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FERNDALE GATEWAY STORMWATER STUDY: CHARACTERIZATION AND BASIN PLANNING

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Submitted to:
City of Ferndale
Public Works Department

Prepared for: The City of Ferndale
2095 Main Street
Ferndale, WA 98248

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1.0 Purpose of Study

1.1 Study Purpose

In response to the interest shown by property owners, the City of Ferndale has undertaken the Main Street Master Plan Planned Action Environmental Impact Statement (PAEIS) for the approximately 443 acres surrounding the Interstate 5/Main Street interchange (Exit 262) in Ferndale. Through this process, it became apparent that a regional drainage study of the area is needed. This study is intended to provide sufficient documentation in regards to the City's drainage infrastructure, in both the existing and "Full Build-out" conditions, to supplement the previous work documented in the PAEIS.

1.2 Study area

The Ferndale Gateway consists of approximately 443 acres of partially developed land in the vicinity of the Interstate 5/Main Street interchange. This area can be divided into five stormwater basins. These are the Riverside Drive, Riverside Golf, Haggen, Tenmile/Deer Creek and Creighton basins. A map of the study area and the subject basins are shown on Figure 1. Each one of these basins has its own discharge to a receiving water body. All basins are within the WRIA 1 basin, and ultimately discharge to the Nooksack River. Although the basins are within a similar geographic area, there is a clear split between those which discharge directly to the Nooksack River and those which do not. A more detailed description of the studied basins will be documented later in this report.

1.3 Study Objective

The primary objectives of this study are as follows:

1. Update the City's Stormwater System Inventory, through the use of as-builts and topographic survey. This shall be in a format that can be utilized by City staff to update the Geodatabases.
2. Perform hydrologic and hydraulic modeling to determine deficiencies in the City's infrastructure in both the existing and full build-out conditions.
3. Evaluate the habitat, value, function and potential for cultural or historic resources of the receiving waters and potential regional mitigation sites.
4. Document development standards which should apply to the specific basins based on the results of the hydraulic analysis and evaluation of environmental sensitivity of the receiving waters.
5. Develop a capital improvement program based on the hydraulic schedule.

2.0 System Inventory

2.1 Description of Work

The purpose of the System inventory update was to produce a more accurate representation of the City's infrastructure which could be utilized by City staff to update the Geodatabase. As this was a study of the City's infrastructure, that detailed information in regard to private facilities was not included within the inventory. Although, private facility information was reviewed to determine the extent and pattern of the drainage as it affects the City's system.

Original information received by Reichhardt and Ebe Engineering Inc. from the City was based on information gathered in a Drainage Inventory performed by the City in 2000. This information was updated for use in the 2006 Comprehensive Stormwater Plan, partially funded by the Department of

Ecology. The Comprehensive Stormwater Plan map has been updated, through City staff efforts, in more recent years as information has become available.

Reichhardt & Ebe has performed numerous roadway projects within the study area. As-built survey information from such projects was utilized in updating the system inventory map. Also, the Washington State Department of Transportation (WSDOT) provided as-built information of its facilities for use in this project. Being that this information was fairly dated, it was used in guiding a Licensed Professional Surveyor to perform topographic survey of these facilities, once a permit was received by the WSDOT allowing access to their facilities.

In an effort to more accurately describe the City's infrastructure, a meeting was held with City staff to determine the level of information required, and the methods of which to gather it. It was at this meeting that it was determined that minor and private system information was not necessary to meet the purposes of this study as it is not the City's responsibility to size, construction or maintain said facilities. It was decided that major systems would be topographically surveyed. Invert elevations were gathered on necessary reaches and rim elevations on all so that measure downs could be easily calculated or gathered as necessary. In order to enhance the efficiency of the survey crew, City staff located drainage structures, brushed survey lines of sight, provided traffic control, and handled structure covers as needed.

2.2 Description of Product

Utilizing the data gathering methods described in the previous section, existing information, as-built survey, and new survey was incorporated into a single AutoCAD drawing file. AutoCAD is extremely spatially accurate and can be imported into GIS systems, and can be utilized for future designs. However, future use of this drawing file should be prefaced with the fact that the information was not gathered for design purposes, and that verification of the data should be performed in order to assure that the accuracy of data suits the intended use.

During the data consolidation effort, outdated information, such as previously identified structures that had been removed during various construction projects, was purged from the map. The result is a map which has sufficient accuracy to describe the major drainage reaches within the Gateway study area. This allows for accurate determination of flow direction, needed capacity, and receiving water. A sample of the AutoCAD drawing is shown in Figure 2. Due to the size of the study area, a single exhibit is not sufficient to portray the value of the information. A digital copy of the information has been provided to the City.

3.0 Hydrologic and Hydraulic Modeling

3.1 Method

The purpose of the modeling exercise was to determine the sufficiency of the City's infrastructure in the current state of development as well as the full build-out scenario. There are many factors that can be considered in determining sufficiency. For example a determination of sufficiency may be made if the basin is subject to flow control exemptions per the Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW). The only way that this exemption can be claimed is if the conveyance to the flow control exempt receiving water body has sufficient capacity in a man-made channel which is non-erosive. For this reason, a part of this study was to characterize the receiving water bodies, and the standards which should apply to those in accordance with the SWMMWW.

Standard methodology for performing conveyance calculations is to model a single event using the SCS Curve Number Method (SCS) or the Santa Barbara Unit Hydrograph Method (SBUH). Until such time that the Western Washington Hydrology Model (WWHM) is capable of providing output with a 15 minute increment for the required conveyance storm frequency events, it tends to underestimate the peak flows for conveyance analysis. This is discussed in Volume 1 of the SWMM and is alluded to in Chapter 4 of Volume V.

Furthermore, this study benefited from previous work performed. The 2005 Stormwater Comprehensive Plan for the City completed modeling of the entire City. This modeling looked at the existing and future build-out conditions based on information available at that time. In doing so, basins were delineated, the soil types categorized, the rainfall intensities determined and the general flow paths were identified. Modeling from the previous work was the starting point for this study, with build-out conditions identified by the PAEIS included. Basins had to be modified in accordance with the study area. Updated full build-out conditions were inserted based on more recent developments in City code and developer interest. As mentioned above, more accurate existing conveyance information was added to increase the accuracy of the conveyance analysis.

3.2 Basin Area Physical Descriptions

3.2.1 Historic Rainfall Intensities

Rainfall intensities used for this study were the same used for the 2005 Stormwater Comprehensive Plan. These are shown in Table 1 below:

TABLE 1 - RAINFALL INTENSITIES USED

Storm Event	Inches in 24 hours
6 Month	1.37
2 Year	1.90
10 Year	2.80
25 Year	3.25
100 Year	4.00

All stormwater modeling conducted for this study was based on a Type 1A, 24 hour storm event using the Santa Barbara Unit Hydrograph method. Per Volume V, Chapter 4 of the SWMM the 6 Month storm event is 72 percent of the 2 Year rainfall.

3.2.2 Soils

Soils for this study were the same used for the 2005 Stormwater Comprehensive Plan. This data is from the Natural Resource Conservation Service.

3.2.3 Existing Conditions

Existing condition land cover characteristics for the study area were generated from the 2005 Stormwater Comprehensive Plan. This data was defined based on spring 2002 Walker and Associates, Inc. and City of Ferndale Aerial Vector CAD drawings and Aerial Photo Images. Existing land cover characteristics were defined by observed use on the aerial data. The CAD vector lines and photo images provided a detailed snapshot of those characteristics. The land use was separated into the following categories:

- Hydro area (areas frequently inundated with water)

- Building Area
- Driveway area (800 SF per house)
- Paved area (roads and parking)
- Gravel area (roads and parking)
- Tree area
- Lawn area
- Pasture area

For a more detailed description of the modeling basis, please refer to the 2005 Stormwater Comprehensive Plan. Due to the fact that the study area boundary did not necessarily follow the hydrologic basin boundaries, minor adjustments were required to prepare the model for this study. Modeling output reports can be found in the appendix for the existing condition. Table 2 below provides an acreage summary of the existing land cover of each basin.

TABLE 2 - BASIN AREA SUMMARY

Basin	Total Area	Wetland Area*	Developable Land	Ex. Impervious	Ex. Pervious
Haggen	**30.65**	**0**	**30.65**	**5.78**	**24.87**
Riverside Golf	**47.21**	**4.31**	**42.9**	**2.87**	**40.03**
Subbasin: North	*28.05*	*0.94*	*27.11*	*0.03*	*27.08*
Subbasin: South	*19.16*	*3.37*	*15.79*	*2.84*	*12.95*
Riverside Drive West of 1-5	**135.07**	**9.00**	**126.07**	**45.14**	**80.94**
Subbasin: W of I-5	*17.91*	*2.78*	*15.13*	*0.75*	*14.37*
Subbasin: NW of I-5	*36.09*	*1.89*	*34.2*	*8.72*	*25.48*
Subbasin: I-5	*14.8*	*0*	*14.8*	*8.56*	*6.25*
Subbasin: SW of I-5	*66.27*	*4.33*	*61.94*	*27.11*	*34.84*
Riverside Drive East of 1-5	**37.62**	**1.15**	**36.47**	**7.01**	**29.46**
Tenmile & Deer Creek	**173.16**	**39.54**	**133.62**	**25.32**	**108.29**
Subbasin: North of Main	*46.02*	*6.04*	*39.98*	*16.17*	*23.81*
Subbasin: South of Main East	*104.89*	*32.09*	*72.8*	*4.05*	*68.74*
Subbasin: South of Main West	*22.25*	*1.41*	*20.84*	*5.1*	*15.74*
Creighton	**59.66**	**37.18**	**22.48**	**1.06**	**21.42**

*Wetland areas are based on previous City of Ferndale Critical Areas analysis. They are areas of "probable" wetlands. They are not verified through means of actual delineations.

3.2.4 Full Build-out Conditions

For the purposes of this study, the Full Build-out Condition was modified from the 2005 Stormwater Comprehensive Plan, with the exception of the Haggen basin. Various development proposals were taken into account, such as Pioneer Plaza, a private development proposal which analyzed a large

portion of the Tenmile & Deer Creek basins, but has since expired due to inaction. The build-out condition is consistent with the PAEIS. Wetlands identified in the City's critical areas were generally assumed to remain un-impacted, unless there were development proposals which portrayed impact with mitigation that has since been completed. Discussions with City staff resulted in more basin based assumptions for development. These assumptions will be described for each of the basins considered.

3.2.5 Haggen

The Haggen basin was initially studied when the upgrade to Ferndale's Main Street was designed. The roadway improvement project included the construction of a completely new stormwater conveyance system. It also included the construction of a regional water quality pond (the Neubauer Pond). The pond was sized to treat the entire contributing basin prior to discharging to the Nooksack River, based on the best available data. The study has been amended based on information of higher accuracy. Basic treatment is provided through a wetpond, BMP T10.10 per the SWMMWW. Enhanced treatment would typically be required for the intended use of this basin, however, this reach of the Nooksack River is a Basic Treatment Receiving Water Body per Appendix I-C of the SWMMWW. Detention is not provided within this basin as it was determined that the time to peak for this basin can be measured in minutes, while the time to peak within the Nooksack river is nearly one day. By allowing the water to release from this basin prior to the peak of the Nooksack system the potential for increasing the impact of flooding on the Nooksack River is minimized. The pond is also compliant with Minimum Requirement #7 of the 2005 SWMM, as this reach of the Nooksack is a Flow Control-Exempt Surface Water per Appendix I-E of the SWMM. The original Drainage Report for the Main Street Improvement Project was completed in 2001. Since that time additional analysis has been performed to compensate for actual development conditions. These documents are on file with the City.

3.2.6 Riverside Golf

The stormwater within this basin is conveyed and outfalls to the Nooksack River on private property. For this reason this basin was not analyzed for conveyance and development impacts to the City's stormwater system. If land within the basin is developed, the developers may need to permit a separate outfall system. Development within the floodplain must comply with Ferndale Municipal Code (FMC) 15.24.180 which requires the incorporation of low impact development (LID) techniques.

3.2.7 Riverside Drive West of I-5

This basin is currently partially developed. The area south of Main Street includes the most highly developed land. The area north of Main Street is developed abutting the street. This basin also includes the area of Interstate 5 (I-5). WSDOT facilities make up approximately one half (1/2) of the conveyance reaches which drain this basin to the Nooksack River. North of Main Street there is a large ditch, constructed as a portion of I-5, which drains through a number of culverts and a flood gate as it discharges to the Nooksack River. South of Main Street, there are a number of private pipelines and ditches as well as City owned pipelines which convey the water north to this WSDOT system. For this reason, it is important to coordinate with WSDOT regarding any changes or improvements necessary to this conveyance system.

Developable areas, which do not include probable wetland areas, were assumed to achieve a 95% impervious cover in the full build-out condition in this basin. The extent of the Nooksack River floodplain is of concern within this basin, north of Main Street. For this analysis, north of Main Street, it was assumed that if development was to occur it would be done along the existing roadway corridors. If stormwater mitigation was required, it likely would occur in the Riverside Golf basin, as the mitigated area is under the same ownership.

3.2.8 Riverside Drive East of I-5

Minor development exists in the southern portions of this basin. The undeveloped portion includes a pond which is constructed as mitigation for portions of the existing development. It was assumed that this pond was filled and mitigation was provided with an alternative method. This provided for more developable area in this basin. The impervious coverage of the developed area was assumed to be 95%. The discharge for the basin is to a farm ditch which then enters a culvert which discharges to the Nooksack River. A flood gate is currently installed on the culvert to keep high river water levels from inundating the farm fields. Development within this basin will need to be sensitive to the beneficial use of this farmland as the owner has expressed concern about additional volumes of water hindering his ability to utilize the fields in a manner consistent with historical practices.

3.2.9 Tenmile & Deer Creek

Pockets of development currently exist within this basin area. Many are very intense, with respect to lot coverage. Several adjacent parcels south of Main Street are held by the same ownership. A development plan for this area entitled Pioneer Plaza was submitted to the City in 2005. This proposal estimated the area of wetlands to be preserved and created as well as the anticipated impervious coverage of the developed area. The general flow paths for the area south of Main Street are via large drainage swales which cross Main Street in two large culverts which then drain to Tenmile/Deer Creek.

Within this basin area, north of Main Street, there are a number of developments. There is a mobile home park and a site which includes a truck stop, McDonalds, Denny's, and a hotel. Generally, other than those areas which are directly adjacent to Main Street, these areas drain independently to Tenmile/Deer Creek.

The developable area within this basin, not including wetlands, was assumed to have an impervious coverage of 95% for this study.

3.2.10 Creighton

The study area includes the headwaters of the Creighton basin. This portion of the basin eventually discharges to Silver Creek after crossing under I-5. A large part of this area is undeveloped and was included in the Pioneer Plaza development proposal which was discussed in the Tenmile & Deer Creek basin above. Similar to that basin, the development submittal was utilized to determine the developable area within those parcels. The remaining non-wetland areas were assumed to be developed with 95% impervious coverage.

3.3 Hydraulic System Performance

Hydrologic and hydraulic calculations were performed using the StormShed software, produced by Engenious Systems, Inc. The Santa Barbara Unit Hydrograph methodology was used to determine runoff from the basins. Standard practice when evaluating hydraulic conveyance performance is to ensure that the 25 year return frequency storm can pass within the conveyance system and that no adverse impacts occur to downstream and adjacent properties during the 100 year return frequency storm, which was the methodology utilized for this study.

The major City infrastructure was modeled within the software to allow for the hydrologic and hydraulic calculations to be performed interactively. Minor alterations were made to these systems to allow for conservative analysis as well as minimization of the complexity of the model. Some of these alterations included simplifying conveyance reaches. This was done by combining multiple reaches of similar pipe size and slope into a single reach having similar average flow characteristics. It was also assumed that the basins would enter at the headwaters of the conveyance reaches. This eliminated the need to break

the basins into numerous sub-basins for individual reach basins. Another simplification was in regard to ditch reaches. There is a large length of ditches within the study area. It was not economical to survey each individual ditch reach to a level of certainty required for a complete hydraulic analysis. Instead, cross sections of the significant drainage ditches were surveyed in a number of locations to get an approximation of the relevant conveyance capacity. Less significant reaches were estimated based on the City's aerial contours. Figure 3 shows the general model layout.

3.3.1 Existing Condition

The existing condition model was completed for the land use characteristics described above. Model runs were computed for the following return frequency storms: 6-month, 2, 10, 25, & 100-year. The complete results for this model can be found in the appendix. A summary of the results are included in Table 3 of this report. It can be seen from this model that there are a number of deficiencies in the existing conveyance system. They include:

Reach M-R-3 – This reach is a 24-inch culvert which crosses Main Street Road in the Tenmile / Deer Creek basin and flows from the south, north into the formal creek system. This crossing is within a natural ravine area, which appears to have been culverted and filled for the roadway construction. The ravine itself appears to be lowland saturated areas. The amount of saturation which is caused by the lack of conveyance capacity in the culvert has not been determined.

Reach P-R-1 & 2 – These reaches are a part of a system intended to maintain the drainage of farm lands which occurred prior to the construction of the Nooksack River dike flood protection system. These reaches do not have sufficient capacity to convey the water which contributes to the reaches. This causes the excess water to be stored in the area of the farm fields. Reach W-R-8 – This reach is parallel to I-5 and drains the area of Riverside Drive Basin south of Main Street. The culvert is just north of Labounty Drive. No conveyance deficiencies occur during the 25-year storm, only the 100-year event. In this event the flow is only 16% over the modeled capacity, which is not an issue as long as adjacent and downstream properties are not impacted.

Reach M-R-6 – This reach also drains the area of Riverside Drive Basin which is south of Main Street. It is the major crossing under Main Street. This reach is modeled to be 3% over capacity in the 100-year return frequency event, which is not an issue as long as adjacent and downstream properties are not impacted. These results could be slightly skewed as there is another 24-inch system which flows under the I-5 Southbound On Ramp which may provide additional capacity, and therefore moderate the capacity of this reach. However, this system was found in poor repair and was not modeled as an alternative route. A maintenance agreement should be negotiated with WSDOT for conveyance within areas controlled by WSDOT unless there is a feasible alternative.

Reach M-R-1 & 2 – These reaches are located near the intersection of Main Street and Riverside Drive,. These reaches showed poor capacity in all modeled storm events. This was due to the fact that it was assumed that the entire basin entered into the headwaters of the modeled reaches. Upon further investigation of the probability of flows, these reaches have sufficient capacity as they only drain a small portion of the Riverside Drive Basin north of Main Street. An area weighted proportion of the flow was calculated which shows that at a maximum only 9% of the entire basin could flow to these reaches, which equates to a maximum of 1.8 cfs. Reach M-R-1 has the capacity to flow nearly 3 cfs in its existing condition.

Reach W-R-2 & 3 – These WSDOT reaches are two older 30-inch corrugated metal pipes (CMP) which have minimal slopes. They are the last culverts prior to the WSDOT drainage discharging to the

Nooksack River under I-5. They are modeled to have deficiencies in all model storms with the exception of the 6-month return frequency storm. The ultimate effect to downstream or adjacent properties at this time is minimal as the downstream property is the inactive golf course property. Being that these are the furthest downstream culverts, they are critical for the effectiveness of the system above and should be considered for improvement.

TABLE 3 - EXISTING CONDITION SURCHARGING CONVEYANCE

Reach	Pipe Size (in)	Ex. Flow (cfs)	Flow Ratio	Replacement	Reason
6-mo					
M-R-1$_{(6\text{-}mo)}$	*12*	*3.7567*	*1.25*	*No*	*Only 1.8 cfs is anticipated to enter*
M-R-2$_{(6\text{-}mo)}$	*8*	*3.7567*	*5.89*	*No*	*Only 1.8 cfs is anticipated to enter*
P-R-1$_{(6\text{-}mo)}$	*12*	*3.2194*	*2.38*	*Yes*	*Farm Field impacted by upstream development*
2-yr					
M-R-1$_{(2\text{-}yr)}$	*12*	*6.4067*	*2.14*	*No*	*See 6-month description.*
M-R-2$_{(6\text{-}mo)}$	*8*	*6.4067*	*10.04*	*No*	*See 6-month description.*
P-R-1$_{(2\text{-}yr)}$	*12*	*5.5350*	*4.10*	*Yes*	*See 6-month description.*
W-R-2$_{(2\text{-}yr)}$	*30*	*14.7873*	*1.16*	*Yes*	*Increased Capacity required*
W-R-3 $_{(2\text{-}yr)}$	*30*	*14.7873*	*1.48*	*Yes*	*Increased Capacity required*
10-yr					

M-R-1$_{(10\text{-}yr)}$	*12*	*11.1155*	*3.71*	*No*	*See 6-month description.*
M-R-2$_{(10\text{-}yr)}$	*8*	*11.1155*	*17.42*	*No*	*See 6-month description.*
P-R-1$_{(10\text{-}yr)}$	*12*	*9.7197*	*7.20*	*Yes*	*See 6-month description.*
W-R-2$_{(10\text{-}yr)}$	*30*	*25.2213*	*1.97*	*Yes*	*See 2-year description.*
W-R-3$_{(10\text{-}yr)}$	*30*	*25.2213*	*2.53*	*Yes*	*See 2-year description.*
M-R-3$_{(10\text{-}yr)}$	*24*	*5.9291*	*1.04*	*Questionable*	*Saturated lands indicate a lack of drainage. Wetland Study required*
P-R-2$_{(10\text{-}yr)}$	*12*	*9.7197*	*1.68*	*Yes*	*Farm Field impacted by upstream development*
25-yr					
M-R-1$_{(25\text{-}yr)}$	*12*	*13.4978*	*4.50*	*No*	*See 6-month description.*
M-R-2$_{(25\text{-}yr)}$	*8*	*13.4978*	*21.15*	*No*	*See 6-month description.*
P-R-1$_{(25\text{-}yr)}$	*12*	*11.8855*	*8.80*	*Yes*	*See 6-month description.*
W-R-2$_{(25\text{-}yr)}$	*30*	*30.4958*	*2.39*	*Yes*	*See 2-year description.*
W-R-3$_{(25\text{-}yr)}$	*30*	*30.4958*	*3.06*	*Yes*	*See 2-year description.*
M-R-3$_{(25\text{-}yr)}$	*24*	*7.2215*	*1.26*	*Questionable*	*See 10-year description.*
P-R-2$_{(25\text{-}yr)}$	*12*	*11.8855*	*2.05*	*Yes*	*See 10-year*

					description.
100-yr					
M-R-1$_{(100\text{-}yr)}$	*12*	*17.4693*	*5.83*	*No*	*See 6-month description.*
M-R-2$_{(100\text{-}yr)}$	*8*	*17.4693*	*27.38*	*No*	*See 6-month description.*
P-R-1$_{(100\text{-}yr)}$	*12*	*15.5107*	*11.49*	*Yes*	*See 6-month description.*
W-R-2$_{(100\text{-}yr)}$	*30*	*39.4398*	*3.09*	*Yes*	*See 2-year description.*
W-R-3$_{(100\text{-}yr)}$	*30*	*39.4398*	*3.96*	*Yes*	*See 2-year description.*
M-R-3$_{(100\text{-}yr)}$	*24*	*9.3802*	*1.64*	*Questionable*	*See 10-year description.*
P-R-2$_{(100\text{-}yr)}$	*12*	*15.5107*	*2.68*	*Yes*	*See 10-year description.*
W-R-8$_{(100\text{-}yr)}$	*24*	*17.9696*	*1.16*	*Yes*	*Increased Capacity required*
M-R-6$_{(100\text{-}yr)}$	*24*	*17.9696*	*1.03*	*Yes*	*Increased Capacity required*

3.3.2 Full Build-out Condition

The full build-out condition model was completed for the land use characteristics described in section 3.2.4; all developable lands were assumed to have 95% impervious cover in the full build-out condition. Model runs were computed for the following return frequency storms: 6-month, 2, 10, 25, & 100-year. The results for this model can be found in the appendix. Generally, there are no new reaches with conveyance capacity issues in the build-out condition compared to the existing condition. A number of the reaches show signs of deficiency in smaller return frequency storms. These are:

Reach M-R-3 – This reach shows deficiency during the 10 year event.

Reach W-R-2 & 3 – These reaches show deficiency in all modeled events, including the 6 month return frequency event.

3.4 Capital Improvements

The hydraulic performance section above has identified several reaches which have conveyance capacity deficiencies in the existing condition, full build-out condition, or both. Improvements to these reaches should be considered to eliminate the existing and or future deficiencies. Before improvements are

made, full analysis should be performed of both the necessary facilities, the impacts to critical areas and cultural resources should also be studied. Environmental review was not included in the City's Planned Action Ordinance or the PAEIS. This means that SEPA review has not been performed on the recommended capital improvement. Many of the reaches that should be considered for improvement have individual nuances that require special attention, which will be addressed in this section.

Table 4 shows the reaches which should be considered for improvement, and are also depicted in Figure 3. Potential sizes and slopes are shown for informational purposes only. The actual size and slope should be determined on available elevation and corridor in order to achieve the calculated flow, through a more comprehensive design process. It was assumed for this study that the pipes would be designed to convey the 100-year full build-out un-detained flow. When comparing the existing condition to full build-out flow, there is not a drastic increase in flow. Similarly, the difference between the 25-year and 100-year return frequency flows are not that great when considering pipe size increases. For the purposes of this report the 100-year flow was chosen to show the greatest difference between existing and potential pipe sizes for conservative sizing. In areas where flow control will be required, such as the Tenmile & Deer Creek basin south of Main Street, conveyance can be sized for the 25-year existing condition as it is modeled for this report. Much of the current land cover is not Native Forest; therefore, once flow control mitigation is installed to meet that standard the flows to the facilities will be smaller. However, conservative sizing does allow for additional capacity in the event that a mitigation facility does fail.

TABLE 4 - RECOMMENDED CAPITAL IMPROVEMENTS

Reach	Existing Size	Existing Capacity (cfs)	100 yr. Existing Flow (cfs)	100 yr. Full Build Out Flow (undetained) (cfs)	Potential Size	Potential Slope	Length	Estimated Costs
M-R-3	24"	5.72	9.38	10.65	36"	0.22%	115	$174,000
W-R-8	24"	15.49	17.97	19.91	30"	1.59%	251	$189,000
M-R-6	24"	17.38	17.97	19.91	30"	0.5%	122	$174,000
W-R-2	30"	9.96	39.44	44.22	48"	0.33%	331	(see W-R-3)
W-R-3	30"	12.78	39.44	44.22	48"	0.3%	238	$407,000

A number of reaches identified in the model as having insufficient capacity in the hydraulic system performance section above should not be considered for improvement. This is due to conservative modeling which can be justified through engineering methods, habitat concerns, or concerns regarding adjacent and/or downstream properties. These reaches are discussed below:

Reach M-R-3 – This reach has hydraulic capacity issues, but improvements may be precluded by environmental concerns. Proposed upstream developments should provide a study of potential impacts to the environment caused by the needed capacity improvement as well as the detailed impacts to the hydrology.

Reach P-R-1 & 2 – As stated above, these reaches are a part of a system intended to maintain the drainage of farm lands which occurred prior to the construction of the Nooksack River dike flood protection system. As we have shown through the hydraulic system performance, these pipes are not sized sufficiently to convey the water which is generated from the existing development and farm fields which contribute to the area. As development occurs, the increased impervious coverage impedes natural infiltration and therefore increases the peak flow as well as the volume of runoff. Standard

stormwater mitigation methods such as detention ponds do reduce the amount of peak flow that is released from the facility. However, the volume of water which is released is still greater than the native condition. This increased volume needs to be stored and causes increased inundation, both in depth and duration, within the subject properties.

Two potential solutions to this issue are apparent. One would be for future development to participate in the improvement of this outfall. An appropriately sized and confined outfall system could increase the beneficial use of both the proponent of development and the farm land. The second alternative would be to re-route runoff from the development areas to another outfall. This alternative has two potential variations: running a storm line north on Barrett Road to Tenmile Creek, or running a storm line north adjacent to Interstate-5 and combining this with the existing outfall under I-5. As mentioned in the Environmental Reconnaissance, routing to Tenmile is not a biologically viable option. It is recommended to route to the I-5 outfall as it is a few hundred feet downstream of the existing outfall to the same receiving water.

Reach M-R-1 & 2 – As described above, these reaches show insufficient capacity only due to the methods of which they were modeled. Under the current capacity of use, these reaches do not merit consideration for improvement.

Potential Additional Improvements

A number of reaches and infrastructure not previously identified in this document should be considered for improvement. This may be due to conservative modeling which can be justified through engineering methods, habitat concerns, or concerns regarding adjacent and/or downstream properties. These reaches are discussed below:

WSDOT Outfall – A significant portion of the Gateway study area drains through the stormwater system installed as a part of the Interstate-5 construction. This means that proper drainage function of this area is completely reliant on the downstream WSDOT facilities. During the inventory investigation the WSDOT outfall was located and examined. A flood gate was found at the end of the WSDOT pipe W-R-1. It was observed that a significant amount of sediment was within the outfall gate structure. This has the ability to inhibit the function of the outfall and is recommended for monitoring by the City and/or WSDOT. A photo of the discharge can be found in the Environmental Reconnaissance included in the appendix.

Table 5 provides a summary of improvements which should be considered for all basins. This table provides costs for improvements which should be included as a part of the capital improvements program. Preliminary cost estimates are included in the appendix for informational purposes.

3.5 Improvement Summary

TABLE 5 - BASIN PLANNING SUMMARY

Basin	Location/Description	SWMMWW Exemptions	SWMMWW Requirements	Conveyance Deficiencies	Needed Capital Improvements	Estimated Costs
Haggen	Southwest corner of the study area	Flow Control	Basic Treatment (provided by Neubauer Pond)	N/A		--
	Largely developed	Enhanced Treatment	Beneficiaries must pay in accordance with City Ordinance			--
			If Existing Haggen Pond is removed, stormwater from property must be conveyed to Neubauer pond			--
Basin	**Location/Description**	**SWMMWW Exemptions**	**SWMMWW Requirements**	**Conveyance Deficiencies**	**Needed Capital Improvements**	**Estimated Costs**
Riverside Golf	Western side of the study area.	Flow Control (if adequate conveyance to Nooksack River is provided)	Basic Treatment	N/A	New outfall if development occurs	--
	A majority of the basin is privately owned and undeveloped. Does not discharge through City system	Enhanced Treatment (if discharged to Nooksack River is provided)			Development mitigation as needed	--

Basin	Location/Description	SWMMWW Exemptions	SWMMWW Requirements	Conveyance Deficiencies	Needed Capital Improvements	Estimated Costs
Riverside Drive West of I-5	Partially developed area along I-5 and West	Flow Control (if adequate conveyance to Nooksack River is provided)	Basic Treatment (if discharged to Nooksack River is provided)	WSDOT conveyance System to Nooksack (WR1, WR2, WR3)	I-5 Conveyance and Outfall Upgrade	$407,000
	Discharge to Riverside Drive Ditch	Enhanced Treatment (if discharged to Nooksack River is provided)		Main St Crossings (MR6)	Main St Crossing (MR6)	$174,000
				Labounty Rd Conveyance (WR8)	Labounty Rd Conveyance (WR8)	$189,000
				Ditch Cleaning and reshaping (WD2, WD3)	Ditch Cleaning and reshaping (WD2, WD3)	$372,000
				Ditch Cleaning and reshaping (WD1)	Ditch Cleaning and reshaping (WD1)	$255,000
					Development mitigation as needed	

Basin	Location/Description	SWMMWW Exemptions	SWMMWW Requirements	Conveyance Deficiencies	Needed Capital Improvements	Estimated Costs
Riverside Drive East of I-5	Found on the northeast quadrant of I-5 and Main Street	Flow Control (if adequate conveyance to Nooksack River is provided)	Basic Treatment (if discharged to Nooksack River is provided)	Farm Field Drainage to Nooksack (PR1, PR2)	Need new conveyance and Outfall to Nooksack to eliminate impacts to farm fields.	
	Minor development has occurred near Main Street *An existing mitigation pond for this development is located in the undeveloped portion of the basin.*	Enhanced Treatment (if discharged to Nooksack River is provided)			Development mitigation as needed	
Basin	**Location/Description**	**SWMMWW Exemptions**	**SWMMWW Requirements**	**Conveyance Deficiencies**	**Needed Capital Improvements**	**Estimated Costs**
Tenmile & Deer Creek	Basin is located east of I-5, along Main Street.			Main StCrossings (MR3)	Main StCrossing (MR3)	$174,000
Basin	**Location/Description**	**SWMMWW Exemptions**	**SWMMWW Requirements**	**Conveyance Deficiencies**	**Needed Capital Improvements**	**Estimated Costs**
Creighton	Southwest corner of the study area			N/A	N/A	--
	Area is largely undeveloped.					

4.0 Condition of Receiving Waters

The habitat, value, function and cultural or historic resources of the study area and its receiving waters were analyzed by a qualified biologist and environmental permit specialist. The results of the analysis can be found in the appendix. The results of this investigation were utilized in determining the development standards and permitting issues discussed in the following sections of this report.

In the text below there is discussion regarding areas which are exempt from the enhanced treatment requirement because they discharge to the Nooksack River. The Nooksack River is a basic treatment receiving water body per the SWMMWW and is a man-made channel of sufficient conveyance. This exemption does not exempt facilities from complying with Volume IV of the SWMMWW in providing Source Control BMP's for specific land uses.

5.0 Development Standards and Permitting Issues

The results of this study have assisted in determining acceptable methods for providing mitigation for development in accordance with the Department of Ecology (DOE) Stormwater Management Manual (SWMMWW), protection of biological function and other permitting issues. The Environmental Reconnaissance report found in the appendix was used to assist in determining the biological function and other permitting issues. A summary of the results are listed below for each basin within the study area.

5.1 Basins

5.1.1 Haggen

Conveyance has been designed and constructed within the Main Street corridor, to the existing Neubauer Stormwater facility, and to the Nooksack River. This infrastructure provides both water quality and flow control in accordance with the DOE SWMMWW. Flow control is technically not provided, however a man-made conveyance to a “Flow Control Exempt” receiving water is provided, exempting the need for detention. The Neubauer Stormwater facility was sized to include the parcels included in the Haggen development stormwater study. However, in an effort to minimize the load on a City owned pumping facility beneath the Rail Road overcrossing a gravity storm system would be required from the Haggen pond in order to drain it to the Neubauer facility. This would minimize the potential for the flooding of Main Street and adjacent parcels. If a gravity system was installed, the Haggen detention pond could be removed from service.

5.1.2 Riverside Golf

As this basin does not discharge through infrastructure that is owned or maintained by the City. For this reason it was not intensively considered in this study. Development of this property will need to comply with the DOE SWMMWW as well as the Critical Areas Ordinance by the City of Ferndale, floodplain management, and other regulatory requirements. It is feasible that this property could permit its own outfall through man-made conveyance to the ordinary high water mark of the Nooksack River. If this can be achieved, the development would only be required to meet basic treatment levels and would not require flow control for increased impervious areas. Permitting a new outfall would require approval from a number of state and federal agencies.

5.1.3 Riverside Drive W

Development within this area could take advantage of the existing outfall to the Nooksack River adjacent to Interstate-5, which is the existing point of discharge. This outfall could allow the properties to develop while achieving only basic treatment, and not requiring flow control. However, as described in the Hydraulic System Performance section, there are a number of reaches that currently do not have capacity within this basins downstream conveyance. These issues need to be resolved prior to development without flow control mitigation.

Alterations to the WSDOT facilities will likely require a General Permit and plan review process by WSDOT. Upgrades to the outfall system will require a Hydraulic Approval Permit which will be reviewed by the Department of Fish and Wildlife. As this would be an upgrade to an existing outfall, the permit requirements will be less intensive than constructing a new outfall. Development of this property will need to comply with the DOE SWMMWW as well as any critical areas ordinance by the City of Ferndale, floodplain management, and other regulatory requirements.

5.1.4 Riverside Drive E

Reaches P-R-1 & 2 have capacity deficiencies. Multiple alternatives have been discussed which would help alleviate this downstream impact. It is recommended that the City consider having an alternative conveyance route established prior to any further development of this basin. Currently the man-made conveyance to the Nooksack River does not have sufficient conveyance capacity, so this area would be subject to flow control. If an alternative route with sufficient capacity can be constructed the requirement for flow control would likely be removed. As long as this basin continues to be routed through a man-made conveyance system, only basic treatment is required per the SWMMWW. Development of this property will need to comply with the DOE SWMMWW as well as any critical areas ordinance by the City of Ferndale, floodplain management, and other regulatory requirements.

5.1.5 Tenmile and Deer Creek

This basin drains to Tenmile and Deer Creek which has been evaluated in the Environmental Reconnaissance. From this evaluation it was found that the Creek does not comply with the requirements within the SWMMWW which would allow for Enhanced Treatment and Flow Control exemptions. Therefore, all properties should comply fully with the SWMMWW for proposed development.

This basin has two distinct parts, that which is north of Main Street and that which is south. From the data which was utilized for this study, it appears that the majority of the area north of Main Street does not flow through any facilities owned or maintained by the City of Ferndale. Many of these parcels are adjacent to Tenmile and Deer Creek. Development of this property will need to comply with the DOE SWMMWW as well as any critical areas ordinance by the City of Ferndale, floodplain management, and other regulatory requirements.

The larger portion of this basin lies south of Main Street. The general flow is to the north where the flow crosses under Main Street in two culverts, modeled as Reaches M-R-3 and M-R-4, and then into Tenmile and Deer Creek. Reach M-R-3 has capacity deficiencies in the 25 and 100-year return frequency storms in the existing condition. A more comprehensive analysis should be performed to determine if increasing its capacity will have adverse impacts to wetlands. Based on previously submitted development plans for a large portion of this property, significant wetland areas exist within this basin. Development of this portion of the basin south of Main Street will need to comply with the DOE SWMMWW as well as any critical areas ordinance by the City of Ferndale, floodplain management, and other regulatory requirements.

5.1.6 Creighton

Generally, the water from this basin is characterized as being overland flow. It is at the head waters of the larger basin. Previous development submittals show that a large portion of this area is wetland. As there is no man-made channel that extends to the Nooksack River, there are no exemptions from Enhanced Treatment or Flow Control. Development of this property will need to comply with the DOE SWMMWW as well as any critical areas ordinance by the City of Ferndale, floodplain management, and other regulatory requirements.

6.0 Characterization and Basin Planning

6.1 Application of LID techniques

Low Impact Development (LID) is a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design. Conservation intends to minimize impervious surfaces, native vegetation loss, and stormwater runoff. LID Best Management Practices (BMPs) are constructed facilities that can be used to assist in mitigating for the impacts of development. LID BMPs include, but are not limited to: bioretention/rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, minimal excavation foundations, vegetated roofs, and water re-use.

In order to achieve conservation, local governments must look for opportunities to change their local development codes to minimize impervious surfaces and retain native vegetation in all development situations. Most importantly, to maintain the beneficial uses of lowland freshwater systems will require land use planning that targets retention of a majority of a creek's watershed in its natural condition, and retains most of the benefits of headwater areas, connected wetlands, riparian, and floodplain areas.

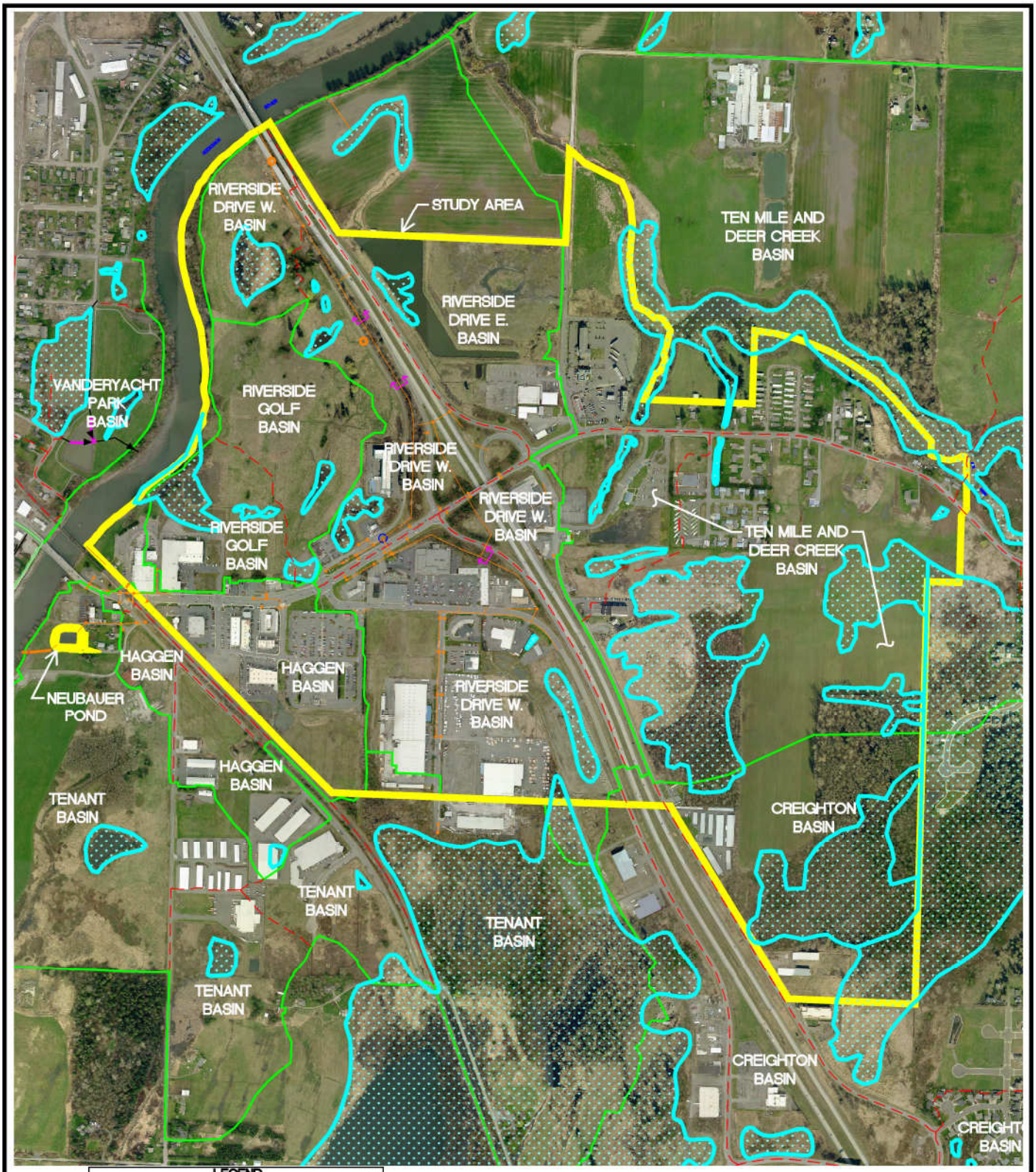
Not all sites are appropriate for a complete LID project, as site conditions determine the feasibility of using LID techniques. The development context shall be established by an initial site analysis consistent with the requirement of the SWMMWW, Volume I, Section 3.1.1. The City of Ferndale has adopted LID techniques as the preferred stormwater practice within the 100-year Floodplain of the Nooksack River (Ferndale Municipal Code 15.24.180 (B)1).

6.2 Potential Locations for Regional Water Quality & Flow Control Facilities

Regional stormwater facilities are an alternative for water quality and flow control mitigation that are based on a more basin wide approach. They also consolidate the responsibility for maintenance and operations to a single entity, which often leads to a higher level of system performance.

Within the Gateway Area, the Neubauer regional stormwater mitigation facility is in operation. Development participates in this facility per Ordinance 1620. This facility was constructed in part to mitigate for a City transportation upgrade within the basin. There was not sufficient room within the existing corridor to mitigate for that project. Therefore, the City found an appropriate parcel to construct mitigation, and through foresight, determined that it would be beneficial to parcels which were served by that transportation corridor to construct additional mitigation which could be utilized by those parcels.

Figures



R&E Reichhardt & Ebe ENGINEERING INC
423 Front St., Lynden, WA 98264 (360) 354-3687
813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

FERNDALE GATEWAY STORMWATER STUDY
FIG. 1

9/30/13 1"=1000' 11046

LEGEND

- = BASIN BOUNDARY
- = SUB BASIN BOUNDARY
- = STORM REACH
- = WETLANDS
- = SURVEY POINT LOCATION
- = SURVEYED DITCH CROSS-SECTION
- N=____ = NODE
- R=____ = REACH

HAGGEN BASIN

RIVERSIDE GOLF BASIN

RIVERSIDE GOLF BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE E. BASIN

STUDY AREA

GRAPHIC SCALE

0 200 400

(IN FEET)

1 inch = 400 ft.

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DESIGNED BY DRAWN BY CHECKED BY	R&E Reichhardt & Ebe ENGINEERING INC 423 Front St, Lynden, WA 98264 (360) 354-3687 813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713	NO.	DATE	REVISION	BY	CITY OF FERNDALE 2095 MAIN STREET FERNDALE, WA 98248	FERNDALE GATEWAY STORMWATER STUDY FIG. 2-A	JOB# / DWG 11046 EXHIBIT SCALE H:1"=400' V: n/a DATE 9/30/13 SHEET 2A

LEGEND

- BASIN BOUNDARY
- SUB BASIN BOUNDARY
- STORM REACH
- WETLANDS
- SURVEY POINT LOCATION
- SURVEYED DITCH CROSS-SECTION
- N=____ NODE
- R=____ REACH

GRAPHIC SCALE

0 200 400

(IN FEET)

1 inch = 400 ft.

RIVERSIDE DRIVE W. BASIN

CREIGHTON BASIN

TEN MILE AND DEER CREEK BASIN

TEN MILE AND DEER CREEK BASIN

STUDY AREA

	DESIGNED BY	R&E Reichhardt & Ebe ENGINEERING INC 423 Front St, Lynden, WA 98264 (360) 354-3687 813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713	NO.	DATE	REVISION	BY	CITY OF FERNDALE 2095 MAIN STREET FERNDALE, WA 98248	FERNDALE GATEWAY STORMWATER STUDY FIG. 2-B
	DRAWN BY							JOB# / DWG 11046 EXHIBIT; DATE 9/30/13
	CHECKED BY							SCALE H:1"=400' V: n/a; SHEET 2B

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LEGEND

- = BASIN BOUNDARY
- = SUB BASIN BOUNDARY
- = STORM REACH
- = WETLANDS
- = SURVEY POINT LOCATION
- = SURVEYED DITCH CROSS-SECTION
- N-____ = NODE
- R-____ = REACH
- = RECOMMENDED IMPROVEMENT

HAGGEN BASIN

RIVERSIDE GOLF BASIN

RIVERSIDE GOLF BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE W. BASIN

RIVERSIDE DRIVE E. BASIN

STUDY AREA

N-NOOKSACK RIVER 1
R-WR1
N-N1
R-WD1
N-WN2
R-WR2
N-WS1
R-WR3
N-WN3
R-WD2
N-NOOKSACK RIVER 2
N-PS2
N-PS1
R-PR2
R-PR1
R-PD1
N-PN1
N-NOOKSAC RIVER
N1
R-TMC D4
N-MS2
R-MR2
N-MS1
R-MR1
N-MN1
N-MS3
R-WD3
R-MR6
R-MR5
N-MN6
R-MD1
N-WN4
R-WR4
N-WS2
N-WN5
R-WR5
R-WD4
N-WN6
R-WR6
R-WR7
N-WN8
N-WN9
R-WD6
N-WN10
R-WD5
N-WN7
R-WR8
N-LS1

RECOMMENDED IMPROVEMENTS

REACH	EXIST SIZE	PROP SIZE	LENGTH	EST COST
M-R-3	24"	36"	115'	$174,000
W-R-8	24"	30"	251'	$189,000
M-R-6	24"	30"	122'	$174,000
W-R-2	30"	48"	331'	(SEE W-R-3)
W-R-3	30"	48"	238'	$407,000

GRAPHIC SCALE
0 200 400
(IN FEET)
1 inch = 400 ft.

DESIGNED BY
DRAWN BY
CHECKED BY

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423 Front St, Lynden, WA 98264 (360) 354-3687
813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713

NO.	DATE	REVISION	BY

CITY OF FERNDALE
2095 MAIN STREET
FERNDALE, WA 98248

FERNDALE GATEWAY STORMWATER STUDY
FIG. 3-A

JOB# / DWG: 11046 EXHIBIT
DATE: 9/30/13
SCALE: H:1"=400' V: n/a
SHEET: 3A

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LEGEND

- = BASIN BOUNDARY
- = SUB BASIN BOUNDARY
- = STORM REACH
- = WETLANDS
- = SURVEY POINT LOCATION
- = SURVEYED DITCH CROSS-SECTION
- N-____ = NODE
- R-____ = REACH
- ★ = RECOMMENDED IMPROVEMENT

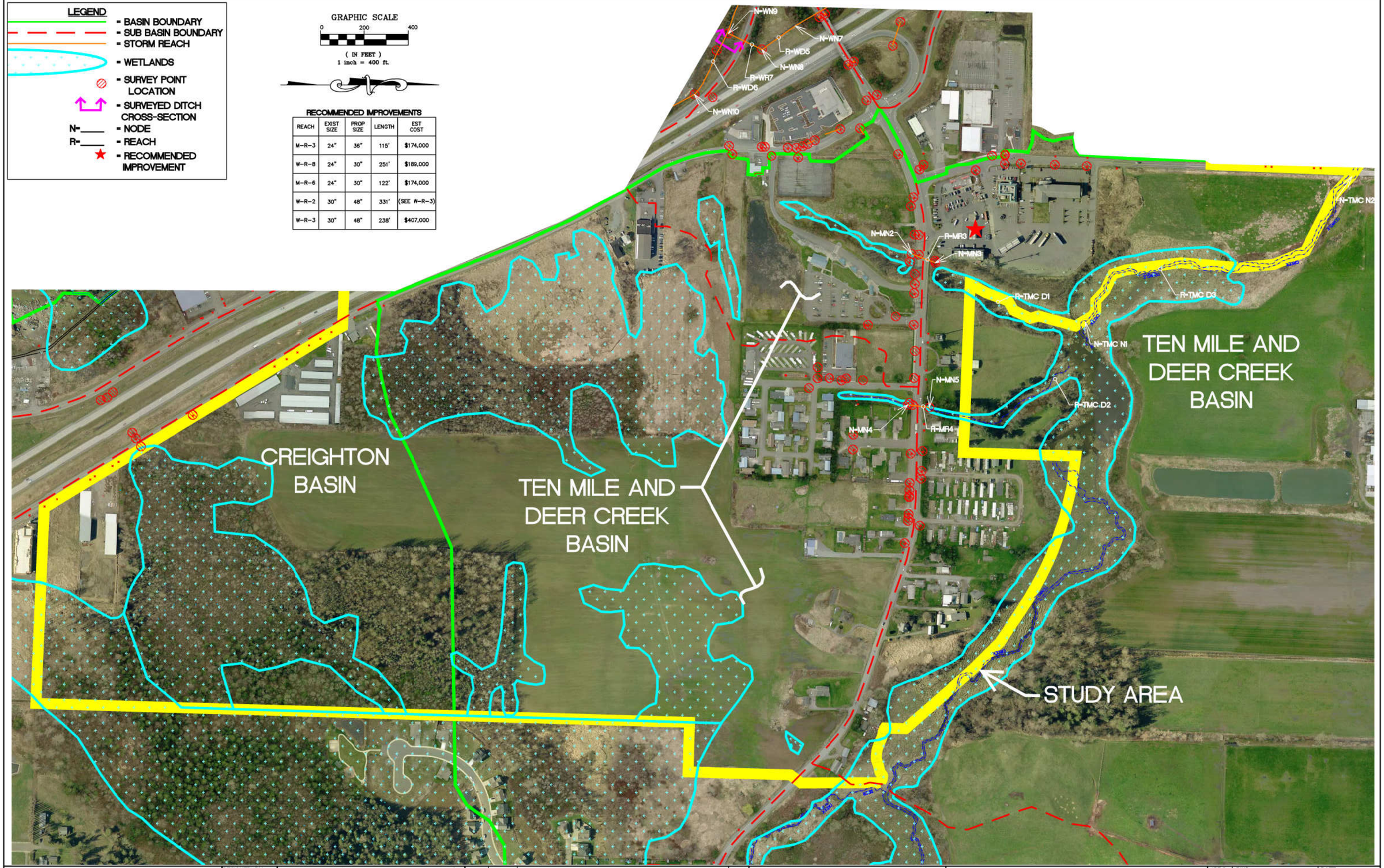
GRAPHIC SCALE

0 200 400

(IN FEET)
1 inch = 400 ft.

RECOMMENDED IMPROVEMENTS

REACH	EXIST SIZE	PROP SIZE	LENGTH	EST COST
M-R-3	24"	36"	115'	$174,000
W-R-8	24"	30"	251'	$189,000
M-R-6	24"	30"	122'	$174,000
W-R-2	30"	48"	331'	(SEE W-R-3)
W-R-3	30"	48"	238'	$407,000



	DESIGNED BY	R&E Reichhardt & Ebe ENGINEERING INC 423 Front St, Lynden, WA 98264 (360) 354-3687 813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713	NO.	DATE	REVISION	BY	CITY OF FERNDALE 2095 MAIN STREET FERNDALE, WA 98248	FERNDALE GATEWAY STORMWATER STUDY FIG. 3-B
	DRAWN BY							JOB# / DWG 11046 EXHIBIT; DATE 9/30/13
	CHECKED BY							SCALE H:1"=400' V: n/a; SHEET 3B

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Appendix

Existing Condition StormShed Model

Full Build-out StormShed Model

Existing Condition StormShed Conveyance

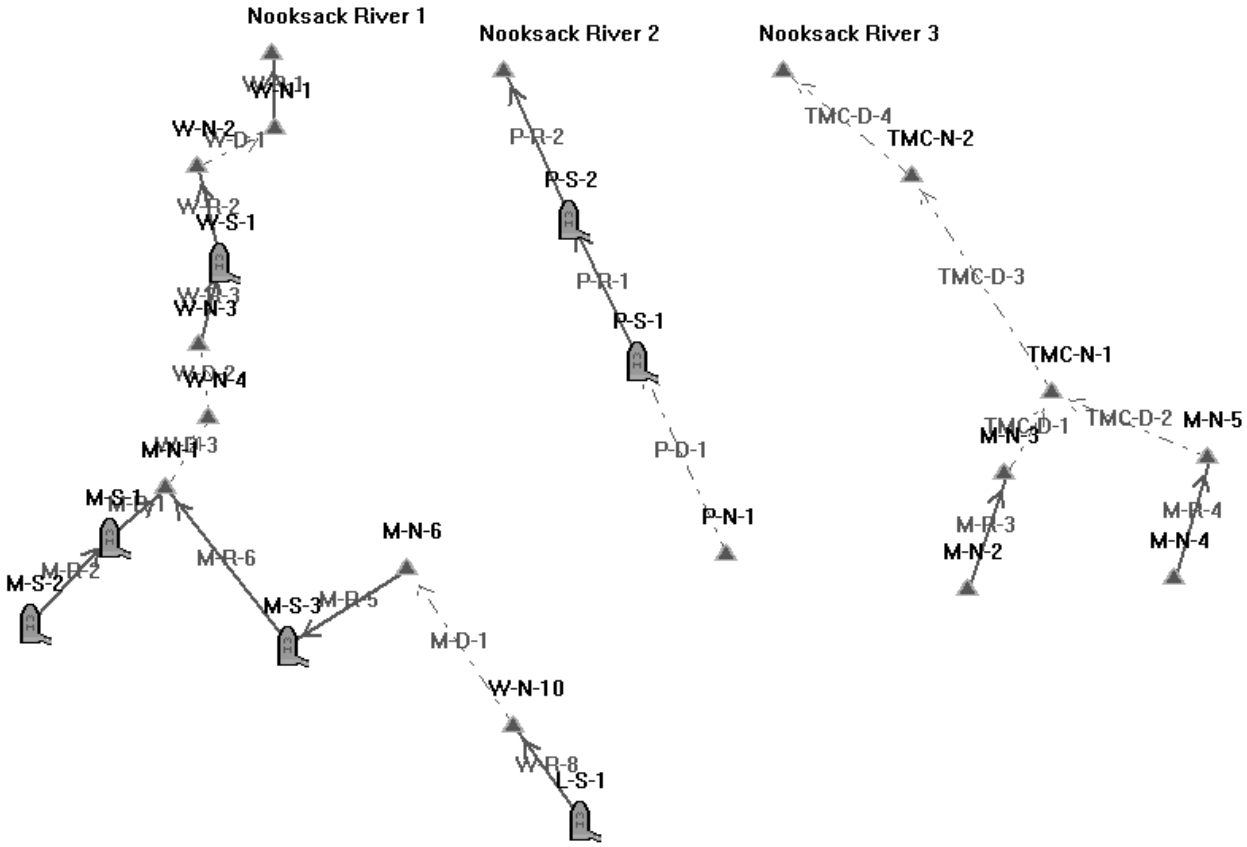
Full Build-out StormShed Conveyance

Environmental Reconnaissance

Preliminary Cost Estimates

EXISTING CONDITION STORMSHED MODEL

Ferndale Gateway – EXISTING CONDITIONS
Riechhardt & Ebe Engineering, Inc.



Project Precips

[6 mo]	1.37 in
[2 yr]	1.90 in
[10 yr]	2.80 in
[25 yr]	3.25 in
[100 yr]	4.00 in

Reach Records

Reach ID: M-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
759.0000 ft	0.10 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-10	M-N-6	25.2600 ft	24.5086 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
0.0000 ac	0.0000 cf	0.0000 cf	0.0000 ft/s	0.0000 ft

Ent Loss	Exit Loss	Frict Loss	Start TW
0.000000 ft	0.000000 ft	0.000000 ft	0.0000 ft

Reach ID: M-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
72.0000 ft	0.60 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-1	M-N-1	27.4000 ft	26.9680 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	15.7794 cf	2.9978 cf	5.2637 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.253568 ft	6.267838 ft	11.966228 ft	27.9680 ft	
comment:	Hydrograph not shifted, 0.49 min forwarded.Submerged or overtop bank condition.			

Reach ID: M-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
8" Diam	Plastic	0.0090	Mannings Formula	
Length	Slope	Entrance Loss		
386.0000 ft	0.13 %	Groove End Projecting		
Diam				
0.6667 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-2	M-S-1	27.9400 ft	27.4382 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	15.7794 cf	0.6381 cf	24.7277 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.898941 ft	9.494703 ft	306.748047 ft	28.1049 ft	
comment:	Hydrograph not shifted, 0.26 min forwarded.Submerged or overtop bank condition.			

Reach ID: M-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
24" Diam	Corr Metal - normal	0.0240	Mannings Formula	
Length	Slope	Entrance Loss		
115.0000 ft	0.22 %	Headwall		
Diam				
2.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-2	M-N-3	15.4500 ft	15.2004 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	8.5580 cf	5.7236 cf	1.4952 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.017358 ft	0.034716 ft	0.557769 ft	17.2004 ft	

comment: Hydrograph not shifted, 1.28 min forwarded.Submerged or overtop bank condition.

Reach ID: M-R-4

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
98.0000 ft	2.07 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-4	M-N-5	20.6000 ft	18.5711 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	24.2286 cf	32.0539 cf	7.1774 ft/s	1.6242 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.399964 ft	0.799928 ft	1.158873 ft	20.3767 ft	

Reach ID: M-R-5

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
253.0000 ft	0.35 %	Groove End Projecting		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-6	M-S-3	24.5100 ft	23.6245 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
0.0000 ac	0.0000 cf	0.0000 cf	0.0000 ft/s	0.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	0.0000 ft	

Reach ID: M-R-6

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
24" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
122.0000 ft	0.50 %	Groove End Projecting		
Diam				
2.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-3	M-N-1	23.7600 ft	23.1500 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
0.0000 ac	0.0000 cf	0.0000 cf	0.0000 ft/s	0.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	0.0000 ft	

Reach ID: P-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1572.0000 ft	0.51 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
P-N-1	P-S-1	22.0000 ft	14.0001 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	14.3674 cf	14.3674 cf	1.5472 ft/s	1.3290 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	15.3291 ft	

Reach ID: P-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
259.0000 ft	0.14 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
P-S-1	P-S-2	12.1300 ft	11.7599 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	14.3674 cf	1.3504 cf	10.6390 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.039250 ft	5.196251 ft	41.881390 ft	22.0800 ft	
comment:	Hydrograph shifted 10.00 min, 7.34 min forwarded.Submerged or overtop bank cond			

Reach ID: P-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
61.0000 ft	2.63 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
P-S-2	Nooksack River 2		11.6800 ft	10.0739 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	14.3674 cf	5.7968 cf	2.4785 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.039250 ft	5.196251 ft	9.863956 ft	11.0739 ft	
comment:	Hydrograph shifted 10.00 min, 7.75 min forwarded.Submerged or overtop bank cond			

Reach ID: TMC-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation

Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
724.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-3	TMC-N-1	15.2000 ft	14.6699 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	8.5580 cf	8.5580 cf	0.6598 ft/s	1.6385 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	16.3084 ft	

Reach ID: TMC-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1021.0000 ft	0.38 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-5	TMC-N-1	18.5700 ft	14.6701 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	24.2286 cf	24.2286 cf	1.5927 ft/s	1.8067 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	16.4768 ft	

Reach ID: TMC-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1617.0000 ft	0.17 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-1	TMC-N-2	14.6700 ft	12.0003 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	58.0743 cf	58.0743 cf	1.1485 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.4547 ft	

comment: Hydrograph shifted 40.00 min, 3.04 min forwarded.Submerged or overtop bank cond

Reach ID: TMC-D-4

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		

1428.0000 ft	0.02 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-2	Nooksack River 3		12.0000 ft	11.7000 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	58.0743 cf	58.0743 cf	3.2194 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.1544 ft	
comment:	Hydrograph shifted 50.00 min, 0.43 min forwarded.Submerged or overtop bank cond			

Reach ID: W-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
268.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-2	W-N-1	15.2600 ft	15.0724 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	35.4146 cf	2.9081 ft/s	1.5759 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	17.6700 ft	

Reach ID: W-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1365.0000 ft	0.23 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-4	W-N-3	19.9300 ft	16.8314 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	35.4146 cf	1.4456 ft/s	2.4011 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	19.4200 ft	

Reach ID: W-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
913.0000 ft	0.73 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	

Up Node	Dn Node	Up Invert	Dn Invert	
M-N-1	W-N-4	26.5500 ft	19.8851 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	15.7794 cf	15.7794 cf	1.8115 ft/s	1.2758 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	22.3311 ft	

Reach ID: W-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
165.0000 ft	2.90 %	Groove End Projecting		
Diam				
2.5000 ft				

Up Node	Dn Node	Up Invert	Dn Invert	
W-N-1	Nooksack River 1		15.0700 ft	10.2850 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	70.0377 cf	14.3080 ft/s	1.2583 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.635775 ft	3.178875 ft	1.223118 ft	12.3048 ft	

Reach ID: W-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
331.0000 ft	0.33 %	Headwall		
Diam				
2.5000 ft				

Up Node	Dn Node	Up Invert	Dn Invert	
W-S-1	W-N-2	16.3500 ft	15.2610 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	12.7780 cf	2.7715 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.059638 ft	0.119276 ft	8.362735 ft	17.7610 ft	

comment: Hydrograph shifted 30.00 min, 2.05 min forwarded.Submerged or overtop bank cond

Reach ID: W-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
238.0000 ft	0.20 %	Headwall		
Diam				
2.5000 ft				

Up Node	Dn Node	Up Invert	Dn Invert	
W-N-3	W-S-1	16.8200 ft	16.3440 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	9.9628 cf	3.5547 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.404120 ft	0.808239 ft	6.013084 ft	25.6389 ft	
comment:	Hydrograph shifted 30.00 min, 0.06 min forwarded.Submerged or overtop bank cond			

Reach ID: W-R-8

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
24" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
251.0000 ft	1.59 %	Headwall		
Diam				
2.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
L-S-1	W-N-10	29.2600 ft	25.2691 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	15.9301 cf	15.4930 cf	5.6110 ft/s	1.6951 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.199629 ft	0.399257 ft	4.218132 ft	27.2691 ft	
comment:	Hydrograph not shifted, 3.25 min forwarded.Submerged or overtop bank condition.			

Node Records

Node ID: L-S-1

Desc:	Manhole structure		
Start El:	29.2600 ft	Max El:	31.6100 ft
Contrib Basin:	Riverside-SW of I-5-Ex	Contrib Hyd:	
Hgl Elev:	31.7100 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.0000 ft		

Node ID: M-N-1

Desc:	Manhole structure		
Start El:	26.5500 ft	Max El:	27.8000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	27.9000 ft		

Node ID: M-N-2

Desc:	Manhole structure		
Start El:	15.4500 ft	Max El:	17.4500 ft
Contrib Basin:	TMDC-SW-Ex	Contrib Hyd:	
Hgl Elev:	17.5500 ft		

Node ID: M-N-3

Desc:	Manhole structure		
Start El:	15.2000 ft	Max El:	17.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	16.8385 ft		

Node ID: M-N-4

Desc:	Manhole structure		
Start El:	20.6000 ft	Max El:	23.1000 ft
Contrib Basin:	TMDC-SE-Ex	Contrib Hyd:	
Hgl Elev:	23.2000 ft		

Node ID: M-N-5

Desc:	Manhole structure		
Start El:	18.5700 ft	Max El:	21.0700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	20.3767 ft		

Node ID: M-N-6

Desc:	Manhole structure		
Start El:	24.5100 ft	Max El:	27.0100 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	20.3767 ft		

Node ID: M-S-1

Desc:	Manhole structure		
Start El:	27.4000 ft	Max El:	30.7200 ft

Contrib Basin:		Contrib Hyd:	
Hgl Elev:	20.5194 ft		
Struct Type:	CB-TYPE 1	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	1.4160 ft	Bot Area:	3.9700 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	31.7309 ft		

Node ID: M-S-2

Desc:	Manhole structure		
Start El:	27.9400 ft	Max El:	29.7400 ft
Contrib Basin:	Riverside-NW of I-5-Ex	Contrib Hyd:	
Hgl Elev:	29.8400 ft		
Struct Type:	CB-TYPE 1	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	1.4160 ft	Bot Area:	3.9700 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.0000 ft		

Node ID: M-S-3

Desc:	Manhole structure		
Start El:	23.6200 ft	Max El:	29.7400 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	29.8400 ft		
Struct Type:	CB-TYPE 1	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	1.4160 ft	Bot Area:	3.9700 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.0000 ft		

Node ID: Nooksack River 1

Desc:	Manhole structure		
Start El:	4.1300 ft	Max El:	7.6100 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	7.7100 ft		

Node ID: Nooksack River 2

Desc:	Manhole structure		
Start El:	10.0800 ft	Max El:	108.0000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	11.0739 ft		

Node ID: Nooksack River 3

Desc:	Manhole structure		
Start El:	11.7000 ft	Max El:	108.0000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	13.1544 ft		

Node ID: P-N-1

Desc:	Manhole structure		
Start El:	22.0000 ft	Max El:	108.0000 ft
Contrib Basin:	Riverside-E-Ex	Contrib Hyd:	
Hgl Elev:	23.3290 ft		

Node ID: P-S-1

Desc:	Manhole structure		
Start El:	12.1300 ft	Max El:	13.5500 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	13.6500 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	0.0000 ft		

Node ID: P-S-2

Desc:	Manhole structure		
Start El:	11.6800 ft	Max El:	21.9800 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	22.0800 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	5.1963 ft		

Node ID: TMC-N-1

Desc:	Manhole structure		
Start El:	14.6700 ft	Max El:	108.0000 ft
Contrib Basin:	TMDC-N-Ex	Contrib Hyd:	
Hgl Elev:	13.6700 ft		

Node ID: TMC-N-2

Desc:	Manhole structure		
Start El:	12.0000 ft	Max El:	108.0000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	11.0000 ft		

Node ID: W-N-1

Desc:	Manhole structure		
Start El:	15.0700 ft	Max El:	17.5700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6700 ft		

Node ID: W-N-10

Desc:	Manhole structure		
Start El:	25.2600 ft	Max El:	26.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	26.7490 ft		

Node ID: W-N-2

Desc:	Manhole structure		
Start El:	15.2600 ft	Max El:	17.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6870 ft		

Node ID: W-N-3

Desc:	Manhole structure		
Start El:	16.8200 ft	Max El:	19.3200 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	19.4200 ft		

Node ID: W-N-4

Desc:	Manhole structure		
Start El:	19.9300 ft	Max El:	22.4300 ft
Contrib Basin:	Riverside-I-5-Ex	Contrib Hyd:	
Hgl Elev:	22.3311 ft		

Node ID: W-S-1

Desc:	Manhole structure		
Start El:	16.3500 ft	Max El:	31.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	25.6389 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.8082 ft		

Contributing Drainage Areas

Drainage Area: Riverside-E-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	36.4700 ac	93.15	1.10 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	36.4700 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	7.0100 ac
Pervious	92.00	29.4600 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	0.67%	0.1500	47.43 min
Shallow	Lawn	994.00 ft	0.30%	11.0000	18.75 min

Drainage Area: Riverside-I-5-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	14.8000 ac	95.47	1.78 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	14.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	8.5600 ac
Pervious	92.00	6.2400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Pasture	300.00 ft	0.33%	0.1500	62.96 min
Channel	Ditch	1846.00 ft	0.22%	17.0000	38.59 min
Channel	Pipe	87.00 ft	0.25%	21.0000	1.38 min
Channel	Ditch	167.00 ft	1.20%	17.0000	1.49 min
Channel	Pipe	346.00 ft	1.44%	21.0000	2.29 min

Drainage Area: Riverside-NW of I-5-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	34.2000 ac	93.53	0.74 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	34.2000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	8.7200 ac
Pervious	92.00	25.4800 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	1.33%	0.1500	36.05 min
Shallow	Lawn	260.00 ft	1.00%	11.0000	3.94 min
Channel	Ditch	210.00 ft	0.25%	17.0000	4.12 min

Channel	Pipe		58.00 ft	1.00%	21.0000	0.46 min

Drainage Area: Riverside-SW of I-5-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	61.9500 ac	94.63	2.85 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	61.9500 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	27.1100 ac
Pervious	92.00	34.8400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Brush	207.00 ft	0.48%	0.8000	153.68 min
Shallow	Brush	603.00 ft	0.17%	5.0000	15.11 min
Channel	Pipe	102.00 ft	0.25%	42.0000	0.81 min
Channel	Pipe	188.00 ft	0.50%	42.0000	1.06 min
Channel	Pipe	115.00 ft	1.30%	42.0000	0.40 min

Drainage Area: TMDC-N-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	39.9800 ac	94.43	0.17 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	39.9800 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	16.1700 ac
Pervious	92.00	23.8100 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Overland Flow	300.00 ft	1.00%	0.0110	5.00 min
Shallow	Overland Flow	570.00 ft	2.80%	11.0000	5.16 min

Drainage Area: TMDC-SE-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	72.8000 ac	92.33	1.63 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	72.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	4.0500 ac
Pervious	92.00	68.7500 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T3.sheet	300.00 ft	0.67%	0.2400	69.07 min
Shallow	TD-T3.shallow	1314.10 ft	0.46%	11.0000	20.01 min

Channel	TD-T3.ch1	20.00 ft	0.40%	42.0000	0.13 min
Channel	TD-T3.ch2	500.00 ft	0.40%	21.0000	6.27 min
Channel	TD-T3.ch3	319.70 ft	0.63%	27.0000	2.49 min

Drainage Area: TMDC-SW-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	20.8400 ac	93.47	1.00 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	20.8400 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	5.1000 ac
Pervious	92.00	15.7400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T2.sheet	300.00 ft	1.00%	0.2400	58.85 min
Shallow	TD-T2.shallow	186.10 ft	5.91%	11.0000	1.16 min
Channel	TD-T2.ch1	10.00 ft	15.00%	42.0000	0.01 min

ROUTEHYD [] THRU [Proposed] USING AND [6 mo] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	4.1519	15.4930	0.27	0.7071	24" Diam	4.1792	4.9316	Riverside-SW of I-5-Ex
M-D-1	61.9500	4.1519	----	1.00	0.5004	Ditch	1.8431	-----	
M-R-5	61.9500	4.1519	26.3590	0.16	0.6708	30" Diam	3.9168	5.3698	
M-R-6	61.9500	4.1519	17.3761	0.24	0.6655	24" Diam	4.5400	5.5310	
M-R-2	34.2000	3.7567	0.6381	5.89	-1.0000	8" Diam	5.8870	1.8281	Riverside-NW of I-5-Ex
M-R-1	34.2000	3.7567	2.9978	1.25	-1.0000	12" Diam	1.2532	3.8169	
W-D-3	96.1500	7.5054	----	1.00	0.8903	Ditch	1.4866	-----	
W-D-2	110.9500	8.8928	----	1.00	1.2822	Ditch	1.0130	-----	Riverside-I-5-Ex
W-R-3	110.9500	8.8928	9.9628	0.89	1.8414	30" Diam	2.2944	2.0296	
W-R-2	110.9500	8.8928	12.7780	0.70	1.5353	30" Diam	2.8130	2.6031	
W-D-1	110.9500	8.8928	----	1.00	0.8115	Ditch	2.0165	-----	
W-R-1	110.9500	8.8928	70.0377	0.13	0.6016	30" Diam	9.7801	14.2680	
M-R-3	20.8400	1.9885	5.7236	0.35	0.8135	24" Diam	1.6572	1.8219	TMDC-SW-Ex
TMC-D-1	20.8400	1.9885	----	1.00	0.8145	Ditch	0.4485	-----	
M-R-4	72.8000	4.8770	32.0539	0.15	0.6591	30" Diam	4.7159	6.5300	TMDC-SE-Ex
TMC-D-2	72.8000	4.8770	----	1.00	0.8440	Ditch	1.0445	-----	
TMC-D-3	133.6200	13.2975	----	1.00	1.6643	Ditch	0.9996	-----	TMDC-N-Ex
TMC-D-4	133.6200	13.2975	----	1.00	2.6313	Ditch	0.4639	-----	
P-D-1	36.4700	3.2194	----	1.00	0.6353	Ditch	1.0329	-----	Riverside-E-Ex
P-R-1	36.4700	3.2194	1.3504	2.38	-1.0000	12" Diam	2.3840	1.7194	
P-R-2	36.4700	3.2194	5.7968	0.56	0.5324	12" Diam	7.5736	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					11.2787	
W-N-1	Nooksack River 1	16.4137	--na--	--na--	--na--	16.4137	17.5700
W-N-2	W-N-1	16.4383	--na--	--na--	--na--	16.4384	17.7600
W-S-1	W-N-2	18.0696	0.0817	0.0146	------	18.0024	31.2000
W-N-3	W-S-1	18.7841	--na--	--na--	--na--	18.7841	19.3200
W-N-4	W-N-3	21.2122	--na--	--na--	--na--	21.2122	22.4300
M-N-1	W-N-4	27.4403	--na--	--na--	--na--	27.4403	27.8000
M-S-3	M-N-1	27.5077	0.0111	0.0129	------	27.5095	29.7400
M-N-6	M-S-3	27.5448	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1110	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	30.2358	------	------	------	30.2358	31.6100
M-S-1	M-N-1	29.0726	1.7985	0.0582	------	27.3322	30.7200
M-S-2	M-S-1	46.1370	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	14.6313	--na--	--na--	--na--	14.6313	108.0000
TMC-N-1	TMC-N-2	16.3343	--na--	--na--	--na--	16.3343	108.0000
M-N-3	TMC-N-1	16.3927	--na--	--na--	--na--	16.3927	17.2000
M-N-2	M-N-3	16.5374	--na--	--na--	--na--	16.5374	17.4500
M-N-5	TMC-N-1	19.4140	--na--	--na--	--na--	19.4140	21.0700
M-N-4	M-N-5	21.5714	--na--	--na--	--na--	21.5714	23.1000
P-S-2	Nooksack River 2	12.8895	0.2609	0.0025	------	12.6311	21.9800
P-S-1	P-S-2	15.1759	------	------	------	13.6500	13.5500
P-N-1	P-S-1	22.6353	--na--	--na--	--na--	22.6353	108.0000

ROUTEHYD [] THRU [Proposed] USING AND [2 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	6.8226	15.4930	0.44	0.9290	24" Diam	4.7750	4.9316	Riverside-SW of I-5-Ex
M-D-1	61.9500	6.8226	----	1.00	0.6492	Ditch	2.1241	-----	
M-R-5	61.9500	6.8226	26.3590	0.26	0.8677	30" Diam	4.5069	5.3698	
M-R-6	61.9500	6.8226	17.3761	0.39	0.8706	24" Diam	5.1975	5.5310	
M-R-2	34.2000	6.4067	0.6381	10.04	-1.0000	8" Diam	10.0398	1.8281	Riverside-NW of I-5-Ex
M-R-1	34.2000	6.4067	2.9978	2.14	-1.0000	12" Diam	2.1372	3.8169	
W-D-3	96.1500	12.5833	----	1.00	1.1455	Ditch	1.7068	-----	
W-D-2	110.9500	14.7873	----	1.00	1.6245	Ditch	1.1562	-----	Riverside-I-5-Ex
W-R-3	110.9500	14.7873	9.9628	1.48	-1.0000	30" Diam	1.4843	2.0296	

W-R-2	110.9500	14.7873	12.7780	1.16	-1.0000	30" Diam	1.1573	2.6031	
W-D-1	110.9500	14.7873	----	1.00	1.0431	Ditch	2.3130	-----	
W-R-1	110.9500	14.7873	70.0377	0.21	0.7798	30" Diam	11.3119	14.2680	
M-R-3	20.8400	3.3841	5.7236	0.59	1.1064	24" Diam	1.8977	1.8219	TMDC-SW-Ex
TMC-D-1	20.8400	3.3841	----	1.00	1.0586	Ditch	0.5176	-----	
M-R-4	72.8000	8.6574	32.0539	0.27	0.8876	30" Diam	5.5456	6.5300	TMDC-SE-Ex
TMC-D-2	72.8000	8.6574	----	1.00	1.1182	Ditch	1.2183	-----	
TMC-D-3	133.6200	22.8283	----	1.00	2.1226	Ditch	1.1481	-----	TMDC-N-Ex
TMC-D-4	133.6200	22.8283	----	1.00	-1.0000	Ditch	1.2655	-----	
P-D-1	36.4700	5.5350	----	1.00	0.8369	Ditch	1.2001	-----	Riverside-E-Ex
P-R-1	36.4700	5.5350	1.3504	4.10	-1.0000	12" Diam	4.0986	1.7194	
P-R-2	36.4700	5.5350	5.7968	0.95	0.7818	12" Diam	8.4019	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	**To Node**	**ft**	**ft**	**ft**	**ft**	**ft**	**ft**
	Nooksack River 1					11.5811	
W-N-1	Nooksack River 1	16.8849	--na--	--na--	--na--	16.8849	17.5700
W-N-2	W-N-1	16.9016	--na--	--na--	--na--	16.9016	17.7600
W-S-1	W-N-2	19.2502	0.1409	0.0252	------	19.1345	31.2000
W-N-3	W-S-1	20.3942	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	21.5545	--na--	--na--	--na--	21.5545	22.4300
M-N-1	W-N-4	27.6955	--na--	--na--	--na--	27.6955	27.8000
M-S-3	M-N-1	27.8774	0.0300	0.0349	------	27.8823	29.7400
M-N-6	M-S-3	27.9776	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1128	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	30.7200	------	------	------	30.7200	31.6100
M-S-1	M-N-1	31.1805	5.2308	0.1691	------	26.1189	30.7200
M-S-2	M-S-1	80.5499	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	16.7926	--na--	--na--	--na--	16.7926	108.0000
M-N-3	TMC-N-1	16.8410	--na--	--na--	--na--	16.8410	17.2000
M-N-2	M-N-3	17.0165	--na--	--na--	--na--	17.0165	17.4500
M-N-5	TMC-N-1	19.6882	--na--	--na--	--na--	19.6882	21.0700
M-N-4	M-N-5	21.9438	--na--	--na--	--na--	21.9438	23.1000
P-S-2	Nooksack River 2	13.9312	0.7712	0.0075	------	13.1675	21.9800
P-S-1	P-S-2	20.3087	------	------	------	13.6500	13.5500
P-N-1	P-S-1	22.8369	--na--	--na--	--na--	22.8369	108.0000

ROUTEHYD [] THRU [Proposed] USING AND [10 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	11.5548	15.4930	0.75	1.2873	24" Diam	5.4061	4.9316	Riverside-SW of I-5-Ex
M-D-1	61.9500	11.5548	----	1.00	0.8482	Ditch	2.4567	-----	
M-R-5	61.9500	11.5548	26.3590	0.44	1.1582	30" Diam	5.1932	5.3698	
M-R-6	61.9500	11.5548	17.3761	0.66	1.1920	24" Diam	5.9182	5.5310	
M-R-2	34.2000	11.1155	0.6381	17.42	-1.0000	8" Diam	17.4188	1.8281	Riverside-NW of I-5-Ex
M-R-1	34.2000	11.1155	2.9978	3.71	-1.0000	12" Diam	3.7079	3.8169	
W-D-3	96.1500	21.5834	----	1.00	1.4774	Ditch	1.9657	-----	
W-D-2	110.9500	25.2213	----	1.00	2.0672	Ditch	1.3259	-----	Riverside-I-5-Ex
W-R-3	110.9500	25.2213	9.9628	2.53	-1.0000	30" Diam	2.5316	2.0296	
W-R-2	110.9500	25.2213	12.7780	1.97	-1.0000	30" Diam	1.9738	2.6031	
W-D-1	110.9500	25.2213	----	1.00	1.3459	Ditch	2.6627	-----	
W-R-1	110.9500	25.2213	70.0377	0.36	1.0371	30" Diam	13.1035	14.2680	
M-R-3	20.8400	5.9291	5.7236	1.04	1.7124	24" Diam	2.0705	1.8219	TMDC-SW-Ex
TMC-D-1	20.8400	5.9291	----	1.00	1.3826	Ditch	0.5999	-----	
M-R-4	72.8000	15.6271	32.0539	0.49	1.2316	30" Diam	6.4887	6.5300	TMDC-SE-Ex
TMC-D-2	72.8000	15.6271	----	1.00	1.4780	Ditch	1.4223	-----	
TMC-D-3	133.6200	39.9298	----	1.00	2.7107	Ditch	1.3232	-----	TMDC-N-Ex
TMC-D-4	133.6200	39.9298	----	1.00	-1.0000	Ditch	2.2135	-----	
P-D-1	36.4700	9.7197	----	1.00	1.1034	Ditch	1.3960	-----	Riverside-E-Ex
P-R-1	36.4700	9.7197	1.3504	7.20	-1.0000	12" Diam	7.1975	1.7194	
P-R-2	36.4700	9.7197	5.7968	1.68	-1.0000	12" Diam	1.6768	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El

From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					11.9962	
W-N-1	Nooksack River 1	17.6342	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6785	--na--	--na--	--na--	17.6785	17.7600
W-S-1	W-N-2	22.0932	0.4099	0.0733	------	21.7566	31.2000
W-N-3	W-S-1	25.4212	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	21.9972	--na--	--na--	--na--	21.9972	22.4300
M-N-1	W-N-4	28.0274	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.4217	0.0860	0.1001	------	28.4358	29.7400
M-N-6	M-S-3	28.7092	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1181	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	31.2280	------	------	------	31.2280	31.6100
M-S-1	M-N-1	37.6381	15.7454	0.5091	------	22.4018	30.7200
M-S-2	M-S-1	185.9721	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	17.3807	--na--	--na--	--na--	17.3807	108.0000
M-N-3	TMC-N-1	17.4232	--na--	--na--	--na--	17.3000	17.2000
M-N-2	M-N-3	17.6507	--na--	--na--	--na--	17.5500	17.4500
M-N-5	TMC-N-1	20.0618	--na--	--na--	--na--	20.0618	21.0700
M-N-4	M-N-5	22.5214	--na--	--na--	--na--	22.5214	23.1000
P-S-2	Nooksack River 2	18.4421	2.3782	0.0231	------	16.0871	21.9800
P-S-1	P-S-2	38.1088	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.1034	--na--	--na--	--na--	23.1034	108.0000

ROUTEHYD [] THRU [Proposed] USING AND [25 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	13.9565	15.4930	0.90	1.4845	24" Diam	5.5816	4.9316	Riverside-SW of I-5-Ex
M-D-1	61.9500	13.9565	----	1.00	0.9315	Ditch	2.5856	-----	
M-R-5	61.9500	13.9565	26.3590	0.53	1.2932	30" Diam	5.4466	5.3698	
M-R-6	61.9500	13.9565	17.3761	0.80	1.3571	24" Diam	6.1494	5.5310	
M-R-2	34.2000	13.4978	0.6381	21.15	-1.0000	8" Diam	21.1522	1.8281	Riverside-NW of I-5-Ex
M-R-1	34.2000	13.4978	2.9978	4.50	-1.0000	12" Diam	4.5026	3.8169	
W-D-3	96.1500	26.2418	----	1.00	1.6167	Ditch	2.0677	-----	
W-D-2	110.9500	30.4958	----	1.00	2.2485	Ditch	1.3917	-----	Riverside-I-5-Ex
W-R-3	110.9500	30.4958	9.9628	3.06	-1.0000	30" Diam	3.0610	2.0296	
W-R-2	110.9500	30.4958	12.7780	2.39	-1.0000	30" Diam	2.3866	2.6031	
W-D-1	110.9500	30.4958	----	1.00	1.4707	Ditch	2.7976	-----	
W-R-1	110.9500	30.4958	70.0377	0.44	1.1537	30" Diam	13.7747	14.2680	
M-R-3	20.8400	7.2215	5.7236	1.26	-1.0000	24" Diam	1.2617	1.8219	TMDC-SW-Ex
TMC-D-1	20.8400	7.2215	----	1.00	1.5154	Ditch	0.6315	-----	
M-R-4	72.8000	19.2099	32.0539	0.60	1.3947	30" Diam	6.8234	6.5300	TMDC-SE-Ex
TMC-D-2	72.8000	19.2099	----	1.00	1.6255	Ditch	1.5003	-----	
TMC-D-3	133.6200	48.6371	----	1.00	2.9505	Ditch	1.3909	-----	TMDC-N-Ex
TMC-D-4	133.6200	48.6371	----	1.00	-1.0000	Ditch	2.6962	-----	
P-D-1	36.4700	11.8855	----	1.00	1.2150	Ditch	1.4722	-----	Riverside-E-Ex
P-R-1	36.4700	11.8855	1.3504	8.80	-1.0000	12" Diam	8.8012	1.7194	
P-R-2	36.4700	11.8855	5.7968	2.05	-1.0000	12" Diam	2.0504	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					12.1670	
W-N-1	Nooksack River 1	17.9953	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6825	--na--	--na--	--na--	17.6825	17.7600
W-S-1	W-N-2	24.0947	0.5993	0.1071	------	23.6025	31.2000
W-N-3	W-S-1	28.9602	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.2097	--na--	--na--	--na--	22.2097	22.4300
M-N-1	W-N-4	28.1667	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.6612	0.1255	0.1461	------	28.6817	29.7400
M-N-6	M-S-3	29.0805	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1218	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	31.4702	------	------	------	31.4702	31.6100
M-S-1	M-N-1	42.2274	23.2180	0.7508	------	19.7602	30.7200
M-S-2	M-S-1	260.8942	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000

TMC-N-1	TMC-N-2	17.6205	--na--	--na--	--na--	17.6205	108.0000
M-N-3	TMC-N-1	17.6611	--na--	--na--	--na--	17.3000	17.2000
M-N-2	M-N-3	17.8202	--na--	--na--	--na--	17.5500	17.4500
M-N-5	TMC-N-1	20.2298	--na--	--na--	--na--	20.2298	21.0700
M-N-4	M-N-5	22.7993	--na--	--na--	--na--	22.7993	23.1000
P-S-2	Nooksack River 2	22.0916	3.5561	0.0346	------	18.5702	21.9800
P-S-1	P-S-2	51.4991	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.2150	--na--	--na--	--na--	23.2150	108.0000

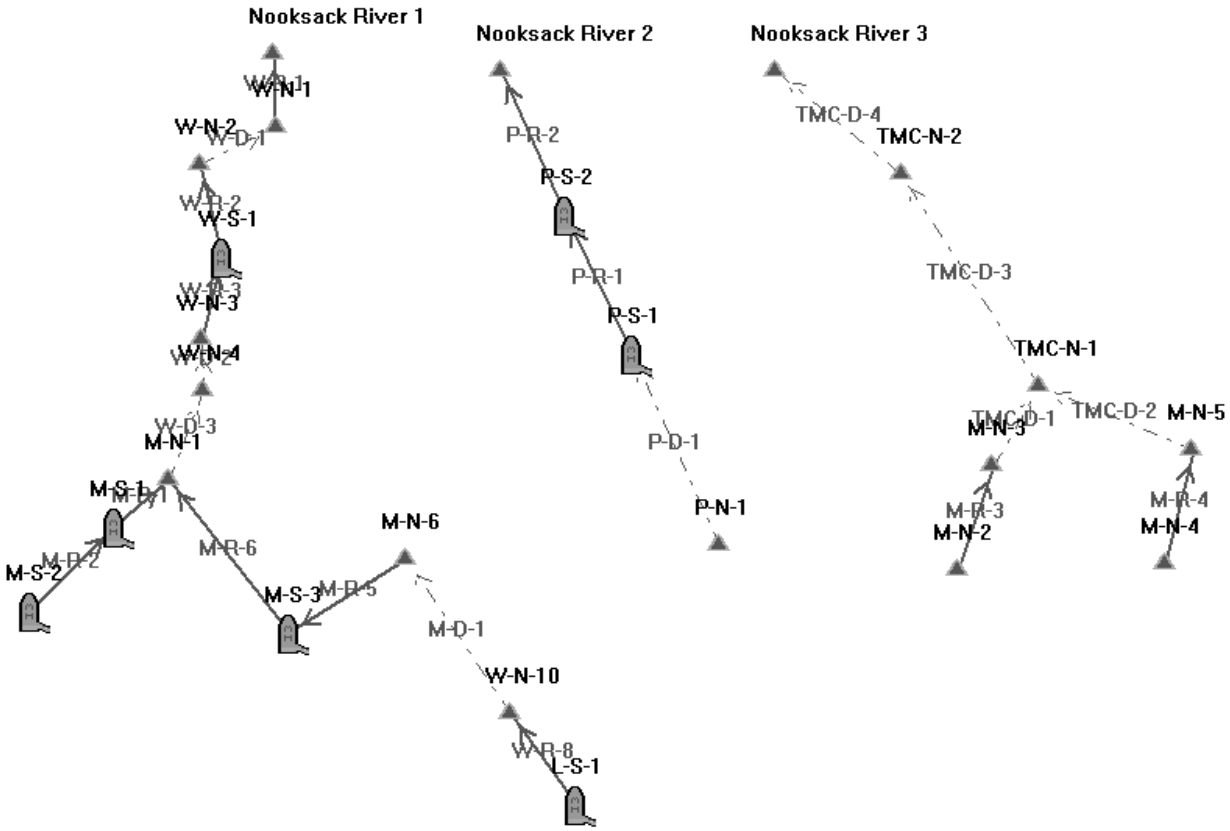
ROUTEHYD [] THRU [Proposed] USING AND [100 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	17.9696	15.4930	1.16	-1.0000	24" Diam	1.1598	4.9316	Riverside-SW of
I-5-Ex									
M-D-1	61.9500	17.9696	----	1.00	1.0540	Ditch	2.7666	-----	
M-R-5	61.9500	17.9696	26.3590	0.68	1.5144	30" Diam	5.7771	5.3698	
M-R-6	61.9500	17.9696	17.3761	1.03	1.7083	24" Diam	6.2876	5.5310	
M-R-2	34.2000	17.4693	0.6381	27.38	-1.0000	8" Diam	27.3759	1.8281	Riverside-NW of
I-5-Ex									
M-R-1	34.2000	17.4693	2.9978	5.83	-1.0000	12" Diam	5.8275	3.8169	
W-D-3	96.1500	34.0351	----	1.00	1.8198	Ditch	2.2109	-----	
W-D-2	110.9500	39.4398	----	1.00	2.5165	Ditch	1.4856	-----	Riverside-I-5-Ex
W-R-3	110.9500	39.4398	9.9628	3.96	-1.0000	30" Diam	3.9587	2.0296	
W-R-2	110.9500	39.4398	12.7780	3.09	-1.0000	30" Diam	3.0865	2.6031	
W-D-1	110.9500	39.4398	----	1.00	1.6556	Ditch	2.9901	-----	
W-R-1	110.9500	39.4398	70.0377	0.56	1.3422	30" Diam	14.6904	14.2680	
M-R-3	20.8400	9.3802	5.7236	1.64	-1.0000	24" Diam	1.6389	1.8219	TMDC-SW-Ex
TMC-D-1	20.8400	9.3802	----	1.00	1.7086	Ditch	0.6756	-----	
M-R-4	72.8000	25.2579	32.0539	0.79	1.6729	30" Diam	7.2347	6.5300	TMDC-SE-Ex
TMC-D-2	72.8000	25.2579	----	1.00	1.8410	Ditch	1.6098	-----	
TMC-D-3	133.6200	63.2083	----	1.00	-1.0000	Ditch	1.2500	-----	TMDC-N-Ex
TMC-D-4	133.6200	63.2083	----	1.00	-1.0000	Ditch	3.5040	-----	
P-D-1	36.4700	15.5107	----	1.00	1.3776	Ditch	1.5785	-----	Riverside-E-Ex
P-R-1	36.4700	15.5107	1.3504	11.49	-1.0000	12" Diam	11.4857	1.7194	
P-R-2	36.4700	15.5107	5.7968	2.68	-1.0000	12" Diam	2.6758	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					12.4015	
W-N-1	Nooksack River 1	18.8051	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6911	--na--	--na--	--na--	17.6911	17.7600
W-S-1	W-N-2	28.3546	1.0024	0.1792	------	27.5314	31.2000
W-N-3	W-S-1	36.4926	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.4465	--na--	--na--	--na--	22.5300	22.4300
M-N-1	W-N-4	28.3698	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	29.1618	0.2081	0.2421	------	29.1959	29.7400
M-N-6	M-S-3	29.8570	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1296	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	33.3985	------	------	------	31.7100	31.6100
M-S-1	M-N-1	51.8532	38.8913	1.2575	------	14.2195	30.7200
M-S-2	M-S-1	418.0383	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	13.6700	--na--	--na--	--na--	13.6700	108.0000
M-N-3	TMC-N-1	16.9086	--na--	--na--	--na--	16.9086	17.2000
M-N-2	M-N-3	17.9331	--na--	--na--	--na--	17.5500	17.4500
M-N-5	TMC-N-1	20.4110	--na--	--na--	--na--	20.4110	21.0700
M-N-4	M-N-5	23.2645	--na--	--na--	--na--	23.2000	23.1000
P-S-2	Nooksack River 2	29.8376	6.0562	0.0589	------	22.0800	21.9800
P-S-1	P-S-2	78.1597	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.3776	--na--	--na--	--na--	23.3776	108.0000

FULL BUILD-OUT STORMSHED MODEL

Ferndale Gateway – PROPOSED CONDITIONS
Riechhardt & Ebe Engineering, Inc.



Project Precips

[6 mo]	1.37 in
[2 yr]	1.90 in
[10 yr]	2.80 in
[25 yr]	3.25 in
[100 yr]	4.00 in

Reach Records

Reach ID: M-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
759.0000 ft	0.10 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-10	M-N-6	25.2600 ft	24.5086 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
0.0000 ac	0.0000 cf	0.0000 cf	0.0000 ft/s	0.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	

0.000000 ft	0.000000 ft	0.000000 ft	0.0000 ft

Reach ID: M-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
72.0000 ft	0.60 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-1	M-N-1	27.4000 ft	26.9680 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	15.7794 cf	2.9978 cf	5.2637 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.253568 ft	6.267838 ft	11.966228 ft	27.9680 ft	
comment:	Hydrograph not shifted, 0.49 min forwarded.Submerged or overtop bank condition.			

Reach ID: M-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
8" Diam	Plastic	0.0090	Mannings Formula	
Length	Slope	Entrance Loss		
386.0000 ft	0.13 %	Groove End Projecting		
Diam				
0.6667 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-2	M-S-1	27.9400 ft	27.4382 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	15.7794 cf	0.6381 cf	24.7277 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.898941 ft	9.494703 ft	306.748047 ft	28.1049 ft	
comment:	Hydrograph not shifted, 0.26 min forwarded.Submerged or overtop bank condition.			

Reach ID: M-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
24" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
115.0000 ft	0.22 %	Headwall		
Diam				
2.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-2	M-N-3	15.4500 ft	15.2004 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	8.5580 cf	5.7236 cf	1.4952 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.017358 ft	0.034716 ft	0.557769 ft	17.2004 ft	
comment:	Hydrograph not shifted, 1.28 min forwarded.Submerged or overtop bank condition.			

Reach ID: M-R-4

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
98.0000 ft	2.07 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-4	M-N-5	20.6000 ft	18.5711 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	24.2286 cf	32.0539 cf	7.1774 ft/s	1.6242 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.399964 ft	0.799928 ft	1.158873 ft	20.3767 ft	

Reach ID: M-R-5

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
253.0000 ft	0.35 %	Groove End Projecting		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-6	M-S-3	24.5100 ft	23.6245 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
0.0000 ac	0.0000 cf	0.0000 cf	0.0000 ft/s	0.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	0.0000 ft	

Reach ID: M-R-6

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
24" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
122.0000 ft	0.50 %	Groove End Projecting		
Diam				
2.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-3	M-N-1	23.7600 ft	23.1500 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
0.0000 ac	0.0000 cf	0.0000 cf	0.0000 ft/s	0.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	0.0000 ft	

Reach ID: P-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1572.0000 ft	0.51 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
P-N-1	P-S-1	22.0000 ft	14.0001 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	14.3674 cf	14.3674 cf	1.5472 ft/s	1.3290 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	15.3291 ft	

Reach ID: P-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
259.0000 ft	0.14 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
P-S-1	P-S-2	12.1300 ft	11.7599 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	14.3674 cf	1.3504 cf	10.6390 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.039250 ft	5.196251 ft	41.881390 ft	22.0800 ft	
comment:	Hydrograph shifted 10.00 min, 7.34 min forwarded.Submerged or overtop bank cond			

Reach ID: P-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
61.0000 ft	2.63 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
P-S-2	Nooksack River 2		11.6800 ft	10.0739 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	14.3674 cf	5.7968 cf	2.4785 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.039250 ft	5.196251 ft	9.863956 ft	11.0739 ft	
comment:	Hydrograph shifted 10.00 min, 7.75 min forwarded.Submerged or overtop bank cond			

Reach ID: TMC-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	

	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
724.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-3	TMC-N-1	15.2000 ft	14.6699 ft	
Conduit Summary:				
Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	8.5580 cf	8.5580 cf	0.6598 ft/s	1.6385 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	16.3084 ft	

Reach ID: TMC-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1021.0000 ft	0.38 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-5	TMC-N-1	18.5700 ft	14.6701 ft	
Conduit Summary:				
Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	24.2286 cf	24.2286 cf	1.5927 ft/s	1.8067 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	16.4768 ft	

Reach ID: TMC-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1617.0000 ft	0.17 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-1	TMC-N-2	14.6700 ft	12.0003 ft	
Conduit Summary:				
Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	58.0743 cf	58.0743 cf	1.1485 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.4547 ft	
comment:	Hydrograph shifted 40.00 min, 3.04 min forwarded.Submerged or overtop bank cond			

Reach ID: TMC-D-4

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1428.0000 ft	0.02 %			

Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-2	Nooksack River 3		12.0000 ft	11.7000 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	58.0743 cf	58.0743 cf	3.2194 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.1544 ft	

comment: Hydrograph shifted 50.00 min, 0.43 min forwarded.Submerged or overtop bank cond

Reach ID: W-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
268.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-2	W-N-1	15.2600 ft	15.0724 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	35.4146 cf	2.9081 ft/s	1.5759 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	17.6700 ft	

Reach ID: W-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1365.0000 ft	0.23 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-4	W-N-3	19.9300 ft	16.8314 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	35.4146 cf	1.4456 ft/s	2.4011 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	19.4200 ft	

Reach ID: W-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
913.0000 ft	0.73 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	

M-N-1	W-N-4	26.5500 ft	19.8851 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	15.7794 cf	15.7794 cf	1.8115 ft/s	1.2758 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	22.3311 ft	

Reach ID: W-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
165.0000 ft	2.90 %	Groove End Projecting		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-1	Nooksack River 1		15.0700 ft	10.2850 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	70.0377 cf	14.3080 ft/s	1.2583 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.635775 ft	3.178875 ft	1.223118 ft	12.3048 ft	

Reach ID: W-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
331.0000 ft	0.33 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-S-1	W-N-2	16.3500 ft	15.2610 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	35.4146 cf	12.7780 cf	2.7715 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.059638 ft	0.119276 ft	8.362735 ft	17.7610 ft	

comment: Hydrograph shifted 30.00 min, 2.05 min forwarded.Submerged or overtop bank cond

Reach ID: W-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
238.0000 ft	0.20 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-3	W-S-1	16.8200 ft	16.3440 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth

110.9500 ac	35.4146 cf	9.9628 cf	3.5547 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.404120 ft	0.808239 ft	6.013084 ft	25.6389 ft	
comment:	Hydrograph shifted 30.00 min, 0.06 min forwarded.Submerged or overtop bank cond			

Reach ID: W-R-8

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
24" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
251.0000 ft	1.59 %	Headwall		
Diam				
2.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
L-S-1	W-N-10	29.2600 ft	25.2691 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	15.9301 cf	15.4930 cf	5.6110 ft/s	1.6951 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.199629 ft	0.399257 ft	4.218132 ft	27.2691 ft	
comment:	Hydrograph not shifted, 3.25 min forwarded.Submerged or overtop bank condition.			

Node Records

Node ID: L-S-1

Desc:	Manhole structure		
Start El:	29.2600 ft	Max El:	31.6100 ft
Contrib Basin:	Riverside-SW of I-5-Prop	Contrib Hyd:	
Hgl Elev:	31.7100 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.0000 ft		

Node ID: M-N-1

Desc:	Manhole structure		
Start El:	26.5500 ft	Max El:	27.8000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	27.9000 ft		

Node ID: M-N-2

Desc:	Manhole structure		
Start El:	15.4500 ft	Max El:	17.4500 ft
Contrib Basin:	TMDC-SW-Prop	Contrib Hyd:	
Hgl Elev:	17.5500 ft		

Node ID: M-N-3

Desc:	Manhole structure		
Start El:	15.2000 ft	Max El:	17.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	16.8385 ft		

Node ID: M-N-4

Desc:	Manhole structure		
Start El:	20.6000 ft	Max El:	23.1000 ft
Contrib Basin:	TMDC-SE-Prop	Contrib Hyd:	
Hgl Elev:	23.2000 ft		

Node ID: M-N-5

Desc:	Manhole structure		
Start El:	18.5700 ft	Max El:	21.0700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	20.3767 ft		

Node ID: M-N-6

Desc:	Manhole structure		
Start El:	24.5100 ft	Max El:	27.0100 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	20.3767 ft		

Node ID: M-S-1

Desc:	Manhole structure		
Start El:	27.4000 ft	Max El:	30.7200 ft

Contrib Basin: Contrib Hyd:
Hgl Elev: 20.5194 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 31.7309 ft

Node ID: M-S-2

Desc: Manhole structure
Start El: 27.9400 ft Max El: 29.7400 ft
Contrib Basin: Riverside-NW of I-5-Prop Contrib Hyd:
Hgl Elev: 29.8400 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 0.0000 ft

Node ID: M-S-3

Desc: Manhole structure
Start El: 23.6200 ft Max El: 29.7400 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 29.8400 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 0.0000 ft

Node ID: Nooksack River 1

Desc: Manhole structure
Start El: 4.1300 ft Max El: 7.6100 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 7.7100 ft

Node ID: Nooksack River 2

Desc: Manhole structure
Start El: 10.0800 ft Max El: 108.0000 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 11.0739 ft

Node ID: Nooksack River 3

Desc: Manhole structure
Start El: 11.7000 ft Max El: 108.0000 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 13.1544 ft

Node ID: P-N-1

Desc: Manhole structure
Start El: 22.0000 ft Max El: 108.0000 ft
Contrib Basin: Riverside-E-Prop Contrib Hyd:
Hgl Elev: 23.3290 ft

Node ID: P-S-1

Desc:	Manhole structure		
Start El:	12.1300 ft	Max El:	13.5500 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	13.6500 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	0.0000 ft		

Node ID: P-S-2

Desc:	Manhole structure		
Start El:	11.6800 ft	Max El:	21.9800 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	22.0800 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	5.1963 ft		

Node ID: TMC-N-1

Desc:	Manhole structure		
Start El:	14.6700 ft	Max El:	108.0000 ft
Contrib Basin:	TMDC-N-Prop	Contrib Hyd:	
Hgl Elev:	13.6700 ft		

Node ID: TMC-N-2

Desc:	Manhole structure		
Start El:	12.0000 ft	Max El:	108.0000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	11.0000 ft		

Node ID: W-N-1

Desc:	Manhole structure		
Start El:	15.0700 ft	Max El:	17.5700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6700 ft		

Node ID: W-N-10

Desc:	Manhole structure		
Start El:	25.2600 ft	Max El:	26.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	26.7490 ft		

Node ID: W-N-2

Desc:	Manhole structure		
Start El:	15.2600 ft	Max El:	17.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6870 ft		

Node ID: W-N-3

Desc:	Manhole structure		
Start El:	16.8200 ft	Max El:	19.3200 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	19.4200 ft		

Node ID: W-N-4

Desc:	Manhole structure		
Start El:	19.9300 ft	Max El:	22.4300 ft
Contrib Basin:	Riverside-I-5-Prop	Contrib Hyd:	
Hgl Elev:	22.3311 ft		

Node ID: W-S-1

Desc:	Manhole structure		
Start El:	16.3500 ft	Max El:	31.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	25.6389 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.8082 ft		

Contributing Drainage Areas

Drainage Area: Riverside-E-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	36.4700 ac	97.70	1.10 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	36.4700 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	34.6500 ac
Pervious	92.00	1.8200 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	0.67%	0.1500	47.43 min
Shallow	Lawn	994.00 ft	0.30%	11.0000	18.75 min

Drainage Area: Riverside-I-5-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	14.8000 ac	97.70	1.78 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	14.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	14.0600 ac
Pervious	92.00	0.7400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Pasture	300.00 ft	0.33%	0.1500	62.96 min
Channel	Ditch	1846.00 ft	0.22%	17.0000	38.59 min
Channel	Pipe	87.00 ft	0.25%	21.0000	1.38 min
Channel	Ditch	167.00 ft	1.20%	17.0000	1.49 min
Channel	Pipe	346.00 ft	1.44%	21.0000	2.29 min

Drainage Area: Riverside-NW of I-5-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	34.2000 ac	97.70	0.74 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	34.2000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	32.4900 ac
Pervious	92.00	1.7100 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	1.33%	0.1500	36.05 min
Shallow	Lawn	260.00 ft	1.00%	11.0000	3.94 min
Channel	Ditch	210.00 ft	0.25%	17.0000	4.12 min

Channel	Pipe		58.00 ft	1.00%	21.0000	0.46 min

Drainage Area: Riverside-SW of I-5-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	61.9500 ac	97.70	2.85 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	61.9500 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	58.8500 ac
Pervious	92.00	3.1000 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Brush	207.00 ft	0.48%	0.8000	153.68 min
Shallow	Brush	603.00 ft	0.17%	5.0000	15.11 min
Channel	Pipe	102.00 ft	0.25%	42.0000	0.81 min
Channel	Pipe	188.00 ft	0.50%	42.0000	1.06 min
Channel	Pipe	115.00 ft	1.30%	42.0000	0.40 min

Drainage Area: TMDC-N-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	39.9800 ac	97.70	0.17 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	39.9800 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	37.9800 ac
Pervious	92.00	2.0000 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Overland Flow	300.00 ft	1.00%	0.0110	5.00 min
Shallow	Overland Flow	570.00 ft	2.80%	11.0000	5.16 min

Drainage Area: TMDC-SE-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	72.8000 ac	97.70	1.63 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	72.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	69.1600 ac
Pervious	92.00	3.6400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T3.sheet	300.00 ft	0.67%	0.2400	69.07 min
Shallow	TD-T3.shallow	1314.10 ft	0.46%	11.0000	20.01 min

Channel	TD-T3.ch1	20.00 ft	0.40%	42.0000	0.13 min
Channel	TD-T3.ch2	500.00 ft	0.40%	21.0000	6.27 min
Channel	TD-T3.ch3	319.70 ft	0.63%	27.0000	2.49 min

Drainage Area: TMDC-SW-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	20.8400 ac	97.70	1.00 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	20.8400 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	19.8000 ac
Pervious	92.00	1.0400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T2.sheet	300.00 ft	1.00%	0.2400	58.85 min
Shallow	TD-T2.shallow	186.10 ft	5.91%	11.0000	1.16 min
Channel	TD-T2.ch1	10.00 ft	15.00%	42.0000	0.01 min

ROUTEHYD [] THRU [Proposed] USING AND [6 mo] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	5.9071	15.4930	0.38	0.8564	24" Diam	4.5984	4.9316	Riverside-SW of I-5-Prop
M-D-1	61.9500	5.9071	----	1.00	0.6025	Ditch	2.0395	-----	
M-R-5	61.9500	5.9071	26.3590	0.22	0.8044	30" Diam	4.3293	5.3698	
M-R-6	61.9500	5.9071	17.3761	0.34	0.8038	24" Diam	5.0017	5.5310	
M-R-2	34.2000	5.9913	0.6381	9.39	-1.0000	8" Diam	9.3889	1.8281	Riverside-NW of I-5-Prop
M-R-1	34.2000	5.9913	2.9978	2.00	-1.0000	12" Diam	1.9986	3.8169	
W-D-3	96.1500	11.3898	----	1.00	1.0918	Ditch	1.6623	-----	
W-D-2	110.9500	13.1054	----	1.00	1.5367	Ditch	1.1206	-----	Riverside-I-5-Prop
W-R-3	110.9500	13.1054	9.9628	1.32	-1.0000	30" Diam	1.3154	2.0296	
W-R-2	110.9500	13.1054	12.7780	1.03	2.1119	30" Diam	2.9627	2.6031	
W-D-1	110.9500	13.1054	----	1.00	0.9834	Ditch	2.2396	-----	
W-R-1	110.9500	13.1054	70.0377	0.19	0.7326	30" Diam	10.9317	14.2680	
M-R-3	20.8400	3.2249	5.7236	0.56	1.0741	24" Diam	1.8761	1.8219	TMDC-SW-Prop
TMC-D-1	20.8400	3.2249	----	1.00	1.0342	Ditch	0.5110	-----	
M-R-4	72.8000	9.0806	32.0539	0.28	0.9104	30" Diam	5.6190	6.5300	TMDC-SE-Prop
TMC-D-2	72.8000	9.0806	----	1.00	1.1442	Ditch	1.2338	-----	
TMC-D-3	133.6200	21.8302	----	1.00	2.0809	Ditch	1.1351	-----	TMDC-N-Prop
TMC-D-4	133.6200	21.8302	----	1.00	-1.0000	Ditch	1.2102	-----	
P-D-1	36.4700	5.3978	----	1.00	0.8265	Ditch	1.1919	-----	Riverside-E-Prop
P-R-1	36.4700	5.3978	1.3504	4.00	-1.0000	12" Diam	3.9971	1.7194	
P-R-2	36.4700	5.3978	5.7968	0.93	0.7639	12" Diam	8.3844	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					11.5017	
W-N-1	Nooksack River 1	16.7569	--na--	--na--	--na--	16.7569	17.5700
W-N-2	W-N-1	16.7754	--na--	--na--	--na--	16.7754	17.7600
W-S-1	W-N-2	19.0495	0.1107	0.0198	------	18.9586	31.2000
W-N-3	W-S-1	19.9481	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	21.4708	--na--	--na--	--na--	21.4708	22.4300
M-N-1	W-N-4	27.6418	--na--	--na--	--na--	27.6418	27.8000
M-S-3	M-N-1	27.7782	0.0225	0.0262	------	27.7819	29.7400
M-N-6	M-S-3	27.8533	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1121	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	30.4564	------	------	------	30.4564	31.6100
M-S-1	M-N-1	30.7775	4.5745	0.1095	------	26.3125	30.7200
M-S-2	M-S-1	73.9702	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	16.7509	--na--	--na--	--na--	16.7509	108.0000
M-N-3	TMC-N-1	16.7995	--na--	--na--	--na--	16.7995	17.2000
M-N-2	M-N-3	16.9697	--na--	--na--	--na--	16.9697	17.4500
M-N-5	TMC-N-1	19.7141	--na--	--na--	--na--	19.7141	21.0700
M-N-4	M-N-5	21.9816	--na--	--na--	--na--	21.9816	23.1000
P-S-2	Nooksack River 2	13.8541	0.7334	0.0071	------	13.1278	21.9800
P-S-1	P-S-2	19.9194	------	------	------	13.6500	13.5500
P-N-1	P-S-1	22.8265	--na--	--na--	--na--	22.8265	108.0000

ROUTEHYD [] THRU [Proposed] USING AND [2 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	8.7430	15.4930	0.56	1.0752	24" Diam	5.0802	4.9316	Riverside-SW of I-5-Prop
M-D-1	61.9500	8.7430	----	1.00	0.7371	Ditch	2.2760	-----	
M-R-5	61.9500	8.7430	26.3590	0.33	0.9914	30" Diam	4.8238	5.3698	
M-R-6	61.9500	8.7430	17.3761	0.50	1.0037	24" Diam	5.5397	5.5310	
M-R-2	34.2000	8.7809	0.6381	13.76	-1.0000	8" Diam	13.7604	1.8281	Riverside-NW of I-5-Prop
M-R-1	34.2000	8.7809	2.9978	2.93	-1.0000	12" Diam	2.9292	3.8169	
W-D-3	96.1500	16.8834	----	1.00	1.3172	Ditch	1.8439	-----	
W-D-2	110.9500	19.4322	----	1.00	1.8393	Ditch	1.2403	-----	Riverside-I-5-Prop
W-R-3	110.9500	19.4322	9.9628	1.95	-1.0000	30" Diam	1.9505	2.0296	

W-R-2	110.9500	19.4322	12.7780	1.52	-1.0000	30" Diam	1.5208	2.6031	
W-D-1	110.9500	19.4322	----	1.00	1.1896	Ditch	2.4866	-----	
W-R-1	110.9500	19.4322	70.0377	0.28	0.9004	30" Diam	12.2074	14.2680	
M-R-3	20.8400	4.7436	5.7236	0.83	1.3892	24" Diam	2.0367	1.8219	TMDC-SW-Prop
TMC-D-1	20.8400	4.7436	----	1.00	1.2447	Ditch	0.5659	-----	
M-R-4	72.8000	13.3849	32.0539	0.42	1.1266	30" Diam	6.2361	6.5300	TMDC-SE-Prop
TMC-D-2	72.8000	13.3849	----	1.00	1.3751	Ditch	1.3661	-----	
TMC-D-3	133.6200	32.1439	----	1.00	2.4673	Ditch	1.2525	-----	TMDC-N-Prop
TMC-D-4	133.6200	32.1439	----	1.00	-1.0000	Ditch	1.7819	-----	
P-D-1	36.4700	7.9511	----	1.00	1.0010	Ditch	1.3233	-----	Riverside-E-Prop
P-R-1	36.4700	7.9511	1.3504	5.89	-1.0000	12" Diam	5.8878	1.7194	
P-R-2	36.4700	7.9511	5.7968	1.37	-1.0000	12" Diam	1.3716	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	**To Node**	**ft**	**ft**	**ft**	**ft**	**ft**	**ft**
	Nooksack River 1					11.7802	
W-N-1	Nooksack River 1	17.2243	--na--	--na--	--na--	17.2243	17.5700
W-N-2	W-N-1	17.2370	--na--	--na--	--na--	17.2370	17.7600
W-S-1	W-N-2	20.3327	0.2433	0.0435	------	20.1329	31.2000
W-N-3	W-S-1	22.3083	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	21.7844	--na--	--na--	--na--	21.7844	22.4300
M-N-1	W-N-4	27.8672	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.1987	0.0493	0.0573	------	28.2068	29.7400
M-N-6	M-S-3	28.3633	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1146	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	30.9363	------	------	------	30.9363	31.6100
M-S-1	M-N-1	34.0027	9.8260	0.2353	------	24.4120	30.7200
M-S-2	M-S-1	126.6231	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	17.1373	--na--	--na--	--na--	17.1373	108.0000
M-N-3	TMC-N-1	17.1812	--na--	--na--	--na--	17.1812	17.2000
M-N-2	M-N-3	17.4278	--na--	--na--	--na--	17.4278	17.4500
M-N-5	TMC-N-1	19.9451	--na--	--na--	--na--	19.9451	21.0700
M-N-4	M-N-5	22.3433	--na--	--na--	--na--	22.3433	23.1000
P-S-2	Nooksack River 2	16.0046	1.5914	0.0155	------	14.4287	21.9800
P-S-1	P-S-2	29.1651	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.0010	--na--	--na--	--na--	23.0010	108.0000

ROUTEHYD [] THRU [Proposed] USING AND [10 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	13.5417	15.4930	0.87	1.4481	24" Diam	5.5591	4.9316	Riverside-SW of I-5-Prop
M-D-1	61.9500	13.5417	----	1.00	0.9178	Ditch	2.5646	-----	
M-R-5	61.9500	13.5417	26.3590	0.51	1.2702	30" Diam	5.4062	5.3698	
M-R-6	61.9500	13.5417	17.3761	0.78	1.3278	24" Diam	6.1153	5.5310	
M-R-2	34.2000	13.4602	0.6381	21.09	-1.0000	8" Diam	21.0933	1.8281	Riverside-NW of I-5-Prop
M-R-1	34.2000	13.4602	2.9978	4.49	-1.0000	12" Diam	4.4901	3.8169	
W-D-3	96.1500	26.1551	----	1.00	1.6142	Ditch	2.0660	-----	
W-D-2	110.9500	30.1093	----	1.00	2.2359	Ditch	1.3872	-----	Riverside-I-5-Prop
W-R-3	110.9500	30.1093	9.9628	3.02	-1.0000	30" Diam	3.0222	2.0296	
W-R-2	110.9500	30.1093	12.7780	2.36	-1.0000	30" Diam	2.3563	2.6031	
W-D-1	110.9500	30.1093	----	1.00	1.4620	Ditch	2.7884	-----	
W-R-1	110.9500	30.1093	70.0377	0.43	1.1454	30" Diam	13.7292	14.2680	
M-R-3	20.8400	7.2938	5.7236	1.27	-1.0000	24" Diam	1.2743	1.8219	TMDC-SW-Prop
TMC-D-1	20.8400	7.2938	----	1.00	1.5224	Ditch	0.6331	-----	
M-R-4	72.8000	20.6315	32.0539	0.64	1.4590	30" Diam	6.9364	6.5300	TMDC-SE-Prop
TMC-D-2	72.8000	20.6315	----	1.00	1.6795	Ditch	1.5282	-----	
TMC-D-3	133.6200	49.4774	----	1.00	2.9722	Ditch	1.3969	-----	TMDC-N-Prop
TMC-D-4	133.6200	49.4774	----	1.00	-1.0000	Ditch	2.7428	-----	
P-D-1	36.4700	12.2406	----	1.00	1.2321	Ditch	1.4836	-----	Riverside-E-Prop
P-R-1	36.4700	12.2406	1.3504	9.06	-1.0000	12" Diam	9.0642	1.7194	
P-R-2	36.4700	12.2406	5.7968	2.11	-1.0000	12" Diam	2.1116	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El

From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					12.1553	
W-N-1	Nooksack River 1	17.9661	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6822	--na--	--na--	--na--	17.6822	17.7600
W-S-1	W-N-2	23.9352	0.5842	0.1044	------	23.4554	31.2000
W-N-3	W-S-1	28.6781	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.1634	--na--	--na--	--na--	22.1634	22.4300
M-N-1	W-N-4	28.1642	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.6166	0.1182	0.1375	------	28.6359	29.7400
M-N-6	M-S-3	29.0114	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1212	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	31.4279	------	------	------	31.4279	31.6100
M-S-1	M-N-1	42.1482	23.0889	0.5529	------	19.6121	30.7200
M-S-2	M-S-1	259.6003	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	17.6422	--na--	--na--	--na--	17.6422	108.0000
M-N-3	TMC-N-1	17.6821	--na--	--na--	--na--	17.3000	17.2000
M-N-2	M-N-3	17.8307	--na--	--na--	--na--	17.5500	17.4500
M-N-5	TMC-N-1	20.2495	--na--	--na--	--na--	20.2495	21.0700
M-N-4	M-N-5	22.9085	--na--	--na--	--na--	22.9085	23.1000
P-S-2	Nooksack River 2	22.7598	3.7717	0.0367	------	19.0248	21.9800
P-S-1	P-S-2	53.9506	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.2321	--na--	--na--	--na--	23.2321	108.0000

ROUTEHYD [] THRU [Proposed] USING AND [25 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	15.9301	15.4930	1.03	1.6951	24" Diam	5.6110	4.9316	Riverside-SW of I-5-Prop
M-D-1	61.9500	15.9301	----	1.00	0.9940	Ditch	2.6790	-----	
M-R-5	61.9500	15.9301	26.3590	0.60	1.4020	30" Diam	5.6221	5.3698	
M-R-6	61.9500	15.9301	17.3761	0.92	1.5070	24" Diam	6.2730	5.5310	
M-R-2	34.2000	15.7794	0.6381	24.73	-1.0000	8" Diam	24.7277	1.8281	Riverside-NW of I-5-Prop
M-R-1	34.2000	15.7794	2.9978	5.26	-1.0000	12" Diam	5.2637	3.8169	
W-D-3	96.1500	30.7624	----	1.00	1.7383	Ditch	2.1542	-----	
W-D-2	110.9500	35.4146	----	1.00	2.4011	Ditch	1.4456	-----	Riverside-I-5-Prop
W-R-3	110.9500	35.4146	9.9628	3.55	-1.0000	30" Diam	3.5547	2.0296	
W-R-2	110.9500	35.4146	12.7780	2.77	-1.0000	30" Diam	2.7715	2.6031	
W-D-1	110.9500	35.4146	----	1.00	1.5759	Ditch	2.9081	-----	
W-R-1	110.9500	35.4146	70.0377	0.51	1.2583	30" Diam	14.3080	14.2680	
M-R-3	20.8400	8.5580	5.7236	1.50	-1.0000	24" Diam	1.4952	1.8219	TMDC-SW-Prop
TMC-D-1	20.8400	8.5580	----	1.00	1.6385	Ditch	0.6598	-----	
M-R-4	72.8000	24.2286	32.0539	0.76	1.6242	30" Diam	7.1774	6.5300	TMDC-SE-Prop
TMC-D-2	72.8000	24.2286	----	1.00	1.8067	Ditch	1.5927	-----	
TMC-D-3	133.6200	58.0743	----	1.00	-1.0000	Ditch	1.1485	-----	TMDC-N-Prop
TMC-D-4	133.6200	58.0743	----	1.00	-1.0000	Ditch	3.2194	-----	
P-D-1	36.4700	14.3674	----	1.00	1.3290	Ditch	1.5472	-----	Riverside-E-Prop
P-R-1	36.4700	14.3674	1.3504	10.64	-1.0000	12" Diam	10.6390	1.7194	
P-R-2	36.4700	14.3674	5.7968	2.48	-1.0000	12" Diam	2.4785	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					12.3048	
W-N-1	Nooksack River 1	18.4088	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6870	--na--	--na--	--na--	17.6870	17.7600
W-S-1	W-N-2	26.3027	0.8082	0.1445	------	25.6389	31.2000
W-N-3	W-S-1	32.8643	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.3311	--na--	--na--	--na--	22.3311	22.4300
M-N-1	W-N-4	28.2883	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.8917	0.1635	0.1903	------	28.9184	29.7400
M-N-6	M-S-3	29.4380	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1254	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	32.0861	------	------	------	31.7100	31.6100
M-S-1	M-N-1	47.4556	31.7309	0.7599	------	16.4846	30.7200
M-S-2	M-S-1	346.2465	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000

TMC-N-1	TMC-N-2	13.6700	--na--	--na--	--na--	13.6700	108.0000
M-N-3	TMC-N-1	16.8385	--na--	--na--	--na--	16.8385	17.2000
M-N-2	M-N-3	17.8103	--na--	--na--	--na--	17.5500	17.4500
M-N-5	TMC-N-1	20.3767	--na--	--na--	--na--	20.3767	21.0700
M-N-4	M-N-5	23.1849	--na--	--na--	--na--	23.2000	23.1000
P-S-2	Nooksack River 2	27.1734	5.1963	0.0506	------	22.0800	21.9800
P-S-1	P-S-2	70.1969	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.3290	--na--	--na--	--na--	23.3290	108.0000

ROUTEHYD [] THRU [Proposed] USING AND [100 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	19.9146	15.4930	1.29	-1.0000	24" Diam	1.2854	4.9316	Riverside-SW of I-5-Prop
M-D-1	61.9500	19.9146	----	1.00	1.1077	Ditch	2.8432	-----	
M-R-5	61.9500	19.9146	26.3590	0.76	1.6237	30" Diam	5.9017	5.3698	
M-R-6	61.9500	19.9146	17.3761	1.15	-1.0000	24" Diam	1.1461	5.5310	
M-R-2	34.2000	19.6244	0.6381	30.75	-1.0000	8" Diam	30.7531	1.8281	Riverside-NW of I-5-Prop
M-R-1	34.2000	19.6244	2.9978	6.55	-1.0000	12" Diam	6.5464	3.8169	
W-D-3	96.1500	38.4087	----	1.00	1.9216	Ditch	2.2805	-----	
W-D-2	110.9500	44.2187	----	1.00	2.6445	Ditch	1.5293	-----	Riverside-I-5-Prop
W-R-3	110.9500	44.2187	9.9628	4.44	-1.0000	30" Diam	4.4384	2.0296	
W-R-2	110.9500	44.2187	12.7780	3.46	-1.0000	30" Diam	3.4605	2.6031	
W-D-1	110.9500	44.2187	----	1.00	1.7442	Ditch	3.0795	-----	
W-R-1	110.9500	44.2187	70.0377	0.63	1.4411	30" Diam	15.0898	14.2680	
M-R-3	20.8400	10.6539	5.7236	1.86	-1.0000	24" Diam	1.8614	1.8219	TMDC-SW-Prop
TMC-D-1	20.8400	10.6539	----	1.00	1.8102	Ditch	0.6981	-----	
M-R-4	72.8000	30.1953	32.0539	0.94	1.9300	30" Diam	7.4259	6.5300	TMDC-SE-Prop
TMC-D-2	72.8000	30.1953	----	1.00	1.9946	Ditch	1.6851	-----	
TMC-D-3	133.6200	72.3297	----	1.00	-1.0000	Ditch	1.4304	-----	TMDC-N-Prop
TMC-D-4	133.6200	72.3297	----	1.00	-1.0000	Ditch	4.0097	-----	
P-D-1	36.4700	17.8933	----	1.00	1.4725	Ditch	1.6382	-----	Riverside-E-Prop
P-R-1	36.4700	17.8933	1.3504	13.25	-1.0000	12" Diam	13.2500	1.7194	
P-R-2	36.4700	17.8933	5.7968	3.09	-1.0000	12" Diam	3.0868	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					12.4968	
W-N-1	Nooksack River 1	19.3311	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6967	--na--	--na--	--na--	17.6967	17.7600
W-S-1	W-N-2	31.0774	1.2600	0.2252	------	30.0426	31.2000
W-N-3	W-S-1	41.3071	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.5745	--na--	--na--	--na--	22.5300	22.4300
M-N-1	W-N-4	28.4716	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	29.4498	0.2556	0.2974	------	29.4916	29.7400
M-N-6	M-S-3	30.3036	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1341	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	34.7972	------	------	------	31.7100	31.6100
M-S-1	M-N-1	58.1099	49.0787	1.1753	------	10.2065	30.7200
M-S-2	M-S-1	520.1806	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	13.6700	--na--	--na--	--na--	13.6700	108.0000
M-N-3	TMC-N-1	17.0102	--na--	--na--	--na--	17.0102	17.2000
M-N-2	M-N-3	18.1456	--na--	--na--	--na--	17.5500	17.4500
M-N-5	TMC-N-1	20.5646	--na--	--na--	--na--	20.5646	21.0700
M-N-4	M-N-5	23.8143	--na--	--na--	--na--	23.2000	23.1000
P-S-2	Nooksack River 2	36.0450	8.0597	0.0785	------	22.0800	21.9800
P-S-1	P-S-2	96.7118	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.4725	--na--	--na--	--na--	23.4725	108.0000

EXISTING CONDITION STORMSHED CONVEYANCE

Ferndale Gateway - EXISTING CONDITIONS
Conveyance Upgrades Considered
Riechhardt & Ebe Engineering, Inc.

Project Precips

[6 mo]	1.37 in
[2 yr]	1.90 in
[10 yr]	2.80 in
[25 yr]	3.25 in
[100 yr]	4.00 in

Reach Records

Reach ID: M-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
759.0000 ft	0.10 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-10	M-N-6	25.2600 ft	24.5086 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	17.9696 cf	17.9696 cf	2.7666 ft/s	1.0540 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	27.1100 ft	

Reach ID: M-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
72.0000 ft	0.60 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-1	M-N-1	27.4000 ft	26.9680 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	17.4693 cf	2.9978 cf	5.8275 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.536447 ft	7.682237 ft	14.666523 ft	27.9680 ft	

comment: Hydrograph not shifted, 0.44 min forwarded.Submerged or overtop bank condition.

Reach ID: M-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
8" Diam	Plastic	0.0090	Mannings Formula	

Length	Slope	Entrance Loss		
386.0000 ft	0.13 %	Groove End Projecting		
Diam				
0.6667 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-2	M-S-1	27.9400 ft	27.4382 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	17.4693 cf	0.6381 cf	27.3759 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
2.327455 ft	11.637275 ft	375.968719 ft	28.1049 ft	
comment:	Hydrograph not shifted, 0.23 min forwarded.Submerged or overtop bank condition.			

Reach ID: M-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
115.0000 ft	0.22 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-2	M-N-3	15.4500 ft	15.2004 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	9.3802 cf	10.3775 cf	2.3938 ft/s	1.8610 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.044489 ft	0.088977 ft	0.203834 ft	17.0614 ft	

Reach ID: M-R-4

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
98.0000 ft	2.07 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-4	M-N-5	20.6000 ft	18.5711 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	25.2579 cf	32.0539 cf	7.2347 ft/s	1.6729 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.406378 ft	0.812755 ft	1.259432 ft	20.4110 ft	

Reach ID: M-R-5

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
253.0000 ft	0.35 %	Groove End Projecting		
Diam				

2.5000 ft

Up Node	Dn Node	Up Invert	Dn Invert	
M-N-6	M-S-3	24.5100 ft	23.6245 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	17.9696 cf	26.3590 cf	5.7771 ft/s	1.5144 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.041618 ft	0.208089 ft	0.411425 ft	28.3821 ft	

Reach ID: M-R-6

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
122.0000 ft	0.50 %	Groove End Projecting		

Diam
2.5000 ft

Up Node	Dn Node	Up Invert	Dn Invert	
M-S-3	M-N-1	23.7600 ft	23.1500 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	17.9696 cf	31.5050 cf	6.6285 ft/s	1.3528 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.041618 ft	0.208089 ft	0.198395 ft	27.9000 ft	

Reach ID: P-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1572.0000 ft	0.51 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
P-N-1	P-S-1	22.0000 ft	14.0001 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	15.5107 cf	15.5107 cf	1.5785 ft/s	1.3776 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	15.3777 ft	

Reach ID: P-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
259.0000 ft	0.14 %	Groove End Projecting		

Diam
1.0000 ft

Up Node	Dn Node	Up Invert	Dn Invert	
P-S-1	P-S-2	12.1300 ft	11.7599 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	15.5107 cf	1.3504 cf	11.4857 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.211234 ft	6.056168 ft	48.812252 ft	22.0800 ft	
comment:	Hydrograph shifted 10.00 min, 6.97 min forwarded.Submerged or overtop bank cond			

Reach ID: P-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
61.0000 ft	2.63 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
P-S-2	Nooksack River 2		11.6800 ft	10.0739 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	15.5107 cf	5.7968 cf	2.6758 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.211234 ft	6.056168 ft	11.496322 ft	11.0739 ft	
comment:	Hydrograph shifted 10.00 min, 7.35 min forwarded.Submerged or overtop bank cond			

Reach ID: TMC-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
724.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-3	TMC-N-1	15.2000 ft	14.6699 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	9.3802 cf	9.3802 cf	0.6756 ft/s	1.7086 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	16.3785 ft	

Reach ID: TMC-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1021.0000 ft	0.38 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-5	TMC-N-1	18.5700 ft	14.6701 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	25.2579 cf	25.2579 cf	1.6098 ft/s	1.8410 ft

Ent Loss	Exit Loss	Frict Loss	Start TW
0.000000 ft	0.000000 ft	0.000000 ft	16.5111 ft

Reach ID: TMC-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1617.0000 ft	0.17 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-1	TMC-N-2	14.6700 ft	12.0003 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	63.2083 cf	63.2083 cf	1.2500 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.5169 ft	

comment: Hydrograph shifted 40.00 min, 0.22 min forwarded.Submerged or overtop bank cond

Reach ID: TMC-D-4

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1428.0000 ft	0.02 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-2	Nooksack River 3		12.0000 ft	11.7000 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	63.2083 cf	63.2083 cf	3.5040 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.2166 ft	

comment: Hydrograph shifted 40.00 min, 7.01 min forwarded.Submerged or overtop bank cond

Reach ID: W-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
268.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-2	W-N-1	15.2600 ft	15.0724 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	39.4398 cf	39.4398 cf	2.9901 ft/s	1.6556 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	17.6700 ft	

Reach ID: W-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1365.0000 ft	0.23 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-4	W-N-3	19.9300 ft	16.8314 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	39.4398 cf	39.4398 cf	1.4856 ft/s	2.5165 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	19.4200 ft	

Reach ID: W-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
913.0000 ft	0.73 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-1	W-N-4	26.5500 ft	19.8851 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
96.1500 ac	34.0351 cf	34.0351 cf	2.2109 ft/s	1.8198 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	22.5300 ft	

Reach ID: W-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
165.0000 ft	2.90 %	Groove End Projecting		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-1	Nooksack River 1		15.0700 ft	10.2850 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	39.4398 cf	70.0377 cf	14.6904 ft/s	1.3422 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.670209 ft	3.351043 ft	1.516950 ft	12.4015 ft	

Reach ID: W-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
48" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
331.0000 ft	0.33 %	Headwall		
Diam				
4.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-S-1	W-N-2	16.3500 ft	15.2610 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	39.4398 cf	44.7489 cf	4.0188 ft/s	2.9157 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.125395 ft	0.250790 ft	0.845690 ft	18.1767 ft	

Reach ID: W-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
48" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
238.0000 ft	0.30 %	Headwall		
Diam				
4.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-3	W-S-1	16.8200 ft	16.1060 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	39.4398 cf	42.7312 cf	3.8595 ft/s	3.0317 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.115648 ft	0.231295 ft	0.608079 ft	19.4520 ft	

Reach ID: W-R-8

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
251.0000 ft	1.59 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
L-S-1	W-N-10	29.2600 ft	25.2691 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	17.9696 cf	28.0908 cf	6.0703 ft/s	1.4532 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.286092 ft	0.572185 ft	1.632691 ft	26.8600 ft	

Node Records

Node ID: L-S-1

Desc:	Manhole structure		
Start El:	29.2600 ft	Max El:	31.6100 ft
Contrib Basin:	Riverside-SW of I-5-Ex	Contrib Hyd:	
Hgl Elev:	31.5715 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.0000 ft		

Node ID: M-N-1

Desc:	Manhole structure		
Start El:	26.5500 ft	Max El:	27.8000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	27.9000 ft		

Node ID: M-N-2

Desc:	Manhole structure		
Start El:	15.4500 ft	Max El:	17.4500 ft
Contrib Basin:	TMDC-SW-Ex	Contrib Hyd:	
Hgl Elev:	17.4444 ft		

Node ID: M-N-3

Desc:	Manhole structure		
Start El:	15.2000 ft	Max El:	17.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	16.9086 ft		

Node ID: M-N-4

Desc:	Manhole structure		
Start El:	20.6000 ft	Max El:	23.1000 ft
Contrib Basin:	TMDC-SE-Ex	Contrib Hyd:	
Hgl Elev:	23.2000 ft		

Node ID: M-N-5

Desc:	Manhole structure		
Start El:	18.5700 ft	Max El:	21.0700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	20.4110 ft		

Node ID: M-N-6

Desc:	Manhole structure		
Start El:	24.5100 ft	Max El:	27.0100 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	27.1100 ft		

Node ID: M-S-1

Desc:	Manhole structure		
Start El:	27.4000 ft	Max El:	30.7200 ft

Contrib Basin: Contrib Hyd:
Hgl Elev: 13.8498 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 38.8913 ft

Node ID: M-S-2

Desc: Manhole structure
Start El: 27.9400 ft Max El: 29.7400 ft
Contrib Basin: Riverside-NW of I-5-Ex Contrib Hyd:
Hgl Elev: 29.8400 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 0.0000 ft

Node ID: M-S-3

Desc: Manhole structure
Start El: 23.6200 ft Max El: 29.7400 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 28.3821 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 0.2081 ft

Node ID: Nooksack River 1

Desc: Manhole structure
Start El: 4.1300 ft Max El: 7.6100 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 12.4015 ft

Node ID: Nooksack River 2

Desc: Manhole structure
Start El: 10.0800 ft Max El: 108.0000 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 11.0739 ft

Node ID: Nooksack River 3

Desc: Manhole structure
Start El: 11.7000 ft Max El: 108.0000 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 13.2166 ft

Node ID: P-N-1

Desc: Manhole structure
Start El: 22.0000 ft Max El: 108.0000 ft
Contrib Basin: Riverside-E-Ex Contrib Hyd:
Hgl Elev: 23.3776 ft

Node ID: P-S-1

Desc:	Manhole structure		
Start El:	12.1300 ft	Max El:	13.5500 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	13.6500 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	0.0000 ft		

Node ID: P-S-2

Desc:	Manhole structure		
Start El:	11.6800 ft	Max El:	21.9800 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	22.0800 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	6.0562 ft		

Node ID: TMC-N-1

Desc:	Manhole structure		
Start El:	14.6700 ft	Max El:	108.0000 ft
Contrib Basin:	TMDC-N-Ex	Contrib Hyd:	
Hgl Elev:	13.6700 ft		

Node ID: TMC-N-2

Desc:	Manhole structure		
Start El:	12.0000 ft	Max El:	108.0000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	11.0000 ft		

Node ID: W-N-1

Desc:	Manhole structure		
Start El:	15.0700 ft	Max El:	17.5700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6700 ft		

Node ID: W-N-10

Desc:	Manhole structure		
Start El:	25.2600 ft	Max El:	26.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	26.8600 ft		

Node ID: W-N-2

Desc:	Manhole structure		
Start El:	15.2600 ft	Max El:	17.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6911 ft		

Node ID: W-N-3

Desc:	Manhole structure		
Start El:	16.8200 ft	Max El:	19.3200 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	19.4200 ft		

Node ID: W-N-4

Desc:	Manhole structure		
Start El:	19.9300 ft	Max El:	22.4300 ft
Contrib Basin:	Riverside-I-5-Ex	Contrib Hyd:	
Hgl Elev:	22.5300 ft		

Node ID: W-S-1

Desc:	Manhole structure		
Start El:	16.3500 ft	Max El:	31.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	19.4520 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.2313 ft		

Contributing Drainage Areas

Drainage Area: Riverside-E-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	36.4700 ac	93.15	1.10 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	36.4700 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	7.0100 ac
Pervious	92.00	29.4600 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	0.67%	0.1500	47.43 min
Shallow	Lawn	994.00 ft	0.30%	11.0000	18.75 min

Drainage Area: Riverside-I-5-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	14.8000 ac	95.47	1.78 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	14.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	8.5600 ac
Pervious	92.00	6.2400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Pasture	300.00 ft	0.33%	0.1500	62.96 min
Channel	Ditch	1846.00 ft	0.22%	17.0000	38.59 min
Channel	Pipe	87.00 ft	0.25%	21.0000	1.38 min
Channel	Ditch	167.00 ft	1.20%	17.0000	1.49 min
Channel	Pipe	346.00 ft	1.44%	21.0000	2.29 min

Drainage Area: Riverside-NW of I-5-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	34.2000 ac	93.53	0.74 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	34.2000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	8.7200 ac
Pervious	92.00	25.4800 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	1.33%	0.1500	36.05 min
Shallow	Lawn	260.00 ft	1.00%	11.0000	3.94 min
Channel	Ditch	210.00 ft	0.25%	17.0000	4.12 min

Channel	Pipe		58.00 ft	1.00%	21.0000	0.46 min

Drainage Area: Riverside-SW of I-5-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	61.9500 ac	94.63	2.85 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	61.9500 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	27.1100 ac
Pervious	92.00	34.8400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Brush	207.00 ft	0.48%	0.8000	153.68 min
Shallow	Brush	603.00 ft	0.17%	5.0000	15.11 min
Channel	Pipe	102.00 ft	0.25%	42.0000	0.81 min
Channel	Pipe	188.00 ft	0.50%	42.0000	1.06 min
Channel	Pipe	115.00 ft	1.30%	42.0000	0.40 min

Drainage Area: TMDC-N-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	39.9800 ac	94.43	0.17 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	39.9800 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	16.1700 ac
Pervious	92.00	23.8100 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Overland Flow	300.00 ft	1.00%	0.0110	5.00 min
Shallow	Overland Flow	570.00 ft	2.80%	11.0000	5.16 min

Drainage Area: TMDC-SE-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	72.8000 ac	92.33	1.63 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	72.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	4.0500 ac
Pervious	92.00	68.7500 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T3.sheet	300.00 ft	0.67%	0.2400	69.07 min
Shallow	TD-T3.shallow	1314.10 ft	0.46%	11.0000	20.01 min

Channel	TD-T3.ch1	20.00 ft	0.40%	42.0000	0.13 min
Channel	TD-T3.ch2	500.00 ft	0.40%	21.0000	6.27 min
Channel	TD-T3.ch3	319.70 ft	0.63%	27.0000	2.49 min

Drainage Area: TMDC-SW-Ex

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	20.8400 ac	93.47	1.00 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	20.8400 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	5.1000 ac
Pervious	92.00	15.7400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T2.sheet	300.00 ft	1.00%	0.2400	58.85 min
Shallow	TD-T2.shallow	186.10 ft	5.91%	11.0000	1.16 min
Channel	TD-T2.ch1	10.00 ft	15.00%	42.0000	0.01 min

ROUTEHYD [] THRU [Proposed] USING TYPE1A AND [25 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	13.9565	28.0908	0.50	1.2453	30" Diam	5.7135	5.7226	Riverside-SW of I-5-Ex
M-D-1	61.9500	13.9565	----	1.00	0.9315	Ditch	2.5856	-----	
M-R-5	61.9500	13.9565	26.3590	0.53	1.2932	30" Diam	5.4466	5.3698	
M-R-6	61.9500	13.9565	31.5050	0.44	1.1652	30" Diam	6.2239	6.4182	
M-R-2	34.2000	13.4978	0.6381	21.15	-1.0000	8" Diam	21.1522	1.8281	Riverside-NW of I-5-Ex
M-R-1	34.2000	13.4978	2.9978	4.50	-1.0000	12" Diam	4.5026	3.8169	
W-D-3	96.1500	26.2418	----	1.00	1.6167	Ditch	2.0677	-----	
W-D-2	110.9500	30.4958	----	1.00	2.2485	Ditch	1.3917	-----	Riverside-I-5-Ex
W-R-3	110.9500	30.4958	42.7312	0.71	2.4981	48" Diam	3.6942	3.4004	
W-R-2	110.9500	30.4958	44.7489	0.68	2.4225	48" Diam	3.8308	3.5610	
W-D-1	110.9500	30.4958	----	1.00	1.4707	Ditch	2.7976	-----	
W-R-1	110.9500	30.4958	70.0377	0.44	1.1537	30" Diam	13.7747	14.2680	
M-R-3	20.8400	7.2215	10.3775	0.70	1.5352	30" Diam	2.2845	2.1141	TMDC-SW-Ex
TMC-D-1	20.8400	7.2215	----	1.00	1.5154	Ditch	0.6315	-----	
M-R-4	72.8000	19.2099	32.0539	0.60	1.3947	30" Diam	6.8234	6.5300	TMDC-SE-Ex
TMC-D-2	72.8000	19.2099	----	1.00	1.6255	Ditch	1.5003	-----	
TMC-D-3	133.6200	48.6371	----	1.00	2.9505	Ditch	1.3909	-----	TMDC-N-Ex
TMC-D-4	133.6200	48.6371	----	1.00	-1.0000	Ditch	2.6962	-----	
P-D-1	36.4700	11.8855	----	1.00	1.2150	Ditch	1.4722	-----	Riverside-E-Ex
P-R-1	36.4700	11.8855	1.3504	8.80	-1.0000	12" Diam	8.8012	1.7194	
P-R-2	36.4700	11.8855	5.7968	2.05	-1.0000	12" Diam	2.0504	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					12.1670	
W-N-1	Nooksack River 1	17.9953	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6825	--na--	--na--	--na--	17.6825	17.7600
W-S-1	W-N-2	19.1143	0.2119	0.0379	------	18.9403	31.2000
W-N-3	W-S-1	19.7878	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.2097	--na--	--na--	--na--	22.2097	22.4300
M-N-1	W-N-4	28.1667	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.1703	0.1255	0.1461	------	28.1908	29.7400
M-N-6	M-S-3	28.5896	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1218	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	31.0552	------	------	------	31.0552	31.6100
M-S-1	M-N-1	42.2274	23.2180	0.5300	------	19.5394	30.7200
M-S-2	M-S-1	260.8942	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	17.6205	--na--	--na--	--na--	17.6205	108.0000
M-N-3	TMC-N-1	17.6611	--na--	--na--	--na--	17.3000	17.2000
M-N-2	M-N-3	17.5394	--na--	--na--	--na--	17.5500	17.4500
M-N-5	TMC-N-1	20.2298	--na--	--na--	--na--	20.2298	21.0700
M-N-4	M-N-5	22.7993	--na--	--na--	--na--	22.7993	23.1000
P-S-2	Nooksack River 2	22.0916	3.5561	0.0346	------	18.5702	21.9800
P-S-1	P-S-2	51.4991	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.2150	--na--	--na--	--na--	23.2150	108.0000

ROUTEHYD [] THRU [Proposed] USING TYPE1A AND [100 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	17.9696	28.0908	0.64	1.4532	30" Diam	6.0703	5.7226	Riverside-SW of I-5-Ex
M-D-1	61.9500	17.9696	----	1.00	1.0540	Ditch	2.7666	-----	
M-R-5	61.9500	17.9696	26.3590	0.68	1.5144	30" Diam	5.7771	5.3698	
M-R-6	61.9500	17.9696	31.5050	0.57	1.3528	30" Diam	6.6285	6.4182	
M-R-2	34.2000	17.4693	0.6381	27.38	-1.0000	8" Diam	27.3759	1.8281	Riverside-NW of I-5-Ex
M-R-1	34.2000	17.4693	2.9978	5.83	-1.0000	12" Diam	5.8275	3.8169	
W-D-3	96.1500	34.0351	----	1.00	1.8198	Ditch	2.2109	-----	
W-D-2	110.9500	39.4398	----	1.00	2.5165	Ditch	1.4856	-----	Riverside-I-5-Ex
W-R-3	110.9500	39.4398	42.7312	0.92	3.0317	48" Diam	3.8595	3.4004	

W-R-2	110.9500	39.4398	44.7489	0.88	2.9157	48" Diam	4.0188	3.5610	
W-D-1	110.9500	39.4398	----	1.00	1.6556	Ditch	2.9901	-----	
W-R-1	110.9500	39.4398	70.0377	0.56	1.3422	30" Diam	14.6904	14.2680	
M-R-3	20.8400	9.3802	10.3775	0.90	1.8610	30" Diam	2.3938	2.1141	TMDC-SW-Ex
TMC-D-1	20.8400	9.3802	----	1.00	1.7086	Ditch	0.6756	-----	
M-R-4	72.8000	25.2579	32.0539	0.79	1.6729	30" Diam	7.2347	6.5300	TMDC-SE-Ex
TMC-D-2	72.8000	25.2579	----	1.00	1.8410	Ditch	1.6098	-----	
TMC-D-3	133.6200	63.2083	----	1.00	-1.0000	Ditch	1.2500	-----	TMDC-N-Ex
TMC-D-4	133.6200	63.2083	----	1.00	-1.0000	Ditch	3.5040	-----	
P-D-1	36.4700	15.5107	----	1.00	1.3776	Ditch	1.5785	-----	Riverside-E-Ex
P-R-1	36.4700	15.5107	1.3504	11.49	-1.0000	12" Diam	11.4857	1.7194	
P-R-2	36.4700	15.5107	5.7968	2.68	-1.0000	12" Diam	2.6758	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	**To Node**	**ft**	**ft**	**ft**	**ft**	**ft**	**ft**
	Nooksack River 1					12.4015	
W-N-1	Nooksack River 1	18.8051	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6911	--na--	--na--	--na--	17.6911	17.7600
W-S-1	W-N-2	19.6419	0.2313	0.0413	------	19.4520	31.2000
W-N-3	W-S-1	20.3933	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.4465	--na--	--na--	--na--	22.5300	22.4300
M-N-1	W-N-4	28.3698	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.3481	0.2081	0.2421	------	28.3821	29.7400
M-N-6	M-S-3	29.0433	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1296	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	31.5715	------	------	------	31.5715	31.6100
M-S-1	M-N-1	51.8532	38.8913	0.8878	------	13.8498	30.7200
M-S-2	M-S-1	418.0383	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	13.6700	--na--	--na--	--na--	13.6700	108.0000
M-N-3	TMC-N-1	16.9086	--na--	--na--	--na--	16.9086	17.2000
M-N-2	M-N-3	17.4444	--na--	--na--	--na--	17.4444	17.4500
M-N-5	TMC-N-1	20.4110	--na--	--na--	--na--	20.4110	21.0700
M-N-4	M-N-5	23.2645	--na--	--na--	--na--	23.2000	23.1000
P-S-2	Nooksack River 2	29.8376	6.0562	0.0589	------	22.0800	21.9800
P-S-1	P-S-2	78.1597	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.3776	--na--	--na--	--na--	23.3776	108.0000

FULL BUILD-OUT STORMSHED CONVEYANCE

Ferndale Gateway - PROPOSED CONDITIONS
Conveyance Upgrades Considered
Riechhardt & Ebe Engineering, Inc.

Project Precips

[6 mo]	1.37 in
[2 yr]	1.90 in
[10 yr]	2.80 in
[25 yr]	3.25 in
[100 yr]	4.00 in

Reach Records

Reach ID: M-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
759.0000 ft	0.10 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-10	M-N-6	25.2600 ft	24.5086 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	19.9146 cf	19.9146 cf	2.8432 ft/s	1.1077 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	27.1100 ft	

Reach ID: M-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
72.0000 ft	0.60 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-1	M-N-1	27.4000 ft	26.9680 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	19.6244 cf	2.9978 cf	6.5464 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.938917 ft	9.694585 ft	18.508390 ft	27.9680 ft	

comment: Hydrograph not shifted, 0.39 min forwarded.Submerged or overtop bank condition.

Reach ID: M-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
8" Diam	Plastic	0.0090	Mannings Formula	

Length	Slope	Entrance Loss		
386.0000 ft	0.13 %	Groove End Projecting		
Diam				
0.6667 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-S-2	M-S-1	27.9400 ft	27.4382 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
34.2000 ac	19.6244 cf	0.6381 cf	30.7531 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
2.937128 ft	14.685637 ft	474.453003 ft	28.1049 ft	
comment:	Hydrograph not shifted, 0.21 min forwarded.Submerged or overtop bank condition.			

Reach ID: M-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
36" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
115.0000 ft	0.22 %	Headwall		
Diam				
3.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-2	M-N-3	15.4500 ft	15.2004 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	10.6539 cf	16.8750 cf	2.5248 ft/s	1.7294 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.049494 ft	0.098987 ft	0.099443 ft	17.0102 ft	

Reach ID: M-R-4

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
98.0000 ft	2.07 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-4	M-N-5	20.6000 ft	18.5711 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	30.1953 cf	32.0539 cf	7.4259 ft/s	1.9300 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.428131 ft	0.856262 ft	1.799940 ft	20.5646 ft	

Reach ID: M-R-5

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
253.0000 ft	0.35 %	Groove End Projecting		
Diam				

2.5000 ft

Up Node	Dn Node	Up Invert	Dn Invert	
M-N-6	M-S-3	24.5100 ft	23.6245 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	19.9146 cf	26.3590 cf	5.9017 ft/s	1.6237 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.051115 ft	0.255575 ft	0.505312 ft	28.4922 ft	

Reach ID: M-R-6

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Smooth CDEP	0.0120	Mannings Formula	
Length	Slope	Entrance Loss		
122.0000 ft	0.50 %	Groove End Projecting		

Diam
2.5000 ft

Up Node	Dn Node	Up Invert	Dn Invert	
M-S-3	M-N-1	23.7600 ft	23.1500 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	19.9146 cf	31.5050 cf	6.7897 ft/s	1.4422 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.051115 ft	0.255575 ft	0.243668 ft	27.9000 ft	

Reach ID: P-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1572.0000 ft	0.51 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
P-N-1	P-S-1	22.0000 ft	14.0001 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	17.8933 cf	17.8933 cf	1.6382 ft/s	1.4725 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	15.4726 ft	

Reach ID: P-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
259.0000 ft	0.14 %	Groove End Projecting		

Diam
1.0000 ft

Up Node	Dn Node	Up Invert	Dn Invert	
P-S-1	P-S-2	12.1300 ft	11.7599 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	17.8933 cf	1.3504 cf	13.2500 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.611932 ft	8.059660 ft	64.960236 ft	22.0800 ft	
comment:	Hydrograph shifted 10.00 min, 6.32 min forwarded.Submerged or overtop bank cond			

Reach ID: P-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
12" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
61.0000 ft	2.63 %	Groove End Projecting		
Diam				
1.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
P-S-2	Nooksack River 2		11.6800 ft	10.0739 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
36.4700 ac	17.8933 cf	5.7968 cf	3.0868 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
1.611932 ft	8.059660 ft	15.299516 ft	11.0739 ft	
comment:	Hydrograph shifted 10.00 min, 6.65 min forwarded.Submerged or overtop bank cond			

Reach ID: TMC-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
724.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-3	TMC-N-1	15.2000 ft	14.6699 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
20.8400 ac	10.6539 cf	10.6539 cf	0.6981 ft/s	1.8102 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	16.4801 ft	

Reach ID: TMC-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1021.0000 ft	0.38 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-5	TMC-N-1	18.5700 ft	14.6701 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
72.8000 ac	30.1953 cf	30.1953 cf	1.6851 ft/s	1.9946 ft

Ent Loss	Exit Loss	Frict Loss	Start TW
0.000000 ft	0.000000 ft	0.000000 ft	16.6647 ft

Reach ID: TMC-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1617.0000 ft	0.17 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-1	TMC-N-2	14.6700 ft	12.0003 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	72.3297 cf	72.3297 cf	1.4304 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.6207 ft	

comment: Hydrograph shifted 30.00 min, 6.89 min forwarded.Submerged or overtop bank cond

Reach ID: TMC-D-4

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1428.0000 ft	0.02 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
TMC-N-2	Nooksack River 3		12.0000 ft	11.7000 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
133.6200 ac	72.3297 cf	72.3297 cf	4.0097 ft/s	-1.0000 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	13.3204 ft	

comment: Hydrograph shifted 40.00 min, 2.82 min forwarded.Submerged or overtop bank cond

Reach ID: W-D-1

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
268.0000 ft	0.07 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-2	W-N-1	15.2600 ft	15.0724 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	44.2187 cf	44.2187 cf	3.0795 ft/s	1.7442 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	17.6700 ft	

Reach ID: W-D-2

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
1365.0000 ft	0.23 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-4	W-N-3	19.9300 ft	16.8314 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	44.2187 cf	44.2187 cf	1.5293 ft/s	2.6445 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	19.4759 ft	

Reach ID: W-D-3

Section Properties:

Shape:	Ditch		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
	Conc-Spun	0.0600	Mannings Formula	
Length	Slope	Entrance Loss		
913.0000 ft	0.73 %			
Width	Bank Hgt	ss1	ss2	
3.0000 ft	3.0000 ft	3.00h:1v	3.00h:1v	
Up Node	Dn Node	Up Invert	Dn Invert	
M-N-1	W-N-4	26.5500 ft	19.8851 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
96.1500 ac	38.4087 cf	38.4087 cf	2.2805 ft/s	1.9216 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.000000 ft	0.000000 ft	0.000000 ft	22.5300 ft	

Reach ID: W-R-1

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Conc-Spun	0.0130	Mannings Formula	
Length	Slope	Entrance Loss		
165.0000 ft	2.90 %	Groove End Projecting		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-1	Nooksack River 1		15.0700 ft	10.2850 ft

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	44.2187 cf	70.0377 cf	15.0898 ft/s	1.4411 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.707153 ft	3.535764 ft	1.906843 ft	12.4968 ft	

Reach ID: W-R-2

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
48" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
331.0000 ft	0.33 %	Headwall		
Diam				
4.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-S-1	W-N-2	16.3500 ft	15.2610 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	44.2187 cf	44.7489 cf	4.0596 ft/s	3.2363 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.127951 ft	0.255902 ft	1.063053 ft	18.4973 ft	

Reach ID: W-R-3

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
48" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
238.0000 ft	0.30 %	Headwall		
Diam				
4.0000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
W-N-3	W-S-1	16.8200 ft	16.1060 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
110.9500 ac	44.2187 cf	42.7312 cf	3.8652 ft/s	3.4197 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.096134 ft	0.192268 ft	0.764370 ft	20.1060 ft	

Reach ID: W-R-8

Section Properties:

Shape:	Circular		Routing Method:	Travel Time Translation
Size	Material	Mannings n	Hyd params By	
30" Diam	Corr Metal - normal		0.0240 Mannings Formula	
Length	Slope	Entrance Loss		
251.0000 ft	1.59 %	Headwall		
Diam				
2.5000 ft				
Up Node	Dn Node	Up Invert	Dn Invert	
L-S-1	W-N-10	29.2600 ft	25.2691 ft	

Conduit Summary:

Trib Area	Flow	Capacity	Velocity	Normal Depth
61.9500 ac	19.9146 cf	28.0908 cf	6.2084 ft/s	1.5544 ft
Ent Loss	Exit Loss	Frict Loss	Start TW	
0.299254 ft	0.598507 ft	2.005270 ft	26.8600 ft	

Node Records

Node ID: L-S-1

Desc:	Manhole structure		
Start El:	29.2600 ft	Max El:	31.6100 ft
Contrib Basin:	Riverside-SW of I-5-Prop	Contrib Hyd:	
Hgl Elev:	31.7100 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.0000 ft		

Node ID: M-N-1

Desc:	Manhole structure		
Start El:	26.5500 ft	Max El:	27.8000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	27.9000 ft		

Node ID: M-N-2

Desc:	Manhole structure		
Start El:	15.4500 ft	Max El:	17.4500 ft
Contrib Basin:	TMDC-SW-Prop	Contrib Hyd:	
Hgl Elev:	17.3777 ft		

Node ID: M-N-3

Desc:	Manhole structure		
Start El:	15.2000 ft	Max El:	17.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.0102 ft		

Node ID: M-N-4

Desc:	Manhole structure		
Start El:	20.6000 ft	Max El:	23.1000 ft
Contrib Basin:	TMDC-SE-Prop	Contrib Hyd:	
Hgl Elev:	23.2000 ft		

Node ID: M-N-5

Desc:	Manhole structure		
Start El:	18.5700 ft	Max El:	21.0700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	20.5646 ft		

Node ID: M-N-6

Desc:	Manhole structure		
Start El:	24.5100 ft	Max El:	27.0100 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	27.1100 ft		

Node ID: M-S-1

Desc:	Manhole structure		
Start El:	27.4000 ft	Max El:	30.7200 ft

Contrib Basin: Contrib Hyd:
Hgl Elev: 10.2065 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 49.0787 ft

Node ID: M-S-2

Desc: Manhole structure
Start El: 27.9400 ft Max El: 29.7400 ft
Contrib Basin: Riverside-NW of I-5-Prop Contrib Hyd:
Hgl Elev: 29.8400 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 0.0000 ft

Node ID: M-S-3

Desc: Manhole structure
Start El: 23.6200 ft Max El: 29.7400 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 28.4922 ft
Struct Type: CB-TYPE 1 Classification Catch Basin
Ke Descrip: CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5
Catch Depth: 1.4160 ft Bot Area: 3.9700 sf
Condition: No particular shape. Status: Existing Structure
Approach Credit: 0.2556 ft

Node ID: Nooksack River 1

Desc: Manhole structure
Start El: 4.1300 ft Max El: 7.6100 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 12.4968 ft

Node ID: Nooksack River 2

Desc: Manhole structure
Start El: 10.0800 ft Max El: 108.0000 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 11.0739 ft

Node ID: Nooksack River 3

Desc: Manhole structure
Start El: 11.7000 ft Max El: 108.0000 ft
Contrib Basin: Contrib Hyd:
Hgl Elev: 13.3204 ft

Node ID: P-N-1

Desc: Manhole structure
Start El: 22.0000 ft Max El: 108.0000 ft
Contrib Basin: Riverside-E-Prop Contrib Hyd:
Hgl Elev: 23.4725 ft

Node ID: P-S-1

Desc:	Manhole structure		
Start El:	12.1300 ft	Max El:	13.5500 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	13.6500 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	0.0000 ft		

Node ID: P-S-2

Desc:	Manhole structure		
Start El:	11.6800 ft	Max El:	21.9800 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	22.0800 ft		
Struct Type:		Classification	
Ke Descrip:			
Catch Depth:	0.0000 ft	Bot Area:	0.0000 sf
Condition:	No particular shape.	Status:	Proposed Structure
Approach Credit:	8.0597 ft		

Node ID: TMC-N-1

Desc:	Manhole structure		
Start El:	14.6700 ft	Max El:	108.0000 ft
Contrib Basin:	TMDC-N-Prop	Contrib Hyd:	
Hgl Elev:	13.6700 ft		

Node ID: TMC-N-2

Desc:	Manhole structure		
Start El:	12.0000 ft	Max El:	108.0000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	11.0000 ft		

Node ID: W-N-1

Desc:	Manhole structure		
Start El:	15.0700 ft	Max El:	17.5700 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6700 ft		

Node ID: W-N-10

Desc:	Manhole structure		
Start El:	25.2600 ft	Max El:	26.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	26.8600 ft		

Node ID: W-N-2

Desc:	Manhole structure		
Start El:	15.2600 ft	Max El:	17.7600 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	17.6967 ft		

Node ID: W-N-3

Desc:	Manhole structure		
Start El:	16.8200 ft	Max El:	19.3200 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	19.4200 ft		

Node ID: W-N-4

Desc:	Manhole structure		
Start El:	19.9300 ft	Max El:	22.4300 ft
Contrib Basin:	Riverside-I-5-Prop	Contrib Hyd:	
Hgl Elev:	22.5300 ft		

Node ID: W-S-1

Desc:	Manhole structure		
Start El:	16.3500 ft	Max El:	31.2000 ft
Contrib Basin:		Contrib Hyd:	
Hgl Elev:	19.7797 ft		
Struct Type:	CB-TYPE 2-48	Classification	Catch Basin
Ke Descrip:	CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5		
Catch Depth:	2.0000 ft	Bot Area:	12.5664 sf
Condition:	No particular shape.	Status:	Existing Structure
Approach Credit:	0.2320 ft		

Contributing Drainage Areas

Drainage Area: Riverside-E-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	36.4700 ac	97.70	1.10 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	36.4700 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	34.6500 ac
Pervious	92.00	1.8200 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	0.67%	0.1500	47.43 min
Shallow	Lawn	994.00 ft	0.30%	11.0000	18.75 min

Drainage Area: Riverside-I-5-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	14.8000 ac	97.70	1.78 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	14.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	14.0600 ac
Pervious	92.00	0.7400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Pasture	300.00 ft	0.33%	0.1500	62.96 min
Channel	Ditch	1846.00 ft	0.22%	17.0000	38.59 min
Channel	Pipe	87.00 ft	0.25%	21.0000	1.38 min
Channel	Ditch	167.00 ft	1.20%	17.0000	1.49 min
Channel	Pipe	346.00 ft	1.44%	21.0000	2.29 min

Drainage Area: Riverside-NW of I-5-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	34.2000 ac	97.70	0.74 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	34.2000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	32.4900 ac
Pervious	92.00	1.7100 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Lawn	300.00 ft	1.33%	0.1500	36.05 min
Shallow	Lawn	260.00 ft	1.00%	11.0000	3.94 min
Channel	Ditch	210.00 ft	0.25%	17.0000	4.12 min

Channel	Pipe		58.00 ft	1.00%	21.0000	0.46 min

Drainage Area: Riverside-SW of I-5-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	61.9500 ac	97.70	2.85 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	61.9500 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	58.8500 ac
Pervious	92.00	3.1000 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Brush	207.00 ft	0.48%	0.8000	153.68 min
Shallow	Brush	603.00 ft	0.17%	5.0000	15.11 min
Channel	Pipe	102.00 ft	0.25%	42.0000	0.81 min
Channel	Pipe	188.00 ft	0.50%	42.0000	1.06 min
Channel	Pipe	115.00 ft	1.30%	42.0000	0.40 min

Drainage Area: TMDC-N-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	39.9800 ac	97.70	0.17 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	39.9800 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	37.9800 ac
Pervious	92.00	2.0000 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Overland Flow	300.00 ft	1.00%	0.0110	5.00 min
Shallow	Overland Flow	570.00 ft	2.80%	11.0000	5.16 min

Drainage Area: TMDC-SE-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	72.8000 ac	97.70	1.63 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	72.8000 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	69.1600 ac
Pervious	92.00	3.6400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T3.sheet	300.00 ft	0.67%	0.2400	69.07 min
Shallow	TD-T3.shallow	1314.10 ft	0.46%	11.0000	20.01 min

Channel	TD-T3.ch1	20.00 ft	0.40%	42.0000	0.13 min
Channel	TD-T3.ch2	500.00 ft	0.40%	21.0000	6.27 min
Channel	TD-T3.ch3	319.70 ft	0.63%	27.0000	2.49 min

Drainage Area: TMDC-SW-Prop

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	20.8400 ac	97.70	1.00 hrs	
Impervious	0.0000 ac	0.00	0.00 hrs	
Total	20.8400 ac			

Supporting Data:

Pervious CN Data:

Impervious	98.00	19.8000 ac
Pervious	92.00	1.0400 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	TD-T2.sheet	300.00 ft	1.00%	0.2400	58.85 min
Shallow	TD-T2.shallow	186.10 ft	5.91%	11.0000	1.16 min
Channel	TD-T2.ch1	10.00 ft	15.00%	42.0000	0.01 min

ROUTEHYD [] THRU [Proposed] USING TYPE1A AND [25 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	15.9301	28.0908	0.57	1.3480	30" Diam	5.9020	5.7226	Riverside-SW of I-5-Prop
M-D-1	61.9500	15.9301	----	1.00	0.9940	Ditch	2.6790	-----	
M-R-5	61.9500	15.9301	26.3590	0.60	1.4020	30" Diam	5.6221	5.3698	
M-R-6	61.9500	15.9301	31.5050	0.51	1.2583	30" Diam	6.4361	6.4182	
M-R-2	34.2000	15.7794	0.6381	24.73	-1.0000	8" Diam	24.7277	1.8281	Riverside-NW of I-5-Prop
M-R-1	34.2000	15.7794	2.9978	5.26	-1.0000	12" Diam	5.2637	3.8169	
W-D-3	96.1500	30.7624	----	1.00	1.7383	Ditch	2.1542	-----	
W-D-2	110.9500	35.4146	----	1.00	2.4011	Ditch	1.4456	-----	Riverside-I-5-Prop
W-R-3	110.9500	35.4146	42.7312	0.83	2.7784	48" Diam	3.8013	3.4004	
W-R-2	110.9500	35.4146	44.7489	0.79	2.6851	48" Diam	3.9485	3.5610	
W-D-1	110.9500	35.4146	----	1.00	1.5759	Ditch	2.9081	-----	
W-R-1	110.9500	35.4146	70.0377	0.51	1.2583	30" Diam	14.3080	14.2680	
M-R-3	20.8400	8.5580	16.8750	0.51	1.5126	36" Diam	2.3958	2.3873	TMDC-SW-Prop
TMC-D-1	20.8400	8.5580	----	1.00	1.6385	Ditch	0.6598	-----	
M-R-4	72.8000	24.2286	32.0539	0.76	1.6242	30" Diam	7.1774	6.5300	TMDC-SE-Prop
TMC-D-2	72.8000	24.2286	----	1.00	1.8067	Ditch	1.5927	-----	
TMC-D-3	133.6200	58.0743	----	1.00	-1.0000	Ditch	1.1485	-----	TMDC-N-Prop
TMC-D-4	133.6200	58.0743	----	1.00	-1.0000	Ditch	3.2194	-----	
P-D-1	36.4700	14.3674	----	1.00	1.3290	Ditch	1.5472	-----	Riverside-E-Prop
P-R-1	36.4700	14.3674	1.3504	10.64	-1.0000	12" Diam	10.6390	1.7194	
P-R-2	36.4700	14.3674	5.7968	2.48	-1.0000	12" Diam	2.4785	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	To Node	ft	ft	ft	ft	ft	ft
	Nooksack River 1					12.3048	
W-N-1	Nooksack River 1	18.4088	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6870	--na--	--na--	--na--	17.6870	17.7600
W-S-1	W-N-2	19.3983	0.2244	0.0401	------	19.2140	31.2000
W-N-3	W-S-1	20.1112	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.3311	--na--	--na--	--na--	22.3311	22.4300
M-N-1	W-N-4	28.2883	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.2522	0.1635	0.1903	------	28.2789	29.7400
M-N-6	M-S-3	28.7985	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1254	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	31.4193	------	------	------	31.4193	31.6100
M-S-1	M-N-1	47.4556	31.7309	0.7599	------	16.4846	30.7200
M-S-2	M-S-1	346.2465	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	13.6700	--na--	--na--	--na--	13.6700	108.0000
M-N-3	TMC-N-1	16.8385	--na--	--na--	--na--	16.8385	17.2000
M-N-2	M-N-3	17.1694	--na--	--na--	--na--	17.1694	17.4500
M-N-5	TMC-N-1	20.3767	--na--	--na--	--na--	20.3767	21.0700
M-N-4	M-N-5	23.1849	--na--	--na--	--na--	23.2000	23.1000
P-S-2	Nooksack River 2	27.1734	5.1963	0.0506	------	22.0800	21.9800
P-S-1	P-S-2	70.1969	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.3290	--na--	--na--	--na--	23.3290	108.0000

ROUTEHYD [] THRU [Proposed] USING TYPE1A AND [100 yr] NOTZERO RELATIVE

Reach	Area	Flow	Full Q	% Full	nDepth	Size	nVel	fVel	CBasin / Hyd
-----	ac	cfs	cfs	ratio	ft	----	ft/s	ft/s	----------
W-R-8	61.9500	19.9146	28.0908	0.71	1.5544	30" Diam	6.2084	5.7226	Riverside-SW of I-5-Prop
M-D-1	61.9500	19.9146	----	1.00	1.1077	Ditch	2.8432	-----	
M-R-5	61.9500	19.9146	26.3590	0.76	1.6237	30" Diam	5.9017	5.3698	
M-R-6	61.9500	19.9146	31.5050	0.63	1.4422	30" Diam	6.7897	6.4182	
M-R-2	34.2000	19.6244	0.6381	30.75	-1.0000	8" Diam	30.7531	1.8281	Riverside-NW of I-5-Prop
M-R-1	34.2000	19.6244	2.9978	6.55	-1.0000	12" Diam	6.5464	3.8169	
W-D-3	96.1500	38.4087	----	1.00	1.9216	Ditch	2.2805	-----	
W-D-2	110.9500	44.2187	----	1.00	2.6445	Ditch	1.5293	-----	Riverside-I-5-Prop
W-R-3	110.9500	44.2187	42.7312	1.03	3.4197	48" Diam	3.8652	3.4004	

W-R-2	110.9500	44.2187	44.7489	0.99	3.2363	48" Diam	4.0596	3.5610	
W-D-1	110.9500	44.2187	----	1.00	1.7442	Ditch	3.0795	-----	
W-R-1	110.9500	44.2187	70.0377	0.63	1.4411	30" Diam	15.0898	14.2680	
M-R-3	20.8400	10.6539	16.8750	0.63	1.7294	36" Diam	2.5248	2.3873	TMDC-SW-Prop
TMC-D-1	20.8400	10.6539	----	1.00	1.8102	Ditch	0.6981	-----	
M-R-4	72.8000	30.1953	32.0539	0.94	1.9300	30" Diam	7.4259	6.5300	TMDC-SE-Prop
TMC-D-2	72.8000	30.1953	----	1.00	1.9946	Ditch	1.6851	-----	
TMC-D-3	133.6200	72.3297	----	1.00	-1.0000	Ditch	1.4304	-----	TMDC-N-Prop
TMC-D-4	133.6200	72.3297	----	1.00	-1.0000	Ditch	4.0097	-----	
P-D-1	36.4700	17.8933	----	1.00	1.4725	Ditch	1.6382	-----	Riverside-E-Prop
P-R-1	36.4700	17.8933	1.3504	13.25	-1.0000	12" Diam	13.2500	1.7194	
P-R-2	36.4700	17.8933	5.7968	3.09	-1.0000	12" Diam	3.0868	7.3807	

-----	-----	Rch	App	Bend	Junct	HW	Max El/
-----	-----	Loss	Head	Loss	Loss	Elev	Rim El
From Node	**To Node**	**ft**	**ft**	**ft**	**ft**	**ft**	**ft**
	Nooksack River 1					12.4968	
W-N-1	Nooksack River 1	19.3311	--na--	--na--	--na--	17.6700	17.5700
W-N-2	W-N-1	17.6967	--na--	--na--	--na--	17.6967	17.7600
W-S-1	W-N-2	19.9702	0.2320	0.0415	------	19.7797	31.2000
W-N-3	W-S-1	21.1588	--na--	--na--	--na--	19.4200	19.3200
W-N-4	W-N-3	22.5745	--na--	--na--	--na--	22.5300	22.4300
M-N-1	W-N-4	28.4716	--na--	--na--	--na--	27.9000	27.8000
M-S-3	M-N-1	28.4504	0.2556	0.2974	------	28.4922	29.7400
M-N-6	M-S-3	29.3042	--na--	--na--	--na--	27.1100	27.0100
W-N-10	M-N-6	27.1341	--na--	--na--	--na--	26.8600	26.7600
L-S-1	W-N-10	31.7121	------	------	------	31.7100	31.6100
M-S-1	M-N-1	58.1099	49.0787	1.1753	------	10.2065	30.7200
M-S-2	M-S-1	520.1806	------	------	------	29.8400	29.7400
TMC-N-2	Nooksack River 3	11.0000	--na--	--na--	--na--	11.0000	108.0000
TMC-N-1	TMC-N-2	13.6700	--na--	--na--	--na--	13.6700	108.0000
M-N-3	TMC-N-1	17.0102	--na--	--na--	--na--	17.0102	17.2000
M-N-2	M-N-3	17.3777	--na--	--na--	--na--	17.3777	17.4500
M-N-5	TMC-N-1	20.5646	--na--	--na--	--na--	20.5646	21.0700
M-N-4	M-N-5	23.8143	--na--	--na--	--na--	23.2000	23.1000
P-S-2	Nooksack River 2	36.0450	8.0597	0.0785	------	22.0800	21.9800
P-S-1	P-S-2	96.7118	------	------	------	13.6500	13.5500
P-N-1	P-S-1	23.4725	--na--	--na--	--na--	23.4725	108.0000

ENVIRONMENTAL RECONNAISSANCE

Widener & Associates Transportation & Environmental Planning

10108 32nd Ave W, Suite D, Everett, WA 98204 Tel (425) 348-3059 Fax (425) 348-3124

TO: Dale Buys, Reichhardt & Ebe Engineering

FROM: Ross Widener & Associates

SUBJECT: City of Ferndale, Gateway Project – Environmental Reconnaissance [Stormwater Outfall Conveyance and Flow Control (SWMMWW Volume I, 2.5.7 Minimum Requirement #7)]

DATE: December 27, 2012

The purpose of this document is to discuss the outcome from the review of background information related to cultural resources, critical areas, and fish and wildlife habitat, in concurrence with a field survey for the proposed City of Ferndale, Gateway Project (Commercial Business Park). The project area is the Interstate (I) -5 bridge crossing over the Nooksack River within the City of Ferndale, Whatcom County, Washington within portions of Sections 20, 21, 28 and 29 of Township 39N, Range 2E. Refer to attached Figure Main Street Master Plan - Planned Action Area. The black line demarcates the City of Ferndale boundaries.

The following database information has been reviewed:

1. Washington Information System for Architectural and Archeological Records Data (WISSARD) accessed on December 21, 2012.
2. Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species Map accessed on December 21, 2012.
3. Washington State Department of Natural Resources, Washington Natural Heritage Program database accessed December 21, 2012.
4. National Wetlands Inventory (NWI) Maps accessed on December 21, 2012.
5. Washington State Department of Ecology water Resource Inventory Area (WRIA) Maps accessed December 21, 2012
6. Streamnet Mapper accessed August 29, 2012.
7. Whatcom County Shoreline Master Program Update, Background Information – Volume I, Shoreline Inventory and Characterization Report (PARTS I - IV) & Map Folio
8. Whatcom County Shoreline Master Program maps and data accessed December 21, 2012
9. TITLE 23, Shoreline Management Program, Adopted by Whatcom County May 27, 1976. This revised Program was adopted February 27, 2007 to comply with the Shoreline Master Program Guidelines, Washington Administrative Code (WAC) 173-26. And was approved by the Department of Ecology August, 8, 2008.
10. Whatcom County Planning and Development Services GIS map data accessed December 21, 2012.
11. City of Ferndale zoning Maps dated January 31, 2011.
12. Washington State Department of Ecology 303(d) Water quality Assessment Database accessed on December 21, 2012.
13. Washington State Department of Ecology Facility Site Atlas Database accessed on December 21, 2012.
14. FEMA FIRM maps for Whatcom County.

Historical Properties

The Department of Archeology and Historic Preservation database includes no properties listed on the National Register of Historic Places within the project area. Mueler Hause located at 1628 Main Street is within the Historic Property Inventory; however, its eligibility for the register has not been determined. No sites of cultural significance are known in the Action Area; however, a cultural resources survey would be necessary prior to project construction.

Zoning

Areas within the Riverside Basin outside of the City of Ferndale Limits are zoned as Agriculture. The study area is within the City of Ferndale and areas west of the I-5 corridor are zoned as Floodway and small area of General Business. East of the I-5 corridor zoning is Mixed Use Commercial and Gateway Development. Refer to the Planned Action Area Map.

Watersheds

The Planned Action Area is within the Lower Nooksack River Basin, Water Resources Inventory Area (WRIA) #1 Nooksack River. Ten Mile Creek is a 303(d) listed water body for the dissolved oxygen criteria. The Nooksack River and Silver Creek are not listed as a 303(d) water body within the Planned Action Area. The Nooksack River is listed for dissolved oxygen in the reach downstream. There are no superfund sites or contaminated sediments within the area[12].

Streams

According to Whatcom County GIS maps, both the Nooksack River and Ten Mile Creek are mapped Fish and Wildlife Conservation Areas requiring a 150 foot buffer protection zone from the ordinary high water mark[10].

Wetlands

The National Wetlands Inventory was referenced for information on known wetlands in the project area[4]. Several small isolated freshwater ponds/emergent wetland areas were mapped both east and west of the I-5 corridor. These areas are currently farmed or mowed. An approximate 7.63 acre palustrine, emergent, diked and permanently flooded wetland system was mapped within Ten Mile Creek just northeast of the Super 8 Bellingham Airport complex. A wetland mitigation site exists along Barrett Road approximately 500 feet north of the Super 8 Bellingham Airport complex.

The Nooksack River is mapped as a riverine, lower perennial, unconsolidated bottom permanently flooded wetland within the Planned Action Area.

Aquifer Recharge Areas

Whatcom County maps several wellhead protection zones just northeast of the Action Area[10].

Floodplains and Floodways

Frequently flooded areas are areas located along major rivers, streams, and coastal areas where the depth, velocity, intensity and frequency of flood water during major events presents a risk to human life and property. According to the City of Ferndale GIS maps, the Planned Action Area is partially within the 100-year floodplain[10].

Regulation of frequently flooded areas as required by Chapter 36.70A RCW and Chapter 365-190 WAC is provided through the floodplain management ordinance of the City of Ferndale, Chapter 15.24 Ferndale Municipal Code.

According to FEMA FIRM maps, the Planned Action Area is mapped as Zone AE - Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.

Hazardous and Problem Waste

The Ecology GIS database was accessed on December 21, 2012[13]. From that search, it was determined that two Leaking Underground Storage Tank (LUST) facility sites were still active. Both clean-up activities began in 1995 for the Shell Station at 1846 Main Street; and Starvin Sams at 43310 Slater Road. There were seven non-active cleanup sites, including one state clean up, one voluntary, one veterinary, two tire distributors, one lube and oil shop and a trucking company.

There are four active hazardous waste generators including the AT&T wireless location at 1678 Main Street Suite 5; Jem Auto Sales and Service at 5640 Barrett Ave; Oceanus Plastics Inc. at 2445 Salaslan Loop Road Bldg #3; and a propane storage facility at 5387 Labounty Drive. It is recommended that a hazardous facility site search be conducted prior to any development activity.

Shorelines

The Nooksack River is a Whatcom County Shoreline of Statewide Significance and includes that area plus 200 feet landward of the floodway within the geomorphic floodplain; (Upland areas within 200 feet of the geomorphic floodway, but outside of the floodplain are not included.)

According to Tile 23 of the Whatcom County Code and the Shoreline Master Program Maps, the Nooksack River and Ten Mile Creek are both designated as "Resource Shorelines" within the Planned Action Area. The Resource Shoreline area is applied to shoreline areas designated as Agriculture, Rural Forestry, Commercial Forestry and Mineral Resource Lands in the Whatcom County Comprehensive Plan and includes areas where the shoreline currently accommodates ongoing resource management, where natural vegetation cover has been altered but substantial ecological functions or the potential for restoring ecological functions are present [8, 9].

Priority Habitat and Species

Table 1: Species and Critical Habitats listed as being potentially present in Whatcom County/Nooksack River

Common Name	**Scientific Name**	**Federal Status**
Gray Wolf	*Canis lupis*	Endangered
Bull Trout (Coastal/Puget Sound DPS)	*Salvelinus confluentus*	Threatened
Canada Lynx	*Lynx canadensis*	Threatened
Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened
Chinook Salmon Critical Habitat		
Grizzly Bear	*Ursus arctos*	Threatened
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened
Marbled Murrelet Critical Habitat		
Northern Spotted Owl	*Strix occidentalis caurina*	Threatened
Northern Spotted Owl Critical Habitat		Designated
Steelhead (Puget Sound ESU)	*Oncorhynchus mykiss*	Threatened

There is no suitable habitat or documented occurrences of gray wolves, grizzly bears, marbled murrelets, Canada lynx, or northern spotted owls within the Planned Action Area or within one mile of the project area; therefore, it can be assumed that any proposed improvement or development plans will not affect these species. The Washington State Natural Heritage Program Information System was also reviewed for sensitive plant species within the area. There were no records of any such plants occurring either within the Planned Action Area or within one mile of the project area[2]. However, prior to any development plans a current research of existing documentation and occurrences is recommended.

According to Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS) maps, priority fish presence has been mapped within the Nooksack River and Ten Mile Creek[2]. The Nooksack River has been mapped for occurrence, migration and breeding habitat of Steelhead Trout (*Onchorhyncus mykiss*). Both the Nooksack River and Ten Mile Creek have been mapped for occurrence of Bull Trout (Coastal/Puget Sound DPS). Steelhead are listed with NOAA Fisheries as a threatened species. Bull Trout is listed with the United States Department of Fish and Wildlife Service (USFWS) as a threatened species.

The Nooksack River is designated as Critical Habitat for Bull Trout and Chinook salmon.

<u>Potential Ecological Functions Provided by Nooksack River and Ten Mile Creek</u>

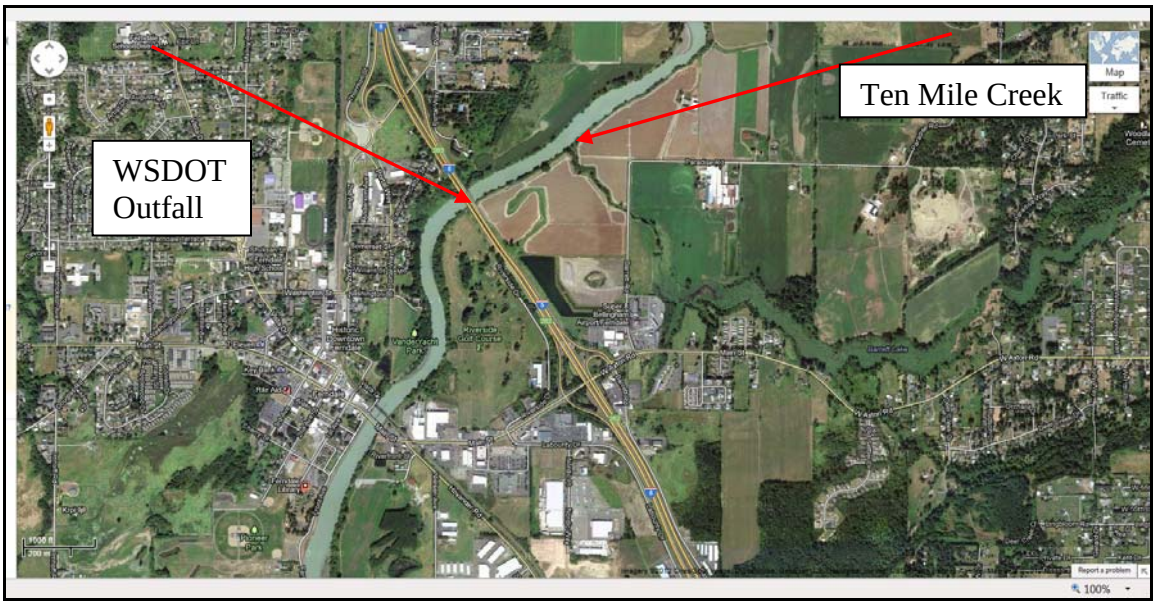
- Flood attenuation;
- Tidal exchange/organic matter exchange;
- Stream base-flow and groundwater support;
- Water quality improvement (nutrient/toxin/pathogen cycling and retention provides water quality benefits;
- Shoreline stabilization, sediment retention, reduction in erosion shoreline protection;
- Biological support and wildlife habitat including:
    (a) Food web support
    (b) Habitat structure
    (c) Habitat connectivity
    (d) Salinity gradients
    (e) Refugia – from predators (i.e., turbid waters of tidal channels and salmon)
- Organic matter to nearshore and habitats – detritus, terrestrial insects;
- Terrestrial insects from riparian vegetation are important prey for juvenile salmon in nearshore habitats;
- Shade (moisture retention, temperature amelioration);
- Wildlife habitat – physical habitat structure/refugia; foraging; reproductive habitat for terrestrial wildlife; nesting, roosting, and perch trees for raptors, herons, kingfishers, and a variety of marine migratory and resident waterfowl;
- LWD from riparian zone/buffers and upland areas can provide habitat structure (refuge from predators, attachment sites) and source of organic material for detrital food webs in adjacent intertidal waters[7].

<u>Site Investigation</u>

A preliminary site visit was conducted on June 6, 2012 with a more detailed investigation conducted on August 31, 2012 when the following photos were taken. On both days, the weather was clear, sunny, and approximately 68 degrees. On August 31, it had not rained in over a month.

An approximate 0.40 mile length (2,150-feet) area along the Nooksack River dike/levy and nearshore was investigated both to the east and west of the existing I-5 bridge crossing. Total area investigated was approximately 0.80 miles.

Areas were traversed over land, and along the nearshore of the Nooksack River. Low Tide on August 31, 2012 was at 11:38 AM. Our investigation occurred from 10:00AM until 2:00PM. Two potential outfalls were located during the discovery, one is the WSDOT outfall, the other is Ten Mile Creek. As the following details are presented please refer to the inserted photos and the attached Figure 1 Photo Point Locations.



Aerial photograph depicting the view of the proposed project area. Red arrows point to Ten Mile Creek and the WSDOT Outfall as they relate to the Nooksack River.

WSDOT Outfall

The WSDOT outfall is located under I-5 in between the north and south bound lanes. Discharge from this outfall includes highway road runoff from I-5.

The WSDOT outfall would be exempt from flow control as it meets the criteria included in the Stormwater Management Manual included in section 2.5.7 Minimum Requirement #7: Flow Control (Applicability). The Nooksack River is a Flow Control-Exempt Receiving Water in this location. As required in section 2.5.7, the conveyance system is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection, etc.) and extends to the ordinary high water line of the Nooksack River. The natural course for runoff in these areas is to the Nooksack River, so no flow from Ten Mile Creek or wetlands will be diverted by the use of this outfall.

Discharge from this outfall to the Nooksack River would also only require basic treatment. Sites that discharge directly (or, indirectly through a municipal storm sewer system) to Basic Treatment Receiving Waters, such as the Nooksack River in this area, are not subject to enhanced treatment requirements.

Photo Point 1. WSDOT outfall under I-5. Located in between the north and south bound lanes, the red arrow points to the outfall location. This is a tide gate that functions (opens and closes in response to high water flows behind the tide gate).

Photo Point 1. Same WSDOT outfall as above, it shows an approximate 8-inch depth of sediment in front of the tide gate.

Photo Point 2. Facing southeast

Photo Point 3. Facing northwest

Photo Point 3. Facing northwest

Upland Areas (East of I-5)

The levy was traversed on both sides of I-5 (west and east). The following photos show the vegetation communities surrounding the area, located to the east of the I-5 Bridge crossing along the levy and uplands.

The uplands along the Nooksack River consist mostly of farmlands and grass fields with a vegetative buffer of no more than 50-feet wide. The vegetative buffer consists predominantly of non-native shrubs and trees (Black Locust and Himalayan blackberry), and a small portion of native vegetation including common snowberry, big leaf maple, red alder and wild rose.

Photo Point 4. Facing east shows vegetative buffer and adjacent uplands (farm land).

Ten Mile Creek

During the investigation, Ten Mile Creek was photographed and evaluated for potential utilization as an outfall conveyance for this project. The creek contains a high percentage of fine-sediment, and lacks coarse grained-sediment within the stream channel.

Photo Point 5. Facing SE, Ten Mile Creek outfall location.

Photo Point 5. Facing NW shows Ten Mile Creek connection to Nooksack River.

Photo Point 5. Facing N shows Ten Mile Creek connection to Nooksack River.

Photo Point 5. Taken from Ten Mile Creek. Red arrow shows location of "outfall investigators" near I-5 Bridge over Nooksack River.

Photo Point 5. Taken from Ten Mile Creek. Shows nearshore conditions along the south side of the Nooksack River.

Photo Point 6. Facing northwest towards Ten Mile Creek riparian corridor.

Photo Point 6. Facing east towards tidally influenced areas of Ten Mile Creek.

Photo Point 7. Facing northeast towards Ten Mile Creek tidally influenced areas.

Photo Point 8. At Barrett Road Bridge Crossing over Ten Mile Creek Facing South

Photo Point 8. At Barrett Road Bridge Crossing over Ten Mile Creek Facing North.

Photo Point 8. At Barrett Road Bridge Crossing over Ten Mile Creek Facing West.

The next series of photos were taken from the west side of I-5 along the south shore of the Nooksack River. The photos are presented from east to west along the Nooksack nearshore.

Photo Point 9. Facing West.

Photo Point 10. Panorama 1 of 5.

Photo Point 10. Panorama 2 of 5

Photo Point 10. Panorama 3 of 5.

Photo Point 10. Panorama 4 of 5.

Photo Point 10. Panorama 5 of 5. Farthest point West along the south shoreline of the Nooksack River.

The next series of photos were taken from VanderYacht Park, located on the north side of the Nooksack River. These photos capture most of the shoreline area where investigators were not able to traverse on the southside of the Nooksack; photos are presented from west to east.

Photo Point 11. Panorama 1 of 8.

Photo Point 11. Panorama 2 of 8.

Photo Point 11. Panorama 3 of 8.

Photo Point 11. Panorama 4 of 8.

Photo Point 11. Panorama 5 of 8.

Photo Point 11. Panorama 6 of 8.


Photo Point 11. Panorama 7 of 8.

Outfall to Silver Creek and Wetlands

The Creighton Basin in the southeastern corner of the Planned Action Area discharges through a culvert under I-5 to wetlands and to Silver Creek. Discharge from this area requires flow control as it is not an exempt waterbody.

Redirecting these flows directly to the Nooksack River to minimize flow control is not a feasible option. Direct discharge to an exempt receiving water cannot result in the diversion of drainage from any perennial stream or from any category I, II, or III wetland.

Outfall to Ten Mile Creek

It was determined that the utilization of Ten Mile Creek as a potential conveyance for the increased contribution of surface water flows originating from the proposed Gateway Commercial Development into the Nooksack River is not a biologically viable alternative.

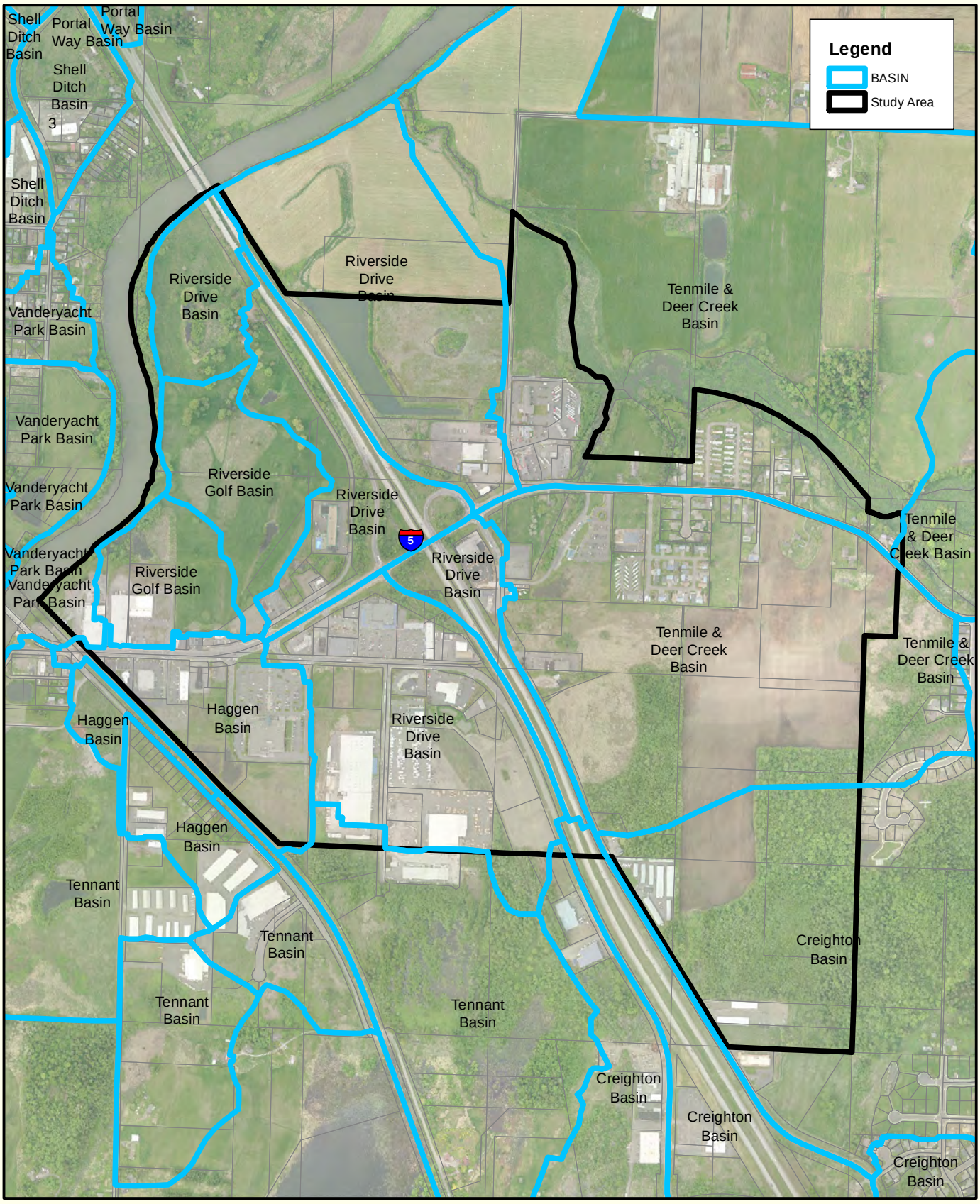
The increased flows under low tides and high flows would have detrimental biological effects:

1. Cause incising of the creek channel and stream bank erosion within Ten Mile Creek.
2. Scour Ten Mile Creek substrate habitat.
3. Increase sediment load contribution into the Nooksack River.
4. Cause potential flooding at the mouth of the creek.
5. Disturb potential stream habitat within both Ten Mile Creek and the Nooksack River.

The use of Ten Mile Creek would also require flow control and potentially enhanced treatment, as it is not exempted from these requirements in the Stormwater Management Manual.

The utilization of the existing WSDOT outfall conveyance system, which is mitigated by an existing tide gate, would be less detrimental to the downstream receiving waters of the Nooksack River. Use of the Nooksack River would only require basic treatment and does not require flow control. Therefore, the WSDOT outfall is biologically a better alternative for the Riverside Drive Basin.

The Ten Mile & Deer Creek Basin should maintain its existing points of discharge while providing appropriate mitigation.



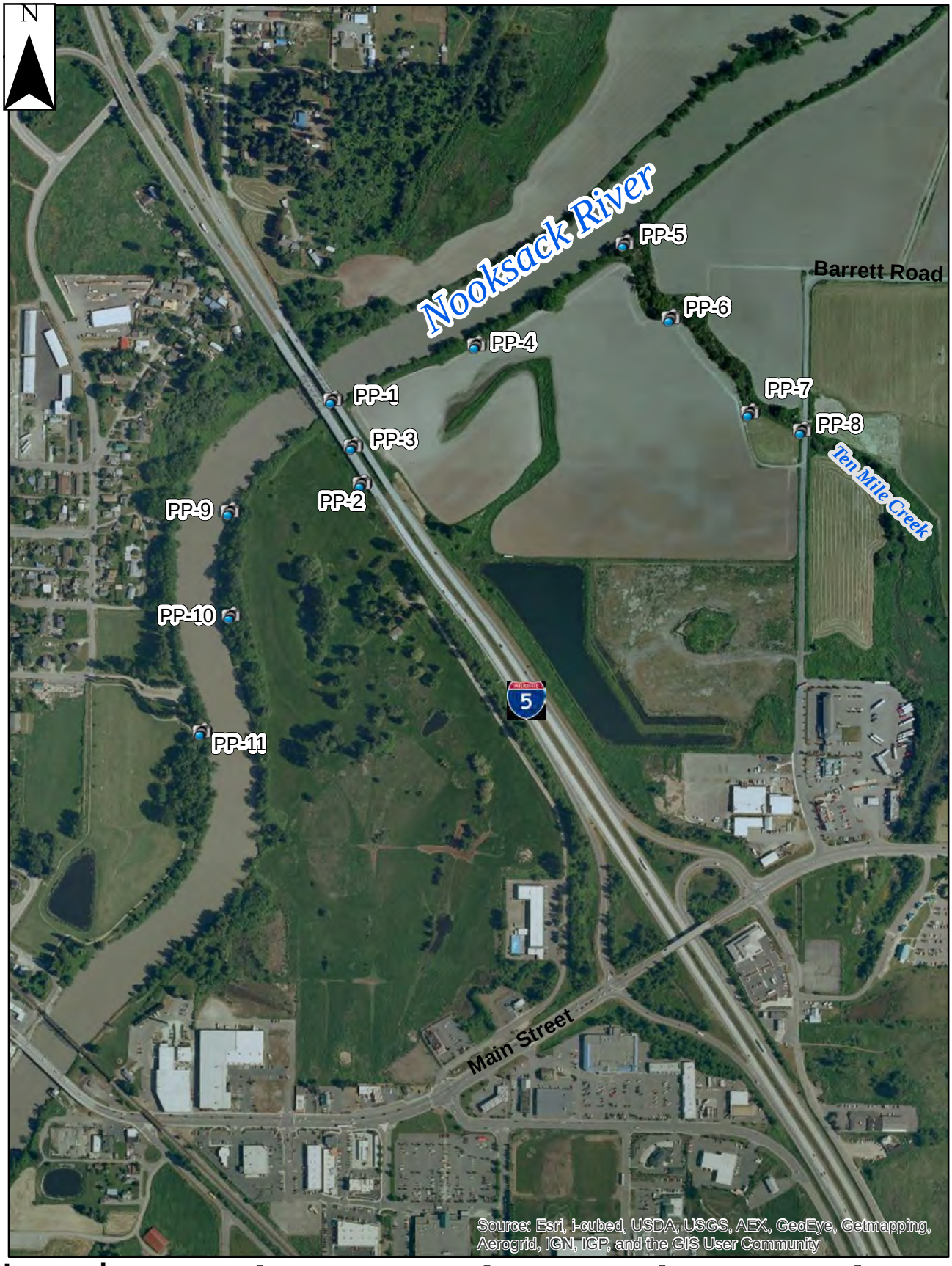
Map Date: August 11, 2011

Main Street Master Plan
Planned Action Area

City of Ferndale, WA

0 215 430 860 1,290 1,720 Feet

City of Ferndale WASHINGTON



Legend

Photo-Point

0.15 0.075 0 0.15 Miles

Figure 1: Photo Point Locations

Gateway Storwmwater Conveyance Investigation

City of Ferndale

December 20, 2012

PRELIMINARY COST ESTIMATE

Reichhardt & Ebe Engineering, Inc.
423 Front Street, Suite 201
Lynden, WA 98264
Phone: (360) 354-3687

PROJECT: ***FERNDALE GATEWAY MAIN STREET CROSSING PROJECT***

Cost Analysis (CONCEPTUAL PHASE)

Prepared For: City of Ferndale

Prepared By: B. Kuiken
Prepared On: April 10, 2013

Design:

	Civil Engineering (R&E)	Prime - Plans & Specs	$12,500.00
	Surveying (Compass Point)	Topo & Existing Conditions	$5,000.00
	Material Testing (GeoTest)	Soils / Cores	$1,500.00
			$19,000.00

R.O.W.:

Currently no R.O.W. anticipated		***$0.00***

Construction Administration:

Civil (R&E)	Prime	$20,000.00
Survey (Compass Point)		$2,000.00
Testing (GeoTest)		$3,000.00
		$25,000.00

Construction Costs:

Total From Below =	***$130,000.00***

Grant Cost Distribution:

Total ***$174,000.00***

Called By: City of Ferndale
For: **M-R-3**
ESTIMATE

PRELIMINARY ENGINEER'S ESTIMATE

By: B. Kuiken
Date: April 10, 2013

Item No.	Item	Quantity	Unit	Unit Price	Amount	Spec Ref. #
1	Mobilization	1	LS	$ 15,000.00	$ 15,000.00	1-09.7
2	Spill Prevention, Control, and Countermeasures (SPCC) Plan	1	LS	$ 1,000.00	$ 1,000.00	1-07.15
3	Flaggers and Spotters	600	HR	$ 48.00	$ 28,800.00	1-10
4	Other Traffic Control Labor	30	HR	$ 48.00	$ 1,440.00	1-10
5	Project Temporary Traffic Control	1	LS	$ 2,000.00	$ 2,000.00	1-10
6	Clearing and Grubbing	1	LS	$ 2,000.00	$ 2,000.00	2-01
7	Removal of Structures and Obstructions	1	LS	$ 2,000.00	$ 2,000.00	2-02
8	Sawcut ACP	1,000	LF-IN	$ 0.50	$ 500.00	2-02
8	Water	15	M.GAL	$ 30.00	$ 450.00	2-07
9	Shoring or Extra Excavation Class B	1,000	SF	$ 0.30	$ 300.00	2-09
10	Gravel Base	200	TON	$ 11.00	$ 2,200.00	4-02
11	Crushed Surfacing Top Course	20	TON	$ 20.00	$ 400.00	4-04
12	HMA for Pavement Repair Cl. 1/2" PG 64-22	35	TON	$ 125.00	$ 4,375.00	5-04
13	Corrugated Polyethylene Storm Sewer Pipe, 36 In. Diam.	115	LF	$ 75.00	$ 8,625.00	7-04
14	Catch Basin Type 2, 54 In. Diam	2	EA	$ 3,500.00	$ 7,000.00	7-05
15	Removal and Replacement of Unsuitable Material Including Haul	20	CY	$ 12.00	$ 240.00	7-09
16	Dewatering	1	LS	$ 2,000.00	$ 2,000.00	7-09
17	ESC Lead	15	DAY	$ 100.00	$ 1,500.00	8-01
18	Erosion/Water Pollution Control	1	EST	$ 4,000.00	$ 4,000.00	8-01
19	Seeding, Fertilizing and Mulching	150	SY	$ 2.00	$ 300.00	8-01
20	Topsoil Type A	20	CY	$ 40.00	$ 800.00	8-02
21	Landscape Restoration	1	EST	$ 5,000.00	$ 5,000.00	8-02
22	Quarry Spalls	10	CY	$ 50.00	$ 500.00	8-15
23	Paint Line	100	LF	$ 1.00	$ 100.00	8-22
24	Pothole Existing Underground Utility	4	EA	$ 200.00	$ 800.00	8-30
25	Repair Existing Public and Private Facilities	1	EST	$ 10,000.00	$ 10,000.00	8-31

Estimate

Subtotal:	$	101,330.00
Sales Tax (8.7%):	$	8,815.71
Sub TOTAL	$	110,145.71
Contingency @ 10% of Construction Cost	$	11,014.57
TOTAL	$	121,160.28
GRAND TOTAL	**$**	**130,000.00**

This estimate was prepared without the benefit of a complete design and therefore shall be considered preliminary and subject to change due to the possibility of changes in the quantity and nature of work and changes in unit prices overtime.

Reichhardt & Ebe Engineering, Inc.
423 Front Street, Suite 201
Lynden, WA 98264
Phone: (360) 354-3687

PROJECT: ***FERNDALE GATEWAY LABOUNTY CROSSING PROJECT***

Cost Analysis (CONCEPTUAL PHASE)

Prepared For: City of Ferndale

Prepared By: B. Kuiken
Prepared On: April 10, 2013

Design:

	Civil Engineering (R&E)	Prime - Plans & Specs	$14,000.00
	Surveying (Compass Point)	Topo & Existing Conditions	$5,000.00
	Material Testing (GeoTest)	Soils / Cores	$1,000.00
			$20,000.00

R.O.W.:

	Easement or ROW needed		***$20,000.00***

Construction Administration:

	Civil (R&E)	Prime	$15,000.00
	Survey (Compass Point)		$1,500.00
	Testing (GeoTest)		$2,500.00
			$19,000.00

Construction Costs:

	Total From Below =	***$130,000.00***

Grant Cost Distribution:

	Total	***$189,000.00***

Called By: City of Ferndale
For: **W-R-8**
ESTIMATE

PRELIMINARY ENGINEER'S ESTIMATE

By: B. Kuiken
Date: April 10, 2013

Item No.	Item	Quantity	Unit	Unit Price	Amount	Spec Ref. #
1	Mobilization	1	LS	$ 15,000.00	$ 15,000.00	1-09.7
2	Spill Prevention, Control, and Countermeasures (SPCC) Plan	1	LS	$ 1,000.00	$ 1,000.00	1-07.15
3	Flaggers and Spotters	225	HR	$ 48.00	$ 10,800.00	1-10
4	Other Traffic Control Labor	10	HR	$ 48.00	$ 480.00	1-10
5	Project Temporary Traffic Control	1	LS	$ 2,000.00	$ 2,000.00	1-10
6	Clearing and Grubbing	1	LS	$ 2,000.00	$ 2,000.00	2-01
7	Removal of Structures and Obstructions	1	LS	$ 2,000.00	$ 2,000.00	2-02
8	Sawcut ACP	800	LF-IN	$ 0.50	$ 400.00	2-02
8	Water	15	M.GAL	$ 30.00	$ 450.00	2-07
9	Shoring or Extra Excavation Class B	2,000	SF	$ 0.30	$ 600.00	2-09
10	Gravel Base	400	TON	$ 11.00	$ 4,400.00	4-02
11	Crushed Surfacing Top Course	15	TON	$ 20.00	$ 300.00	4-04
12	HMA for Pavement Repair Cl. 1/2" PG 64-22	75	TON	$ 125.00	$ 9,375.00	5-04
13	Corrugated Polyethylene Storm Sewer Pipe, 30 In. Diam.	255	LF	$ 75.00	$ 19,125.00	7-04
14	Catch Basin Type 2, 54 In. Diam	2	EA	$ 3,500.00	$ 7,000.00	7-05
15	Removal and Replacement of Unsuitable Material Including Haul	20	CY	$ 12.00	$ 240.00	7-09
16	Dewatering	1	LS	$ 2,000.00	$ 2,000.00	7-09
17	ESC Lead	15	DAY	$ 100.00	$ 1,500.00	8-01
18	Erosion/Water Pollution Control	1	EST	$ 5,000.00	$ 5,000.00	8-01
19	Seeding, Fertilizing and Mulching	500	SY	$ 2.00	$ 1,000.00	8-01
20	Topsoil Type A	25	CY	$ 40.00	$ 1,000.00	8-02
21	Landscape Restoration	1	EST	$ 5,000.00	$ 5,000.00	8-02
22	Quarry Spalls	10	CY	$ 50.00	$ 500.00	8-15
23	Paint Line	50	LF	$ 1.00	$ 50.00	8-22
24	Pothole Existing Underground Utility	2	EA	$ 200.00	$ 400.00	8-30
25	Repair Existing Public and Private Facilities	1	EST	$ 10,000.00	$ 10,000.00	8-31

Estimate

Subtotal:	$	101,620.00
Sales Tax (8.7%):	$	8,840.94
Sub TOTAL	$	110,460.94
Contingency @ 10% of Construction Cost	$	11,046.09
TOTAL	$	121,507.03
GRAND TOTAL	**$**	**130,000.00**

This estimate was prepared without the benefit of a complete design and therefore shall be considered preliminary and subject to change due to the possibility of changes in the quantity and nature of work and changes in unit prices overtime.

Reichhardt & Ebe Engineering, Inc.
423 Front Street, Suite 201
Lynden, WA 98264
Phone: (360) 354-3687

PROJECT: ***FERNDALE GATEWAY MAIN STREET CROSSING PROJECT***

Cost Analysis (CONCEPTUAL PHASE)

Prepared For: City of Ferndale

Prepared By: B. Kuiken
Prepared On: April 10, 2013

Design:

Civil Engineering (R&E)	Prime - Plans & Specs		$12,000.00
Surveying (Compass Point)	Topo & Existing Conditions		$5,500.00
Material Testing (GeoTest)	Soils / Cores		$1,500.00
			$19,000.00

R.O.W.:

Currently no R.O.W. anticipated		***$0.00***

Construction Administration:

Civil (R&E)	Prime	$20,000.00
Survey (Compass Point)		$2,000.00
Testing (GeoTest)		$3,000.00
		$25,000.00

Construction Costs:

	Total From Below =	***$130,000.00***

Grant Cost Distribution:

Total	***$174,000.00***

Called By:	City of Ferndale
For:	**M-R-6**
	ESTIMATE
	PRELIMINARY ENGINEER'S ESTIMATE
By:	B. Kuiken
Date:	April 10, 2013

Item No.	Item	Quantity	Unit	Unit Price	Amount	Spec Ref. #
1	Mobilization	1	LS	$ 15,000.00	$ 15,000.00	1-09.7
2	Spill Prevention, Control, and Countermeasures (SPCC) Plan	1	LS	$ 1,000.00	$ 1,000.00	1-07.15
3	Flaggers and Spotters	600	HR	$ 48.00	$ 28,800.00	1-10
4	Other Traffic Control Labor	30	HR	$ 48.00	$ 1,440.00	1-10
5	Project Temporary Traffic Control	1	LS	$ 2,000.00	$ 2,000.00	1-10
6	Clearing and Grubbing	1	LS	$ 2,000.00	$ 2,000.00	2-01
7	Removal of Structures and Obstructions	1	LS	$ 2,000.00	$ 2,000.00	2-02
8	Sawcut ACP	1,500	LF-IN	$ 0.50	$ 750.00	2-02
8	Water	15	M.GAL	$ 30.00	$ 450.00	2-07
9	Shoring or Extra Excavation Class B	1,500	SF	$ 0.30	$ 450.00	2-09
10	Gravel Base	300	TON	$ 11.00	$ 3,300.00	4-02
11	Crushed Surfacing Top Course	20	TON	$ 20.00	$ 400.00	4-04
12	HMA for Pavement Repair Cl. 1/2" PG 64-22	50	TON	$ 125.00	$ 6,250.00	5-04
13	Corrugated Polyethylene Storm Sewer Pipe, 30 In. Diam.	125	LF	$ 75.00	$ 9,375.00	7-04
14	Catch Basin Type 2, 54 In. Diam	2	EA	$ 3,500.00	$ 7,000.00	7-05
15	Removal and Replacement of Unsuitable Material Including Haul	20	CY	$ 12.00	$ 240.00	7-09
16	Dewatering	1	LS	$ 2,000.00	$ 2,000.00	7-09
17	ESC Lead	15	DAY	$ 100.00	$ 1,500.00	8-01
18	Erosion/Water Pollution Control	1	EST	$ 4,000.00	$ 4,000.00	8-01
19	Seeding, Fertilizing and Mulching	250	SY	$ 2.00	$ 500.00	8-01
20	Topsoil Type A	20	CY	$ 40.00	$ 800.00	8-02
21	Landscape Restoration	1	EST	$ 5,000.00	$ 5,000.00	8-02
22	Quarry Spalls	10	CY	$ 50.00	$ 500.00	8-15
23	Paint Line	100	LF	$ 1.00	$ 100.00	8-22
24	Pothole Existing Underground Utility	4	EA	$ 200.00	$ 800.00	8-30
25	Repair Existing Public and Private Facilities	1	EST	$ 10,000.00	$ 10,000.00	8-31

Estimate

Subtotal:	$	105,655.00
Sales Tax (8.7%):	$	9,191.99
Sub TOTAL	$	114,846.99
Contingency @ 10% of Construction Cost	$	11,484.70
TOTAL	$	126,331.68
GRAND TOTAL	**$**	**130,000.00**

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Reichhardt & Ebe Engineering, Inc.
423 Front Street, Suite 201
Lynden, WA 98264
Phone: (360) 354-3687

PROJECT: ***FERNDALE GATEWAY NOOKSACK RIVER OUTFALL PROJECT***

Cost Analysis (CONCEPTUAL PHASE)

Prepared For: City of Ferndale

Prepared By: B. Kuiken
Prepared On: April 25, 2013

Design:

	Civil Engineering (R&E)	Prime - Plans & Specs	$25,500.00
	Surveying (Compass Point)	Topo & Existing Conditions	$5,000.00
	Material Testing (GeoTest)	Soils / Cores	$1,500.00
	Permitting (Widener & Associates)	NEPA / JARPA	$20,000.00
			$52,000.00

R.O.W.:

	Currently no R.O.W. anticipated	***$0.00***

Construction Administration:

	Civil (R&E)	Prime	$40,000.00
	Survey (Compass Point)		$2,000.00
	Testing (GeoTest)		$3,000.00
			$45,000.00

Construction Costs:

	Total From Below =	***$310,000.00***

Grant Cost Distribution:

	Total	***$407,000.00***

Called By: City of Ferndale
For: **W-R-1,2,3**
ESTIMATE

PRELIMINARY ENGINEER'S ESTIMATE

By: B. Kuiken
Date: April 25, 2013

Item No.	Item	Quantity	Unit	Unit Price	Amount	Spec Ref. #
1	Mobilization	1	LS	$ 30,000.00	$ 30,000.00	1-09.7
2	Spill Prevention, Control, and Countermeasures (SPCC) Plan	1	LS	$ 1,000.00	$ 1,000.00	1-07.15
3	Flaggers and Spotters	800	HR	$ 48.00	$ 38,400.00	1-10
4	Other Traffic Control Labor	40	HR	$ 48.00	$ 1,920.00	1-10
5	Project Temporary Traffic Control	1	LS	$ 2,000.00	$ 2,000.00	1-10
6	Clearing and Grubbing	1	LS	$ 3,000.00	$ 3,000.00	2-01
7	Removal of Structures and Obstructions	1	LS	$ 5,000.00	$ 5,000.00	2-02
8	Water	20	M.GAL	$ 30.00	$ 600.00	2-07
9	Shoring or Extra Excavation Class B	6,000	SF	$ 0.30	$ 1,800.00	2-09
10	Gravel Base	1,250	TON	$ 11.00	$ 13,750.00	4-02
11	Crushed Surfacing Top Course	100	TON	$ 20.00	$ 2,000.00	4-04
12	Commercial HMA	50	TON	$ 140.00	$ 7,000.00	5-04
13	Corrugated Polyethylene Storm Sewer Pipe, 48 In. Diam.	750	LF	$ 70.00	$ 52,500.00	7-04
14	Catch Basin Type 2, 84 In. Diam	5	EA	$ 4,000.00	$ 20,000.00	7-05
15	Pinch Valve Outfall	1	EA	$ 25,000.00	$ 25,000.00	7-09
16	Removal and Replacement of Unsuitable Material Including Haul	50	CY	$ 12.00	$ 600.00	7-09
17	Dewatering	1	LS	$ 2,000.00	$ 2,000.00	7-09
18	ESC Lead	20	DAY	$ 100.00	$ 2,000.00	8-01
19	Erosion/Water Pollution Control	1	EST	$ 10,000.00	$ 10,000.00	8-01
20	Seeding, Fertilizing and Mulching	900	SY	$ 2.00	$ 1,800.00	8-01
21	Topsoil Type A	100	CY	$ 40.00	$ 4,000.00	8-02
22	Landscape Restoration	1	EST	$ 5,000.00	$ 5,000.00	8-02
23	Quarry Spalls	10	CY	$ 50.00	$ 500.00	8-15
24	Paint Line	100	LF	$ 1.00	$ 100.00	8-22
25	Pothole Existing Underground Utility	5	EA	$ 200.00	$ 1,000.00	8-30
26	Repair Existing Public and Private Facilities	1	EST	$ 20,000.00	$ 20,000.00	8-31

Estimate

Subtotal:	$	250,970.00
Sales Tax (8.7%):	$	21,834.39
Sub TOTAL	$	272,804.39
Contingency @ 10% of Construction Cost	$	27,280.44
TOTAL	$	300,084.83
GRAND TOTAL	**$**	**310,000.00**

This estimate was prepared without the benefit of a complete design and therefore shall be considered preliminary and subject to change due to the possibility of changes in the quantity and nature of work and changes in unit prices overtime.