Perrinville Creek Stormwater Flow Reduction Predesign

Part 1 – Seaview Park Infiltration Facility Predesign Report

#T31020

Prepared for:

City of Edmonds
Public Works
Department
Engineering Division

Prepared by:

TETRA TECH

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PRESENTED TO

City of Edmonds Public Works
121 5th Avenue North
Edmonds, WA 98020

PRESENTED BY

Tetra Tech, Inc.
1420 5th Avenue, Suite 550
Seattle, WA 98101

P 206.883.9300
F 206.883.9301
tetratech.com

Prepared by:

Eric Mendel, P.E.	10/17/2014
Project Engineer	Date

Reviewed by:

Greg Gaasland, P.E.	10/6/2014
Senior Engineer	Date

Authorized by:

Richard L. Schaefer, P.E. 10/17/2014	
Project Manager	Date

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EXECUTIVE SUMMARY

The City of Edmonds ("City") desires to improve the water quality and aquatic habitat in the lower reaches of Perrinville Creek, including at its mouth in Puget Sound. The 764-acre watershed, located both within the City of Edmonds and the City of Lynnwood, largely developed prior to modern stormwater quantity and quality controls.

The 30-inch-diameter Perrinville Creek culvert under Talbot Road near Puget Sound is a fish barrier, and the City has completed a preliminary design report for replacing it with a larger fish-friendly box culvert to permit access to upstream habitat. Replacing the culvert, however, could broaden sedimentation deposition and flooding risk in the lower reaches of Perrinville Creek, since the existing culvert restricts some high creek flows.

The primary goal of this project is to reduce high stormwater flows in Perrinville Creek. Flow reduction will provide multiple hydrologic and biological benefits to both the creek and Browns Bay in Puget Sound, allowing for the replacement of an anadromous fish barrier culvert and habitat improvements in the creek's lower reaches, reducing erosion and sedimentation that are impacting aquatic habitat and City infrastructure, and reducing the amount of pollutants in the aquatic environment. In addition, this project along with other projects recommended to retrofit the hydrology of the Perrinville Creek watershed, will reduce flood flows in the creek and corresponding risk to adjoining properties.

To achieve this goal the City is looking to implement priority stormwater retrofit projects which were selected based on a flow control reduction analysis performed by Tetra Tech and discussed in further detail in the report, *Perrinville Creek Stormwater Flow Reduction Retrofit Study, October 2014*. This report details the results of hydrologic modeling, geomorphic and geologic characterization of the creek, the development target flow levels, and identification of locations and approaches for flow reduction methodologies. From this report, the City of Edmonds has selected two sites to advance to preliminary design. These sites were selected based on their cost-effectiveness in reducing scouring flows in the creek, employing their 2-year peak flow reduction as a comparative measure. The Seaview Park Infiltration Facility was selected as one of the two preliminary design projects because it provided the best opportunity for significant reductions in frequent storm flows through storage, infiltration, and attenuation of peak flows while containing the footprint of improvements to City property.

The project area falls within the Sub-basin 13 area of the Perrinville Creek Sub-watershed as defined in the retrofit study. The project site is located in Seaview Park in the City of Edmonds near the intersection of 186th Street SW and 80th Avenue W. The park currently consists of a parking lot, tennis courts, lawn area and typical park vegetation of trees and shrubs. The proposed project site is in a lawn area north of the parking lot. The site has approximately a 5% downhill slope to the north. An existing 24" diameter storm sewer within 80th Avenue West collects 53 acres of residential area in catch basins and pipes flowing generally to the north. Because of the large contributing drainage area, publicly owned land, and drop in grade downstream, this location provides a good opportunity to intercept flows with a retrofit. Flows from the basin will be split off from the 24-inch storm sewer at a location north of the intersection of 186th Avenue SW, and the flows will be directed to the adjacent park area for storage and infiltration.

The proposed retrofit project consists of a subsurface 84-inch diameter pipe infiltration system with a footprint approximately 120 feet long by 60 feet wide and an associated storage volume of 62,000 cubic feet, which includes 28,000 cubic feet of pre-settling storage. The infiltration facility is controlled by a downstream orifice riser structure which is designed to overflow large storm events without upstream flooding. Because this project will achieve stormwater reduction through infiltration, a basic level of treatment will be provided by pre-settling pipes prior to the perforated infiltration pipes. These chambers will slow flow in an area contained with baffle walls to promote settling of suspended sediment and to contain floatables. The total project cost is estimated to be $845,000 which includes the costs for completing the design, construction bid package, permitting; the construction cost with a 20% contingency; and construction phase inspection, management and engineering support.

1.0 INTRODUCTION

The Perrinville Creek drainage basin is 764 acres in northern Edmonds and western Lynnwood. Perrinville Creek has the three conditions typical of Puget Sound coastal watersheds: a broad headwater plateau, urban land use, and stormwater runoff concentrated in pipe conveyance systems. Below the confluence of four tributary drainages, the creek drops steeply through a ravine eroded into glacial and pre-glacial deposits. The creek emerges from the ravine and transitions to a lower-gradient channel, forming an alluvial fan. The creek drops 260 feet in elevation over about one mile before discharging to Browns Bay in Puget Sound. Approximately 90 percent of the watershed is residential land use; the remaining 10 percent is commercial.

The City is working to improve the aquatic habitat in the lower reaches of Perrinville Creek, including at its mouth in Puget Sound. The 30-inch-diameter Perrinville Creek culvert under Talbot Road is a fish barrier, and the City has completed a preliminary design report for replacing it with a fish-friendly box culvert to permit access to some upstream habitat. Replacing the culvert, however, could broaden sedimentation deposition and present flooding risk in the lower reaches of Perrinville Creek, since the existing culvert is restricting some high creek flows.

The primary goal of this project is to reduce flows in Perrinville Creek by attenuating peak flows of stormwater runoff. The flow reduction will provide multiple hydrologic and biological benefits to both the creek and Browns Bay in Puget Sound, such as allowing for the replacement of an anadromous fish barrier culvert, reducing erosion and sedimentation that are impacting aquatic habitat and City infrastructure, and reducing the amount of pollutants in the aquatic environment.

The *Perrinville Creek Stormwater Flow Reduction Study* (October 2014) identifies 12 recommended capital projects to reduce storm flows in the creek, and this project was been identified, in consultation with the City of Edmonds, as a priority project to be advanced through preliminary design. The location of the project within the context of the watershed is shown in Figure 1. This project infiltrates and attenuates peak flows for a 53-acre tributary area in the upper reaches of the Perrinville Creek watershed through interception of the storm main by an 84-inch diameter subsurface pipe infiltration system.

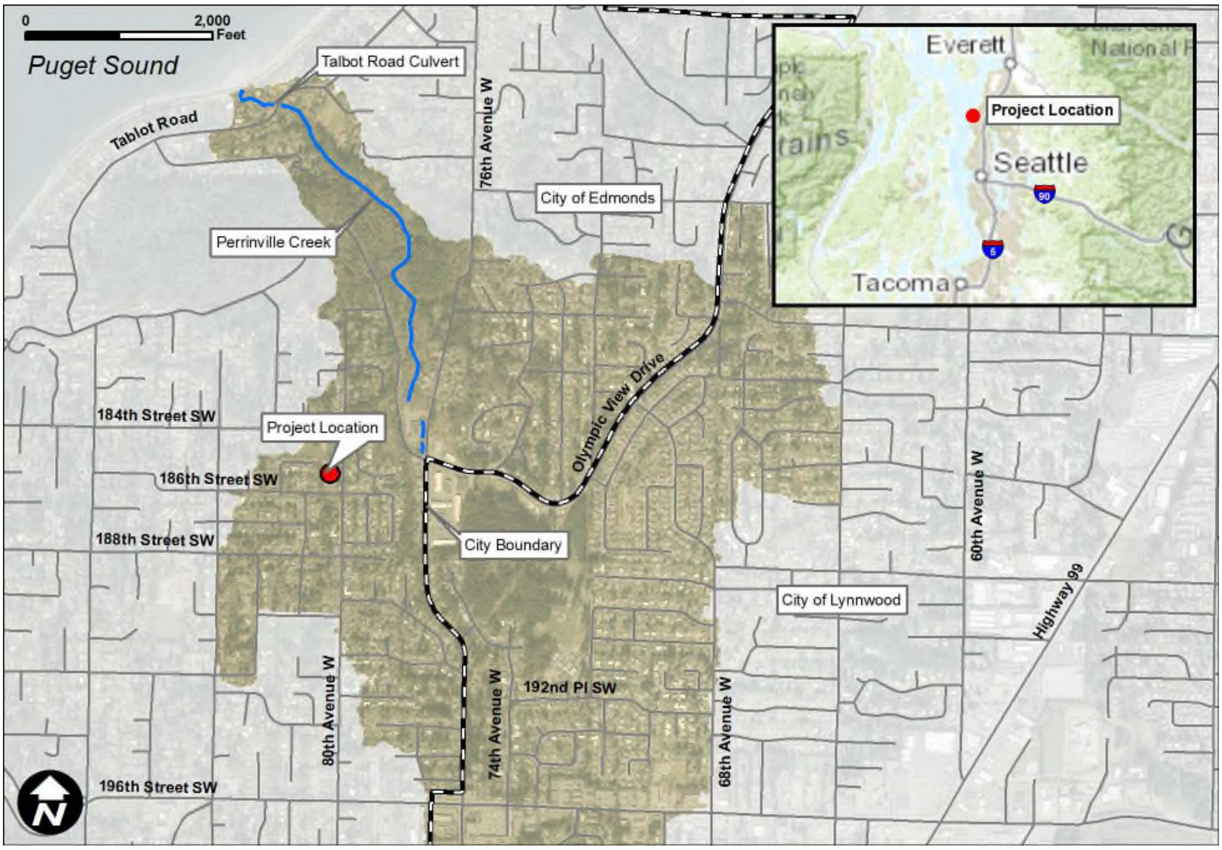


Figure 1. Project Location Map

1.1 TASKS PERFORMED TO COMPLETE THE PREDESIGN REPORT

The following tasks were performed to prepare the predesign report for the Seaview Park Infiltration Facility retrofit project:

1. Collect data from existing sources.
2. Develop concept level solutions to maximize 2-year peak-flow reduction.
3. Conduct field survey and mapping of project area.
4. Analyze sub-watershed hydrology and conveyance system hydraulics.
5. Evaluate peak-flow reductions.
6. Prepare preliminary design plans, cost estimate and predesign report.

1.2 PROJECT DESIGN TEAM

Tetra Tech, a national engineering consulting firm, has been retained by the City of Edmonds Public Works Department to design stormwater retrofits for the Perrinville Creek area. Associated Earth Sciences, Inc. is assisting Tetra Tech in soils/infiltration testing for select locations within the watershed area.

Jerry Schuster, PE is the Project Manager for the City of Edmonds. Jerry represents the City's interests as the project owner and grantee, coordinates communication between consultant and city staff, and acts as the liaison between the project team and the public.

Rick Schaefer, PE, is Tetra Tech's Project Manager to deliver both the study and the project predesigns. Rick is responsible for the day-to-day management of the project and provides technical direction to the team performing analyses and deliverables. Rick has a bachelor's degree in Civil Engineering from the University of Michigan, and Master Degree in Civil Engineering from North Carolina State University. Rick is registered as a Professional Engineer in the State of Washington (#19988) and State of California (#41430).

Greg Gaasland, P.E. provides QA/QC for the project. Greg has 30 years of experience designing storm drain systems. Greg has a Bachelor's and Master's degrees in Civil Engineering from the University of Washington and is registered as a Professional Engineer in the State of Washington (#26923).

Eric Mendel, P.E., is the lead designer responsible for developing plans specifications and cost estimates (PSE) for each design submittal. Eric has 13 years of design experience focusing on storm drain design for urban and roadway projects. Past design experience includes storm drain system design for the I-405 Congestion Relief Project. Eric has a Bachelor's degree from Washington State University is a registered as a Professional Engineer in the State of Washington (#43689) and holds a LID design certification from Washington State University.

Bryan Thomasy is the lead CAD technician responsible for production of the design drawings. Bryan is a certified professional and subject matter expert in AutoCAD Civil 3D 2013. Bryan has 24 years of experience that include stormwater and watershed drainage design.

Erik VanBuskirk is the lead for the mapping of the project area. Erik has 20 years of experience as a surveyor with a certificate in Basic Land Survey the United States Marine Corps, via Palomar Community College. Erik is also registered as a Professional Land Surveyor in the State of Washington (#46325).

1.3 DATA COLLECTION

The following data were collected to support the Seaview Park Infiltration Facility predesign:

- GIS shapefiles of land cover, soils, water features and storm drain inventory.
- LiDAR mapping of the ground surface topography.
- Design guidance and standards from Ecology.
- Planimetric mapping of roads and utilities in the public right-of-way.
- Elevation of the ground surface, storm drain and sanitary sewer systems in the public right-of-way.
- Geomorphic Characterization study of Perrinville Creek

1.4 DESCRIPTION OF THE PROBLEM

The City is working to improve the water quality and aquatic habitat in the lower reaches of Perrinville Creek, including at its mouth in Puget Sound. The 30-inch-diameter Perrinville Creek culvert under Talbot Road is a fish barrier, and the City has completed a preliminary design report for replacing it with a fish-passable box culvert to permit access to some upstream habitat. Replacing the culvert, however, could affect sedimentation and flooding risk in the lower reaches of Perrinville Creek, since the existing culvert is restricting some high creek flows.

The primary goal of this project is to reduce flows in Perrinville Creek by attenuating peak flows of stormwater runoff. The flow reduction will provide multiple hydrologic and biological benefits to both the creek and Browns Bay in Puget Sound, such as allowing for the replacement of an anadromous fish barrier culvert, reducing erosion and sedimentation that are impacting aquatic habitat and City infrastructure, and reducing the amount of pollutants in the aquatic environment.

Although the City has been investigating many options of flow reduction for Perrinville Creek, this project is one opportunity that has been identified as a priority project which has been advanced to preliminary design.

2.0 PROJECT SUMMARY

2.1 EXISTING CONDITIONS

This project is located along the western limits of the City of Edmonds, in the central upper reaches of the Perrinville Creek watershed, and is situated immediately downgradient of the outlet from Sub-basin 13 of the watershed as identified in the *Perrinville Creek Stormwater Flow Reduction Retrofit Study, October 2014*. The project site is located in Seaview Park in the City of Edmonds near the intersection of 186th Street SW and 80th Avenue W. The park currently consists of a parking lot, tennis courts, lawn area and typical park vegetation of trees and shrubs. The proposed project site is on the north side of the parking lot in the lawn area. The site has approximately a 5% downhill slope to the north. The existing site basemap is included on the proposed site plan layout included in Attachment 1.

An existing 24-inch diameter storm sewer on the west side of 80th Avenue West flows to the north of 186th Street SW. Stormwater runoff from the contributing drainage basin of this residential area flows northeast to Perrinville Creek from its southern limits at 192nd Street SW (see Figure 2).

The contributing headwaters consist primarily of relatively flat residential area also characterized as medium-density residential. The upper areas of the sub-basin west of 83rd Avenue West are relatively flat and are separated by a steep ridgeline running north-south to the east. Grades flatten out nearing 81st Avenue West and slopes average between 1-3% before nearing the steeper slopes at the northeast corner of the basin. Runoff is collected in roadside ditches, curb and gutters, catch basins, and 8- to 24-inch diameter conveyance pipes.

An existing 24-inch diameter storm sewer within 80th Avenue West collects 53 acres of residential area in a conveyance system that flows generally to the north. Because of the large contributing drainage area, publicly owned land, and the drop in grade downstream, this location provides a good opportunity to intercept flows with a retrofit.

2.2 DESCRIPTION OF SOILS

The soils in Seaview Park are predominately sand overlain by a relatively thin mantle of till and provide excellent infiltration opportunities. A geotechnical investigation was performed as part of the flow reduction analysis. The geotechnical analysis included installing a groundwater monitoring well and collecting soil investigation borings to perform a soil profile. Seaview Park was identified as an area with highly infiltrative soils. The geotechnical recommendations suggest hydrologic modeling using infiltration rates of 2 inches per hour. This is the maximum allowable infiltration rate based on the 2005 Ecology stormwater manual.

The soils within Seaview Park are very sandy and 2 inches per hour infiltration rate will be easily attainable and may be higher in some cases. The groundwater at Seaview Park was determined to be 40 feet below the ground surface with a large layer of infiltrative sandy silt and gravels. Due to the broad extent of the aquifer, and the extensive layer of outwash soils, groundwater mounding is not of concern with designing and operating an infiltration system in this location. The subsurface exploration and infiltration assessment is summarized in the Subsurface Exploration, Infiltration Assessment, and Geotechnical Engineering Report (Associated Earth Sciences, Inc. 2014).

2.3 PROPOSED PROJECT

The proposed project will re-route the existing stormwater conveyance system using a flow splitter located approximately 150 feet north of the intersection of 186th Street SW and 80th Avenue W and route frequent storm flows, and portions of large storm flows, to an underground infiltration gallery.

The stormwater flow will enter a corrugated metal pipe (CMP) system that will provide pre-settling and underground detention volume while stormwater infiltrates into the soils below the gravel and pipes. The infiltration gallery consists of a subsurface 84-inch diameter CMP infiltration system with a footprint approximately 150 feet long by 60 feet wide and an associated storage volume of 62,000 cubic feet which includes 28,000 cubic feet of pre-settling storage. The pipe system will be backfilled with three feet of gravel between the pipes and one foot over the top of the pipes. Another four feet below the pipes will be excavated and backfilled with gravel to provide additional storage and contact with the highly infiltrative native soils.

The stormwater will first be routed to a series of watertight pre-settling pipes which will provide basic water quality treatment prior to entering the perforated infiltration pipes and gravel. These baffled pre-settling pipes will allow sediments/pollutants to settle out and trap oils and floatables for removal. Once the stormwater exits the pre-settling pipes it will enter the perforated infiltration pipes and gravel. These pipes and gravels will provide storage while the stormwater infiltrates into the native soils.

Outflow from the facility is controlled by a weir overflow structure at the north end of the infiltration gallery. This overflow will connect to the existing stormwater conveyance system to the north along 80th Avenue and provide relief during extreme storm events or maintenance.

The proposed plan and profile are shown in Attachment 1 on the preliminary design drawings.

The following elements were considered when developing the proposed project:

- Maximize infiltration capabilities while providing overflows for large storms
- Consider a system that will have minimal impact during construction
- Ease of maintenance access to the facility
- Locate the retrofit on public property
- Avoid/resolve existing utility conflicts

The proposed project addresses the goals of peak flow reduction in Perrinville Creek through both flow attenuation and infiltration in the facility. Additional benefits from this facility include basic stormwater treatment for flows that are directed to the facility, improving water quality through settlement of suspended solids, trapping of floatables in the baffled pipe sections, and filtering of pollutants through infiltration into native soils.

2.4 OPTIONAL PROJECT FEATURES

The preliminary design shown is the facility proposed to accomplish the 2-year stormwater flow reduction goals. This design will reduce flows entering Perrinville Creek from the existing stormwater conveyance system. The Seaview Park site allows for several optional features that could be considered in the project's final design, recognizing the project will be subject to further review for various construction approvals by agencies and stakeholders, such as the Parks Board. Such potential options could include the use of a bioswale paralleling the parking lot before entering the infiltration gallery.

The site allows for options to provide an irrigation water supply for the park. In the final design stage, a vault with a pump system could be designed to collect water near the infiltration gallery and utilize water being stored for watering lawns and vegetation within the park.

3.0 SITE ASSESSMENT

The following engineering investigations were performed to support the development of the predesign report:

- Hydrologic analysis to estimate peak runoff rates for conveyance design
- Hydraulic analysis to size and evaluate performance of the proposed storm drain system
- Project mapping to define existing conditions and map known utilities
- Field reconnaissance to verify existing conditions

A project location map is located on Figure 1. The basemap of existing conditions can be found in the preliminary design drawings found in Attachment 1.

4.0 PRELIMINARY PROJECT DESIGN

Preliminary design drawings are found in Attachment 1. The footprint of the facility extends across the open grass area in the lower portion of the park, and the available footprint is bounded and constrained by a slope to the west, trees on the north and east, and the parking lot to the south. The facility is designed to provide the optimum reduction in stormwater flows to that are creating the erosion and sedimentation problems in Perrinville Creek, as determined in the *Perrinville Creek Stormwater Flow Reduction Retrofit Study, October 2014.*

The available footprint establishes the maximum capacity of the project:

- The footprint defines the maximum horizontal area of the facility's infiltration gallery and, thereby, the maximum infiltration rate from the facility to the underlying outwash.
- The footprint defines the volume available for active storage and treatment within the facility.

The City has had successful experience utilizing large-diameter tanks for stormwater storage in constructing a similar stormwater infiltration system in a city-owned park, and it is a cost-efficient means of storage in this type of facility. Total storage in the system is comprised of:

- Water quality treatment volume in the tanks
- Active storage volume in the tanks
- Active storage in the gravel zone between the tanks and the outwash

The capacity of the facility to infiltrate runoff to the outwash layer is determined by the design infiltration rate (reduced from measured rates to the 2.0 inches/hour limit established in Ecology design guidance) and the facility footprint. The maximum design diversion rate of 5.0 cfs was established based on this design infiltration rate and the active storage available in the system.

The amount of the tank volume to be allocated to water quality treatment is driven by the volume of runoff directed to the tank system. The sizing of the presettling volume in the tank system is based upon the full 52-acre tributary area, which may be conservatively large as discussed in Section 8.0 of this report.

The balance of the tank storage is allocated to active storage along with the void volume in the gravel zone. This active storage volume, along with the infiltration rate into the outwash layer, determines the effectiveness of the facility in reducing peak discharges to the downstream storm drainage system and Perrinville Creek. Dead storage and active storage elevations within the tanks are shown on the plans; these elevations will be controlled by two weirs at the outlet from the structure. Detailed design of the weir controls will be prepared as an element of final design.

The design of the tanks includes manhole access to allow inspection and maintenance. Baffles will be installed in the first two tanks to promote concentration of most of the sediment deposition and floatables so as to minimize maintenance efforts. Proposed baffle locations are shown on the tank system plan view in the drawings; detailed design of the baffles would be prepared as an element of final design.

5.0 ENVIRONMENTAL REVIEW DOCUMENTATION

Environmental review will be completed in later design phases per discussions with Ecology.

6.0 PRELIMINARY COST ESTIMATE AND COST TO COMPLETE

The total project cost is estimated to be $845,000, including a base construction cost estimate of $503,000 and $101,000 in design contingency at this stage of design completion. Preliminary cost estimates are found in Attachment 2. The costs include the base construction cost estimate; an allowance for final design, preparation of the construction bid package, permitting, and construction phase engineering support; an allowance for construction contingencies; and a provision for City costs to administer construction. All estimates are in 2014 dollars.

Unit costs were generally derived from bid tabs from recently completed projects in the area and from Washington State Department of Transportation bid tabs for recent local projects. Adjustments for preliminary level cost assumptions were made using recent unit bid item costs. Unit prices used for the estimates are shown in Attachment 2.

The additional costs associated with construction of the project are estimated to total approximately $340,000. The cost breakdown is as follows:

- $75,000 for final engineering and preparation of bid package
- $75,000 for construction management
- $25,000 for preparation and coordination of permits and approvals
- $15,000 for City project management and administration
- $50,000 for management reserve

Alternative project features as discussed in Section 2.4 above could affect the project costs.

7.0 FACILITY MAINTENANCE NEEDS

Facility maintenance needs are summarized below. Because this project falls within the Western Washington Phase II Municipal Stormwater Permit area, maintenance requirements from the permit will also apply (S.5.C.5).

<u>Pipelines and Catch Basins</u>

1. Inspection annually or after a major storm event of catch basins for sediment accumulation. Structures will be cleaned if the depth of deposits is equal to or greater than one-third the depth from the basin to the invert of the lowest pipe into or out of the basin.
2. Annual inspection for any deterioration threatening the structural integrity of the facility.

<u>Orifice Control Structure</u>

1. Inspect once every six months, preferably after storm events and greater than 0.5 inches of rainfall in 24 hours.
2. Remove trash and debris in excess of 25% of the sump depth or 1 foot below orifice plate
3. Remove any debris blockage of orifices and overflow
4. Check structural integrity of all elements and water tightness of connections

<u>Pipe Detention/Infiltration System</u>

1. Inspect Air-Vents, remove any obstructions of openings.
2. Remove sediment and debris accumulation in excess of 10% of the diameter of the storage pipe for ½ the length of any one section or 15% accumulation at any one point in the storage area.

3. Seal any openings which allow material in or seepage out.
4. Tanks sections bent more than 10% out of the design should be evaluated and/or repaired.
5. Repair any cracks or structural damage.

Operation and maintenance for the infiltration gallery is minimal and will only require typical stormwater system maintenance tasks. The conveyance pipes and all manholes should have the sumps cleaned of accumulated sediment as needed.

The pre-settling section of pipe will need to have sediment removed as it accumulates. This is fairly simple and can be performed with a vactor truck. If a bioswale or alternative water quality BMP was selected, different maintenance items would be needed such as mowing.

The infiltration gallery will have inspection ports and manhole style access points for cleaning out the pipes as needed. The inspection port will provide access to measure water levels for maintenance staff to record and read throughout the life of the facility. When staff notices water levels remaining higher and reduced infiltration they will be able to provide maintenance or repairs as needed.

Overall, the maintenance on this system should be within the range of typical stormwater facilities.

8.0 DESIGN FLOWS AND SYSTEM HYDRAULICS

The design objective for this project is to reduce the magnitude of frequent storm discharges in order to reduce the magnitude and duration of scouring flows downstream in Perrinville Creek. The Perrinville Creek basin has been built out over the last several decades and with that urbanization there has been an increase in impervious surfaces. The increase in impervious surfaces has altered stormwater runoff flow patterns. The existing stormwater system in this basin is predominately older and has minimal stormwater flow control facilities to mitigate for the altered stormwater runoff patterns. Due to the increase in surface runoff, peak flows entering Perrinville Creek are now higher and more intense than before the urbanization of the City of Edmonds. The higher more intense flows have caused erosion and bed load sediment issues within Perrinville Creek. The goal of this project is to intercept a portion of the stormwater runoff and reduce the 2-year peak flow by providing infiltration at a site in Seaview Park. The 2-year discharge was selected as the surrogate for sizing of facilities in the Study. Reducing these peak flows through infiltration should reduce peak discharge rates and durations in the creek downstream, thereby providing an overall improvement to the erosion and sediment issues within Perrinville Creek, while also replenishing groundwater and supporting stream base flows.

Peak design flows for the analysis and sizing were estimated from the 2-year through the 100-year return period using the Western Washington Hydrology Model (WWHM). The WWHM model was selected as the appropriate tool to estimate peak stormwater runoff rates because it uses actual rainfall data and is able to represent the varying land-use and soil conditions with a sub-basin. A 15-minute time-step is used for conveyance design to ensure that high-intensity, short-duration runoff flows that typically cause flooding in urbanized areas are considered in the sizing of conveyance facilities.

The WWHM model used regional runoff land-use parameters and 15-minute rainfall from the Everett precipitation gage. Precipitation values were regionally adjusted by a 0.80 scaling factor as suggested by the WWHM model. Pan evaporation from Puyallup was adopted and multiplied by a 0.76 regional scaling factor.

Sub-basins were delineated with respect to the conveyance network using LiDAR created from 2-foot contours supplied by the City of Edmonds. No reach routing was included in the sub-basin model so peak flow rates represent the un-attenuated condition; this may produce conservative peak flow estimates.

The hydrologic modeling of the basin for Seaview Park has calculated the 2-year flow from the existing land use as approximately 5 cubic feet per second (Table 2).

The proposed facility hydraulic model shows a reduction of the 2-year peak flows by approximately 2 cfs along with overall reduction in larger storm event flows. The model results are from WWHM 2012 and use existing land cover acreage in Sub-basin 13 as delineated in Figure 2. The summary land use characteristics used in the model are show in Table 1 and can be found in more detail in Attachment 3. The modeling results for the existing land use are shown in Table 2; model results assuming a fully forested condition are also provided in Table 2 for purposes of comparison with historic conditions. Detailed hydraulic modeling results can be found in Attachment 3.

TABLE 1 - WWHM LAND COVER PARAMETERS

Soil Type, Land Cover	Area (acres)
C, Forest	0.5
C, Lawn	41.1
Impervious Area	11.2
Total	**52.8**

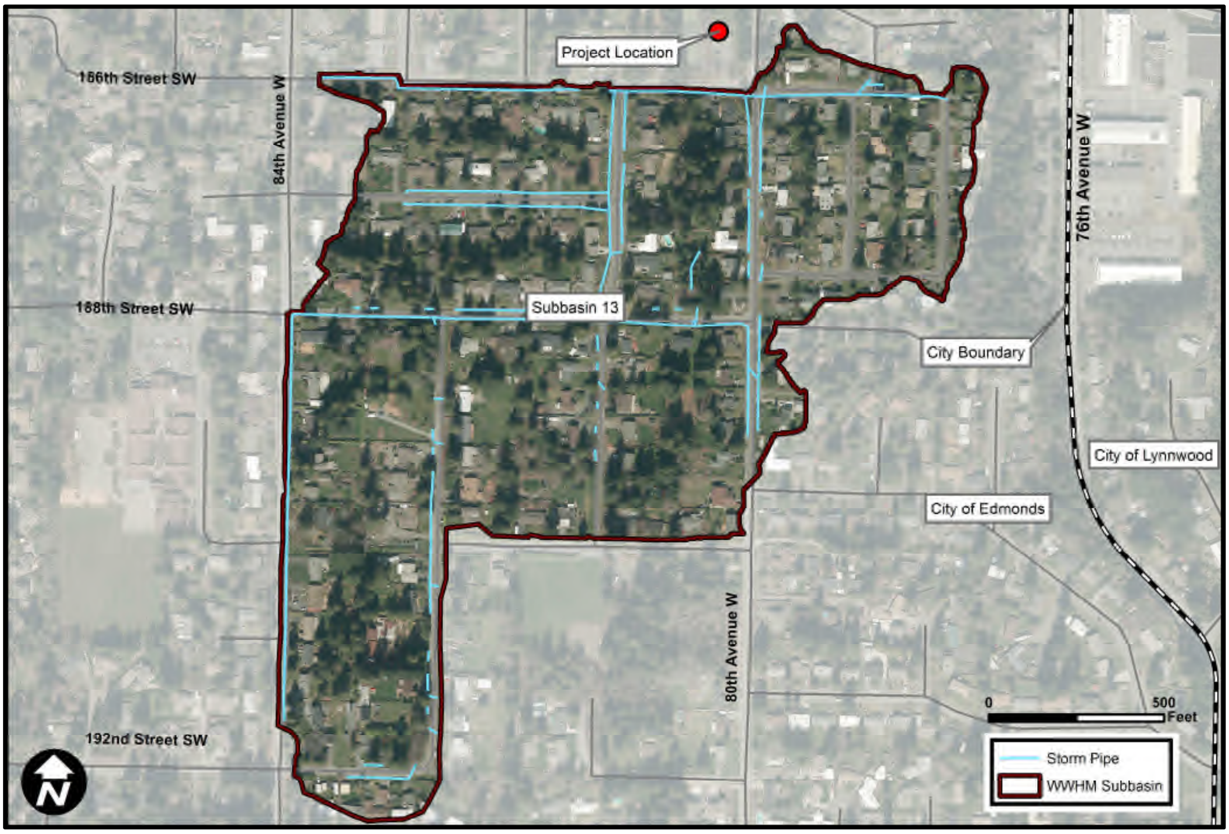


Figure 2. WWHM sub-basin for the Seaview Park Infiltration Facility

TABLE 2 - HYDROLOGIC MODEL RESULTS

EXISTING CONDITIONS		EXISTING CONDITION W/ PROPOSED FACILITY		HISTORIC FORESTED FLOW	
Return Period	Discharge (cfs)	Return Period	Discharge (cfs)	Return Period	Discharge (cfs)
2-Year	4.8	2-Year	3.0	2-Year	0.037
5-Year	7.4	5-Year	4.5	5-Year	0.043
10-Year	9.6	10-Year	5.3	10-Year	0.046
25-Year	12.8	25-Year	6.1	25-Year	0.048
50-Year	15.8	50-Year	6.5	50-Year	0.049
100-Year	19.1	100-Year	6.9	100-Year	0.050

The predicted performance of the facility differs from that described in the Study because of conservative assumptions made in preparing this preliminary design. The measured infiltrative capacity of the outwash is higher than the design infiltration rate, which has been capped at 2 inches/hour in accord with Ecology design guidelines. For this preliminary design and estimating costs, the presettling (treatment) volume has been determined based on the full tributary area of 52 acres; however, because flows are directed to the facility through a diversion and the facility will not experience the full range of flows from the tributary basin, the volume of the storage designated for treatment may be conservatively large, and the facility's resulting peak flow reduction performance may, in fact, exceed that predicted in the study and this report.

During final design, it is recommended the following be addressed to enhance performance in reducing frequent storm discharge rates:

1. Evaluate with the Department of Ecology the level of treatment to provide sedimentation effective to protect infiltration capacity.
2. Modifications to the flow splitting design to optimize performance.

9.0 WATER QUALITY BENEFITS

Infiltration through use of On-site Stormwater Management BMPs can provide both the treatment of stormwater, through the ability of certain soils to remove pollutants, and volume control of stormwater, by decreasing the amount of stormwater that becomes surface runoff and discharges to receiving waters. Infiltration through engineered treatment facilities that utilize the natural soil profile can also be very effective at treating stormwater runoff, but pre-treatment must be applied and soil conditions appropriate to achieve effective treatment while not impacting ground water resources.

The stormwater collected in this facility is runoff from areas of residential development. The typical pollutants of concern in stormwater runoff from residential areas are: 1) Low levels of oil and grease, total suspended solids, and heavy metals such as copper and zinc from residential roadways and 2) Nutrients, pesticides/herbicides from lawns and landscaping. Infiltration for pollutant removal is practicable and effective in this situation with pre-treatment incorporated into the facility.

The receiving water for the stormwater runoff from this basin is Perrinville Creek which is a fish-bearing stream. The proposed infiltration facility will reduce runoff and provide water quality treatment by infiltrating stormwater runoff into the soil. The groundwater below the proposed facility likely supplies base flows to Perrinville Creek. Since the groundwater below this proposed facility eventually supplies Perrinville Creek, enhanced treatment has been included in this preliminary design. One of the following options will be chosen during the design phase to satisfy the enhanced treatment requirement:

- Infiltration treatment - If infiltration is through soils meeting the minimum site suitability criteria for infiltration treatment (See Section 3.3.7 of Volume III of the most current version of the *Stormwater Management Manual for Western Washington.*), a pre-settling basin or a basic treatment facility can serve for pretreatment.

- Infiltration preceded by Basic Treatment - If infiltration is through soils that do not meet the soil suitability criteria for infiltration treatment, treatment must be provided by a basic treatment facility, unless the soil and site fit the description in the next option below.

- Infiltration preceded by Enhanced Treatment - If the soils do not meet the soil suitability criteria, treatment will be provided by a bioretention facility designed to per the most current version of the *Stormwater Management Manual for Western Washington.*

The runoff from this basin currently receives minimal to no water quality treatment as the majority of the basin was developed before current water quality treatment requirements. The proposed facility will provide water quality treatment to the runoff from this basin using pre-treatment BMPs and infiltration. This facility will provide immense improvements to the water quality of the stormwater runoff from this basin.

10.0 CONSTRUCTION SCENARIO

A potential construction sequencing scenario is outlined below. Actual sequencing will be determined by the contractor at the time of construction.

Potential Construction Sequence:

1. Establish clearing limits
2. Install erosion control
3. Maintain erosion control
4. Install new pipe infiltration facility
5. Implement and maintain traffic control
6. Sawcut and remove pavement
7. Provide temporary flow bypass
8. Remove existing pipe
9. Relocate utilities (if needed)
10. Restore pavement
11. Install plantings and seeding
12. Remove erosion control

10.1 CONSTRUCTION SCHEDULE

The project construction schedule has not been established but would occur during the summer and early fall time period.

10.2 CONSTRUCTION EQUIPMENT

Construction equipment used to construct this project has not been specified, but the contractor will most likely use excavators, end loaders, and dump trucks normally associated with utility projects of this type. Light trucks, bobcats, and other utility vehicles will also be used.

10.3 PERMIT REQUIREMENTS

The following permits are anticipated for this project:

- City of Edmonds, Encroachment Permit (Parks)
- Drainage Design and Erosion Control Permit Application
- City of Edmonds, Right-Of-Way Construction Permit Application
- City of Edmonds, Street Use Permit Application
- SEPA environmental checklist

11.0 REFERENCES

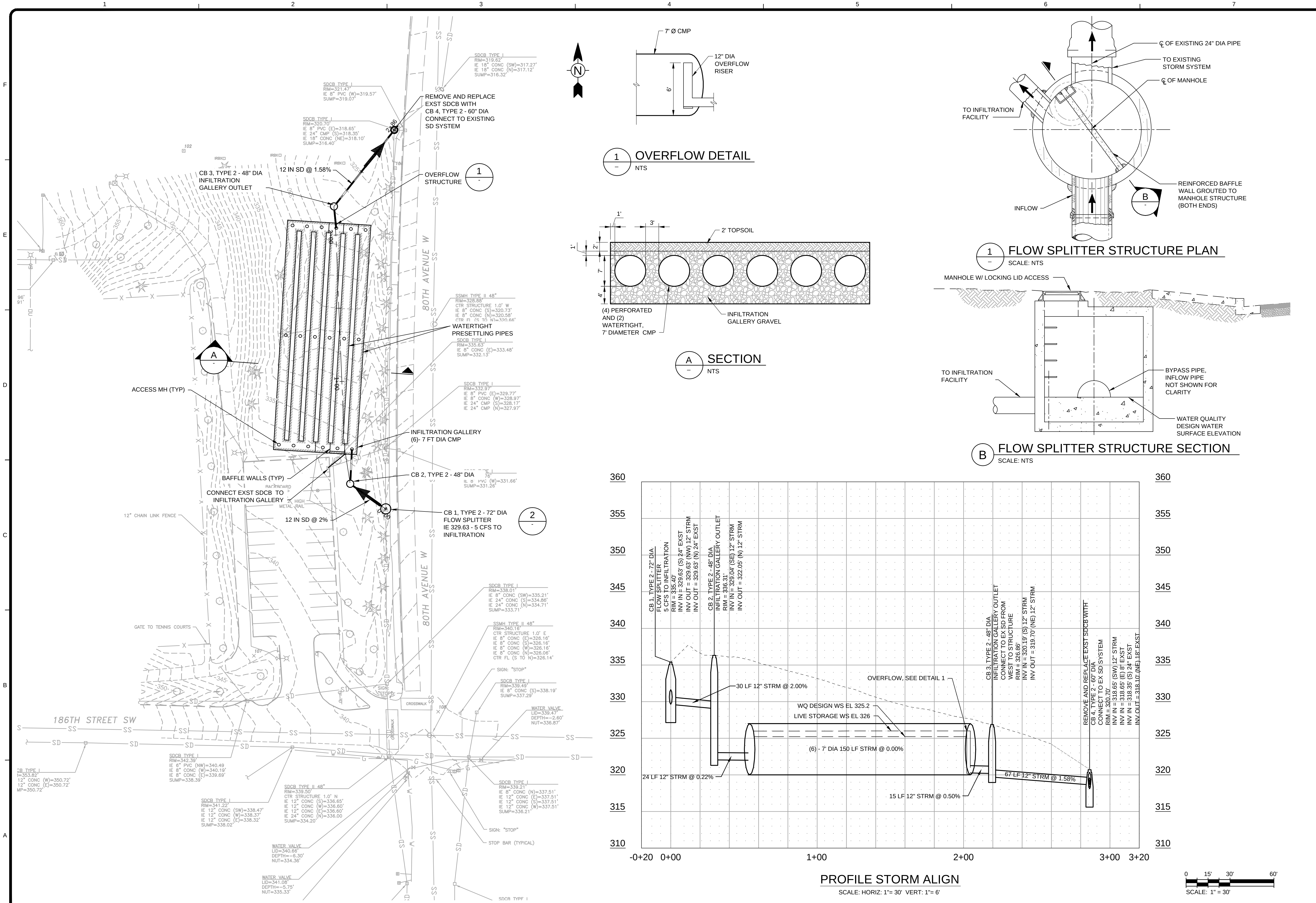
Tetra Tech. 2014. *Perrinville Creek Stormwater Flow Reduction Retrofit Study* (October 2014). Prepared for City of Edmonds Public Works.

Associated Earth Sciences, Inc., 2014 *Subsurface Exploration, Infiltration Assessment, and Geotechnical Engineering Report* July, 2014. Prepared for Tetra Tech.

Washington State Department of Ecology, 2005. Stormwater Management Manual for Western Washington.

ATTACHMENT 1

PRELIMINARY DESIGN DRAWINGS



TETRA TECH

www.tetratech.com

MARK	DATE	DESCRIPTION	BY

SITE LAYOUT
80TH AVENUE

Project No.:	T31020
Designed By:	EM
Drawn By:	EM/BKT
Checked By:	GG

C-001
Sheet

Bar Measures 1 inch

1/27/2015 10:25:44 AM - P:\T31020 EDMONDS PERRINVILLE CREEK\8 CAD\SHEETFILES\C-001 SITE PLAN - 80TH AVENUE.DWG - MENDEL, ERIC

ATTACHMENT 2

PRELIMINARY COST ESTIMATE

ITEM NO.	ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL COST
	SITE SEAVIEW PARK #16				
1	MOBILIZATION (10%)	1	LS	$ 41,895	$ 41,895
2	CONTRACTOR PROVIDED SURVEY (3%)	1	LS	$ 12,569	$ 12,569
3	TESC (5%)	1	LS	$ 20,948	$ 20,948
4	TRAFFIC CONTROL (2%)	1	LS	$ 8,379	$ 8,379
5	SAWCUTTING	50	LF	$ 2	$ 100
6	STRUCTURAL EXCAVATION CLASS B INCL. HAUL	4000	CY	$ 15	$ 60,000
7	SCHEDULE A STORM SEWER PIPE 12 IN. DIAM.	190	LF	$ 40	$ 7,600
8	INFILTRATION PIPE / CHAMBERS	950	LF	$ 225	$ 213,750
9	GRAVEL BACKFILL FOR DRAIN	2500	CY	$ 40	$ 100,000
10	FLOW RESTRICTOR	1	EA	$ 3,000	$ 3,000
11	CONNECTION TO DRAINAGE STRUCTURE	3	EA	$ 1,000	$ 3,000
12	CATCH BASIN TYPE 2 (48" DIA.)	2	EA	$ 3,000	$ 6,000
13	CATCH BASIN TYPE 2 (60" DIA.)	1	EA	$ 4,500	$ 4,500
14	FLOW SPLITTER CATCH BASIN TYPE 2 (72" DIA.)	1	EA	$ 6,000	$ 6,000
15	PAVEMENT PATCH	1	LS	$ 5,000	$ 5,000
16	LANDSCAPING	1	LS	$ 10,000	$ 10,000
	CONSTRUCTION COST SUBTOTAL				$ 502,740
	DESIGN CONTINGENCY	20%			$ 100,548
	PERMITTING	5%			$ 25,137
	DESIGN FEES	15%			$ 75,411
	CITY PM / ADMIN	3%			$ 15,082
	CONSTRUCTION MANAGEMENT	15%			$ 75,411
	MANAGEMENT RESERVE	10%			$ 50,274
	PROJECT COST TOTAL				$ 845,000

* ALL COST ESTIMATES IN 2014 DOLLARS

ATTACHMENT 3

WWHM OUTPUT

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	vault_LID seaview 9.24
Site Name:	
Site Address:	
City:	
Report Date:	10/1/2014
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.80
Version:	2014/01/16

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

13

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
C, Forest, Flat	0.297
C, Forest, Mod	0.144
C, Forest, Steep	0.069
C, Lawn, Flat	24.492
C, Lawn, Mod	15.052
C, Lawn, Steep	1.576
Pervious Total	41.63
Impervious Land Use	Acres
ROADS FLAT	11.217
Impervious Total	11.217
Basin Total	52.847

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

13

Bypass:	No
GroundWater:	No

Pervious Land Use	Acres
C, Forest, Flat	0.297
C, Forest, Mod	0.144
C, Forest, Steep	0.069
C, Lawn, Flat	24.492
C, Lawn, Mod	15.052
C, Lawn, Steep	1.576
Pervious Total	41.63

Impervious Land Use	Acres
ROADS FLAT	11.217
Impervious Total	11.217
Basin Total	52.847

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

Width: 80 ft.
Length: 60 ft.
Depth: 7 ft.
Infiltration On
Infiltration rate: 2
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft): 2522.718
Total Volume Through Riser (ac-ft): 679.898
Total Volume Through Facility (ac-ft): 3202.617
Percent Infiltrated: 78.77
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 6 in.
Element Flows To:
Outlet 1 Outlet 2

Vault Hydraulic Table

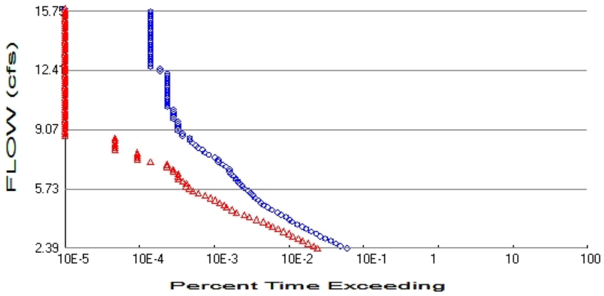
Stage(ft)	**Area(ac)**	**Volume(ac-ft)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.110	0.000	0.000	0.000
0.0778	0.110	0.008	0.000	0.222
0.1556	0.110	0.017	0.000	0.222
0.2333	0.110	0.025	0.000	0.222
0.3111	0.110	0.034	0.000	0.222
0.3889	0.110	0.042	0.000	0.222
0.4667	0.110	0.051	0.000	0.222
0.5444	0.110	0.060	0.000	0.222
0.6222	0.110	0.068	0.000	0.222
0.7000	0.110	0.077	0.000	0.222
0.7778	0.110	0.085	0.000	0.222
0.8556	0.110	0.094	0.000	0.222
0.9333	0.110	0.102	0.000	0.222
1.0111	0.110	0.111	0.000	0.222
1.0889	0.110	0.120	0.000	0.222
1.1667	0.110	0.128	0.000	0.222
1.2444	0.110	0.137	0.000	0.222
1.3222	0.110	0.145	0.000	0.222
1.4000	0.110	0.154	0.000	0.222
1.4778	0.110	0.162	0.000	0.222
1.5556	0.110	0.171	0.000	0.222
1.6333	0.110	0.180	0.000	0.222
1.7111	0.110	0.188	0.000	0.222
1.7889	0.110	0.197	0.000	0.222
1.8667	0.110	0.205	0.000	0.222
1.9444	0.110	0.214	0.000	0.222
2.0222	0.110	0.222	0.000	0.222
2.1000	0.110	0.231	0.000	0.222
2.1778	0.110	0.240	0.000	0.222
2.2556	0.110	0.248	0.000	0.222
2.3333	0.110	0.257	0.000	0.222
2.4111	0.110	0.265	0.000	0.222
2.4889	0.110	0.274	0.000	0.222
2.5667	0.110	0.282	0.000	0.222

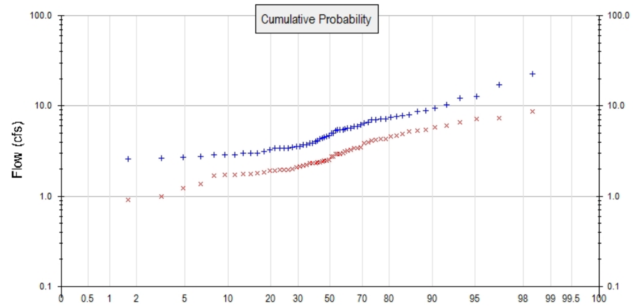
2.6444	0.110	0.291	0.000	0.222
2.7222	0.110	0.300	0.000	0.222
2.8000	0.110	0.308	0.000	0.222
2.8778	0.110	0.317	0.000	0.222
2.9556	0.110	0.325	0.000	0.222
3.0333	0.110	0.334	0.000	0.222
3.1111	0.110	0.342	0.000	0.222
3.1889	0.110	0.351	0.000	0.222
3.2667	0.110	0.360	0.000	0.222
3.3444	0.110	0.368	0.000	0.222
3.4222	0.110	0.377	0.000	0.222
3.5000	0.110	0.385	0.000	0.222
3.5778	0.110	0.394	0.000	0.222
3.6556	0.110	0.402	0.000	0.222
3.7333	0.110	0.411	0.000	0.222
3.8111	0.110	0.420	0.000	0.222
3.8889	0.110	0.428	0.000	0.222
3.9667	0.110	0.437	0.000	0.222
4.0444	0.110	0.445	0.000	0.222
4.1222	0.110	0.454	0.000	0.222
4.2000	0.110	0.462	0.000	0.222
4.2778	0.110	0.471	0.000	0.222
4.3556	0.110	0.480	0.000	0.222
4.4333	0.110	0.488	0.000	0.222
4.5111	0.110	0.497	0.000	0.222
4.5889	0.110	0.505	0.000	0.222
4.6667	0.110	0.514	0.000	0.222
4.7444	0.110	0.522	0.000	0.222
4.8222	0.110	0.531	0.000	0.222
4.9000	0.110	0.539	0.000	0.222
4.9778	0.110	0.548	0.000	0.222
5.0556	0.110	0.557	0.000	0.222
5.1333	0.110	0.565	0.000	0.222
5.2111	0.110	0.574	0.000	0.222
5.2889	0.110	0.582	0.000	0.222
5.3667	0.110	0.591	0.000	0.222
5.4444	0.110	0.599	0.000	0.222
5.5222	0.110	0.608	0.000	0.222
5.6000	0.110	0.617	0.000	0.222
5.6778	0.110	0.625	0.000	0.222
5.7556	0.110	0.634	0.000	0.222
5.8333	0.110	0.642	0.000	0.222
5.9111	0.110	0.651	0.000	0.222
5.9889	0.110	0.659	0.000	0.222
6.0667	0.110	0.668	0.083	0.222
6.1444	0.110	0.677	0.267	0.222
6.2222	0.110	0.685	0.510	0.222
6.3000	0.110	0.694	0.800	0.222
6.3778	0.110	0.702	1.130	0.222
6.4556	0.110	0.711	1.497	0.222
6.5333	0.110	0.719	1.896	0.222
6.6111	0.110	0.728	2.326	0.222
6.6889	0.110	0.737	2.784	0.222
6.7667	0.110	0.745	3.268	0.222
6.8444	0.110	0.754	3.778	0.222
6.9222	0.110	0.762	4.312	0.222
7.0000	0.110	0.771	4.869	0.222
7.0778	0.110	0.779	5.448	0.222

7.1556	0.000	0.000	6.048	0.000

Analysis Results

POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 41.63
Total Impervious Area: 11.217

Mitigated Landuse Totals for POC #1
Total Pervious Area: 41.63
Total Impervious Area: 11.217

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	4.775391
5 year	7.38731
10 year	9.549641
25 year	12.842737
50 year	15.749161
100 year	19.084862

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	3.001809
5 year	4.487309
10 year	5.273141
25 year	6.061181
50 year	6.524705
100 year	6.903412

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	5.453	1.836
1950	7.034	3.253
1951	3.849	2.350
1952	4.530	3.447
1953	4.977	0.907
1954	12.255	4.286
1955	7.146	4.090
1956	2.890	2.376
1957	6.469	5.180
1958	12.622	5.384

1959	4.131	2.759
1960	4.434	3.164
1961	22.656	4.901
1962	4.322	3.396
1963	8.948	2.984
1964	3.716	2.533
1965	2.581	1.735
1966	2.656	1.748
1967	7.577	2.953
1968	4.993	3.904
1969	17.284	7.143
1970	3.497	1.959
1971	5.885	3.929
1972	8.051	7.325
1973	5.712	2.443
1974	7.004	3.471
1975	6.231	1.698
1976	3.752	2.964
1977	3.000	1.973
1978	2.988	2.330
1979	9.557	6.611
1980	4.018	2.455
1981	3.411	1.773
1982	3.288	2.928
1983	5.631	3.214
1984	3.598	2.301
1985	5.389	4.733
1986	8.684	5.811
1987	5.471	4.178
1988	3.571	2.342
1989	5.491	0.984
1990	2.881	2.215
1991	3.406	2.067
1992	4.712	1.980
1993	3.106	1.377
1994	2.759	1.899
1995	2.849	2.159
1996	5.955	4.548
1997	10.210	8.726
1998	5.525	1.725
1999	2.981	1.814
2000	7.127	2.148
2001	2.712	0.237
2002	2.539	1.922
2003	3.419	1.239
2004	7.871	2.750
2005	3.425	2.007
2006	7.438	6.032
2007	6.567	5.464
2008	4.570	4.304
2009	3.909	2.472

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	22.6558	8.7263
2	17.2843	7.3252
3	12.6220	7.1427

4	12.2552	6.6110
5	10.2103	6.0320
6	9.5565	5.8111
7	8.9476	5.4639
8	8.6843	5.3838
9	8.0515	5.1804
10	7.8709	4.9014
11	7.5774	4.7330
12	7.4380	4.5484
13	7.1456	4.3045
14	7.1269	4.2863
15	7.0340	4.1778
16	7.0041	4.0902
17	6.5667	3.9294
18	6.4691	3.9037
19	6.2311	3.4710
20	5.9548	3.4471
21	5.8849	3.3963
22	5.7119	3.2533
23	5.6312	3.2144
24	5.5245	3.1640
25	5.4907	2.9844
26	5.4707	2.9637
27	5.4531	2.9530
28	5.3891	2.9283
29	4.9932	2.7594
30	4.9767	2.7496
31	4.7122	2.5332
32	4.5705	2.4721
33	4.5295	2.4547
34	4.4338	2.4433
35	4.3225	2.3760
36	4.1311	2.3497
37	4.0184	2.3419
38	3.9091	2.3296
39	3.8494	2.3010
40	3.7516	2.2149
41	3.7164	2.1594
42	3.5977	2.1484
43	3.5709	2.0671
44	3.4968	2.0072
45	3.4252	1.9802
46	3.4191	1.9726
47	3.4110	1.9589
48	3.4057	1.9218
49	3.2885	1.8988
50	3.1056	1.8364
51	3.0004	1.8144
52	2.9884	1.7733
53	2.9805	1.7485
54	2.8895	1.7354
55	2.8812	1.7252
56	2.8493	1.6979
57	2.7587	1.3773
58	2.7119	1.2387
59	2.6560	0.9845
60	2.5810	0.9070
61	2.5387	0.2366

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.3877	1280	515	40	Pass
2.5227	1042	455	43	Pass
2.6576	900	391	43	Pass
2.7926	775	323	41	Pass
2.9276	651	284	43	Pass
3.0625	558	240	43	Pass
3.1975	493	214	43	Pass
3.3324	427	183	42	Pass
3.4674	365	153	41	Pass
3.6024	321	129	40	Pass
3.7373	276	114	41	Pass
3.8723	238	98	41	Pass
4.0073	217	79	36	Pass
4.1422	195	63	32	Pass
4.2772	167	54	32	Pass
4.4122	149	42	28	Pass
4.5471	126	37	29	Pass
4.6821	110	31	28	Pass
4.8171	98	29	29	Pass
4.9520	89	25	28	Pass
5.0870	83	22	26	Pass
5.2219	75	19	25	Pass
5.3569	71	16	22	Pass
5.4919	65	13	20	Pass
5.6268	62	11	17	Pass
5.7618	53	10	18	Pass
5.8968	51	9	17	Pass
6.0317	46	9	19	Pass
6.1667	44	8	18	Pass
6.3017	41	7	17	Pass
6.4366	39	7	17	Pass
6.5716	35	7	20	Pass
6.7066	34	6	17	Pass
6.8415	34	6	17	Pass
6.9765	31	5	16	Pass
7.1114	28	5	17	Pass
7.2464	24	3	12	Pass
7.3814	24	2	8	Pass
7.5163	22	2	9	Pass
7.6513	18	2	11	Pass
7.7863	16	2	12	Pass
7.9212	15	1	6	Pass
8.0562	13	1	7	Pass
8.1912	12	1	8	Pass
8.3261	11	1	9	Pass
8.4611	10	1	10	Pass
8.5961	10	1	10	Pass
8.7310	8	0	0	Pass
8.8660	8	0	0	Pass
9.0009	7	0	0	Pass
9.1359	7	0	0	Pass
9.2709	7	0	0	Pass
9.4058	7	0	0	Pass

9.5408	7	0	0	Pass
9.6758	6	0	0	Pass
9.8107	6	0	0	Pass
9.9457	6	0	0	Pass
10.0807	6	0	0	Pass
10.2156	6	0	0	Pass
10.3506	5	0	0	Pass
10.4856	5	0	0	Pass
10.6205	5	0	0	Pass
10.7555	5	0	0	Pass
10.8904	5	0	0	Pass
11.0254	5	0	0	Pass
11.1604	5	0	0	Pass
11.2953	5	0	0	Pass
11.4303	5	0	0	Pass
11.5653	5	0	0	Pass
11.7002	5	0	0	Pass
11.8352	5	0	0	Pass
11.9702	5	0	0	Pass
12.1051	5	0	0	Pass
12.2401	5	0	0	Pass
12.3751	4	0	0	Pass
12.5100	4	0	0	Pass
12.6450	3	0	0	Pass
12.7799	3	0	0	Pass
12.9149	3	0	0	Pass
13.0499	3	0	0	Pass
13.1848	3	0	0	Pass
13.3198	3	0	0	Pass
13.4548	3	0	0	Pass
13.5897	3	0	0	Pass
13.7247	3	0	0	Pass
13.8597	3	0	0	Pass
13.9946	3	0	0	Pass
14.1296	3	0	0	Pass
14.2646	3	0	0	Pass
14.3995	3	0	0	Pass
14.5345	3	0	0	Pass
14.6694	3	0	0	Pass
14.8044	3	0	0	Pass
14.9394	3	0	0	Pass
15.0743	3	0	0	Pass
15.2093	3	0	0	Pass
15.3443	3	0	0	Pass
15.4792	3	0	0	Pass
15.6142	3	0	0	Pass
15.7492	3	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	2.2408 acre-feet
On-line facility target flow:	1.873 cfs.
Adjusted for 15 min:	1.873 cfs.
Off-line facility target flow:	1.0738 cfs.
Adjusted for 15 min:	1.0738 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Vault 1 POC	☐	2914.11			☐	78.78			
Total Volume Infiltrated		2914.11	0.00	0.00		78.78	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   vault_LID seaview 9.24.wdm
MESSU      25   Prevault_LID seaview 9.24.MES
           27   Prevault_LID seaview 9.24.L61
           28   Prevault_LID seaview 9.24.L62
           30   POCvault_LID seaview 9.241.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      PERLND      11
      PERLND      12
      PERLND      16
      PERLND      17
      PERLND      18
      IMPLND       1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        13                          MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   10      C, Forest, Flat         1    1    1    1   27    0
   11      C, Forest, Mod          1    1    1    1   27    0
   12      C, Forest, Steep        1    1    1    1   27    0
   16      C, Lawn, Flat           1    1    1    1   27    0
   17      C, Lawn, Mod            1    1    1    1   27    0
   18      C, Lawn, Steep          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
```

```
  <PLS > ************* Active Sections *****************************
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
 10         0    0    1    0    0    0    0    0    0    0    0    0
 11         0    0    1    0    0    0    0    0    0    0    0    0
 12         0    0    1    0    0    0    0    0    0    0    0    0
 16         0    0    1    0    0    0    0    0    0    0    0    0
 17         0    0    1    0    0    0    0    0    0    0    0    0
 18         0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY

PRINT-INFO
  <PLS > ***************** Print-flags ***************************** PIVL  PYR
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
 10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 18         0    0    4    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO

PWAT-PARM1
  <PLS >  PWATER variable monthly parameter value flags  ***
  # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
 10         0    0    0    0    0    0    0    0    0    0    0
 11         0    0    0    0    0    0    0    0    0    0    0
 12         0    0    0    0    0    0    0    0    0    0    0
 16         0    0    0    0    0    0    0    0    0    0    0
 17         0    0    0    0    0    0    0    0    0    0    0
 18         0    0    0    0    0    0    0    0    0    0    0
END PWAT-PARM1

PWAT-PARM2
  <PLS >      PWATER input info: Part 2         ***
  # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
 10              0       4.5      0.08       400      0.05       0.5     0.996
 11              0       4.5      0.08       400       0.1       0.5     0.996
 12              0       4.5      0.08       400      0.15       0.5     0.996
 16              0       4.5      0.03       400      0.05       0.5     0.996
 17              0       4.5      0.03       400       0.1       0.5     0.996
 18              0       4.5      0.03       400      0.15       0.5     0.996
END PWAT-PARM2

PWAT-PARM3
  <PLS >      PWATER input info: Part 3         ***
  # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
 10              0         0         2         2         0         0         0
 11              0         0         2         2         0         0         0
 12              0         0         2         2         0         0         0
 16              0         0         2         2         0         0         0
 17              0         0         2         2         0         0         0
 18              0         0         2         2         0         0         0
END PWAT-PARM3
PWAT-PARM4
  <PLS >     PWATER input info: Part 4                                     ***
  # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
 10            0.2       0.5      0.35         6       0.5       0.7
 11            0.2       0.5      0.35         6       0.5       0.7
 12            0.2       0.3      0.35         6       0.3       0.7
 16            0.1      0.25      0.25         6       0.5      0.25
 17            0.1      0.25      0.25         6       0.5      0.25
 18            0.1      0.15      0.25         6       0.3      0.25
END PWAT-PARM4

PWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
          ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
  # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
 10              0         0         0         0       2.5         1         0
 11              0         0         0         0       2.5         1         0
```

```
   12             0         0         0         0       2.5         1         0
   16             0         0         0         0       2.5         1         0
   17             0         0         0         0       2.5         1         0
   18             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
13***
PERLND  10                       0.297     COPY   501     12
PERLND  10                       0.297     COPY   501     13
PERLND  11                       0.144     COPY   501     12
PERLND  11                       0.144     COPY   501     13
PERLND  12                       0.069     COPY   501     12
PERLND  12                       0.069     COPY   501     13
PERLND  16                      24.492     COPY   501     12
PERLND  16                      24.492     COPY   501     13
PERLND  17                      15.052     COPY   501     12
PERLND  17                      15.052     COPY   501     13
PERLND  18                       1.576     COPY   501     12
```

```
PERLND  18                      1.576     COPY   501     13
IMPLND   1                     11.217     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
```

```
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   vault_LID seaview 9.24.wdm
MESSU      25   Mitvault_LID seaview 9.24.MES
           27   Mitvault_LID seaview 9.24.L61
           28   Mitvault_LID seaview 9.24.L62
           30   POCvault_LID seaview 9.241.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      PERLND      11
      PERLND      12
      PERLND      16
      PERLND      17
      PERLND      18
      IMPLND       1
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  1                    MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out            ***
   10     C, Forest, Flat         1    1    1    1   27    0
   11     C, Forest, Mod          1    1    1    1   27    0
   12     C, Forest, Steep        1    1    1    1   27    0
   16     C, Lawn, Flat           1    1    1    1   27    0
   17     C, Lawn, Mod            1    1    1    1   27    0
   18     C, Lawn, Steep          1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***
```

```
ACTIVITY
  <PLS > ************* Active Sections *****************************
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
 10         0    0    1    0    0    0    0    0    0    0    0    0
 11         0    0    1    0    0    0    0    0    0    0    0    0
 12         0    0    1    0    0    0    0    0    0    0    0    0
 16         0    0    1    0    0    0    0    0    0    0    0    0
 17         0    0    1    0    0    0    0    0    0    0    0    0
 18         0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY

PRINT-INFO
  <PLS > ***************** Print-flags ***************************** PIVL  PYR
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
 10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 18         0    0    4    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO

PWAT-PARM1
  <PLS >  PWATER variable monthly parameter value flags  ***
  # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
 10         0    0    0    0    0    0    0    0    0    0    0
 11         0    0    0    0    0    0    0    0    0    0    0
 12         0    0    0    0    0    0    0    0    0    0    0
 16         0    0    0    0    0    0    0    0    0    0    0
 17         0    0    0    0    0    0    0    0    0    0    0
 18         0    0    0    0    0    0    0    0    0    0    0
END PWAT-PARM1

PWAT-PARM2
  <PLS >      PWATER input info: Part 2         ***
  # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
 10              0       4.5      0.08       400      0.05       0.5     0.996
 11              0       4.5      0.08       400       0.1       0.5     0.996
 12              0       4.5      0.08       400      0.15       0.5     0.996
 16              0       4.5      0.03       400      0.05       0.5     0.996
 17              0       4.5      0.03       400       0.1       0.5     0.996
 18              0       4.5      0.03       400      0.15       0.5     0.996
END PWAT-PARM2

PWAT-PARM3
  <PLS >      PWATER input info: Part 3         ***
  # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
 10              0         0         2         2         0         0         0
 11              0         0         2         2         0         0         0
 12              0         0         2         2         0         0         0
 16              0         0         2         2         0         0         0
 17              0         0         2         2         0         0         0
 18              0         0         2         2         0         0         0
END PWAT-PARM3
PWAT-PARM4
  <PLS >     PWATER input info: Part 4                                   ***
  # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
 10            0.2       0.5      0.35         6       0.5       0.7
 11            0.2       0.5      0.35         6       0.5       0.7
 12            0.2       0.3      0.35         6       0.3       0.7
 16            0.1      0.25      0.25         6       0.5      0.25
 17            0.1      0.25      0.25         6       0.5      0.25
 18            0.1      0.15      0.25         6       0.3      0.25
END PWAT-PARM4

PWAT-STATE1
  <PLS > *** Initial conditions at start of simulation
           ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
  # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
```

```
   10               0         0         0         0       2.5           1         0
   11               0         0         0         0       2.5           1         0
   12               0         0         0         0       2.5           1         0
   16               0         0         0         0       2.5           1         0
   17               0         0         0         0       2.5           1         0
   18               0         0         0         0       2.5           1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
13***
PERLND  10                       0.297     RCHRES   1      2
PERLND  10                       0.297     RCHRES   1      3
PERLND  11                       0.144     RCHRES   1      2
PERLND  11                       0.144     RCHRES   1      3
PERLND  12                       0.069     RCHRES   1      2
PERLND  12                       0.069     RCHRES   1      3
PERLND  16                      24.492     RCHRES   1      2
PERLND  16                      24.492     RCHRES   1      3
PERLND  17                      15.052     RCHRES   1      2
```

```
PERLND  17                      15.052     RCHRES   1      3
PERLND  18                       1.576     RCHRES   1      2
PERLND  18                       1.576     RCHRES   1      3
IMPLND   1                      11.217     RCHRES   1      5

******Routing******
PERLND  10                       0.297     COPY     1     12
PERLND  11                       0.144     COPY     1     12
PERLND  12                       0.069     COPY     1     12
PERLND  16                      24.492     COPY     1     12
PERLND  17                      15.052     COPY     1     12
PERLND  18                       1.576     COPY     1     12
IMPLND   1                      11.217     COPY     1     15
PERLND  10                       0.297     COPY     1     13
PERLND  11                       0.144     COPY     1     13
PERLND  12                       0.069     COPY     1     13
PERLND  16                      24.492     COPY     1     13
PERLND  17                      15.052     COPY     1     13
PERLND  18                       1.576     COPY     1     13
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                        in  out                              ***
    1     Vault  1               2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *        *  *  *  *  *         ***
    1        0  1  0  0    4  5  0  0  0        0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
```

```
          *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1        0            4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.110193  0.000000  0.000000  0.000000
  0.077778  0.110193  0.008571  0.000000  0.222222
  0.155556  0.110193  0.017141  0.000000  0.222222
  0.233333  0.110193  0.025712  0.000000  0.222222
  0.311111  0.110193  0.034282  0.000000  0.222222
  0.388889  0.110193  0.042853  0.000000  0.222222
  0.466667  0.110193  0.051423  0.000000  0.222222
  0.544444  0.110193  0.059994  0.000000  0.222222
  0.622222  0.110193  0.068564  0.000000  0.222222
  0.700000  0.110193  0.077135  0.000000  0.222222
  0.777778  0.110193  0.085706  0.000000  0.222222
  0.855556  0.110193  0.094276  0.000000  0.222222
  0.933333  0.110193  0.102847  0.000000  0.222222
  1.011111  0.110193  0.111417  0.000000  0.222222
  1.088889  0.110193  0.119988  0.000000  0.222222
  1.166667  0.110193  0.128558  0.000000  0.222222
  1.244444  0.110193  0.137129  0.000000  0.222222
  1.322222  0.110193  0.145699  0.000000  0.222222
  1.400000  0.110193  0.154270  0.000000  0.222222
  1.477778  0.110193  0.162841  0.000000  0.222222
  1.555556  0.110193  0.171411  0.000000  0.222222
  1.633333  0.110193  0.179982  0.000000  0.222222
  1.711111  0.110193  0.188552  0.000000  0.222222
  1.788889  0.110193  0.197123  0.000000  0.222222
  1.866667  0.110193  0.205693  0.000000  0.222222
  1.944444  0.110193  0.214264  0.000000  0.222222
  2.022222  0.110193  0.222834  0.000000  0.222222
  2.100000  0.110193  0.231405  0.000000  0.222222
  2.177778  0.110193  0.239976  0.000000  0.222222
  2.255556  0.110193  0.248546  0.000000  0.222222
  2.333333  0.110193  0.257117  0.000000  0.222222
  2.411111  0.110193  0.265687  0.000000  0.222222
  2.488889  0.110193  0.274258  0.000000  0.222222
  2.566667  0.110193  0.282828  0.000000  0.222222
  2.644444  0.110193  0.291399  0.000000  0.222222
  2.722222  0.110193  0.299969  0.000000  0.222222
  2.800000  0.110193  0.308540  0.000000  0.222222
  2.877778  0.110193  0.317110  0.000000  0.222222
  2.955556  0.110193  0.325681  0.000000  0.222222
  3.033333  0.110193  0.334252  0.000000  0.222222
  3.111111  0.110193  0.342822  0.000000  0.222222
  3.188889  0.110193  0.351393  0.000000  0.222222
  3.266667  0.110193  0.359963  0.000000  0.222222
  3.344444  0.110193  0.368534  0.000000  0.222222
  3.422222  0.110193  0.377104  0.000000  0.222222
  3.500000  0.110193  0.385675  0.000000  0.222222
  3.577778  0.110193  0.394245  0.000000  0.222222
  3.655556  0.110193  0.402816  0.000000  0.222222
  3.733333  0.110193  0.411387  0.000000  0.222222
  3.811111  0.110193  0.419957  0.000000  0.222222
  3.888889  0.110193  0.428528  0.000000  0.222222
  3.966667  0.110193  0.437098  0.000000  0.222222
  4.044444  0.110193  0.445669  0.000000  0.222222
  4.122222  0.110193  0.454239  0.000000  0.222222
  4.200000  0.110193  0.462810  0.000000  0.222222
  4.277778  0.110193  0.471380  0.000000  0.222222
  4.355556  0.110193  0.479951  0.000000  0.222222
```

```
  4.433333  0.110193  0.488522  0.000000  0.222222
  4.511111  0.110193  0.497092  0.000000  0.222222
  4.588889  0.110193  0.505663  0.000000  0.222222
  4.666667  0.110193  0.514233  0.000000  0.222222
  4.744444  0.110193  0.522804  0.000000  0.222222
  4.822222  0.110193  0.531374  0.000000  0.222222
  4.900000  0.110193  0.539945  0.000000  0.222222
  4.977778  0.110193  0.548515  0.000000  0.222222
  5.055556  0.110193  0.557086  0.000000  0.222222
  5.133333  0.110193  0.565657  0.000000  0.222222
  5.211111  0.110193  0.574227  0.000000  0.222222
  5.288889  0.110193  0.582798  0.000000  0.222222
  5.366667  0.110193  0.591368  0.000000  0.222222
  5.444444  0.110193  0.599939  0.000000  0.222222
  5.522222  0.110193  0.608509  0.000000  0.222222
  5.600000  0.110193  0.617080  0.000000  0.222222
  5.677778  0.110193  0.625650  0.000000  0.222222
  5.755556  0.110193  0.634221  0.000000  0.222222
  5.833333  0.110193  0.642792  0.000000  0.222222
  5.911111  0.110193  0.651362  0.000000  0.222222
  5.988889  0.110193  0.659933  0.000000  0.222222
  6.066667  0.110193  0.668503  0.083820  0.222222
  6.144444  0.110193  0.677074  0.267323  0.222222
  6.222222  0.110193  0.685644  0.510112  0.222222
  6.300000  0.110193  0.694215  0.800140  0.222222
  6.377778  0.110193  0.702785  1.130678  0.222222
  6.455556  0.110193  0.711356  1.497257  0.222222
  6.533333  0.110193  0.719927  1.896629  0.222222
  6.611111  0.110193  0.728497  2.326294  0.222222
  6.688889  0.110193  0.737068  2.784249  0.222222
  6.766667  0.110193  0.745638  3.268844  0.222222
  6.844444  0.110193  0.754209  3.778688  0.222222
  6.922222  0.110193  0.762779  4.312586  0.222222
  7.000000  0.110193  0.771350  4.869500  0.222222
  7.077778  0.110193  0.779920  5.448516  0.222222
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC      ENGL    0.8           PERLND   1 999 EXTNL  PREC
WDM      2 PREC      ENGL    0.8           IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP      ENGL    0.76          PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP      ENGL    0.76          IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   1 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3
```

```
  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY            INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY            INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY            INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       17
RCHRES     OFLOW  OVOL   1                 COPY            INPUT  MEAN
  END MASS-LINK   17

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

ERROR/WARNING ID: 341   6

DATE/TIME: 1957/ 2/24 11:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4237E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1957/ 2/24 11:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-1.638E+04	1.7060	1.7060E+00	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1958/ 5/31 19: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4616E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1958/ 5/31 19: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-2.612E+04	2.7206	2.7206	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1960/10/23 9:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4384E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1960/10/23 9:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-2.017E+04	2.1008	2.1008E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1969/ 6/27 11: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4987E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1969/ 6/27 11: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-3.567E+04	3.7155	3.7155E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1969/ 6/27 11:15

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.5144E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1969/ 6/27 11:15

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-3.971E+04	4.1365	4.1365E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1972/ 9/22 19:30

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4905E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1972/ 9/22 19:30

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-3.355E+04	3.4949	3.4949	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1972/ 9/22 19:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.5193E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1972/ 9/22 19:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0).

Probably ftable was extrapolated. If extrapolation was small, no problem.
Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-4.097E+04	4.2680	4.2680E+00	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1972/ 9/22 20: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.5173E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1972/ 9/22 20: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-4.046E+04	4.2143	4.2143E+00	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1978/11/ 3 20:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4332E+04

ERROR/WARNING ID: 341   5

DATE/TIME: 1978/11/ 3 20:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-1.882E+04	1.9608	1.9608E+00	2

ERROR/WARNING ID: 341   6

DATE/TIME: 1978/11/ 3 21: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.5114E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1978/11/ 3 21: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-3.892E+04	4.0544	4.0544E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1986/ 1/18 9: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4390E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1986/ 1/18 9: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-2.031E+04	2.1156	2.1156E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1986/ 1/18 9:15

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

```
NROWS         V1         V2        VOL
92 3.3600E+04 3.3973E+04 3.4024E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1986/ 1/18  9:15

RCHRES:     1
```

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

```
A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 9600.0     -1.091E+04    1.1369  1.1369E+00      2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1986/ 1/18 19:30

RCHRES:     1
```

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

```
NROWS         V1         V2        VOL
92 3.3600E+04 3.3973E+04 3.4162E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1986/ 1/18 19:30

RCHRES:     1
```

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

```
A          B          C      RDEP1      RDEP2  COUNT
0.0000E+00 9600.0     -1.446E+04    1.5065     1.5065       2
```

```
ERROR/WARNING ID:   341   6

DATE/TIME: 1996/12/31 23:15

RCHRES:     1
```

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

```
NROWS         V1         V2        VOL
92 3.3600E+04 3.3973E+04 3.4371E+04
```

```
ERROR/WARNING ID:   341   5

DATE/TIME: 1996/12/31 23:15

RCHRES:     1
```

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-1.982E+04	2.0645	2.0645E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1996/12/31 23:30

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.5519E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1996/12/31 23:30

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-4.934E+04	5.1400	5.1400E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1996/12/31 23:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.6654E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1996/12/31 23:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-7.855E+04	8.1820	8.1820	2

ERROR/WARNING ID: 341 6

DATE/TIME: 1996/12/31 24: 0

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4477E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 1996/12/31 24: 0

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-2.256E+04	2.3505	2.3505E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 2006/ 2/ 4 0:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4882E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 2006/ 2/ 4 0:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-3.297E+04	3.4346	3.4346E+00	2

ERROR/WARNING ID: 341 6

DATE/TIME: 2006/12/14 16:45

RCHRES: 1

The volume of water in this reach/mixed reservoir is greater than the value in the "volume" column of the last row of RCHTAB(). To continue the simulation the table has been extrapolated, based on information contained in the last two rows. This will usually result in some loss of accuracy. If depth is being calculated it will also cause an error condition. Relevant data are:

NROWS	V1	V2	VOL
92	3.3600E+04	3.3973E+04	3.4041E+04

ERROR/WARNING ID: 341 5

DATE/TIME: 2006/12/14 16:45

RCHRES: 1

Calculation of relative depth, using Newton's method of successive approximations, converged to an invalid value (not in range 0.0 to 1.0). Probably ftable was extrapolated. If extrapolation was small, no problem. Remedy; extend ftable. Relevant data are:

A	B	C	RDEP1	RDEP2	COUNT
0.0000E+00	9600.0	-1.135E+04	1.1822	1.1822	2

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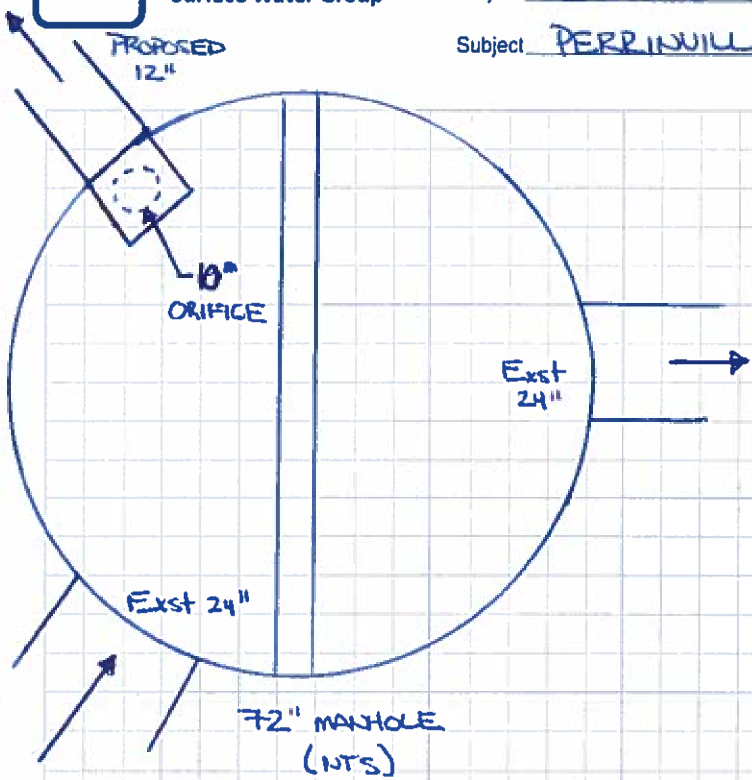
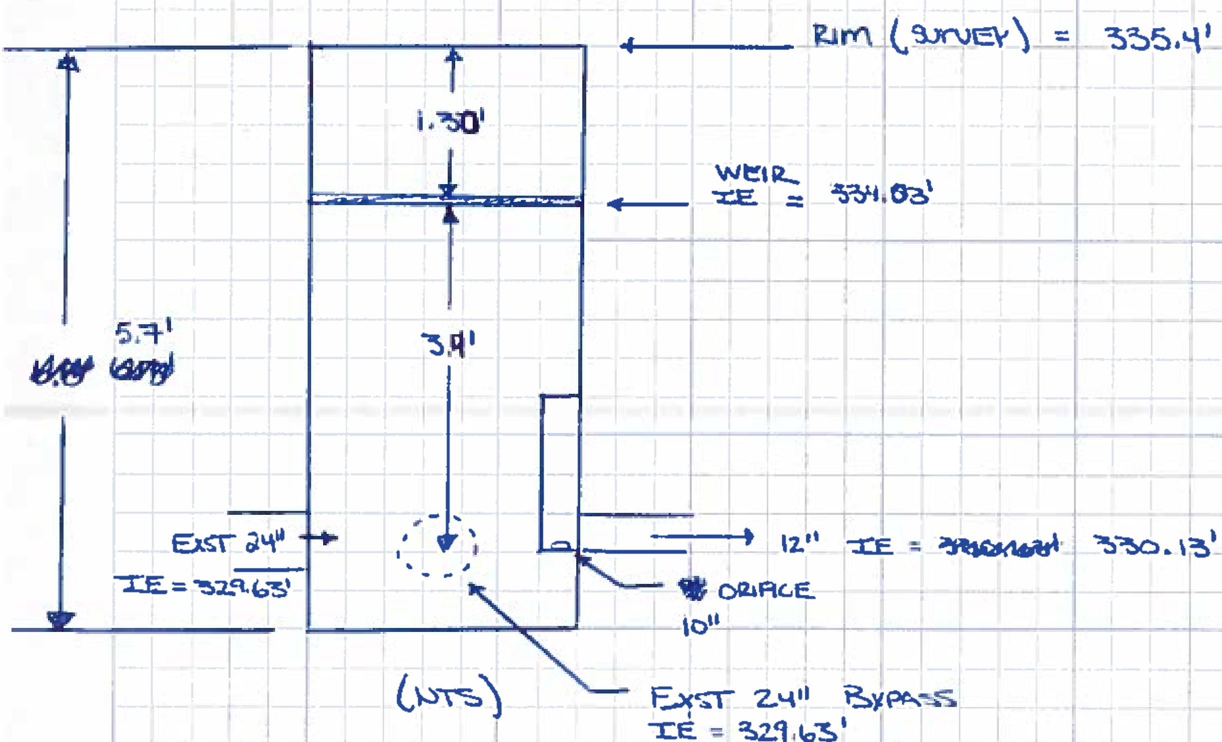
TETRA TECH
Surface Water Group

Client ____ Job No. ____ Page ____ of ____

Project SEAVIEW FLOW SPLIT Date 2/2/15 Date chkd. ____

Subject PERRINVILLE By GW Chkd. by ____





100 - YEAR PEAK FLOW = 15.3 CFS. EQUAL TO 1.0' HEAD OVER WEIR.

Stage over Orifice (ft)	Orifice Control Discharge (cfs)	Weir Discharge (cfs)
0	0.00	0
0.1	0.86	0
0.2	1.21	0
0.3	1.49	0
0.4	1.72	0
0.5	1.92	0
0.6	2.10	0
0.7	2.27	0
0.8	2.43	0
0.9	2.57	0
1	2.71	0
1.1	2.84	0
1.2	2.97	0
1.3	3.09	0
1.4	3.21	0
1.5	3.32	0
1.6	3.43	0
1.7	3.54	0
1.8	3.64	0
1.9	3.74	0
2	3.84	0
2.1	3.93	0
2.2	4.02	0
2.3	4.11	0
2.4	4.20	0
2.5	4.29	0
2.6	4.37	0
2.7	4.46	0
2.8	4.54	0
2.9	4.62	0
3	4.70	0
3.1	4.78	0
3.2	4.85	0
3.3	4.93	0
3.4	5.00	0
3.5	5.07	0.54
3.6	5.15	1.52
3.7	5.22	2.79
3.8	5.29	4.30
3.9	5.36	6.01
4	5.42	7.90
4.1	5.49	9.96
4.2	5.56	12.16
4.3	5.62	14.51
4.4	5.69	17.00
4.5	5.75	19.61
4.6	5.82	22.35
4.7	5.88	25.20

ORIFICE EQUATION:
Q = (C*A) * (sqrt(2*g*H))

Orifice Coefficeint =	0.62
Orifice Diameter (in) =	10.0
Orifice Area (ft^2) =	0.55

WEIR EQUATION:
Q = (C*L) * (H^1.5)

Weir Coefficeint =	3.00
Weir Length (ft) =	5.67

WQ Volume	2.2	ac-ft	from WWHM model		
	95,832	cf		2.24	AC-FT
30% of WQ Vol. for Presettling	28,750	cf	pg 6-1 Vol. 5	97,574	CF
Each Pipe Volume @ 7 ft dia. X 156 ft	6,000	cf			
Infiltration Vault Model					
6x80x60					
Total Facility Volume Needed					
Infiltration	33,600	cf	from WWHM		
Pre-settling	28,750	cf	from WWHM		
	62,350	cf			

See CMP worksheet

1. Use pipes as presettling wq water level.
2. Outlet pipe at SW corner to distribute water from tanks after settling to gravel infiltration below pipes.
3. Overflow outlet at north end in pipes for emergency overflow.

Pretreatment. Presettling basins are often used to remove sediment from runoff prior to discharge into other treatment facilities. Basic treatment facilities, listed in Step 6 – Figure 2.1, can also be used to provide pretreatment. Pretreatment often must be provided for filtration and infiltration facilities to protect them from clogging or to oil/water separator.

Design Criteria
1. A presettling basin shall be designed with a wetpool. The treatment volume shall be at least 30 percent of the total volume of runoff from the 6-month, 24-hour storm event.
2. If the runoff in the Presettling Basin will be in direct contact with the soil, it must be lined per the liner requirement in Section 4.4.
3. The Presettling Basin shall conform to the following:
a) The length-to-width ratio shall be at least 3:1. Berms or baffles may be used to lengthen the flowpath.
b) The minimum depth shall be 4 feet; the maximum depth shall be 6 feet.
4. Inlets and outlets shall be designed to minimize velocity and reduce turbulence. Inlet and outlet structures should be located at extreme

ends of the basin in order to maximize particle-settling opportunities.

pg 4-1 vol V
Wetpool facilities are sized based upon use of the NRCS (formerly known as SCS) curve number equations in Chapter 2 of Volume III, for the 6-month, 24-hour storm. Treatment facilities sized by this simple runoff volume-based approach are the same size whether they precede detention, follow detention, or are integral with the detention facility (i.e., a combined detention and wetpool facility).
Unless amended to reflect local precipitation

DYODS™

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CONTECH CMP DETENTION SYSTEMS

CONTECH CONSTRUCTION PRODUCTS INC.

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dyods@contech-cpi.com

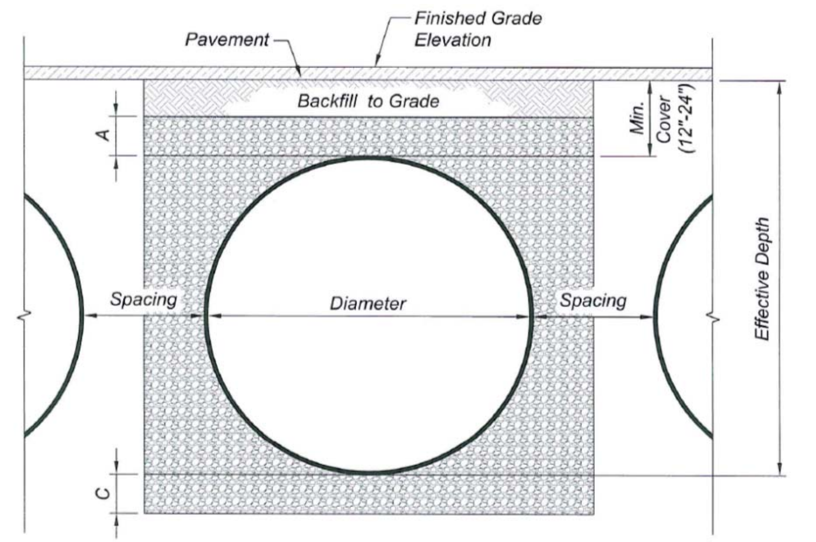
Project Summary

Date:	9/1/2014
Project Name:	Seaview Park - Perrinville
City / County:	Edmonds
State:	WA
Designed By:	Eric Mendel
Company:	Tetra Tech
Telephone:	206-389-4980

Enter Information in Blue Cells

Corrugated Metal Pipe Calculator

Storage Volume Required (cf):	62,350	
Limiting Width (ft):	60.00	
Effective Depth Below Asphalt (ft):	10.00	
Solid or Perforated Pipe:	Perforated	
Shape Or Diameter:	84	38.48 ft^2 Pipe Area
Spacing between Barrels (ft):	3.00	
Stone Width Around Perimeter of System (ft):	1	
Depth A: Porous Stone Above Pipe (in):	0	
Depth C: Porous Stone Below Pipe (in):	48	
Stone Porosity (0 to 40%):	40	



System Sizing

Use Custom Layout (at right) for layout adjustment

Pipe Storage:	36,022 cf	
Porous Stone Storage:	26,608 cf	
Total Storage Provided:	62,630 cf	100.4% Of Required Storage
Number of Barrels:	6 barrels	
Length Per Barrel:	156.00 ft	
Rectangular Footprint (W x L):	59. ft x 158. ft	

CONTECH Materials

Total CMP Footage:	936 ft
Approximate Total Pieces:	42 pcs
Approximate Coupling Bands:	36 bands
Approximate Truckloads:	21 trucks

Construction Quantities**

Total Excavation:	3453 cy
Porous Stone Backfill For Storage:	2464 cy Stone
Backfill to Grade Excluding Stone:	-345 cy Fill

Construction quantities are approximate and should be verified upon final design

Custom Layout

To adjust layout, enter desired barrel length in the light blue boxes below.

Excess Footage = 0

Barrel 12	0
Barrel 11	0
Barrel 10	0
Barrel 9	0
Barrel 8	0
Barrel 7	0
Barrel 6	156
Barrel 5	156
Barrel 4	156
Barrel 3	156
Barrel 2	156
Barrel 1	156