alternative 2 - 100-Year Overtopping
Salmon Creek, Seward, Alaska Section 205

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	30	50	10%	4%	2%	1%	.4%	.2%
Relic		1	Reach 1	levee	0.0100	0.0185	0.1703	0.4288	0.6068	0.9940	0.8545	0.6431	0.4997	0.3425	0.2243
		2	Reach 2	levee	0.0100	0.0151	0.1412	0.3666	0.5328	0.9959	0.9084	0.7561	0.4991	0.3605	0.1892
		3	Reach 3	levee	0.0100	0.0278	0.2453	0.5701	0.7551	0.9114	0.7801	0.6027	0.5002	0.3134	0.1787
		4	Reach 4	levee	0.0100	0.0339	0.2919	0.6450	0.8220	0.8488	0.7294	0.6042	0.4992	0.2889	0.1406
		5	Reach 5	levee	0.0100	0.0355	0.3030	0.6614	0.8355	0.8296	0.6956	0.5889	0.5012	0.3794	0.2897
		6	Reach 6	levee	0.0100	0.0340	0.2922	0.6455	0.8224	0.8331	0.7088	0.6045	0.5002	0.4050	0.3136
		7	Reach 7	levee	0.0100	0.0253	0.2261	0.5365	0.7224	0.9372	0.7801	0.6285	0.5003	0.3557	0.2472
		8	Reach 8	levee	0.0100	0.0188	0.1726	0.4337	0.6123	0.9876	0.8683	0.6139	0.4999	0.3716	0.2716
		9	Reach 9	levee	0.0100	0.0227	0.2054	0.4982	0.6832	0.9657	0.7987	0.6142	0.5008	0.3710	0.2658
Bear Creek		10	Reach 10	levee	0.0100	0.0149	0.1394	0.3626	0.5279	0.9850	0.9057	0.7706	0.5013	0.4491	0.3439
		11	Reach 11	levee	0.0100	0.0170	0.1572	0.4014	0.5748	0.9751	0.8852	0.7566	0.5006	0.4367	0.2986
		12	Reach 12	levee	0.0100	0.0296	0.2598	0.5945	0.7779	0.8995	0.7474	0.6187	0.5006	0.3188	0.1324
		13	Reach 13	levee	0.0100	0.0243	0.2177	0.5212	0.7069	0.9382	0.7971	0.6550	0.5010	0.3600	0.1772
		14	Reach 14	levee	0.0100	0.0283	0.2496	0.5774	0.7620	0.9000	0.7567	0.6286	0.5006	0.3767	0.2201
		15	Reach 15	levee	0.0100	0.0224	0.2027	0.4931	0.6778	0.9560	0.8190	0.6687	0.4993	0.3579	0.1816
		16	Reach 16	levee	0.0100	0.0240	0.2154	0.5171	0.7027	0.9418	0.7998	0.6550	0.5004	0.3599	0.1848
		17	Reach 17	levee	0.0100	0.0211	0.1919	0.4722	0.6553	0.9488	0.8357	0.7153	0.5001	0.3865	0.2162
		18	Reach 18	levee	0.0100	0.0373	0.3163	0.6804	0.8506	0.8249	0.6723	0.5517	0.5007	0.3666	0.1999
		19	Reach 19	levee	0.0100	0.0245	0.2197	0.5249	0.7107	0.9307	0.7966	0.6635	0.4999	0.3750	0.2011
		20	Reach 20	levee	0.0100	0.0245	0.2196	0.5248	0.7106	0.9319	0.7943	0.6640	0.5003	0.3717	0.1995
		21	Reach 21	levee	0.0100	0.0228	0.2057	0.4988	0.6837	0.9472	0.8111	0.6761	0.5002	0.3674	0.2155
		22	Reach 22	levee	0.0100	0.0282	0.2487	0.5759	0.7606	0.8990	0.7624	0.6396	0.5004	0.3711	0.1604
Kwechak		23	Reach 23	levee	0.0100	0.0127	0.1202	0.3190	0.4729	0.9998	0.9625	0.8063	0.5003	0.2531	0.2009
		24	Reach 24	levee	0.0100	0.0100	0.0956	0.2601	0.3948	0.9997	0.9932	0.9464	0.4961	0.2639	0.1439
		25	Reach 25	levee	0.0100	0.0129	0.1218	0.3226	0.4775	0.9997	0.9763	0.8276	0.4999	0.1369	0.0471

Table 9
Project Performance
Alternative 3 - 500-Year Overtopping
Salmon Creek, Seward, Alaska Section 205

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	30	50	10%	4%	2%	1%	.4%	.2%
Relic		1	Reach 1	levee	0.0020	0.0061	0.0597	0.1687	0.2650	0.9998	0.9821	0.9033	0.8092	0.6583	0.5005
		2	Reach 2	levee	0.0020	0.0043	0.0419	0.1205	0.1926	0.9998	0.9959	0.9703	0.8518	0.7337	0.5011
		3	Reach 3	levee	0.0020	0.0118	0.1122	0.3003	0.4485	0.9697	0.9184	0.8354	0.7757	0.6406	0.5009
		4	Reach 4	levee	0.0020	0.0129	0.1214	0.3218	0.4765	0.9522	0.9085	0.8558	0.8020	0.6606	0.5009
		5	Reach 5	levee	0.0020	0.0171	0.1581	0.4033	0.5771	0.9353	0.8580	0.7838	0.7116	0.5983	0.5013
		6	Reach 6	levee	0.0020	0.0189	0.1733	0.4351	0.6140	0.9210	0.8426	0.7673	0.6806	0.5931	0.5000
		7	Reach 7	levee	0.0020	0.0093	0.0894	0.2449	0.3738	0.9908	0.9387	0.8587	0.7656	0.6310	0.5013
		8	Reach 8	levee	0.0001	0.0005	0.0055	0.0165	0.0273	0.9998	0.9997	0.9997	0.9997	0.9997	0.9997
		9	Reach 9	levee	0.0020	0.0093	0.0892	0.2445	0.3733	0.9956	0.9411	0.8367	0.7480	0.6238	0.5002
Bear Creek		10	Reach 10	levee	0.0020	0.0091	0.0877	0.2406	0.3679	0.9945	0.9552	0.8711	0.6549	0.6059	0.5002
		11	Reach 11	levee	0.0020	0.0089	0.0855	0.2351	0.3603	0.9919	0.9563	0.8840	0.6959	0.6378	0.5005
		12	Reach 12	levee	0.0020	0.0050	0.0486	0.1388	0.2204	0.9967	0.9806	0.9520	0.9023	0.7762	0.5006
		13	Reach 13	levee	0.0020	0.0065	0.0628	0.1769	0.2771	0.9952	0.9678	0.9178	0.8347	0.7237	0.4996
		14	Reach 14	levee	0.0020	0.0094	0.0904	0.2475	0.3774	0.9842	0.9381	0.8757	0.7899	0.6839	0.5006
		15	Reach 15	levee	0.0020	0.0063	0.0611	0.1724	0.2704	0.9972	0.9738	0.9240	0.8329	0.7187	0.4993
		16	Reach 16	levee	0.0020	0.0066	0.0640	0.1799	0.2814	0.9955	0.9672	0.9145	0.8286	0.7153	0.5006
		17	Reach 17	levee	0.0020	0.0070	0.0677	0.1896	0.2955	0.9939	0.9661	0.9194	0.7915	0.6963	0.5000
		18	Reach 18	levee	0.0020	0.0122	0.1156	0.3084	0.4591	0.9627	0.9015	0.8352	0.8007	0.6919	0.5000
		19	Reach 19	levee	0.0020	0.0076	0.0736	0.2049	0.3176	0.9915	0.9569	0.9023	0.8051	0.7027	0.4993
		20	Reach 20	levee	0.0020	0.0069	0.0674	0.1888	0.2944	0.9939	0.9630	0.9123	0.8167	0.7100	0.5013
		21	Reach 21	levee	0.0020	0.0069	0.0671	0.1882	0.2935	0.9956	0.9656	0.9114	0.8036	0.6875	0.5013
		22	Reach 22	levee	0.0020	0.0069	0.0674	0.1888	0.2944	0.9900	0.9598	0.9164	0.8449	0.7505	0.4999
Kwechak		23	Reach 23	levee	0.0020	0.0045	0.0440	0.1263	0.2015	0.9998	0.9995	0.9834	0.8524	0.5855	0.5004
		24	Reach 24	levee	0.0020	0.0032	0.0314	0.0913	0.1475	0.9997	0.9997	0.9997	0.9228	0.7230	0.4997
		25	Reach 25	levee	0.0020	0.0023	0.0227	0.0666	0.1086	0.9997	0.9997	0.9997	0.9985	0.8481	0.4993

APPENDIX B
CLEAN WATER ACT 404(b)(1) EVALUATION

EVALUATION UNDER
SECTION 404(b)(1) CLEAN WATER ACT 40 CFR PART 230

Flood Risk Management Project
Salmon Creek
near Seward, Alaska

I. Project Description and Background

A. Location: The project area is along the north bank of Salmon Creek (a.k.a, Kwechak Creek) where it exits Kwechak Canyon near the community of Bear Creek, Alaska, about 5 miles northeast of Seward (figure 1).

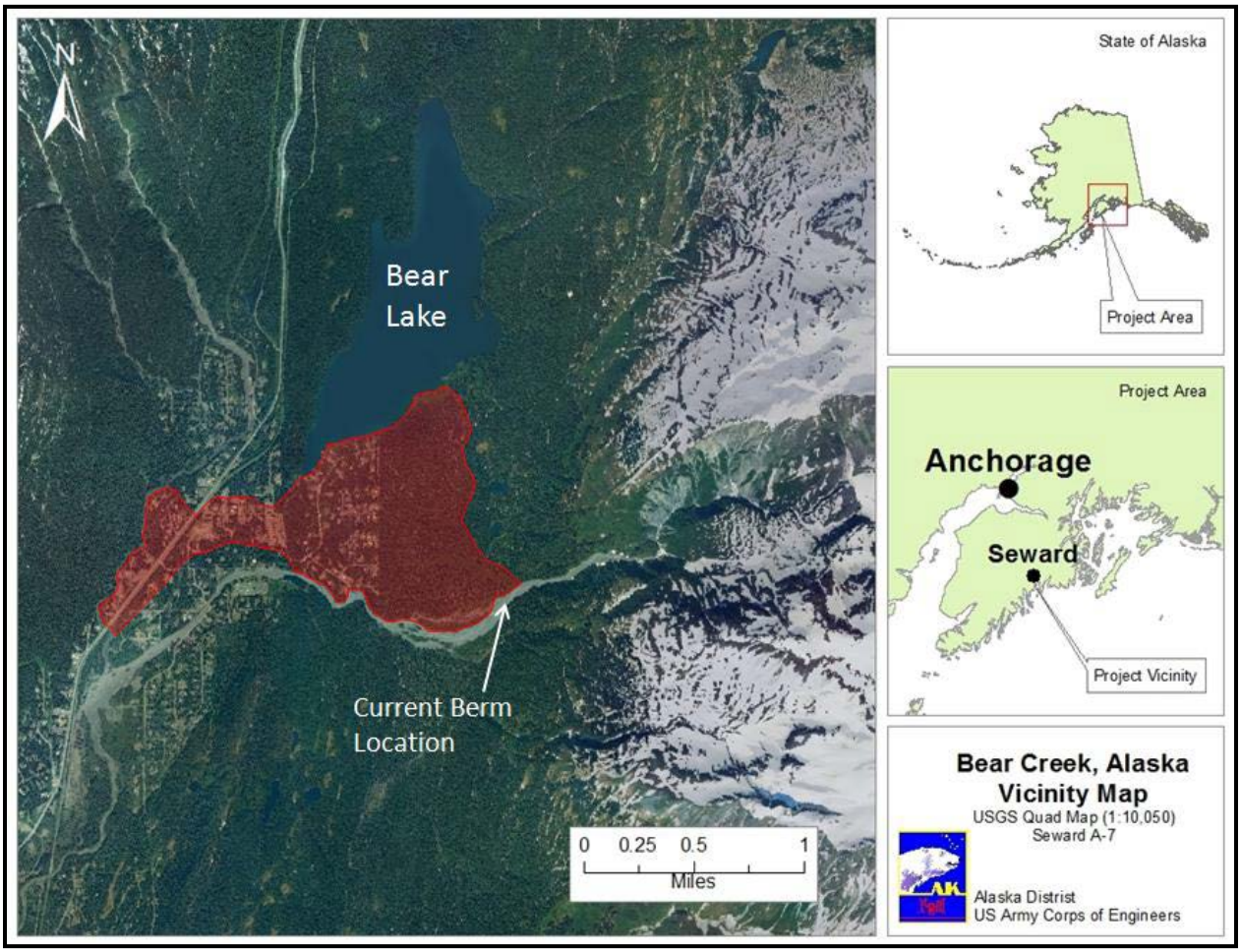

Figure 1. Location and vicinity of project site (area shaded in red is currently subject to flooding from Salmon Creek).

B. General Description of Project: Like numerous other streams flowing out of the mountains near Seward, Salmon Creek is subject to a wide variation in flow rates. Ordinarily the stream is relatively

shallow and narrow, meandering through a wide bed of alluvial deposits (figure 2), but heavy rains or rapid snow-melt often cause a rapid increase in stream flow and energy, especially at the project study site where Salmon Creek exits Kwechak Canyon. Under these conditions, Salmon Creek is prone to overflow its alluvial fan as it exits the canyon and seek relic channels towards Bear Lake, causing flood damage to residential areas south of Bear Lake. Local authorities have attempted to limit flooding by pushing up an *ad hoc* berm out of the abundant alluvial material adjacent to the stream, but this requires considerable effort to maintain, and the proposed project seeks to provide a more durable means of containing Salmon Creek along this particular reach during high stream flows.

Figure 2. A view of Salmon Creek during a non-flood period, looking upstream (east) towards the point at which it exits the mountains. The stream's broad bed of alluvial material, and the remains of a locally-constructed berm, are visible in the foreground.

The integrated feasibility report and environmental assessment (FR/EA) to which this evaluation is appended contains a full discussion of the problems and alternatives. The report examined three construction alternatives, several non-structural alternatives, and the no-action alternative. The recommended alternative constructs a 1,500-foot-long stone-armored revetment along a portion of the north bank of Salmon Creek prone to overflow (figure 3). The crest of the revetment would be 12 feet wide. The project would also include a 3,225-foot-long gravel road to replace the unimproved dirt trail currently leading to the project area; a 6,000-square-foot gravel parking lot and a 1,500-foot gravel walking trail would enhance recreational use of the site.

There is no Ordinary High Water (OHW) datum established for this reach of Salmon Creek. The proposed revetment will be keyed into the alluvial bed roughly three feet below a "1-Year Water Surface Elevation" datum used for project design (figure 3). This document presumes that some portion of the constructed revetment will be below OHW within waters-of-the-U.S., and is therefore subject to Section 404 of the Clean Water Act.

C. Authority: This feasibility study was conducted under authority granted by Section 205 of the Flood Control Act of 1948 (Public Law 80-858) as amended, which permits the Secretary of the Army, (through the Chief of Engineers), to construct small flood-control projects no specifically authorized by Congress with language specifically stating:

> *"…The Secretary of the Army is hereby authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed $2,000,000 for any on fiscal year, for the construction of small flood-control projects not specifically authorized by congress…"*

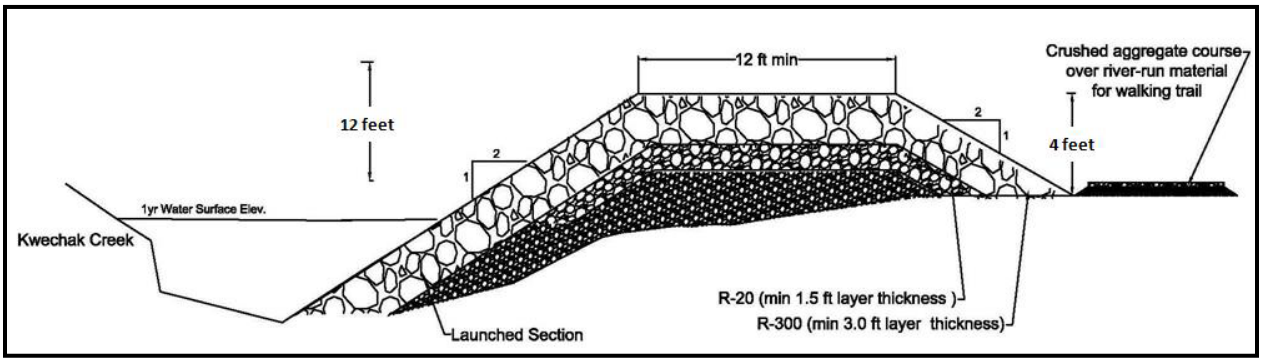

Figure 3. A representative cross section of the recommended alternative (Alternative L3) revetment.

D. General Description of Dredged or Fill Material: Construction of the revetment will use a combination of alluvial material available at the project site, and stone obtained from a nearby off-site quarry. The recommended plan revetment would make use of about 4,030 cubic yards of on-site alluvial material (gravel and sand) as core material. Quarried material would include 7,310 cubic yards of armor stone and 2,040 cubic yards of filter stone. Only a portion of this placed material would constitute a discharge (i.e., be placed in waters-of-the-U.S.); the volume of this discharge is impossible to calculate as we do not know the elevation of OHW. A trench roughly 5.5 feet deep, 1,500 feet long, and perhaps 11 feet wide would need to be excavated in the alluvial bed to key-in the toe of the revetment. Approximately 2,000 cubic yards of excavated alluvial material would be placed upland, and incorporated into some portion of the project.

E. Description of the Proposed Discharge Site: The Salmon Creek alluvial fan is an extensive bed of sand, gravel, and cobbles discharged from Kwechak Canyon during high-flow events (figure 2). The material is highly disturbed both by violent outwashes and by repeated reconstruction of the temporary berm, and is almost entirely devoid of vegetation.

The stream itself is in a fairly natural condition, bounded by the 1,400-foot temporary embankment on the north and a mountain slope on the south. This bounded area is roughly 200 feet wide at the upstream

terminus of the embankment and widens to approximately 300 feet wide at the downstream terminus. The stream migrates between the two boundaries, depositing a large amount of sediment in the form of glacial till. Because of these conditions and the stream's steep slope at this location, there is little vegetation present in the riparian area along this reach of the stream.

F. Description of Discharge Method: The alluvial sand and gravel used for core material will be pushed into place using a front end loader or similar equipment. The quarried rock will be transported to the construction site via dump truck, and placed into position using an excavator.

II. Factual Determinations

A. Physical Substrate Determinations: The project site is a heavily disturbed deposit of alluvial sands and gravels. The revetment of rock and local alluvial materials would be placed mostly upland, but its toe is presumed to extent below OHW of the Salmon Creek stream bed.
The toe of the revetment will extend a vertical depth of 5.5 feet below OHW, and with a design slope of 1V:2H will extend 11 feet horizontally from the north bank OHW contour toward the stream channel centerline. This extent is minimal considering the width of the stream bed, and the previous construction methods of the Kwechak Revetment, resulting in minimal modifications or alterations to the overall physical substrate and associated functional condition of the stream.

B. Water Circulation, Fluctuations, and Salinity Determinations: The intent of the project is to alter water flow patterns during within the Salmon Creek system, reducing the likelihood of the stream overflowing its north bank at the outwash site. Downstream of the project area, the stream bed is considered to be sufficiently broad to accommodate the high flow volumes confined to the stream by the completed revetment. This confining of flood waters would presumably result in greater fluctuation of water levels within Salmon Creek, at least for brief periods of time, which may result in alluvial material transported further downstream than has been historically observed. The revetment will have no long-term effect on the quality of the stream water itself, to include salinity, dissolved gases, temperature, or nutrient transport.

C. Suspended Particulate/Turbidity Determinations: The glacially-influenced Salmon Creek is naturally quite turbid at all flow rates (figure 2). Project construction has the potential to release more sediment into the stream environment; however, best management practices will be employed to minimize sediment transport as a result of the project, and will be detailed in a Stormwater Pollution Prevention Plan (SWPPP) to be prepared by the contractor prior to site work. Work within the stream flow will be avoided. Sedimentation controls such as silt fences will be used to minimize surface transport of sediment via rain or wind.

D. Contaminant Determinations: The materials used to construct the revetment would be native sand and gravel collected from the project site, and rock from a local quarry. Both materials would be clean and free of contaminants.

E. Aquatic Ecosystems and Organism Determinations: No aquatic plants have been observed in Salmon Creek adjacent to the project site. The highly dynamic nature of the stream system and frequent large-scale movement of sediments makes it unlikely that significant freshwater invertebrate communities are present; any communities that may become established would likely be removed from the area during subsequent high flow events. It is possible that small resident fish may be at times present in the stream adjacent to the project area, but none have been observed. Salmon are present in lower reaches of Salmon

Creek, but the upper reach adjacent to the project site is not cataloged as an andromous stream by the Alaska Department of Fish & Game.

F. Proposed Discharge Site Determinations: Construction operations associated with installing the revetment, with the application of appropriate best management practices, would have a negligible effect on the stream water column. The proposed action would comply with applicable water quality standards and would have no appreciable detrimental effects on municipal and private water supplies, recreational and commercial fisheries, water-related recreation, or aesthetics.

G. Determination of Cumulative and Secondary Effects on the Aquatic Ecosystem: Under the no-project condition, local authorities would need to continue to enter the Salmon Creek alluvial fan to rebuild the temporary berm. The proposed revetment would require much less maintenance than the current arrangement, and greatly reduce the frequency with which heavy equipment needs to enter the stream setting. The net effect of the project would be to reduce the recurrent disturbance of the alluvial fan by heavy equipment, with the attendant sediment discharge and risk of fuel or hydraulic fluid releases.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

A. Adaptation of the Section 404 (b)(1) Guidelines to this Evaluation: The proposed project complies with the requirements set forth in the Environmental Protection Agency's Guidelines for Specification of Disposal Sites for Dredged or Fill Material.

B. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem: The no-project and non-structural alternatives did not meet the project objectives. The three revetment alternatives differed primarily in their height; all required the keying-in of the revetment toe to below the streambed.

C. Compliance with Applicable State Water Quality Standards: The proposed construction project would not be expected to have an appreciable adverse effect on water supplies, recreation, growth and propagation of fish, shellfish and other aquatic life, or wildlife. It would not be expected to introduce petroleum hydrocarbons, radioactive materials, residues, or other pollutants into Salmon Creek or any other water body.

D. Compliance with Applicable Toxic Effluent Standards or Prohibition Under Section 307 of the Clean Water Act: No toxic effluents that would affect water quality parameters are associated with the proposed project. Therefore, the project complies with toxic effluent standards of Section 307 of the Clean Water Act.

E. Compliance with Endangered Species Act of 1973: No species listed under the Endangered Species Act are present at or near the project site, according to information obtained from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service web sites.

F. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection. Research, and Sanctuaries Act of 1972: Not applicable; no marine sanctuaries are present near the project site.

G. Evaluation of Extent of Degradation of the Waters of the United States: There are no municipal or private water supplies in the area that could be negatively affected by the proposed project. The construction activities, with the application of best management practices, would pose little risk of

introducing additional sediment into Salmon Creek. There would be no significant adverse impacts to plankton, fish, shellfish, or wildlife.

H. Appropriate and Practicable Steps Taken to Avoid and Minimize Potential Adverse Impacts of the Discharge on the Aquatic Environment: Incorporating the following avoidance and minimization measures into the proposed project would help to ensure that no significant adverse impacts will occur:

- The revetment will be constructed during a low-flow period at Salmon Creek, and work within the stream flow will be avoided. To the extent practical, the stream will not be allowed to flood the work-site.
- No construction equipment will travel through the stream flow.
- The contractor will prepare a Storm Water Pollution and Prevention Plan (SWPPP) detailing steps to be taken to control the movement of sediment from the project site.

I. On the Basis of the Guidelines the Proposed Site for the Discharge of Fill Material is: Specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

SECTION 404(b)(1) CLEAN WATER ACT
(40 CFR PART 230)
FINDING OF COMPLIANCE

Flood Risk Management Project
Salmon Creek
near Seward, Alaska

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The principle discharge to waters of the U.S. proposed in this project would be the placement of rock and native alluvial material to create a revetment along 1,500 feet of Salmon Creek in an area prone to outwash and flooding. The toe of the revetment would be keyed-in below the level of the streambed; there is no Ordinary High Water datum for this reach of Salmon Creek, but the placement of some portion of the proposed revetment is presumed to constitute a discharge to waters of the U.S.

3. The planned discharge would not violate any applicable State water quality standards, nor violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. The planned discharge will not harm any endangered species or their critical habitat.

5. The proposed discharge will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values will not occur.

6. Appropriate steps to avoid and minimize potential adverse impacts of the discharge on aquatic systems include:

- The revetment will be constructed during a low-flow period at Salmon Creek, and work within the stream flow will be avoided. To the extent practical, the stream will not be allowed to flood the work-site.
- No construction equipment will travel through the stream flow.
- The contractor will prepare a Storm Water Pollution and Prevention Plan detailing steps to be taken to control the movement of sediment from the project site.

7. On the basis of the Section 404(b)(1) guidelines, the Corps' proposed site of construction and discharge is specified as complying with the subject guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to Salmon Creek's aquatic ecosystem.

5/21/2015
Date

Michael D. Noah
U.S. Army Corps of Engineers
Alaska District
Chief, Environmental Resources Section

APPENDIX C
HYDRAULICS AND HYDROLOGY

HH Appendix

1.0 Introduction

1.1 Purpose

The Salmon Creek 205 Feasibility Study is to determine Federal interest in project continuation in the feasibility and construction phases of this flood control project. This analysis presents the background hydrology and hydraulics information required to develop the without project estimate of average annual damages utilizing the HEC-FDA program.

1.2 Project Description

Salmon Creek is located in Seward, approximately 70 air miles south of Anchorage (see Figure 1: Study Area, in main report). Kenai Peninsula Borough (KPB) currently maintains a river run material earthen embankment approximately 1,500 ft in length on the right bank of Kwechak Creek, a tributary of Salmon Creek. The embankment is monitored by KPB representatives multiple times daily during rain events and has required emergency stabilization work to be performed to maintain a level of protection to the residents living downstream of the embankment. If the embankment is not maintained, there is a high risk of inundation and property damages into the Bear Creek Subdivision. The objective of a project is to provide an embankment that would require little maintenance and reduce the risk of floods and property damages.

1.3 Historical Flooding

Rivers surrounding the city of Seward have a history of damaging floods. The area receives nearly 40 percent of its total annual precipitation during September through November. The only easily developable land in the area is generally within floodplains and on the alluvial fans. The alluvial fans form as stream channels migrate across the ground surface, often changing course drastically during large events. As a result, the entire surface of the fan apron is subject to flooding at any given time, and a single flood zone across the fan is not easily delineated.

In October 1986, rains from Typhoon Carmen dropped 18 inches of precipitation in Seward over three days. This event constitutes the highest recorded 24-hour rainfall event for the Seward area in the last 100 years. The resulting flood was estimated to have been a 350-yr event (USACE, 1994). Several bridges and roads were washed out and wide-spread flooding damaged residential and commercial properties.

In September 1995, Typhoon Oscar dropped more than 9 inches of precipitation in Seward, the second highest 24-hour rainfall event recorded in the Seward area since 1908.

In October 2002, two major storms resulted in 14.5 inches of rainfall in 1 week. Due to the severe flooding in the Salmon, a Seward/Bear Creek Flood Service area was created.

As is typical of most of Alaska, there is little information available concerning historical floods on the Kenai Peninsula. There is no record of a major flood with known discharge and documented water levels. Public agencies and longtime residents, however, can verify that floods have occurred (FEMA, 2014).

1.4 Recent FEMA Floodplain Mapping

The Federal Emergency Management Agency (FEMA) released a preliminary update to the Kenai Peninsula Borough Flood Insurance Study (FIS) and Maps in June 2014. This FIS included detailed study and flood profiles for Kwechak Creek and Bear Creek. FEMA provided the HEC-RAS models for each of the streams to the Alaska District for use in the Salmon 205 project (see Figure 1). The upstream limit of the Kwechak Creek model began well downstream of the existing berm location; and assumed no flows would travel out of bank through the Bear Creek subdivision.

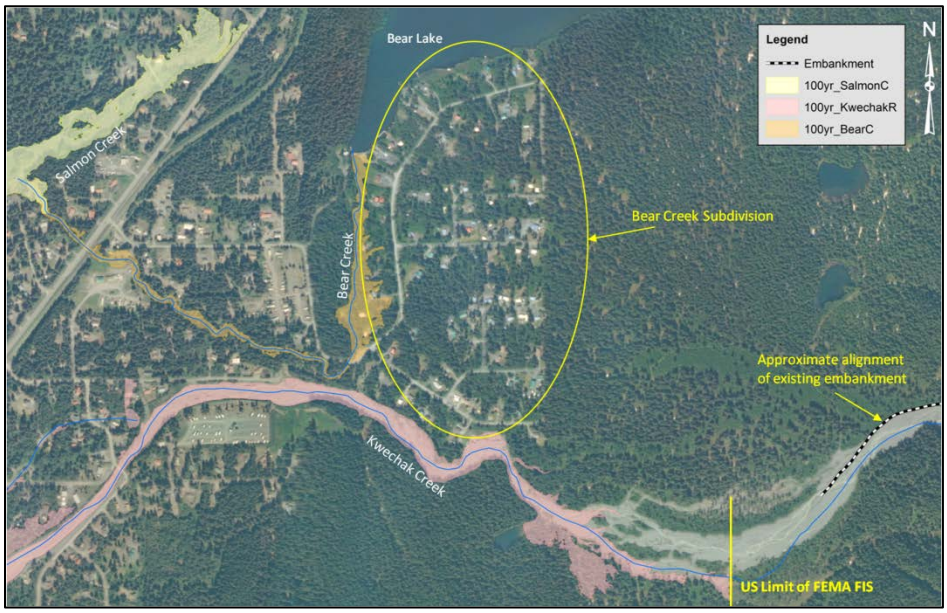

Figure 1 - Project Location (2012 Imagery provided by Borough)

2.0 Hydrology

Most precipitation in the study area occurs during September and October. Snow begins to fall in October and stops in April or early May. The National Climactic Data Center reports the average annual temperature in Seward is 40°F, with an average annual precipitation of 69 inches and an average annual snowfall of 84 inches. Kwechak Creek (Salmon Creek) is a glacier fed stream that originates at Bear Glacier. It is characterized by a steep gradient channel contained within a narrow valley that opens onto a broad alluvial fan. Heavy debris and gravel bars cause shifting and frequent channel changes. Its watershed is approximately 7.1 square miles.

Hydrologic analyses were presented in the FEMA FIS and the reported frequency discharges for Bear and Kwechak Creeks were used for this project. The borough-wide FIS was performed by Northwest Hydraulic Consultants, Inc. under contract with FEMA. The FIS included detailed studies of Bear Creek, Kwechak Creek and Salmon Creek. Stream discharges were initially estimated using USGS regression equations developed by the USGS. These data were evaluated against observations of extreme peak discharges resulting from surge-release floods (i.e. debris dam failures) or other anomalous events and appropriate adjustments were then made to the peak flows (FEMA, 2014).

The frequency discharges used for the Salmon 205 analysis of Bear Creek and Kwechak Creek are shown in Table 1. The development of the Relic Channel flows is shown in Section 3.0.

Table 1 - Frequency Discharges

Flooding Source	Profile Names and Flow Rates (cfs)							
	1yr	2yr	5yr	10yr	50yr	100yr	200yr	500yr
Bear Creek (at upstream FIS limit)	25	100	240	440	610	690	720	880
Kwechak Creek (at upstream FIS limit)	500	700	900	1190	2140	2780	3500	5160

The Bear Creek flows were not modified from the FEMA FIS, and properties along the lower portion of Bear Creek were minimally affected by the 'with' and 'without project' conditions. The Kwechak Creek flows provided in the FEMA FIS were plotted with -2 SD (standard deviations) to +2 SD with an equivalent record of 15 years to account for the uncertainty in the provided discharges (see Figure 2). These curves were applied to the economic model for damages as well as the 'with project' and 'without project' berm performance calculations.

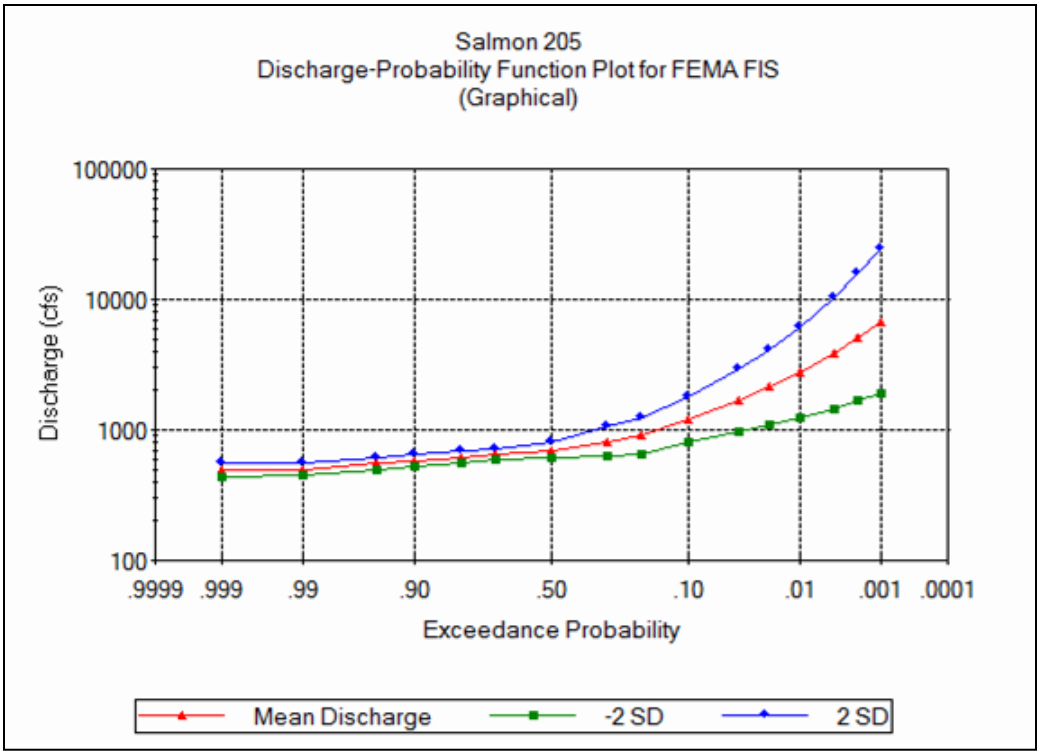

Figure 2 –Discharge-Probability Curve for Kwechak Creek with FEMA FIS Discharge

3.0 Hydraulics

A combined HEC-RAS model was developed using the Kwechak and Bear Creek models provided by FEMA. Arrows are shown in blue to indicate expected flow paths through the area if there was no diversion structure along the right bank of Kwechak Creek. FEMA provided cross-sections for Bear Creek and Kwechak Creek. The remaining cross-sections were generated utilizing HEC-GeoRAS and 2012 LiDAR imagery for the extended portion of Kwechak Creek and the Relic Channel (see Figure 3). A lateral structure was modeled on the right bank of Kwechak Creek near the existing berm to simulate the overbank flow observed by the Borough during high flow events. Lateral structures were also modeled along the entire length of the Relic Channel in both the right and left overbanks to allow overflow from the assumed channel to flow out of the system into lower elevation areas. The properties at risk of flooding are approximately 3,600 feet downstream of the current embankment (circled area in the figure below).

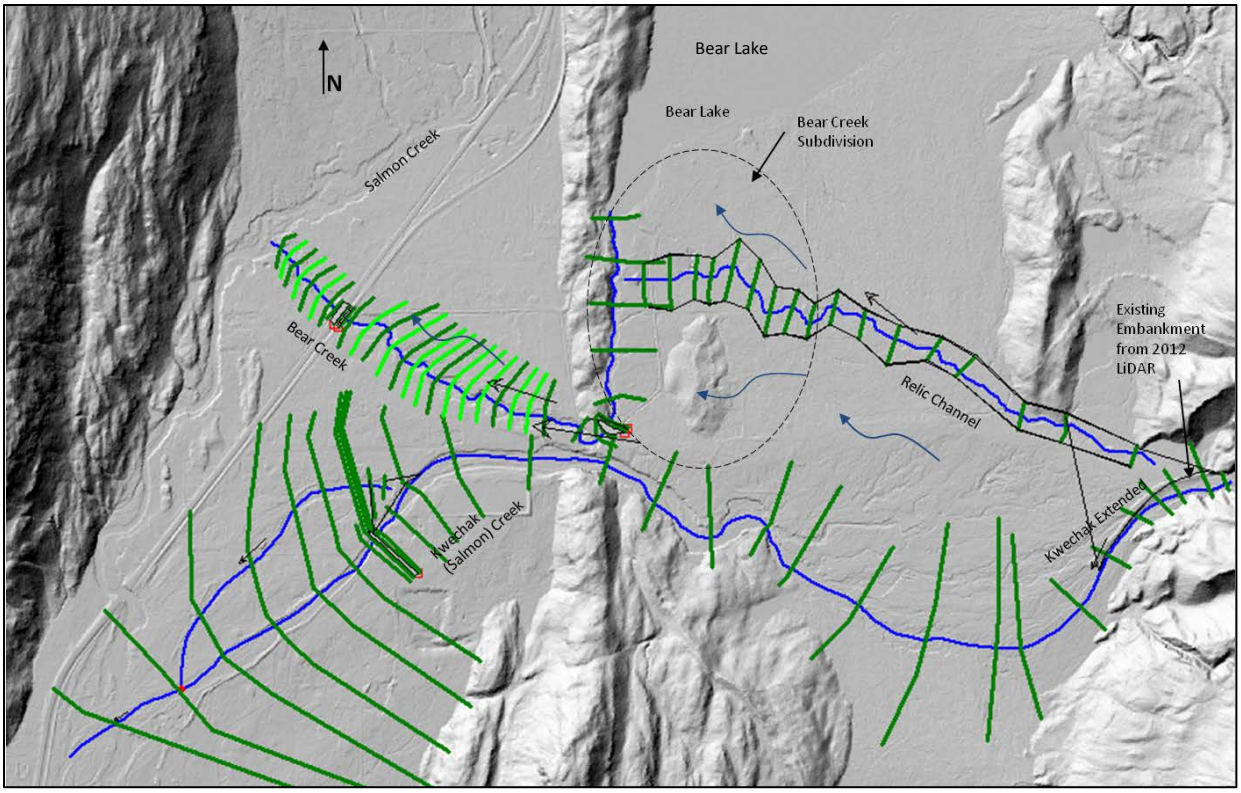

Figure 3 - Cross-Section Locations for Analysis

3.1 Relic Channel Flow Development

To estimate overland flows of Kwechak Creek near the diversion berm, a lateral structure was modeled at the right bank. The existing topography near the berm was modified to an assumed natural ground to simulate the 'without project' conditions. The lateral structure height was increased for each model run to allow for the following project scenarios: 50-yr and 100-yr overtopping, and the 'with project' conditions (protection at the 500-yr event). The lateral structure tail water was connected to the first two cross-sections in the Relic Channel, and flow optimization was selected for each model run. The resulting maximum weir depth and flow profile for each scenario is shown in Table 2.

Table 2 – Calculated Flow from Kwechak Creek Overbank to Relic Channel

Flooding Source: Relic Channel	Lateral Structure, Max Weir Depth (ft)	Profile Names and Flow Rate, Weir (cfs)							
		1yr	2yr	5yr	10yr	50yr	100yr	200yr	500yr
Without Project	2.55				95	760	1030	1800	3080
50-yr Overtopping	1.37					20	270	720	1760
100-yr Overtopping	1.37						290	730	1770
With Project*									
*With Project assumes any 500yr or less event would stay within Kwechak Creek due to the diversion berm									

Manning's "n" roughness values were selected based on professional judgment and comparing channel characteristics observed at the site to photographs of channels with computed "n" values. Roughness values used for the analysis are shown in Table 3.

Table 3 - Manning's "n" Values

Reach	Channel "n"	Overbank "n"
Bear Creek*	0.04	0.065
Kwechak Creek*	0.050-0.065	0.065-0.085
Relic Channel	0.05	0.065
*From FEMA FIS		

Water surface elevations (WSEs) were calculated at each cross-section within the three reaches for the following conditions:

1. Without Project – assuming Kwechak Creek out of bank flow at the 10-yr event and no embankment built or maintained
2. 50-yr Overtopping – assuming the embankment is overtopped at the 50-yr water surface elevation
3. 100-yr Overtopping – assuming the embankment is overtopped at the 100-yr water surface elevation
4. With Project – assuming the embankment is built at the 500-yr water surface elevation.

All structure (embankment) options are intended to lower the risk of flooding and property damages from Kwechak Creek overbank flows toward Bear Lake and Bear Creek. The designed embankment is intended to function as an armored diversion structure that will require little maintenance by the Borough, and will not be certified as a levee for future FEMA mapping efforts.

The last flood event to occur in the Bear Creek Subdivision was after the September 1995 rainfall event. The modeled without project flood extents matched well with the resident accounts of historical flooding and damages sustained in the area as compared to the Borough's map of the 1995 flood event (see Figure 4). Flood fighting and berm maintenance has prevented flooding in the area since its construction. Due to the topography of the area and the alluvial characteristics of Kwechak Creek, there is an accepted level of uncertainty with the flood boundary extents. It is likely that some overbank flow would be captured in the various other relic-type channels in the study area; some flow may temporarily go out of bank and return to Kwechak Creek; while in other areas the flow may drain directly toward Bear Lake. The artificial lateral structures placed along the Relic Channel may not accurately capture all the flow paths, but it does allow for flow to be removed from the system, and give a somewhat realistic estimate of the amount of water available in the assumed Relic Channel and immediate vicinity. Without project flood extents are shown as hatched areas, outlined by blue (500-yr) and magenta (100-yr). The 1995 flood extents provided by the Borough are shown in solid light blue for comparison.

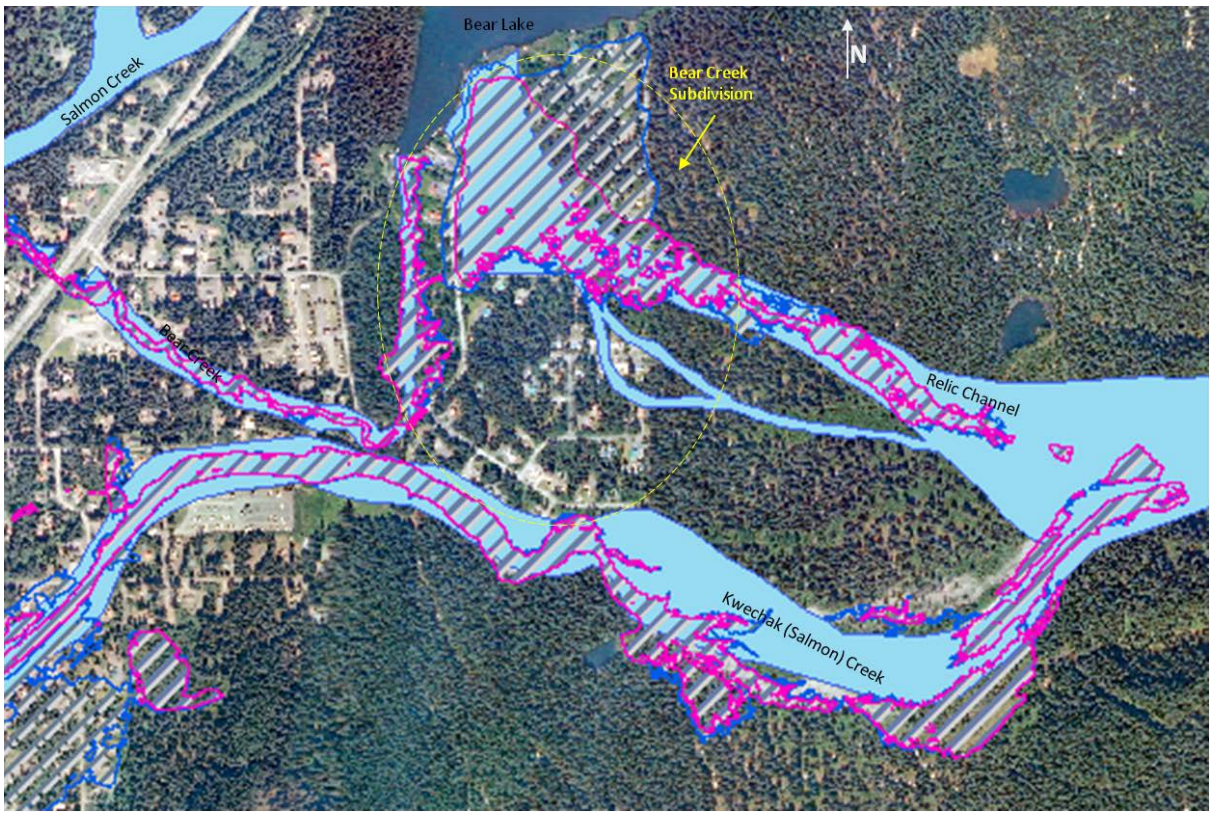

Figure 4 – Without Project Flood Extents (hatched) Compared to 1995 Flood Extents (light blue)

The water surface elevations along the Relic Channel were the most affected by the height of the embankment. There was no flow (and no water surface change) assumed in the Relic Channel at the 'with project' condition. The maximum flow (and highest water surface elevations) occurred when the embankment was removed, the 'without project' condition. Additional flow from the Relic Channel into Bear Creek slightly raised the water surface elevations from the reported FEMA FIS (see Table 4). At the 'with project' condition, the water surface along Bear Creek and Kwechak Creek were very close to those reported in the FEMA FIS. Water Surface Elevations for a few of the basins in this analysis are shown in Table 3.

Table 4 – Water Surface Elevations (in feet) for Select Basins in Analysis

Basin No.	Stream	Station	Without Project*		Overtops 50-yr			Overtops 100-yr		With Project		FEMA 100yr
			Invert	500-yr	50-yr	100-yr	500-yr	100-yr	500-yr	50-yr	100-yr	
1	Relic	2066	296.84	300.77	297.32	298.58	299.68	298.63	299.68			
5	Relic	1271	276.26	279.87	276.79	277.48	278.31	277.51	278.32			
7	Relic	816	264.50	267.76	265.08	265.73	266.71	265.76	266.71			
18	Bear	1501	184.99	188.95	188.50	188.56	188.95	188.56	188.95	188.45	188.56	188.77
22	Bear	597	170.87	174.51	173.97	174.11	174.51	174.11	174.51	173.89	174.06	174.06
24	Kwechak	1778	158.54	162.58	161.31	161.67	162.58	161.67	162.58	161.38	161.67	161.67
*Without Project assumes overtopping occurs near the 10-year event												

4.0 Structures and Basins for Flood Damage Calculations

First floor elevations were determined by a field survey of the project area. Measurements were made from the first floor of houses, mobile homes, sheds, garages and shops to the ground elevation. These measurements were converted to elevations by adding to or subtracting from the LiDAR ground elevations near the structures. An ArcGIS shapefile was generated with the location and elevation of each structure.

The Flood Damage Reduction Analysis (HEC-FDA), used to determine damages, compares structure first floor elevations to a minimum of eight water surface elevations. Hydrologic basins were developed for the entire project area based on elevation contours derived from the LiDAR. WSEs calculated in HEC-RAS were applied to each basin as a comparison to first floor elevations of structures within each basin. Each structure was assigned WSEs at 1-, 2-, 5-, 10-, 50-, 100-, 200- and 500-yr events. The basin delineation and structure locations (black dots) for the HEC-FDA model are shown in Figure 5.

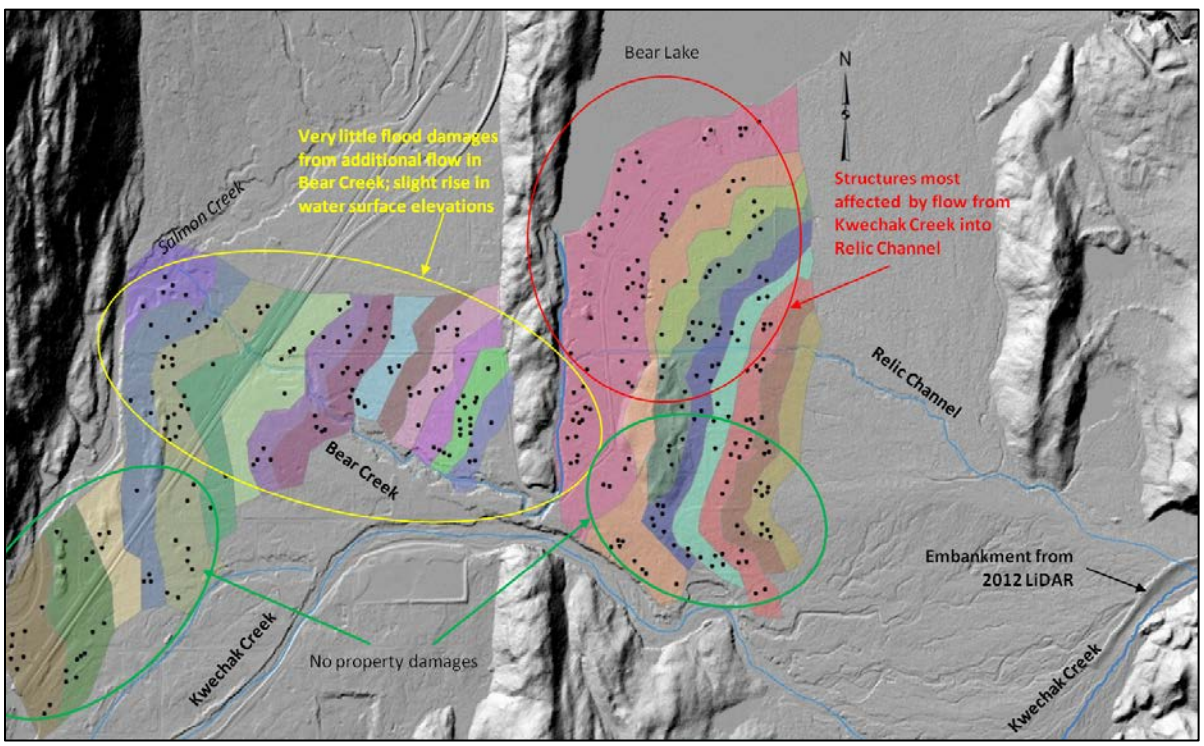

Figure 5 - HEC-FDA Basins and Structure Locations

Economists from the New Orleans District input the structure location, values, basins and reach water surface elevations for the without and with project conditions to the HEC-FDA model. Twenty-five basins were delineated with a total of 379 structures. The structures were a combination of one and two story residences, split level residences, mobile homes, attached and detached garages, and sheds (see the Economics Appendix for a detailed explanation of basin economics and HEC-FDA model runs).

5.0 Designed Embankment

A designed embankment was proposed for this project at various levels of protection based on calculated water surface elevations. Riprap sizes were computed using guidance in the Engineering Manual 1110-2-1601, Hydraulic Design of Flood Control Channels. The designed diversion structure was intended to be easily constructed with locally available materials; and provide a more sustained structure than the current river-run only embankment that has to be rebuilt after a major event. The designed embankment was not intended to be a levee, or meet certification requirements.

A three-layer system comprised of river-run materials, a filter layer, and an armor layer was proposed. The embankment was a minimum of 12 ft wide at the crest to accommodate construction and maintenance vehicles. The side slopes were proposed at 2H:1V (horizontal to vertical) for ease of construction. The armor layer was sized based on a velocity of 10.2 ft/s, a depth over the toe of the bank of 4 ft and a riprap specific gravity of 2.65. The SAM Hydraulic Design Package for Channels (SAMwin) software, developed for the Coastal and Hydraulics Laboratory (CHL), was used to determine the size of riprap required. The results of the SAMwin calculations are shown in Figure 5.

```
RIPRAP SIZE FOR A GIVEN VELOCITY AND DEPTH

USING GRADED RIPRAP TABLES FROM EM 1110-2-1601

  LAYER  D30CR  DMAXRR    D30    D50    D90    WIDTH    CY/FT  TONS/FT    $/FT
    #      FT     IN       FT     FT     FT      FT
     5    0.75   21.00   0.85   1.03   1.23     8.94    0.870    0.045    0.00


 RIPRAP SIZE      = LAYER#  5              DMAX, INCHES       =       21.
   VELOCITY, FT   =      10.20             VSS/VAVG           =     1.083
   BEND RADIUS,FT =      1100.             TOP WIDTH, FT      =       60.
   R/W            =     18.333             VERT VEL CORR, Cv  =     1.030
   LOCAL DEPTH, FT=       4.00             DESIGN DEPTH       =      3.20
   SAFETY FAC, Sf =       1.10             STABILITY COEF, Cs =     0.300
   THICKNESS, IN  =      31.50             THICKNESS COEF, Cv =     1.750
   SIDE SLOPE     =       2.00             SIDE SLOPE CORR, K1=     1.180
   SP.GR. RIPRAP  =       2.65             POROSITY, %        =     38.00
   CHANNEL TYPE   =   NATURAL             COST PER FOOT,$/FT =      0.00
```

Figure 6 – SAMwin Riprap Size Calculations

Utilizing ASTM D 6092-97-03, Specifying Standard Sizes of Stone for Erosion Control, and the calculated diameter required for riprap, a standard riprap size was determined to be R-300 (weight of less than 700 lbs, or Class III rip-rap) with a filter layer of R-20 (weight of less than 100 lbs, or Class I rip-rap). Proposed embankment heights, based on level of protection, are shown in Table 5. A typical section for the designed embankment is shown in Figure 7. The main embankment should be built just outside the active channel; and the scour protection should be placed during very low water so as to not disturb the active waterway.

Table 5 - Designed Embankment Elevations

Level of Protection	Embankment Height	
	River-side	Land-side
50-yr	8 ft	3 ft
100-yr	10 ft	4 ft
500-yr	12 ft	4 ft

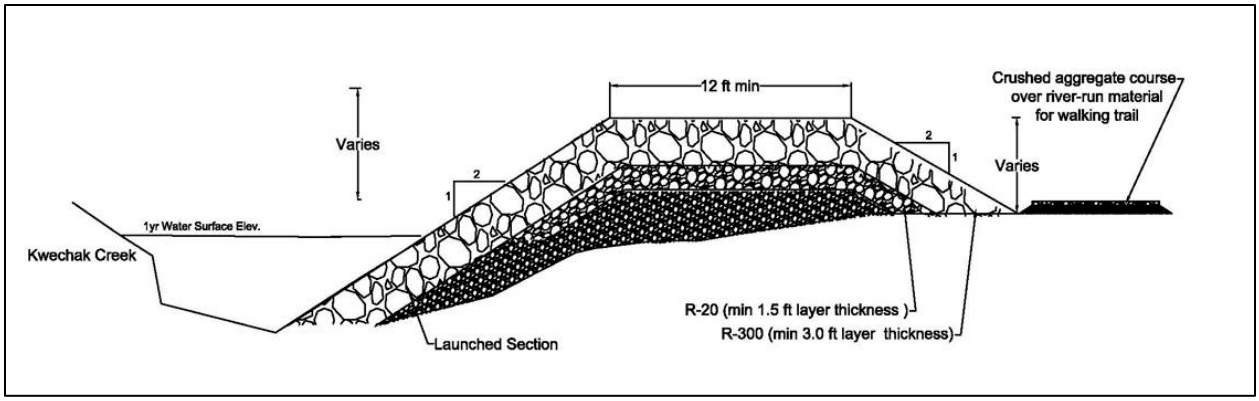

Figure 7 - Designed Embankment Typical Section

Scour at the toe of the embankment was evaluated utilizing procedures found in EM 1110-2-1601. A launchable section at the toe of the bank was proposed to allow easy monitoring of high-flow scour and maintenance after the high flow subsides. The maximum calculated channel velocity near the berm is 12.4 ft/s at the 500-yr discharge. The D_{50} (1.03 ft) riprap could be displaced at channel velocities greater than 8 ft/s, or events that are 50-yr or greater.

For rapid scour in gravel bed streams, the stone section height before launching was designed to be a minimum of 7.5 feet (2.5 times the bank protection thickness of 3 ft). The average range for this toe protection method is 2.5 to 3.0 times the bank protection thickness.

5.1 Likely Project Performance

Project performance depicts information about the hydrologic/hydraulic characteristics associated with a damage reach and/or plan. The information is computed for a specified target stage. Project performance information includes information on the expected annual target stage, exceedance probability, long-term risk, and conditional non-exceedance probability by events. To account for the uncertainty in the calculated water surface elevations of the overtopping scenarios, a standard deviation range of -2 SD to +2 SD was applied to the discharge at the berm in the FDA model and a 1 ft error was applied to the calculated water surface elevations (Figure 8).

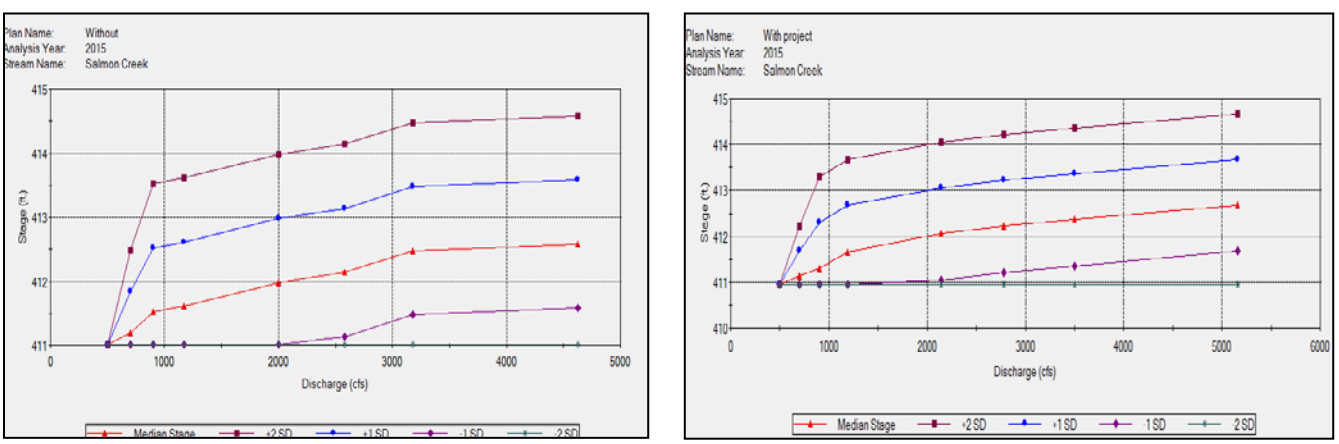

Figure 8 – Stage-Discharge Plot for Without and With Project Berm

The performance calculations presented in Figure 9 compare the 'without project' berm elevation to the designed embankment elevation for the 'with project' condition.

Levee only example Project Performance
by Plans and Damage Reaches by Analysis Year 2015
(Stages in ft.)

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Plan Name	Stream Name	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	30	50	10%	4%	2%	1%	.4%	.2%
Without	Salmon Cree	1	levee	levee	0.1000	0.2826	0.9639	0.9998	1.0000	0.5054	0.3614	0.3255	0.2952	0.2271	0.1968
With projec	Salmon Cree	1	levee	levee	0.0001	0.0039	0.0380	0.0924	0.1763	0.9917	0.9758	0.9689	0.9625	0.9441	0.9345

Figure 9 – Project Performance through HEC-FDA

The 'without project' berm has a 96% chance of being exceeded within the next ten years and a 100% chance of being exceeded in the next 50 years. The 'with project' embankment has a 26% chance of being exceeded within the next 10 years and a 5% chance of being exceeded in the next 50 years. The 'with project' embankment is also 93% likely not to be exceeded by the 500-yr event.

5.2 Potential Upstream and Downstream Impacts with Placement of Armored Berm

The upstream portion of Kwechak Creek is very steep and completely contained within a narrow valley. The armored structure is intended to function just as the current river-run unarmored berm maintained by the Borough; with the exception of required maintenance after each large event. The armored structure is designed to divert the 500-yr flow in Kwechak Creek plus one foot. The height of the river-run berm from the 2012 LiDAR was approximately 4 feet higher than what is actually required based on the weir flow calculations. The armored berm will actually require less river-run rock as core material than the current berm configuration.

Armoring a smaller, more effective berm, will prevent the overland flooding that occurred in 1995 when the river-run only berm was breached and flooded properties in the Bear Creek Subdivision. Some flow path changes are expected downstream regardless of the placement of the armored berm, due to the nature of the alluvial stream. A version of the unarmored berm will continue to be maintained by the Borough to provide flood protection for its residents. By providing this project, the Borough will reduce its maintenance, and have a sustainable diversion structure.

6.0 Access Road, Parking Lot and Recreation Trail

In order for the Borough to maintain a designed embankment, an access road is required. There are several trails used by residents that could be "built-up" with a gravel course and widened to accommodate two-way vehicle traffic during the construction of the embankment, and for maintenance, emergency access and recreation. An extension to Oleander Road was proposed to access the embankment, and a small parking lot to accommodate 20 vehicles and provide a staging area for construction equipment, flood fighting, and recreation. A recreation trial was also proposed along the land side toe of the embankment.

The 24 ft wide by 3,225 ft long access road was designed to utilize the existing off-road trails, built up with a 6-inch layer of crushed aggregate surface course. The 120 ft x 50 ft parking lot and 1500 ft long by 8 ft wide walking trail along the toe of the embankment will be composed of river-run materials with a 6-inch crushed aggregate surface course overlay. A conceptual site plan of these features is shown in Figure 10. The access road will be placed on natural high ground and the embankment (diversion) structure will be placed just outside of the active channel, very near the current berm alignment.

Figure 10 – Site Plan of Recreation Features (2012 Imagery)

7.0 References

American Society for Testing and Materials, ASTM 6092-97-03, Standard Practice for Specifying Standard Sizes of Stone for Erosion Control, 2003

Kenai Peninsula Borough, GIS Department, http://www2.borough.kenai.ak.us/GISDept/ags.html

FEMA, Flood Insurance Study, Kenai Peninsula Borough, Alaska and Incorporated Areas, Volumes 1 and 2, Preliminary June 13, 2014

U.S. Army Corps of Engineers, Seward Area Rivers, Flood Damage Prevention Interim Reconnaissance Report, February 1994

U.S. Army Corps of Engineers, Seward Alaska Planning Assistance to States Flood Risk Management, November 2011

U.S. Army Corps of Engineers, Hydrologic Engineering Center Flood Damage Reduction Analysis, HEC-FDA, version 1.2.5

U.S. Army Corps of Engineers, Hydrologic Engineering Center River Analysis System, HEC-RAS, version 4.1.0

U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC Flood Damage Analysis, HEC-FDA, version 1.2.5

U.S. Army Corps of Engineers, EM 1110-2-1601, Hydraulic Design of Flood Control Channels

US Army Corps of Engineers, SAM Hydraulic Design Package for Channels

APPENDIX D
COST ENGINEERING

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 330933

POA – Salmon Creek Section 205
Flood Risk Management - Seward, Alaska

The Salmon Creek Section 205 as presented by Alaska District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of February 26, 2015, the Cost MCX certifies the estimated total project cost:

FY 2016 Project First Cost:	$3,219,000
Fully Funded Cost:	$3,281,000
Feasibility Cost:	$ 200,000
Estimated Federal Cost:	$2,283,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management throughout the life of the project.

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Kim C. Callan, PE, CCE, PM
Chief, Cost Engineering MCX
Walla Walla District

**** TOTAL PROJECT COST SUMMARY ****

PROJECT: **Salmon Creek Section 205**
PROJECT NO: **P2 #330933**
LOCATION: **Seward, Alaska**

DISTRICT: **Alaska District**
PREPARED: **2/9/2015**
POC: **CHIEF, COST ENGINEERING, xxx**

This Estimate reflects the scope and schedule in report; Draft Integrated Feasibility Report, Jan 2015

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
									Program Year (Budget EC):	2016					
									Effective Price Level Date:	1-Oct- 15					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	REMAINING COST ($K)	Spent Thru: 10/1/2014 ($K)	TOTAL FIRST COST ($K)	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
08	ROADS, RAILROADS & BRIDGES	$149	$131	88%	$280	1.9%	$152	$133	$285		$285	1.4%	$154	$135	$289
11	LEVEES & FLOODWALLS	$1,833	$520	28%	$2,353	1.9%	$1,867	$530	$2,397		$2,397	1.4%	$1,894	$537	$2,431
14	RECREATION FACILITIES	$32	$4	12%	$36	1.9%	$33	$4	$37		$37	1.4%	$33	$4	$37
	CONSTRUCTION ESTIMATE TOTALS:	$2,014	$655	33%	$2,669	1.9%	$2,052	$667	$2,719		$2,719	1.4%	$2,081	$676	$2,758
01	LANDS AND DAMAGES	$5	$2	30%	$7	1.9%	$5	$2	$7		$7		$5	$2	$7
30	PLANNING, ENGINEERING & DESIGN	$301	$12	4%	$313	3.4%	$311	$12	$323		$323	3.4%	$322	$13	$335
31	CONSTRUCTION MANAGEMENT	$151	$14	9%	$165	3.4%	$156	$14	$170		$170	6.9%	$167	$15	$182
	PROJECT COST TOTALS:	$2,471	$681	28%	$3,153		$2,524	$695	$3,219		**$3,219**	1.9%	$2,575	$706	$3,281

_____ CHIEF, COST ENGINEERING, xxx

_____ PROJECT MANAGER, xxx

_____ CHIEF, REAL ESTATE, xxx

_____ CHIEF, PLANNING, xxx

_____ CHIEF, ENGINEERING, xxx

_____ CHIEF, OPERATIONS, xxx

_____ CHIEF, CONSTRUCTION, xxx

_____ CHIEF, CONTRACTING, xxx

_____ CHIEF, PM-PB, xxxx

_____ CHIEF, DPM, xxx

ESTIMATED TOTAL PROJECT COST:		**$3,281**
ESTIMATED FEDERAL COST:	65%	$2,133
ESTIMATED NON-FEDERAL COST:	35%	$1,148
22 - FEASIBILITY STUDY (CAP studies):		**$200**
ESTIMATED FEDERAL COST:		$150
ESTIMATED NON-FEDERAL COST:		$50
ESTIMATED FEDERAL COST OF PROJECT		**$2,283**

**** TOTAL PROJECT COST SUMMARY ****

**** CONTRACT COST SUMMARY ****

PROJECT: Salmon Creek Section 205
LOCATION: Seward, Alaska
This Estimate reflects the scope and schedule in report; Draft Integrated Feasibility Report, Jan 2015

DISTRICT: Alaska District
POC: CHIEF, COST ENGINEERING, xxx

PREPARED: 2/9/2015

WBS Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared:			1-Feb-15	Program Year (Budget EC):			2016					
		Estimate Price Level:			1-Oct-14	Effective Price Level Date:			1 -Oct-15					
				RISK BASED										
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	ESC (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	PHASE 1 or CONTRACT 1													
08	ACCESS ROAD	$149	$131	87.6%	$280	1.9%	$152	$133	$285	2016Q4	1.4%	$154	$135	$289
11	RIVER REVETMENT	$1,641	$500	30.4%	$2,140	1.9%	$1,671	$509	$2,180	2016Q4	1.4%	$1,695	$516	$2,212
14	REC FEATURES (PARKING AND TRAIL)	$32	$4	12.2%	$36	1.9%	$33	$4	$37	2016Q4	1.4%	$33	$4	$37
11	MOB&DEMOBE	$192	$20	10.6%	$213	1.9%	$196	$21	$216	2016Q4	1.4%	$198	$21	$220
	CONSTRUCTION ESTIMATE TOTALS:	$2,014	$655	32.5%	**$2,669**		$2,052	$667	$2,719			$2,081	$676	$2,758
01	LANDS AND DAMAGES	$5	$2	30.0%	$7	1.9%	$5	$2	$7	2016Q1		$5	$2	$7
30	PLANNING, ENGINEERING & DESIGN													
0.03	Project Management	$60	$2	3.9%	$62	3.4%	$62	$2	$64	2016Q4	2.9%	$64	$2	$66
	Planning & Environmental Compliance			3.9%										
0.09	Engineering & Design	$181	$7	3.9%	$188	3.4%	$187	$7	$195	2016Q4	2.9%	$193	$8	$200
0.005	Engineering Tech Review ITR & VE	$10	$0	3.9%	$10	3.4%	$10	$0	$11	2016Q4	2.9%	$11	$0	$11
0.005	Contracting & Reprographics	$10	$0	3.9%	$10	3.4%	$10	$0	$11	2016Q4	2.9%	$11	$0	$11
	Engineering During Construction			3.9%										
0.02	Planning During Construction	$40	$2	3.9%	$42	3.4%	$41	$2	$43	2017Q4	6.9%	$44	$2	$46
	Project Operations			3.9%										
31	CONSTRUCTION MANAGEMENT													
0.065	Construction Management	$131	$12	9.0%	$143	3.4%	$135	$12	$148	2017Q4	6.9%	$145	$13	$158
0.005	Project Operation:	$10	$1	9.0%	$11	3.4%	$10	$1	$11	2017Q4	6.9%	$11	$1	$12
0.005	Project Management	$10	$1	9.0%	$11	3.4%	$10	$1	$11	2017Q4	6.9%	$11	$1	$12
	CONTRACT COST TOTALS:	$2,471	$681		**$3,153**		$2,524	$695	$3,219			$2,575	$706	**$3,281**

Basis of Cost Estimate – CWE04

Salmon Creek Sec 205 Flood Risk Management
Seward, Alaska

2. Description of Project: Provide an armored revetment, approximately 1,500 feet in length that will provide flood risk management to the area. Construction will require the upgrade of 3,225 feet of mud trail to accommodate equipment. Minor recreation features will be included to facilitate the public's enjoyment of the area after construction has been completed.

3. Documents used for estimate: Draft Interim Integrated Feasibility Report, Environmental Assessment, and Draft Finding of No Significant Impact, Salmon Creek Section 205, Dated February 2015, Rock Quantity from H&H Design 2-6-2015

4. Estimating Software: EXCEL and MCACES 2nd Gen.

5. Databases/Libraries:
Labor: Alaska Labor & Mech, Based on Davis Bacon wage decision & AKDOL Pam 600 dated October 2014
Equipment: MII Equipment 2012 Region 09 – CW, Remote construction fuel costs per current market conditions
Cost Book: MII English Cost Book 2012

6. Direct Cost Markups:
Productivity: 100%
Overtime (Work Schedule): Breakwater 6-12, Surveys 6-12.
Sales Tax: 0%

7. Contractor Markups:
Payroll Tax: AK, Excavation - NOC
JOOH: Prime – 27.6%, Sub –15%
HOOH: Prime – 7%, Sub – 5%
Profit: Prime – 10% Sub – 10%
Bond: Prime – 2%, Sub – 5%

8. Owner Markups:
Escalation to MPt: (2016) 4%
Contingency: 24% based on Risk Analysis (ARA Spreadsheet)
SIOH: 7.5%
PED 10% (per input from PDT)

9. Factors impacting the estimate:

The Contractor will furnish all labor, equipment, supplies and materials to accomplish the work. Type of solicitation is IFB; contract is firm-fixed price with unit pricing. The contractor is required to provide boundary, line and grade control surveys and it is anticipated he will have a Topographic Survey subcontractor perform this shortly after contract award and NTP.

Mobilization and demobilization was estimated assuming an Anchorage Contractor. Contractors without the required equipment would have to sub-contract to others adding tiered overhead and mobilization costs. If a contractor from the Seward area were to be awarded contract, mob-demobe would decrease. This issue is accounted for in the risk register. The estimate assumes local labor would be available for the equipment operations.

Assume required Contractor Equipment/Plant consists of hydraulic excavators, off-road dump truck, front end loader for placement of rock. Trucking would be sub-contracted. A dozer and grader would also be required for limited durations during the placement operations.

Rock Prices: There isn't a local quarry in operation so a current quote was not available. Historical awarded unit prices were used for a breakwater project that as constructed at Seward and Valdez. Seward was mainly off-shore so the awarded unit prices were adjusted to just account for this difference. Valdez was trucked to the project site so both had similarities and adjustments were made to arrive at a unit price. The volume of rock was also factored into the final number used in the estimate. The volume of rock needed for this project are quite a bit less than the two used for comparison.

Rock Haul: Another big factor affecting cost for this rock is the haul distance. The estimate used a spreadsheet to calculate production based on haul distance and truck capacity (see spreadsheet for details). Various distances were input and a production calculated. After consideration estimator judgment was applied and the production based on the closest quarry was used. The potential variations in cost if farther quarries were used in the estimate were considered and addressed in the risk register.

In-Situ Core Material: The project also includes use of in-situ material (river run gravel) for the core layer. The design requires it to be shaped at a specific alignment and height. It's assumed this material will not need dewatering, or any sorting/separating. This is based on input from the PDT after multiple site visits and discussions with the local entities that have used this material in the past for flood mitigation (with varying degrees of success).

Access Road: The projects access is currently via a 4-wheel drive one-lane trail. This trail will need improvement. To deliver equipment and material, the trail will require upgrades. The project then requires this trail to be widened and a suitable driving course installed for public access to the site for recreational purposes. The

geotechnical data known about this trail is limited. The improvements needed to make it adequate for construction where estimated using assumptions that clearing and grubbing will occur first, the ground is dry and will not require extensive gravel fill to bridge wet soupy areas. The risk register addresses these unknowns as it is a fairly high possibility that the trail could need substantial upgrades to allow heavy equipment and rock trucks access without degrading it to the point that it needs a lot of work to leave in good shape. The contingency for this work item is very high because of the lack of existing data.

Schedule: The project schedule assumes the Feasibility study approved in June 2015, PED beginning in Sept 2015, Award March 2016, Construction Summer of 2016. The Mii indicates duration of between 6 and 8 weeks on-site for the construction of the revetment, parking lot, walking trail and access road improvement. Escalation is calculated within the TPCS spreadsheet.

Y:\P\CW\02 W\Salmon Creek Sec 205\01 Feasibility Study\02C CWE04\Salmon Creek_Baseline CWE04.mlp

CWE based on Feb 2015 Feasibility Study Report (Draft)

Quantities are based on PDT Provided quantities on 2-6-15 for Max Height (12' river side; 4' land side) - In-situ River rock = 4033 cy; Filter Layer = 2040 cy; A-Rock = 7306 cy

This report doesn't include Contingency or SIOH mark-ups. Those mark-ups are included in the Risk Register and TPCS. The escalation shown in the report accounts for changes in the Cost Book and equipment manual costs to make the effective price level current.

Estimated by	Cost Engineering Branch
Designed by	Hydraulics & Hydrology Section
Prepared by	KJH
Preparation Date	2/9/2015
Effective Date of Pricing	11/3/2014
Estimated Construction Time	90 Days

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Description	Quantity	UOM	ProjectCost
Summary Report from MCACES			**2,014,091**
Access Road	**1**	**LS**	**149,192**
Construct 2 Lane Gravel Access Road	**3,250**	**LF**	**149,192**
River Revetment	**1**	**LS**	**1,640,717**
Third Party Survey for Qty & Design Verification	**3**	**EA**	**70,437**
Construct Core, In Situ River Run Rock	**4,033**	**CY**	**90,115**
Construct Filter Rock Layer -	**2,039**	**CY**	**221,252**
Construct A-Rock Layer -	**7,306**	**CY**	**1,258,913**
Recreational Features	**1**	**LS**	**32,110**
Parking Area	**670**	**SY**	**12,164**
Trail	**1,245**	**SY**	**19,946**
Mob & Demob	**1**	**LS**	**192,072**
Equipment on Standby for Haul	**40**	**HR**	**22,143**
Haul Equipment on Road	**40**	**HR**	**114,480**
Mob/Demob Personnel	**40**	**HR**	**55,449**

Abbreviated Risk Analysis

Project Name & Location: **Salmon Creek Flood Control, Seward, Alaska**
Project Development Stage/Alternative: **Feasibility (Alternatives)**
Risk Category: **Low Risk: Typical Construction, Simple**

District: **POA**
Alternative: **Alt A**
Meeting Date: **12/22/2014**

Total Estimated Construction Contract Cost = **$ 2,014,091**

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ 5,000		20.00%	$ 1,000	$ 6,000
1	08 01 ROADS	Access Road	$ 149,192		87.58%	$ 130,663	$ 279,855
2	11 02 FLOODWALLS	River Revetment	$ 1,640,717		30.45%	$ 499,596	$ 2,140,313
3	14 RECREATION FACILITIES	Parking and Trail	$ 32,110		12.22%	$ 3,923	$ 36,033
4	11 02 FLOODWALLS	Mobe-Demobe	$ 192,072		10.64%	$ 20,439	$ 212,511
5			$ -		0.00%	$ -	$ -
6			$ -		0.00%	$ -	$ -
7			$ -		0.00%	$ -	$ -
8			$ -		0.00%	$ -	$ -
9			$ -		0.00%	$ -	$ -
10			$ -		0.00%	$ -	$ -
11			$ -		0.00%	$ -	$ -
12	All Other (less than 10% of construction costs)	Remaining Construction Items	$ -	0.0%	0.00%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 278,710		3.91%	$ 10,903	$ 289,613
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 220,034		9.09%	$ 20,004	$ 240,038
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals					
Real Estate	$ 5,000	20.00%	$ 1,000	$ 6,000.00	
Total Construction Estimate	$ 2,014,091	32.50%	$ 654,621	$ 2,668,712	
Total Planning, Engineering & Design	$ 278,710	3.91%	$ 10,903	$ 289,613	
Total Construction Management	$ 220,034	9.09%	$ 20,004	$ 240,038	
Total	**$ 2,517,835**	**27%**	**$ 686,528**	**$ 3,204,363**	
		Base	**50%**	**80%**	
	Range Estimate ($000's)	$2,518k	$2,930k	$3,204k	

* 50% based on base is at 50% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

Salmon Creek Flood Control, Seward, Alaska Alt A
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Scope Growth	Acquisition Strategy	Construction Elements	Quantities for Current Scope	Specialty Fabrication or Equipment	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$5
08 01 ROADS	**Access Road**	5	3	5	4	N/A	3	0	$149
11 02 FLOODWALLS	River Revetment	1	1	2	4	N/A	2	1	$1,641
14 RECREATION FACILITIES	Parking and Trail	0	N/A	0	2	N/A	1	0	$32
11 02 FLOODWALLS	Mobe-Demobe	0	0	0	1	N/A	0	1	$192
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
0	**0**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	$0
All Other (less than 10% of construction costs)	Remaining Construction Items	N/A	N/A	0	0	0	0	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	1	N/A	N/A	1	N/A	0	N/A	$279
31 CONSTRUCTION MANAGEMENT	Construction Management	1	N/A	0	N/A	N/A	N/A	N/A	$220
									$2,513
Risk		$ 104	$ 44	$ 227	$ 206	$ -	$ 70	$ 33	**$686**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ 104	$ 44	$ 227	$ 206	$ -	$ 70	$ 33	**$686**
								Total	**$3,198**

Salmon Creek Flood Control, Seward, Alaska Alt A

Feasibility (Alternatives)
Abbreviated Risk Analysis
Meeting Date: 22-Dec-14

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns (consult Risk Elements tab)	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
PS-1	Access Road	With limited study, there could be a change in construction features related to alignment, length and quantities. Assumption is clear and grub, rough grade then add 6" of CAB. The existing soils may require more sub-base and CAB to build a road able to withstand heavy loads that will deliver rock for revetment.	Since a detailed design study can't be done before feasibility, there is no way to reduce this risk by getting survey and geotech data before the feasibility study. There is an existing 4-wheel drive trail that appears in good shape, but its very likely that the road could require a thicker material for strength. The impact could be significant due the fact that all material except river run gravel would need to be imported.	Significant	Very LIKELY	5
PS-2	River Revetment	The designed solution addresses the flood risk mitigation fairly well. The current solution works (local govt shapes burm with in-situ material) but it's not permanent and during really bad events allows waters to reach private homes. This design will address the known flood events and is permanent.	The likelyhood that the designed scope won't be adequate to address flood problem is unlikely, and if it occurred the impact would be moderate.	Moderate	Unlikely	1
PS-3	Parking and Trail	scope is straight forward. Provide a flat well graded area with a solid driving surface for recreational users to park.	parking area is well defined and design simple to provide parking access.	Negligible	Unlikely	0
PS-4	Mobe-Demobe	scope of project is well defined in terms of what will be needed equipment and crew to complete. Contractors likely will have low difficulty finding local workers to hire.	Scope changes won't require different equipment or personnel to be mobilized. Very good source of local labor to complete this type of work.	Negligible	Possible	0
PS-13	Planning, Engineering, & Design	use historical costs for design and engineering on similar projects		Marginal	Possible	1
PS-14	Construction Management	use historical costs for design and engineering on similar projects		Marginal	Possible	1
AS-1	Access Road	8A or Small business likely with limited competition.	Its likely this project will be focused on small business interests and possible that it could be a sole source type of a contract. This would limit competition and thus increase overall bid cost.	Moderate	Likely	3
AS-2	River Revetment	Acquisition stratagy not known at this point. If full and open, not highly risky project to construct; should be good bid competition as this work is fairly common for heavy civil type contractors; bid schedule can be set up to address variations in quantities;	If plan changes to small business and/or 8a, could impact overall costs and schedule. Still anticipate fairly robust competition if small business, but may have more sub-contractors.	Marginal	Possible	1
AS-4	Mobe-Demobe			Negligible	Unlikely	0
CON-1	Access Road	Virgin ground excavation with unknown subsurface conditions. There could be extra SWPPP measures that would be required that are not adequately addressed in estimate. Also, the road would need to bewidened and improved in order to get rock to the site. the contractor would then need to ensure the road is adequate and 'new' prior to final acceptance. Not typically easy to estimate these costs and thus it could be a concern.	Most excavation and civil contractors that would be eligible for this type of work have road experience but without more design info, encountering unique things like groundwater & wetlands or other challanging features would cause impacts. Developing the access to truck rock in then repairing/finishing the road prior to demobe is an unknown and there could be some significant impacts to the overall cost and schedule as the contractor may essentially have to build a road twice.	Critical	Likely	5

CON-2	River Revetment	Revetment work is all above water line, entails full design layered rubblemound feature of work; access is a slightly challanging;	The construction of the revetment may present challenges in terms of access and maintaining a steady supply of rock to keep up with placement crews. Assume the trucking & quarry production will keep up with placement crew. If not, the schedule could be impacted. Other elements of the project are straight forward and shouldn't impact the overall risk.	Moderate	Possible	2
CON-3	Parking and Trail	Construction of parking area and trail has very simple construction elements. Provide graded area with a suitable driving surface	No real concerns for constructing these features.	Negligible	Unlikely	0
CON-4	Mobe-Demobe	Based on short season and expected window to complete, mob used crew and equipment sizes to fit exptected time duratino	mobe-demobe number provides equip and	Negligible	Unlikely	0
CON-12	Remaining Construction Items			Negligible	Unlikely	0
CON-14	Construction Management	cost for this element depends on workforce size and if a full time QAR is available for on-site survealance. Typically, the costs are reimbursed, but a good average was used in the estimate	variations may occur but if they do it will likely reduce the estimated costs.	Negligible	Possible	0
Q-1	Access Road	Insufficient investigations, and possible increase in quantities due to changes. Design development at this point is very rough and quantities of river run material required to construct road are very rough guess.	The quantities of river run, sub-base and CAB are likely to change to construct a road capable of allowing access for construction and for a permanent road after project is completed.	Significant	Likely	4
Q-2	River Revetment	Quantities for the revetment were provided by H&H design team and include no additional factor for 'fluff'. They used LIDAR and end area section to calculate. There is some inherant risk that these quantites will vary when in PED. There is also a chance the existing surface will change between a fully designed project and actual construction.	At PED after a topo survey is obtained, the calculated quantities are very likely to change. The mitigation possibilities are to use the VEQ clause and a properly structured bid schedule in the contract based on a PED topo survey. Concern also exists because quantity used in estimate includes no additional factor for fluff. Therefore Impact could marginal to moderate because the majority of the material needed is A-rock and Filter and its required to be shipped in. The biggest portion is in-situ material which has essentially no cost to purchase.	Moderate	Very LIKELY	4
Q-3	Parking and Trail	To construct parking area and trail, base course is in-situ material and import crushed agg base course (D-1) type material. Calculating quantity of D-1 based on concept design simple, but it's possible the final quantity during consturction may increase	scope of D-1 easy to calculate based on concept design, but possible that PED will require additional thickness of D-1. Impact could be	Moderate	Possible	2
Q-4	Mobe-Demobe	assume truck equipment and labor from Anchorage. If contractor has equipment and personnel in Seward, the cost in the baseline will most likely be less.	Its likely a Seward area contractor will be competative and if so, the impact of the estimate will be negligible.	Negligible	Likely	1
Q-12	Remaining Construction Items			Negligible	Unlikely	0
Q-13	Planning, Engineering, & Design	quantity of rock determined during PED will depend on good topo survey prior to developing design model.	unknown if a topo survey will be available during PED. Costs for PED may vary depending on the information available during development of drawings	Marginal	Possible	1
FE-12	Remaining Construction Items			Negligible	Unlikely	0
EST-1	Access Road	Use of gross assumptions, ROM estimates, and lack of field/design data. Assumed clear and grub to widen road and minimal excavation and fill required for road development	Without any survey or geo technical information or investigation on the road alignment, the likelihood that overexcavation of subbase will be needed is likely and would be a moderate impact to the cost estimate.	Moderate	Likely	3
EST-2	River Revetment	Used historical prices for rock, crew and productivity from similar projects in the region since no operating quarries to obtain a quote; the crew and productivity used are fairly tested based on field observations and through research of daily production logs where possible.	Rock prices used were on the upper end of the spectrum from historical data so impacts will be lessened, however it's likely the unit price will vary.	Marginal	Likely	2
EST-3	Parking and Trail	Used quote for D-1 from reliable source in Anchorage and escalated it for procurment in Seward Ak. Assumed a local quarry has D-1 in area as this is a very common material used in all types of construction in the area.	Very possible the quote for D-1 used in estimate will vary during PED and into construction, but quantity is fairly small and overall impact to project would be marginal.	Marginal	Possible	1

EST-4	Mobe-Demobe	Assumed mobe-demobe from Anchorage & large equipment spreads to finish project within 6-8 week duration.	if a Seward area contractor, estimated cost for mob-demobe will be reduced.	Negligible	Possible	0
EST-12	Remaining Construction Items			Negligible	Unlikely	0
EST-13	Planning, Engineering, & Design	used historical range of cost for PED from PDT.	assumption is sound as this project scope is typical of work completed by this district.	Negligible	Unlikely	0
EX-1	Access Road	concern of heavy rain events during construction that could slow down progress, cause wash out of partially constructed site, and access road.	Likely that the weather will cause some delays, but the duration of the project is such that there is enough time in the summer to construct the project with potetial delays.	Negligible	Possible	0
EX-2	River Revetment	High rain during planned construction window could cause re-work if partial sections are washed out;	could write specifications to require contractor to close unfiinshed sections and prevent from leaving core exposed for some duration. PED stage can discuss and address this issue fairly easy because it's been done on past projects that are similar in scope.	Moderate	Unlikely	1
EX-3	Parking and Trail	High rain during planned construction window could cause re-work if partial sections are washed out;	small scope of work should be low challenge to start and complete once D-1 has been delivered to project.	Negligible	Unlikely	0
EX-4	Mobe-Demobe	Based on assumption of an Anchorage area contractor, price of gas changes will cause increase in the cost.	Used price of gas that is higher than current price to account for anticipated increases. If price of gas goes up, mob-demobe may increase	Marginal	Possible	1
EX-12	Remaining Construction Items			Negligible	Unlikely	0

APPENDIX E
RECREATION

SALMON CREEK SECTION 205
RECREATION DEVELOPMENT PLAN

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1.0 Recreational Development Plan

1.1 Introduction

Recreation Facilities provide community citizens with social opportunities, physical activities, educational programs, and community pride. Access to recreational facilities is a crucial component to community health. It is important to residents to provide future generations with natural resources that are minimally impacted and recreationally enjoyable. Natural areas can facilitate multiple uses outside of flood risk management including: outdoor recreation, environmental education, tourism, community and cultural activities, and fish and wildlife habitat preservation. Recreation features provide opportunities for various age groups and abilities to engage in physical activity, education, and social interaction.

In September 2009, The State of Alaska Department of Natural Resources prepared the Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2009-2014. This document cites outdoor participation rates across a wide array of recreational activities including (but not limited to):

- Backpacking
- Camping
- Jogging/Running
- Hiking
- Skiing (Downhill, Cross-Country, and Backcountry)
- Trapping
- Dog-Mushing and Skijoring
- Berry Picking
- Snow Machining (Snowmobiling)
- Walking

Health and fitness, education and sustainability, and community cohesiveness are all components of recreation that contribute to the quality of life for citizens. It is the goal of the Salmon Creek Section 205 Recreation Development Plan to provide the highest quality, sustainable features to promote recreational outdoor activities, enhancing the quality of life for users. Quality of life can be an economic driver for an area as it attracts businesses and industries. In Alaska in particular, quality of life as it relates to recreational opportunities is of great importance to residents.

The recreation features described in this development plan are based upon expressed needs and activity participation rates listed in the SCORP. The citizens of Alaska have expressed a desire and need for recreation facilities that would helps bring communities together while offering a place for both passive and active recreational and educational opportunities.

The site selected for recreation measures is at the site of the selected project for construction of structural flood risk management (FRM) measures along upper Salmon Creek, (known locally as “Kwechak Creek”). The features described in this recreation development plan are ancillary to

the construction of FRM measures along Salmon Creek, and some recreation measures take advantage of features that would be required for operation and maintenance (O&M) activities. The features include a trail on the crest of the revetment, a parking and picnicking area, and vault toilets.

Construction of these recreational measures would provide access to many recreation opportunities. The project site lies on land owned by the Kenai Peninsula Borough (KPB). The site is bordered to the west by land owned by the State of Alaska Department of Natural Resources and to the east by land owned by the United State Forest Service. The site provides access to upper Salmon Creek, large forested areas, multiple lakes (via trail), alpine canyons, and other backcountry and day-use opportunities.

1.2 Recreation Supply and Demand Analysis

1.2.1 Overview

Recreational needs are determined by using a regional analysis or "market area" approach. The approach is a generalized way of presenting recreational supply/demand relationships for land and water use within the project area and is similar to that used by many states in preparing their SCORP. The analysis has three objectives:

- Determine the demand for recreational activities within the project market area
- Translate these demands into facility needs
- Identify potential recreational development in the project area

The demand-need determination is composed of three elements: demand, supply, and need (where need is demand minus supply). For this analysis, the "capacity method" was utilized. This method is typically used when:

- The project is small in nature
- Recreation is facility-oriented as opposed to resource-oriented
- There is limited data or ability to gather data and use of alternative use-estimating procedures would be less useful or efficient

All of these conditions are present at Salmon Creek. The project is fairly small in nature, no hunting, fishing, or trapping recreation benefits are used. There is limited existing data about site-specific recreation trends and a survey effort would be very costly compared to the total study cost. Therefore, some assumptions were made. Throughout the analysis, when assumptions were made, they were conservative in nature and every attempt is made to explain the rationale and background thinking that lead to the assumptions.

1.2.1 Demand

Demand is commonly viewed as an expression of desire to engage in an activity by an individual in a given area. Activities and the portions of the year in which they are available are listed in

Table 1. These activities are those listed in the SCORP that would reasonably be available at the project site.

Table 1. Recreational Opportunities Listed in the SCORP Available at Salmon Creek

Activity	Season (Months)	Approximate Season Days
Summer Activities		
Backpacking or tent camping in backcountry	Apr-Oct	210
Bicycling or Mountain Biking	Apr-Oct	210
Bird Watching or Wildlife Viewing	Apr-Oct	210
Hiking (Day)	Apr-Oct	210
Jogging or running out-of-doors	Apr-Oct	210
Picnicking	Apr-Oct	210
Walking for Fitness	Apr-Oct	210
Walking the Dog	Apr-Oct	210
Winter Activities		
Skiing (backcountry)	Nov-Mar	150
Skiing (cross-country)	Nov-Mar	150
Dog-Mushing or Skijoring	Nov-Mar	150
Snow Machining	Nov-Mar	150
Sledding	Nov-Mar	150
Snow Shoeing	Nov-Mar	150

While many of the summer activities such as hiking and walking can be done year-round, the participation rates are likely to be far less in the winter. Because of this, the activities were generally divided into those which were primarily done when there is no snow cover (April-October) and those that are done when there is adequate snow cover (November-March).

Participation rates in these activities were derived from a survey effort of 600 Alaskans whose details were listed in the SCORP. For each listed activity, respondents were asked to state whether they participated in the activity “very frequently” (nearly every day in season), “frequently” (a few times per week in season), “occasionally” (a few times per month in season), “rarely” (a few times per season), or “never”. For the activities listed in Table 1, the following participation rates were noted by the survey results.

Table 2. Participation Rates

Activity	Very Frequently	Frequently	Occasionally	Rarely	Never
Summer Activities					
Backpacking or tent camping	5.5%	13.7%	29.3%	15.8%	35.7%
Bicycling or Mountain Biking	22.0%	23.5%	22.0%	9.7%	22.8%
Bird Watching or Wildlife Viewing	34.0%	24.5%	18.3%	8.3%	14.8%
Hiking (Day)	22.0%	23.5%	22.0%	9.7%	22.8%
Jogging or running out-of-doors	22.0%	23.5%	22.0%	9.7%	22.8%
Picnicking	34.0%	24.5%	18.3%	8.3%	14.8%
Walking for Fitness	34.0%	24.5%	18.3%	8.3%	14.8%
Walking the Dog	34.0%	24.5%	18.3%	8.3%	14.8%
Winter Activities					
Skiing (backcountry)	7.8%	22.2%	21.3%	12.3%	36.3%
Skiing (cross-country)	7.8%	22.2%	21.3%	12.3%	36.3%
Dog-Mushing or Skijoring	7.8%	22.2%	21.3%	12.3%	36.3%
Snow Machining	7.8%	22.2%	21.3%	12.3%	36.3%
Sledding	7.8%	22.2%	21.3%	12.3%	36.3%
Snow Shoeing	7.8%	22.2%	21.3%	12.3%	36.3%

Note: Responses to certain activities were grouped together for reporting purposes in the SCORP. For instance, responses to frequency of participation in "Specific Outdoor Winter Sports" (Table A3.5 in the SCORP) included all winter activities available at this site. "Specific Non-Winter Outdoor Sports" (Table A3.6 in the SCORP) included Bicycling or Mountain Biking, Hiking (Day), Horseback Riding, and Jogging or running out-of-doors. "Specific Camping Types" (Table A3.4 in the SCORP) included "Backpacking or tent camping". The only activities which the SCORP reported specific participation rates for were: "ATV Riding" and "Walking, parks, picnic, berry picking, bird watching" (Table A3.8 in the SCORP). While this is not ideal, it is the best information available on participation in the listed activities.

Seward is a recreation destination for people from all of Southcentral Alaska, therefore it is reasonable to assume that people from the Kenai Peninsula Borough, Municipality of Anchorage, and the southern Matanuska-Susitna Borough (including the cities of Palmer and Wasilla) could make use of recreational facilities at Salmon Creek. Therefore, this area is assumed to make up the market area for this study. The population of the market area is shown in Table 3.

Table 3. Total Population of Market Area

Area	Sub-Area	Population
Kenai Peninsula Borough		55,400
Municipality of Anchorage		291,826
Matanuska-Susitna Borough	City of Palmer	5,937
Matanuska-Susitna Borough	City of Wasilla	7,831
Total		360,994

Even though all of Southcentral Alaska makes up the larger market area for recreation opportunities in the Seward area, there is a smaller market area that makes up what is likely to constitute the population that will use recreation facilities at Salmon Creek on a daily basis throughout the calendar year (instead of only during the summer tourist season). This area is generally located south of the Seward Highway (Hwy) junction with the Sterling Highway at

Mile 37 of the Seward Hwy. This focused market area includes the City of Seward and five census-designated places (CDPs). The area has a population of 5,060 with a breakdown of population by area and travel time from each area to the project site shown in Table 4.

Table 4. Area Population and Travel Times to Project Site

Area	2013 Estimated Population	Percent of Total Market Area Population	Estimated Travel Time to Project Site (minutes)
Bear Creek CDP	2,100	41.5%	7
Crown Point CDP	75	1.5%	28
Lowell Point CDP	75	1.5%	21
Moose Pass CDP	249	4.9%	34
Primrose CDP	74	1.5%	19
City of Seward	2,487	49.2%	11
Total:	**5,060**		

Source: Population Estimates: State of Alaska Department of Labor and Workforce Development estimates
Travel Times: Google Earth

1.2.2 Supply

Existing supply of facilities was determined by aggregating the number of similar recreational opportunities within the market area. These are no other known trail facilities of this type within the market area due to its versatility and location near the area's population centers. However, there are many trailheads and recreational areas that provide a similar-enough experience to be counted as contributing to the overall supply of recreational opportunities.

There are a number of recreation providers in the market area including: the City of Seward, the City of Kenai, the City of Soldotna, the City of Homer, the Municipality of Anchorage, the City of Palmer, the City of Wasilla, the State of Alaska, and the United States Forest Service. Each of those providers and the opportunities they provide within the market area are discussed below.

1.2.2.1 City of Seward

The City of Seward Department of Parks and Recreation owns and operates Waterfront Park which provides tent camping opportunities. This facility is approximately seven miles from the project area. The City also has approximately five miles of walking and bike paths, many of them along city streets.

1.2.2.2 City of Kenai

The City of Kenai provides thirteen parks throughout the city limits. These facilities provide such recreational opportunities such as playgrounds, picnic shelters, community memorials, gardens, basketball courts, volleyball courts, baseball fields, river access, restrooms, and a disc-golf course.

1.2.2.3 City of Soldotna

The City of Soldotna provides eleven of parks throughout the city. These facilities provide camping, river access, boat launches, RV waste dumps, wood and ice vending, baseball and soccer fields, playgrounds, picnic pavilions, restrooms, dog areas, open fields, and a skate park.

1.2.2.4 City of Homer

The City of Homer provides 19 parks throughout the city. These facilities provide campgrounds, playgrounds, community memorials, picnic pavilions, multiple sports opportunities, restrooms, a skate park, gardens, horseback riding, bird watching, kite surfing, grilling facilities, RV waste dumps, a disc-golf course, fishing, and ski trails.

1.2.2.5 Municipality of Anchorage

The Municipality of Anchorage provides 223 parks, 250 miles of trails, 110 athletic fields, 5 pools, 11 recreation centers, and 82 playgrounds. These facilities provide a wide range of recreational opportunities including running and ski trails, picnic shelters, playgrounds, dog areas, campgrounds, lakes, ice rinks, sledding hills, grilling facilities, restrooms, bird watching, etc.

1.2.2.6 City of Palmer

The City of Palmer provides eight parks throughout the city. These facilities include picnic pavilions, a municipal airport, golf course, skateboard park, restrooms, and soccer fields.

1.2.2.7 City of Wasilla

The City of Wasilla provides six parks throughout the city. These facilities include a skateboard park, volleyball courts, basketball courts, bmx track, outdoor amphitheater, playgrounds, camping facilities, ball fields, gardens, multi-use trails, and restrooms.

1.2.2.8 State of Alaska

The State of Alaska Division of Parks & Outdoor Recreation owns and operates well over 50 facilities in the market area. Because of the large number of facilities owned and operated by the state, a brief listing is provided below. The State facilities provide a wide range of recreational opportunities.

1.2.2.8.1 State Recreation Areas

- Caines Head
- Captain Cook
- Clam Gulch
- Deep Creek
- Ninilchik
- Lowell Point
- Johnson Lake
- Morgan’s Landing

- Bing's Landing
- Pipeline
- Swiftwater
- Anchor River

1.2.2.8.2 State Recreation Sites

- Kasilof
- Crooked Creek
- The Pillars
- Stariski
- Diamond Creek

1.2.2.8.3 State Marine Parks

- Resurrection Bay
- Thumb Cove
- South Esther Island
- Shoup Bay
- Sunny Cove
- Sandspit Point
- Safety Cove
- Driftwood Bay

1.2.2.8.4 Special Management Areas

- Kenai River Special Management Area
- Captain Cook Special Management Area
- Anchor River Special Management Area

1.2.2.8.5 State Parks

- Kachemak Bay
- Chugach

1.2.2.9 United States National Park Service

The United States National Park Service provides recreation opportunities within the Kenai National Wildlife Refuge and Kenai Fjords National Park. Most of this park is difficult to access and covered by the Harding Ice Field.

1.2.2.10 United States Fish and Wildlife Service

The United States Fish and Wildlife Service provides recreation opportunities within the Kenai National Wildlife Refuge. Opportunities include fishing, hunting, hiking, skiing, canoeing, and camping.

1.2.2.11 United States Forest Service

The United States Forest Service's (USFS) Chugach National Forest Eastern Kenai Peninsula and Seward Ranger District provides a wide array of recreation opportunities. USFS owns and operates a number of public-use trails ranging in difficulty from easy to very difficult. Some of the trails offer dispersed camping opportunities at designated backcountry sites. In the winter, some of these trails double as cross-country and backcountry skiing trails.

1.2.2.11.1 Carter Lake Trail

The Carter Lake trailhead is located at Mile 34 Seward Highway, approximately 29 miles from the project site. It offers a 3.4-mile hiking trail to Carter and Crescent Lakes with designated backcountry campsites.

1.2.2.11.2 Grayling Lake Trail

The Grayling Lake trailhead is located at Mile 13.2 Seward Highway, approximately eight miles from the project site. It offers a 1.5-mile hiking trail.

1.2.2.11.3 Johnson Pass Trail

Johnson Pass Trail is a 23-mile trail that runs between two trailheads. The north trailhead is located at Mile 64 Seward Highway and the south trailhead is located at Mile 32.5 Seward Highway. The trail offers opportunities for mountain biking and dispersed camping.

1.2.2.11.4 Lost Lake Trail

The Lost Lake trailhead is located at Mile 5 Seward Highway, approximately 2.5 miles from the project site. It offers a 7.3-mile hiking trail to Lost Lake where there are camping opportunities. It connects with the Primrose Trail at Lost Lake.

1.2.2.11.5 Primrose Trail

The Primrose trailhead is located at Mile 17 Seward Highway, approximately 11 miles from the project site. It offers a 7.5-mile hiking trail to Lost Lake where there are camping opportunities.

1.2.2.11.6 Ptarmigan Creek Trail

The Ptarmigan Creek trailhead is located at Mile 23 Seward Highway, approximately 17 miles from the project site. It offers a 3.5-mile hiking trail with a connection to Ptarmigan Lake Trail where dispersed backcountry campsites are available.

1.2.2.11.7 Resurrection River Trail

The Resurrection River trailhead is located on Exit Glacier Road, approximately 11 miles from the project site. It offers a 17-mile hiking trail. It is heavily brushed with trees often impeding travel and includes multiple water crossings. It is considered to be a very challenging trail with limited winter activities.

1.2.2.11.8 Victor Creek Trail

The Victor Creek trailhead is located at Mile 19.7 Seward Highway, approximately 14 miles from the project site. It offers a 2.25-mile hiking trail with steep climbs through dense spruce/hemlock forest for approximately one-half of the trail.

1.3 Need

In 2013, the State of Alaska reported visitation to state park facilities within the Kenai Area of 1.1 million visitors, approximately three times the population of the market area. There are also multiple federal and local recreation facilities throughout the market area that experience additional visitation. In 2013, 72 percent of visitors to State of Alaska facilities within the Kenai Peninsula area were State of Alaska residents. The remaining 28 percent were non-residents.[1] Given that the local population engages heavily in recreation throughout the year and that there are hundreds of thousands of annual non-resident visitors to the market area, it is reasonable to assume that excess demand exists to fill the capacity of a small-scale recreational development such as the one proposed at Salmon Creek.

This assumption is further supported by visitation to the Lowell Point State Recreation Site (SRS) in the Lowell Point CDP. Lowell Point SRS has facilities similar to those that are planned for Salmon Creek (camping, trails, etc.). Lowell Point SRS experienced 65,361 visitations in 2013. While there are some differences between the recreational opportunities provided at Lowell Point and those that are planned for Salmon Creek, the two sites are similar enough for comparison's sake. It is assumed that there is sufficient demand for recreational opportunities that would be provided at Salmon Creek for the project to support a level of visitation similar to that seen at Lowell Point SRS. Despite the abundance of recreational facilities in the market area, there are relatively few facilities such as the one that is being proposed at Salmon Creek. This facility is somewhat unique in that it provides a multi-use (walking/biking/skiing) trail along with opportunities for birdwatching, picnicking, snowmachining, and access to backcountry hiking and camping.

1.4 Capacity Analysis

Utilizing guidance published in two IWR documents, a capacity analysis was performed for the planned recreational facilities at Salmon Creek.[2,3] The capacity analysis is performed in two steps. The first step produces an average "design day load" (DDL). The second step produces assumed daily use.[4] This daily use estimate is then annualized to produce capacity and visitation, (which are assumed to be equal under the capacity method).

For the Salmon Creek project, it is assumed that recreational participation is limited by the number of parking spaces provided. Calculation of the DDL is expressed as:

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[1] State of Alaska Parks Visitor Counts for the Kenai Peninsula and Prince William Sound
[2] IWR Report 86-R-4
[3] IWR Report 74-R-1
[4] Calculation and assumptions were confirmed during conversations with Matt Rea, Northwestern Division

DDL = Instantaneous Capacity Per Unit x Daily Turnover Rate x Number of Units

Given that the limiting factor at the Salmon Creek site is parking availability and 20 parking spaces are planned, the DDL calculation is:

1.5 (people per car x 1 car per space) x 2.0 x 20 (number of spaces) = DDL of 60
Note: The turnover rate of 1.5 was within the range of 1.0 to 2.0 as set forth by IWR Report 74-R1.

The second step in the calculation is to determine the average daily use (ADU). Calculation of the ADU is expressed as:

ADU = DDL x Average Number of Weekend Days in Peak Season x Proportion of Peak Season Use Expected on Weekend Days x Proportion of Annual Use Expected During Peak Season

While Alaska's peak season is generally assumed to include the three months of June, July, and August, (and therefore approximately 26 weekend days), IWR Report 74-R1 states that nationwide, the average number of weekend days is nine. In an effort to be conservative with assumptions, (given the uncertainty associated with these calculations), the IWR average number of weekend days in the peak season was used. The report further states that generally between 50 percent and 60 percent of peak season use occurs on weekends. The most conservative estimate in this range was utilized (50%). The State of Alaska provided visitation data for the area for calendar year 2013. That data showed that 47 percent of all visitations occurred in the months of June and July, therefore this percentage was utilized. The ADU calculation is therefore:

60 (DDL) x 9 x 0.50 x 0.47 = ADU of 127

When annualized, (multiplying by 365), the average annual use expected at Salmon Creek is 46,419 visits. This is approximately 19,000 annual visits (29 percent) less than that experienced at Lowell Creek SRS and seems reasonable in nature. This average annual visitation number is multiplied by the difference in the without-project and with-project visitation and Unit Day Value (UDV) to produce annual recreation benefits. For the without-project visitation estimate, visitation at the nearest comparable facility with similar facilities was used. This facility was Caines Head State Recreation Area, which had visitation of 16,529 in 2013.

1.5 Unit Day Value Calculations

The benefits for recreation development for the Salmon Creek Section 205 project have been estimated using Economic Guidance Memorandum 14-03 entitled "Unit Day Values for Recreation, Fiscal Year 2014". The Average Annual Recreation Value (AARV) is calculated from the determined Unit Day Value (UDV) and the Annualized Visitation (AV) for both the existing conditions and proposed alternative. The Average Annual Recreation Benefits (AARB) is the difference between the AARV for existing conditions and AARV for the facility improvements.

The UDV is converted from the assigned point value for the existing site. The assigned point value is determined using judgment factors for each of the five criteria. All of the activities at Salmon Creek are considered to be "General Recreation". EGM 14-03 lists guidelines for calculating point values for recreation sites. These guidelines are listed in Table 5.

Table 5. Recreation Point Value Guidelines

Criteria	Judgment Factors				
Recreation Experience [1] Total Points: 30 Point Value:	Two general activities [2] 0-4	Several general activities 5-10	Several general activities; one high quality activity [3] 11-16	Several general activities; more than one high quality high activity 17-23	Numerous high quality value activities; some general activities 24-30
Availability of opportunity [4] Total Points: 18 Point Value:	Several within 1 hr. travel time; a few within 30 min. travel time 0-3	Several within 1 hr. travel time; non within 30 min. travel time 4-6	One or two within 1 hr. travel time; none within 45 min. travel time 7-10	None within 1 hr. travel time 11-14	None within 2 hr. travel time 15-18
Carrying capacity [5] Total Points: 14 Point Value:	Minimum facility for development for public health and safety 0-2	Basic facility to conduct activity(ies) 3-5	Adequate facilities to conduct without deterioration of the resource or activity experience 6-8	Optimum facilities to conduct activity at site potential 9-11	Ultimate facilities to achieve intent of selected alternative 12-14
Accessibility Total Points: 18 Point Value:	Limited access by any means to site or within site 0-3	Fair access, poor quality roads to site; limited access within site 4-6	Fair access, fair road to site; fair access, good roads within site 7-10	Good access, good roads to site; fair access, good roads within site 11-14	Good access, high standard road to site; good access within site 15-18
Environmental quality Total Points: 20 Point Value:	Low aesthetic factors [6] that significantly lower quality [7] 0-2	Average aesthetic quality; factors exist that lower quality to minor degree 3-6	Above average aesthetic quality; any limiting factors can be reasonably rectified 7-10	High aesthetic quality; no factors exist that lower quality 11-15	Outstanding aesthetic quality; no factors exist that lower quality 16-20

[1] Value for water-oriented activities should be adjusted if significant seasonal water level changes occur.
[2] General activities include those that are common to the region and that are usually of normal quality. This includes picnicking, camping, hiking, riding, cycling, and fishing and hunting of normal quality.
[3] High quality value activities include those that are not common to the region and/or Nation, and that are usually of high quality.
[4] Likelihood of success at fishing and hunting.
[5] Value should be adjusted for overuse.
[6] Major aesthetic qualities to be considered include geology and topography, water, and vegetation.
[7] Factors to be considered to lowering quality include air and water pollution, pests, poor climate, and unsightly adjacent areas.

Given these guidelines, recreation point values were determined for the existing and with-project conditions. For Salmon Creek, the assigned point value is 16, which converted to the UDV of $4.64. Assigned points, criteria, and judgment factors are shown in Table 6.

Table 6. Existing Recreation Point Value

Criteria (Maximum Points)	Judgment Factors (Range of Points)	Assigned Point Value & Rationale
Recreation Experience (30)	Several general activities (5-10)	5 – The area currently offers opportunities for several outdoor activities such as hiking, camping, skiing, and snow machining.
Availability of Opportunity (18)	Several within 1 hr. travel time; a few within 30 min. travel time (0-3)	0 – There are abundant opportunities for hiking, camping, skiing, and snow machining within the market area.
Carrying Capacity (14)	Minimum facility for development for public health and safety (0-2)	0 - There are no facilities in the area.
Accessibility (18)	Limited access by any means to site or within site (0-3)	1 - Current access to area is by two-track trail. A 4-wheel drive vehicle is necessary to access the site. Intermittent conditions make access with an unmodified 4-wheel drive vehicle difficult or impossible.
Environmental Quality (20)	Above average aesthetic quality; any limiting factors can be reasonably rectified (7-10)	10 – This is a backcountry area with no development visible from the site except for the existing berm and deposition area which are not particularly aesthetically pleasing.
Total (100)	Range for factors (12-28)	Total Assigned Points: 16

As shown above, there is ample opportunity at the site for more recreation to take place. The proposed recreation measures include:

- Parking Area
- Multi-Use Trail on the landside of the Revetment

After taking construction of these measures into account, the with-project point values and UDV were calculated. Point value calculations for the with-project condition are shown in Table 7.

Table 7. With-Project Recreation Point Values

Criteria (Maximum Points)	Judgment Factors (Range of Points)	Assigned Point Value & Rationale
Recreation Experience (30)	Several general activities (5-10)	10 – Construction of the recreation measures would allow for multiple new general activities to take place at the project site.
Availability of Opportunity (18)	Several within 1 hr. travel time; a few within 30 min. travel time (0-3)	3 – There are abundant opportunities for hiking, camping, skiing, and snow machining within the market area but there are more limited opportunities for trail-specific walking and biking. The benches provide opportunities for bird-watching and wildlife viewing.
Carrying Capacity (14)	Adequate facilities to conduct without deterioration of the resource or activity experience (6-8)	8 – Through offering a well-constructed parking area and path, it is less likely that the area will suffer from degradation than if these measures were not included.
Accessibility (18)	Good access, good roads to site; fair access, good roads within site (11-14)	11 – Construction of the project necessitates the upgrade of the current access trail to a two-way compacted gravel road consistent with roads in the neighborhood.
Environmental Quality (20)	Outstanding aesthetic quality; no factors exist that lower quality (16-20)	16 – With an upgrade of the existing berm to an engineered revetment with trail and the deposition area turned into a parking and picnic area, all limiting factors will be rectified. This will leave users with a spectacular experience from an aesthetics perspective.
Total (100)	Range for factors (38-55)	Total Assigned Points: 48

Total assigned points for the with-project condition are 48 which converts to a UDV of $7.32, or an increase of $2.68.

The Average Annual Recreation Benefits (AARB) are derived by subtracting the Average Annual Recreation Values (AARV) for the existing condition from the AARV for the with-project condition. The result of this calculation is shown in Table 8.

Table 8. Average Annual Recreation Benefit Calculation

Item	Annual Visitations	UDV	Value
Without-Project AARV	16,529	$4.64	$ 76,695
With-Project AARV	46,419	$7.32	$339,784
AARB			**$263,089**

APPENDIX F
GEOTECHNICAL FEASIBILITY REPORT

US Army Corps of Engineers

Geotechnical Feasibility Report

Salmon Creek Section 205

Seward, Alaska, Alaska District, Pacific Ocean Division

November 2014

PN: ####
Status: DRAFT

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 6898
JBER, AK 99506-0898

CEPOA-EN-G-GM

November 2014

MEMORANDUM FOR

Civil Works Project Management (CEPOA-PM-C), Jason Norris)

SUBJECT: Geotechnical Feasibility Report for Salmon Creek Section 205, Seward, Alaska.

1. This report was authorized and forwarded on to Geotechnical and Materials Section by the Project Management Branch via the Project Manager Jason Norris.

2. Enclosed is the Geotechnical Feasibility Report for Salmon Creek Section 205, Seward, Alaska. Included with the report are the Project Location and Vicinity Map, a discussion of the findings of the geotechnical evaluation, and preliminary engineering design recommendation for the project.

3. As a result of this geotechnical evaluation the project site is suitable for the construction of the proposed berm.

4. Questions should be addressed to Matthew Perrett at 808-497-6718 or John Rajek at 907-753-5695.

James Sauceda, P.E.
Chief, Geotechnical and Engineering Services
CEPOA-G

John Rajek, P.E.
Chief, Geotechnical and Materials Section
CEPOA-G-GM

Matthew Perrett, E.I.T.
Civil Engineer
CEPOH-EC-T

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1.0 Introduction

This report documents the results of a geotechnical evaluation performed for the Salmon Creek Section 205 flood risk management project in Seward, Alaska. The scope of the investigation was to obtain a historical prospective of the site, identify surface and subsurface conditions, and address geotechnical concerns relevant to the project. This report presents a summary of the findings based on historical documents and site observations. This report also includes preliminary engineering analysis for identified site conditions and preliminary geotechnical recommendations for the design and construction of a proposed berm.

A subsurface exploration program and a more detailed engineering analysis are needed before final geotechnical recommendations for the design and construction of the proposed berm can be made.

2.0 Location and Project Description

The project area is located within the limits of the Kenai Peninsula Borough near the City of Seward, Alaska. Seward is located approximately 70 air miles southeast of Anchorage. The project site is located where Salmon Creek exits a steep mountain gorge and enters the valley floor. A Project Location and Vicinity Map is provided in Appendix A as Sheet A-1.

This project consists of evaluating a proposed berm to improve flood risk management of the floodplain between Salmon Creek and Bear Lake. The creek has a tendency to overflow its banks during heavy rainfall events, threatening the Bear Creek subdivision and infrastructure including the Seward Highway and the Alaska Railroad.

Flood protection is currently provided by a berm maintained by the borough; a photo of this berm is shown in Figure 1. The berm is approximately 1,400 feet in length and consists of alluvial deposits including boulders, cobbles, gravels, sand, and fine-grained soils. The existing berm is inadequate to provide flood protection beyond the two to five-year return interval and requires routine maintenance to mitigate erosion and flooding issues.

A total of four project alternatives are being considered for this project area. These alternatives are:

1. Elevating or flood proofing affected structures.
2. Abandoning the floodplain.
3. Continuing maintenance of the existing embankment. This is the no-action alternative.
4. Constructing a berm.

Based on a preliminary analysis of these alternatives, the final option (construction of a berm) is likely to be the best option. Flood-proofing structures without maintaining the existing

embankment would still require sediment removal activities after each flooding event. The relocation of 54 residences may not be cost effective, may negatively affect the local economy, and will not handle the potential flooding of Seward Highway and Alaska Railroad. Finally, the existing embankment will only confine the creek during a 1-year flooding event; a greater event will lead to flooding of the surrounding area.

Figure 1: Looking northwest at the existing berm from the creek bed.

3.0 Previous Investigations

Previous investigations were conducted by other agencies in the vicinity of the project, providing a broad assessment of the project area in relation to flood events. No subsurface explorations have been conducted in the vicinity of the project. The investigations are presented in the following reports.

- Jones, H., Stanley, & Zenone, Chester (1988). *Flood of October 1986 at Seward, Alaska*. Water-Resources Investigations Report 87-4278: U.S. Geological Survey.

- Forest Service (2011). *Salmon Creek Landscape Assessment – Kenai Peninsula Zone, Chugach National Forest*. U.S. Department of Agriculture.

- Kenai Peninsula Borough (May 2010). *Seward/Bear Creek Flood Service Area – Flood Hazard Mitigation Plan*.

4.0 Regional Geology

Seward is located on the axis of the Chugach Mountains geosyncline. The region is underlain by sedimentary rocks of the Valdez Group. These rocks have undergone low-grade metamorphism and consist mainly of greywacke, phyllite, argillite, and slate. Unconsolidated glacially-derived sediments fill the valley floors and overlie the bedrock on low-angle slopes.

The proposed project alignment is situated within the alluvial outwash where Salmon Creek exits a steep valley and enters the valley floor. The outwash is characterized by alluvial deposits of river run boulders, cobbles, gravels, sand, and glacial till.

A geologic map detail of the area is provided in Figure 2. Refer to *Geology of the Prince William Sound and Kenai Peninsula Region, Alaska* (Wilson and Hults, 2007) for the complete geologic map.

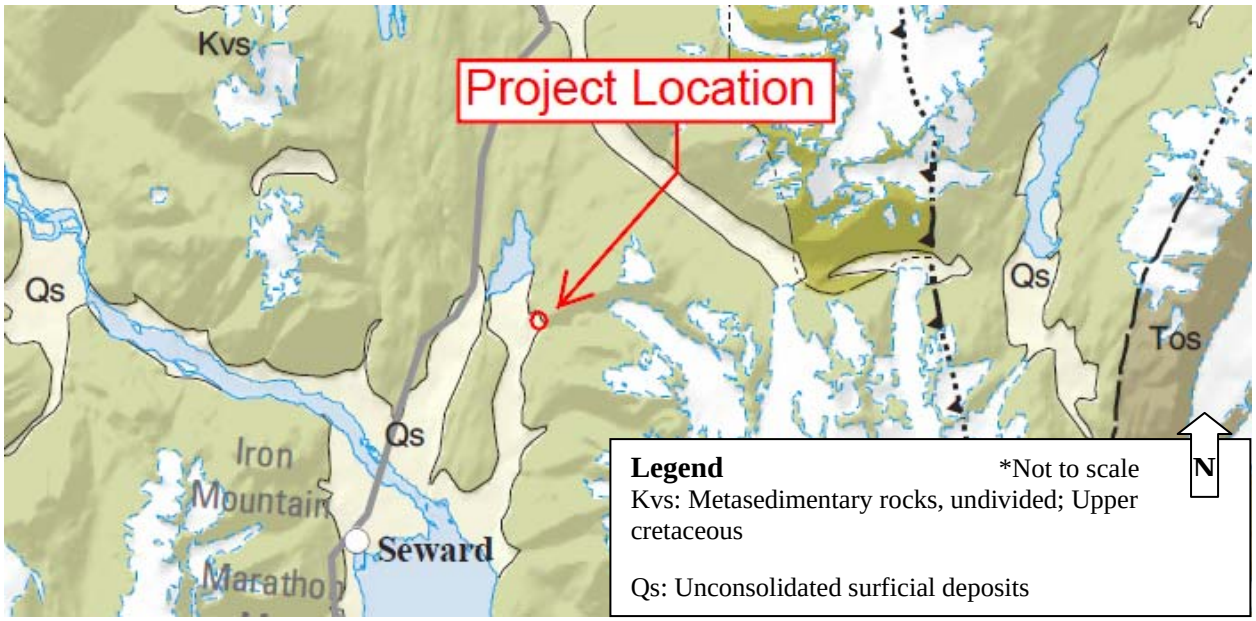

Figure 2: Geology in the vicinity of Seward.

5.0 Field Exploration

Engineers from the U.S. Army Corps of Engineers, Alaska District (USACE-AD) performed site reconnaissance at the project location on 30 April and 29 October 2014. A subsurface exploration has not been conducted. Field classifications of the soils were in accordance with ASTM D 2488, Description and Identification of Soils (Visual-Manual Procedure). A full geotechnical investigation will be required to develop design documents.

6.0 Site Conditions

6.1. Surface Conditions

The existing berm consists of alluvial deposits including boulders, cobbles, gravels, sand, and fine-grained soils; a sample of the embankment materials is shown in Figure 3.

Figure 3: Typical alluvial deposits including boulders, cobbles, and gravel used in the construction of the existing berm.

Although a subsurface investigation was not performed as part of this study, visual-manual procedures were performed in accordance with ASM D 2488. The soil was classified as a well-graded gravel with sand, cobbles, and boulders. The materials are gray, hard, and subangular. Trace amounts of silty fines are present. The volume of cobbles and boulders ranges between five and ten percent. Organic materials consisting of felled tree branches are present in the existing berm. The assumed gradation of the existing berm is shown in Figure 4.

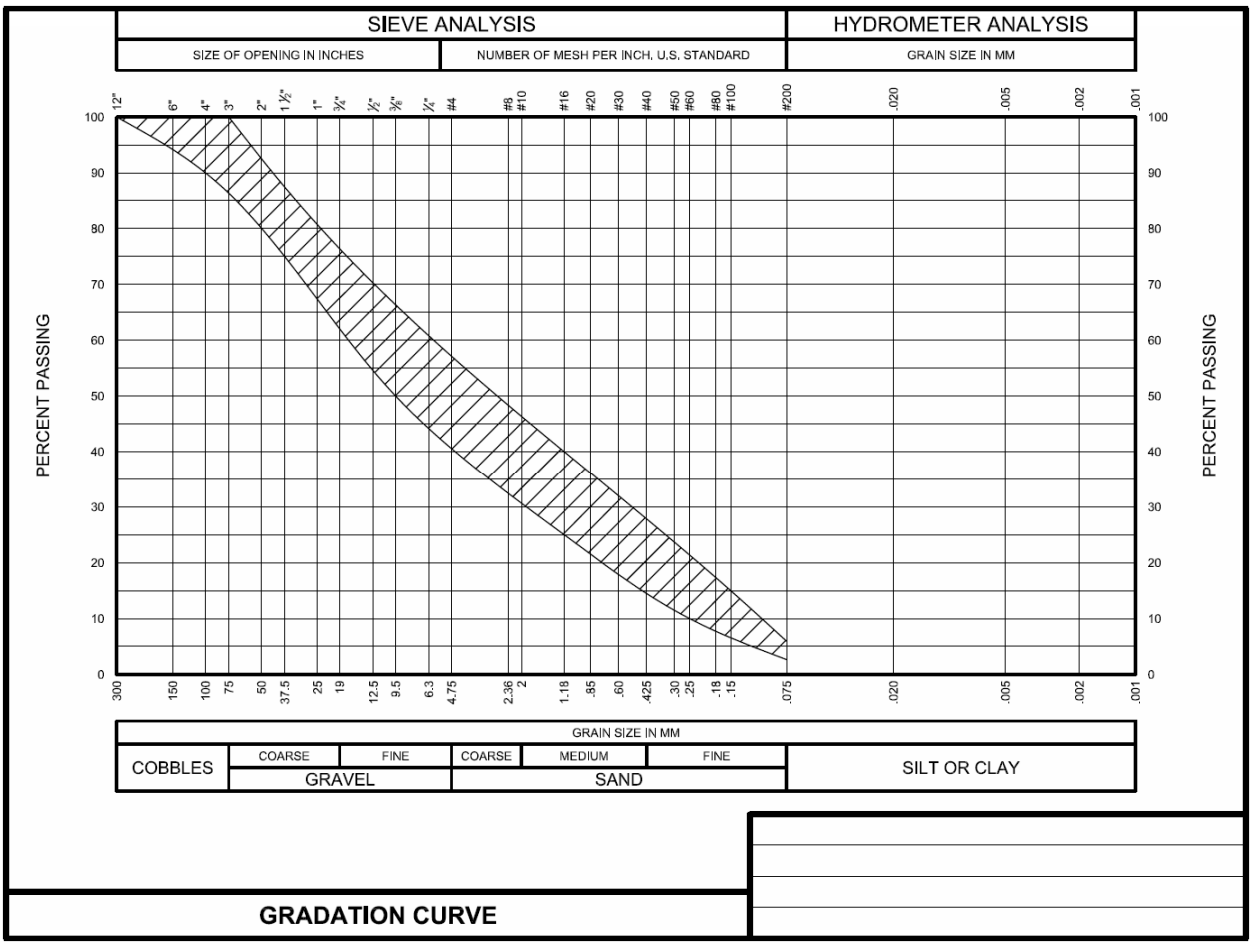

Figure 4: Gradation of embankment material using visual-manual procedures.

The berm experienced streambank erosion during the six-month interval between site visits; a comparison of the embankment erosion is shown by Figure 5 (April 2014) and Figure 6 (October 2014).

The most severe erosion is occurring at the southwest terminus where a braid of the creek is flowing directly adjacent to the berm, undercutting the embankment. The minimum crest width at this location is approximately eight feet (Figure 7).

Figure 5: Looking northwest at the existing berm from the creek bed. Photo taken on 30 April 2014.

Figure 6: Looking northwest at the existing berm from the creek bed. Photo taken on 29 October 2014.

Figure 7. Eight-foot minimum crest width where erosion is most severe.

6.2. Subsurface Conditions

The existing berm was created by pushing the in-situ material together until the structure was formed. Given this, it was assumed that the material that makes up the berm surface was representative of the material inside the berm. The soil elsewhere on the project site appeared to match the surface gradation shown in Figure 4. With no additional information available, this material gradation was assumed to be representative of the near-surface soil conditions around the berm as well.

7.0 Preliminary Engineering Analysis

An engineering analysis was performed on a conceptual berm section. The section chosen represents the addition of riprap protection to the creek side and crest portion of the existing embankment.

The berm section evaluated involved a 12-foot crest width, a 2H:1V (horizontal:vertical) side slope on the riverside of the berm, and a 2H:1V side slope on the landside of the berm. Two layers of riprap are to be added on top of the berm; a 1.5-foot layer of a filter material, followed by a 3-foot layer of an riprap material. In accordance with ASTM D 6092-14, the filter material will consist of an R-20 graded stone, while the outer layer will consist of an R-300 grade stone. The allowable gradations of these materials are shown in Sheet A-2. The crest was located at an elevation of 409.5 feet (NAVD88). It was assumed that the existing grade along the water side of the berm was at an elevation of 392 feet (NAVD88) and that the existing grade along the landside of the berm was at an elevation of 400 feet (NAVD88). The alluvial deposit soil unit

was assumed to have a thickness equal to the extent of the model. A sketch of the section evaluated is shown in Figure 8.

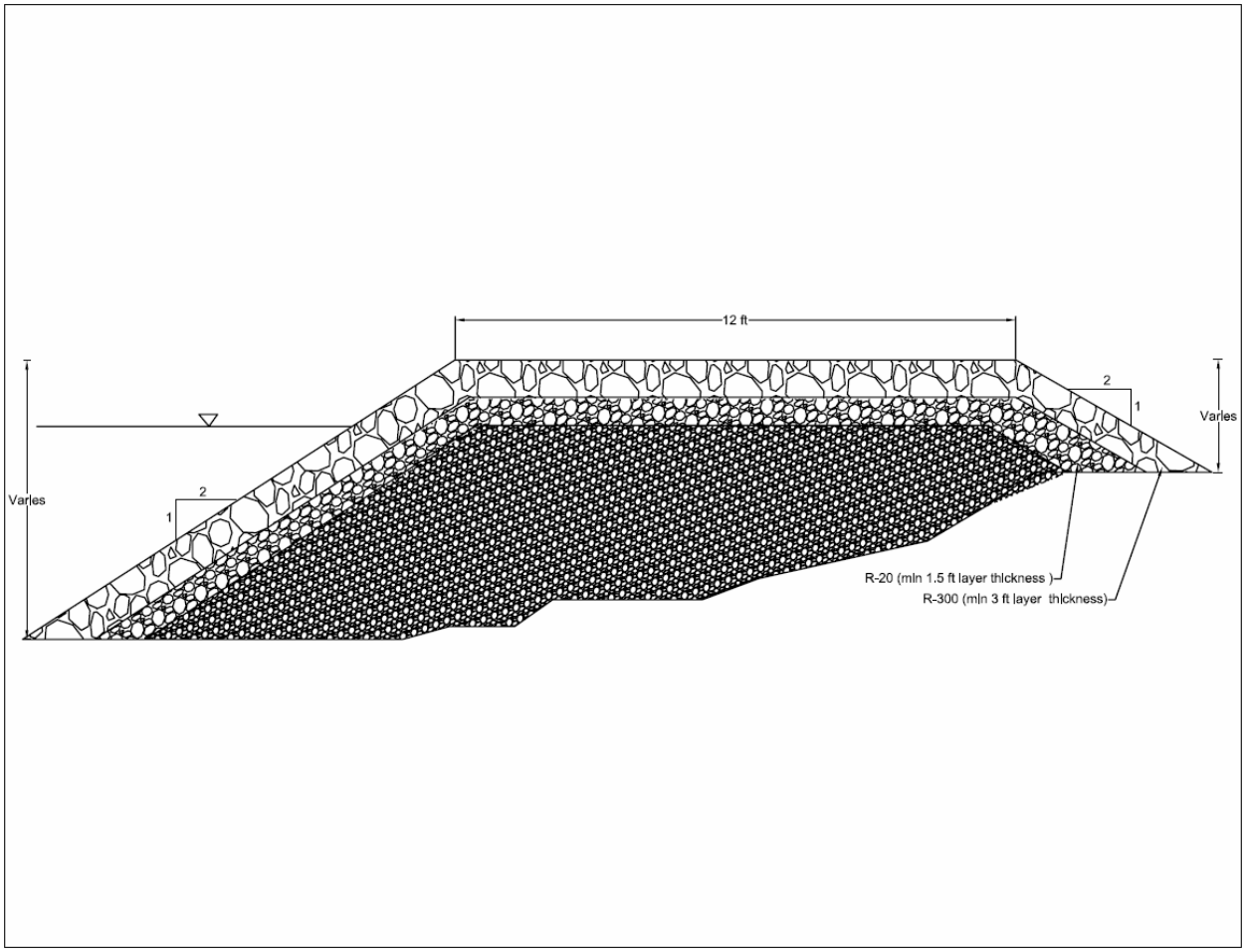

Figure 8: Section detail of proposed berm

The engineering analysis was based on the project engineer's interpretation of the project site conditions and assumptions made on the engineering characteristics of the existing berm and borrow source. A more extensive exploration program is needed to verify or identify deviations from these design assumptions.

7.1. Riprap Layer Analysis

An R-300 graded material was chosen to meet the level of protection needed for this berm. However, it was found that the interface between R-300 graded material and the in-situ material did not meet the filtration and permeability requirements set out in EM 1110-2-1100 Part VI. To address this, an R-20 graded material was added between the R-300 layer and the in-situ material to act as a filter. With the R-20 material as a filter, the riprap system is able to meet the requirements set out in EM 1110-2-1100. The appropriate calculations supporting this are shown below:

$$d_{85_{Foundation}} \approx 1.26_{in}$$

$$d_{15_{Foundation}} \approx 0.006_{in}$$

$$R_{20} = d_{Filter}$$

$$d_{15_{Filter\ (Retention)}} \approx 5_{in}$$

$$d_{15_{Filter\ (Permeability)}} \approx 2.8_{in}$$

$$Retention\ of\ Foundation\text{:}\ \frac{d_{15_{Filter\ (Retention)}}}{d_{85_{Foundation}}} < (4\ to\ 5)\ \therefore\ d_{85_{Foundation}} * 4 > d_{15_{Filter}}$$

$$1.26 * 4 = 5.04 > 5\ \therefore OK$$

$$Permeability\text{:}\ \frac{d_{15_{Filter\ (Permeability)}}}{d_{15_{Foundation}}} > (4\ to\ 5)\ \therefore\ d_{15_{Foundation}} * 5 < d_{15_{Filter}}$$

$$0.02 * 5 = 0.1 < 2.8\ \therefore OK$$

$$Retention\ of\ Filter\text{:}\ \frac{d_{15_{Riprap}}}{d_{85_{Filter}}} < (4\ to\ 5)\ \therefore\ d_{85_{Filter}} * 4 > d_{15_{Riprap}}$$

$$d_{15_{Riprap}} \approx 12.75\ in$$

$$d_{85_{Filter}} \approx 5.7\ in$$

$$5.7 * 4 = 22.8 > 12.75\ \therefore OK$$

$$Internal\ Stability\ of\ Filter\text{:}\ \frac{d_{60_{Filter}}}{d_{15_{Filter}}} < 10\ \therefore\ d_{15_{Filter}} * 10 > d_{60_{Filter}}$$

$$d_{60_{Filter}} \approx 9.5\ in$$

$$d_{15_{Filter}} \approx 5\ in$$

$$5 * 10 = 50 > 9.5\ \therefore OK$$

Note that each of these materials contain a range of potential gradations. When appropriate, the most critical gradation was chosen for each individual calculation.

7.2. Seepage Analysis

A seepage analysis was not performed for this project. An assumed phreatic line based on the water level was assumed when conducting the slope stability analysis.

7.3. Berm Slope Stability Analysis

A slope-stability analysis was performed using the Spencer method in Slope/W of the Geo-Studio software suite to understand the stability conditions of the embankment during flood

events. Four separate analyses were conducted to reflect different potential slope failure conditions. Strength parameters were chosen based on engineering judgment of the material types. Specifically, a friction angle of 34° and a dry unit weight of 130 pcf were used in the slope stability analysis; these numbers were chosen based on the gradation of the in-situ material, in accordance with Figure 4-7 of EL-6800 (Kulhawy and Mayne, 1990). Minimum factors of safety for berm slope stability are presented in Table 1 as stated in EM 1110-2-1913 Design and Construction of Levees Table 6-1b.

Table 1: Minimum Factors of Safety – Levee Slope Stability

Type of Slope	Applicable Stability Conditions and Required Factors of Safety			
	End-of-Construction	Long-Term (Steady Seepage)	Rapid Drawdown [1]	Earthquake [2]
New Levees	1.3	1.4	1.0 to 1.2	(See Below)

[1] *Sudden drawdown analyses. F.S. = 1.0 applies to pool levels prior to drawdown for conditions where these water levels are unlikely to persist for long periods preceding drawdown. F.S. =1.2 applies to pool level, likely to persist for long periods prior to drawdown.*
[2] *See ER 1110-2-1806 for guidance. An EM for seismic Stability analysis is under preparation.*

To account for the proposed riprap layers (R-300 and R-20), a separate layer was added to each analysis using the estimated geotechnical properties of these materials. In accordance with the USACE Shore Protection Manual, a porosity of 37% was assumed for riprap materials. In addition to this, a friction angle of 40° was assumed for the riprap materials. Finally, an estimate of 2.7 was chosen for the specific gravity of the materials. To determine the dry unit weight of the riprap materials, the following relationship was used:

$$\gamma_d = G_s(1-n)\gamma_w$$

Where:

$$\gamma_d = Estimated\ dry\ unit\ weight$$

$$G_s = Specific\ gravity$$

$$n = Porosity$$

$$\gamma_w = Unit\ weight\ of\ water = 62.4\ pcf$$

Thus:

$$\gamma_d = 2.7(1-0.37)62.4 = 106.1\ pcf$$

A summary of the critical factor of safety results for each of the following conditions is shown in Table 2.

Table 2: Calculated Critical Factors of Safety

Critical Factors of Safety for the Proposed Berm			
End-of-Construction (Riverside)	End-of-Construction (Landside)	Long-Term (Steady Seepage)	Rapid Drawdown
1.5	1.6	1.4	1.2

7.3.1. End of Construction

For this condition, the water level at the berm is at an assumed elevation of 3 feet above the creek channel. This is representative of the post-construction berm state. EM 1110-2-1913 states that both sides of the structure should be evaluated when reviewing this condition. The critical factor of safety for both the riverside and the landside of the berm are shown in Table 2. Each of these factors of safety are above the minimum recommended by Table 1. The critical slip surfaces for each side are shown in Figure 9 and Figure 10.

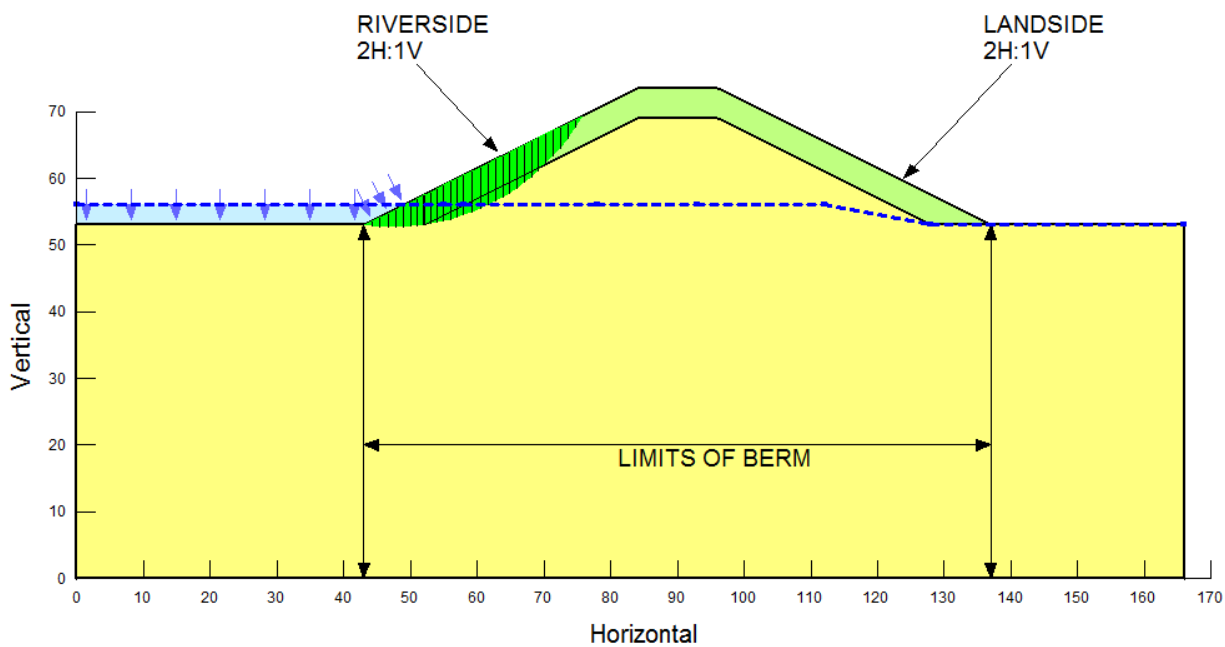

Figure 9: Critical riverside slip surface for steady state condition

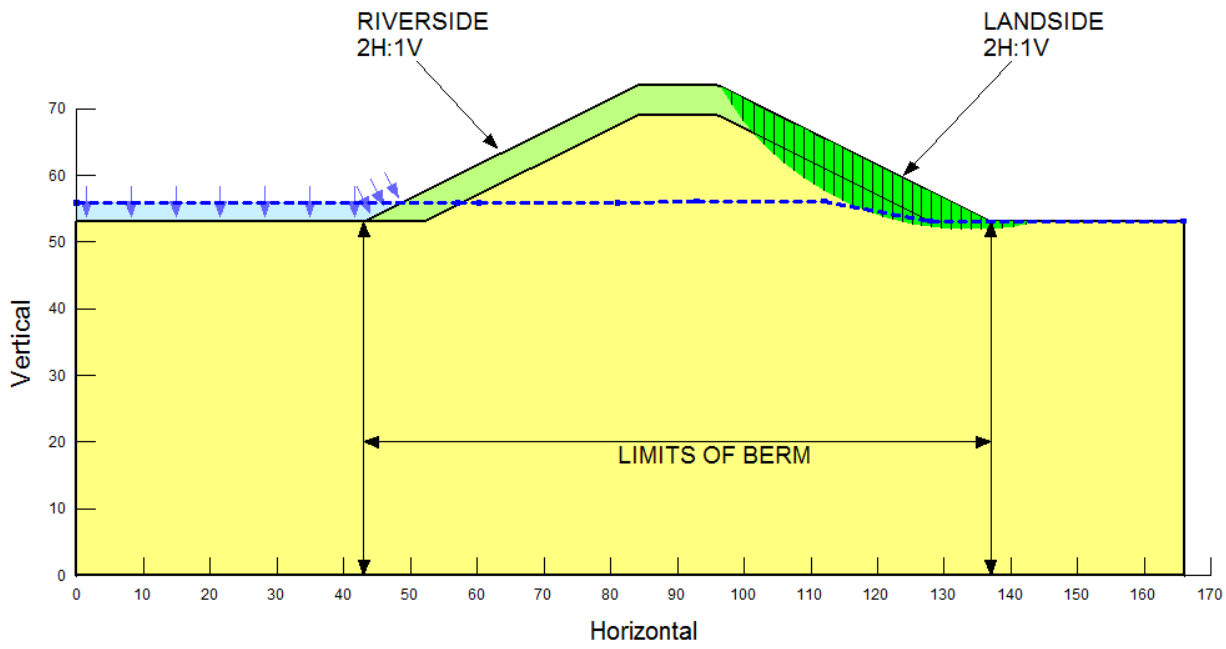

Figure 10: Critical landside slip surface for steady state condition

7.3.2. Long-Term (Steady Seepage)

For this condition, the water level at the berm was increased to 16 feet above the creek channel. As a result, water has seeped into the berm, saturating the soil. EM 1110-2-1913 states that under this condition, the landside of the berm is the critical analysis point. Based on the slope stability analysis, the critical factor of safety for this condition is shown in Table 2. This result is equal to the 1.4 called for in Table 1. The critical slip surface for this condition is shown in Figure 11.

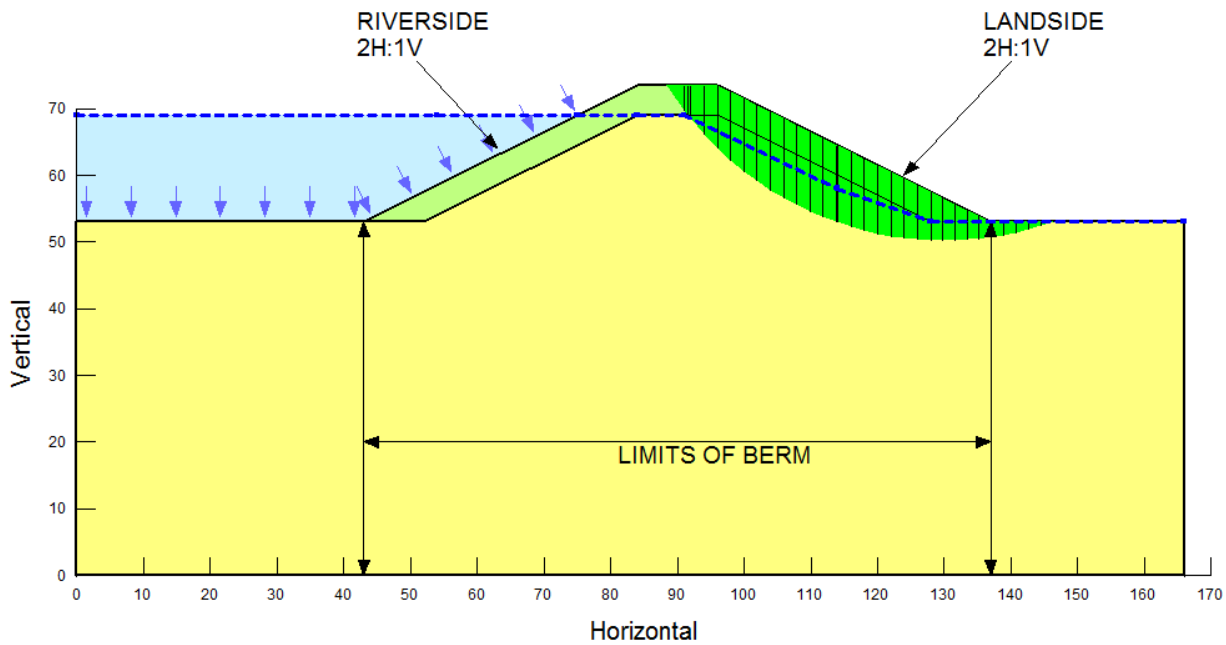

Figure 11: Critical slip surface for full flood condition

7.3.3. Rapid Drawdown

For this condition, the water level at the berm has returned to its assumed resting point following a flood event. However, the water level inside of the berm has not yet drained from the structure. This case represents the condition of the berm immediately following a flood event. EM 1110-2-1913 states that the critical side for this condition will be the riverside. Based on the analysis performed, the critical factor of safety is shown in Table 2. This is equal to the minimum that is called for in Table 1. The critical slip surface for this result is shown in Figure 12.

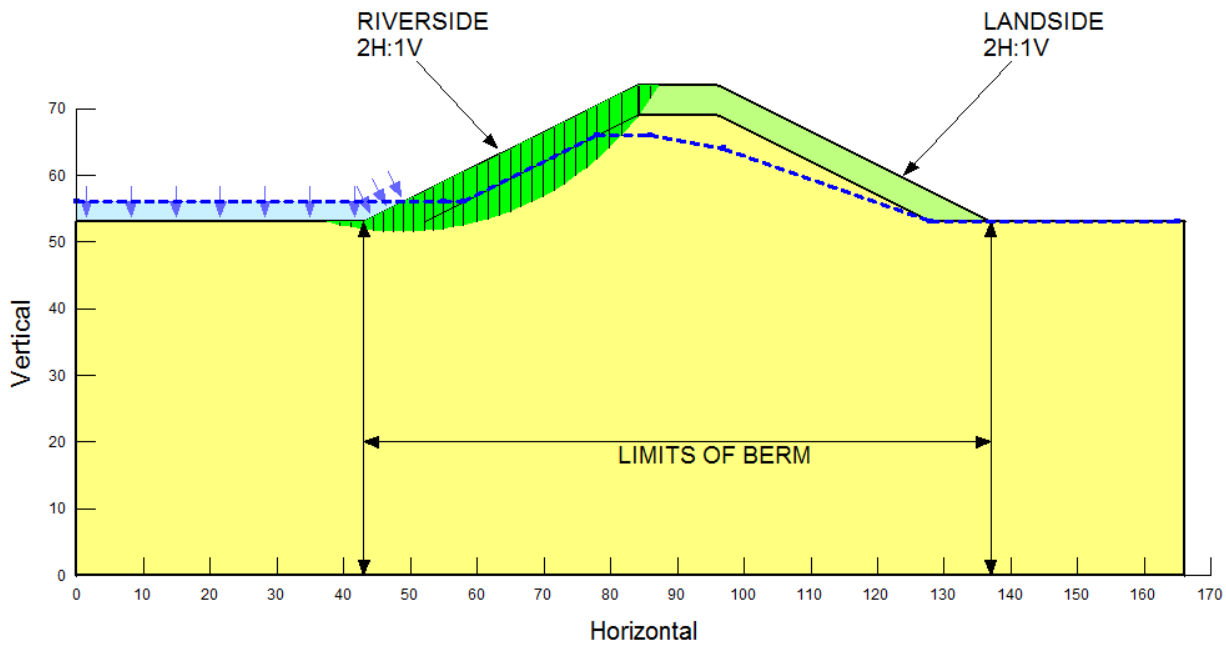

Figure 12: Critical slip surface for drawdown condition

7.4. Seismic Analysis and Earthquake Ground Motions

Alaska is the most tectonically active region in the United States and experiences more than half of all earthquakes recorded in North America each year (Alaska Earthquake Information Center, 2014). The present tectonic framework of Alaska is dominated by subduction of the Pacific plate underneath the North American plate at an angle of about 45 degrees, with a rate of closure of about three inches per year.

Subduction of the Pacific plate generates earthquakes. The epicentral depth of these earthquakes traces the depth of the interface between the two plates as the Pacific plate subducts until it warms enough to lose strength and become plastic (Figure 13, Alaska Earthquake Center, 2014).

Seismic activity displayed in Figure 14 is from 1899 to Dec 2004. Although the intensity of most earthquakes in this area is less than a Richter magnitude 6.0, several earthquakes with larger magnitudes have occurred. Seward is located approximately 100 miles from the epicenter of the Alaska Earthquake of March 27, 1964. Having a Richter magnitude 9.2, the earthquake destroyed a large portion of coastal facilities in Seward and resulted in tectonic subsidence of about 3.5 feet.

Given the frequency and duration of the design event, the likelihood of a significant seismic event when the berm is loaded is minimal. Therefore, it was determined that a seismic analysis was not warranted for this report.

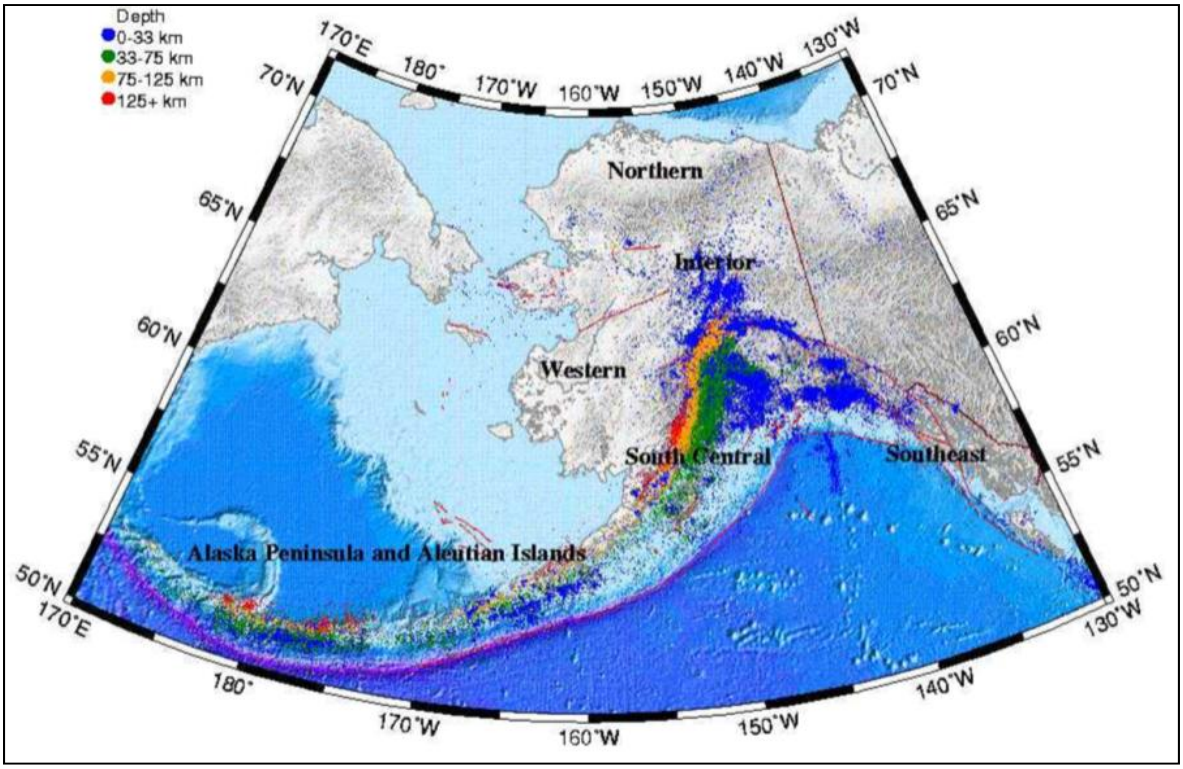

Figure 13: Epicentral depths of Alaskan Earthquakes

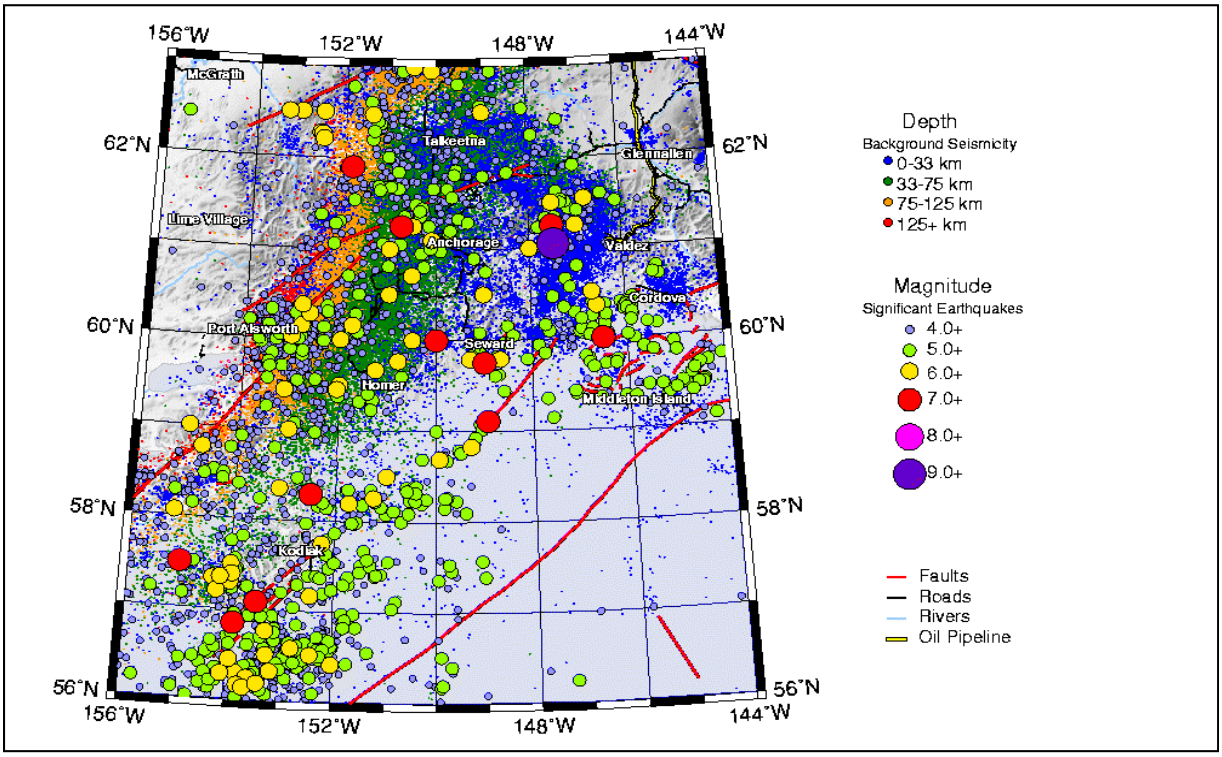

Figure 14: South Central Alaska Seismicity

8.0 References

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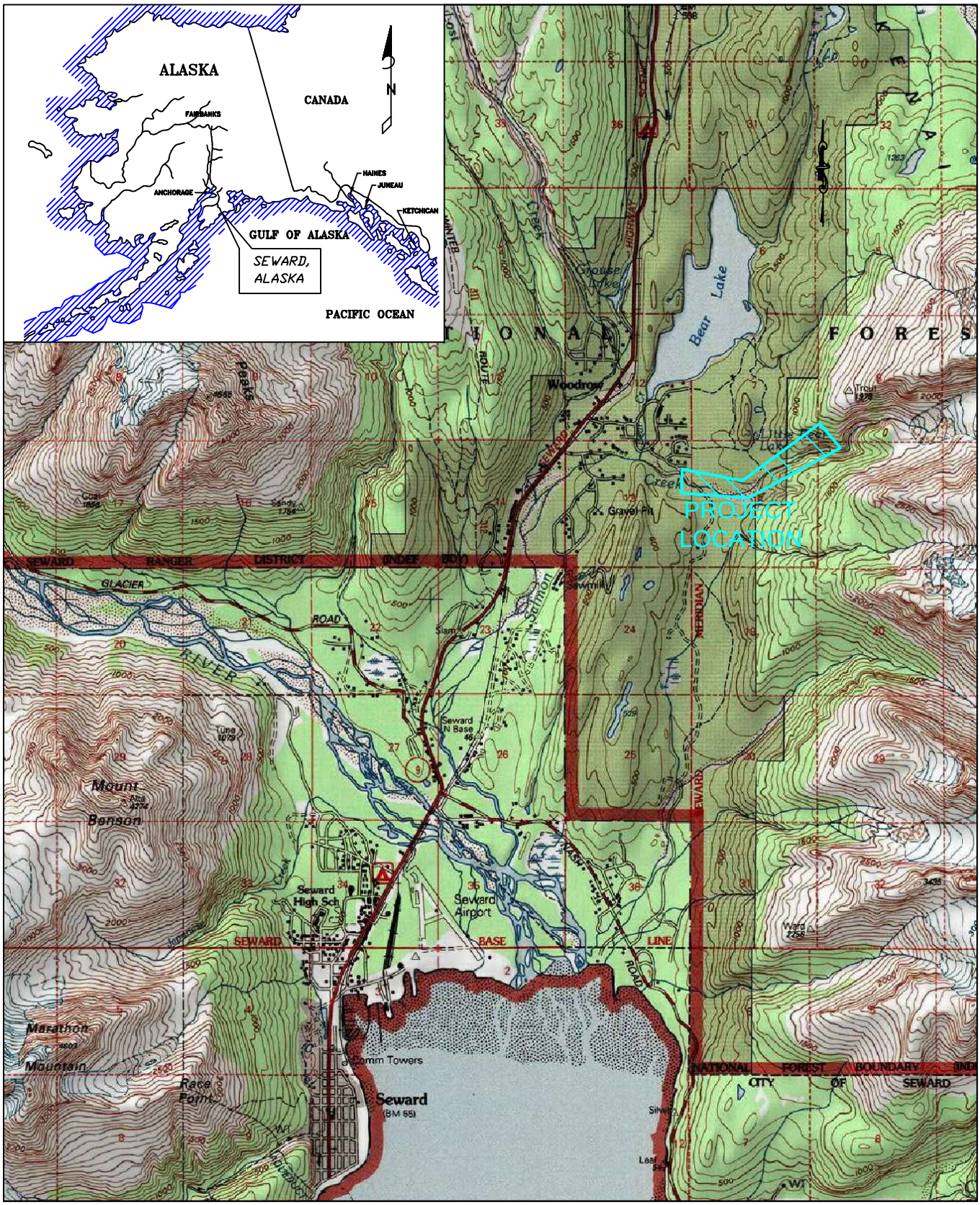
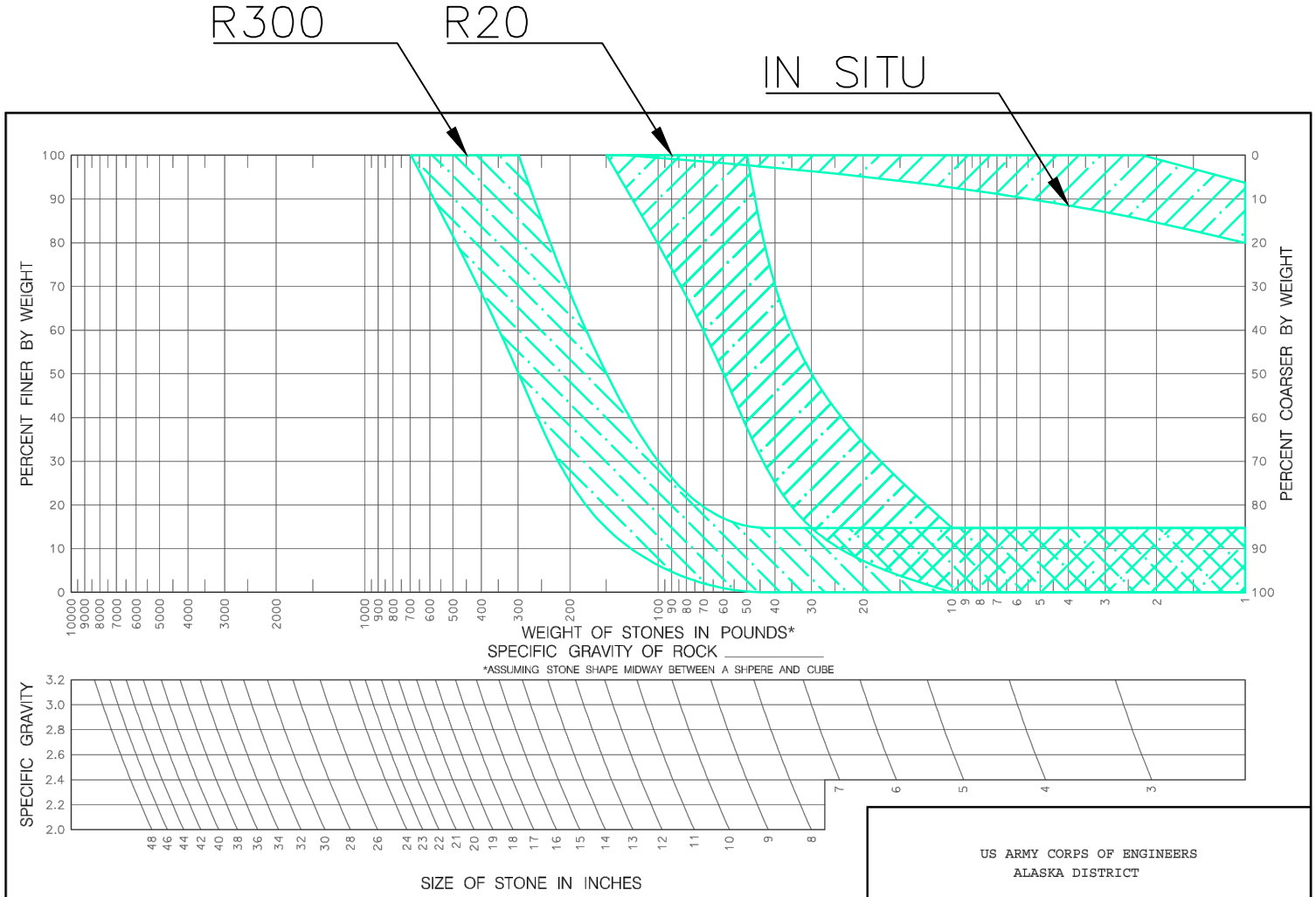


ALASKA DISTRICT
CORPS OF ENGINEERS
Geotechnical and Materials

LOCATION AND VICINITY MAP
SALMON CREEK SECTION 205
SEWARD, ALASKA

SCALE: NTS
DATE: NOVEMBER 2014
DRAWN/RVW: GAF/JJR
SHEET A-1



US ARMY CORPS OF ENGINEERS
ALASKA DISTRICT

PROJECT: _____ DATE: _____

RIPRAP GRADATION CURVES

ENG FORM 4055
APR 67

SHEET A-2

APPENDIX G
REAL ESTATE

US Army Corps of Engineers ® Pacific Ocean Division	**REAL ESTATE PLAN** **APPENDIX**	**Alaska District**

FLOOD RISK MANAGEMENT

SALMON CREEK, ALASKA

Real Estate Division
Alaska District
U.S. Army Corps of Engineers

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FLOOD RISK MANAGEMENT IMPROVEMENTS

SEWARD, ALASKA

REAL ESTATE PLAN

PURPOSE:

This Real Estate Plan (REP) will be consolidated into the decision document Feasibility Report for Flood Risk Management at Salmon Creek, Alaska. The purpose of the feasibility study is to evaluate the effects of construction of flood risk management measures along Salmon Creek in Seward, Alaska. The REP identifies and describes the real estate requirements for the lands, easements, rights-of-way, relocations and disposal areas (LERRD) that will be required.

PROJECT TYPE AND APPLICABILITY:

This feasibility study is being conducted under authority granted by Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended.

Nonfederal Sponsor for the project is the Kenai Peninsula Borough.

PROJECT SCOPE AND CONTENT:

This study examines the feasibility and environmental effects of constructing flood risk management measures along Salmon Creek at Seward, Alaska. The City of Seward is located on the southern coast of the Kenai Peninsula, approximately 75 air miles south-southwest of Anchorage. The project area is shown below in Figure 1.

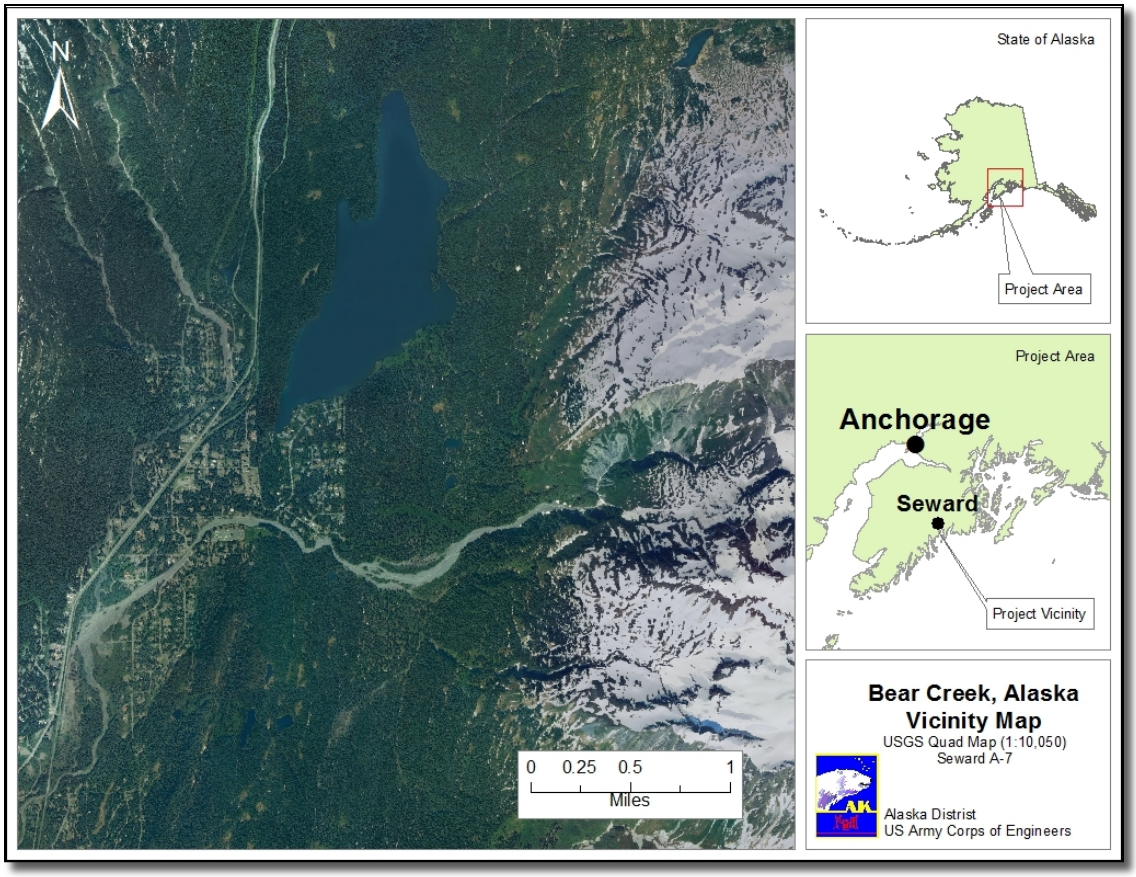

Figure 1: Study Area

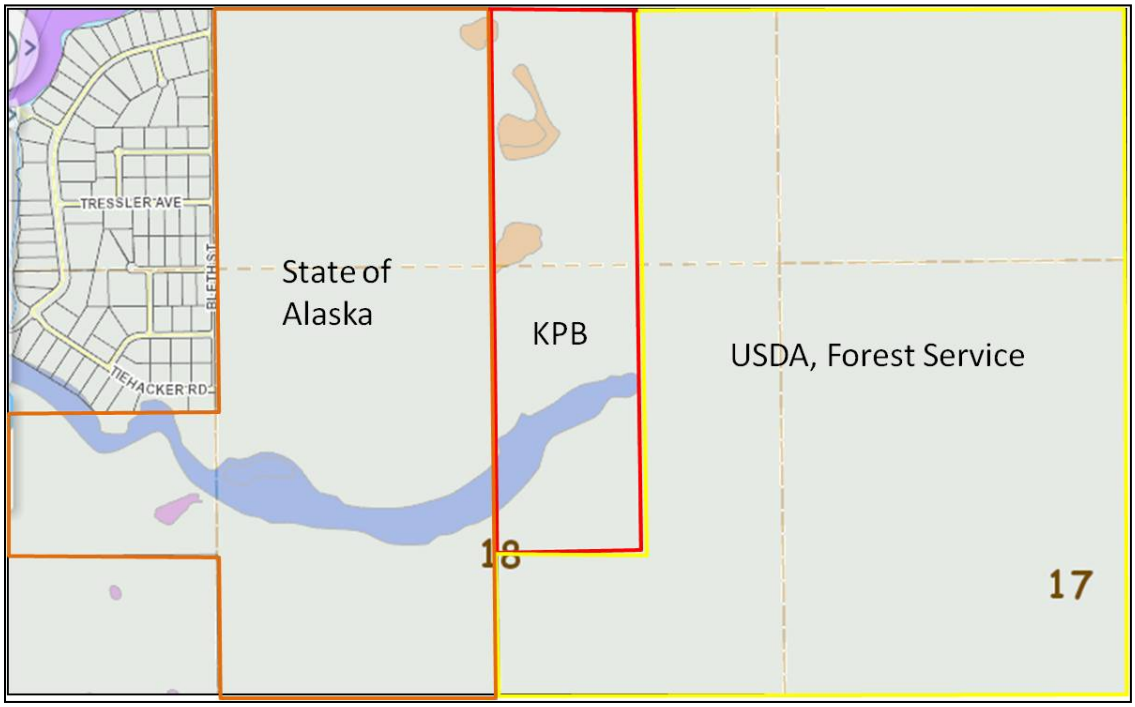

Figure 2. Land Ownership

Alternative 1

Alternative 1 is a permanent, engineered revetment approximately 1,440 feet in length that closely mirrors the alignment of the temporary flood-fighting berm constructed by the non-Federal partner during high flow events. The revetment would be constructed in a manner which would encourage self-scouring, moving sediment downstream to a wider floodplain. This design feature would lower O&M costs and ensure that Salmon Creek would not recapture its relic channel. Due to the rudimentary nature of current site access, this alternative would require the current access trail to be upgraded to a two-lane gravel road stretching from the eastern terminus of Orlander Avenue to the project site. A trail would be constructed atop the revetment for O&M access. This alternative is expected to be highly effective as preventing Salmon Creek from entering its relic channels and causing flooding within the study area.

Alternative 2

Alternative 2 is a permanent, engineered revetment approximately 1,600 feet in length that generally follows the alignment of the current of the temporary berm constructed by the non-Federal partner during high flow events. The revetment would be setback to allow for greater meandering of the stream during high flow events and increased deposition within the outwash plain. While this alternative would allow for greater floodplain functionality, it would increase O&M costs over the study period. Due to the rudimentary nature of current site access, this alternative would require the current access trail to be upgraded to a two-lane gravel road stretching from the eastern terminus of Orlander Avenue to the project site. A trail would be constructed atop the revetment for O&M access. This alternative is expected to be highly effective in preventing Salmon Creek from entering its relic channel and causing flooding within the study area.

Alternative 1&2

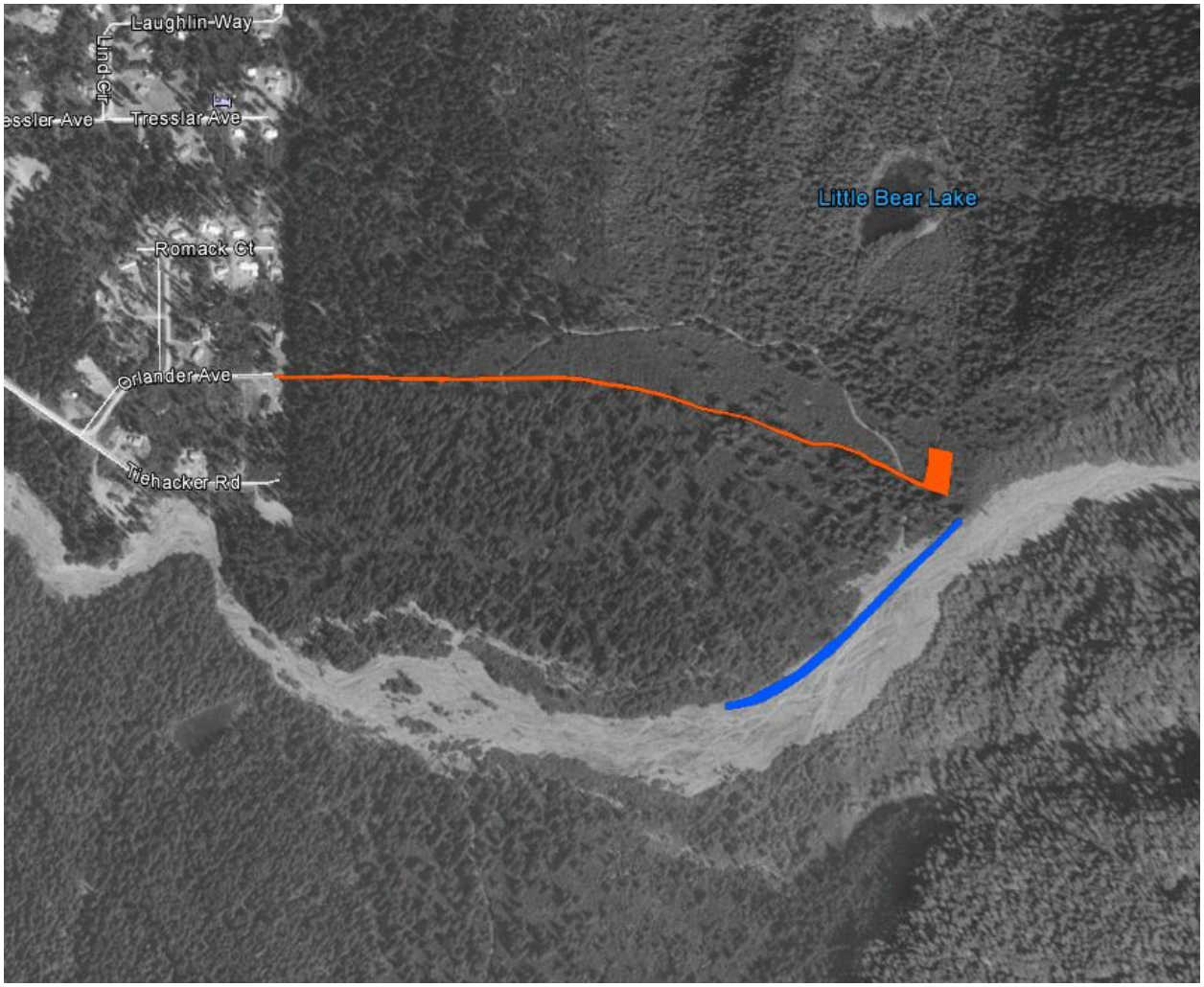

Figure 3. Project Alternative Location

The preferred alternative is Alternative 1 and will be recommended for TSP.

DESCRIPTION OF LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATION and DISPOSAL (LERRD):

The project area is located along the northern shore of Salmon Creek east of the Bear Lake Subdivision approximately 75 air miles south-southwest of Anchorage, within Section 18, Township 1 North, Range 1 East, Seward Meridian. The Kenai Peninsula Borough owns all the land in the project area and the State owns the lands for the access route.

LERD necessary to implement this project include NFS, State of Alaska, fee-simple lands for project and staging area and a perpetual road easements for the access road no disposal areas required. The State of Alaska owns the land east of the Bear Lake Subdivision to just west of the project area, the Kenai Peninsula Borough owns the land immediately surrounding the project area.

Real estate requirements are as follows:

TABLE 1- LERRD REQUIREMENTS

FEATURES	**OWNERS**	**ACRES**	**INTEREST**	**LOCAL**
Access Road	State of Alaska	3.10 AC	Road Easement	
Access Road and Parking Area	Kenai Peninsula Borough	1.78 AC	Fee	
Revetment	Kenai Peninsula Borough	1.92 AC	Fee	
TOTAL PROJECT BOUNARY		6.80 AC		

PROJECT COMPONENTS:
See Baseline Cost Estimate Section.

STANDARD ESTATES:

ROAD EASEMENT:

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts No.__ and __) for the location, construction, operation, maintenance, alteration and replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); 5/ subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

FEE:

The fee simple title to (the land described in Schedule A)1/ (Tracts No. ___ and ___), subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines. 2/

NON-STANDARD ESTATES:
None

FEDERAL LANDS:
None

NEAREST OTHER EXISTING FEDERAL PROJECT:
There are no other existing Federal Projects that will be affected by the project footprint.

NAVIGATION SERVITUDE:
None

INDUCED FLOODING:
Flooding is not expected as a result of the project.

BASELINE COST ESTIMATE FOR REAL ESTATE:
The NFS will negotiate to secure real estate interest in the privately owned lands for the project (See Exhibit "A" -Real Estate Map). The NFS will acquire all necessary real estate interest in the lands necessary for the project.

The Kenai Peninsula Borough Assessors web site was used to attain the valuation.

Table 2: Baseline Cost Estimates for Land, Easements, Rights-of-Way, Relocations and Disposal Area

ITEM	FEDERAL	LOCAL	TOTAL
Admin Costs	$8,000	$12,000	$20,000
Land Acquisition Costs Kenai Peninsula Borough State of Alaska	$0	 $8,300 $1,700	$10,000
Subtotal	$8,000	$22,000	$30,000
20% Contingency - Crediting	$1,600	$4,400	$6,000
PROJECT TOTALS	**$9,600**	**$26,400**	**$36,000**

Values in the Baseline Cost Estimate are estimates and not a final LERRD value for crediting purposes.

UTILITIES & FACILITIES RELOCATIONS:
No known utilities or facilities are located in this area and no relocations are required.

RELOCATION ASSISTANCE BENEFITS:
There are no P.L. 91-646 businesses or residential relocation assistance benefits required for this project.

HTRW IMPACTS:
There are no known information pertaining to hazardous, toxic and radioactive wastes or materials, within the project footprint was provided.

MINERAL/TIMBER ACTIVITY:
There are no current or anticipated mineral or timber activities within the vicinity of the proposed project that will affect construction, operation, or maintenance of the proposed project. Nor will any subsurface minerals or timber harvesting take place within the project.

REAL ESTATE MAP:
The Real Estate Map will be produced by POA, in collaboration with the Kenai Peninsula Borough.

SPONSORSHIP CAPABILITY:
The Kenai Peninsula Borough is a fully capable sponsor for acquiring the required lands, easements, and rights-of-way (See Exhibit "A" - Sponsor Real Estate Acquisition Capability Assessment). The Sponsor has professional experienced staff and legal capability to provide all lands, easements, and rights-of-way required for project purposes. The Borough has been advised of P.L. 91-646 requirements; and they have been advised of the requirements for documenting expenses for LERRD crediting purposes. The Sponsor's point of contact information is:

Kenai Peninsula Borough
Mayor Mike Navarre
144 North Binkley Street, Soldotna, AK, 99669
907-262-4441

Dan Mahalak
Seward Bear Creek Flood Service Area
302 Railway Ave #123, Seward, AK, 99669
907-398-1144
Dmahalak@kpb.us

NOTIFICATION OF SPONSOR AS TO PRE-PCA LAND ACQUISITION:
The non-Federal sponsor has been notified in writing about the risks associated with acquiring land before the execution of the PCA and the Government's formal notice to proceed with acquisition.

ZONING ORDINANCES ENACTED:
No zoning ordinances will be enacted to facilitate the proposed ecosystem restoration activities. Therefore, no takings are anticipated as a result of zoning ordinance changes. No zoning ordinances are proposed in lieu of, or to facilitate acquisition in connection with the project.

SCHEDULE:
The anticipated project schedule, unless revised after coordination with NFS, as shown in Table 3.

Table 3 Project Schedule

FLOOD RISK MANAGEMENT IMPROVEMENTS SEWARD, ALASKA	COE START
RECEIPT OF FINAL DRAWINGS FROM ENGINEERING	2-4 weeks after PPA execution
FORMAL TRANSMISSION OF ROW DRAWINGS & INSTRUCTIONS TO ACQUIRE LERRD	4-6 weeks after PPA execution
CERTIFY ALL NECESSARY LERRD AVAILABLE FOR CONSTRUCTION	6-9 months after PPA execution
PREPARE & SUBMIT CREDIT REQUESTS	6-8 months upon completion of Project
REVIEW/APPROVE OR DENY CREDIT REQUESTS	6 months of Sponsor submission

VIEWS OF FEDERAL, STATE, AND REGIONAL AGENCIES:

This project is supported by Federal, State, and Regional agencies. The Corps has met with representatives of the Kenai Peninsula Borough and other pertinent parties to discuss aspects of the proposed action. Further coordination will be ongoing. In compliance with NEPA rules/regulations, letters will be sent to resource agencies and residents in the area; public notices will transpire within the project vicinity.

VIEWS OF LOCAL RESIDENTS:

The Kenai Peninsula Borough has conducted public meetings concerning this project. Local residents are in favor of the project with funding remaining an issue to be resolved. Further coordination will be ongoing between the Kenai Peninsula Borough, US Army Corps of Engineers, State and Federal resource agencies, and residents in the area.

ANY OTHER RELEVANT REAL ESTATE ISSUES:

None

PREPARED BY:

_____

JOHN J SMITH
Realty Specialist

REVIEWED AND APPROVED BY:

_____

MICHAEL D COY
Chief of Real Estate

EXHIBIT A

FLOOD RISK MANAGEMENT

SALMON CREEK, ALASKA

ASSESSMENT OF NON-FEDERAL SPONSOR'S

REAL ESTATE ACQUISITION CAPABILITY

1. **LEGAL AUTHORITY**:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES** __X____ **NO** _____

b. Does the sponsor have the power of eminent domain for this project?
YES __X____ **NO** _____

Does the sponsor have "Quick-Take" authority for this project?

YES __X____ **NO** _____

c. Are any of the lands/interests in land required for this project located outside the sponsor's political boundary? **YES** __X____ **NO** _____

d. Are any of the lands/interests in land required for this project owned by an entity whose property the sponsor cannot condemn? **YES** __X____ **NO** _____

2. **HUMAN RESOURCE REQUIREMENTS**:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended?
YES _____ **NO** __X_

b. If the answer to 2a is "YES" has a reasonable plan been developed to provide such training? **YES** _____ **NO** _____

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **YES** __X____ **NO** _____

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? **YES** __X____ **NO** _____

e. Can the sponsor obtain contractor support, if required in a timely fashion?
YES __X____ **NO** _____

f. Will the sponsor likely request USACE assistance in acquiring real estate?

YES _____ **NO** __X____

3. **OTHER PROJECT VAIRABLES**:

a. Will the sponsor's staff be located within reasonable proximity to the project site?

YES __X____ **NO** _____

b. Has the sponsor approved the project/real estate schedule/milestones?

YES __X____ **NO** _____

4. **OVERALL ASSESSMENT**:

a. Has the sponsor performed satisfactorily on other USACE projects?

YES __X____ **NO** _____

b. With regard to this project, the sponsor is anticipated to be:

HIGLY CAPABLE _____ **FULLY CAPABLE** _X____

MODERATELY CAPABLE _____ **MARGINALLY CAPABLE** _____

INSUFFICIENTLY CAPABLE _____

Justification for Insufficient Capability:

5. **COORDINATION**:

a. Has this assessment been coordinated with the sponsor?

YES __X____ **NO** _____

b. Does the sponsor concur with this assessment?

YES __X____ **NO** _____

Justification for Sponsor Non-concurrence:

SPONSOR:

_____

Name
Title

PREPARED BY:

_____

JOHN J SMITH
Realty Specialist

REVIEWED AND APPROVED BY:

_____

MICHAEL D. COY
Chief, Real Estate

APPENDIX H
AGENCY COORDINATION AND CORRESPONDENCE

T 10·10·14 3130-1R COE

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 6898
JOINT BASE ELMENDORF-RICHARDSON, AK 99506-0898

Environmental Resources Section

OCT 07 2014

RECEIVED

OCT 10 2014

OHA

Ms. Judith Bittner
State Historic Preservation Officer
Alaska Department of Natural Resources
Office of History and Archaeology
550 West 7th Avenue, Suite 1310
Anchorage, AK 99501-3565

Dear Ms. Bittner;

The U.S. Army Corps of Engineers, Alaska District (Corps), in partnership with the Kenai Peninsula Borough, is proposing to improve an earthen embankment along Salmon Creek near Seward, Alaska (Section 18, T1N, R1E, USGS Quadrangle Seward A-7; Figure 1). The purpose of this letter is to notify your office of this undertaking and to seek your concurrence on a determination of effect.

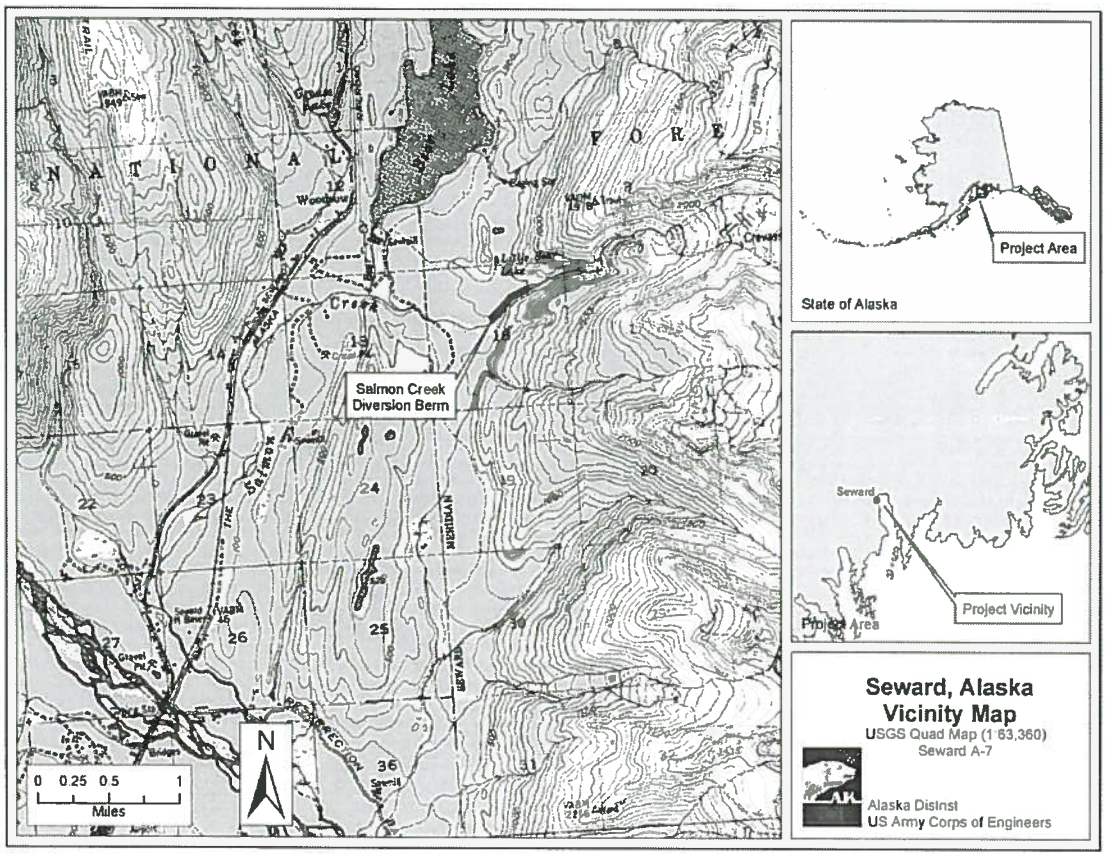

Figure 1. Salmon Creek diversion berm project location (Section 18, T1N, R1E, USGS Quad Seward A-7).

Project Description

The proposed project would include stabilizing Salmon Creek's earthen embankment with armor rock so as to divert breakout floods from spilling into the Bear Creek subdivision. The area of potential effect for this undertaking encompasses a 1,400-foot-long, 30-foot-wide section of the creek's eastern embankment, as well as the placement of a gravel Caterpillar track and a staging area. Armor rock will be brought in and manually placed alongside the eastern berm to help stabilize the bank against high-flow, flood events. A pre-existing parking lot will be utilized as a staging area for the armor rock and machinery. No indirect effects to modern or historic cultural materials are anticipated. Construction for the eastern creek embankment stabilization project is anticipated to start in the spring of 2017.

The borough currently maintains the earthen embankment, which is believed to have initially been modified by a private land owner during the 1950's. Ongoing maintenance and reshaping of the creek berm has also been completed by the Seward/Bear Creek Flood Service Area (SBCFSA) as part of the current flood mitigation plan for Bear Lake subdivision and downstream developments. The structural integrity of the existing earthen berm is usually compromised during any high water event due to erosion and must be reconstructed afterward by emergency response efforts with a D9 bulldozer.

As constructed, the current embankment leaves the area of Seward and Bear Creek vulnerable to flooding and sediment transport related issues. This area has historically been susceptible to damages from breakout flooding when the creek migrates due to water flow level or when sediment fills the streambed. Historical aerial photography identifies several relic channels where Salmon Creek has broken out of its current channel.

Assessment of Effects

There are no known cultural resources reported in the project area. Ground disturbing activities proposed for this undertaking are limited to the previously disturbed flood plain and modified eastern bank. Transport of armor rock and machinery would be along the flood plain. The proposed staging area has been used for this purpose in the past and currently serves as a parking lot for recreationalists. The potential for cultural material to be encountered in the area of potential effects is minimal.

Therefore, we seek your concurrence in the determination that the proposed undertaking will result in no historic properties affected. If you have any questions about this project, please contact me by phone at (907)753-5670, or by email Shona.D.Pierce@usace.army.mil.

Sincerely,

Shona D. Pierce

Shona Pierce
Archaeologist

MSJ **No Historic Properties Affected**
Alaska State Historic Preservation Officer
Date: 10-10-14 **File No.:** 3130-1R COE
Please review: ***36 CFR 800.13 / A.S. 41.35.070(d)***

THE STATE of ALASKA
GOVERNOR SEAN PARNELL

Department of Fish and Game
DIVISION OF HABITAT
Kenai Peninsula Office
514 Funny River Road
Soldotna, Alaska 99669-8255
Main: 907.714.2475
Fax: 907.260.5992

FISH HABITAT PERMIT FH 14-V-0347

ISSUED: November 4, 2014
EXPIRES: December 31, 2017

U.S. Army Corps of Engineers, Alaska District
Tatton Suter
2204 3rd St.
JBER, AK 99506

Dear Mr. Suter:

Re: Flood Control Levee
Kwechak (Salmon) Creek
Section 18, T 1N, R 1E, S.M.
Kenai Peninsula Borough Parcel No. 125-350-05
River Center Tracking No. 11116

Pursuant to AS 16.05.841(Fishway Act), the Alaska Department of Fish and Game (ADF&G), Division of Habitat, has reviewed your proposal to replace and modify the existing Kwechak Levee into a more permanent, engineered structure. The project will occur along the right bank of Kwechak Creek to prevent the creek from overflowing during flood conditions and damaging housing units and infrastructure in the Bear Creek Subdivision and Seward Highway below.

Project Description

The Kenai Peninsula Borough currently maintains an earthen embankment (Kwechak Levee) approximately 1,400 feet in length and 85 feet wide at the referenced location on Kwechak (Salmon) Creek. The footprint and alignment of the newly constructed levee will be located on the existing footprint of the current levee. The new levee will be composed of three layers of different rock sizes. The base layer will be a two-foot thick layer of large rip-rap (D_{50} 656 lbs.) with an approximate volume of 20,000 cubic yards. The secondary layer will be a one and a half foot layer of rip-rap (D_{50} 66 lbs.) with an approximate volume of 15,000 cubic yards. The final layer will be smaller core, river-run rock that will complete the berm structure and is anticipated to require a volume of approximately 70,000 cubic yards. Equipment and vehicles will access the area from an access road off Orlander Avenue and will stage at a gravel area outside of the creek banks. The large and medium rock will be transported from local quarries to the construction site and the core, river-run rock will be taken from the existing Kwechak Levee. Construction will remain above ordinary high water (OHW) and no rock material will be

excavated from below the ordinary high water mark. Proposed construction dates are spring 2017 until fall 2017.

Fish Resources

Kwechak Creek supports resident Dolly Varden and other species of resident fish. Your project as proposed has the potential to obstruct the efficient passage and movement of fish.

In accordance with AS 16.05.841 (Fishway Act), project approval is hereby given subject to the project description above and the following stipulations:

1. The Division of Habitat shall be contacted at (907) 714-2475 three days prior to project initiation.

2. Gravel and river-run rock shall be removed in shallow even lifts to avoid the creation of fish entrapment basins. All depressions and potholes created by the rock removal shall be leveled to avoid fish entrapment.

3. The flood control structure shall be designed, installed, and maintained to accommodate the efficient passage and movement of fish, both upstream and downstream.

You are responsible for the actions of contractors, agents, or other persons who perform work to accomplish the approved project. For any activity that significantly deviates from the approved plan, you shall notify the Division of Habitat and obtain written approval in the form of a permit amendment before beginning the activity. Any action that increases the project's overall scope or that negates, alters, or minimizes the intent or effectiveness of any stipulation contained in this permit will be deemed a significant deviation from the approved plan. The final determination as to the significance of any deviation and the need for a permit amendment is the responsibility of the Division of Habitat. Therefore, it is recommended you consult the Division of Habitat immediately when a deviation from the approved plan is being considered.

For the purpose of inspecting or monitoring compliance with any condition of this permit, you shall give an authorized representative of the state free and unobstructed access, at safe and reasonable times, to the project site. You shall furnish whatever assistance and information as the authorized representative reasonably requires for monitoring and inspection purposes.

This letter constitutes a permit issued under the authority of AS 16.05.841 and must be retained on site during project activities. Please be advised that this determination applies only to activities regulated by the Division of Habitat; other agencies also may have jurisdiction under their respective authorities. This determination does not relieve you of your responsibility to secure other permits; state, federal, or local. You are still required to comply with all other applicable laws.

In addition to the penalties provided by law, this permit may be terminated or revoked for failure to comply with its provisions or failure to comply with applicable statutes and regulations. The department reserves the right to require mitigation measures to correct disruption to fish and

game created by the project and which was a direct result of the failure to comply with this permit or any applicable law.

You shall indemnify, save harmless, and defend the department, its agents, and its employees from any and all claims, actions, or liabilities for injuries or damages sustained by any person or property arising directly or indirectly from permitted activities or your performance under this permit. However, this provision has no effect if, and only if, the sole proximate cause of the injury is the department's negligence.

Any questions or concerns about this permit may be emailed to brian.blossom@alaska.gov or call (907) 714-2481.

Sincerely,

Cora Campbell, Commissioner

Ginny Litchfield

By: Ginny Litchfield
Kenai Peninsula Area Manager
ADF&G, Division of Habitat

cc: KRC File

By email only:

AWT Seward
ADF&G Seward

COE - KFO

From: Blossom, Brian D (DFG)
To: Suter, Tatton POA
Subject: [EXTERNAL] Kwechak (Salmon) Creek Flood Berm
Date: Tuesday, March 24, 2015 9:45:01 AM

Tatton,

I've looked over your amended application and confirmed with my supervisor that you will not need an amended permit from ADF&G Habitat Division and we will keep a copy of your amended changes on file with us. The stipulations in the original Fish Habitat permit will still apply to your amended project.

Sincerely,

Brian

Brian Blossom

Habitat Biologist

Department of Fish and Game

Kenai Peninsula

907-714-2481

Kenai Peninsula Borough
RIVER CENTER
514 Funny River Road • Soldotna, AK 99669 • (907) 714-2460 • Fax: (907) 260-5992

Mike Navarre
Borough Mayor

Dear US Army Corp of Engineers:

PARCEL ID: 12535005

PROJECT DESCRIPTION: Modify/replace the existing Kwechak Levee to a more permanent, engineered structure

Enclosed please find the individual permits from the following River Center Agencies:

	Expiration	Agency
☐	*Not Required*	Kenai Peninsula Borough, Habitat Protection
☐	**Denied**	Kenai Peninsula Borough, Floodplain Development
☐	12/31/2017	State of Alaska, Department of Fish & Game Habitat Division

Each of these permits have expiration dates. Please review them carefully. If you are unable to complete your project by the expiration dates, you must apply for an extension to your permits.

The permittee is responsible for the actions of the contractors, agents, or other persons who perform work to accomplish the approved plan. For any activity that deviates from the approved plan, the permittee shall notify the River Center and obtain written approval before beginning the activity.

If you have any questions regarding your project please contact the River Center at (907) 260-4882.

Kenai Peninsula Borough
RIVER CENTER
514 Funny River Road • Soldotna, AK 99669 • (907) 714-2460 • Fax: (907) 260-5992

Mike Navarre
Borough Mayor

FLOODPLAIN DEVELOPMENT PERMIT – DENIED RC# 11116

3/19/2015

US Army Corp of Engineers
2204 3rd St
JBER, AK 99506

Dear US Army Corp of Engineers:

Pursuant to KPB Chapter 21.06, the Kenai Peninsula Borough (KPB) River Center has reviewed your permit application and cannot issue a permit at this time. This permit denial is in accordance with National Flood Insurance Program (NFIP) and Kenai Peninsula Borough Regulations, "…the floodplain development permit shall be valid for a 1 year period from the issue date, and the start of construction must occur within 180 days of the permit issue date."

The amended permit has been received and is added into the permit file showing the updated project time periods and updated project design.

The location of the work is as follows:

Parcel ID: 12535005
Legal Desc: T 1N R 1E SEC 7 & 18 Seward Meridian SW W1/2 SE1/4 OF SEC 7 & W1/2 NE1/4 OF SEC 18

Applicant's Project Description

This project activity is modifying and/or replacing the existing Kwechak Levee to create a more permanent, engineered structure on Salmon Creek to prevent flooding to the community.

Flood information is based on the Regulatory Floodplain Map for the Kenai Peninsula Borough. This document does not imply the referenced project areas will or will not be free from flooding or damage. This information does not create liability on the part of the Borough, or its officers or employees for any damage that results from reliance on this information.

Please resubmit the Multi-Agency Permit Application to the River Center in the appropriate time frame to obtain a permit. Contact me with any questions or modifications of this project at (907) 714-2464.

Sincerely,

Harmony J. Curtis
Floodplain Administrator
Donald E. Gilman River Center

Kenai Peninsula Borough
RIVER CENTER
514 Funny River Road • Soldotna, AK 99669 • (907) 714-2460 • Fax: (907) 260-5992

Mike Navarre
Borough Mayor

KENAI PENINSULA BOROUGH – HABITAT PROTECTION DISTRICT

10/30/2014 **RC Number:** 11116

US Army Corp of Engineers
2204 3rd St
JBER, AK 99506

Dear US Army Corp of Engineers:

Pursuant to KPB 21.18, the Kenai Peninsula Borough (KPB) River Center has reviewed your permit application and finds that your project is not within the borough's Anadromous Water body Habitat Protection District and therefore no habitat review is required. Other borough, state and federal permits may be required.

The location of the work is as follows:

Parcel ID:	12535005
Legal Description:	T 1N R 1E SEC 7 & 18 Seward Meridian SW W1/2 SE1/4 OF SEC 7 & W1/2 NE1/4 OF SEC 18
Waterbody:	Salmon Creek

Applicant's Project Description

The purpose of the project is to: Modify/replace the existing Kwechak Levee to a more permanent, engineered structure.

Permitted Activity within the Habitat Protection District

The project is located more than 50-feet landward of the Ordinary High Water Mark of the water body reference above. No habitat permit is required.

Please call me if you have questions regarding this No Review determination at 907-714-2463.

Sincerely,

Nancy Carver
Resource Planner
Donald E. Gilman River Center

From: Carver, Nancy
To: Suter, Tatton POA
Subject: [EXTERNAL] RC 11116
Date: Tuesday, March 24, 2015 11:23:52 AM

Mr. Suter, this is a follow-up to our conversation today referencing the above-mentioned permit number. On 10/30/14 I issued a No Review letter on this project based on the project description at that time. Today, you wanted to double check that this same No Review would still be in effect due to a change in the project. The Kwechak River is located in Seward and is not one of the streams that we manage under the Borough's 50-foot Habitat Protection District. Most of Seward is except from this section of code because the steams tend to meander around along. So, the original No Review letter is still in effect. Thank you for checking with us to make sure the permitting on the project was correct. If you have any additional questions please feel free to contact me at any time.

Thank you,

Nancy

Nancy J. Carver

Resource Planner

Kenai River Center, KPB

ncarver@kpb.us

Phone: 907.714.2463

Fax: 907.260.5992