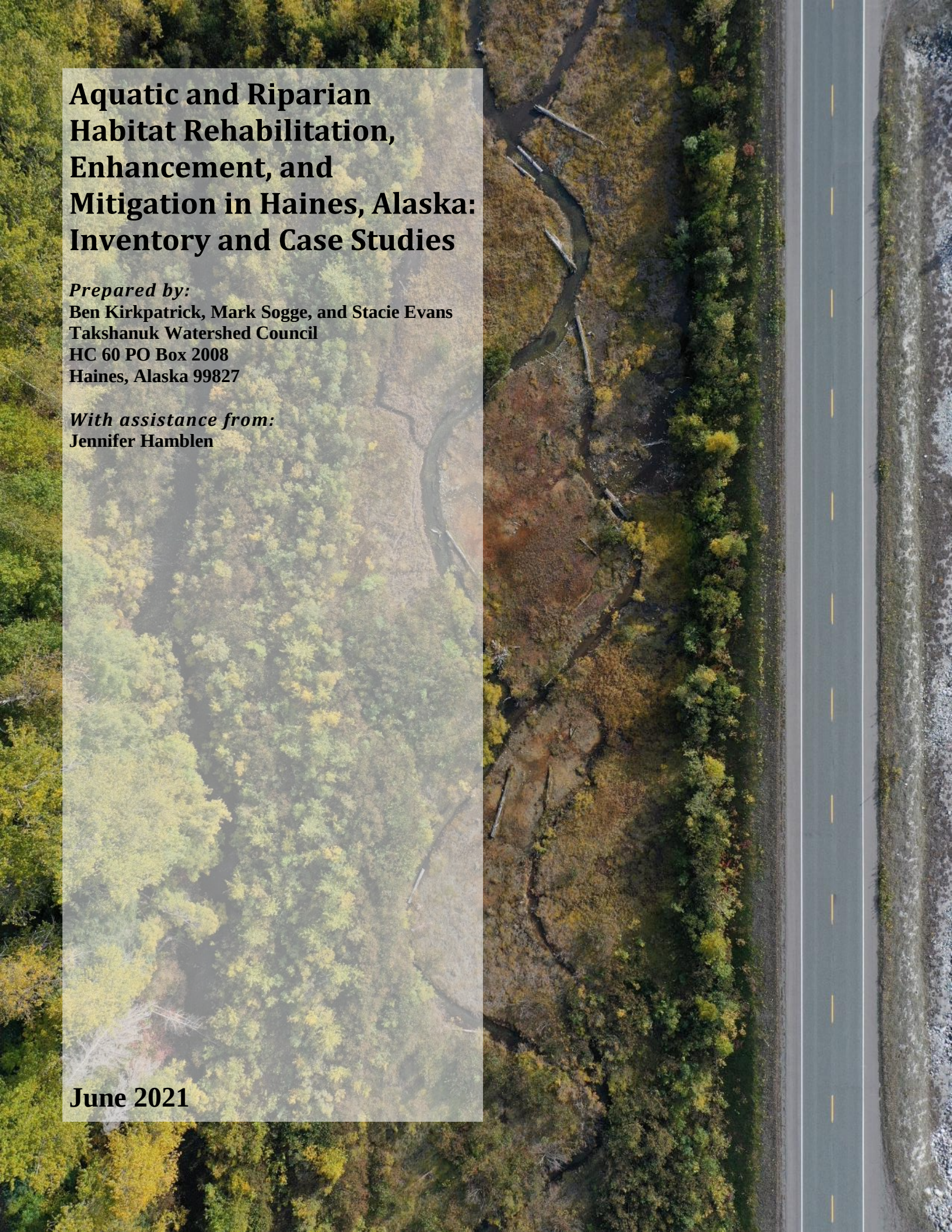

# Aquatic and Riparian Habitat Rehabilitation, Enhancement, and Mitigation in Haines, Alaska: Inventory and Case Studies


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## ACKNOWLEDGEMENTS

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## ABOUT Takshanuk Watershed Council

The mission of the Takshanuk Watershed Council (TWC) is to provide stewardship of the Chilkat, Chilkoot, and Ferebee River systems. Through restoration, education, research, and community involvement we seek to benefit the natural ecology, economy, and quality of life valued by all residents. Our vision for the Council is to promote the appreciation and sustainability of the healthy, natural ecosystems within the area. Through our initiatives, we attain a better understanding of our watershed's ecology and use this information to foster good stewardship of the streams, rivers, lakes, and lands. To learn more, visit us on the web at takshanuk.org.

LIST OF ABBREVIATIONS

ADF&G: Alaska Department of Fish and Game

ADOT/PF: Alaska Department of Transportation and Public Facilities

AWC: Anadromous Waters Catalogue (ADF&G)

CIV: Chilkat Indian Village

CMP: Corrugated Metal Pipe

COE: U.S. Army Corps of Engineers

DOF: Division of Forestry

ELJ: Engineered Log Jam

JWP: Juneau Watershed Partnership

NOAA: National Oceanic and Atmospheric Administration

NRCS: Natural Resources Conservation Service

NSRAA: Northern Southeast Regional Aquaculture Association

OHMP: Office of Habitat Management and Permitting

REM: Restoration, Enhancement, Mitigation

TWC: Takshanuk Watershed Council

USFWS: U.S. Fish and Wildlife Service

# Table of Contents

PROJECT ASSESSMENTS

1. 29 Mile Creek (Klehini River) Enhancement
2. 29 Mile Creek (Klehini River) Tributary Creation
3. 29 Mile (Klehini River) Wetland Creation
4. 30 Mile Creek (Klehini River) Culvert
5. 37 Mile Creek (Klehini River) Creation
6. 37 Mile Wetlands (Klehini River) Creation
7. 37 Mile (Klehini River) Wetland Channels Creation
8. Chilkoot River Bank Stabilization
9. McKenzie Creek (Klehini River) Enhancement
10. Sawmill Creek Restoration/Creation
11. Cannery Creek (Letnikof Bay) Replacement
12. Cliff Creek (Klehini River) Culvert Installation
13. Muskrat Creek (Chilkat River) Culvert Replacement
14. Comstock Creek (Chilkat River) Culvert Replacement
15. 37 Mile Creek Tributary (Klehini River) Culvert Installation
16. Big Boulder Creek (Klehini River) Bank Stabilization and Enhancement
17. Chilkat River (Haines Highway ~15 Mile) Bank Stabilization
18. Chilkat River (Klukwan) Bank Stabilization
19. Kelsall Road (Chilkat River) Bank Stabilization
20. Klehini River (Haines Highway ~36 Mile) Bank Stabilization

# INTRODUCTION

In 1994, the Alaska Department of Fish and Game (ADF&G) published a report entitled "Restoration and Enhancement of Aquatic Habitats in Alaska: Case Study Reports, Policy Guidance, and Recommendations" (Parry and Seaman 1994[1]). The purpose of the report was to assess the extent and status of aquatic habitat restoration and enhancement work in Alaska, develop guidelines and policy recommendations to assure more effective and efficient restoration and enhancement activities in the future, and to inform local planners throughout the state about the strengths and limitations of restoration and enhancement techniques in Alaska and the related policy issues. This was a statewide effort with a limited number of case studies in Southeast Alaska, but with far-reaching implications for improving future project success based on the project findings. Using this report as a guide, the Juneau Watershed Partnership (JWP) partnered with the U.S. Fish and Wildlife Service (USFWS) to inventory and assess past habitat restoration, enhancement, and mitigation projects (i.e., REM projects) implemented within the City and Borough of Juneau road system (Seifert and Sumner 2015[2]). Using the JWP report as a template the Takshanuk Watershed Council (TWC) is providing an overview of projects on the Haines road system.

The project goals were to:

1. Develop a habitat improvement project inventory
2. Evaluate a subset of the projects to inform future habitat improvement practices
3. Identify projects that require additional habitat improvement actions

This report is intended to be a "living" document. Over time, existing projects will be re-evaluated, and new projects will be assessed and added to the inventory. We expect that this report will evolve to incorporate new methods and practices, assessment information, and construction or evaluation techniques, ultimately improving the success of REM projects in the Haines area. The TWC and the USFWS encourage comments and suggestions that will improve the accuracy and utility of this report.

# METHODS

## Project Inventory

The REM project inventory was compiled primarily through reports and permit documents extracted from ADF&G files. Information was also obtained through interviews with citizens and staff from agencies and other organizations.

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[1] Parry, B.L. and G.A. Seaman. 1994. Restoration and Enhancement of Aquatic Habitats in Alaska: Case Study Reports, Policy Guidance, and Recommendations. Technical Report No. 94-3. Alaska Department of Fish and Game, Habitat Restoration Division. Anchorage, AK.

[2] Seifert, S., A. Sumner. 2015. Aquatic and Riparian Habitat Rehabilitation, Enhancement, and Mitigation in Juneau, Alaska: Inventory and Case Studies. Juneau Watershed Partnership. Juneau, AK.

Included in the inventory were on-the-ground projects impacting aquatic and riparian habits that were accessible from the Haines area road system and completed prior to 2018. However, some Haines Highway projects that were completed after 2016 were also eliminated as it was too soon to evaluate their performance.

We excluded any stock enhancement and fish population, productivity, or assessment projects not directly related to manipulation of habitat. Within these limits, 199 projects of varying complexity and success were identified. Projects that did not contribute to restoration, enhancement or mitigation, but did impact fish habitat were listed as disturbance. This included new culverts, fill, and most riprap projects. Culverts that replaced existing culverts and improved fish passage were generally listed as enhancement.

The following information was determined for each project to the extent possible:

- project type
- goals
- objectives
- methods
- system (stream, wetland, lake, riparian, other)
- watershed
- water body
- problem/need
- location information
- timeline
- permit information
- responsible organization

**Project Types**

**Restoration:** The re-establishment of ecosystem processes and functions, community structure, and species diversity. This describes 30 projects in this review.

**Mitigation:** Any of the project types that are intended to compensate for habitat deterioration, damage, or loss as a result of anthropogenic (human) activities. This describes 41 projects in this review.

**Enhancement:** Any manipulation of existing habitat that improves its value and ability to meet specified requirements of one or more species. This describes 29 projects in this review.

**Disturbance:** Habitat is disturbed through mining, road building, streambed material excavation, bank stabilization and culvert installation. This describes 99 projects in this review.

In cases where the goals and objectives were not clearly stated in project documentation, professional judgment and agency/staff recollection were used to delineate reasonable project goal(s) and objectives. Projects where documentation was too limited to define scope, goals, or primary objectives, were left incomplete in the dataset.

## MAPS OF REM AND DISTURBANCE PROJECTS

Figure 1. Map of all REM and Disturbance sites included in project inventory. Case studies are indicated with a star.

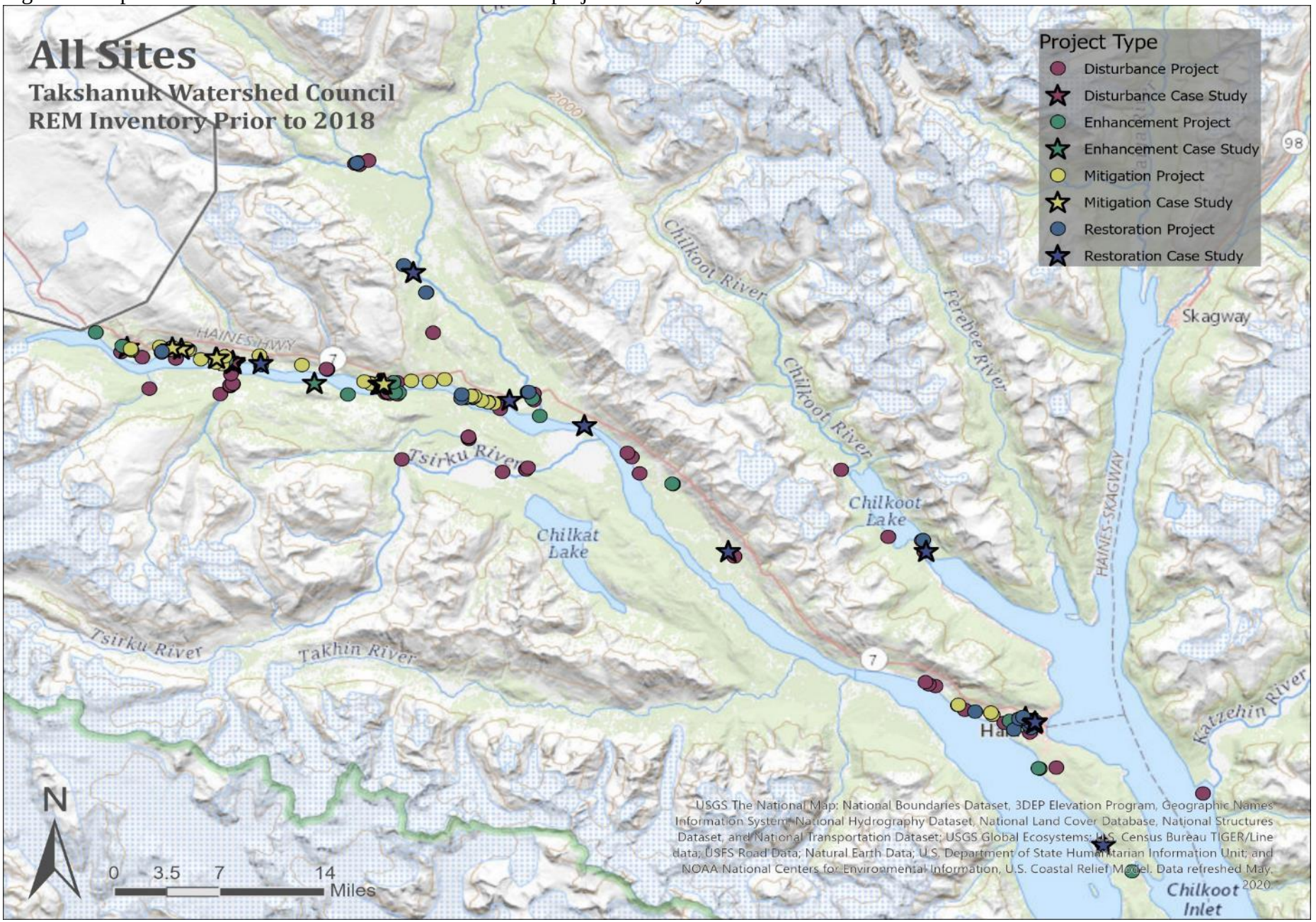


Figure 2. Zoomed in map of REM and Disturbance sites located in the upper Chilkat Valley. Case studies are indicated with a star.

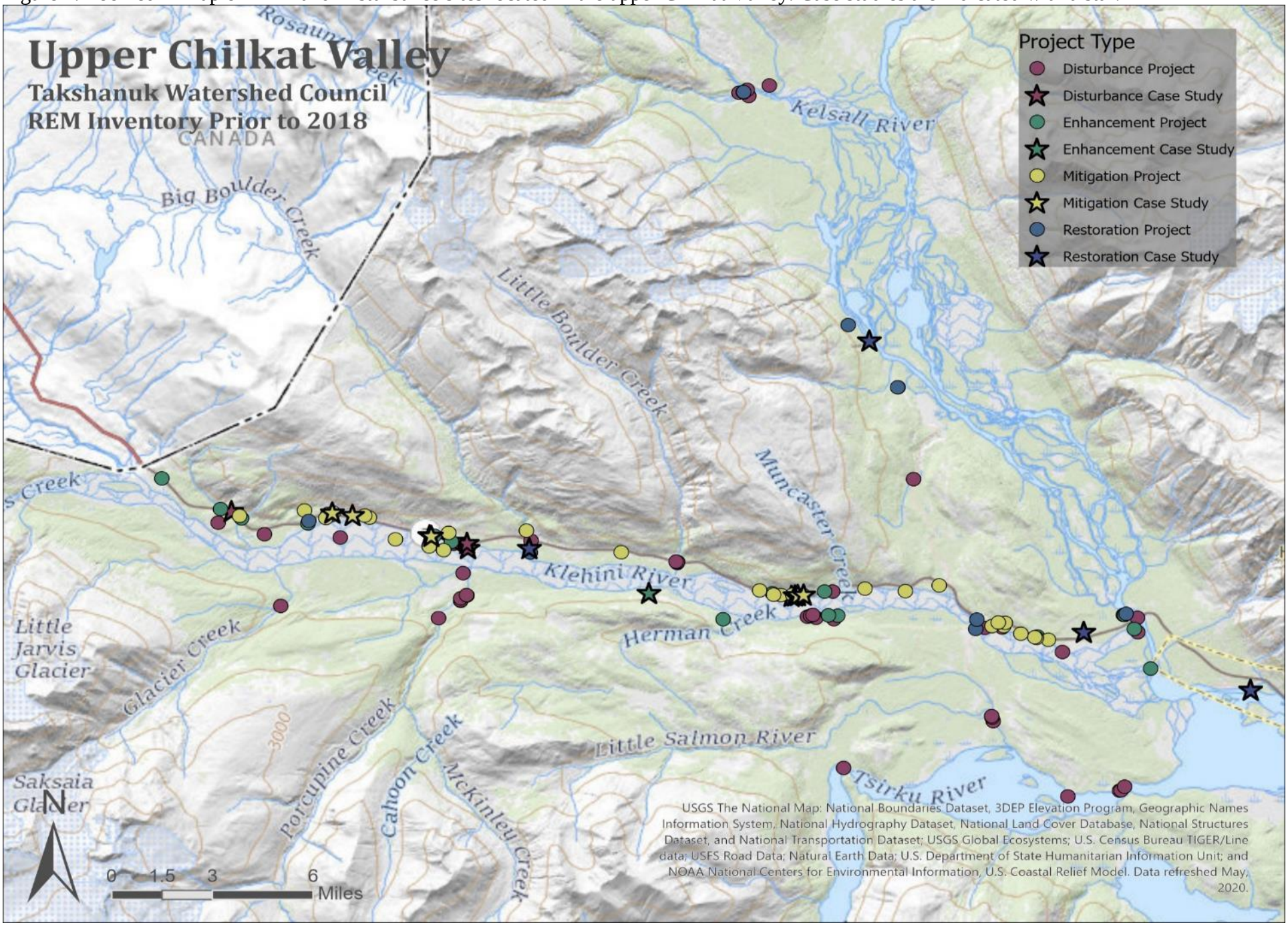


Figure 3. Zoomed in map of REM and Disturbance sites located in the middle Chilkat and Chilkoot Valleys. Case studies are indicated with a star.

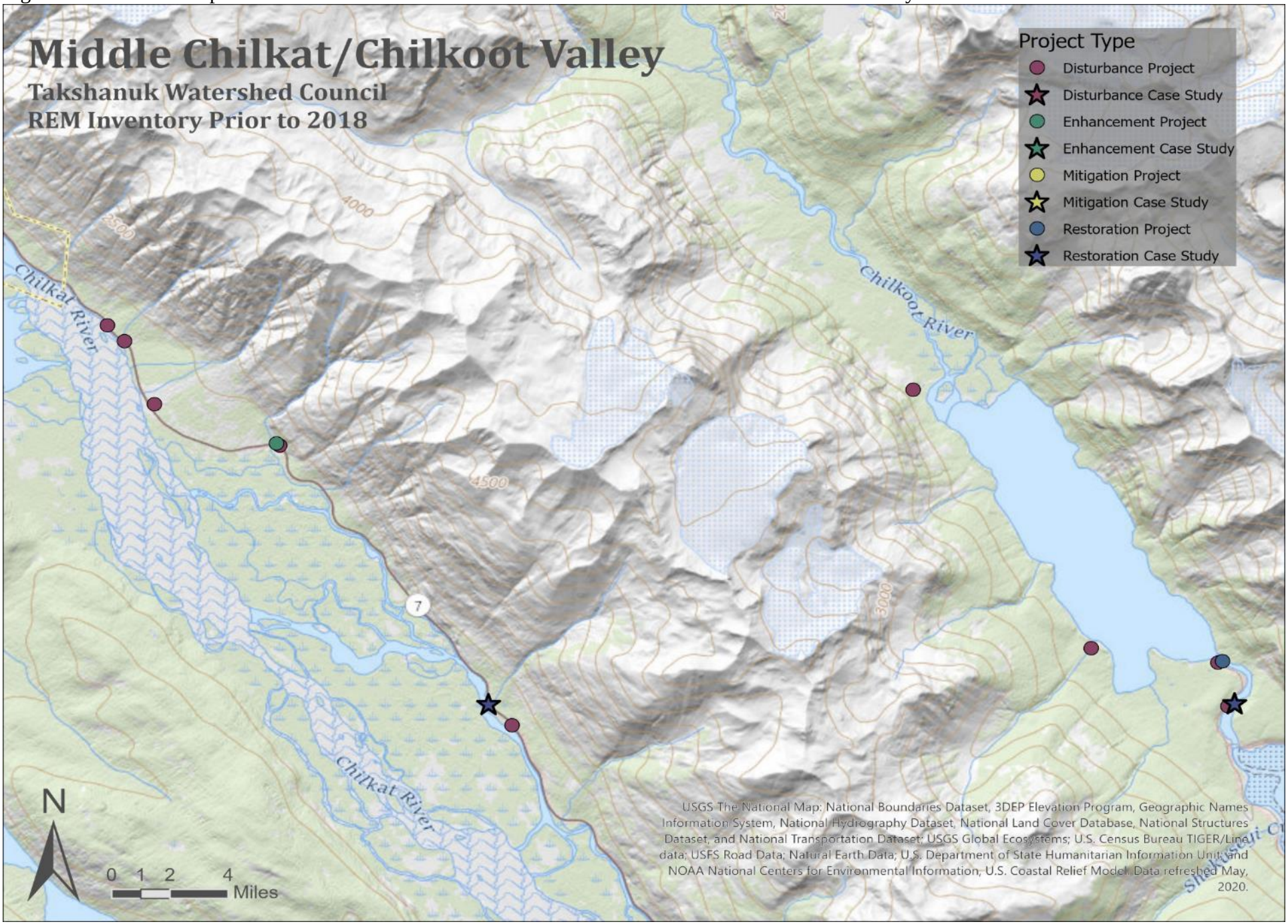
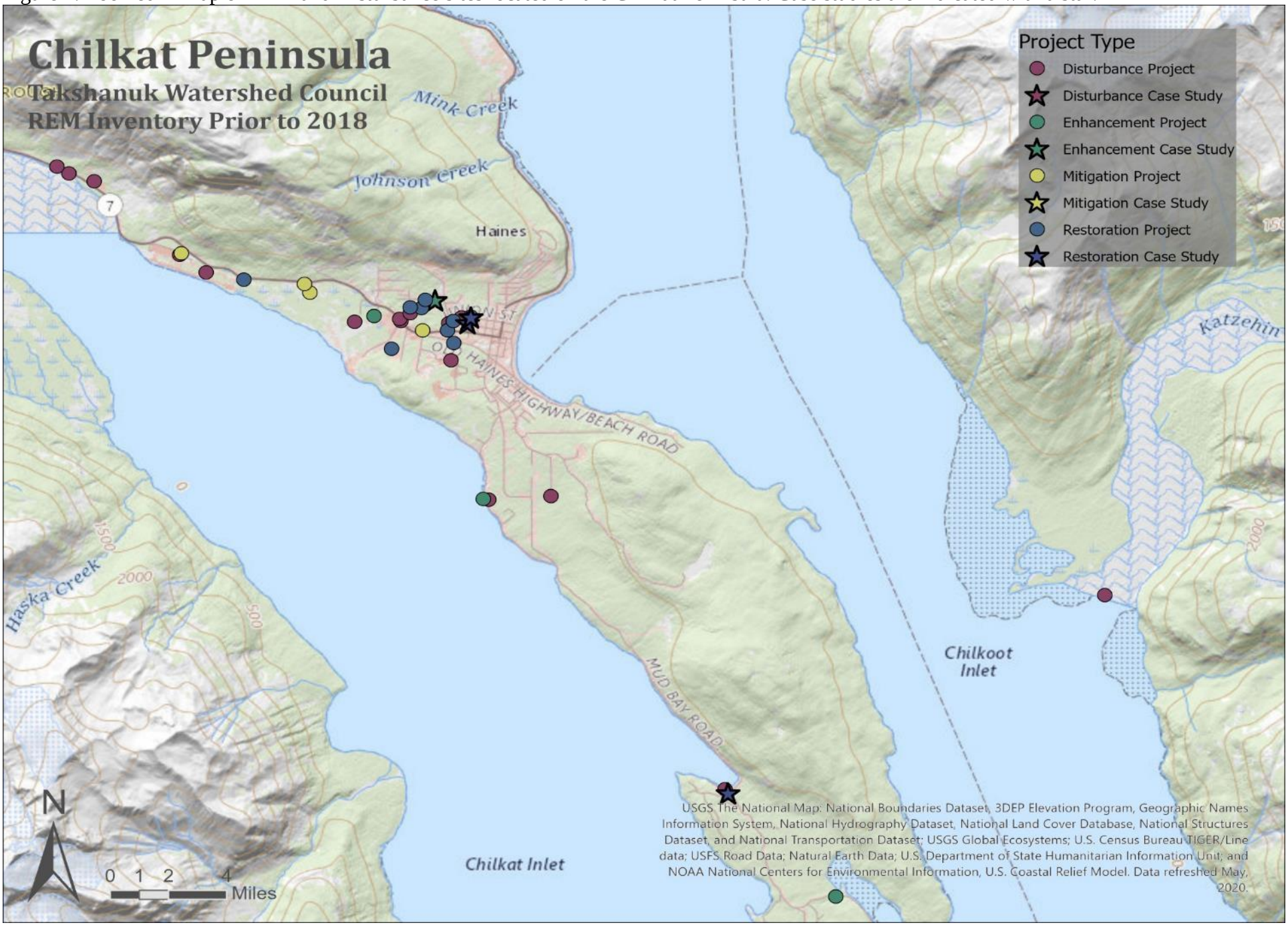


Figure 4. Zoomed in map of REM and Disturbance sites located on the Chilkat Peninsula. Case studies are indicated with a star.



# RESULTS - Project inventory

Within the limits of project scope, 199 projects were identified and included in the project inventory (Appendix B).

**Waterbody**

Twenty-six (26) primary waterbodies were represented in the project inventory. Projects were also completed in several smaller tributaries that were listed under the primary waterbody. Klehini River tributaries containing multiple projects, however, were listed separately. Most of these projects are related to the Haines Highway or the Haines town site. The majority (55.2%) of projects centered on four waterbodies: Klehini River, Sawmill Creek, Chilkat River, and 37 Mile Creek.

| Water Body | no. | % |
|---|---|---|
| Klehini River | 46 | 23.1 |
| Sawmill Creek | 25 | 12.6 |
| Chilkat River | 22 | 11.0 |
| 37 Mile Creek | 17 | 8.5 |
| Porcupine Creek | 11 | 5.5 |
| Tsirku River | 7 | 3.5 |
| Herman Creek | 7 | 3.5 |
| 29 Mile Creek | 7 | 3.5 |
| Nataga Creek | 6 | 3.0 |
| Chilkoot River/Lake | 6 | 3.0 |
| Little Salmon Creek | 5 | 2.5 |
| Big Boulder Creek | 4 | 2.0 |
| Cannery Creek | 4 | 2.0 |

| Water Body | no. | % |
|---|---|---|
| Little Boulder Creek | 4 | 2.0 |
| 30 Mile Creek | 4 | 2.0 |
| Yindastuki Creek | 4 | 2.0 |
| Mosquito Lake Inlet | 4 | 2.0 |
| Holgate Creek | 3 | 1.5 |
| Unnamed Streams | 3 | 1.5 |
| Mink Creek | 2 | 1.0 |
| Glacier Creek | 2 | 1.0 |
| Horse Farm Creek | 2 | 1.0 |
| Kelsall River | 2 | 1.0 |
| Katzehin River | 1 | 0.5 |
| Muskrat Creek | 1 | 0.5 |
| Schnabel Creek | 1 | 0.5 |
| **Totals** | **199** | **100%** |

**Project Goal**

Goals and objectives, whether stated or implied, as well as the type of project implemented, were determined for the inventoried projects. To facilitate an overall assessment and summarization of the findings, these projects were grouped into categories according to the project's primary goal or type of project. Stream channel manipulation, fish passage improvement, and stream bank stabilization were the most common project types, comprising 28.6%, 21.6%, and 20.6% of all projects, respectively. Disturbance and debris removal projects generally have a negative impact on fish habitat, but are needed to maintain infrastructure.

| Project Goal | no. | % |
|---|---|---|
| Stream channel manipulation | 57 | 28.6 |
| Fish passage improvement | 43 | 21.6 |
| Stream bank stabilization | 41 | 20.6 |
| Debris removal/disturbance | 24 | 12.1 |
| Bridge removal/installation | 18 | 9.1 |
| Wetland creation/rehabilitation | 11 | 5.5 |
| Floodplain restoration | 4 | 2.0 |
| Water Quality Improvement | 1 | 0.5 |
| **Totals** | **199** | **100%** |

| Habitat Type | no. | % |
|---|---|---|
| Stream | 184 | 92.5 |
| Wetland | 9 | 4.5 |
| Lake/Pond | 4 | 2.0 |
| Stream/Pond | 2 | 1.0 |
| **Totals** | **199** | **100%** |

**Habitat type**

Identified projects almost exclusively involved stream habitats, with wetland and pond habitats being involved to a much lesser extent. There were no identified projects in saltwater; the primary activity taking place in the marine environment in Haines has been filling to create parking lots in Portage Cove and Lutak Inlet. The Haines area is dominated by stream/river habitat of the Chilkat and Chilkoot Rivers. Chilkoot and Chilkat Lakes provide important habitat, but there is limited development along their shores. There are significant wetlands along the river systems, which provide critical functions of regulating and filtering flow into the rivers. There has been limited development in these wetlands, with the exception of the Haines Highway, which has filled significant riverine and emergent wetlands over the years, but this is little reflected in the identified projects. It is important to note that more complex projects involved multiple habitats.

# RESULTS AND DISCUSSION – Project assessments

Twenty-one (21) of the total 199 inventoried REM projects were assessed. Individual project assessments (case studies) are provided in Appendix A. The following is a summary of the findings based on these assessments.

**Stream Channel Manipulation**
Six stream channel relocation or rehabilitation projects were assessed of the 57 stream channel manipulation projects documented in Haines between 1980 and 2017. Channel rehabilitation is defined as the reconstruction of a channel along the original alignment and channel relocations move the channel to a new alignment. Both types of projects usually include various in-stream and riparian habitat improvements.

**Fish Passage Improvement**
Six of the 43 total inventoried fish passage projects were assessed. Five of the projects involved the replacement of an existing culvert, and one was a new installation. Culverts were replaced because they constricted the stream channel, were structurally failing, and/or were perched. These conditions can restrict upstream passage of fishes and effect conveyance of stream flow, debris, and sediment. There were also 15 bridge projects in the inventory, however none of these involved replacing a culvert or improving fish passage. There was one case where a culvert replaced a bridge, 37 Mile Creek tributary, with detrimental effects on fish passage (as described in the Studly Culvert case study). There was another case, Holgate Creek, where ADF&G installed a fish ladder in a culvert that was too small and steep to successfully improve fish passage.

Twenty-seven (27) of the inventoried fish passage improvement projects were conducted by the Alaska Department of Transportation and Public Facilities (ADOT/PF) as they upgraded highways in the Haines area. There is a current memorandum of agreement between ADOT/PF and ADF&G that standardizes how culverts will be designed and installed. Since this agreement was put in place over 20 years ago, fish passage issues on state highways have been resolved as roads are upgraded or built. As fish passage is required under state law (AS 16.870), these upgrades are not allowable as mitigation for other unavoidable adverse impacts associated with a project.

TWC, sometimes partnered with the Haines Borough, identified and replaced five culverts that were not providing adequate fish passage; four of these are documented in the case studies.

**Stream Bank Stabilization**
Six of the 41 stream bank stabilization projects documented in Haines between 1980 and 2017 were assessed. Due the recent nature of the ongoing Haines Highway project, this analysis stops at the end of 2016. Most bank stabilization projects were located on the mainstem Chilkat River and its most accessible tributary the Klehini River (15 total projects). There were also extensive lengths of riprap installed prior to 1980 on the Chilkat River to protect the Haines Highway.

At most sites rip-rap has been used to construct revetments for armoring the stream bank. Biostabilization techniques were employed at five sites, which included one large engineered

logjam (ELJ). Rock vanes were used at one site and a rock gabion was used at another site. Log cribs or log revetments were installed at another two sites. The recent permits for most bank stabilization projects required site revegetation with seed, vegetated mats, or native trees and shrubs.

At the time of our site assessments, all of the projects were successfully preventing erosion. The two bioremediation projects were successful in stopping the primary activity causing erosion. The cessation of trampling from commercial raft take-out at 15 Mile Chilkat River, and boat wakes from commercial jet boat activity near the Kelsall Road, likely helped. The Klukwan ELJ is in a high-energy location and has remained stable. A one-year, four season study by TWC demonstrated that the ELJ was used by rearing king and coho salmon in greater numbers than a nearby riprap revetment.

Over half of these projects were conducted by ADOT/PF (30) and were related to the Haines Highway or other state maintained roadways. Most were required mitigation and five are detailed in case studies (Appendix A). There were also four projects for Northern Southeast Regional Aquaculture Association (NSRAA) chum salmon enhancement. ADF&G and TWC also enhanced fish habitat in Big Boulder and Sawmill Creeks.

**Debris Removal/Disturbance**
None of these 24 projects were assessed with a case study. This project goal category covers a wide spectrum including cleaning debris off of the Wells Bridge, removing junk vehicles, and violations requiring removal of material placed in a waterbody.

**Bridge Removal or Replacement**
Four collapsed logging road bridges were removed and 14 bridges were permitted to be installed or upgraded. None of these were assessed with a case study. Temporary bridges have been used for construction purposes as on the Klehini River and Big Boulder Creek. One is also used for seasonal access to Chilkat Lake in the winter. The Katzehin River bridge was permitted, but never constructed for the Juneau Access project. Bridges and culverts were permitted for Chilkoot Lake and River tributaries for logging access in1990 and never removed. They are now collapsed and causing degradation of spawning area.

**Wetland/Pond Creation**
Two wetland creation projects, along with the associated channels to drain these wetlands, were assessed of the 11 wetland creation projects in Haines between 1980 and 2017 documented for this study. Wetlands are complex and naturally take decades, or longer, to develop the necessary hydrologic characteristics, soils, and plants. With one exception these were all ADOT/PF mitigation for unavoidable impacts to wetlands during road construction. The exception was a private landowner trying to mitigate for impact to a stream by creating a pond.

**Floodplain Restoration/Reclamation**
These 4 projects were related to floodplain gravel mining for road construction. None of these were assessed with a case study. The intention was to ensure that fish were not trapped in mining areas as they flooded, so drainage channels were constructed and maintained throughout the project. The area appears to have fully recovered.

# ASSESSMENT OF PROJECT SUCCESS

**Stream Channel Manipulation**
Channel reconfigurations have been implemented with varied success. Most projects of this type in the last 20 or so years were related to the Haines Highway upgrade project and were well researched and designed. Several smaller projects connected existing streams to culverts that were moved due to highway redesign; these were generally low gradient and functioned as designed. Larger projects, such as the creation of the 37 Mile Creek extension in a former Klehini River floodplain, have continued to function as designed. Even the most successful streams take time to develop into fully functional systems. Stream design needs to accelerate the revegetation of all associated riparian zones, and should provide for the long term natural contribution of large woody debris. Complex stream morphology can be achieved and maintained through the design of durable stream structures, with productive changes occurring over time as new wood is introduced into the system.

Unless the streams are protected from river flood flows, it is challenging to design and construct persistent productive systems within the flood plains of glacial rivers. The notable failures where caused by expected, but untimely, changes in the mainstem Klehini River within its floodplain. The river overwhelmed and obliterated the completed mitigation work, or entered a side channel that then overwhelmed the designed channel. In the case of the Big Boulder channel creation, conservative design of the channel subsequently starved the channel of water and severely limited its usefulness as fish habitat. It did, however, function as high flow relief for a compromised streambank downstream. While it is always risky to manipulate waterways in a dynamic area such as Haines, it can be a useful tool with adequate research and careful design.

**Culverts**
Culvert removals/replacements have been relatively successful in improving fish passage. In the last 25 years, culvert design has been improved and standardized. The Haines Highway is an example of greatly improved fish passage as the highway is rebuilt and culverts are upgraded. The one example of a failing bridge that was replaced by a culvert, the Studley project, has resulted in compromised fish passage, with at least one experience of blockage also resulted in local flooding. While a properly designed culvert can provide decades of reliable fish and water passage, the dynamic nature of the local waterbodies requires all stream crossings to be periodically monitored to ensure they are functioning as designed.

**Bank Stabilization**
Streambank stabilization projects with riprap (rock) revetments produced varied, but predictable results. Successful riprap revetment projects function to prevent localized erosion. There are numerous examples of riprap revetments that have been in place for decades and remain stable. Riprap revetments do not to hold up during high flow events if not engineered adequately (e.g. Haines Highway near 36 mile) and can require expensive and extensive rebuilding.

There are several concerns regarding these rock projects. They tend to speed up the current, which increases erosive forces and requires additional engineering, usually with more rock to prevent additional erosion. This faster current generally provides little habitat for rearing juvenile or returning adult salmonids. There is also little riparian vegetation left after these projects are

completed, which reduces sources of large wood and organic material that provide habitat and food for rearing salmonids. There are examples of decades old riprap projects that do have some vegetation established, however the riparian area is still compromised compared non-riprapped areas.

Bioengineered streambank stabilization has been successful in slow and fast current areas, as demonstrated by the Kelsall River, Big Boulder, and Klukwan projects; all three nearly two decades old. These projects are subject to the same concerns as riprap projects regarding high water events, downstream erosion, and the dynamic nature of waterbodies in a temperate rainforest. However, by slowing the current instead of speeding it up, these projects maintain or even improve fish habitat, while encouraging more vegetation in the riparian zone along the bank.

**Wetland Creation/Enhancement**

Wetland creation has been moderately successfully in Haines. Most of the wetland creation/enhancement projects were related to the Haines Highway upgrade project. These projects were well researched and designed, however successful wetland creation requires the groundwater level to be neither too low nor too high after construction. Wetlands designed to be ground water supported need to be relatively flat in both cross-channel and down-channel directions. Stream channels within wetlands should be designed to maintain saturated soil conditions throughout the wetlands, and function primarily as a conduit for high water flows, not as low flow drainage channels. While many of these projects retain wetland characteristics, significant portions are becoming uplands as alders and other non-wetland vegetation encroaches. It is important to time the construction of wetlands to avoid the complications of high water flows. Wetland design also needs to consider elevation changes that will result from glacial rebound, and potential hydrology changes driven by adjacent aggrading rivers.

# CONCLUSIONS

This project provided significant insight to the pros and cons of REM projects on the Haines road system, but more work is required to fully understand why some projects worked and some failed. It will take additional time and funding to collect data as REM projects continue, as well as to summarize the data further. Some historical REM projects were not included in the inventory due to the significant effort that it takes to sort through the large number of projects and non-uniform reporting. As time and funding allow, this living document should be updated with these historical projects (e.g. projects related to the Haines Airport construction), as well as the significant number of projects completed since 2017.

Over the past 30 years, considerable effort and funding have been directed toward improving aquatic and riparian habitats in Haines for the purpose of restoration, enhancement, and/or mitigation. While a significant number of projects have been monitored to evaluate whether project goals were met, there has been little to no follow-through to learn from past projects and implement those lessons in current and future projects. Further analysis of past projects should be able to provide guidelines and recommendations regarding future project design and implementation.

# APPENDIX A. CASE STUDIES: Assessed REM Project Summaries

## 29 Mile Creek Enhancement (ADOT/PF Mitigation Site CH-8)

**Project Type:** Stream Channel Manipulation
**Project Location:** Between 59.42046, -136.07743 and 59.42122, -136.06912
**Waterbody/Watershed:** 29 Mile Creek
**Anadromous Stream Number:** 115-32-10250-2077-3046

**Project Need:** This stream enhancement project was designed as mitigation for the stream impacts resulting from a Haines Highway improvement project. The enhancement project added large woody debris to an 1100-ft long reach of 29 Mile Creek. Prior to this project the creek was a groundwater spring fed system located in a relic Klehini River flood channel. The flow of the creek varied with the groundwater elevation, but did not reach sufficient volume to create a morphologically diverse stream environment. The original stream was very uniform in depth and composed primarily of a long glide. Clear gravels occurred where there was strong upwelling. The woody debris added by this project, combined with the introduction of controlled 30 Mile Creek or Klehini River flood flows via a periodically opened gated culvert located up-steam, were designed to make the existing stream more complex, and more productive. Additionally, clear groundwater flows were increased by the construction of a tributary to this creek.

**Goal(s):** To provide cover, stabilize banks, maintain and create pool forms and encourage deposition of spawning size gravel.

**Timeline:** Construction Completed 1999.

**Objective:**

1) To place wood to increase fish habitat complexity and extent, benefitting both rearing and spawning salmonids.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities.

**Methods Used:** Large woody debris in the form of root wads and logs were placed at seven different locations along the stream. The wood was stabilized by keying it into the banks and the bottom of the stream.

In conjunction with this project, 29 Mile Creek was extended and connected to a gated culvert across the new road alignment. The culvert was designed to be opened periodically to allow a substantially increased volume of water to enter 29 Mile Creek. This increased flow was to mimic a flood event and provide the hydraulic forces necessary to create and maintain pools by interacting with the added woody debris.

**Authorizations:** Army Corps of Engineers permit 2-920515. ADF&G Fish Habitat Permits FG 98-I(J)-36.

**Monitoring:** Monitoring was conducted by ADF&G from 2000-2004.

**Project Outcome:** ***Moderately Successful***
The monitoring found that the stream was initially well utilized by rearing salmonids. However, beavers constructed a dam near the lower end of enhanced stream reach and blocked all fish passage for a few years. The removal of a gate blocking an upstream culvert in 2002 allowed the flood flows of the Klehini River to enter the system and resulted in the beaver dam washing out in 2004.

Unfortunately, the long-term oversight necessary to monitor the need for the introduction of flood flows via the gated culvert was not provided for by the mitigation project. Since the Klehini River is a mobile, aggrading system it is not a simple task to remove and replace the gate. Sometimes equipment is required to excavate material in order to clear the culvert inlet or direct river flows into 29 Mile Creek. The gate was not replaced after its removal in 2002 and its location is unknown.

This site was visited twice for this report. At the time of the first visit (July 31, 2020), silty river

water was flowing down the entire 29 Mile Creek. Under these conditions, the productivity of the stream was reduced in comparison to a clear, ground water fed system. It was not possible to see if the increased flows had resulted in a more complex stream environment.

The site was visited again on October 24, 2020. At this time the Klehini River level had dropped enough to stop the flow of river water into the enhanced channel. The river flow has worked with the placed large woody debris and created a number of deep pools. There were also undercut banks and some areas of gravel at the pool tailouts. Unfortunately, the long-term influx of silty water has resulted in the deposition of a large amount of silt into the channel. The silt will limit the amount of gravel available for spawning and will reduce survival of any salmon eggs deposited in the stream. The silt will also reduce the primary productivity and macroinvertebrate population of the stream. Upwelling was observed in only two locations.

**Lessons Learned:**

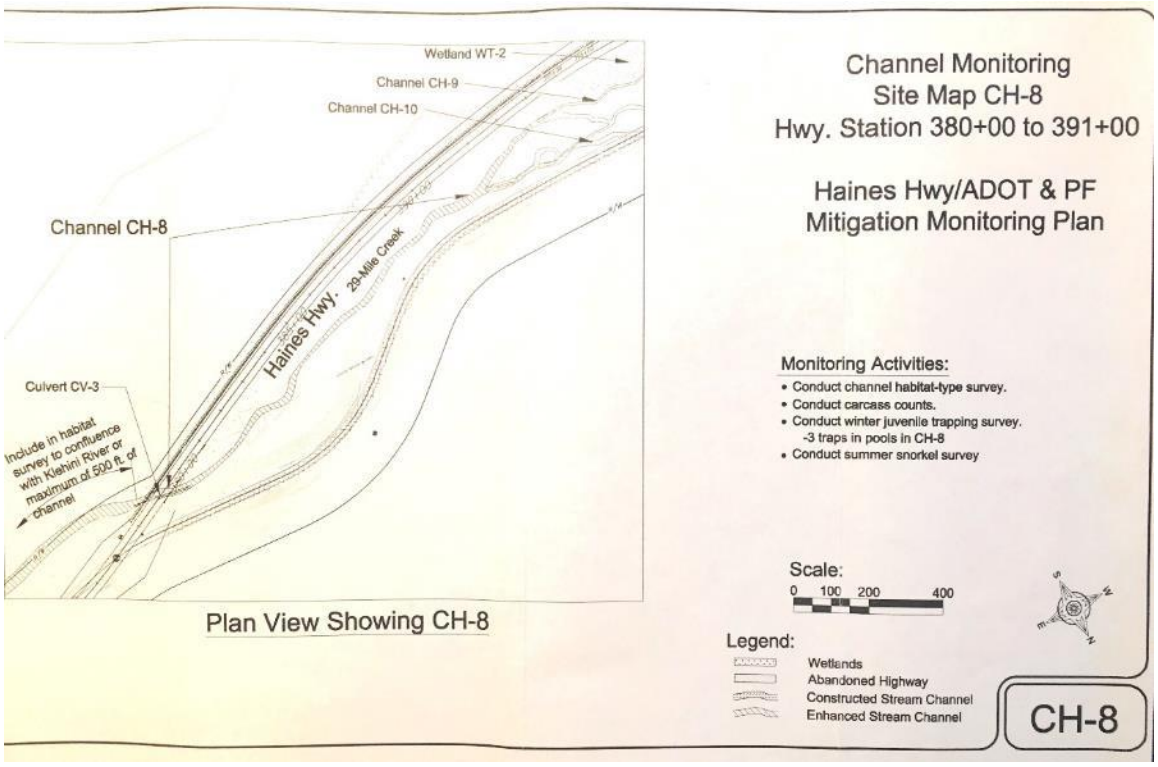
- Mitigation projects dependent on the periodic intervention of agency personnel and equipment need to have a well funded and clearly laid out long-term plan.
- The productivity of an existing stream system can be compromised by well intentioned by poorly implemented mitigation projects.
- This project may need active intervention to both block future flows of river water and clean the deposited silt.

**Project Significance:** This project, in combination with a groundwater tributary project, a channel extension project, and a culvert with flow control had the potential to illustrate the effectiveness of mitigation projects requiring long term hands-on management.

**Recommendations:**

- Locate or fabricate a replacement headgate for the 29/30 Mile Creek culvert.
- Secure funding that will allow for the removal and replacement of the headgate at the 29/30 Mile Creek culvert as required.
- Secure the commitment of a competent non-profit organization to annually monitor the creek and determine when the headgate should be opened and closed. This organization could also oversee or complete the excavation required to open up the channel to the inlet of the culvert.
- Monitor the long-term flow of the Klehini River and 30 Mile Creek adjacent to the culvert entrance. In addition to opening water flow to periodically provide increased scouring, also allow clear flows when possible to flush out excess silt currently present in 29 Mile Creek.

**References:** ADFG Habitat permit, ADOT/PF design and environmental documents, Inter-Fluve monitoring plan, ADFG annual monitoring reports, personal comm.



Plan view, 29 Mile Creek Enhancement (CH-8).


Beaver dam in CH-8, 2002 (left) and 2003 (right).

Debris in CH-8 in 2000; just upstream of culvert.

Klehini River flows in 29 Mile Creek (CH-8) on (left) and confluence of 29 Mile Tributary (CH-9) and 29 Mile Creek (right) on July 31, 2020.

Large woody debris in 29 Mile Creek on July 31, 2020.

29 Mile Creek (CH-8) large woody debris (left) and scoured pond (right) on October 24, 2020.

## 29 Mile Creek Tributary (ADOT/PF Mitigation Site CH-9)

**Project Type:** Stream Channel Manipulation
**Project Location:** 59.42027, -136.08113
**Waterbody/Watershed:** New tributary of 29 Mile Creek
**Anadromous Stream Number:** 115-32-10250-2077-3046

**Project Need:** This stream and pond creation project was designed as mitigation for the stream impacts resulting from a Haines Highway improvement project. Specifically, this mitigation project was designed to supplement the water flows to 29 Mile Creek, which was, prior to the highway realignment, located in a former Klehini River flood channel and fed solely by upwelling water. The new highway alignment pushed out into the Klehini River floodplain and resulted in the 29 Mile Creek headwaters area being protected from any Klehini River flood events. This provided the opportunity to constructed a tributary stream that would both increase available fish habitat and increase flow into the 29 Mile Creek system.

**Goal(s):** To create a productive stream system that increases the water flow to 29 Mile Creek.

**Timeline:** Process initiated 1999. Construction Completed 1999-2000.

**Objectives:**
1) Create salmon spawning and rearing area.
2) Increase the water flows into 29 Mile Creek.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities.

**Methods Used:** This stream ties into the original 29 Mile Creek invert elevation. From this elevation upstream the stream grade was excavated to follow the groundwater elevation at the time of construction. The created channel is about 600' in length and has a width of 6-7'. The stream was excavated to be fairly uniform in grade, and lacked the construction of a complicated pool and riffle morphology. Some woody debris was added to improve habitat complexity. The stream was incised below the surrounding river floodplain elevation, and the banks are uniformly steep. A 400' long pool was excavated at the upstream end of the stream. This pool tied into upwelling groundwater.

**Authorizations:** Army Corps of Engineers permit 2-920515. ADF&G Fish Habitat Permits FG 98-I(J)-36.

**Monitoring:** Monitoring was conducted by ADF&G from 2001-2003.

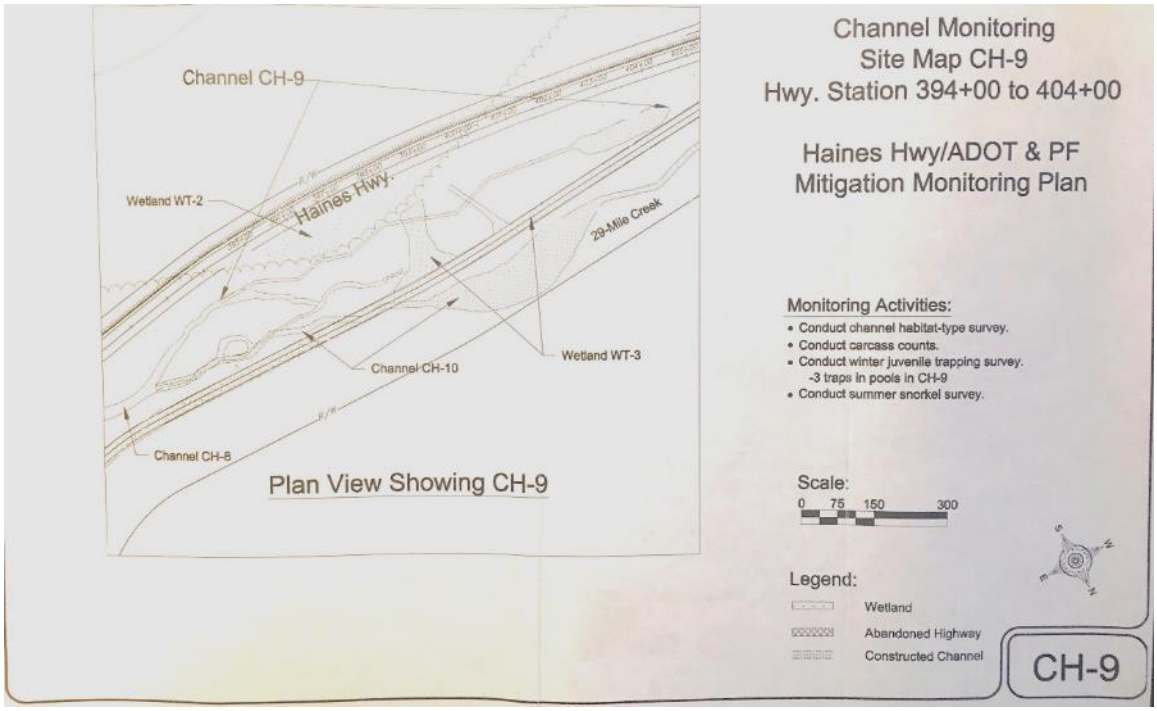
**Project Outcome:** ***Successful***
The monitoring found that the stream and pond were utilized by rearing salmonids. A small number of spawning salmon were observed in the pool soon after construction. The stream has good flow and contributes clear groundwater to 29 Mile Creek. The riparian area of the stream has vegetated well, with near 100% cover. The pond perimeter is also well vegetated. The installed large woody debris has persisted and continues to influence stream morphology.

**Lessons Learned:**
- Stream construction provides the opportunity to create complex pool and riffle environments, as well as productive undercut bank habitat. This stream was not designed to create these habitats, so its viability as fish habitat is less than it could have been.

**Project Significance:** River floodplains are often associated with transportation corridors and can provide the opportunity for innovative mitigation projects. Protected stream habitat can be created to provide long-term areas of habitat productivity.

**Recommendations:**
- Although it would be difficult to complete, the addition of more large woody debris would increase the complexity of the stream channel.

**References:** ADFG Habitat permit, ADOT/PF design and environmental documents, Inter-Fluve monitoring plan, ADFG annual monitoring reports, personal comm.



Plan view, 29 Mile Creek Tributary (CH-9).

29 Mile Creek Tributary pond during final construction in 2000.

Pond in 2001 (left) and 2003 (right).


29 Mile Creek Tributary (CH-9) in 2000 (left) and 2002 (right).


29 Mile Creek Tributary (CH-9) pond, from upstream end (left) and CH-9 outlet (right) in 2020.


Typical stream section (left) and large woody debris in 29 Mile Creek Tributay (CH-9) (right) in 2020.

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## 29 Mile Wetland (ADOT/PF Mitigation Site WT-3)

**Project Type:** Stream Channel Manipulation
**Project Location:** 59.42037, -136.07990
**Waterbody/Watershed:** 29 Mile Creek
**Anadromous Stream Number:** Adjacent to stream #115-32-10250-2077-3046

**Project Need:** This wetland creation was designed as mitigation for the wetland and stream impacts resulting from a Haines Highway improvement project.

**Goal(s):** To create functional wetlands.

**Timeline:** Process initiated 1999. Construction Completed 2000.

**Objectives:** Create 0.7 acres of wetlands.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities.

**Methods Used:** The wetland was created by excavating 0.7 acres of the former highway embankment to an elevation below the original ground elevation. A field modification added 0.5 acres to the wetlands by excavating to floodplain elevation between the abandoned highway and an adjacent mitigation channel. Both areas were seeded with wetland seeds, but each had a different seed mix.

**Authorizations:** Army Corps of Engineers permit 2-920515. No ADF&G Fish Habitat Permit required.

**Monitoring:** Monitoring was conducted by ADF&G from 2001-2003.

**Project Outcome:** ***Moderately Successful***
The monitoring by ADF&G found that approximately 50% of the designed wetland area was dry, unvegetated, elevated roadbed and channel berm. The site visit conducted in 2020 did not delineate the wetlands, or measure the total area. However, it was observed that a substantial area of wetlands persists, and this area appears to be larger than the area designated wetlands in the design documents.

**Lessons Learned:**

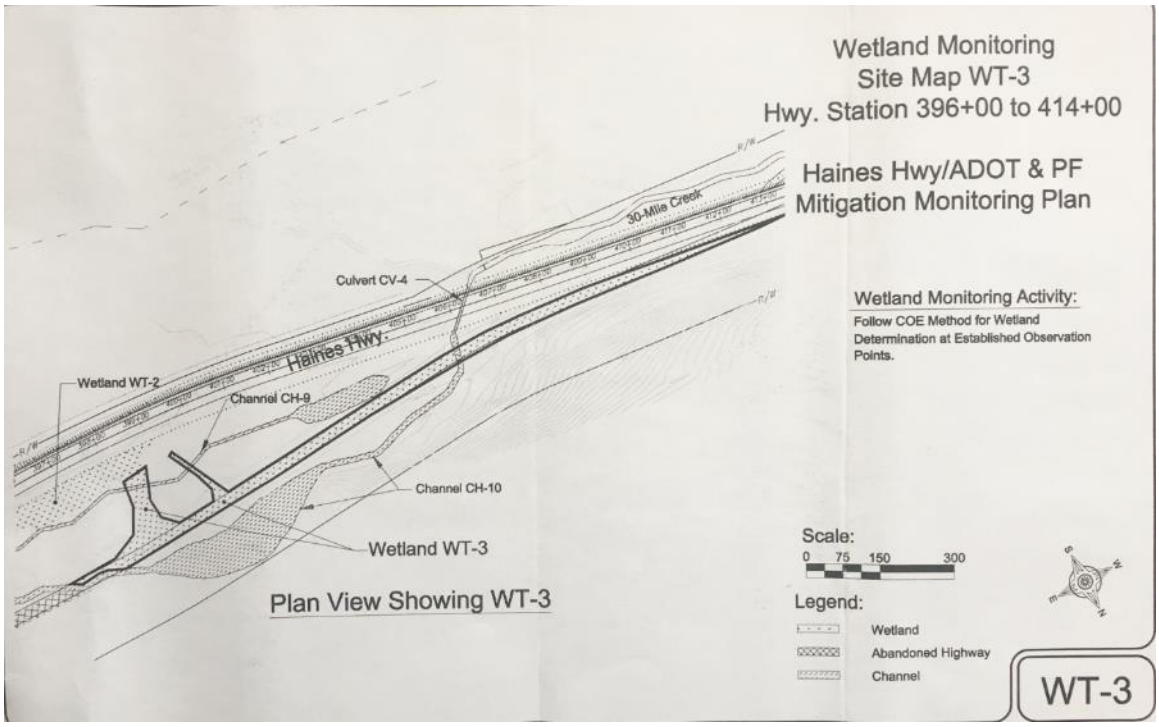
- The design of this wetland included a long and narrow section excavated along the alignment of the old roadbed. This section was bounded on both sides by newly constructed streams, which resulted in the section being well drained, and soon becoming established as an upland.
- The successful portion of the wetland tapped into upwelling water flows that provided the hydrology needed to create a true wetland.

**Project Significance:** This wetland was constructed with a substantial amount of field design. The design flexibility allowed for the excavation to respond to the groundwater flows that were unveiled during the construction, and to modify the original design to take advantage of unexpected circumstances.

**Recommendations:**

- Institute a long term (once every 10 years) monitoring schedule of this wetlands to document the persistence and evolution of a created wetlands.

**References:** COE permit, ADOT/PF design and environmental documents, Inter-Fluve monitoring plan, ADFG annual monitoring reports, personal comm.



Plan view, 29 Mile Wetland (WT-3).


Aerial view of 29 Mile Wetland (WT-3), 2020

29 Mile Wetland (WT-3) photo point 2 in 2002 (left) and 2005 (right).

29 Mile Wetland (WT-3) photo point 4 in 2002 (left) and 2005 (right).

29 Mile Wetland (WT-3) from the east end (left) and west end (right) in 2020.

## 29/30 Mile Creek Culvert (ADOT/PF Mitigation Site CV-4)

**Project Type:** Fish Passage Improvement
**Project Location:** 59.4202, -136.0826
**Waterbody/Watershed:** 29 and 30 Mile Creek
**Anadromous Stream Number:** 115-32-10250-2077-3046 and 115-32-10250-2077-3052

**Project Need:** This 98-ft long, 60-inch diameter culvert was designed to convey controlled flows from 30 Mile Creek into 29 Mile Creek. As part of the stream mitigation work completed with the upgrading of the Haines Highway, 29 Mile Creek was lengthened and enhanced with large woody debris. Prior to this project 29 Mile Creek was a groundwater fed system with no connection to 30 Mile Creek. The 29 Mile Creek system was occasionally flooded by the Klehini River, but the new highway alignment blocked these flows. This culvert was designed with a removable head gate which would allow for the passage of clear water from 30 Mile Creek but exclude silt laden Klehini River flood flows.

**Goal(s):** To convey a controlled volume of water from 30 Mile Creek into the existing and newly constructed portions of 29 Mile Creek.

**Timeline:** Construction completed 1999.

**Objectives:**

1) To provide adequate fish passage at all flows up to the fish passage design flow.
2) To provide controlled flow of water from 30 Mile Creek to 29 Mile Creek.
3) To exclude Klehini River flood flows when it was determined to be advantageous.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities.

**Methods Used:** The culvert was placed within the new alignment of the Haines Highway. It was installed with a slope of 0.5% with the inlet elevation determined by the existing invert elevation of the adjacent 30 Mile Creek. Approximately 6 inches of gravel was placed in the culvert.

**Authorizations:** Army Corps of Engineers permit 2-920515. ADF&G Fish Habitat Permit FG 98-I(J)-35

**Monitoring:** Monitoring was conducted by ADF&G from 2000-2003, with observations also occurring in 2004.

**Project Outcome:** ***Moderately Successful***
In the year following the construction of this culvert the Klehini River moved toward the north side of its floodplain and captured the lower part of 30 Mile Creek. The old 30 Mile Creek channel immediately above this culvert became a channel of the river, and remains so, in 2020. This has precluded the possibility of conveying a controlled volume of clear 30 Mile Creek water through this culvert.

In 2002, in response to the construction of a beaver dam near the lower end of the enhanced 29 Mile Creek channel, the head gate of this culvert was removed. The result of this removal was the eventual flow of Klehini River water into 29 Mile Creek. Since the head gate was totally removed, no attempt (beyond pipe capacity) was make to control the volume of this flow. The beaver dam was washed out, but the entire 29 Mile Creek was subjected to silt laden river flows.

The Klehini River deposited a large amount of gravel and wood at the culvert inlet. Although water still flowed through this blockage, it is likely that the pipe does not provide fish passage.

**Lessons Learned:**

- Structures requiring long term intervention by agency personnel in order to function properly need to have a well-funded, long-term plan.
- In dynamic river systems projects need to be able to adjust to major changes in flow patterns.

**Project Significance:** This project was designed to provide the opportunity for long-term intervention to assure the productivity of a major salmon spawning and rearing stream. It currently offers the opportunity for a government or nonprofit entity to step in and provide the needed management.

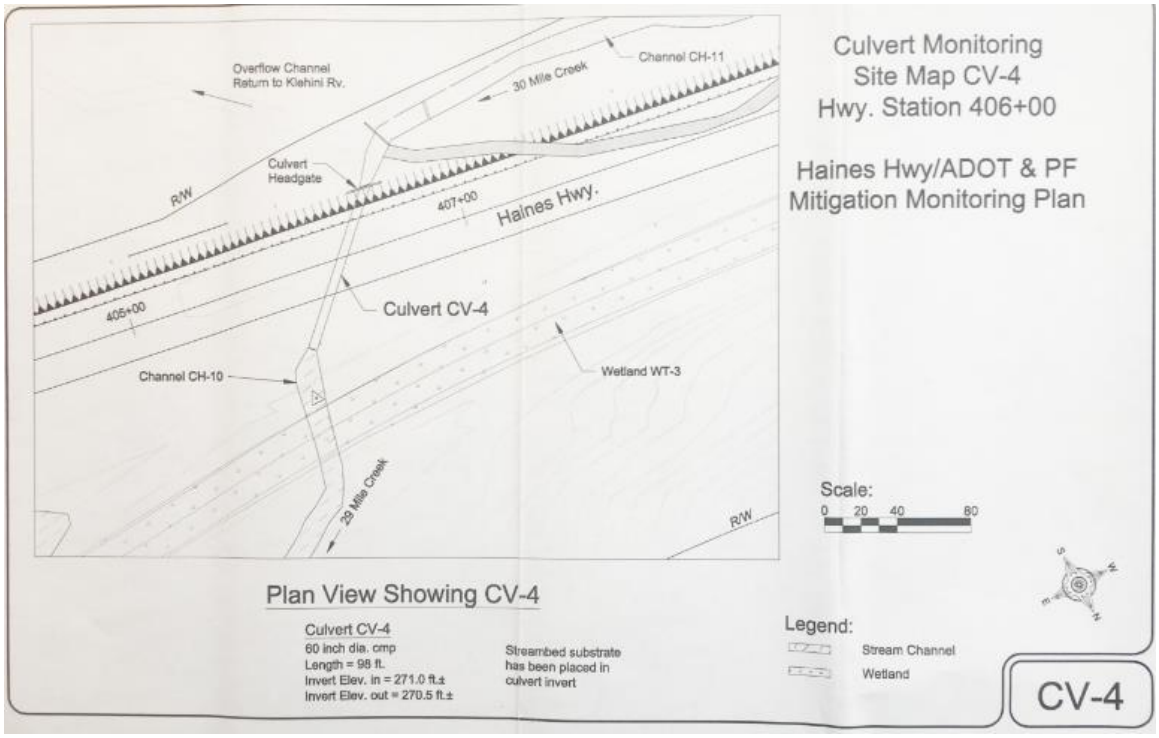
**Recommendations:**

- Locate or fabricate a replacement gate for the culvert headgate.

- Secure funding that will allow for the removal and replacement of the headgate as required.
- Secure the commitment of a competent non-profit organization to annually monitor the 29 Mile Creek and determine when the gate should be opened and closed. This organization could also oversee or complete the excavation required to open up the channel to the inlet of the culvert.
- Monitor the long-term flow of the Klehini River and 30 Mile Creek adjacent to the culvert entrance. In addition to opening the headgate to periodically provide increased scouring, also allow clear flows when possible to flush out excess silt currently present in 29 Mile Creek.

**References:** ADFG Habitat permit, ADOT/PF design and environmental documents, Inter-Fluve monitoring plan, ADFG annual monitoring reports, personal comm.

**Note:** ADOT/PF Haines maintenance personnel do not know what happened to the steel head-gate. It is not on site and not in the ADOT/PF yard.



Plan view of the 29/30 Mile Creek (CV-4) culvert.


CV4 Inlet in April 1999 (left) and May 2000 (right).


CV4 Inlet in September 2000 (left) and July 2002 (right).

CV4 Inlet in June 2004 (left) and 2005 (right).

CV4 Inlet in September 2004 (left) and 2006 (right).


CV4 outlet in September 2000 (left) and August 2001 (right).


CV4 outlet in August 2004 (left) and September 2005 (right).


CV-4 outlet (July 31, 2020) (left). Klehini River deposited gravels and woody debris at the CV-4 inlet (right). Note the vertical steel rail for the steel plate headgate (October 17, 2020).

## 37 Mile Creek (ADOT/PF Mitigation Site CH-13)

**Project Type:** Fish Passage Improvement
**Project Location:** Between 59.43926, -136.27164 and 59.43427, -136.23651;
**Waterbody/Watershed:** 37 Mile Creek
**Anadromous Stream Number:** 115-32-10250-2077-3136

**Project Need:** This stream creation project was designed as mitigation for the stream impacts resulting from a Haines Highway improvement project. As part of this highway upgrading, the ADOT/PF proposed constructing a significant proportion of the new highway on the floodplain of the Klehini River. This new alignment isolated and protected a portion of the floodplain, providing the opportunity for the creation of a 7000-foot long extension of 37 Mile Creek.

**Goal(s):** To create a productive stream system.

**Timeline:** Process initiated 1999. Construction Completed 2000.
**Objectives:**

1) Create coho salmon spawning and rearing habitat.
2) Create a stream in which natural processes ensure that riparian vegetation does not encroach on or constrict the channel, and ensure that fine organic and mineral sediments do not accumulate in pools and embed gravels.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities. *With assistance from: Inter-Fluve, Inc.*

**Methods Used:** The stream design was based on an extensive study of the hydrology of the Klehini river floodplain, the morphology and hydraulics of the existing 37 Mile Creek, and the topography and hydrology of the existing riverbank on the north side of the new stream channel. The stream was designed with an alternating and morphologically diverse series of pools, riffles, glides, and runs. The general stream alignment was determined by following the existing bank on the north side the Klehini floodplain. Pools were created to take advantage of existing rocky outcrops and other features on the north bank. On the south bank pools were created by directing scouring flows into constructed pools lined with banks formed by fabric wrapped soil lifts. Root wads and other large woody debris was utilized to provide local scour to maintain the pool forms. Pool tailouts were formed with gravel sized for spawning coho, while riffles were constructed with existing floodplain material. Large woody debris was spread liberally throughout the channel, with additional debris expected to be contributed over time from the intact forest on the north bank. The south bank was formed by a constructed berm separating the stream from the adjacent wetlands. This berm was vegetated with willow cuttings, and was expected to be colonized with other riparian vegetation.

The stream was constructed with the full flow of the water present. This allowed the fine-tuning of each element of the stream, assuring that it functioned well.

The created section of the stream was protected from flood events in excess of the estimated 10-year flood flow volume. This was accomplished by the construction of an overflow channel upstream of the created stream section that will divert excess flood volumes directly into the Klehini River.

**Authorizations:** Army Corps of Engineers permit 2-920515. ADF&G Fish Habitat Permits FG 99-I(J)-55 and FG 99-I(J)-56.

**Monitoring:** Monitoring was conducted by ADF&G from 2001-2006, and in 2011.

**Project Outcome:** ***Successful***
Throughout the monitoring conducted by ADF&G the new stream channel was found to be well utilized by spawning and rearing salmonids. The design of the pools has been successful in both maintaining the shape of the pools and assuring that

organic and mineral sediments did not accumulate beyond that expected in natural systems. The large woody debris has persisted, and provides complex hydraulic environments for fish use. As predicted, the forested slope on the north bank has been providing additional large woody debris. While the establishment of riparian vegetation on the berm along the south bank was initially slow, the bank is now completely vegetated with a diverse community of trees and shrubs. Spawning gravels have persisted and do not appear to be cemented by fine materials. The stream is not exactly as constructed, but has not changed in any catastrophic way. It appears to have attained a state of dynamic equilibrium.

**Lessons Learned:**

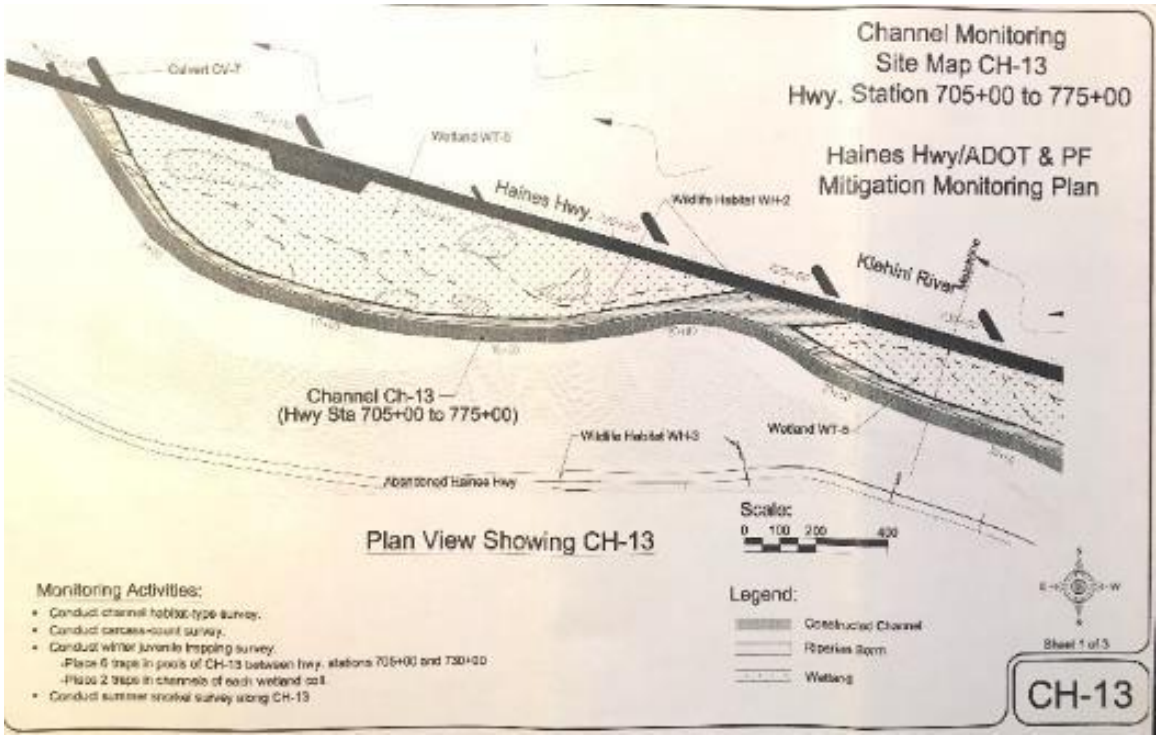
- The establishment of riparian vegetation takes a good deal of time if there is minimal soil preparation and no plantings beyond willow cuttings. More extensive preparation and the planting of a diverse array of vegetation (such as cottonwood logs) would have jump-started the revegetation process.
- Construction within flowing water allows for the real time adjustment of stream morphology and woody debris, increasing the chances of constructing channels that function well.
- A thorough design process and creative implementation can result in a stream that maintains productivity with no additional intervention needed.

**Project Significance:** River floodplains are often associated with transportation corridors and can provide the opportunity for innovative mitigation projects. Protected wetland and stream habitat can be created to provide long-term areas of habitat productivity.

**Recommendations:**

- Periodically monitor the constructed channel to assure that large trees falling from the hillside have not blocked the stream flow and caused it to avulse into the adjacent wetlands.

**References:** ADFG Habitat permits, ADOT/PF design and environmental documents, Inter-Fluve design and monitoring plans, ADFG annual monitoring reports, personal comm.



Plan view, portion of 37 Mile Creek (CH-13)

37 Mile Creek (CH-13) prior to channel modifications on June 14, 2000.

CH-13 construction underway on June 16, 2000.


CH-13 is being transformed in July 2000.

37 Mile Creek (CH-13) is taking shape throughout July 2000.



CH-13 glide to riffle transition, undisturbed bank on the left side (left). Post construction large woody debris from existing north bank (right). 2020.



CH-13 large woody debris installed in a pool along the constructed right bank (left) and north bank (right). 2020.

## 37 Mile Wetland Channels

**Project Type:** Wetlands Creation
**Project Location:** Between 59.43438, -136.23773 and 59.43870, -136.27243; Within wetland WT-5
**Waterbody/Watershed:** Tributary to 37 Mile Creek
**Anadromous Stream Number:** tributaries to115-32-10250-2077-3136

**Project Need:** In conjunction with the upgrading of the Haines Highway, the ADOT/PF proposed constructing a significant proportion of the new highway on the floodplain of the Klehini River. As part of the mitigation for the impact of this new alignment, 15.7 acres of wetland were created. Within this wetland, approximately 18,000 linear feet of small channels were constructed. While it was recognized that these channels would likely serve as fish habitat, this was not stated as the goal of the channel construction.

**Goal(s):** The channel's primary purpose was to simply provide an open water component of the emergent wetlands, and also to serve to drain excessive surface water volumes.

**Timeline:** Process initiated 1999. Construction Completed 2000-2001.

**Objectives:**
1) Construct a system of small channels within four separate wetland cells.
2) Utilize the banks of the channels to delineate the internal borders of the wetland cells.
3) Install specific backwater structures designed to keep wetland water elevations high relative to the ground surface.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities. *With assistance from: Inter-Fluve, Inc.*

**Methods Used:** The channels were constructed following the grading of the existing Klehini River floodplain substrate to an elevation calculated to provide substantial groundwater flow to the created wetlands. The banks of the channels were built of seedless hay bales laid end for end, and staked into place. Channel width was generally 3-5', but varied based on anticipated flows. Backwater structures composed of large diameter bank logs and cobble fill were placed as required to assure the channels did not drain the adjacent wetlands. Wetland soil was filled in against the hay bales, and large woody debris was placed within and across the channel. Shrubs and wetland grasses were planted along the riparian area of the channels.

**Authorizations:** Army Corps of Engineers permit 2-920515. ADF&G Fish Habitat Permit FG 99-I(J)-56

**Monitoring:** Monitoring was conducted by ADF&G from 2001-2006, and in 2011. The stream channels were determined to provide excellent rearing habitat for juvenile salmonids, and fish were found to be present

**Project Outcome:** ***Successful***
The channels did succeed in serving to drain excessive water from the created wetland complexes. The wetlands exhibit no surface erosion, and no new channels have eroded away wetland soil. The channels have, for the most part, served as open water, but are in fact stream habitat rather than emergent wetlands. Except for some periodic drying out, the channels have provided very productive fish habitat.

**Lessons Learned:**
- The original design documents suggested that the channels have a width to depth ratio near 1. However, significant water was encountered during construction and the channels were built wider to carry the flow. This may have resulted in less water available to the wetlands, and thus altered both the final area of wetlands created and the saturation level of the created wetlands.
- The hay bales used to delineate the channel banks have eroded with time, and have resulted in widening of the channels. This is positive in terms of providing more fish habitat, but may have resulted in lowering the adjacent wetland water table. Coir logs may have been better colonized by riparian vegetation, maintained stream design width, and ended up providing more undercut habitat.

**Project Significance:** As an integral part of the large wetland complex these stream channels served both to maintain the functionality of the wetlands and to provide productive juvenile salmon habitat.

**Recommendations:**

- In similar conditions, use coir logs instead of hay bales to construct the banks of streams within created wetland complexes.
- In similar conditions, keep created channel narrow in hopes of forcing ground water to saturate the wetland soils.
- In similar conditions, keep wetland and stream gradient near zero to encourage emergent wetland flooding and prevent the channels from serving as dewatering structures.
- Maintain backwater structures as necessary to avoid lowering the wetland water table.

**References:** ADFG Habitat permit, ADOT/PF design and environmental documents, Inter-Fluve design and monitoring plans, ADFG annual monitoring reports, personal comm

Overview of portion of 37 Mile wetland channels in 2020.


Wetland Channel construction in July 2000 (left). Wetland Channels in 2001 (right).

Wetland Channels in winter January 2002 (left) and February 2005 (right).


Wetland Channels occasional go dry as in September 2004.


Wetland Channels are well established in 2005.


37 Mile wetland channel with backwater structure (left). Backwater structure floated out of place by flooding caused by beaver dam (right). 2020.


37 Mile wetland channel with woody debris (left). 37 Mile wetland channel with decomposing hay bale banks visible (right). 2020

## 37 Mile Wetland (ADOT/PF Mitigation Site WT-5)

**Project Type:** Wetlands Creation
**Project Location:** Between 59.43438, -136.23773 and 59.43870, -136.27243;
**Waterbody/Watershed:** Klehini River floodplain
**Anadromous Stream Number:** 115-32-10250-2077

**Project Need:** This wetland creation was designed as mitigation for the wetland and stream impacts resulting from the Haines Highway improvement project. As part of this highway upgrading, the ADOT/PF proposed constructing a significant proportion of the new highway on the floodplain of the Klehini River. This new alignment isolated and protected a portion of the floodplain, providing the opportunity for the creation of a wetland and stream complex.

**Goal(s):** To create emergent wetlands.

**Timeline:** Process initiated 1999. Construction Completed 1999-2001.

**Objectives:** Create 15.7 acres of wetlands in four separate cells.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities. *With assistance from: Inter-Fluve, Inc.*

**Methods Used:** The wetlands were designed to parallel the assumed groundwater slopes. The groundwater flows were driven by the adjacent Klehini River to the south, as well as 37 Mile Creek and the adjacent mountain range to the north. Initially, the existing floodplain material was graded to an elevation one foot below the final design elevation of the wetland surface. Meadow channels within the wetlands were laid out using hay bales as banks, and then imported wetland soil was placed on top of the floodplain material and graded to a depth of one foot, up to the edges of the stream channels. Four separate wetland cells were created, with the internal streams feeding into 37 Mile Creek. Some areas of existing vegetation within the cells were left intact. The wetlands were seeded with an emergent seed mix. Within each of the cells a 100 x 100 foot test plot was planted with handpicked native wetland seeds.

**Authorizations:** Army Corps of Engineers permit 2-920515. ADF&G Fish Habitat Permit FG 99-I(J)-56.

**Monitoring:** Monitoring was conducted by ADF&G from 2001-2006, and in 2011. At the end of the 5 year more extensive monitoring period the total area of the wetland cells was found to be composed of approximately 2/3 wetland, and 1/3 upland, with a total of 10.8 acres of wetlands.

**Project Outcome:** ***Moderately Successful***
In each of the four wetland cells the upstream ends of the cells tended to remain wetlands, while the downstream ends tended toward becoming predominantly uplands. The upstream ends had the greatest amount of upwelling, and remained much more saturated. The downstream ends were much better drained and transitioned rapidly from wetland to upland. Often the perimeter of the wetland cells also transitioned to upland.

**Lessons Learned:**

- The intent of the project was that all the created wetlands would remain wetlands, yet about 1/3 of the area reverted to uplands.
- The meadow channels constructed within the cells exceeded the design width to depth ratio of 1, and the width of the streams increased over time, as the hay bales decomposed. The streams did not, in all cases, back up the water level within the wetland cells to the elevation of the top of the wetland soil.
- The downstream end of each wetland cell tended to dry out, suggesting that design changes were needed to address variations in ground water upwelling. Smaller cells may have been more successful. Another possible design change may have been more active directing of channel water into the downstream end areas of the wetlands.

**Project Significance:** River floodplains are often associated with transportation corridors and can provide the opportunity for innovative mitigation projects. Protected wetland and stream habitat can be created to provide long-term areas of habitat productivity.

**Recommendations:**

- In similar conditions, create smaller wetland cells and terrace each of the cells to be relatively flat. Control the water elevation within each cell by matching the desired wetland water elevation to the elevation of water level of the adjacent stream at the wetland outlet.
- In similar conditions, minimize the width and depth of streams created within the wetland complex to avoid creating channels that may dewater the wetland.

**References:** ADFG Habitat permit, ADOT/PF design and environmental documents, Inter-Fluve design and monitoring plans, ADFG annual monitoring reports, personal comm.

Aerial view of 37 Mile Wetland cell WT-5A in 2020.

37 Mile Wetlands (WT-5) creation in July (left) and August (right) 2000.


WT-5 becoming established in 2001.


WT-5 has become established by 2006.

Non-wetland vegetation has begun encroaching in parts of 37 Mile Wetlands (WT-5) in 2006.

Wetland cell WT-5A (left) and WT-5B (right) in 2020.

Wetland cell WT-5C with dead willows, indicating change in hydrology (left) and Wetland cell WT-5D (right) in 2020.

## Chilkoot Weir Bank Stabilization

**Project Type:** Bank Stabilization
**Project Location:** 59.33014, -135.55715 and 59.33199, -135.55548
**Waterbody/Watershed:** Chilkoot River
**Anadromous Stream Number:** 115-33-10200

**Project Need:** The Alaska Department of Fish and Game operates a fish counting and sampling weir on the Chilkoot River. Bank erosion was occurring on the east side of the river, just upstream of the weir. Additionally, the river was undermining a large spruce tree on the south bank of the river, and threatening to overtop a jetty at the east end of the weir.

**Goal(s):** To repair and prevent further bank erosion at three locations and to reinforce the jetty at the end of the weir.

**Timeline:** Construction completed 2004.

**Objectives:**

1) Construct two rock vanes on the east bank designed to deflect high velocity flows away from the riverbank. Reinforce the existing bank at the same locations.
2) Construct a rock bench below the undermined spruce tree and built a rock vane just upstream to direct river flows away from the bank.
3) Widen and raise the existing jetty with rock.

**Responsible Organization:** Alaska Department of Fish and Game. *With assistance from: Natural Channel Design, Inc.*

**Methods Used:** The rock vanes were constructed of rock similar to that occurring in the Chilkoot River. The vanes were keyed into the bed of the river and consisted of footer rocks averaging 24" in diameter and top rocks averaging 36" in diameter. The vanes were about 25 feet in length. They were built with an upstream angle of 25 degrees and dipped slightly downward from floodplain elevation to the channel bed at the outer tip. The vanes were tied into the bank with reinforcing rock built up from the riverbed to the top of the bank.

To reinforce under the spruce tree a narrow rock bench was constructed. Unsorted angular rock was used to build the bench up to floodplain elevation, with the voids filled to minimize the risk of water flow through the fill. A rock vane was constructed just upstream of the rock bench.

The existing jetty at the east end of the weir was widened to a width of 10 feet and raised to the height of the adjacent vegetated floodplain. It was constructed of angular rock with an average diameter of less than one foot.

**Authorizations:** Army Corps of Engineers permit D-2003-1474. ADF&G Fish Habitat Permit FH 03-I(J)-24

**Monitoring:** No official monitoring program. Periodic inspection by ADF&G staff.

**Project Outcome:** ***Successful***
The rock vanes have functioned well to direct river flows away from the downstream banks. No further bank erosion has occurred in either the weir area or under the spruce tree. The jetty was partially eroded over time by high flood events and was eventually topped by a new section of the weir.

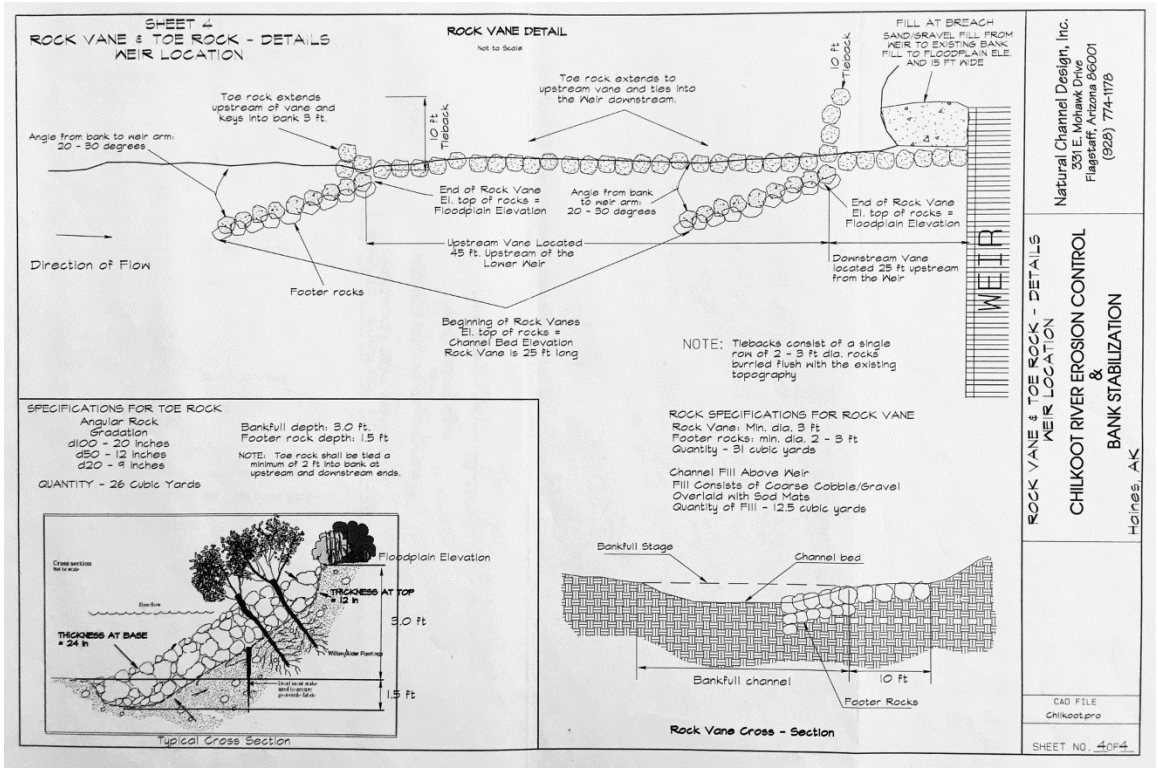
**Lessons Learned:**

- Rock vanes combined with bank reinforcement function well to deflect river flow away from the banks and to stabilize previously eroded banks.
- Rock jetties subject to the full force of river flood events need to be constructed of rocks specifically sized to withstand the hydraulic forces that will occur.

**Project Significance:** This project utilized a well-tested vane design to that both blended into the existing river and functioned to protect the banks.
**Recommendation:**

- Continue monitoring the conditions of the vanes to assure that the rock remains in place and the vanes function as designed.

**References:** ADFG Habitat permit, Natural Channel Design, Inc. plans and specifications, personal comm.



Design plan plan for Chilkoot Weir Bank Stabilization.

Bank stabilization and vane construction, 2004.

Vane above Chilkoot weir, 2020.

Vane and rock bench below the spruce tree, 2020.

## McKenzie Creek Restoration

**Project Type:** Stream Channel Manipulation
**Project Location:** 59.43994, -136.28030
**Waterbody/Watershed:** McKenzie Creek
**Anadromous Stream Number:** 115-32-10250-2077-3136-4010

**Project Need:** McKenzie Creek is a catalogued anadromous fish stream providing spawning, rearing, and migration habitat for coho salmon and Dolly Varden char. The creek is a tributary to 37 Mile Creek. McKenzie Creek intersects the old alignment of the Haines Highway and prior to this project was directed through two 6.5' diameter culverts, just above the confluence with 37 Mile Creek. Upstream of the culverts the stream is largely undisturbed, and retains its naturally occurring biological productivity. The existing culverts were not imbedded into the streambed but did provide adequate fish passage to upstream habitats.

**Goal(s):** Improve juvenile and adult fish passage. Create a new stream section that provides pool/riffle habitat, with possible spawning area. Create a floodplain terrace and well-vegetated riparian habitat.

**Timeline:** Process initiated 1999. Construction Completed 2001.

**Objectives:**

1) Remove existing culvert and create new 64' long stream channel, improving fish passage to upper reaches of the creek.
2) Create new stream section with pool/riffle morphology.
3) Increase habitat complexity within existing scour pool by adding large woody debris.
4) Vegetate riparian area and create floodplain terrace.

**Responsible Organization:** Alaska Department of Transportation and Public Facilities. *With assistance from: Inter-Fluve, Inc.*

**Methods Used:** The existing culverts were removed and a new stream channel was constructed. A notched log was installed at the upstream end of the new channel to limit subsurface flows through the newly constructed channel. The channel was constructed with one pool, and spawning gravel was placed at the pool tailout. A boulder complex was placed at the downstream end of the new channel to help maintain the stream morphology. One log was placed in an existing pool just downstream of the new channel. A 50' wide terraced floodplain was constructed to mimic the undisturbed stream contours, and the floodplain was vegetated with willow cuttings.

**Authorizations:** Army Corps of Engineers permit 2-920515. ADF&G Fish Habitat Permit FG 99-I(J)-55

**Monitoring:** Monitoring was conducted by ADF&G from 2001-2006, and in 2011.

**Project Outcome:** ***Successful***
Nearly 20 years after construction the stream channel is functioning as designed. The basic channel pool/riffle morphology has endured, though there has been some filling of the pool, and the gravel placed for spawning is cemented with silt and organic matter. The sill log is still in place, as are the placed boulders and LWD. The floodplain is well vegetated, and the riparian vegetation is well established. The new channel appears to provide good rearing habitat and has no impediments to the migration of juvenile or adult salmon. The old roadbed continues to be used as a transportation corridor for four wheelers with the associated cutting of vegetation, destruction of cut banks, and alteration of stream substrate.

**Lessons Learned:**

- Monitoring revealed that the revegetation of the riparian area was initially unsuccessful. A more intensive replanting plan would have allowed the site to attain full productivity more quickly.
- The construction of undercut banks would have improved the quality of the habitat for rearing fish.

**Project Significance:** This project exemplifies the successful replacement of culverts with a highly functional stream channel. It also illustrates the usefulness and durability of sill logs and boulder complexes to add stability over time.

**Recommendation:**

- Create a steam crossing structure for 4-wheelers to use as an alternative to driving through the stream.

**References:** ADFG Habitat permit, ADOT/PF design and environmental documents, Inter-Fluve design and monitoring plans, ADFG annual monitoring reports, personal comm

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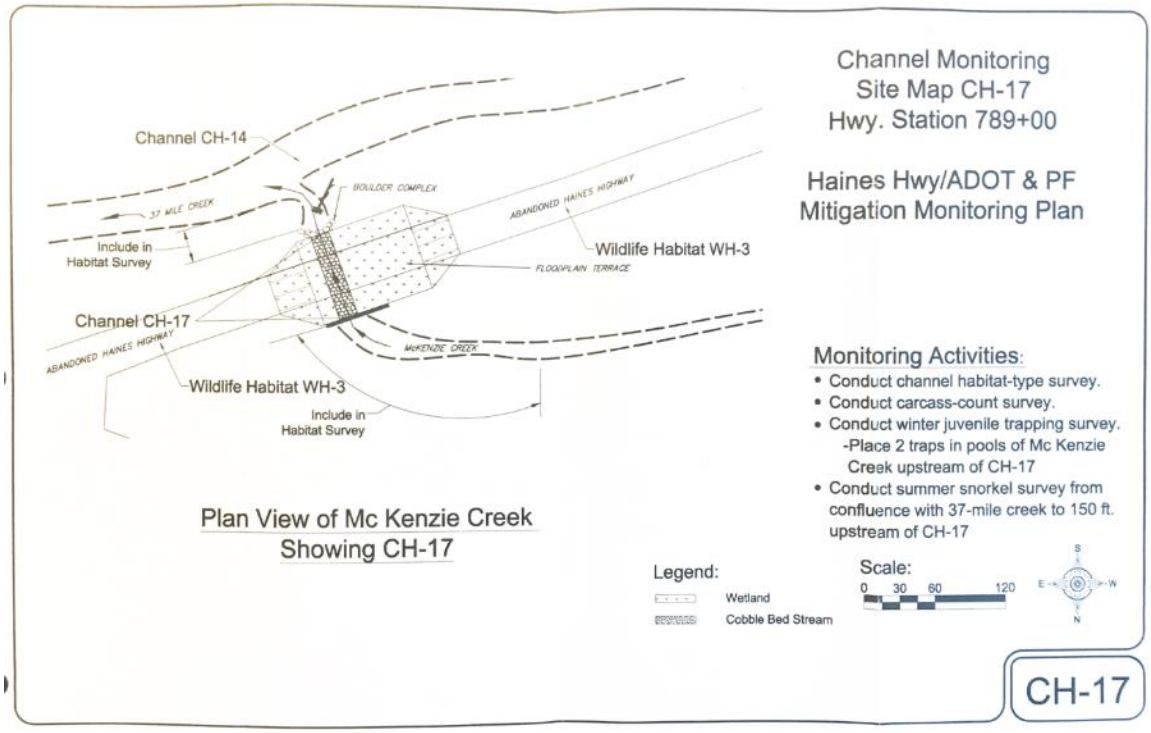


Plan view for McKenzie Creek restoration


McKenzie Creek in 2002.

MacKenzie Creek in 2006.

Restored McKenzie Creek channel from upstream end, sill log in the foreground (left). Restored McKenzie Creek channel from downstream end, placed boulders in the foreground (right). 2020.

## Sawmill Creek Restoration

**Project Type:** Fish Passage Improvement
**Project Location:** 59.23697, -135.45356
**Waterbody/Watershed:** Sawmill Creek
**Anadromous Stream Number:** 115-32-10300-2002-3019-4008

**Project Need:** Sawmill Creek is a catalogued anadromous fish stream that lies within the more urbanized parts of the city of Haines. It is a complex stream system composed of many distinct tributaries. The development of Haines has altered the stream in numerous places. This project focused on a section of a tributary that had likely been relocated sometime in the past. The existing stream alignment passed through a poorly designed culvert that limited fish access and was periodically blocked, causing the stream to divert through the forest. The stream was also eroding the clay substrate along its relocated alignment and creating a head-cut that further restricted fish access. There was substantial productive fish habitat upstream of the proposed restoration area. Both cutthroat trout and coho salmon use this tributary for spawning and rearing, and Dolly Varden char are also present.

**Goal(s):** Improve juvenile and adult fish passage. Enhance a portion of the existing stream and create a new stream section that provides pool/riffle habitat, with possible spawning areas. Create an effective floodplain and well-vegetated riparian habitat. Increase stream complexity.

**Timeline:** Process initiated 2001. Construction Completed 2004.

**Objectives:**

1) Relocate a portion of the stream to a new alignment, eliminating the need for a culvert.
2) Create new stream section with pool/riffle morphology.
3) Increase habitat complexity by adding large woody debris, both within the stream and within the floodplain.
4) Revegetate portions of the riparian zone.

**Responsible Organizations:** U.S. Fish and Wildlife Service. City and Borough of Haines. *With assistance from: Inter-Fluve, Inc. and Streamcraft.*

**Methods Used:** The new alignment and existing stream was mapped in detail with all riparian vegetation typed and located. Each pool and riffle section was located to utilize existing morphology and vegetation, including tree root systems. The initial excavation was completed with a small backhoe working on pads, minimizing the impact to vegetation and the banks. Large woody debris was distributed within the floodplains at the time of excavation and placed in the pool locations as they were excavated. After the excavation, riffle and spawning gravel was hauled in by wheelbarrow and placed by hand with tight elevation control. Additional woody debris was placed by hand. Revegetation was completed as part of a subsequent educational project.

**Authorizations:** Army Corps of Engineers permit D-2003-0894. ADF&G Fish Habitat Permit FH 03-I(J)-39

**Monitoring:** Monitoring was conducted by TWC.

**Project Outcome:** ***Moderately Successful***
Although most of the channel remains intact, major flood events have mobilized and redistributed much of the placed riffle and spawning gravel. Pool locations have shifted. Much of the smaller woody debris placed in the stream has been washed downstream. However, the placement of large woody debris in the floodplain has functioned effectively to slow flood flows and maintain channel alignment. Fish passage has been maintained, and the newly scoured pools should provide good rearing habitat. Significant amounts of gravel have washed out of the upstream portion of the stream and been deposited in a wide and flat area in the middle of the restored stream (see bottom photos on page 48). This area may function well for spawning, but may dewater at low flows.

**Lessons Learned:**

- Protection of existing riparian vegetation allows for stream banks to rapidly stabilize.
- Instream woody debris needs to be designed to withstand large flood flows.
- Structures designed to maintain constructed pool morphology must be sized for flood flows.

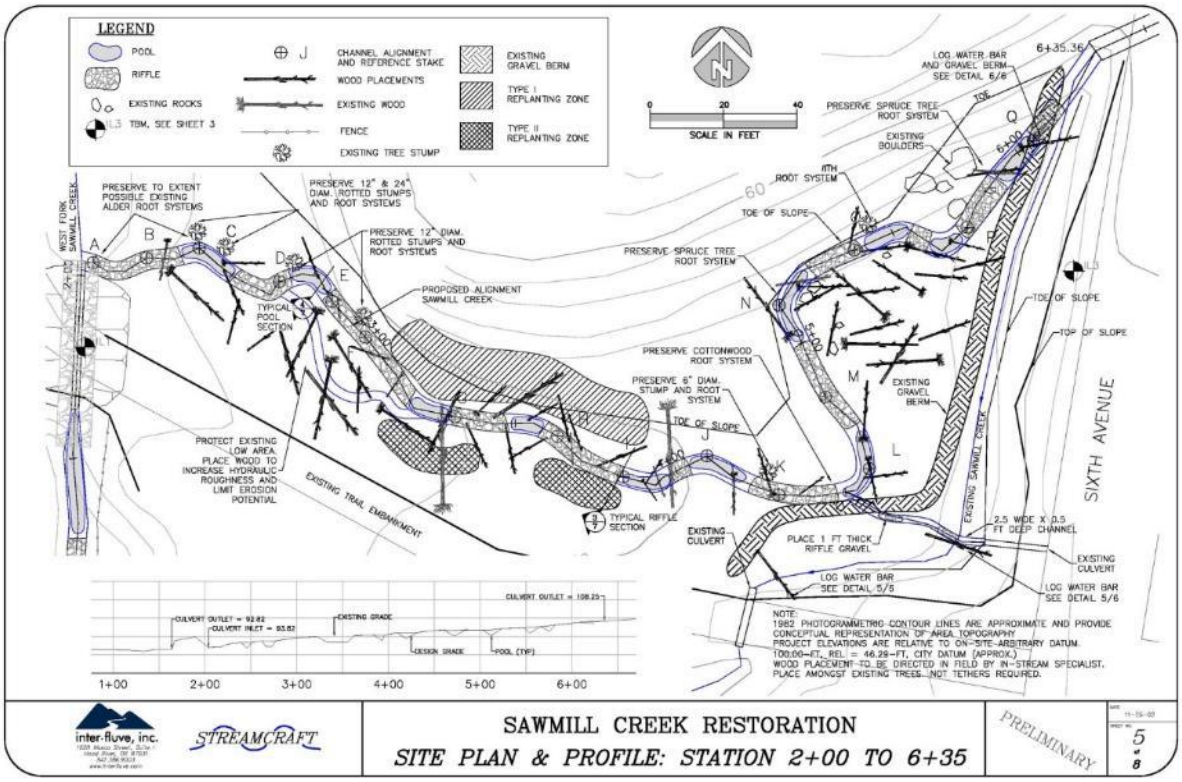
**Project Significance:** This project represents the successful restoration of a very urban stream and can serve as a model project for the continued restoration/enhancement of Sawmill Creek. The project is also very accessible to the local school and could be utilized as an educational laboratory.

**Recommendations:**

- Place some new large woody debris in the broad, midstream section of the restored stream. This wood should be placed to use water flows to recreate a narrower channel that will provide fish passage during low water.
- Seed the stream with new spawning gravel by periodically placing the gravel at the outlet of the culvert on 6$^{th}$ Avenue and allowing it to move downstream during high water events.
- Replace large wood as needed to recreate the structures necessary to form pools where designed. Use wood large enough to withstand flood flows.

**References:** ADFG Habitat permit, COE permit, Inter-Fluve, Inc and Streamcraft design, monitoring, and education plan, USFWS grant agreement, City of Haines project correspondence, TWC monitoring reports, personal comm.

Upper reach of restored stream channel in 2020.



Plan view for Sawmill Creek restoration.


Sawmill Creek channel construction September 2003.


Placing material in constructed channel October 2003 (left). Diverting stream into newly constructed channel in November 2003 (right).


Lower section of restored channel from midstream, post 2020 historic flood event (left). Mid-channel bend with recent erosion (right).

## Big Boulder Creek Bank Stabilization/Aquatic Habitat Improvement

**Project Type:** Bank Stabilization
**Project Location:** 59.4315, -136.1955
**Waterbody/Watershed:** Big Boulder Creek
**Anadromous Stream Number:** 115-32-10250-2077-3098

**Project Need:** Eroding bank could allow stream to enter adjacent material mining site that is below stream grade. This could dewater king salmon spawning habitat.

**Goal(s):** Stabilize eroding bank and improve aquatic habitat.

**Timeline:** 2008-2011

**Objectives:**
1) Stabilize eroding bank
2) Reestablish distributary channel
3) Improve aquatic habitat

**Responsible Organizations:** Takshanuk Watershed Council

**Methods Used:**
1. Regrade eroding slope 2:1
2. Install rock toe and root wads on eroding slope
3. Cable trees to boulders, bury willow poles, revegetated disturbed bank
4. Excavate new distributary channel
5. Place habitat features in distributary channel
6. Two years later additional habitat features were added

**Authorizations:** Fish Habitat Permit FH08-I-036; Amendment A in 2010

**Monitoring:** A five year monitoring program was conducted.

**Project Outcome:** ***Mostly Successful.*** The primary objective of stabilizing the eroding bank and preventing capture by the adjacent material mining site has been met. The distributary channel has not provided spawning habitat, but has diverted flow away from revetment.

**Lessons Learned:**
- Another example of the negative effects from restricting the flow on a high energy outwash fan, which concentrates and scours the active channel.
- Do not allow material mining sites adjacent to productive fish habitat.
- Regulating flow in a constructed distributary channel is tricky.
- Ensure that all partners and permitting agencies are being consulted during all phases of a project.

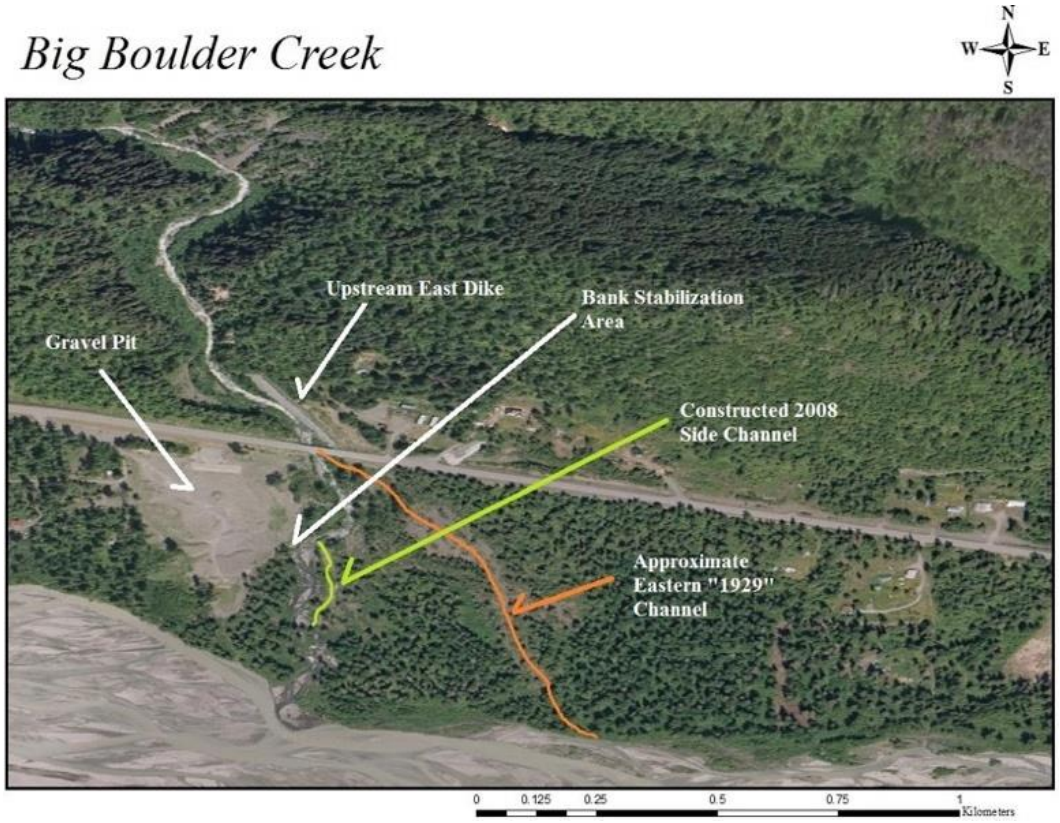
**Project Significance:** Big Boulder Creek was potentially one high water event away from being captured by adjacent material mining site.

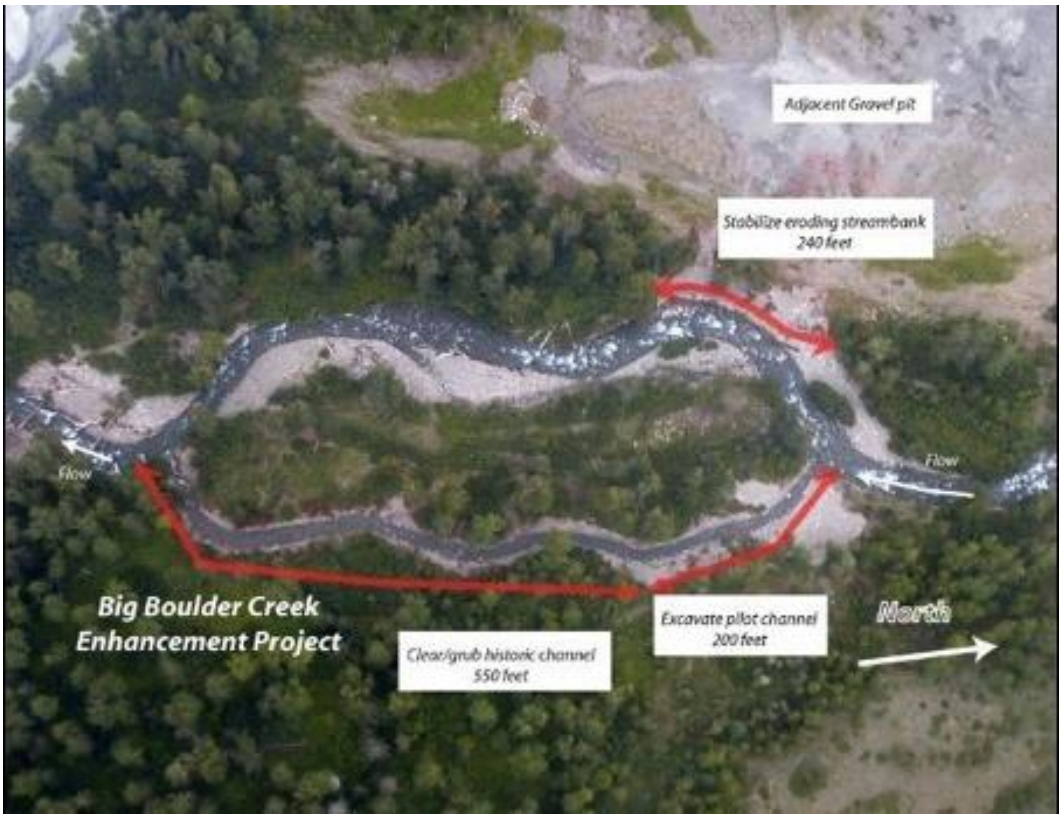
The Boulder Creeks are two of the only sites king salmon spawning can be observed from the road system in SE.

Big Boulder was the site of early habitat mitigation to compensate for impacts associated with installing a bridge.

**Recommendations:**
- While the revetment remains stable, there continues be a threat of stream capture by the adjacent material mining site. Reinforce revetment to increase stability and fish habitat.
- Consider adding additional flow to the distributary channel
- Consider reestablishing instream structures to break up the concentrated flow in the mainstem. This should increase spawning habitat for king salmon.

**References:** Habitat Permit and Amendment, TWC Project Documents, TWC Monitoring Reports, ADF&G Trip Reports (09/19/2008, 09/17/2014), ADF&G Memo 10/23/2013, personal comm.




Aerial imagery locating TWC project details.

Compromised bank before (left) and after (right) stabilization.

Pulling bank back from 1:1 (left) to 2:1 (right) slope in 2008.

Rock toe was placed and upper layer of rock was underlain with willow poles (left). Four rootwads were buried, cabled, and ballasted (right), and spruce revetment was placed above rock toe (not pictured).

Revetment with graded slope, toe rock, willow poles, root wads, and spruce trees in July 2008 (left). Revetment in 2020 (right).

Estimation of historic channels prior to bridge placement (left). Proposed features for channel construction (right).


Excavating historic channel (left). Alder and willow clumps planted along banks (right).


Rock cluster in channel (left). Monitoring includes photo points, x-sections, and spawning surveys (right).

Completed channel in 2010.

## Chilkat River Commercial Raft Takeout

**Project Type:** Bank Stabilization
**Project Location:** 59.3300, -135.7470
**Waterbody/Watershed:** Chilkat River
**Anadromous Stream Number**: 115-32-10250

**Project Need:** River bank was eroding due to commercial raft take out operations in the Chilkat Bald Eagle Preserve.

**Goal(s):** Restore vegetation to stabilize bank while conducting a workshop using techniques developed on the Kenai River.

**Timeline:** Spring 2005 & 2011.

**Objectives:**
1) Stabilize eroding bank
2) Provide for commercial raft take-out.
3) Demonstrate techniques developed on the Kenai River

**Responsible Organization:** ADF&G-SF, DPOR

**Methods Used:**
1. Coir log was staked with locally harvested shrub stakes just above OHWL
2. Hand held drill used to assist placing live willow stakes

**Authorizations:** Fish Habitat Permit FH05-I-0021 & FH11-I-0046, NWP 13 (COE), Special Parks (DPOR), Special Area Permit (ADF&G)

**Monitoring:** Pre and post photos were taken. Habitat Division has done two site visits to document progress

**Project Outcome:** ***Successful.*** A primary reason for project success was that commercial raft take outs ceased in this area after the second restoration effort, which was the prime disturbance.

**Lessons Learned:** The initial design included a cabled spruce tree revetment in front of the staked coir log and a light penetrating grate for retrieving rafts. As the site use changed these features were not needed. Sport fishing activity, especially in the fall, continues to impact this site.

**Project Significance:** This project is located in the Chilkat Bald Eagle Preserve, commercial operations are to only occur if they do not impact bald eagles and fish habitat which attracts eagles.

This site has revegetated and stabilized as desired. However, commercial raft takeouts have severely impacted the currently used site downstream. The nearby downed tree has increased fish habitat at this site, though bank stability has also been compromised.

**Recommendations:**
- All commercial raft take out sites need to be monitored and remediated if necessary.

**References:** Fish Habitat Permits, ADFG Habitat Division Field reports. personal comm.

Revegetated site in 2020.


Raft takeout location in September 2004 (left). ADF&G, Division of Parks, and Chilkat Guides work on revegetating the raft takeout area in March 2005 (right).


Willow cuttings growing in June 2005 (left). Some willows are surviving in June 2006, but bank continues to unravel (right).


Another restoration project was initiated in August 2011.

A DF&G Sportfish Div conducted a restoration workshop attended by TWC, SAWC, and local volunteers (left). Restoration site in May 2012, and coir log with live staking (right).

Site in November 2015 (left). Site in September 2018 after tree fell (right).

## Chilkat River - Klukwan Cultural Center Engineered Logjam

**Project Type:** Bank Stabilization
**Project Location:** 58.3980, -135.8850
**Waterbody/Watershed:** Chilkat River
**Anadromous Stream Number**: 115-32-10250

**Project Need:** The Chilkat Indian Village (CIV) determined to build their Cultural Center adjacent to the Chilkat River and needed to protect their investment from the threat of erosion.

**Goal(s):** Stabilize the bank adjacent to the Chilkat Indian Village Cultural Center without compromising fish habitat.

**Timeline:** Winter 2008, 2012 and 2013.

**Objectives:**

1) Stabilize river bank adjacent to the CIV Cultural Center
2) Improve fish habitat
3) Demonstrate alternative bank stabilization technique

**Responsible Organization:** Chilkat Indian Village

**Methods Used:**

1. CIV wanted to considered alternative bank protection techniques; ADF&G funds provided a design.
2. CIV approved the proposal and extra construction cost.
3. RFP released seeking design proposals.
4. Herrera was selected and provided designs and construction oversight.
5. Project was designed for three phases, the third phase below the boat ramp has yet be built or needed.

**Authorizations:** Fish Habitat Permit FH07-I-0134

**Monitoring:** Post project photos were the only monitoring. A one year, multi-seasonal minnow trapping project was completed by TWC for CIV.

**Project Outcome:** *Successful.* The river bank became stabilized and revegetated. Erosion is not currently an issue in this location 15+ years later. Limited minnow trapping indicates the structure is used year-round by king and coho juvenile salmon.

**Lessons Learned:** ADF&G worked with CIV to hire a design firm for an engineered logjam revetment plan.

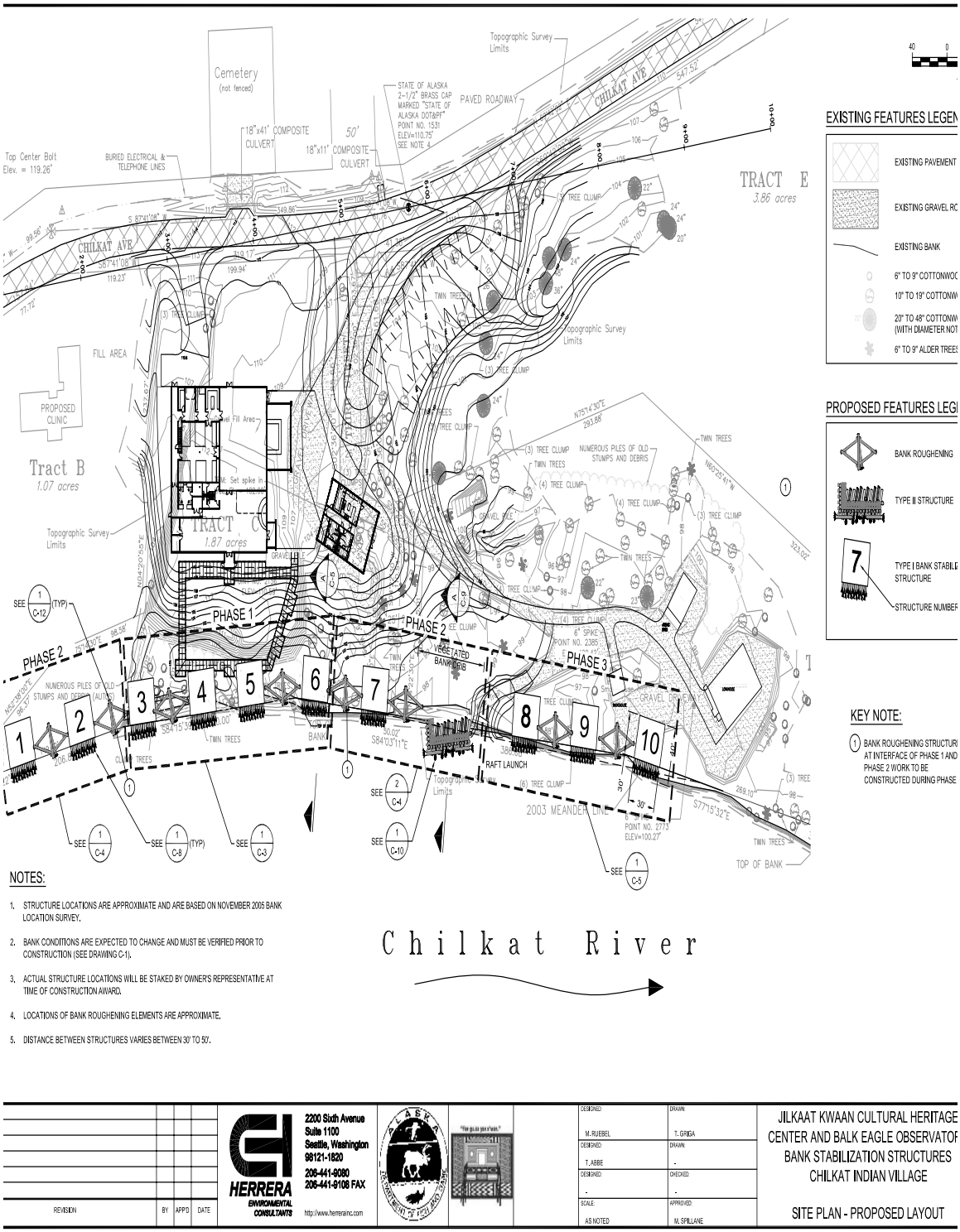
Alternatives to riprap are feasible for long-term bank stabilization and can also improve fish habitat.

**Project Significance:** This project was a demonstration of alternative bank stabilization techniques on a large high energy river to protect important infrastructure and provide improved fish habitat.

**Recommendations:**

- Better document monitoring efforts.
- Better document fish habitat and use.

**References:** OHMP Permit, personal comm, TWC Minnow Trapping Report, NRCS-CIV ltr, ADF&G RFP, Herrera documents.




NOTES:

1. STRUCTURE LOCATIONS ARE APPROXIMATE AND ARE BASED ON NOVEMBER 2006 BANK LOCATION SURVEY.
2. BANK CONDITIONS ARE EXPECTED TO CHANGE AND MUST BE VERIFIED PRIOR TO CONSTRUCTION (SEE DRAWING C-1).
3. ACTUAL STRUCTURE LOCATIONS WILL BE STAKED BY OWNER'S REPRESENTATIVE AT TIME OF CONSTRUCTION AWARD.
4. LOCATIONS OF BANK ROUGHENING ELEMENTS ARE APPROXIMATE.
5. DISTANCE BETWEEN STRUCTURES VARIES BETWEEN 30' TO 50'.

| REVISION | BY | APP'D | DATE |
|---|---|---|---|

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue
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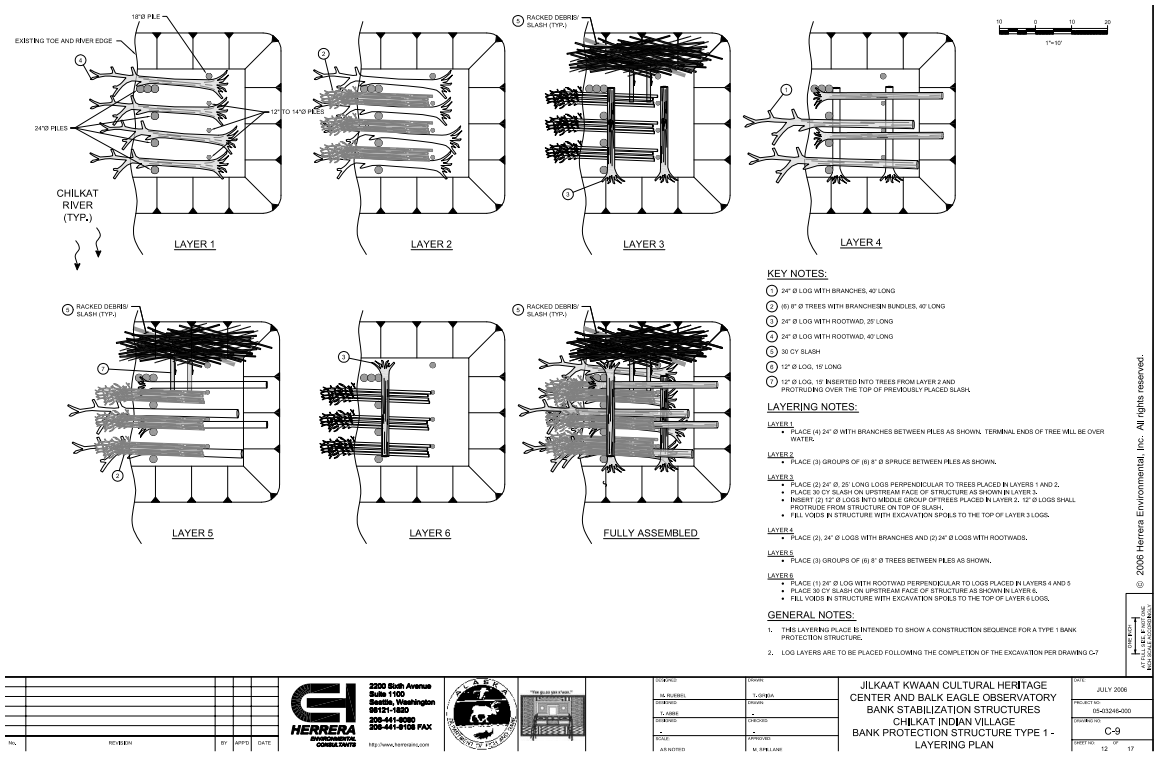
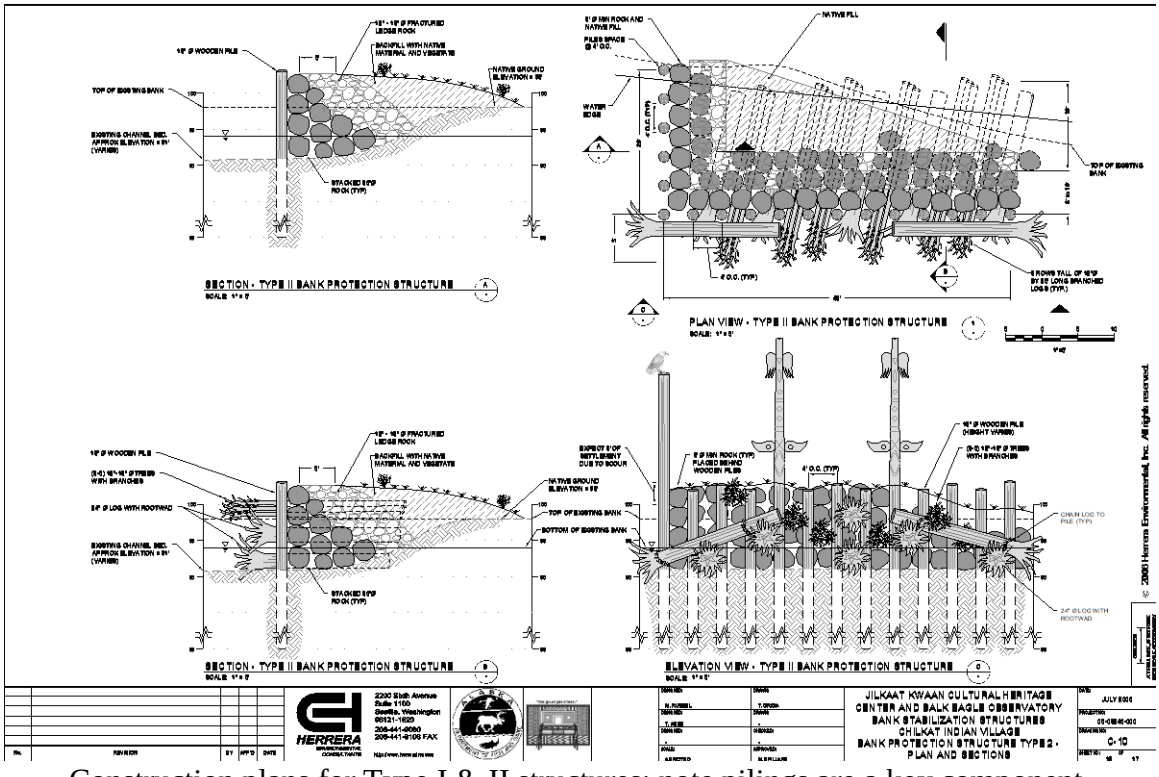
| | |
|---|---|
| DESIGNED: M. RUEBEL | DRAWN: T. GRIGA |
| DESIGNED: T. ABBE | DRAWN: - |
| DESIGNED: - | CHECKED: - |
| SCALE: AS NOTED | APPROVED: M. SPILLANE |

JILKAAT KWAAN CULTURAL HERITAGE CENTER AND BALK EAGLE OBSERVATOF
BANK STABILIZATION STRUCTURES
CHILKAT INDIAN VILLAGE

SITE PLAN - PROPOSED LAYOUT

The original site plans from 2006.




Construction plans for Type I & II structures; note pilings are a key component.


Type I & II structures shortly after construction in April and July 2008 (left). By August 2009, some revegetation has started (right).


By July 2010, revegetation and site recovery has started (left). By May 2011, debris accumulation on structures and revegetation continue (right).


In early 2012, pilings are driven for Phase II and prep work is complete by July (left). Phase II construction in May 2013 (right).


Phase II construction (left) contrasts with Phase I construction (right) in May 2015.


Revegetation progress in July 2016 (left). Use at the boat ramp inhibits revegetation (left).


Site in February (left) and August (right) 2017.


Bank complexity in May 2020 (left). Steep at boat ramp (right).

## Chilkat River - Kelsall Road Bank Stabilization

**Project Type:** Bank Stabilization
**Project Location:** 59.4805, -135.0491 Kelsall Road just upstream from boat landing
**Waterbody/Watershed:** Chilkat River
**Anadromous Stream Number**: 115-32-10250

**Project Need:** A distributary channel of the Chilkat River that leads to an area known as Bear Flats was eroding into the Kelsall Road. This road provides access to the Haines State Forest for recreation and logging operations.

**Goal(s):** Stabilize the bank adjacent to the Kelsall Road without compromising fish habitat.

**Timeline:** October 2003.

**Objectives:**
1) Stabilize river bank along Kelsall Road
2) Demonstrate alternative bank stabilization technique

**Responsible Organization:** Division of Forestry (DOF), Haines State Forest

**Methods Used:**
1. Contractor harvested small spruce trees to place along effected bank
2. Cables with duck-bill anchors secured trees in place

**Authorizations:** Fish Habitat Permit FH03-J-036

**Monitoring:** Post project photos were the only monitoring

**Project Outcome:** *Successful.* The river bank became stabilized and revegetated. Erosion is not currently an issue in this location 15+ years later. Large commercial jet boats no longer use this channel, so primary erosive force is gone.

**Lessons Learned:** ADF&G worked with DOF to develop a plan and purchased the duck-bill anchors. DOF provided the contractor to complete the project.

**Project Significance:** This project was an early demonstration of alternative bank stabilization techniques, providing a low-cost method to stabilize a low energy river bank and provide improved fish habitat. The small spruce trees proved effective in dissipating the energy from boat wakes, the primary energy source.

**Recommendations:**
- Better document monitoring efforts.

**References:** OHMP Permit, personnel comm

By 2020, the spruce trees are rotting away, but vegetation is becoming established.

Streambank shortly after installation of spruce trees in October 2003.

Streambank in May 2004 (left) and August 2004 (right). Spruce trees were defoliating by August.

Cables holding spruce trees in 2020 (left) and 2003 (right).

## Klehini River - Riprap Revetment

**Project Type:** Banks Stabilization
**Project Location:** 59.4315, -136.2219 Haines Highway 35-37 Mile
**Waterbody/Watershed:** Klehini River, 37 Mile Creek, Spring Pond Creek
**Anadromous Stream Number**: 115-32-10250-2077, 115-32-10250-2077-3136, 115-32-10250-2077-3130

**Project Need:** ADOT determined that to upgrade the Haines Highway to improve safety and operational efficiency it needed to move the roadbed into the Klehini River floodplain near mileposts 35-37.

**Goal(s):** Protect the highway prism where it enters the Klehini River floodplain. Allow fish passage for 37 Mile and Spring Pond Creeks where they exit through the revetment.

**Timeline:** Summer 2000 & 2005 - 2006.

**Objectives:**
1) Design and construct a revetment to withstand the Klehini River
2) Allow fish access through the revetment.

**Responsible Organization:** ADOT

**Methods Used:**
1. Original revetment was built, against ADF&G recommendations.
2. Additional reinforcement was placed upstream of 37 Mile Cr culvert
3. As revetment unraveled, additional riprap was placed at the toe.
4. Additional riprap was placed around the 37 Mile Cr culvert.
5. root wads with boles were embedded in revetment below 37 Mile Cr culvert.

**Authorizations:** Fish Habitat Permit FH05-I-075&A, FH05-I-020, FH04-I-0100, FH03-I(J)-40, and FH99-J-054 & numerous amendments.

**Monitoring:** Habitat Division did a site visit. This was not included in the project monitoring plan.

**Project Outcome:** ***Successful to date.*** The road prism and fish passage have been maintained since the final upgrade in 2006. The aggrading nature of the Klehini River at this location has resulted in the toe of the revetment being buried, leaving the upper revetment susceptible to erosion.

37 Mile Creek has year around access through the revetment. Spring Pond Creek is more problematic, but the habitat is much less extensive.

**Lessons Learned:** Always double check hydraulic calculations during revetment design.

Routing a culvert through a revetment is a design challenge.

**Project Significance:** ADOT was determined to relocate this section of the Haines Highway into the floodplain of the mainstem Klehini River. This was ostensibly to save construction and maintenance costs. ADOT proposed significant mitigation and monitoring projects to reach a no significant impact finding. In an effort to keep costs down the revetment was designed with 1.5-1 slope with bump outs to direct current away from the revetment using 37,000 cy of class 3 riprap.

In 2003, 2004 and 2005 Fish Habitat permits were issued to repair the revetment and reestablish fish passage through the revetment.

In August 2005 it was determined the revetment needed to be redesigned, the bump outs were too close and flow was being directed at the revetment. The slope was reset to 2:1 and an 18’ launch apron constructed utilizing an additional 85,000 cy of class 3 riprap.

**Recommendations:**

- Monitor this revetment regularly to document aggradation and potential failure.
- Future monitoring of the associated mitigation projects should continue to determine efficacy.
- Continue to monitor fish passage through the revetment.

**References:** ADFG Fish Habitat permits, personal comm., and ADFG Habitat Division Field report, personal comm.

During construction in 2000 (left). Parts of the revetment start to unravel by 2003 (right).

Road failure began in 2004 (left) and reconstruction was started that year (right).

A complete rebuild was undertaken in 2006.

## Cannery Creek - Culvert Installation and Channel Improvements

**Project Type:** Fish Passage Improvement
**Project Location:** 59.1709, -135.3873; Mud Bay Road, Letnikof Cove
**Waterbody/Watershed:** Cannery Creek
**Anadromous Stream Number**: 115-32-10230

**Project Need:** Failing perched 48" culvert restricts fish passage to high tides only. This stream provides important rearing habitat for coho salmon from the adjacent Chilkat River.

**Goal(s):** Provide fish passage at all tide levels.

**Timeline:** Spring 2014.

**Objectives:**
1) Replace failing culvert
2) Provide fish passage for juvenile fish at all tide levels.

**Responsible Organization:** TWC

**Methods Used:**
1. Work area was isolated, fish removed and water pumped around
2. Old culvert was removed and stream bed graded to remove perch
3. New culvert installed with rock weir and bed material in culvert

**Authorizations:** Fish Habitat Permit FH13-I-0068, COE NWP

**Monitoring:** Pre and post photos were taken along with a stream profile.

**Project Outcome:** ***Successful.*** During dry periods this streams flow goes subsurface. This occurred prior to the project completion as well. Willow stakes were not successful, too rocky and dry, but due to the location would not have contributed to significant habitat improvement. Additional willow stakes were planted in spring 2021 and were establishing growth when checked in June 2021.

**Lessons Learned:** This was a fairly straight forward project that was completed with minimal complications. A design firm was hired to conduct a hydrologic analysis and determine the correct culvert.

During a large storm in December 2020 the undersized twin culverts upstream were plugged and caused severe erosion at the inlet of this culvert.

**Project Significance:** There appears to be no spawning habitat for coho salmon in this stream, but provides important rearing habitat for juvenile coho salmon that are departing the Chilkat River. This is also a very public space and was a good opportunity to work with the private landowner, who is in the commercial salmon processing business.

**Recommendations:**
- continue to monitor
- replace the upstream culverts that are inadequately designed.

**References:** ADFG Fish Habitat permit, personal comm., TWC documents and ADFG Habitat Division Field reports (07-06-2012, 07-16-2014, 07-06-2015, 11-05-2015).


Cannery Creek drainage area (left). Old culvert outlet and inside drainage in 2013 (right).

Cannery Creek stream diversion (left) and old culvert removal (right).


New culvert installation in spring 2014.


Filling between baffles during culvert installation.


Culvert outlet and channel post construction in 2014

## Cliff Creek - Culvert Installation and Channel Improvements

**Project Type:** Fish Passage Improvement
**Project Location:** 59.4209º N, 136.1440ºW, T28S, R55E, Section 30, CRM, Skagway B-3, Haines, Alaska
**Waterbody/Watershed:** Cliff Creek
**Anadromous Stream Number**: 115-32-10250-2077-3075

**Project Need:** The Haines Borough wanted to relocate a portion of the Porcupine Road into the Klehini River floodplain to avoid a precipitous route carved into a cliff.

**Goal(s):** Provide fish passage and improve fish habitat in Cliff Creek as mitigation for working on the floodplain.

**Timeline:** Summer 2005.

**Objectives:**
1) Excavate excess material out of the stream channel for 1800' to 2' depth.
2) Excavate out two 50' long by 30' wide pools to 3' depth.
3) Install 6' high, 8' wide 43' long culvert.

**Responsible Organization:** Haines Borough

**Methods Used:**
1. Work was done in the dry, during a low water period.

**Authorizations:** Fish Habitat Permit FH05-I-0107

**Monitoring:** No monitoring was conducted, some pre and post project photos were taken.

**Project Outcome:** ***Partially Successful.***
The culvert was not set below the stream channel as permitted. A minimal amount of bed material is on the bottom of the culvert. Due to the flat gradient fish passage does not appear to be impeded.

There is no existing evidence of the two excavated ponds.

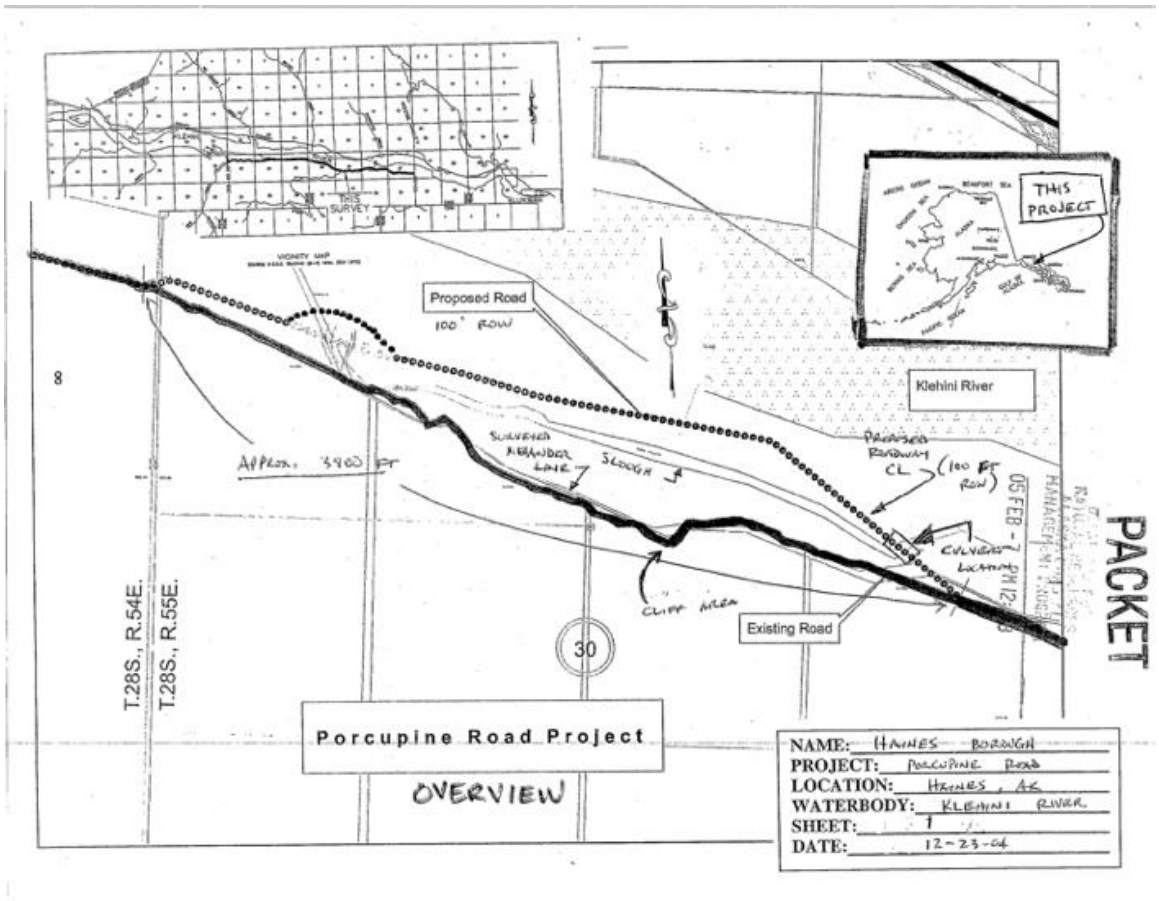
Alders have become established along most of the stream bank and provide stability and cover.

**Lessons Learned:** Ensure it is clearly understood that culverts must be set below the stream bed when discussing with the permittee.

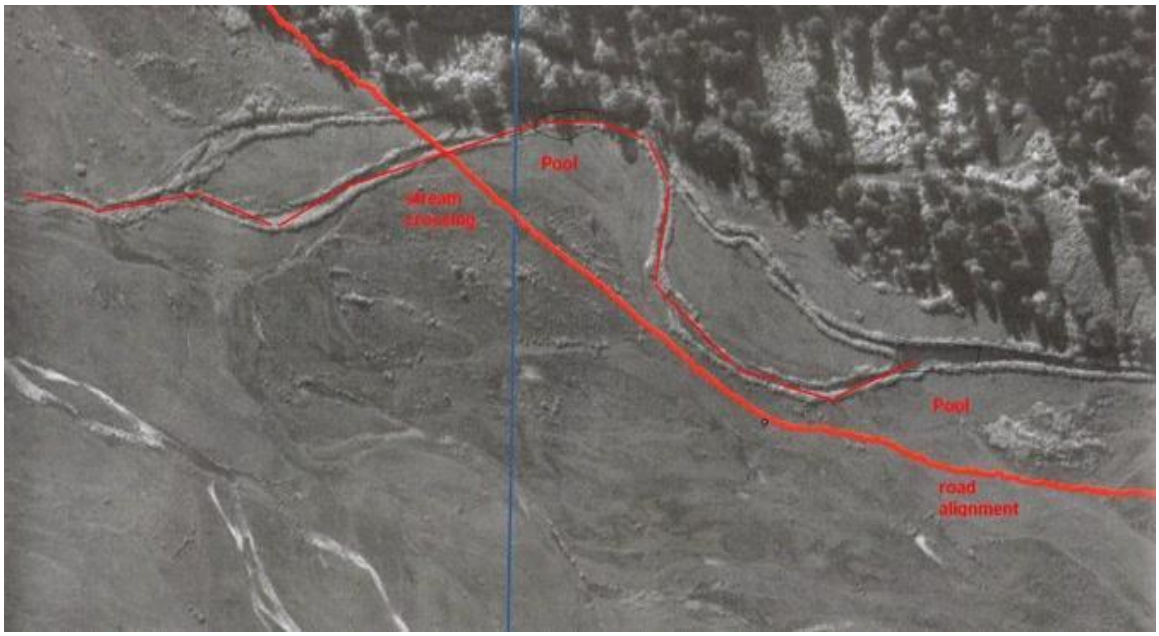
**Project Significance:** This project is on the Klehini River floodplain, to date the active channel of the river has not encroached, but this is only a matter of time. Besides providing recreational access, this new route is the primary route for commercial logging and mine exploration activities.

**Recommendations:**
- Monitor the active Klehini River channel and determine fish usage of this channel.

**References:** ADFG Habitat permit, personal comm., and ACMP review docs, Habitat Div Trip Report (05-19-2005)




Plan view of proposed road layout with pool locations.




Creek and existing road.


Road alignment and culvert location prior to construction in 2005 (left). Culvert outlet in 2007 (right).


Outlet channel in 2007 (left). Channel above culvert, looking toward proposed pool (right)

Culvert inlet in 2020.

## Sawmill Creek Tributary - Culvert Replacement and Channel Improvements

**Project Type:** Fish Passage Improvement
**Project Location:** 59.2402, -135.4618; Comstock Road, Haines
**Waterbody/Watershed:** Sawmill Creek tributary

**Anadromous Stream Number**: 115-32-10300-2002-3013

**Project Need:** Failing perched 24" culvert blocks upstream fish passage. This stream provides important habitat to coho salmon and cutthroat trout.

**Goal(s):** Provide fish passage up and downstream.

**Timeline:** Summer 2012 and 2017.

**Objectives:**
1) Remove perched and failing culvert
2) Provide fish passage up and downstream.
3) Provide stable habitat below culvert.

**Responsible Organization:** TWC, ADOT, USFWS

**Methods Used:**
1. Work area was isolated, fish removed and water pumped around
2. Old culvert was removed and stream bed graded to remove perch
3. New culvert installed with rock weir and bed material in culvert
4. Several years later the downstream area was reinforced due to scour and incursion from a neighboring property owner.

**Authorizations:** Fish Habitat Permit FH10-I-0070, FH12-I-013, FH17-I-007

**Monitoring:** Pre and post photos were taken along with stream profiles and minnow trapping. Habitat Division has done multiple site visits to document progress.

**Project Outcome:** ***Successful.*** Fish passage has been maintained, but project modifications were required due to confined nature of outlet channel and close proximity of residential structures.

It was also noted during monitoring that an adjacent homeowner had placed riprap along the bank below the culvert. While this has been subsequently permitted, the riprap does encroach on the stream channel.

**Lessons Learned:** The initial design was inadequate and did not account for utility lines in the work area.

Monitoring revealed degradation of the downstream channel and minor modifications needed for the culvert to retain water. Additional funding was secured to address these issues.

Ensure all partners and permitting agencies are kept current as a project evolves.
- Always check for utility line conflicts prior to starting a design
- Ensure design has multiple reviews prior to moving forward

An adequately designed culvert will not only pass fish as required, but also pass flood flows with minimal impact. A December 2020 storm cause widespread damage throughout the Haines townsite, including many plugged and over topped culverts. However, minimal disturbance was noted at this site.

**Project Significance:** This is a highly visible location in a residential area and had been noted for fish passage blockage for many years.

Coho salmon have been documented above the culvert by ADF&G and TWC, nominations have been submitted to extend the Anadromous catalog.

**Recommendations:**

- continue to monitor access channel and baffles.
- ensure riprap does not obstruct channel and compromise fish passage.

**References:** Fish Habitat Permits, ADFG Habitat Division Field Trip reports (08-21-2015, 08-17-2017, 09-17-2017, 12-06-2017, 04-18-2018, 08-22-2018, 01-29-2019), 2018 & 2020 TWC Monitoring Reports.

Culvert inlet and outlet before replacement on August 8, 2012.

Preparations for culvert replacement (left) and culvert installation (right) in August 2012.

Tram for infilling the culvert between baffles (left). Culvert infill shortly after completion (right).

Culvert outlet shortly after completion in August 2012 (left) and later in May 2013 (right).

Culvert outlet pre and post channel reconstruction in 2017.

Outlet channel pre (left) and post (right) construction. Note the riprap added by homeowner.

Outlet channel being encroached by riprap in October 2020 (left). After flood event in December 2020 (right).

## Muskrat Creek - Culvert Replacement

**Project Type:** Fish Passage Improvement
**Project Location:** T. 28 S., R. 56 E., Sect. 30, C.R.M. (Skagway B3), Duck Marsh Road, 1/4 mile north of Haines Highway
**Waterbody/Watershed:** Muskrat Creek
**Anadromous Stream Number**: 115-32-10250-2143-2081

**Project Need:** A steeply pitched 18" culvert impounded water above the roadbed and was perched 2' above the streambed below. This impeded fish passage up and downstream and restricted the use of habitat above Duck Marsh Road.

**Goal(s):** Restore fish passage and provide access to habitat above Duck Marsh Road to adult and juvenile coho salmon.

**Timeline:** September 2004.

**Objectives:**
1) Replace undersized perched culvert
2) Restore anadromous fish access above Duck Marsh Road

**Responsible Organization:** Haines Borough, TWC, ADF&G, USUSFWS, NOAA

**Methods Used:**
1. Work area isolated, fish removed, and dewatered
2. Old culvert replaced, bed material placed in new culvert.
3. Disturbed banks stabilized, contoured and seeded.

**Authorizations:** Fish Habitat Permit FH04-I-0111, and Amendment

**Monitoring:** A Monitoring Plan was developed for this project. However, it appears photo documentation and minnow trapping only was performed at this site.

**Project Outcome:** ***Successful.*** Juvenile coho salmon were observed and trapped immediately after the culvert was replaced. The culvert and fish passage appear stable after 15+ years.

**Lessons Learned:** Engaging multiple local, state and federal agencies greatly increases a project's chances of success.

**Project Significance:** This project was an early demonstration of how Takshanuk Watershed Council was able to identify a fish habitat concern and work with local, state and federal authorities to remedy the problem.

Unimpeded access to approximately 1000' of high quality fish habitat was restored.

**Recommendations:**
- Better document monitoring efforts.
- Document extent of anadromous fish use.

**References:** OHMP Permit, ADF&G Muskrat Creek Habitat Survey, TWC Project Description, Haines Borough RFP, Keta Engineering Hydrological Analysis, Monitoring Plan and Final Design Plan


Culvert outlet (left) and inlet (right) before replacement in 2002.

Culvert installation in 2004.

Culvert inlet (left) and outlet (right) approximately three weeks after installation in 2004.

Culvert inlet in January 2005 (left) and June 2005 (right).

Culvert outlet in June 2005 (left) and November 2005 (right).

## Sawmill Creek - 6th & Union St, Culvert Installation and Channel Improvements

**Project Type:** Fish Passage Improvement
**Project Location:** 59.2378° N, 135.4527° W, Section 27, T 30 S., Range 59 E, CRM, Skagway A-2; 6th & Union St, Haines

**Waterbody/Watershed:** Sawmill Creek tributary.
**Anadromous Stream Number**: 115-32-10300-2002-3019-4008

**Project Need:** Original culvert was too narrow and steep to provide fish passage.

**Goal(s):**. Provide up and downstream fish passage for adult and juvenile salmonids.

**Timeline:** June 2008

**Objectives:**
1) Provide fish passage

**Responsible Organization:** ADOT

**Methods Used:**
1. Original culvert was dug up
2. Place new culvert

**Authorizations:** Fish Habitat Permit FH07-I-0010

**Monitoring:** There was no official monitoring, but ADF&G field trip reports documented anadromous fish above the new culvert.

**Project Outcome:** ***Successful.*** The old culvert inlet was 24" and mostly buried under sediment. The culvert outlet was 48" and relatively new. How these two were joined was unknown. This culvert is deeply buried under two roads and a borough parking area that increased difficulty and cost of this project.

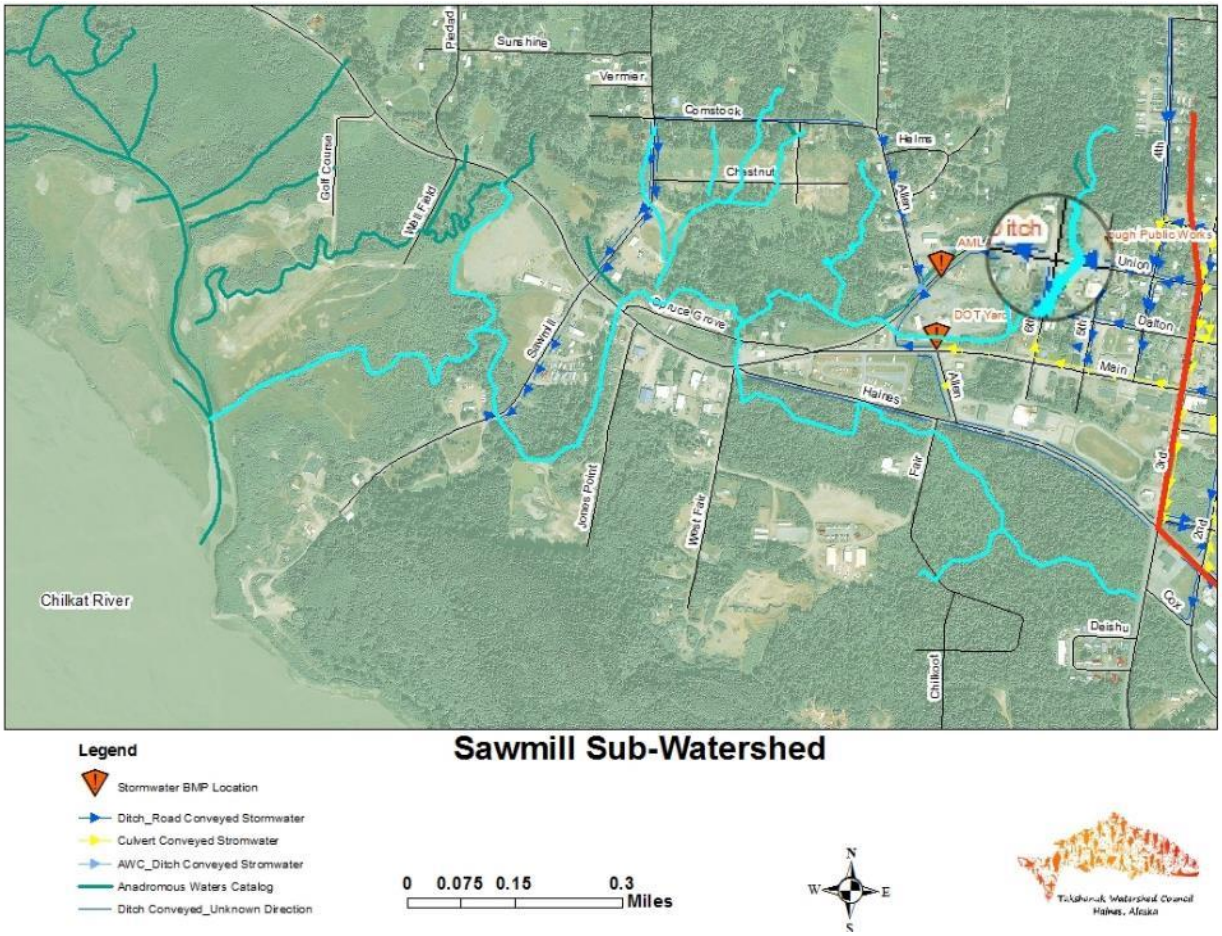
**Lessons Learned:** This baffled culvert was able to provide fish passage in this steep culvert (3%). Baffles placed at an angle, all aligned the same way (note in photo on page 80).

**Project Significance:** This culvert provided access to approximately 1000' of suitable habitat. This project is also located immediately upstream of a TWC restoration project that improved fish habitat in Sawmill Creek.

Haines Borough relocated sand piles to eliminate sediment from entering stream. This was observed during project reconnaissance.

**Recommendations:**
- Continue to monitor how baffles hold sediment.

**References:** ADFG Habitat Division Field Trip reports (06-24-2010, 07-12-2010, 11-24-2010, 08-09-2012) ADF&G culvert survey, TWC Stormwater Report 2019.




Project located in circled area.

Culvert outlet pre replacement in 2008 (left). New culvert installation in 2008 (right).

Culvert inlet (left) and outlet (right) shortly after installation in 2008.

Culvert outlet in May 2012 (left). Inlet baffles in October 2020 (right).

Culvert inlet (left) and outlet (right) in October 2020.

## 37 Mile Creek Trib - Culvert Installation

**Project Type:** Fish Passage Improvement
**Project Location:** T. 28 S., R. 54 E. Sections 24, C.R.M. 38.5 Mile HH Access Road
**Waterbody/Watershed:** 37 Mile Creek Tributary
**Anadromous Stream Number**: 115-32-10250-2077-3136-4053

**Project Need:** Failing bridge required removal to ensure fish passage. Seven foot diameter culvert proposed as replacement.

**Goal(s):** Remove debris from failing bridge, provide vehicle access to subdivision and fish passage up and downstream.

**Timeline:** Summer 2005.

**Objectives:**
1) Remove debris from failing bridge
2) Provide adequate fish passage

**Responsible Organization:** Jim Studley, Haines Real Estate

**Methods Used:**
1. Permit application denied due to concerns regarding fish passage with proposed culvert.
2. FishPass analysis by ADF&G contradicts upstream ADOT analysis and permit granted.
3. Old bridge removed and culvert installed.

**Authorizations:** Fish Habitat Permit FH05-I-0039

**Monitoring:** Habitat Division conducts several site visits and recommends remedial action.

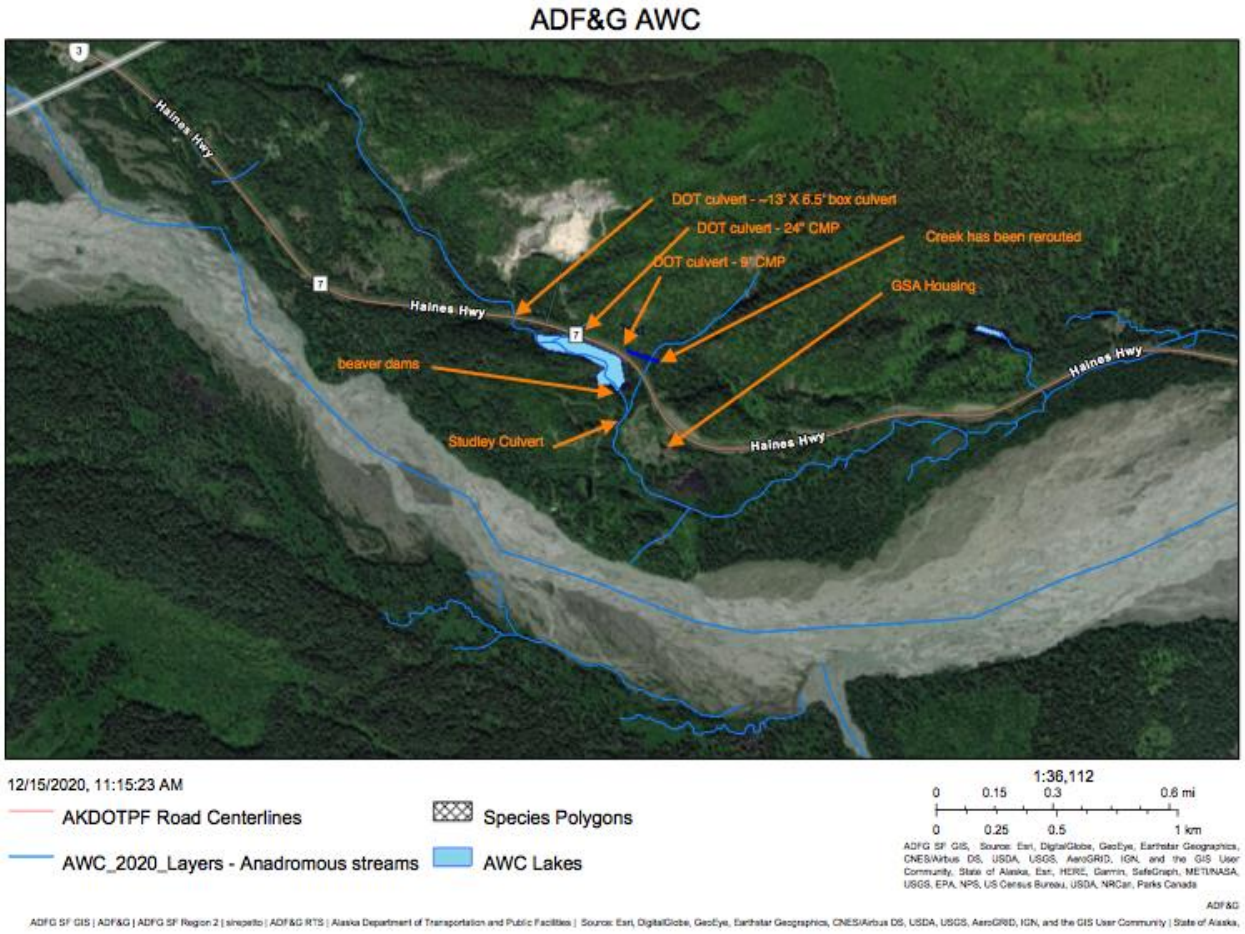
**Project Outcome:** ***Somewhat successful.*** There has been at least one instance (2007) where the upstream beaver dam failed and overwhelmed the culvert and caused flooding at the nearby GSA housing subdivision causing property damage. The culvert did not washout and the beaver dam was rebuilt and continues to regulate flow through the culvert. Currently the dam appears to be abandoned and failing. It appears water flows under and around the culvert as well as through it and the channel is significantly wider than the culvert.

**Lessons Learned:** FishPass analysis was conducted by ADF&G Fairbanks staff with no local ADF&G or ADOT input. The Haines Highway is just upstream of this project and two tributaries flow under the highway before entering the beaver pond above this culvert. The ADOT culverts, CV-11 & 12, are a 9’ CMP and 13’3”X6’9” box culvert respectively.

**Project Significance:** This culvert is located on a private drive. Given its short length it can meet fish passage requirements if the invert was depressed 20% below the thalweg. A condition not meet since shortly after installation. The upstream beaver dam has regulated flow to allow this culvert to hydraulically function with only one known failure.

**Recommendations:**
- Continue to monitor the functioning of this culvert
- Plans to replace this culvert should be initiated.
- Downstream property owners should be alerted to the flood potential if the beaver dam should fail.

**References:** ADF&G Fish Habitat permit, personal comm., ADF&G Habitat Division Field reports, and ADF&G Fish Passage database.




Studly culvert location compared to upstream drainage structures.

Studly culvert outlet (left) and inlet (right) channel prior to construction in April 2005.

Culvert inlet (left) and outlet (right) with some bed material in June 2005.

Culvert inlet (left) and outlet (right) in 2012.

Culvert inlet (left) and outlet (right) in 2015.

Culvert inlet (left) and outlet (right) in October 2020.

# APPENDIX B: Abbreviated REM Inventory

(Full inventory can be provided upon request)

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Highway Mitigation Permits | Many | 2000 | NA | Mitigation | List of permits for Haines Highway mitigation. | NA | NA | FG-98-I(J)-35, FG-98-I(J)-36, FG-98-I(J)-52, FG-99-I(J)-13, FG-99-I(J)-54, FG-99-I(J)-55, FG-99-I(J)-56, FG-99-I(J)-57, FG-00-I(J)-03, FG-00-I(J)-08 3/13/00, FG-01-I(J)-20 |
| 29 Mile Creek | 115-32-10250-2077-3046 | 2000 | Fish Passage Improvement | Enhancement | Install CMP that conveys flow from CH-8 to 29 Mile Creek. | 59.4212 | -136.0684 | See "Highway Mitigation Permits" for full list. |
| 29 Mile Creek | 115-32-10250-2077-3046 | 2000 | Fish Passage Improvement | Enhancement | Install CMP that conveys flow from 30 Mile Creek to 29 Mile Creek (CV-4). | 59.4202 | -136.0826 | See "Highway Mitigation Permits" for full list. |
| 29 Mile Creek | 115-32-10250-2077-3046 | 2000 | Stream channel manipulation | Mitigation | Create channel that extends 29 Mile Creek (CH-9). | 59.4203 | -136.0811 | See "Highway Mitigation Permits" for full list. |
| 29 Mile Creek | 115-32-10250-2077-3046 | 2000 | Stream channel manipulation | Mitigation | Enhance 1100' of 29 Mile Creek with root wads (CH-8). | 59.4205 | -136.0774 | See "Highway Mitigation Permits" for full list. |
| 29 Mile Creek | 115-32-10250-2077-3046 | 2000 | Wetlands Creation | Mitigation | Create pond (PD-2) | 59.4205 | -136.0822 | See "Highway Mitigation Permits" for full list. |
| 29 Mile Creek | 115-32-10250-2077-3046 | 2000 | Wetlands Creation | Mitigation | Create 0.3 acres of wetland (WT-2). | 59.4205 | -136.0778 | See "Highway Mitigation Permits" for full list. |
| 29 Mile Creek | 115-32-10250-2077-3046 | 2000 | Wetlands Creation | Mitigation | Create 0.7 acres of wetland (WT-3). | 59.4204 | -136.0799 | See "Highway Mitigation Permits" for full list. |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| 30 Mile Creek | 115-32-10250-2077-3052 | 2000 | Fish Passage Improvement | Enhancement | Install CMP that conveys flow of 30 Mile Creek across highway (CV-5). | 59.4208 | -136.0908 | See "Highway Mitigation Permits" for full list. |
| 30 Mile Creek | 115-32-10250-2077-3052 | 2000 | Stream channel manipulation | Mitigation | Relocate 1400' of 30 Mile Creek with stream habitat treatments (CH-11). | 59.4204 | -136.0871 | See "Highway Mitigation Permits" for full list. |
| 30 Mile Creek | 115-32-10250-2077-3052 | 2001 | Stream channel manipulation | Mitigation | Construct channel to pass 30 Mile Creek under highway. | 59.4215 | -136.0963 | FG01-I(J)-20A |
| 30 Mile Creek | 115-32-10250-2077-3052 | 2001 | Stream channel manipulation | Mitigation | Establish connecting channel to pass 30 Mile Creek through culvert. | 59.4215 | -136.0963 | FG01-I(J)-20 |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2009 | Bridge installation | Disturbance | Place vertical supports on log stringer bridge. | 59.4348 | -136.3095 | FH09-I-0076A |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Fish Passage Improvement | Enhancement | Install aluminum box culvert to carry CH-13 (CV-7). | 59.4344 | -136.2365 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Fish Passage Improvement | Enhancement | Install CMP near WT-6 (CV-11). | 59.4385 | -136.3195 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Fish Passage Improvement | Enhancement | Install CMP (CV-8). | 59.4393 | -136.2807 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Fish Passage Improvement | Enhancement | Install CMP to carry CH-15 (CV-9). | 59.4393 | -136.2821 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Fish Passage Improvement | Enhancement | Install aluminum box culvert to convey flow of 37-Mile Creek through road (CV-12). | 59.4407 | -136.3285 | See "Highway Mitigation Permits" (row 1) for full list. |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Fish Passage Improvement | Enhancement | Install aluminum structural plate pipe arch as improvement over existing pipe (CV-13). | 59.4480 | -136.3538 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Stream channel manipulation | Mitigation | Relocation of 700' of 37-Mile Creek (CH-15). | 59.4386 | -136.2831 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Stream channel manipulation | Mitigation | Extend 7000' of 37 Mile Creek (CH-13). | 59.4393 | -136.2716 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Stream channel manipulation | Mitigation | Remove culvert and construct channel to connect 2 ponds to 37 Mile Creek (CH-16). | 59.4392 | -136.2663 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Stream channel manipulation | Mitigation | Enhance 2500' of 37-Mile Creek by adding LWD and spawning gravel (CH-14). | 59.4399 | -136.2800 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Wetlands Creation | Mitigation | Create wetland (WT-7). | 59.4387 | -136.2643 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek | 115-32-10250-2077-3136 | 2000 | Wetlands Creation | Mitigation | Create wetland north of new highway and CH-13 (WT-5). | 59.4344 | -136.2377 | See "Highway Mitigation Permits" (row 1) for full list. |
| 37 Mile Creek Trib | 115-32-10250-2077-3136-4053 | 2005 | Disturbance | Disturbance | Replace collapsed bridge with CMP. | 59.4402 | -136.3237 | FH05-I-0039 |
| 37 Mile Creek Trib | 115-32-10250-2077-3136-4053 | 2005 | Fish Passage Improvement | Enhancement | Changed culvert size to 8.' | 59.4395 | -136.2822 | FH05-I-0039A |
| 37 Mile Creek Trib | 115-32-10250-2077-3136-4018 | 2001 | Fish Passage Improvement | Restoration | Remove deposited roadbed material from streambed. | 59.4379 | -136.2905 | FG01-I(J)-33 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| 37 Mile Creek Trib | 115-32-10250-2077-3136-4010 | 2000 | Stream channel manipulation | Mitigation | Replaced twin culverts with cobble stream bed on McKenzie Creek (CH-17). | 59.4399 | -136.2803 | See "Highway Mitigation Permits" (row 1) for full list. |
| Big Boulder Creek | 115-32-10250-2077-3098 | 2008 | Bank Stabilization | Restoration | Stabilize eroding bank near gravel pit and reconnect historic channels. | 59.4315 | -136.1955 | FH08-I-0036 |
| Big Boulder Creek | 115-32-10250-2077-3098 | 1991 | Bridge installation | Disturbance | Install bridge used for road construction. | | | FG-90-I(J)-58 |
| Big Boulder Creek | 115-32-10250-2077-3098 | 2010 | Stream channel manipulation | Restoration | Install root wads, digger logs, ELJs, boulder clusters, boulder darts, and wind deflectors. | 59.4304 | -136.1951 | FH08-I-0036A |
| Big Boulder Creek | 115-32-10250-2077-3098 | 1992 | Stream channel manipulation | Mitigation | Cable large woody debris into stream channel. | 59.4356 | -136.1968 | FG-92-I(J)-09 |
| Cannery Creek (Letnikof) | 115-32-10230 | 2013 | Fish Passage Improvement | Restoration | Replace perched culvert with metal squash culvert and rock weirs. | 59.1709 | -135.3873 | FH13-I-0068 |
| Cannery Creek (Letnikof) | 115-32-10230 | 1997 | Stream channel manipulation | Disturbance | Channelize Cannery Creek where it flows through moorage floats. | 59.1715 | -135.3881 | FG97-I(J)-59 |
| Cannery Creek (Letnikof) | 115-32-10230 | 2006 | Stream channel manipulation | Disturbance | Remove 20 yards of gravel and floats from Cannery Creek. | 59.1715 | -135.3881 | FH06-I-0097A |
| Cannery Creek (Letnikof) | 115-32-10230 | 2010 | Stream channel manipulation | Disturbance | Remove substrate to facilitate dock float removal. | 59.1715 | -135.3881 | FH10-I-0079 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Chilkat River | 115-32-10250 | 2007 | Bank Stabilization | Restoration | Use root wad revetments and bank roughening structures constructed of logs. | 59.3980 | -135.8850 | FH07-I-0134 |
| Chilkat River | 115-32-10250 | 2003 | Bank Stabilization | Restoration | Stabilize streambank on Chilkat River with anchored spruce tree revetments. | 59.4805 | -136.0491 | FH03-I(J)-36 |
| Chilkat River | 115-32-10250 | 2009 | Bank Stabilization | Restoration | Rebuild marina access channel and stabilize bank in Chilkat River. | 59.4160 | -135.9386 | FH09-I-0057 |
| Chilkat River | 115-32-10250 | 2011 | Bank Stabilization | Restoration | Stabilize and revegetate bank near mile 14.2 using brush layering and coir log. | 59.3300 | -135.7470 | FH11-I-0046 |
| Chilkat River | 115-32-10250 | 2013 | Bank Stabilization | Disturbance | Stabilize bank to protect road. | 59.3830 | -135.8440 | FH13-I-0110 |
| Chilkat River | 115-32-10250 | 2006 | Debris Removal | Disturbance | Remove logjam from bridge abutment on Chilkat River. | 59.4150 | -135.9338 | FH06-I-0030 |
| Chilkat River | 115-32-10250 | 2001 | Disturbance | Disturbance | Install CMP to access private property on other side of slough. | | | FG01-I(J)-34 |
| Chilkat River | 115-32-10250 | 2007 | Stream channel manipulation | Enhancement | Widen and deepen abandoned channel on the Chilkat River for chum spawning. | 59.4030 | -135.9280 | FH07-I-0001 |
| Chilkat River | 115-32-10250 | 1991 | Stream channel manipulation | Enhancement | Create coho spawning channel that empties into NSRAA spawning channel. | 59.4157 | -135.9393 | FG91-I(J)-31 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Chilkat River | 115-32-10250 | 1980 | Stream channel manipulation | Disturbance | Place fill in Chilkat River for road construction. | 59.3270 | -135.7410 | FG-80-I-3 |
| Chilkat River | 115-32-10250 | 2014 | Stream channel manipulation | Disturbance | Change policy to not take out bald eagle perching trees. | 59.3720 | -135.8320 | FH14-I-0105-SA |
| Chilkat River | 115-32-10250 | 2014 | Stream channel manipulation | Disturbance | Amendment to previous permit. | 59.3720 | -135.8320 | FH14-I-0115-SA |
| Chilkat River Trib | 115-32-10250-2008-3004 | 2010 | Disturbance | Disturbance | Install CMP to assure fish passage and natural water flow. | 59.2580 | -135.5550 | FH10-I-0161 |
| Chilkat River Trib | 115-32-10250-2008-0910 | 2011 | Disturbance | Disturbance | Road improvement, install culverts. | 59.2590 | -135.5580 | FH11-I-0122, -0122A |
| Chilkat River Trib | 115-32-10250-2064 | 2015 | Fish Passage Improvement | Restoration | Remove a sediment and debris berm that limits fish passage. | 59.2431 | -135.5105 | FH15-I-0052 |
| Chilkat River Trib | 115-32-10250-2129 | 1989 | Fish Passage Improvement | Enhancement | Replace culvert. | 59.4842 | -136.0583 | FG-89-I(J)-04 Revision A |
| Chilkat River Trib | 115-32-10250-2129 | 1989 | Fish Passage Improvement | Restoration | Replace culvert. | 59.4842 | -136.0583 | FG-89-I(J)-04 |
| Chilkat River Trib | 115-32-10250-2977 | 2006 | Stream channel manipulation | Enhancement | Renew spawning substrate in channel by importing and distributing gravel. | 59.4124 | -135.9350 | FH06-I-0005 |
| Chilkat River Trib | 115-32-10300-2014 | 2012 | Stream channel manipulation | Mitigation | Satisfy notice of violation for unauthorized fill and reestablish flow in the abandoned channel. | 59.2413 | -135.4937 | FH12-I-0208, -0209, -0210, -0210A |
| Chilkat River Trib | 115-32-10250-2064 | 2014 | Stream channel manipulation | Disturbance | Prevent landslide deposits. | 59.3808 | -135.8396 | FH14-I-0116 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Chilkat River Tribs | 115-32-10250-2077<br>115-32-10250-2079 | 2004 | Disturbance | Disturbance | Improve slough crossing by hardening and elevating roadbed. | | | FH04-I-0011 |
| Chilkat River Klehini Rivers | 115-32-10250<br>115-32-10250-2077 | 1986 | Bank Stabilization | Disturbance | None given in permit. | | | FG-86-I-4 |
| Chilkoot Lake | 115-33-10200-0010 | 2013 | Bank Stabilization | Disturbance | Place rock along a concrete retaining wall near boat launch. | 59.3358 | -135.5615 | FH13-I-0070 |
| Chilkoot Lake and Chilkoot River Tribs | 115-33-10200-0010<br>115-33-10020 | 1990 | Disturbance | Disturbance | Bridge and road construction. | 59.3378 | -135.5937 | FG-90-I(J)-11 |
| Chilkoot River | 115-33-10020 | 2003 | Bank Stabilization | Restoration | Stabilize streambank upstream of fish weir with series of rock vanes. | 59.3301 | -135.5572 | FH03-I(J)-42 |
| Chilkoot River | 115-33-10020 | 2005 | Bank Stabilization | Restoration | Stabilize banks with coir logs, soil wraps, and plantings. | 59.3360 | -135.5603 | FH05-I-0076 |
| Chilkoot River | 115-33-10020 | 2004 | Bank Stabilization | Disturbance | Repair erosion on the bank of the Chilkoot Lake Rd adjacent to Chilkoot River with riprap. | 59.3297 | -135.5589 | FH04-I-0023 |
| Chilkoot River Trib | 115-33-10200-2009 | 2017 | Bridge Removal | Disturbance | Remove bridge collapsing into Glory Hole Creek. | 59.3740 | -135.6390 | FH17-I-0187 |
| Glacier Creek | 115-32-10250-2077-3151 | 1988 | Bank Stabilization | Disturbance | None given in permit. | 59.4178 | -136.3025 | FG-88-I(J)-64 |
| Glacier Creek | 115-32-10250-2077-3151 | 2003 | Bridge Removal | Disturbance | Remove collapsed bridge from creek with equipment. | 59.4178 | -136.3025 | FH03-I(J)-35 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Herman Creek | 115-32-10250-2077-3061 | 2016 | Bank Stabilization | Enhancement | Stabilize banks of newly constructed spawning channel tributary. | 59.4155 | -136.0628 | FH16-I-0065A |
| Herman Creek | 115-32-10250-2077-3061 | 1984 | Stream channel manipulation | Disturbance | Allowed spawning habitat loss to install culverts, if mitigated with habitat elsewhere. | 59.4147 | -136.0645 | FG-84-I-27 |
| Herman Creek | 115-32-10250-2077-3061 | 2004 | Stream channel manipulation | Enhancement | Renew substrate with 307 cubic yards of clean, screened gravels. | 59.4156 | -136.0668 | FH04-I-0091 |
| Herman Creek | 115-32-10250-2077-3061 | 2016 | Stream channel manipulation | Enhancement | Excavate 1400' channel with 25 ft bed width and 0.1% gradient. | 59.4155 | -136.0628 | FH16-I-0065 |
| Herman Creek Spawning Channel #3 | 115-32-10250-2077-3061-4002 | 2017 | Stream channel manipulation | Disturbance | Excavate deposited gravel, return to original stream bed grade, reestablish stream bank. | 59.4156 | -136.0668 | FH17-I-0085, -0085A |
| Herman Creek Spawning Channel #3 | 115-32-10250-2077-3061-4002 | 2008 | Stream channel manipulation | Enhancement | Renew gravel substrate in uppermost 200' of Herman Creek spawning channel. | 59.4147 | -136.1121 | FH08-I-0013 |
| Herman Creek Tribs | 115-32-10250-2077-3061-4002 115-32-10250-2077-3061-4001 | 2015 | Stream channel manipulation | Disturbance | Extend Herman Creek spawning channels, stabilize banks, construct flood protection berm. | 59.4150 | -136.0721 | FH15-I-0053, -0054 |
| Holgate Creek | 115-32-10260 | 1983 | Disturbance | Disturbance | Install 2 30" culverts. | 59.2127 | -135.4324 | FG-83-I-25 |
| Holgate Creek | 115-32-10260 | 1991 | Fish Passage Improvement | Enhancement | Install detachable fishway in existing culvert, place boulders near culvert inlet. | 59.2123 | -135.4496 | FG-91-I(J)-15 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Holgate Creek | 115-32-10260 | 1980 | Stream channel manipulation | Disturbance | | 59.2122 | -135.4482 | FG-80-I-23 |
| Horse Farm Creek | 1115-32-10250-2060-3011 | 2014 | Disturbance | Disturbance | Install utility line underneath creek. | 59.3662 | -135.8002 | FH14-I-0009 |
| Horse Farm Creek | 1115-32-10250-2060-3011 | 2014 | Stream channel manipulation | Enhancement | Place several root wads in constructed pond(s). | 59.3665 | -135.8010 | FH14-I-0106, -0106A |
| Katzehin River | 115-34-10700 | 2006 | Bridge installation | Disturbance | Construct permanent bridge across Katzehin River for Juneau Access Improvement Project. | 59.1988 | -135.2915 | FH06-I-0043 |
| Kelsall River | 115-32-10250-2143-3005 | 2004 | Bank Stabilization | Disturbance | Place log revetment along Nataga Creek upstream of access to new Kelsall River bridge. | 59.5390 | -136.1033 | FH04-I-0090 |
| Kelsall River | 115-32-10250-2143 | 2017 | Bridge Removal | Disturbance | Remove remaining structures of failed bridge from Kelsall River. | 59.5396 | -136.1017 | FH17-I-0106 |
| Klehini River | 115-32-10250-2077 | 2005 | Bank Stabilization | Disturbance | Stabilize riprap to prevent erosion damage to highway between mileposts 35 and 37. | 59.4332 | -136.2283 | FH05-I-0020 |
| Klehini River | 115-32-10250-2077 | 2001 | Bank Stabilization | Disturbance | Reinforce banks of Klehini River to eliminate road flooding. | 59.4157 | -136.0735 | FG01-I(J)-08 |
| Klehini River | 115-32-10250-2077 | 2013 | Bank Stabilization | Disturbance | Perform emergency bank stabilization. | 59.4153 | -136.0758 | FH13-I-0060 |
| Klehini River | 115-32-10250-2077 | 1994 | Bank Stabilization | Disturbance | Rip rap placement to prevent bank erosion. | 59.4212 | -136.0649 | FG94-I(J)-40 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Klehini River | 115-32-10250-2077 | 2004 | Bank Stabilization | Disturbance | Extend expiration date and extra riprap for expanded erosion to avoid hwy wash out. | 59.4315 | -136.2219 | FH03-I(J)-40 Amendment 1 |
| Klehini River | 115-32-10250-2077 | 1989 | Bank Stabilization | Disturbance | Repair erosion caused by Klehini River tributary. | 59.4326 | -136.2280 | FG-89-I(J)-47 |
| Klehini River | 115-32-10250-2077 | 2003 | Bank Stabilization | Disturbance | Repair failing diversion dikes from MP 35 to 37. | 59.4315 | -136.2219 | FH03-I(J)-40 |
| Klehini River | 115-32-10250-2077 | 2004 | Bank Stabilization | Disturbance | Repair portions of failing revetment near milepost 36 with 1680 cubic yards of Class III riprap. | 59.4327 | -136.2223 | FH04-I-0100 |
| Klehini River | 115-32-10250-2077 | 2012 | Bridge installation | Disturbance | Install prefab bridge. | 59.4340 | -136.2770 | FH12-I-0144 |
| Klehini River | 115-32-10250-2077 | 2015 | Debris Removal | Disturbance | Debris removal off bridge pier. | 59.4126 | -135.9995 | FH15-I-0042 |
| Klehini River | 115-32-10250-2077 | 2007 | Debris Removal | Disturbance | An excavator will work below ordinary high water to remove debris. | 59.4127 | -135.9919 | FH07-I-0203 |
| Klehini River | 115-32-10250-2077 | 2016 | Debris Removal | Disturbance | Remove a 3-ton boulder. | 59.4375 | -136.3295 | FH16-I-0042 |
| Klehini River | 115-32-10250-2077 | 2000 | Fish Passage Improvement | Enhancement | CMP installed with minimum of 6" of stream substrate (CV-1). | 59.4106 | -135.9767 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Fish Passage Improvement | Enhancement | CMP with minimum of 6" stream substrate (CV-2). Conveys flow from PD-1 to CH-4. | 59.4137 | -135.9929 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2002 | Fish Passage Improvement | Restoration | Repair outlet basin of culvert CV-2 at 26.1 Mile. | 59.4146 | -136.0029 | FG02-I(J)-19 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Klehini River | 115-32-10250-2077 | 2000 | Fish Passage Improvement | Enhancement | Installed CMP (CV-6); conveys CH-12; 1' streambed material placed in the invert. | 59.4330 | -136.2290 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Fish Passage Improvement | Enhancement | Installed CMP (CV-10); 1' class I riprap and 0.5' streambed material in invert; conveys CH-18. | 59.4373 | -136.2908 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 1998 | Fish Passage Improvement | Mitigation | Relocate culvert, new channel constructed. | 59.4131 | -135.9964 | FG98-I(J)-52A |
| Klehini River | 115-32-10250-2077 | 2015 | Fish Passage Improvement | Restoration | Potentially did some riprap revegetation. | 59.4124 | -136.0033 | FH15-I-0139, -0139A |
| Klehini River | 115-32-10250-2077 | 2000 | Floodplain Restoration | Mitigation | Mining permit covered extraction up to 60,000 cubic yards in northern edge of Klehini (RM-1). | | | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Floodplain Restoration | Mitigation | Mining permit covered an extraction up to 20,000 cubic yards in Klehini floodplain (RM-2). | | | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Floodplain Restoration | Mitigation | Mining permit covered an extraction up to 40,000 cubic yards in Klehini floodplain (RM-3). | | | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Floodplain Restoration | Mitigation | Mining permit covered extraction up to 460,000 cubic yards in Klehini floodplain (RM-4). | | | See "Highway Mitigation Permits" (row 1) for full list. |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | Brush, willow clumps, and woody debris placed to add complexity to new channel banks (CH-1). | 59.4104 | -135.9779 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | Habitat enhancement of riprap protection on south face of highway embankment (CH-3). | 59.4113 | -135.9840 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | Habitat enhancement of riprap placed along south face of highway embankment (CH-7). | 59.4219 | -136.0510 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | Created channel adjacent to highway through CV-1 (CH-2). | 59.4103 | -135.9773 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | Created channel south of highway to replace existing creek that was filled (CH-4). | 59.4131 | -135.9913 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | CH-6l is located south of highway to form new wetted channel to replace filled channel. | 59.4213 | -136.0337 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | CH-5 located along west side of highway near embankment. Created to replace filled channel. | 59.4227 | -136.0191 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | Created channel (CH-10) north of hwy with floodplain terrace and habitat treatments. | 59.4305 | -136.1560 | See "Highway Mitigation Permits" (row 1) for full list. |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | North side of highway; channel (CH-12) created to replace filled trib, and to connect to CV-6. | 59.4351 | -136.2303 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Stream channel manipulation | Mitigation | Channel (CH-18) created along north side of hwy (M Sogge - moved during construction). | 59.4404 | -136.2923 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2005 | Stream channel manipulation | Disturbance | Relocate portion of road on Klehini River floodplain; required mitigation (FH05-I-0107). | 59.4155 | -136.0745 | FH05-I-0108 |
| Klehini River | 115-32-10250-2077 | 1982 | Stream channel manipulation | Disturbance | ADFG felt would improve spawning area due to upwellings behind proposed berm. | | | FG-82-I-21 |
| Klehini River | 115-32-10250-2077 | 1982 | Stream channel manipulation | Disturbance | Allowed winter construction - no spawning where construction taking place. | | | FG-82-I-21A |
| Klehini River | 115-32-10250-2077 | 1998 | Wetlands Creation | Mitigation | Pond excavation and wetlands creation permitted near steel bridge. | 59.4139 | -135.9936 | FG98-I(J)-52B |
| Klehini River | 115-32-10250-2077 | 2000 | Wetlands Creation | Mitigation | Pond excavation and wetlands creation permitted near steel bridge. | 59.4139 | -135.9936 | FG98-I(J)-52B |
| Klehini River | 115-32-10250-2077 | 2000 | Wetlands Creation | Mitigation | North of highway; expansion of existing pond to > 3 ' depth (PD-1). | 59.4138 | -135.9907 | See "Highway Mitigation Permits" (row 1) for full list. |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Klehini River | 115-32-10250-2077 | 2000 | Wetlands Creation | Mitigation | Located adjacent to existing pond on north side of highway; 0.3 acres (WT-1). | 59.4098 | -135.9721 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Wetlands Creation | Mitigation | Located to south of highway, near CH-11 (WT-4). | 59.4205 | -136.0903 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River | 115-32-10250-2077 | 2000 | Wetlands Creation | Mitigation | Adjacent to highway, created by excavation of abandoned highway embankment (WT-6). | 59.4391 | -136.3203 | See "Highway Mitigation Permits" (row 1) for full list. |
| Klehini River Tribs | 115-32-10250-2077 | 1980 | Bridge installation | Disturbance | Logging haul road crossing construction on Bear, Porcupine, and Glacier Creeks. | 59.4256 | -136.2240 | FG-80-I-33 |
| Klehini River37-Mile CreekSpring Pond Creek | 115-32-10250-2077115-32-10250-2077-3136115-32-10250-2077-3130 | 2006 | Bank Stabilization | Disturbance | Extend revetment riprap timing due to severe storms taking contractor to other locations. | 59.4345 | -136.2384 | FH05-I-0075A |
| Klehini Trib | 115-32-10250-2077-3075 | 2005 | Fish Passage Improvement | Enhancement | Part of Porcupine Rd realignment - install culvert and deepen stream channel. | 59.4209 | -136.1440 | FH05-I-0107 |
| Little Boulder Creek | 115-32-10250-2077-3078 | 1987 | Bank Stabilization | Disturbance | Allowed work to continue to July 22, 1987. | 59.4283 | -136.1324 | FG-87-I(J)-19 Amendment A |
| Little Boulder Creek | 115-32-10250-2077-3078 | 1990 | Bridge installation | Disturbance | Revised plan to widen stream channel below the bridge, addition of riprap. | | | FG-90-I(J)-59A |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Little Boulder Creek | 115-32-10250-2077-3078 | 1991 | Bridge installation | Disturbance | Used for road construction. | | | FG-90-I(J)-59 |
| Little Boulder Creek | 115-32-10250-2077-3078 | 2012 | Stream channel manipulation | Disturbance | Put in large rock and fill with stream substrate to stabilize channel upstream of bridge. | 59.4282 | -136.1317 | FH12-I-0203 |
| Little Salmon River | 115-32-10250-2067 | 1988 | Bank Stabilization | Disturbance | Section 1, T29S, R55E, CRM | 59.3914 | -135.9963 | FG-88-I(J)-65 |
| Little Salmon River | 115-32-10250-2067 | 2008 | Bridge installation | Disturbance | Remove failing log stringer bridge with 60' modular steel bridge at same location. | 59.3914 | -135.9963 | FH08-I-0154 |
| Little Salmon River | 115-32-10250-2067 | 2006 | Stream channel manipulation | Disturbance | Extend excavation above and below bridge from 100' to 440', with depth of 10' instead of 6'. | 59.3906 | -135.9958 | FH05-I-0079B |
| Little Salmon River | 115-32-10250-2067 | 2005 | Stream channel manipulation | Disturbance | No obvious amendments to project for this Amendment. | 59.3914 | -135.9963 | FH05-I-0079A |
| Little Salmon River | 115-32-10250-2067 | 2005 | Stream channel manipulation | Disturbance | Reestablish course and depth of the Little Salmon River above and below bridge. | 59.3918 | -135.9965 | FH05-I-0079 |
| Mink Creek | 115-34-10220-2011 | 2005 | Fish Passage Improvement | Enhancement | Remove three existing 72"x44' culverts with a single larger arch culvert, 148"x93"x53'. | 59.1564 | -135.3599 | FH05-I-0147 |
| Mink Creek | 115-34-10220-2011 | 2000 | Fish Passage Improvement | Enhancement | Culvert extension. | 59.1564 | -135.3599 | FG00-I(J)-12A |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Mosquito Lake Inlet | 115-32-10250-2123 | 1989 | Fish Passage Improvement | Disturbance | Culvert replacement. | 59.4478 | -136.0301 | FG-89-I(J)-03 |
| Mosquito Lake Inlet Trib | 115-32-10250-2123-3002 | 1988 | Disturbance | Disturbance | T28S, R55E, CRM section SE 1/2 Section 3, Kelsall Rd. | 59.4695 | -136.0368 | FG-88-I(J)-62 |
| Mosquito Lake Inlet Trib | 115-32-10250-2123-3002 | 1989 | Fish Passage Improvement | Disturbance | Culvert replacement and fill. | 59.4695 | -136.0368 | FG-89-I(J)-39 |
| Mosquito Lake Inlet Trib | 115-32-10250-2123-3002 | 1991 | Fish Passage Improvement | Restoration | Culvert replacement. | 59.4695 | -136.0369 | FG91-I(J)-51 |
| Muskrat Creek | 115-32-10250-2143-2081 | 2004 | Fish Passage Improvement | Restoration | Replace 18" perched culvert with 95"x67"x46' structural plate culvert buried at 18". | 59.4117 | -135.9568 | FH04-I-0111A |
| Nataga Creek | 115-32-10250-2143-3005 | 2006 | Bank Stabilization | Disturbance | Repair log revetment on bank, protecting access ramp to Kelsall River bridge crossing. | 59.5390 | -136.1033 | FH06-I-0104 |
| Nataga Creek | 115-32-10250-2143-3005 | 2004 | Bank Stabilization | Disturbance | Place riprap along right bank of Nataga Creek above abutment of Bridge on Kelsall road. | 59.5389 | -136.1053 | FH04-I-0089 |
| Nataga Creek | 115-32-10250-2143-3005 | 2007 | Bank Stabilization | Disturbance | Excavate failed retaining wall and support logs; install riprap, filter fabric, and new support logs. | 59.5391 | -136.1034 | FH07-I-0108 |
| Nataga Creek | 115-32-10250-2143-3005 | 2004 | Bridge Removal | Disturbance | Remove damaged bridge on Kelsall road; install temporary armored drivable rock ford. | 59.5390 | -136.1033 | FH04-I-0101 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Nataga Creek | 115-32-10250-2143-3005 | 1981 | Fish Passage Improvement | Restoration | Relocation of stream back to original channel, bridge reconstruction. | 59.5391 | -136.1033 | FG-81-I-22 |
| Nataga Creek Kelsall River | 115-32-10250-2143-3005 115-32-10250-2143 | 2014 | Disturbance | Disturbance | Small scale mining. | 59.5382 | -136.1011 | FH14-I-0024, -0029 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2009 | Bank Stabilization | Disturbance | Re-key boulders to stabilize bank around bridge abutment. | 59.4204 | -136.2226 | FH09-I-0077 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2007 | Bank Stabilization | Disturbance | Place a few large boulders at the toe of the bank slope below ordinary high water. | 59.4149 | -136.2346 | FH07-I-0209 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2006 | Bank Stabilization | Disturbance | Reconstruct berm along bank of river destroyed by flood. | 59.4191 | -136.2250 | FH06-I-0100 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2014 | Bank Stabilization | Disturbance | 3 constructed berms. | 59.4196 | -136.2250 | FH14-I-0101 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2014 | Bank Stabilization | Disturbance | Bank stabilization. | 59.4196 | -136.2250 | FH14-I-0122 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2012 | Bridge installation | Disturbance | New bridge will be longer and will not restrict flow as much. | 59.4204 | -136.2226 | FH12-I-0116, -0116A |
| Porcupine Creek | 115-32-10250-2077-3111 | 2012 | Debris Removal | Disturbance | Removal of accumulated sediment and debris from main channel. | 59.4203 | | FH12-I-0189 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2016 | Bank Stabilization | Disturbance | None given in permit. | 59.4190 | -136.2250 | FH16-I-0087 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2001 | Bank Stabilization | Disturbance | Remove a downed tree and reinforcing stream bank with local streambed materials. | 59.4204 | -136.2226 | FG01-I(J)-07 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Porcupine Creek | 115-32-10250-2077-3111 | 2006 | Bridge installation | Disturbance | Install permanent steel bridge across Porcupine Creek to transport placer material by truck. | 59.4204 | -136.2226 | FH06-I-0022 |
| Porcupine Creek | 115-32-10250-2077-3111 | 2015 | Debris Removal | Disturbance | Remove debris from Porcupine Creek and place on banks to block over-flow channels. | 59.4190 | -136.2250 | FH15-I-0055 |
| Sawmill Creek | 115-32-10300-2002 | 1990 | Debris Removal | Restoration | Stream restoration project, seek additional materials from ADFG. | 59.2334 | -135.4729 | FG-90-I(J)-31 |
| Sawmill Creek | 115-32-10300-2002 | 1989 | Debris Removal | Restoration | Stream restoration project, seek additional materials from ADFG. | 59.2334 | -135.4729 | FG-89-I(J)-35 |
| Sawmill Creek | 115-32-10300-2002 | 1990 | Fish Passage Improvement | Restoration | Replace culvert on road to Sewage Treatment Plant and Fairgrounds. | 59.2342 | -135.4571 | FG-90-I(J)-46 |
| Sawmill Creek | 115-32-10300-2002 | 2011 | Water Quality Improvement | Mitigation | Groundwater treatment system discharge. | 59.2360 | -135.4650 | FH11-I-0103 |
| Sawmill Creek Pond | 115-32-10300-2002-0010 | 2011 | Stream channel manipulation | Disturbance | Remove debris and sediment with heavy equipment to improve flow and fish passage. | 59.4348 | -136.3095 | FH11-I-0115 |
| Sawmill Creek Trib | 115-32-10300-2002-3019-4008 | 2007 | Bank Stabilization | Restoration | Remove junked vehicles from 10 m section of stream. | 59.2379 | -135.4527 | FH07-I-0011 |
| Sawmill Creek Trib | 115-32-10300-2002 | 2003 | Bridge installation | Disturbance | Install 2 culverts and 15 bridges on tribs for a golf course; place fill in a wetland for access road. | 59.2372 | -135.4823 | FH-03-I(J)-09 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Sawmill Creek Trib | 115-32-10300-2002-3028 | 2008 | Disturbance | Disturbance | Culvert installation. | 59.2318 | -135.4578 | FH08-I-0006 |
| Sawmill Creek Trib | 115-32-10300-2002-3011 | 1994 | Disturbance | Disturbance | Install 30" culvert in anadromous stream. | 59.2373 | -135.4705 | FG94-I(J)-57 |
| Sawmill Creek Trib | 115-32-10300-2002-3013-4007 | 2013 | Disturbance | Disturbance | Culvert installation. | 59.2384 | -135.4682 | FH13-I-0071 |
| Sawmill Creek Trib | 115-32-10300-2002-3019-4005 | 2007 | Fish Passage Improvement | Disturbance | Replace a 20' segment of an arch culvert. | 59.2370 | -135.4584 | FH07-I-0008 |
| Sawmill Creek Trib | 115-32-10300-2002-3019 | 2007 | Fish Passage Improvement | Disturbance | Replace a 20' segment of 36" diameter culvert. | 59.2378 | -135.4551 | FH07-I-0009 |
| Sawmill Creek Trib | 115-32-10300-2002-3019-4008 | 2003 | Fish Passage Improvement | Restoration | Remove a culvert and connect existing stream flow to the reconstructed original channel. | 59.2370 | -135.4536 | FH03-I(J)-39 |
| Sawmill Creek Trib | 115-32-10300-2002-3019-4005 | 2008 | Fish Passage Improvement | Restoration | Replace failing culvert and remove downstream debris. | 59.2373 | -135.4572 | FH08-I-0152 |
| Sawmill Creek Trib | 115-32-10300-2002-3019-4008 | 2007 | Fish Passage Improvement | Restoration | ADOT proposal to leave existing culvert until new culvert installed to limit disturbance. | 59.2378 | -135.4527 | FH07-I-0010A |
| Sawmill Creek Trib | 115-32-10300-2006 | 2015 | Fish Passage Improvement | Enhancement | Replace culvert with more suitable, larger culvert 60' long, 71" wide by 47" high arch culvert. | 59.2380 | -135.4774 | FH15-I-0050 |
| Sawmill Creek Trib | 115-32-10300-2002-3013-4017 | 2013 | Fish Passage Improvement | Restoration | Replace 24" 40'long pipe with 42"x29" arch. | 59.2391 | -135.4653 | FH13-I-0095 |
| Sawmill Creek Trib | 115-32-10300-2002-3019-4008 | 2007 | Fish Passage Improvement | Restoration | Replace a 30" culvert with a 72" diameter culvert. | 59.2378 | -135.4527 | FH07-I-0010 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Sawmill Creek Trib | 115-32-10300-2002-3013 | 2010 | Fish Passage Improvement | Enhancement | Install two round 48" diameter, 55' long metal pipes together, spanning 8' over the7' streambed. | 59.2402 | -135.4618 | FH10-I-0070 |
| Sawmill Creek Trib | 115-32-10300-2002-3013-4013 | 2012 | Fish Passage Improvement | Restoration | Remove existing culvert and install aluminum box culvert. | 59.2403 | -135.4643 | FH12-I-0139 |
| Sawmill Creek Trib | 115-32-10300-2002-3013-4013 | 2017 | Stream channel manipulation | Restoration | Reconstruct streambed using larger rock and a roughened channel design. | 59.2403 | -135.4643 | FH17-I-0079 |
| Sawmill Creek Tribs | 115-32-10300-2002-3013 115-32-10300-2002-3013-4007 | 1994 | Bank Stabilization | Restoration | Restoration Plan required by Restoration Plan by Haines Magistrate Lynn Asper. | 59.2392 | -135.4682 | FG94-I(J)-37 |
| Sawmill Creek Tribs | 115-32-10300-2002-3013 115-32-10300-2002-3013-4007 115-32-10300-2002-3019 | 1993 | Bridge installation | Disturbance | ADFG recommended to leave timber along small streams; required to restore damaged banks. | 59.2376 | -135.4708 | FG93-I(J)-29 |
| Sawmill Creek Tribs | 115-32-10300-2002-3019 115-32-10300-2002-3019-4005 | 2008 | Fish Passage Improvement | Restoration | Remove culvert and replace with a new culvert discharging to a different tributary. | 59.2360 | -135.4587 | FH08-I-0111 and -0113 |
| Sawmill Creek Tribs | 115-32-10300-2002-3013 115-32-10300-2002-3019 115-32-10300-2002-3013-4008 | 1993 | Stream channel manipulation | Disturbance | ADFG ordered removal of two French drains, one was diverting flow out of stream channel. | 59.2376 | -135.4708 | FG93-I(J)-44 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Schnabel Creek | 115-32-10250-2006 | 2014 | Bank Stabilization | Disturbance | Maintain dikes. | 59.2569 | -135.5485 | FH14-I-0121 |
| Several Streams | | 2013 | Disturbance | Disturbance | Power sluicing. | | | FH13-I-0075 to 0084 |
| Several streams | | 2015 | Disturbance | Disturbance | None given in permit. | | | FH15-I-0016 to -0018 |
| Tsirku River | 115-32-10250-2067 | 2013 | Bank Stabilization | Disturbance | Bank stabilization. | 59.3728 | -135.9637 | FH13-I-0058 |
| Tsirku River | 115-32-10250-2067 | 2014 | Bank Stabilization | Disturbance | 250' riprap armoring. | 59.3751 | -135.9392 | FH14-I-0041 |
| Tsirku River | 115-32-10250-2067 | 2017 | Bridge installation | Disturbance | Allow public access for vehicle and equipment crossing and temporary bridges. | 59.3742 | -135.9407 | FH17-I-0002-GP |
| Tsirku River | 115-32-10250-2067 | 2005 | Bridge installation | Disturbance | Install temporary log bridge for public access. | 59.3741 | -135.9414 | FH05-I-0156 |
| Tsirku River | 115-32-10250-2067 | 2004 | Stream channel manipulation | Disturbance | Widen and deepen a secondary channel of Tsirku and reconstruct failed 200' berm. | 59.3795 | -136.0603 | FH04-I-0009 |
| Tsirku River | 115-32-10250-2067 | 2004 | Stream channel manipulation | Disturbance | Widen and deepen a secondary channel of Tsirku and reconstruct failed 200' berm. | 59.3795 | -136.0603 | FH04-I-0009A |
| Tsirku River | 115-32-10250-2067 | 2004 | Stream channel manipulation | Disturbance | Widen and deepen a secondary channel of Tsirku and reconstruct failed 200' berm. | 59.3795 | -136.0603 | FH05-I-0001 |
| Unnamed Stream No. | 115-34-10210 | 1987 | Disturbance | Disturbance | Culvert installation. | | | FG-87-I(J)-30 |

| Waterbody /Watershed | AWC # | Year began | Project Goal | Project Type | Short description | Lat. | Long. | ADFG Permit |
|---|---|---|---|---|---|---|---|---|
| Yindastuki Creek | 115-32-10250-2002 | 2016 | Bank Stabilization | Mitigation | Use backhoe to place a rock ditch lining at intersection of drainage ditch and creek. | 59.2468 | -135.5264 | FH16-I-0106 |
| Yindastuki Creek | 115-32-10250-2002 | 2016 | Stream channel manipulation | Disturbance | Airport infrastructure. | 59.2441 | -135.5201 | FH16-I-0104, -0105 |
| Yindastuki Creek | 115-32-10250-2002 | 2016 | Stream channel manipulation | Disturbance | Airport infrastructure. | 59.2466 | -135.5268 | FH16-I-0099, -0103 |
| Yindastuki Creek Trib | 115-32-10300-2014 | 2014 | Stream channel manipulation | Mitigation | Satisfy notice of violation for unauthorized fill and reestablish flow in the abandoned channel. | 59.2425 | -135.4951 | FH14-I-0078, -0079 |