Klawock Causeway. Photo Credit: M. Kampnich @TNC

Klawock River, Salmon Passage and Habitat Restoration Project

Grant # NA09NMF4630301

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The completion of this project would not have been possible without the support of a variety of partners over the years. These partners include:

- Alaska Department of Transportation and Public Facilities
- Alaska Department of Fish and Game
- City of Klawock
- Craig Improvement Association
- Ducks Unlimited
- Keta Engineering
- Klawock Community Association
- Klawock Hatchery
- Klawock Heenya Corporation
- Klawock Watershed Council
- NOAA Fisheries
- The Alaska Trollers Association
- The Nature Conservancy
- USDA Forest Service
- U.S. Fish and Wildlife Service

FINAL REPORT

Section I. Executive Summary

The Klawock River Salmon Passage and Habitat Restoration Project, supported by funding from NOAA, The Nature Conservancy and the American Recovery & Reinvestment Act, was the final act in a decade-long quest to restore a historical migration corridor for fish within the Klawock River watershed.

The Klawock village is reached by a narrow isthmus and a paved and raised causeway that crosses the Klawock River estuary. Historically, the isthmus was an unpaved, low water crossing that was under water at higher tidal stages, which allowed out-migrating fish to access eelgrass habitat north of the causeway, and in-migrating fish to move directly up into the Klawock River to spawn. A highway was constructed over the isthmus in 1964, and the elevated roadbed blocked all hydrologic connectivity between the Klawock River lagoon and Klawock Bay and created a barrier to fish.

The construction of a fish friendly, concrete culvert beneath the Klawock – Hollis Highway on Prince of Wales Island in 2011, allowed salmon to pass beneath this highway for the first time since its construction in 1964. Initial monitoring results suggests that the culvert is already accomplishing its short-term goal, as adult and juvenile salmon have been observed and documented migrating to and from the river via the new passage. Local fishing habits are already becoming apparent and utilized near the culvert during the first season post-construction, again indicating the presents of fish in this new connection between the Klawock estuary and the ocean. The long-term goal of increasing salmon stocks in this area to historical levels will not be evident for some time still, but initial results are promising.

The restoration project provided employment for a number of people in a variety of positions and industries. Forty-two different positions benefited from the funding provided by this grant including; scientists, engineers, project and restoration managers, construction superintendents, equipment operators, land surveyors, and others. These positions were housed within non-profits, state agencies, and independent private businesses.

This project can be considered a success for estuary and salmon habitat restoration and the community of Klawock in Southeast Alaska. This project represents a wonderful example of what can be accomplished when diverse groups, with often conflicting ideology, come together for the common goal of bettering the environment and the community.

An array of partners made this project successful, including conservation NGO's, local tribes, federal, state, and local agencies, and private businesses. Each of these partners had their own

reasons and incentives for supporting the goal of improving the health of the Klawock River watershed. By pooling their strengths and their resources together, they were able to realize that goal. The partnerships forged throughout this process have led to discussions of additional restoration projects.

Section II. Introduction (1-2 pages)

The village of Klawock on Prince of Wales Island has a population of 854 people, approximately 50 percent of whom are Alaska Native. Klawock residents adhere strongly to customary and traditional values and practices, including subsistence harvest of fish and wildlife. Historically, commercial, sport fisheries and secondary businesses were all supported by the harvest of salmon.

The 29,061 acre Klawock River watershed on the west coast of Prince of Wales Island contains more than 132 miles of streams that serve as important spawning habitat for pink, chum, coho and sockeye salmon, as well as steelhead, cutthroat trout and Dolly Varden char. Sockeye salmon harvests of more than 30,000 fish were typical from the late 1880s through the 1950s. Since 1960, fish counts have seldom exceeded 20,000 sockeye and reached only 10,000 fish in six of the past 50 years. Similarly dramatic declines occurred for pink salmon and chum salmon in the latter half of the 20th century.

The settlement of Tlingit Indian populations at Klawock has spanned uncountable generations. A major attribute in this location has been access to the Klawock River and the Klawock Lake, which together provided an important salmon spawning system. Today, the most important subsistence activity for local residents is the salmon fishery at the mouth of the Klawock River, with sockeye being traditionally the most valued of the four salmon species that return to the river each year to spawn. A 1997 study documented that 69 percent of Klawock households use sockeye salmon, with an average of 117 pounds per household. Subsistence sockeye harvest by residents of Klawock has been relatively steady in recent decades at about 6,000 fish annually.

The Klawock village is reached by a narrow isthmus and a paved and raised causeway that crosses the Klawock River estuary. Historically, the isthmus was an unpaved, low water crossing that was under water at higher tidal stages, which allowed out-migrating fish to access eelgrass habitat north of the causeway, and in-migrating fish to move directly up into the Klawock River to spawn. Sea water could mix freely with fresh water in the lagoon creating an estuary and habitat that supported fish that sustained local people. A highway was constructed over the isthmus in 1964, and the elevated roadbed blocked all hydrologic connectivity between the Klawock River lagoon and Klawock Bay and created a barrier to fish.

Recorded cannery harvests, escapement estimates and personal interviews reveal that between 1886 and 2002, sockeye numbers have decreased dramatically. Prior to 1920, Klawock River harvests exceeding 60,000 fish were not unusual. In the 1930's, sockeye counts on the Klawock

River averaged 30,000 fish. Over the past 50 years, sockeye counts have rarely exceeded 20,000 fish, and have reached only 10,000 fish in six of those years.[1]

Responses to a subsistence fisheries survey in 2001 suggested numerous potential causes for decreases in the harvest of salmon, including: commercial interception, construction of a hatchery, logging, sport charter fishing, the causeway over the estuary, and weather patterns. Continued harvest restrictions remain in place to conserve the Klawock salmon population. The Klawock Watershed Council has played a key role, building partnerships to protect and enhance habitat for salmon, in an effort to restore the salmon population to traditional levels.

The causeway, part of the Klawock-Hollis highway, had long been of concern to biologists and the community of Klawock. Its construction 50 years ago effectively shut down a natural migration route for salmon. A coalition of agencies, elected officials, fishermen and conservationists joined together in earnest nearly a decade ago to address the causeway issue, but the process was slow, hampered in large part by a lack of funds. The opening of the causeway to the passage of salmon was finally realized in 2011, fulfilling a long awaited wish of the people of Klawock.

Objectives and Theory of Change

Goals: Improve salmon habitat and population with a long-term goal of restoring fisheries to historic levels to meet the needs of local residents and others.

Theory of Change: This project will enable salmon passage beneath a highway that has blocked all fish passage since 1964, along a historic migration corridor of the Klawock River. Vastly improved habitat conditions for both juvenile and adult salmon are expected to occur following construction of a fish friendly cast concrete culvert measuring 100 feet long, 18 foot wide and 8 feet tall that will restore hydrologic connectivity between the estuary and the bay. Increased access to improved salmon habitat will occur with a new migration corridor and increases in eelgrass habitat, which will increase the likelihood of salmon survival and improve salmon populations. The history, culture, and economy of Klawock provide important context for this project. Long-term, the restoration of salmon populations to historic levels will support the use of salmon as the principal subsistence food of the Tlingit people.

[1] Ratner, Nancy C., P. Brown, J. Dizard, PhD, A. Paige, J. Rowan, M. Smith, M. Turek and D. Yates. 2005. Klawock River and Sarkar Subsistence Salmon Harvest Use Pattern. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report (Study No. FIS01-105). Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska.

Figure 1: (Before) Aerial photograph, 1929. The Klawock estuary and the mouth of the Klawock River is at the bottom of the photo. There is no evidence of transportation other than by boats, and pools of standing water demonstrate the passage of water over the inter-tidal isthmus at high tide. Red arrow indicated the location of the isthmus. Photo: US Navy, 1929.

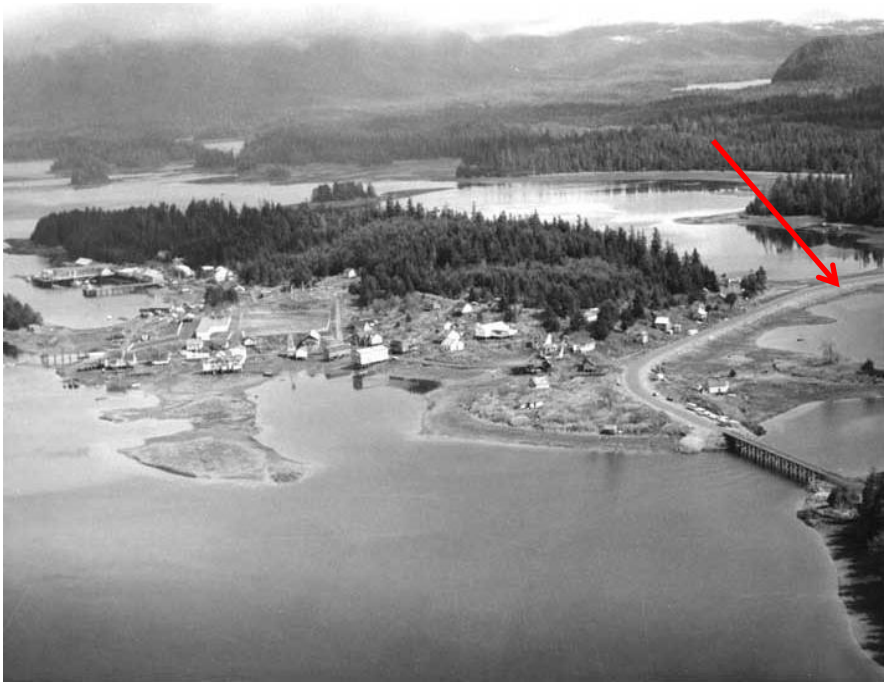

Figure 2: (After) This aerial photograph shows construction of a road in 1964 through the corner of the village, and over a bridge, one of the two exits from the estuary. The previous exit is above and on the right side of the photo, where you can see the road goes along what became a causeway: an elevated road (marked by the red arrow). Photo: Aaron T. Isaacs, 1964

Section II. Methodology

Site Location

Klawock – Hollis Highway crossing of the Klawock estuary, at Klawock AK. 055 33’ 12.07” N 133 15’ 19.19”W Craig Alaska Quad C-4.

Site Description

The Klawock River watershed is located on the west coast of Prince of Wales Island 35 miles west of Ketchikan. It is a coastal watershed approximately 29,061 acres in size with over 132 miles of streams, most of which are designated anadromous habitat, and 2,800-acre Klawock Lake. Major landowners are the US Forest Service and three Native corporations.

Klawock is located on a false island of Prince of Wales Island, and is connected to Prince of Wales Island by a narrow inter-tidal isthmus. Historically, at higher tidal stages, the isthmus was flooded and allowed passage of fish between the Klawock River lagoon and Klawock Bay to the North. Construction of the Klawock-Hollis highway circa 1964 completely blocked fish passage at all tidal stages.

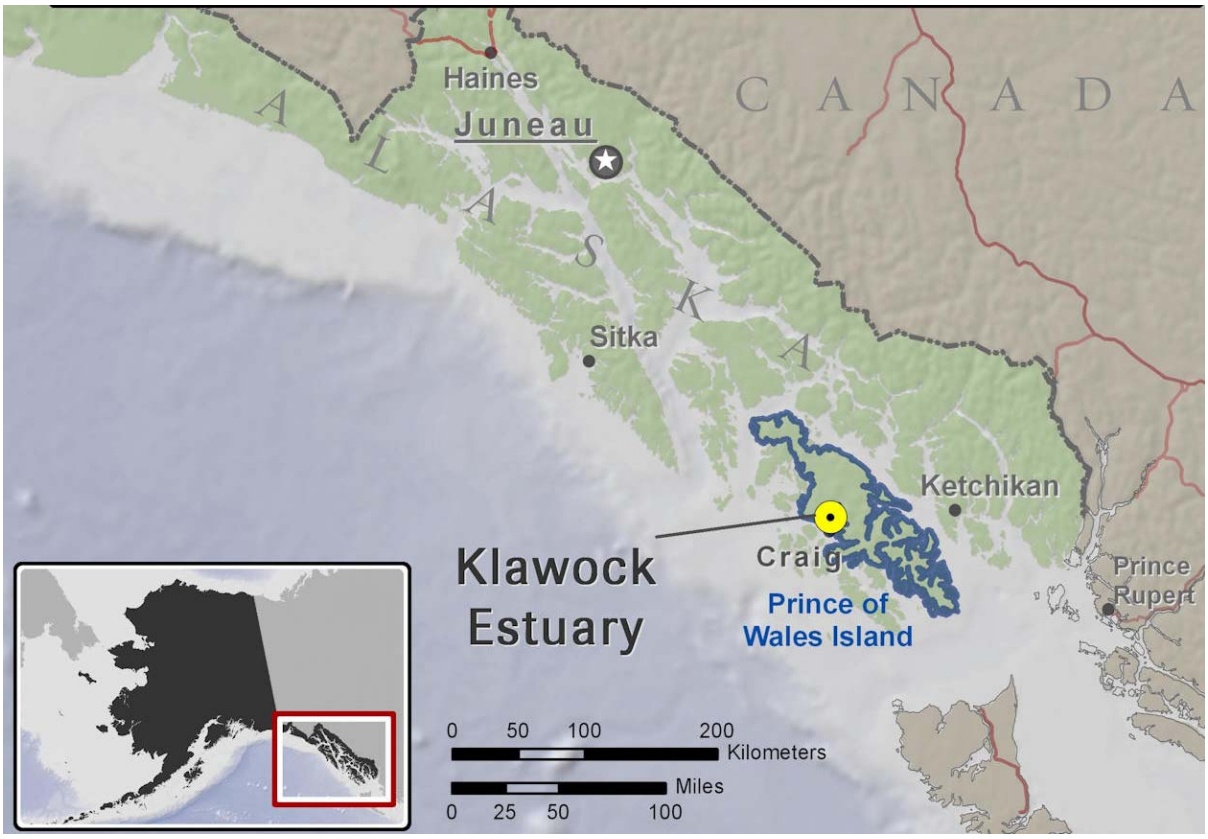

Figure 4: Map showing the project location in Southeast Alaska on Prince of Wales Island. Map produced by TNC.

Figure 5: Aerial photo showing project site for the fish friendly culvert with the Klawock Estuary at the bottom of the photo and the Klawock Bay at the top of the photo.

This project proposed to correct a major fish passage issue identified by biologists in the lower reaches of the Klawock watershed. The aim was to restore Klawock River estuarine hydrology by constructing a culvert through a causeway that was created in 1964. This culvert would provide fish passage through the earthen causeway that provides the foundation for the State Craig-Klawock-Hollis highway across the eastern portion of Klawock Bay, allowing juvenile fish leaving the estuary at a vulnerable stage of their life to access 460 acres of eelgrass habitat that lies immediately seaward of the causeway. The culvert would also allow adult salmon to enter the Klawock River through the causeway, allowing them to more easily reach more than 65 miles of important stream and lake habitat in the Klawock River watershed.

Improved rearing habitat was predicted based on two predictions. The first was that with access through the new corridor, juvenile salmon would have easier access to eelgrass beds located outside of the causeway. The second prediction was that salinity would increase within the Klawock River lagoon, increasing eelgrass habitat in this area. This in turn would result in larger

juveniles and increased survival as juveniles leave the estuary, as well as higher ocean survival rates due to their increased size. Expansion of eelgrass beds were expected to also benefit other fish, including juvenile rockfish and forage fish.

A broad coalition of agencies, elected officials, fishermen and conservationists joined together to open the Klawock causeway and restore access to the Klawock River. These partners include:

- Alaska Department of Transportation and Public Facilities
- Alaska Department of Fish and Game
- City of Klawock
- Craig Improvement Association
- Ducks Unlimited
- Keta Engineering
- Klawock Community Association
- Klawock Hatchery
- Klawock Heenya Corporation
- Klawock Watershed Council
- NOAA Fisheries
- The Alaska Trollers Association
- The Nature Conservancy
- USDA Forest Service
- U.S. Fish and Wildlife Service

Work on this project began long before the current grant. In 2002, the U.S. Forest Service conducted a watershed assessment to determine the functionality of aquatic systems in the Klawock Watershed, including the estuary. In 2004, the Klawock Watershed Council began an ongoing program of salmon habitat improvement, and identified remediation of the barrier at Klawock Causeway as a restoration priority. In 2005, Keta Engineering was retained by Ducks Unlimited to evaluate and design alternatives to provide fish passage through the causeway with the goal of returning to pre-causeway conditions. Design alternatives for the culvert were pre-selected by Ducks Unlimited, members of the Klawock Watershed Council, and various members of state and federal agencies. Designs consisted of different configurations using standard corrugated-metal (aluminum) or pre-cast concrete structures.

A biological study was conducted to assess and quantify the amounts of rearing habitat that would be made available for outmigrant salmonids, and to develop criteria for the size of the culvert. Existing site conditions, such as utilities, hydrological/hydraulic conditions, topography, and right of way were examined, and design alternatives for a culvert were proposed.

The final selection was a pre-cast three-sided concrete box culvert, 18’ wide, 100’ long, and 8’ high. The culvert was designed to run beneath the highway and isthmus.

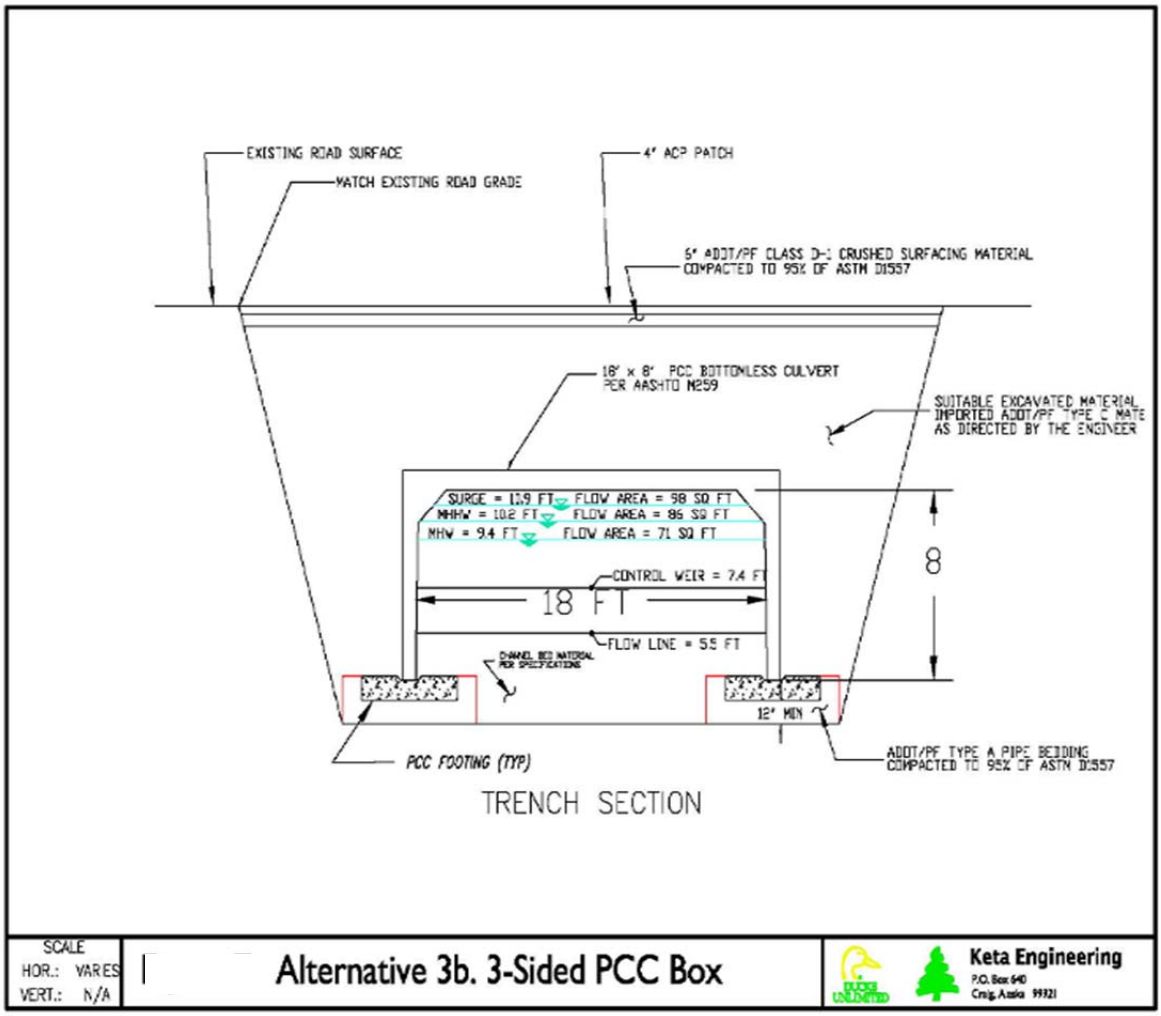

Figure 6: Chosen culvert design.

With all of these pieces in place, funding was finally attained in 2009, the majority of it through this ARRA grant. With funding in hand, the process of constructing the culvert began in earnest.

TNC’s role was to provide oversight for this project. National and state TNC staff provided fiscal and policy review and oversight, quality control, administrative support and an agency liaison as needed. State and local TNC staff oversaw contract, grant, and agreement management (including the grant and agreement between TNC and DOT&PF); financial accounting; performance monitoring and reporting. TNC staff and local partners conducted public outreach and liaised with the community. TNC staff also monitored onsite performance, and worked with the Alaska Department of Transportation and Public Facilities (DOT&PF) project manager to gauge progress.

DOT&PF had been a consultant for the causeway project since 2006. As construction was to take place on DOT's right of way, a sub-award was agreed upon between TNC and DOT&PF that facilitated transfer of a lump sum from TNC to DOT&PF.

Alaska DOT&PF managed the construction and implementation of the project located on their property. DOT&PF approved the project's engineering and technical drawings. DOT&PF also packaged and advertised the construction contract, reviewed bids, selected the contractor, and paid the contractor's billings. The project was contracted by DOT&PF in a single contract, and DOT&PF used its formal bid process to select a contractor. This procedure is consistent with TNC's practice for projects and contracts the size of the causeway project. There was one contractor for both fabrication and construction.

Final Engineering of the project consisted of DOT performing the following tasks:

1. Complete geotechnical work, review hydrology data, complete structural specifications, include special provisions, complete plan set
2. Survey control
3. Right of way certification
4. Review and initiate 106 process. Provide other environmental support services as required
5. Review and complete hydrology study
6. Complete geotechnical investigation per DOT standards
7. Review and complete structural design
8. Coordinate utility relocation/service interruptions
9. Complete all civil design work
10. Complete all structural engineering work
11. Provide erosion and sedimentation control plan
12. Provide traffic control plan
13. Provide complete set of bid documents including plans, construction specifications and various documents required for federally funded projects
14. Administer the advertising and bidding process. Respond to bidder questions, issue addendum as needed during the bidding process
15. Select the lowest responsible bidder in accordance with state statute
16. Provide construction oversight including contractor progress payments, on-site inspections, review and approval of material submittals, change orders, materials testing, construction claims and project close-out.

Figure 7: Construction underway on culvert beneath highway. Photo Credit: The Nature Conservancy, 2011

Figure 8: Photo of completed culvert at low-tide. Photo: The Nature Conservancy, 2011

Environmental Compliance was an important component of this project. NOAA was the action agency for NEPA compliance; the causeway project was handled through NOAA's programmatic EIS authority. Title 16 (ADF&G), Corps of Engineers, and Coastal Management permits were applied for by the following agencies as indicated:

NEPA -- through a programmatic EA, NOAA

State Historic Preservation – FWS and TNC

ADF&G Title 16 – FWS

COE – DOT&PF

ACZM – DOT&PF

The project could not have been completed without the assistance of the many partners. The Klawock Watershed Council coordinated local regulatory permitting, public outreach and provided a liaison to the City of Klawock, the Klawock Indian Association, and DOT&PF. US Fish and Wildlife Service coordinated the technical studies, and contracted for the culvert design and engineering on the Klawock River project, working with affected publics. Ducks Unlimited sponsored the technical engineering for the project. The Alaska Trollers Association secured initial funding for technical engineering.

Biological and Hydrological Monitoring

A biological and hydrological monitoring plan was developed by TNC and NMFS in order to assess the success of the restoration project. The monitoring was focused on the following key indicators;

1. Presence of adult and/or juvenile salmon migrating through the new culvert breaching the causeway would indicate success;
2. Increase in the salinity within Klawock Lagoon would indicate a favorable hydrological response to the breaching of the causeway;
3. In general, any establishment of eelgrass in the Klawock Lagoon would indicate success; utilization of this eelgrass by salmonids and/or other species would indicate positive progress.

Monitoring involved video capture of fish passage and quantifying change associated with hydrologic parameters, eelgrass health and distribution, and fish use of eelgrass beds near the causeway.

A pre-construction baseline for the project site did not exist prior to this project so early restoration targets were established based on a field investigation of the site by Florey in 2004. According to their report, eelgrass appeared to entirely fill Klawock Bay on the north side of the

causeway at depths below +3 feet and extended along the shore 3 miles to the north covering an estimated 460 acres. Salinity on the north side of the causeway at 30 cm depth was 23 ppt. In the Klawock River Lagoon, salinity ranged from 0 to 4 ppt and no eelgrass was found.[2] Earlier investigations, however, by Murphy et al (2000)[3] compared fish assemblages in eelgrass and non-eelgrass sites and found eelgrass to be widespread in the lower intertidal and subtidal zones at +3 to -20 feet mllw in the Klawock Inlet area, outside the Klawock River Lagoon.

The monitoring plan emphasizes basic hydrological monitoring (sampling) and monitors other important eelgrass and fish utilization parameters. It focused initially on a protocol for sampling salinity and temperature in the Klawock River estuary, which are the principal hydrological functions that affect the establishment of eelgrass. A second protocol was designed to determine the extent to which salmon will successfully migrate through the fish-passage structure. A parallel indicator of success is the extent to which migrating juvenile and adult salmon will make use of existing and potentially enhanced eelgrass production.

Hydrologic Parameters:

Salinity and water temperature sampling will indicate degree of hydrologic change at two depths (30 cm below surface and 30 cm above bottom) at one or more stations in Klawock Lagoon and one or more stations in Klawock Bay, before and after breaching of the causeway. Sampling began in January, 2010, and continued weekly for five weeks. It was decided however, that using continuously deployed data loggers would be the most efficient way to monitor these parameters in the study area. In July of 2011, 7 HOBO U24 Conductivity Loggers (Onset Computer Corporation, Bourne, Massachusetts), which record water temperature (°C) and conductivity (µs/cm), and 2 HOBO U20 Water Level Loggers (Onset Computer Corporation, Bourne, Massachusetts), which record absolute pressure (psi) and water temperature (°C) were deployed in the lagoon and the bay (Figure 2). Loggers were periodically retrieved and data downloaded in the field.

Eelgrass:

[2] Optimum salinities are from 10 to 39 ppt. (McRoy 1966); eelgrass can tolerate salinity as low as 5 ppt (Hartog 1970). At low to intermediate salinities (10 to 20 ppt) , eelgrass can survive, but productivity is reduced by 50% (www.seagrassLI.org).

[3] Murphy, M. L., S. W. Johnson, and D. J. Csepp. 2000. A comparison of fish assemblages in eelgrass and adjacent subtidal habitats near Craig, Alaska. Alaska Fishery Research Bulletin 7:11-21.

TNC partnered with the NOAA Coastal Resources Center to create a pre-construction benthic and marsh vegetation map of the study site. Multispectral aerial photography was collected using a low-flying aircraft on April 19, 2011 by Geovantage Inc. A benthic habitat map consisting of 5 habitat classes (coastal marsh, unconsolidated sediments, unconsolidated bottom, macroalgae, and eelgrass) was developed through image segmentation and a Nearest Neighbor classifier using the Trimble eCognition Developer software (Trimble, Sunnyvale, California). In addition, a Trimble Nomad (Trimble, Sunnyvale, California) was used to physically map eelgrass beds by kayak at low tides. A final benthic habitat map was created with a combination of the classified aerial photography, visual inspection of air and ground photographs, and the ground mapping. This final map was used to quantify acres of all benthic habitat types, including eelgrass beds.

Eelgrass sampling events occurred in May of 2010, August of 2010, April of 2011, and August of 2012. Sampling was conducted at extreme low tides in three sampling sites in the lagoon and three sites in the bay (Biological sampling sites; Figure 2). A quadrat measuring 0.5 m x 0.5 m was used to establish 5 random plots inside the eelgrass bed at each biological sampling site. Within each quadrat, % cover and canopy height (height above the bottom of *80*% of the shoots) was estimated. A quadrat measuring 0.25 m x 0.25 m was placed inside each large quadrat to serve as a subsample; within this small quadrat, all stems were counted, clipped at the sediment, and stored in a cooler for transfer back to laboratory facilities do determine biomass quantity per sample.

Fish Utilization Parameters:

Presence or absence of salmon movement through the causeway will indicate degree of success in reestablishing fish passage. Monitoring salmon use occurred through direct observation, with video assistance to the degree practicable, beginning when the culvert construction was complete.

Sampling events for fish assemblage took place in May of 2010, August of 2010, April of 2011, May of 2012, and August of 2012. Fish were sampled with a variable-mesh beach seine measuring 2.5 x 20 m. All captured fish were identified to species (when possible) and enumerated. In addition, a subsample of 20 fish of each species were measured to fork length. All fish were placed in a recovery bucket for at least 5 minutes before being returned to the ocean.

More details on these methods are provided in the results section and in the attached final monitoring report.

Figure 8: K Koski, Fisheries Biologist, samples eelgrass covered with snail eggs. Photo: The Nature Conservancy, 2010.

Figure 9: K Koski, Fisheries Biologist, measures the length of a shiner perch. Photo: The Nature Conservancy, 2010.

Section III. Condensed Project Timeline (1 page).

Table #1: Project timeline illustrating the major components of the project.

Implementation Plan: Klawock AK	Jul-09	Sep-09	Oct-09	Dec-09	Feb-10	Apr-10	Jun-10	Aug-10	Oct-10	Dec-10	Feb-11	Apr-11	Jun-11	Aug-11	Oct-11	Dec-11	Feb-12	Apr-12	Jun-12	Aug-12	Sep-12
Planning, Engineering, Design																					
Casting, Transport, Materials, Mobilization																					
Traffic Management,																					
Data Base Development (Baseline, Monitoring)																					
Central Support Activities (reports, publications, site visits, media, website																					
Adaptive Management and Monitoring																					
De-mobilization, Public Notice																					
Accounting, reporting																					

Section IV. Results

Habitat Units Constructed/Restored

This project restored Klawock River estuarine hydrology by constructing a culvert through a causeway that was created in 1964. This renewed access for out-migrating juvenile salmonids to 460 acres of eelgrass; and provided adult salmonids with increased access to the 29,061 acre Klawock River watershed. This also provided access to the more than 132 miles of streams, most of which are designated anadromous habitat, and 2,800-acre Klawock Lake.

Socioeconomic Outcomes

Jobs

The ARRA grant funded a total of 17.77 quarterly FTE positions over the life of the project. The number of positions funded or partially funding by the grant number 42, and include positions at The Nature Conservancy, the Alaska Department of Transportation, and with subcontractors. Some of the positions funded or partially funded by the ARRA grant include:

- Southeast Alaska Restoration Program Manager (TNC) - provided project management, grant administration, and coordinated with partners.
- Southeast Alaska Program Director (TNC) - provided general fiscal oversight and monitored design and construction contracting, reporting, and environmental compliance.

- Southeast Alaska Restoration Tech. (TNC) - participated in environmental monitoring, compiled vital statistics for reporting, maintained construction records.
- NOAA ARRA Program Integrator (TNC) – A scientist who supported all project teams with the initial start-up tasks, and helped to create a portfolio of project fact sheets, web pages and other communications materials for promoting the projects throughout the implementation and post-restoration monitoring stages.
- GIS Analyst (TNC) – Collected and compiled monitoring data, created a database for analysis of data, and reported results.

Table #2: Types of positions funded by ARRA Grant

Business activity	**Description**	**Position**
Environment, Conservation and Wildlife Organizations	TNC Central Support and Outreach Team: admin. assistance, hiring, media outreach, public relations, science oversight (see budget narrative)	Program Integrator, Restoration Director, Western Marine Director
Environment, Conservation and Wildlife Organizations	Contracting, reporting, project management, reporting, environmental compliance; partnerships	TNC SE Restoration Manager
	Project oversight / Budget oversight, contracts	TNC SE Program Manager
	Environmental monitoring technician, data recorder, report	TNC Conservation Practitioner
Highway, Street, and Bridge Construction	Contract Construction Services: excavation, fabrication, traffic flow, Survey, logistics, installation of fish passage device, road resurfacing	Project Superintendent, Laborers, Equipment Operators, Manufacturers, Flaggers, Mechanic
Highway, Street, and Bridge Construction	DOT&PF Management: Project contracting and management: Pre-construction engineering and design, Geotech Investigation, design completion, Environmental compliance, environmental monitoring	Project Manager, Project Engineer, Environmental Specialists, Land Surveyors,

Community Engagement and Reaction

Extensive efforts were made to engage the public prior to construction, as it was predicted this project would receive a great deal of attention. These efforts were met with lukewarm interest. Community forums had minimal attendance.

Outreach to specific community groups was more successful than efforts to involve the public. Project representatives met with community organizations, local agencies, and tribal entitites in the area. The Klawock Community Association (KCA) is an example of a successful partnership developed over the course of this project. KCA participated in the project by lending TNC an employee for monitoring purposes. Klawock Heenya, an Alaska Native Corporation on Prince of Wales Island, became very supportive of and involved with the project as well.

Habitat and Species Response

The objectives of culvert construction were to:

1) Initiate fish passage through the breached causeway
2) Restore hydrological connections between river and estuary
3) Increase eel grass habitat
4) Increase fish use of eelgrass habitat

Thus, the objectives of monitoring were to document change as related to these objectives. Specifically they were to:

1) Document fish passage through the new culvert by juveniles and adults of salmonid species present in the Klawock river
2) Demonstrate hydrological changes in the estuary as associated with the breach of the causeway in September of 2011
3) Demonstrate increases in quantity and quality of eelgrass habitat as a result of the breach of the causeway in September of 2011
4) Demonstrate increases in fish use and diversity of eelgrass beds as a result of the breach of the causeway in September of 2011

Monitoring related to these four objectives occurred both before and after breach of the causeway in order to assess change. For a full description of all methodologies and results, see the attachment “Klawock Causeway Final Monitoring Report”.

Objective 1: Fish passage

In order to document fish passage, a video system was installed inside the new culvert, and a full year of footage was analyzed (excluding the winter period) after breach of the causeway. Continual video footage showcased migration through the causeway by adult coho salmon, pink salmon, chum salmon, and steelhead trout (Figure 10). No adult sockeye salmon were positively

identified moving through the culvert, and this is thought to be a product of extremely low escapement on the Klawock River in 2012. In addition, spring migration of juvenile coho, pink, and chum salmon was documented (Figure 11); sockeye salmon smolts were expected to have been present as well, although positive identification was difficult do to similarity to chum smolts and low video resolution. Changes in behavior of adult salmonids was also noticed by both local sport and subsistence users, as they identified new fishing spots near the culvert from which adult salmon were typically not found prior to the breach . This video documentation and local observations confirm that the primary goal of the culvert construction, which was to create fish passage through a historical migration corridor, was accomplished.

Objective 2: Hydrologic parameters

Hydrologic changes were assessed by monitoring water temperature and salinity in several study sites on either side of the causeway. Beginning in August of 2011, continually recording water temperature and water salinity loggers were deployed in three sites upstream of the causeway ("Lagoon sites") and three sites outside of the causeway ("Bay sites"). These loggers were periodically retrieved and data initially analyzed after a full year of deployment. No obvious changes in water temperature or salinity were apparent immediately upon breaching, and the short duration of pre-construction monitoring and the inherent variability in both water temperature and salinity both seasonally and annually make detecting change difficult. However, flow through the culvert at high tides is apparent and changes in patterns of tidal circulation has been qualitatively observed, and thus it is expected that hydrologic change is occurring and may be detectable using temperature and salinity measures only over a longer time period.

Objective 3: Eelgrass habitat

Changes in eelgrass habitat were assessed by monitoring eelgrass health parameters, including % cover, canopy height, blade length, and biomass, at three lagoon sites and three bay sites in both spring and fall seasons. In addition, aerial photography of the study area was acquired in May of 2010, and this photography was used to map eelgrass beds and quantify total cover (Figure 12). The very short time period of post project monitoring makes it unlikely that sampling could capture changes in eelgrass cover. These are likely to develop over the subsequent 5 years. The small sample sizes and inherent variability in eelgrass parameters also made it difficult to quantitatively detect change in eelgrass health after breach of the causeway. Aerial photography was not repeated after the breach of the causeway, but it is expected that changing hydrologic conditions will ultimately influence eelgrass cover and health, and that these changes will only be detectable 5-10 years post-restoration.

Objective 4: Fish use and diversity

Changes in fish use and diversity in nearby eelgrass beds were monitored with beach seine sampling at three lagoon sites and three bay sites in both spring and fall seasons. Small sample

sizes and inherent variability in fish abundance as measured by single beach seines made it difficult to quantitatively detect change in fish use and diversity after the breaching of the causeway. Only long-term monitoring, especially of outgoing salmon smolts, will determine changing patterns in eelgrass use with increased access and improved eelgrass health.

Figure 10. Video documentation of adult pink salmon, coho salmon, steelhead, and chum salmon.

Figure 11. Video documentation of juvenile pink salmon, coho salmon, and chum salmon.

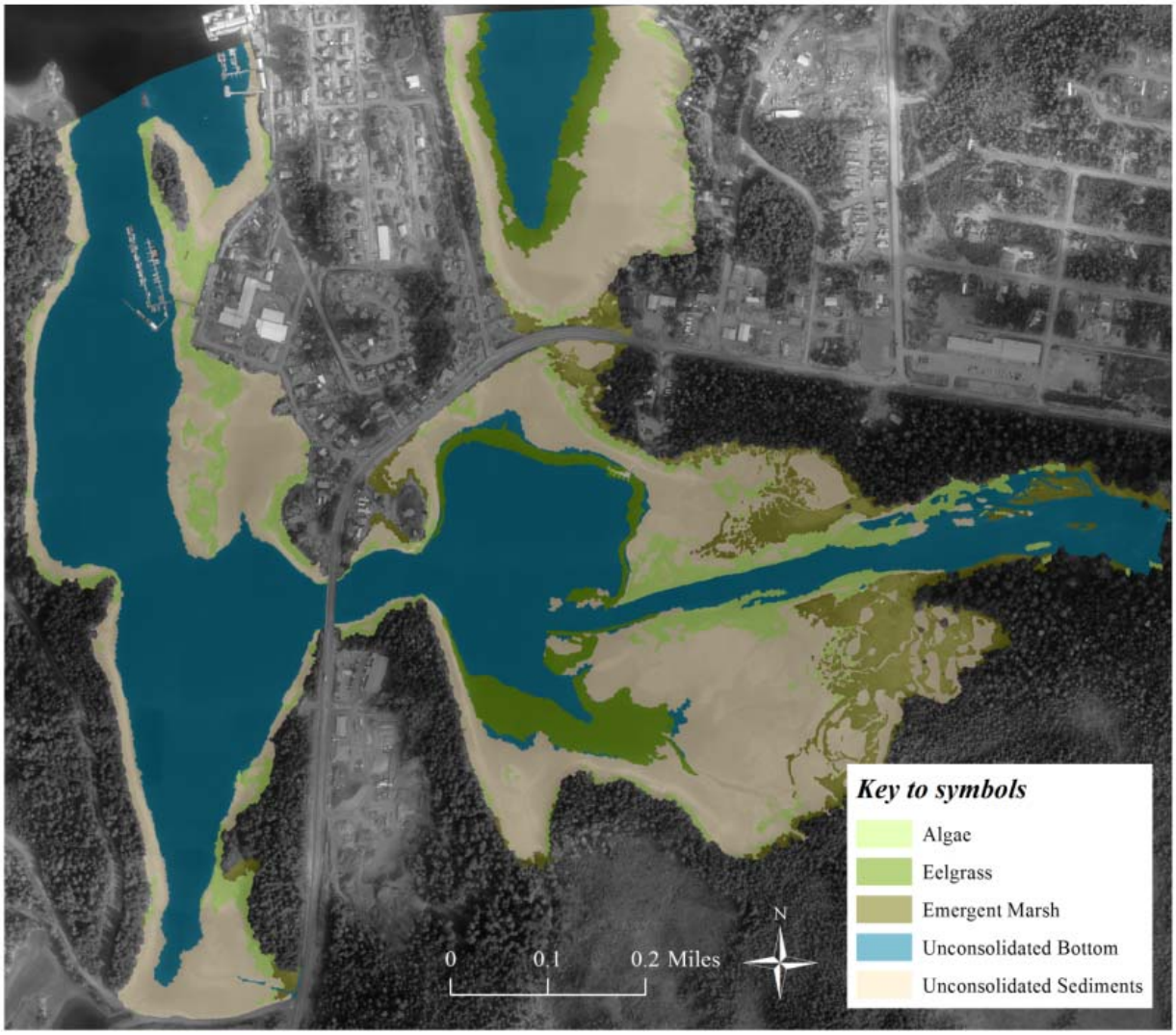

Figure 12. The benthic habitat map created in 2011 from aerial photography

Figure 13: Aerial photograph of Klawock lagoon and causeway during early construction. Photo: The Nature Conservancy, 2010

Figure 14: The culvert and utility lines. Photo: The Nature Conservancy, 2011.

Figure 15: Klawock River (bay) side of the culvert, late summer 2011. Photo: The Nature Conservancy, 2011.

Media and Outreach

The restoration of the Klawock Estuary was predicted to have a high public interest profile given its relative accessibility on the Prince of Wales Island road system. The Klawock Watershed Council, TNC and DOT&PF went to great lengths to ensure the public was directly informed of the project background, goals, results, schedules, etc.

The project was publicized in a variety of ways, including public information meetings, distribution of informational briefing materials, updates on TNC's web-site www.Nature.org, and press releases to print media including the Island News, Ketchikan Daily News.

Figure 15: The first of several meetings TNC and DOT&PF held with local residents of Klawock. Photo: The Nature Conservancy, 2010.

The original community forum at the Klawock Native Brotherhood Sisterhood Tribal Hall in the fall of 2010 was advertised extensively. Flyers containing relevant information were posted in the community, invitations to the city council and local tribal group were issued, and a press release to the Island News resulted in an article. A fact sheet was distributed at the meeting.

More focused project outreach was conducted as well. Informational meetings were held with a local tribal association, the Klawock Community Association, who consequently loaned their Environmental Planner to the project to assist with monitoring. Meetings were also held with the City of Klawock, and Klawock Heenya Corporation, another tribal entity, to discuss and plan for the finding of possible archeological artifacts. The tribe was very supportive of the project.

The most encouraging results of the project have been the video clips showing significant activity – smolts, juveniles, and adult salmon moving through the passage. These clips have been distributed to a number of individuals/entities such as the CEO of Klawock Heenya Corporation, and the administrator for the City of Klawock. Word of the activity within the culvert has traveled, generating excitement among the residents, who believe these signs of activity are a positive development.

In June 2012, a poster and abstract about the project were displayed at the National Fish Passage Conference at the University of Massachusetts Amherst.

Section V. Lessons Learned and Unexpected Outcomes

Video confirmation and local observation show that a historical migration corridor has been restored and that adult and juvenile salmonids are accessing this corridor. The lone exception to this is the lack of documentation of sockeye salmon using the culvert, which is most likely due to the very low escapement of sockeye salmon to the Klawock River in 2012. By the season following the culvert opening, local fishing habits had already been impacted. Fishermen were observed fishing near the roadside, on the North side of the roadway, angling for cohos. These cohos congregated in the tidal area waiting for the tides to rise enough for water to start moving through the culvert.

In addition to documenting fish use of the new corridor, we hoped to detect changes in hydrologic conditions, eelgrass health and abundance, and fish use of eelgrass beds in nearby habitat. Although changing patterns of tidal circulation after breach of the causeway were qualitatively documented, it is difficult to quantitatively detect change in hydrologic parameters given the short monitoring period and inherent variability. Because hydrology is most likely being significantly affected by the breach, it is likely that this will have an impact on eelgrass health and distribution. However, changes large enough to be detected will most likely exist only after a longer time period of 5-10 years. It is also likely that fish use of nearby eelgrass habitat will change over time given new access to this habitat through the corridor and through changing habitat conditions; however, the short monitoring period and inherent variability of sampling methods make it difficult to quantify changes at the time of reporting.

The partners involved in this restoration project had been seeking the funding to complete the culvert for five years prior to receiving this grant. Attempts to secure funding during the previous decade had collapsed. While efforts to secure funding would have continued, this grant finally allowed the partners to put their years of planning into action.

From the beginning, this project was plagued by delays, primarily within the planning and construction timeframes. Final design adjustments and contracting were originally scheduled to begin on July 1, 2009. Construction was to take place during a window of July 1, 2010 through October 31, 2010, but didn't begin until late fall of 2010, and wasn't completed until the fall of 2011. Seasonal fish windows altered the schedule, as construction efforts must meet certain requirements in an aquatic setting when fish are present. Water and sewage lines needed to be re-routed beneath the highway, and permitting issues arose. These delays likely result from trying to do the project quickly when money became available, and scrambling to pull everything together in a short time frame. An extension was given, allowing the project to continue to completion, but more time and attention given to the planning and permitting process would have benefited the project.

Additionally, a more cohesive monitoring plan, one that ensured consistency between pre and post culvert monitoring, would have improved the ability to evaluate predicted changes sooner. It is evident that better planning and organization regarding the monitoring process may have resulted in better documentation of changing hydrologic parameters, eelgrass health, and fish use and diversity of eelgrass habitats. Focusing on thorough monitoring of just a few key parameters, instead of trying to monitor many parameters at many different sites with differing methodologies, may have been more efficient and effective, given cost and logistical concerns. Furthermore, a simplified sampling design and a longer data set of pre-breach conditions may have improved detection of change.

Public outreach about the project gleaned far less interest from the project than expected. Despite being well-advertised, the first community forum had very scant attendance by the public. Only a handful of individuals attended; some felt the restoration would benefit the community, while others felt the expenditures were unnecessary. In all, input from the community was minimal.

The passage of fish through the causeway would not, and could not have occurred without this restoration work. The benefit already being seen by local fishermen, the pooling of coho near the culvert, would not have been possible without this work.

This project brought together a great many partners, working in concert to achieve a restoration goal. Those partnerships created goodwill between many different organizations and agencies.

The partnerships formed throughout the process of restoring fish passage to the Klawock River watershed will likely facilitate further restoration work in the area in the future. The Nature Conservancy is currently speaking with partners in Klawock about the potential for participating on new projects within the watershed.

Section VI. Attachments

1) Final NOAA report form
2) Final monitoring report
3) CST final report
4) Final comprehensive education/Outreach summary