

City of Lynnwood Public Works



Final Conceptual Hydraulic Report

Poplar Way Extension Bridge Improvement Project – Phase 2
(Interstate 5, MP 181.60)
(SR 524, MP 5.29)

September 2013



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Project: Poplar Way Extension Bridge Project – Phase 2
City of Lynnwood, Washington

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I.0 PROJECT OVERVIEW

I.1 Site Location

The proposed project is located in the City of Lynnwood, Snohomish County, Washington. The project site boundaries are situated in Township 27N, Range 04E, Sections 15 and 22. On Interstate 5 (I-5), the project crossing is at Milepost 181.60. On SR 524 the crossing is near Milepost 5.29. See vicinity map, Figure 1.

The project area is located entirely in Water Resource Inventory Area (WRIA) 8, as illustrated in Figure 2. WRIA 8 is divided into two watersheds - Lake Washington/Cedar and Sammamish. The project site lies within the Sammamish watershed. This watershed is further divided into a number of smaller basins and sub-basins. The project site lies within the Golde Creek sub-basin. The project site drains to Golde Creek which drains to Scriber Creek. Scriber Creek drains to Swamp Creek which discharges into the Sammamish River.

I.2 Vicinity Map and WRIA Map

Figure I – Vicinity Map

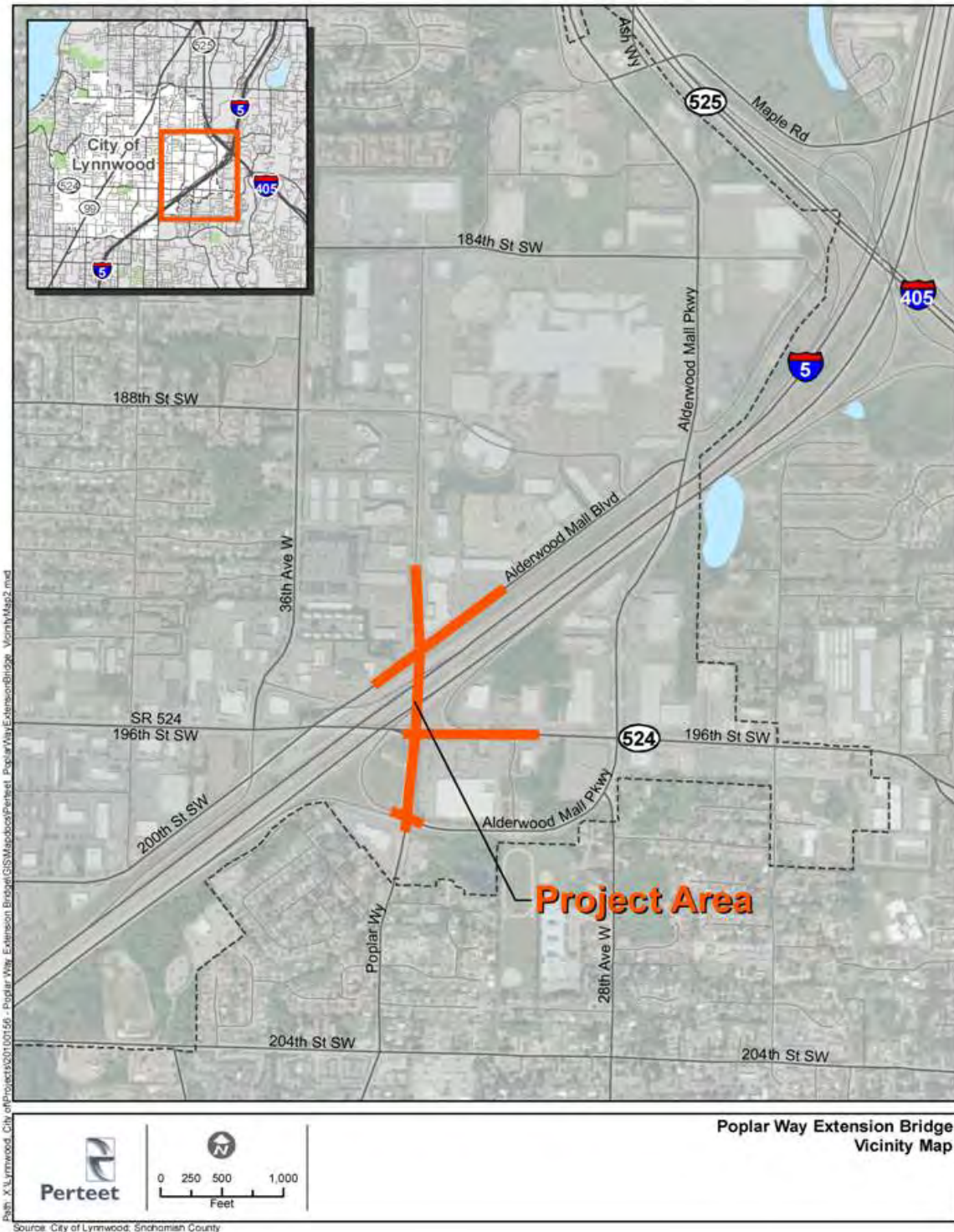


Figure 2 – WRIA Map



I.3 Scope of Project

The Poplar Way Extension Bridge is a key transportation improvement identified within the “Interstate 5 (I-5) to Lynnwood City Center Access Study,” developed by the City in cooperation with the Washington State Department of Transportation (WSDOT), FHWA, and Snohomish County. The City of Lynnwood, working cooperatively with WSDOT and FHWA, proposes to construct a new bridge across I-5 between Poplar Way and 33rd Avenue W (at approximately 196th Street SW [SR 524]). Major elements of the Poplar Way Extension Bridge project will include a new multi-lane bridge structure with six lanes, pedestrian and bicycle facilities; intersection modifications and grade adjustments to accommodate tie-in to existing streets on either side of the freeway; and widening and restriping of portions of Poplar Way, 196th Street SW, Alderwood Mall Boulevard, 33rd Avenue W and Alderwood Mall Parkway. The project will also accommodate the Interurban Trail, which runs along Alderwood Mall Boulevard on the west/northwest side of I-5. This trail is a regional, multi-use paved facility which connects communities from Shoreline to Everett. To accommodate the trail, a separate three-sided concrete box structure will cross over the trail, and the trail profile will be lowered.

The proposed storm drain system will include new catch basins, storm pipe, and Filterra units. The catch basins will be placed along the curblines of the newly widened roadway improvements and will collect runoff from the improved roadway and sidewalk areas. Water quality treatment and oil control will be accomplished by the use of Filterra units. There were three alternatives considered for satisfying the project’s flow control requirements. Each alternative is discussed in greater detail in Section 4.0 of this report. The recommended alternative involves the retrofit of an existing regional detention pond located north of the site. Refer to Appendix A-4 of this report for schematic layouts of each drainage alternative considered. An alternative comparison can also be found in Appendix C of this report. Refer to the figures in Appendix A-2 of this report for a delineation of project limits, new impervious areas, existing drainage conditions, etc.

2.0 SITE CONDITIONS

2.1 Existing Conditions

The entire project is located within both the City of Lynnwood and WSDOT right-of-way. Project limits are confined to portions of the roadway corridors of Alderwood Mall Boulevard, Poplar Way, 196th Street SW, 33rd Avenue W and Interstate 5 (I-5). A portion of the Interurban Trail is also located within the project limits and will be affected by the project improvements. The roadway corridors are comprised mostly of asphalt roadway with adjacent concrete vertical curb, gutter, and sidewalk and in some areas edge of pavement leading to existing roadside ditches. There are also lawn and landscaped areas which are prevalent in areas at the back of sidewalks and on either side of the Interurban Trail. The majority of project area is gradually sloped with one area, 196th Street SW, which approaches 8% grade. The project site is bounded by commercial developments on all sides except where it is bisected by I-5 in the middle of the project. Both underground and aboveground existing utilities are present in most of the project corridor areas. Refer to Section 2.6 of this report for more information relating to the existing utilities associated with this project.

2.2 Existing Hydraulic Features

The majority of runoff generated within the project limits sheet flows off of crowned roadways and adjacent sidewalks into concrete gutters which direct runoff into catch basins. From here, runoff is conveyed in underground storm drain pipe to each of the project site discharge points. Runoff from the Interurban Trail, the west side of Poplar Way, and the area on I-5 which, will be covered by the new bridge, sheet flows off of the roadway and into roadside ditches. These roadside ditches either direct runoff into a storm drain system or continue to convey runoff to the project site discharge points via ditches. Refer to Figures A-2.1 through A-2.7 in Appendix A-2 of this report which show the existing hydraulic features that currently collect and convey runoff within the project site. Project improvements will not adversely affect the existing hydraulic features. Runoff from the post construction project site will continue to be collected and conveyed to the project site discharge points to the greatest extent practical. Drainage basins will also be maintained within the project site to the greatest extent practical. New impervious surfaces and new pollution generating impervious surfaces (PGIS) will be treated according to the requirements which govern this project. Refer to Section 4.0 of this report to see which stormwater Best Management Practices (BMPs) will be used for this project.

There are two general areas where runoff from upstream off-site areas discharge runoff into the project site. Sheet flow from a grassy area just east of the Poplar Way project limits enters the roadside ditch on the west side of Poplar Way. Runoff from the adjacent church and commercial properties north of Alderwood Mall Boulevard and west of 33rd Avenue W discharge runoff into the site at five different locations via storm drain pipe. Refer to Figure A-2.8 in Appendix A-2 of this report to see where these discharge points are located and which areas they are conveying runoff from.

There are two wetlands located within the project vicinity. They are located on the north and south sides of 196th Street SW, between Alderwood Mall Parkway and I-5, directly east of the current project limits. According to the U.S. Fish and Wildlife Service, the National Wetlands Inventory (NWI) indicated that both these wetlands are PFOA systems (palustrine, forested, temporarily flooded). Project improvements are not close enough to impact these wetlands or their buffers.

One stream, Golde Creek, is also located within the project vicinity, directly east of the current project limits. Golde Creek originates north of I-5 in the Alderwood Mall pond facility, travels within a culvert in a southeasterly direction under the mall development and I-5, and daylights immediately south of I-5.

It then flows in a southeasterly direction through the two PFOA wetland areas, and eventually connects with Scriber Creek to the south. The Washington Department of Natural Resources (DNR) maps classify the majority of this stream as a Type F water. However, the northernmost portion – north of 196th Street SW – is classified as a Type N water. The Snohomish County SnoScape maps classify Golde Creek as a fish-bearing stream from its confluence with Scriber Creek to just south of 196th Street SW; north of this area it is classified as non-fish habitat. Project improvements are not close enough to impact this stream or its buffers. Refer to Figure 3 for a delineation of critical areas within the project area vicinity.

The Federal Emergency Management Agency (FEMA) flood insurance map (FIRM) for the area where the project site is located does not show any 100-year floodplains associated with Golde Creek. There are no other 100-year floodplains shown within or nearby the project limits. See Figure 4 for the flood insurance map.

Figure 3 – Critical Areas

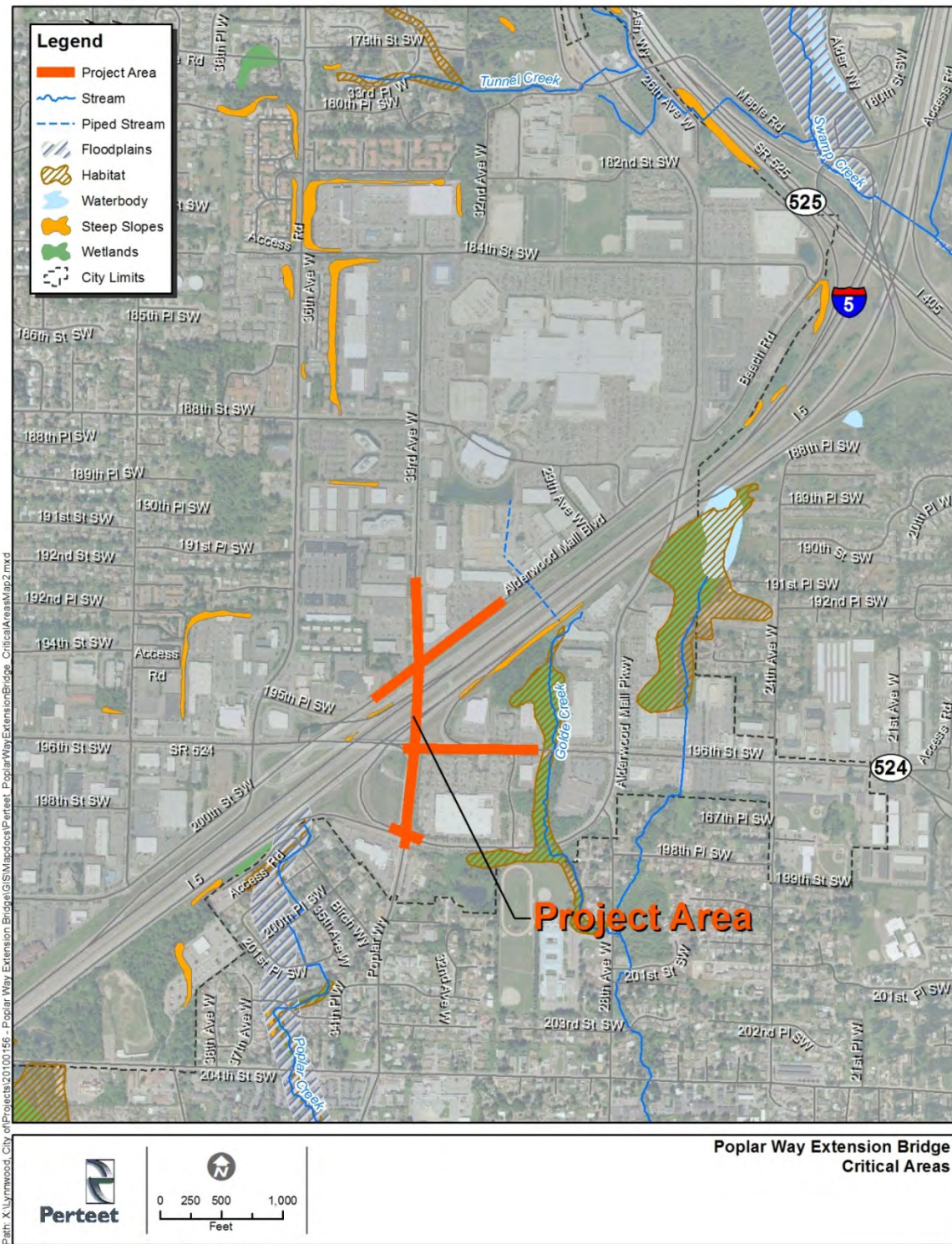
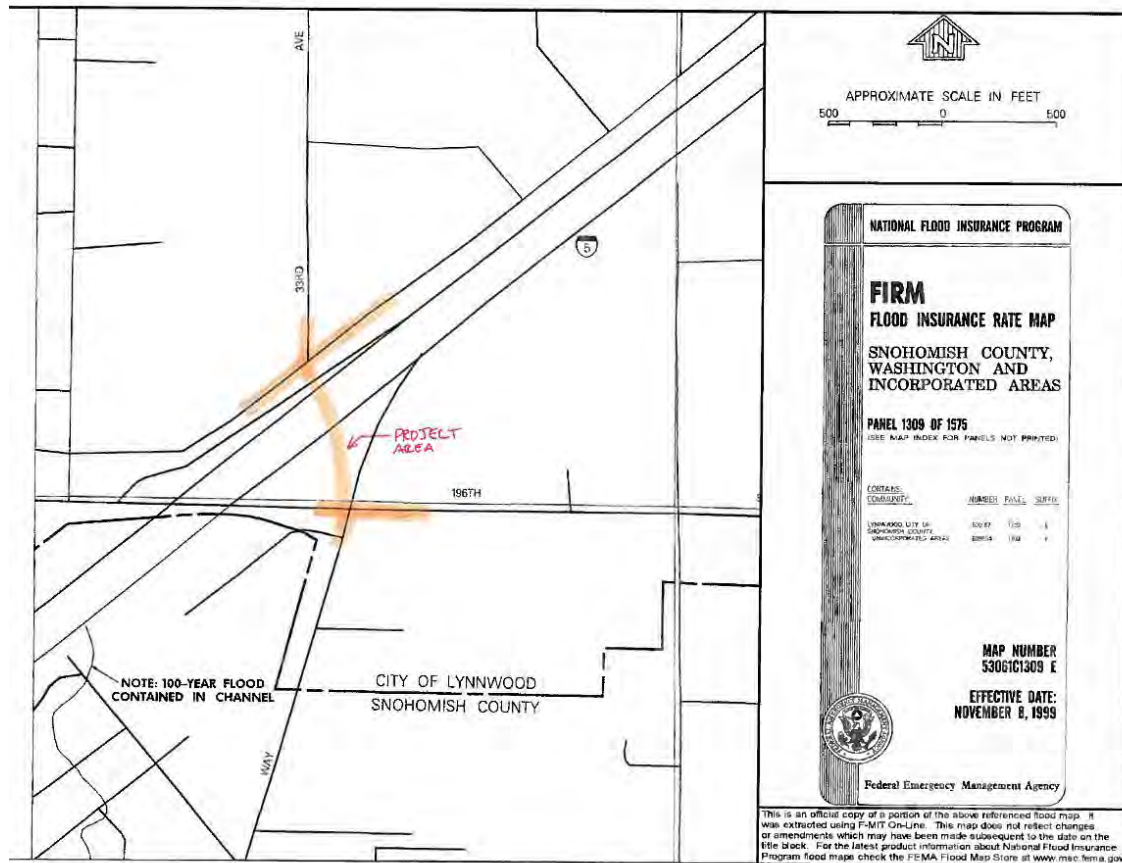


Figure 4 – FEMA Map



2.3 Threshold Discharge Areas (TDAs)

A Threshold Discharge Area (TDA) is a delineation of all the drainage areas that contribute runoff to an on-site single natural or constructed discharge location or multiple natural or constructed discharge locations that combine within ¼ mile downstream (as determined by the shortest flow path) from the project limits. Based on GIS map investigations, basin map investigations, downstream analyses and site investigations by the project engineer, it was determined that the entire project area is divided into four (4) distinct TDAs. A delineation of the existing drainage patterns can be found in the Existing Drainage Condition exhibits (Figures A-2.1 through A-2.7), located in Appendix A-2 of this report. A delineation of TDA boundaries and existing land cover conditions (Figures A-2.16 through A-2.22) can also be found in Appendix A-2 of this report. These figures help illustrate how the four TDAs were determined. Upstream contributing basins were also delineated and can be found in Appendix A-2 as well (Figure A-2.8).

It has been determined through the threshold analysis that one (1) TDA will be required to satisfy both water quality treatment and flow control requirements. The remaining TDAs are under the thresholds and therefore are exempt from any water quality treatment and flow control requirements. Given the close proximity to a regional detention pond and the recent interest by the City of Lynnwood to provide additional available volume within this pond through the use of Thirsty Duck flow regulators, this project will look to take advantage of the additional capacity which will be created in the existing regional pond for flow control. Low impact development stormwater features such as Filterra units will

be incorporated into the project for the purpose of satisfying enhanced water quality treatment requirements as well as oil treatment requirements. Preliminary geotechnical investigations indicate that infiltration Best Management Practices (BMPs) will be limited by lower permeability soils within the project area.

2.3.1 TDA I

TDA I is located within both WSDOT and City of Lynnwood right-of-way, as well as the PUD property which includes the interurban trail. TDA I includes the project area associated with the new bridge over I-5 as well as the roadway improvements planned for 33rd Avenue W, Alderwood Mall Boulevard, and the interurban trail. The TDA I basin limits, as well as the existing on-site drainage system, are illustrated in Figures A-2.2, A-2.3, A-2.4, A-2.6, and A-2.7. 33rd Avenue W and Alderwood Mall Boulevard are both crowned so runoff sheet flows to both sides of the road into gutters and is collected by catch basins along the gutter. The existing drainage system in this TDA consists of storm drain pipes and catch basins which collect and convey stormwater runoff to the northeast. Stormwater runoff generated within the Interurban Trail area of TDA I sheet flows southeasterly over grassy areas and enters a drainage ditch within WSDOT right-of-way. This ditch briefly meanders back into PUD property, continuing in a northeasterly direction prior to re-entering WSDOT right-of-way and being collected by the recently installed storm drain system associated with the WSDOT braided ramp project. This storm drain system conveys runoff to an underground detention vault within WSDOT right-of-way before piping it under I-5 and discharging it into Golde Creek on the south side of I-5. Stormwater runoff generated within the southern portion of TDA I sheet flows off of I-5 and is collected and conveyed in a northeasterly direction by a system of drainage ditches and storm drain pipe. This system also conveys runoff to Golde Creek. There are two discharge points for stormwater runoff in TDA I, a 12-inch storm drain pipe on the north side of Alderwood Mall Boulevard and an existing drainage ditch on the south side of I-5. The 12-inch storm drain system conveys runoff to the northeast along Alderwood Mall Boulevard, eventually discharging into Golde Creek near the entrance to a school bus parking lot. The existing ditch conveys runoff to the southwest and discharges into Golde Creek. Refer to Section 3.8 of this report for the downstream analysis associated with TDA I.

There were no sensitive areas identified within or immediately adjacent to the TDA I project limits.

Stormwater runoff from approximately 9.10 acres of upstream off-site area is tributary to TDA I. This upstream area is divided into five sub-basins: TDA I-A, TDA I-B, TDA I-C, TDA I-D, and TDA I-E. Refer to Figure A-2.8 in Appendix A-2 of this report for a delineation of these off-site areas. Runoff from the upstream basin TDA I-A, approximately 0.70 acres, enters the project site via gutter flow and a 12-inch storm drain pipe and originates from roadway and sidewalk within Alderwood Mall Boulevard right-of-way. Runoff from upstream basin TDA I-B, approximately 2.40 acres, enters the project site via a 12-inch storm drain pipe which drains the flow control and water quality facilities associated with the adjacent Alderwood Community Church development. Runoff from upstream basin TDA I-C, approximately 1.00 acres, enters the project site via an 8-inch and 12-inch storm drain pipe which originates from the adjacent CDS commercial building development. Runoff from upstream basin TDA I-D, approximately 4.60 acres, enters the project site via an 8-inch and 12-inch storm drain pipe which drains the flow control and water quality facilities associated with the adjacent Scan Design and JR Furniture commercial building developments. Runoff from upstream basin TDA I-E, approximately 0.40 acres, enters the project site via gutter flow from 33rd Avenue W right-of-way and sheet flow via landscaped and driveway areas from the adjacent JR Furniture commercial building development.

2.3.2 TDA 2

TDA 2 is located at the south end of the project, adjacent to and south of TDA 1 and north of TDAs 3 and 4. The TDA 2 basin limits as well as the existing on-site drainage system are shown on Figures A-2.2 and A-2.5. TDA 2 is located entirely within WSDOT right-of-way and within the 196th Street SW corridor. 196th Street SW is crowned so runoff sheet flows to both sides of the road into gutters and is collected by catch basins along the gutter. The existing drainage system in this TDA consists of storm drain pipes and catch basins which collect and convey stormwater runoff to the east. The point of discharge for stormwater runoff in TDA 2 occurs via a 12-inch storm drain pipe. The existing drainage system conveys runoff to the east along 196th Street SW, eventually discharging into Golde Creek, which crosses under 196th Street SW. Refer to Section 3.8 of this report for the downstream analysis associated with TDA 2.

Two wetlands and a stream (Golde Creek) are located east of the current TDA 2 project limits. Refer to Section 2.2 of this report for more information regarding these sensitive areas.

Stormwater runoff from approximately 0.30 acres of upstream off-site area is tributary to TDA 2. Refer to Figure A-2.8 in Appendix A-2 of this report for a delineation of this off-site area. This upstream area, TDA 2-A, enters the project site via gutter flow from the 196th Street SW overpass bridge.

2.3.3 TDA 3

TDA 3 is located at the south end of the project, adjacent to and south of TDA 2 and east of TDA 4. The TDA 3 basin limits as well as the existing on-site drainage system are shown on Figures A-2.1 and A-2.2. TDA 3 is located entirely within WSDOT right-of-way and within the Poplar Way corridor. Poplar Way is crowned so runoff in TDA 3 sheet flows to the east side of Poplar Way into gutters and is collected by catch basins. The existing drainage system in this TDA consists of storm drain pipes and catch basins which collect and convey stormwater runoff to the south. The point of discharge for stormwater runoff in TDA 3 occurs via a 12-inch storm drain pipe. The existing drainage system conveys runoff to the south along Poplar Way and then easterly along Alderwood Mall Parkway, eventually discharging into Golde Creek. Refer to Section 3.8 of this report for the downstream analysis associated with TDA 3.

There were no sensitive areas identified within or immediately adjacent to the TDA 3 project limits. There were also no upstream off-site areas contributing any stormwater runoff to TDA 3.

2.3.4 TDA 4

TDA 4 is located at the south end of the project, adjacent to and south of TDA 2 and west of TDA 3. The TDA 4 basin limits as well as the existing on-site drainage system are shown on Figures A-2.1 and A-2.2. TDA 4 is located entirely within WSDOT right-of-way and within the Poplar Way corridor. Poplar Way is crowned so runoff from TDA 4 sheet flows to the west side of Poplar Way and into an existing drainage ditch. This existing ditch collects and conveys stormwater runoff to the south. The point of discharge for stormwater runoff in TDA 4 occurs via this existing drainage ditch. This ditch conveys flow south along Poplar Way and discharges it into an existing storm drain pipe and ditch system which continues south along Poplar Way until it reaches Alderwood Mall Parkway, where the system turns and follows Alderwood Mall Parkway, eventually discharging into Golde Creek. Refer to Section 3.8 of this report for the downstream analysis associated with TDA 4.

There were no sensitive areas identified within or immediately adjacent to the TDA 4 project limits.

Stormwater runoff from approximately 1.2 acres of upstream off-site area is tributary to TDA 4. Refer to Figure A-2.8 in Appendix A-2 of this report for a delineation of this off-site area. This upstream area, TDA 4-A, enters the project site via sheet flow over the grassy area between Poplar Way and the northbound I-5 on-ramp.

2.4 Soils

According to the NRCS soil survey mapping, the project site is underlain by Urban Land and Alderwood-Urban Land Complex (8 to 15 percent slopes) soils. Refer to Figure 5 for the NRCS delineation of soil types in the project site vicinity.

Research of the Washington State Department of Ecology's toxic materials database, performed on August 10, 2011, indicates the presence of 18 underground storage tanks, leaking storage tanks, and voluntary cleanup sites within a ½ mile radius of the project site. Research also notes the presence of 8 sites on Ecology's Confirmed or Suspected Contaminated Sites within a mile of the project site. A hazardous materials report will need to be prepared to document the presence or lack of potential contamination within the project limits.

The following are excerpts taken from the latest Geotechnical Engineering Report prepared by HWA Geosciences Inc., which is being submitted under separate cover. Refer to this report for more detailed information about the project site's soil conditions.

General geologic information for the project area is published in the Preliminary Surficial Geologic Map of the Edmonds East and Edmonds West Quadrangles (Smith, 1975). This map indicates that the near surface deposits across the project corridor consist of Vashon Glacial Till. The soils along the Interstate 5 corridor are shown as Modified Land in association with the construction of the interstate.

Based on our subsurface exploration program, the project site is underlain by a series of glacial till-like soils that are subsequently underlain by course-grained advance outwash that transitions to finer-grained advance outwash at depth. Thin layers of weathered soil and fill were encountered near surface in specific areas across the site.

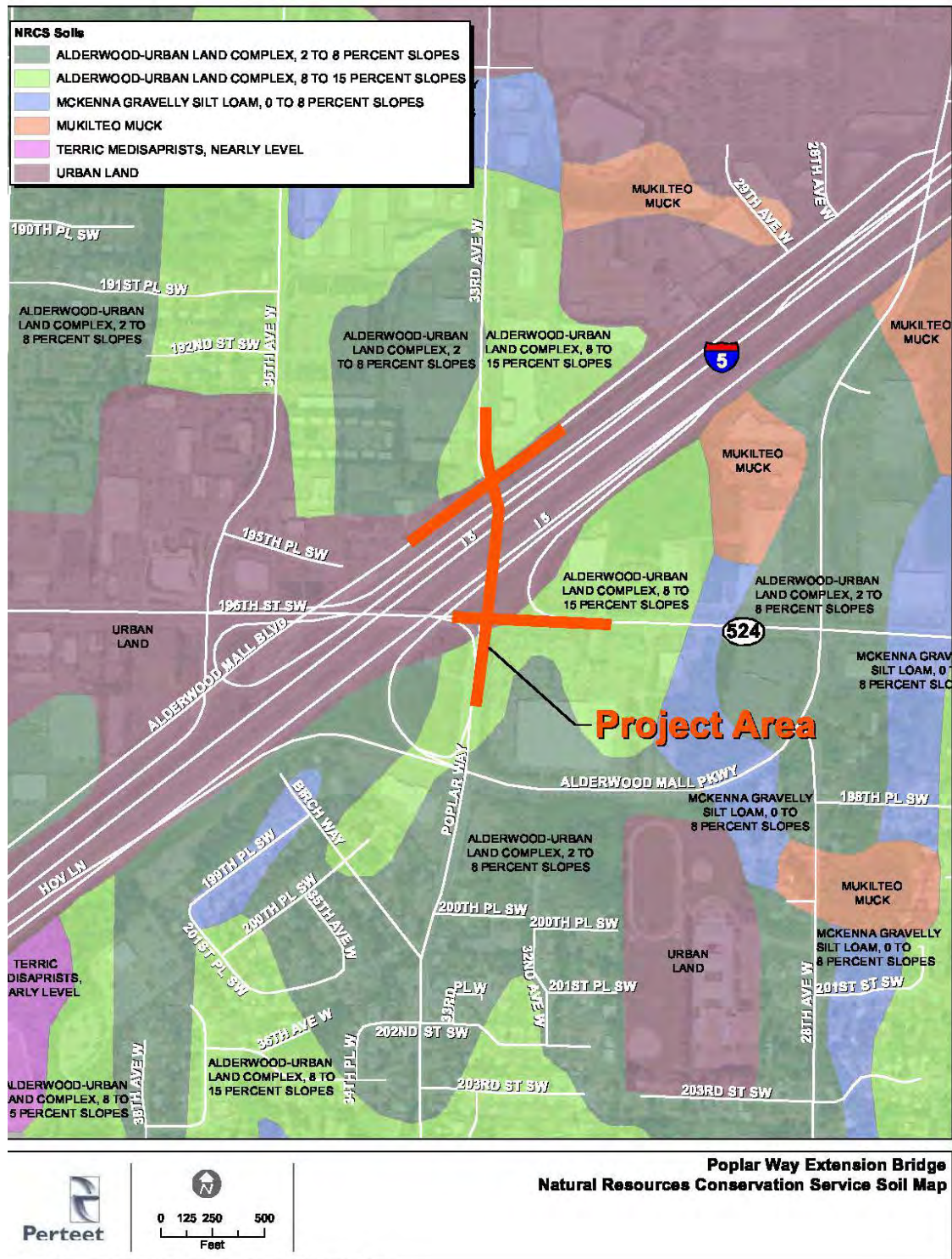
Based on our explorations and a review of explorations by others, we believe that two distinct ground water tables exist across the project site. The upper ground water table consists of perched water trapped on top of the relatively impermeable glacial till-like soil. We believe this perched ground water table to be seasonal in nature with the highest ground water level expected during the wet winter months. For construction purposes, perched ground water should be expected near the top of the glacial till-like soil. The more prominent ground water table, encountered across the project site, is associated with the advance outwash soils present at depth. Our explorations indicate that the ground water within the advance outwash is under significant artesian pressure. The soil conditions encountered in our explorations indicate that this artesian pressure is caused by a series of scattered water bearing sand seams within the overlying glacial till-like soils that are hydraulically connected to the advance outwash. We expect that water bearing sand lenses will be encountered throughout the glacial till-like soils across the site.

It is our understanding that the stormwater generated as part of this project is to be conveyed to two potential stormwater facilities located along the north side of the Interurban trail, east of the intersection of Alderwood Mall Boulevard and 33rd Avenue W. The approximate locations and geometry of these proposed facilities are indicated in Figures 2B and 2C. Soil borings drilled at the locations of the proposed facilities indicate that both sites are underlain by glacial till-like soils near the ground surface. These glacial till-like soils are highly compacted in nature and possess high fines contents. Based on these factors, the native soils in the vicinity of

the proposed stormwater facilities are not suitable for onsite infiltration. It is our recommendation that stormwater management practices other than onsite infiltration be considered for this project.

In addition to evaluating the potential for utilizing onsite infiltration into the near surface soils, HWA also evaluated the potential for infiltrating stormwater into the advance outwash sands, observed at depth across the site, through a series of dry wells. Based on the high artesian pressures observed in the advance outwash sands, we do not recommend utilizing dry wells to infiltrate water into the advance outwash sands.

Figure 5 – NRCS Soils Map



2.5 Existing Stormwater Outfalls

All stormwater runoff generated on the project site is currently discharged from the site at the following locations (also refer to Figure A-2.9 in Appendix A-2):

- TDA 1: 12-inch storm drain pipe on the north side of Alderwood Mall Boulevard, adjacent to the driveway entrance to the Alderwood Towne Center. Drainage ditch on the south side of I-5.
- TDA 2: 12-inch storm drain pipe on the north side of 196th Street SW just east of the driveway to Bed Bath and Beyond.
- TDA 3: 12-inch storm drain pipe on the east side of Poplar Way, just north of Alderwood Mall Parkway.
- TDA 4: Drainage ditch on the west side of Poplar Way, just north of Alderwood Mall Parkway.

2.6 Existing Utilities

Utilities within the Poplar Way Bridge Extension project area include the following: water and sewer owned by the City of Lynnwood; underground and overhead power owned by PUD; gas owned by PSE; fiber optic and coaxial cables owned by Comcast; fiber optics owned by (UTILITY OWNERS CURRENTLY UNKNOWN), and underground and overhead telecommunications operated by (UTILITY OWNERS CURRENTLY UNKNOWN).

The City of Lynnwood has a water line that runs along the center of Poplar Way SW through Alderwood Mall Parkway up to 196th Street SW (SR 524). At Alderwood Mall Parkway, the water main continues east in the eastbound lanes, before crossing to the north side of Alderwood Mall Parkway at the northbound freeway entrance. The water main stays just north of the roadway briefly, before angling into the westbound lanes near the start of the turn lane for the freeway entrance. At the intersection near the staples building, the water main crosses to the south side of Alderwood Mall Parkway and extends west, behind the back of walk. It angles away from the roadway, to the SW, just after crossing a private drive across the street from the start of the turn lane mentioned above. The City of Lynnwood also has a water line that runs along the northernmost edge of Alderwood Mall Boulevard, for the entire length of the project. As this water line crosses to the east side of 33rd Avenue W it tees off, sending one leg north along the east side of 33rd Avenue W. Smaller service connections are also present throughout the project.

The City of Lynnwood has a sanitary sewer line that runs along the northernmost lane of Alderwood Mall Boulevard, from the Northeastern limits of the project, to the driveway to the southwest of 33rd Avenue W, where it angles towards the Alderwood Community Church. Just south of this line, and running parallel to it for the length of the project, is a force sewer main. A sewer line that runs down the center of 33rd Avenue West also ties into the sewer line on Alderwood Mall Boulevard, after crossing to the west side of 33rd just before the two roads intersect. A sanitary sewer line also runs along the northern edge of HWY 524, from the freeway entrance ramp to the eastern project limit.

PUD has overhead and underground facilities throughout the project. Its underground lines run from Alderwood Mall Parkway to SR 524 crossing from the West side of Poplar Way SW to the East roughly 150' south of the intersection. From the intersection, the underground lines continue East along the South side of SR 524, in a joint utility trench with (OWNER OF TELECOM UTILITIES) buried communication lines. PUD's underground power also crosses to the far side of SR 524 at its intersection with Poplar Way, where it extends roughly 115-feet to the east and 135-feet to the west.

Buried power lines also run up both sides of 33rd Avenue W, and along the south side of Alderwood Mall Boulevard, for the length of the project. Buried Power runs SW from 33rd Avenue W along the north side of Alderwood Mall Boulevard as well. There are also Buried power crossings on 33rd Avenue W, and on the northbound freeway entrance ramp off SR 524.

PUD has overhead facilities for the length of the project on the south side of SR 524, on the south side of Alderwood Mall Boulevard. The overhead lines cross Alderwood Mall Boulevard west of 33rd Avenue W, and then immediately cross to the east side of 33rd Avenue W. Overhead power lines cross Alderwood Mall Boulevard diagonally from the Alderwood Community Church moving east. Overhead power lines also cross to the north side of SR 524 roughly 100 feet east of the turn lane for the entrance ramp, and at the entrance ramp start.

(OWNER OF TELECOM UTILITIES) has primarily overhead facilities throughout the project, with only one stretch of overhead lines. Underground telephone lines extend 200-feet east from the intersection of Poplar Way and SR 524 along the south side of the roadway. Telephone lines also extend west along the south side of the roadway from the project limits at the east end of SR 524 to a utility pole roughly 70' east of the turn lane for the freeway entrance ramp. Underground communication lines also run along the side of Alderwood Mall Boulevard for the length of the project, teeing across the road just west of its intersection with 33rd Ave W, which it immediately crosses as well. Buried communication lines run north on both sides of 33rd Ave W, crossing it roughly 125-feet north of its intersection with Alderwood Mall Boulevard. At the same location, overhead telephone lines cross 33rd Avenue W as well.

(OWNER OF FIBER OPTICS) has one stretch of fiber optics that runs the length of the project in I-5's median, and a smaller line that crosses SR 524 roughly 220 feet east of the northbound freeway entrance ramp.

Comcast has coaxial cables running on the north side of Alderwood Mall Boulevard, and SR 524, for the entire length of the project. Comcast's coaxial cables also run up the east side of Poplar Way, and the west side of 33rd Avenue W, for the length of the project.

Comcast also has fiber optic lines that run the length of the project on the south side of Alderwood Mall Boulevard and SR 524. The fiber optic line on Alderwood Mall Boulevard crosses to the east side of 33rd Avenue W, which continues north through the project limits.

PSE has gas lines throughout the project. They run the length of the project on the south side of SR 524, and cross SR 524 150-feet east of the turn lane for the northbound freeway entrance ramp. Gas lines also run the length of the project under the southernmost lane of Alderwood Mall Boulevard. There is a crossing west of 33rd Avenue W, and the gas line continues north in the western lanes of 33rd Avenue W.

3.0 DESIGN STANDARDS

The City of Lynnwood’s current regulatory guide for control of stormwater is the 2005 Department of Ecology Stormwater Manual for Western Washington (Ecology Manual). However, since a large portion of the Poplar Way Extension Bridge project lies within WSDOT right-of-way, the project will also be subject to WSDOT regulations and review. In order to maintain a single consistent set of stormwater regulations and to simplify both the design and review process, the City of Lynnwood has elected to use the 2011 WSDOT Highway Runoff Manual (HRM) and the 2010 WSDOT Hydraulics Manual (HM) as the regulatory guides for all stormwater elements associated with this project. The Ecology Manual and the HRM have been deemed equivalent by Ecology. A Pre-Design Record, documenting the main stormwater requirements to be followed during the design phases of the project, has been prepared. This document summarizes the various requirements and design preferences that will be used throughout the design phases of this project. The Pre-Design Record is also intended to be a working document, where design preferences and requirements can be added, modified or even clarified as needed throughout the design phases of this project. A copy of the Pre-Design Record can be found in Appendix B of this report.

3.1 Design Frequency

The storm infrastructure is designed to comply with the HRM and HM. The design frequency storms used for the different hydraulic structures are listed below in Table 1.

Table 1 – Design Storms

Storm Event (years)	Type of Hydraulic Structure
25	Standard Culverts – design for HW/D ratio
25	Storm drain trunk lines
100	Storm drain lines downstream of detention pond emergency overflow structures
50	Storm drain inlets – vertical curve sag
10	Inlets and gutters
10	Ditches
Storm Event (years)	Temporary Conveyance
10	Ditches
25	Pipes
2	Other / Culverts

The 24-hour isopluvial maps from the HRM will be used for all calculations using the Santa Barbara Urban Hydrograph (SBUH) method. The maps are included in Appendix A-3. The precipitation depths used for SBUH are summarized in Table 2 below.

Table 2 – Precipitation Data

Storm Event	Precipitation (inches)
2-year 24 hour	1.5
10-year 24 hour	2.2
25-year 24 hour	3.0
100-year 24 hour	3.5
Mean Annual Precipitation	40

MGSFlood uses climate region data for precipitation input. The Puget East 40-inch Map is the selected climate region for this project.

3.2 Stormwater Management Guidelines

3.2.1 Performance Standards and Goals

As determined by the threshold analysis for this project, TDA 1 is subject to both water quality treatment and flow control requirements per minimum requirements 5 and 6. Also, both intersections within the project limits (Poplar Way/196th Street SW and Poplar Way/Alderwood Mall Boulevard) will be subject to oil control requirements because the ADTs at these intersections exceed the threshold levels as outlined under minimum requirement 5, thus designating them as high use intersections.

In order to satisfy flow control requirements for this project, an existing regional detention pond (Alderwood Mall pond) located north of the project site will be retrofitted by installing two Thirsty Duck flow regulators within the pond itself. Utilizing two Thirsty Ducks within this pond will more efficiently regulate the release of water from the existing pond, resulting in decreased peak flow durations at the point of compliance with runoff flows from the Poplar Way Extension Bridge equivalent area. The point of compliance for the flow control analysis is located at a large catch basin on the north side of Alderwood Mall Boulevard. This is where runoff from the Poplar Way Extension Bridge equivalent area combines with runoff from the existing Alderwood Mall pond. Refer to Figure A-2.15 in Appendix A of this report for a delineation of the point of compliance. The Alderwood Mall pond was originally designed under the 1992 Ecology Manual which required single event modeling to size flow control facilities. For the point of compliance analysis and to demonstrate how the Poplar Way Extension Bridge project will meet current flow control standards, continuous simulation modeling using WWHM version 4 was used. Refer to Section 4.0 of this report for a detailed explanation of how the point of compliance analysis was conducted and how the flow requirements are being met for this project. Flow control calculations are provided in Appendix A-3 of this report. The original sizing calculations for the Alderwood Mall pond, along with excerpts from the associated drainage report, are provided in Appendix G of this report for reference. As-built pond and flow control structure information from this report were used in the Thirsty Duck retrofit and point of compliance analysis.

The following flow control standards are to be applied to this project:

- Provide storage volume required to match the duration of pre-developed peak flows from 50% of the 2-year up to the 50-year storm flow, using a flow restrictor (such as an orifice or weir), and check the 100-year peak flow for property damage.
- Pre-developed land-use is to assume forested conditions, regardless of actual existing site conditions.

- Modeling for the sizing of detention facilities is to be the continuous simulation model MGS Flood or equivalent, using 1-hour time steps.

The following water quality treatment standards are applied to this project:

- Using the on-line volume based procedure, size the facility to treat 91% of the estimated runoff file for the post-developed condition obtained from MGS Flood or WWHM.
- Modeling for the sizing of water quality facilities is to be the continuous simulation model MGS Flood or equivalent, using 15-minute time steps.
- For this project, the runoff treatment target is for Enhanced Treatment since the ADT is greater than 7,500 for the horizon year 2040.

The following Oil Control treatment standards are applied to this project:

- No ongoing or recurring visible sheen and 24-hour average total petroleum hydrocarbon concentration of not greater than 10 mg/L with a maximum of 15 mg/L for a discrete (grab) sample.

The WWHM version 4 model was used for preliminary sizing of the water quality treatment systems proposed for this project.

Point of compliance calculations as well as water quality treatment calculations are included in Appendix A-3 of this report. Catchment areas for the Filterra units are included in Appendix H of this report.

3.2.2 Threshold Analysis

3.2.2.1 Project Level Threshold Analysis

As indicated above, the 2011 WSDOT HRM and 2010 HM are being used as the regulatory drainage design manuals for this project. There are a total of nine minimum requirements listed in the 2011 WSDOT HRM that may apply to this project. The following step by step threshold analysis will clearly demonstrate which minimum requirements will apply to this particular project. The steps for this analysis can also be followed by referring to Figures 3.1 and 3.2 (Minimum Requirement Applicability at Project Level) in the HRM. Prior to performing the threshold analysis, existing and new impervious surface areas were delineated and quantified. The Stormwater Design Documentation Spreadsheet, located in Appendix A-1 of this report, was also used to help determine which minimum requirements apply.

Totals for these areas are shown in the tables below. Tables 3 and 4 show the total existing and total new impervious surface areas (both non-pollution generating (NPGIS) and pollution generating (PGIS)) for the entire project, while Tables 5 and 6 show the total new impervious surface areas (both non-pollution generating and pollution generating) for each individual TDA. The existing impervious surface and existing PGIS areas listed below were derived from the area delineations shown in Figures A-2.16 through A-2.22, found in Appendix A-2 of this report. The new impervious surface and new PGIS areas listed in Tables 3 through 6 were derived from the area delineations shown in Figures A-2.23 through A-2.29, found in Appendix A-2 of this report. A threshold area tabulation, showing the breakdown of these areas, has also been included in Appendix A-1 of this report. A 3% contingency factor has been added to these areas to account for any small impervious area increases that may occur between 30%

and final design. NPGIS areas typically consist of sidewalk, trail and top of curb surfaces while PGIS areas consist of roadway surfaces where a vehicle is likely to travel.

Table 3 - Project Level Impervious Area Breakdown

Surface Cover Type	Area (Sq ft)
Existing Impervious Surface	225,878
New Impervious Surface	56,987

Table 4 - Project Level Pollution Generating Impervious Surface (PGIS) Breakdown

Surface Cover Type	Area (Sq ft)
Existing PGIS	183,389
New PGIS	46,734

Table 5 - TDA Level Impervious Area Breakdown (Includes 3% design contingency)

TDA	Surface Cover Type	Area (Sq ft)
1	New Impervious Surface	49,698
2	New Impervious Surface	3,246
3	New Impervious Surface	3,903
4	New Impervious Surface	141
TOTAL		56,988

Table 6 - TDA Level New PGIS Area Breakdown (Includes 3% design contingency)

TDA	Surface Cover Type	Area (Sq ft)
1	New PGIS	38,150
2	New PGIS	3,682
3	New PGIS	4,761
4	New PGIS	141
TOTAL		46,734

The following project level threshold analysis is a step by step procedure used to determine which minimum requirements this project will need to satisfy. This procedure follows the WSDOT HRM Minimum Applicability at the Project Level flow chart (Figures 3-1 and 3-2 in the WSDOT HRM). The areas listed in the previous tables are used in the following analysis.

Table 7 - Minimum Requirements (MR) Applicability Procedure – Project Level

Questions	Response	Action Required
<p>Step 1: Do any exceptions listed in HRM section 3-2.2 Apply?</p>	<p>No.</p>	<p>Follow Steps 2 through 6.</p>
<p>Step 2: Does the project have 2,000 square feet or more of new, replaced, or new plus replaced impervious surfaces? Or Does the project have land-disturbing activities of 7,000 square feet or more?</p>	<p>Yes, the project is comprised of 56,987 square feet of new impervious surface. Yes, this project disturbs more than 7,000 square feet of land.</p>	<p>Apply MR 1 through 4 to new and replaced impervious surfaces and to the land disturbed.</p>
<p>Step 3: Does the project add 5,000 square feet or more of new impervious surfaces? Or For Western Washington projects, does the project convert ¾ acre or more of native vegetation to lawn or landscaped area? Or For Western Washington projects, does the project convert 2.5 acres or more of native vegetation to pasture?</p>	<p>Yes, the project adds 56,987 square feet of new impervious surface. No, this project does not convert native vegetation to lawn. No, this project does not convert native vegetation to pasture.</p>	<p>Delineate Threshold Discharge Areas (TDA) for the project. Apply MR 6 through 9 to the new impervious surfaces. Applicability of MR 6 at the TDA level may change based on triggers in Figure 3-3, for each individual TDA.</p>
<p>Step 4: For road / parking lot-related projects (including pavement, shoulder, curbs, and sidewalks) adding 5,000 square feet or more of new impervious surfaces: Do new impervious surfaces add 50% or more to the existing impervious surfaces within the project limits?</p>	<p>No, new impervious surfaces add 21% to the existing impervious surfaces within the project. $56,987 / 225,878 = 25\%$.</p>	<p>No action required. Continue to Step 5.</p>
<p>Step 5: Does the project add 5,000 square feet or more of new pollution-generating impervious surface (PGIS)? Or For Western Washington projects, does the project convert more than ¾ acre of native vegetation to pollution-generation pervious surface (PGPS)?</p>	<p>Yes, the project adds 46,734 square feet of new pollution-generating impervious surface (PGIS). No, this project does not convert native vegetation to PGPS.</p>	<p>Apply MR 5 to the new PGIS. Applicability at the TDA level may change based on triggers in Figure 3-3, for each individual TDA.</p>
<p>Step 6: For road / parking lot-related projects adding 5,000 square feet or more of new PGIS: Do new PGIS add 50% or more to the existing PGIS within the project limits?</p>	<p>No, new PGIS adds only 25% to the existing PGIS within the project limits. $46,734 / 183,389 = 24\%$.</p>	<p>No action required. Continue to step 7 under the TDA level threshold analysis.</p>

Results of Project Level Threshold Analysis

As a result of the project level threshold determination conducted by following steps 1 thru 6 above this project is required to apply all 9 Minimum Requirements as summarized below:

- Minimum Requirements #1 thru #4 shall apply to the new and replaced impervious surfaces and to the land disturbed.
- Minimum Requirement #5 shall apply to the new pollution-generating impervious surfaces only. Applicability of this requirement may change based on triggers resulting from the TDA level analysis. There are no converted Pollution-generating Pervious Surfaces related to this project.
- Minimum Requirements #6 thru #9 shall apply to the new impervious surfaces only. Applicability of this requirement may change based on triggers resulting from the TDA level analysis (refer to TDA level analysis to see if Minimum Requirements #6 through #9 apply to each TDA). There are no converted pervious surfaces related to this project.

3.2.2.2 TDA Level Threshold Analysis

Now that the project level threshold analysis has been completed it is important to conduct another threshold analysis, this time at the TDA level. The TDA Level analysis is conducted to see whether or not Minimum Requirements 5 and 6 (Runoff Treatment and Flow Control) will actually be required within each TDA associated with the project. This procedure follows the WSDOT HRM Minimum Applicability at the TDA Level flow chart (Figure 3-3 in the WSDOT HRM). The areas listed in Table 5 and Table 6 above were used for the following analysis. Steps 10 and 11 are not shown in the following analysis. These steps refer to any exemptions or retrofit analysis that may apply to the project. There are no exemptions or retrofit requirements that apply to any of the TDAs associated with this project, therefore these steps are not shown in the following analysis. Steps 7 and 8 are repeated for each of the 4 TDAs associated with this project.

Table 8 - Minimum Requirements Applicability Procedure – TDA Level

Questions	Response	Action Required
<p>Step 7:(TDA 1) Is the effective PGIS greater than 5,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to PGPS and is there a surface discharge in a natural or manmade conveyance system from the site?</p>	<p>Yes, there is 38,150 square feet of effective PGIS in the TDA. No, this TDA does not convert native vegetation to PGPS.</p>	<p>Minimum Requirement 5 applies to the effective PGIS in TDA 1. Continue to Step 8.</p>

Table 8 - Minimum Requirements Applicability Procedure – TDA Level (Cont.)

Questions	Response	Action Required
<p>Step 8:(TDA 1) Is the effective impervious surface greater than 10,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to lawn or landscaped area and is there a surface discharge in a natural or manmade conveyance system from the site? Or For Western Washington, through a combination of effective impervious surfaces and converted pervious surfaces, does the particular TDA cause a 0.1 cfs or more increase in the 100-year recurrence interval flow?</p>	<p>Yes, there is 49,698 square feet of effective impervious surface in the TDA.</p>	<p>Minimum Requirement 6 applies to the effective impervious surfaces in TDA 1. Continue to TDA 2, Step 7.</p>
<p>Step 7:(TDA 2) Is the effective PGIS greater than 5,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to PGPS and is there a surface discharge in a natural or manmade conveyance system from the site?</p>	<p>No, there is 3,682 square feet of effective PGIS in the TDA. No, this TDA does not convert native vegetation to PGPS.</p>	<p>Minimum Requirement 5 does not apply to the effective PGIS in TDA 2. Continue to Step 8.</p>
<p>Step 8:(TDA 2) Is the effective impervious surface greater than 10,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to lawn or landscaped area and is there a surface discharge in a natural or manmade conveyance system from the site? Or For Western Washington, through a combination of effective impervious surfaces and converted pervious surfaces, does the particular TDA cause a 0.1 cfs or more increase in the 100-year recurrence interval flow?</p>	<p>No, there is 3,246 square feet of effective impervious surface in the TDA. No, the TDA does not convert native vegetation to PGPS. No, There is less than 0.1 cfs increase in the 100-Year recurrence interval flow.</p>	<p>Minimum Requirement 6 does not apply to the effective impervious surfaces in TDA 2. Continue to TDA 3, Step 7.</p>

Table 8 - Minimum Requirements Applicability Procedure – TDA Level (Cont.)

Questions	Response	Action Required
<p>Step 7:(TDA 3) Is the effective PGIS greater than 5,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to PGPS and is there a surface discharge in a natural or manmade conveyance system from the site?</p>	<p>No, there is 4,761 square feet of effective PGIS in the TDA. No, this TDA does not convert native vegetation to PGPS.</p>	<p>Minimum Requirement 5 does not apply to the effective PGIS in TDA 3. Continue to Step 8.</p>
<p>Step 8:(TDA 3) Is the effective impervious surface greater than 10,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to lawn or landscaped area and is there a surface discharge in a natural or manmade conveyance system from the site? Or For Western Washington, through a combination of effective impervious surfaces and converted pervious surfaces, does the particular TDA cause a 0.1 cfs or more increase in the 100-year recurrence interval flow?</p>	<p>No, there is 3,903 square feet of effective impervious surface in the TDA. No, the TDA does not convert native vegetation to PGPS. No, There is less than 0.1 cfs increase in the 100-Year recurrence interval flow.</p>	<p>Minimum Requirement 6 applies to the effective impervious surfaces in TDA 3. Continue to TDA 4, Step 7.</p>
<p>Step 7:(TDA 4) Is the effective PGIS greater than 5,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to PGPS and is there a surface discharge in a natural or manmade conveyance system from the site?</p>	<p>No, there is 141 square feet of effective PGIS in the TDA. No, this TDA does not convert native vegetation to PGPS.</p>	<p>Minimum Requirement 5 does not apply to the effective PGIS in TDA 4. Continue to Step 8.</p>
<p>Step 8:(TDA 4) Is the effective impervious surface greater than 10,000 square feet in the TDA? Or For Western Washington, does the TDA convert ¾ acre or more of native vegetation to lawn or landscaped area and is there a surface discharge in a natural or manmade conveyance system from the site? Or For Western Washington, through a combination of effective impervious surfaces and converted pervious surfaces, does the particular TDA cause a 0.1 cfs or more increase in the 100-year recurrence interval flow?</p>	<p>No, there is 141 square feet of effective impervious surface in the TDA. No, the TDA does not convert native vegetation to PGPS. No, There is less than 0.1 cfs increase in the 100-Year recurrence interval flow.</p>	<p>Minimum Requirement 6 does not apply to the effective impervious surfaces in TDA 4. Continue to TDA 5, Step 7.</p>

Results of TDA Level Threshold Analysis

As a result of the TDA level threshold determination conducted by following steps 7 and 8 above, this project is required to apply Minimum Requirements 5 and 6 as summarized below:

Table 9 - Minimum Requirements Summary Table

TDA #	Minimum Requirement 5 (Runoff Treatment)	Minimum Requirement 6 (Flow Control)
TDA 1	YES	YES
TDA 2	NO	NO
TDA 3	NO	NO
TDA 4	NO	NO

3.2.2.3 Minimum Requirement Summary

The intent of this section is to show how each of the minimum requirements, as outlined in the WSDOT HRM, are being addressed for this project. The minimum requirements are listed in bold text below and a brief description follows each requirement.

Minimum Requirement #1: Stormwater Planning

The stormwater planning components should collectively demonstrate how stormwater management will be accomplished, both during project construction and in the final, developed condition. The two main stormwater planning components of Minimum Requirement #1 are: 1) Construction Stormwater Pollution Prevention Planning, and 2) Permanent Stormwater Control Planning.

A Construction Stormwater Pollution Prevention Plan (SWPPP) that meets the standards set forth in the WSDOT HRM will be prepared as part of this project. The Temporary Erosion and Sediment Control (TESC) plans can be used as a starting point for controlling runoff that occurs during construction. However, since conditions can change often during construction, the contractor must be prepared to adjust erosion and sediment control measures in order to prevent erosion, sedimentation and flooding situations. The SWPPP will serve as a guide for the contractor to refer to during the construction phase of this project.

Permanent Stormwater Control Planning involves the preservation of the new storm drainage system after construction is complete. This hydraulic report, which includes a Maintenance Plan section, can be utilized to maintain and preserve the effective operation of the proposed drainage system well beyond the completion of the project.

Minimum Requirement #2: Construction Stormwater Pollution Prevention

The objective of construction stormwater pollution prevention is to ensure construction projects do not impair water quality by allowing sediment to discharge from the site or allowing pollutant spills. The two components of construction stormwater pollution prevention are Temporary Erosion and Sediment Control (TESC) planning and Spill Prevention, Control and Countermeasures (SPCC) planning.

The SWPPP will be prepared as part of the 90% design package. The contractor will be responsible for ensuring that all construction activity is in compliance with the SWPPP document and standards set forth in the WSDOT HRM.

Minimum Requirement #3: Source Control of Pollutants

The intention of source control is to prevent pollutants from coming into contact and mixing with storm water. In many cases, it is more cost-effective to apply source control than to remove pollutants after they are mixed with runoff. This is certainly the case for erosion control and spill prevention during the construction phase.

Source control is not anticipated to be needed after the project has been completed. However, during the construction phase of the project, source control BMPs shall be on-site at all times in the event of a spill or other hazardous situations. Control of source pollutants will be discussed in the SWPPP.

Minimum Requirement #4: Maintaining the Natural Drainage System

The intent of maintaining the natural drainage system is to 1) preserve and utilize natural drainage systems to the fullest extent because of the multiple benefits such systems provide, and 2) prevent erosion at, and downstream of, the discharge location.

The proposed drainage system was designed to mimic, as close as practical, the existing drainage system within the project limits. After construction, runoff from the project site will continue to discharge offsite at the same locations where it currently discharges.

Minimum Requirement #5: Runoff Treatment

The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms to maintain or enhance beneficial uses of receiving waters. When site conditions are appropriate, infiltration can potentially be the most effective BMP for runoff treatment. Meeting runoff treatment requirements may also be achieved through regional stormwater facilities.

Filterra units will be used in TDA I to treat stormwater runoff for both oil control and water quality treatment. These units will be placed adjacent to the roadway within planter strips and wider sidewalks.

Minimum Requirement #6: Flow Control

The objective of flow control is to prevent increases in the stream channel erosion rates beyond those characteristic of natural or reestablished conditions. The intent is to prevent cumulative future impacts from increased stormwater runoff volumes and flow rates on streams. Wherever possible, infiltration is the preferred method of flow control. Meeting flow control requirements may also be achieved through regional stormwater facilities.

Flow control for this project will be accommodated by retrofitting an existing regional detention pond located just north of the project. The existing detention pond retrofit will involve modification of the existing flow control structure and the installation of two Thirsty Duck flow regulators to more efficiently regulate the release of flows from the existing detention pond and as a result decrease flow durations at the project point of compliance.

Minimum Requirement #7: Wetlands Protection

The objective of wetlands protection is to ensure wetlands receive the same level of protection as any other waters of the state.

There are no wetlands which have been delineated within the project limits. Two wetlands have been delineated east of the current project limits on 196th Street SW. Proposed project improvements will have negligible hydrologic impact on these wetlands. Refer to the Environmental Review Memorandum (ERM), submitted under separate cover, for more information regarding these wetlands.

Minimum Requirement #8: Incorporating Watershed / Basin Planning into Stormwater Management

The objective of incorporating watershed-based/basin planning into stormwater management is to promote the development of watershed-based resource plans as a means to develop and implement comprehensive water resource protection measures. The primary objective of basin planning is to reduce pollutant loads and hydrologic impacts to surface waters and groundwaters in order to protect water resources.

There are four projects in the vicinity of the project that have been identified in the Snohomish County Needs Report. None of these two projects are anticipated to be completed as part of the Poplar Way Bridge project.

Minimum Requirement #9: Operation and Maintenance

The objective of operation and maintenance is to achieve appropriate preventative maintenance and performance checks to ensure stormwater control facilities are adequately maintained and properly operated.

A maintenance plan will be prepared for the proposed storm system and will be included in Section 9.0 of this report.

3.3 Stormwater Retrofit Analysis

The preferred flow control alternative being considered for this project is the retrofit of an existing regional detention pond. The pond to be retrofitted is located at the south end of the Alderwood Mall, north of the project site. The retrofit will not involve any re-grading or the construction of any walls within the pond to increase its capacity. Rather, two Thirsty Duck flow regulating devices will be installed within the footprint of the pond and will replace the existing flow control structure. These two devices will more efficiently regulate the release of runoff from the pond, thereby reducing flow durations at the point of compliance. Flow durations, as a result of the Thirsty Duck devices, will be decreased enough at the point of compliance to where runoff from the equivalent area within TDA I of the project site will be allowed to flow undetained to the project point of compliance and still meet flow control requirements for the project.

3.4 Other Requirements

3.4.1 Permitting Agency Requirements

Section 6.2 of this report contains a list of permits necessary to construct this project. No permit-specific requirements are more stringent than the standard requirements called out in this report.

3.4.2 Watershed / Basin Plans

A TMDL plan has been developed for Swamp Creek to help reduce fecal coliform bacteria in that system. Two recommended projects associated with this TMDL are located in the Golde Creek basin. The projects consist of adding Bacteria bioretention systems and converting an existing drainage ditch into a bioretention swale. There are also four projects in the vicinity of the project that have been identified in the Snohomish County Needs Report. None of these projects are anticipated to be completed as part of the Poplar Way Bridge project. However, the implementation of Filterra Units along 196th Street, 33rd Avenue W and Alderwood Mall Boulevard will be somewhat beneficial in the prevention of fecal coliform within the downstream system.

3.4.3 Local Area Ordinances

There are no local ordinances that will impact the stormwater element of this project.

3.4.4 Agreements

There are no agreements that will impact the stormwater element of this project.

3.5 Hydraulics Manual Deviations

The June 2010 edition of the WSDOT Hydraulics Manual was used for the stormwater design on this project. No deviations were needed from this manual.

3.6 Highway Runoff Manual Deviations

The November 2011 edition of the WSDOT Highway Runoff Manual was also used for the stormwater design on this project. No deviations were needed from this manual.

3.7 Pipe Alternatives

All types of pipe identified in the WSDOT Standard Specifications are acceptable on this project except for galvanized metal pipe. Corrugated polyethylene storm sewer pipe has been selected as the preferred material where suitable for pipe depth and loading. Ductile iron storm sewer pipe has been selected for locations with less than two feet of cover and other locations with special loading.

3.8 Downstream Analysis

A downstream analysis was performed for the Poplar Way Extension Bridge project on February 27, 2013. A downstream analysis includes a review of resources, a visual inspection of storm conveyance systems for evident erosion, sedimentation or other drainage issues and a discussion of possible effects due to proposed project improvements. Photos taken at various locations along the downstream route

are included in the narrative below. The downstream routes have been delineated on Figures A-2.9 through A-2.15 in Appendix A-2 of this report.

Prior to performing any field reconnaissance it is important to gather as much information about the project site and its surrounding area as possible. Becoming familiar with site topography, likely Threshold Discharge Areas (TDAs), receiving waters and various other site related information will aid with the field reconnaissance and in making a complete assessment of site conditions.

Section 2-3.2.1 of the WSDOT Highway Runoff Manual (HRM) provides a list of recommended resources to consult when assessing a project site and its downstream area. Table 10 below provides the applicable information sources from that list which were consulted as part of these downstream analyses. These sources helped to provide an overall view of the project site, its downstream areas and any existing and potential impacts on downstream waters and properties.

Table 10 - Information Sources Consulted

Item #	Source Reviewed	Findings
1	Land Cover Types and Area	GIS mapping from project documents, City of Lynnwood and Snohomish County were reviewed to become familiar with the project area as well of adjacent off-site areas. A significant amount of site reconnaissance was also performed.
2	GIS Data	GIS Data from the City of Lynnwood and Snohomish County was reviewed to for items such as road features, vegetation, topography, land use, drainage, utilities, etc.
3	Topography (USGS maps)	The project site was surveyed and this information is readily available in CAD and various design drawings. Topographic information was also reviewed through GIS data and as-built drawings from previous projects in the area.
4	Existing Stormwater Outfalls	Project survey data and site reconnaissance were used to identify all existing outfalls associated with the project drainage system. These existing outfall locations are shown in Figures A-2.9 through A-2.15 in Appendix A-2 of this report.
5	Drainage Patterns and Areas	The project site was surveyed and this information is readily available in CAD and various design drawings. This survey data was used to identify drainage patterns and areas within the project vicinity. GIS information from the City of Lynnwood and Snohomish County was consulted to aid in drainage pattern assessments for off-site areas draining to the project site and from the project site. As-built drawing from recent nearby projects were also obtained and reviewed to assess both on-site and off-site drainage patterns.
6	FEMA Map	The FEMA map in Figure 4 of this report was reviewed. No issues with floodplains were found.
7	Sensitive Area Map	Sensitive area mapping and information provided by the

Item #	Source Reviewed	Findings
		City of Lynnwood and Snohomish County was reviewed. Refer to Figure 3 of this report for nearby critical areas.
8	Clean Water Act Section 303(d) list of impaired waters	Ecology website. Impairments listed on the 303(d) that are relevant to the City of Lynnwood’s jurisdiction are fecal coliform bacteria, Temperature and Dissolved Oxygen. These impairments are associated with Swamp Creek.
9	Watershed or Drainage Basin Boundaries	The project site is located within WRIA 8 – Cedar / Sammamish Watershed per ecology website: www.ecy.wa.gov/services/gis/maps/wria/number/wria8 . This watershed is divided into smaller basins. The project site lies within the Golde Creek sub-basin. Refer to Figure 2 this report for the WRIA Map.
10	Receiving Waters	GIS mapping and site reconnaissance helped identify the receiving waters for this project. All project site runoff discharges into Golde Creek. Golde Creek discharges into Scriber Creek which discharges into Swamp Creek. Swamp Creek discharges into the Sammamish River which then discharges into Lake Washington.
11	Wetlands	The Environmental Review Memorandum (ERM) was reviewed. No wetlands were identified within the project limits but two were identified just east of the current project limits. Refer to the ERM (submitted under separate cover) for more information.
12	Total maximum daily loads (TMDLs)	A TMDL implementation plan has been developed for Swamp Creek. As part of this plan, two recommended projects have been identified within the Golde Creek basin.
13	Ditches and Open Channel Drainage	GIS mapping, as-built drawings and site reconnaissance were used to help identify ditches and open channel drainage associated with the project.
14	Enclosed Drainage	GIS mapping, as-built drawings and site reconnaissance were used to help identify enclosed drainage systems associated with the project.
15	Utilities	Available utility as-built plans, GIS and survey data were gathered and reviewed. In addition, selected potholing will be conducted to obtain location and depth of certain utilities.
16	Soil Types, Depth, Slope (NRCS)	NRCS mapping and a preliminary geotechnical memorandum associated with the project were reviewed to understand the type of soils which underlie the project site.
17	Groundwater Data	The preliminary geotechnical memorandum was reviewed for groundwater information. At this point it appears that groundwater is generally perched on top of till, where till is present. More investigation will be performed as the project proceeds into the later design phases.
18	Hazardous Materials or Wastes	Research of the Washington State Department of Ecology’s toxic materials database, performed on August 10, 2011,

Item #	Source Reviewed	Findings
		indicates the presence of 18 underground storage tanks, leaking storage tanks, and voluntary cleanup sites within a 1/2 mile radius of the project site. Research also notes the presence of 8 sites on Ecology’s Confirmed or Suspected Contaminated Sites within a mile of the project site. A hazardous materials report will need to be prepared to document the presence of hazardous materials.
19	Environmental Assessment Documents	The Environmental Review Memorandum (ERM) was reviewed.
20	As-builts	City of Lynnwood and WSDOT provided as-builts were reviewed.
21	Snohomish County Drainage Needs Report	Thirteen potential projects have been identified within the Golde Creek corridor by Snohomish County. Most of these projects are associated with the upsizing of undersized culverts and habitat mitigation. Four of these project summaries (just downstream of the Poplar Way Bridge project limits) are included in Appendix D of this report, along with a map showing their locations and the locations of the other identified projects. One of these projects is located within the 1/4 downstream limits of the project and the other three are located beyond the required downstream study area. The project within the downstream study area is not associated with any specific issue. Rather it is intended to help alleviate downstream flooding issues.

The Poplar Way Extension Bridge project is split into four different Threshold Discharge Areas (TDAs). The downstream route for each of these TDAs was followed for approximately one quarter mile downstream of the TDA discharge points. The discharge point is identified as the location where the runoff leaves the project limits.

A walkthrough of all downstream routes was performed on February 27, 2013. The weather was partly sunny with temperatures in the mid-50s and the ground was dry.

3.8.1 TDA I Downstream Analysis

The downstream route for TDA I begins approximately 400 feet northeast of 33rd Avenue W, on Alderwood Mall Boulevard. There are curbs and gutters along this entire portion of Alderwood Mall Boulevard preventing sheet flow from leaving the site. Stormwater is collected by a conveyance system consisting of catch basins and pipes (12 inch) within the project limits. This conveyance system continues to follow Alderwood Mall Boulevard to the northeast for approximately 700 feet after leaving the project limits. At this point, the conveyance system connects to a larger conveyance system coming from a regional detention pond on the south side of the Alderwood Mall. This larger system conveys stormwater to the southeast underneath Alderwood Mall Boulevard and Interstate 5, where it discharges into Golde Creek. The quarter mile point of this downstream route ends approximately 200

feet after the discharge point into the creek. The creek channel at the outfall location was inaccessible due to thick vegetation, so the culvert size and type could not be verified. Near the quarter mile point of this downstream route Golde Creek was approximately 5 feet wide by 1 foot deep with vertical side slopes. The side slopes of the channel look slightly eroded due to the relatively high velocities which the creek will occasionally convey. The creek bottom is cobbled and appeared to be in good condition. Refer to Figure A-2.10 Downstream Map TDA 1 in Appendix A-2 of this report for a delineation of the downstream route along with the locations of where the following photos were taken.

A second discharge point from TDA 1 releases runoff collected from the interurban trail area as well as runoff from mainline I-5. This discharge point, shown in Figure A-2.11, is an existing ditch which discharges into Golde Creek shortly after leaving WSDOT right-of-way and merges with the main TDA 1 downstream flow path.

Construction of the project will not create any new drainage problems nor exacerbate any existing problems within the downstream system of TDA 1. The observed portion of the downstream drainage system appeared to be in good working condition with no signs of significant erosion, sedimentation or flooding.



Photo 100: Start of TDA 1 Downstream Route. Alderwood Mall Boulevard facing northeast.



Photo 101: Alderwood Mall Boulevard facing northeast.



Photo 102: Alderwood Mall Boulevard facing southeast. Location where conveyance system crosses Alderwood Mall Boulevard and Interstate 5.



Photo 103: Golde Creek facing north, near outfall just south of Interstate 5.



Photo 104: Golde Creek facing south, near the outfall just south of Interstate 5.



Photo 105: Golde Creek facing south.



Photo 106: Golde Creek facing north.



Photo 107: Golde Creek facing south.



Photo 108: Golde Creek facing north.



Photo 109: Golde Creek facing south, approximately 300 feet north of 196th Street SW.



Photo 110: Golde Creek facing north, at 196th Street SW.



Photo 111: Golde Creek facing south, at 196th Street SW. Three foot concrete culvert crosses under 196th Street.

3.8.2 TDA 2 Downstream Analysis

The TDA 2 downstream route begins on 196th Street SW approximately 600 feet east of Poplar Way. There is curb and gutter on both sides of 196th Street SW which collects runoff and directs it into catch basins along the gutter line. The catch basins are part of a piped conveyance system which directs runoff to the east along the north side of 196th Street SW. This conveyance system continues for approximately 500 feet to the east of the project limits. At this point, the conveyance system discharges into Golde Creek via a type 2 catch basin which is connected to the 3 foot diameter concrete culvert which conveys Golde Creek under 196th Street SW. The catch basin is very deep and water could be heard flowing through it at the time of this investigation.

The upstream end of the creek channel is 8 feet wide by 3 inches deep and is trapezoidal in cross section. The bottom is cobbled and there are no signs of erosion or sedimentation. The downstream end of the culvert is located several feet above the stream bottom and water flows freely from this end of the culvert. On the south side of 196th Street SW, Golde Creek continues to flow to the south and is approximately 6 feet wide by 1 foot deep with a trapezoidal cross section. The bottom of the channel is silty in this location, but there were no signs of erosion. The velocity of this section of Golde Creek is much lower than to the north of the 196th Street SW. The creek intersects Alderwood Mall Parkway and crosses under the road through an arched corrugated metal culvert with an open bottom. The culvert is 8 feet wide and 5 feet tall allowing the creek to flow through it without altering the width, depth, or velocity of the creek. The quarter mile point of this downstream route is near the halfway point of this culvert. Refer to Figure A-2.12 Downstream Map TDA 2 in Appendix A-2 of this report for a delineation of the TDA 2 downstream route along with the locations of where the following photos were taken.

Construction of the project will not create any new drainage problems nor exacerbate any existing problems within the downstream system of TDA 2. The observed portion of the downstream drainage system appeared to be in good working condition with no signs of significant erosion, sedimentation or flooding.



Photo 400: Beginning of TDA 2 downstream route. 196th Street SW facing east.



Photo 401: 196th Street SW facing east, near Golde Creek



Photo 402: Golde Creek at the 196th Street SW crossing, facing north.

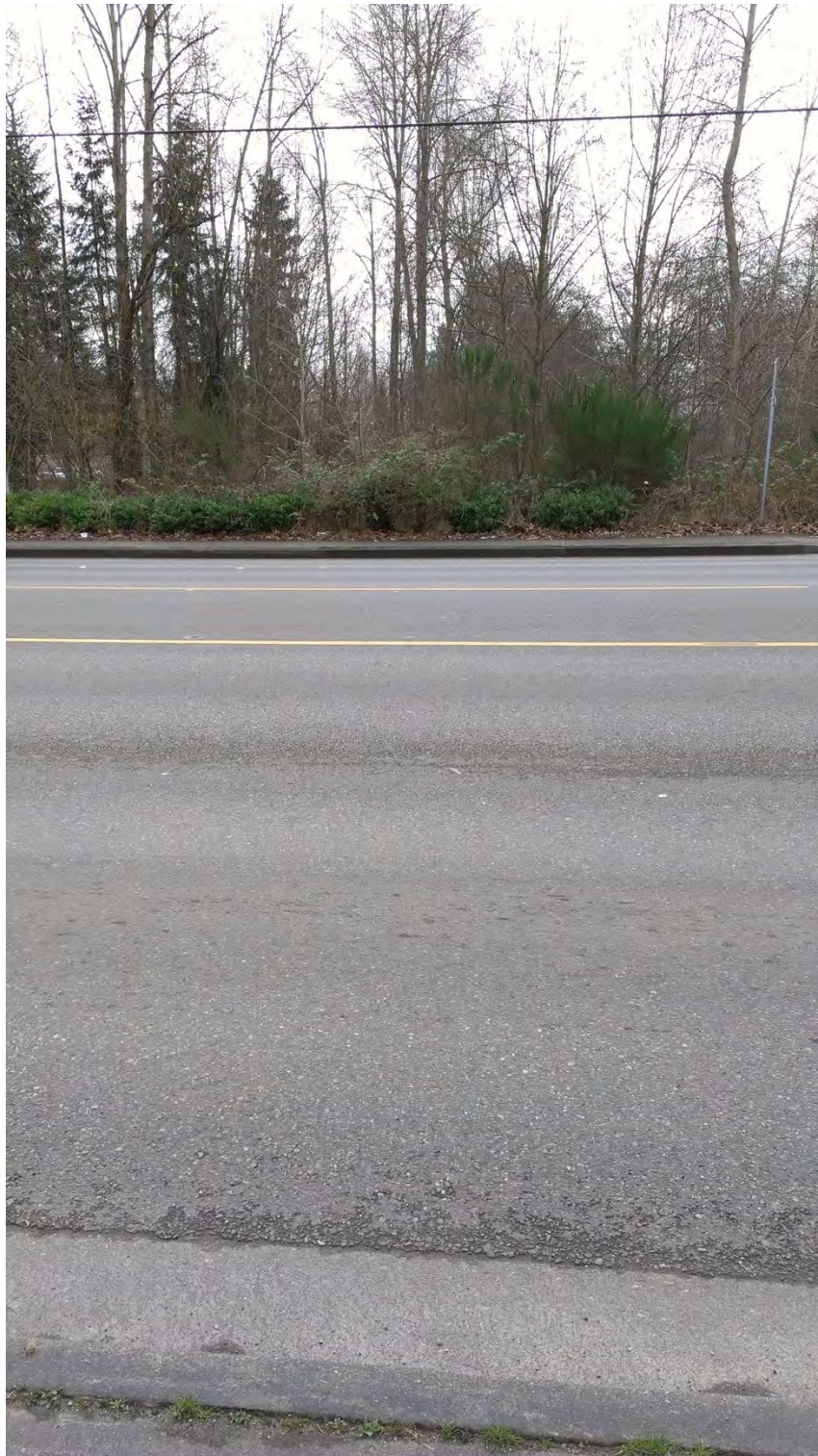


Photo 403: 196th Street SW at the Golde Creek crossing, facing south.



Photo 404: Golde Creek outfall on the south side of 196th Street SW. Photo facing east, creek flowing south.



Photo 405: Golde Creek between 196th Street SW and Alderwood Mall Parkway. Photo facing north.



Photo 406: Golde Creek at Alderwood Mall Parkway crossing. Photo facing south.

3.8.3 TDA 3 Downstream Analysis

The TDA 3 downstream route begins on Poplar Way SW approximately 300 feet north of Alderwood Mall Parkway. There is curb and gutter on the east side of Poplar Way SW which directs runoff from that side of the street into a series of catch basins and pipes. This conveyance system directs flow to the south along Poplar Way SW for approximately 300 feet where it turns and heads east along the north side of Alderwood Mall Parkway in a storm drain system. This storm drain system flows to the east for approximately 1,250 feet before entering an existing pond on the north of Alderwood Mall Parkway at the back of Whole Foods. The quarter mile point along this downstream route is approximately 300 feet prior to the pond. The pond releases water into a ditch which flows to the west along the north side of Alderwood Mall Parkway and outfalls into Golde Creek near the arched culvert directing flows to the south. Refer to Figure A-2.13 Downstream Map TDA 3 in Appendix A-2 of this report for a delineation of the TDA 3 downstream route along with the locations of where the following photos were taken.

Construction of the project will not create any new drainage problems nor exacerbate any existing problems within the downstream system of TDA 3. The observed portion of the downstream drainage system appeared to be in good working condition with no signs of significant erosion, sedimentation or flooding.



Photo 500: Alderwood Mall Parkway facing east.

3.8.4 TDA 4 Downstream Analysis

The TDA 4 downstream route begins on Poplar Way SW approximately 300 feet north of Alderwood Mall Parkway. Runoff from the west side of Poplar Way SW sheet flows into a ditch on the west side of the street. The ditch flows to the south for approximately 200'. At this point, a catch basin at the northwest corner of the intersection with Alderwood Mall Parkway collects the flow from the ditch and directs it a series of pipes and catch basins. This piped conveyance system directs flow to the southeast corner of the intersection and outfalls into a ditch along the south side of Alderwood Mall Parkway. This ditch has some erosion at the outfall from Poplar Way; however, the evidence of erosion

disappears approximately five feet downstream of the outfall. The ditch flows to the east for approximately 350 feet, and then enters an existing pond. The pond releases water into another ditch along the south side of Alderwood Mall Parkway which flows to the east for approximately 900 feet before entering Golde Creek just to the south of the arched culvert mentioned in TDA 2 and TDA 3 downstream analyses. This ditch is very shallow and flat. There is no sign of erosion; however, there were a few areas of standing water that could potentially flood the sidewalk during large rainfall events. The quarter mile point for the TDA 4 downstream route is where the ditch connects to Golde Creek. Refer to Figure A-2.14 Downstream Map TDA 4 in Appendix A-2 of this report for a delineation of the TDA 4 downstream route along with the locations of where the following photos were taken.

Construction of the project will not create any new drainage problems nor exacerbate any existing problems within the downstream system of TDA 4. The observed portion of the downstream drainage system appeared to be in good working condition with no signs of significant erosion, sedimentation or flooding.



Photo 600: Start of ditch to the south of Alderwood Mall Parkway, facing east.



Photo 60I: Pipe outlet into ditch on south side of Alderwood Mall Parkway. Photo facing southwest.



Photo 602: Ditch along Alderwood Mall Parkway, upstream of pond, facing east.



Photo 603: Pond photo taken on Alderwood Mall Parkway facing south.



Photo 604: Pond, photo taken on property to the south of Alderwood Mall Parkway, facing east.



Photo 605: Downstream of pond, Alderwood Mall Parkway facing east.



Photo 606: Ditch along south side of Alderwood Mall Parkway, facing east.



Photo 607: Ditch along the south side of Alderwood Mall Parkway, facing east. Ditch may flood during high intensity rain events in this location.



Photo 608: Ditch along the south side of Alderwood Mall Parkway, facing east. Ditch slope steepens in this area.



Photo 609: Ditch along south side of Alderwood Mall Parkway entering Golde Creek. Photo facing south.

3.9 New Stormwater Outfalls

There will be no new stormwater outfalls as part of this project. The existing stormwater outfalls will be maintained to the greatest extent practical.

4.0 DEVELOPED CONDITIONS

Major elements of the Poplar Way Extension Bridge project will include a new multi-lane bridge structure with six lanes, pedestrian and bicycle facilities; intersection modifications and grade adjustments to accommodate tie-in to existing streets on either side of the freeway; and widening and restriping of portions of Poplar Way, 196th Street SW, Alderwood Mall Boulevard, 33rd Avenue W and Alderwood Mall Parkway. The project will also accommodate the Interurban Trail, which runs along Alderwood Mall Boulevard on the west/northwest side of I-5.

The proposed storm drain system will include new catch basins, storm pipe and Filterra units. The catch basins will be placed along the curbline of the newly widened roadway improvements and will collect runoff from the improved roadway and sidewalk areas. TDA 1 is the only TDA which requires water quality treatment and flow control. Water quality treatment will be accomplished by the use of Filterra units which will mostly be located within widened sidewalk areas. Filterra units, sized for enhanced treatment, will be located at different locations along 33rd Avenue W and Alderwood Mall Boulevard. Since these units will be sized for enhanced treatment they will also be able to satisfy the oil control treatment requirements at the Alderwood Mall Boulevard / 33rd Avenue W / Poplar Way intersection. Filterra units, sized only for oil control, will be located at different locations along 196th Street SW. These units will capture enough runoff to satisfy the oil treatment requirements at the 196th Street SW / Poplar Way intersection. Sizing calculations for the Filterra units have been performed using WWHM4. These calculations are included in Appendix A-3.2 of this report. Catchment areas for each Filterra unit are shown in Figures H.1 and H.2 in Appendix H of this report.

4.1 Flow Control

Three different alternatives for satisfying the flow control requirements for this project were considered. Each alternative is described below.

4.1.1 Alternative #1

This alternative includes the installation of an underground concrete detention vault for the purposes of flow control and the use of Filterra units for the purpose of enhanced water quality treatment as well as oil control. The detention vault for this alternative is located just south of Alderwood Mall Boulevard and just east of Poplar Way, within PUD property. A portion of the vault will be located under the Interurban Trail. Access to the vault will be via the Interurban Trail. Controlled release of runoff from this facility will be conveyed to the existing City of Lynnwood storm drain system within Alderwood Mall Boulevard.

Filterra units, sized for enhanced treatment, will be located at different locations along 33rd Avenue W and Alderwood Mall Boulevard. Since these units will be sized for enhanced treatment they will also be able to satisfy the oil control treatment requirements at the Alderwood Mall Boulevard / 33rd Avenue W / Poplar Way intersection. Filterra units, sized only for oil control, will be located at different locations along 196th Street SW. These units will capture enough runoff to satisfy the oil treatment requirements at the 196th Street SW / Poplar Way intersection.

Refer to Figures A.1 through A.3 in Appendix A-4 of this report for a schematic layout of this alternative.

4.1.2 Alternative #2

This alternative includes the installation of an underground detention vault for the purposes of flow control and the use of Filterra units for the purpose of enhanced water quality treatment as well as oil control. The detention vault for this alternative is located approximately 1,000 feet east of the project, just south of Alderwood Mall Boulevard and within PUD property. This vault will be located in the landscaped area between the Interurban Trail and Alderwood Mall Boulevard. Access to the vault will be via the Interurban Trail. Controlled release of runoff from this facility will be conveyed to the existing City of Lynnwood storm drain system within Alderwood Mall Boulevard.

Filterra units, sized for enhanced treatment, will be located at different locations along 33rd Avenue W and Alderwood Mall Boulevard. Since these units will be sized for enhanced treatment they will also be able to satisfy the oil control treatment requirements at the Alderwood Mall Boulevard / 33rd Avenue W / Poplar Way intersection. Filterra units, sized only for oil control, will be located at different locations along 196th Street SW. These units will capture enough runoff to satisfy the oil treatment requirements at the 196th Street SW / Poplar Way intersection.

Refer to Figures B.1 through B.4 in Appendix A-4 of this report for a schematic layout of this alternative.

4.1.3 Alternative #3

This alternative includes a retrofit of the existing Alderwood Mall detention pond, north of the project site. This retrofit will utilize two Thirsty Duck flow regulator devices placed within the existing pond's footprint and will not involve any pond re-grading or new pond wall construction. These devices will replace the current function of the pond's existing flow control structure. The two Thirsty Duck devices will more efficiently regulate the release of water from the pond, whereby decreasing flows at the designated point of compliance. Refer to Figure A-2.15 in Appendix A of this report for a delineation of the point of compliance.

4.1.3.1 Alderwood Mall Pond

The existing Alderwood Mall Pond is located approximately 1,200 feet north of the Poplar Way Extension Bridge project. It was constructed as part of the Alderwood Mall Expansion project back in 2002. This existing pond was originally sized to satisfy the flow control standards at the time of its construction, which was the 1992 Ecology Manual. The flow control standards at that time were based on single event storm modeling. Therefore, the existing pond was sized to release the proposed on-site 2-year flow rate at one-half of the pre-developed 2-year rate, the proposed on-site 10-year flow rate at the pre-developed 10-year flow rate and the proposed on-site 100-year flow rate at the pre-developed 100-year flow rate. The pond currently detains runoff from the 83.9 acre Alderwood Mall site and also provides adequate storage such that there is no overtopping of the pond during the 100-year storm event for the overall 175 acre (91.1 additional acres of off-site flow) basin. Excerpts and calculations taken from the Alderwood Mall Expansion drainage report are included in Appendix G of this report. Stage and storage information from this report was used in the point of compliance analysis for Alternative #3 discussed below.

4.1.3.2 Approach for Flow Control

The approach to satisfying the flow control requirements for the Poplar Way Extension Bridge project involves the installation of two Thirsty Duck flow regulating devices within the existing Alderwood Mall Pond, located north of the project site. The Thirsty Duck is a proprietary product which can deliver a

constant discharge rate, independent of headwater depth. The result is a much more efficient flow control design which, in the case of a retrofit situation, can create additional storage space within a stormwater facility and/or decrease flow rates and flow durations being released from that same facility. The proposed installation of the two Thirsty Duck devices within the Alderwood Mall Pond will decrease the current flows being released from that pond. At the point of compliance, these decreased flows will compensate for the increased flows associated with the new impervious area from the Poplar Way Extension Bridge project equivalent area. This point of compliance analysis demonstrates that the flow requirements are met for this project without the need to construct a separate flow control facility. The installation of the two Thirsty Duck devices within the existing Alderwood Mall Pond, along with the associated modifications to the existing flow control and emergency overflow structures, will be the only flow control measures required as part of this project. The following discussion describes how the point of compliance approach was modeled.

The Poplar Way Extension Bridge project is required to comply with the 2011 WSDOT HRM. Therefore, the flow control modeling method will be the continuous simulation method. Continuous simulation modeling accounts for compounding storm events and therefore results in larger stormwater facilities than single event modeling. Under current code requirements, which require the use of continuous simulation modeling to size stormwater facilities, the existing Alderwood Mall Pond would not be in compliance with the code requirements. The following modeling approach compares the post developed flow durations to the pre-developed flow durations at the point of compliance for the existing pond basin and the project equivalent area basin.

Since the land cover within the tributary basin to the Alderwood Mall Pond will not change as a result of the Poplar Way Extension Bridge project, both the pre-developed and post developed condition in the model will reflect the current land cover conditions for this basin. Modeling this basin in such a way will accurately represent how the existing pond functions under continuous simulation modeling. The project equivalent area basin will be modeled as forest in the pre-developed condition (as required by code) and impervious in the post developed condition. In order to set the target flow durations for this analysis, the pre-developed flow durations for the project equivalent area basin and the Alderwood Mall Pond basin will be routed to the point of compliance as shown in Figure 6 below. As shown, flows from the Alderwood Mall Pond are first routed through the existing pond's flow control structure and flows from the project equivalent area are released undetained. In the post developed condition the project equivalent area is modeled as impervious surface and the flows from the Alderwood Mall Pond are routed through the Thirsty Duck devices prior to the point of compliance. Refer to Figure 7 below for the Post Developed Modeling Schematic.

Figure 6 – Pre-Developed Modeling Schematic

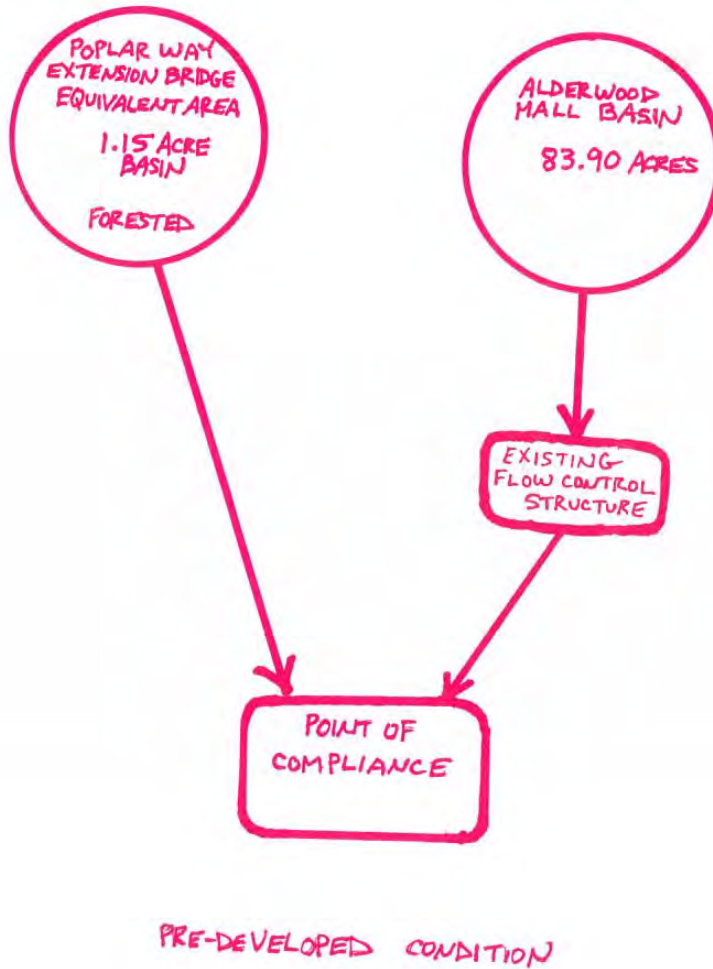
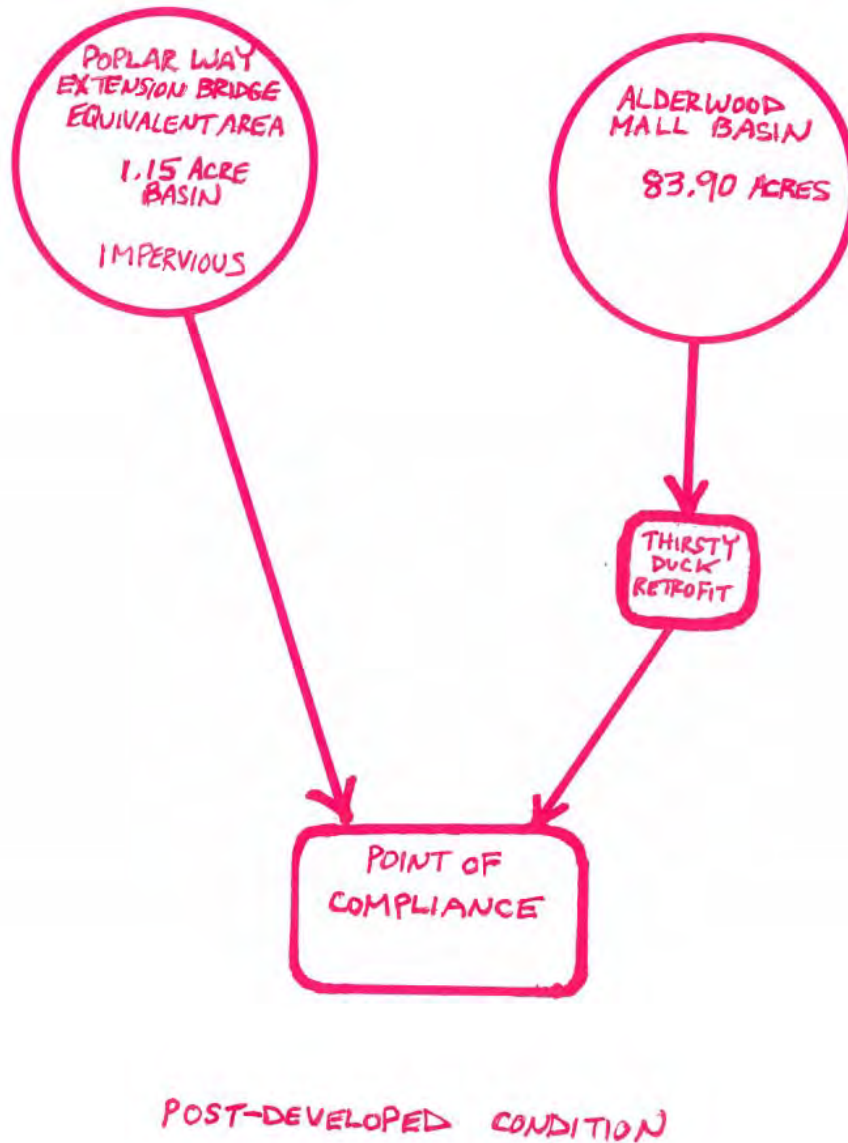


Figure 7 – Post Developed Modeling Schematic



The results of the analysis indicate that installing Thirsty Duck flow devices in the existing Alderwood Mall pond will decrease flow durations enough at the point of compliance to compensate for the increase in flow durations due to the Poplar Way Extension Bridge project. Furthermore, the flow control requirements are met without the need to construct a new facility. The calculations, which demonstrate compliance with the project flow control requirements, are included in Appendix A-3 of this report. A summary of the results and the flow duration curve, which show compliance with the flow control standard, are presented below.

MALL BASIN ANALYSIS RESULTS

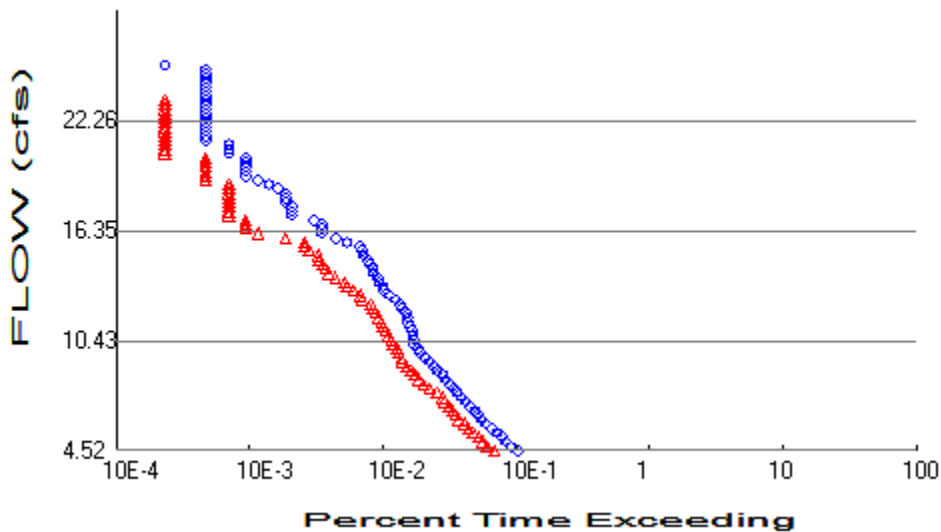
Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	9.04
5 year	14.84
10 year	18.92
25 year	24.19
50 year	28.17
100 year	32.16

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	6.09
5 year	10.02
10 year	13.21
25 year	17.96
50 year	22.06
100 year	26.67

DURATION CURVE



POC I Predeveloped: BLUE
 POC I Mitigated Flow: RED

Calculations were also performed to check the effects of the overall 175 acre basin (83.9 acre mall site plus 91.1 acres of additional area which currently drains to the existing Alderwood Mall Pond). This calculation check was performed for the original Alderwood Mall pond design and therefore will be performed for this design as well. These calculations are also included in Appendix A-3 of this report. The modeling schematic diagrams for this analysis are the same as the ones above except the Alderwood Mall Pond basin consists of 175 acres rather than 83.9 acres. A summary of the results and the flow duration curve, which show compliance with the flow control standard, are presented below.

FULL BASIN ANALYSIS RESULTS

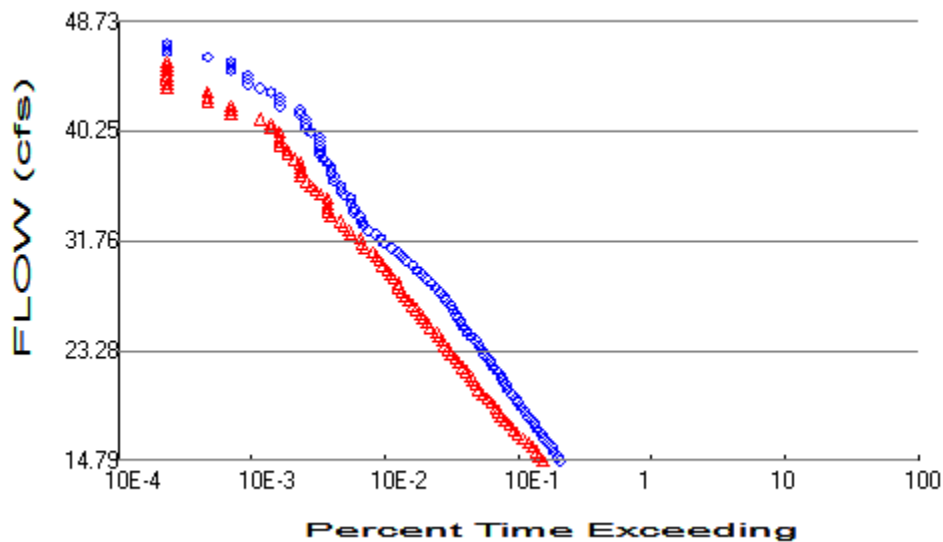
Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	29.59
5 year	36.30
10 year	40.40
25 year	45.28
50 year	48.73
100 year	52.07

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	25.61
5 year	32.77
10 year	37.18
25 year	42.44
50 year	46.18
100 year	49.79

DURATION CURVE



POC I Predeveloped: BLUE
 POC I Mitigated Flow: RED

4.1.3.3 Water Quality Treatment

Filtterra units, sized for enhanced treatment, will be located at different locations along 33rd Avenue W and Alderwood Mall Boulevard. Since these units will be sized for enhanced treatment they will also be able to satisfy the oil control treatment requirements at the Alderwood Mall Boulevard / 33rd Avenue W / Poplar Way intersection. Filtterra units, sized only for oil control, will be located at different locations along 196th Street SW. These units will capture enough runoff to satisfy the oil treatment requirements at the 196th Street SW / Poplar Way intersection.

Refer to Figures C.1 through C.3 in Appendix A-4 of this report for a schematic layout of this alternative.

4.2 Recommendation

It is recommended that Alternative #3 be the preferred alternative for handling the flow control, water quality treatment and oil control treatment requirements associated with the project. Alternative #3 is the cheapest alternative, eliminates the need to construct a new facility (detention vault) which the City would have to own and maintain, and this alternative utilizes an existing regional flow control facility which is a highly beneficial means of controlling stormwater. Refer to the alternative cost comparison in the table below as well as additional comparison information in Appendix C of this report.

Table 11 – Alternative Cost Comparison

Alternative Comparison			
Item	Alternative #1 Cost	Alternative #2 Cost	Alternative #3 Cost
Detention Vault	\$380,000	\$350,000	N/A
Filtterra Units	\$121,000	\$121,000	\$121,000
Conveyance	\$117,410	\$143,417	\$74,100
Shoring/Excavation	\$57,930	\$81,690	\$21,400
Additional Survey	N/A	\$3,500	N/A
Thirsty Duck Retrofit	N/A	N/A	\$50,100
Contingencies	\$135,270	\$139,920	\$53,300
Total	\$811,700	\$839,600	\$319,900

The benefits associated with implementing Thirsty Duck devices for this project are as follows:

- Current peak flow release rates from the pond will be decreased, lessening the impacts on the entire downstream drainage system.
- Eliminates the need to construct a brand new flow control facility that will need to be maintained for years to come.
- Current maintenance practices for the existing regional detention pond will not be affected.
- Use of a regional detention facility is a highly beneficial means of controlling stormwater runoff and is highly encouraged throughout the industry.

4.3 Drainage Basins

The upstream drainage basins adjacent and tributary to the project site will remain unchanged as a result of the Poplar Way Bridge project. The upstream off-site drainage basins will continue to discharge

runoff into existing storm drain systems which will remain active upon project completion. Off-site drainage basins are delineated in Figure A-2.8 in Appendix A of this report.

Individual on-site drainage basins tributary to catch basins and Filterra units will be delineated during the next design phase and will be included in the next hydraulic report submittal.

4.6 Post Developed Drainage Patterns

Upon project completion, runoff from all on-site and tributary off-site areas will be collected and conveyed through the project site within both existing and new storm pipe conveyance systems. These systems will direct flow to each TDA's natural discharge points, to the greatest extent practical. New on-site conveyance systems will collect and convey project site runoff within new storm drain pipe and discharge it into the existing storm drain systems. Runoff from the off-site upstream basins will continue to be collected and conveyed through the project site via the existing storm drain systems.

5.0 HYDROLOGIC AND HYDRAULIC DESIGN

5.1 Calculation Discussion

5.1.1 Flow Control

Retrofit pond sizing calculations are included in Appendix A-3 of this report. The software program WWHM version 4 was used for the analysis. Excerpts from the original drainage report associated with the regional detention pond are included in Appendix G of this report.

5.1.2 Water Quality Treatment

Filtterra units will be used to satisfy both the oil control and water quality treatment requirements associated with this project. The sizing calculations associated with these units are included in Appendix A-3 of this report.

5.1.3 Conveyance Analysis

The storm drain pipe system has not been sized yet. The proposed storm drain system sizing calculations will be provided with the 60% hydraulic report submittal.

6.0 PERMITS AND ASSOCIATED REPORTS

6.1 Environmental Issues, Fish, and Other Endangered Habitat

6.1.1 Receiving Bodies

The immediate receiving water body associated with this project is Golde Creek, located just east of the current project limits. Refer to Section 2.2 of this report and the Environmental Review Memorandum (submitted under separate cover) for more information regarding Golde Creek.

6.1.2 Floodplains

As described in Section 2.2 of this report, there are no floodplains within the project area. Therefore, this project will not affect floodplains or floodways.

6.1.3 Stream Crossings

There are no stream crossings within the project limits. However, Golde Creek crosses under Interstate 5 and 196th Street SW northeast and east of the current project limits. Project improvements will not adversely affect these two crossings. Refer to Section 3.8 (Downstream Analysis) of this report for more information regarding these crossings.

6.1.4 Wetlands

There are no wetlands located within the project limits. However, two wetlands have been delineated just east of the 196th Street SW project limits. Refer to Section 2.2 of this report and the Environmental Review Memorandum (submitted under separate cover) for more information regarding these wetlands.

6.1.5 Steep Slopes

There are no steep slopes located within the project limits. However, small steep slope areas have been identified to the northeast and southwest of project limits. Refer to Figure 3 for the location of these steep slope areas. Project improvements are not anticipated to have any adverse impacts on these steep slope areas.

6.1.6 Other Sensitive Areas

There are no critical aquifer recharge areas (CARAs), wellhead protection zones, or sole-source aquifers (SSAs) within or adjacent to the project limits. There are no water wells on record near the project area; however, there are some monitoring wells nearby. Well reports from these monitoring wells have been reviewed and there is no indication that these wells would be adversely affected by the Poplar Way project. The general area is supplied by municipal water from surface sources.

Research of the Washington State Department of Ecology's toxic materials database, performed on August 10, 2011, indicates the presence of 18 underground storage tanks, leaking storage tanks, and voluntary cleanup sites within a ½ mile radius of the project site. Research also notes the presence of 8 sites on Ecology's Confirmed or Suspected Contaminated Sites within a mile of the project site. A hazardous materials report will need to be prepared to document the presence or lack of potential contamination within the project limits.

There is no critical habitat within or adjacent to the project limits.

6.1.7 Endangered and Threatened Species

There are no threatened or endangered species within or adjacent to the project limits. Refer to the Environmental Review Memorandum (submitted under separate cover) for more information regarding Endangered and Threatened Species.

6.2 Permits / Approvals

Determination of assumed regulatory requirements for a particular project action is based on site reconnaissance, communication with the relevant agencies, research on regulatory requirements, and professional assessment of the site.

Table II below provides a summary of the assumed environmental and land use permits/approvals that will likely be required for the project from federal, state and local agencies. The applicability of each permit is based on a review of the scope, site observations, agency requirements, and best professional judgment.

Table 12 - Environmental Review Summary

Environmental Review/Approval/Permit	Implementing Agency	Required?	Typical Submittal Requirements
Federal			
National Environmental Policy Act Review (NEPA)	FHWA/WSDOT Local Programs	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	Environmental Classification Summary (ECS) with associated technical memoranda and reports
National Historic Preservation Act (NHPA) Section 106 Review	National Park Service (NPS) and State Historic Preservation Office (SHPO)	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	Area of Potential Effect (APE) Concurrence; Cultural Resources Assessment for projects with undisturbed areas or known resources
Discipline Reports and/or Technical Memoranda	WSDOT Local Programs/FHWA	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	Discipline Reports and/or Technical Memoranda: Parks, Air, Noise, Visual Quality, Stormwater, Hazardous Soils
Endangered Species Act (ESA) Section 7 (and Essential Fish Habitat) Consultation	National Marine Fisheries Service (NMFS) and/or U.S. Fish and Wildlife Service (USFWS)	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	No Effect Letter (NEL)
Clean Water Act Section 404 Permit (Nationwide or Individual Permit)*	U.S. Army Corps of Engineers (Corps)	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required*	
Rivers and Harbors Act Section 10 Permit	U.S. Army Corps of Engineers (Corps)	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required	
State			
Hydraulic Project Approval (HPA)*	Washington Department of Fish and Wildlife (WDFW)	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required*	
Clean Water Act Section 401 Water Quality Certification	Washington Department of Ecology (Ecology)	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required	

* Assumes no in-water work will be performed.

Environmental Review/Approval/Permit	Implementing Agency	Required?	Typical Submittal Requirements
Coastal Zone Management (CZM) Certification	Washington Department of Ecology (Ecology)	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	Consistency Form submittal
Executive Order 05-05	State Department of Archeology and Historic Preservation (DAHP)	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required	
National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit	Washington Department of Ecology (Ecology)	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	Notice of Intent; Stormwater Pollution Prevention Plan (SWPPP); SEPA Determination required
Forest Practices Permit	Washington Department of Natural Resources [DNR] or Local Agency	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required	
Aquatic Lands Use Authorization	Washington Department of Natural Resources [DNR] or Local Agency	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required	
State ROW Construction Approval	Washington Department of Transportation, Development Services	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	General Construction Permit and Channelization Plans (Requires prior approval of limited access break and airspace lease)
Local Agency			
State Environmental Policy Act (SEPA)	City of Lynnwood	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	SEPA Checklist
Critical Area Ordinance Review and Compliance Certification	City of Lynnwood	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required	Critical Areas Report and Mitigation Plans; Possibly required for potential impacts to, or construction near Golde Creek, associated wetlands, and/or buffers.
Shoreline Substantial Development, Conditional Use, or Variance Permits	City of Lynnwood; Requires review or approval from Ecology	<input type="checkbox"/> Required <input checked="" type="checkbox"/> Not Required	
Clearing and Grading Permit	City of Lynnwood	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	Local Permit Application; Site Preparation Plans
Right-of-Way Permit	City of Lynnwood Public Works	<input checked="" type="checkbox"/> Required <input type="checkbox"/> Not Required	Local Permit Application; ROW plans

6.3 Easements

No drainage easements are anticipated as part of this project. However, certain areas of the project will require slope easements. Those areas will be identified during the later stages of design.

6.4 Specialty Design

The implementation of two Thirsty Duck flow devices within the existing Alderwood Mall Pond and the modification of that pond's existing flow control structure and emergency overflow structure is the proposed method of flow control for this project. The Thirsty Duck is a proprietary product which can deliver a constant discharge rate, independent of headwater depth. Thirst Duck, LP, who manufactures the Thirsty Duck devices, assisted with the point of compliance analysis as well as the proposed design modifications to the Alderwood Mall Pond. The Thirsty Duck Rating Curve Generation spreadsheet was generated by Thirsty Duck, LP in order to create the discharge information for the mitigated scenario in the WWHM model. This spreadsheet has been included in Appendix A-3 for reference.

6.5 Additional Reports or Studies

Geotechnical report, Environmental Review Memo, SWPPP, etc.

7.0 INSPECTION AND MAINTENANCE SUMMARY

Inspection during construction is covered in the TESC plan. Once the project is complete, the Washington State Department of Transportation will be responsible for the maintenance and operation of the installed drainage systems and stormwater facilities within their jurisdiction. The City of Lynnwood will be responsible for the maintenance and operation of the installed drainage systems and stormwater facilities within their jurisdiction. A separate drainage maintenance manual will be prepared for the project outlining the required inspection and maintenance procedures for the project drainage facilities. The drainage maintenance manual will be included in Appendix F of this report with the 60% hydraulic report submittal. Maintenance procedures outlined in the project drainage maintenance manual supplement those set forth in the WSDOT HRM and the WSDOT Maintenance Manual. Additional standards for maintaining stormwater BMPs are found in the *Regional Road Maintenance Endangered Species Act Program Guidelines* and Instructional Letter (IL) 4057.01 *Environmental Compliance Assurance Procedure For Maintenance Work Activities*.

Maintenance and operation of on-site drainage facilities:

1. Drainage facilities shall be maintained at appropriate times so that their water quantity and water quality control functions, and access are not impaired; and shall include keeping all drainage facilities and access areas free of accumulated debris or trash and all impervious surfaces free from sediment.
2. Maintenance of all drainage facilities shall be conducted by the responsible party in compliance with an operation and maintenance plan for drainage facilities developed in accordance with the requirements of this title.
3. Any modification to detention facilities for maintenance which is not part of an approved maintenance schedule will require prior approval by the City of Lynnwood and/or WSDOT. A revision to the approved plans, drainage computations, or maintenance schedule shall require re-submittal to the City of Lynnwood and/or WSDOT for approval prior to modification.

The attached specific maintenance requirements, found in Appendix F of this report (to be submitted with the 60% hydraulic report), indicate each maintenance component and the conditions when maintenance is required. The drainage facilities shall be inspected twice a year during the first two years of operation, and once a year thereafter. The drainage facilities shall be inspected to determine whether conditions exist which would require maintenance. If it is determined that conditions exist that require maintenance, this maintenance is to be performed in a timely manner.

Any standing water removed during the maintenance operation must be disposed of in a sanitary sewer (as approved by the governing jurisdiction) or to another City of Lynnwood or WSDOT approved discharge location. Residuals must be disposed of in accordance with current health department requirements of the local government.

The facility-specific maintenance standards contained in Appendix F of this report are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facilities' required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

Refer to the sheets in Appendix F as a guide for maintaining the drainage components associated with this project.