Winter 2010

Whatcom Creek hydropower: environmental impact assessment

Margaret Taylor
Western Washington University

Jena Christiansen
Western Washington University

Graham Goodman
Western Washington University

Duncan Kunkel-Patterson
Western Washington University

John Marshall
Western Washington University

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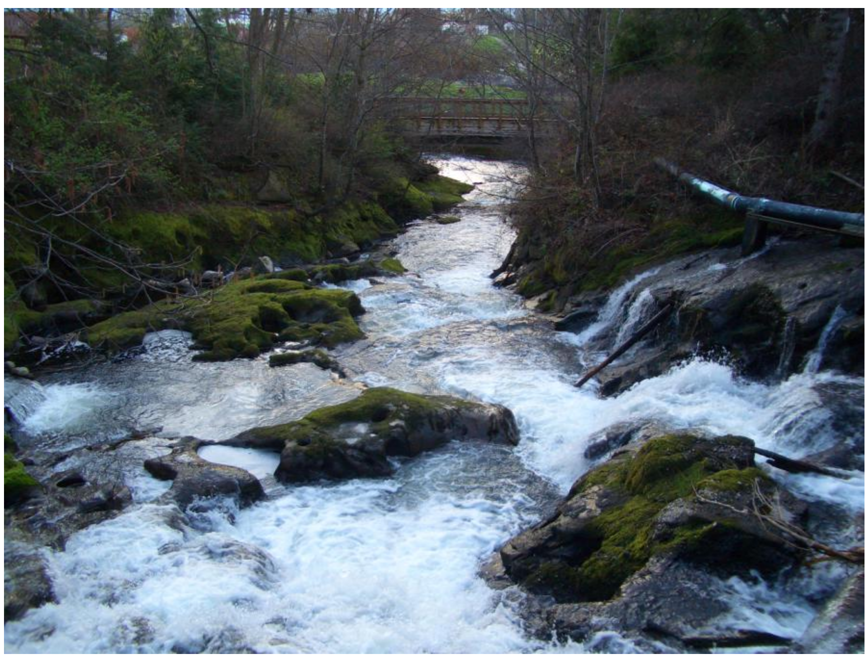

Prepared for ESCI 436/536, Winter 2010
Under the Supervision of Dr. Leo Bodensteiner
Huxley College of the Environment
Western Washington University

This report represents a class project that was carried out by students of Huxley College of the Environment, Western Washington University. 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 positions of individuals from government or the private sector.

Whatcom Creek Hydropower EIA Project Team
Environmental Impact Assessment – ESCI 436
Huxley College of the Environment
Western Washington University
Bellingham, Washington

March 2010

Dear Concerned Citizen:

In accordance with the State Environmental Policy Act (SEPA, WAC 197-11), this Environmental Impact Assessment (EIA) was compiled and developed to evaluate the impacts of directing water from Lake Whatcom down a 48" pipeline that previously serviced the Georgia Pacific paper mill for the purposes of running a small hydroelectric system to be located in an industrial area near Bellingham Bay. Currently, excess water from the lake is flushed down Whatcom Creek at irregular intervals to maintain a court mandated lake level. This report contains studies and analysis conducted by our team as well as official documents, figures, maps, and interviews with University faculty, local businessmen, City of Bellingham officials and Whatcom County officials.

This document was prepared as a requirement for a capstone Environmental Science class offered at Western Washington University. This class is intended to model the Environmental Impact Statement (EIS) process, as outlined under SEPA. When a determination of significance (DS) is made, SEPA stipulates that an EIS must be compiled before development of a project can begin. The goal of this project was to assess positive and negative impacts of water diversion from Whatcom Creek out of Lake Whatcom for the use of power generation.

This EIA addresses the proposed action, the alternative action, and a no action alternative. The proposed action involves diverting enough water from Lake Whatcom to run the turbine at full capacity year-round. The alternative action involves diverting water only during periods of excess flow down Whatcom Creek in order to maintain appropriate flow rates in the creek to accommodate spawning and rearing fish. Under this alternative proposal, the turbine would only be run during periods of water diversion and remain shut off during periods of low flow. By taking no action, the small hydroelectric system would not be installed and current water and pipeline use would remain unchanged.

Sincerely,

Margaret Taylor   Jena Christiansen   Graham Goodman

Duncan Kunkel-Patterson   John Marshall

FACT SHEET

PROJECT TITLE: Whatcom Creek Hydropower

PROJECT DESCRIPTION:
The primary proposal is the installation of a small hydroelectric system at the end of a 48" pipeline that was formerly used to supply the now-defunct Georgia Pacific paper mill with water. The power generation unit will run at full capacity year round and generate an estimated 1480 kW of electricity.

ALTERNATIVES:
The Alternative action is the same as the proposed action, except the unit will be run seasonally only during periods where the release of water from Lake Whatcom is necessary to maintain a court mandated lake level. This will allow for appropriate flow rates to be maintained in Whatcom Creek, as well as maintaining the lake level.

Also discussed is a no action alternative wherein there will be no installation of a small hydroelectric system and no water will be diverted to the former Georgia Pacific pipeline.

PROJECT PROPONENTS/ LEAD AGENCY:

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

CONTACT PERSON:

Dr. Leo Bodensteiner
Huxley College of the Environment
Western Washington University
Bellingham, WA 98225

RELEVANT LAWS AND PERMITS:

Laws

Federal

- Federal Power Act
- Public Utility Regulatory Policies Act
- Electric Consumers Protection Act of 1986
- Electric Consumers Protection Act of 2005
- Energy Policy Act
- Endangered Species Act
- Clean Water Act
- National Environmental Policy Act
- National Historic Preservation Act
- National Dam Safety Program Act

Permits

Federal

- Federal Energy Regulatory Commission (FERC) Application

Washington State

- Section 401 Permit. Section 401 of the Federal Clean Water Act.
- NPDES Municipal Stormwater Permit Section (402)(p)(6) Clean Water Act.
- Hydraulic Project Approval. “Hydraulic Code” Chapter 77.55 RCW.
- US Army Corps Permit-Section 10
- Rivers and Harbors Act of 1899
- Endangered Species Act, Section 7
- Shoreline Management Act

City of Bellingham

- Standard Building Permit
- City Building Permit
- City Shorelines Permit

Table 1. Applicable federal, state, and local permits required for proposal.

Permit Name	Source of Permit	Activity	Contact Agency
Federal			
Federal Energy Regulatory Commission Application Form No. 556	Public Utilities Regulatory Policies Act of 1978. Federal Power Act: Section (3)(17)(E)	Small production facilities generating 80MW or less whose primary energy source is renewable	Federal Energy Regulatory Commission
Section 401 Permit	Federal Clean Water Act: Section 401.	Any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters	Washington State Department of Ecology
US Army Corps Permit	Rivers and Harbors Act of 1899: Section 10. Endangered Species Act: Section 7 Coastal Zone Management Act	activity within, or outside, a state’s coastal zone that will affect land or water uses or natural resources of that state’s coastal zone	United States Army Corps of Engineers

Permit Name	Source of Permit	Activity	Contact Agency
Washington State			
NPDES Municipal Stormwater Permit	Clean Water Act Section (402)(p)(6)	Construction activities that result in land disturbance equal to or greater that one acre	Washington State Department of Ecology
Shoreline Management Permit	Washington State Shoreline Management Act Chapter 173-27 WAC. Chapter 90.58 RCW	Construction adjacent to shorelines of statewide significance	Washington State Department of Ecology Whatcom County
Hydraulic Project Approval	Hydraulic Code Chapter 77.55 RCW WAC 220-110	Work that uses, diverts, obstructs, or changes the natural flow or bed of state waters	Washington State Department of Ecology Washington Department of Fish and Wildlife
City of Bellingham			
Standard Building Permit	City of Bellingham Municipal Code Title 17	Construction of permanent buildings or additions to existing buildings	City of Bellingham
City Building Permit	Municipal Code	Construction of permanent buildings	City of Bellingham
City Shorelines Permit	Municipal Code 16.40	Any development which may alter the shoreline	City of Bellingham

PREPARED BY:

Margaret Taylor – Decision Matrices, Background, Water, Editor
Jena Christiansen – Earth, Plants and Animals, Map, Editor
Graham Goodman – Land and Shore Use, Transportation
Duncan Kunkel-Patterson – Environmental Health, Public Services and Utilities
John Marshall – Executive Summary, Air, Energy and Natural Resources, Other Considerations

ISSUED: March 10, 2010

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Eric Melander, Canyon Industries, Inc.
Adam Fulton, Port of Bellingham

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EXECUTIVE SUMMARY

Three options were examined in this EIA. The first takes 99 cubic feet per second (cfs) from Lake Whatcom year round, the second takes water when Whatcom Creek flows are greater than 100 cfs, typically September – February. The no action alternative leaves all aspects of the site and creek management as they are.

Earth

Under both the proposed and alternative actions, the risk of erosion in Whatcom Creek would be significantly decreased. Since high, irregular flows would be minimized by diverting excess water from Lake Whatcom through the pipeline instead of into the creek, flow rate would become more stable than under current conditions and the stream banks would be less prone to erosion. This would also likely reduce the risk of sedimentation in gravel beds, which can damage fish spawning and rearing habitat. By taking no action, creek flows would remain flashy and irregular with increased risks of erosion.

Plants and Animals

Currently, Whatcom Creek is heavily used by bird, fish, amphibian, and mammal species. The creek hosts four species that hold Federal ESA listings (one bird and three fish) and eight species that hold Washington State listings (seven birds and one fish). Both the proposed action and alternative action would improve fish habitat by reducing the risk of nest destruction by mitigating excessive creek flows. The proposed action may harm migratory fish by drawing down the creek level to a point where it becomes impassible and the water becomes too warm for eggs to properly mature and hatch. This is mitigated under the alternative action.

Water

The proposed action reduces water flow in Whatcom Creek reservoir by diverting water supplies from Lake Whatcom. This has a dual effect of reducing flooding during high flow seasons and reducing flows to very low levels during the summer. While flood reduction could help reduce erosion and infrastructure damage, the resulting seasonal low flows may harm threatened migratory fish and other aquatic organisms. The alternative mitigates this problem by using creek water level data as a determinant for the amount of water that can be diverted through the pipeline. Thus, aquatic organisms have sufficient water while simultaneously reducing risk of flood damage.

Additionally, the diversion of the pipeline from the GP site to Maritime Heritage Park, under the alternative proposal, will reduce the ecological impacts of a new fresh water outlet into Bellingham Bay that would occur under the original proposal.

Natural Resources

Resource availability, renewable, nonrenewable and scenic resources are all affected. Under the proposed action, additional water may need to be diverted from the Middle Fork Nooksack diversion dam to maintain lake levels or a risk of falling below the 311ft winter lake level. This may also significantly affect Whatcom creek levels. Scenic values along the shoreline and along Whatcom Creek will be proportionally damaged. The alternative mitigates these effects by only removing water from the lake during high flow periods.

Infrastructure

Several pieces of infrastructure can or will be affected including the 48" Georgia Pacific Pipeline, electricity transmission, roadways and local utilities. The proposed and alternative actions will not affect current use of the pipeline to provide water the diesel cogeneration power plant downtown. The actions may cause road disruption or closures in the event of a pipe failure and during construction of a water outlet as described in the alternative action. No permanent alterations to infrastructure are required.

Land Use

The land along the waterfront is not currently being used, but current plans of the City anticipate future growth and development in the area. The proposed and alternative actions will have the same impacts on land use, both of which are minimal. The construction of a small scale hydroelectric energy facility near the waterfront will require a piece of land about the same size as a two- or three-car garage. Recreation, including kayaking, fishing, and swimming, may be negatively impacted by water diversion away from the creek. Land use is complicated due to the fact that plans for the waterfront and impacts of these plans are not yet fully known.

Transportation

The construction of a hydroelectric facility will not have significant impacts on transportation and traffic. Current transportation in the area includes the rail line owned by Burlington Northern Santa Fe and the Chestnut/Roeder St Bridge. The City is already planning on relocating the line, making improvements to the bridge, and development of new streets, parking areas, and public transportation. Actions taken by the city will mitigate any impacts on transportation caused by the facility.

SCOPE OF EIA

The scope of this EIA has been determined under the regulations outlined in the Washington State Environmental Policy Act (SEPA). Though all elements of the environment were considered, only elements determined to be affected by the proposal are included in this document.

Elements of the Environment Affected by Proposal

Natural Environment:

- Earth – Erosion, Soils, Topography
- Water – Ground Water, Marine Water, Runoff and Flooding, Public Water Supplies
- Air – Climate
- Plants and Animals – Habitat Diversity, Unique Species, Fish and Wildlife Migration Routes
- Energy and Natural Resources – Nonrenewable Resources, Renewable Resources, Scenic Resources

Built Environment:

- Environmental Health – Noise, Risk of Explosion, Hazardous Materials Risk
- Land Use – Relationship to Existing Land Use Plans, Housing, Aesthetics, Recreation, Historic and Cultural Preservation
- Transportation – Rail Traffic, Traffic Hazards
- Public Services and Utilities – Fire and Police, Parks and Recreation Facilities, Maintenance, Storm Water, Municipal Water Treatment Facility
- Other Considerations – Existing Infrastructure

DECISION MATRIX

Elements of the Natural Environment

	Proposed Action	Alternative	No Action
Earth			
Erosion	++	+	-
Air			
Air Quality	0	0	0
Odor	0	0	0
Climate	+	+	0
Water			
Sedimentation	0	0	0
Runoff	0	0	0
Floods	++	++	0
Surface Water Quality	-	-	0
Surface Water Flow	--	-	0
Groundwater Quality	0	0	0
Groundwater Flow	-	-	0
Public Supplies	-	0	0
Animals/Plants			
Terrestrial Habitat	0	0	0
Freshwater Habitat	+	++	-
Marine Habitat	0	0	0
Unique Species	+	++	-
Fish Migration	-	++	+
Energy			
Available	++	+	0
Nonrenewable	-	-	0
Renewable	++	++	0

Key:

Strong Positive Impact	++
Moderate Positive Impact	+
No Impact / Neutral	0
Moderate Negative Impact	-
Strong Negative Impact	--

Elements of the Built Environment

	Proposed Action	Alternative	No Action
Env. Health			
Noise	-	-	0
Toxin Release	0	0	0
Land/Shore Use			
Aesthetics	+	+	0
Light/Glare	0	0	0
Recreation	0	0	0
Historic/Cultural Preservation	0	0	0
Transportation			
Vehicular Traffic	0	0	0
Parking	0	0	0
Circulation of Goods	0	0	0
Traffic Hazards	0	0	0
Public Services			
Fire Protection	0	0	0
Police	0	0	0
Schools	0	0	0
Parks/Recreation	+	+	0
Maintenance	0	0	0
Water/Storm water	0	0	0
Sewer/Solid Waste	0	0	0

Key:

Strong Positive Impact	++
Moderate Positive Impact	+
No Impact / Neutral	0
Moderate Negative Impact	-
Strong Negative Impact	--

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CHAPTER 1- PROPOSALS

1.1 PROPOSED ACTION

The proposed action entails the construction of a small hydroelectric power system at the end of three miles of 48” pipe that originates at the water treatment plant at Lake Whatcom and ends at the former Georgia Pacific site on the downtown Bellingham waterfront. The pipeline is currently used to supply small amounts of water to a diesel cogeneration peaking plant. The system will be housed within a noise attenuating concrete structure above ground. This proposal calls for the construction of a Canyon Hydro Francis turbine, turbine isolation valve, 900 rpm – 4160 VAC synchronous generator, hydraulic power unit, and switchgear/control package to parallel the generator with Puget Sound Energy. The proposed turbine will be built by Canyon Hydro, a division of Canyon Industries located in Deming, WA. The turbine will run year round, diverting 99 cubic feet per second (cfs), about 64 million gallons of water per day (mgd), directly and untreated (with the exception of a debris screen) from Lake Whatcom. From there the water will exit the facility into Bellingham Bay. Power generation will be connected on site to the 4kv Puget Sound Energy substation. Running at full capacity this equipment will generate 1480 kW of electricity and supply it directly to Puget Sound Energy.

1.2 ALTERNATIVES

1.2.1 Alternative Action

The Alternative Action is to allow the water treatment plant to regulate the flow as needed into the former Georgia Pacific water pipeline below the maximum 99 cfs (64 mgd). In this way it will be possible to maintain a minimum standard flow in Whatcom Creek year round and reduce excessive flows to improve habitat for anadromous fish. This scheme will divert as much water as possible above established safe standards for salmon and trout migration, spawning and rearing and can be managed in real time. Since the shutdown of Georgia Pacific as much as a foot and a half of water is flooded down Whatcom Creek during the fall and winter months in order to reduce the lake level to its winter level of 311 feet. This alternative would reduce the amount of water that must be removed from the lake by the amount used by the hydro turbine, as much as 64 million gallons per day while operational.

This alternative also includes the construction of an outlet pipe to allow fresh water exiting the turbine housing to rejoin with freshwater exiting Whatcom Creek. This will mitigate the effects of freshwater introduction into a marine environment by locating it in an area that is already subjected to freshwater input.

1.2.2 No action

This alternative maintains current conditions and current use of Whatcom creek and the Nooksack diversion as the only means to artificially control the water level in Lake Whatcom. The water pipeline will remain unused except by a single diesel cogeneration peaking plant, whose water use currently has a negligible impact on the lake level.

CHAPTER 2-BACKGROUND

2.1 BACKGROUND

2.1.1 Lake Whatcom Water Use

Lake Whatcom is the primary drinking water source for Whatcom County which regulates lake levels to a minimum of 311 ft. above sea level (ASL) during the summer and a maximum of 314.94 ASL during the winter. Manipulation of a diversion dam and siphon from the Middle Fork of the Nooksack River (constructed in 1962) provides consistent drinking water supplies and prevents flooding of property around the lake and Whatcom Creek.

2.1.2 Whatcom Creek

Whatcom Creek serves as the primary outlet from Lake Whatcom. The creek runs for approximately four miles through forested land, residential, industrial, and downtown sections of Bellingham before reaching Bellingham Bay at Maritime Heritage Park. An oil pipeline fire in 1999 severely impacted the ecology in, and along, Whatcom Creek and while conditions are improving, effects are still evident.

2.1.3 Georgia Pacific Pipeline

The 48-inch pipe runs from the Lake Whatcom to the water treatment plant near Whatcom Falls Park then downtown to the site of the former Georgia Pacific pulp mill at which point it splits into two 24-inch pipes. Previously the mill drew 51 cubic feet per second (cfs) of water from Lake Whatcom through the pipeline until the plant closed in 2001. In 2005 the city of Bellingham acquired 137 acres of waterfront from Georgia Pacific including the former mill property. The actual location of the pipes on the former Georgia Pacific site is unknown since Georgia Pacific did not give the City underground pipe maps of the site during the property transfer. Although previous uses required the water to be chlorinated, this is no longer practiced.

Currently the pipe is used to provide a minimal amount of water used by an adjacent diesel cogeneration peaking plant. This water use has a negligible effect on lake levels.
See figure 1 for location of existing pipeline and figure 7 for proposed location of powerhouse.

CHAPTER 3-THE NATURAL ENVIRONMENT

3.1 EARTH

3.1.1 Existing Environment

3.1.1.1 Soils

There are ten soils that are present in and near Whatcom Creek: Clipper silty clay loam, Labounty silt loam, Cagey silt loam, Squalicum silt loam, Cathcart loam, Barneston silt loam, Kline loam, Labounty-McKenna complex, Bellingham silty clay loam, and Saxon silt loam.

Table 2. Characteristics of soil types occurring along Whatcom Creek.

Soil type	Description
Clipper silty clay loam	poorly drained, very gently sloping areas, high in organic matter; potential source of sand gravel
Labounty silt loam	poor drainage characteristics; very fine sandy and clay silt; will saturate on flat slopes during winter months
Cagey silt loam	poor drainage characteristics; gravelly subsoil layer at depth of about 20 inches offering free lateral water movement over clay till
Squalicum silt loam	rapid surface drainage, low internal drainage; silty clay lain over shale and sandstone bedrock (bedrock occasionally outcrops)
Cathcart loam	well-drained; overlays a thick layer of decomposed sandstone or shale; glacial boulders often occur at the surface
Barneston silt loam	rapidly draining; sandy-gravelly in texture
Kline loam	rapidly draining; sandy-gravelly in texture; occasionally associated with alluvial fans
Labounty-McKenna complex	poor draining; combination of two types of silt-clay loam
Bellingham silty clay loam	poor drainage and likely to saturate
Saxon silt loam	fairly rapid surface drainage, slow internal drainage; poor compaction characteristics

The primary soil along the upper reach of the creek as it leaves Lake Whatcom is Clipper silty clay loam. Then for approximately one mile, the creek flows through an area of Squalicum silt loam. Below this, the creek follows an area of mostly Cathcart loam to Valencia Street and is heavily laden with glacial boulders in this stretch. Between Valencia and Interstate 5, the creek follows a ribbon of Clipper silty clay loam which is bounded on either side by Bellingham silty clay loam and Labounty-McKenna complex. These soils persist until Young Street, where the soil changes to Saxon silt loam which dominates until the mouth of the creek at Bellingham Bay. Other soils are present in small pockets and do not dominate any single portion of the creek. Table 2 gives a brief characterization of each soil type.

3.1.1.2 Topography

The total elevation change from the start of the creek to the mouth is approximately 311 feet. This elevation change varies slightly due to changes in the lake level of Lake Whatcom. The upper reaches of the creek are generally steeper and contain several small waterfalls and large pools. There are several areas where the creek flows over exposed bedrock or glacial boulders. As the creek leaves the forested park where it crosses under Woburn Street, the relief flattens out and the velocity is reduced. For a detailed map of topography along Whatcom Creek, see figure 1.

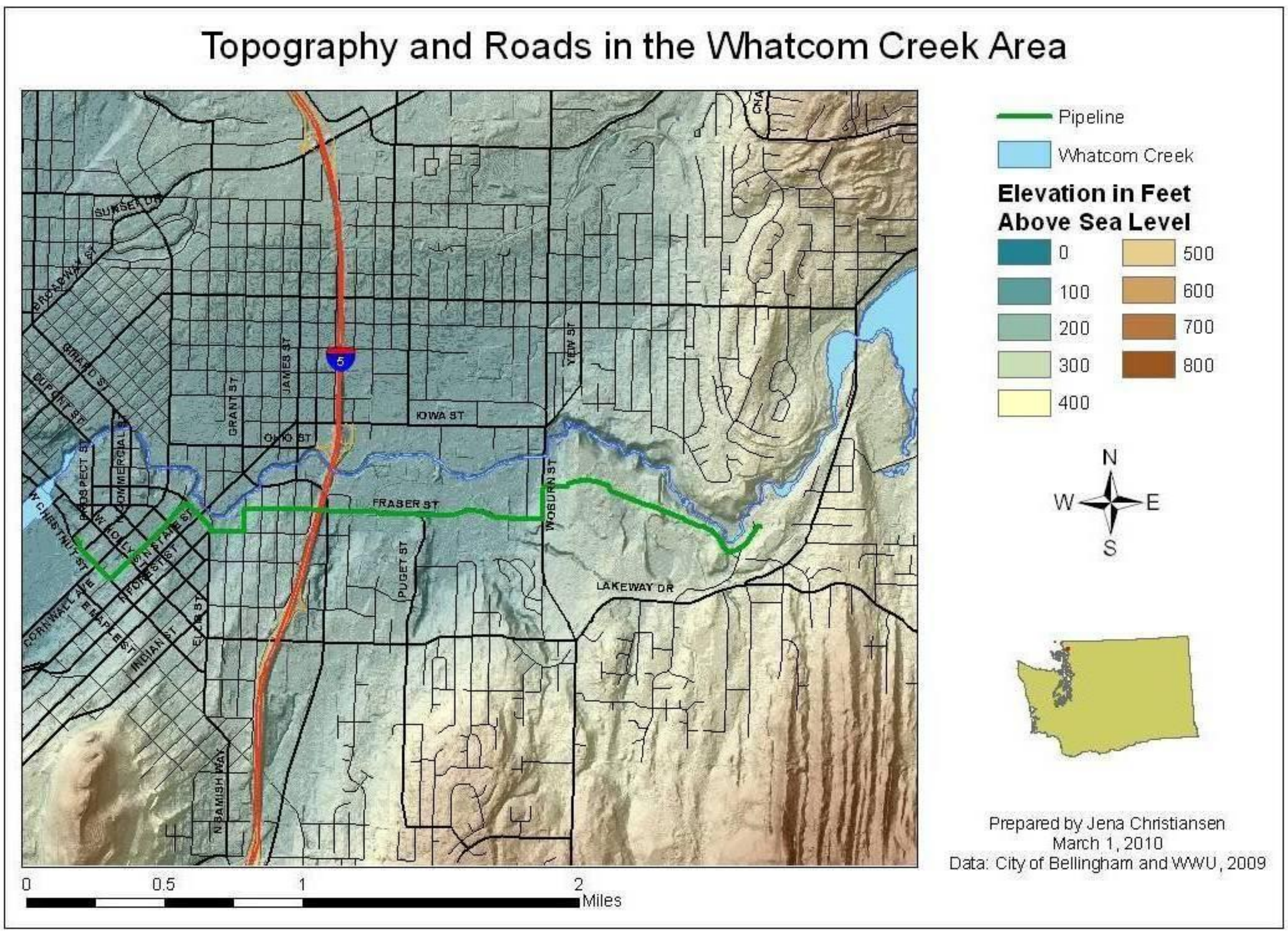

Figure 1. Topography and roads in the Whatcom Creek area in relation to the Georgia Pacific pipeline.

3.1.1.3 Unique Physical Features

The entire Bellingham seaboard, including the former Georgia Pacific site, lies above the Cascadia Subduction Zone. Due to the geologically active nature of this zone, there is a potential for significant seismic activity. Since much of the waterfront industrial site is built on infill, much of the site is vulnerable to a phenomenon called liquefaction. This occurs when a soil substrate takes on liquid-like properties during an earthquake. The powerhouse, turbine, and generator will likely be located somewhere in the industrial site, and in the event of seismic activity could sustain damage as a result of liquefaction. Also, the pipeline has the potential to rupture due to seismic activity.

3.1.1.4 Erosion

Following the 1999 burn along Whatcom Creek, City of Bellingham officials carried out extensive riparian restoration to stabilize stream banks and minimize erosion. This work included planting riparian vegetation, placement of emergency erosion reduction materials (such as hay and landscaping fabric), and installation of large woody debris (LWD) in and along the creek to slow water flow. Due to adjustments made to the stream channel during restoration, some areas are currently experiencing bank erosion as the channel adjusts to its new configuration. The Salmon Wood Park and Cemetery Creek areas are both experiencing extensive erosion due to this adjustment (see figure 2). An area containing steep slopes near the confluence of Hannah Creek and Whatcom Creek has been identified by the City of Bellingham to be at the highest risk of erosion. Whatcom Creek is receiving sediment deposits from these areas, but volumes are relatively small compared to the overall bedload transport capacity. Some stretches of the creek are less prone to erosion as they are exposed weathering sandstone or other bedrock. During high flow periods, such as when water is released from Lake Whatcom to prevent increases in the lake level, the risk of erosion is much higher.

3.1.2 Impacts

3.1.2.1 Proposed Action

By diverting water to run through the pipeline, erosion will likely be reduced as flow rates in the creek will be diminished. Since flows will be kept at a more consistent rate, the likelihood of excess erosion due to flashy, high energy flows will be greatly reduced. Also, excess sediments and suspended solids derived from erosion will be limited. When creeks experience a high pulse of water, the energy in the water picks up larger amount of sediments than would otherwise be transported. As the pulse of slows in a wide area, such as in a shallow gravelly pool where fish may have laid eggs (or a redd), the excess sediment falls out of the water, settling on the bottom of the creek. As the sediment settles on the gravelly bottom, fish eggs that have settled in the gravel become smothered and will not hatch. The proposal will result in a smaller sediment load because of decreases in erosion, reducing the risk of siltation of redds. Bedload transport capacity will likely be diminished due to a general reduction in velocity of the creek.

3.1.2.2 Alternative Action

The alternative action will decrease creek velocity in much the same way as the proposed action. Under this scenario, flow will only be diverted seasonally and during high flow periods, which are the periods of time where risk of erosion is greatest.

3.1.2.3 No Action

By taking no action, erosion potential will remain the same as it is under existing conditions.

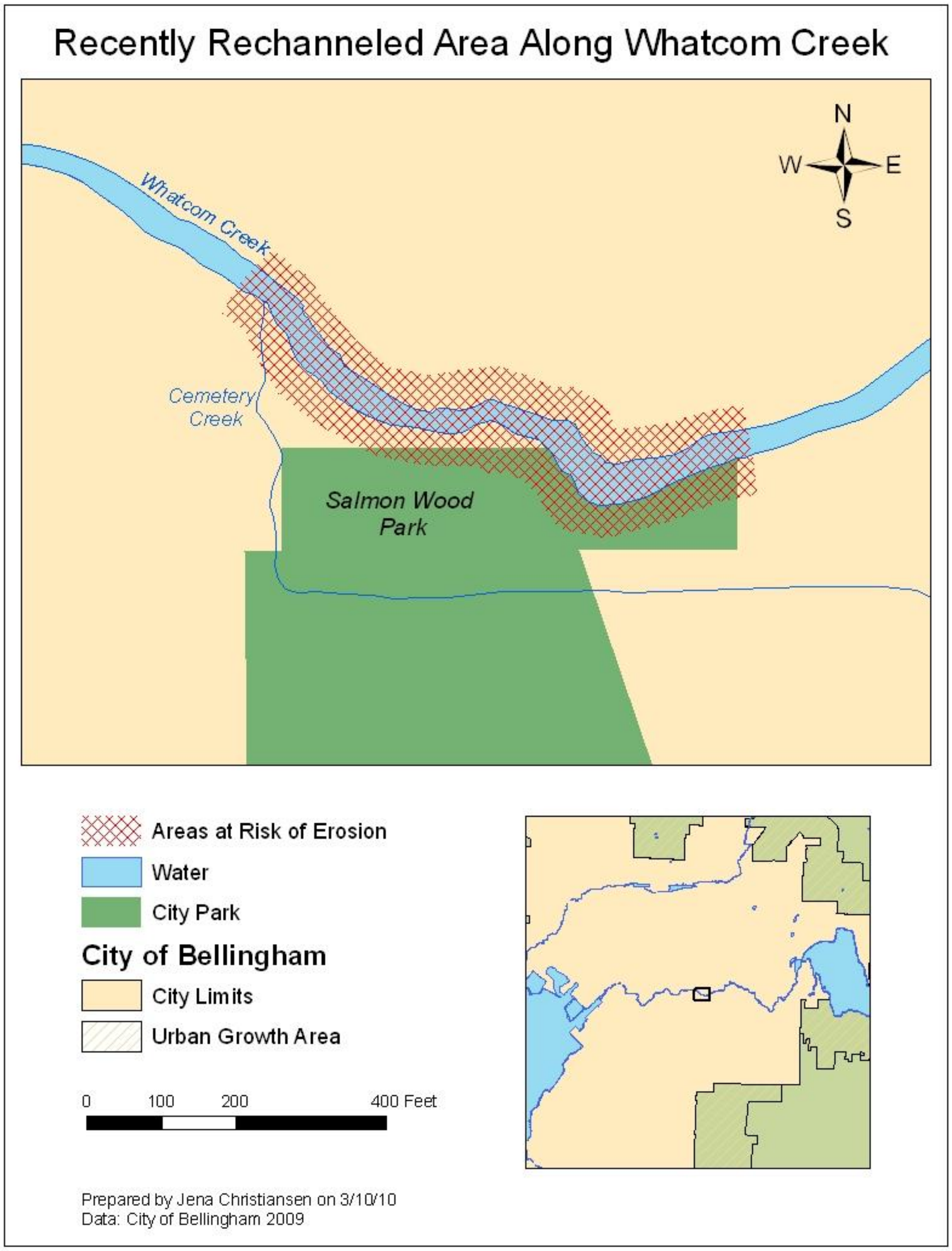

Figure 2. Whatcom Creek and Cemetery Creek confluence near Salmon Wood Park that has been recently rechanneled. This area is at high risk of erosion as the creek adjusts to the new channel configuration.

3.2 WATER

3.2.1 Existing Environment

3.2.1.1 Fresh water

Water quality is determined by a variety of factors including temperature, turbidity, and dissolved oxygen (DO). These factors act as a determinant of environmental health and aquatic habitat quality. Temperatures in Whatcom Creek may be affected by the degree of riparian shading, water flow, water depth, and temperatures of tributary streams. Higher temperatures result in decreased DO which may harm fish eggs and juveniles growing in the creek. Atypical DO levels may also increase the toxicity of certain metals and unwanted nutrients. Studies of Whatcom Creek have indicated that water cools as it travels away from Lake Whatcom toward the bay (Madison 2009). When the creek waters enter the marine system the temperature of combined waters in the mixing zone can affect ecosystem health in the estuary.

Turbidity is a measure of suspended solids in water (essentially a measure of water clarity) and higher levels can affect fish vision and respiration. Higher erosion rates and low flows can potentially increase turbidity because less water is present for the same or greater levels of sediments. DO levels change based on the temperature and pH of the water. High temperatures decrease DO concentrations. Fish eggs require approximately 8 mg/L DO in order to develop properly. Washington State Department of Ecology currently considers Whatcom Creek an impaired body of water with respect to temperature, Fecal coliform, and DO (Washington 2004).

Traditionally, Whatcom creek flows have been determined by the City of Bellingham in an attempt to stabilize Whatcom Lake levels. However, high variability in water levels has been an area of concern ecologists because of challenges to anadromous fish populations at both very high and very low flows. Insufficient water prevents fish from travelling far enough upstream while excessively high flows result in much more energy intensive upstream swimming. Moderate flows provide better fish access and habitat. Whatcom Creek flows vary significantly throughout the year with average monthly flows in 2009 ranging from 3.76 cfs in September to 570.84 cfs in January (Evans 2010). From September to March six species of fish depend on Whatcom Creek for both spawning and rearing, including Puget Sound Chinook salmon and Puget Sound steelhead, listed as threatened under the Endangered Species Act. Fish populations are monitored by City of Bellingham staff and the Whatcom Creek Hatchery.

3.2.1.2 Ground water

The relationship between surface flow and groundwater flow requires complex geophysical analysis. The influence of both on overall stream flow varies seasonally and spatially. Lower stream flows may result in higher influences of groundwater and higher concentrations of dissolved solids typical of groundwater.

Groundwater contamination has been attributed as a primary cause to Lake Whatcom's seasonal low DO levels. When products from leaking septic systems enter groundwater the decomposing organic matter consumes oxygen. Groundwater discharge to lakes typically occurs in areas near the lake and decreases exponentially with distance from shore. This and other concerns with Lake Whatcom water health have prompted groundwater TMDL studies in the area.

3.2.1.3 Marine water

Bellingham Bay marine waters are monitored in similar categories as freshwater but are held to different standards because of the different composition of salt water. Salinity of open marine waters is about 30 ppm in Puget Sound and decreases in estuaries and can be extremely low near the mouth of streams where freshwater inputs are high. Ecosystems in the mixing zone of fresh and salt water can be highly sensitive to change and serve a vital role in the transfer of nutrients. Change in the location of freshwater inputs can disrupt these ecosystems by creating new mixing zones and decreasing the natural freshwater outlet. Similar to fresh water temperature, turbidity, and DO are necessary for the health of aquatic organisms.

3.2.1.4 Runoff and Flooding

A floodgate at the head of Whatcom Creek has been used to release water when lake levels exceed the legal maximum in Lake Whatcom. High rainfall and development projects result in higher than normal seasonal lake levels and creek flows. The creek bed can generally handle the increased flows. However, sandbags have been necessary to protect lower lying homes and businesses during periods of highest flow. A creek area near Iowa Street was widened and deepened to help mitigate floodwaters. However, the results have been negligible (Madison 2009).

3.2.1.5 Public Water Supplies

Lake Whatcom acts as the primary drinking water source for 85,700 people, almost half of Whatcom County. Regulations limit minimum lake levels, however, and occasionally additional water has been needed to be diverted from the Middle Fork of the Nooksack River. As the county grows additional water may need to be allocated or diverted for drinking water supplies.

3.2.2 Impacts

All of the proposed actions would be subject to limits imposed by a growing population in Whatcom County. Eventually the amount of water in Lake Whatcom allocated to drinking water will have to increase. However, tribal water rights along the Nooksack prohibit increased water diversion to Lake Whatcom. Thus reallocation of water would likely eliminate excess flows through the pipeline in as few as 20 years.

3.2.2.1 Proposed action

Diversion of a constant 99 cfs will greatly reduce the amount of water in Whatcom Creek during dry seasons (figure 3). Flow reductions decrease aquatic habitat for fish and invertebrates as well as decrease the viability of Whatcom Creek as a migratory waterway for salmon and other anadromous fish. Because the proposed action does not account for maintaining minimum creek levels, diversion to the pipeline may cause Whatcom Creek to run dry for periods during 8 months out of the year. This would be a devastating blow to aquatic life and probably would eliminate most non-migratory aquatic species. Additionally, low water levels further increase temperature, turbidity, and DO, lowering overall stream health.

However, reducing flow can also act to slightly mitigate seasonal flooding and minimize erosion, reducing seasonal sedimentation and destruction of aquatic habitat.

The release of fresh water to a new location in Bellingham Bay at the Georgia Pacific site will disrupt the ecosystem of the mixing-zone at the mouth of Whatcom Creek. Less fresh water at the mouth will increase the salinity and decrease the habitat for organisms dwelling in the transitional habitat. Similarly the release of fresh water in a new location will decrease the salinity at the new outlet and harm sedentary marine organisms. Furthermore, anadromous fish populations may be confused by the new freshwater outlet and attempt to use the pipeline as a migratory pathway, reducing stock returns. Finally, water traveling through the pipeline does not experience the same cooling effects as water traveling through Whatcom Creek, as well as containing a lower capacity for DO, which may disrupt aquatic organism functions.

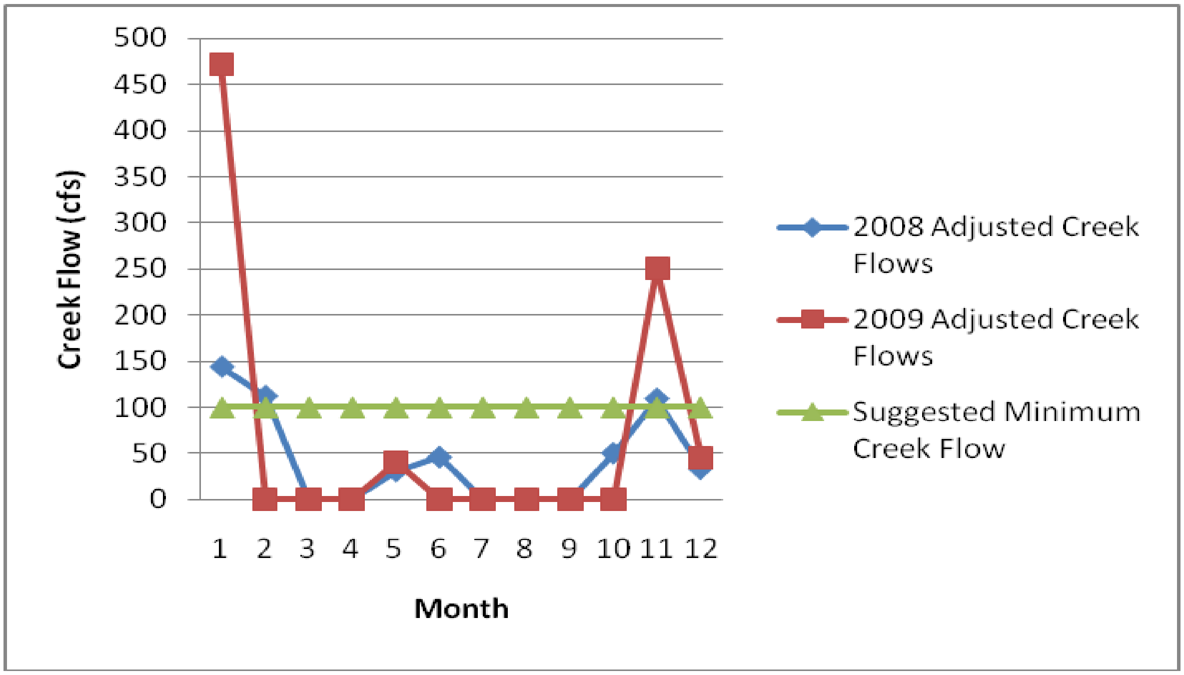

Figure 3. Theoretical flows through Whatcom Creek if the proposed action had been implemented and the pipe was running at full capacity. Note that Whatcom Creek naturally runs below the 100 cfs minimum during drier times of year.

3.2.2.2 Alternative

By diverting water through the pipeline with consideration for Whatcom Creek levels the alternative captures the flood mitigation benefits of the proposal while still allowing for stream health (figure 4). Setting seasonal water levels based on the requirements of aquatic organisms will make water available for ecosystem needs and use the remainder for power generation. Diversion of the water to Maritime Heritage Park will eliminate the impacts of a new freshwater outlet. However, water temperature and DO levels from pipeline water may still alter the mixing zone environment. The installation of a fountain or waterfall using pipeline water at Maritime Heritage Park would both cool and aerate the freshwater thus minimizing impact to the mixing zone.

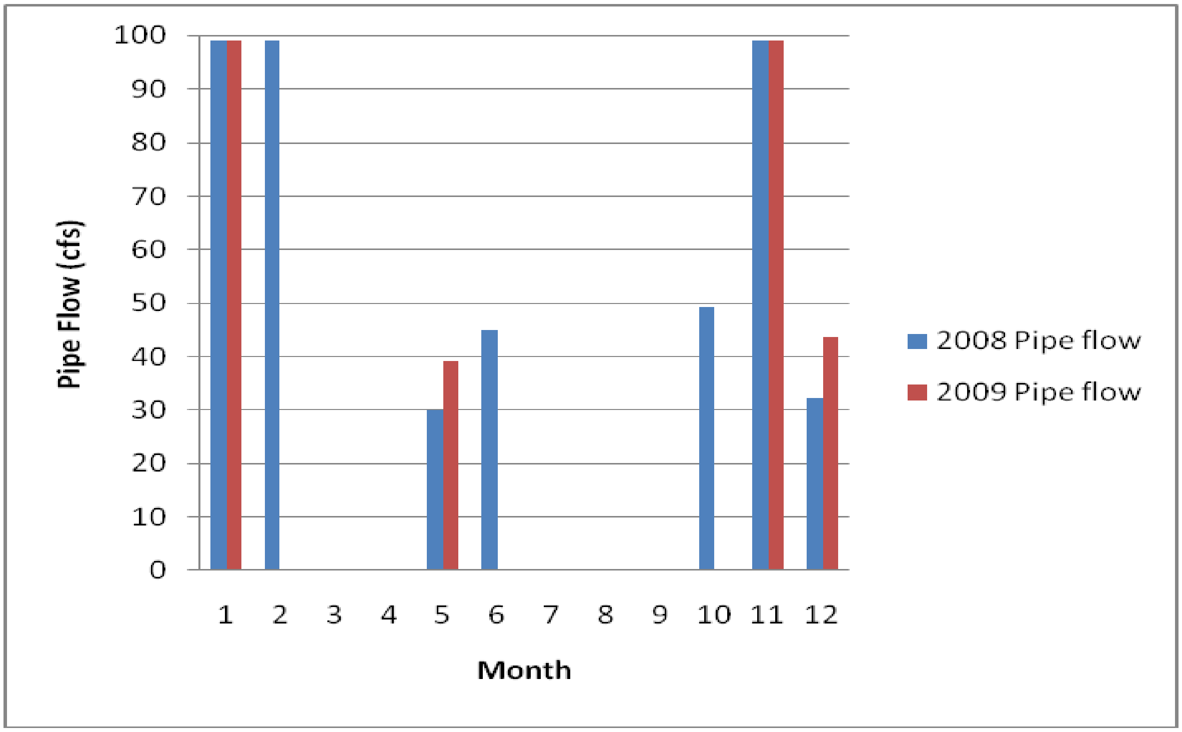

Figure 4. Scenario in which the pipeline would be running as much as possible while trying to maintain a stream flow minimum of 100 cfs. The actual project would likely adjust the minimum stream flow based on salmon migration dates and needs, thus this figure shows an estimate of pipe flow.

3.2.2.3 No action

Flooding will continue to seasonally destroy aquatic habitat however, during the drier months, sufficient water will be available most years.

3.3 AIR

3.3.1 Existing Environment

3.3.1.1 Climate

This project has the potential to offset fossil-fuel derived carbon emissions generated by other forms of power generation. With growing demand for "green" energy and reduction in the use of fossil-fuels, small hydroelectric systems are one part of a multi-part solution.

Bellingham and the surrounding areas are characterized by a marine west coast climate, with an average annual rainfall of 34.84 inches.

3.3.2 Impacts

3.3.2.1 Proposed action

Hydroelectric systems by design emit zero air emissions of any kind once operational. 1480 mw of capacity has the potential to offset 6,696 tons of CO_2 annually generated by fossil fuels.

3.3.2.2 Alternative

Similarly, the alternative of variable pipeline flow will also create zero air emissions and may offset between 0 and 3,000 tons of fossil-fuel derived CO_2 depending on seasonal temperature and rainfall. Exact amounts are unknown.

3.3.2.3 No action

Bellingham is has a goal to purchase 100% green power for municipal operations and will most likely reach this goal without additional hydropower generation in downtown. Purchases by the City of Bellingham will not necessarily offset carbon pollution. Only increased production of power through techniques that do not use hydrocarbons as a fuel source can reduce CO_2 emissions due to electricity production.

3.4 PLANTS AND ANIMALS

3.4.1 Existing Environment

3.4.1.1 Habitat Diversity

Whatcom Creek serves as a greenway that runs from Lake Whatcom to Bellingham Bay along a three-mile course, which acts as a wildlife travel corridor through the City of Bellingham. Its upper reaches cut through a forested park that eventually transitions into a developed urban area, where stream-side habitat is largely preserved by a vegetation buffer. The most abundant tree species along the creek are Douglas fir, western red cedar, red alder, western hemlock, Sitka spruce, bigleaf maple, black cottonwood, and paper birch. This mix of conifers and deciduous trees, along with numerous standing dead trees, provides a diversity of habitat types. The primary invasive vegetative species found along Whatcom Creek Himalayan blackberry.

The pipeline explosion and subsequent burn along Whatcom Creek that occurred in 1999 created numerous snags and pieces of large woody debris along the riparian area which are very beneficial in terms of habitat. According to the Whatcom Creek Post-Fire Evaluation 10-year report (City of Bellingham, 2009), restoration efforts and natural regeneration along the creek have been largely successful. The City of Bellingham has a contracted third-party consulting group to perform ongoing surveys of amphibian, reptile, bird, mammal, and fish populations throughout the burned area since the time of the incident.

3.4.1.2 Unique Species

According to the City of Bellingham's post-fire surveys, five amphibian species, two reptile species, over 66 bird species, six (possibly seven) mammalian species, and six fish species have been confirmed to occupy the creek or utilize the riparian area surrounding Whatcom Creek. Natural fish hatching supplies large amounts of chum annually and fisheries in the creek are augmented by fish released from the hatchery located near the mouth Whatcom Creek adjacent to Maritime Heritage Park (figure 5). Seven bird species confirmed to be utilizing Whatcom Creek have been identified as priority species by the Washington Department of Fish and Wildlife (WDFW), including bald eagle, merlin, pileated woodpecker, Vaux's swift, great blue heron, hooded merganser, and wood duck. Of these, the bald eagle is federally listed under ESA as Recovery status. Chinook salmon in the Puget Sound Region are federally listed under ESA as Endangered and listed by the State of Washington as a criterion 1 priority species. Coho salmon and steelhead are both listed under ESA as Threatened (table 3). For a comprehensive list of species confirmed in or along Whatcom Creek since 1999 by the City of Bellingham, see table 4.

Priority species designations by WDFW area as follows:

Criterion 1, State-Listed and Candidate Species: State-listed species are native fish and wildlife species legally designated as Endangered (WAC 232-12-014), Threatened (WAC 232-12-011), or Sensitive (WAC 232-12-011). State Candidate species are fish and wildlife species that will be reviewed by the department (POL-M-6001) for possible listing as Endangered, Threatened, or Sensitive according to the process and criteria defined in WAC-232-12-297.

Criterion 2, Vulnerable Aggregations: Vulnerable aggregations include species or groups of animals susceptible to significant population declines, within a specific area or statewide, by virtue of their inclination to aggregate. Examples include heron rookeries, seabird concentrations, marine mammal haul outs, shellfish beds, and fish spawning and rearing areas.

Criterion 3, Species of Recreational, Commercial, and/or Tribal Importance: Native and non-native fish and wildlife species of recreational or commercial importance, and recognized species used for tribal ceremonial and subsistence purposes, whose biological or ecological characteristics make them vulnerable to decline in Washington or that are dependent on habitats that are highly vulnerable or are in limited availability

Table 3. Species that hold State and/or Federal listings that have been confirmed to be utilizing Whatcom Creek or its riparian area since 1999.

		Protection Designation	
Common Name	Scientific Name	State	Federal (ESA)
Bald Eagle	*Haliaetus leucocephalus*	Criterion 1	Recovery
Merlin	*Falco columbarius*	Criterion 1	Not Listed
Pileated Woodpecker	*Dryocopus pileatus*	Criterion 1	Not Listed
Vaux's Swift	*Chaetura vauxi*	Criterion 1	Not Listed
Great Blue Heron	*Ardea herodias*	Criterion 2	Not Listed
Hooded Merganser	*Lophodytes cucullatus*	Criterion 3	Not Listed
Wood duck	*Aix sponsa*	Criterion 3	Not Listed
Chinook Salmon	*Oncorhynchus tshawytscha*	Criterion 1	Endangered
Coho Salmon	*Oncorhynchus kisutch*	Not Listed	Threatened
Steelhead	*Oncorhynchus mykiss*	Not Listed	Threatened

The anadromous fish life cycle is characterized by six main stages. First, gravel beds in freshwater streams containing fish nests, or redds, lay dormant for the winter. In spring, eggs hatch and tiny fish called alevins emerge. The alevins will remain close to the redd for several months until the yolk sack attached to their bodies is entirely consumed. Second, nourished by yolk sacks the growing fish emerge from the gravel beds as fry. Depending on the species, fry can spend as much as a year growing and eating in freshwater streams. Survival of the fry is highly correlated to stream water quality. Fish require cold, clear, and clean water systems with lots of shelter from predators. Third, the growing fry begin their journey back downstream to the ocean acquiring silvery scales along the way that are better adapted to their new marine habitat. Healthy estuaries are crucial for this transition because they allow the fish, now called smolts, to feed heavily thus ensuring better survival in the ocean. Fifth, depending on the species, salmon may remain in coastal waters or begin a migration northward to feeding grounds. Finally, salmon find their way back to native streams probably by following scents and chemical traces. Once the salmon reach freshwater they stop feeding and rely on their fat stores to sustain them until they find the upper reaches of the streams where they were born. After spawning, both male and female salmon die and their bodies provide nourishment for river habitat.

Table 4. Species confirmed to be utilizing Whatcom Creek or the adjacent riparian area by the City of Bellingham since 1999 (Whatcom Creek Post-Fire Evaluation: 10 Years After, 2009). Bold species are listed either federally under ESA or by the State of Washington.

Amphibians			
Red-Legged Frog	*Rana aurora*	Long-Toed Salamander	*Ambystoma macrodactylum*
Pacific Tree Frog	*Hyla regilla*	Bull Frog (non-native)	*Rana catesbeiana*
Northwestern Salamander	*Ambystoma gracile*		
Birds			
Great Blue Heron	***Ardea herodias***	Chestnut-Backed Chickadee	*Parus rufescens*
Green-Backed Heron	*Butorides virescens*	Black-Capped Chickadee	*Parus atricapillus*
Mallard Duck	*Anas platyrhynchus*	Dark-Eyed Junco	*Junco hyemalis*
Wood Duck	***Aix sponsa***	Brown Creeper	*Certhia americana*
Common Merganser	*Mergus merganser*	Bewick's Wren	*Thryomanes bewickii*
Hooded Merganser	***Lophodytes cucullatus***	Winter Wren	*Troglodytes troglodytes*
Canada Goose	*Branta canada*	Marsh Wren	*Cistothorus palustris*
Swainson's Thrush	*Catharus ustulatus*	American Dipper	*Cinclus mexicanus*
Varied Thrush	*Ixoreus naevius*	Golden-Crowned Kinglet	*Regulus satrapa*
American Robin	*Turdus migratorius*	Ruby-Crowned Kinglet	*Regulus calendula*
Cedar Waxwing	*Bombycilla cedrorum*	Tern spp.	*Laridae* family
Yellow Warbler	*Dendroica petechia*	**Vaux's Swift**	***Chaetura vauxi***
Yellow-Rumped Warbler	*Dendroica coronata*	Rufus Hummingbird	*Selasphorus rufus*
MacGillivray's Warbler	*Oporornis tolmiei*	Belted Kingfisher	*Ceryle alcyon*
Wilson's Warbler	*Wilsonia pursill*	Red-Breasted Sapsucker	*Sphyrapicus ruber*
Orange-Crowned Warbler	*Vermivora celata*	Downy Woodpecker	*Picoides pubescens*
Black-Throated Gray Warbler	*Dendroica nigrescens*	Hairy Woodpecker	*Picoides villosus*
Common Yellowthroat	*Geothlypis trichas*	Stellar's Jay	*Cyanocitta stelleri*
Western Tanager	*Piranga ludoviciana*	American Crow	*Corvus brachyrhynchos*

Birds (continued)			
Song Sparrow	*Melospiza melodia*	Violet Green Swallow	*Tachycineta thalassina*
White-Srowned Sparrow	*Zonotrichia leucophrys*	Red-Wing Blackbird	*Agelaius phoeniceus*
Pine Siskin	*Carduelis pinus*	Purple Finch	*Carpodacus purpureus*
Bushtit	*Psaltriparus minimus*	American Goldfinch	*Carduelis tristis*
Northern Flicker	*Colaphtes auratus*	Black-Headed Grosbeak	*Pheucticus malanocephalus*
Pileated Woodpecker	***Dryocopus pileatus***	Fox Sparrow	*Passeralla iliaca*
Willow Flycatcher	*Empidomax trailii*	Western Wood Peewee	*Contopus sordidulus*
Pacific Slope Flycatcher	*Empidomax difficilis*	Killdeer	*Charadrius vociferous*
Hammonds Flycatcher	*Empidomax hammondii*	Wilson's Snipe	*Gallinago delicata*
Bald Eagle	***Haliaetus leucocephalus***	Northern Harrier	*Circus cyneus*
Red-Tailed Hawk	*Buteo jamaicensis*	**Merlin**	***Falco columbarius***
Golden-Crowned Sparrow	*Zonotrichia atricapilla*	Common Nighthawk	*Chordeiles minor*
Brown-Headed Cowbird	*Molothrus ater*	European Starling (non-native)	*Sturnus vulgaris*
Fish			
Chinook Salmon	***Oncorhynchus tshawyutscha***	**Steelhead**	***Oncorhynchus mykiss***
Coho Salmon	***Oncorhynchus kisutch***	Cutthroat trout	*Oncorhynchus clarkii*
Chum Salmon	*Oncorhynchus keta*	Humpback Salmon	*Oncorhynchus gorbuscha*
Mammals			
Beaver	*Castor canadensis*	Raccoon	*Procyon lotor*
Coyote	*Canis latrans*	Mink	*Neovison vison*
Black-Tailed Deer	*Odocoilus hemionus columbianas*	Eastern Cottontail Rabbit (non-native)	*Sylviagus floridanu*
River Otter (scat)	*Lontra cacadensis*		
Reptiles			
Painted Turtle (non-native)	*Chrysemys picta*	Common Garter Snake	*Thamnophis sirtalis*

3.4.1.3 Fish and Wildlife Migration Routes

Whatcom Creek has long been used as a wildlife travel corridor that connects the forested park around is origin at the west shore of Lake Whatcom to its mouth at Bellingham Bay. Whatcom Creek also lies within the Pacific flyway that is frequented by migrating birds. The riparian vegetation is heavily used by many bird and mammal species for travel, protection, food, and nesting. The creek itself is home to several amphibian and reptile species as well as to several fish species (see table 4). Though the dam at the origin of Whatcom Creek prohibits anadromous fish from passing into Lake Whatcom, the creek is used annually by spawning and rearing salmon and trout. There are also three sets of waterfalls along the upper third of the creek which impede the ability for fish to migrate upstream.

3.4.2 Impacts

3.4.2.1 Proposed action

The proposed action will improve stream quality and habitat for both aquatic and semi-aquatic species during high flow periods by regulating excessive and sporadic flows via the diversion of excess water from Lake Whatcom down the pipeline instead of into Whatcom Creek. However, during low flow periods (such as in the summer), habitat may be degraded if too much water is diverted and creek flows fall below acceptable rates for fish spawning and rearing. Not only could this render the creek impassible to fish, but water temperatures could rise to levels not conducive to the successful hatching and rearing of eggs. As water warms, the capacity of dissolved oxygen decreases and water may become too anoxic for young fish to survive. If excessive water is diverted for extended periods, riparian vegetation may decline as many riparian species require large amounts of water to thrive.

3.4.2.2 Alternative

The alternative action will both regulate excessive and sporadic flows during the high flow periods and ensure enough water is in the creek to provide suitable spawning and rearing habitat for aquatic and semi-aquatic species during low flow periods. This action will have no significant negative impacts to fish and wildlife.

3.4.2.3 No action

If no action is taken, excessive and sporadic water flows will continue to impact salmon and trout rearing habitat. When excessive water is flushed down the creek during high flow periods to regulate the lake level at Lake Whatcom, redds may be flushed out entirely, crushed by large moving rocks, or silted in by sediments derived from excess erosion and deposited when water velocity slows. Semi-aquatic species may also be impacted because high flow periods during spawning may destroy eggs and wash hatchlings down creek to unsuitable habitat. Terrestrial animal species will likely not be impacted.

High, flashy flows impact vegetation directly adjacent to the stream. As fast moving, high energy water runs over stream side vegetation, the plants are weakened or pulled out from the banks resulting in lower bank stability and increased risk of erosion. Undercutting of banks from flashy flows can also undermine the riparian vegetation, causing further damage as part of the banks cave into the creek.

3.5 ENERGY AND NATURAL RESOURCES

3.5.1 Existing Environment

3.5.1.1 Source and Availability

Lake Whatcom water reservoir currently provides around ten million gallons of water per day for municipal use and far less for industrial uses following the closing of the Georgia Pacific paper mill. It is treated at the filtration plant near Whatcom Creek downstream of the lake outlet. The water supplied to the former Georgia Pacific pipeline is currently not treated; it is passed through a screen room for removal of debris and flooded down the pipeline. Georgia Pacific required that the water be chlorinated at this stage but that chemical treatment is no longer practiced. The pipeline will need to be cleaned prior to turbine startup using a mechanical technique to clear algae buildup currently obstructing the pipe.

3.5.1.2 Nonrenewable Resources

Construction of turbine and housing will require the expenditure of and gasoline and diesel fuels as well as electricity.

3.5.1.3 Conservation and Renewable Resources

Whatcom Creek is recreationally fished for steelhead and chum salmon. The average sport catches for steelhead between 1996 and 2003 were an average reported amount of 45 fish. The creek is open to recreational fishing from the mouth upstream to Woburn Street. Up to two hatchery steelhead per day may be retained from June 1st through February 28th. Drinking water availability is maintained by law through lake water level restrictions of 311 feet in the winter and a maximum of 314.94 feet.

3.5.1.4 Scenic Resources

From Maritime Heritage Park, trails exist on either side of Whatcom Creek. Trails continue on both sides of the creek to Grand Avenue then follow one side or the other to the Railroad Avenue Bridge across the creek. Trails continue along much of the shoreline and parallel to Whatcom Creek (figure 5).

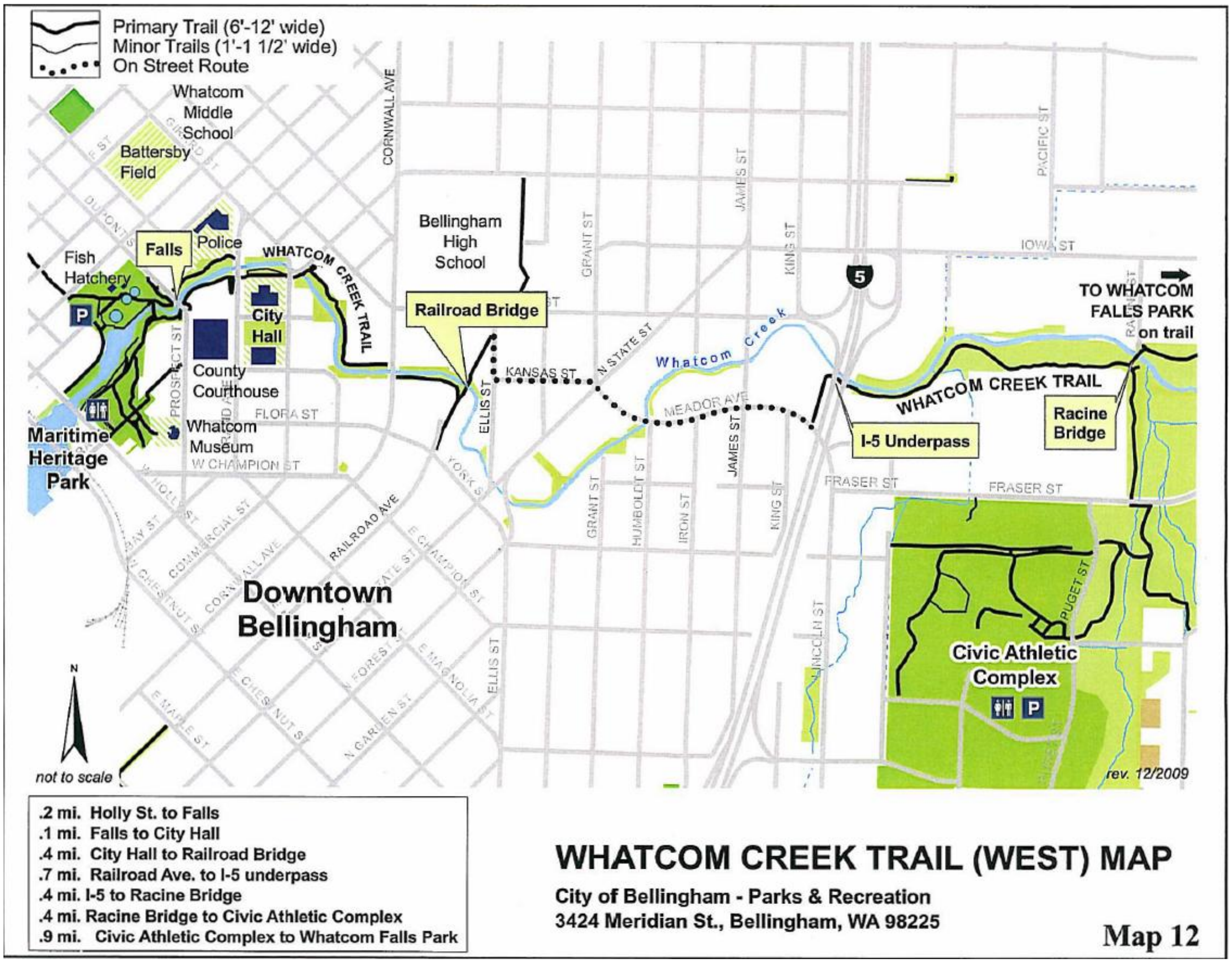

Figure 5. Trails and parks along Whatcom Creek

3.5.2 Impacts

3.5.2.1 Proposed action

The proposed action would remove 99 cfs, about 64 mgd of water from Lake Whatcom. Depending on precipitation and rate of snowpack melt, will likely result in the need to divert additional water at the Middle Fork Nooksack diversion dam due to lake level maintenance requirements. This will not affect the amount of water treated for municipal use. This may significantly reduce water flow down Whatcom Creek will reducing the scenic value of the creek at Marine Heritage Park and on trails and at homes near the creek. Recreational fishing could be damaged during times of low flow and affected by reduced fish populations due to degraded habitat.

3.5.2.2 Alternative

Running the pipeline only when creek flow is in excess of minimal flow needs for fish spawning and rearing will not significantly alter the lake level, as it is merely diversion of this excess flow. Regulating flow in this manner will augment current management techniques of Lake Whatcom levels. Water will only be taken in amounts above the minimum threshold needed for healthy salmon and steelhead populations. Ideally, under this scheme the general practice of adding and subtracting water from Lake Whatcom as set forth in the Lake Whatcom Management Plan will not be significantly altered but the methodology will gain an additional technique for water removal other than relying solely on Whatcom Creek. Any proposal to remove water from the lake via pipeline will necessitate reduced flow down Whatcom Creek in order to maintain lake level.

Similarly, recreational fishing is unlikely to be affected.

3.5.2.3 No action

The no action alternative would leave all scenic resources along the shoreline and at Whatcom Falls Park unaffected.

CHAPTER 4- THE BUILT ENVIRONMENT

4.1 ENVIRONMENTAL HEALTH

4.1.1.1 Noise

The proposed site of the powerhouse is located under a road overpass near railroad tracks adjacent to an industrial area. This area is already subjected to industrial noise levels. Future waterfront development plans may change acceptable noise levels at this site, especially if the area is rezoned.

4.1.1.2 Risk of Explosion

There is very little risk of an explosion in the existing environment. A survey of the proposed site shows that there are electricity transformers there, and there is a small chance of explosion from them, but the risks are very small.

4.1.1.3 Hazardous Materials Risk

The current risk of hazardous materials at the generator site is high. The site is an industrial park that was contaminated with mercury and other pollutants.

4.1.2 Impacts

4.1.2.1 Proposed Action

The proposed action of installing a generator at the end of the Georgia Pacific Water intake pipe would create noise. The spinning turbine and generator will cause noise, and there is a concern that the noise generated will interfere with other proposed development plans for the former Georgia Pacific waterfront site.

Under the proposed action, the turbines would be running at maximum capacity continuously. The generator and turbine will be housed in a small building. The design of the building will employ noise dampening walls and roof. This would reduce the sound heard outside of the generating room, allowing other used for the site to be undisturbed.

The use of small hydro-power generation involves very little increased risk of explosion. The turbines, generator, pipes, and lake water are all non-reactive, and not flammable. There is however a small risk of an explosion in the transformer that allows the generated electricity to be fed onto the utility grid. The risk of this occurring is very remote and can be reduced by purchasing a new transformer with modern safety features and automatic shut-off devices. In the rare event of an explosion, it can be contained inside the generation building. There is a small probability of the pipe line rupturing. But the flow of water would be detected at the municipal water treatment facility and shut down immediately.

The increased risk of a hazardous materials release is very small. The only hazardous materials are manganese bronze bushings in the turbine itself and materials inside the transformer. The bushings of the turbine never come in contact with water, and the risk of them contaminating the environment or affecting human health is very minimal. There are hazardous materials inside the transformer. The risk of contamination and threat to human health is very small and can be contained in the generation room. The generator never will come in contact with the water. The generator is made primarily from copper wire and magnets. These materials can be recycled.

4.1.2.2 Alternative

Under the alternative action, the generator would only be running when Lake Whatcom's water levels are high enough to support both Whatcom Creek and the proposed Hydro plant. The generator would produce less noise hours, but the noise would still be contained within the generation building. Any risk of noise pollution could be reduced by making the building in which the turbine, generator, and transformer are noise proof.

The alternative action risks of explosion are similar to the proposed action, but less likely, due to the decrease operating time. The remote risk of an explosion can be reduced by investing in a modern transformer, with automatic safety shutdowns. Also, if the transformer is located in the generation building, then any potential explosion will be contained by the building.

The alternative has the same hazardous materials risk, but with lower probability of exposure because of fewer hours of operation. To reduce the risk of hazardous materials, the turbine will be painted with non-toxic paint, and will be finely machined, as to not require lubricants. The water flowing through the generator will not come in contact with any hazardous material. The transformer is house in the generator building, so any potential leak of hazardous materials will be contained in the building, and dealt with properly.

4.1.2.3 No Action

If there is no installation and operation of the hydropower, then the noise would not be generated. If there is no action, then the risk of explosion is non-existent and there would be no hazardous material risks.

4.2 LAND USE

4.2.1 Existing Property Conditions

The current zoning of the Bellingham waterfront is Heavy Industrial. The location under consideration for the turbine installation is part of the 137 acres that the City of Bellingham bought from Georgia Pacific in 2006. The edge of the Industrial zone follows Roeder Ave. as it turns into Chestnut St. and bends into Cornwall. All land between this border and the water is part of the Heavy Industrial zoning. The best current estimate of where the turbine would be installed is near the Roeder/Chestnut St. Bridge, approximately a quarter of a mile, or 1300 feet, from the mouth of Whatcom Creek, or just under 3 miles from the headwaters of the creek. This parcel of land, which is near the edge of the waterfront development area, is currently unused and covered in blackberries. Figure 6 shows current zoning along Whatcom Creek and the pipeline.

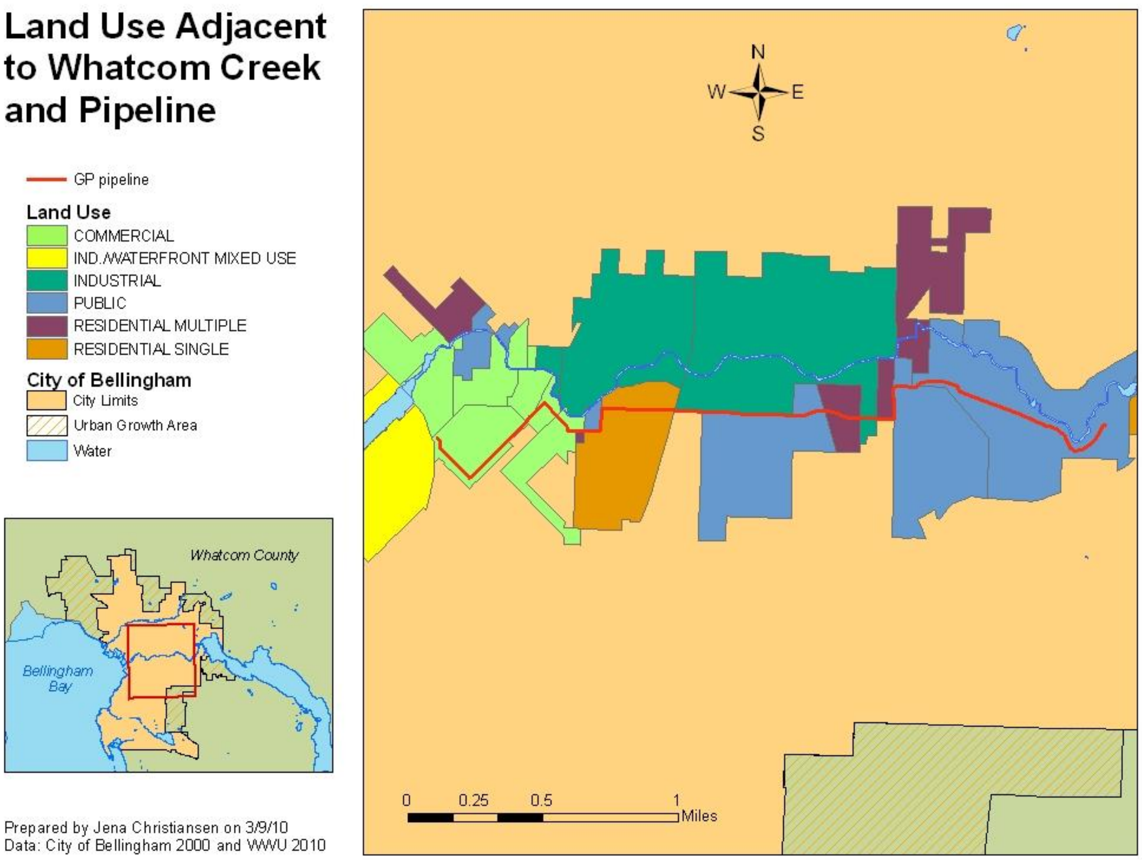

Figure 6. Current zoning in vicinity of Whatcom Creek and pipeline

4.2.1.1 Relationship to Existing Land Use Plans

According to the City's Comprehensive Plan for the Waterfront, the land will eventually be rezoned into Commercial, Residential, Light Industrial, and Mixed Use, although the date at which this will happen is unknown. As a part of the Comprehensive Plan, much of the area owned by the city will be filled several feet higher with miscellaneous debris to prepare for anticipated sea level rise. Future land uses on the specific area in question are difficult to determine, as no plans have been finalized. The area at the terminus of the pipe is currently zoned for Industrial Waterfront Mixed Use (see figure 6).

4.2.1.2 Housing

There is currently no housing in the waterfront area owned by the Port, although future land uses will most likely include multi-family residential units.

4.2.1.3 Aesthetics

Currently, the land in question is fairly desolate. Much of the land is either covered with abandoned buildings, asphalt, dirt, or blackberries. There is evidence of vagrancy in the area as well. Almost any proposal along the waterfront, including a hydropower turbine, will likely take aesthetics into consideration. There has been some discussion over the idea of creating a fountain with the water that leaves the hydro facility.

4.2.1.4 Recreation

Recreational impacts are low. There is a possible impact on recreational fishing at the mouth of Whatcom Creek if flow is diverted away from the creek. Recreational kayaking on Whatcom Creek may also be impacted by the proposal if water is diverted from the creek. There is also a possibility that visitor attendance at Maritime Heritage and Whatcom Falls Parks could decline if there is less water in the creek. Although the recreational value of Whatcom Creek may be impacted, there is potential for educational value if an interpretive site is designated at, or near, the turbine.

4.2.1.5 Historic and Cultural Preservation

The Comprehensive Plan anticipates the preservation of several of the abandoned buildings and structures along the waterfront for historical and renovation purposes. The Waterfront Redevelopment Plan will likely include components of cultural preservation of Bellingham and Pacific Northwest heritage.

4.2.2 Impacts

4.2.2.1 Proposed Action

The impacts on land use are minimal. Under the proposed action, the area where the turbine and hydropower facility will be installed must remain zoned Industrial. This project will require an area approximately the size of a two- or three-car garage. The overall impacts of the Comprehensive Plan will not be fully seen for many years. The phasing process of heavy industrial into mixed use intends to bring in new businesses and residents. This inherently will lead to an increase in traffic and developed land use, both of which are currently almost nonexistent. This proposal anticipates future land use changes and is designed to work alongside future changes in the area.

4.2.2.2 Alternative Action

The difference between the proposed action and the alternative action is how long the turbines will be operational. Under the proposed action, the turbines will be running year-round. Under the alternative action, the turbines will only operate during periods of excess flow in Whatcom Creek. These actions will require the same land use, and essentially have the same land impacts on the area of the turbine's location. Land use impacts are mitigated by educational opportunities and renewable energy at the site.

4.2.3 No Action

No action would leave the piece of land currently unused, as it is at this time. Under the City of Bellingham Comprehensive Plan for the Waterfront, it can be reasonably assumed that there will most likely be a future change in land use. It is likely that this land use will change to residential, commercial, or mixed use in the future, regardless of proposed action outcome.

4.3 TRANSPORTATION

4.3.1 Existing Environment

4.3.1.1 Rail Traffic

There is a rail line running directly through the land owned by the City of Bellingham. Companies that run trains through the area include Amtrak (passenger), Burlington Northern Santa Fe (freight), and Union Pacific (freight). Trains may pass through the city at any hour of any day. The Comprehensive Plan advocates for pushing the line back away from the waterfront. Figure 7 shows roads and rail lines in the vicinity of the pipeline and proposed powerhouse locations.

4.3.1.2 Traffic Hazards

The Chestnut St. Bridge crosses the land owned by the Port. Currently the bridge is a maximum of 35 feet above grade. If the turbine is built below or near the bridge, it could create a distraction to drivers using the bridge.

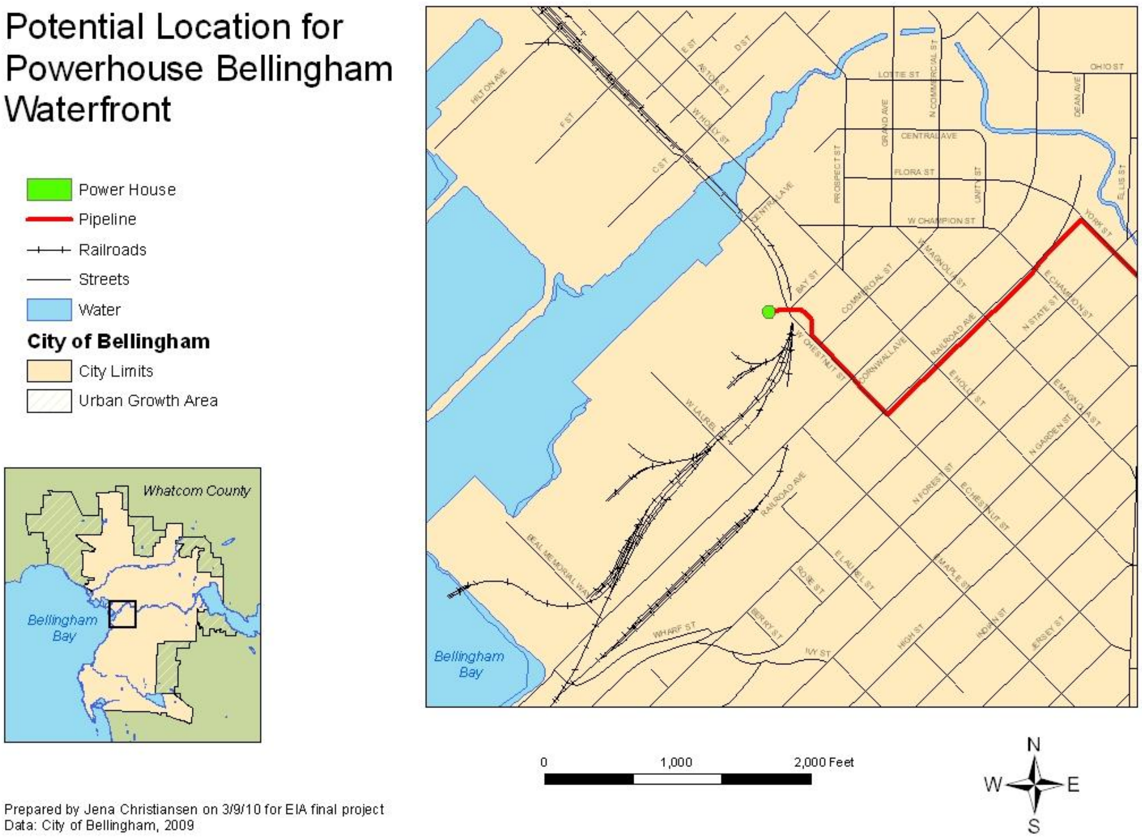

Figure 7. Locations of rail lines and roads in the vicinity of the pipeline and proposed powerhouse location

4.3.2 Impacts

It is unlikely that a hydropower facility alone would create significant impacts on traffic. If the site is used as an educational facility, there may be a more significant impact on traffic due to an increase in visitors to the area. The city has proposals for the waterfront area that will collectively have a large impact on downtown traffic.

4.3.2.1 Proposed Action

The proposed action should not impact traffic drastically from current traffic in the area. Any increase in rail or vehicle traffic that may result in the future will be accommodated by the City's Comprehensive Plan. The City will be responsible for the development of new roads, parking areas, and increased public transit. Relocation of the rail line will need to be negotiated by the City with Burlington Northern Santa Fe.

4.3.2.2 Alternative Action

The alternative action should not impact traffic drastically from current traffic in the area, nor will the alternative actions impacts vary from the proposed action.

4.3.2.3 No Action

If there is no action, then traffic in the waterfront area will not be impacted.

4.4 PUBLIC SERVICES AND UTILITIES

4.4.1 Existing Environment

4.4.1.1 Fire and Police

The Proposed site is in the Bellingham police and fire department's jurisdiction. The nearest fire station, at 1800 Broadway, is less than one mile away. The Police department is less than one mile away, and the site is in a patrolled area.

4.4.1.2 Parks and Recreational Facilities

Lake Whatcom is used as a reservoir and a recreational facility. There are boating and fishing opportunities on the lake.

4.4.1.3 Maintenance

Both pipe and site are not in use.

4.4.1.4 Storm Water

Currently, the excess storm water from Lake Whatcom is flushed down Whatcom Creek, to maintain lake levels.

4.4.1.5 Municipal Water Treatment Facility

The municipal water treatment plant provides water for the city, and has provided water for the pipeline in the past.

4.4.2 Impacts

4.4.2.1 Proposed action

The proposed action will add no extra stress on the police for fire departments. The proposed action would not likely be a terrorism target, nor would it be at high risk of fire. While both departments may need to expand to accommodate the water front development, the project would not affect the scope of the expansion.

The proposed action could adversely affect recreation on Lake Whatcom. If the generator was run all the time without regard to lake level, the lake may experience large swings in the surface levels of the lake. Presently, the lake is used as a recreation area, as well as a reservoir. If the lake levels are volatile, then the lake loses its value as a recreation area.

The pipeline is projected to have a life time of 40 more years. The stock water for the turbine will not have particulates, and is not expected to damage the turbine.

The proposed project would enable Whatcom creek to be protected from storm water. The hydro-project would act as a release for the lake, and reduce the amounts of storm water that would need to be released into Whatcom Creek.

Under the proposed action there would be an increase in volume at the water treatment facility. The increase would not need to be filtered and purified, but it would need to be screened. This might put more work load on the facility. In the past the facility has screened water for the pipe, with no stress on the municipal water supply. The facility is equipped to provide the water, and it is an automated system, not requiring additional equipment or personnel.

4.4.2.2 Alternative

The alternative also presents no additional services by the police or fire departments. The facility would be fitted with security cameras and lights to deter crime.

Because of the court mandate, the lake level would have to remain unaffected, and would not pose a risk of affecting the recreational value of the lake.

Under the alternative, the pipeline, water treatment plant, and generator would be utilized less, and the maintenance costs would be lower.

The storm water impacts would be the same in both the proposed action and the alternative.

The impacts to the water treatment facility would be the same as the proposed action, but to a lesser degree. There will be less water processed, so the strain on the facility would be less.

4.4.2.3 No action

If there is no action taken, there would be no additional stress on the police or fire departments. The lake will remain a recreational area, with no change in value. The water treatment facility will not be affected. Storm water remains unaffected.

4.5 OTHER CONSIDERATIONS

4.5.1 Existing Environment

4.5.1.1 Infrastructure

Current infrastructure includes the 48” water pipeline itself. The pipeline is largely unused, except by a diesel cogeneration plant, which takes a limited amount of water for cooling during peak power conditions. This pipeline was constructed in the early 1940s. Roadways exist above much of the pipeline’s underground pathway. These include Woburn Street, approximately 1.0 mile of Fraser Street, portions of Grant and York Streets, 0.4 miles of Railroad Avenue, and 0.25 miles of West Chestnut Street (see figure 1).

4.5.2 Impacts

4.5.2.1 Proposed Action

Continuous power generation would have no positive or negative impacts on the current 48” pipeline. Current use of the pipeline by a diesel cogeneration plant is periodic, as it is a peaking plant used only during peak power demand during winter months. Use of water by cogeneration plant is so low as to not be measurable by flow meters at the screen room where water to the pipeline is provided.

Installation of a power generator to parallel Puget Sound Energy's power grid will not significantly interfere with current power infrastructure, although construction could cause temporary disruptions in limited downtown areas. Also, in the event that a parallel transmission system is chosen, this increases the danger of maintenance in the case of an outage. This is due to the atypical nature of both sides of a wire being hot when normally power is being generated from one direction.

Renewed use of the pipe increases the risk of pipe rupture, which may require road closures along any of the listed streets, excavation of the site and road use downtime during repair. This also poses a risk to local power transmission, cable and telephone utilities that are carried underground. Since most of the pipe lies in the central plumbing corridor, these risks are already assumed and accounted for in the city's utility management plan.

4.5.2.2 Alternative Action

Effects of the alternative action include those of the proposed action. In addition, construction of water outlet to Whatcom Creek may require excavation and repaving of roadways on the Georgia Pacific site and construction on Roeder Avenue. The outlet will not require permanent compromise of the bridge or roadway but may require temporary road closures during construction.

4.5.2.3 No Action

With no action the 48" water pipeline to the Georgia Pacific site will remain full of water, largely unused and will continue to provide water to the diesel cogeneration power plant during peak power demand conditions.

CHAPTER 5 – CONCLUSION

5.1 Conclusion and Recommendations

After careful considerations, encompassing environmental factors of the natural environment, we recommend that the alternative option be adopted. Implementing the proposed alternative will improve many aspects of the natural environment, without incurring many of the harmful environmental impacts of the proposed action.

Both actions will have little impact on the built environment. Both will generate clean, free electricity. The proposed action the generation would be year round, while the alternative for a significant portion of the year. While the proposed action would generate more electricity than the alternative, it would cause more harm to the natural environment, and threaten the water level in Lake Whatcom. Due to the higher impact on the built environment of the proposed action, we recommend the alternative action.

Both the proposed action and the alternative will improve the environment for plants and animals in and around Whatcom creek, and reduce erosion of the creek's shore. Clean renewable electricity will be produced, and the city of Bellingham would have reduced flood risk. Considering both the natural and built environments, we propose that the alternative action be implemented.

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Figure 2. Whatcom Creek and Cemetery Creek confluence near Salmon Wood Park that has been recently rechanneled

Figure 3. Theoretical flows through Whatcom Creek if the proposed action had been implemented and the pipe was running at full capacity

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Figure 5. Trails and parks along Whatcom Creek

Figure 6. Current zoning in vicinity of Whatcom Creek and pipeline.

Figure 7. Locations of rail lines and roads in the vicinity of the pipeline and proposed powerhouse location

GLOSSARY

Alevin – larval fish that have not yet emerged from the nesting area, typically with the yolk sack still attached

Anadromous – describing fish that hatch in fresh water, migrate to salt water to mature to adults, then migrate back upstream to freshwater to spawn

Aquatic Species – species that live entirely in the water, such as fish

ASL – above sea level (usually feet or meters above sea level)

Bedload – particles of sand, gravel, or soil carried by natural flow of a stream on or immediately above its bed

Cascadia Subduction Zone – zone along the west coast of the United States where the Gorda Plate is pushed beneath the North American Plate resulting in increased volcanic and seismic activity

cfs – cubic feet per second, used to describe the flow rate of water down a creek or pipeline

Conifer Trees – tree species that retain their leaves or needles year-round

Deciduous Trees – tree species that annually drop their leaves or needles

Dissolved Oxygen – the amount of gaseous oxygen (O_2) dissolved in water

Fecal Coliform – a species of bacteria often used as an indicator species for water quality contamination

Federally Endangered Species – an animal or plant species in danger of extinction throughout all or a significant portion of its range as listed under the Endangered Species Act (ESA) of 1973

Federally Threatened Species – an animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range as listed under the Endangered Species Act (ESA) of 1973

Federal Recovery Species – the process by which the decline of an endangered or threatened species is stopped or reversed, or threats to its survival neutralized so that its long-term survival in the wild can be ensured, and it can be removed from the list of threatened and endangered species as specified in the Endangered Species Act (ESA) of 1973

Fry – juvenile fish that have fully absorbed their yolk sack and have emerged from the nesting area

Generator – device that changes mechanical energy (movement) into electrical energy (electricity), usually by creating a rotating electrical field.

Habitat – an ecological or environmental area that is inhabited by a particular species of plant or animal that meets the needs for survival and proliferation of that species

Hazardous Materials – substances that have the potential to adversely affect humans, wildlife, or environment

kW – kilowatt, unit of measuring energy

Liquefaction – taking on liquid properties; can occur to a relatively loose substrate during an earthquake

Municipal Water Treatment Facility – facility that filters, purifies, and distributes drinking water throughout Bellingham located near the West shore of Lake Whatcom

Noise Pollution – unwanted noise that can come from humans, animals, or machines, that disturbs the activity or balance of animal or human life

Parallel Transmission – this refers to the practice of transmitting electricity in both directions along an electric wire

Particulates – small particles in the water, including sand, silt, and other derbies

Peaking Plant – a power generation facility which is used solely for augmenting power generation during times of peak power demand, or "peak load"

Powerhouse – the building where the turbine and generator are housed

Redds – the nests of spawning fish, typically located in riffles or gravel bars composed of medium-sized gravel and are typically 2 to 3 feet wide and 1 to 3 feet deep

Riparian – area of vegetation adjacent to and interacting with a water body such as a creek, river, or lake

rpm – rotations per minute

Seismic activity – earthquake activity caused by the motion of tectonic plates

Semi-aquatic Species – species that require both aquatic and terrestrial habitats, such as frogs

Small Hydroelectric System – power generation facility that captures the potential energy in falling water to produce 1kW to 5MW of electricity

Smolt – salmon or trout that become physically adapted to saltwater and move to a saltwater environment

Storm Water – water that comes from a weather event, such as rain or snow

Terrestrial Species – species that lives on or above the ground, such as birds and many mammals

Transformers – device that changes electricity from one circuit to another

Turbidity – a measure of the cloudiness of water; the cloudier the water, the greater the turbidity. It is caused by suspended matter that interferes with the passage of light through the water

Turbines – rotary devices that extracts energy from moving water (or air), and turns it into useful work, such as kinetic energy that can power a generator

VAC – volts alternating current

Wildlife Travel Corridor – a pathway of vegetation that connects two or more isolated patches of habitat for a range of wildlife species

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