Salt Creek Watershed: An Assessment of Habitat Conditions, Fish Populations and Opportunities for Restoration

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Executive Summary

This watershed analysis was conducted to identify restoration actions that will help restore stream habitat and biological populations of Salt Creek, an independent tributary to the Strait of Juan de Fuca. Geomorphic conditions, stream and riparian habitat, barriers to fish migration and status of biological populations were assessed. The assessment was combined with information obtained through interviews with long-time residents, and recommendations from the scientific literature to create a prioritized restoration strategy at the watershed scale. Overall habitat conditions within Salt Creek represent a paradox, containing both largely functional areas such as the estuary, combined with greatly simplified stream and riparian habitats throughout the majority of the stream network. Stream habitat has been most directly affected by the chronic loss of large woody debris (LWD) which has caused fundamental changes in the functional condition of stream types. Loss of in-channel wood is directly attributable to repeated removal of riparian forests over time, combined with intentional LWD removal. In response, channel incision of up to 1.5 m vertically has occurred in mainstem Salt Creek between river mile 1.0-6.5, as well as portions of Nordstrom Creek. Loss of LWD also resulted in the conversion of pool-riffle and forced pool-riffle to plane-bed channel types throughout Salt Creek. Channel incision and conversion to plane-bed channel types has resulted in a loss of pools, spawning gravel and disconnection of the floodplain.

Riparian forest conditions are currently inadequate to fully support habitat forming processes. The vast majority of riparian forests are dominated by young to medium aged stands of deciduous species. Riparian forests are old enough to shade the channel network, but are generally incapable of providing adequate sources of LWD. At the watershed scale nearly 52% of the channel lengths surveyed rated low for near-term LWD recruitment potential. Only 18% of the channel lengths inventoried rated high for near-term LWD recruitment potential. Low gradient channels (0-2%), were determined to have the lowest near-term LWD recruitment potential. Roads disproportionately affect riparian habitat in Salt Creek. A total of 9.3 miles of stream adjacent roads were inventoried within the 51.6 miles of channel network surveyed. Collectively road crossings and riparian adjacent roads affect about 11.2 miles of riparian forests.

We identified 8 total and 21 partial barriers to fish migration within Salt Creek watershed. These consist of culverts that have been constructed on state, county and private roads. Several streams have multiple barriers that will require significant corrections. In addition a significant number of ponds have been constructed within the stream network. These barriers limit access to 25 miles of formerly accessible stream habitat. This represents approximately one-half of the historically accessible watershed).

Low flow is a natural limiting factor to fish rearing in Salt Creek, which could easily be deleteriously affected by consumptive water withdrawals. Salt Creek is currently closed to further new water rights development. A total of 255 perfected water rights totaling 7.2 cfs have been issued. While there is currently no system of determining the current actual usage of water from Salt Creek, the basin appears to be already over allocated based upon the number and volume

of water rights as compared to low flow conditions. Clearly, the conservation of water from Salt Creek needs to be considered by residents at the watershed scale as part of any effort to restore fish resources.

Based on an assessment of the available adult population data, populations of winter steelhead have declined to critically low levels, while chum salmon teeter on the verge of extirpation. Coho salmon populations are static or declining, showing no signs of recovery, despite significant reductions in fishing mortality during the last decade. Despite the trends in adult coho returns and serious habitat degradation, Salt Creek still retains productive potential based upon smolt yields measured in recent years. Much of this productivity is due to the high proportion of low-gradient stream habitat in the stream network. A remarkable 59% of stream network has gradients less than 4%, while 46% and 27% of the channel network has gradients less than 2% and 1%, respectively.

Based upon these data and scientific principles of watershed restoration we made recommendations for the specific conditions found within Salt Creek. We concluded that (active) restoration in Salt Creek should be conducted sequentially over time by the following categories: 1) linear reconnection of historically accessible habitats, 2) lateral reconnection of floodplain habitats, 3a) restoration of riparian/wetland functions, 3b) instream habitat restoration, and 4) removing/reducing current ecosystem stressors. Within each category of restoration we have identified specific actions by location to guide restoration actions within the watershed. Many of these actions are complimentary and could be conducted simultaneously. For example, efforts to restore instream habitat can be designed to restore lateral reconnection of floodplains. We also recommend that an effort to reintroduce/rebuild chum salmon be made. In addition to these active restoration efforts, protection of existing functional habitats through acquisition/easement (passive restoration) or other means should be considered as an equal priority along with active restoration where possible. Restoration efforts should be closely linked to a long term monitoring program to assess effectiveness. This program should be conducted at reach, sub-basin and watershed scales.

Table of Contents

List of Figures

List of Tables

Acknowledgments

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"We thought that the supply of fish would continue forever."
-Ezra Meeker (1921), Washington Territories

INTRODUCTION

The nearly continuous 150 year decline of salmon in the Pacific Northwest has provided the impetus for recent efforts to restore watersheds and their salmon populations. Historically productive for coho and chum salmon, steelhead, cutthroat trout and Pacific lamprey, Salt Creek has been classified as a high priority for restoration on the North Olympic Peninsula (NOPLEG 2002). Surprisingly, little is known of the Salt Creek habitat conditions or fish populations as a whole. Standardized repeatable monitoring of fish populations was not initiated until the mid-1980's for coho salmon and mid-1990's for steelhead, and we are aware of no existing comprehensive habitat surveys.

A limiting factors analysis has been completed for the western Strait of Juan de Fuca region (WRIA 19) as a whole (Smith 2000). However, this analysis lacked detailed restoration recommendations for Salt Creek because of the limitations of the existing quantitative data at that time. General recommendations for increasing in-channel LWD, improving riparian forest conditions, the identification of three fish passage barriers, and an estuarine restoration project were identified in this report. This project is intended to increase site specific knowledge of Salt Creek through the application of a scientifically designed identification of factors limiting to freshwater habitat including fish passage, stream and riparian habitat. We combined these techniques with the knowledge of long-time residents who shared their observations of Salt Creek over the years. These factors were then used in combination with recommendations from the scientific literature to prioritize restoration efforts on willing private landowners in Salt Creek.

We assessed the current habitat conditions in the Salt Creek watershed during 2002-2003 with the objective of developing a prioritized restoration plan for the basin. The North Olympic Salmon Coalition (NOSC), a regional fisheries enhancement group received funding in 2002 from the Salmon Recovery Funding Board (SRFB) to perform an assessment of physical habitat conditions in Salt Creek and to identify willing private landowners to develop a prioritized list of habitat restoration projects that could be systematically implemented. NOSC has requested the expertise of the Lower Elwha Klallam Tribe's (LEKT) fisheries department to design, collect and analyze habitat conditions within the Salt Creek watershed. The Lower Elwha Klallam Tribe is a federally recognized Indian Tribe, whose treaty area includes the Salt Creek watershed. The Tribe is a co-manager of the salmon resources of Salt Creek and supports the efforts of NOSC and private citizens to restore salmon habitat in Salt Creek.

STUDY AREA

Salt Creek is an independent tributary to the Strait of Juan de Fuca (SJF) located 15 miles west of Port Angeles (Figure 1). The watershed is 19.1 mi^2 in size and includes 23.4 miles of streams accessible to anadromous salmonid (Phinney and Bucknell 1975). The watershed has little relative relief and drains a series of low hills (maximum elevation 3000'/917 m) paralleling the SJF. Base rocks in Salt Creek include primarily those of sedimentary origin including the Twin River Formation (Tabor and Cady 1978), which is dominated by sandstones, siltstones and conglomerates. An area of basalt origin is located at the northeast portion of the drainage at Striped Peak. Salt Creek has been strongly influenced by the most recent continental glaciation (Vashon Stade~25,000 years ago). During the peak of this glacial advance, much of Salt Creek was buried by as much as 3000' of ice. Salt Creek is dominated by glacial outwash features and associated soil types. Drainage patterns have also been affected by glacial features as well: a series of glacial striations are clearly visible on aerial photographs across the west side of the watershed. Several small tributaries and wetland complex drain these features.

Salt Creek receives between 35-55" (89-1,397 mm) of precipitation annually depending upon elevation, predominately as rainfall (SCS 1965). The majority of precipitation occurs between October and March, and the annual hydrograph is dominated by peak flows in winter associated with storms of maritime Pacific origin. Low base flows are common during the spring and summer months when stream flows are almost entirely supported by groundwater contributions. Although Salt Creek has not been assessed for flow by continuous gauging, peak flow and low flow can be estimated. Using relationships developed by Amermann and Orsborn (1987) we estimated peak discharge in the vicinity of 2,000 cfs and average annual low flow at less than 2.0 cfs.

Almost the entire Salt Creek watershed is located within the western hemlock zone (Henderson et al. 1989). Within this forest association Douglas fir is typically the dominant tree species in younger stands, with late successional forests shifting toward western hemlock and red cedar (though no significant older forest stands remain in the basin). Land ownership patterns in Salt Creek are a complex blend of state and industrial forest land, agricultural and rural residential uses. State forest lands are mostly located in the headwaters, while agricultural and rural residential lands are strongly clustered in low gradient landforms in the middle and lower watershed.

Salt Creek has a rich cultural history supporting several significant Klallam cultural sites, including: teu' dlt (Agate Point-translates "abounds in mussels"), TL sEent (Crescent Bay-translates "deep"), Klte-tun-ut (Salt Creek), Tsatso-Al sEnt (Tongue Point-translates "close by the deep place") (James 1993). Three camp/village sites have been documented in the vicinity (Waterman 1920). Klte-tun-ut was the site of a large permanent village. The Salt Creek watershed was settled by Euro-Americans in the late nineteenth century and Port Crescent was a thriving town during the initial logging of the area's renowned cedar and Douglas fir stands. Large scale clearing was conducted to support agriculture. During World War II, gun emplacements were constructed at Camp Hayden. Prior to this, access to Salt Creek was limited to unimproved dirt roads.

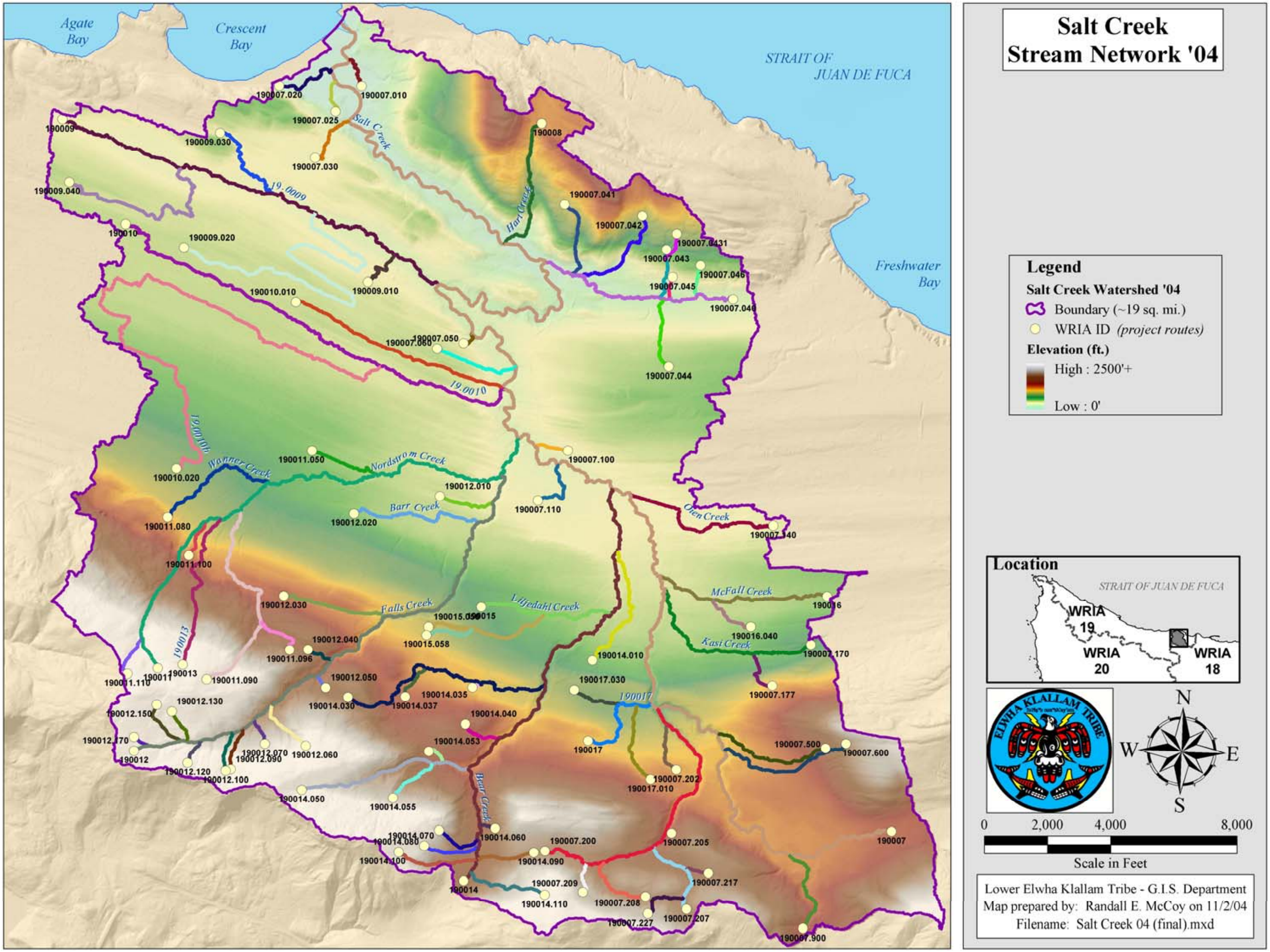

Figure 1. Location map, stream network and topography of the Salt Creek watershed.

METHODS

Identifying Cooperative Landowners

With over 300 individual private property owners in the basin, our first step was to determine who owned property adjacent to waters of Salt Creek and to determine their potential interest in the project. We used Geographic Information Systems (GIS) to identify private landowners whose ownership boundaries crossed fish bearing portions of Salt Creek and its tributaries. By comparing data bases from the Clallam County tax assessor's office and USGS stream layers we were able to identify a total of 92 parcels of various size that bordered known fish bearing reaches of Salt Creek. The parcels ranged in size from 2.5 acres to hundred's of acres. Individual landowners were initially mailed a brochure prepared by NOSC that briefly described the project, its objectives, and asked for permission to access property to conduct the habitat assessment. Approximately 30 residents responded favorably to the initial mailing and agreed to allow access for the survey. Follow-up contacts for those who did not respond to the brochure were attempted by phone or by visiting individual properties. Though there was considerable difficulty contacting some non-resident landowners, we were ultimately able to gain permission to access 66 of 92 parcels (71.7%) to conduct the assessment (Figure 2). We were denied access to large blocks of private land in upper Bear Creek, and portions of upper Falls and Salt Creek (above Highway 112). Where denied access, assessments of individual stream reaches were conducted as comprehensively as possible. The lack of access did not significantly affect the conclusions made for overall habitat condition on Salt Creek. However, the lack of access to approximately 30% of the potentially most productive habitat represents a significant lost opportunity to restore Salt Creek as a whole.

Stream Segmentation

We used existing geomorphic data generated for Salt Creek by the statewide Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP). This data includes individual stream reaches based upon geomorphic differences including stream size, stream order, gradient, and valley confinement as determined from USGS topographic maps (1:24,000). These geomorphic characteristics provide a useful tool to understand and predict the response of streams to physical inputs of water, sediment and large wood (Montgomery & Buffington 1993). They also provide a logical stratification system for habitat inventory and restoration projects in that it allows grouping of streams with similar physical characteristics and predictable biological responses (Table 1).

Because digital elevation models used to generate the USGS stream layer have relatively high rates of error, we visually inspected stream break points for accuracy in the field. Based upon actual measurements of stream gradient and valley width, as well as professional judgment, some breakpoints in low and moderate gradient channel reaches were adjusted either upstream or downstream in the field. These locations were measured with a Global Positioning System (GPS) and the data base adjusted accordingly. In higher gradient channels, we used LiDAR (Light Detection and Range) imaging data to generate an elevation model and calculate stream gradients for the entire channel network. Final stream geomorphic classifications for Salt Creek are depicted in Figure 3 and their lengths in Table 2.

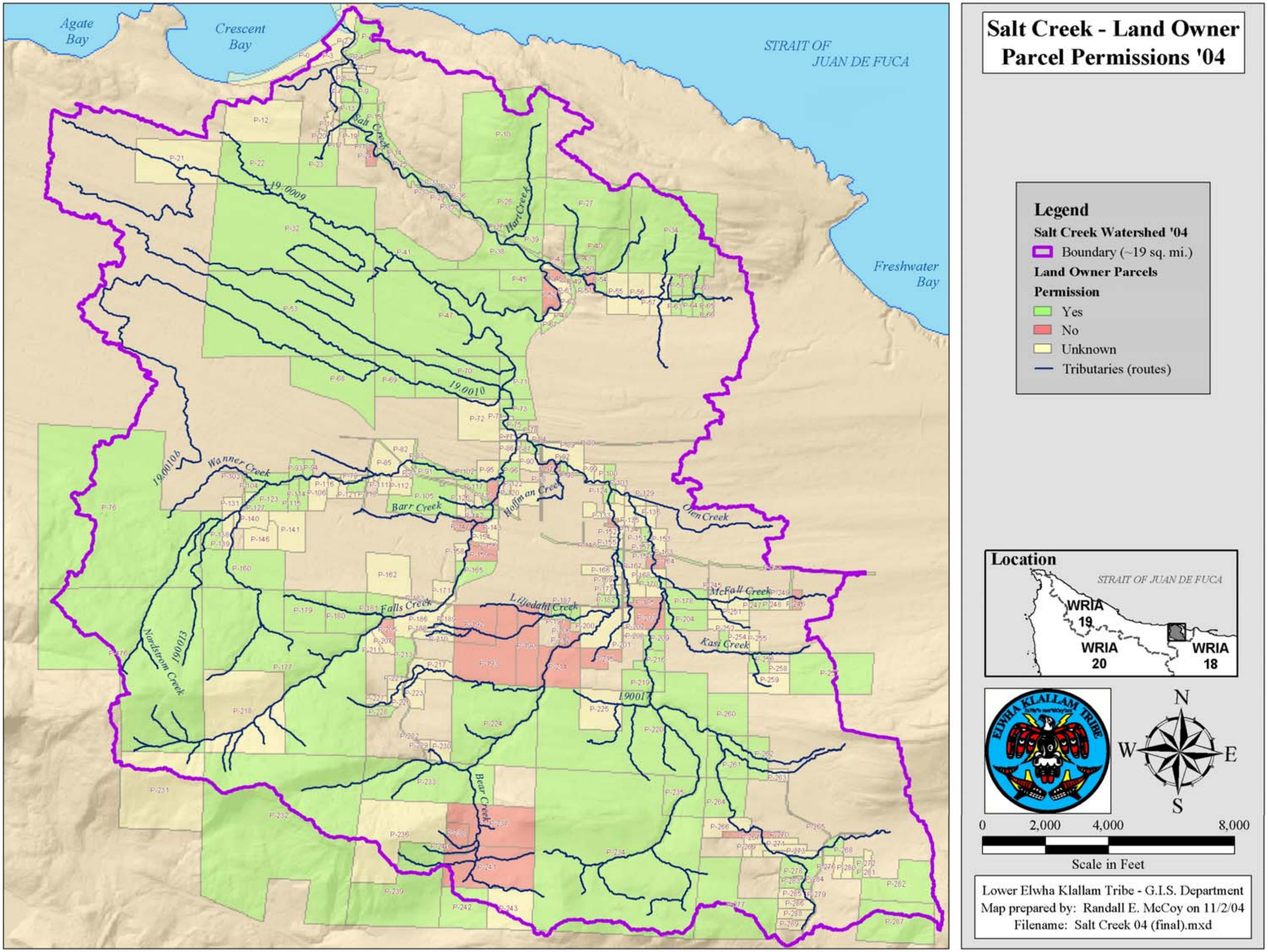

Figure 2. Parcel Permission Map. Permission to access depicted in green, denial in red, and no response is uncolored.

Table 1. Potential channel gradient categories, valley confinement and habitat types used for Salt Creek.

Channel Gradient Categories (%)	***Valley Confinement Categories***	***Stream Types***
<1	Unconfined	Floodplain Migration
1-2	Moderately Confined	Pool-Riffle
2-4	Confined	Forced Pool Riffle
4-8		Plane Bed
8-20		Step Pool Cascade
>20		Cascade

Table 2. Stream mileage by gradient and confinement classification for Salt Creek

Gradient (%)	***Valley Confinement***	***Class***	***Distance (ft.)***	***Distance (mi.)***	***Percent (%)***
<1	Confined	1C	10,303	2.0	2.5
<1	Mod. Confined	1M	4,525	0.9	1.1
<1	Unconfined	1U	104,115	19.7	24.9
1-2	Confined	2C	20,277	3.8	4.9
1-2	Mod. Confined	2M	16,435	3.1	3.9
1-2	Unconfined	2U	43,554	8.2	10.4
2-4	Confined	3C	41,545	7.9	10.0
2-4	Mod. Confined	3M	6,937	1.3	1.7
2-4	Unconfined	3U	9,866	1.9	2.4
4-8	Confined	4C	68,778	13.0	16.5
4-8	Mod. Confined	4M	3,274	0.6	0.8
4-8	Unconfined	4U	4,224	0.8	1.0
8-20	Confined	5C	56,860	10.8	13.6
8-20	Mod. Confined	5M	720	0.1	0.2
>20	All Types	6	26,030	4.9	6.2
Total			**417,443**	**79.1**	**100.0**

Stream & Riparian Habitat Conditions

We chose to quantify stream habitat conditions only within the low to moderate gradient (<6%) stream classes encountered within Salt Creek and its tributaries. These low-gradient stream types were assumed to support the majority of current and historic fish production (spawning and rearing) sites within the basin. These areas also represent the mostly likely areas for restoration activities to be conducted. Within each gradient and confinement class (reach), we quantified habitat conditions based upon sub-sampling of the various geomorphic reach types found in Salt Creek (Table 3). We used selected elements of the TFW Ambient Monitoring protocols (Pleus et al. 1999) to measure habitat conditions. Starting points within each reach were randomly selected and measurements proceeded in an upstream direction until a minimum of 10% of the total reach length was quantified. All measurements were made during summer low flow periods.

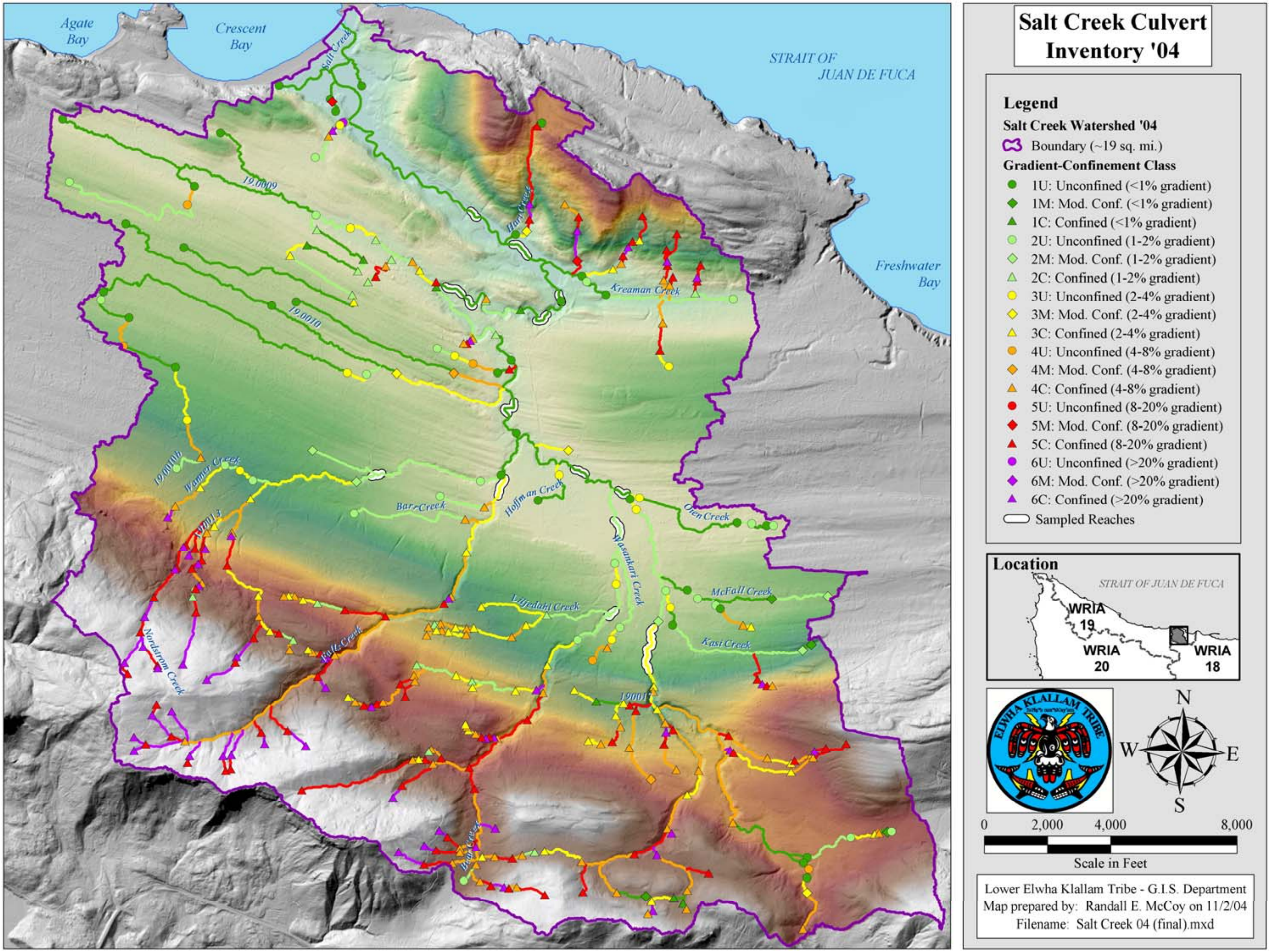

Figure 3. Final stream segmentation map with reaches sampled for habitat quality shaded in white.

Table 3. Stream reach, geomorphic classification, and percentage of total sampled for habitat quality in Salt Creek, summer 2003.

Stream (River Mile)-Code	***Class***	***Total Reach Length (feet)***	***Length Sampled (feet)***	***Percent Sampled***
Salt (2.2)-SC1	1U	16,622.45	335	2.0
Salt (2.6)-SC2	1U	16,622.45	705	4.2
Salt (3.1)-SC3	1U	16,622.45	315	1.9
Salt (3.3)-SC4	1C	2,298.80	508	22.1
Salt (4.1)-SC5	1C	2,397.96	325	13.6
Salt (4.2)-SC6	1C	2,397.96	649	27.1
Salt (5.7)-SC7	1U	3,576.31	755	21.1
Salt (6.6)-SC8	1U	6,231.79	435	7.0
Salt (7.0)-SC9	1U	6,231.79	359	5.8
Salt (8.5)-SC10	3C	3,631.37	1840	50.7
Bear (0.3)-BC1	2U	3,118.01	686	22.0
Bear (1.0)-BC2	2U	3,146.09	410	13.0
Falls (0.1)-FC1	3C	3,618.87	706	19.5
Nordstrom (1.3)-NC2	2M	5,132.13	442	8.6
Total		***49,773.78***	***8,470***	***17.0***

We identified habitat types using the system established by Bisson et al. (1982). Within each sampling reach we measured habitat type and surface area as well as stream width and depth (wetted and bankfull) using a laser rangefinder. At each pool encountered we measured the maximum pool depth and the tail out depth with a graduated survey rod in order to calculate the residual pool depth. Residual pool depth is found by subtracting the maximum pool depth from the pool outlet depth, and is used to normalize for differences in streamflow during different survey times. A pool forming factor (logjam, LWD, roots of standing tree, boulders, bedform, etc) was assigned for each pool. We visually assessed stream substrate within each sampled reach for the presence/absence of spawning gravel, cobble embededness (cementing of substrate by sand/silts) and for deposition of fine sediment on the bed surface.

The characteristics of in-channel large woody debris (LWD) were also described. LWD was defined as those pieces with midpoint diameters $\geq$10 cm and lengths $\geq$2.0 m. We identified the tree species, diameter, length, relative decay and position within the channel for each measured species. A special emphasis was made on the identification of key pieces of LWD. A key piece of large woody debris is defined by its size and potential to be stable with reference to channel size (
Table 4). A decay factor was assigned to each piece using the seven category system developed by Grette (1985). These habitat parameters were selected as key diagnostics of overall habitat quality and can be compared to values

established for similar stream types in the literature (FEMAT 1993; WFPB 1997; Beechie and Sibley 1997).

Table 4. Key piece criteria based upon minimum LWD diameter (m) and length (m) for channels up to 20 meters bankfull width. Source: WDNR 1997.

Min. Diam. (m)	***BFW<5 m***	***BFW 5-10 m***	***BFW 10-15 m***	***BFW 15-20 m***
0.50	6	13	31	
0.55	5	11	26	
0.60	4	9	22	32
0.65	3	8	19	28
0.70	3	7	19	24
0.75	3	6	14	21

We used both remote sensing and visual assessment techniques to evaluate riparian conditions in Salt Creek. At reaches measured for streamhabitat conditions, we visually assessed riparian forest conditions along both banks of the creek and landward for approximately 62 m (200’). We identified the dominant species (deciduous, coniferous, or mixed), density and age of the overstory trees. We assessed understory conditions for presence of suppressed conifers and dominant ground cover species. We measured the percentage canopy cover shading the stream channel within each reach using a spherical densitometer. While these techniques provided a general sense of riparian conditions along low to moderate gradient portions of Salt Creek, they did not necessarily provide detailed enough information at the basin scale to guide restoration.

We used aerial photographs and LiDAR images to assess riparian forest type and age along the entire stream network and in the watershed as a whole (WFPB 1997). Riparian Condition Units (RCUs) were defined by dominant vegetation type, average tree size, and stand density. The dominant vegetation type was classified as conifer (≥70% coniferous species), hardwood (≥70% hardwood species), grass (non-forested pasture), or mixed (all other forested cases). Average tree size was classified as small (<12”DBH), medium (≥12” and <20”DBH), or large (≥20”DBH). Stand density was defined as sparse if greater than 1/3 of the ground within a given RCU was exposed; otherwise the stand density was classified as dense. The codes used to classify each RCU used the first letter of each riparian attribute listed above. For example, a RCU dominated by hardwoods and classified as large size and sparse spacing would be recorded as HLS. Aerial photographs taken during December 2003 were used to classify the majority of the riparian conditions (1994 and 2000 digital orthophotos were also used for interpretation in areas where the winter time photos were either clouded over or had dark shadows). LiDAR data used to develop a GIS layer depicting tree height was also used to help estimate tree size. Each RCU boundary was plotted on a 1:24,000 scale base map using aerial photographs and LiDAR data to aid in the positioning. The length and width of each RCU was measured using a map wheel or a transparent scale on the base map and aerial photos.

We measured summer stream temperature between June and September in 2002 and 2003 at several locations in the Salt Creek watershed using continuous recording thermographs (Hobo XT) housed in waterproof containers. Each thermograph was factory-calibrated prior to deployment and placed in deep, well-shaded pools along a gradient beginning in the tributaries and continuing through the mainstem of Salt Creek to just above tidally influenced reaches (Table 5). Thermographs were removed prior to fall rainstorms and data downloaded using a personal computer. The data was imported to Microsoft Excel and summarized by daily average, minimum and maximum temperature. In late August stream discharge was measured at all thermograph stations using the partial cell technique; with the purpose being to assess the potential relationship between flows and observed temperature patterns. We used a Marsh-MacBirnney Model 2000 flow meter and self adjusting wading rod (Scientific Instruments) to measure stream velocity.

Table 5. Thermograph monitoring locations in the Salt Creek Watershed, summer 2002 and 2003.

Year	***Dates***	***Location***	***River Mile***
2002	June 20-Oct. 22	Lower Camp Hayden Road	1.0
2002	June 20-Oct. 22	Above Cascades	3.5
2002	June 20-Oct. 22	Camp Hayden Road Bridge	5.1
2002	June 20-Oct. 22	Nordstrom Creek @ Nordstrom Rd.	0.5
2003	June 20-Sept. 10	Lower Camp Hayden Road	1.0
2003	June 20-Sept. 10	North Portion Green Crow Property	2.5
2003	June 20-Sept. 10	South Portion Green Crow Property	4.0
2003	June 20-Sept. 10	Above Confluence w/ Bear Creek	5.7
2003	June 20-Sept. 10	Lower Bear Creek	0.1
2003	June 20-Sept. 10	Falls Creek @ Highway 112 Culvert	0.4
2003	June 20-Sept. 10	Nordstrom Creek @ Nordstrom Rd.	0.5

Biological Populations

We compiled and summarized existing data for salmon and steelhead populations from databases maintained by Washington Department of Fish and Wildlife (WDFW) and the Lower Elwha Klallam Tribe (LEKT). Some historic adult coho escapement data was found for Salt Creek dating back to the early 1950's. This data was mostly scattered observations of live fish that could only be used to estimate relative abundance in the 1960-70's. Repeatable, scientifically based redd count surveys were initiated by WDFW in 1984 for adult coho salmon, while accurate steelhead redd surveys date only to 1995. Smolt outmigration monitoring is even more recent, beginning in 1998. This data represents the most reliable information for assessing current status and trends of salmon populations in Salt Creek. Unfortunately, the data offers little in terms of describing historic conditions in Salt Creek as the data does not account for the most recent declines reported by Salt Creek residents in the 1960-70's. Nor does it record the declines of salmon reported in Puget Sound in the early twentieth century as a result of fisheries supporting canneries (Lichatowich 1999; Montgomery 2003). It does, however, offer a means of evaluating the success or failure of society to restore and rebuild a resource that according to long-time observers was much more abundant than today.

Additionally we obtained biological data collected by Clallam County Streamkeepers. Streamkeepers utilizes citizens volunteers to conduct water quality monitoring and uses the Biotic Index of Biological Integrity (BIBI), which is based upon the population and community structure of stream benthic organisms (Karr 1991). Benthic organisms are primarily insects such as mayflies, stoneflies and caddisflies. These communities are sensitive to changes in water and habitat quality and can be used as an effective monitoring tool (Karr & Chu 1999). Streamkeepers initiated three monitoring sites on Salt Creek beginning in 2002 at river mile 1.5, 4.2, and 5.4.

Culvert Assessment

Salt Creek and its tributaries are crossed in multiple locations by state, county and privately owned roads. Because of the density of stream crossings, fish passage was assumed to be a potentially significant limiting factor for salmonids in Salt Creek. With the exception of the four Highway 112 culverts owned by Washington Department of Transportation (WDOT), the type, condition, and passability of Salt Creek stream crossings has never been rigorously evaluated. We assessed fish passage conditions at stream crossings in 2003 using the level A fish passage assessment developed by WDFW (2000). We used GIS tools to map and locate all known intersections of streams and roads in Salt Creek. At each individual culvert, we collected information on type, condition, diameter, length, outlet drop, gradient, capacity, and velocity conditions within the culvert. These data were used to assess the passibility of each structure for adult and juvenile fish as a percentage. The data collection emphasis was placed primarily upon low to moderate gradient (<6%) streams which were assumed to support the majority of historic fish production. Higher gradient stream channels are located primarily on private and state forest lands, and culverts on these lands are regulated under the Forests and Fish Agreement (FFA). The FFA requires landowners to identify and correct human caused fish passage barriers by 2015 using an inventory process known as RMAP (Road Mapping and Prioritization).

Bridges, box culverts and other crossing structures both functional and abandoned were also located in the field and visually assessed for potential effects on habitat forming processes. This includes size of the opening in relation to channel size. Undersized crossing structures, even if passable by fish, may harm other ecological processes important to fish. These may include altered velocity conditions or limitations to the streams ability to transport sediment or large wood.

Other Visual Assessments

While conducting the watershed assessment, we also looked for other factors that might limit salmon recovery. These include sources of fine sediment such as landslides, source and non-point pollutants, constraints to lateral channel migration (rip-rap, floodplain roads). We also located both existing and potential off-channel areas that might be enhanced as rearing areas. These were photographed and located using a GPS unit.

Landowner Interviews

In order to capture the observations and views of Salt Creek residents we interviewed 6 long-time residents who were knowledgeable about the watershed. Their direct experience dates to the late 1930's, though several are descendants of pioneer families whose residency in Salt Creek dates to the late 1800's. The purpose of the interview was to record short-term historical observations of fish populations and watershed conditions in the Salt Creek Watershed based upon observations of long-time residents. This information was used to support observation made during the assessment, as well as to explain changes in watershed characteristics over time. The following people were interviewed: Harold Barr, Bud Taggart, Howard Hart, Dan Duncan, Dick Goin, and John McFall. They were asked the following questions:

1. ***Please date and describe your earliest recollection of conditions in Salt Creek.***

2. ***What species of fish were native to Salt Creek and can you roughly estimate their population sizes in terms of numbers of returning adults?***

3. ***When did you begin to notice a decline in fish numbers by species?***

4. ***What in your opinion was the primary reason for the observed decline of each species.***

5. ***Have any species of fish been introduced to Salt Creek? If so by who (m), why, and when?***

6. ***Were the introductions in your opinion successful?***

7. ***What in your opinion are the factors currently limiting the recovery of salmon and steelhead in Salt Creek?***

8. ***Can salmon and steelhead ultimately be restored in Salt Creek?***

9. ***If yes, what in your opinion should be the highest restoration priorities? If no, why not?***