3.1 Water Resources

This section describes existing water resources on the project site and in the project vicinity, evaluates potential impacts associated with the alternatives on these water resources, and describes proposed project mitigation measures. This section is primarily based on the *Stormwater Site Plan for Fairhaven Highlands* (SSP) submitted to the City of Bellingham, August 2007, prepared by Ronald T. Jepson and Associates (Jepson). The SSP was written specifically for Alternative 2A, but could be incorporated into any of the developed alternatives. The SSP provides stormwater mitigation design recommendations showing that the site could be developed with stormwater controls that would adequately provide water quality treatment and detain and release stormwater flows as required by the 2005 Department of Ecology's Stormwater Management Manual (SWMM). Mitigation is required to assure post-development runoff frequencies and durations do not exceed the pre-development flow rates and durations, that the quality of stormwater runoff is not degraded, and that on and off-site water bodies are not adversely impacted by the quantity and quality of stormwater runoff resulting from development of the site.

3.1.1 Studies and Coordination

The SSP for Fairhaven Highlands was submitted to the City of Bellingham in August of 2007 and made available for public review. The SSP utilized guidelines as set forth in the 2005 SWMM, the Puget Sound Action Team's 2005 Low Impact Development Technical Guidance Manual for Puget Sound (LIDTGM) and recommendations in Wetlands and Urbanization, Implications for the Future by Azous and Horner, 2000 (Azous and Horner).

The SSP was supplemented by the following studies:

- *GeoEngineers*: Geotechnical Engineering Report, Proposed Fairhaven Highlands Development, Bellingham, WA, July 27, 2007
- *Northwest Ecological Services*: Wetland Delineation for the Fairhaven Highlands, Bellingham, WA, October 2005
- *Northwest Ecological Services:* Wetland Hydrology Monitoring, December 2005 through December 2006
- *Clear Creek Solutions*: Wetland CC and KK Fluctuation Analysis, August 2007

Except for the no action alternative, all alternatives will require permanent stormwater control systems designed and constructed according to the 2005 SWMM. The SWMM requires pre- and post-developed runoff be quantified using a continuous runoff model, specifically the Western Washington Hydrology Model (WWHM). WWHM's Hydrological Simulation Program parameters are based on calibrated watersheds located in Western Washington. For Whatcom County, the program uses precipitation data from a gauge located in Blaine and then scales the precipitation to a specific project site using published National Oceanic and Atmospheric Administration rainfall map data. Site rainfall data for this specific location is scaled 80%. The model generates 40+ years of hourly runoff data for both pre-development and post-development land use conditions. Flow duration analysis is conducted for 100 flow levels between the lower erosive zone limit (50% of the pre-development two-year flow frequency) and the upper limit (pre-development 50-year flow frequency value). There are three criteria by which flow duration values are compared (SWMM, Vol. III, 2-9):

- If the post-development flow duration values exceed any of the pre-development flow levels between 50% and 100% of the two-year pre-development peak flow values (100% threshold) then the flow control standard requirement has not been met.

- If the post-development flow duration values exceed any of the pre-development flow values between 100% of the two-year and 100% of the 50-year pre-development peak flow values more than 10% of the time (110% threshold) then the flow control standard has not been met.

- If more than 50% of the flow duration levels exceed the 100% threshold then the flow control standard has not been met.

The WWHM was also used for the wetland fluctuation analysis for wetlands CC and KK. The wetland fluctuation analysis utilizes the stage storage curve of the wetland which defines the relationship between the depth of water (stage) and storage volume. The model then calculates pre- and post developed monthly average water depths based on 40+ years of rainfall data and land cover. The model then determines the number of times (measured by a one hour time step) that water levels were above or below the mean by a determined value. Studies by Azous and Horner have found that limits on the frequency and the duration of flooding events may help mitigate losses to wetland plant diversity and biological habitat. Excursions and durations about the mean were quantified by Clear Creek solutions for Alternative 2A and can be found in the appendices of the SSP. A primary stormwater design goal was to protect on and off-site water bodies by matching post-development seasonal wetland water levels (hydroperiods) to the existing pre-development hydroperiods. This analysis could be performed for any of the alternatives, possibly changing detention requirements based on differing amounts of impervious and landscaped surfaces and forest cover.

For each of the developed alternatives, stormwater runoff will be collected and directed to stormwater detention and infiltration facilities and treated by a number of water quality best management practices (BMPs) such as bio-retention and filtration facilities.

3.1.2 Affected Environment

Surface Water

The Fairhaven Highlands project is located within the Chuckanut Creek and Padden Creek watersheds. There are 13 delineated wetlands at the project site. Wetland hydrology is supplied primarily by surface and subsurface flows. None of the on-site wetlands were found to receive significant groundwater contributions except Wetland FF. The majority of rainwater falling on the site is captured in the forest canopy and forest duff layer and attenuated by wetlands. Past saturation, stormwater currently flows to Padden Creek and Chuckanut Creek, the majority of which is carried by existing ditches and city stormwater systems.

Ground Water

Groundwater conditions on site are discussed in the Earth, Soils, and Geology section.

3.1.3 Impacts

Surface Water

Changes in land use can impact surface waters in a number of direct and indirect ways. Development can cause habitat loss, introduction of pollutants, nutrients, and suspended solids, changes in temperature, and hydrologic changes. Stormwater mitigation would be required to detain and treat post-developed stormwater flows. Stormwater detention ponds and infiltration facilities would be incorporated into any of the developed alternatives. Water quality BMPs would be required to provide enhanced treatment to downstream water bodies per the SWMM.

Grading and site preparation would expose soils to erosion and potentially increase sediment and nutrient loadings in runoff thereby degrading aquatic habitats in wetlands and streams. Temporary erosion controls per the SWMM would be incorporated to capture sediments.

Each wetland at the Fairhaven Highlands site has a corresponding drainage basin which contributes surface and subsurface flows. All developed alternatives would isolate wetlands from their contributing basins; therefore treated runoff from landscaped and impervious surfaces would need to be routed to the wetlands to maintain seasonal patterns of water levels. All developed alternatives would increase the quantity and rate of runoff to the wetland systems and Padden and Chuckanut Creeks. Stormwater controls would be required to avoid flooding and protect the stream channels from the erosive effects of high peak flow rates.

Groundwater

There are presently no known active uses of groundwater (from wells) at the site, and no installation/use of any new water supply wells is assumed as part of site development, therefore; groundwater use at the site would not change.

Water Quality

A combination of water quality treatment facilities would be utilized throughout the project site. Bio-retention facilities, dispersion, sand filter treatment, and/or retention would perform the required stormwater quality treatment for each basin. This project will require an added level of water quality treatment due to multi-family housing and the low phosphorus content of the existing wetlands. Sand filter treatment, in conjunction with the required enhanced treatment facilities (bioretention), will be utilized to reduce phosphorus runoff from roads and landscaped areas. In the enhanced buffer alternatives, wider buffer widths will provide treatment utilizing natural dispersion through the native forest duff. The combination of bioretention (raingarden) areas and dispersion will also abate temperature increases within the wetlands.

The following section is a brief overview of stormwater contaminants typical of residential development, such as Fairhaven Highlands.

- Metals – Lead, zinc, cadmium, and copper are heavy metals typically used to assess stormwater quality and its impacts. Heavy metals are mainly found in runoff from road systems and originate from wear of moving vehicle parts. Most metals bind easily to natural soil and sediment materials, and a significant fraction of metals in stormwater runoff are affiliated with total suspended solids.
- Oil, Grease, and Total Petroleum Hydrocarbons – Oil and grease have natural vegetative and manmade components. Total petroleum hydrocarbons (TPH) are a subset of oil and grease derived solely from petroleum products that are more volatile than oil and grease. Natural oils from vegetation generally comprise the remainder. TPH results from automotive spills, leaks, antifreeze, hydraulic fluids, and asphalt leachate.
- Total Suspended Solids – Suspended solids are comprised of inorganic and organic material and can be transported by, suspended in, or deposited by stormwater. Suspended solids are generally considered one of the most substantial non-point source (no single discrete source) contaminants, because other contaminants bind to fine particulates.
- Nutrients – Nitrogen and phosphorus occur in stormwater runoff from sediment erosion, roadways and parking lots, and fertilizers from landscaped areas.
- Fecal Coliform - Fecal coliform are bacteria found in plants, soil, and human and animal waste. Increases in impervious surfaces lead to increases in pathogen deposition and polluted stormwater runoff.

The proposed water quality controls include a number of measures to provide basic, enhanced, and phosphorous treatment for stormwater runoff. The water quality treatment facilities specifically designed for Alternative 4F could be incorporated into any of the developed alternatives. Enhanced water quality treatment is required for multi-family project sites that discharge to fish-bearing streams or to waters or conveyance systems tributary to fish-bearing streams. Enhanced treatment facilities are intended to provide a higher rate of removal of dissolved metals than basic treatment facilities. The design incorporates bioretention areas or raingardens and large or amended sand filters for all pollution generating surfaces. Large and amended sand filters also qualify for phosphorous treatment per the SWMM. A water quality analysis of Wetlands CC and KK performed in September of 2006 found very low levels of phosphorous. Incorporating large or amended sand filters within the enhanced treatment facilities will further reduce phosphorous levels from post-developed flows. Treated runoff will then either be infiltrated, detained in vaults or ponds, or released to the wetlands to maintain hydrology. Treated runoff routed to the wetlands will be level spread and sheet flow through the native vegetation before entering wetlands. Dispersion through native vegetation will promote infiltration, evapotranspiration, temperature cooling, and further treat post-developed flows.

Flooding

Stormwater controls can adequately protect downstream water bodies and developments from the adverse effects of increased runoff due to development. However, if stormwater facilities are not maintained, flooding could occur if systems are not functioning as designed. Stormwater facilities are typically designed for the 100-yr flow frequency, if larger storm events occur, facilities could overflow releasing unmitigated flows downstream.

Stormwater facilities constructed at Fairhaven Highlands would most likely be maintained by a homeowners association. Typically, the association is required to enter into a signed contract agreeing to operate and maintain the system as outlined in the SSP. Stormwater easements will be granted to the COB to allow for monitoring, testing, and emergency maintenance if necessary.

The following discussion pertains to the quantitative stormwater analysis performed for Alternative 2A; the remaining developed alternatives would have like consequences should flooding occur as each alternative could utilize the proposed stormwater controls. The SSP developed for Alternative 2A has a detention pond located in the cul-de-sac serving the single-family area located in the north area of the proposed site plan. If the detention pond was to overflow, runoff would flow to the northwest corner through approximately 300 ft of forest with possible erosive flows to the slope before entering Wetland BB or the mobile home park northwest of the site. The proposed infiltration facility (which would be implemented in all developed alternatives) is located in the upper center of the site. A long-term infiltration rate of 6 inches/hour at that location was identified by Geo-Engineers based on two pilot infiltration tests (PIT). A factor of safety of 6 was applied to this rate to account for possible sediment build up and clogging over time. The design infiltration rate is equal to 1 inch/hour. Stormwater will receive enhanced treatment removing sediments and pollutants before being directed for infiltration, thereby reducing build up of sediments. If the infiltration facility was to fail and overflow, stormwater would flow to Wetland CC and Wetland KK and flow offsite to an existing ditch located along Chuckanut Drive. There is a stormwater detention vault proposed under the entrance road, to be located approximately 200 ft from Chuckanut Drive; flood flows from the vault would enter Wetland CC and flow offsite to the existing ditch located along Chuckanut Drive. Proper maintenance and monitoring will greatly reduce the likelihood of flooding due to facility failures.

Erosion

Proposed construction activities would disturb onsite soils and increase the potential for soil erosion. Without mitigation, surface water runoff could transport eroded soils to on-site wetlands and offsite receiving waters. The use of heavy equipment during construction typically requires onsite fueling and often limited storage of products, such as lubricating oil and hydraulic fluid, which creates a risk for accidental spills. Unintended release of fuels, oil or hydraulic fluid could contaminate soils and, if untended or uncontrolled, migrate to groundwater or into surface water resources. Potential increases in turbidity and pollutants in receiving waters could impact the water quality in these waters. During construction, temporary erosion and sediment control BMPs, as specified in the 2005 SWMM, would be implemented. A Stormwater Pollution Prevention Plan (SWPPP) would be prepared and implemented, as required by the National Pollution Discharge Elimination (NPDES) Construction Stormwater General Permit. NPDES permits are required for all construction activities on sites greater than one acre when discharging stormwater into surface waters. The NPDES will also require weekly turbidity monitoring. The SWPPP would prevent or minimize uncontrolled sediment release to the offsite receiving waters and would identify plans for control measures and spill response to prevent or control construction equipment leakage of fuel, oil, or hydraulic fluid.

3.1.4 Significant Unavoidable Adverse Impacts

All developed alternatives would affect total wetland area. Complete avoidance of wetlands would only occur under the no action alternative. Impacts on wetland areas would be mitigated by creating new wetlands at local and state prescribed ratios. All developed alternatives would result in varying losses of forested areas. Forest cover is the highest and best use of land in a watershed, in terms of reducing excess nutrient runoff, interception, and uptake of rainfall. Forests act as a sink for nutrients, locking them up in live and dead biomass and generate very little if any stormwater runoff. Studies in Puget Sound lowland forests area have found that storm events are moderated by infiltration, evaporation, and transpiration, producing less than 1% of surface runoff. Loss of forest cover can be mitigated by detaining and treating stormwater. Stormwater controls for Fairhaven Highlands will be required to release post-developed runoff at pre-developed forested conditions.

All developed alternatives would result in unavoidable temporary environmental impacts due to necessary construction activities. Water resource impacts associated with construction include sediment from erosion of exposed soils which has the potential for entering surface water runoff and could impact wetlands and surface waters in the vicinity of the project area. Appropriate mitigation measures for erosion and sedimentation impacts would be implemented during construction, including BMPs.

The no action alternative would remove 739 housing units that have already been counted in the COB's Comprehensive Plan as infill within city limits. Lack of urban housing could lead to rural sprawl and degradation of resources.

3.1.5 <u>Alternative Analysis</u>

The stormwater controls outlined in the submitted SSP for Fairhaven Highlands for Alternative 2A could be adapted to any of the developed alternatives. Changes in impervious, landscaped surfaces, and forest cover will require changes in detention volumes and sizing of water quality treatment facilities. The following table depicts percentage of land cover for each of the alternatives. Non-pollution generating surfaces include roofs, sidewalks, and stormwater ponds. Pollution generating surfaces include roads and parking areas.

Alternative Analysis - Percentage of Land Use								
Land Use	**No Action**	**1A**	**1B**	**1C**	**2A**	**2F**	**3D**	**4F**
Forest	92.4	26.6	26.6	26.6	42.9	42.9	44.3	30.9
Wetlands	7.6	6.6	6.6	6.6	6.9	6.9	6.9	6.9
Non-Pollution Generating Impervious Surface	0	22.0	22	22.2	13.7	13.8	14.4	13.7
Pollution Generating Impervious Surface	0	13.7	14.4	14.9	11.2	11.6	11.9	11.8
Landscape Areas	0	31.0	31	31.7	25.3	24.8	24.3	36.7
Total	**100**	**100**	**101**	**102**	**100**	**100**	**102**	**100**

3.1.6 <u>Alternative 1A</u>

Alternative 1A is the site plan included in the 2005 vested application.

On-Site Impacts

The on-site impacts to site hydrology, water quality, flooding, and erosion were discussed qualitatively in the Impacts section and apply to this alternative with the exceptions noted below.

Alternative 1A was prepared prior to extensive geotechnical, ecological,. and stormwater studies. The site plan for this alternative includes stormwater ponds at several locations across the site. As a result of current studies, this alternative would probably not include the number of stormwater ponds shown as the infiltration facility and quantitative wetland hydro-period analysis would be integrated. Therefore, the stormwater management system would be changed to adequately maintain hydrology to wetlands and protect stream channels.

Alternative 1A proposes land uses as quantified in the following table and shown in Exhibit 1A-3:

Land Use	Area (AC)	Percent of Site
Forest	21.88	26.6%
Wetlands	5.47	6.6%
Non-Pollution Generating Impervious Surface	18.12	22.0%
Pollution Generating Impervious Surface	11.31	13.7%
Landscape Areas	25.49	31.0%
Total	**82.27**	**100.0%**

Compared to Alternative 2A there is a decrease in forested areas and corresponding increase in impervious and landscaped. Therefore, this alternative would require greater detention volumes and water quality treatment facilities

Off-Site Impacts

The off-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative with the exceptions noted below.

Proposed construction activities will include various off-site impacts, including lane widening along Chuckanut Drive, the 16th Street connection, and minor stormwater conveyance improvements. All improvements will meet the City of Bellingham Standards, the DOE SWMM, and WSDOT standards.

3.1.7 <u>Alternative 1B</u>

Alternative 1B is the same as Alternative 1A except that it incorporates the widening of the existing 12th Street Bridge.

On-Site Impacts

The on-site impacts related to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative. No significant changes in on-site impacts result between Alternatives 1A and 1B.

Land Use	Area (AC)	Percent of Site
Forest	21.88	26.6%
Wetlands	5.47	6.6%
Non-Pollution Generating Impervious Surface	18.12	22.0%
Pollution Generating Impervious Surface	11.81	14.4%
Landscape Areas	25.49	31.0%
Total	**82.77**	**100.6%**

Off-Site Impacts

Replacing the existing Fairhaven Bridge will add an estimated 0.5 acres of impervious surfaces that would require stormwater mitigation at the bridge site in the forms of detention and enhanced water quality treatment.

Construction would most likely fill or severely impact existing wetlands and increases in the amount of impervious surfaces could indirectly change the diversity and density of local fish and insect populations within the adjacent creek. Reconstructing the existing bridge to a much wider structure would have direct effects on the surrounding water quality. This would be primarily due to the larger impervious, pollution-generating surfaces contributing increased metal concentrations and sediment to Padden Creek. Enhanced water quality treatment facilities would help to offset any effects on water quality. However, this would come at a high cost since additional properties would be needed to site these facilities. Impacts to existing sensitive areas would need to comply with federal, state, and local permit regulations adding additional costs to the project through installation of mitigation measures to offset negative effects.

Indirect effects on sensitive wetland areas could include changes in hydrology, increased noise and light, or intrusion by invasive plant species. Fish resources could be indirectly affected as riparian buffers could be lost or the general water quality degraded by added pollution flowing into the creek. Effects on wildlife could include replacement of existing habitat by new impervious surfaces and, where habitat quality is reduced, by increased noise and visual disturbance. More sensitive wildlife may avoid these areas completely. Other effects could include increased mortality of animals trying to cross the widened roadway section. Open areas left under bridge structures could promote long-term soil erosion and transport of sediment-laden runoff to downstream habitats. Changes in slope stability could also increase susceptibility to seismic disturbances.

The extremely high price associated with this alternative may be best utilized to better accommodating future development in accordance with the City of Bellingham's Master Plan.

3.1.8 Alternative 1C

The on-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative with the exceptions noted below.

The site layout for Alternative 1C is the same as Alternative1A except that it includes the construction of an arterial collector street from Chuckanut Drive to 24th Street through the project site.

On-Site Impacts

Alternative 1C proposes land uses as quantified in the following table and shown in Exhibit 1C-3:

Land Use	Area (AC)	Percent of Site
Forest	21.88	26.6%
. Wetlands	5.47	6.6%
Non-Pollution Generating Impervious Surface	18.3	22.2%
Pollution Generating Impervious Surface	12.23	14.9%
Landscape Areas	26.04	31.7%
Total	**83.92**	**102.0%**

Off-Site Impacts

The construction of the connection to 24th Street will add approximately 40,000 sf of impervious area. This impervious area would require the construction of an additional stormwater detention and water quality facility as this area slopes away from the project. Low impact development techniques would be employed to maintain site hydrology and minimize impacts to the environment.

3.1.9 Alternative 2A

Alternative 2A is a revision initiated and proposed by the project proponent. The project team was asked to minimize environmental disturbance of the project site and increase buffer widths while maintaining the overall unit count.

On-Site Impacts

The SSP was written to address this particular site plan layout. The on-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative. Alternative 2A proposes land uses as quantified in the following table and shown in Exhibit 2A-3:

Land Use	Area (AC)	Percent of Site
Forest	35.29	42.9%
Wetlands	5.65	6.9%
Non-Pollution Generating Impervious Surface	11.26	13.7%
Pollution Generating Impervious Surface	9.24	11.2%
Landscape Areas	20.82	25.3%
Total	**82.26**	**100.0%**

Off-Site Impacts

The off-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative.

3.1.10 Alternative 2F

Alternative 2F is the same as Alternative 2A except the site layout includes the addition of a public street connecting the project to 16th Street.

On-Site Impacts

Alternative 2F proposes land uses as quantified in the following table and shown in Exhibit 2F-3:

Land Use	Area (AC)	Percent of Site
Forest	35.29	42.9%
Wetlands	5.65	6.9%
Non-Pollution Generating Impervious Surface	11.38	13.8%
Pollution Generating Impervious Surface	9.55	11.6%
Landscape Areas	20.4	24.8%
Total	**82.27**	**100.0%**

The on-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative with the exceptions noted below.

Stormwater facilities would be increased in size to accommodate the above-mentioned increase in impervious areas. An additional off-site raingarden would likely be utilized to provide water quality treatment for the 16th Street modification.

Off-Site Impacts

The on-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative with the exceptions noted below.

3.1.11 <u>Alternative 3D</u>

Alternative 3D is a variation that eliminates the proposed road bisecting Wetland CC and Wetland KK.

On-Site Impacts

The on-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative with the exceptions noted below.

Removing the road between Wetland CC and Wetland KK will reduce the impacts to the two wetlands by reducing buffer impacts and creating habitat connectivity. Alternative 3D proposes land uses as quantified in the following table and shown in Exhibit 3D-3:

Land Use	Area (AC)	Percent of Site
Forest	36.44	44.3%
Wetlands	5.65	6.9%
Non-Pollution Generating Impervious Surface	11.81	14.4%
Pollution Generating Impervious Surface	9.82	11.9%
Landscape Areas	20.03	24.3%
Total	**83.75**	**101.8%**

Off-Site Impacts

The off-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative with the exceptions noted below.

3.1.12 Alternative 4F

Alternative 4F is the same as Alternative 2F except that the southern portion of the site is single family units, with a larger number of multifamily units clustered in the northern portion.

On-Site Impacts

Alternative 4F proposes land uses as quantified in the following table and shown in Exhibit 4F-3:

Land Use	Area (AC)	Percent of Site
Forest	25.46	30.9%
Wetlands	5.62	6.8%
Non-Pollution Generating Impervious Surface	11.27	13.7%
Pollution Generating Impervious Surface	9.7	11.8%
Landscape Areas	30.23	36.7%
Total	**82.28**	**100.0%**

Off-Site Impacts

The off-site impacts to site hydrology, water quality, flooding, and erosion were discussed in section 3.3.3 and apply to this alternative.