PULLEN CREEK ACTION PLAN

PUBLISHED BY THE

TAIYA INLET WATERSHED COUNCIL

FEBRUARY 2006

Dear Readers

The Taiya Inlet Watershed Council (TIWC) was formed in 2002 with a mission to preserve and protect the health of the Taiya Inlet Watershed through research, restoration, education and communication. For reasons described in this document, Pullen Creek was quickly identified as a priority TIWC focus. As TIWC has worked on this and other Pullen Creek projects, we have learned about water's intrinsic ability to attract people and its fundamental value to our lives.

TIWC is not a management entity in itself and does not – in this plan – seek to make management decisions which will impact the creek and its stakeholders. Rather, we hope that using this plan we can establish partnerships with stakeholders to help synergize action on issues impacting the health of the creek and, ultimately, the health of the Taiya Inlet watershed.

We are sharing our vision of Pullen Creek as it exists now, and we introduce recommendations about its potential as we come together to face challenges in its management. Thus, this action plan synthesizes existing information about the creek and suggests steps we can take to preserve the health of the creek for future generations.

Sincerely,

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Financial Support

This publication was financed through a grant from the United States Fish and Wildlife Service Coastal Conservation Program.

PULLEN CREEK ACTION PLAN

SECTION I Background

1 INTRODUCTION 1

1.1 Regional Description

Southeast Alaska sits on the boundary of two major tectonic plates: the Pacific plate in the West and the North American Plate in the East. The collision of these two plates has caused the uplift of the Coastal Mountain Range which runs the length of Southeast Alaska. Skagway sits nestled among glacially carved valleys and fjords at the northern end of the Lynn Canal, a 90-mile fjord that slices deep into the heart of the Coast Mountains. The community is surrounded by mountains rising up to 6,000 feet in altitude and filled with glaciers and ice fields. Geologically, the area is extremely active; current processes affecting the region include glacial outburst flooding, glacial erosion and deposition.

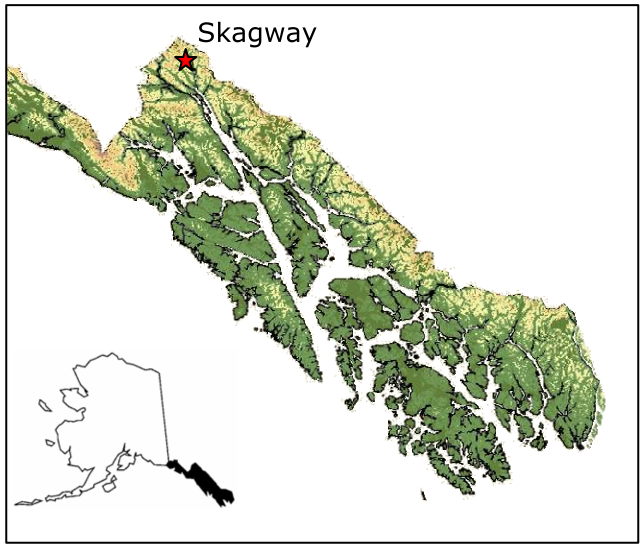


Figure 1: Pullen Creek is located in the town of Skagway, in northern Southeast Alaska.

As a result of Skagway's location deep within the coast mountain range, the area is influenced both by the rainforest climate of Southeast Alaska and the continental climate typical of interior Alaska and Canada. As a result, Skagway is much drier than the rest of Southeast Alaska with an average of 26.5 inches of precipitation and 49.1 inches of snow annually (Skagway Chamber of Commerce, 2005). Skagway has a maritime climate with cool summers and mild winters. Average summer temperatures range from 45-67°F and winter temperatures range from 18-37°F.

Figure 2: Skagway is located at the mouth of the Skagway River Valley.

There are two major watersheds, the Taiya and Skagway; these valleys provide short routes to glacier free mountain passes which link the coast to the interior. Thus, this is the northern-most and interior-most conduit for ecological exchange between the temperate rainforest and interior continental ecosystems. Because of this link, the area remains an important avenue for plant and animal expansions and species interchange. As a result, Skagway hosts unique communities of flora and fauna. In close proximity to Skagway are a diverse collection of habitat zones hosting a diverse faunal community. Some species uncommon in other parts of Southeast Alaska are found in the Skagway region, including the arctic ground squirrel and the pika. Other wildlife that may be seen throughout the area includes bear, whales, salmon, mountain goat, lynx, and river otter.

Vegetation within the region is dependant on elevation and ranges from coastal rainforest to boreal and sub-alpine forests. Common tree species are western and mountain hemlock, Sitka spruce, paper birch, black cottonwood, alder, willow and sub-alpine fir. Understory and herbaceous vegetation includes high bush cranberry, goat's beard, devil's club, blueberry, currant, ferns and mosses. The area surrounding Skagway provides habitat for moose, mountain goat, brown and black bears, wolf, wolverine, porcupine, hoary marmot, snowshoe hare, whales, seals, salmon and trout.

1.2 Pullen Creek

Pullen Creek, once known as Mill Creek, is an extensively modified, small urban stream that flows through the City of Skagway. It is found in Hydrologic Unit Code 1901303 and located in the eastern section of the City of Skagway, at approximately 59° 27′ north and 135° 18′ west. The mainstem is approximately 1.5 miles long and has a spring-fed headwater located at the base of the steep mountainside on the eastern side of town. Two additional springs give the creek two tributaries. Tributary 1 is 0.34 miles long and also hosts the Jerry Meyers Fish Hatchery. Tributary 2 splits form the mainstem at 18th Street, approximately 1.3 miles from the mouth. The second tributary is 0.34 miles long and headwaters directly under the White Pass rail yard at the northern end of town. A majority of tributaries 1 and 2 currently runs adjacent to the White Pass railway. Natural water flows ranging up to 6 to 7 cubic feet per second (cfs) during spring thaw and 1 to 2.7 cfs the rest of the year (Rusanowski 2004).

Figure 3: Pullen Creek (shown in blue) runs through Skagway and into the Skagway Harbor.

The creek has received supplemental flows from hydroelectric generation (up to 40 cfs) for more than 100 years. The tailrace, where flow from the AP&T hydroelectric plant enters the creek, divides Pullen Creek into two distinct sections. Above the tailrace the creek is generally less than 10 feet in width, below it the channel is less complex and varies from 19 to 58 feet in width (Rusanowski 2004). Much of this section parallels the railroad tracks and portions of streambank are heavily degraded and trampled. The Jerry Myers Fish Hatchery is a small hatchery which was built in 1981. It is run by the Skagway School District for education purposes. As a result, introduced or enhanced species in the creek include Chinook and pink salmon in addition to its native species.

1.3 Community Demographics

Figure 4: Downtown Skagway is colorfully patterned after the Klondike Gold Rush.

Skagway's current year round population is estimated at 860 individuals. Each summer Skagway hosts an ever increasing number of visitors from cruise ships, the ferry system and people traveling the Klondike Highway. In 2005 over 900,000 people visited Skagway, making it the 23rd most visited cruise port in the world (Wilkinson, personal communication). To accommodate this influx, Skagway hosts a summer seasonal population of approximately 2000, including year round residents. An Economic Impact Study conducted by the City of Skagway in 1999 found that 51% of the owners of visitor-related businesses are not year round residents (Skagway Traditional Council 2004). Skagway's demographic provides a unique opportunity to educate large numbers of people about salmonid life history and watershed stewardship.

Heavily influenced by visitors and temporary residents, local demographics add additional challenges to maintaining stream and watershed health. High turnover of visitors and residents make it difficult to teach them how to care for and protect streams and riparian zones. The impacts of tourism are far-reaching. Many visitors concentrate in certain portions of the creek and trample fragile riparian habitat and aquatic plants. Quite simply, many places in the Creek's corridor are being "loved to death". Some visitors may care very much about the environment, but are uneducated about the fragile nature of Pullen Creek's habitat and resources unwittingly cause many impacts to the area.

2 HISTORY OF PULLEN CREEK

One hundred twenty or more years ago, before development occurred in the Skagway Valley, a clear spring fed creek flowed through its east side. The creek rushed among a lush spruce and cottonwood forest until, near its mouth, it flowed through salt marsh and tidal mud flats before emptying into the ocean. It was surrounded by forest, had multiple tributaries, wetlands and a considerable estuary at its mouth. In 1887, Captain William Moore, predicting the oncoming gold rush, founded a 160-acre homestead here and built a cabin, wharf, and crude sawmill near the creek, which was called Mill Creek. Eventually this creek became known as Pullen Creek.

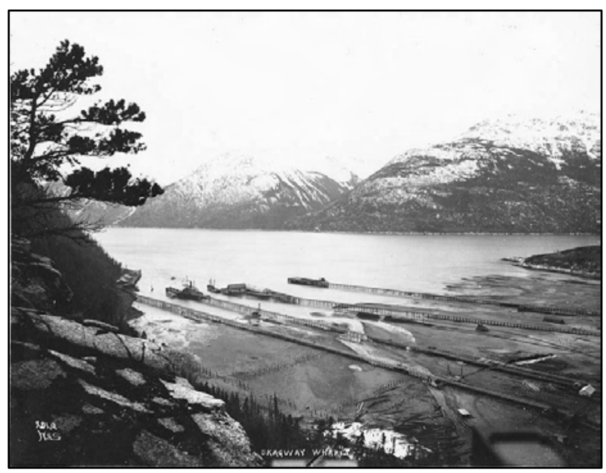


Figure 5: Pullen Creek once flowed through extensive salt marsh and mud flats at its mouth.

In July 1897 the first boatloads of stampeders began to trickle into Skagway. In the following years tens of thousands of transient gold seekers poured through the region, setting the stage for the community of Skagway. The area was soon stripped of trees as building needs of the new town pressed in upon the surrounding forest. Over the following 100 years of urbanization, riparian habitat was dramatically reduced, tributaries were filled in or relocated, and most wetland and marsh areas were eliminated. Though not documented during the Klondike Gold Rush, the creek is expected to have contained ideal habitat for a variety of flora and fauna including a variety of migratory and resident birds, Dolly Varden char, coho salmon, and black and brown bears.

Over the years the entire length of Pullen Creek has been modified for various purposes. Activities have varied from moving the mouth of the stream, construction of ponds along its length, installing and removing bridges and culverts, adding culverts for access to moving and diverting the stream bed to more convenient locations for property use. Rainbow and brook trout were introduced to the Dewey Lakes system, and populations of Chinook, pink and coho salmon have been enhanced through the fish hatchery.

Today Pullen Creek is almost entirely urbanized as its entire boundary lies within the City of Skagway. The creek has been moved and channelized numerous times, a majority of the mainstem is subject to impervious surfaces, there are impacts from street run-off and 31 culverts, and many of the banks are trampled. It has received supplemental water from hydroelectric generation for more than 100 years.

3 IMPORTANCE OF PULLEN CREEK

Despite its impairment, Pullen Creek still provides the surrounding community with beneficial and often essential resources such as fish and wildlife habitat, recreation, aquatic education, open-space, drainage and aesthetics. The stream provides students at the school with an outdoor laboratory for raising salmon and to learn about aquatic ecology and water quality. It is valued by local residents for aesthetic value and wildlife habitat. It provides over-wintering rearing and spawning habitat for salmonids.

3.1 PUBLIC PERCEPTION

Public awareness of the impacts of habitat loss on small streams such as Pullen Creek has immeasurable value in protecting and restoring salmonid habitat. Because of the degraded habitat and the number of threatened or endangered salmonid species in the Pacific Northwest, Alaska has the opportunity to learn from these losses and protect and maintain its wild salmon resources. The loss of small streams and the salmon resource in urban areas of Puget Sound, the Fraser River Valley, and the Columbia River basin attest to the challenge of maintaining habitat for salmon. Public attitudes and perceptions towards Pullen Creek within the community are changing as a result of work being completed there. Public information is gradually educating the community on the benefits of restoration and the importance of habitat protection in urban areas.

3.3 ECONOMICS

Pullen Creek, at the floor of the Skagway River valley, is located in a setting of striking beauty, with towering mountains, glaciers and rushing streams. The natural landscape is the foundation for the major local industry: tourism. Continued impairment of watershed resources in developed areas like the Skagway Valley, however, may reduce future options for these and other industries in the region. Land-use planning and development in the Skagway Valley and other developing areas of the Taiya Inlet watershed have an opportunity to take responsibility for sustaining the resource needs of both the immediate community and important regional industries.

Coho salmon provide an example of a watershed resource where economic analyses have been done that indicate their importance to the regional economy. Whether viewed by cruise ship visitors, captured for subsistence, or simply observed as wildlife in a stream, coho salmon are a conspicuous part of the socio-economic fabric of Alaska. More than one-half of all mature coho are harvested in commercial, recreational, or subsistence fisheries for use in dozens of "products" ranging from caviar to cat food and from eco-tourism to fish leather (Koske & Lorenz 1999).

3.2 FISH AND WILDLIFE HABITAT

Figure 6: Pullen Creek provides overwintering habitat for juvenile coho salmon and Dolly Varden

Pullen Creek and its riparian corridor provide habitat for a variety of fish and wildlife. It is an anadromous fish stream that provides habitat for salmon and char. Salmon from Pullen Creek contribute annually to sport anglers, tourists, and local enjoyment. Other fish such as stickleback, herring, euchalon, sculpin, capelin, and flatfish may be using stream, pond, and wetland habitat associated with this watershed. Songbirds, shorebirds, waterfowl, and raptors use the watershed extensively either as residents or as migrants. Mammals such as red squirrel, voles, and mice use the corridor year-round, black & brown bear, mink, and marten are less common but utilize the watershed as well.

3.4 ECOSYSTEM VALUES

Along with contributing to regional economies, salmon also benefit other regional resources. Adult salmon provide important food for a variety of bird species, terrestrial and marine mammals. Adult salmon transfer essential nutrients from marine to freshwater and riparian environments through decomposition of carcasses and eggs. Juveniles provide food for birds, other fish and mammals. All of the streams draining into the Skagway Valley support a diverse flora and fauna. The streams provide the critical freshwater inflow, both volume and quality, necessary to maintain the diversity of aquatic vegetation and invertebrates important in fish and wildlife food chains.

Figure 7: Many avian species use Pullen Creek's habitat

4 CURRENT CONDITIONS

4.1 FISH HABITAT

The Skagway community has expressed that Pullen Creek has the potential to support substantial wild and hatchery salmon runs. Pullen Creek has problems, however, that affect fish habitat including water quality, fish passage obstructions, changes in hydrology, debris accumulation and urban runoff. Trapping efforts by the Skagway Traditional Council revealed that coho and Dolly Varden use the creek year-round and in its entirety as rearing habitat. Restorative efforts and a watershed assessment may help to improve fish habitat in Pullen Creek, potentially improving fish runs and benefiting the Skagway community.

In 2005 AP&T staff conducted several escapement surveys for Pullen Creek. Pink, chinook and coho salmon were observed. An estimated total peak count for pinks was 660 on August 17, 2005. For chinooks a peak of 142 was also recorded on August 17. Coho were also counted, for unknown reasons there were fewer fish than in previous years, and a peak of 20 was recorded on October 20, 2005 (Martin 2005). Many areas in this region had low returns for coho this year (Martin 2005). See Appendix F for complete survey results.

Jerry Meyers Fish Hatchery

In 1979 Pullen Creek was designated an Area Meriting Special Attention (AMSA) as part of the Skagway Coastal Management Plan. As part of the long-range plan, the Skagway School system was given a Scientific Education Permit to operate a fish hatchery. The Jerry Meyers Fish Hatchery, built by the school district in 1981 with a $30.000 appropriation by the Alaska State Legislature, is owned by the city and run by the School District. The hatchery was built on the upper portion of tributary 1, which is spring fed approximately 100 meters upstream of the structure. The hatchery, as an outdoor classroom, was recognized as the Alaska Vocational Education Program of the Year in 1989. Chinook and coho eggs are harvested from Pullen and Lillegraven Creeks for the hatchery.

Figure 8: The Jerry Meyers Fish Hatchery is a small facility run by the Skagway City School.

Fish Passage

Fish passage in Pullen Creek has been an issue for many years. Culverts impact fish habitat by creating velocity barriers to juvenile fish. Certain portions of the creek flow underground for considerable distances. Several projects in recent years have improved these issues and some barriers to fish passage still exist. The creek's outfall, for example, is elevated several feet above its original location, in the past forcing fish to migrate into the stream through a culvert that was only accessible during high tide.

Figure 9: Perched culverts like this one create formidable and sometimes impassable barriers to juvenile salmonids

As a part of a mitigation project for the Skagway Airport, the Alaska Department of Transportation and Public Facilities (ADOTPF) placed a flume structure at the opening of the culvert to improve access. The structure was damaged during subsequent winter storms, and the outfall was once again in need of improvements to benefit fish passage. In another mitigation project, WP&YR is in the process of installing a new outfall for the creek which is hoped to reduce or eliminate fish passage issues at the outfall.

In another mitigation project, ADOTPF replaced two culverts between the mouth and Broadway Street. In addition, the section between the culverts was "daylighted" utilizing rock dams to create pools to aid fish migrating upstream. ADOTPF also created a rock weir and installed baffling in the Congress Way culvert to decrease flow rates and improve fish passage. The rock dams and weir were quickly washed out and, in 2005, large boulders and a new weir were installed. Fish passage for juveniles, however, is still impeded at the Congress Way crossing (Spillane & Mostrenko 2005).

In 2000 it was observed that a small culvert above the AP&T tailrace was preventing the large runs of pinks from accessing upper Pullen Creek. AP&T removed this culvert and "daylighted" the creed section in 2001 with ADF&G's guidance. A new creek bed was subsequently created with gravel and the creek banks were revegetated.

Above Pullen Pond, there are two culverts which included in a section of the creek dubbed the "Congress Way Reach". This stretch of stream is overly wide and very shallow. The east bank has no riparian vegetation and a dike composes the west bank. Despite these habitat impairments, the reach is known for spawning and some juvenile salmonids have been documented.

A final issue for fish in Pullen Creek is the storm drain system. Certain drains are accessible to fish at higher flows and lead them to the gutter system. The problem is most noticeable at the storm drains that enter the creek on 9th and 10th streets. The fish could become trapped in the gutter system when water levels decrease. This results in unnecessary fish kills that could be prevented with screens or some sort of barrier that blocks entry into the storm drain system.

Sport and Commercial Fishing

Salmon returning to Pullen Creek must migrate into the stream through a culvert. Hatchery and wild salmon must mill in saltwater off the mouth of the stream until sufficient high tide and stream flows allow them to pass through the culvert. This situation increases the vulnerability of the fish to sport fishing. To ensure that enough Chinook salmon enter Pullen Creek for brood stock needs, the area of Taiya Inlet north of a line extending from an ADF&G marker on the Broadway Dock, to a department marker on the ore terminal dock are closed to sport fishing during June and August.

Figure 10: Pullen Creek is a popular destination for anglers during the summer and fall

Dewey Lakes Hydroelectric Project

With the advent of the Klondike Gold Rush, Dewey Lakes Hydro began supplying water and power to the City. Under various ownerships, power has been supplied to the city ever since that time with discharge of water to Pullen Creek near the present powerhouse site. Alaska Power and Telephone Company (AP&T) acquired ownership of the power facilities in 1957, and over the years have upgraded and added turbines, and increased seasonal flows to a maximum of 40 cfs. The project has operated without significant changes for the last 20 years.

AP&T discharges water from the hydroelectric project into Pullen Creek at their powerhouse, located approximately 0.4 miles upstream from the mouth of the creek. Water is gathered from an 8.2 square mile drainage area that includes Reid Creek, Upper Dewey Lake, Dewey Creek, Devil's Punchbowl, Snyder Creek, Icy Lake, Ice Creek and Lower Dewey Lake. This drainage is primarily fed by snowmelt and ice melt from the Denver Glacier. Water from the project is slightly colder (0.5 - 2°C) than the spring fed waters of Pullen Creek.

4.2 HYDROLOGY

Pullen Creek is a low gradient stream system which is spring fed from three separate headwater locations. The source of these springs are unknown, they possibly originate from independent aquifers, the Skagway River, or a combination of both. Construction of dikes, stormwater conduits, and the hydroelectricity project have significantly altered the natural hydrology of the watershed, changing its boundaries and rerouting natural watercourses. Portions of the creek have been relocated several times, dredging and filling has occurred, road crossing have been constructed; these and other activities have altered hydrological processes significantly.

Discharge in Pullen Creek varies with location. Generally, the creek can be split into two discharge regimes, upstream from the AP&T tailrace of hydroelectric related discharge and downstream from the same location. Above the tailrace, average discharge is between 0.5 – 2.0 CFS. Below the tailrace, discharge ranges from less than 2.0 to 40 CFS depending upon the volume being discharged through the Dewey Lakes Hydroelectric project.

As a result of supplemental input from the Dewey Lakes Hydroelectric project, Pullen Creek has two very different flow regimes. Upstream of the tailrace, Pullen Creek generally flows at less than 6 cfs, is less than ten feet wide and with a depth generally less than 2 feet. Winter and spring discharges from the project are typically less than 5 cfs, while flows in the rest of the year are commonly above 20 cfs. Maximum discharge flows are 40 cfs.

Riparian vegetation along Pullen Creek varies and does not follow a consistent pattern. In some locations adequate vegetation is present with alder, willow, spruce and herbaceous vegetation. Areas such as these generally have stable banks and provide cover for the stream. Some sections of the creek do not have any vegetation at all. Areas like this can potentially change the hydrology of the creek as erosion occurs.

Stream sediments in Pullen Creek also vary depending upon whether they are located upstream or downstream of the AP&T tailrace. Generally, upstream the streambed consists of silt/sand, detritus and aquatic vegetation. Below the tailrace where the stream has been effective in transporting finer material downstream, the bed substrate consists of gravel, cobble and boulders.

Figure 11: Areas like this one, with no riparian vegetation, contribute significant amounts of sediment to the creek

5 TAIYA INLET WATERSHED COUNCIL

In November of 2002, the Southeast Conference, a non profit organization, solicited interest from communities throughout Southeast Alaska in forming watershed councils through the Community Watershed Project (CWP). The CWP was initiated as a cooperative agreement between the Southeast Conference and the Alaska Department of Fish & Game to provide financial and technical support for new and existing watershed councils in Southeast Alaska. Skagway citizens recognized the value of the unique landscape in which they live, and enthusiastically responded to the solicitation by developing a local watershed council to promote the health and vitality of upper Taiya Inlet watersheds.

Rivers and streams are an integral part of the community, providing fish and wildlife habitat, recreation, and economic opportunities within the town itself and in the greater Skagway area. Chum, pink, and coho salmon, Chinook salmon through an enhancement program, Dolly Varden char and eulachon can be found spawning and rearing in local streams, and are highly valued by residents and visitors alike. Indeed, the highlight of many visitors' experience in Skagway is the sight of salmon migrating up Pullen Creek and spawning in its clear, shallow waters.

The area's streams and rivers have been impacted by historic and present land uses. Pullen Creek and Skagway Harbor were placed on the Clean Water Act Section 303(d) list of Impaired Water Bodies as a result of elevated metals concentrations associated with a now defunct ore transfer facility. In addition to heavy metals contamination, water quality and fish habitat in Pullen Creek has been compromised by debris accumulation, fish passage obstructions, and urban runoff. Similar water quality and habitat degradation has been identified in the much larger Taiya and Skagway river systems as a result of streambank and upland erosion, flood control efforts, development, recreation impacts, and urbanization.

TIWC was formed to help the community address these issues and identify conservation opportunities. TIWC is a 501(c)(3) tax exempt organization directed by seven board members and supported by one staff Coordinator. The board is composed of two co-chairs, secretary, treasurer, and three directors. The TIWC is a community partnership working to protect and improve the health of the watershed through education, communication, research and restoration, its goals are as follows:

Landscape Goals

- Collaborate with stakeholders to restore, protect and understand habitat for fish, wildlife and other organisms
- Encourage and facilitate research opportunities in the Taiya Inlet watershed

Community Goals

- Promote community understanding and stewardship of the watershed through outreach and education
- Participate in community planning efforts to promote watershed stewardship

Organizational Goals

- Build organizational capacity
- Form a balanced and diverse partnership of citizens, businesses, and organizations
- Develop program for long-term sustainability

SECTION II Action Plan

6 RATIONALE FOR A PULLEN CREEK ACTION PLAN

Pullen Creek faces many challenges, but still makes a valuable contribution to anadromous fish habitat in the upper Taiya Inlet watershed. It is an important drainage corridor that provides over-wintering rearing habitat for coho salmon and Dolly Varden char, and provides spawning habitat for coho, pink and chum salmon and Dolly Varden. In addition, there are parks and trails on Pullen Creek which hold value for the community. Pullen Pond and Molly Walsh Park provide recreational value, fishing opportunities, tourism values and educational opportunities.

If key concerns such as erosion, trampling, fish passage obstructions, and stormwater runoff can finally be resolved, the community would benefit. Pullen Creek would be a safer and healthier human environment, the capacity to support fish and wildlife would increase, and visitors and residents would have a better experience there. TIWC has written this plan with the hope that our land-management entities and other stakeholders will build partnerships among one another and with TIWC to implement suggestions in the plan and, most importantly, find ways to ensure the long-term sustainability of Pullen Creek and its watershed.

7 NOTED PROBLEMS IN PULLEN CREEK

Pullen Creek is almost entirely urbanized, as its entire boundary lies within the City of Skagway. The creek faces a variety of challenges affecting water quality and fish habitat: debris accumulation, channelization, fish passage obstructions, and stormwater runoff.

Figure 12: Certain portions of Pullen Creek are very popular with visitors and residents, particularly for salmon viewing and anglers.

Land Use

We believe that much of the impairment in Pullen Creek stems from land-use management that does not protect the creek. Foot traffic from tourists and other pedestrians and stormwater management are two areas where the watershed could be carefully controlled and management coordinated with urban development. Lack of coordination in the past has led to damage to the creek's functions and resources. Limited residential, commercial, and industrial land in the Skagway area also requires that management be well planned, by working with all stakeholders this can be accomplished. Land-use policies must protect not only watershed resources but also the economic vitality of the community.

8 POTENTIAL PROBLEMS

Heavy Metals

Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that have been set for them. The law requires that these jurisdictions establish priority rankings for waters on the lists. In 1986 Pullen Creek was placed on the Clean Water Act Section 303(d) list of Impaired Water Bodies as a result of elevated levels of metals associated with a now defunct ore transfer facility. The creek was never actually tested for the presence of lead, however, this assumption was made on the basis of lead contamination found in the Skagway Harbor.

It is generally believed that the Skagway Nahku Ore Terminal is largely responsible for the metal contamination found in the Skagway Harbor. It is suspected that the Ore Terminal and White Pass railway activities may have contaminated Pullen Creek because the rail line, which runs along a large portion of Pullen Creek, was used to transport lead and zinc ore from the Yukon to the Skagway Nahku Ore Terminal. The WP&YR transport of mining ore concentrate from the Yukon Territory occurred at the terminal from 1967-1993, with a brief break from 1982-1986 with the closure of the Cyprus Anvil lead-zinc mine in Faro, Canada. During its operation, approximately 50,000 tons of ore concentrate passed through the terminal each month. The Faro Mine, which supplied the industry, was a galena mining and concentrating (by flotation) facility that produced low grade zinc (60%) and lead (40%). Ore was transported by railway until 1982, and then by trucks through town from 1986-1993. The ore was uncovered and dust could be disbursed by air movement to settle in the local waterways (Skagway Traditional Council 2004).

There are other potential sources of heavy metal contamination in Skagway that should not be discounted. During World War II there was military build-up in Skagway. There are 9 Formerly Used Defense Sites (FUDS) in the Skagway area, and these sites are still being assessed as to potential contamination concerns they may have had on the community (Skagway Traditional Council 2004). Urbanization may also be a source of contamination to water resources throughout the Skagway area.

Hydrocarbons

There are 12 officially reported Alaska Department of Environmental Conservation hydrocarbon contaminated sites within the City of Skagway. These sites range from underground storage tanks on private property, to operations associated with White Pass, to potential contamination from a large military presence in Skagway during World War II. These sites have created a concern within the community of Skagway about the potential of hydrocarbon contamination to various water resources including Pullen Creek.

9 SOLUTIONS

We approach the management of the Pullen Creek watershed with the idea that through partnership with management agencies and organizations the healthiest watershed will result. Thus, TIWC will partner with land-management entities to take three general approaches to maintaining the health of Pullen Creek and its watershed: management, restoration, and education. Success will only come when local organizations partner together to ensure these practices are established and maintained. Using these strategies, TIWC hopes to partner with managers and stakeholders

Management of local land use has a significant impact on how conflicts between desired land-use, watershed functions, and pollutants are resolved. The watershed approach requires management to be organized by geographic rather than demographic areas. The watershed approach allows managers to plan for and understand how development affects critical and protected watershed functions, such as water quality control, and fish and wildlife habitat.

Restoration is a key component to maintaining and restoring the health of Pullen Creek. Loss of stream resources and current development mean that proper management and education will not be enough to revive the stream's functions. At this stage, significant restoration will have to be completed to attain that goal. This plan identifies restoration opportunities and potential funding sources.

Figure 13: Students participate in harvesting salmon eggs for the Jerry Meyers fish hatchery

Education is the key to effective restoration and management. Through education programs a conservation ethic can be woven into this community's fabric. This ethic will help establish stewardship practices which ensure the long-term sustainability not just of Pullen Creek, but for the entire watershed.

Strategies

We suggest a strategy for implementing this plan wherein TIWC will serve as a liaison between Pullen Creek stakeholders to enhance communication. We believe that by building partnerships among the various land management agencies and stakeholders we can develop sound management strategies for the Pullen Creek watershed. To ensure management that meets the needs of all stakeholders, we recommend using an adaptive approach. Adaptive management is a cyclic, learning-oriented approach to the management of complex environmental systems that are characterized by uncertainty about system processes and the potential ecological, social and economic impacts of different management options. Adaptive management attempts to deal with our limitations or inability to assess impacts to the environment as a means to produce and deliver better environmental outcomes such as strategies, goals and restoration projects.

10 THE PLAN

10.1 MANAGEMENT

The watershed perspective for land management is a relatively new approach. The watershed perspective allows tasks to be organized by geographic rather than demographic areas, integrating natural barriers with management style. The watershed is broadly considered the best framework for managing urban land-use on a sustainable basis, allowing managers to plan for and understand how development affects critical and protected watershed functions such as water quality, and fish and wildlife habitat.

Suitable management and control of activities causing the most degradation to the watershed is the necessary first step to halt abuses to Pullen Creek and begin the recovery process. Those issues will be complicated by Skagway's extremely limited land base, where managers must consider watershed management policies that protect the watershed while minimizing adverse effects on the existing inventory of residential, commercial, and industrial land.

Management Goals

- Reduce and manage non-point source pollution in the Pullen Creek watershed
- Identify and manage sources of degradation with focus on riparian areas

By opening avenues of communication to the community with this plan, we hope to foster a community discussion to consider options for improvement such as streamside setbacks, riparian buffers, and other changes in land use. Improvements of management in two key areas, BMPs and riparian zone protection, are discussed below.

Reduce & Manage Non-Point Source Pollution

Figure 14: Stormwater runoff carries nonpoint source pollution, which can significantly impact water quality

This plan encourages stakeholders to work together to build partnerships and develop best management practices which will protect the watershed. BMPs are considered one of the best means of implementing measures to protect natural resources. BMPs are effective, practical, structural or managerial methods which prevent or reduce the movement of sediment, nutrients, pesticides and other pollutants from the land to surface or ground water, or which otherwise protect water quality. Examples of structural methods include sediment basins, fencing and oil/water separators; while managerial methods could include runoff routing, fertilizer management, and snow management or removal practices. BMPs are developed to achieve a balance between water quality protection and development and are particularly effective at reducing nonpoint source pollution.

Nonpoint source pollution is in materials that wash off the landscape with rain water or snow melt, or stormwater. As water moves across and through the land it picks up and carries away natural and human-made pollutants and deposits them in lakes, streams and rivers, wetlands, coastal waters, and even our underground sources of drinking water. The amount of pollutants from any particular spot is small and insignificant, but when combined from over the landscape, can create water quality problems. To effectively reduce non-point source pollution from stormwater, various types of BMPs must usually be combined. BMPs for urban runoff minimize delivery of pollutants from human activities to water resources and are an effective way to implement pollution control. Most urban stormwater BMPs were developed to prevent impacts from nonpoint source pollution to the physical and biological integrity of surface and ground water.

The process of selecting and using BMPs has three elements: (1) a comprehensive evaluation of the type of pollution present, (2) an understanding of the mechanisms of pollutant control, and (3) consideration of the management goal. Site-specific factors such as climate, environmental conditions, and economics should also be considered so that BMPs are sized, placed, and coordinated where they will do the most good. In practice, no single "best" BMP system to control a particular pollutant exists and sometimes several BMP systems must be coordinated for the best result.

Riparian Zone Protection

Thickly vegetated areas found along rivers, streams, and lakes are known as the riparian zone. These are areas of transition between aquatic and upland ecosystems, and they offer numerous benefits to wildlife and people that are often overlooked. Biologically diverse, these areas maintain ecological linkages throughout the forest landscape, connecting hillsides to streams and upper headwaters to lower valley bottoms. There are no other landscape features within the forest that provide the natural linkages of riparian areas.

Figure 15: Riparian zones are essential to stream function

Fallen trees and other woody debris provide fish habitat, food organisms and shade. Riparian areas provide mammals, birds, amphibians, and other wildlife with many essential habitat components. Riparian areas are particularly important for protecting channel morphology and determining the distribution of anadromous fish habitat. These areas also provide storage of surface water, moderate ground-water discharge, dissipate flooding, and provide nutrient cycling and removal of pollutants. In urban settings such as Pullen Creek, riparian vegetation buffers the effects of development on all waterbodies.

Riparian habitat is often the first stream habitat to be impacted by urban development, indeed, much of this habitat in Pullen Creek has been removed or destroyed. Through active management of riparian habitat by local, state and federal entities; fostering increased awareness of riparian area fisheries habitat values; and supporting close coordination and cooperation among all stakeholders, we can protect the health of our riparian habitat and minimize the need to for restoration projects to bring back degraded habitat. Ultimately, we will ensure the health and longevity of our riparian habitat, essential to the health of Pullen Creek and maintaining our water quality.

10.2 RESTORATION

While improved land-use management is critical to maintaining and improving Pullen Creek, management alone will not be enough to restore the creeks ecologic and aesthetic functions. Specific restoration measures will be required to enable Pullen Creek to fill its niche within the Taiya Inlet watershed. Restoration is a complex endeavor that begins by recognizing natural or human-induced disturbances that are damaging the structure and function of the ecosystem or preventing its recovery to a sustainable condition. It requires an understanding of the structure and function of a stream corridor ecosystem and the physical, chemical and biological processes that shape them (Dunster and Dunster 1996). Restoration, as defined in this document, includes a broad range of actions and measures designed to enable stream corridors to recover dynamic equilibrium and function at a self-sustaining level.

Figure 16: Restoration projects will enable Pullen Creek to provide habitat for fish, wildlife and people

The first and most critical step in implementing restoration is to, where possible, halt disturbance activities causing degradation or preventing recovery of the ecosystem (Kauffman et al. 1993). Restoration may vary from passive approaches that involve remove or attenuation of disturbance activities to active restoration that involves intervention and installation of measures to repair damages.

Pullen Creek provides an array of ecologic, hydrologic and aesthetic functions to the Taiya Inlet watershed. It provides habitat for native flora and fauna within the community's urban setting, it serves as an essential travel corridor for certain species while connecting our community to its natural environment. We have established three target restoration areas which will ensure the ability of Pullen Creek to fulfill its ecologic niche, identified below.

Figure 17: Replacing culverts which block fish passage is essential to restoring habitat and hydrologic function

Restoration Goals

- Restore hydrologic function to Pullen Creek and eliminate barriers to fish passage
- Establish and maintain a healthy riparian zone wherever possible, providing for sediment filtration, absorption of runoff, erosion prevention, and fish and wildlife habitat
- Restore aesthetic values to the stream corridor and provide educational and recreational opportunities to residents and visitors

In addition to implementing development policies and BMPs, loss of aquatic resources in Pullen Creek encourages restoration to meet community and ecological needs. Beyond fulfilling environmental standards, the process of restoring the watershed can be used to achieve community objectives including watershed enhancement, water quality improvement and educational programs. Restoration projects should be implemented only after input and collaboration from stakeholders has been achieved. Restoration also must be timed to maximize the benefit of other projects within the watershed. Restoration opportunities are identified by reach in Appendix B.

Hydrology

The natural hydrology of Pullen Creek has been impacted by channel relocation, hydroelectric supplementation and road crossings. Several improperly sized or placed culverts limit fish passage and impede the natural hydrology of the system. Restoration of aquatic habitat and channel morphology will require improved culvert sizing and placement as well as stream channel restoration. Restoration and maintenance of the riparian zone will help ensure the long-term sustainability of restoration to the hydrologic processes in Pullen Creek.

Riparian Zone

Improved land-use planning will be important for protecting riparian habitat on Pullen Creek, but too much degradation has occurred for this to solve the problem alone. Specific projects will be required to restore healthy streamside vegetation to the stream corridor. The impact of a healthy riparian zone on creek health cannot be understated, it is one of the single most important factors effecting stream health. Healthy riparian vegetation can help reduce and prevent pollution, provide habitat and food for aquatic and terrestrial species, and help protect streambanks from erosion. Specific sites in need of vegetation restoration have been identified in this plan.

Aesthetic Values

The community and stakeholders have identified aesthetics as a priority for the Pullen Creek corridor. Due in part to Pullen Creeks prominent location in downtown Skagway, it provides an impressive opportunity for visitor education, particularly about the ecology of salmonids. Restoration projects in the watershed should address educational opportunities wherever possible. There are sites on Pullen Creek that could be enhanced to provide a more pleasant experience for visitors and residents, these same projects could improve habitat for species using the corridor.

10.3 EDUCATION

An effective Pullen Creek action plan can only become a quality and productive entity through the education and connection to the community that it offers. Partnerships with schools and community provide a genesis of learning and understanding of what constitutes the creeks environment. Opportunities for community education must also be created that will adequately inform and illustrate the functions and goals of a watershed council, as well as illuminating processes and procedures enacted to achieve the intended objectives. Through education and outreach healthy resources and quality of life can be more easily achieved in the community.


Figure 18: Creek cleanups educate community members and improve the creek's health

Education Goals:

- To foster a responsive conservation ethic and a sense of stewardship within Skagway residents and businesses that integrates with other community priorities.
- To promote increased appreciation and knowledge among residents and visitors about aquatic resources, fish and fish habitat, and watersheds

To make this plan work TIWC, residents of the area, and other partners must work together to develop a personal conservation ethic that addresses daily activities in how people treat water use, runoff, potential pollutants, streamside vegetation, instream habitat and fish and wildlife. Developing a sense of ownership and community pride can help the restoration process and prevent further degradation in other streams. When streamside sites are being developed for any purpose, the conservation ethic should be considered and applied.

Through TIWC and this plan the public can help develop strategies to protect or restore Pullen Creek and other Taiya Inlet watershed streams. Although this plan provides technical background on the problems and strategies to solve them, the community needs to decide the relative importance of issues such as free-flowing streams with salmon and trout, health concerns and flood risks.

11 PROJECTS

11.1 CURRENT PROJECTS

Efforts at monitoring water quality and fish habitat in Pullen Creek have been separate projects by various organizations. Projects include assessment, mitigation and restoration.

11.1.1 Alaska Department of Transportation and Public Facilities (ADOTPF) Airport Mitigation Project

ADOTPF completed an expansion of the Skagway Airport in 2001, which included a modification of the Skagway River to divert flow away from the airport. With the airport expansion, ADOTPF was required to complete several mitigation projects on Pullen Creek, largely directed towards improving fish passage. Mitigation projects included replacing the Broadway Street Culvert with two larger culverts, which created a "daylighted" segment of the creek on a stretch located near the ferry terminal. A rock weir was built and baffle plates installed to back water into the Congress Way culvert and improve fish passage. Mitigation work was completed in 1999 and according to the Skagway Airport Improvements Final Environmental Assessment, monitoring of Pullen Creek mitigation measures will evaluate impacts over a period of five years. Monitoring included fish identification and enumeration, fish passage, water flow measurements and assessment of macroinvertebrate recruitment in the daylighted section.


Figure 19

A consulting firm, Silver King International completed the first monitoring in October 2002. At that time, the Pullen Creek structures were found to have two deficiencies: first, the four rock dams located near the ferry terminal had been washed out; second, the rock weir in Pullen Pond had washed out. The daylighted channel, according to the evaluation, is likely used more as a migratory passage than a rearing area. Both the dams and the rock weir were designed with undersized rocks that could not withstand increased flows (Bethers 2002, 2003).

The weir structure at the Congress Way culvert was rebuilt in spring 2004 with larger rocks. Rock dams in the daylights reach were replaced with larger boulders. 2004 monitoring reports that *it is unlikely that juvenile salmonids can move upstream through the Second Avenue* (Congress way) *culvert under the flow conditions encountered*. The report indicates that juvenile fish are present above the culvert and that, at a minimum, successful coho and Dolly Varden spawning is occurring there (Sogge 2004).

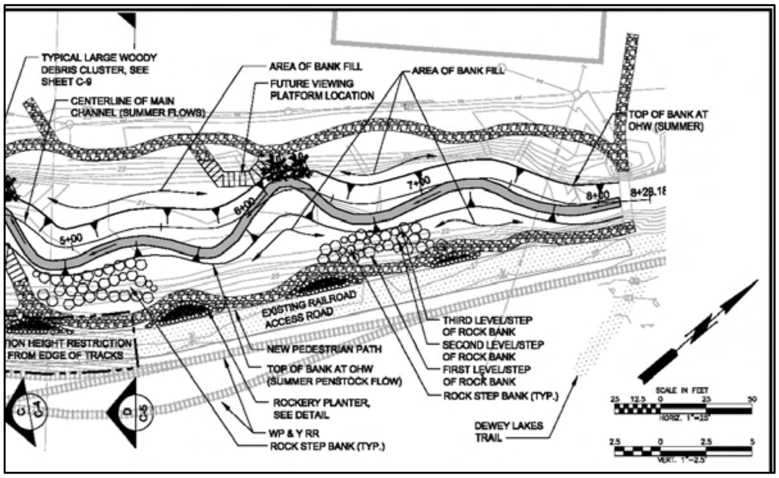
Figure 20: ADOT&PF installed this rock weir at the upstream end of Pullen Pond

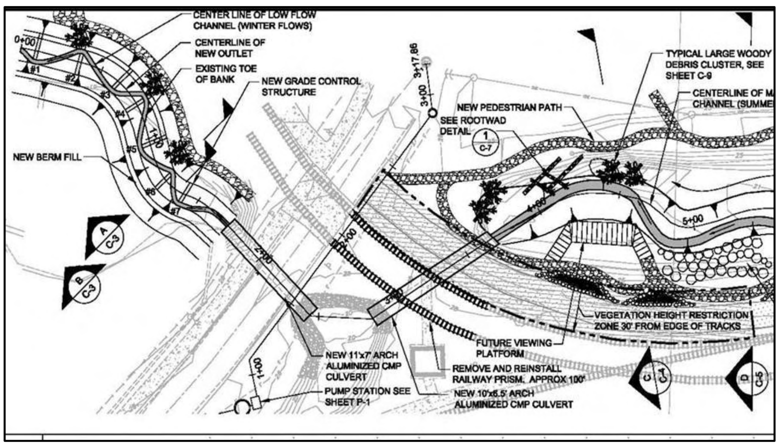
In September 2004 TIWC contracted with Herrera Environmental Consultants to complete design work for the Congress Way restoration project (described below). Detailed survey work and modeling was completed for the area, including an evaluation of fish passage at the Congress Way culvert. A design memorandum received from Herrera in April 2005 reports that fish passage for all life stages through this portion of Pullen Creek is currently less than one percent.

11.1.2 Alaska Power and Telephone Dewey Lakes Hydroelectric Project

The Dewey Lakes Hydroelectric project has been supplying power and water to the City of Skagway since the Gold Rush. Alaska Power and Telephone Company (AP&T) acquired ownership of the project in 1957. AP&T is currently undertaking the task of relicensing the Dewey Lakes Hydroelectric project. Through its application with the Federal Energy Regulatory Commission (FERC), AP&T will monitor to determine if the power plant may be adversely impacting Pullen Creek.

Addressing agency concerns, AP&T is collecting baseline data on the following parameters as part of its monitoring efforts: temperature, conductance, pH, total dissolved solids, total suspended solids, turbidity, nitrogen, phosphorus, biological oxygen demand, alkalinity, chlorophyll A, fecal coliform, nitrates, nitrites, total coliform and hardness. Water temperature is being monitored within the tailrace and just above the railroad culvert. In addition, water temperature stratification in the reservoir will be collected on a quarterly basis. A habitat survey was conducted by the Shipley Group using the U.S. Forest Service "Fish and Aquatic Stream Habitat Survey" protocols.





Figures 21 & 22: the restoration plan for the Congress Way reach, the southwest part of the reach is at left and the northeast above.

11.1.3 Congress Way Reach Restoration

The TIWC initiated a restoration project on the Congress Way Reach of Pullen Creek in April 2004. The project is still in the planning phase, with design expected to be completed in December 2005 and construction planned for 2006-2007. The Congress Way reach of Pullen Creek is approximately 130 meters long. Land ownership lies with the City of Skagway and includes a right-of-way for the WP&YR railroad.

At the south end of the reach, the creek passes through two culverts. Both culverts are impediments to fish passage, as both are undersized and one is overly steep, creating a velocity barrier to juvenile fish as they seek overwintering habitat. As a consequence of heavy foot and vehicular traffic, the area supports little vegetation and contributes significant amounts of sediment from the nearby railway to the creek. With significant restoration measures, the Congress Way reach has the potential to support increased spawning and rearing habitat for native anadromous species including Coho salmon and Dolly Varden char.

Project Goals:

- Improve fish & wildlife habitat and passage
    - Improve fish passage through the culverts under Congress Way and the railroad tracks
    - Revegetate streambanks and enhance riparian habitat
    - Protect streambanks from future degradation
- Stream Channel Rehabilitation
    - e channel which accommodates flows from Dewey Lakes hydroelectric project while providing increased habitat features not currently available to fish
    - Increase sediment transport through culverts
    - Increase fish habitat complexity/spawning substrate availability
- Pedestrian Safety and Traffic Control
    - Control access to streambanks
    - Provide access for fish viewing, sport fishing, and other streamside activities
    - Limit access to railroad tracks if possible, improve traffic flow so pedestrians will be drawn away from tracks
- Improve Aesthetic and Educational Value of Area for Residents & Tourists

11.1.4 Skagway Traditional Council (STC) Assessment

Pullen Creek is listed on the 1996 303(d) impaired waterbody list and on the Alaska Clean Water Action (ACWA) list for heavy metal contamination. When it was listed there was no evaluation completed by the State of Alaska, and it was therefore carried over to the EPA 1998 303(d) list. Under the ACWA program Pullen Creek was scheduled for a Total Maximum Daily Load (TMDL) to recover the waterbody from heavy metal contamination, however, there was a lack of baseline data for an appropriate evaluation and to begin this process. In July of 2003 the STC applied for and received money from the ACWA program to begin gathering baseline contaminant data on Pullen Creek, to be used in future ACWA programs.

The final report for this study was submitted in July 2005 and makes several recommendations, stating that the data collected was to screen for contaminants and start developing a baseline of water quality information. The study showed that heavy metals are present in bank soils and sediments associated with Pullen Creek (Skagway Traditional Council 2005). At a meeting with stakeholders it was recommended that STC move forward with the development of a Waterbody Recovery Plan under the ACWA program for fiscal year 2006. The Waterbody Recovery Plan should address the cumulative effects of current and future construction projects along or near Pullen Creek. In additional, all projects that occur near Pullen Creek should have a pre-construction and post-construction monitoring program to help safeguard the potential of reintroducing contaminants held in soils and sediments (Skagway Traditional Council 2005).

Figure 23: Soil & sediment samples were collected during the study to test for heavy metal and hydrocarbon contamination

Contaminants appear to be more closely associated with the Fish Hatchery site (Reach 4, see Appendix B), where arsenic, barium, cadmium, chromium, lead, mercury and zinc were all found in exceedence of standards in soils and sediments. It is recommended that a comprehensive site specific study be conducted in this area to determine the extent of contamination (Skagway Traditional Council 2005).

11.1.5 White Pass & Yukon Route - Broadway Dock Expansion

WP&YR is currently constructing a project which will expand the Broadway Dock, which is located near the mouth of Pullen Creek. The project involves dredging out the area where the current outfall of the creek is located to make room to extend ship capacity at the dock. The outfall will be moved a short distance to the north. As mitigation for this project, a new fish ladder will be installed, which should improve access to the creek for salmon during lower tidal levels.

Figure 24

11.1.6 Chinook Salmon Enhancement

Chinook salmon were introduced in recent years as a part of a four-party agreement worked out with Douglas Island Pink and Chum (DIPAC), Burro Creek Hatchery, Jerry Meyers Fish Hatchery and the City of Skagway. According to the agreement, the Skagway hatchery provides eggs for DIPAC, which raises the eggs and returns the fry for "imprinting" at the pen located in Pullen Pond. ADF&G installs a weir each summer and harvests eggs for shipment to DIPAC, staff counted a total of 159 chinook salmon at the weir from July – August 2005 (Erickson, personal communication)

The City of Skagway, with assistance from the Southeast Conference, investigated the potential to expand the hatchery. The expansion project had support form the local commercial sport fisheries and DIPAC, however a River Habitat Study (Merrell, 1993), determined that expansion was not feasible at the present location. Merrell's reasoning is that the summer water temperatures are too cold for optimal growth and rearing of fish and that the current location does not present ample space for building a larger facility. Merrell suggests relocating the hatchery site downstream from the powerhouse, as Pullen Park is a suitable site and is currently being used as a collection point to capture mature salmon for eggs and for rearing salmonids before release. The City of Skagway is currently exploring the possibility of building a new hatchery on the west side of Pullen Pond.

11.1.7 Stormwater mapping

Figure 25: Stormwater catchbasins dot the town of Skagway

The Alaska Clean Water Action (ACWA) program recently funded TIWC to map the Skagway stormwater system. This project is part of a longer-term goal of ensuring the watershed has high water quality for many years to come. The first part of this process is to build an accurate picture of our stormwater system by mapping all of our catchbasins and discharge pipes.

Stormwater is the water from rainfall or snowmelt that flows across the land surface. As stormwater flows over driveways, lawns and sidewalks, it picks up debris, chemicals, dirt and other pollutants. This water can flow into a stormwater catchbasin or directly into a lake, stream, river, wetland or our coastal waters. Stormdrain discharge pipes and catchbasins (a catchbasin is a curbside opening that collects rainwater from streets and serves as an entry point to the stormdrain system) dot the town of Skagway. Skagway does not have a good picture of its system of catchbasins, outfalls, and other runoff conduits and it is difficult to understand what happens to our stormwater and how we can help keep it clean.

Mapping involves taking a closer look at each catchbasin and outfall. Condition and GPS coordinates are recorded and photos are taken. After mapping is completed TIWC will have a complete picture of our stormwater system. We will be able to answer questions like *which catchbasins drain to Pullen Creek*?

11.2 FUTURE PROJECTS

If specific restoration projects on Pullen Creek were undertaken its quality could be improved significantly. We have identified three key areas where we feel improvements could make the most significant improvements: stream crossings, riparian zone and stream channel restoration. Appendix B contains specific stream reaches and associated projects.

11.2.1 Stream Crossings

Improper sizing and installation of culverts has created notable problems in Pullen Creek. The damming effect created at crossings has degraded the stream channel in some locations and the stream no longer flushes sediments or passes water efficiently. We recommend resolving this by replacing them with larger culverts placed at the appropriate elevation. Gravel can be placed in the bottom of large culverts to simulate a streambed and maintain fish habitat and passability. The most critical culvert crossings are at Congress Way in downtown Skagway, and the railroad crossing just above Congress Way.

Replacing culverts with bridges should be considered where possible, but bridges can be expensive depending on their capacity needs and whether materials are imported or locally obtained. Bridges can be cost effective when they are made of local materials, and cost less to install and maintain because much less instream work or water diversion is needed. The design life and long-term maintenance needs are comparable to culverts.

Figure 26: Culverts that are too small inhibit fish passage by increasing stream velocities, at negatively impact stream hydrology

In recent years some culverts have been removed and those creek sections "daylighted", examples include a site near the AP&T powerhouse and the site just above the outfall. This improves fish habitat. There are still some culverts that force Pullen Creek to run under ground for unnecessarily long distances. In the future, we recommend that stakeholders work together to remove these culverts and daylight all possible portions of the creek.

11.2.2 Riparian Zone Revegetation

Stream or river banks are riparian areas, and the plants that grow there are called riparian vegetation. Riparian habitats can range from a dense thicket of shrubs to a closed canopy of large, mature trees like spruce. Riparian systems are one of our most important – and most neglected – habitat types. Riparian areas are valuable because of the many functions they serve. Riparian habitats help our area in many ways:

Figure 27: Sluffing of stream banks, as has occured at this location along Pullen Creek, damages stream habitat and infrastructure necessary for community functions

- Bank stabilization and water quality protection: The roots of riparian trees and shrubs help hold streambanks in place, preventing erosion. Riparian vegetation also traps sediment and pollutants, helping keep water clean.
- Fish & wildlife habitat: As dying or uprooted trees fall into the stream, their trunks, root wads and branches slow the flow of water. Large snags create fish habitat by forming pools and riffles in the streams. Riffles are shallow gravelly sections of the stream where water runs faster. Many of the aquatic insects that salmon eat live in riffles and salmon require riffles for spawning. Pools are used for resting, rearing and refuge from summer heat and winter cold. An overwhelming percentage of terrestrial wildlife species use riparian habitats during some part of their life cycle. Riparian vegetation provides food, nesting and hiding places for these animals.
- Food chain support: Salmon and trout, during the freshwater stage of their life cycle, eat mainly aquatic insects. Aquatic insects spend most of their life in water. They feed on leaves and woody material such as logs, stumps and branches that fall into the water from streambanks. Standing riparian vegetation is habitat for other insects that sometimes drop into the water, providing another food source for fish.
- Flood control: During high stream flows, riparian vegetation slows and dissipates floodwaters. This prevents erosion that damages fish spawning areas and aquatic insect habitats.

Loss of riparian vegetation has contributed to Pullen Creek degradation. Encroachment of residences, businesses and roads has left little or no buffer between development and the stream. Most vegetation adjacent to roadways has been removed, contributing to high sedimentation rates from winter road sanding. Loss of streamside vegetation has impaired fish habitat and degraded water quality by accelerating streambank erosion, loss of streamside trees, and removing sources of woody debris. Revegetation options include:

- acquire greenbelt areas along stream
- Plant vegetation along reaches exposed to road sanding and plowing or where riparian habitat has been damaged
- Place woody debris (i.e. tree boles, root wads) in selected stream reaches for instream habitat
- Work with landowners to develop streamside setbacks (riparian buffer zones)

11.2.3 Stream Channel Restoration

Through 100 years of urbanization, Pullen Creek's channel has been dredged, relocated, filled, augmented, diked, and in general impacted through human development. Channel restoration could improve habitat and aesthetic values at many sites along the creek. The most important site for channel restoration is the Congress Way reach, located just above Pullen Pond. Restoration is planned for this reach in 2006. In locations where the creek has been straightened, projects could include re-meandering of the channel to improve hydrologic function and habitat values.

11.2.4 Stormwater Management

Stormwater can pose threats to the environment. In developed areas runoff from rain or snowmelt carries natural and manmade pollutants into wetlands, lakes, streams and groundwater. This stormwater can affect water quality, habitat and living resources, and may carry bacteria, nutrients, pesticides and hydrocarbons. Stormwater also conveys sediments that cause siltation of aquatic habitats, and contributes floatable debris, resulting in increased turbidity and declining water clarity. If land owners and managers can work together to manage stormwater, its impacts to Pullen Creek can be minimized.

Figure 28

11.2.5 Fish Hatchery

The City of Skagway is currently considering a proposal to build a fish hatchery on the west side of Pullen Pond. This hatchery would be used for Chinook salmon enhancement, currently completed by DIPAC (see 11.1.6). Pullen Creek could not support a natural salmon run (Cremata, 2005). The impacts to the stream of such a hatchery are not known, but production is thought not to exceed the amount already released through the DIPAC agreement.

SECTION III APPENDICES

APPENDIX A ACKNOWLEDGEMENTS

Many individuals and agencies have contributed to the Pullen Creek Action Plan. In 2003 various agencies and local citizens and organizations came together to form the Taiya Inlet Watershed Council. Through the council, issues in Pullen Creek have begun to be addressed. Without the help of local, federal, state, and municipal organizations this plan would not have been produced.

U.S. Fish & Wildlife Service	Neil Stichert
NOAA - National Marine Fisheries Service	Erika Phillips
USDA - Natural Resources Conservation Service	Samia Savell
Alaska Department of Fish & Game	Ben Kirkpatrick
Prince of Wales Tribal Environmental Consortium	Cathy Needham
Skagway Traditional Council	
Cathy Needham	
Taiya Inlet Watershed Council Board of Directors	Elaine Furbish
	Meg Hahr
	Dan Fangmeier
	Dimitra Lavrakas
	Sandy Snell-Dobert
	Andrew Cremata

Appendix B - Reach descriptions and future projects

This appendix describes Pullen Creek beginning from the mouth and working upstream to each of the tributaries. We have broken the creek down into six different reaches for ease of ease of description. These reaches are:

1. Outfall to Pullen Pond
2. Pullen Pond to AP&T tailrace (also called Congress Way reach)
3. AP&T tailrace to 18th Avenue fork
4. Fish hatchery
5. 18th Avenue headwater spring in WP&YR railyard (near 23rd Avenue)
6. 18th Avenue to headwater spring at base of hill on the east side of town (near 21st Avenue)

Figure 1: Pullen Creek has been divided into six reaches, indicated above in yellow or blue.

Reach 1 – Outfall to Pullen Pond

This reach of Pullen Creek begins at the mouth of the creek, where Pullen Creek spills out of a culvert and into the Skagway harbor. The reach extends approximately 1/4 mile upstream to the upstream end of Pullen Pond. Much of the reach harbors a wide riparian buffer zone. Pullen Pond is surrounded by a network of "social" trails and contains little native vegetation. There are two culverts within the reach.

Figure 2: Reach 1 of Pullen Creek

Much work has been done in this area in recent years, mostly associated with mitigation for various projects outside of the creek. Pullen Pond is a popular recreational destination for Skagway residents and visitors. The heavily used park contains a picnic area, benches, two docks overlooking the pond, parking and is landscaped with grassy lawns and a few trees. This landscape supports limited riparian vegetation and lacks the infrastructure necessary to direct and control the many thousands of people that visit the area daily or weekly during the busy visitor season.

Future Opportunity:

An enhancement project at Pullen Pond could involve planting native vegetation around the pond to establish a riparian zone, and establishing pathways and access points to the pond. Enhancements at Pullen Pond should be coordinated with the Congress Way restoration project and proposed fish hatchery to maximize the benefits of these projects.

Reach 2 – Congress Way

Reach 2 of Pullen Creek has been dubbed the Congress Way reach. It extends from the south side of the culvert passing under Congress way approximately .17 miles north, where the AP&T tailrace enters the creek. The WP&YR railroad parallels the creek on the east side, and a dike composes the west bank. The east bank is virtually devoid of vegetation and lacks riparian cover, essential for juvenile fish, while the left bank has reasonably good alder and shrub cover.

Figure 3: This figure illustrates reach 2 in blue. This reach extends from Pullen Pond upstream to the AP&T power plant and tailrace.

The reach is 30-50 feet wide, shallow, and with a substrate of heavy silt deposits. At the south end of the reach the creek passes through two culverts, one under the railroad tracks and the other passing under Congress Way. Both culverts are impediments to fish passage, as one both are undersized and one is overly steep, creating a velocity barrier to juvenile fish.

Future Opportunities:

- At and upstream of the footbridge at the Dewey Lakes trailhead the east bank of the creek has been denuded of riparian vegetation by trampling. Riparian vegetation should be reestablished at the site and pedestrian control measures implemented.
- The Dewey Lakes Hydroelectric System pipe crosses the creek in this area and may be too low, potentially disrupting flows at high water levels.
- Work with WP&YR to establish and maintain native vegetation, possibly implementing best management practices to encourage long term sustainability of efforts.
- Complete Congress Way restoration project between Pullen Pond and footbridge, which will replace culverts, and restore riparian vegetation and stream hydrology.

Reach 3 –AP&T tailrace north to 18th Avenue

This reach of the creek extends from above the AP&T tailrace to a creek junction near the intersection of 18th and State streets. Due to the heavily residential nature of most of the reach, it contains limited riparian vegetation and passes through 15 culverts as it courses its way through the community.

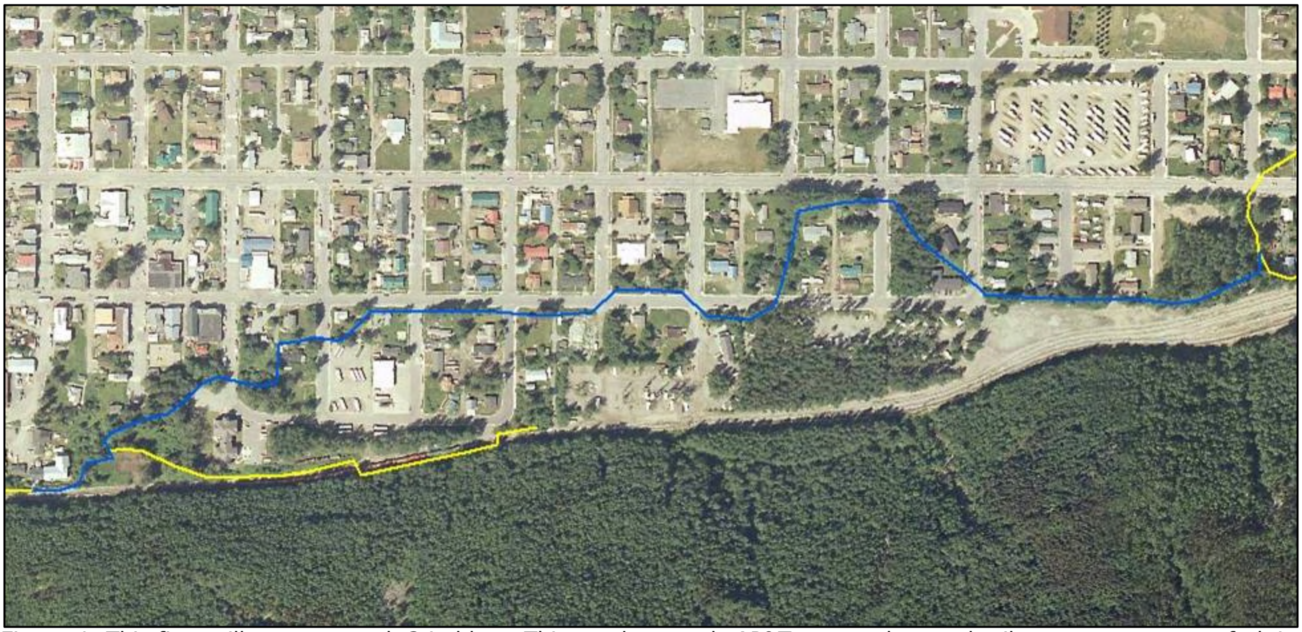


Figure 4: This figure illustrates reach 3 in blue. This reach extends AP&T power plant and tailrace upstream to a fork in the creek (junction with reaches 5 & 6). Reach 4, the Fish hatchery reach can be seen in yellow at the bottom.

This reach of Pullen Creek faces challenges typical in urban streams. It passes through many culverts, some of which may limit fish passage; large areas are paved with impervious surfaces and stormwater runoff may impact water quality; there are significant underground distances that must be passed by fish; in many locations where the creek passes through yards and near roadways, the riparian zone is severely limited.

Future Opportunities:

- AP&T daylighted the reach of Pullen Creek located just above the tailrace. Attempts to reestablish vegetation have been thwarted by trampling. Site monitoring should continue and further plantings be completed.
- Work with WP&YR to establish and maintain native vegetation, possibly implementing best management practices to encourage long term sustainability of efforts.
- For a 1-block stretch between 10th and 11th the gabions and sidewalk are collapsing into the creek. The gabions could be replaced with something more structurally sound that would appropriate support the sidewalk and nearby roadway. While this work is being completed, the creek could be re-meandered and aquatic and riparian vegetation planted.

- There are a number of sites along the creek that require improvements to restore fish passage including culvert removal or replacement, dams removal, and other structures limiting fish passage or otherwise causing degradation of the stream and/or its habitat. Some of these include:
  - The culvert at 15th street near Broadway is possibly not set right, or restoration of stream hydrology needs to occur above the culvert, for water is pooling there.
  - The culvert in the alley between 16th and 17th, at the east end near the railroad tracks may need to be replaced. Sediment transport through this area could be enhanced if flows were restored by recreating a channel above the culvert.
  - The culvert in the alley between 13th and 14th is perched and should be replaced as it inhibits fish passage.
  - Considerable restoration of native riparian vegetation due to trampling is possible in this reach. Much of this has been caused by uncontrolled access to the creek by visitors in public areas, but restoration opportunities are also apparent on private property.
  - There are some locations where the creek is bridged with structures that may inhibit fish passage or prevent the passage of light. These include fences or bridges that extend to or below the waters surface, and culverts and structures that bridge or cover the creek. Each of these structures represents and opportunity to "daylight" the creek and/or restore uninhibited fish passage by removing unnecessary culverts, removing or modifying bridges/fences, and removing or modifying other structures that cover the creek.

Reach 4 – Fish Hatchery Reach

The mouth of reach 4, which contains the fish hatchery, empties into Reach 3 of Pullen Creek not far above the AP&T tailrace. It is fed by a very small headwater spring and flows from that spring, through the Jerry Myers fish hatchery, and downstream to join with the mainstem of Pullen Creek. There is a small manmade pond located just above the hatchery. This section flows through two culverts, both underneath the railroad tracks. It is a small, low flow channel which parallels the railroad tracks for most of its length.

Figure 5: Reach 4, the fish hatchery reach, is illustrated in blue. It branches off of Reach 3 just above AP&T and extends approximately to 10th Avenue.

Future Opportunities:

- There are several sites in this reach in which, working with landowners, the creek could be remeandered and restored to reestablish riparian vegetation and restore a functional hydrology to the creek.
- Work with WP&YR to establish and maintain native vegetation, possibly implementing best management practices to encourage long term sustainability of efforts.
- Wetland Creation: Because most wetlands associated with the Pullen Creek watershed have been removed, new wetland areas could be created for natural filtration of sediment and other pollutants and to increase fish habitat. Unfortunately, space for wetland development is limited. One site includes one of the springs that forms Pullen Creek, located near the east end of 10th avenue. The area is large and ponded, with significant stormwater contributions. A wetland could be created at the site that would be useful for filtering stormwater and other runoff. Wetlands such as these are aesthetically pleasing and attract wildlife, benefiting the area.

Reach 5

This spring fed tributary of Pullen Creek is another low flow channel. It extends upstream from the junction near 18th & State streets, through residential properties to the WP&YR rail yard, where a spring flows. This reach faces many of the same challenges as Reach 3, urbanization, impervious surfaces, and approximately 10 culverts.

Figure 6: Reach 5 branches off the mainstem of the creek near the intersection of 18th and State streets. It originates from a small spring in the WP&YR railyard.

Future Opportunities:

- Work with private property owners to re-meander the creek, re-establish riparian buffer zones and restore stream hydrology to sites where these have been degraded.
- Explore the possibility of relocating the creek where urbanization has irreversibly damaged stream hydrology and habitat.
- There are a number of sites along the creek that require improvements to restore fish passage including culvert removal or replacement, dam removal, and other structures limiting fish passage or otherwise causing degradation of the stream and/or its habitat. This would include replacement or resetting to a lower elevation of the culvert located on 19th Street between State and Main, which is slightly perched.
- There are sites with extensive debris and litter which could cause stream damage or contamination. These sites represent a cleanup opportunity for the community of Skagway, which would restore the aesthetics of these sites and ensure clean water in Pullen Creek and throughout our watershed.

Reach 6 – Main headwaters

Reach 6 originates from a hillside runoff spring located at the base of the steep hillside on the East side of town. This is the primary headwater of Pullen Creek, providing most of its flow. This reach parallels the railroad tracks for almost its entire length, passing through 1 culvert before joining with Reach 3.

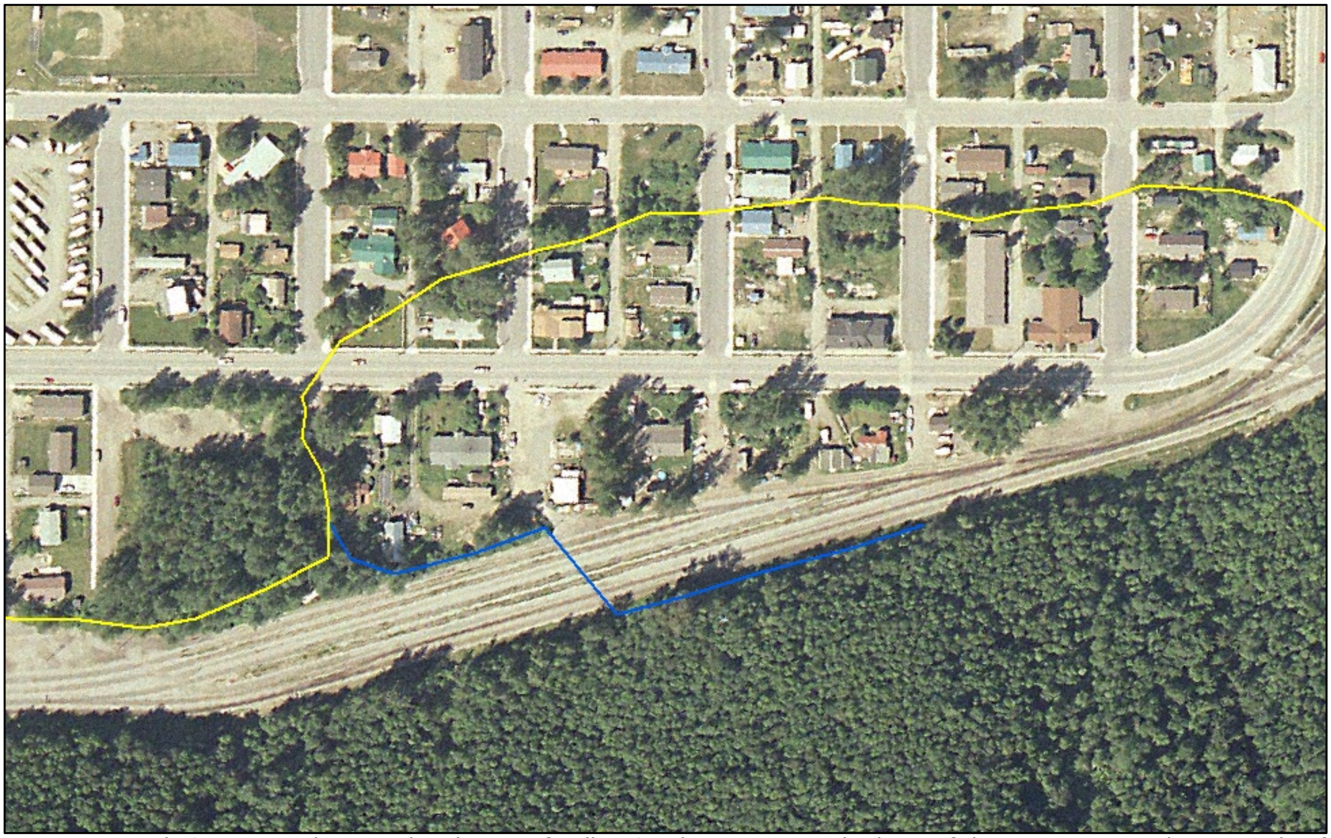


Figure 7: Reach 6 contains the main headwater of Pullen Creek, a spring at the base of the mountain, on the east side of Skagway. This reach extends from the fork in the creek to the spring.

Future Opportunities:

- Work with WP&YR to establish and maintain native vegetation, possibly implementing best management practices to encourage long term sustainability of efforts.

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APPENDIX D WATER QUALITY PARAMETERS AND DATA

Appendix D contains a summary of water quality data collected in the 2003-2005 assessment of Pullen Creek conducted by the Skagway Traditional Council. The complete data from the study can be obtained from the report, Pullen Creek Assessment, prepared for the ADEC ACWA program.

Figure 1: Sampling sites used in the STC assessment of Pullen Creek.

Table 1: Summary of basic water quality parameters, discharge and substrate type for sampling sites (STC 2004).

	Pullen Pond	Fish Hatchery	Tributary Two	White Pass Pond	Headwaters
Air Temp (°C)	-6	-4	-	-2	-3
Water Temp(°C)	0.25	3.12	3.72	4.13	4.39
DO (mg/L)	28.20	18.34	11.36	10.72	16.20
pH	6.17	7.11	6.61	6.14	6.26
Conductivity (µS/cm)	0.099	0.202	0.154	0.154	0.153
Discharge (cfs)	0.135	.018	0.056	0.003	0.032
Substrate Type					
Silt (Si)	18%	0%	11%	18%	4%
Sand (s)	10%	50%	8%	15%	8%
Very Fine Gravel (VFG)	0%	0%	0%	2%	2%
Fine Gravel (FG)	0%	0%	4%	10%	10%
Medium Gravel (MGR)	7%	0%	4%	14%	25%
Coarse Gravel (CGR)	9%	0%	6%	5%	14%
Very Coarse Gravel (VCG)	20%	0%	13%	5%	8%
Small Cobble (SC)	16%	0%	7%	5%	4%
Large Cobble (LC)	6%	0%	2%	3%	0%
Boulder (B)	11%	0%	3%	1%	1%
Detritus (D)	0%	50%	25%	10%	4%
Wood (W)	1%	0%	8%	4%	0%
Garbage/Plastic (G)	2%	0%	1%	8%	0%
Vegetation (V)	0%	0%	8%	0%	0%
	SI/S <2mm	MG 8-15.9mm		SC 64-127.9mm	
	VFG 2-3.9mm	CG 16-31.9 mm		LC 128-255.9mm	
	FG 4-7.9mm	VCG 32-63.9mm		B >256mm	

Table 2: Summary of results of heavy metal testing at five sites in Pullen Creek. All samples were collected in accordance to STC's QAPP. Heavy metal analysis on water, sediments and bank soils were conducted at Shoalwater Bay Laboratory. Data from soil samples were compared back to the State of Alaska's method 2 soil clean-up levels. Data on water samples were compared back to the State of Alaska water quality standards. For sediments, the data were compared to National Oceanic Atmospheric Administration's (NOAA) Effects Range Median (ERM) for Sediment Quality Guidelines. There were no guidelines set for barium or selenium in NOAA's guidelines, so these parameters were compared to the State of Alaska's method 2 soil clean-up levels. Exceedences are indicated in red.

Pullen Pond

	Feb-04			May-04			Aug-04			Nov-04			Mar-05		
	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed
units	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg
Arsenic (As)	3.700	ND	13.000	4.4	ND	0.8	1.5	ND	2.9	14.0	ND	2.4	ND	ND	ND
Barium (Ba)	367	77	1290	280.0	ND	250.0	105.0	1200.0	394.0	99.0	0.0460	168.0	53.3	0.0520	132.0
Cadmium (Cd)	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.5	ND	2.1	ND	ND	1.3
Chromium (Cr)	7.7	1.6	20	2.4	ND	5.5	2.2	1.6	3.6	7.9	ND	7.3	6.9	ND	4.2
Copper (Cu)	N/A	ND	N/A	N/A	ND	N/A	N/A	ND	N/A	28.0	ND	34.0	12.9	ND	9.7
Lead (Pb)	123.0	ND	422.0	90.0	ND	80.0	54.6	ND	52.8	60.0	ND	113.0	19.6	ND	33.4
Mercury (Hg)	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	0.1	ND	ND	0.1
Selenium (Se)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver (Ag)	ND	1.01	1.2	ND	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc (Zn)	85	ND	293	130.0	ND	110.0	49.3	ND	137.0	63.0	0.0030	174.0	39.3	0.0070	90.6

Tributary One

	Feb-04			May-04			Aug-04			Nov-04			Mar-05		
	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed
units	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg
Arsenic (As)	20	N/A	7.1	1.9	N/A	1.2	7.0	N/A	2.3	1.4	N/A	5.5	ND	N/A	ND
Barium (Ba)	452	N/A	1080	210.0	N/A	190.0	408.0	N/A	99.7	156.0	N/A	172.0	240.0	N/A	191.0
Cadmium (Cd)	0.9	N/A	0.7	ND	N/A	ND	0.7	N/A	ND	1.5	N/A	3.1	8.0	N/A	2.4
Chromium (Cr)	13	N/A	12	5.1	N/A	5.5	6.1	N/A	2.7	5.4	N/A	12.0	14.2	N/A	11.4
Copper (Cu)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.9	N/A	29.0	59.3	N/A	36.8
Lead (Pb)	346	N/A	263	340.0	N/A	75.0	438.0	N/A	60.7	18.0	N/A	108.0	485.0	N/A	116.0
Mercury (Hg)	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	0.0	N/A	0.1	0.3	N/A	0.1
Selenium (Se)	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND
Silver (Ag)	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND
Zinc (Zn)	317	N/A	551	1800.0	N/A	240.0	960.0	N/A	179.0	48.0	N/A	353.0	1200.0	N/A	452.0

Fish Hatchery

	Feb-04			May-04			Aug-04			Nov-04			Mar-05		
	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed
units	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg
Arsenic (As)	8.2	N/A	19.2	3.0	N/A	3.4	12.0	N/A	4.8	5.8	N/A	4.5	ND	N/A	ND
Barium (Ba)	653	N/A	1340	180.0	N/A	180.0	302.0	N/A	180.0	250.0	N/A	172.0	320.0	N/A	196.0
Cadmium (Cd)	1.3	N/A	1.7	ND	N/A	ND	5.4	N/A	ND	3.4	N/A	2.5	7.1	N/A	ND
Chromium (Cr)	19.9	N/A	43.5	6.4	N/A	14.0	12.0	N/A	7.1	6.7	N/A	11.2	22.8	N/A	8.7
Copper (Cu)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	115.0	N/A	14.3	187.0	N/A	17.3
Lead (Pb)	1240	N/A	207	620.0	N/A	98.0	1627.0	N/A	64.4	592.0	N/A	70.0	2090.0	N/A	50.3
Mercury (Hg)	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	0.2	N/A	0.1	2.1	N/A	0.1
Selenium (Se)	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND
Silver (Ag)	2.1	N/A	0.7	ND	N/A	0.6	5.4	N/A	ND	ND	N/A	ND	ND	N/A	ND
Zinc (Zn)	673	N/A	835	650.0	N/A	770.0	2554.0	N/A	218.0	373.0	N/A	170.0	1790.0	N/A	134.0

Tributary Two (18th and State)

	Feb-04			May-04			Aug-04			Nov-04			Mar-05		
	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed
units	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg
Arsenic (As)	8.1	N/A	15	2.7	N/A	1.6	6.1	N/A	8.6	2.6	N/A	4.0	ND	N/A	ND
Barium (Ba)	1060	N/A	1070	290.0	N/A	200.0	250.0	N/A	248.0	133.0	N/A	136.0	244.0	N/A	198.0
Cadmium (Cd)	0.800	N/A	2.000	ND	N/A	ND	ND	N/A	1.0	2.0	N/A	3.1	ND	N/A	2.0
Chromium (Cr)	6.2	N/A	32	3.6	N/A	5.6	7.2	N/A	14.0	7.9	N/A	4.3	7.5	N/A	11.7
Copper (Cu)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.0	N/A	9.7	34.5	N/A	20.7
Lead (Pb)	116	N/A	373	54.0	N/A	66.0	129.0	N/A	232.0	33.0	N/A	53.0	186.0	N/A	107.0
Mercury (Hg)	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	0.1	N/A	0.0	0.2	N/A	0.1
Selenium (Se)	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND	ND	N/A	ND
Silver (Ag)	ND	N/A	0.9	ND	N/A	ND	ND	N/A	0.8	ND	N/A	ND	ND	N/A	ND
Zinc (Zn)	263	N/A	913	94.0	N/A	200.0	179.0	N/A	565.0	109.0	N/A	91.0	166.0	N/A	271.0

White Pass Pond															
	Feb-04			**May-04**			**Aug-04**			**Nov-04**			**Mar-05**		
	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed	soil	water	sed
units	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg	mg/kg	ug/L	mg/kg
Arsenic (As)	12.90	ND	17.50	4.7	ND	1.2	7.6	ND	7.8	5.7	0.0002	4.2	ND	ND	ND
Barium (Ba)	1360	84	1840	120.0	ND	170.0	344.0	130	397.0	318.0	0.0520	159.0	356.0	0.0520	187.0
Cadmium (Cd)	2.8	ND	1.6	ND	ND	ND	2.3	ND	0.6	3.5	ND	2.3	3.0	ND	2.0
Chromium (Cr)	19.8	0.63	30.6	11.0	ND	6.9	15.0	0.7	14.0	12.0	ND	12.0	18.7	ND	16.9
Copper (Cu)	N/A	ND	N/A	N/A	ND	N/A	N/A	ND	N/A	49.0	0.0010	32.0	73.5	ND	47.3
Lead (Pb)	520	ND	633	740.0	ND	130.0	358.0	ND	159.0	168.0	0.0010	123.0	350.0	0.0010	215.0
Mercury (Hg)	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	0.1	0.2	ND	0.2
Selenium (Se)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver (Ag)	2.60	ND	2.40	2.2	0.5	ND	1.9	ND	0.8	ND	ND	ND	2.6	ND	ND
Zinc (Zn)	391	ND	557	290.0	ND	160.0	320.0	ND	145.0	127.0	ND	139.0	345.0	ND	200.0

APPENDIX E GLOSSARY OF TERMS

ACWA Alaska Clean Water Action Program

ADEC Alaska Department of Environmental Conservation

ADF&G Alaska Department of Fish and Game

ADOTPF Alaska Department of Transportation and Public Facilities

AP&T Alaska Power and Telephone

BMP Best Management Practice: As defined by federal code "A best management practice is a means of practice or combination of practices that is determined by a state (or designated area-wide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals."

Buffer (1) An area of land separating two distinct land uses that acts to soften or mitigate the effects of one land use on the other. (2) The area that surrounds a wetland and that reduces adverse impacts to it from adjacent development.

Catalogued salmon stream Streams listed in the *Catalog of waters important for the spawning, rearing or migration of anadromous fishes* compiled and published by the Alaska Department of Fish and Game.

GPS Geographic Positioning System

Heavy Metal Refers to any metallic chemical element that has a relatively high density and is toxic, highly toxic or poisonous at low concentrations. Examples of heavy metals include mercury, cadmium, arsenic, chromium, thallium, and lead.

Hydrocarbon Any of numerous organic compounds, such as benzene and methane, which contain only carbon and hydrogen.

Niche The ecological role of a species in the community; the many ranges of conditions and resource qualities within which the organism or species persists, often conceived as a multidimensional space.

Nonpoint Source Pollutants Pollutants from many diffuse sources. Nonpoint-source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water.

Pollutant waste matter that contaminates the water, air or soil

Restoration a broad range of actions and measures designed to enable stream corridors to recover dynamic equilibrium and function at a self-sustaining level.

Riparian/riparian zone The area and vegetation such as trees, shrubs and grasses along the banks of a stream, lake or wetland. The riparian zone plays an important role in maintaining stream flow, water quality, and fish and wildlife habitat.

Runoff Drainage or flood discharge that leaves an area as surface flow or as pipeline flow

Sediment Soil, sand, and minerals washed from land into water, usually after rain. Sediment can destroy fish-nesting areas, clog animal habitats, and cloud waters so that sunlight does not reach aquatic plants.

STC Skagway Traditional Council

Stewardship A cooperative form of planning and management of natural resources in which all users and managers share the responsibility for management and conservation.

Stewardship embodies a new ethic of caring for local ecosystems in the interests of long-term sustainability.

Stormwater Precipitation that accumulates in natural and/or constructed storage and stormwater systems during and immediately following a storm event

Stream Crossing Man-made traverse of a waterbody (i.e., bridge, culvert, ford)

TIWC Taiya Inlet Watershed Council

Turbidity A unit of measurement which indicates how cloudy or muddy the water is or, by quantifying the degree to which light traveling through a water column is scattered by the suspended particles (the greater the scattering, the higher the turbidity). Turbidity can be caused by suspended silt or soil particles and organic matter

USFWS United States Fish & Wildlife Service

Watershed: (1) The complete area within which water flows to a common point, including both surface and groundwater that discharges to or receives from that surface water. (2) A waterway and the surrounding land that drains water into it. (3) Watersheds are nature's boundaries for water resources. When rain falls or when snow melts, water flows downhill through rivulets, brooks, wetlands, rains and ditches into streams, rivers, lakes and eventually to the ocean.

APPENDIX F 2005 PULLEN CREEK ESCAPEMENT SURVEY SUMMARY

Pink Salmon

Date	Number	Peak
August 2	176	
August 10	62	
August 17	102	660
August 22	57	

Chinook Salmon

Date	Number	Peak
August 2	5	
August 10	15	
August 17	22	142
August 22	8	

Coho Salmon

Date	Number	Peak
October 4	0	
October 20	0	
October 24	11	71