Fall 2017

Environmental Impact Assessment of: Squalicum Creek Restoration Project

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Prepared for ENVS 493; Fall 2017
Huxley College of the Environment - Western Washington University

HUXLEY
COLLEGE OF THE ENVIRONMENT

Squalicum Creek Restoration Project - EIA Team
Environmental Impact Assessment - ENVS 493
Huxley College of the Environment
Western Washington University
516 High St.
Bellingham, WA 98225

Dear Concerned Citizen,

The following document is an Environmental Impact Assessment (EIA) for Phase 3 of the Squalicum Creek Restoration project. Students from Western Washington University wrote and prepared the assessment. In the document, you will find an analysis of three restoration options: a proposed action, an alternative action and no action alternative. The creek under analysis has proven to be vital for salmon during their annual run.

The proposed action for this restoration project has been broken down into three parts. The first part seeks to remove the BNSF rail bridge from its current location, which crosses over the creek, and inlay the tracks on to the Roeder Avenue bridge. The next phase includes the removal of 352 feet of concrete lining on the bottom of Squalicum Creek. Finally, contaminated soil lining the banks of the creek will be removed. The purpose of the proposed action is to restore the creek for both the creek's benefit, the salmon, and to improve the overall aesthetics of the area. How the proposed action is to be undertaken has been outlined for you in this document.

An alternative action was also considered. The alternative project requires slightly different methods than the proposed action but aims to accomplish the same goal; a full restoration of this ecosystem. The methods used for the alternative action are outlined in this document. The third option includes taking the course of No Action. In the event that the Proposed Action and the Alternative Action are non-viable, then no restorative action will take place in this location, at this time. This action has also been explained in detail throughout the document for your review.

Our team analyzed the natural and built environmental elements of the project area and the potential impacts to each element from the scopes of the proposed action, alternative action, and no action. This document provides an analysis of each affected area in further detail.

The primary goal of this project is to restore the creek for the benefit of the salmon species that use the habitat for their yearly spawning. A healthier creek with less obstacles and challenges for the fish will mean healthier and more productive populations in the future.

Thank you for your interest in this project.

Sincerely,

Darren Chromey, Ticika Dominick, Ben Knoot, Irene Munger, Isabelle Ranson

Environmental Impact Assessment

Huxley College of the Environment

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Signature ____________________ (Darren Chromey)

Signature ____________________ (Ben Knoot)

Signature ____________________ (Isabelle Ranson)

Signature ____________________ (Ticika Dominick)

Signature ____________________ (Irene Munger)

Date: November 27th, 2017

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Prepared for ENVS 493; Fall 2017
Dr. Tamara Laninga
Huxley College of the Environment - Western Washington University

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Fact Sheet

Title:
Squalicum Creek Restoration

Description of Project:
The Squalicum Creek Restoration project seeks to increase the health and vitality of a critical salmon habitat. This can be achieved with the removal of a 350 foot concrete channel currently lining the streambed in this section of the creek. Additionally, the project includes either the complete deconstruction of the BNSF railway crossing the creek, or significant modification of this structure, which currently creates a major obstacle impeding successful native salmon runs.

Legal Site Description:
Latitude and Longitude: 48.760585°N , -122.508598°W

Proposer:
Port of Bellingham
1801 Roeder Ave
Bellingham, WA 98225

Lead Agency:
City of Bellingham
210 Lottie St
Bellingham, WA 98225

Required Permits:

Federal -
USCG Bridge Permit (in the case of bridge modification)

State -
NPDES Construction Stormwater General Permit and Coverage
WA DOE: 401 Water Quality Certification
Air Quality Notice of Construction Permit
WDFW: Hydraulic Project Approval
WA DNR: Aquatic Use Authorization

Local -
COB Clearing Permit
COB Public Works Permit
COB Storm Water Permit
COB Shoreline Permit

Contributions by Author:

Darren Chromey - Environmental Studies
Plants, Land Use

Ticika Dominick - Environmental Science
Scribe, Glossary, Water

Ben Knoot - Environmental Policy
Primary Editor, Formatting, Air, Infrastructure, Transportation, Citizens Letter, Executive Summary

Irene Munger - Environmental Studies
Communications, Fact Sheet, Earth, Historical and Cultural Preservation

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Tables and Figures, Formatting, Animals, Environmental Health, Conclusion

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Bellingham, WA 98225

Acknowledgement:

The students responsible for this report would like to acknowledge Mike Hogan with the Port of Bellingham for providing the team with the documents necessary for completing our research and analysis, and for being available to answer any additional inquiries. The group also wishes to acknowledge their professor, Dr. Tamara Laninga who created this project and provided professional help and guidance in the preparation of this report.

Issue Date:

December 11, 2017

Public Presentation:

Monday, December 11, 2017 at 3:00 pm
Port of Bellingham Conference Room
1801 Roeder Ave
Bellingham, WA 98225

Executive Summary

Project Objectives: The principle objective of this restoration project is to create a healthy, productive environment for salmon populations. The creek has been altered by various entities making it less habitable for salmon that use the creek during their run. With this restoration project, salmon will ideally have a more natural and safe environment to complete their run.

Proposed Action: Phase 3 of the Squalicum Creek restoration project can best be described in three parts. Part one seeks to remove the Burlington Northern Santa Fe (BNSF) rail bridge and incorporate it with the adjacent Roeder Ave bridge. As the most challenging obstacle for native species of fish, the removal of this bridge will significantly improve the health and vitality of the creek's ecosystem. The next phase of action includes the removal of the concrete foundation currently lining the bottom of the creek; an unforgiving surface to fish swimming in shallow waters. In the final phase of the proposed action, contaminated soils will be extracted and taken away from the banks of the creek. The soil has been contaminated by petroleum and motor oil resulting from various forms of industrial activity over the years creating a toxic environment. This proposed action provides the most benefits for native salmon species while improving biodiversity.

Alternative Action: The alternative action, like the proposed action, is best explained in three parts. The first part of this action seeks to modify the BNSF rail bridge, rather than completely removing this infrastructure. Modification of the bridge will be in compliance with the Washington Department of Fish and Wildlife (WDFW) standards set in place for the construction of bridges over salmon streams and proper passage standards The second phase includes the removal of the concrete lining the bottom of the creek, while the third phase consists of the removal of toxic soil currently lining the banks of the creek.

No Action Alternative: Under the no action alternative, no restorative action would occur in this proposed project area. The BNSF railroad bridge would remain in place without any modifications to the infrastructure, the concrete lining would not be removed from the bottom of the creek, and the contaminated soil would remain in and around the banks of the creek.

Elements of the Environment Impact Analyzed: For this project, the State Environmental Policy Act (SEPA) guidelines were used to determine which elements of the environment would be significantly impacted by the proposed, alternative and no action options (WAC § 197-11-960). After analysis of the various elements, our team has determined the following elements to be significantly impacted by the proposed, alternative and no action alternatives; Earth, Air, Water, Plants, Animals, Environmental Health, Land Use (Shoreline Emphasis), Historic and Cultural Preservation, Infrastructure and Transportation. Each element is detailed and analysed under the three action options in this report.

Mitigation Measures: Mitigation measures for this restoration project are based around construction. Best Management Practices (BMP's) are an important part to every construction project and are used to ensure the best outcome for the project.

Recommendations Based on our analysis of the three action options and their potential impacts on the various elements of the surrounding area, our team finds that the best option for the Squalicum Creek Restoration project would be to take the course of the Proposed Action. The Proposed Action obtained the highest score in the decision matrix (Table ES.1), our team's points system for determining the adverse and beneficial impacts on various elements in each action phase.

Two different total scores have been calculated for determining the severity of impact on each of the elements of the environment which we deemed were of significance. “Total Score with *” represents the score taking the temporary impacts, such as “concrete dust” into consideration. We recognize that while some of the action phases will impact various elements, their effects will be temporary. “Total Score without *” represents a score that does not take the temporary impacts, such as “concrete dust” into consideration. In determining that it would be more beneficial to accept the potential adverse effects for the short period of time in order to reap the rewards from the long term effects, our team suggests that the “Total Score without *” should be considered over the “Total Score with *”. Above all, our team highly recommends enacting the Proposed Action or the Alternative Action over taking the course of No Action. Taking no action will continue to cause the ecosystem to decay and the creek and its inhabitants cannot afford to be so close to restored but lacking in the final details.

Table ES.1 Decisions Matrix

Impacted Area	Proposed Action	Alternative Action	No Action
Earth*	-1	-1	-2
Air	-	-	-
*Concrete Dust**	-1	-1	0
Carbon Dioxide Gas Release	-2	-1	0
Nitrogen Gas Release	-2	-2	0
Water	+2	+1	-1
Plants	+2	+2	-2
Animals	+2	+2	-1
Environmental Health *	-1	-1	0
Land Use	+1	+1	-1
Cultural/Historic Preservation*	-1	-1	-2
Transportation*	-1	0	0
Infrastructure	-	-	-
Bridge Removal	+2	-	-2
Bridge Modification	-	+1	-2
Concrete Lining Removal	+2	+2	-2
Total Score with *	+2	+2	-15
Total Score without *	+7	+5	-11

* Indicates temporary impact

Key

+2	Very Positive Impact
+1	Positive Impact
0	No Impact
-1	Negative Impact
-2	Very Negative Impact

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Glossary of Technical terms

Term:	Definition:
Alluvial	Of, relating to or derived from alluvium.
Benzene	A gas with a sweet odor, found normally around gas stations. It is known to be a human carcinogen.
Biodiversity	The variety of life in the world or in a particular habitat or ecosystem.
CO_2 (Carbon Dioxide)	Is a colorless gas and is the most significant long-lived gas that contributes to global warming.
Creosote	A dark brown oil distilled from coal tar and used as a wood preservative. It contains a number of phenols, cresols, and other organic compounds.
Contaminants	A polluting substance that causes another substance to become impure.
Estuarine / Estuary	The connection point between freshwater and saltwater.
Extinction/ Extirpation	The loss of a species forever/local population loss of a species, but the species continues to live on somewhere else.
Fecal Coliform	A bacteria typically found in the feces of warm-blooded animals.
Fecundity	The number of offspring a female produces on average.
Greenhouse Gas	Any gas that absorbs and emits radiation within the thermal infrared range.
Glaciomarine Drift	Consists of unsorted, unstratified silt and clay with varying amounts of sand, gravel, cobbles, and occasional boulders. Derived from sediment melted out of floating glacial ice that was deposited on the seafloor.
Glacial Till	Unsorted glacial sediment derived from the erosion and entrainment of material by the moving ice of a glacier.
Homogeneously	Of the same kind or alike.
Immemorial	Originating in the distant past; very old
Impermeable	Not allowing fluid to move through.
Leach	Drain away from soil.
Noxious	Harmful, poisonous, or very unpleasant.

Osmoregularity	An organism's internal balance between water and chemical ions (positive or negative compounds such as salt.) Important indicator of health.
PM 2.5 Pollutant	These are coarse dust particles that are 2.5 to the 10 micrometers in diameter
Population dynamics	Change in population numbers from birth, death, fecundity, or migration in or out of the population.
Rip-rap	Loose stone used to form a foundation for a breakwater or other structure
Runoff	The draining away of water (or substances carried in it) from the surface of an area of land, a building or structure, etc.
Salmonid/ Salmonoid	A family of ray-finned fish. Includes trout, salmon, char, and graylings
Salmon Run	A migration of salmon up a river from the sea, in order to spawn
Smolt	Salmon life stage. When a young salmon's physiology has changed enough to enter the sea.
Spawn	When salmon lay eggs up river, usually on gravel beds
Tributary	A river or stream flowing into a larger river or lake

Acronyms and Abbreviations

BMP - Best Management Practices

BNSF - Burlington Northern Santa Fe Railway

CO_2 - Carbon Dioxide

COB - City of Bellingham

EIA - Environmental Impact Assessment

EIS - Environmental Impact Statement

ESA - Endangered Species Act

POB - Port of Bellingham

SEPA - State Environmental Policy Act

WA DOE - Washington State Department of Ecology

WDFW - Washington Department of Fish and Wildlife

WDNR - Washington Department of Natural Resources

2.0 Project Overview

Properties adjacent to the proposed project at Squalicum Creek include industrial, commercial, and transportation passages. Nearby, Bellingham Bay hosts maritime and fishery industry activities. Property belonging to the Port of Bellingham (POB) lies on either side of the privately owned railway spur, and is currently leased by the full-service public refrigeration operation, Bellingham Cold Storage. Developed roads and parking lots also occupy the vicinity near this section of Squalicum Creek. The surrounding landscape in Whatcom county has undergone expansive growth, including agricultural and urban development (Roose, 2002). Historically this property was the epicenter for the industrial construction of wartime vessels, including Minesweepers. Going back even further, the land was occupied by the Coast Salish Lummi tribe, and had infrastructures belonging to these First Nations people, shown in Figure 2.1 (Port of Bellingham, 2013).

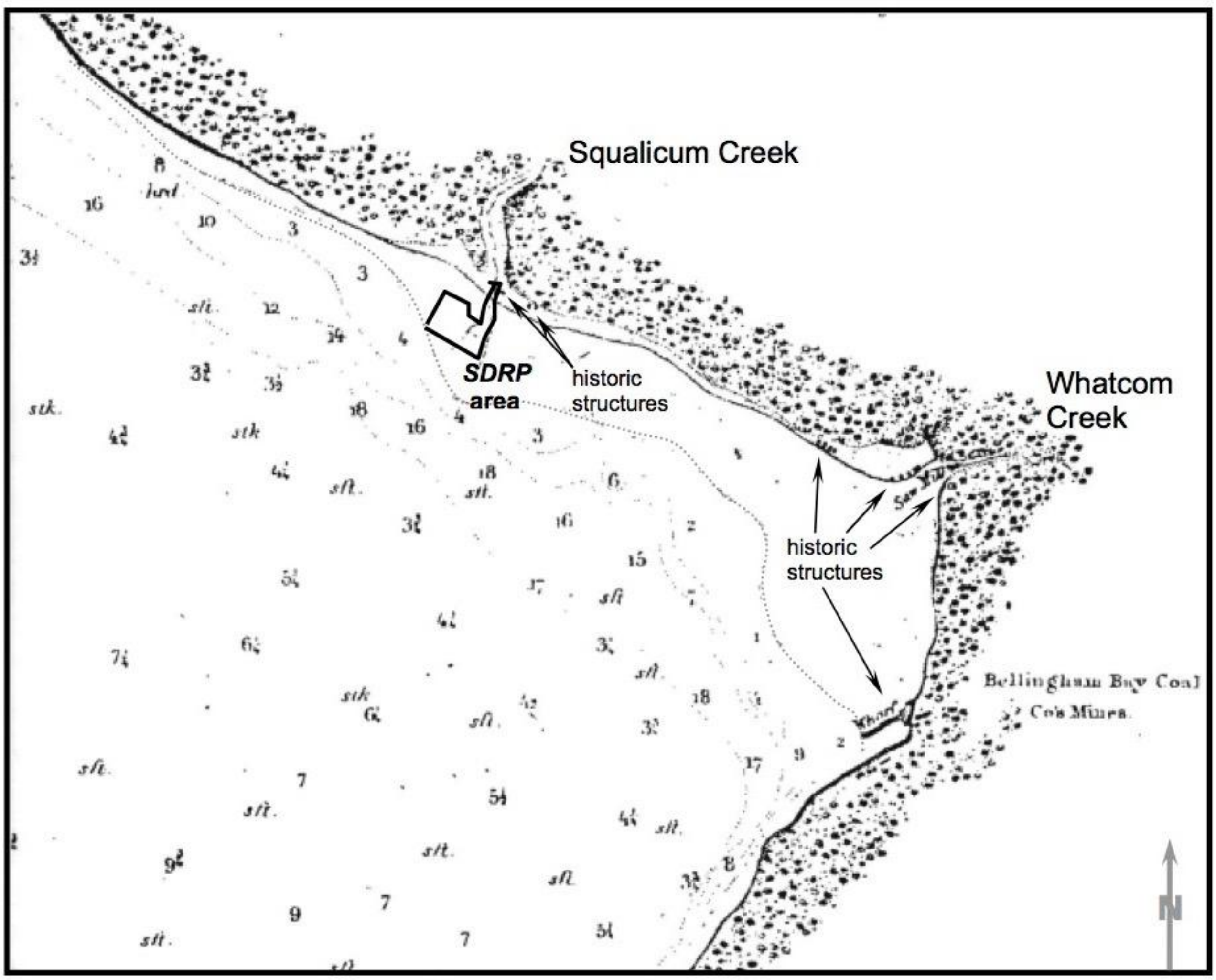

Figure 2.1: Bellingham Bay Hydrographic Chart produced by the US Coastal Survey in 1856; depicts historic structures and features (Source: Rosario Archaeology L.L.C., 2013)

Beginning in 2007, the Port of Bellingham (POB), along with the Washington Department of Natural Resources (WDNR), has been facilitating a complete overhaul of the Squalicum Creek tributary, shown in Figure 2.2. This tributary flows from the base of the Cascades, and leads into Bellingham Bay. As a critical habitat for Chum and Coho salmon, as well as Cutthroat and Steelhead trout, the revitalization of this creek continues to be imperative (Port of Bellingham, n.d.).

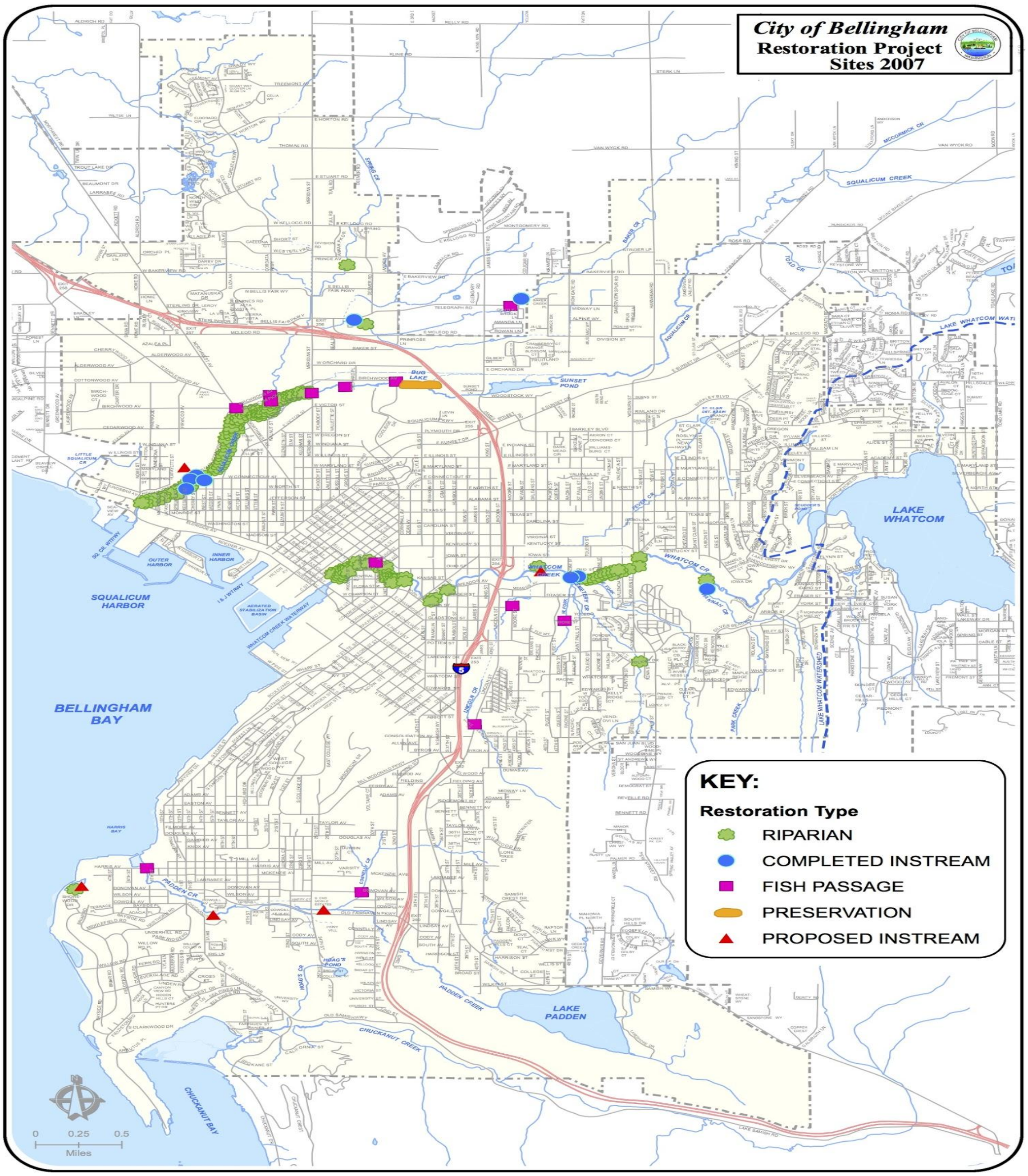

Figure 2.2: Habitat Restoration Sites in City Limits (Source: City of Bellingham, 2007).

The Port of Bellingham's Sqaulicum Creek Restoration efforts will be completed utilizing multiple phases. Phase 1 was completed in 2009 with the removal of a 15,500 square foot derelict pier along with the removal of 680 creosote piles which were residing in contiguous areas of the Sqaulicum Creek delta. In 2013, POB then focused on the Squalicum Creek estuary for Phase 2, which focused on removing and replacing bulkheads, piles, and miscellaneous debris with log jams, buffer zones, and vegetation management (Port of Bellingham, n.d.).

The final phase of the project, Phase 3, will help complete the full restoration of Squalicum Creek. With the removal of 350 feet of concrete channel, along with either bridge removal or significant modification, fish passage will no longer be impeded; allowing those species which have been deemed critical a clean waterway in which they can freely complete their life cycle, and enjoy the benefits of which only their natural habitat can provide (Port of Bellingham, n.d.).

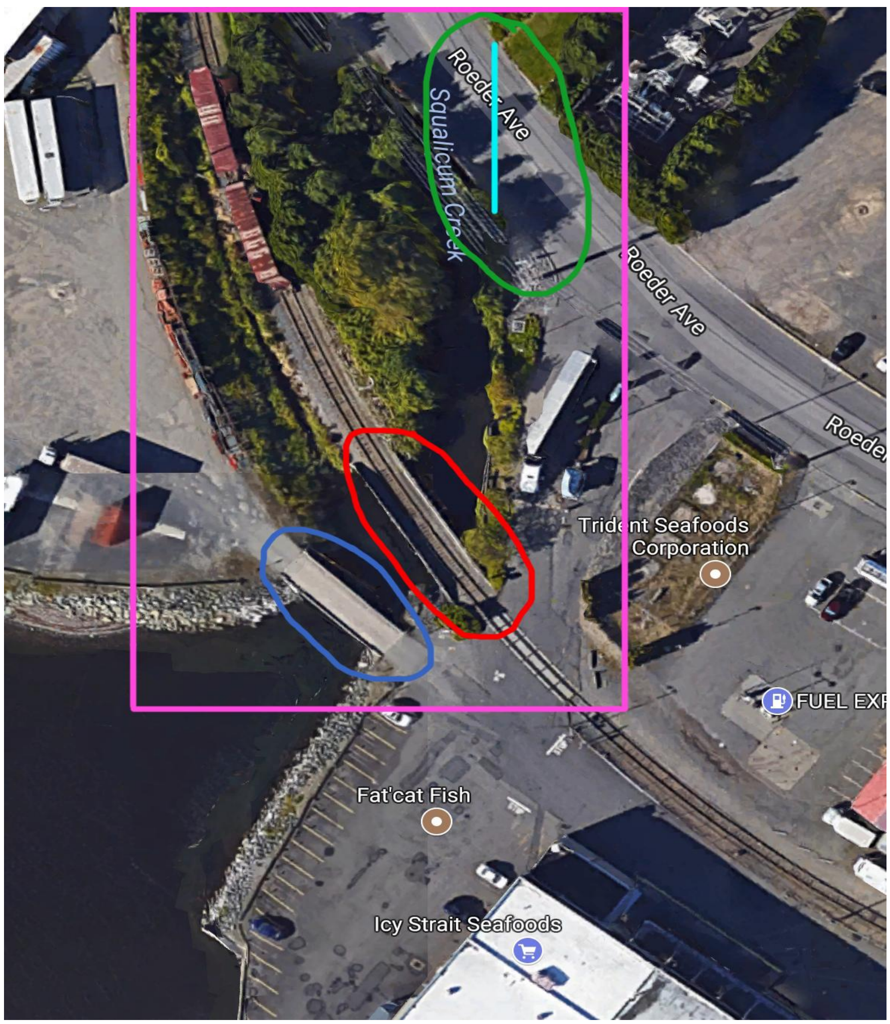

Figure 2.3: Squalicum Creek Restoration Phase 3 Project Area. The project area is contained in the pink rectangle. The blue circle depicts the private truck bridge, red circle depicts BNSF railroad bridge, the green circle depicts Roeder Avenue bridge and the light blue line represents the 350ft concrete bottom covering the City of Bellingham sewer main.

In order to complete this project, the State Environmental Policy Act (SEPA) guidelines were taken into account. SEPA outlines specific guidelines to follow when a project alters the natural and built environment (WAC § 197-11-960). For this project the SEPA checklist was consulted to determine which aspects of the environment were significantly impacted. This is critical for determining the outcome of the project and the methods that will be used during the operations. In accordance with the SEPA Environmental Checklist under Washington Administrative Code (WAC) § 197-11-444, the following elements were determined to be of significance: earth, air, water, plants, animals, environmental health, land-use, historic/cultural preservation and infrastructure/traffic. Each of these elements are analyzed under three project actions options: the proposed, alternative and no action. An overview of each action follows.

Proposed Action

The proposed action for the Squalicum Creek restoration is as follows. In order to protect salmon populations traveling through Squalicum Creek, the proposed action suggests that work on the project be conducted in multiple parts. Part one calls for the removal of the Burlington Northern Santa Fe (BNSF) railroad bridge and to relocate it as inlaid tracks onto Roeder Avenue, seen in Figure 2.4. Because the BNSF railroad bridge has supports in the creek, it creates a fish passage barrier. The removal of this bridge would reduce impediments for fish on their journey up stream.

Figure 2.4: BNSF Rail Spur Location. The red line represents the current location of the BNSF railroad bridge. The green line represents the relocation of the BNSF railroad bridge, under the proposed action.

Part two of the proposed action is the removal of the concrete lining the bottom of the creek and replacing it with the appropriate mix of gravel and sediment in accordance to the Washington Department of Fish and Wildlife (WDFW) standards. The concrete is currently protecting a City of Bellingham Sewer Main. For the location of the city sewer main, see Figure 2.5. Concrete is very rough and does not shift, should a fish rub against it. By removing the concrete, the salmon will have a greater chance of arriving at their spawn site, uninjured.

Figure 2.5: City of Bellingham Sewer Line Location. The blue line represents the location of the City of Bellingham sewer main under Squalicum Creek. The blue line also represents the length of concrete lining the bottom of the creek to be removed under the proposed and alternative action.

Part three of the proposed action is the removal of the contaminated soil that lines the banks of the creek. Proper disposal of the soil is to be determined, based on the contaminates within the soil, shown in Table 1 in "Natural Elements - Earth". Contaminates from the soil, leach into the creek and affect the salmon. The removal of these contaminates will provide a healthier creek for the salmon and will prevent the salmon from becoming exposed to contaminants that adversely affect them.

Alternative Action

An alternative action option is also considered. The alternative action, like the proposed action is broken down into three parts, of which, parts two and three are the same. Instead of removing the entire BNSF railroad bridge, the alternative action modifies the bridge. Modification of the bridge will be completed using the WDFW bridge building standards in regards to fish passage. The bottom half of the bridge is a very effective salmon barrier. The modification of the bridge may completely remove the impediment for the salmon, but it will increase the fish passage on their journey up creek. Parts two and three of the alternative action are the same as those discussed in the proposed action.

No Action Alternative

Under the no action alternative, no restorative action would occur in this project area, at this time. The BNSF railroad bridge would remain in place and as is, the concrete lining would not be removed and remain at the bottom of the creek, and the contaminated soil would remain on the banks of the creek. A detailed analysis of the impacts of each action in relation to the elements of the environment follows.

Elements of the Environment

3.0 Natural Elements

3.1 Earth

3.1.1 Existing Conditions

The proposed location for this project sits in a region which was formed by glaciomarine drift (Goldin 1992:164). Squalicum Creek flows from the Cascade foothills, just north of Lake Whatcom, as part of a tributary that empties into Bellingham Bay. Sections of Upper Squalicum Creek have been rerouted as part of a large scale restoration project. Due to nutrient rich soils deposited by glacial till, these waters have the potential to support Pink, Chum, and Coho salmon, Cutthroat trout, and Sea-Run trout (Port of Bellingham, n.d.).

Topographic features include a concrete streambed which forms an artificial base that this channel flows over, approximately 324 feet in length. The channel has a width of 32 feet (Anchor Environmental, 2005), (Port of Bellingham, 2013). The section of interest along Squalicum Creek has a moderate slope on either side of the embankments. No hazardous slopes currently exist in this section of the creek, however these conditions are subject to change as the creek, left in its current condition, will continue to experience massive flooding, as shown in Figure 3.2, and overtime could lead to massive erosion. Coastal regions, such as Bellingham, will become vulnerable to sea level rise. Significant flooding events, such as 100 year floods, have been predicted to occur at higher frequencies as a result of both increased global temperatures due to climate change, and the melting of the polar ice caps (Lindsey, 2017).

Seismic hazards, including liquefaction, exist in the vicinity of this channel, shown in Figure 3.1. Liquefaction occurs when soils become highly saturated, disturbing soil strength and stiffness. The weakening of the soil results in unstable foundations. In general, earthquakes most commonly trigger these kind of events, however significant alterations in structures through construction practices can also initiate a reaction. High pressure conditions can occur in areas where liquefaction exists, potentially causing structures to collapse. In some cases, high pressure can result in landslides (Johnson, 2000).

Soils generally found in the vicinity of the project include dredge spoils, imported fill material, concrete, gravel, pavement, rip-rap, and debris from historic shipyard structures. Some native alluvial sediments such as, beach gravels and coarsely consolidated sands with shells originating from saltwater habitats, have also been documented, shown in Table 3.1. (Port of Bellingham, 2013). Due to poor habitat conservation, the soils have been exposed to significant erosion (Port of Bellingham, n.d.). Due to the historical industrial use of this area, soils tested at this site have been found to be contaminated with petroleum and motor oil (Fulton, 2012).

Liquefaction

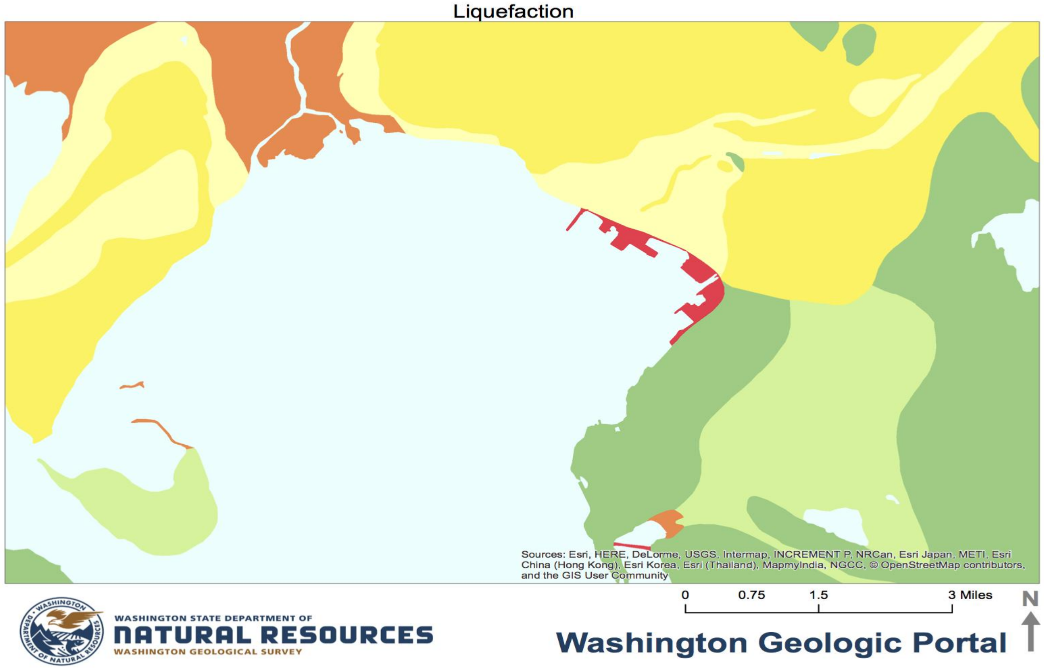

Figure 3.1: Seismic Hazards near the Squalicum Creek Restoration project site. Includes high susceptibility of liquefaction at the mouth of Squalicum Creek, identified in red. (Source: Washington State Department of Natural Resources).

Table 3.1: Squalicum Creek Soil Data

Unit #	Depth (cmb mgs)	Soil Description	Inclusions/Comments
SP 1	0-14	firm, structureless, very dark brown (Munsell 10YR2/2) gravelly organic sand	No cultural materials
SP 1	14-39	loose, very dark grayish brown (10YR3/2) coarse-grained extremely gravelly sand	introduced fill material; no cultural materials; 40% gravel and 10% cobble
SP 1	39-50	slightly firm, structureless, very dark gray (10YR3/1) coarse- grained sand	introduced fill material; abundant small (< 1 cm diam.) to tiny angular, soft bituminous coal fragments
SP 1	50-92	loose very dark gray (10YR3/1) very gravelly coarse-grained sand	loose very dark gray (10YR3/1) very gravelly coarse-grained sand
SP 1	92-107+	loose, very dark grayish brown (10YR3/2) very gravelly, medium-grained sand	introduced fill material; no cultural materials; 30% gravel and 5% cobble

SP 2	0-31	firm, structureless, very dark brown (Munsell 10YR2/2) gravelly loamy sand	introduced fill material; 30% gravel and 5% cobble; large (rip-rap sized) quarry spalls and pavement chunks; very large quarry spall encountered at 31 cm.

NOTES: cmb mgs = cm below modern ground surface, SP1 = shovel probe #1, SP2 = shovel probe #2
(Source: Rosario Archaeology L.L.C, 2013)

Unique features in this area include the Roeder Avenue Bridge and the Burlington Northern Santa Fe railway spur. These two structures create toxic runoff from vehicle and railway transportation. This runoff then seeps into the surrounding soils and waterways, while creating a noxious environment for local plants and wildlife (Port of Bellingham, 2013), (Port of Bellingham, n.d.). This project seeks to remove or modify a portion of these barriers, with no additional impermeable surfaces to be installed.

3.1.2 Proposed Action

The proposed action to completely extract the BNSF bridge and remove the concrete channel will temporarily impact the surrounding soil. Cleanup methods addressing contaminated soils in this area will temporarily impact the streambed. Once contaminated soils have been extracted, they must be taken to the landfill in order to comply with the WA DOE Toxic Cleanup Program (Reitz, 2016). Cautionary measures should be taken during prior to and during construction to avoid erosion and the seismic hazard of liquefaction.

Impacts

Removal of the BNSF railway will disturb surrounding soils, allowing for the temporary release of petroleum and motor oil, both of which have been discovered in samples collected from within the figure vicinity, shown in Figure 3.2 (Fulton, 2012). Construction of the new railway with the Roeder Avenue bridge poses the possibility of runoff reaching the creek, contaminating the water. Particulates released into the air could also settle into the soil and waterway. The removal of the concrete foundation in this section of Squalicum Creek could potentially lead to further erosion along the embankments by exposing more soil to stream flow. Alterations in the landscape from the removal also threaten to significantly disrupt the characteristics and geometry of the creek's slope.

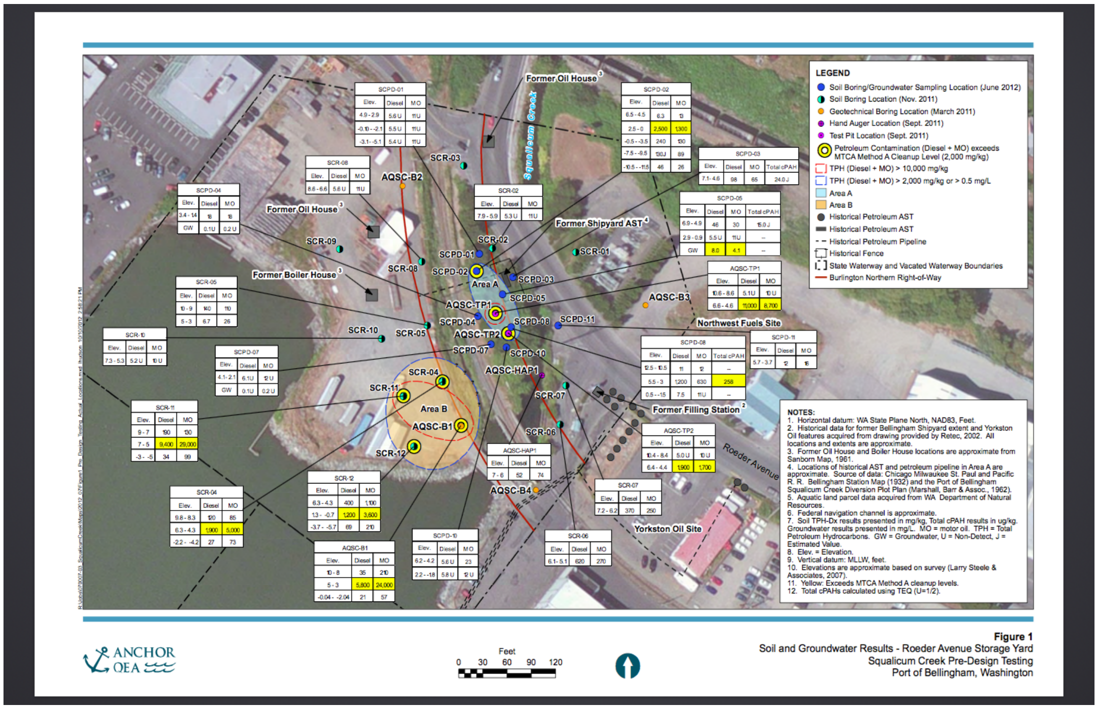

Figure 3.2: Soil and Groundwater Results for the project area. (Source: Squalicum Pre-Design Summary, 2012)

Mitigation

Anticipating these changes emphasizes the need to implement vegetation and natural habitat management. Mulching and matting will be used to reduce further erosion in the area. Reduction in the slope's steepness should also be considered. The POB must conduct annual erosion inspections in order to assess any type of weathering that may occur after the restoration project has been completed. The condition of underlying soils, as well as the release of sequestered carbon dioxide and other potential contaminates, raises concern. To address this issue, the Urban Stream Monitoring Program conducted by the City of Bellingham could expand their scope to include continuous water quality analysis in this area of the creek both during and after the construction phases. The proper permits, listed in the Fact Sheet, must be obtained prior to work on this project. Due to the temporary contamination resulting from construction, soil health should be measured throughout this process and special attention must be paid to the release of emissions from excavation and construction machinery.

3.1.3 Alternative Action

The course of alternative action includes modification to the railway spur, the removal of the concrete channel and cleanup of toxic soils.

Impacts

In the event that the course of alternative action be implemented, flood events, due to barriers created by the railway spur which interrupt natural stream flow, will continue to affect this area. Impacts from the removal of the concrete streambed will remain the same as those found in the proposed action section.

Mitigation

With the exception of reducing the slope grade of the surrounding embankments, mitigation efforts for the alternative action mirror those laid out in the proposed action section.

3.1.4 No Action

In the case of pursuing the course of no action, deteriorating conditions will continue to exist. Fish barriers disrupt the natural flow and tides of the creek. Due to these circumstances, the probability of continued flooding in this area remains likely.

3.2 Air

3.2.1 Existing Conditions

The air quality over the the project site is mixed with the air of the surrounding area. The Washington State Department of Ecology monitors the air quality every day and Bellingham's air is rated as "Good" with the dominate air pollution being fine particulate matter (PM2.5 micrometers) (Washington State Department of Ecology, 2017). Within the project site, there are two gas stations and one oil company and it is likely that fumes and chemicals have escaped and now remain in the air. Those gas stations are: Northwest Fuel (commercial), Fuel Express (commercial) and the oil company is, Yorkston Oil.

Through the U.S. standards on vapor recovery (Kirchgessner and Barghout, 2007), the two gas stations nearby should be equipped with this technology to minimize vapor loss. See Figure 3.3 and 3.4.

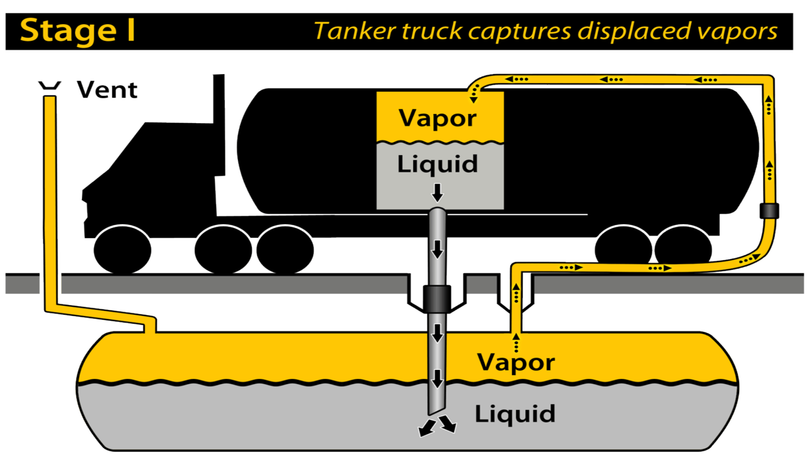

Figure 3.3: Vapor recovery system for fuel tanker to fuel tank (Source: Potter, Thomas, Whitener, Konopaski, 2015)

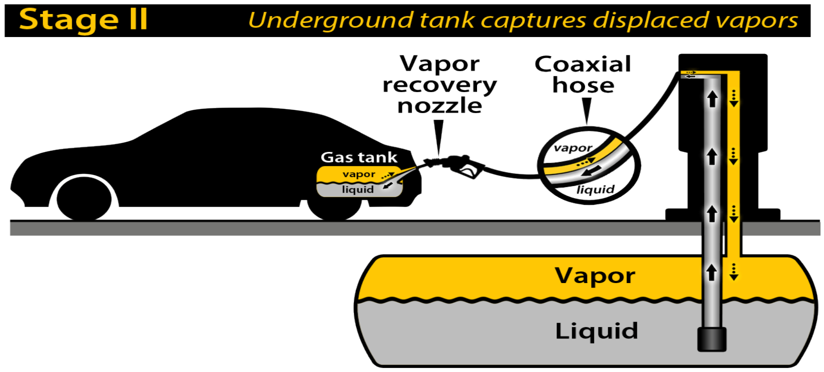

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Figure 3.4: Vapor recovery system for fuel pump to car tank. (Source: Potter, Thomas, Whitener, Konopaski, 2015)

Even with this technology, it is likely that some vapors have been released via minor spills or improper pump use. Accompanying these minor spills and pump mishandlings will be higher levels of benzene present in the air. A 2007 report by the US Department of Health and Human Services on a Toxicological Profile for Benzene reported on a study by Lyman(1982) that states, "Residence times of 472 years for rural atmospheres and 152 years for urban atmospheres were calculated [for Benzene]" (281). Though this is not a significant enough situation that requires action, it should still be taken into consideration.

3.2.2 Proposed Action

The proposed action is broken down into three parts; the removal of the BNSF railroad bridge and its relocation onto Roeder Avenue, the removal of the concrete lining the bottom of the creek and the removal of the contaminated soil. All three parts will impact the air.

Impacts

The construction phase of this project will be the most significant source of impact on the air. The first part of this action, the removal of the BNSF rail bridge, will require the use of heavy duty, diesel machinery. See Table 3.2 for construction vehicle emission approximations. During construction, concrete dust, nitrogen from the soils, carbon dioxide, both from the soil and the machinery will be released into the air. Once the bridge is removed, the rails will need to be inlayed in Roeder Avenue. This will require cutting into asphalt, releasing more particles. The second part of the proposed action is the removal of the concrete lining the bottom of the creek. Again, the use of heavy duty, diesel machinery will cause the immediate area to be saturated with carbon dioxide, nitrogen and concrete dust. Depending on the size of the particles, concrete dust will remain in the atmosphere for a short period of time, to indefinitely. (Peterson, Shaurette, and Clarke, 2017). The third part of this proposed action is the removal of contaminated soil on the banks of the creek. During this part of the action, contaminants from the soil may leach into the air. Also, the use of a heavy duty digger will release carbon dioxide and saturate the immediate area. All substances released in the atmosphere during construction will contribute to the current atmospheric condition. After the completion of the restoration, constant creek visitation is not expected, and activity on the BNSF rail line will be limited. Occasional emissions from the train are expected. The constant stream of cars and trucks driving along Roeder

Avenue should be considered for the air quality of the area but is not a significant concern (See Environmental Element Section "Traffic - Existing Conditions" for traffic patterns)

Table 3.2: Vehicle emission approximations. VOC = Volatile Organic Compounds (ex. Formaldehyde), CO =Carbon Monoxide, NOx = Nitrous Oxide, PM-10 = particles that are equal to or smaller than 10 micrometers, PM-2.5 =particles that are equal to or smaller than 2.5 micrometers (fine particles), SO2 =Sulfur Dioxide and CO2 = Carbon Dioxide. (Source: Federal Emergency Management Agency, n.d.)

Assumptions for Combustible Emissions					
Type of Construction Equipment	Num. of Units	HP Rated	Hrs/day	Days/yr	Total hp-hrs
Water Truck	1	300	8	240	576000
Diesel Road Compactors	1	100	8	90	72000
Diesel Dump Truck	2	300	8	90	432000
Diesel Excavator	1	300	8	15	36000
Diesel Hole Trenchers	1	175	8	15	21000
Diesel Bore/Drill Rigs	1	300	8	15	36000
Diesel Cement & Mortar Mixers	1	300	8	240	576000
Diesel Cranes	1	175	8	240	336000
Diesel Graders	1	300	8	90	216000
Diesel Tractors/Loaders/Backhoes	2	100	8	90	144000
Diesel Bull Dozers	1	300	8	90	216000
Diesel Front End Loaders	1	300	8	90	216000
Diesel Fork Lifts	2	100	8	90	144000
Diesel Generator Set	6	40	8	240	460800

Emission Factors							
Type of Construction Equipment	VOC g/hp-hr	CO g/hp-hr	NOx g/hp-hr	PM-10 g/hp-hr	PM-2.5 g/hp-hr	SO2 g/hp-hr	CO2 g/hp-hr
Water Truck	0.440	2.070	5.490	0.410	0.400	0.740	536.000
Diesel Road Compactors	0.370	1.480	4.900	0.340	0.330	0.740	536.200
Diesel Dump Truck	0.440	2.070	5.490	0.410	0.400	0.740	536.000
Diesel Excavator	0.340	1.300	4.600	0.320	0.310	0.740	536.300
Diesel Trenchers	0.510	2.440	5.810	0.460	0.440	0.740	535.800
Diesel Bore/Drill Rigs	0.600	2.290	7.150	0.500	0.490	0.730	529.700
Diesel Cement & Mortar Mixers	0.610	2.320	7.280	0.480	0.470	0.730	529.700
Diesel Cranes	0.440	1.300	5.720	0.340	0.330	0.730	530.200
Diesel Graders	0.350	1.360	4.730	0.330	0.320	0.740	536.300
Diesel Tractors/Loaders/Backhoes	1.850	8.210	7.220	1.370	1.330	0.950	691.100
Diesel Bull Dozers	0.360	1.380	4.760	0.330	0.320	0.740	536.300
Diesel Front End Loaders	0.380	1.550	5.000	0.350	0.340	0.740	536.200
Diesel Fork Lifts	1.980	7.760	8.560	1.390	1.350	0.950	690.800
Diesel Generator Set	1.210	3.760	5.970	0.730	0.710	0.810	587.300

Mitigation

While the use of construction equipment is inevitable and necessary, measures should be taken to reduce idle time and the most efficient means of work should be implemented so as to conserve as much fuel and reduce emissions as much as possible. For example, the document, *Cleaner Diesels: Low Cost Ways to Reduce Emissions from Construction Equipment* states, "This section describes three operating strategies to reduce diesel emissions: (1) equipment idle control and reduction, (2) engine preventive maintenance, and (3) equipment operator training. Each offers contractors a way to reduce diesel emissions…" (Cleaner Diesels, March 2007).

If the gas stations are not equipped with the latest in vapor capture technology, they should be encouraged to do so. Monitoring the local air quality will be a determining factor when the type of work for the day is decided. The Northwest Clean Air Agency website has links to an up-to-date air quality index (http://nwcleanairwa.gov/air-quality-center/). During the removal of the bridge, operators should prevent the disturbance of the soil as much as possible. This will minimize the release of carbon dioxide, nitrogen and any other contaminants in the soil. A report by the Washington Department of Transportation regarding bridge construction on State Route 522. While this SR-522 bridge is larger than the BNSF rail bridge, similar measures can be taken to prevent construction damage. See Figure 3.5.

6 What best management practices will be implemented during construction?

WSDOT will require the contractor to implement BMPs to reduce erosion and sedimentation and to prevent debris or contaminants from entering project waters. The selection of BMPs will be based on permitting requirements, but BMPs may include the following measures:

- Define construction limits clearly with stakes prior to the beginning of ground-disturbing activities, and prohibit disturbance beyond these limits.
- Prohibit construction equipment from entering the ordinary high water mark of project area streams, except where allowed by a permit.
- Locate staging and stockpile areas away from streams and wetlands.
- Use mulching, matting, and netting; filter fabric fencing; quarry rock entrance mats; sediment traps and ponds; temporary stream bypasses; or surface water interceptor swales and ditches.
- Cure concrete sufficiently prior to contact with water to avoid leaching (i.e., prohibit fresh concrete from coming into contact with waters of the State).

4-8 Construction Effects and Mitigation

- Use bubble curtains or other sound attenuation measures during in-water pile driving to reduce acoustical effects to fish and other aquatic species.
- Schedule excavation and grading work to avoid disturbances during wet winter months.
- Develop a spill containment plan, educate workers about the plan, and have the necessary materials on site prior to and during construction.
- Clean equipment that is used for in-water work prior to operations below the ordinary high water mark, and prevent untreated wash and rinse water from discharging into surface waters.
- Refuel equipment within a designated refueling containment area away from the shoreline, streams, or any designated wetland areas.
- Inspect all vehicles daily for fluid leaks before leaving the vehicle staging area, and repair any leaks before the vehicle resumes operation.

Figure 3.5: Construction Best Management Practices (Source: WSDOT)

3.2.3 Alternative Action

Under the alternative action, the project is divided into three parts: the modification of the BNSF rail bridge, the removal of the concrete lining the bottom of the creek and the removal of the contaminated soil that line the banks of the creek. The modification of the bridge will be completed using the standards that WDFW has set forth in regards to salmon passage (Barnard, et al., 2013). . Like the proposed action, the alternative action will require the use of heavy duty, diesel machinery.

Impacts

See above in “proposed action” for a description of the impacts of construction on each part of the action.

Impacts from the modification of the bridge will all be beneficial to the fish as they make their way up stream. With a modern fish passage system in place, individual fish will not have as difficult of a time continuing their journey up the creek. Similar to the proposed action, the removal of the concrete lining the bottom of the creek will prevent the fish from becoming injured. The appropriate mix of gravel and sediment as well as a modern fish passage system will mean healthier fish arriving at the spawning site.

Mitigation

Under the alternative action, best management practices are to be used when constructing the modifications of the bridge. See Figure 3.6, above. (WSDOT, Ch.4 Construction Effects and Mitigation)

3.2.4 No Action

Under the no action alternative, no construction will be taking place in this area. Because no construction will occur, the immediate air within the project site will not become unusually saturated with carbon dioxide, nitrogen, concrete dusts and any other soil contaminants.

3.3 Water

3.3.1 Existing Conditions

Squalicum Creek is a glacier-formed stream marked by a high presence of glacial outwash and drift soils. These soils have a low infiltration rate and high runoff potential. There are several inputs into Squalicum Creek, including precipitation, Toad Lake, Lake Squalicum, and Baker Creek. Historically, Squalicum Creek provided 32 miles of salmon habitat and it presently has the strongest ability to have high water quality and fish habitat within Bellingham City limits (City of Bellingham, n.d.).

The mouth of the creek is marked by artificial till and industrial land use. The Washington Department of Ecology has categorized the mouth of the creek near Roeder Avenue as Category 5 “Polluted Water” due to dissolved oxygen, fecal coliform, and temperature conditions (City of Bellingham, n.d.). Petroleum has been detected at multiple locations at levels above the Model Toxics Controls Act Method A Cleanup of 2000 milligrams per kilogram (mg/kg) (Fulton, 2012). The locations with high petroleum levels reside near the Roeder Avenue bridge and BNSF railway. Squalicum Creek has also been listed with impaired in-streamflow and fish habitat conditions. Limiting factors for fish habitat include large woody debris, gravel quality, and built structures that reduce the salmonid access to the creek.

Previous restorations have been completed by both the City of Bellingham and the Port of Bellingham at the creek’s estuary and well as further upstream near I-5. These projects sought to restore fish habitat, replace invasive species with native ones, and reduce soil erosion (City of Bellingham, n.d.; Port of Bellingham, n.d.). The proposed action outlined below seeks to fully realize the benefits of past and future restoration projects along Sqaulicum Creek.

3.3.2 Proposed Action

The proposed action is the removal of the BNSF railway bridge, with the rail rerouted and inlaid onto the Roeder avenue bridge, the removal of the concrete bottom of the creek, and the removal of contaminated soil.

Impacts

The removal of the BNSF railway bridge has the possibility of releasing trapped pollutants within the contaminated soils into the water. During construction, run-off from machinery into the water is a high possibility. Disturbed sediment may also increase the turbidity of the water during this time. As more shoreline will be exposed after the BNSF bridge is removed, an increase in soil erosion is possible. This may temporarily decrease dissolved oxygen levels as photosynthetic processes will have a harder time functioning in cloudy water. The soil underneath the concrete bottom will also have to be removed as it is polluted by historical industrial land-use. This has the potential to release some of these contaminants into the stream flow before there is a chance for it to be removed.

Mitigation

Working during low-tide seems to be the most efficient means for mitigating impacts on water during construction work on the bridge, removal of the concrete bottom, and soil removal. This could help reduce how many pollutants enter the creek's watershed. It is suggested that in-water construction occur within a work-window between early summer after salmon migrate to sea and early fall before they return upstream (WSDOT, n.d.). Hydrologic analyses is necessary to determine seasonal variability and low-flows of Squalicum Creek in order to increase maximum efficiency (Washington State Department of Fish and Wildlife, 2013). Construction should occur when the stream levels are low and the chance for high precipitation are at a minimum. Flow duration curves are important tools for hydrologic analysis and urban planning. See Figure 3.6 for a flow duration curve of Squalicum Creek and nearby streams.

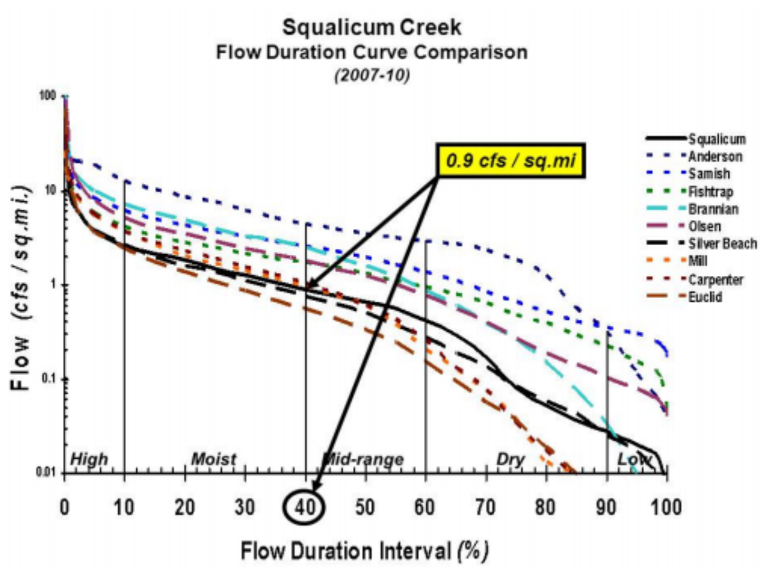


Figure 3.6. A comparison of flow duration curves between Squalicum Creek and nearby streams (Source: Washington State Department of Ecology, 2012).

3.3.3 Alternative Action

The alternative to the proposed action would be the modification of the BNSF railway bridge as opposed to total removal. As with the proposed action, the alternative also includes the removal of the concrete bottom and contaminated soils.

Impacts

Since modification of the bridge is a smaller project than total removal, there are less impacts than the proposed action. There are also, however, less benefits. Modification would allow easier access to upstream Squalicum Creek, but it does not maximize the benefits of the project or other restoration projects that have occurred in the past. Run-off from machinery is still a concern.

Mitigation

As with the proposed action, working during low-tide seems to be the most effective method for avoiding pollutants from entering the area and reducing construction impacts. Hydrologic analyses will determine when streamflow is low and precipitation events are unlikely. It is recommended to work outside of salmon runs between early summer and early fall to reduce negative impacts.

3.3.4 No Action

No action would leave contaminated soils and fish barriers behind. While this provides no new impacts than what is current, restoration of areas further upstream won't be realized until fish have access at the mouth of the creek. There is no mitigation possible without action.

3.4 Plants

3.4.1 Existing Conditions

Squalicum Creek is one of four salmon spawning habitats. Currently the vegetation along the shoreline of this project are choking not only the shoreline but Squalicum Creek itself (Figure 3.7). With the concrete lining, and noxious weeds, the creek is not suitable for fish passage. With Invasive species such as Himalayan Blackberry, Knotweed, Hinge Bindweed (Morning Glory) Reed Canary Grass and Hairy Willow Herb are a few identified in the area. Washington Native Plant Society website is a good resource to seek knowledge not only about Native Plants but Invasive Species (wnps.org).

Figure 3.7: Invasive species choking the banks of Squalicum Creek. Upstream of Roeder Ave. bridge. (Source: Darren Chomey, 12/4/17)

3.4.2 Proposed Action

The proposed action is broken down into three parts: the removal of the BNSF railroad bridge and its relocation onto Roeder Avenue, the removal of the concrete lining the bottom of the creek and the removal of the contaminated soil. All but the removal of the concrete lining will impact the air.

Impacts

For our proposed action Part one calls for the removal of the Burlington Northern Santa Fe railroad bridge and to relocate it as inlaid tracks onto Roeder Avenue. Part Two is the removal of the concrete that is lining the creek bed. With the absence of the railway bridge vegetation will improve and increase plant habitat as well as the surrounding ecosystem. It will improve the ecosystem around the creek. Native plants will be planted along the shoreline. New soil will have to be imported locally due to the already contaminated soil present along the creek. Best time to plant native species is in the fall or spring for the plants to get a good amount of water. Flooding and high runoff into the creek is normal during those seasons so planting may be an issue.

Mitigation

The restoration of this project could lead to the introduction of noxious weeds and other invasive species through the air and in the soil considering the location of where the soil is taken from. Shoreline restoration will use plant species native to the region which will be put in the ground by hand. Native species are key to restore fish habitat and stabilize the shoreline from erosion.

3.4.3 Alternative Action

The alternative to the proposed action would be the modification of the BNSF railway bridge as opposed to total removal. As with the proposed action, the alternative also includes the removal of the concrete bottom and contaminated soils.

Impacts

With the alternative action, there will be a decrease in land available for native planting from the proposed action. Not a big reduction as there will still be removal of invasive species and introduction to native plants along the shoreline.

Mitigation

With the renovation of the railway bridge, the planting would likely be delayed until the rehab on the bridge is complete. Native vegetation would still be implemented. After every construction that has planting required, the vegetation is planted last. After the concrete lining and renovation of the railway bridge is complete the planting of vegetation can start.

3.4.4 No Action

If this project does not get completed, no change will be made to the vegetation in the area.

3.5 Animals

3.5.1 Existing Conditions

Squalicum Creek provides habitat, water, food, and breeding opportunities for both aquatic and terrestrial species. The most significant residents are eight salmon and trout species including the threatened Chinook salmon, bullhead trout, and steelhead trout. Sqaulicum creek is home to the largest number of salmon and trout in the area. For a detailed list of significant species see Table A.1 in Appendix A. For a list of potentially impacted species see Table A.2 in Appendix A.

Fish populations in Squalicum Creek have been declining. According to a study measuring salmon smolt populations conducted through Western Washington University (see Table 3.4). Coho and Cutthroat numbers have decreased by approximately 81% in 17 years.

Table 3.4: Fish populations counted via smolt traps in Squalicum Creek from 1998, 2001, and 2015. (Source: COB, n.d.)

Table 1. Squalicum Creek smolt trap counts by species and by year.

Common Name	Species	1998 (Mar 20-Jun 21)*	2001 (Mar 14-Jun 21)	2015 (Feb 27-Jun 22)
Coho	*Onchorynchus kisutch*	7,168	3,939	1,394
Cutthroat	*Onchorynchus clarkii*	1,270	1,121	237
Steelhead/ Rainbow	*Onchorynchus mykiss*	185	771	141
Brown Trout	*Salmo trutta*	-	4	8
Unknown Trout sp.	*Onchorynchus sp.*	-	1	7
Three-spine stickleback	*Gasterosteus aculeatus*	-	27	45
Pacific Lamprey	*Entosphenus tridentatus*	-	-	30
Western Brook Lamprey	*Lampetra richardsoni*	-	-	33
Lamprey sp.	*Lampetra sp.*	-	18	106
Bluegill	*Lepomis macrochirus*	-	412	36
Yellow Perch	*Perca flavescens*	-	11	1
Sunfish sp.	*Lepomis sp.*	-	-	4
Largemouth bass	*Micropterus salmoides*	-	131	3
Brown Bullhead	*Ameiurus nebulosus*	-	-	5
Yellow Bullhead	*Ameiurus natalis*	-	8	1
Bullhead/Catfish sp.	*Ameiurus sp.*	-	-	5
Sculpin	*Cottus sp.*	-	2	-
	TOTAL	8,623	6,445	2,056

* Only salmonid species were reported in the 1998 Squalicum Creek smolt trap data. Data source: Downen, M. R., 1999. *Relation of Salmonid Survival Growth and Outmigration to Environmental Conditions in a Disturbed, Urban Stream. Squalicum Creek, Washington.* Thesis: Western Washington University, Bellingham, WA.

The current state of Squalicum Creek negatively affects fish passage. According to the Stream Habitat Restoration Guidelines made by the Washington Department of Fish and Wildlife, manmade structures can become physical barriers that impede fish passage and reduce connectivity through habitat fragmentation, (2012, 480). In the case of Squalicum Creek, fish migration is hindered by limited space beneath the BNSF bridge. During spawning seasons, all previous Squalicum creek born fish return to breed and the current limited space beneath the BNSF bridge causes delays. The Roeder Ave bridge supports result in excess flooding during wet seasons making it more difficult for fish to swim while fighting against a strong current.

The existing artificial bottom of Squalicum Creek makes the stretch of the waterway difficult to maneuver through or pass easily. The concrete was laid fairly flat and is not manuable by the flowing waters. This creates a relatively flat surface that has universal velocity. A natural creek bottom can be eroded and shaped by the flowing water and provide areas of refuge where young can hide from the current, opportunities to forage for food, and gain traction. In addition, a diverse creek bottom offers temperature refuges which the EPA determines as having a positive influence on salmon survival rates taking warmer summer temperatures and climate change into account (Ebersole, et al., 2017). Because the water cannot smooth the concrete, small rough protections may cut the underside of fish, but additional research is needed to verify that concern.

Overall, the current state of the creek has damaging effects on population numbers and species health. The toxic soil beneath the concrete is not a danger to local species in its current contained state. The concrete bottom is an impenetrable surface which prevents access to the toxic soil below. The chemicals may become dangerous in the future when exposed to water or air. But, the process of removing such soil would be a major concern.

3.5.2 Proposed Action

All parts of this project will impact on fish species. The removal of the concrete bottom and toxic soil will provide a more natural creek bed. Removal of the BNSF bridge, and addition of rail to Roeder Ave bridge will provide more space for easy fish passage.

Impacts

Complete removal of the concrete bottom and replacement of toxic soils would provide a natural habitat to the creek bed. Fish species would have areas of refuge, changes in water velocity, and areas to feed and gain traction. The fish would not be cut by sharp projections of the concrete.

Complete removal of the rail bridge would allow easy access from estuary to creak. Fish would experience less traffic when moving upstream and more fish would successfully arrive to breed. These changes would have a positive impact on species populations and health.

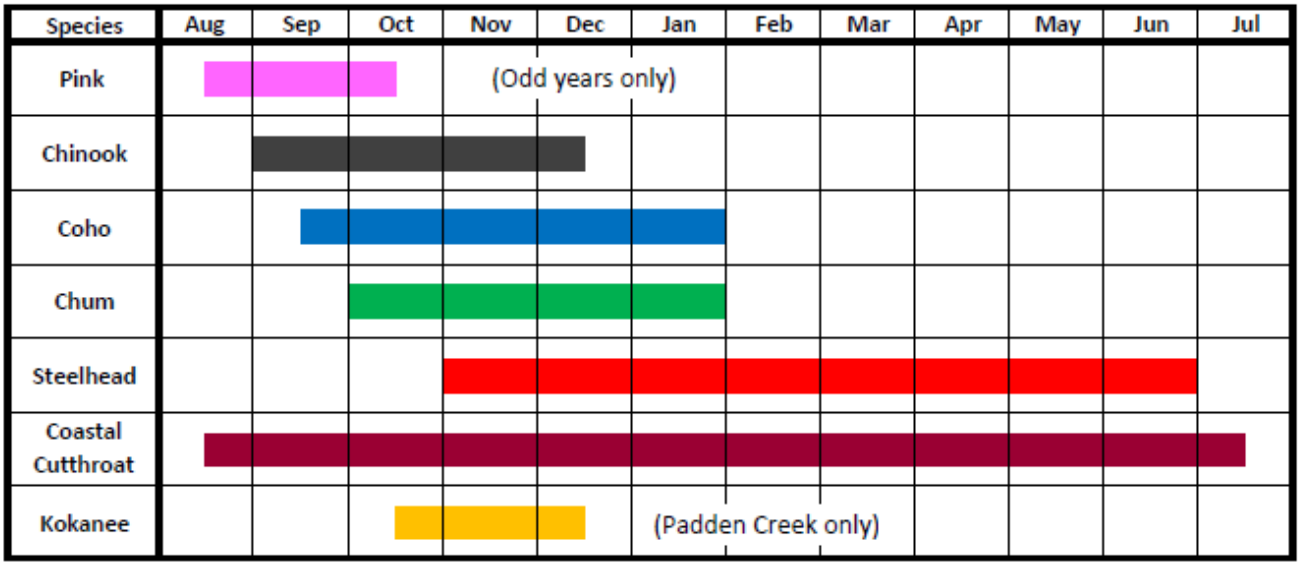
Removal of toxic soil is a major concern. The main chemicals are petroleum and motor oil. In a study of adult salmon's reactions to petroleum hydrocarbons, Weber, Maynard, Gronlund and Konchin (1981) determined that Coho salmon consciously avoid hydrocarbons (petroleum) under estuarine conditions. Further, they found young salmon are more sensitive to pollutants than adult salmon and avoided the water more than the adults (Weber, *et al.*, 2011). A secondary concern arises from metals. Grassie et al., (2013) found detrimental impacts to Atlantic salmon with exposure to aluminum. Specifically, they found that aluminum build up in a salmon's gills impaired the internal water and ion balance (osmoregularity) of the fish causing physical stress and reduced brain activity.

Some restoration projects during the 1990s experienced damaging impacts on salmon species due to toxic chemicals. Salmon experienced "erratic surface swimming, gaping, fin splaying, and loss of orientation and equilibrium. Affected fish died within hours, and female carcasses generally showed high rates (>90%) of egg retention (Scholz, *et al*., 2011). Leakage into stream water would spread into the bay which could be dangerous for saltwater species. However, after dilution of the chemicals the impacts would be significantly less damaging.

Mitigation

When working with animals it is important to limit disturbance.

1. Removal of concrete and alteration to bridges is recommended to occur between spawning seasons (see Figure 3.8). Runs occur throughout the year and are specific to species and stream, and can be impacted by temperature and water flow regimes (NOAA, 2016).



*Based on BTC returns to Whatcom Creek and WDFW/COB/NSEA Spawner Surveys available as of 8/29/17. Kokanee timing estimate based on spawner surveys & pers. comm. with Larry Sisson at WDFW Lake Whatcom Trout Hatchery.

Figure 3.8: Observed spawning times of salmon in Bellingham Streams. (Source: COB, n.d.)

2. Careful removal of the toxic soil is recommended. Evidence from Scholz, *et al*. (2011) suggests that many metals and petroleum compounds come into the waterway via storm runoff. Runoff should be redirected while excavation is underway. It may prove impossible to limit water flow through the Creek during removal of soils, therefore excavation is suggested to occur during a dry season with significantly less water flow.

3.5.3 Alternative Action

Complete removal of the concrete bottom and toxic soil would have the same result in the alternative action as in the proposed. Alteration of the BNSF bridge would provide similar increases in fish passage but less drastic than the proposed.

Impacts

Alteration of the rail bridge would provide more space for fish passage and fish would experience less traffic when moving upstream and more fish would successfully arrive to breed. This change would have a similar impact on species health as the proposed action.

Mitigation

Recommendations on the alternative action are the same as to the proposed action.

3.5.4 No Action

The concrete bottom would remain intact, and the toxic soil would remain hidden beneath it. There would be no removal or alteration of either Roeder Ave bridge or the BNSF bridge. This does not rapidly improve or worsen the current conditions.

Impacts

Short term impacts to no action is identical to current conditions. The state of the concrete bottom and fish passage barriers negatively impact fish species. If the concrete bottom and fish bridge barriers are left in place fish species population dynamics and health could continue to drop. This could result in more thriving species to become threatened and current threatened species to become endangered or locally extinct (extirpation).

If toxic soil remains trapped beneath the concrete bottom, the toxic chemicals will be no immediate danger to animals in the area. But future dangers such chemicals could create are unknown.

4.0 Built Environment

4.1 Environmental Health

4.1.1 Existing Conditions

Squalicum Creek is located in an industrial part of Bellingham. There are no residential homes in the immediate vicinity. Because there is no construction or exposed chemicals currently in Squalicum Creek human health is not a concern in the creek's current state. Squalicum Creek and the three bridges across it create no stressful conditions and no noise as is. People are not impacted by the concrete bottom, the bridge supports that hinder fish passage, or the contained toxic soil.

Concerns will arise during deconstruction/construction/removal of the bridges, concrete, and soil. The severity of concerns will be determined by the route of action.

4.1.2 Proposed Action

The removal of the concrete bottom would require a construction crew to be present below the Roeder Ave bridge. Addition of the rail to the Roeder Ave bridge will require a construction crew to be present on top of the Roeder Ave bridge.

People facing exposure:

1. Construction crews - highest exposure risk
2. Restoration employees - medium exposure risk
3. Local industry employees (not part of restoration project) - small exposure risk
4. Local pedestrian and vehicle traffic - small exposure risk

Impacts

Demolition equipment such as jackhammers and concrete crushers will cause disrupting noise. This may be stressful to local businesses. Removal of the BNSF bridge may cause time delays and tension to the local industries that use it. Addition of the rail to the Roeder Ave will cause local traffic delays, stress, and noise.

The chemicals and particles lifted into the air during excavation and construction are a concern to the employees and volunteers working on the restoration project. If inhaled, particles can cause respiratory problems. It is illegal for the construction dust to cross onto another property (Washington Department of Ecology, 2016). The soil/dust will be as contained as is possible during construction therefore employees working in nearby businesses should not be in danger of exposure nor should any distant residential buildings. In addition, civilians driving across Roeder Ave bridge during construction may be exposed to chemicals if car windows are rolled down. But this is unlikely and the risk is minimal.

Long term noise pollution can impact human health in multiple ways. Physically, noise can lead to ear drum damage. Noise can interfere with communication and activity, and cause annoyance and stress. Noise can be potentially damaging to native birds and aquatic mammals (Federal Highway

Administration, 2017). In this project however all noise and stress to occur will be short lived. After excavation of the concrete and toxic soil, and the construction of a new rail track are complete there will be no noise or stress in the area anymore. So stress and noise are overall not a major concern.

Overall, residents will not be impacted, workers on project face the highest risk with high exposure, and local industry employees face a medium risk simply from being nearby for prolonged periods of time.

Mitigations

All mitigations must occur during construction times.

1. All employees and volunteers must wear appropriate protection attire. This includes long pants, close toed shoes, masks to prevent inhalation of air blown particles, high quality ear plugs or muffs, etc. This will limit stress and noise exposure.
2. Local pedestrian traffic should be limited during certain times of construction or removal.
3. Local vehicle traffic should be limited during certain times of construction or removal.
4. All employees of construction team must be trained. ContractorOrientation.com (https://contractororientation.com/Default.asp) offers comprehensive online orientation for contractors working with or for the railroads. Those working on BNSF Railways should complete their online Contractor Orientation

4.1.3 Alternative Action

The removal of the concrete bottom and toxic soil will require a construction crew to be present below the Roeder Ave bridge. The alteration of the fish passages beneath the BNSF bridge will not impact traffic during that time.

Impacts

The removal of the concrete bottom and the toxic soil leads to the same health concerns in the proposed action as they do in the alternative.

There will be no removal of the BNSF bridge or addition of a new rail to the Roeder Ave bridge. This alternative option leads to less stress and noise occurring than the proposed action.

Mitigations

Recommendations are the same for the Alternative action and proposed action.

4.1.4 No Action

No stress or noise will be created by leaving Squalicum Creek in its current state.

4.2 Land Use

4.2.1 Existing Conditions

The adjacent properties are currently used for industrial and commercial activities and transportation corridors (roadways and railways) within public right-of-way and private property (Figure 4.1). The property on either side of the private vehicular bridge at the mouth of Squalicum Creek is owned by the Port of Bellingham (Port) and leased by Bellingham Cold Storage. Bellingham Cold Storage uses the property as a full-service public refrigerated warehousing facility. The spur railway line extends to the east and west adjacent to the project property, bisecting Port-owned property, with Bellingham Cold Storage to the south and vacant and parking lots north of the railway. Areas north of Roeder Avenue include developed, vacant property owned by the Port and vacant property owned by the City of Bellingham.

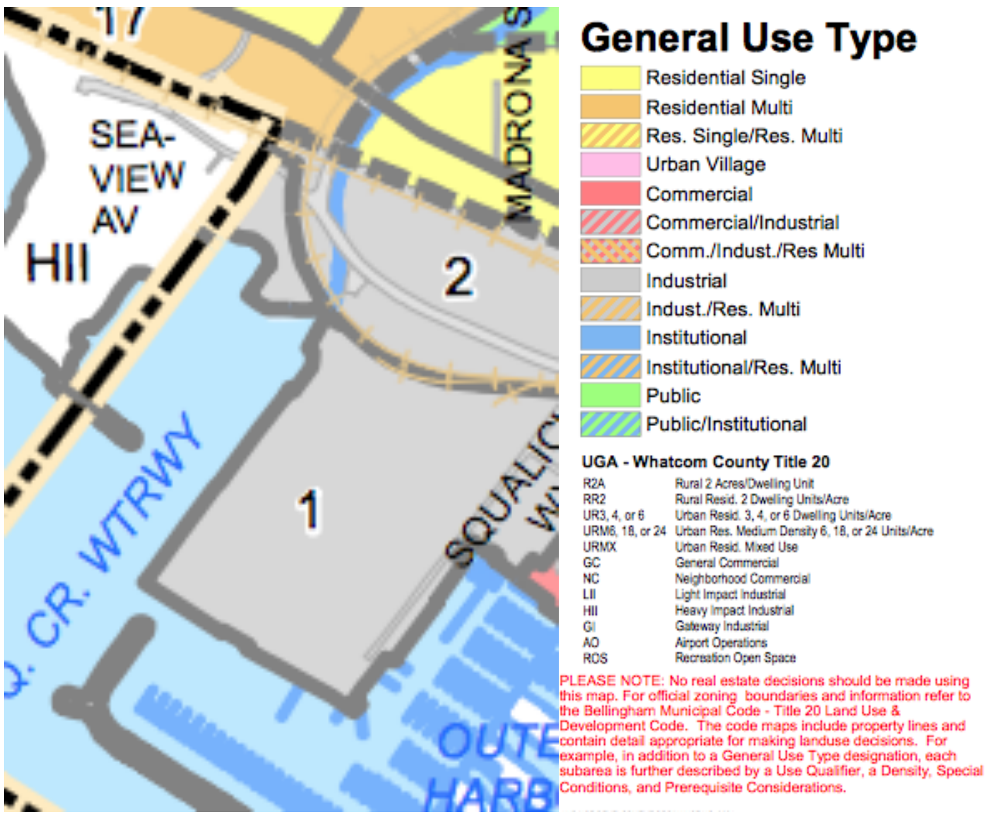


Figure 4.1 Land Use for Proposed Project Area. (Source: COB CityIQ)

4.1.2 Proposed Action

All parts of the project will be impacted except for no action. Congestion, detours and closures will be part of the proposed action.

Impacts

The removal of the concrete bottom will cause construction hassles and potential detours for the commercial companies. Removal of the BNSF bridge, and addition of rail to Roeder Ave bridge will provide congestion, detours and possibly closures for trucks and workers to get to and from their commercial work.

Mitigations

Mitigation through land use could be difficult because of the amount of traffic through this project area. Construction signs and pre-emptive warnings will be needed to warn the industrial area. Public will have to be aware of this project through social media and the Herald. The commercial and industrial areas will have to be prepared for possible bridge restrictions and even closures. If closures happen on Roeder Ave, some shipments may not be able to come in as the main rail bridge may be restricted to some shipments.

4.2.3 Alternative Action

Removal of the concrete bottom and renovation of the BNSF bridge would provide an increase in fish passage but less than the proposed action.

Impacts

Complete removal of the concrete bottom and toxic soil would have the same result in the alternative action as in the proposed. Alteration of the BNSF bridge would provide similar increases in fish passage but less drastic than the proposed. If we join the two roads (railroad bridge onto Roeder Avenue) together there may be more impacts regarding closures and detours. The renovation could be more cost effective than a whole new railway bridge. With the renovation of the rail bridge as part of our alternative, that could likely cause delays in the area. Detours would have to be put in place thus adding time to get to destinations.

Mitigations

Modifying the railway bridge to improve fish passage may not have as much as an impact as laying tracks onto the Roeder Ave bridge. There will still have to be construction signs and pre-emptive warnings of the project before it begins. If the alternative is just to retrofit the rail bridge then there could be less closures on Roeder Ave Bridge to help lessen the weight of detours and closures.

4.2.4 No Action

No action means land use will continue to be used for commercial companies with little to no environmental changes.

4.3 Historic and Cultural Preservation

4.3.1 Existing Conditions

Buildings with historical significance sit adjacent to the proposed project area. However, the Historic Property Inventory Form completed by Rosario Archaeology L.L.C. states that no structures, buildings, or sites that currently qualify for nor could qualify for preservations registers. The 2011 Cultural Resources Monitoring Plan for the Squalicum Creek Delta Restoration Project, also conducted by Rosario Archaeology L.L.C., indicates that items of cultural significance may be present and could be buried beneath fill material from historical shoreline construction. Historical documents show evidence of established Lummi Nation property near the shoreline where phase one of the project has been completed, as seen in Figure 2.1 (Port of Bellingham, 2013). This evidence suggests that human activity could have extended to surrounding areas that reach beyond the shoreline, which may have significant cultural implications in regards to the proposed project area.

The Squalicum Creek tributary supports species of salmon that the Lummi Nation has deemed critical for spiritual and economic values as well as a main source of sustenance, all of which help to support their members (Lummi Nation, 2009). The need to protect this species should be of the utmost importance. The species can not thrive in the current conditions that exist in this section of the creek. In order to successfully complete the necessary steps included in the salmon life cycle, critical changes need to be made to help this be achieved (Port of Bellingham, n.d.).

Based upon the contractual agreement between the Port of Bellingham and the Lummi Nation, the POB has consented to, "Protecting, restoring and enhancing the area's natural resources." As such, the POB must do their part to uphold their obligation by any means necessary. This includes improvements made in the Waterfront District, where this section of Squalicum Creek flows through. (Lummi Nation, 2009)

4.3.2 Proposed Action

Due to the great distance between the buildings in the vicinity and the proposed project site, the proposed action would not have any significant impact on historical preservation. The proposed action could disturb culturally significant items that may be buried beneath the concrete streambed and under the BNSF bridge.

Impacts

Improvements made to the creek through this project would help to restore the cultural integrity of the Lummi Nation in the Waterfront District of Bellingham. The removal of the BNSF bridge and the concrete channel will help with stream and tide flows, increasing protection, habitat, and productivity for critical salmon species. Due to the possibility that items of cultural value may exist buried under the soil in this area, careful mitigation efforts will need to be practiced in order to reduce as much impact on potential artifacts as possible.

Mitigation

The removal of the built environment, concrete bottom and bridges, will need to be monitored and evaluated by a Washington State Department of Archaeology and Historic Preservation (DAHP) professional. Notification and consultation with the Lummi Nation Tribal Historic Preservation Office will be implemented to assess any excavated materials which may be of cultural significance. Based on the Framework Principles set forth in the Intergovernmental Framework Agreement enacted on August 4, 2009, the POB must, "Work with the Lummi Nation to address any cultural resources and/or cultural practices affected by each project listed on Exhibit 'B'." The Squalicum Creek Restoration Project has been listed on "Exhibit B". Additionally, the POB and the Lummi Nation have agreed to, "Mitigate impacts to natural resources from projects listed on Exhibit 'B' through sequential mitigation in compliance with the Mitigation Policy set forth in Exhibit 'C'." The POB will also be responsible for any disruption to Lummi Nation's fishers, and will provide information regarding vessels, schedules, and routes that may cause any interference with fishing practices during the completion of this project. (Lummi Nation, 2009).

4.3.3 Alternative Action

The alternative action proposal seeks to apply modification to the BNSF bridge, remove the concrete channel, and to extract toxic soil.

Impacts

The same impacts from the proposed action are applicable to the alternative action.

Mitigation

Mitigation efforts for the alternative action should mirror those which have been recommended in the proposed action section above.

4.3.4 No Action

Under the circumstances that the no action alternative be implemented, severe impacts will result. The health and vitality of sacred salmon species will continue to be threatened. Agreements made between the Lummi Nation and the POB will be compromised. Potential items of cultural significance will remain buried.

4.4 Infrastructure

4.4.1 Existing Conditions

Within the project area, there are three bridges. The first bridge is a concrete truck bridge that spans the mouth of the creek. This bridge is used solely by the industries on either side of the creek and does not transport passenger traffic. This bridge provides unimpeded fish passage because it is a modern bridge that does not have any structure based in the creek. The second bridge is the BNSF railroad bridge. It is a spur that branches off of the main railroad that allows easy transfer of materials across the creek. This bridge causes the greatest issue for fish. This bridge has structural support based in the creek and impedes fish travel upstream. The final bridge is the Roeder Avenue bridge. This bridge has several pillars for support that are based in the creek and while considered a fish barrier, it does not impede fish passage. Other infrastructure in place is the 350 feet of concrete lining on the bottom of the creek that covers a City of Bellingham sewer main. The concrete presents issues for the fish. Migrating adults can be injured in the process of swimming up the creek, especially when the water level is low.

4.4.2 Proposed Action

The proposed action is broken down in three parts but only two parts are significant in relation to infrastructure: 1) the removal of the BNSF rail bridge, along with its relocation onto Roeder Avenue (see Figure 4.2) and 2) the removal of the concrete lining on the bottom of the creek (Figure 2.5).

Once the concrete is removed, the appropriate mix of gravel and sediment will be laid in the creek. *Stream Habitat Restoration Guidelines 2012* outlines specific gravel requirements for salmon. The Washington Department of Fish and Wildlife produced this document in 2012 for the Washington State Aquatic Habitat Guidelines Program. For the full report, view link http://wdfw.wa.gov/publications/01374/wdfw01374.pdf

Figure 4.2: Map of Proposed Action, Part 1. The red line represents the current location of the BNSF railroad bridge. The green line indicates the location per the proposed action, inlayed on Roeder Avenue.

Figure 4.3: City of Bellingham Sewer Line Location. The blue line represents the location of the City of Bellingham sewer main under Squalicum Creek. The blue line also represents the length of concrete lining the bottom of the creek to be removed under the proposed and alternative action. (CityIQ for City of Bellingham)

Impacts

The removal of the bridge will allow for unimpeded fish passage as well as increase the aesthetics of the creek. Salmon populations will thrive from the removal of this barrier. With the concrete removed, the fish will not scrape themselves as they swim upstream and die before they reach their spawning site. The gravel beds that replace the concrete are softer than concrete and shift with the fish as they jockey for position. Healthier fish arriving in their spawning grounds means a healthier future population.

Mitigation

The BNSF bridge removal should be completed using the best methods available. For example, “clear-span bridge structures, materials and equipment must not be dragged through, or otherwise alter, streambeds during removal procedures;” (*Standards and Best Practices for Instream Works - Clear Span Bridge Removal*) For more relevant information and best management practices, see link for the full document. http://www.env.gov.bc.ca/wld/instreamworks/downloads/Bridges.pdf

The best and safest measures should be used when removing the concrete lining. For example, “...monitor pH frequently in the watercourse immediately downstream of the isolated worksite until the works are completed. Emergency measures should be implemented if downstream pH has changed more than 1.0 pH unit.” (*Standards and Best Practices for Instream Works - 5. Concrete Works*) For the full document, see link http://www.env.gov.bc.ca/wld/instreamworks/downloads/GeneralBMPs.pdf Keeping the concrete intact as much as possible will prevent the release of stored carbon and concrete dust. Caution should be taken to prevent creek bottom destruction and soil bank erosion during construction.

4.4.3 Alternative Action

Under the alternative action, there are three parts but only two parts are significant in relation to infrastructure: the modification of the BNSF rail bridge and the removal of the concrete lining the bottom of the creek.

The first part involves the modification of the BNSF railroad bridge, rather than completely removing the bridge. Modification of the bridge should be completed to give the best available passage to the fish. The Washington Department of Fish and Wildlife produced, *Water Crossing Design Guidelines, 2013*. An example of the material that can be found in this document is as follows, "As general guidance, the bridge should be elevated above common flood flows, and curbs should be installed to prevent fine sediment from running off the deck into the stream." (For the full document, see link http://wdfw.wa.gov/publications/01501/wdfw01501.pdf)

The second part is the removal of the concrete lining and its disposal. will be removed and disposed of, without damaging the sewer main below. Once the concrete is removed, the appropriate mix of gravel and sediment will be laid in the creek. (Refer to Figure 4.3, above)

Impacts

Upon the improvement of the BNSF railroad bridge in regards to salmon passage, fish will have an easier time moving up stream. Fish that do not have to work as hard are healthier and have more success breeding. With the concrete removed, the fish will not scrape themselves as they swim upstream. For impacts from part two and part three, see above in "Proposed Action".

Mitigation

The BNSF bridge modification should be completed using the best methods available and the least damaging methods to the stream. For example, "...waste materials collected during removal and application of protective coatings operations (e.g., blasting abrasives, paint particles, rust and grease) should be collected and retained for disposal at appropriate locations. Waste materials must not be deposited into watercourses or riparian areas" (Standards and Best Practices for Instream Works - Bridge Superstructure Maintenance or Repair) For more, see link "Proposed Action - Mitigation"

The best and safest measures should be used when removing the concrete lining (See link for concrete in "Proposed Action - Mitigation") Keeping the concrete intact as much as possible will prevent the release of stored carbon and concrete dust. Caution should be taken to prevent creek bottom destruction and soil bank erosion during construction.

4.4.4 No Action

Under the no action alternative, no action will be taken to improve the fish barriers. The concrete lining will continue to harm the fish on their journey upstream and the BNSF rail bridge will continue to tire out the fish before the fish reach their spawning site, likely leading to a decline in salmon populations.

4.5 Transportation

4.5.1 Existing Conditions

Within the project area, there is one main road, Roeder Avenue. Roeder Avenue bridges Squaliucm creek and thus, the traffic patterns on Roeder Avenue should be considered. A 2008 traffic study found, "...5499 vehicles per day (vpd) on Roeder Ave south of Squalicum Creek Parkway (Whatcom Council of Governments, 2012).

4.5.2 Proposed Action

Under the proposed action, there are three parts but only one is significant in regards to traffic, the process of inlaying the BNSF railroad onto Roeder Avenue. Some adverse traffic effects will come from construction crews entering and exiting the work area for all parts of the action.

Impacts

During the process of inlaying the rails on Roeder Ave, the traffic will slow down, but after construction is complete, traffic should flow as usual (See "Existing Conditions Above"). Roeder Avenue will now see occasional train traffic but not very often because the tracks are for a rail spur.

Mitigation

When the rail is inlayed on Roeder Ave, proper traffic safety, signing and precautions should be taken to provide a steady, smooth flow of traffic.Some kind of barrier unit should be implemented between the train tracks and the passenger traffic.

4.5.3 Alternative Action

Under the alternative action, there are three parts of the project but none of the three parts will significantly affect traffic. The greatest effect to traffic will be construction crews entering and exiting the work site and the temporary presence of construction vehicles using the roadway.

4.5.4 No Action

Under the no action alternative, because no construction will be taking place in the project area, traffic will flow as usual (See "Existing Conditions" above).

5.0 Conclusion and Recommended Action

After evaluating the potential impacts of restoring Squalicum Creek on the elements of the environment, the recommended route of action is the proposed action. Complete removal of the concrete bottom and the toxic soil, and replacement of the BNSF bridge will have the greatest positive impact on the salmon species of Squalicum Creek.

All elements of the natural environment will be improved by implementing the proposed action. Soil and water health will improve significantly. Natural tide flows will result in less erosion and provide critical flood mitigation. Native plant species will be reintroduced. Fish species will flourish. There will be no long term noise or stress and no long term air or water concerns.

The built environment will be improved aesthetically and culturally by revitalizing the natural landscape and restoring sacred salmon species health. Any Lummi artifacts will be excavated carefully and respectfully. There will be no long term traffic concerns or any dramatic land use changes. The infrastructure will be improved to provide better opportunities to salmon without interfering with local industries or personal property.

If the proposed action is unattainable then the alternative action is recommended. Complete removal of the concrete bottom and toxic soil, and alteration of the BNSF bridge still positively restores the creek to a more sustainable and healthy condition. The no action route has the potential to further degrade the environment past the point of revival.

Table 5.1 Decision Matrix

Impacted Area	Proposed Action	Alternative Action	No Action
Earth*	-1	-1	-2
Air	-	-	-
*Concrete Dust**	-1	-1	0
Carbon Dioxide Gas Release	-2	-1	0
Nitrogen Gas Release	-2	-2	0
Water	+2	+1	-1
Plants	+2	+2	-2
Animals	+2	+2	-1
Environmental Health *	-1	-1	0
Land Use	+1	+1	-1
Cultural/Historic Preservation*	-1	-1	-2
Transportation*	-1	0	0
Infrastructure	-	-	-
Bridge Removal	+2	-	-2
Bridge Modification	-	+1	-2
Concrete Lining Removal	+2	+2	-2
Total Score with *	+2	+2	-15
Total Score without *	+7	+5	-11

Key

+2	Very Positive Impact
+1	Positive Impact
0	No Impact
-1	Negative Impact
-2	Very Negative Impact

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7.0 Appendices

Appendix A: Animals

Table A.1: Significant animals in the immediate vicinity of the project that will be influenced by the routes of action.

Common name	Scientific name	ESA status
Chinook salmon	Oncorhynchus tshawytscha	Threatened
Bull trout	Salvelinus confluentus	Threatened
Steelhead trout	Oncorhynchus mykiss	Threatened
Coho salmon	Oncorhynchus kisutch	
Chum salmon	Oncorhynchus keta	
Sea-run cutthroat trout	Oncorhynchus clarkii clarkii	
Pink salmon	Oncorhynchus gorbuscha	
Sockeye salmon	Oncorhynchus nerka	
Additional range of amphibians/insects		

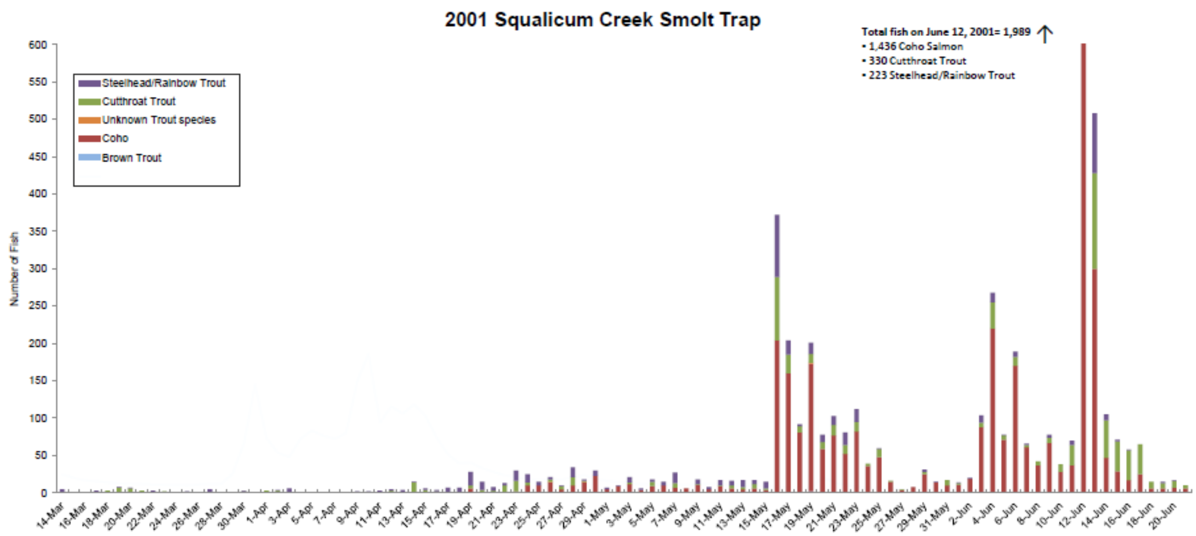
Figure A.1: Salmon Species by appearance (Nooksack Salmon Enhancement Association).

Figure A.2: Trout species by appearance Upper right: Steelhead. Lower right: Bull trout. (Washington Department of Fish and Wildlife, Fishing and Shellfishing).

Table A.2: Known common animals within one mile of the project area that may potentially be impacted by the proposed actions and alternatives.

Common name	**Scientific name**	**ESA status**
Bocaccio rockfish	Sebastes paucispinus	Endangered
Yelloweye rockfish	Sebastes ruberrimus	Threatened
Marbled murrelet	Brachyramphus marmoratus	Threatened
Caspian Tern	Sterna caspia	
Surf smelt	Hypomesus pretiosus	
Pacific sand lance	Ammodytes hexapterus	
Pacific herring	Clupea harengus pallasi	
Dungeness crab	Cancer magister	
Pandalid shrimp	Pandalidae spp.	
River otter	Lontra canadensis	
Harbor seal	Phoca vitulina	
Stickleback	Sp.	
Pacific lamprey	Entosphenus tridentatus	
Western brook	Lampetra richardsoni	

Bluegill	Lepomis macrochirus	
Yellow perch	Perca flavescens	
Largemouth bass	Micropterus salmoides	
Brown bullhead	Ameiurus nebulosus	
Yellow bullhead	Ameiurus natalis	
Sculpin	Cottus sp.	



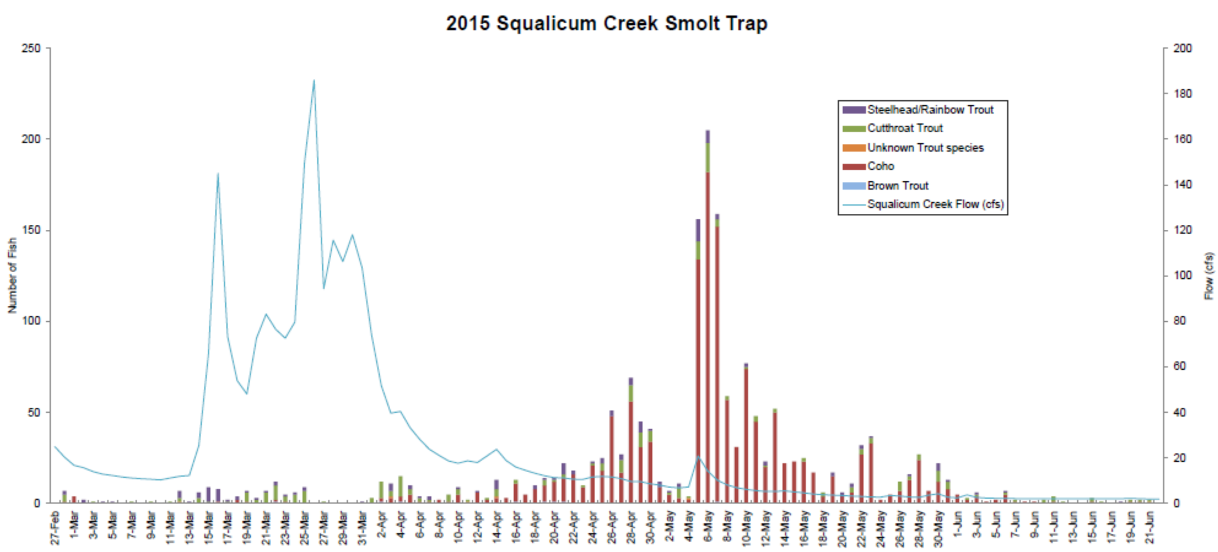


Figure A.3: (top) shows the number of smolt counted in Squalicum Creek in 2001 and (bottom) Shows the number counted in 2015. From the City of Bellingham's Squalicum Creek Smolt Trap Data Summary.

Appendix B: Water

Table B.1: Shows categories of water assessment as outlined by the Washington State Department of Ecology.

Categories of Water Assessment	
Category 1	Meets tested standards for clean waters
Category 2	Waters of concern
Category 3	Insufficient data
Category 4	Polluted waters that do not require a TMDL
Category 4a	has a TMDL
Category 4b	has a pollution control program
Category 4c	is impaired by a non-pollutant
Category 5	Polluted waters that require a TMDL or other WQI project

Appendix C - Squalicum Creek Project Elements

Figure C.1: Detailed layout of project elements.

Appendix D-Plants

Table D.1: Evergreen Shrubs via Washington Native Plant Society.

Botanical Name	Common Name
Arctostaphylos uva-ursi	Kinnikinnick
Cassiope mertensiana	Mertens' Mountain-heather
Gaultheria humifusa	Alpine Spicywintergreen
Gaultheria shallon	Salal
Juniperus communis	Common Juniper, Ground Juniper
Ledum glandulosum	Western Labrador Tea, Trapper's Tea
Linnaea borealis	Twinflower
Mahonia aquifolium	Tall Oregon Grape
Mahonia nervosa	Cascade Oregon Grape
Phyllodoce empetriformis	Pink Mountain-heather
Rhododendron groenlandicum	Labrador Tea
Rhododendron macrophyllum	Pacific Rhododendron
Vaccinium ovatum	Evergreen Huckleberry
Vaccinium oxycoccos	Bog Cranberry