Swift Creek
Sediment Management Action Plan (SCSMAP)
And SCSMAP Phase 1 Project Plan
Draft Environmental Impact Statement

Appendix D

Swift Creek Draft EIS Fisheries Technical Information Report

Prepared by
Cedarock Consultants, Inc.
January 2013
FISHERIES TECHNICAL INFORMATION REPORT

SWIFT CREEK

SEDIMENT MANAGEMENT PROJECT

Whatcom County, Washington

Prepared for:

Wheeler Consulting Group
PO Box 1404
Burlington, Washington 98233

Prepared by:

Cedarock Consultants, Inc.
19609 244th Avenue NE
Woodinville, Washington 98077

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EXECUTIVE SUMMARY

This report evaluates anticipated effects of the proposed Swift Creek Sediment Management Action Plan (SCSMAP) on fisheries resources in the Swift Creek drainage (composed of the north and south forks) and within the Sumas River downstream to the Canadian border. Swift Creek is a tributary to the Sumas River; within the Fraser River system. Swift Creek was historically a fish-bearing watercourse with resident trout and salmon use. The North Fork still contains a trout population. A large natural landslide in the upper watershed has been contributing an unusually high level of sediment to the South Fork Swift Creek since the early 1940’s. Sediment moves downslope to the alluvial fan and then on to the Sumas River. Areas of impaired habitat are caused by burial of fish habitat under sand and silt, by degraded water quality, and by influencing the need to protect adjacent landowners and infrastructure from damaging flood events and channel changes. Contaminants such as trace metals and asbestos also affect aquatic habitat quality. The result has left Swift Creek downstream of the slide without functional fish habitat. Fish habitat in the Sumas River is also affected to a lesser degree by the same factors. Breckenridge Creek to the north is at risk of being affected should Swift Creek change direction to the north and deliver high flows and sediment to that watercourse.

The EIS for the SCSMAP looks at three alternative actions. The No Action and SCSMAP adoption alternatives would not physically change the Swift Creek landscape and no benefits or adverse effects to the fish populations would occur as a result. Poor water quality, episodes of excessive sediment deposition, and lack of stable habitat development would continue to discourage fish use in Swift Creek and have adverse effects on fish use in the Sumas River. Periodic maintenance would continue as before to protect infrastructure and the levees. The maintenance would have a potential adverse effect on fish habitat because of in-channel disturbances and water quality changes. There are possible future actions that are reviewed under the SCSMAP adoption alternative but they are not proposed for physical action under this EIS review.

The SCSMAP Phase 1 implementation alternative includes construction of three projects designed to control sediment movement and water flow. While some of the proposed sediment management strategies would take place within potentially and historically fish-bearing waters, there are few if any fish currently believed to be in these areas. Some adverse influences to fish may occur such as inhibiting migration of cutthroat trout to and from the North Fork Swift Creek channel. But the majority of the effects of the proposed action to reduce sediment supply and transport should be neutral to positive. This analysis finds that no unavoidable significant adverse effects to the existing condition of fisheries resources or fish habitat are likely to occur under the proposed action or alternatives.
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1.0 INTRODUCTION

This report evaluates anticipated effects of the proposed Swift Creek Sediment Management Action Plan (SCSMAP; Whatcom County 2012a) on fisheries resources in Swift Creek and the Sumas River downstream from the confluence with Swift Creek. Whatcom County has prepared the SCSMAP to address the impacts of a large natural landslide in the upper watershed of the south fork of Swift Creek which contributes high levels of sediment to the watercourse. The landslide has resulted in aquatic habitat impairment downstream through Swift Creek and into the Sumas River (Figure 1). Extremely heavy sediment loads, the necessity to deal with the sediment and resultant channel changes, and contaminants such as trace metals and asbestos naturally occurring within the landslide material all affect aquatic habitat quality.

The project area is located within Whatcom County, Washington near the City of Nooksack (Figure 2). Swift Creek, a Type F fish-bearing watercourse, drains the forested lands on the west side of Sumas Mountain, then flows through predominantly agricultural and rural lands in a westerly direction to the Sumas River which flows northerly to the Fraser River in Canada.

Breckenridge Creek will not be directly affected by implementation of the SCSMAP with the possible exception of part of one small tributary. However, Breckenridge Creek is potentially in the path of catastrophic floods or debris flows from Swift Creek so there could be a difference in future habitat quality based on both Project and Non-Project actions. Fisheries resources and aquatic habitat in the lower creek are briefly reviewed to provide an understanding of resources potentially at risk.

The description of existing conditions is based to a great extent on existing literature, primarily the Water Resource Inventory Area (WRIA) 1 Salmonid Recovery Plan (Nooksack Natural Resources et al. 2005), the WRIA 1 Limiting Factors Analysis (Smith 2002), and the Whatcom County Shoreline Master Program Update (Parametrix and Adolfson 2006). Significant portions of the downstream three miles of the Swift Creek channel, as well as several smaller portions of the Sumas River, were walked or observed from nearby access points in October 2012 to assist in preparing this technical report. Discussions with Jeff Kamps (Area Habitat Biologist, Washington Department of Fish and Wildlife (WDFW)), Tom Westergreen (Resource Manager, Great Western Lumber Company), Letitia Wheeler (Senior Environmental Project Manager, Wheeler Consulting Group), and Paul Pittman (Geologist, Element Solutions) were also very helpful.
Figure 1. Location Map

Source KWL (2008)
Figure 2. Vicinity Map

Source KWL (2008)
2.0 PROJECT DESCRIPTION

A complete description of the actions proposed within the SCSMAP is provided in Chapter 4 of the SCSMAP (Whatcom County 2012); environmental review alternatives are detailed within Section 2.4 of the DEIS and briefly summarized here. To help evaluate and describe the project, the Swift Creek alluvial fan was divided into three reaches. These reaches are shown in Figure 3.

Figure 3. Swift Creek Reaches

2.1 No Action Alternative

The No Action alternative assumes that the SCSMAP is not adopted and Phase 1 projects would not be developed. Sediment accumulation in the lower Swift Creek watershed would continue at natural rates. A prioritized planning effort to manage this sediment accumulation and associated problems of flooding and avulsion would not be implemented, but Whatcom County would continue to respond to sediment-related problems on an as-needed basis at about the same level that exists today; which includes periodic removal of accumulated sediment and maintenance of the stream channel, levees and bridge crossings.

2.2 SCSMAP Adoption Alternative – Proposed Non-Project Action

Under this alternative the SCSMAP would be adopted setting the strategy for managing sediment-related issues in the Swift Creek watershed. The SCSMAP establishes clear avenues for future actions to protect watershed infrastructure and adjacent watersheds, and to
minimize property damage and health impacts. This alternative does not include physical implementation or construction of any project actions.

Strategies selected by the County for consideration were divided into “Active” and “Passive” categories. Active management strategies generally consist of construction actions that would result in physical changes to the environment in and around Swift Creek. Passive management strategies generally include plans and studies that would guide future active strategy implementation.

Sediment management actions considered for potential future implementation include the following:

- **Active Management Strategies**
  - Flood Hazard Management (Bank Armoring, Debris Deflection / Setback Levees, Infrastructure Revision)
  - Sediment Management (In-Stream Sediment Traps, Sediment Basin(s), Sediment Stockpiling, Safe Sediment Disposal, Swift Creek North Fork Re-Route)
  - Maintenance and Repair (Annual Maintenance Program, Channel Conveyance, Large-Scale Maintenance and Repair)
  - Landslide Stabilization (Surface Drainage, Landslide Toe Stabilization)

- **Passive Management Strategies**
  - Flood Hazard Management Planning (Watershed-Wide Flood Hazard Management Plan, Technical Flood Hazard Identification)
  - Land Acquisition Program (Floodplain Acquisition Program)
  - Monitoring (Landslide Movement Monitoring, Creek Channel Monitoring, Sediment Storage Monitoring)
  - Education, Warning, Emergency Response (Sediment and Flood Education and Outreach, Warning and Emergency Response)

Additional description on all these actions is available in Section 2.4 of the DEIS.

### 2.3 SCSMAP Phase 1 Implementation Alternative – Proposed Project Action

This alternative consists of a series of sediment management actions included in the first phase of SCSMAP implementation. Implementation would include construction of one or more of the following actions (described in more detail below).

- Debris Deflection/Setback Levees (Right Bank Oat Coles Reach, Left Bank Goodwin Reach, Right Bank Goodwin Reach)
- In-Stream Sediment Traps (Canyon Reach)
- Sediment Basins (Upper Goodwin Reach)
Chapter 4 of the SCSMAP (Whatcom County 2012) provides a complete list and detailed description of the various sediment management strategies that may be implemented by Whatcom County.

The Debris Deflection and Setback Levees are designed to contain overbank flooding and debris flows or debris floods to within the existing Swift Creek channel and floodplain. The structures would be built outside of the current active channel and would not directly disturb existing or future in-stream habitat.

In-stream sediment traps would be constructed across the active channel within the canyon reach and would function like small dams. They would directly affect existing and future in-stream habitat, the movement of water and sediment, and the ability of fish to migrate past the structures.

Sediment basins would be constructed in the Goodwin Reach and would function like lakes. They would eliminate all existing and future in-stream habitat where constructed. The movement of water and sediment past the basins would be altered, and the ability of fish to migrate past the structures could be impeded.

2.4 **Additional Fish Protection Permitting Requirements**

A number of permits from local, state, and federal regulatory authorities will be required before construction actions planned under Phase 1 for the Swift Creek channel can commence. Staff from Whatcom County, WDFW, Washington Department of Ecology (Ecology), U.S. Army Corps of Engineers (Corps), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), Environmental Protection Agency (EPA), local Indian Tribes, local Conservation Districts, and others may provide input. Whatcom County, WDFW, Ecology, Corps, NMFS, and USFWS will have permitting authority. Local Tribes will be consulted for federal actions. Public comment will also be solicited during the permitting process.

Whatcom County will issue grading and critical area permits, as well as conducting additional review under the State Environmental Protection Act (SEPA). Hydraulic Project Approval (HPA) is required for all work that will use, divert, obstruct, or change the natural flow or bed of any fresh waters of the state (WAC 220-110-010). WDFW has hydraulic project permitting authority and is responsible for protecting fish life. For all new construction activity exceeding five acres, a National Pollutant Discharge Elimination System (NPDES) Permit is required from Ecology for discharge of stormwater. The NPDES permit requires preparation of a stormwater pollution prevention plan (SWPPP). Temporary Erosion and Sediment Control (TESC) best management practices (BMPs) would be implemented and maintained in accordance with the SWPPP.

The discharge of dredge or fill material into waters of the United States requires a Section 404 Permit that is issued by the Corps. This in turn requires review under Section 7 of the Endangered Species Act (ESA) for potential impacts to listed species such as Chinook salmon, bull trout, and steelhead trout. The Section 7 review is completed by the NMFS and USFWS.
Local Indian tribes have review authority as an independent government to protect their rights to fish. In the State of Washington, before proceeding with work under a Corps authorized permit, Section 401 of the federal Clean Water Act requires that the permit applicant receive a Water Quality Certification/Coastal Zone Management Consistency Response which in Washington is administered by Ecology. This certification verifies that the proposed action complies with all provisions under the federal Clean Water Act, state water quality laws, and other appropriate state laws (such as the Hydraulic Code).

Detailed design analysis and planning for each feature potentially affecting the watercourse or instream flows should be completed to avoid or minimize impacts to aquatic resources to the extent practicable. For identified unavoidable impacts the use of best available science should be applied to prepare appropriate compensatory mitigation measures.

### 3.0 AFFECTED ENVIRONMENT

#### 3.1 Basin Setting

The Sumas River and its eastern tributaries including Swift Creek and Breckenridge Creek drain the forested lands of Sumas Mountain, then flow through predominantly agricultural and rural lands in a northerly direction to the Fraser River in Canada. The Sumas Mountain range has a peak elevation of around 3,400 feet. The elevation falls quickly to lowland elevations averaging around 80 feet in the City of Nooksack (Figure 2). From here the elevation is relatively flat losing only another 50 feet as the Sumas River travels north to the border of Canada. Snowfall and rain-on-snow events are common on Sumas Mountain, but rainfall is the dominant form of precipitation in the lowlands.

#### 3.2 Habitat Condition Evaluation Criteria

To help evaluate the condition of fish habitat, and in particular salmonid habitat (trout and salmon) assessment metrics developed by a number of agencies were employed. One of the more common systems of metrics is used by the NMFS and USFWS to determine if biological conditions are suitable for supporting species listed under the federal Endangered Species Act (NOAA 1996, USFWS 1998). Habitat characteristics include water quality (temperature, sediment, and chemical contamination), habitat access (physical barriers to migration), in-stream habitat elements (substrate, large woody debris, pool frequency, pool quality, refugia, and off-channel habitat), channel condition and dynamics (width/depth ratio, streambank stability, floodplain connectivity), in-stream flow and hydrology (changes in peak/base flows, drainage network), and general watershed conditions (road density and location, disturbance history, riparian condition). Water quality standards for salmonids in Washington State have also been established by Ecology (2011) for the purpose of protecting aquatic habitat. These metrics were relied on for the evaluations of Swift Creek and the Sumas River completed in this document.
3.3 Swift Creek

3.3.1 Water Quality

Water quality data have been collected in Swift Creek by various organizations. In an asbestos toxicity study, researchers from the University of British Columbia collected information on pH, heavy metals, and asbestos concentrations between August 1983 and September 1984 (Schreier 1987). Whatcom County sampled a broad set of water quality parameters between May 2003 and June 2004 as baseline information on habitat quality (Whatcom County 2012b). Turbidity measurements were made by Pacific Surveying and Engineering, Inc. (PSE) during the winter of 2011 and 2012 as a means to calculate suspended sediment loading (PSE 2012). Results for water quality parameters that most strongly affect fish habitat quality are summarized in Table 1.


<table>
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<tr>
<th>Parameter</th>
<th># Samples</th>
<th>Acceptable</th>
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<th>Maximum</th>
<th>Minimum</th>
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<td>pH</td>
<td>21</td>
<td>6.5 – 8.5</td>
<td>8.1</td>
<td>8.8</td>
<td>7.5</td>
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<tr>
<td>Temperature (°C)</td>
<td>22</td>
<td>&lt;18.0</td>
<td>8.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Dissolved Oxygen (mg/L)</td>
<td>11</td>
<td>&gt;8.0</td>
<td>10.2</td>
<td>14.3</td>
<td>4.5</td>
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<td>Turbidity (NTU)</td>
<td>18,000+&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt;75</td>
<td>243</td>
<td>&gt;3,000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0</td>
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<sup>a</sup> Sampling occurred more frequently during the winter so the average temperature value is likely underestimated.

<sup>b</sup> Includes data recorded continuously every 15 minutes from October 2011 to April 2012 (PSE 2012).

<sup>c</sup> Sensor limit for turbidity was 3,000 NTU but values in excess of this occurred on at least 14 different occasions.

mg/L = milligrams per liter

NTU = nephelometric turbidity units

Asbestos in its undisturbed state has not been found to have significant adverse effects on fish health (Schreier 1989). However, when broken down by the action of water trace metals (Nickel, Cobalt, Chromium, and Manganese) and asbestos fibers are released in high concentrations. The metals are released at pH values below about 8.0 (Schreier et. al. 1987). The average pH is around 8.1 in Swift Creek and around 7.0 in the Sumas River. These metals have been found to accumulate in muscle tissues of fish in the Sumas River downstream of Swift Creek (Schreier et. al. 1987). No known fish mortality has been traced to the asbestos or water quality in Swift Creek or the Sumas River, but at sub-lethal levels, trace metals can affect fish migration, olfactory systems (ability to feed), and normal gill function (respiratory system) (Wedemeyer 1977). In anadromous salmonids, trace metal exposure during the freshwater (juvenile) rearing phase can compromise smoltification leading fish to remain in freshwater longer than normal. Upon reaching seawater, the change in water chemistry exacerbates the effect of accumulated metals on gill function and fish can quickly die (Wedemeyer 1996). Asbestos fibers at concentrations reported in Swift Creek can cause lesions, kidney damage, tumors, and other health issues.
pH is a measure of the hydrogen ion activity in water and is commonly thought of as the “acidity”. pH can directly affect fish health, or have an indirect effect as the toxicity of various common pollutants is markedly affected by changes in pH. State surface water quality standards for char and salmonid rearing habitat require pH to be within the range of 6.5 to 8.5 (Ecology 2011). Only one exceedence of the state water quality criteria was observed when a value of 8.78 was recorded during October 2003.

Fish metabolic rates increase rapidly as temperatures rise. Many biological processes such as spawning and egg hatching are geared to natural annual temperature changes. Each fish species has a temperature range that it can tolerate, and within that range it has optimal temperatures for growth and reproduction. Temperatures considered optimal for salmonids are generally below 18°C although they can tolerate higher temperatures for short periods if acclimated to that temperature. The data show that water temperature is generally very low with the single exceedence above 18.0°C recorded on May 17, 2004. Water temperature was measured during an October 9, 2012 field visit. No significant rainfall had occurred within the previous two months. Stream flow at a rate of roughly 30 gallons per minute was observed in both creek forks, with the combined flow continuing downstream to Goodwin Road where it went subsurface. Water temperature was measured between 1:00 - 1:15 pm on a warm (18°C) sunny day. Temperature in the North Fork was 11°C and in the South Fork was 10°C.

Dissolved oxygen (DO) is also an important water quality parameter for salmonids and other aquatic organisms; low oxygen levels can be harmful to all life stages and can directly affect the survival of aquatic organisms. Washington state surface water quality standards require that DO concentrations exceed 8.0 mg/L in fresh waters designated for salmonid spawning, rearing, and migration (Ecology 2011). Salmonid rearing and migration only areas should exceed 6.5 mg/L DO. The lowest safe level of DO for trout is approximately 5 mg/L (Piper et al. 1982). Reduced food consumption has been observed at oxygen concentrations near 4 to 5 mg/L and fish death often occurs if DO drops below 3 mg/L (Piper et al. 1982). DO in Swift Creek was typically well within the satisfactory limits for salmonids. Only two values below the state standard of 8.0 mg/L were observed; both of these occurred during the summer of 2003.

High turbidity can change fish behavior, growth, physiology, and egg development, or indirectly affect fish by decreasing food supply and cover. During high turbidity events some fish stop feeding and seek cover, whereas others migrate into tributaries or to areas with clearer water (Chapman and Bjornn 1969). Physiological reactions to turbidity can include excessive mucus secretion, excretory and respiration interference that can lead to suffocation. Sigler et al. (1984) exposed juvenile coho and steelhead salmon to varying turbidity over 14 days. After being exposed to turbidity greater than 165 NTU all fish left the channel. Turbidity in Swift Creek averages 243 NTU with frequent pulses above 1,000 NTU.

Fine sediments less than 0.85 mm in diameter (fine sand and smaller) can also impair water quality and degrade salmonid spawning habitat and spawning success (Chapman 1988, Tappel and Bjornn 1983). Fine sediments in large volumes can reduce summer and winter rearing

Reports of extreme turbidity events coincide with ongoing erosion and mass wasting of the Swift Creek landslide. Significant turbidity was also reported to be a common occurrence during periods of rainfall and for a long time thereafter. These high turbidity levels occur in the South Fork Swift Creek and downstream to the Sumas River but are not reported in the North Fork (Figure 4).

Water clarity was examined during an October 9, 2012 field visit. No significant rainfall had occurred within the previous two months and a stream flow rate of roughly 30 gallons per minute was observed in both creek forks, with the combined flow continuing downstream to Goodwin Road where it went subsurface. Water in both creeks was clear with no sign of turbidity.

3.3.2 Habitat Access

Fish migration barriers are physical or chemical features that prevent or hinder the upstream movement of fish into habitat that would otherwise be available and suitable for rearing and/or spawning. These barriers can consist of physical obstructions such as undersized or excessively long culverts, dams/weirs, debris jams, or excessively steep reaches; or water quality impairments such as high temperatures, high turbidity, or low dissolved oxygen. Migration barriers are considered problematic if they are manmade or adversely influenced by humans.

Suitable fish passage habitat should include water depths adequate to completely cover fish, deeper holding areas every few hundred feet or less, areas with protection from the direct force of water movement, and deep areas (pools) downstream of obstacles that must be overcome that will allow jumping. None of these are currently present in sediment-affected areas of Swift Creek.
A number of partial fish migration barriers are present in Swift Creek. Partial barriers are those that are temporal in nature or not absolute in magnitude for all species. The absence of flow downstream of Goodwin Road during the late summer, and the extremely high turbidity and suspended sediment levels in the mainstem and South Fork during the winter and spring are partial fish migration barriers currently found in the system. Beaver dams in the North Fork may present partial barriers at times. The only absolute fish migration barriers observed within Swift Creek are near-vertical 5 to 10-foot drops in grade upstream of the Canyon Reach of the South Fork (starting at River Mile (RM) 3.0). These waterfalls are formed by large boulders wedged into the narrow canyon (Figure 5).

### 3.3.3 In-Stream Habitat Elements

Fish require a variety of habitat types in order to complete their various life stages. Riffles and pool tailouts covered with clean, suitably-sized gravel are required for spawning. Deep pools with overhead cover like logs and undercut banks are required for rearing and protection from predators.

Habitat conditions in Swift Creek were qualitatively assessed during the stream survey, from conversations with biologists familiar with the watershed, and from water quality data collected by Whatcom County. Quantitative measurements made by Cascade Environmental Services, Inc. (1998) were also utilized. Habitat characteristics were separated into functions and characterized as either: Properly Functioning, At Risk, or Not Properly Functioning using the NOAA (1996) criteria. A Properly Functioning Condition is defined as the sustained presence of natural habitat-forming processes necessary for the long-term survival of the species through the full range of environmental variation. Anything else is considered degraded.

#### 3.3.3.1 Swift Creek and South Fork

Under existing conditions pools within Swift Creek and the South Fork Swift Creek are few in number, relatively small, and short-lived due to frequent large pulses of sediment (Figure 6). Very little cover is present and water depths are too shallow due to the exaggerated width to depth ratios. This is primarily a result of the extremely high sediment loads experienced in the channel. A shortage of large woody debris (LWD) also contributes to low pool frequencies. LWD deflects flow into the bed and creates (scours) depressions in the substrate. Most pools observed during the survey were associated with logs or root wads. The channel is dominated by long riffles and glides. The extreme sediment loads have buried any historic off-channel habitat within the Goodwin and Canyon Reaches. Dredging and dikes have eliminated off-
channel habitat within the Oat Coles Reach. Instream habitat in Swift Creek and the South Fork would be considered *Not Properly Functioning* under the NOAA (1996) guidelines.

![Figure 6](image6.png)

**Figure 6. Examples of existing channel characteristics near RM 1.5 (Goodwin Reach) and RM 2.7 (Canyon Reach).**

### 3.3.3.2 North Fork

The North Fork Swift Creek is in relatively good condition with little evidence of recent catastrophic events (Figure 7). Pool frequency and condition were good, sediment supply appeared to be balanced with transport capacity, large wood was common, and numerous small off-channel pools were noted. Similar conditions were reported during surveys conducted 14 years ago indicating habitat is fairly stable (Cascade Environmental Services, Inc. 1998). Beaver dams in the upper valley also reportedly offer excellent winter refuge.

![Figure 7](image7.png)

**Figure 7. North Fork existing conditions**

Instream habitat in the North Fork would be considered *Properly Functioning* under the NOAA (1996) guidelines based on the quick survey and reports from others.
3.3.4 Riparian Function

Riparian buffers perform many functions essential to fish survival and productivity. Vegetation in riparian areas shades streams and maintains cool water temperatures needed by most fish native to the Pacific Northwest. Plant roots stabilize stream banks and help control erosion and sedimentation. Adjacent vegetation creates overhanging cover for fish. Riparian habitat contributes leaves, twigs, and insects to streams, thereby providing basic food and nutrients that support fish and aquatic wildlife. Large trees that fall into streams create pools, riffles, backwater, small dams, and off-channel habitat that are needed by fish for cover, spawning, rearing, and protection from predators. Riparian vegetation, litter layers, and soils filter incoming sediments and pollutants, thereby assisting in the maintenance of high water quality needed for healthy fish populations. Riparian habitat moderates stream volumes by reducing peak flows during flooding periods and by storing and slowly releasing water into streams during low flows (Knutson and Naef 1997).

3.3.4.1 Swift Creek and South Fork

The Oat Coles Reach was long ago cleared of most riparian vegetation and converted to cropland. The levees now found along both sides of the creek between Oat Coles Road and Goodwin Road eliminated all riparian vegetation from this area. A patch of natural vegetation is found along both banks of Swift Creek downstream (west) of Oat Coles Road for a distance of between 400 and 1,000 feet. The vegetation is set back from the immediate channel 50-100 feet along parts of the south side due to recent grading which significantly limits the function in this area.

Forestland adjacent to the Goodwin and Canyon reaches has been logged in the past but is returning to a well vegetated native forest except immediately adjacent to the creek where frequent disturbance, both natural (flooding and soil chemistry) and manmade (gravel mining) have precluded revegetation. A patch of moderate aged coniferous forest located just upstream of Goodwin Road is relatively close to the channel for approximately 3,000 feet. Flooding and sediment deposition have overwidened the active channel such that much of the forest vegetation is set back 10 to 100 feet from the active watercourse. While this limits riparian function, this area likely has the highest riparian value within the three study reaches.

Overall, the riparian areas adjacent to the Swift Creek and South Fork Swift Creek channels consist of relatively young to non-existent vegetation set well back from the active channel. As such they are considered not properly functioning.

3.3.4.2 North Fork

The North Fork Swift Creek flows through a relatively well-vegetated watershed with wide, mature, coniferous/deciduous tree buffers with dense understory (Figure 7). While logging has occurred, good riparian buffers adjacent to the creek channel were maintained. A short site visit into the North Fork channel, and discussions with others more familiar with the basin all
indicate that riparian functions including shade, bank stability, LWD input, nutrient contribution, etc. are all good. As such the buffers are considered to be properly functioning.

3.3.5 Channel Condition and Dynamics

The relationship between channel width and depth provides an indication of channel stability and response to past changes in stream flow. Increases in sediment rates and volumes often results in excessive sediment deposition which can increase the width to depth ratio. Bank armoring can also affect width to depth ratios. Roots from vegetation growing along the streambank help stabilize soils and reduce erosion. Floodplains are areas above the ordinary high water mark where overbank flows travel downslope during flooding events. These areas allow potentially erosive volumes of water to travel away from the main stream channel, thus helping to prevent excessive erosion. Impaired conditions occur when width to depth ratios are high (greater than 10), bank armoring or diking is present, and off-channel or floodplain areas are disconnected hydrologically to the mainstream channel.

3.3.5.1 Swift Creek and South Fork

Observations made during the survey found that width/depth ratios for Swift Creek and the South Fork channel are extremely high due primarily to excessive sediment deposition. The channel is very unstable and prone to constant shifting and avulsion. There is little to no vegetation along low flow channel banks. Where vegetation is present, it is found outside the bankfull channel area. Several thousand feet of bank armoring, along with several road bridges artificially stabilize portions of the bank, particularly on the alluvial fan where channel processes would naturally be most dynamic for a river with high sediment loading. The bank protection and bridges interfere with normal channel processes. Channel condition and processes would be considered Not Properly Functioning under the NOAA (1996) guidelines.

3.3.5.2 North Fork

No evidence of exaggerated width to depth ratios, or artificial bank protection were observed or described for the North Fork Swift Creek. This branch of the creek is believed to be Properly Functioning under the NOAA (1996) guidelines.

3.3.6 Flow/ Hydrology

Instream flows were measured in Swift Creek from October 2011 to May 2012 (PSE 2012). Flows ranged from 0 to 155 cubic feet per second (CFS) during this period. The average flow was 9.4 cfs. Snowfall and rain-on-snow events are common on Sumas Mountain where Swift Creek is located (Parametrix and Adolfson 2006). Forest practices are the dominant land use in the upland area of Sumas Mountain. Most of the higher elevations are coniferous forest, with mixed and predominately deciduous forests at lower elevations. Forest practices on the slopes of Sumas Mountain have altered forest cover, but there is relatively little bare land/immature vegetation in rain-on snow zones so the effects of forest clearing on peak flows may be less pronounced than in other areas of the Nooksack basin (Parametrix and Adolfson 2006). No documentation of significantly impaired peak flows has been reported within the greater Sumas
Watershed including Swift Creek. However, Ecology has closed this watershed to additional water rights, which suggests that summer low flows are impaired at some level.

3.3.7 Fish Use

3.3.7.1 Swift Creek and South Fork

Swift Creek is known to have historically contained fish, and may continue to provide habitat during periods of lower sediment recruitment. Local and state agency and tribal biologists have identified Swift Creek as known or presumed fish-bearing waters for both steelhead and cutthroat trout (Whatcom County 2005, WDFW 2012, Smith 2002). Few site-specific studies have been conducted, but one that recently surveyed three sections of the creek from the mouth to the canyon area failed to find any fish (Cascade Environmental Services, Inc. 1998). It is generally believed that no fish utilize the South Fork except incidentally or in migrating to or from the North Fork (Kamps pers. con. 2012). The lack of fish is likely caused by very poor rearing and spawning habitat conditions, frequent natural and anthropogenic disturbances, and poor water quality.

3.3.7.2 North Fork

The North Fork contains a documented cutthroat trout population (Cascade Environmental Services, Inc. 1998, Kamps pers. con. 2012). Six trout between 60 and 95 millimeters were captured during surveys in 1998 and observations by trained biologists suggest the population is currently “abundant” (Kamps pers. con. 2012). Little is known about this population. It is unknown whether or not fish occasionally immigrate or emigrate from the population. While the population is currently completely or partially isolated, this has only been true since the Swift Creek slide reactivated in the 1940’s. Because it is likely that the population was able to migrate to and from the Sumas River prior to the 1940’s the existing population is probably closely related to fish found in the Sumas River. If so, the North Fork population is not genetically distinct from other regional populations. A genetically distinct population would be much more vulnerable to extirpation.

3.4 Sumas River

3.4.1 Water Quality

Water quality sampling in the Sumas River has been conducted by Whatcom County and the USGS. Monitoring was conducted at various locations in the Sumas River headwaters between May 2003 and June 2004 by Whatcom County. A single monitoring station was located on the Sumas River at Rock Road starting in June 2004 and ending in July 2006. Data were collected at this location for the Whatcom County WRIA 1 program over the 26-month period (Herrera 2007). Results for water quality characteristics for which state water quality standards have been promulgated are provided below. Additional water quality analyses are found in the report prepared for Whatcom County (Herrera 2007).

The USGS has a gauge and monitoring station at South Pass Road and has been collecting discharge and turbidity data since January 2011 (USGS Gauge #12214350). During the period
between April 21, 2011 and January 11, 2013 instream flows ranged from a minimum of 5.2 cfs to a maximum of 264 cfs with an average of 28.9 cfs.

Table 2. Sumas River water quality data collected 2003-2006, and 2011-2013.

<table>
<thead>
<tr>
<th>Variable</th>
<th># of Samples</th>
<th>Acceptable</th>
<th>Average</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>41</td>
<td>6.5 – 8.5</td>
<td>7.3</td>
<td>8.1</td>
<td>6.6</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>41</td>
<td>&lt;18.0</td>
<td>8.9</td>
<td>15.7</td>
<td>3.9</td>
</tr>
<tr>
<td>D.O. (mg/L)</td>
<td>33</td>
<td>&gt;8.0</td>
<td>7.2</td>
<td>12.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>&gt;50,000</td>
<td>&lt;75</td>
<td>68.7</td>
<td>1,910</td>
<td>1.1</td>
</tr>
</tbody>
</table>

The state water quality standard measured as the 7-day average daily maximum (7-DADMax) is 17.5°C. Water temperatures were measured during sampling events and also continuously between July 15 to October 13, 2005. Water temperatures in the Sumas River ranged from 3.9 to 15.7°C, with a median value of 8.9°C between May 2003 and June 2004, and ranged from 5.3 to 19.1°C, with a median value of 11.5°C from June 2004 to July 2006. Temperatures exceeded the state water quality standard during the summer but were on average very cool.

Dissolved oxygen levels measured in the Sumas River ranged from 2.7 to 12.3 mg/L, with a median value of 7.2 mg/L between May 2003 and June 2004, and ranged from 4.8 to 11.3 mg/L, with a median value of 8.6 mg/L from June 2004 to July 2006. Thirty–two (32) percent of the samples collected from the Sumas River did not meet the state standard of 8.0 mg/L during the latter two years.

Levels of pH in the Sumas River site ranged from 6.6 to 8.1 with a median value of 7.3 between May 2003 and June 2004, and ranged from 6.05 to 7.49 with a median value of 7.19 from June 2004 to July 2006. Less than 4 percent of the samples exceeded the state standard.

Turbidity levels at the Sumas River site from June 2004 to July 2006 ranged from 2.9 to 104 NTU, with a median value of 13 NTU and a mean value of 20 NTU. Turbidity measured at the USGS gauge ranged from 1.1 NTU to 1,910 NTU with an average of 68.7 NTU April 21, 2011 and January 11, 2013.

The Sumas River has one reach listed on the 2008 (most current) 303(d) list for fecal coliform bacteria, one for bioassessment, and one for dissolved oxygen. Fecal coliforms are commonly found as a result of natural (wildlife) deposits, and from agricultural waste material deposited on managed croplands or from cattle. However, fecal coliform bacteria do not represent a threat to fish habitat value or habitat impairment unless they are correlated with nutrient or toxic (unionized ammonia) loadings. Several of the tributaries of the Sumas River had been listed in the past for dissolved oxygen, fecal coliform bacteria, and pH resulting in poor water
quality in the drainage basin; however, all of these reaches have been removed from the most recent 303(d) list (Ecology 2009).

3.4.2 Habitat Access

There are no absolute or permanent fish migration barriers located on the Sumas River downstream of Swift Creek. Anadromous fish have been observed upstream past the City of Nooksack. The Barrowtown Pump Station located in Canada near the downstream end of the Sumas River may on occasion hinder upstream migration but is not a significant obstacle. The current Barrowtown Pump Station was built starting in 1975 and is the largest drainage pump station in Western Canada. Water flow in the Sumas River is controlled by gravity drain floodgates and used for irrigation in the Sumas Valley. Irrigation water has historically been stored in the Sumas River from May 24 through to September 15 by closing the floodgates. The floodgates are then opened by September 15 each year to allow upstream passage of migrating salmon into the Sumas River and its tributaries (IRC 1994).

3.4.3 Habitat Elements

The Sumas River is a very low gradient system with a slope downstream of the City of Nooksack averaging approximately 0.08 percent. No data on LWD density are available, but pictometry does not show significant amounts of instream LWD (Parametrix and Adolfson 2006). The lack of LWD perpetuates low pool frequency. The proportion of fine material in the substrate is high as would be expected in low grade systems with low LWD frequencies. This condition is exacerbated by the high sediment volumes coming from Swift Creek. Banks are generally stable and not believed to be a significant source of sediment (Parametrix and Adolfson 2006).

3.4.4 Channel Condition and Dynamics

The Sumas River channel is generally unconfined by terrain, but protected from future movement by 15 permanent public road crossings, and bank maintenance by adjacent landowners (Parametrix and Adolfson 2006). The width to depth ratio is fairly low due to a historically equilibrated supply-transport mechanism and highly stable, well vegetated banks that limited migration, particularly avulsions. There are no significant areas of bank erosion on the mainstem channel.

3.4.5 Flow/ Hydrology

Bank stabilization and surface drainage facilitation have reduced surface water storage throughout much of the Sumas River watershed. Groundwater infiltration/recharge remains high due to the low level of impervious surface. However, water withdrawal rates are also high. The combined effect is a decrease in summer baseflows in regional creeks. No documentation of significantly impaired peak flows was found for the Sumas WMU (City of Nooksack 2010).
3.4.6 Fish Use

3.4.6.1 Chinook Salmon

Small numbers of late Chinook salmon have occasionally been observed in the Sumas River drainage and are believed to use the Sumas River upstream to about Kinney Creek (Nooksack Natural Resources et al. 2005). The historic range of fall Chinook salmon is presumed to include most of the Sumas River and including Breckenridge Creek (Nooksack Natural Resources et al. 2005). While historically indigenous, the original late Chinook population is now considered extinct (Nooksack Natural Resources et al. 2005). Current Nooksack late-timed Chinook are considered non-native, and primarily Green River origin, due to the extensive history of non-native hatchery releases.

3.4.6.2 Bull Trout

Migratory bull trout have been observed foraging within the lower Sumas River and in tributaries within British Columbia, but distribution and extent of use these systems is not well known. Experts believe that it is unlikely that bull trout spawning or rearing occurs in the Sumas River or its tributaries given the relatively low elevation of this drainage and general unsuitability of habitat (Nooksack Natural Resources et al. 2005) but foraging is likely to occur. WDFW has documented or presumed bull trout use up to the confluence with Dale Creek (Figure 2) which is a tributary to the Sumas River upstream of Swift Creek (Kamp pers. con. 2012).

3.4.6.3 Coho Salmon

Coho salmon are the mostly widely distributed anadromous salmonids in the Sumas River system. Presumed and historic ranges extend throughout the mainstem and well into all the large and medium sized tributaries (Nooksack Natural Resources et al. 2005, WDFW 2012).

3.4.6.4 Chum Salmon

Fall chum salmon are fairly widely distributed in the Sumas River and some of the larger tributaries but not beyond Breckenridge Creek (Nooksack Natural Resources et al. 2005, WDFW 2012).

3.4.6.5 Steelhead

Winter steelhead trout have been documented in the Sumas River and most of the tributaries up to Swift Creek (Nooksack Natural Resources et al. 2005, WDFW 2012).

3.4.6.6 Sockeye Salmon

Sockeye are not found in the Sumas River much beyond Johnson Creek near the City of Sumas (Nooksack Natural Resources et al. 2005, WDFW 2012). Historic distribution is not presumed to extend beyond this point.

3.4.6.7 Pink Salmon

Pink salmon have not been reported within the Sumas River watershed (Nooksack Natural Resources et al. 2005, WDFW 2012).
3.4.6.8 Cutthroat Trout

Anadromous and resident cutthroat trout are presumed to be found throughout all suitable habitats in the Sumas River watershed (Smith 2002; Nooksack Natural Resources et al. 2005).

3.5 Breckenridge Creek

Breckenridge Creek is a tributary to the Sumas River entering from the east near the City of Nooksack. The Breckenridge Creek basin is located adjacent to and north of the Swift Creek basin.

3.5.1 Habitat

The lower portion of Breckenridge Creek lies on the outwash plain of the Sumas River and has a gradient less than 0.1 percent. The creek meanders down a relatively well vegetated channel with good riparian cover and debris input characteristics (Whatcom County 2006). Pools and other low gradient habitat favored by coho and resident trout are abundant in the mainstem reach and several minor tributaries. Substrates are dominated by finer materials which reduce spawning habitat quality on the outwash plain. The section of channel upstream of the outwash plain has gradients approaching 2 percent with better spawning habitat conditions.

3.5.2 Fish Use

Breckenridge Creek contains a year-round population of resident cutthroat trout and is known to be utilized by several species of salmonids. Coho salmon spawn in Breckenridge Creek and juveniles are found rearing in the lower portion and accessible tributaries all year (Nooksack Natural Resources et al. 2005, Whatcom County 2006, Kamps pers. con. 2012, WDFW 2012). Chum salmon have also been observed spawning in the lower creek. Chinook salmon and steelhead trout have been observed nearby in the Sumas River and are presumed to utilize Breckenridge Creek on occasion for rearing and foraging. Spawning by either of these species has not been observed.

3.6 Existing Conditions Summary

Swift Creek and the South Fork Swift Creek currently contain very little fish habitat and no more than periodic short-term use by any fish species. This is due primarily to the chronic extreme turbidity events during the winter, very low to absence of surface flows during the summer, and the lack of channel features that provide rearing, spawning, or migration habitat for fish. The North Fork Swift Creek has good quality habitat and currently contains an isolated resident trout population. While fish may be able to outmigrate downstream to the Sumas River, it is less likely that the reverse trip is possible due to numerous physical and water quality issues found in the mainstem of Swift Creek.

The Sumas River in the vicinity of Swift Creek and downstream has fair to good quality habitat and naturally reproducing populations of anadromous and resident salmonids. Habitat quality is adversely affected by the high fine sediment load and asbestos contamination coming from Swift Creek.
Breckenridge Creek also has fair to good quality habitat and naturally reproducing populations of anadromous and resident salmonids. The channel is not currently directly affected by ongoing issues with Swift Creek.

4.0 EVALUATION OF IMPACTS

4.1 Short Term Impacts Analysis

This section evaluates the short term impacts to fish and fish habitat that would occur during work necessary to maintain existing levees and infrastructure as would be required under all scenarios, or to build various components of the Phase 1 action. Impacts can include (1) direct physical loss or degradation of habitat resulting from work within the active channel; (2) changes in delivery of fine and coarse sediments from disturbed surfaces in the adjacent riparian area, or side channels; (3) impacts to water quality; and (5) changes in water quantity. The influence of each of these factors on fish habitat and the existing site conditions is discussed below.

4.1.1 No Action

No construction would occur under the No Action alternative but maintenance of the channel, levees, and bridge crossings would continue as needed to provide a minimal acceptable level of protection against flooding. This would include periodic (every two to three years) excavation of accumulated sediment from below public bridges and repair of levees. Regulatory oversight would be required and operations would proceed under conditions of maintenance permits issued by local, state, and/or federal agencies. Most actions would be timed to avoid or minimize impacts to fisheries and would typically occur during the summer when the channel is dry or only minimal flow is present. Whatcom County would also continue to react to emergency situations and to complete whatever measures can reasonably be provided to protect public property. Emergency situations often result in heightened environmental damage as property protection measures are completed as quickly as possible without adequate time to consider suitable site-specific environmental protection. Possible impacts from maintenance activities would most likely be associated with insults to water quality coming from petroleum products leaking from machinery, increased turbidity, disturbance of toxic materials buried in the substrate, and pouring of concrete. Destabilization of the streambed and streambanks, as well as damage to any riparian vegetation may also occur.

Mitigation is often completed after-the-fact as a response to the damage rather than to avoid damage on the first place. These emergency situations are likely to occur at a higher frequency than if the SCMSAP were adopted and pro-active measures implemented to control sediment and flooding. No specific significant adverse effects to aquatic habitat or fisheries resources from maintenance-related actions would be expected under the No-Action Alternative, but fish would continue to suffer heightened adverse effects of chronic disturbances due to the need for continued maintenance.
Adoption of the SCSMAP establishes clear avenues for future actions but does not include physical implementation or construction of any project actions. The SCSMAP contains a number of management strategies that with adoption of the plan could eventually become constructed solutions. These have been identified as Active Management Strategies in the SCSMAP (See Table 4-1 in SCSMAP). Active Management Strategies include activities that will physically disturb the watercourse and could directly affect aquatic habitat. These include some of the sediment management actions such as the in-stream sediment traps and sediment basins, and maintenance and repair actions that would require dredging to maintain channel conveyance. All of the in-stream actions are proposed in the South Fork and downstream mainstem of Swift Creek where fisheries use is believed to be currently absent based on the poor quality of habitat including water quality. All of the instream actions would require specific and detailed review by state and federal agencies before they are undertaken. A normal part of this review would include analysis of short term protection of aquatic habitat during construction. Most actions would be timed to avoid or minimize impacts to fisheries and would typically occur during the summer when the channel is dry or only minimal flow is present. Possible impacts from construction would most likely be associated with insults to water quality coming from petroleum products leaking from machinery, increased turbidity, disturbance of toxic materials buried in the substrate. Some work may be required immediately adjacent to the North Fork of Swift Creek if a reroute of the North Fork is realized. Fish in this area could be subject to visual and noise disturbances during construction.

Other Active Management Strategies are designed to occur outside the active stream channel and would have less potential to adversely affect aquatic habitat than the in-channel work. Examples of these actions include the building of new levees, sediment stockpiling, and landslide stabilization. Any effects of these actions on fisheries are likely to be indirect and less substantial than in-channel activities. Some of the work can disturb or displace riparian vegetation. Replanting or mitigation planting in other areas of the watercourse should be a component of any design that has this effect.

The Passive Management Strategies of the SCSMAP do not include any physical changes to the watershed but are designed to provide for additional information and means for making decisions about future management of the watershed. These strategies would not result in any adverse construction effects on fisheries.

Adoption of the SCSMAP would require additional review before physical changes are made to the watershed. Review would include the identification and design of mitigation strategies needed to avoid, minimize, and mitigate potential construction effects on fish habitat. Based on the types of strategies that have been identified, and the poor existing condition of the resource, it is not expected that adoption of the SCSMAP would result in future construction activities that would have any unavoidable significant adverse effects on fish or fish habitat.
4.1.3 SCSMAP Phase 1 Implementation Alternative – Proposed Project Action

Implementation of the Phase 1 alternative would result in one or more of the following actions being completed within or adjacent to the Swift Creek channel:

- Debris Deflection/Setback Levees
- In-Stream Sediment Traps
- Sediment Basins

The second two actions would involve instream construction and direct construction effects to habitat and water quality. The levee work would be completed near the active channel but could indirectly affect habitat quality if contaminated runoff reaches fish-bearing waters. Work will occur near the North and South Forks of Swift Creek, the mainstem of Swift Creek, and near a tributary to Breckenridge Creek (South Pass Setback Levee).

4.1.3.1 Direct Effects

Direct effects include the physical loss of habitat use on a temporary basis during construction. This can be the result of portions of the channel being physically eliminated, or simply disturbed to the extent that no use by fish is possible or probable. A common example is when construction requires that all stream flow be diverted around a construction area thereby drying up a stream reach.

It is assumed that under terms of the Hydraulic Project Approval (HPA) required by the WDFW for hydraulic actions, each in-channel work area would be blocked off and any fish relocated to downstream locations. Instream and hyporheic flow would be intercepted and pumped around the work areas to undisturbed reaches of channel downstream. This may require lowering of the groundwater table by pumping. Outflow would be directed downstream out of the work area or re-infiltrated away from the creek. TESC measures would be implemented as necessary to stabilize and/or remove disturbed sediments prior to returning that natural flow to the creek. If any fish are present in the work areas, it is possible that not all of them would be recovered prior to filling, so it is expected a low level of fish mortality could occur.

In-channel construction required for the Phase 1 actions would disturb areas of Swift Creek or the South Fork Swift Creek that are currently highly degraded due to excessive sediment deposition, lack of pools, and poor water quality. It is not believed that any fish currently occupy these areas on more than an incidental basis. The loss of rearing habitat availability for the construction period would not critically interrupt the life cycle of any fish population. No in-channel construction is proposed within any other waterbody.

With the use of BMPs, proper site inspection, and implementation of the SWPPP, HPA and Section 404 and 401 permit conditions, none of the construction or maintenance projects are reasonably expected to cause significant adverse effect to aquatic habitat.
4.1.3.2 Impacts to Water Quality

Water quality components that are critical to fish habitat and most often affected by land disturbance near creeks include water temperature, turbidity, toxic chemicals, metals, DO, nutrients, and pH.

Increased turbidity is the most likely result of the instream and near-stream work that could occur during construction under Phase 1. Very fine sediments, which elevate turbidity for a sustained period, can directly affect fish behavior and physiology, or indirectly decrease food supply, habitat availability, or the ability of fish to find prey. Turbidity can also exacerbate existing problems, such as poor dissolved oxygen (DO) levels or high temperatures, and lower fish tolerance to other water quality parameters. Behavioral modifications include cessation of feeding and outmigration. Physical reactions include excessive mucus secretion, excretory interference and respiratory complications resulting in possible suffocation (Redding et al. 1987).

Construction measures would be designed during the permitting phase using BMPs to protect water quality. These measures would be reviewed and subject to permits by several agencies. Because virtually all of the work includes common grading activities using normal construction equipment, and work can be completed during the summer low flow period in Swift Creek when flows are very low in the Goodwin and Canyon reaches, and largely absent in the Oat Coles reach, the expected efficacy of these methods is high. In addition, though much of the material being moved contains elements potentially hazardous to aquatic habitat, all of material being disturbed was historically deposited by the river and is native to the area. The risk that sub-standard water will be discharged to Swift Creek, Breckenridge Creek, or the Sumas River is low. Therefore, no significant adverse construction-related water quality impacts to fish or fish habitat are expected.

4.1.3.3 Impacts to Riparian Habitat

The South Pass and Lower Goodwin setback levees would be constructed in areas with no, or only very minor existing riparian vegetation so construction would not eliminate any valuable trees that would otherwise contribute shade or nutrients. The Upper Goodwin setback/debris deflection levee would eliminate some riparian vegetation but is located for the most part well back from the creek with an existing intervening road. The levee is also located on the north side of the creek so the loss of some trees will not lead to decreased shading.

4.2 Long-Term Impacts Analysis

This section describes the long-term effects that follow completion of any construction or change in policy. Impacts are typically related to changes in land configuration, land use, or land management.
4.2.1 **No Action**

Under the No-Action Alternative Whatcom County would continue as usual to react to emergency situations and to conduct periodic maintenance on an as-needed basis to protect infrastructure. There would be no construction. Baseline habitat conditions would continue to suffer but are not expected to get significantly worse after 70+ years of ongoing slide-related impacts. Fish habitat in Swift Creek would continue in its degraded state and the fish population in the Sumas River that is being affected by reduced water quality and heightened fine sediment loads would continue to be depressed.

The No-Action Alternative is not expected to have a significant adverse effect on fish populations or fish habitat.

4.2.2 **SCSMAP Adoption Alternative – Proposed Non-Project Action**

Large quantities of sediment would continue to enter and move through the channel and in-channel maintenance would continue as usual under this option. The level of monitoring and study of the site would increase in preparation for Phase 1 actions. Over the long term, adoption of the SCSMAP could facilitate a variety of projects that would lead to work within and adjacent to the channel. These projects could include instream work such as bank armoring, sediment traps and basins, dredging, a reroute of the North Fork of Swift Creek, and various maintenance activities. Near channel work such as levee construction, sediment stockpiling, and landslide stabilization could result in the removal of riparian vegetation. All of these actions can have long term effects on natural channel development which tends to suppress fish habitat suitability.

Instream structures in particular can adversely affect salmonid migration and result in further isolation of the North Fork cutthroat trout population. Sediment basins and in-stream sediment traps would likely span the channel with artificial structures over which fish may not be able to pass. Fish passage in both the upstream and downstream directions should be considered during the design of any in-stream structures. These structures should not be left in place longer than required to provide the designed protection functions. Triggers should be identified for their removal.

Fish passage upstream from the Sumas River to the North Fork Swift Creek and to RM 3.0 on the South Fork Swift Creek (location of natural fish migration barrier) is not currently believed to be possible under most conditions. During the summer there is a mile or more of channel within the Oat Coles Reach that is dry. During the winter, very high flows, very high turbidity, and the lack of suitable habitat would inhibit most fish from making the journey (See Section 3.2.2). One option under review that would avoid isolating the population consists of rerouting the North Fork Channel to a connection with Breckenridge Creek. If a channel revision proves feasible, and fish passage could be provided in the new channel, the sediment management structures would have little effect on the North Fork fish population. Because the North Fork population is currently healthy despite the poor passage conditions, the population
is a minor component of the larger Sumas drainage trout population, and further isolation can’t be shown to directly affect the fish, it isn’t believed that a significant adverse effect would occur.

Fish habitat is to a large extent dependent on sufficient coarse sediment in streams to provide spawning gravels, and deformable bed thickness capable of creating deep pools. However, too much coarse sediment can reduce the fish production capacity of a stream. Sediments can fill pools or deposit in amounts that create chronic channel instability with changing bed elevations and highly mobile stream channels. Dry reaches can result where summer low flows are inadequate to fill increased interstitial spaces in deposits of coarse sediment. These are some of the effects currently observed in Swift Creek due to the heightened sediment loads. Levees, bank armoring, and slide stabilization would reduce sediment recruitment. The sediment traps, sediment basins, and dredging could reduce instream sediment loads. If allowed to continue unregulated, it is possible that sediment loading could drop to a level where the beneficial affects of sediment in creating fish habitat are no longer achieved. While sediment removal has been deemed necessary for human health and safety reasons, the reduction in sediment supply could adversely affect spawning and rearing habitat downstream of removal locations.

Levees adversely influence future channel migration and the development of complex habitat. This effect can be partially mitigated with instream structures (e.g. LWD placement) and by other means. Care should be taken to avoid locating levees in areas with sensitive habitat such as wetlands and tributary streams.

Riparian tree removal as necessary for the construction of levees and the sediment basins, and continued use of riparian areas for sediment storage could reduce potential riparian benefits over the long term. This would be even more important if the North Fork Swift Creek is rerouted to Breckenridge Creek thus eliminating a significant source of nutrients and wood to the Swift Creek channel. The nutrients, organic debris, logs, etc. being delivered to Swift Creek are not currently functioning in Swift Creek due to the absence of fish and habitat. But their value could be significant in the future. Reversing any reroute of this channel should be considered in the future to restore these benefits once fish are restored to Swift Creek.

Large scale maintenance projects could include work on South Pass Road. A tributary to Breckenridge Creek used as rearing habitat by juvenile coho (Kamps pers. con. 2012) crosses under South Pass Road near the proposed South Pass Setback Levee. Much of the flow in this tributary comes off the Swift Creek alluvial fan. If the culvert is eliminated, coho rearing habitat in the tributary would be adversely affected. It is not known what proportion of coho rearing habitat the tributary provides or how the quality compares with other areas of Breckenridge Creek. This should be evaluated before any action is taken that might reduce flow.

With virtually no habitat present in the affected areas, none of the instream or near-stream actions being considered under either the active or passive management strategies of the SCSMAP are likely to have significant adverse effects on fish habitat in Swift Creek. If
reasonable care is taken as projects are designed to avoid sensitive areas, and monitoring is conducted to allow the regulation of sediment movement rather than the complete cessation, it is not expected that the SCSMAP Adoption Alternative would have any significant adverse effects on fisheries resources in Swift Creek or downstream in the Sumas River.

Changes to surface drainage in the area of the slide may have an effect on flows in Swift Creek if surface water normally headed towards the slide is diverted to Swift Creek. If runoff that might have infiltrated into the slide area is instead directed to Swift Creek without detention, the results could be slight increases in peak flow rates. According to early reports the volume of water crossing the slide is on the order of several cfs (Converse Davis Dixon 1976). Peak flows in Swift Creek normally exceed 100 cfs so the amount of water to be diverted is not a significant portion of the total flow. Attenuation downstream will further reduce impacts and by the time flows reach known fish-bearing waters in the Sumas River there will be no measurable effects.

Any rerouting of the North Fork Swift Creek Tributary will reduce flows in the mainstem of Swift Creek by about half (NHC 2010) and increase flows elsewhere if the final destination is to another watercourse (e.g. Breckenridge Creek). Because of the current lack of habitat in Swift Creek downstream of the confluence with the North Fork, the effect of reducing flows in this area on fish and fish habitat is expected to be minimal. A slight reduction in flow in the Sumas River between the mouth of Swift Creek and the mouth of Breckenridge Creek (a little over a mile) will also occur if the North Fork is routed to Breckenridge Creek. The North Fork tributary represents less than about five percent of the contributing drainage area to the Sumas River at this point so the effect will be relatively small.

Flows in portions of Breckenridge Creek could increase significantly if the North Fork tributary is routed to this watercourse. The lower reaches provide habitat for resident trout and juvenile coho which generally prefer calm, slow moving waters. If diversion of the North Fork Swift Creek to Breckenridge Creek is proposed, an instream flow study should be conducted to determine how the change in flow volume will affect water depths and velocities in fish-bearing waters on a seasonal basis. Measures such as the addition of LWD or opening new off-channel habitat areas may need to be taken to offset increases in velocities.

The SCSMAP Adoption Alternative is not expected to have a significant adverse effect on fish populations or fish habitat.

4.2.3 SCSMAP Phase 1 Implementation Alternative – Proposed Project Action

4.2.3.1 Impacts to Sediment Recruitment

Coarse sediment enters the stream network naturally through bank erosion, mass wasting events, and catastrophic landscape events such as dam-break floods and debris torrents. The proposed SCSMAP Phase 1 changes will influence natural delivery of coarse sediments to Swift Creek by altering natural rates of bank erosion, mass wasting, and catastrophic events, and by
changing the depositional patterns of material that gets to Swift Creek. The most notable changes will occur as a result of proposed landslide stabilization (sediment input reduction) and the various in-channel sediment management activities (e.g. grade controls and sediment basins) which are designed to trap and remove sediment from the creek.

The extensive sediment removal and input-reduction actions proposed for Swift Creek will reduce or eliminate ongoing impacts excessive sediment volumes currently have on the Swift Creek and South Fork Swift Creek channels downstream of the slide. The North Fork Swift Creek channel will not be affected by any of the sediment management proposals. While initiation of the slide and chronic sediment inputs are believed to be results of natural processes, the massive volumes of sediment have effects that are not beneficial to fish habitat. This is in part due to the excessive volume of all material, and in part due to the large amounts of very fine material and elevated metal and asbestos fiber levels within this material.

The different sediment management proposals will have varying effects on aquatic habitat. The in-stream sediment traps proposed for the canyon reach will initially trap all bedload material (fine to coarse sediment not including suspended sediments). Suspended sediments will continue to move downstream where (in the absence of proposed sediment basins) most will deposit in lower gradient areas within the Oat Coles Reach or in Swift Creek. As the in-stream sediment traps fill, larger and larger sediment sizes will again begin to migrate downstream. If left alone, sediment transport characteristics would return to baseline levels within a year or two. Dredging behind the structures is proposed as a measure to restore the sediment-trapping capacity on an as needed basis. Initial calculations indicate dredging would be required every year to every few years. The benefit of the in-stream sediment traps to fish habitat is that occasional pulses of coarse sediment can be allowed to pass downstream thus replenishing the supply. This can be managed by varying the duration between dredging activities and location/volume of sediment removal. The downside of the in-stream sediment traps is that they do a poor job of eliminating the finer sediment sizes that have a proportionally larger adverse effect on aquatic habitat quality. The sediment ponds would capture virtually all sediments except the dissolved fraction which is likely to continue on to the Pacific Ocean with little impact on habitat downstream. Periodic maintenance would be completed to maintain the ability to capture all sediments. This would result in starving the Oat Coles Reach of all sediment and reducing the amount of sediment input to the Sumas River. While this would likely preclude any potential spawning or rearing habitat formation on the alluvial fan while the sediment ponds are operating, there is none located there under existing conditions so the expected impact is minimal. If in the future sediment input rates to Swift Creek begin to abate, and monitoring indicates this could be permanent; efforts should be made to reduce the sediment trapping ability of the ponds. This could be done by reducing or eliminating dredging, or bypassing the ponds with a new channel.

Reduction of coarse sediment input and proposed alterations to downstream sediment transport will not have a significant adverse effect on fish habitat in Swift Creek for two principal reasons: 1) there is currently little if any functional fish habitat in Swift Creek or the
South Fork Swift Creek downstream of the slide, and 2) the North Fork Swift Creek where good quality fish habitat is present will not be affected by the sediment reduction proposals.

Sediment reduction will affect spawning habitat in the Sumas River to some extent. Swift Creek is not the sole source of gravel for the Sumas River; coarse sediment needed for spawning habitat formation also comes from other sources. Adverse effects on spawning habitat are offset by the reduction in the harmful volumes of fine sediments that are being deposited in the Sumas River. As a whole, sediment reduction is expected to have a benefit to habitat in the Sumas River for the foreseeable future due to the reduction in fine sediment deposits, turbidity, and water quality degradation.

Over the very long term, plans should include identifying the appropriate time and methods for removing the in-stream sediment traps. While the impact of sediment trapping will naturally abate as the structures fill up over time, the structures will block fish passage (see next section for further discussion). Eliminating the sediment ponds may not be as high a priority because by reducing maintenance dredging, they can be allowed to gradually fill over time and will eventually be indistinguishable from a natural alluvial flood plain (assuming any anthropogenic structures that create fish passage blockages are removed).

4.2.3.2 Habitat Access

Fish migration to current and future habitat in Swift Creek may be blocked at three locations by proposed projects. Two of the locations are located on Swift Creek and would be created by in-channel sediment capture structures. The third location is located on a tributary to Breckenridge Creek where the South Pass setback levee and South Pass Road changes could block access to coho rearing habitat.

Two of the proposed sediment management techniques may introduce new upstream fish passage barriers on Swift Creek. The sediment ponds would block fish passage upstream at about RM 1.5 (Goodwin Road) and the in-stream sediment traps would block access starting at about RM 2.3. The barriers would preclude fish migration from known fish-bearing waters in the Sumas River upstream to the fish population in the North Fork Swift Creek, and to potential habitat in the area between the new barriers and the existing natural fish migration barrier at RM 3.0 on the South Fork Swift Creek (Figure 5). Future use by coho and steelhead, as well as resident trout could be affected.

Given the existing poor fish passage conditions in Swift Creek, introducing anthropogenic fish passage blockages is not a significant problem with the possible exception of further isolating the fish population currently found in the North Fork Swift Creek. While little is known about this population, and there is no reason to believe it is genetically distinct, its continued presence may depend on the occasional immigration of new members. Permanent isolation may lead to eventual extirpation of this population.
A tributary to Breckenridge Creek currently originates in the area south of South Pass Road and north of Swift Creek. It passes under South Pass Road in a culvert immediately to the east of where the South Pass Setback Levee has been proposed. Coho salmon juveniles have been observed rearing in the creek north of South Pass Road (Kamps pers. con. 2012), and it is possible they utilize the watercourses to the south as well. Construction of the South Pass Setback Levee is not expected to directly affect the tributary channel, but it could eliminate wetlands feeding the channel thus decreasing the drainage area and possibly some areas used for rearing. The potential for this to occur should be examined in more detail during the final design phase and appropriate mitigation identified if necessary. Raising the elevation of South Pass Road is also under consideration. Preliminary discussions have discussed eliminating the connecting culvert which passes the tributary from south to north, thus removing much of the contributing watershed for the tributary and access to potential habitat in this area. This would likely be done to keep contaminated overflow from Swift Creek out of the Breckenridge system. If the connection will be eliminated, further analysis should be completed to identify the importance of this tributary to juvenile coho salmon, and quantify effects of the action. Appropriate mitigation should be identified if necessary.

4.2.3.3 Habitat Elements

The extremely high sediment loads experienced in the Swift Creek and South Fork Swift Creek channels over the last few decades have resulted in significant impairment to the existing instream fish habitat. Swift Creek downstream of the slide provides almost no functional habitat elements. With virtually no habitat present in the affected areas, none of the actions proposed under Phase 1 of the SCSMAP are likely to have significant adverse effects on fish habitat in Swift Creek.

Fish habitat in the Sumas River and potentially Breckenridge Creek is currently adversely affected by the ongoing processes in Swift Creek. Swift Creek currently provides very little habitat forming elements such as LWD to the Sumas River and none to Breckenridge Creek. The proposed actions will not change this condition and therefore are not expected to have a significant adverse effect on habitat in any other waterbody. None of the proposed actions will affect habitat in the North Fork Swift Creek.

4.2.3.4 Riparian Function

With a few minor exceptions there is no functional riparian buffer adjacent to Swift Creek and the South Fork Swift Creek. However, development of the sedimentation ponds will result in elimination of the larger of the last two semi-functional sections of forestland adjacent to the creek. Opportunities might be found elsewhere, such as within the South Pass Road Setback Levee, to replace some of this function.

The North Fork Swift Creek contains a good quality functional buffer and is considered to be properly functioning. None of the proposed actions will affect this buffer. The nutrients, organic debris, logs, etc. being delivered to Swift Creek are not currently functioning in Swift Creek due to the absence of fish and habitat. They may, however, currently benefit fish in the
Sumas River. The in-stream sediment traps and sediment basins would reduce the ability of some of the material (woody debris, leaf litter, etc) to migrate downstream to the Sumas River.

While some changes would occur, no significant adverse effects to functioning fish habitat from tree removal or other proposed riparian changes are expected.

4.2.3.5 Channel Condition and Dynamics

Reducing the sediment load to Swift Creek and the South Fork channel should help the natural channel formation process over time by reducing channel instability. Width to depth ratios should begin to lower, eventually allowing riparian growth closer to the channel. The risk of channel shifting and avulsion will also be reduced downstream of the sediment traps and basins. This should have a minor beneficial effect on natural channel processes in the Oat Coles Reach which might result in some natural fish habitat development. The decrease in sediment load is also expected to benefit channel condition in the Sumas River for the same reasons. However, complete and long term elimination of sediment input could eventually adversely affect spawning habitat by reducing the amount of coarse sediment in which fish spawn. No change will occur in the North Fork Swift Creek. No significant adverse effects to channel condition and dynamics are expected.

4.2.3.6 Flow/ Hydrology

The proposed actions will have some minor influences on flow rates and volumes. In-Stream Sediment Traps and settling ponds in Swift Creek will temporarily retard flow rates and may on occasion create new areas of sub-surface flow due to a lowering of the surface grade and increased soil depths. The changes will be most noticeable at the immediate locations of the structures but will attenuate downstream. It is doubtful that any measurable change in flow rate will occur by the time flows reach the Sumas River. While flow changes would normally affect fish habitat quality, the areas of proposed structures currently have very poor quality and no known fish use. As such the impacts will be negligible.

4.2.3.7 Conclusion

The SCSMAP Phase 1 Implementation Alternative is not expected to have a significant adverse effect on fish populations or fish habitat.

5.0 MITIGATION MEASURES

Mitigation measures described here are provided as means to avoid, minimize and mitigate effects to fish and fish habitat from some of the actions that could result from adoption and eventual implementation of the SCSMAP or from the SCSMAP Phase 1 Implementation Plan. Because of the very poor condition of existing habitat in much of the potentially affected area, it is unlikely that any of the actions will have more than a minor adverse effect on fish. But some actions could affect regional fisheries resources already under significant pressure and efforts at further reducing the effects of these actions should be considered during the final design phase.
5.1 Swift Creek North Fork Re-Route

This action is under consideration as a means of reducing flow in the mainstem of Swift Creek through redirection of the North Fork to the Breckenridge Creek watershed. This would benefit the overall sediment management strategy. It would also potentially provide a stable and more suitable migration route for fish to travel to and from good quality habitat in the North Fork basin and would help prevent isolation and possible extirpation of the existing population. The following measures should be considered before this action is undertaken:

- A channel design should be developed to ensure upstream fish passage is provided and reasonably expected to persist given expected flows and material (sediment and wood) movement. Consideration for required migration characteristics such as holding pools, jump heights, and cover should be taken.
- Monitoring should be undertaken to ensure no impassable barriers develop once the channel has been completed.
- Provisions for undoing the channel reroute and restoring North Fork flow to Swift Creek in the future should be considered as a way to restore riparian benefits, natural flow and sediment transport characteristics, and fish access once conditions are stabilized in Swift Creek.
- An instream flow study of Breckenridge Creek should be conducted to determine how the change in flow volume will affect water depths and velocities in fish-bearing waters on a seasonal basis. Measures such as the addition of LWD or opening new off-channel habitat areas may need to be taken to offset increases in velocities.

5.2 Sediment Supply

The proposed sediment management actions may be very effective in reducing coarse sediment supply. This could adversely affect spawning habitat in the Sumas River to some degree. The following actions are recommended to ensure critical habitat for salmon is not significantly impaired:

- Monitor coarse sediment supply to make sure downstream reaches are not being starved. Supplementation might be an option if this occurs.
- If fine sediment input rates to Swift Creek begin to abate, and monitoring indicates this could be permanent; measures should be taken to reduce the sediment trapping ability of the structures with a goal of allowing more coarse sediment migration.

5.3 Fish Passage

The in-stream sediment traps and sediment basins will block upstream fish passage.

- Reasonable opportunities for getting fish past these structures should be considered.
- Plans should include identifying the appropriate triggers and methods for removing the in-stream sediment traps, and bypassing or allowing the sediment basins to fill when the slide stabilizes.
• Re-routing the North Fork Channel to a connection with Breckenridge Creek could help prevent isolation of the North Fork resident trout population and reopen this area to anadromous salmonids such as coho and steelhead.

5.4 Riparian Function

Development of the sedimentation ponds will result in elimination of the larger of the last two semi-functional sections of forestland adjacent to the creek. Some of the setback levees will also displace riparian vegetation.

• Opportunities for riparian planting should be identified adjacent to Swift Creek and the Sumas River. Shrubs and trees should be added to restore lost functions. Plants should be maintained until they have the ability to outcompete exotic species.

5.5 South Pass Road Tributary

Construction of the South Pass Setback Levee and modifications to South Pass Road may adversely affect the Breckenridge tributary channel or contributing wetlands feeding the channel.

• Further analysis should be completed to identify the importance of this tributary to juvenile coho salmon, and quantify the effects of any actions on flow rates. Appropriate mitigation should be identified if necessary.

5.6 Coordinate Planning

Effects of emergency responses to flooding or sediment movement can produce significant adverse effects on fish habitat.

• Consider proactive and coordinated planning efforts to help prevent emergencies and protect aquatic habitat when emergencies do occur.

6.0 UNAVOIDABLE SIGNIFICANT ADVERSE IMPACTS

While many of the proposed sediment management strategies would take place within potentially and historically fish-bearing waters, there are few if any fish currently believed to be in the area. Some indirect adverse influences fish habitat and fish populations may occur but the majority of the effects of the proposed actions to reduce sediment supply and transport should be positive (Table 3). This analysis finds that no unavoidable significant adverse effects to the existing condition of fisheries resources or fish habitat are likely to occur under the proposed actions or alternatives.
Table 3a. Evaluation of Change to Aquatic Habitat Quality and Fish Use under the three Alternatives

<table>
<thead>
<tr>
<th>Habitat Quality Indicator</th>
<th>Description of Function</th>
<th>Environmental Baseline Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>Low water temperatures, low turbidity levels, and low levels of pollutants and metals are required for good quality salmonid habitat.</td>
<td>Extremely high turbidity levels have been commonly reported in Swift Creek and the Sumas River downstream. Most other measured water quality parameters are fair to good.</td>
</tr>
<tr>
<td>Fish Habitat Access</td>
<td>Anthropogenic (manmade) barriers can hinder the movement of fish into habitat otherwise suitable for rearing and/or spawning.</td>
<td>No anthropogenic structures block upstream fish passage. Lack of suitable habitat and very poor water quality is greatest obstacle to upstream fish movement.</td>
</tr>
<tr>
<td>Habitat Elements</td>
<td>Habitat elements crucial to fish habitat consist of substrate, downed trees, and pools in a variety of configurations.</td>
<td>Substrate dominated by excessive fine material, an almost complete lack of LWD and low pool frequency severely limit fish habitat quality.</td>
</tr>
<tr>
<td>Riparian Function</td>
<td>Riparian forests provide downed trees, shade, beneficial nutrients, and bank stability.</td>
<td>Plant growth near Swift Creek may be inhibited by water quality issues. Unvegetated levees and bank protection separate the channel from significant forest growth.</td>
</tr>
<tr>
<td>Channel Condition and Dynamics</td>
<td>Fish habitat quality is a function of channel condition and the ability of the channel to naturally adapt to changing flow and sediment rates.</td>
<td>Most of Swift Creek and the Sumas River from the alluvial fan downstream is confined and relatively isolated from the historic floodplain. The streambank is armored in places and vegetation is thin. Bank protection, ditching, and bridges limit channel dynamics.</td>
</tr>
<tr>
<td>Flow and Hydrology</td>
<td>Instream flow is a function of basin-wide conditions. Flow rates and volumes affect aquatic habitat quality.</td>
<td>May be slight influence by forest practices including road frequency in the upper basin, and some impervious surface on alluvial fan. No abnormally high peak flows or low base flows reported.</td>
</tr>
<tr>
<td>Fish Use</td>
<td>Native fish abundance and diversity reflects the quality of regional fish habitat conditions.</td>
<td>No known fish use in Swift Creek and South Fork Swift Creek downstream of landslide. Healthy trout population in North Fork Swift Creek. Trout and anadromous salmon in Sumas River.</td>
</tr>
</tbody>
</table>


## Table 3b. Evaluation of Change to Aquatic Habitat Quality and Fish Use under the three Alternatives

<table>
<thead>
<tr>
<th>Habitat Quality Indicator</th>
<th>Expected Future Condition</th>
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</thead>
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<tr>
<td></td>
<td>No Action</td>
</tr>
<tr>
<td>Water Quality</td>
<td>No change from baseline conditions.</td>
</tr>
<tr>
<td>Fish Habitat Access</td>
<td>No change from baseline conditions.</td>
</tr>
<tr>
<td>Habitat Elements</td>
<td>No change from baseline conditions.</td>
</tr>
<tr>
<td>Riparian Function</td>
<td>No change from baseline conditions.</td>
</tr>
<tr>
<td>Channel Condition and Dynamics</td>
<td>No change from baseline conditions.</td>
</tr>
<tr>
<td>Flow and Hydrology</td>
<td>No change from baseline conditions.</td>
</tr>
<tr>
<td>Fish Use</td>
<td>No change from baseline conditions.</td>
</tr>
</tbody>
</table>
7.0 REFERENCES

Cascade Environmental Services, Inc. 1998. Swift Creek fish habitat. 8pp.


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