Winter 2017

Environmental impact assessment: Maddox Creek culvert removal and habitat restoration project

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ESCI 493 Winter 2017

Huxley College of the Environment
Western Washington University

<u>Environmental Impact Assessment</u>

Huxley College of the Environment

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February 26, 2017

Dear Concerned Citizen:

As part of a school project the Environmental Science (ESCI) 493 class of Huxley College of the Environment at Western Washington University created a document analogous to an Environmental Impact Statement (EIS) to evaluate the environmental impacts of the removal of an existing culvert located in Maddox Creek in Mt Vernon, WA. This Environmental Impact Assessment (EIA) is based off the Washington State Environmental Policy Act (SEPA) outlined in chapter 197-11 WAC in regards to projects and actions causing significant environmental impact on the surrounding area. This assessment analyzes the significant environmental impacts in a format resembling that of SEPA's EIS, including the proposed project, alternatives to the project, and the environmental elements that will be significantly impacted by the proposed actions.

The proposed project concerns a 6-foot in diameter by 210-foot long steel pipe that extends along Maddox Creek reaching into Bonnie Rae City Park located in Mt Vernon, WA. The culvert was installed in 1968 in preparation for a road that was never built. In lieu of the forgotten road, an extension of Anderson road was completed in 2012 and culverts were installed beneath Anderson and Blodgett Rd to allow substantial fish passage. The Maddox Creek culvert removal project has been part of several of Mt Vernon's Capital Improvement Plans (CIP) including the most recent plan for 2017-2022. The project was never completed due to a lack of funding. The City of Mt Vernon plans to begin allocating funds for removing the culvert in 2018, unless they are provided with grants prior to this date. The removal is anticipated to be completed by 2021 and cost roughly $500,000 to $600,000. The culvert removal will be a joint project between Skagit County Public Works and the City of Mt Vernon Public Works.

The culvert in question is located in Maddox Creek in the lower Skagit watershed. The creek is connected to the Skagit River through a series of creeks and siphons. The culvert within the creek has been an active fish barrier since its installation, blocking access to spawning and rearing habitat for coho salmon, steelhead, and sea-run cutthroat trout.

The segment of Maddox Creek containing the culvert is located in a ravine. The culvert was installed as a provision to an arterial road meant to connect south Mt. Vernon to Interstate 5. Covering the culvert is an estimated 262 thousand cubic feet of clay fill material derived from a county road widening project done on Blackburn Road south of Maddox Creek. The steel pipe was initially galvanized with zinc but since then has begun to rust and corrode. The pipe is rusting where the water flows through and the outlet is experiencing erosion at the base of the pipe. The culvert rests at a 3.8% slope with a sharp outfall above the tail water; the slope and length of pipe make it nearly impossible for fish to swim through the culvert. The culvert itself is structurally failing. The top of the pipe has a collapsing dent, and the fill around the pipe is eroding as the water seeps out via the rotting bottom and the outlet of the pipe. Failure of the culvert will result in a massive mudflow downstream causing extensive damage to private properties, agricultural lands, and drainage systems. Removing the culvert will not only restore fish habitat but also protect adjacent lands from potential large-scale property damage.

The proposed action of removing the culvert includes removing the fill above the pipe, excavating the pipe with heavy machinery, and fully restoring the creek's natural habitat by reconstructing the stream channel and stabilizing the slope. An alternative to this action will be to install a slip liner on the interior of the existing culvert with weirs downstream and in the slip liner itself to flood the pipe creating enough flow to allow fish passage. The backwater at the culvert outlet will raise and shorten the distance between the culvert and creek channel. This alternative is a short term solution that will require additional maintenance and funding. The final alternative to the project is the "No Action" alternative which will leave the site as it is. Taking no action will not only cause the culvert to continue to block fish passage, but it also increases the vulnerability of properties downstream to being seriously impacted by heavy mudflow carrying the fill and woody debris from around the culvert once the pipe finally fails.

Mitigation measures for the proposed actions include taking steps to rehabilitate the natural landscape and vegetation. Silt fences and re-vegetation will be used to stabilize vegetation and soil to prevent sediment erosion and cover the area.

Maddox Creek Culvert Removal and Habitat Restoration Project

Environmental Impact Assessment

Prepared for:
Leo Bodensteiner
ESCI 493 Environmental Impact Assessment
Western Washington University
Huxley College of the Environment

Prepared by: Madison DonTigny, Thomas Hart, Alexa Jones, Josh Ludden, and Maura McKole

Note: *This document represents a class project that was carried out by students at Western Washington University, Huxley College of the Environment. It has not been undertaken at the request of any persons representing local government or private individuals, nor does it necessarily represent the opinion or position of individuals from government or the private sector.*

Fact Sheet

Maddox Creek Culvert Removal and Habitat Improvement Project Proposal

Description of Project:

The EIA was completed as a class project for the ESCI 493 class of Huxley College of the Environment at Western Washington University in regards to a culvert removal proposal to help restore inaccessible salmonid habitat. A group of students performed an analysis of the environmental impacts that will arise from removing the culvert to open up fish passage making spawning and rearing habitat available for coho salmon, steelhead and sea-run cutthroat trout.

The proposed project is to remove an eroding 6-foot diameter by 210-foot long culvert pipe that is acting as a fish passage barrier to traditional spawning and rearing habitat of sea-run cutthroat trout, threatened steelhead trout, and coho salmon. The culvert is situated in Maddox Creek with South Laventure Road to the northeast and residential housing to the northwest. Removing the culvert will expose approximately two miles of spawning and rearing habitat for spawning and rearing salmon and trout. The proposed action includes removing approximately 262 thousand cubic feet of fill covering the culvert, excavating the pipe, and restoring the riparian habitat. Alternatives to this action include: 1) installing a slip liner on the inside of the existing culvert and weirs systems inside the slip line and downstream in the channel to backwater the culverts outlet in order to flood the culvert to allow for fish passage; or 2) the “No Action” alternative which will leave the culvert and creek in its current condition. Mitigation for the proposed and alternative actions will consist of stabilizing the surrounding vegetation and soil using silt fences, planting, hydroseeding/fertilizing, and mulching and installation of erosion control mats for erosion and sediment control.

Legal Description of Location:

Site ID: 03.2966 5.40
Latitude: 48.40281°N
Longitude: -122.31768°W

Project Proponent / Contact Person:

Leo Bodensteiner, Ph.D, Professor
Huxley College of the Environment
Western Washington University
Bellingham, WA 98225

Lead Agency:
Huxley College of the Environment
Western Washington University
Bellingham, WA 98225

Required Licenses and Permits:
Washington Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA)
Critical Areas Ordinance Permit
Corps of Engineers (Corps) Nationwide Permit (NWP) 27
Skagit County Grading Permit
Shoreline Exemption Permit
Floodplain Development Permit
Fish Habitat Enhancement Project Permit
Possible permit streamlining under Fish Habitat Enhancement HPA program

Contributions:
Alexa Jones:
Site Description, Water elements 2.4.3, 2.4.4, and 2.4.5, Flora and Fauna, Air, Energy/Natural Resources and table of contents

Josh Ludden:
Project Summary and Proposal
Elements of the Built Environment: Land/Shoreline Use, Public Services & Utilities

Thomas Hart:
Decision Matrix
Elements of the Built Environment: Transportation, Environmental Health, Glossary

Maura Mckole
Concern Citizen Letter
Fact Sheet
Abbreviations

Madison DonTigny:
Proposed Action, Alternative Actions, Recommendations (Executive Summary & Body)
Elements of the Natural Environment: Geology, Topography, Soils, Erosion, Surface Water, Runoff/Absorption

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Acknowledgements
Dr. Leo Bodensteiner
Professor at Western Washington University
Huxley College of the Environment

Kurt Buchanan
Retired WDFW Fish Biologist

Blaine Chesterfield
Mt. Vernon Public Works

Wendy Cole
Washington Department Fish and Wildlife

Kyle Koch and Susan Madsen
Skagit Fisheries Enhancement Group

Jeff McGowan
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Issue Date: March 9th, 2017

Public Presentation:
REI Bellingham
Address: Sehome Village, 400 36th St, Bellingham, WA 98225
Date: Thursday, March 9th
Time: 4:00pm-4:45pm

Executive Summary

Background

The lower portion of Maddox Creek's fate is currently in jeopardy. As of now, there is a 210-foot long, 6-foot diameter pipe that connects two portions of the creek. It was installed in 1968 to provide a way to allow Maddox Creek to continue to flow along its natural path while preparing the area for the planned extension of 19th street. The extension of the road never came to fruition, so the installation of the culvert was more or less unnecessary. The culvert itself, and the valley it sits in, is covered by about 262 thousand cubic feet of clay-like soil that was transported from the widening project of Blackburn Rd. Now, nearly 50 years after being installed, the culvert is beginning to fail. The top is beginning to cave in and the bottom near the outlet is rusting away causing underwash and erosion that makes it more of a barrier to fish passage.

Proposed Action

The proposed action will daylight Maddox Creek by removing the deteriorating culvert and reconnecting the upstream and downstream channel slopes to allow fish passage. Prior to construction, streamflow will be diverted away from the site of construction with a pump. To remove the culvert, the overlying fill will be excavated down to the depth of the bottom of the culvert. Following excavation of the culvert, the streambeds will be graded and the slopes re-aligned. The streambank and hillslopes will undergo stabilization measures and erosion control practices to reduce sheet erosion and surface runoff in accordance with best management practices (Whatcom Conservation District, 2009). Vegetative cover and a riparian buffer will be restored to the cleared streambanks and hillslopes, and the site will be improved beyond the existing conditions. Overall, the proposed action will provide numerous long-term benefits to Maddox Creek and the native fish species: coho, steelhead and sea-run cutthroat.

Alternative Action

The alternative action will alter the structural conditions of the culvert and downstream tailwaters to allow fish passage. The deteriorating culvert will receive a slip liner to increase the structural competence and life-span of the barrel and reduce the risk of failure. To allow fish passage, a streambed control fish passageway will be installed downstream, and backfill material will be added to the streambed, which will stimulate flooding of the culvert and mitigate the perch height barrier to migratory fish (WDFD, 2009). Furthermore, a 10-step weir pool fish passageway will be installed within the culvert to allow fish passage through the culvert (WDFD, 2009). Maintenance and oversight of the weirs will be required to achieve the objectives for fish passage. Native vegetation will be replaced, and mitigation measures such as silt fencing, erosion control blankets, and mulching around newly planted vegetation will be added to improve conditions for fish habitat. The alternative action will allow fish passage but will not alleviate adverse impacts on stream conditions from the undersized culvert. Some fish may still be wary using the dark, long culvert and may never make it upstream of the culvert.

No Action

The no action alternative proposes to leave the existing culvert in place below the clay fill and implement no measures to improve the barrier for fish passage. The slope of the culvert will remain a barrier to migratory fish, and current stream conditions will not be improved. The deteriorating culvert is expected to eventually fail and wash the clay overfill downstream, damaging private and public property, farmland, and road structures. This damage is dependent on discharge and velocity of water at the time of failure. The no action alternative will result in considerable adverse impacts to the natural and built environment and have detrimental consequences for the prosperity of fish in Maddox Creek.

Recommendations

The proposed action is the preferred course of action. The proposed action will have greater beneficial impacts to long-term functioning of the stream and fish passage than the alternative action. The no action alternative is not a legal option under the Washington State and Federal Endangered Species Acts. Puget Sound steelhead has been listed as Threatened under the Federal Endangered Species Act. Removal of the culvert is the only viable solution to effectively eliminate the fish passage barrier and the risk of culvert failure in the long term. The alternative action will serve as a short-term solution that will allow fish passage to upstream habitat but will not significantly improve the existing erosion and water quality conditions resulting from the undersized culvert. Eventually, a long-term solution will be required if the alternative action is implemented. It is essential to remove the derelict culvert from Maddox Creek before failure occurs for the protection and prosperity of the native fish species - coho, steelhead and sea-run cutthroat - and the preservation of downstream public and private property.

Decision Matrix:

Key: positive impact: (+) negative impact: (-) impact: (0)	Proposed Action		Alternative Action		No Action	
	Short term	Long Term	Short Term	Long Term	Short Term	Long Term
Earth						
Soils	-	+	-	+	-	-
Topography	-	0	-	0	0	-
Erosion	-	+	-	+	-	-
Water						
Surface Water	-	+	-	-	-	-
Runoff/Adsorption	-	+	-	0	-	-
Groundwater	0	+	0	0	0	0
Flooding	-	+	-	-	-	-
Plants and Animals						
Flora	-	+	0	0	0	-
Fauna	-	+	-	+	-	-
Environmental Health						
Noise	-	0	-	0	0	0
Release of Toxic Material	-	+	-	+	-	-
Transportation						
Transportation Systems	0	0	0	0	0	-
Vehicular Traffic	-	0	-	0	0	-
Movement/Circulation	0	0	0	0	0	-
Traffic Hazards	-	0	-	0	0	-
Land and Shoreline Use						
Aesthetics	0	+	0	0	0	0
Recreation	0	+	0	+	0	0
Public Services and Utilities						
Parks and Rec	0	+	0	+	0	0
Maintenance	0	0	0	-	0	-

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Glossary:

Alluvium: A glacial till sediment mixture of moderately well-sorted silt, clay and sand with some pebble gravel (Lee et al., 2008).
Armoring: the natural or artificial reinforcement of a streambed with large material, such as rocks, via removal of smaller material through erosion
Backfill: material used to refill an excavation
Backwater: A small, generally shallow body of water attached to the main channel with little or no current of its own pushed back by a dam or current
Backwater Pool: A pool that formed as a result of an obstruction like a large tree, weir, dam, or boulder
Baffling System: a system of structures set into a river, stream, etc in order to ease fish passage
Bank Stability: The properties of a stream bank that counteract erosion, for example, soil type and vegetative cover
Bed: The bottom of a channel
Bed Material: The sediment mixture that a streambed is composed of
Bedrock: Solid rock that underlies the soil and fragmented rock
Channel: An area that contains continuously or periodically flowing water that is confined by banks and a stream bed
Channelization: The process of changing (usually straightening) the natural path of a waterway
Clay: Substrate particles that are smaller than silt and generally less than 0.003 mm in diameter
Creek: a stream smaller than a river
Creeping Hillslope: term for the slow movement of a hill slope through erosion by a waterway
Compaction [Soils]: the compression of sediment by the weight of the soil above, or by machinery, results in increased soil density and reduced permeability
Culvert: a drain or channel under a road, sidewalk, etc
Daylight: In restoration terms, a verb that denotes the excavation and restoration of a stream channel from an underground culvert, covering, or pipe
Drainage Area: The total surface area upstream of a point on a stream that drains

toward that point. Not to be confused with a watershed. The drainage area may include one or more watersheds

Erosion: process by which the surface of the earth is worn away by water

Flow: The amount of water passing a particular point in a stream or river, usually expressed in cubic feet per second (cfs)

Excavation: to expose or lay bare through digging, e.g. with heavy machinery

Fill: a quantity of earth, stones, etc. for building up the level of an area

Fish Passage: a waterway traversable by fish

Galvanizing: to coat metal, such as iron or steel, in zinc in order to protect it from rusting

Glacial Till: A mixture of unsorted sand, gravel, silt and clay deposited beneath the Vashon ice sheet during retreat (Lee et al., 2008).

Gravel: Substrate particles that are .08 to 2.5 inches

Groundwater Flow: Water that moves through the subsurface soil and rocks

Groundwater Table: The upper surface of the zone of saturation, except where the surface is formed by an impermeable body

Hoogdal Silt Loam: A soil type composed of roughly 20% silt, 40% clay, and 40% sand

Hydric: Wet

Infiltration: The movement of water through the soil surface into the soil

Macroinvertebrates: Organisms without a backbone, generally visible to the naked eye; "bugs"

Mitigation: the act of lessening or correcting for an impact on the environment resulting from an action

Morphology: The form, shape, or structure of a stream or organism

Percolation: The slow movement of water through pores in soil or permeable rock

Perennial Stream: A stream that normally flows year-round because it lies at or below the groundwater table, which constantly replenishes it

Permeability: The capability of soil and other geological formation to transmit water

Plunge Pool: a basin excavated by falling water

Reach: A section of stream between two different points

Rearing: the development of adolescent fish

Recessional Deposits: A mixture of well-sorted sand and gravel deposited by streams draining from the ice during the Vashon ice sheet retreat, as well as silt and clay deposited in lakes dammed by the retreating ice sheet (Lee et al., 2008).

Recessional Marine Deposits: A recessional deposit mixture of fossil-bearing stony silt, sand, and clay and medium to well-sorted massive to laminated sand, silt and clay (Lee et al., 2008).

Riparian [habitat]: habitat situated on the bank of a river or other body of water

Roughening: creation of unevenness in soil to prevent erosion

Salmonid: belonging or pertaining to the family Salmonidae, including salmon, trout,

char, and whitefish
Sand: Substrate particles that are .062 to 2.0 millimeters. Sand is larger than silt and smaller than gravel
Scour: The erosive action of running water in streams, which excavates and carries away material from the bed and banks
Sedimentation: (1) The combined processes of soil erosion, entrainment, transport, deposition, and consolidation. (2) Deposition of sediments
Sediment Load: The soil particles transported through a channel by stream flow.
Shoring: the bracing of a steep slope to reduce erosion
Silt/Clay: Substrate particles that are <.062 millimeters
Slip Liner: netting placed on a slope of loose earth to prevent a landslide
Slope: The ratio of the change in elevation over distance
Spawning: salmonid reproduction method involving the laying of eggs directly in the water to be separately fertilized by the male
Storm Flow: the increase in the flow of a waterway attributed to storms
Stream Bank: The side slopes of an active channel between which the stream flow is normally confined
Stream Channel: The bed where a natural stream of water runs or may run; the long narrow depression shaped by the concentrated flow of a stream and covered continuously or periodically by water
Stream Gradient: A general slope or rate of change in vertical elevation per unit of horizontal distance of the water surface of a flowing stream
Streambed: (1) The unvegetated portion of a channel boundary below the baseflow level. (2) The channel through which a natural stream of water runs or used to run, as a dry streambed
Streambed Control (SBC): Grade controls installed directly in the streambed; may be comprised of wood, rock, or other materials. Streambed controls are placed in channels to accommodate drops by influencing water flow, gradient, sediment, bed elevation, or other stream functions. They may function like stair steps to backwater culverts or they may promote aggradation of the stream channel to reduce drops (WDFW, 2009)
Substrate: (1) The composition of a streambed, including either mineral or organic material (2) Materials that form an attachment medium for organisms
Surface runoff: rainfall that has not penetrated the soil or been absorbed by flora, quickest way for precipitation to reach a stream
Suspended Sediments and Particulates: See ‘Turbidity’
Terracing: creation of dikes along a slope to hold runoff and sediment to reduce erosion
Turbidity: The amount of suspended particles in water, such as clay, silt, and algae that cause light to be scattered and absorbed, not transmitted in straight lines through the water

Unconsolidated deposits: loose materials, ranging from clay to sand to gravel that are not physically cemented or metaphorized together, and are not solid rock.
Unzipping: see ‘Channelization’
Urbanization: the act of taking on the characteristics of a city
Watershed: region or area drained by a river, stream, etc
Weir Pool (WP): The weir pool fishway is the most common style fishway found in the Pacific Northwest. This type of fishway has sufficiently sized pools to dissipate the turbulence and energy of the water entering over the upstream weir. The hydraulic controls between the pools are overflow weirs. The size, shape and material composition of weir pool type fishways can vary greatly (WDFW, 2009).
Weir*:* a small dam in a river
Wetland: land that has a wet and spongy soil, such as a marsh, bog, or swamp
Woody debris: logs, sticks, etc found in a river or stream

Acronyms and abbreviations:

AQI: Air quality index
ATSDR: Agency for Toxic Substance and Disease Registry
CFS: Cubic feet per second
CIP: Capital Improvements Plan
Corps: Army Corps of Engineers
EIA: Environmental Impact Assessment
EIS: Environmental Impact Statement
HPA: Hydraulic Project Approval
LWD: Large woody debris
NWCAA: Northwest Clean Air Agency
NWP: Nationwide Permit
PUD: Public Utility District
SBC: Stream bed control
USDA: U.S Department of Agriculture
WDFW: Washington Department of Fish and Wildlife
WP: Weir pool

1. Introduction

1.1 Project Objectives and Proposal Summary

The proposed action to remove the deteriorating culvert from the lower portion of Maddox Creek is necessary in order to provide spawning salmon an easier route to reach their spawning ground. The existing culvert itself spans 210 feet and is 6 feet in diameter. It was installed in 1968 in anticipation for a road that was planned to be constructed over the creek, yet that plan never came to fruition. Since the road was never built, the culvert serves virtually no purpose and is doing more harm than good at this point. The culvert is now approaching 50 years of age which is well past the life expectancy for the material that was used as well as the way that it was installed. There are areas where the culvert is fully rusted through, which has likely been leeching metal into the stream, while also causing under-wash and erosion of the soil surrounding it. According to the Kurt Buchanan (retired fish biologist from WDFW, personal communication, 2017), it has actually been failing for the past 20 years so this is not new information, yet no maintenance has taken place to repair the issues over the past few decades.

Upon visiting the site, it was quite clear to see that this culvert is absolutely a barrier to fish searching for spawning ground further up the creek. There is a 1.74-meter gap from the surface of the water to the bottom edge of the pipe outflow. While that distance is obviously not very fish friendly, if one were actually to make it into the pipe, it will face a harsh current, and the steep slope of the pipe will toss it right back out. Furthermore, this distance that water has to drop has begun to create a plunge pool at the outlet, eating away material while cascading into the water below. Similarly, the mouth of the pipe, while 6 feet in diameter, is not wide enough to accommodate the flow that is flowing through the creek during the winter. This has caused the water to start eating into the bank around the pipe, trying to get downhill as fast as possible. If this continues then the erosion will undermine the usefulness of the culvert as a system.

Issues associated with current condition include culvert failure, which over time will lead to a large washout of soil, trees, and water. The fill that covers the culvert and the valley that it lies in consists of over 262 thousand cubic feet of clay-like sediment that was transported from the widening of Blackburn Road. The clay-like soil is rather impermeable and does not erode as easily as sandier soil. This means that the fill will stay intact long enough to let the water on the backside of the culvert build up to a dangerous level. The downstream flow of this wash out will likely have significant impacts on private properties, both homes and possibly businesses, as well as ditches used in agricultural irrigation systems. This will result in possibly millions of dollars in damages that can be avoided by removing the culvert.

1.2 Site Description

Figure 1. This is an aerial view of the culvert from Google Earth. The red dot marks the location of the culvert within Bonnie Rae Park.

The Maddox Creek Culvert is located within Bonnie Ray Park and is on Skagit County and City of Mount Vernon property. Clay fill was taken from the construction of Blackburn Road and dumped on top of the culvert in 1968 when there were plans of building a road. The road was never built in this location. According to a WDFW report (2016) the culvert is 210 feet long and 6 feet in diameter with a 3.80% slope. The slope is determined to be the main reason that this culvert is defined as a fish passage barrier. The depth of fill for the abandoned road is 8.20 meters. The culvert width to stream width ratio is 0.27. The culvert width to stream width ratio demonstrates that the culvert is undersized and does not adequately accommodate the stream flow. This is because a culvert width to stream width ratio of 1 or larger is required in order to not restrict flow (WDFW, 2009).

Maddox Creek directly upstream of the culvert has been described as good habitat for salmon that is moderately influenced by stormwater. This habitat was evaluated in 2008 by the City of Mt Vernon. A briefing document created by Skagit County mentions extensive efforts to restore the upper reaches of Maddox Creek.

Currently the culvert is failing and portions of the bottom of the culvert are completely rusted out, with water flowing beneath the culvert in those areas. A portion of the top of the culvert is caving in. Water can be clearly seen coming out from underneath the culvert at the outlet end. Also the water at the inlet end is trying to carve its path next to the culvert, cutting away at the bank and creating a whirlpool before entering the mouth of the culvert.

Figure 2. Water seeping from the rusting culvert bottom.

The Stream Survey Maps (2008) evaluation of the upstream section of Maddox Creek identified the vegetation to be predominantly coniferous forest with 75% canopy cover. The substrate in the stream is pebble, and there is large woody debris (LWD) present.

WDFW survey (2016) shows that downstream of the culvert the stream is predominantly ditched along Interstate 5 and through agricultural fields. This same survey found that sediments were mostly fine but with some gravel. Substrate directly downstream of the culvert consists primarily of pebble (Mount Vernon, 2008). Canopy cover is sparse downstream of the culvert.

Steelhead, sea-run cutthroat, and coho were all observed downstream of the culvert. Nine redds belonging to coho along with 40 spawning adults were identified below the culvert on November 7, 2016 (Freet, 2016). Resident cutthroat trout have been observed above the culvert, showing that it is suitable habitat for salmon and trout.

1.3 Proposed action

The objectives of the proposed action are to daylight the creek section by completely removing the decaying steel culvert, and to reconnect the upstream and downstream stream channels to allow fish passage.

Prior to excavation, a temporary road will be constructed to provide access for construction equipment to the clay overfill and reduce the contact area of foot and vehicular traffic. Water flow will be diverted by installing a temporary dam upstream and downstream, where, between the dams, a pump will transfer water flow around the construction site. Silt fencing will be placed along the downslope perimeter of disturbed and excavated slopes to barricade loose sediment and stormwater runoff from draining into the stream channel during construction. Vegetative cover will be cleared from the clay fill mound and the adjacent hillslopes and stream banks.

To remove the culvert, the overlying 8.20-meter clay fill depth will be excavated to create an incision down to the face of the culvert. Impounded fill and soil will be transferred off-site. The volume of clay fill to be impounded is expected to be around 262 thousand cubic feet. Excavated streambank and slopes will be stabilized by shoring and benching.

After the culvert is removed, the upstream and downstream streambed slopes will require grading and realignment to restore channel connectivity. Once the upstream and downstream channels have been reconnected, gravel will be deposited over the graded stream channel.

Lastly, the stream will undergo restoration. Restoration of the stream will include restoring vegetation cover to cleared soil surfaces by planting, seeding, and fertilizing. A riparian buffer will be created by planting on the cleared streambanks. In addition, mulch and erosion control mats will be used to cover and protect exposed soil surfaces.

Best management practices will be followed to prevent unwanted discharge of sediment and pollution into the stream during and after construction activity (Whatcom Conservation District, 2009). Construction activity will occur between the time of August 1 and September 30 in order to inflict the lowest impact to fish species. This timing also correlates with the period of low seasonal wetness and precipitation, which reduces the impacts to soils, runoff, and erosion.

1.4 Alternative Action

The objectives of the alternative action are to improve the structural conditions of the existing culvert and to add structural features to the stream to eliminate the slope barrier and allow fish passage. The structural competence of the existing culvert will be improved by adding a slip liner to the interior of the deteriorating steel culvert, although the effects are temporary and serve as a short-term solution to the structural incompetency.

In order to eliminate the slope barrier, a streambed-control fish passageway will be installed downstream of the culvert outlet that will flood the culvert by increasing tailwater levels and mitigate the culvert perch height (WDFW, 2009). The type of streambed control fish passageway will be an adjustable weir to control water levels of the flooded culvert. Below the culvert outlet backfill will be deposited to reduce the height between the downstream channel and the perched culvert. In addition, a v-notched weir pool fish passageway will be installed within the culvert with ten weir steps, spaced 10 feet apart, a foot deep apiece allowing fish passage through the culvert. The depth of the water complies with the most stringent requirements for coho salmon passage outlined in the WDFW Fish Passage Manual (2009).

To protect water quality during construction, water flow will be diverted around the culvert with the methods used for the proposed action. Rip-rap or bedrock material will be installed to stabilize the streambed and streambank in the streambed-controlled fish passageway. Removed vegetation will be restored with the same methods in the proposed action. Best management practices will be followed to reduce the input of pollutants and sediment into the stream from installation of the slip liner and downstream weir (Whatcom Conservation District, 2009). Following restoration, continual maintenance and oversight will be required of the weir pool fish passageway and the streambed-control fish passageway to uphold conditions for fish passage. Timing of construction will be same as that stated for the proposed action.

Figure 3. Example of a weir pool fish passageway within a culvert (WDFW, 2009).

Figure 4. Example of a streambed control fish passageway, using downstream log controls to backwater a culvert (WDFW, 2009).

1.5 No Action Alternative

The objectives of the no action alternative are to leave the culvert in its current condition and to implement no measures to improve the barrier for fish passage. Site conditions are expected to worsen over time and become further degraded by the eventual failure of the culvert. The no action alternative will ultimately lead to complete failure of the culvert that will wash the 262 thousand cubic feet of clay fill downstream. The culvert could either fail by buckling due to erosion underneath the barrel or by sediment falling in through cracks overtop, filling the culvert and blocking waterflow. Obstruction in either situation will cause water flow to accumulate upstream of the fill, until reaching the fill top and causing outwash of the fill pile. The damage done to downstream properties and habitat is dependent on discharge and velocity of water at the time of failure.

Failure will also result in reduced fish habitat. Swift sediment-laden water has the potential to scour stream bed features and destroy macrohabitat features.

2. Elements of the Natural Environment

2.1 Earth

<u>2.1.1 Geology:</u>

The City of Mt. Vernon lies in the Skagit River Valley, in the Puget Sound Lower Domain, and is classified into nine sub-drainage basins, including the Maddox Creek sun-drainage basin. The existing geologic landforms of the City of Mt. Vernon are comprised of unconsolidated deposits of glacial till and recessional deposits from the retreat of the Vashon ice-sheet during the Fraser Glaciation Period in the Puget Sound Lowland around 13,000 years ago. The general sediment composition of the Maddox Creek area consists of younger alluvium and recessional marine deposits. Alluvium material is composed of “moderately well-sorted silt, clay and sand with some pebble gravel”, and ranges from one to ten meters in depth over the bedrock layer near Mt. Vernon. Recessional marine deposits consist of “fossil-bearing stony silt, sand, and clay and medium to well-sorted massive to laminated sand, silt and clay,” approximately 15-18 meters in depth in areas with alluvial bottomland near Mt. Vernon (Lee et al., 2008).

Maddox Creek site area does not contain any volcanoes and does not intercept any major fault zones. The closest fault zone is the Devil Mountain Fault Zone and is about three miles south of Bonnie Rae Park *(DNR, Natural Hazards Geologic Information Portal, n.d.).*

<u>Proposed Action</u>

Excavation and grading procedures will occur at the topsoil layer. Landslides are a risk for Hoogdal silt loam soil slopes if they are not properly stabilized during construction activity. However, it is unlikely landslides or slumping will occur under best management practices (Whatcom Conservation District, 2009). The proposed action will have not have a significant impact on the geologic conditions of the site.

<u>Alternative Action</u>

Grading and backfill procedures will not significantly impact the geologic conditions of the site.

<u>No Action</u>

No action will have not have a significant impact to the geologic conditions of the site.

2.1.2 Soils:

Existing Conditions

The site location is underlain by one main soil type, Hoogdal silt loam. Hoogdal silt loam is characterized as a moderately, well-drained soil of terrace escarpments with slopes composing a 30-60% gradient. Soil permeability is slow, and the available water capacity is high. Runoff is rapid, and the potential of water erosion is severe (USDA, *Web Soil Survey, n.d.*). This soil type is designated as a woodland and is not considered a prime farmland or a hydric soil. Vegetative cover is necessary to prevent erosion. Disturbed and de-vegetated soil is susceptible to experience landslides. Steep yarding paths, skid trails, and firebreaks not protected by vegetative cover are prone to rilling and gullying (Klungland and McArthur, 1989).

The existing conditions of the hillslopes are not stable and demonstrate soil creep. The streambanks are recorded in a survey to not have been artificially hardened (City of Mt. Vernon, 2008). The clay fill overlying the culvert is classified as very soft and is being eroded by underwash and perforations in the culvert barrel. The streambanks are being undercut by pooling water during high flows at the culvert inlet. The streambed is being scoured by the culvert outfall. Soils in the sub-drainage basin exhibit fair vegetative cover and little exposure. Increased runoff flows from urbanization exacerbates soil creep and erosion of the streambank and streambed.

Figure 5. Hoogdal silt loam soil unit is denoted as 69. Silt loam soils are characterized by a makeup of roughly 20% silt, 40% clay and 40% sand (USDA, *Web Soil Survey, n.d.*). Maddox Creek is represented as the blue line extending from Blackburn Road to

the north and Anderson Road to the south. The culvert location in Maddox Creek is roughly south of 19th Street in Mt. Vernon.

Proposed Action

For the proposed action, culvert removal will require construction activity involving excavation and grading, and clearing vegetative cover. Excavation will compact soils and reduce infiltration, which will increase erosion and surface water runoff (NRCS, 2000). Clearing vegetative cover will expose soil surfaces and increase the potential for water and wind erosion. Erosion and compaction impacts to soils will be mitigated following best management practices (Whatcom Conservation District, 2009). The impacts will be limited to the construction period. Long-term impacts will be mitigated with restoration of vegetation. Pollution to soils from construction activity will be mitigated following best management practices (Bouey, 2016a).

Removal of the culvert will eliminate the constricted water flow causing erosion of the streambank. This will have a long-term beneficial impact to streambank soils.

The proposed action will restore the vegetative cover following construction. Restoration of vegetative cover by planting, seeding, mulching and fertilizing of the cleared streambanks and hillsides will increase soil infiltration from plant root growth and reduce surface runoff (NRSC, 2000). Plant growth will also stabilize disturbed soils and reduce the risk of water and wind erosion to soils (NRSC, 2000). Restoration efforts will mitigate for construction impacts, while also improving vegetation beyond the initial conditions. In the long term soils will experience beneficial impacts from the restoration of vegetative cover and a riparian buffer for the proposed action.

Mitigation Measures:

To reduce the compaction of soils, a road will be built to the site location for the movement of heavy machinery and foot traffic in order to consolidate traffic to a hardened, non-compactable surface. For non-paved surfaces, efforts to minimize the area and duration of vehicle and foot traffic will be implemented. Excavation during times of low seasonal rainfall, when soils are less saturated and less compactable, will mitigate soil compaction. The preservation of topsoil and vegetative cover will be implemented to minimize the area of compaction (Bouey, 2016a; Buchanan and Warinner, 2017; McCowan, 2017).

To mitigate the impacts of erosion, vegetative cover and undisturbed topsoil will be preserved when feasible and will reduce the area of exposed and disturbed soil surfaces. Excavation during times of low seasonal rainfall will help reduce the likelihood of water erosion of exposed soil surfaces. Slopes will be stabilized by shoring and benching during excavation. Restoring vegetative cover by planting, mulching and seeding, and applying erosion control blankets will protect exposed soil surfaces from erosion by surface water runoff (Bouey, 2016a; Buchanan and Warinner, 2017; McCowan, 2017.

Silt fencing and creek diversion will mitigate sedimentation. Silt fencing will catch turbid runoff from disturbed soils before it enters the stream channel. Creek diversion will prevent erosion of the graded streambed and streambank. Erosion control measures will also mitigate sedimentation by reducing the transportation of sediments from disturbed soil surfaces (Bouey, 2016a; Buchanan and Warinner, 2017; McCowan, 2017).

Alternative Action

For the alternative action, preserving the structural integrity of the culvert will require installation of a slip liner, deposition of backfill material, and weir placement downstream.

These activities will require heavy machinery use that will compact soils. The impact of compaction for the alternative action is expected to be less than the proposed action due to the less invasive construction procedures and shorter time requirement for project completion. The impact of compaction will be limited to the construction period and will be mitigated using the same methods indicated for the proposed action with the exception that a tracking pad can used for the short-term traffic movement in place of a road (NRSC, 2000).

Addition of the weir pool fishway in the culvert may increase backway levels at the culvert inlet and increase erosion of the streambanks. Short and long term impacts of erosion can be mitigated with armoring and vegetative cover.

For the alternative action, backwatering the downstream flow to reduce the perch height will require deposition of backfill material and weir placement downstream of the culvert. Addition of the weir and backfill material downstream will backwater flow to reach the culvert outlet barrel. This will increase water levels behind the weir and upstream channel. Increased water levels will cause the stream channel to widen and erode the soils of the streambank that become submerged (Rickard et al., 2003). Erosion of clay fill will also increase from the increased water levels. Short- and long-term impacts from erosion will be mitigated with armoring and vegetative cover.

Mitigation Measures:

Measures to mitigate the impacts of soil compaction are the same as those indicated for the proposed action. Erosion of the streambanks and streambed will be mitigated with armoring using large boulders, riprap material, or gravel to stabilize the streambanks. Enhancing or adding a riparian buffer to the streambank adjacent to the pooled waters will help to stabilize the streambank and reduce water erosion. An adjustable weir could mitigate the impact of streambed scour by controlling the outfall velocity below the weir (WA Department Forestry).

No Action

No action will result in adverse impacts to existing soil conditions, as high stream flows will continue to erode and undercut the streambank at the culvert inlet. The continual urbanization of the surrounding area could contribute increased volumes of stormwater runoff. Increased stormwater runoff will degrade soils in the drainage sub-basin, erode the clay fill and streambanks, and exacerbate soil creep. If the culvert were to fail, streambank and hillside soils could experience scouring and sedimentation from the build-up of blocked water at the culvert and the out-washing of the fill material downstream.

2.1.3 Topography:

Existing Conditions

Maddox creek flows along a ravine at a steep gradient (2%<) in the drainage sub-basin between steep woodland hillslopes. The clay fill overlying the culvert exhibits steep slopes upstream and downstream descending to the culvert. The dominant soil type at the site, Hoogdal silt loam, is characterized by slope gradients of 30-60% and elevation ranging from 100 to 300 feet (USDA, *Web Soil Survey, n.d.)*. Coniferous trees growing on the hillslopes are bending upslope, indicating that the hillslopes are creeping and not stable.

Figure 6. Steep woodland hillside, facing the right bank directly downstream of the culvert.

Proposed Action

Culvert removal will require substantial excavation of the fill material, and an estimated 262 thousand cubic feet of fill material will be removed (Bouey, 2016). Some of the topsoil layer will be removed during excavation but will not extend to the subsoil layer. Excavation will destabilize hillslopes in the short term. This impact will be mitigated by benching and shoring techniques, erosion control measures, and restoring vegetation. In the short and long term, there will be significant adverse changes in topography from fill and topsoil removal.

The streambed will require moderate grading of the bed material to realign the upstream and downstream stream channels. Grading of the streambed will have little impact to the change in topography overall and will result in moderate alterations of the stream slope.

Alternative Action

The alternative action will require the deposition and grading of backfill material below the culvert outlet and installation of a weir downstream. Grading will increase the stream channel elevation below the culvert outlet. The streambanks will require minor excavation and stabilization procedures for installment of the downstream weir. Excavation will require incisions into the sides of the streambank and into the streambed to cut a groove to support the weir from shifting out of place (Open Channel Flow, 2016). These impacts will not significantly alter the topography of the stream and sub-drainage basin. Grading and excavation will have minor changes to topography in the short and long term.

No Action

No action will not significantly impact topography in the short term. However, erosion at the inlet and outlet as well as downstream sedimentation will persist. Culvert failure will adversely impact topography by downstream sedimentation and erosion of the hillsides and streambanks from the outwash of the clay fill. Sedimentation and erosion will have impacts to the stream channel, hillslope, and streambank gradients and could cause stream migration, channel widening, and redistribution of flood levels (Bates et al., 2003). The impact to topography could range anywhere from moderate to severe depending on the rate of fill outwash.

2.1.4 Unique Physical Features:
The geologic features of the Maddox Creek site are not considered to be unique. There are no natural landmarks present at the site.

Proposed Action
No impacts will occur to unique geologic features or natural landmarks by the proposed action.

Alternative Action
No impacts will occur to unique geologic features or natural landmarks by the alternative action.

No Action
No action will have no impact to unique physical features or natural landmarks.

2.1.5 Erosion:
Existing Conditions
The culvert is undersized and a stream depth to width ratio of 0.27 fails to accommodate the full stream width. Water flows at the inlet are eroding the streambank at the mouth of the culvert due to the undersized barrel diameter. The stream banks adjacent to the culvert mouth are undercut from water pooling at the inlet during high flows, and the channel has widened as a result. A plunge pool exists at the culvert outlet and was formed by the discharge of high velocity water. The pool has been carved out over the 40-year period since the culvert was installed in the stream channel. Water leaking through corrosion induced perforations in the culvert and are causing fill material underneath the pipe to erode and destabilize the surrounding fill.

The streambanks are classified as moderately unstable, with minor erosion, bank undercutting, and scalloping of banks (City of Mt. Vernon, 2008). The increased input of stormwater runoff from urbanization has magnified erosion of the streambanks, streambed, and clay fill. There is a stream of water from overland flow draining down the clay fill slope and eroding the clay fill.

Figure 7. An undercut streambank to the left of the culvert inlet, where backwater pools during high flows, and erodes the streambank.

Proposed Action

Construction activity would indirectly increase the erosion of soils by the removal of vegetative cover and disturbances to soils by excavation and grading procedures. Impacts to erosion during and after construction activity will be mitigated and will not be long term. Minor erosion of soil surfaces and the streambed post-construction is expected to occur and the impacts will be short term.

Culvert removal will eliminate the source of high velocity water scouring the downstream streambed at the plunge pool. In the long term erosion of the streambed below the culvert will be mitigated by culvert removal.

Mitigation Measures:

Erosion to soils and the streambed during construction will be mitigated by diverting the streamflow away from the graded channel and cleared streambanks. The preservation of topsoil and vegetative cover when feasible will reduce the area of exposed soils that could experience erosion before vegetative cover or artificial protective cover can be lain down. Restoring vegetative cover to the cleared hillslopes and streambank by seeding, fertilizing, and mulching will mitigate long-term impacts of erosion. Erosion control mats will also protect exposed soil surfaces and mitigate the impact of erosion in the short term. Armoring the streambed and streambank with gravel will mitigate erosion in the short term by stabilizing disturbed soils and streambed sediment.

Alternative Action

The alternative action will backwater the stream flow to reach the culvert by placing a weir downstream of the culvert outlet and depositing backfill material to raise the streambed elevation. Backwatering will dam water behind the weir and increase water levels at that stream cross section. The increased water levels will wash out and erode soils that become submerged. The weir pool fishway in the culvert will increase backwater levels at the inlet, exacerbating the existing streambank erosion.

Backwatering the culvert may also increase erosion of the clay fill at the inlet and outlet.

Backwatering the of culvert with a downstream weir will mitigate the streambed scour at the culvert outlet in the short and long term by slowing the water flow and forming a pool at the outlet (Furness et al., 1990).

Addition of a weir downstream will constrict and increase the velocity of the outfall flow. The high velocity outflow will potentially scour the streambed below the weir and carve out a plunge pool over time if the water flow is highly constricted (Rickard et al., 2003).This impact can be mitigated. Long-term scouring of the streambed could occur if the weir outflow rate is continually high and constricted. This impact can be mitigated.

Mitigation Measures: The weir outflow rate and downstream scour can be mitigated with structural controls on the weir and/or armoring the streambed with boulders and erosion resistant material (WA Department Forestry). Long-term streambank and streambed erosion can be mitigated with stabilization measures such as armoring the streambed and streambanks erosion resistant material with large boulders, rip-rap, and gravel. Planting of vegetative cover over the streambanks will aid in bank stabilization that will resist water erosion.

No Action

No action will result in continued erosion of the streambank and fill, and scour of the downstream channel. Overland flow draining down the clay fill will persist and erode the clay fill. If the culvert fails completely, overlying fill will be washed downstream, which will scour the channel, stream banks, and hillslopes of fill sediment.

2.2 Air

Existing Conditions

The area surrounding Maddox Creek is highly developed and experiences regular vehicular traffic. The existing air quality conditions for the City of Mt. Vernon were determined by the Northwest Clear Air Agency to be “good” for ground-level ozone. Ground-level ozone is the primary air pollutant of concern in the jurisdiction of the Northwest Clean Air Agency. A “good” rating on the Air Quality Index (AQI) indicates that air quality is “satisfactory and air pollution poses little or no risk” to human health (NWCAA, 2017). Additionally, a “good” rating means that all other pollutants besides ozone including sulfur dioxide, particle pollution, nitrogen dioxide, lead and carbon monoxide do not pose a threat to air quality within the area.

Proposed Action

Construction activity for the proposed action will release fossil fuel emissions and particulate matter into the air from excavation and grading procedures, and deposition of backfill material. The impacts to air quality from construction activity on a local and regional scale will be minor and limited to the construction period. No long-term impact to air quality will result from construction activity.

Alternative Action

Fossil fuel emissions and particulate matter will be present during the construction period, but will not impact air quality overall.

No Action

No action will not affect air quality.

2.3 Energy and Natural Resources:

Existing Conditions

The Maddox Creek site's timber, water, and rock are not currently being harvested for natural resources. Natural resources are also not currently being used at the site.

Proposed Action

The proposed action will require natural resources. This requirement is short term and limited to fuel consumption for construction procedures, and rock and fill requirements for bank stabilization and stream bank topography. Mulch, erosion control blankets, and saplings will also be required to complete the proposed action.

Alternative Action

The alternative action will also require natural resources limited to fuel for construction procedures and materials for the adjustable weir. Saplings, mulch and erosion control blankets will be needed to restore trampled vegetation and minimize erosion.

No Action

No action will not affect renewable and nonrenewable energy or natural resource requirements of the site.

2.4 Water

2.4.1 Surface Water

Existing Conditions

Maddox Creek is a perennial stream that flows from the northeast border of Maddox Creek sub-basin. The critical section of Maddox Creek flows down a steep gradient (>2%) through an open channel from Blackburn Road to Anderson Road in a predominantly forested wetland near highly urbanized and cleared areas with little to no riparian buffer (Lee, L.C., 2007). Surface water of the creek section exhibits pools and riffles (Lee, L.C., 2007).

A watershed survey (2008) determined water quality was significantly degraded from impervious surfaces, development, forest clearing, ditching and draining, and channelization, with a great potential for restoration (Lee, L.C., 2007). Water inputs to the stream section were noted to be significantly degraded from impervious surfaces, urbanization and cleared vegetation. The culvert degrades water quality through downstream streambed scour and upstream erosion of the streambanks and clay fill at the culvert entrance, which increases the concentration of suspended particles in the stream (Hotchkiss, R.H., Frei, C.M., 2007). Increased volumes of stormwater runoff have resulted from the urbanization of the surrounding area and exacerbate erosion from the constricted flow caused by the undersized culvert.

Proposed Action

Best management practices mandate that water bodies be protected from erosion and sediment runoff (Whatcom Conservation District, 2009). To comply with this mandate, construction activity will divert water flows around the culvert site during the time of excavation to protect the existing water quality. Water quality will not be adversely impacted during the construction period for this reason. Following restoration of the stream flow to the channel, there will be an increase in suspended sediments downstream of the site in the short term (Merrill and Casaday, 2001). The release of pollution from construction activity is unlikely to occur and will be controlled by best management practices, including placement of erosion control blankets, silt fencing (Whatcom Conservation District, 2009). Water quality will be adversely impacted for the short term for no more than several hundred feet downstream (Merrill, R.B. and Casaday, E., 2001). Impacts of soil compaction, erosion and runoff to water quality will be mitigated during and after construction.

Water quality will improve with the culvert removal and planting a functional riparian buffer. The stream is anticipated to experience reduced downstream sedimentation and improved particulate retention (Sutter, F.C., 2015).

Mitigation Measures: During excavation, erosion will be mitigated by benching and shoring slopes. Erosion of exposed soils will be mitigated by planting, seeding, and mulching to cover and stabilize loose soils. Erosion control mats and the deposition of gravel in the streambed will protect against erosion from surface runoff. Silt fencing will be placed downslope of disturbed soils and trap sediment before entering the stream channel.

Alternative Action
The alternative action will also divert water flow to protect water quality during the installation of the slip liner and addition of the backfill material. The downstream weir will slow the movement of water below the culvert and develop a plunge pool below the weir outfall. At the pool areas, it is likely the stream cross section will widen and streambed elevation could increase (WA Department Forestry, 2004). Scouring of the streambed from weir outfall and the streambank erosion resulting from backwatering will increase downstream sedimentation in the short-term. Water quality will be adversely impacted in the short-term from temporary sedimentation. Long term sedimentation can be mitigated with riprap material at the weir outfall.

The alternative action will create slowed backwaters at the weir pool and upstream channel. The slow backwater at the weir pool and upstream channel will accumulate sediment in the short and long term (Axness and Clarking, 2013). Increased sedimentation at the pools will contribute to turbid waters downstream at intervals, depending on water levels and precipitation. The slowed, turbid waters exposed to sunlight will be higher in temperature than the fast-moving shaded stream sections (Axness and Clarking, 2013).

The long term impacts to water quality are not expected to be adverse. Water quality conditions may improve with the implementation of the erosion mitigation measures.

Mitigation Measures: Erosion of the streambanks and clay fill will be mitigated by armoring the streambanks with riprap material. Sedimentation of the slowed backwater above the weir pool can be partially mitigated with an adjustable weir to control the stream flow.

No Action
No action will result in continued degradation of stream water quality from sedimentation resulting from erosion at the culvert. The eventual failure of the culvert will adversely impact water quality. Water quality will be degraded beyond the current conditions by increased turbidity from fill outwash and consequential erosion of the streambank and hillsides (Bate et al., 2003).

2.4.2 Runoff/Absorption
Existing Conditions
The existing soil type offers a moderate drainage capacity and a rapid runoff rate (USDA, *Web Soil Survey, n.d.*). Maddox Creek drainage capacities are significantly degraded by stream channelization, forest clearing, development, ditching and draining, and the filling of slopes and depressions (Lee, L.C., 2008).Surrounding urbanization has

increased the rate and volume of stormwater runoff into the Maddox Creek drainage basin, increasing runoff rates over the soil and increasing water flow in the stream.

<u>Proposed Action</u>

Construction activity will compact soils and increase surface runoff because of reduced infiltration. The impacts to runoff will be limited to the short term, during and after the construction period, and the impacts will be mitigated following best management practices (Whatcom Conservation District, 2009). Exposed soil surfaces will receive vegetative cover following construction. Restored vegetative growth will increase soil drainage capacities and reduce runoff in the long term.

<u>Mitigation Measures:</u> To reduce the compaction of soils, a road will be built to the site location for the movement of heavy machinery and foot traffic in order to consolidate traffic to a hardened, non-compactable surface. For non-paved surfaces, efforts to minimize the area and duration of vehicle and foot traffic will be implemented. Excavation during times of low seasonal rainfall, when soils are less saturated and less compactable, will mitigate soil compaction. The preservation of topsoil and vegetative cover will be implemented to minimize the area of compaction (Bouey, 2016a; Buchanan and Warinner, 2017; McCowan, 2017).

To mitigate the impacts of erosion, vegetative cover and undisturbed topsoil will be preserved when feasible and will reduce the area of exposed and disturbed soil surfaces. Excavation during times of low seasonal rainfall will help reduce the likelihood of water erosion to exposed soil surfaces. Slopes will be stabilized by shoring and benching during excavation. Restoring vegetative cover by planting, mulching, seeding, and applying erosion control blankets will protect exposed soil surfaces from erosion by surface water runoff (Bouey, 2016a; Buchanan and Warinner, 2017; McCowan, 2017.

<u>Alternative Action</u>

The alternative action will require heavy machinery and moderate excavation to install the slip liner and weir pool fishway, deposit backfill, and install the downstream weir. This activity will compact soils and increase surface runoff. The impact of surface runoff will be less than the proposed action. Runoff impacts will be mitigated with best management practices in the short term. These best management practices include erosion control blankets, silt fencing, re-vegetation, and mulching (Whatcom Conservation District, 2009). The alternative action will not have significant adverse impacts to runoff in the long term following best management practices (Whatcom Conservation District, 2009).

<u>Mitigation Measures:</u> Runoff can be mitigated with the soil compaction and erosion mitigation measures identified for the proposed action.

No Action
No action will have no impact to runoff in the short term. Overland flow draining down the clay fill will persist. In the long term, increased urbanization may increase stormwater inputs to the drainage basin and increase surface runoff. When the culvert fails, runoff will increase as soils experience sedimentation. This is because as bare soils are exposed from sedimentation and erosion of vegetation there is a reduced means of infiltration. Sedimentation of the stream channel from outwashed fill will reduce absorption by the streambed.

2.4.3 Groundwater

Existing Conditions
Very little water can permeate the clay soils that are characteristic of this portion of the watershed. Soil saturation develops swiftly. When the soil becomes saturated the rest of the water that falls as precipitation moves to the river in the form of surface runoff rather than subsurface flow.

The vegetation in the fill on top of the culvert is dominated by deciduous species. Currently, during the fall and winter months when the most rain falls, the deciduous trees are bare and there are no leaves to intercept the precipitation, increasing surface runoff. This means there are very low flows in summer months because the very small amount of water that is held in the clayey soils evaporates quickly, thus groundwater to maintain base flow conditions during summer is absent.

Water is supplied to citizens living within the area primarily by Skagit Public Utility District rather than private wells. This means that the groundwater is not being depleted for household uses. Ditching to provide drainage for agricultural fields is a common occurrence within this watershed. This reduces infiltration and increases the rate of soil moisture loss, further depleting some of the natural groundwater during dryer months.

Proposed Action
Compacting soils and removing vegetation during construction will lead to more surface runoff and less infiltration of water into the soils. This could have a short-term negative effect on groundwater. Long-term effects will be minimized by the mitigation measures.

Mitigation Measures: Replanting of vegetation especially coniferous species along the stream bank following culvert removal is an essential mitigation measure to ensure infiltration and replenishing of groundwater. Once planted, conifers, with their year round leaves, will intercept precipitation before it hits the clayey soils directly. This will help to reduce surface runoff and increases infiltration. When the canopy captures moisture before it hits the ground a portion of the water is evaporated, another portion of the water slowly reaches the soils, and the last portion is absorbed by the tree. Slowing precipitation before it reaches the ground helps it to be absorbed more readily. In the meantime while the conifers grow to an effective canopy height, erosion control blankets and mulch will increase infiltration.

Alternative Action
The alternative action will also compress soils and trample vegetation to a degree. Groundwater may see very small changes in input.

Mitigation Measures: Replanting of vegetation in the riparian zone will prevent any long-term effects on groundwater as stated in the mitigation measures for the proposed action. Short-term effects will be mitigated by applying mulch and erosion control blankets to allow increased infiltration.

No Action
No action in the case of a culvert failure may affect groundwater by washing away vegetation and leaving exposed sediments. This will increase surface runoff and lead to less infiltration. Replanting of vegetation and application of erosion control blankets to increase infiltration could be challenging on the steep ravine banks.

2.4.4 Public Water Supplies

Existing Conditions
Currently Maddox Creek empties into the Skagit River, which is used as a public water supply. Skagit Public Utility District supplies water to citizens within the area and sources their water from Skagit River upstream of the confluence with Maddox Creek. Given that Maddox Creek runs 5.4 miles before entering the Skagit River, no actions that have occurred at the culvert on Maddox Creek have affected the public water supply.

Proposed Action
The size of the culvert removal and Maddox Creek are both fairly small, and it is unlikely that the hydrology will change downstream following the removal of the culvert (Heinz Center 2002). If some sediment or nutrients were released by allowing the water to flow through the excavated channel, they will settle out in slow waters or be used up by organisms before reaching the Skagit River. Given that the water sourced for public water supplies is upstream of where Maddox Creek drains into Skagit River there will be no effect on public water supplies.

Alternative Action

The alternative action will not have any effect on public water supplies because Maddox Creek drains into Skagit River downstream of the public water supply intake.

No Action

If the culvert failed, it is unlikely public water supplies will be affected. This is because most homes and developments in the area are serviced by Skagit Public Utility District water lines. Currently Skagit Public Utility District sources their water primarily from southern Cultus Mountain streams and the Skagit River. The river runs 5.4 miles before reaching the Skagit River giving any sediments a debris released during failure time to settle out and be deposited on the stream bed and banks before reaching the Skagit River. Also, Water sourced from the Skagit River for public water supplies is diverted upstream of the confluence with Maddox Creek. Because of these two reasons, in the case of a culvert failure, there would be no effect on public water supplies.

2.4.5 Flooding

Existing Conditions

Flooding has not been an issue despite the size of the culvert for the water flow of Maddox Creek and the depth of the ravine, although fast moving water in the culvert has led to significant erosion of the 6-ft diameter pipe on the bottom. Water leaking through the eroded portions of the culvert is moving under the culvert, eroding what the culvert is setting on. Water can be clearly seen coming out of the ground underneath the culvert on the outlet end. The culvert is also collapsing in on itself in one area. These factors will be addressed in the no action alternative and how they will affect flooding.

Figure 8. Water spilling out from the deteriorating culverts bottom, eroding the fill material below the pipe.

Proposed Action

The proposed action of removing the culvert and daylighting the stream will, in the long term, only reduce flood risk. Since flooding will likely only occur in the event of a failing culvert, restoring this portion of the channel to its original state will decrease the risk of flooding tremendously. Although, during the construction period some riparian vegetation may be removed or trampled causing increased surface runoff for a short period of time.

Mitigation Measures: Stream bed re-alignment, bank stabilization, the addition of weirs upstream, and re-planting of riparian vegetation will decrease the likelihood of flooding in the long term. Bank stabilization will help to ensure that the steep bank does not slip into the channel and cause a backup of water. Also, re-planting of coniferous vegetation on the creek banks will increase water infiltration and absorption and decrease surface runoff. Revegetation occurs rapidly reducing the impacts of surface runoff (Aspen Institute 2002).

Alternative Action

Adding weirs below the improved culvert will help to flood the culvert for fish passage but could create additional issues. Adding the slipliner to stabilize and seal the culvert, along with a weir system, can often lead to a further restricted culvert (Nick Hartley, 2014). This may increase the flooding potential and may inevitably lead to culvert failure. Effects of culvert failure on flooding are addressed in the no action alternative.

No Action
Given the culvert's deteriorated condition no action could result in the failure of the culvert. There are two ways this could occur. First, given the erosion below the culvert, the culvert could collapse on itself restricting water flow until water backed up and overflowed the top of the fill. This will wash all the fill, along with the culvert, downstream and into downstream properties, possibly destroying the box culvert under the downstream road. Second, the culvert could collapse enough to let sediment from the above substrate to fill the culvert blocking water flow. The water will then be forced through the leaky bottom of the culvert, and the culvert along with the fill will wash downstream. Either way, culvert failure will lead to flooding and washout.

2.5 Plants and Animals

2.5.1 Flora

Existing Conditions
The Stream Survey Maps from 2008 show that the site has native vegetation, primarily coniferous, that provides 75% canopy cover and good quantities of large woody debris upstream of the culvert. The same survey also shows clearing of all types of vegetation along with substantial impervious surfaces as a result of development within the watershed. Downstream of the culvert the watershed is more urbanized. Upstream much of Maddox Creek is ditched through agricultural fields and along I-5. Fairly recently native vegetation has been planted along these reaches, where previously riparian vegetation was lacking. The vegetation that is characteristic to the fill on top of the culvert is red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*) along with blackberry and other shrubs.

Proposed Action
Once the water is diverted back to the stream channel after the culvert is removed, sediment release could possibly affect algal growth and invertebrate populations downstream but these effects may not be measurable (Stanley and Doyle 2003). If algal and invertebrate communities do show decreases, they will be short term and will recover rapidly (Orr et al. 2008). Also, during the construction period a noticeable amount of riparian vegetation may be removed or trampled leading to increased surface runoff.

Mitigation Measures: Weirs can be placed upstream of the culvert removal to slow water and prevent channelization and increased sediment deposition after the water is released back through the channel. Silt fencing along with replanting vegetation can help to reduce surface runoff and increased storm flows, reducing turbidity and siltation. Revegetation can occur swiftly, and impacts on turbidity and stormflow can be minimized quickly (Aspen Institute 2002).

Alternative Action
The alternative action will change current flora noticeably. Although the alternative action will not trample riparian vegetation as much as the proposed action, some heavy machinery will still need access to the culvert and below the culvert to install the slipliner and the weirs.

Mitigation Measures: Revegetation along with silt fencing will reduce sedimentation.

No Action
Given the culvert's deteriorated condition, no action could result in the failure of the culvert, eroding and destroying riparian vegetation. In the case of a failure riparian vegetation will be harmed along with stream habitat.

2.5.2 Fauna

Existing Conditions
There are Coho, Steelhead and Sea-Run Cutthroat present in Maddox Creek downstream of the culvert. There is evidence to show that habitat above the culvert was historically used by these species. Resident Cutthroat are also present upstream of the culvert. In 2016 41 live Coho, 11 Coho carcasses, and 9 Coho redds were observed downstream of the culvert by Skagit Fisheries Enhancement Group (Freet, 2016). The Steelhead and Cutthroat trout have not been monitored in this location by Skagit Fisheries Enhancement Group.

Proposed Action
The proposed action will open up 2,868 square meters of spawning habitat and 15,887 square meters of rearing habitat for Coho, Steelhead and Sea-Run Cutthroat. Steelhead and Sea-Run Cutthroat both spawn in spring, and Coho spawn in fall. All three species have juveniles that live in streams for 1-2 years before they enter saltwater. Timing determined by best management practices stipulates that all instream construction must be performed between August 1st and September 30th to minimize impact on fish populations (Whatcom Conservation District, 2009)**.** It is estimated that the project will take 4-6 weeks. During construction the stream will be re-routed around the construction zone and a fish screen will be used on the water pump to prevent harm to fish.

After the culvert is removed re-establishment of water flow nutrient, sediment and organic matter transport will likely have positive effects on periphyton growth along with invertebrate populations. This will likely increase food for juvenile salmon along with creating better habitat for these salmon overall.

During construction trampling of riparian vegetation along with compacting of soils could lead to increased surface runoff and sedimentation. Also, after the water is released back through the channel, channelization could occur, increasing sedimentation and eroding some essential habitat features for salmonids. Some of these habitat features can be undercut banks, sorted substrate, and woody debris. Effects of channelization can take a longer time to remediate than the effects of sedimentation. Sedimentation can have harmful effects on salmonids including: suffocating eggs, clogging gills and increasing water temperatures. As turbidity increases from sedimentation, energy from light is absorbed into the dark particles within the water, increasing the temperature of the water.

Mitigation Measures: Monitoring for a short period after the culvert is removed should be performed to ensure channelization is either not happening or mitigated further if occurring. Weirs are to be added upstream of the culvert removal to prevent channelization by slowing water. Also silt fencing and revegetation is to occur following construction. This is to reduce short term effects of sedimentation.

Alternative Action

The alternative action will make upstream habitat available to fish by adding weirs within the culvert to slow water and create pools for fish to rest in (Nick Hartley, 2014). Adding the weirs below the culvert will flood the outlet end of the culvert so that fish can enter the outlet end without having to jump. Upstream movement of salmon is inhibited by culverts and they may still not pass through the 210 foot metal structure even after these efforts are performed. This is because fish are not used to long dark tunnels that decrease visibility and instinctually stay away from them.

During construction soils may become compacted increasing surface runoff and sedimentation. This will be exacerbated by the trampling of riparian vegetation. Sedimentation can suffocate salmonid eggs, clog gills and increase water temperatures. As turbidity increases from sedimentation, light energy is absorbed by the dark particles in the water. This increases the temperature of the water.

Mitigation Measures: Maintenance and monitoring are required to ensure functionality. Substrate will be added to provide habitat for salmon species. Revegetation and silt fencing will decrease sedimentation from increased surface runoff. Effects of sedimentation will also be mitigated by performing the construction between August 1st and September 30th.

No Action

Given the culvert's deteriorated condition, no action will likely result in the failure of the culvert, decreasing habitat for native fish species along with eroding and destroying riparian habitat. In the case of a failure sediments released could suffocate salmonid eggs, clog salmonid gills, and reduce water clarity for salmonids to see predators and prey. Released sediments could also bury periphyton, killing the primary producers of this stream habitat. This may lead to die-offs of invertebrates, the food of juvenile salmon.

The failure of this culvert could also lead to habitat destruction. The failure will probably occur during a high flow event. This will lead to stream bed scouring, displacing riffle-pool substrate. This alters rearing and spawning habitat for salmonids. The failure could also lead to intense erosion and erasure of undercut banks, also decreasing salmon habitat.

3. Elements of the Built Environment

3.1 Transportation

3.1.1 Transportation Systems

Existing Conditions

The site is approximately one-half mile from Interstate-5 exit 225 for Anderson Road, shortly past where Anderson Road turns into LaVenture Road. Maddox Creek runs along LaVenture Road at the point where the culvert is located. Downstream, where Maddox Creek intercepts Anderson Road, is a bridge over a box culvert, with more culverts located further downstream.

Proposed Action

The proposed action will not have an impact on transportation systems because...

Alternate Action

The alternate action will not have an impact on transportation systems because...

No Action

Taking no action will not have an impact on transportation systems in the short term. In the long term, a failure of the culvert may wash the 262 thousand cubic feet of fill downstream. Depending on the strength of the current pushing the fill, such a washout may cause damage to infrastructure downstream, such as the bridge on Anderson Road.

<u>**3.1.2 Vehicular Traffic/Traffic Hazards**</u>

Existing Conditions

The culvert was originally installed to allow a road to be built over the stream. The anticipated need for the road to accommodate future traffic was not realized so it was not built. The site is adjacent to Anderson Road as it changes into LaVenture Road approximately one half mile from exit 225 on Interstate 5. Downstream are a number of culverts under existing roads, which have recently been updated to conform with current standards. These updates include installation of box culverts for fish passage, replacing fish passage barriers.

Proposed Action

As there was no anticipated need for the road, the removal of the culvert will not require the modification or replacement of any roadway. Depending on how culvert removal proceeds, there may be traffic flow disruptions leading to congestion along Anderson Road Such disruptions may cause a short-term impact at times of construction. Upon project completion any such disruptions will cease.

Mitigation Measures: The installation of a service road to the site will limit traffic disruptions to those caused by vehicles and machinery for the project entering or leaving the roadway.

Alternative Action

Traffic concerns will be the same in the alternative action as they will in the proposed action. Following the culvert modification process, times of periodic maintenance could cause additional minor disruptions to traffic along the adjacent road.

Mitigation Measures: As with the proposed action, using a service road will limit most traffic issues caused by construction activities. Disruptions caused by routine maintenance could be mitigated by timing such activities during times of light traffic.

No Action

Taking no action to address the declining condition of the culvert will lead to the culvert's failure. This will collapse the 262 thousand cubic feet of sediment, largely dense clay, into the stream, where there are a number of other culverts with roads over them downstream. The clay is likely to damage habitat as it flows through the culverts downstream. In the worst case scenario, the flow will damage these culverts as it passes, requiring repairs along multiple stretches of roadway, possibly negatively affecting traffic in the area. The bridges over the downstream culverts may need repair, requiring detours, which will slow traffic further. The likelihood of damage is dependent on how quickly the fill will be eroded, which is dependent on the strength of the current at the time of failure.

3.1.3 Waterborne, Rail, and Air Traffic

Existing Conditions

Maddox Creek is too small to be used as a waterway, there are no railroad tracks in the vicinity, and there are no airports or any other infrastructure related to air traffic nearby that could be affected by the culvert or its removal.

Proposed Action

The proposed action will have no impact on waterborne, rail, or air traffic.

Alternative Action

The alternative action will have no impact on waterborne, rail, or air traffic.

No Action

Taking no action will have no impact on waterborne, rail, or air traffic.

3.1.4 Parking

Existing Conditions

The culvert is not located in a place where parking services are readily available.

Proposed Action

The proposed action will have no impact on parking.

Alternative Action

The alternative action will have no impact on parking.

No Action

Taking no action will have no impact on parking.

3.1.5 Movement/Circulation of People or Goods

Existing Conditions

Access to Interstate-5 via the nearby exit 225 allows ease of circulation of people and goods through the surrounding neighborhood.

Proposed Action

Should construction activity cause traffic congestion, the circulation of people and goods could temporarily slow. Any disruptions will cease upon project completion.

Alternative Action
Should construction activity cause traffic congestion, the circulation of people and goods could temporarily slow. Any disruptions will cease upon project completion, excepting times of periodic maintenance.

No Action
Should the force of the sediment flow be strong enough to cause damage to infrastructure downstream of the site, repairs will have a temporary negative impact on the circulation of people and goods through the surrounding neighborhood.

3.2 Environmental Health

3.2.1 Noise

Existing Conditions
The culvert does not produce any noise that will be detrimental to the health, safety, or wellness of nearby residents. While the stream does produce natural noise, it is quiet enough to not adversely affect those living nearby.

Proposed Action
The nearby Willitt Street and 18th Street are part of a residential neighborhood with a large concentration of private homes. Noise from the machinery used in the culvert removal process is likely to negatively impact those living in this area over the short term. Following removal of the culvert, noise will no longer be an issue.

Mitigation Measures: Limiting work on the culvert to standard business hours will help to mitigate the noise impact, as people are less likely to be home during that time of day.

Alternative Action
Similar to the proposed action, the nearby residential area will be negatively impacted by noise from the modification of the culvert. There may be noise impacts resulting from periodic maintenance on the culvert, yet they will likely not be as significant as the noise generated from construction.

Mitigation Measures: As with the proposed action, limiting work times to when residents are not home should mitigate noise impact.

No Action
As noise impacts are limited to the construction period, not undergoing the project will result in no noise impact.

3.2.2 Risk of explosion

Existing Conditions

There is no risk of explosion from the culvert or Maddox Creek at present

Proposed Action

Barring the very small chance of catastrophic machine or equipment failure during construction, there is no risk of explosion from the proposed action.

Alternative Action

Barring the very small chance of catastrophic machine or equipment failure during construction, there is no risk of explosion from the alternative action.

No Action

Taking no action will neither increase nor decrease the risk of explosion.

3.2.3 Risk of release of toxic or hazardous substances

Existing Conditions

The culvert is in a state of disrepair. The bottom of the pipe is corroding from fast moving water, which is releasing particulate matter composed of rusted metal into the stream. Metal culverts are often coated with a galvanizing agent, and this culvert was coated with zinc. The zinc is currently oxidizing with the rest of the culvert. While trace amounts of the element are necessary for survival, excessive levels of zinc can be toxic. Exposure can occur either through inhalation, ingestion, or via skin contact. As the zinc is confined to the water and surrounding sediment, risk of exposure here comes from either ingestion or skin contact. If ingested, toxic levels of zinc can lead to nausea, vomiting, anemia, as well as problems with the immune system. It is estimated that consuming 27 grams per day over two weeks is lethal for a human. Contact through the skin is much less hazardous, requiring chronic exposure to do any serious harm (ATSDR, 2015). A concentration of zinc in freshwater of greater than 120 μg/L is considered dangerous to aquatic life (EPA, 2017). The life span of the coating on culverts, as well as the concentration of zinc found in the water, is dependent on how thickly it was applied. Typically when dissolved into water, zinc will deposit itself in the surrounding sediment, where its risk of ingestion is greatly diminished. Given the size of the culvert, the amount of zinc runoff is likely not enough to cause health issues for the nearby populace.

Proposed Action

Removing the culvert will remove a potential source of zinc contamination. However, the culvert removal process may release a larger quantity of rusted iron oxide and zinc.

There is also a risk of oil or fuel leaks from faulty machinery or other equipment used during construction. These risks are minimal and will last only as long as the construction period.

Mitigation Measures: Following best management practices include diverting streamflow during construction and transporting fill and the excavated culvert to a separate site (Whatcom Conservation District, 2009). These measures will minimize the discharge of material during construction. Proper maintenance on equipment and machinery will minimize risk of oil leaks.

Alternative Action

Adding the slipliner to the culvert will reinforce it and slow the release of the corroded metal into the stream. The modifications to allow fish passage may necessitate reapplication of an anti-corroding agent, particularly if the weirs are made of metal. Spraying such a substance onto the surface of the culvert may cause zinc to enter the stream if proper precautions are not taken. Periodic maintenance will be required to ensure the culvert is not corroding. In the long term, as the new coat of galvanizing agent ages, levels of zinc in Maddox Creek could increase.

Risk of discharge from leaky machinery is similar to the proposed action, and the need for periodic maintenance means that risk will be present for those periods as well, though at a lower level.

Mitigation Measures: Diverting streamflow during construction will minimize the risk of contaminants entering the stream during construction. Proper maintenance on equipment and machinery will minimize risk of oil leaks.

No Action

Taking no action will increase the amount of corroding metal released into the stream. As more of the zinc coating agent dissolves, the culvert will corrode at a higher rate, until it ultimately fails releasing any rusted metal left at the site to flow downstream along with any contaminated sediment that may be present.

3.3 Land and Shoreline Use

3.3.1 Relationship to existing land use plans and to estimated population

Existing Conditions

The proposed actions to remove the culvert in the lower portion of Maddox Creek will have very limited, if any, effect on the current land use plans and population of the city.

Proposed Action
The proposed action of removing the culvert will not have any negative impacts on the land use plans. If anything it might make living in a close vicinity to the creek more appealing to new residents.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity as best as possible will have no effect on the land use plans or populations of the city.

No Action
By taking no action, the existing conditions will remain deteriorate as time goes on.

3.3.2 Housing

Existing Conditions
Currently, the culvert in Maddox Creek is on the verge of failing. When it does fail, there is a possibility that private homes in the area could be affected by flood waters and muddy debris.

Proposed Action
The proposed actions to remove the culvert in the lower portion of Maddox Creek will have very limited, if any, effect on the housing stock within the surrounding area or within the city as a whole. As for the current homes close to the creek, removing the culvert will ensure their safety by eliminating a possible flooding risk.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity will ensure the safety of the homes within the immediate vicinity of the culvert location. However, it will only be delaying a flooding risk further into the future if the culvert is not properly maintained.

No Action
By taking no action, the existing conditions will deteriorate as time goes on. Houses near the creek will continue to be at risk for flooding.

3.3.3 Light and glare

Existing Conditions

The culvert is located on the floor of a small valley and surrounded by trees. The culvert itself is difficult to get and generally does not get much sunlight due to the canopy cover, so it provides no light and causes no glare.

Proposed Action

The effects from removing the culvert in Maddox Creek will have very limited, if any, effect on producing any additional issues with lighting or glare.

Alternative Action

The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity will have very limited, if any, effect on producing any additional lighting. Glare will not occur unless many trees are cleared in the removal process.

No Action

Taking no action will maintain the existing condition, which in this case, will be the creek continuing to not produce light or glare.

3.3.4 Aesthetics

Existing Conditions

The culvert currently sets in the lower section of Maddox Creek, which runs through Bonnie Rae Park and is not easily accessible to the public. The banks are extremely steep and muddy and have the potential to create harmful situations for those trying to see the creek. As of now there are no public trails that connect to the creek from the surrounding streets or the park.

Proposed Action

By removing the culvert, the water flowing through the creek will be regain its natural flow, sights and sounds. This will allow more natural processes to take place. If removed, fish will be able to make their way further upstream in search of new spawning grounds. A walking/running trail will allow the public to view the seasonal aspects that a fish bearing creek exhibits.

Alternative Action

The alternative action of slip-lining the culvert, and building a weir system at the outlet in order to flood the culvert, will change the aesthetic appeal. The weir system will make the creek appear fuller and more resemble the natural appearance of a stream. This action will also make it possible for fish to pass to the upper portions of the creek. Live fish in the creek will also make it seem more natural.

No Action

By taking no action the aesthetics of the creek will be unchanged from the existing conditions. Few are able to access this secluded natural area and view the limited, albeit degraded, aspects that are present.

3.3.5 Recreation

Existing Conditions

The section of Maddox Creek that contains the culvert and runs through Bonnie Rae Park provides no recreational opportunities. Because the creek itself is difficult to get to due to the steep, muddy banks, it is currently hard to use the creek for any recreational activity without a significant exertion.

Proposed Action

Along with the proposed action to remove the culvert, the construction of a walking/running trail system will provide a recreational activity for the residents living near the park. Creekside walking/jogging trails allow the public to connect with nature.

Alternative Action

The alternative action of installing a slip liner and weirs might improve recreation in the park immediately; if not the alternative action will at the least provide a good opportunity for future recreation projects. While a small amount of construction is underway to install the weirs below the culvert it may be the perfect time to begin installing a trail system that will benefit the community.

No Action

If no action is taken, which means the culvert will stay as is, then there will be no recreational opportunities provided to the public.

3.3.6 Historic and cultural preservation

Existing Conditions

The current situation of having a failing culvert in Maddox Creek has very little, if any effect on the historic and cultural preservation of Mount Vernon. There is very little evidence that Maddox Creek has cultural or historical relevance. Besides the presence of salmon within the creek, the creek does not have any other unique natural resources that would have been used historically or for cultural purposes.

Proposed Action
The proposed action to remove the culvert in the lower portion of Maddox Creek will have very limited, if any, effect on the historical and cultural preservation of the city/community.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity will have very little if any effect on the historic and cultural preservation of Mount Vernon.

No Action
By taking no action, the existing conditions deteriorate as time goes on.

3.3.7 Agricultural Crops
Existing Conditions
Maddox Creek is currently used by farmers downstream as an irrigation source for their farmlands. It also serves to drain excess water from fields upstream.

Proposed Action
The proposed actions to remove the culvert in Maddox Creek will ensure that it will continue to serve as a source of irrigation water. The drainage it provides upstream will not be interrupted.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity will only delay the failure further into the future.

No Action
By taking no action, the existing conditions will deteriorate as time goes on.

3.4 Public Services and Utilities
3.4.1 Fire
Existing Conditions
The failing culvert in Maddox Creek currently has no impacts on the provision of fire services to the public.

Proposed Action
The proposed actions to remove the culvert in the lower portion of Maddox Creek will have very limited, if any, effect on the provision of fire-fighting services.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity will have very limited, if any, effect on the provision of fire-fighting services.

No Action
By taking no action, the existing conditions will deteriorate as time goes on. This does not affect the ability to provide fire services to the public.

3.4.2 Police

Existing Conditions
The failing culvert in Maddox Creek currently has no impacts on the provision of police services to the public.

Proposed Action
The proposed actions to remove the culvert in the lower portion of Maddox Creek will have very limited, if any, effect on providing police services to the public.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity as best as possible will have very limited, if any, effect on providing police services to the public.

No Action
By taking no action, the existing conditions will remain the same while getting worse as time goes on. However, this still does not affect the city's ability to provide police services to the public.

3.4.3 Schools

Existing Conditions
The area of Maddox Creek that contains the failing culvert is within a mile to the south of public elementary and middle schools. Jefferson Elementary is about a five- minute walk and Mount Baker Middle School is a fifteen- to twenty-minute walk from the site of the culvert.

Proposed Action
The proposed action to remove the culvert from Maddox Creek will have very limited, if any, adverse effects on the education that the nearby schools provide. The opportunity to provide the students with an educational program about the life cycle of salmon and

how the culvert was a barrier to their reproduction may be welcomed.

Alternative Action

The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity will have very limited, if any, adverse effects on the education that the nearby schools provide. The opportunity to provide the students with an educational program about the life cycle of salmon and how the culvert was a barrier to their reproduction may be welcomed.

No Action

By taking no action, the existing conditions will deteriorate as time goes on. While this does not directly impact the schools, the opportunity to use Maddox Creek to educate students on the lifecycles of salmon will be lost.

3.4.4 Parks and Other Recreational Facilities

Existing Conditions

Currently, the culvert itself is not easily accessible by the public due to steep, treacherous terrain. While the land it is located on is designated as a park, it does not offer any of the amenities one associates with a park such as trails and facilities. There is potential in the future for both to be added and for the creek to be made more accessible to people. As it stands, Bonnie Ray Park is an underutilized swath of land. It contains a large open field, suitable for a sports field as well as a forested area that Maddox Creek runs though. The park is wedged in between two areas of residential development, but it does not offer much opportunity for the public to partake in any activities that generally occur at a park.

Proposed Action

By removing the culvert, there will be an opportunity to begin developing the park to better serve the public. This includes the opportunity to install a trail system as well as general park facilities such as restrooms, picnic tables, and covered gathering structures. Taking this action will allow the public to utilize Bonnie Rae Park, rather than just having it remain unused as designated park-space.

Alternative Action

By not fully removing the culvert but adding a slip liner and weir system at the outlet of the culvert, opportunities for the city/county to install a trail system will still be present and allow the park to better serve the public. The weir system should allow fish to continue further up the creek which will make a creekside trail even more desirable for those interested in the seasonal changes that a fish-bearing creek demonstrates.

No Action
If no action is taken the space will stay as is: designated as a park but receiving no use.

3.4.5 Maintenance

Existing Conditions
The culvert was installed in 1968 and has received no maintenance to date. The culvert itself is a 210 foot long pipe that is now in very poor condition. It is buckling from the top and has rusted so bad in some areas that it has actually eaten all the way through the pipe leading to further issues such as under wash and uncontrollable erosion, both of which affect the overall health of the stream.

Proposed Action
The proposed action of removing the corroding, out-of-date culvert will require inspection and upkeep to ensure that the creek is flowing as desired and not eroding the banks.

Alternative Action
A slip-lining and weir system installed in the culvert and portion of the creek below it will require routine maintenance. The weirs will require periodic checks to ensure that fish can pass. The stream bank will require monitoring to identify signs that erosion is occurring. This action will require more maintenance than the proposed action of complete removal of the culvert.

No Action
If no action is taken, the existing conditions will continue. The culvert will continue to corrode likely leading to catastrophic failure. Failure will require considerable construction to restore drainage provided by the stream. The stream habitat will likely be significantly adversely affected by sedimentation caused by erosion of soil that has collapsed into the stream.

3.4.6 Communications

Existing Conditions
The current condition of the culvert beginning to fail has a very limited, if any, effect on the provision of communication services.

Proposed Action
The proposed actions to remove the culvert in the lower portion of Maddox Creek will have very limited, if any, effect on the provision of communication services.

Alternative Action

The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity as best as possible will have very limited, if any, effect on the provision of communication services.

No Action
By taking no action, the existing conditions for communication will remain the same.

3.4.7 Wastewater/storm water
Existing Conditions
The current condition of the culvert beginning to fail has very little, if any effects on the amounts of wastewater or stormwater that enters into the creek.

Proposed Action
The proposed action of removing the culvert in the Lower portion of Maddox Creek will likely have little to no effect on the amount of wastewater/storm water entering Maddox Creek.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity as best as possible will have little to no effect on the amount of wastewater/storm water entering Maddox Creek.

No Action
By taking no action, the existing conditions will remain the same while getting worse as time goes on.

3.4.8 Sewer/solid waste
Existing Conditions
While the culvert is in the beginning stages of failure, that has no effect on the amount of sewer or solid waste that enters into the creek.

Proposed Action
The proposed action to remove the culvert will likely have no effect on increasing or reducing the sewage and solid waste levels that might be in the creek.

Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity as best as possible will have no effect on increasing or reducing the sewage and solid wastes level that might be in the creek.

No Action
By taking no action, the existing conditions of sewage and solid waste levels in the stream will remain the same.

3.4.9 Other governmental services or utilities
Existing Conditions
While the culvert is in the beginning stages of failure, that has no effect on the ability for the city to provide any governmental services/utilities.

Proposed Action
The proposed actions to remove the culvert in the lower portion of Maddox Creek will not have an effect on governmental agencies or utilities.
Alternative Action
The alternative action of installing weirs to backflood the culvert and a slip liner to maintain its structural integrity as best as possible will have very limited, if any, effect on governmental agencies or utilities.

No Action
By taking no action, the existing conditions will remain the same.

4. Recommended Action

We recommend the proposed action as the preferred action. Complete removal of the culvert is the most cost-effective method to restore the ecological functioning of the stream in the short and long term (Sutter, 2015). The alternative action is a short-term solution to the fish-barrier obstruction and the deteriorating structure of the culvert and will require continual oversight and maintenance. Moreover, the alternative action does not mitigate for the impacts of the undersized culvert. The alternative action intends to improve the existing circumstances until a long-term solution can be implemented. The no action alternative is not a legal option under the Washington State Endangered Species Act and Federal Endangered Species Act (1973). The proposed action is the most invasive action but offers the most short- and long-term benefits to the natural and built environment compared against the alternative actions. The alternative actions will not resolve the underlying problem of the deteriorating culvert and the risk of failure. The ecological and economic costs of removing the culvert before it fails are far less than the cost of restoring Maddox Creek and the downstream built environment from a mass-wasting event resulting from failure of the culvert. It is essential that the culvert be removed before failure occurs, or else adverse impacts will be inflicted to Maddox Creek and the people and fish it supports.

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6. Appendices

Appendix A:

Figure 9. Spatial images of Maddox Creek drainage sub-basin in Mt. Vernon, WA. Featured at left is year 1956 (Collection of Aerial Photographs). Featured at right is year 2017 (Google Maps, 2017).

Appendix B:

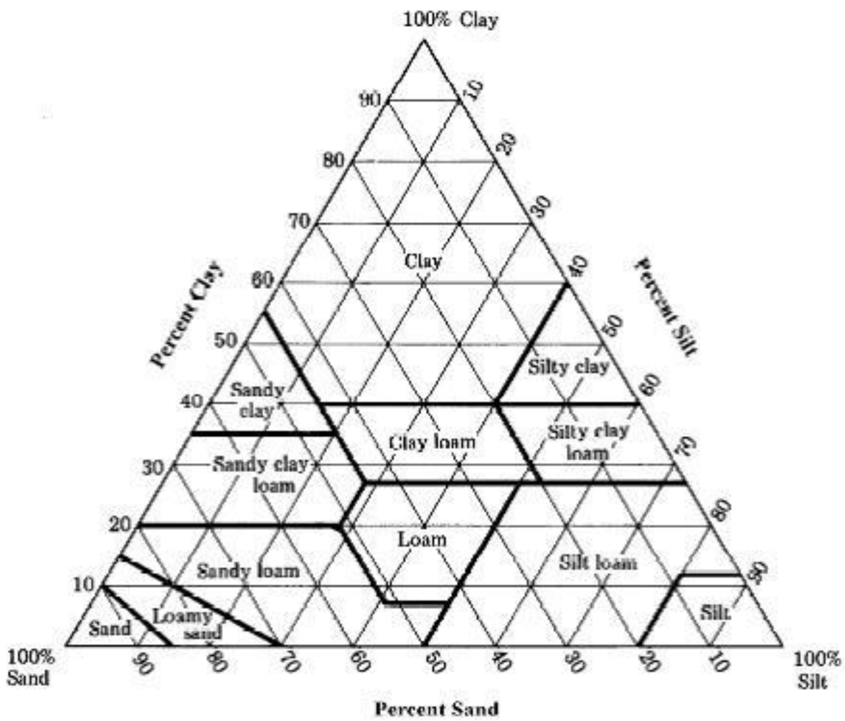

Figure 10. Soil Texture Triangle (Cornell University, 2007).

Appendix C:

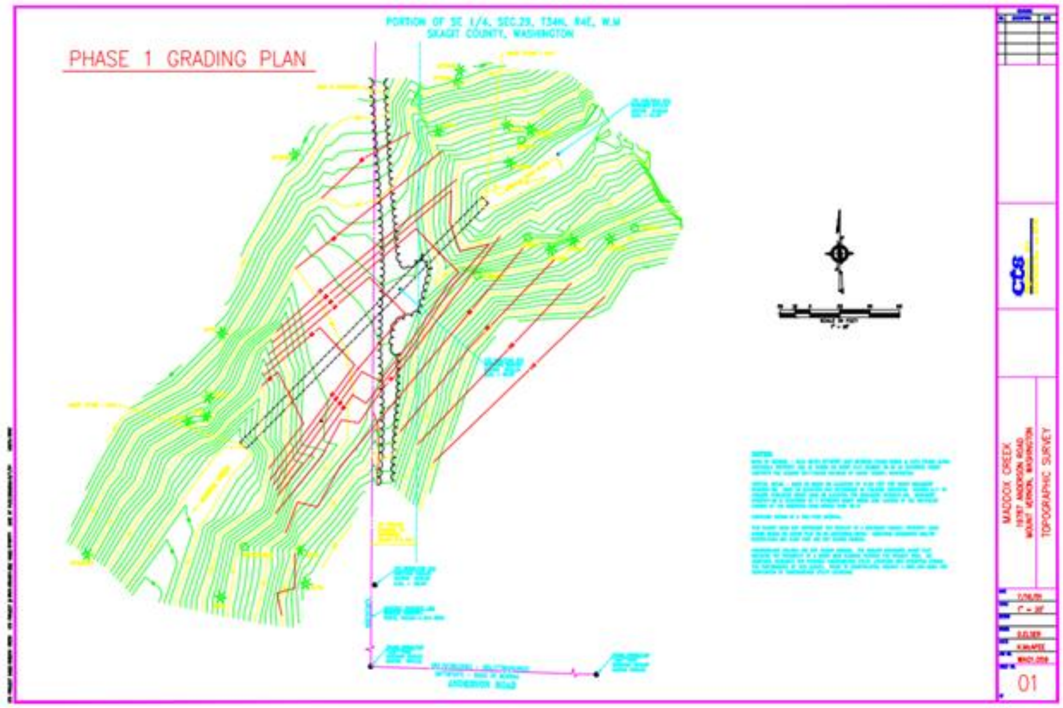

Figure 11. Phase one for excavation and removal of the Maddox Creek culvert. CTS Engineers Inc. created these plans.

Appendix D:

Figure 12. Phase two for excavation and removal of the Maddox Creek culvert. CTS Engineers Inc. created these plans.

Appendix E:

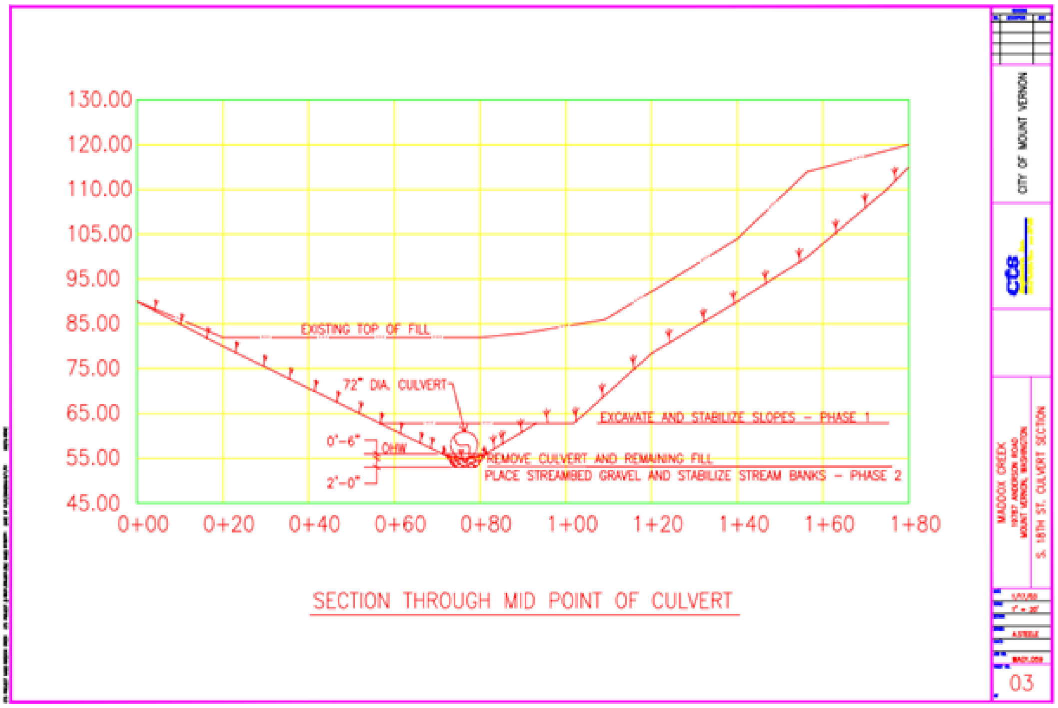

Figure 13. Pictured is the side view of the culvert and the fill to be removed during excavation and removal of the culvert. CTS Engineers Inc. created these plans.