APPENDIX E

Drainage Report

Port Gamble Redevelopment Plan

PRELIMINARY PLAT DRAINAGE REPORT

Kitsap County, Washington

Submitted by:
Pope Resources, a Delaware Limited Partnership
By: Olympic Property Group, LLC, its manager
19950 7th Avenue Northeast, Suite 200
Poulsbo, Washington 98370

Issued: January 17, 2013
Revised: August 20, 2018

BEAU J. WILLERT
STATE OF WASHINGTON
54972
REGISTERED
PROFESSIONAL ENGINEER
8/21/18

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DAVID EVANS
AND ASSOCIATES INC.

TABLE OF CONTENTS

LIST OF SUPPLEMENTAL INFORMATION

SECTION 1

Vicinity Map

SECTION 2

Groundwater Recharge Basin Exhibit
WWHM Recharge Module Output

SECTION 3

Watershed Delineation Exhibit
Kitsap County Critical Aquifer Recharge Map
Kitsap County Geologically Hazardous Area Map
Kitsap County Surface Waters Map
FEMA FIRM Panels

SECTION 4

Soil Survey

SECTION 5

Flow Splitter Exhibit
WWHM Output for Flow Splitter
Wetland Recharge Exhibit
WWHM Wetland Recharge Calculations
Recreation Detention Pond and Wetpool Basin Exhibit
WWHM Output for Recreation Detention Pond

SECTION 6

Water Quality Pond Basins Exhibit
Kitsap County Rainfall Map
Stormfilter Basin Exhibits (East and West)
WWHM Output for Stormfilter
Stormfilter Sizing Table
Rain Garden Basin Exhibits (Alternative 1, Alternative 2, and Town Site site plans)
WWHM Rain Garden Output
Rain Garden Sizing Table (Alternatives 1 and 2)

SECTION 7

Conveyance Basins Exhibit (Alternative 1 and 2 site plans)
WWHM Output for Conveyance Flows
Manning's Equation Calculation

1 Executive Summary

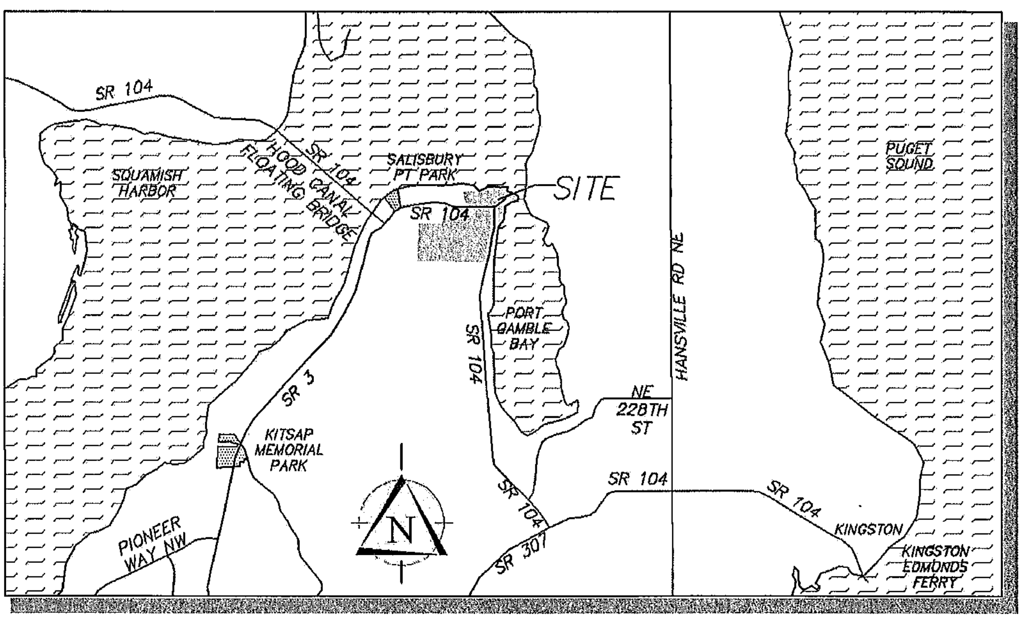
The Port Gamble preliminary plat is located approximately one mile east of the Hood Canal Bridge on both sides of State Route 104 (SR 104). More generally, it is located in portions of Sections 5, 6, 7, and 8, Township 27 North, Range 2 East in Kitsap County; see the vicinity map on the next page. Port Gamble was established as a "company town" adjacent to a waterfront lumber mill in the mid-nineteenth century. When the mill closed in 1995, it was the longest active mill in the country. The National Parks Service designated the town as a National Historic District in November of 1966. The project proposes to preserve Port Gamble's historical features and values while providing additional residential, commercial and retail development along with updated services and amenities. The Port Gamble property is owned by Pope Resources, as a successor to, Pope and Talbot, who previously owned and operated the mill. Olympic Property Group (OPG), a wholly owned subsidiary of Pope Resources, now manages the property.

The Port Gamble preliminary plat area consists of approximately 318.2 acres of land. The preliminary plat proposes to develop single and non-single family residential, commercial development, parks, passive use and natural open space. The preliminary plat also seeks to develop the site's sewer and water utilities, stormwater and transportation infrastructure to support this development. The proposed stormwater infrastructure will implement water quality treatment for areas in the existing condition, currently untreated. See the Project Narrative submitted with the preliminary plat submittal for more description of the project.

The project site includes waterfront property and is bordered by Port Gamble Bay to the east and Hood Canal to the north. The existing development on the site is a mix of residential, industrial and commercial uses. The north portion of the project area includes the historic town of Port Gamble, referred to in this report as "the Town Site", which consists of several single-family residences, open space and a downtown area that hosts several shops and restaurants. Along the waterfront, in the northeastern corner of the property, there use to be a lumberyard and several docks, this area is referred to in this report as "the Mill Site".

The Mill Site is approximately 25 acres and is bordered to the east by Port Gamble Bay and by Hood Canal to the north. The Mill Site is flat and low lying, having an elevation of 10 to 14 feet above Hood Canal and Port Gamble Bay. The landward edges of the Mill Site slope steeply up to the town of Port Gamble, approximately 40 feet above the Mill Site. The Mill Site is accessed by an existing asphalt access road that runs down the bluff from the Town Site. The Mill Site was once used as a lumber mill and port with a lumberyard and docks. Since then, the Mill Site has undergone a cleanup and all structures have been removed, except for the marine lab.

The preliminary plat has two proposed site plans for the Mill Site. One site plan, "Alternative 1" includes development over the previously mentioned portions of the Mill Site. The other site plan, called "Alternative 2" leaves portions of the Mill Site undeveloped. Stormwater management strategies have been developed for both of these site plan alternatives and are discussed within this report.



VICINITY MAP

The south portion of the project site is currently undeveloped and consists of forested area, an open grass field, and a stream running to the north. A 7.9-acre tract located in the southeast corner of the project is proposed to be developed by this project for recreational uses. This tract is referred to as the "Recreation tract" throughout this report. Machias Creek flows north along the west property line into Hood Canal via a new pocket beach outfall. Another stream, Ladine-DeCoteau Creek, flows south off site into Port Gamble Bay. There are several wetlands on site, particularly along the south perimeter of the project.

This report has been prepared to address the stormwater management of the Port Gamble Preliminary Plat as required by the 2010 Kitsap County Stormwater Design Manual. Construction of proposed stormwater facilities described in this report are proposed to be phased as needed to accommodate the development of the project.

2 Minimum Requirements

This preliminary plat application will comply with the following Minimum Requirements as outlined in Section 12 of the Kitsap County Code.

Minimum Requirement #1: Plans and Reports

This report, along with the submitted plans serve to satisfy Minimum Requirement 1, to submit plans and reports in accordance with the criteria stipulated by the Kitsap County Drainage Manual.

Minimum Requirement #2: Stormwater Pollution Prevention Plans (SWPPPs)

See *Section 10: Stormwater Pollution Prevention Plan.*

Minimum Requirement #3: Source Control of Pollution

This project will comply with this minimum requirement. Specific BMPs will be addressed under the final engineering phase when all specified land uses and potential pollution sources have been identified.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

In the existing condition, stormwater runoff from the site flows into Port Gamble Bay or Hood Canal either directly via surface flow and an existing storm drainage system or indirectly through Machias Creek and Ladine-DeCoteau Creek. A portion of the site's runoff flows to on-site wetlands prior to entering these creeks.

In the developed condition, stormwater will flow to Port Gamble Bay and Hood Canal through proposed stormwater outfalls. A portion of the proposed stormwater system will discharge to Machias Creek and Ladine-DeCoteau Creek via a level spreader from proposed stormwater ponds. Wetland recharge will be accomplished by routing roof runoff to onsite wetlands. See *Section 5: Flow Control.*

Minimum Requirement #5: On-site Stormwater Management

This project will maintain the average annual volume of water that infiltrates onsite at or above predevelopment levels. The proposed developed area within the site was found to be 153 acres. This was modeled as forest with type C soils (see attached soil survey at the end of Section 4) in the Western Washington Hydrologic Model 3 (WWHM) computer program. The predeveloped average annual recharge volume was found to be 112.13 acre-feet by the WWHM recharge module. For stormwater modeling purposes, in order to generate a post development average annual recharge volume, the following developed conditions were used; Alternative 1 site plan disturbed area (large impact area, thus providing a more conservative volume), 60% impervious and 40% pervious proposed lot/tract coverage. The post developed average annual recharge volume was found to be 35.38 acre-feet by the WWHM recharge module. A figure showing the modeled areas of the project site as well as the WWHM recharge module analysis are attached at the end of this section

The developed site sewer system will be served by a membrane bioreactor (MBR) wastewater facility that discharges to a large onsite septic system, which will disperse treated water back into the project area's groundwater. The annual daily flow rate for this system is estimated to be 90,000 gallons per day; this is equal to 100 acre-feet per year. When this recharge water volume is added to the post-developed average annual recharge volume, the total infiltrated volume is 135.38 acre-feet, greater than the modeled predeveloped recharge volume of 112.13 acre-feet.

Minimum Requirement #6: Runoff Treatment

Basic water quality treatment is required by the Kitsap County Stormwater Design Manual. The manual specifies that enhanced treatment will not be required for this project as stormwater is discharged directly to salt water. Based on the current plans, basic water quality treatment will be achieved through the use of rain gardens, Contech Stormfilters, and stormwater quality ponds. However, other water quality treatment facilities may be considered with final engineering plans. See *Section 6 – Water Quality Design.*

Minimum Requirement #7: Flow Control

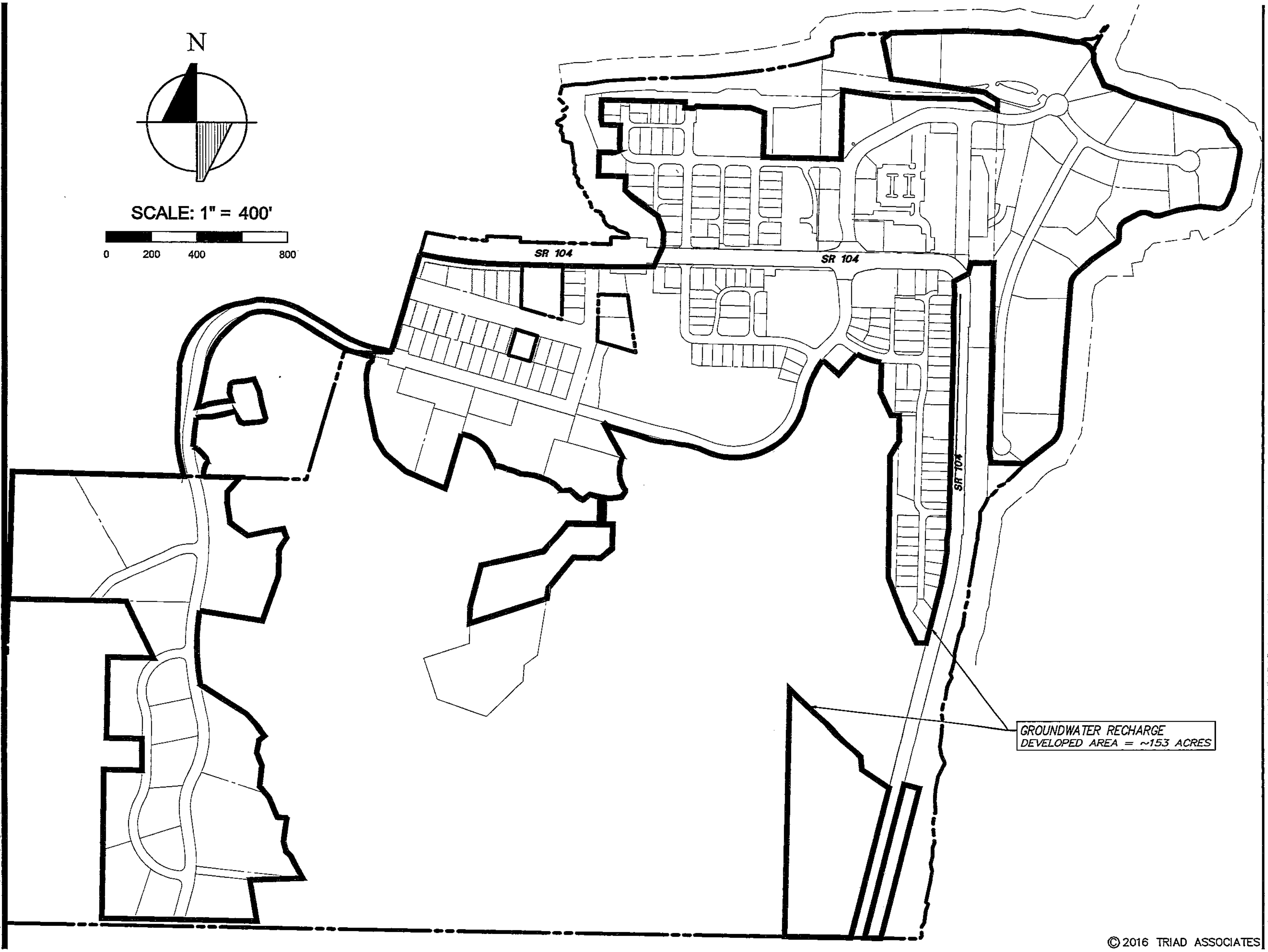
The majority of the project's runoff will discharge directly to salt water and therefore flow control will not be required for these portions of the site. A portion of the stormwater tributary to the proposed stormwater ponds will discharge into Machias Creek, Ladine-DeCoteau Creek, wetlands, and existing drainage features. These discharges will meet the flow control standards set forth in the Kitsap County Stormwater Design Manual. See *Section 5 – Flow Control.*

Minimum Requirement #8: Wetlands Protection

The *Wetland and Stream Delineation Report* has been prepared by GeoEngineers to identify and discuss critical areas onsite. This report is identified in *Section 8 – Special Reports*. Buffers around wetlands have been provided based on the recommendations in the *Critical Areas Report.* Roof runoff from a portion of the proposed development will be diverted to the wetlands via splash blocks or level spreaders to provide wetland recharge. See *Section 5 – Flow Control.*

Minimum Requirement #9: Operation and Maintenance

This project will satisfy the operation and maintenance requirements with specific measures and plans to be provided in final engineering.



triad
20300 Woodinville Snohomish Rd NE
Suite A • Woodinville, WA 98072
p: 425.415.2000 f: 425.486.5059
w: triadassociates.net

GROUNDWATER RECHARGE

PORT GAMBLE
REDEVELOPMENT PLAN

KITSAP COUNTY, WASHINGTON

STAMP NOT VALID UNLESS SIGNED AND DATED

JOB NO. 08-029

SHEET NO. 1 OF 1

tjw, Aug 31, 2017 – 11:13am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0831 RECHARGE exhibit.dwg, GROUNDWATER RECHARGE

Western Washington Hydrology Model
PROJECT REPORT

Project Name: 12-1204
Site Address:
City :
Report Date : 12/24/2012
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 0.80
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	153

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	61

Impervious Land Use	Acres
ROADS MOD	92

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.602082
5 year	2.571117
10 year	3.108721
25 year	3.66228
50 year	3.993989
100 year	4.268123

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	25.060575
5 year	34.304517
10 year	40.98511
25 year	50.082403
50 year	57.348287
100 year	65.043542

POC #1 Recharge

Average Annual Recharge for POC: 1

Acre-Feet

Predeveloped: 112.13

Mitigated: 35.38(+ 100 from LOSS) = 135.38

Pass/Fail: ~~Failed~~ 135.38 > 112.13 therefore PASS

Water Quality BMP Flow and Volume for POC 1.

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 **cfs.**

Adjusted for 15 min: 0 **cfs.**

Off-line facility target flow: 0 **cfs.**

Adjusted for 15 min: 0 **cfs.**

Perlnd and Implnd Changes

No changes have been made.

---

3 Level 1 Downstream Analysis

3.1 Existing Drainage System

The Project's watershed has been delineated using LIDAR contours. The majority of the runoff generated within the preliminary plat area flows directly into Hood Canal or Port Gamble Bay. A portion of the site drains to Machias Creek, which flows into Hood Canal at the west edge of the preliminary plat boundary. A portion of the runoff generated by the preliminary plat area, flows offsite and discharges to Ladine-DeCoteau Creek, which then flows approximately 1,300 feet south of the preliminary plat boundary and eventually into Port Gamble Bay. The preliminary plat boundary and the tributary offsite drainage area, make up the project's study area. The study area is presented in the *Watershed Delineation Exhibit*, provided at the end of this section.

The majority of the runoff currently generated by the developed portions of the study area, either flow directly into Hood Canal, Port Gamble Bay or Machias Creek, without the aid of any storm drainage system. In the existing condition, a system of ditches and culverts run parallel SR 104 and collect surface runoff from the state route and minor roads. The ditches and culverts direct flows into Machias Creek, which eventually discharges into the Hood Canal. The ditch system is in good working condition, as of a November 14, 2012. Runoff from the Town Site that does not make it into the ditch system, flows along the road or overland into the Mill Site. As of January of 2017, the in-water portion of Port Gamble Bay and the Mill Site (former sawmill facility) cleanup were completed. Work for the cleanup begin in early 2015. Prior to cleanup efforts, the existing outfalls to Hood Canal and Port Gamble Bay were plugged to eliminate potential stormwater from leaving the site untreated. Additionally, any existing asphalt or concrete was perforated and a berm was provided along the perimeter of the cleanup site. All stormwater entering the Mill Site is contained and filtered before entering Port Gamble Bay or Hood Canal.

The site's topography consists of flat to moderate slopes throughout the Town Site with steep slopes at the edge of the Town Site sloping down to the Mill Site and waterfront. There are also steep slopes along the banks of Machias Creek. Existing vegetation varies from large tracts of evergreen and deciduous trees and undergrowth to large open grassy areas to landscaped developed areas. The Town Site is covered by large grassy areas interspersed with a few trees and landscaped gardens. The Mill Site is free of vegetation, the ground there being firmly compacted bare earth or pavement.

Machias Creek runs from south to north along the western edge of the Town Site. There are wetlands along the stream and to the south of the Town Site. Machias Creek conveys a portion of the study area's runoff to Hood Canal. Machias Creek runs through a ravine that is about 70' deep with steeply banked side slopes. The banks of the creek are heavily vegetated and appear to have no erosion problems. Machias Creek flows through a 36-inch pipe culvert, which is 140-feet long, to pass under SR 104 and through another pipe culvert to pass under a seldom-used utility road further south of the Town Site. These culverts were examined, measured, and found to be in working condition as of the November 14, 2012 site visit. Ladine-DeCoteau Creek, which flows off the project site, flows through a concrete box culvert, 3-foot wide and 3-foot deep, under SR 104 to discharge into Port Gamble Bay. The box culvert was inspected and found to be working during the November 14, 2012 site visit.

South of the Town Site, and north of the Recreation tract, there are tracts of wetlands that have been delineated by GeoEngineers in their *Wetland and Stream Delineation Report*. There is a substantial amount of standing water over portions of these wetlands, possibly the result of several beaver dams observed during the November 14th site visit.

In general, the stormwater systems serving the developed portions of the project site appear to be performing adequately. There are no known major drainage issues within the study area.

3.2 Downstream Analysis Study Area

The total area of the Preliminary plat boundary is approximately 320.2 acres. The total area of the study area being considered in this downstream analysis is approximately 359 acres. In the Watershed Delineation Figure, the project area has been split into four basins, labeled

A, B, C and D. See the attached Watershed Delineation Exhibit, presented at the end of this section.

Basin A has an area of 188.9 acres and discharges flows into Machias Creek, which flows north into Hood Canal. 5.9 acres within the Preliminary Plat boundary in Basin A does not flow to Machias Creek, but flows north off of the site and eventually into Hood Canal. This area is undeveloped in the current site plan, however if this area is to be developed stormwater management features will be extended to the area. 23.8 acres of land outside of the project boundary flows onto the project site, and eventually into Machias Creek.

Basin B is 25.6 acres and flows north into Hood Canal. Basin C is 54.2 acres and flows into Port Gamble Bay. Basin D is 90.0 acres and discharges flow south, off of the project area into Ladine-DeCoteau Creek, which flows into Port Gamble Bay approximately 1,300 feet downstream. Approximately 5.4 acres of land outside of the Preliminary Plat boundary drains into Basin D. There is an additional area of approximately 240 acres that flows into Ladine-DeCoteau Creek that is not contained in the Preliminary Plat boundary.

Numerous physical inspections of the preliminary plat project site and study area have been conducted by Triad in the form of formal surveys and directed site visits by TRIAD staff. Specifically, a site visit of November 14, 2012 was used to verify the information presented in this downstream analysis.

3.3 Resource Review

A review of the available resources in regards to potential and existing water quality, runoff volumes and rates, flooding, and streambank erosion problems within the study area has been conducted in an attempt to identify potential drainage issues. The information gained from this review has been incorporated into this downstream analysis and has been utilized by the preliminary plat drainage report and design. As-built information for existing stormwater systems, along with literature, maps and classifications made available by Kitsap County were also examined.

The following information was obtained through a study of resources available via the Kitsap County web site:

Portions of the site are within a Category One ("Potential for certain land use activities to adversely affect groundwater is high") and Category Two ("Provide recharge to aquifers that are currently or will become potable water supplies and are vulnerable to contamination based on the type of land use activity"). Critical Aquifer Recharge Areas are based on the June 2007 Critical Aquifer Recharge Area map accessed from the Kitsap County Website. Impacts related to these critical areas will be further analyzed through the Environmental Impact Statement process.

Portions of the site lie within geologically hazardous areas describes as "High Hazard Areas: Slopes >30% & Unstable" and as "Moderate Hazard Areas: Slopes 15%-30% and/or other geologic issues" by the June 2007 Geologically Hazardous Area map accessed from the Kitsap County website. Buffer zones have been determined by Terracon in their report "Geotechnical Setback Review, Port Gamble Redevelopment" dated September 27, 2017. Development will occur in compliance with the regulations associated with these geologic hazard areas.

Machias Creek is not marked or named in the Surface Waters map dated December 2007 accessed from the Kitsap County website.

FEMA FIRM number 53035C0105E addresses the flood zones on the project site and is attached at the end of this section. The Mill Site is shown within the existing floodplain. However, it is proposed to be filled to an elevation of 16, above the floodplain.

Wetlands within the project boundary have been identified by GeoEngineers in their "Wetland and Stream Baseline Date Report" dated January 27, 2015. This report can be found in Section 8. These wetlands are shown on the attached watershed delineation.

3.4 Responses to Table 4.11 – Evidence of Predicted Problems

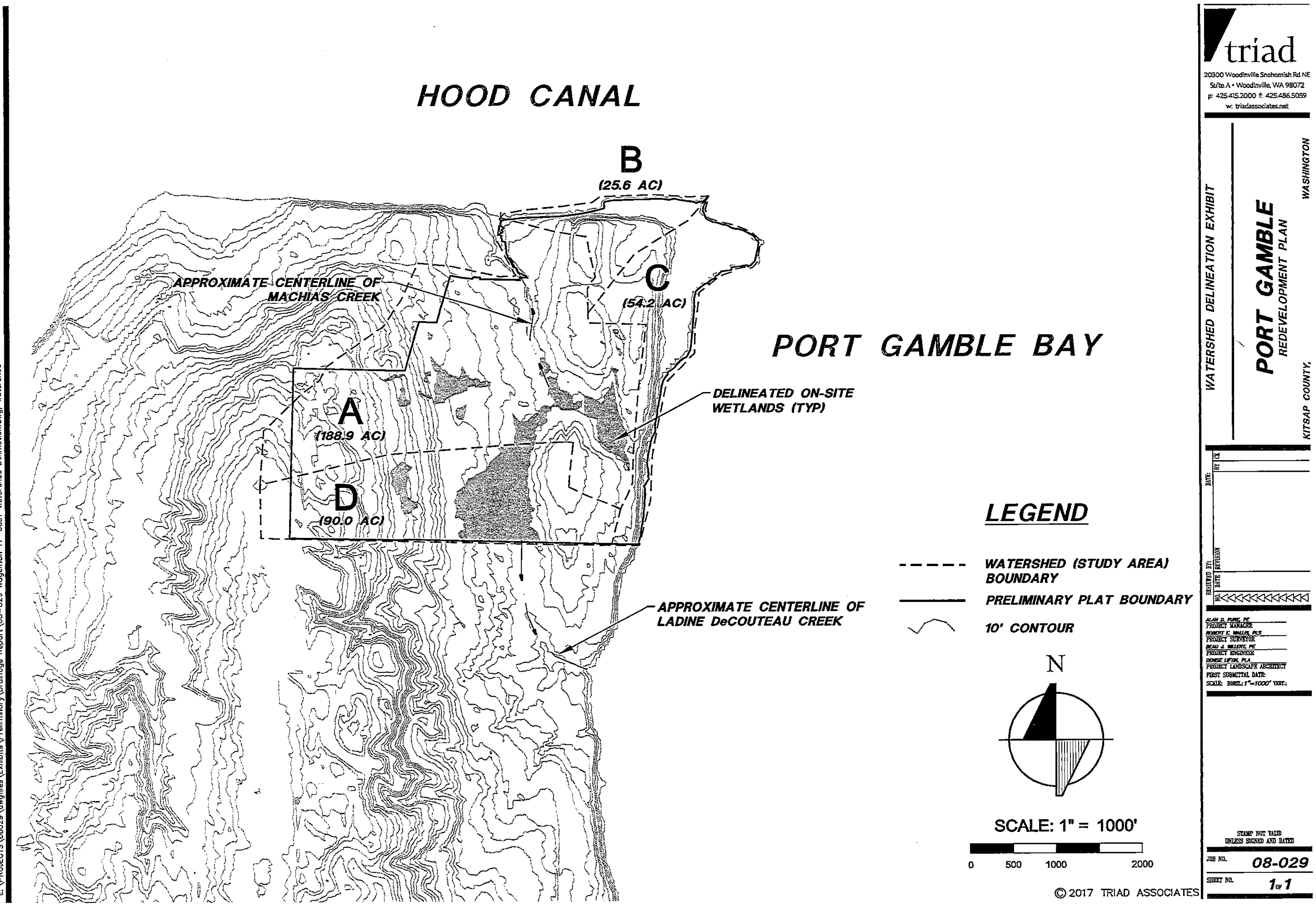
Based on the reviewed information of the study area, responses to the questions presented by Table 4.11 of the Kitsap County Stormwater Design Manual are given below:

1. **Evidence of potential for contamination of surface waters.** No evidence of surface water contamination was observed during site visits.

2. **Overtopping, scouring, bank sloughing or sedimentation.** Based on our inspection of the creek system, drainage ditches, and conveyance systems there appears to be no overtopping, scouring, bank sloughing, or sedimentation problems within the basin. The potential for these problems appears to be minimal.

3. **Significant destruction of aquatic habitat or organisms.** Based on our field inspection, there appears to be no significant destruction of aquatic habitat or organisms. In its current condition, the study area does not appear to have problems in this area.

4. **Evidence of potential for contamination of groundwater.** There appears to be a minimal risk of groundwater contamination in the study areas current configuration. There is a possibility of groundwater contamination occurring through accidental spills associated with traffic passing through the site.



HOOD CANAL
PORT GAMBLE BAY
B
(25.6 AC)
C
(54.2 AC)
A
(188.9 AC)
D
(90.0 AC)
APPROXIMATE CENTERLINE OF MACHIAS CREEK
DELINEATED ON-SITE WETLANDS (TYP)
APPROXIMATE CENTERLINE OF LADINE DeCOUTEAU CREEK
LEGEND
WATERSHED (STUDY AREA) BOUNDARY
PRELIMINARY PLAT BOUNDARY
10' CONTOUR
N
SCALE: 1" = 1000'
0
500
1000
2000
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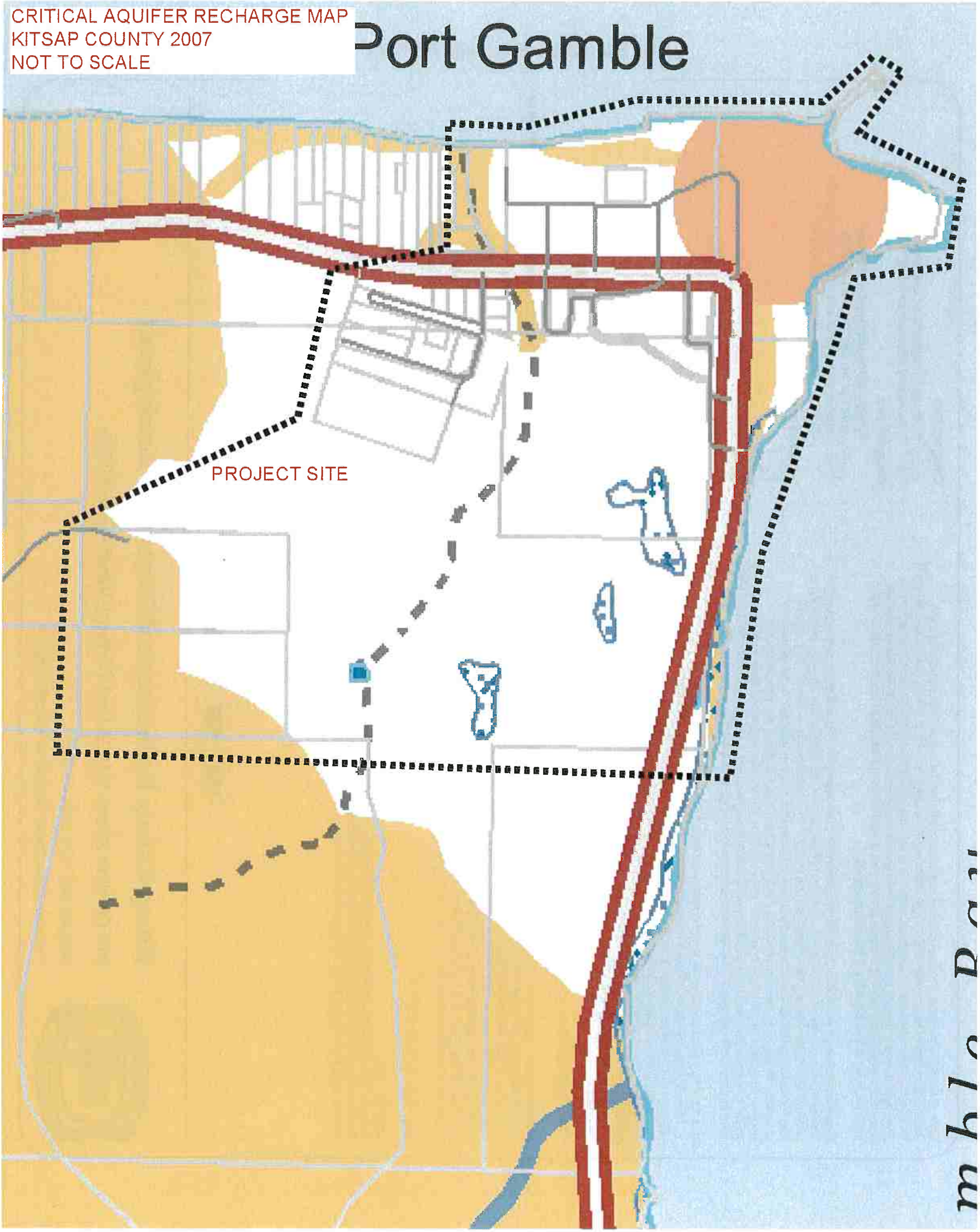
w: triadassociates.net
WATERSHED DELINEATION EXHIBIT
PORT GAMBLE
REDEVELOPMENT PLAN
KITSAP COUNTY,
WASHINGTON
STAMP NOT VALID UNLESS SIGNED AND DATED
JOB NO. 08-029
SHEET NO. 1 OF 1


CRITICAL AQUIFER RECHARGE MAP
KITSAP COUNTY 2007
NOT TO SCALE
Port Gamble
PROJECT SITE

Critical Aquifer Recharge Map Key

Critical Aquifer Recharge Areas – Kitsap County has adopted, based on information from the Washington State Department of Ecology, a conservative approach based on a worst-case scenario for contamination movement to groundwater, and will use wellhead protection area boundaries (five- and ten-year time of travel) derived from sound analytical and numerical modeling, and will also incorporate waterbearing surface geology as a method to identify and classify CARAs which includes a list of five Significant Recharge Areas.

Potable water is an essential life-sustaining element. The majority of Kitsap County drinking water comes from groundwater supplies in aquifers. Critical aquifer recharge areas are very important to shallow and deepwater aquifer recharge. The intent of this ordinance is to identify and classify aquifer recharge areas and address land use activities that pose a potential to contaminate or otherwise threaten aquifer water quality. This ordinance shall not affect any right to use or appropriate water as allowed under state or federal law. In addition, these requirements do not apply to those activities, which have potential contaminant sources below threshold amounts as set forth in applicable statutes of the Revised Code of Washington or local regulations.

It is the policy of Kitsap County to accomplish the following:
A. Identify, preserve and protect aquifer recharge areas, identify areas susceptible to contamination and prevent degradation of the quality of potable groundwater;
B. Recognize the relationship between surface and groundwater resources; and,
C. Give priority to potable water resource areas per WAC 365-190-080 (2) in the planning and regulation of land uses that may contaminate or degrade groundwater.
D. Balance competing needs for water supply while preserving essential natural functions and processes.

* THIS MAP IS NOT A SUBSTITUTE FOR FIELD SURVEY *

Determination of fitness for use lies with the user, as does the responsiblity for understanding the accuracy and limitations of this map and data. There is no guarantee or warranty to its accuracy as to labeling, placement or location of any geographic features present on this map. These data are intended for informational purposes only, and should not be considered authoritative for engineering, navigational, surveying, and other site-specific uses. Kitsap County assumes no legal liability arising from the use of this map in a manner not consistent with the original intent. In no event shall Kitsap County be liable for damages of any kind, including loss of anticipated benefits arising from the use of this map and data.

Map Date: June 27, 2007

Data Sources:
Ownership parcels created by Kitsap County IS-GIS--Hydro data from WA. DNR 2007
Transportation information from Kitsap County CENCOM--Soils data from SCS Soils Surveys
Aquifer data from Kitsap Public Utilities District--Wellhead Protection Zones from KPUD and WA Dept of Health

Category One

Potential for certain land use activities to adversely affect groundwater is high

Category Two

Provide recharge to aquifers that are current or will become potable water supplies and are vulnerable to contamination based on the type of land use activity

Incorporated Cities

Urban Growth Areas

Right-of-Ways

- State HWY/Route
- Principal Arterial
- Secondary Arterial/Collector
- Railroad

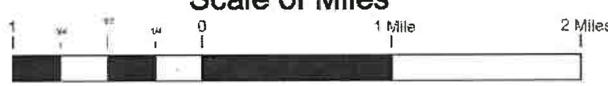
WaterBody Cartographic Feature Code

- Bay, estuary, Puget Sound
- Lake, Pond, Reservoir, Gravel pit or quarry filled with water
- Marsh, wetland, swamp, bog
- DNR, NWI, Surveyed Wetlands

Fish Habitat Water Type Code

- (S) Designated Shoreline of the State
- (F) Fish Habitat
- (N) Non-fish Habitat
- (U) Unknown, unmodeled hydrographic feature.

Scale of Miles

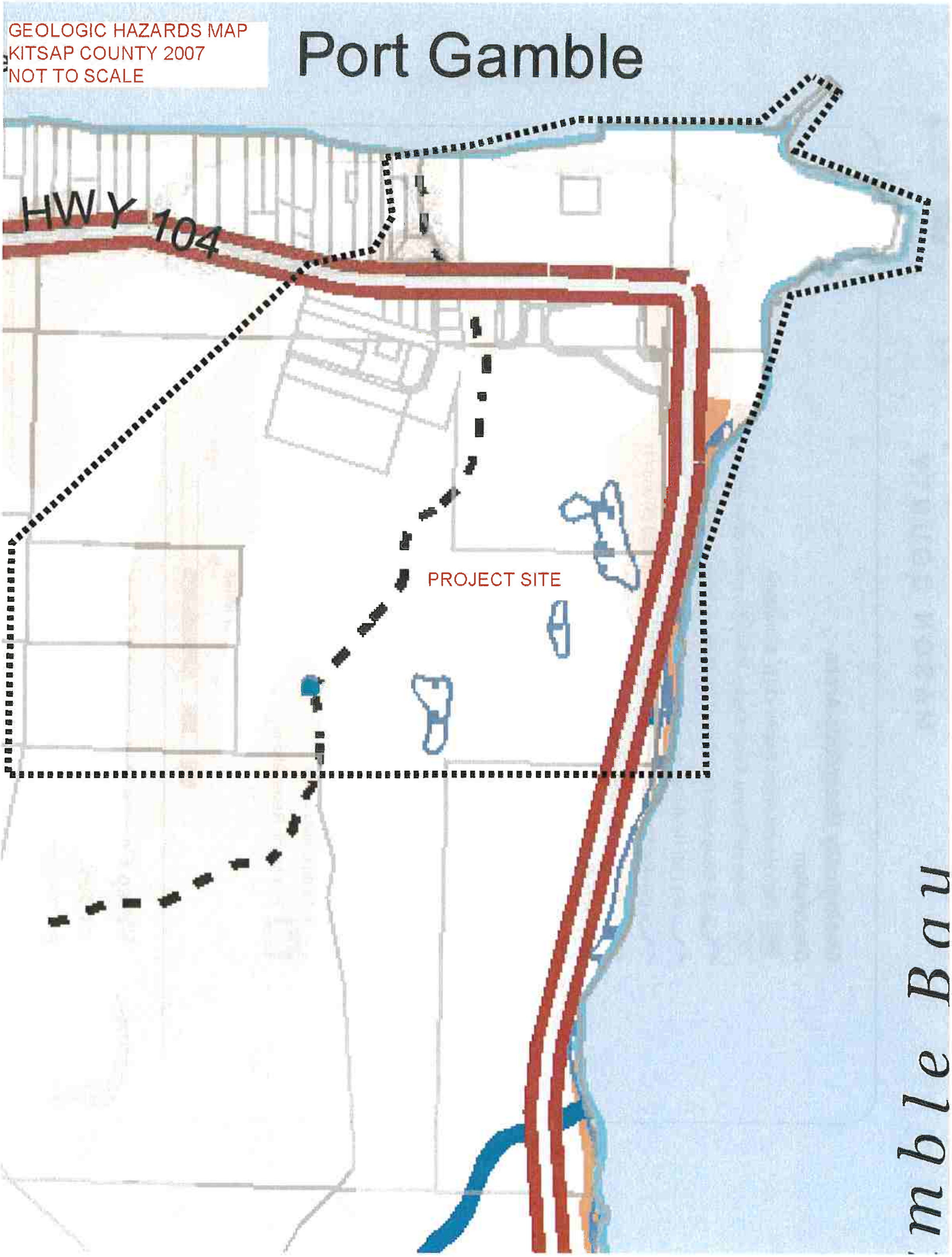


Kitsap County Department of Community Development

614 Division Street, MS-36 Port Orchard, Washington 98366

(360) 337-7181 * FAX (360) 337-4925

Product of Kitsap County Geographic Information System


GEOLOGIC HAZARDS MAP
KITSAP COUNTY 2007
NOT TO SCALE
Port Gamble
HWY 104
PROJECT SITE

Geohazards Map Key

MASON COUNTY

Geologically Hazardous Areas

Description

- High Hazard Areas: Slopes >30% & Unstable
- Moderate Hazard Areas: Slopes 15%-30%, and/or other geologic issues
- (S) Designated Shoreline of the State as defined in WAC 222-16-030
- (F) Fish Habitat as defined in WAC 222-16-030 (2)
- (N) Non-fish Habitat as defined in WAC 222-16-030 (3) and (4)
- (U) Unknown, unmodeled mapped hydrographic feature.

Major Arterials

- State HWY/Route
- Principal Arterial
- Railroad
- Fresh Water
- Wetlands (DNR, NWI, Surveys)
- Saltwater
- Parcels
- Urban Growth Areas
- Incorporated Cities
- Fed Indian Reservations

Scale of Miles

1 0 1 Mile 2 Miles

Kitsap County Department of Community Development

614 Division Street, MS-36 Port Orchard, Washington 98366

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Product of Kitsap County Geographic Information System

Critical Drainage Areas

Critical Drainage Areas

Designated Urban Growth Areas

Designated Urban Growth Areas

Cansus Urbanized Areas

Waterbodies

Puget Sound

Waterbodies (defined in WAC 222-16-030)

Lake, Pond, Reservoir, Gravel pit or quarry filled with water

Boundary Borders

Military Boundary

Military Boundary

City Boundary

City Boundary

Reservation Boundary

Reservation Boundary

UGA Boundary

UGA Boundary

Buildings

Building Footprints

Roads

Roads

Local Roads

State Highway

Collector / Arterial

Local Roads

Streams

Watercourse - DNR and Wildfish Conservancey

(S) Designated Shoreline of the State

(F) Fish Habitat

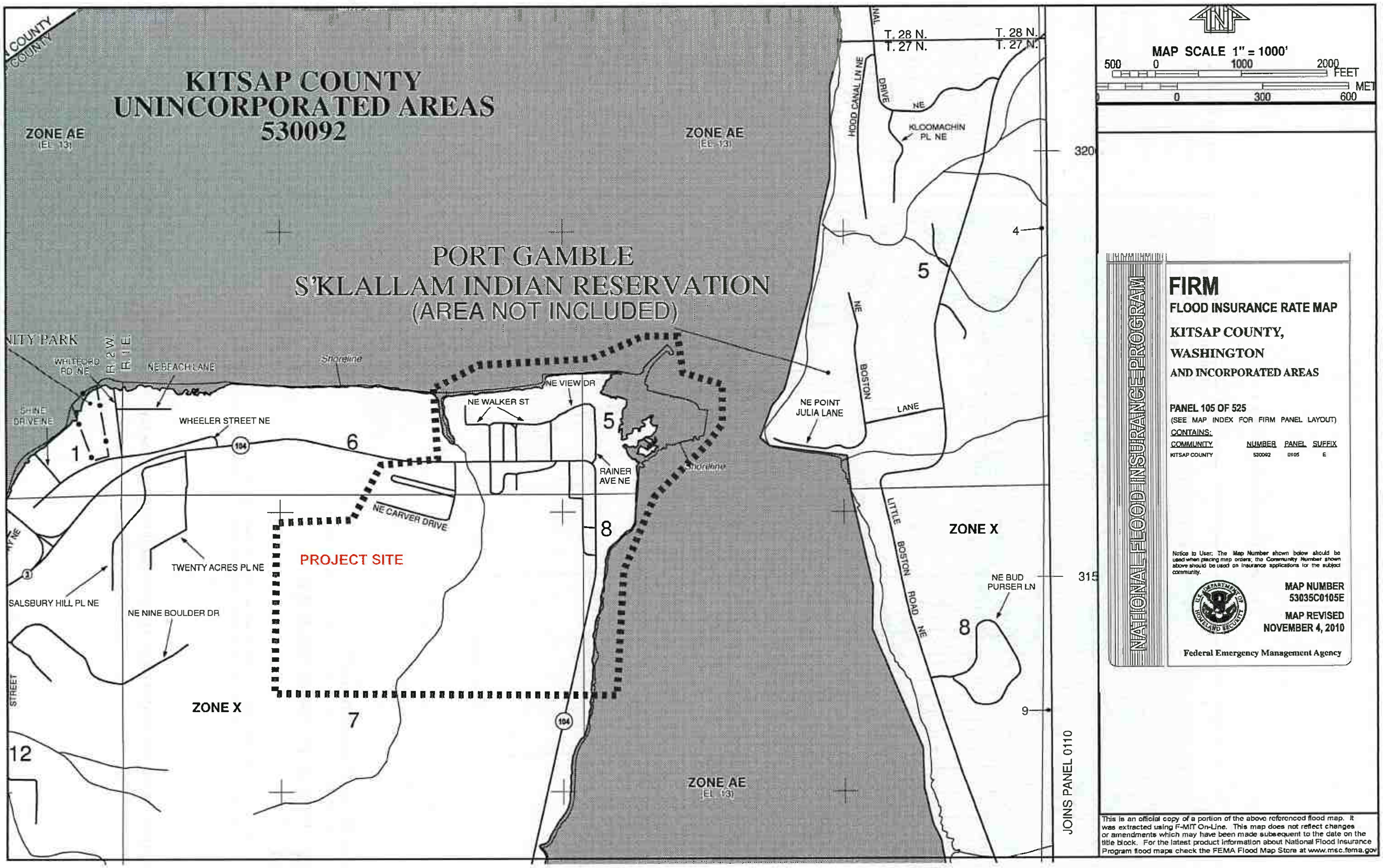
(N) Non-fish Habitat

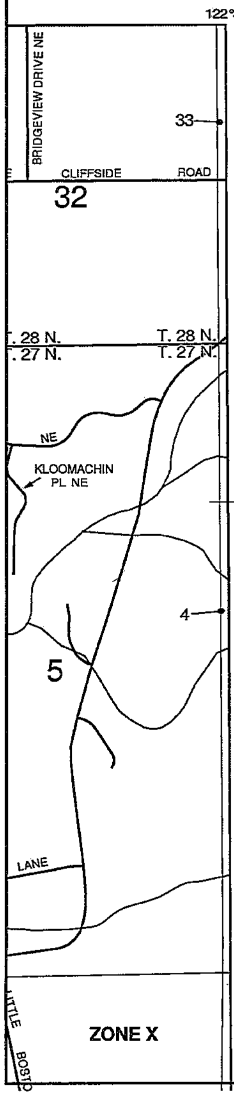
(U) Unknown, unmodaled hydrographic feature

× × No Channel as depicted by DNR

Parcels

Tax Parcels Outlines


KITSAP COUNTY
UNINCORPORATED AREAS
530092
ZONE AE
(EL 13)
PORT GAMBLE
S'KLALLAM INDIAN RESERVATION
(AREA NOT INCLUDED)
WHITFORD RD NE
NE BEACH LANE
SHINE DRIVE NE
WHEELER STREET NE
NE WALKER ST
NE VIEW DR
RAINER AVE NE
NE CARVER DRIVE
PROJECT SITE
TWENTY ACRES PL NE
SALSBURY HILL PL NE
NE NINE BOULDER DR
ZONE X
NE POINT JULIA LANE
HOOD CANAL LN NE
KLOOMACHIN PL NE
BOSTON LANE
LITTLE BOSTON ROAD NE
NE BUD PURSER LN
T. 28 N.
T. 27 N.
R. 2 W.
R. 1 E.
JOINS PANEL 0110
MAP SCALE 1" = 1000'
FEET
METERS
FIRM
FLOOD INSURANCE RATE MAP
KITSAP COUNTY, WASHINGTON
AND INCORPORATED AREAS
PANEL 105 OF 525
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
KITSAP COUNTY 530092 0105 E
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER 53035C0105E
MAP REVISED NOVEMBER 4, 2010
Federal Emergency Management Agency
NATIONAL FLOOD INSURANCE PROGRAM
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

~~~~ 513 ~~~~ Base Flood Elevation line and value; elevation in feet*

~~(EL 987) Base Flood Elevation value where uniform within zone;~~

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

KITSAP COUNTY, WASHINGTON AND INCORPORATED AREAS

PANEL 105 OF 525

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KITSAP COUNTY	530092	0105	E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER 53035C0105E

MAP REVISED NOVEMBER 4, 2010

Federal Emergency Management Agency

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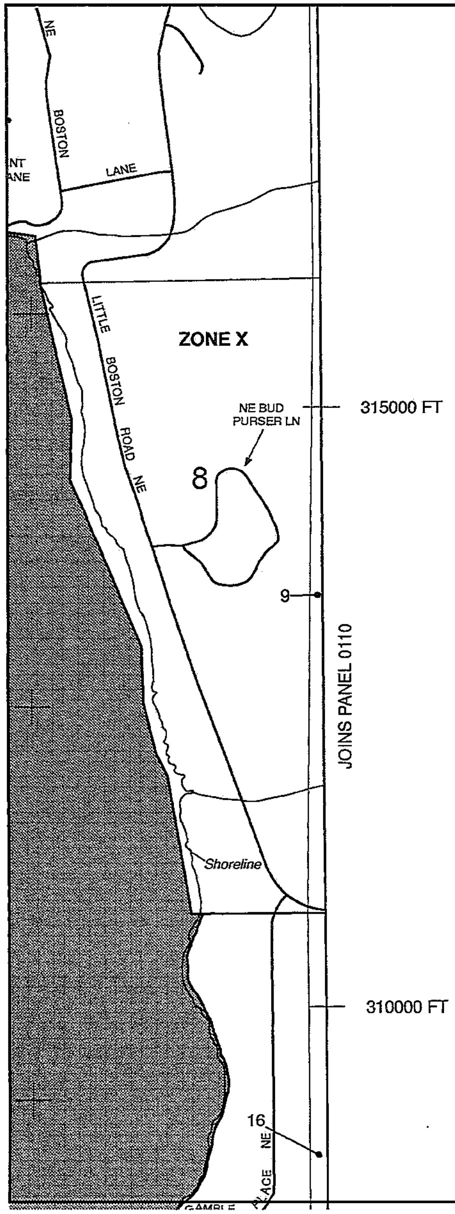

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

~~ 513 ~~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)———(A)	Cross section line
(23)- - - - - - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 10
6000000 FT	5000-foot grid ticks: Washington State Plane coordinate system, north zone (FIPSZONE 4601), Lambert Conformal Conic
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
December 18, 2007

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2010 –to add roads and road names, to incorporate previously issued Letters of Map Revision, and to reflect revised shoreline.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
KITSAP COUNTY, WASHINGTON AND INCORPORATED AREAS

PANEL 105 OF 525
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KITSAP COUNTY	530092	0105	E

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MAP NUMBER
53035C0105E

MAP REVISED
NOVEMBER 4, 2010

Federal Emergency Management Agency

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4 Drainage Concept

4.1 Design Procedures

The stormwater management plan for this project has been designed to comply with the Kitsap County Stormwater Design Manual (KCSWDM) dated February 16, 2010. Per the manual, the Western Washington Hydraulic Model Version 3 (WWHM) has been used to perform hydraulic analyses for the design of the project's drainage. WWHM was used for the design and analysis of the detention ponds, groundwater recharge, wetland recharge, rain gardens, Stormfilters and conveyance systems. WWHM output files have been included in the pertinent sections throughout this report to support the design of the stormwater management features presented in this submittal.

In WWHM the site was modeled as having moderate slopes. Although this is conservative given the relatively flat nature of portions of the site, many areas of the site have slopes meeting WWHM's moderate slope classification of 5-15% slopes. A soil survey obtained from the USDA Web Soil Survey service shows that the site consists of mainly type C soils. Soil types listed for the project area include Kapowsin, Kitsap, McKenna, Poulsbo, Urban land-Alderwood and Dystric Xerorthents. Type C soils were therefore used as inputs in WWHM. See the attached soil survey at the end of this section for additional details.

4.2 Proposed Stormwater Features

The proposed stormwater features include a conveyance system, water quality treatment facilities, detention facilities, and outfalls. Basic water quality treatment will be achieved through the use of water quality ponds, Contech Stormfilters located in manholes or vaults, and several rain gardens. The majority of the site's stormwater will be discharged to Hood Canal or Port Gamble Bay using stormwater outfalls. The rest of the site's stormwater will be discharged to Machias Creek, Ladine-DeCoteau Creek, or to onsite wetlands. Portions of the site such as open spaces, forested tracts and an existing cemetery will have no proposed storm drainage features.

Portions of the existing drainage system will be incorporated into the proposed design. The majority of the existing drainage system will be replaced and improved with the planned development. The majority of the ditch system serving SR 104 will remain. Under the proposed development, the ditch system will enter the proposed conveyance system and will receive basic water quality treatment before being discharged to salt water. A few of the stormwater outfall serving the Mill Site will be retained, improved, and used as part of the proposed drainage system. Some of these existing outfalls will be abandoned. These specific outfalls are noted in the storm drainage plans submitted with the preliminary plat application. Most of the existing curbs and drainage paths on existing minor roadways will be replaced by the proposed stormwater system. Construction of proposed stormwater facilities described in this report are proposed to be phased as needed to accommodate the development of the project.

Soil Map


47° 51' 32"
47° 51' 31"
47° 50' 42"
47° 50' 41"
122° 36' 24"
122° 34' 11"
122° 36' 25"
122° 34' 12"
529600
529800
530000
530200
530400
530600
530800
531000
531200
531400
531600
531800
532000
5300600
5300400
5300200
5300000
5299800
5299600
5299400
5299200
Port Gamble
Beach Ln
Whitford Rd
Wheeler St
Sandbury Hill Pl
Babcock St
Walker Rd
View Dr
Rainier Ave
Puget Ave
Tinsdale Ave
Kitsap Ave
Talbot St
Power Dr
Gamble Way
Carver Dr
Keller St
Foster St
Point Julia Ln
Boston Ln
10
22
23
24
29
32
39
40
41
63
N
Map Scale: 1:7,630 if printed on B size (11" x 17") sheet.
Meters
0
100
200
400
600
Feet
0
500
1,000
2,000
3,000

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:7,630 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kitsap County Area, Washington
Survey Area Data: Version 7, Jul 2, 2012

Date(s) aerial images were photographed: 7/21/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Kitsap County Area, Washington (WA635)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10	Dystric Xerorthents, 45 to 70 percent slopes	23.1	7.4%
22	Kapowsin gravelly loam, 0 to 6 percent slopes	85.7	27.5%
23	Kapowsin gravelly loam, 6 to 15 percent slopes	26.3	8.4%
24	Kapowsin variant gravelly clay loam, 0 to 5 percent slopes	2.2	0.7%
29	Kitsap silt loam, 8 to 15 percent slopes	32.8	10.5%
32	McKenna gravelly loam	54.7	17.5%
39	Poulsbo gravelly sandy loam, 0 to 6 percent slopes	17.0	5.4%
40	Poulsbo gravelly sandy loam, 6 to 15 percent slopes	2.4	0.8%
41	Poulsbo gravelly sandy loam, 15 to 30 percent slopes	36.8	11.8%
63	Urban land-Alderwood complex, 0 to 8 percent slopes	26.0	8.3%
Subtotals for Soil Survey Area		**307.0**	**98.4%**
Totals for Area of Interest		**312.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the

DOE. Soil classification table

2.3.2 Runoff Parameters

All storm event hydrograph methods require input of parameters that describe physical drainage basin characteristics. These parameters provide the basis from which the runoff hydrograph is developed. This section describes only the key parameter of curve number that is used to estimate the runoff from the water quality design storm. .

Curve Number

The NRCS (formerly SCS) has, for many years, conducted studies of the runoff characteristics for various land types. After gathering and analyzing extensive data, NRCS has developed relationships between land use, soil type, vegetation cover, interception, infiltration, surface storage, and runoff. The relationships have been characterized by a single runoff coefficient called a "curve number." The National Engineering Handbook - Section 4: Hydrology (NEH-4, SCS, August 1972) contains a detailed description of the development and use of the curve number method.

NRCS has developed "curve number" (CN) values based on soil type and land use. They can be found in "Urban Hydrology for Small Watersheds", Technical Release 55 (TR-55), June 1986, published by the NRCS. The combination of these two factors is called the "soil-cover complex." The soil-cover complexes have been assigned to one of four hydrologic soil groups, according to their runoff characteristics. NRCS has classified over 4,000 soil types into these four soil groups. Table 2.2 shows the hydrologic soil group of most soils in the state of Washington and provides a brief description of the four groups. For details on other soil types refer to the NRCS publication mentioned above (TR-55, 1986).

Table 2.1 Hydrologic Soil Series for Selected Soils in Washington State

Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group
Agnew	C	Hoko	C
Ahl	B	Hoodsport	C
Aits	C	Hoogdal	C
* Alderwood	C	Hoypus	A
Arents, Alderwood	B	Huel	A
Arents, Everett	B	Indianola	A
Ashoe	B	Jonas	B
Baldhill	B	Jumpe	B
Barneston	C	Kalaloch	C
Baumgard	B	Kapowsin	C/D *
Beausite	B	Katula	C
Belfast	C	Kilchis	C
Bellingham	D	Kitsap	C *
Bellingham variant	C	Klaus	C
Boistfort	B	Klone	B
Bow	D	Lates	C
Briscot	D	Lebam	B
Buckley	C	Lummi	D
Bunker	B	Lynnwood	A
Cagey	C	Lystair	B
Carlsborg	A	Mal	C
Casey	D	Manley	B

* - found on site

Table 2.1 Hydrologic Soil Series for Selected Soils in Washington State

Soil Type	Hydrologic Soil Group	Soil Type	Hydrologic Soil Group	
Cassolary	C	Mashel	B	
Cathcart	B	Maytown	C	
Centralia	B	McKenna	D	*
Chehalis	B	McMurray	D	
Chesaw	A	Melbourne	B	
Cinebar	B	Menzel	B	
Clallam	C	Mixed Alluvial	variable	
Clayton	B	Molson	B	
Coastal beaches	variable	Mukilteo	C/D	
Colter	C	Naff	B	
Custer	D	Nargar	A	
Custer, Drained	C	National	B	
Dabob	C	Neilton	A	
Delphi	D	Newberg	B	
Dick	A	Nisqually	B	
Dimal	D	Nooksack	C	
Dupont	D	Norma	C/D	
Earlmont	C	Ogarty	C	
Edgewick	C	Olete	C	
Eld	B	Olomount	C	
Elwell	B	Olympic	B	
Esquatzel	B	Orcas	D	
Everett	A	Oridia	D	
Everson	D	Orting	D	
Galvin	D	Oso	C	
Getchell	A	Ovall	C	
Giles	B	Pastik	C	
Godfrey	D	Pheeney	C	
Greenwater	A	Phelan	D	
Grove	C	Pilchuck	C	
Harstine	C	Potchub	C	
Hartnit	C	Poulsbo	C	*
Hoh	B	Prather	C	
Puget	D	Solleks	C	
Puyallup	B	Spana	D	
Queets	B	Spanaway	A/B	
Quilcene	C	Springdale	B	
Ragnar	B	Sulsavar	B	
Rainier	C	Sultan	C	
Raught	B	Sultan variant	B	
Reed	D	Sumas	C	
Reed, Drained or Protected	C	Swantown	D	
Renton	D	Tacoma	D	
Republic	B	Tanwax	D	
Riverwash	variable	Tanwax, Drained	C	
Rober	C	Tealwhit	D	
Salal	C	Tenino	C	
Salkum	B	Tisch	D	
Sammamish	D	Tokul	C	
San Juan	A	Townsend	C	
Scamman	D	Triton	D	
Schneider	B	Tukwila	D	
Seattle	D	Tukey	C	
Sekiu	D	Urbana	C	
Semiahmoo	D	Vailton	B	
Shalcar	D	Verlot	C	
Shano	B	Wapato	D	
Shelton	C	Warden	B	
Si	C	Whidbey	C	

* - found onsite

5 Flow control

The majority of this project's stormwater will outfall directly to Hood Canal or Port Gamble Bay. The Kitsap County Stormwater Design Manual exempts these areas from flow control due to the limited risk of flooding and erosion when discharging to salt water. No flow control is proposed for these portions of the stormwater system.

5.1 Discharges to Machias Creek from Water Quality Pond

A portion of the water from the water quality pond serving the west portions of the property will be discharged to Machias Creek via a flow splitter and level spreader. The level spreader will disperse flows and eliminate point discharges in an effort to limit and remove the possibility for erosion hazards. Water will exit the pond through an outlet structure. The outlet structure consists of a concrete manhole with a reverse slope inlet pipe that connects it to the pond. The outlet structure also has a birdcage structure that acts as a primary overflow for the pond. The pond will have a secondary overflow spillway that will release water over the pond berm and into Machias Creek in the event that the flow control structure and primary overflow fail. Inside of the outlet structure there is an internal baffle wall that is set at the water quality stage of the pond. Water will enter the overflow structure, flow over the baffle wall and then flow through an outlet pipe to the flow splitter manhole downstream.

The flow splitter is a concrete manhole with two outlet structures. One outlet structure has a riser with a single bottom orifice. This outlet will release water to the Hood Canal outfall. The other outlet structure is a down turned elbow with a single orifice and shear gate. This orifice will release flow to Machias Creek.

The orifice sizes and configurations for the flow splitter were designed in WWHM. The outlet to Machias Creek (POC #1) will match a flow duration curve for the area tributary to Machias Creek upstream of SR104. The flow splitter duration curve for the developed (mitigated) site was designed to match up to the 2-year storm event of the predeveloped site. In the attached WWHM printout, the mitigated flows approximately match the predeveloped curve up to the

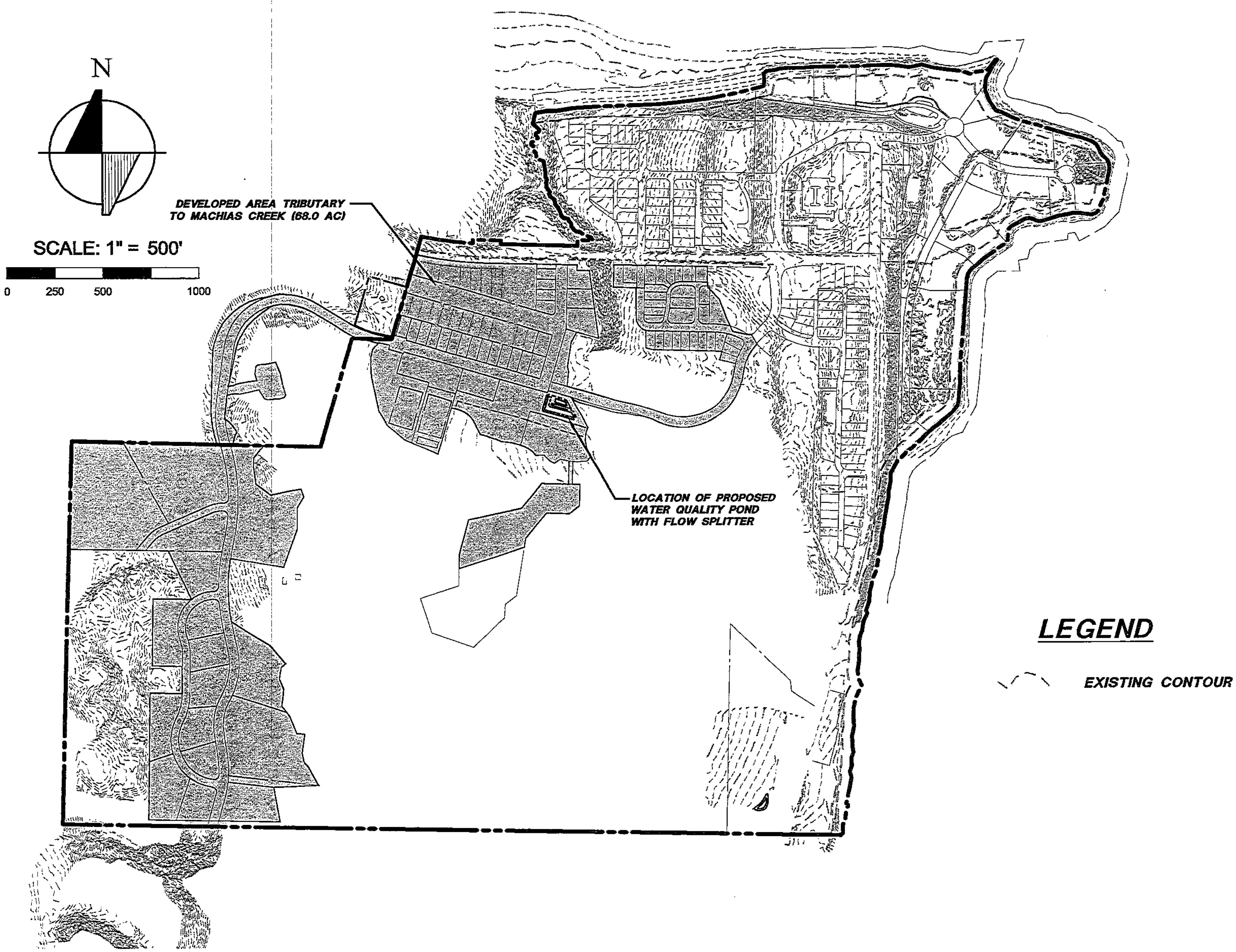
2-year storm event. Above the 2-year event, discharges are compliant but do not match the preexisting duration curve as closely. The outlet to Hood Canal (POC #2) is exempt from flow control standards and does not match any predeveloped durations. The results of this model are attached at the end of this section.

5.2 Wetland Recharge

A small portion of the developed site is within the watershed area tributary to adjacent on-site wetlands. In the developed areas adjacent to the wetlands, a portion of the runoff generated by roof tops will be diverted to the wetlands, via splash blocks and/or level spreaders, in order to maintain wetland hydrology. The developed area within the wetland tributary area was obtained from LIDAR contours with in AutoCAD, and then modeled in WWHM. It was determined that 7.98 roof tops with an area of 1,200 square feet each will provide enough water to equal the 2-year pre-development (forested) peak flow of the disturbed area. Eight roof tops were therefore diverted back into the wetlands. A basin map exhibit and WWHM calculations supporting this conclusion is presented at the end of this section.

5.3 Recreation Tract Flow Control

A stormwater detention pond will provide flow control for the Recreation Tract and additional parking along SR 104. The pond was sized using WWHM assuming that the developed Recreation Tract will have 50% impervious coverage. WWHM produced a required detention volume of 88,658 cubic feet while the proposed pond will have a volume of 89,668 cubic feet. The pond will also provide basic water quality treatment via a wetpool. The wetpool will add additional volume to the pond (9,037 cu.ft.). See the attached Recreation Tract Detention Pond and Wetpool Basin Exhibit along with the WWHM calculations for detention volume. Water quality volumes are discussed in Section 6 of this report.



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p: 425.415.2000 f: 425.486.5059
w: triadassociates.net

FLOW SPLITTER BASIN EXHIBIT

PORT GAMBLE
REDEVELOPMENT PLAN

KITSAP COUNTY, WASHINGTON

ALAN D. FURE, PE
PROJECT MANAGER
ROBERT E. WALLIS, PLS
PROJECT SURVEYOR
BEAU J. WILLERT, PE
PROJECT ENGINEER
DENISE LIFTIN, PLA
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.: 1"=500' VERT.:

STAMP NOT VALID UNLESS SIGNED AND DATED
JOB NO. 08-029
SHEET NO. 1 of 1

ljw, Oct 03, 2017 – 11:23am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0831 flow splitter exhibit.dwg, FLOW SPLITTER

Western Washington Hydrology Model
PROJECT REPORT

Project Name: Flow Splitter
Site Address:
City :
Report Date : 9/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 1.00
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	68

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Flat	27.2

Impervious Land Use	Acres
ROADS FLAT	40.8

Element Flows To:

Surface	Interflow	Groundwater
Flow Splitter 1,	Flow Splitter 1,	

Name : Flow Splitter 1
Bottom Length: 1ft.

Bottom Length: 1ft.
Depth : 5ft.
Side slope 1: 0 To 1
Side slope 2: 0 To 1
Side slope 3: 0 To 1
Side slope 4: 0 To 1

Structure Splitter Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Primary(cfs)	Secondary(cfs)
0.000	0.000	0.000	0.000	0.000
0.056	0.000	0.000	0.143	0.458
0.111	0.000	0.000	0.202	0.647
0.167	0.000	0.000	0.247	0.793
0.222	0.000	0.000	0.285	0.916
0.278	0.000	0.000	0.319	1.024
0.333	0.000	0.000	0.349	1.121
0.389	0.000	0.000	0.377	1.211
0.444	0.000	0.000	0.403	1.295
0.500	0.000	0.000	0.428	1.374
0.556	0.000	0.000	0.451	1.448
0.611	0.000	0.000	0.473	1.519
0.667	0.000	0.000	0.494	1.586
0.722	0.000	0.000	0.514	1.651
0.778	0.000	0.000	0.534	1.713
0.833	0.000	0.000	0.552	1.773
0.889	0.000	0.000	0.571	1.831
0.944	0.000	0.000	0.588	1.888
1.000	0.000	0.000	0.605	1.942
1.056	0.000	0.000	0.622	1.996
1.111	0.000	0.000	0.638	2.048
1.167	0.000	0.000	0.654	2.098
1.222	0.000	0.000	0.669	2.147
1.278	0.000	0.000	0.684	2.196
1.333	0.000	0.000	0.699	2.243
1.389	0.000	0.000	0.713	2.289
1.444	0.000	0.000	0.727	2.335
1.500	0.000	0.000	0.741	2.379
1.556	0.000	0.000	0.755	2.423
1.611	0.000	0.000	0.768	2.466
1.667	0.000	0.000	0.781	2.508
1.722	0.000	0.000	0.794	2.549
1.778	0.000	0.000	0.807	2.590
1.833	0.000	0.000	0.819	2.630
1.889	0.000	0.000	0.832	2.670
1.944	0.000	0.000	0.844	2.709
2.000	0.000	0.000	0.856	2.747
2.056	0.000	0.000	0.868	2.785
2.111	0.000	0.000	0.879	2.822
2.167	0.000	0.000	0.891	2.859
2.222	0.000	0.000	0.902	2.896
2.278	0.000	0.000	0.913	2.932
2.333	0.000	0.000	0.924	2.967
2.389	0.000	0.000	0.935	3.002
2.444	0.000	0.000	0.946	3.037
2.500	0.000	0.000	0.957	3.071
2.556	0.000	0.000	0.967	3.105
2.611	0.000	0.000	0.978	3.139

2.667	0.000	0.000	0.988	3.172
2.722	0.000	0.000	0.998	3.205
2.778	0.000	0.000	1.009	3.237
2.833	0.000	0.000	1.019	3.270
2.889	0.000	0.000	1.029	3.302
2.944	0.000	0.000	1.038	3.333
3.000	0.000	0.000	1.048	3.364
3.056	0.000	0.000	1.058	3.395
3.111	0.000	0.000	1.067	3.426
3.167	0.000	0.000	1.077	3.457
3.222	0.000	0.000	1.086	3.487
3.278	0.000	0.000	1.096	3.517
3.333	0.000	0.000	1.105	3.546
3.389	0.000	0.000	1.114	3.576
3.444	0.000	0.000	1.123	3.605
3.500	0.000	0.000	1.132	3.634
3.556	0.000	0.000	1.141	3.663
3.611	0.000	0.000	1.158	3.691
3.667	0.000	0.000	1.178	3.720
3.722	0.000	0.000	1.194	3.748
3.778	0.000	0.000	1.208	3.775
3.833	0.000	0.000	1.221	3.803
3.889	0.000	0.000	1.234	3.831
3.944	0.000	0.000	1.246	3.858
4.000	0.000	0.000	1.258	3.885
4.056	0.000	0.000	1.270	4.294
4.111	0.000	0.000	1.281	5.021
4.167	0.000	0.000	1.292	5.953
4.222	0.000	0.000	1.303	7.052
4.278	0.000	0.000	1.314	8.295
4.333	0.000	0.000	1.325	9.666
4.389	0.000	0.000	1.335	11.15
4.444	0.000	0.000	1.345	12.75
4.500	0.000	0.000	1.356	14.45
4.556	0.000	0.000	1.366	16.24
4.611	0.000	0.000	1.376	18.13
4.667	0.000	0.000	1.386	20.10
4.722	0.000	0.000	1.395	22.15
4.778	0.000	0.000	1.405	24.29
4.833	0.000	0.000	1.415	26.50
4.889	0.000	0.000	1.424	28.78
4.944	0.000	0.000	1.434	31.14
5.000	0.000	0.000	1.443	33.56
5.056	0.000	0.000	1.643	36.05

Discharge Structure Outlet 1
Riser Height: 5 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 4.8 in. **Elevation:** 0 ft.
Orifice 1 Diameter: 1.7 in. **Elevation:** 3.6 ft.

Discharge Structure Outlet 2
Riser Height: 5 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 8.6 in. **Elevation:** 0 ft.

Element Flows To:
Outlet 1 **Outlet 2**
Machias Creek, Hood Cannal,

Name : Machias Creek
Bottom Length: 500ft.
Bottom Width : 50ft.
Manning's n : 0.03
Channel bottom slope 1: 0.05 To 1
Channel Left side slope 0: 2 To 1
Channel right side slope 2: 2 To 1
Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.

Element Flows To:
Outlet 1 **Outlet 2**

Channel Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.574	0.000	0.000	0.000
0.056	0.576	0.032	4.493	0.000
0.111	0.579	0.064	14.27	0.000
0.167	0.582	0.096	28.06	0.000
0.222	0.584	0.129	45.35	0.000
0.278	0.587	0.161	65.80	0.000
0.333	0.589	0.194	89.21	0.000
0.389	0.592	0.227	115.4	0.000
0.444	0.594	0.260	144.2	0.000
0.500	0.597	0.293	175.6	0.000
0.556	0.599	0.326	209.4	0.000
0.611	0.602	0.359	245.5	0.000
0.667	0.605	0.393	284.0	0.000
0.722	0.607	0.427	324.7	0.000
0.778	0.610	0.460	367.6	0.000
0.833	0.612	0.494	412.5	0.000
0.889	0.615	0.528	459.6	0.000
0.944	0.617	0.563	508.8	0.000
1.000	0.620	0.597	559.9	0.000
1.056	0.623	0.631	613.0	0.000
1.111	0.625	0.666	668.1	0.000
1.167	0.628	0.701	725.1	0.000
1.222	0.630	0.736	783.9	0.000
1.278	0.633	0.771	844.7	0.000
1.333	0.635	0.806	907.3	0.000
1.389	0.638	0.842	971.7	0.000
1.444	0.640	0.877	1037.	0.000
1.500	0.643	0.913	1105.	0.000
1.556	0.646	0.948	1175.	0.000
1.611	0.648	0.984	1247.	0.000
1.667	0.651	1.020	1320.	0.000

1.722	0.653	1.057	1395.	0.000
1.778	0.656	1.093	1472.	0.000
1.833	0.658	1.130	1550.	0.000
1.889	0.661	1.166	1630.	0.000
1.944	0.663	1.203	1712.	0.000
2.000	0.666	1.240	1795.	0.000
2.056	0.669	1.277	1881.	0.000
2.111	0.671	1.314	1967.	0.000
2.167	0.674	1.352	2056.	0.000
2.222	0.676	1.389	2146.	0.000
2.278	0.679	1.427	2237.	0.000
2.333	0.681	1.464	2330.	0.000
2.389	0.684	1.502	2425.	0.000
2.444	0.686	1.540	2522.	0.000
2.500	0.689	1.579	2620.	0.000
2.556	0.692	1.617	2719.	0.000
2.611	0.694	1.656	2820.	0.000
2.667	0.697	1.694	2923.	0.000
2.722	0.699	1.733	3027.	0.000
2.778	0.702	1.772	3133.	0.000
2.833	0.704	1.811	3240.	0.000
2.889	0.707	1.850	3349.	0.000
2.944	0.710	1.889	3460.	0.000
3.000	0.712	1.929	3572.	0.000
3.056	0.715	1.969	3685.	0.000
3.111	0.717	2.008	3800.	0.000
3.167	0.720	2.048	3917.	0.000
3.222	0.722	2.088	4035.	0.000
3.278	0.725	2.129	4154.	0.000
3.333	0.727	2.169	4275.	0.000
3.389	0.730	2.209	4398.	0.000
3.444	0.733	2.250	4522.	0.000
3.500	0.735	2.291	4648.	0.000
3.556	0.738	2.332	4775.	0.000
3.611	0.740	2.373	4903.	0.000
3.667	0.743	2.414	5033.	0.000
3.722	0.745	2.455	5165.	0.000
3.778	0.748	2.497	5298.	0.000
3.833	0.750	2.538	5433.	0.000
3.889	0.753	2.580	5569.	0.000
3.944	0.756	2.622	5706.	0.000
4.000	0.758	2.664	5845.	0.000
4.056	0.761	2.706	5986.	0.000
4.111	0.763	2.749	6128.	0.000
4.167	0.766	2.791	6271.	0.000
4.222	0.768	2.834	6416.	0.000
4.278	0.771	2.876	6562.	0.000
4.333	0.774	2.919	6710.	0.000
4.389	0.776	2.962	6859.	0.000
4.444	0.779	3.006	7010.	0.000
4.500	0.781	3.049	7162.	0.000
4.556	0.784	3.092	7316.	0.000
4.611	0.786	3.136	7471.	0.000
4.667	0.789	3.180	7628.	0.000
4.722	0.791	3.224	7786.	0.000
4.778	0.794	3.268	7945.	0.000
4.833	0.797	3.312	8106.	0.000

4.889	0.799	3.356	8269.	0.000
4.944	0.802	3.401	8433.	0.000
5.000	0.804	3.445	8598.	0.000
5.056	0.807	3.490	8765.	0.000

Name : Hood Cannal
Bottom Length: 500ft.
Bottom Width : 50ft.
Manning's n : 0.03
Channel bottom slope 1: 0.05 To 1
Channel Left side slope 0: 2 To 1
Channel right side slope 2: 2 To 1
Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.

Element Flows To:
Outlet 1 **Outlet 2**

Channel Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.574	0.000	0.000	0.000
0.056	0.576	0.032	4.493	0.000
0.111	0.579	0.064	14.27	0.000
0.167	0.582	0.096	28.06	0.000
0.222	0.584	0.129	45.35	0.000
0.278	0.587	0.161	65.80	0.000
0.333	0.589	0.194	89.21	0.000
0.389	0.592	0.227	115.4	0.000
0.444	0.594	0.260	144.2	0.000
0.500	0.597	0.293	175.6	0.000
0.556	0.599	0.326	209.4	0.000
0.611	0.602	0.359	245.5	0.000
0.667	0.605	0.393	284.0	0.000
0.722	0.607	0.427	324.7	0.000
0.778	0.610	0.460	367.6	0.000
0.833	0.612	0.494	412.5	0.000
0.889	0.615	0.528	459.6	0.000
0.944	0.617	0.563	508.8	0.000
1.000	0.620	0.597	559.9	0.000
1.056	0.623	0.631	613.0	0.000
1.111	0.625	0.666	668.1	0.000
1.167	0.628	0.701	725.1	0.000
1.222	0.630	0.736	783.9	0.000
1.278	0.633	0.771	844.7	0.000
1.333	0.635	0.806	907.3	0.000
1.389	0.638	0.842	971.7	0.000
1.444	0.640	0.877	1037.	0.000
1.500	0.643	0.913	1105.	0.000
1.556	0.646	0.948	1175.	0.000
1.611	0.648	0.984	1247.	0.000
1.667	0.651	1.020	1320.	0.000
1.722	0.653	1.057	1395.	0.000

1.778	0.656	1.093	1472.	0.000
1.833	0.658	1.130	1550.	0.000
1.889	0.661	1.166	1630.	0.000
1.944	0.663	1.203	1712.	0.000
2.000	0.666	1.240	1795.	0.000
2.056	0.669	1.277	1881.	0.000
2.111	0.671	1.314	1967.	0.000
2.167	0.674	1.352	2056.	0.000
2.222	0.676	1.389	2146.	0.000
2.278	0.679	1.427	2237.	0.000
2.333	0.681	1.464	2330.	0.000
2.389	0.684	1.502	2425.	0.000
2.444	0.686	1.540	2522.	0.000
2.500	0.689	1.579	2620.	0.000
2.556	0.692	1.617	2719.	0.000
2.611	0.694	1.656	2820.	0.000
2.667	0.697	1.694	2923.	0.000
2.722	0.699	1.733	3027.	0.000
2.778	0.702	1.772	3133.	0.000
2.833	0.704	1.811	3240.	0.000
2.889	0.707	1.850	3349.	0.000
2.944	0.710	1.889	3460.	0.000
3.000	0.712	1.929	3572.	0.000
3.056	0.715	1.969	3685.	0.000
3.111	0.717	2.008	3800.	0.000
3.167	0.720	2.048	3917.	0.000
3.222	0.722	2.088	4035.	0.000
3.278	0.725	2.129	4154.	0.000
3.333	0.727	2.169	4275.	0.000
3.389	0.730	2.209	4398.	0.000
3.444	0.733	2.250	4522.	0.000
3.500	0.735	2.291	4648.	0.000
3.556	0.738	2.332	4775.	0.000
3.611	0.740	2.373	4903.	0.000
3.667	0.743	2.414	5033.	0.000
3.722	0.745	2.455	5165.	0.000
3.778	0.748	2.497	5298.	0.000
3.833	0.750	2.538	5433.	0.000
3.889	0.753	2.580	5569.	0.000
3.944	0.756	2.622	5706.	0.000
4.000	0.758	2.664	5845.	0.000
4.056	0.761	2.706	5986.	0.000
4.111	0.763	2.749	6128.	0.000
4.167	0.766	2.791	6271.	0.000
4.222	0.768	2.834	6416.	0.000
4.278	0.771	2.876	6562.	0.000
4.333	0.774	2.919	6710.	0.000
4.389	0.776	2.962	6859.	0.000
4.444	0.779	3.006	7010.	0.000
4.500	0.781	3.049	7162.	0.000
4.556	0.784	3.092	7316.	0.000
4.611	0.786	3.136	7471.	0.000
4.667	0.789	3.180	7628.	0.000
4.722	0.791	3.224	7786.	0.000
4.778	0.794	3.268	7945.	0.000
4.833	0.797	3.312	8106.	0.000
4.889	0.799	3.356	8269.	0.000

4.944	0.802	3.401	8433.	0.000
5.000	0.804	3.445	8598.	0.000
5.056	0.807	3.490	8765.	0.000

Name : Basin 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	68

Impervious Land Use	Acres

Element Flows To:
Surface **Interflow** **Groundwater**

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.323823
5 year	2.015646
10 year	2.557903
25 year	3.345453
50 year	4.010833
100 year	4.747394

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.31411
5 year	1.348159
10 year	1.36429
25 year	1.380229
50 year	1.389836
100 year	1.398021

Maximum Developed Flow Tributary to Machias Creek

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.474	1.295
1951	2.140	1.364
1952	1.031	1.329
1953	0.968	1.214
1954	1.244	1.290
1955	1.872	1.328
1956	2.470	1.380

1957	1.679	1.322
1958	2.402	1.299
1959	1.746	1.331
1960	1.381	1.333
1961	1.297	1.317
1962	1.252	1.306
1963	1.708	1.273
1964	2.609	1.332
1965	1.254	1.298
1966	1.273	1.250
1967	0.662	1.272
1968	1.753	1.307
1969	1.843	1.347
1970	0.840	1.329
1971	0.976	1.299
1972	1.485	1.335
1973	1.325	1.381
1974	0.951	1.320
1975	1.232	1.296
1976	0.992	1.283
1977	1.016	1.289
1978	0.766	1.306
1979	1.030	1.255
1980	3.242	1.380
1981	1.084	1.290
1982	1.230	1.330
1983	1.290	1.331
1984	1.197	1.311
1985	1.238	1.238
1986	1.823	1.344
1987	4.381	1.379
1988	1.815	1.330
1989	0.978	1.339
1990	1.506	1.180
1991	1.291	1.290
1992	1.387	1.321
1993	1.085	1.280
1994	0.647	1.303
1995	0.551	1.267
1996	1.259	1.294
1997	2.484	1.355
1998	5.473	1.405

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	5.4732	1.4054
2	4.3813	1.3812
3	3.2419	1.3803
4	2.6093	1.3799
5	2.4835	1.3789
6	2.4698	1.3641
7	2.4017	1.3545
8	2.1402	1.3471
9	1.8719	1.3445
10	1.8425	1.3391
11	1.8233	1.3354

12	1.8153	1.3329
13	1.7532	1.3317
14	1.7461	1.3312
15	1.7076	1.3306
16	1.6790	1.3303
17	1.5061	1.3297
18	1.4852	1.3290
19	1.3865	1.3288
20	1.3810	1.3276
21	1.3247	1.3222
22	1.2973	1.3207
23	1.2905	1.3199
24	1.2902	1.3170
25	1.2727	1.3114
26	1.2589	1.3069
27	1.2538	1.3061
28	1.2521	1.3060
29	1.2442	1.3028
30	1.2381	1.2990
31	1.2319	1.2988
32	1.2299	1.2984
33	1.1967	1.2958
34	1.0849	1.2951
35	1.0843	1.2944
36	1.0315	1.2904
37	1.0296	1.2902
38	1.0159	1.2901
39	0.9923	1.2895
40	0.9783	1.2834
41	0.9764	1.2802
42	0.9682	1.2733
43	0.9512	1.2718
44	0.8403	1.2667
45	0.7656	1.2547
46	0.6618	1.2504
47	0.6472	1.2376
48	0.5509	1.2143
49	0.4744	1.1803

POC #1
The Facility PASSED

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.6619	4334	4206	97	Pass
0.6957	3882	3742	96	Pass
0.7296	3479	3297	94	Pass
0.7634	3085	2941	95	Pass
0.7972	2731	2598	95	Pass
0.8310	2451	2290	93	Pass
0.8649	2194	2026	92	Pass
0.8987	1979	1766	89	Pass
0.9325	1752	1526	87	Pass
0.9664	1545	1299	84	Pass
1.0002	1369	1093	79	Pass

1.0340	1233	938	76	Pass
1.0678	1116	778	69	Pass
1.1017	1006	662	65	Pass
1.1355	900	550	61	Pass
1.1693	796	448	56	Pass
1.2032	712	378	53	Pass
1.2370	632	327	51	Pass
1.2708	557	226	40	Pass
1.3046	498	74	14	Pass
1.3385	458	14	3	Pass
1.3723	418	5	1	Pass
1.4061	385	0	0	Pass
1.4399	356	0	0	Pass
1.4738	329	0	0	Pass
1.5076	303	0	0	Pass
1.5414	281	0	0	Pass
1.5753	267	0	0	Pass
1.6091	252	0	0	Pass
1.6429	237	0	0	Pass
1.6767	214	0	0	Pass
1.7106	195	0	0	Pass
1.7444	181	0	0	Pass
1.7782	165	0	0	Pass
1.8120	158	0	0	Pass
1.8459	149	0	0	Pass
1.8797	142	0	0	Pass
1.9135	136	0	0	Pass
1.9474	128	0	0	Pass
1.9812	126	0	0	Pass
2.0150	123	0	0	Pass
2.0488	118	0	0	Pass
2.0827	115	0	0	Pass
2.1165	112	0	0	Pass
2.1503	109	0	0	Pass
2.1841	108	0	0	Pass
2.2180	105	0	0	Pass
2.2518	105	0	0	Pass
2.2856	102	0	0	Pass
2.3195	100	0	0	Pass
2.3533	94	0	0	Pass
2.3871	90	0	0	Pass
2.4209	85	0	0	Pass
2.4548	85	0	0	Pass
2.4886	79	0	0	Pass
2.5224	78	0	0	Pass
2.5563	75	0	0	Pass
2.5901	74	0	0	Pass
2.6239	71	0	0	Pass
2.6577	70	0	0	Pass
2.6916	69	0	0	Pass
2.7254	67	0	0	Pass
2.7592	67	0	0	Pass
2.7930	64	0	0	Pass
2.8269	62	0	0	Pass
2.8607	61	0	0	Pass
2.8945	60	0	0	Pass
2.9284	60	0	0	Pass

2.9622	56	0	0	Pass
2.9960	56	0	0	Pass
3.0298	55	0	0	Pass
3.0637	53	0	0	Pass
3.0975	53	0	0	Pass
3.1313	51	0	0	Pass
3.1651	50	0	0	Pass
3.1990	49	0	0	Pass
3.2328	47	0	0	Pass
3.2666	45	0	0	Pass
3.3005	42	0	0	Pass
3.3343	41	0	0	Pass
3.3681	41	0	0	Pass
3.4019	39	0	0	Pass
3.4358	38	0	0	Pass
3.4696	37	0	0	Pass
3.5034	35	0	0	Pass
3.5372	34	0	0	Pass
3.5711	33	0	0	Pass
3.6049	33	0	0	Pass
3.6387	32	0	0	Pass
3.6726	32	0	0	Pass
3.7064	31	0	0	Pass
3.7402	29	0	0	Pass
3.7740	28	0	0	Pass
3.8079	28	0	0	Pass
3.8417	27	0	0	Pass
3.8755	26	0	0	Pass
3.9094	26	0	0	Pass
3.9432	23	0	0	Pass
3.9770	22	0	0	Pass
4.0108	21	0	0	Pass

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	1.323823
5 year	2.015646
10 year	2.557903
25 year	3.345453
50 year	4.010833
100 year	4.747394

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	11.46101
5 year	16.473248
10 year	20.15333
25 year	25.220269
50 year	29.302683
100 year	33.653495

Maximum Developed Flow Tributary to Hood Canal

Yearly Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1950	0.474	8.766
1951	2.140	18.608
1952	1.031	10.920
1953	0.968	9.200
1954	1.244	12.411
1955	1.872	16.242
1956	2.470	15.645
1957	1.679	6.312
1958	2.402	12.409
1959	1.746	26.234
1960	1.381	10.574
1961	1.297	8.469
1962	1.252	30.881
1963	1.708	12.448
1964	2.609	21.066
1965	1.254	8.096
1966	1.273	6.763
1967	0.662	6.967
1968	1.753	26.523
1969	1.843	15.277
1970	0.840	22.573
1971	0.976	8.577
1972	1.485	14.859
1973	1.325	23.880
1974	0.951	12.618
1975	1.232	14.341
1976	0.992	12.827
1977	1.016	10.363
1978	0.766	7.683
1979	1.030	7.108
1980	3.242	19.267
1981	1.084	7.094
1982	1.230	9.109
1983	1.290	8.967
1984	1.197	11.431
1985	1.238	10.267
1986	1.823	14.183
1987	4.381	16.199
1988	1.815	14.409
1989	0.978	10.467
1990	1.506	12.620
1991	1.291	7.052
1992	1.387	7.484
1993	1.085	9.282
1994	0.647	9.075
1995	0.551	5.727
1996	1.259	8.286
1997	2.484	9.820
1998	5.473	17.283

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	5.4732	30.8805
2	4.3813	26.5228
3	3.2419	26.2340
4	2.6093	23.8797
5	2.4835	22.5729
6	2.4698	21.0663
7	2.4017	19.2670
8	2.1402	18.6083
9	1.8719	17.2830
10	1.8425	16.2421
11	1.8233	16.1986
12	1.8153	15.6452
13	1.7532	15.2766
14	1.7461	14.8592
15	1.7076	14.4085
16	1.6790	14.3407

17	1.5061	14.1834
18	1.4852	12.8271
19	1.3865	12.6200
20	1.3810	12.6180
21	1.3247	12.4475
22	1.2973	12.4111
23	1.2905	12.4086
24	1.2902	11.4313
25	1.2727	10.9201
26	1.2589	10.5744
27	1.2538	10.4673
28	1.2521	10.3630
29	1.2442	10.2665
30	1.2381	9.8196
31	1.2319	9.2824
32	1.2299	9.2003
33	1.1967	9.1093
34	1.0849	9.0750
35	1.0843	8.9666
36	1.0315	8.7663
37	1.0296	8.5775
38	1.0159	8.4693
39	0.9923	8.2858
40	0.9783	8.0959
41	0.9764	7.6825
42	0.9682	7.4840
43	0.9512	7.1076
44	0.8403	7.0936
45	0.7656	7.0518
46	0.6618	6.9672
47	0.6472	6.7632
48	0.5509	6.3123
49	0.4744	5.7271

POC #2

Facility FAILED duration standard for 1+ flows.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.6619	4334	24346	561	Fail
0.6957	3882	23160	596	Fail
0.7296	3479	22026	633	Fail
0.7634	3085	21034	681	Fail
0.7972	2731	20111	736	Fail
0.8310	2451	19346	789	Fail
0.8649	2194	18684	851	Fail
0.8987	1979	17989	908	Fail
0.9325	1752	17387	992	Fail
0.9664	1545	16799	1087	Fail
1.0002	1369	16219	1184	Fail
1.0340	1233	15631	1267	Fail
1.0678	1116	15111	1354	Fail
1.1017	1006	14587	1450	Fail
1.1355	900	14067	1563	Fail
1.1693	796	13552	1702	Fail
1.2032	712	13105	1840	Fail
1.2370	632	12671	2004	Fail
1.2708	557	12233	2196	Fail
1.3046	498	11808	2371	Fail
1.3385	458	11404	2489	Fail
1.3723	418	11000	2631	Fail
1.4061	385	10661	2769	Fail
1.4399	356	10356	2908	Fail

This portion of the facility duration is tributary to Hood Canal (POC #2), which is exempt from flow control standards.

1.4738	329	10004	3040	Fail
1.5076	303	9686	3196	Fail
1.5414	281	9359	3330	Fail
1.5753	267	9072	3397	Fail
1.6091	252	8780	3484	Fail
1.6429	237	8479	3577	Fail
1.6767	214	8217	3839	Fail
1.7106	195	7942	4072	Fail
1.7444	181	7706	4257	Fail
1.7782	165	7504	4547	Fail
1.8120	158	7323	4634	Fail
1.8459	149	7156	4802	Fail
1.8797	142	6980	4915	Fail
1.9135	136	6787	4990	Fail
1.9474	128	6602	5157	Fail
1.9812	126	6396	5076	Fail
2.0150	123	6215	5052	Fail
2.0488	118	6056	5132	Fail
2.0827	115	5889	5120	Fail
2.1165	112	5764	5146	Fail
2.1503	109	5627	5162	Fail
2.1841	108	5494	5087	Fail
2.2180	105	5356	5100	Fail
2.2518	105	5236	4986	Fail
2.2856	102	5103	5002	Fail
2.3195	100	4965	4965	Fail
2.3533	94	4845	5154	Fail
2.3871	90	4703	5225	Fail
2.4209	85	4609	5422	Fail
2.4548	85	4489	5281	Fail
2.4886	79	4368	5529	Fail
2.5224	78	4226	5417	Fail
2.5563	75	4133	5510	Fail
2.5901	74	4032	5448	Fail
2.6239	71	3946	5557	Fail
2.6577	70	3837	5481	Fail
2.6916	69	3743	5424	Fail
2.7254	67	3666	5471	Fail
2.7592	67	3588	5355	Fail
2.7930	64	3511	5485	Fail
2.8269	62	3432	5535	Fail
2.8607	61	3350	5491	Fail
2.8945	60	3256	5426	Fail
2.9284	60	3175	5291	Fail
2.9622	56	3093	5523	Fail
2.9960	56	3026	5403	Fail
3.0298	55	2937	5340	Fail
3.0637	53	2873	5420	Fail
3.0975	53	2824	5328	Fail
3.1313	51	2773	5437	Fail
3.1651	50	2712	5424	Fail
3.1990	49	2656	5420	Fail
3.2328	47	2589	5508	Fail
3.2666	45	2536	5635	Fail
3.3005	42	2471	5883	Fail
3.3343	41	2433	5934	Fail
3.3681	41	2376	5795	Fail

3.4019	39	2328	5969	Fail
3.4358	38	2274	5984	Fail
3.4696	37	2228	6021	Fail
3.5034	35	2181	6231	Fail
3.5372	34	2137	6285	Fail
3.5711	33	2088	6327	Fail
3.6049	33	2033	6160	Fail
3.6387	32	1989	6215	Fail
3.6726	32	1932	6037	Fail
3.7064	31	1885	6080	Fail
3.7402	29	1845	6362	Fail
3.7740	28	1794	6407	Fail
3.8079	28	1761	6289	Fail
3.8417	27	1722	6377	Fail
3.8755	26	1686	6484	Fail
3.9094	26	1654	6361	Fail
3.9432	23	1626	7069	Fail
3.9770	22	1596	7254	Fail
4.0108	21	1565	7452	Fail

The development has an increase in flow durations from 1/2 predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

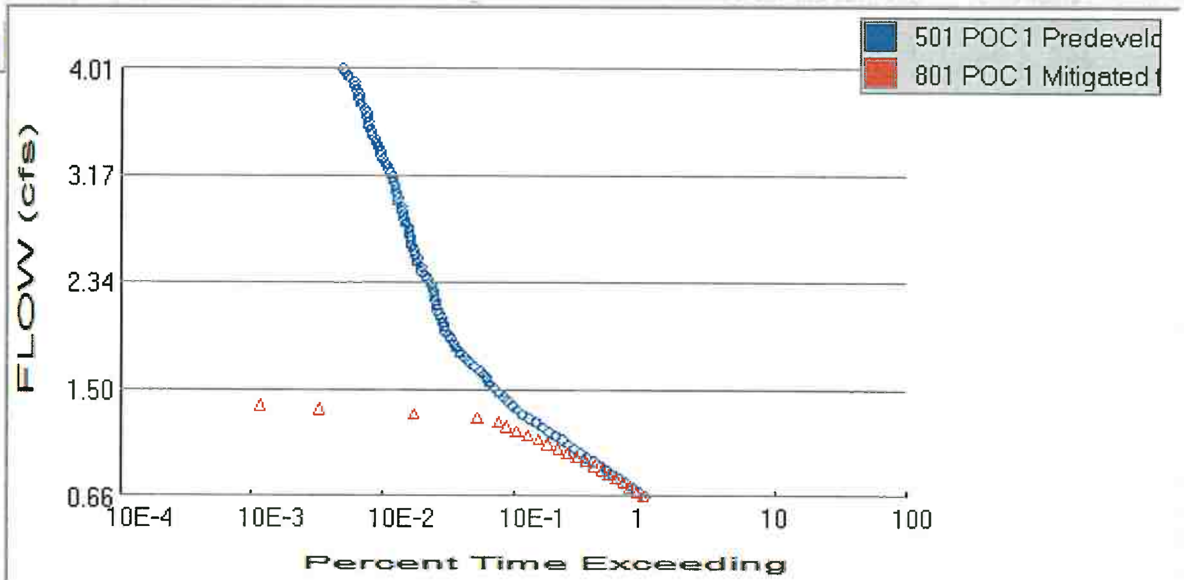
Water Quality BMP Flow and Volume for POC 2.
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

Perlnd and Implnd Changes

No changes have been made.

WWHM FLOW DURATION CURVE FOR FLOW SPLITTER

Analysis



Durations | Flow Frequency | Water Quality

Hydrograph | Wetland Fluctuation | Recharge Pass/Fail

Analyze datasets

501 POC 1 Predeveloped flow
801 POC 1 Mitigated flow

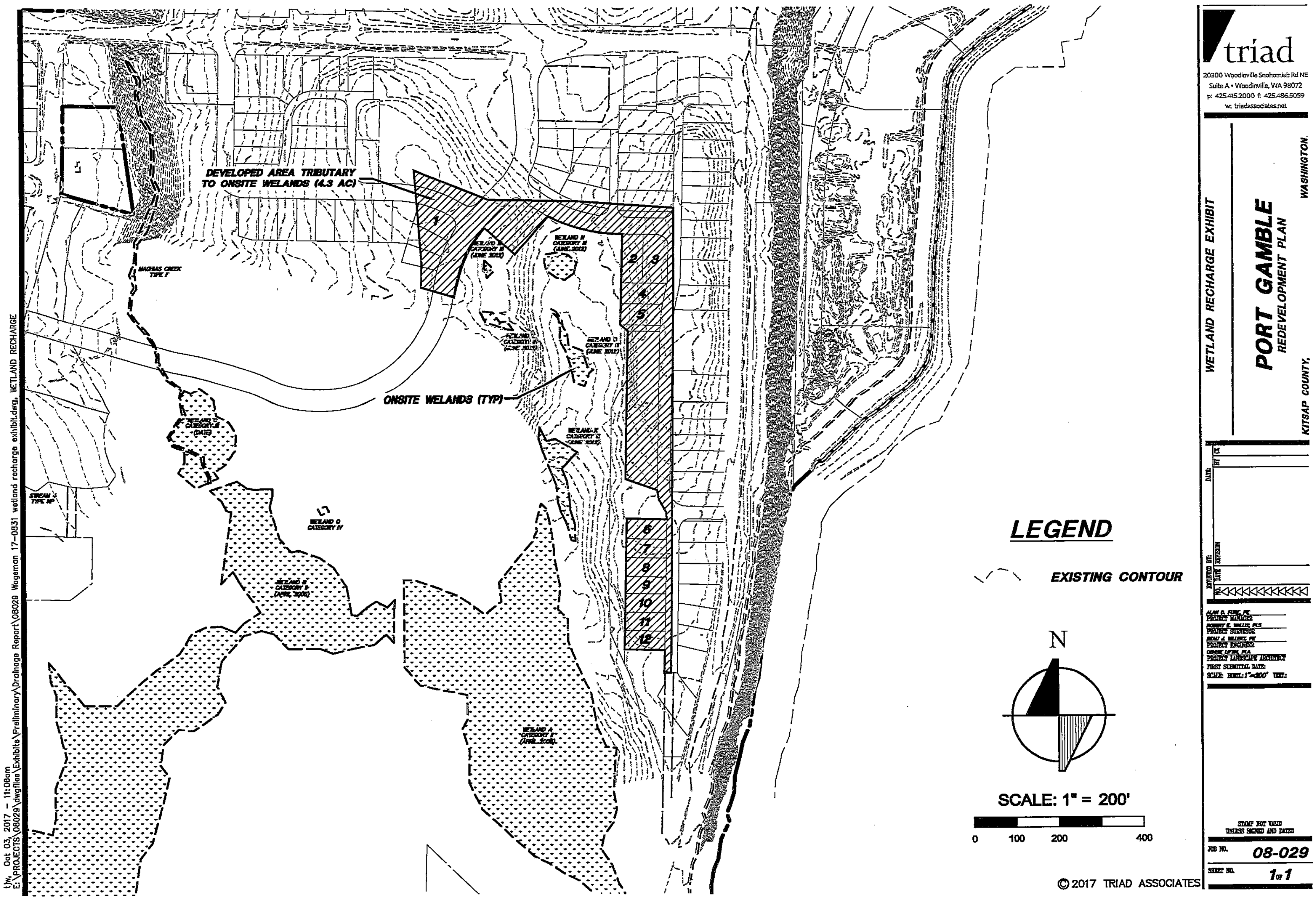
Evap | POC 1 | POC 2

All Datasets | Flow | Stage | Precip

The Facility PASSED

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.6619	4334	4206	97	Pass
0.6957	3882	3742	96	Pass
0.7296	3479	3297	94	Pass
0.7634	3085	2941	95	Pass
0.7972	2731	2598	95	Pass
0.8310	2451	2290	93	Pass
0.8649	2194	2026	92	Pass
0.8987	1979	1766	89	Pass
0.9325	1752	1526	87	Pass
0.9664	1545	1299	84	Pass
1.0002	1369	1093	79	Pass
1.0340	1233	938	76	Pass
1.0678	1116	778	69	Pass
1.1017	1006	662	65	Pass
1.1355	900	550	61	Pass
1.1693	796	448	56	Pass
1.2032	712	378	53	Pass
1.2370	632	327	51	Pass
1.2708	557	226	40	Pass
1.3046	498	74	14	Pass
1.3385	458	14	3	Pass
1.3723	418	5	1	Pass
1.4061	385	0	0	Pass
1.4399	356	0	0	Pass
1.4738	329	0	0	Pass
1.5076	303	0	0	Pass
1.5414	281	0	0	Pass
1.5753	267	0	0	Pass
1.6091	252	0	0	Pass
1.6429	237	0	0	Pass
1.6767	214	0	0	Pass



triad
20300 Woodinville Snohomish Rd NE
Suite A • Woodinville, WA 98072
p: 425.415.2000 f: 425.486.5059
w: triadassociates.net
WETLAND RECHARGE EXHIBIT
PORT GAMBLE
REDEVELOPMENT PLAN
KITSAP COUNTY, WASHINGTON.
DEVELOPED AREA TRIBUTARY TO ONSITE WELANDS (4.3 AC)
ONSITE WELANDS (TYP)
MACHIAS CREEK TYPE F
WETLAND O CATEGORY IV
1
2
3
4
5
6
7
8
9
10
11
12
LEGEND
EXISTING CONTOUR
N
SCALE: 1" = 200'
0
100
200
400
STAMP NOT VALID UNLESS SIGNED AND DATED
JOB NO. 08-029
SHEET NO. 1 OF 1
© 2017 TRIAD ASSOCIATES
I:\w, Oct 03, 2017 – 11:08am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0831 wetland recharge exhibit.dwg, WETLAND RECHARGE

Western Washington Hydrology Model
PROJECT REPORT

Project Name: 12-1213 Wetland Recharge
Site Address:
City :
Report Date : 12/18/2012
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 0.80
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	4.3

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres

Impervious Land Use	Acres
ROOF TOPS FLAT	0.2

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.045026
5 year	0.07226
10 year	0.087369
25 year	0.102927
50 year	0.112249
100 year	0.119954

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.044317
5 year	0.06005
10 year	0.071332
25 year	0.086601
50 year	0.098731
100 year	0.111523

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.002	0.038
1951	0.057	0.066
1952	0.039	0.044
1953	0.024	0.036
1954	0.026	0.050
1955	0.049	0.064
1956	0.088	0.055
1957	0.057	0.027
1958	0.069	0.044
1959	0.058	0.081
1960	0.044	0.045
1961	0.044	0.031
1962	0.047	0.101
1963	0.023	0.044
1964	0.040	0.071
1965	0.044	0.035
1966	0.041	0.027
1967	0.021	0.028
1968	0.066	0.109
1969	0.057	0.059
1970	0.030	0.071
1971	0.034	0.035
1972	0.055	0.051
1973	0.049	0.082
1974	0.023	0.050
1975	0.041	0.056
1976	0.035	0.045
1977	0.036	0.041
1978	0.009	0.034
1979	0.030	0.029
1980	0.095	0.067
1981	0.031	0.029
1982	0.036	0.037
1983	0.052	0.040

1984	0.037	0.042
1985	0.044	0.038
1986	0.069	0.060
1987	0.182	0.057
1988	0.058	0.053
1989	0.037	0.044
1990	0.034	0.045
1991	0.040	0.030
1992	0.047	0.033
1993	0.031	0.036
1994	0.021	0.037
1995	0.017	0.026
1996	0.038	0.038
1997	0.104	0.042
1998	0.209	0.056

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.2090	0.1094
2	0.1822	0.1009
3	0.1037	0.0821
4	0.0945	0.0812
5	0.0880	0.0712
6	0.0691	0.0705
7	0.0689	0.0670
8	0.0662	0.0657
9	0.0584	0.0641
10	0.0577	0.0601
11	0.0572	0.0592
12	0.0570	0.0573
13	0.0567	0.0565
14	0.0549	0.0558
15	0.0516	0.0545
16	0.0495	0.0533
17	0.0487	0.0508
18	0.0472	0.0500
19	0.0470	0.0499
20	0.0442	0.0453
21	0.0441	0.0452
22	0.0439	0.0450
23	0.0436	0.0444
24	0.0411	0.0439
25	0.0409	0.0438
26	0.0403	0.0436
27	0.0395	0.0424
28	0.0390	0.0422
29	0.0377	0.0410
30	0.0367	0.0399
31	0.0365	0.0383
32	0.0365	0.0382
33	0.0358	0.0376
34	0.0349	0.0375
35	0.0339	0.0368
36	0.0336	0.0364
37	0.0313	0.0361
38	0.0312	0.0349

39	0.0296	0.0348
40	0.0296	0.0336
41	0.0264	0.0333
42	0.0235	0.0308
43	0.0230	0.0303
44	0.0229	0.0294
45	0.0210	0.0288
46	0.0207	0.0279
47	0.0165	0.0275
48	0.0091	0.0273
49	0.0023	0.0263

POC #1
The Facility PASSED

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0225	3981	673	16	Pass
0.0234	3673	585	15	Pass
0.0243	3385	518	15	Pass
0.0252	3114	480	15	Pass
0.0261	2856	422	14	Pass
0.0270	2635	377	14	Pass
0.0280	2436	319	13	Pass
0.0289	2254	280	12	Pass
0.0298	2096	250	11	Pass
0.0307	1952	226	11	Pass
0.0316	1812	204	11	Pass
0.0325	1684	174	10	Pass
0.0334	1564	143	9	Pass
0.0343	1443	122	8	Pass
0.0352	1324	112	8	Pass
0.0361	1230	101	8	Pass
0.0370	1132	90	7	Pass
0.0379	1056	74	7	Pass
0.0388	984	66	6	Pass
0.0397	912	61	6	Pass
0.0406	842	55	6	Pass
0.0415	782	53	6	Pass
0.0425	738	49	6	Pass
0.0434	692	49	7	Pass
0.0443	651	44	6	Pass
0.0452	621	39	6	Pass
0.0461	587	33	5	Pass
0.0470	556	33	5	Pass
0.0479	523	32	6	Pass
0.0488	492	30	6	Pass
0.0497	457	29	6	Pass
0.0506	436	26	5	Pass
0.0515	415	24	5	Pass
0.0524	394	24	6	Pass
0.0533	375	22	5	Pass
0.0542	359	22	6	Pass
0.0551	332	21	6	Pass
0.0561	315	20	6	Pass

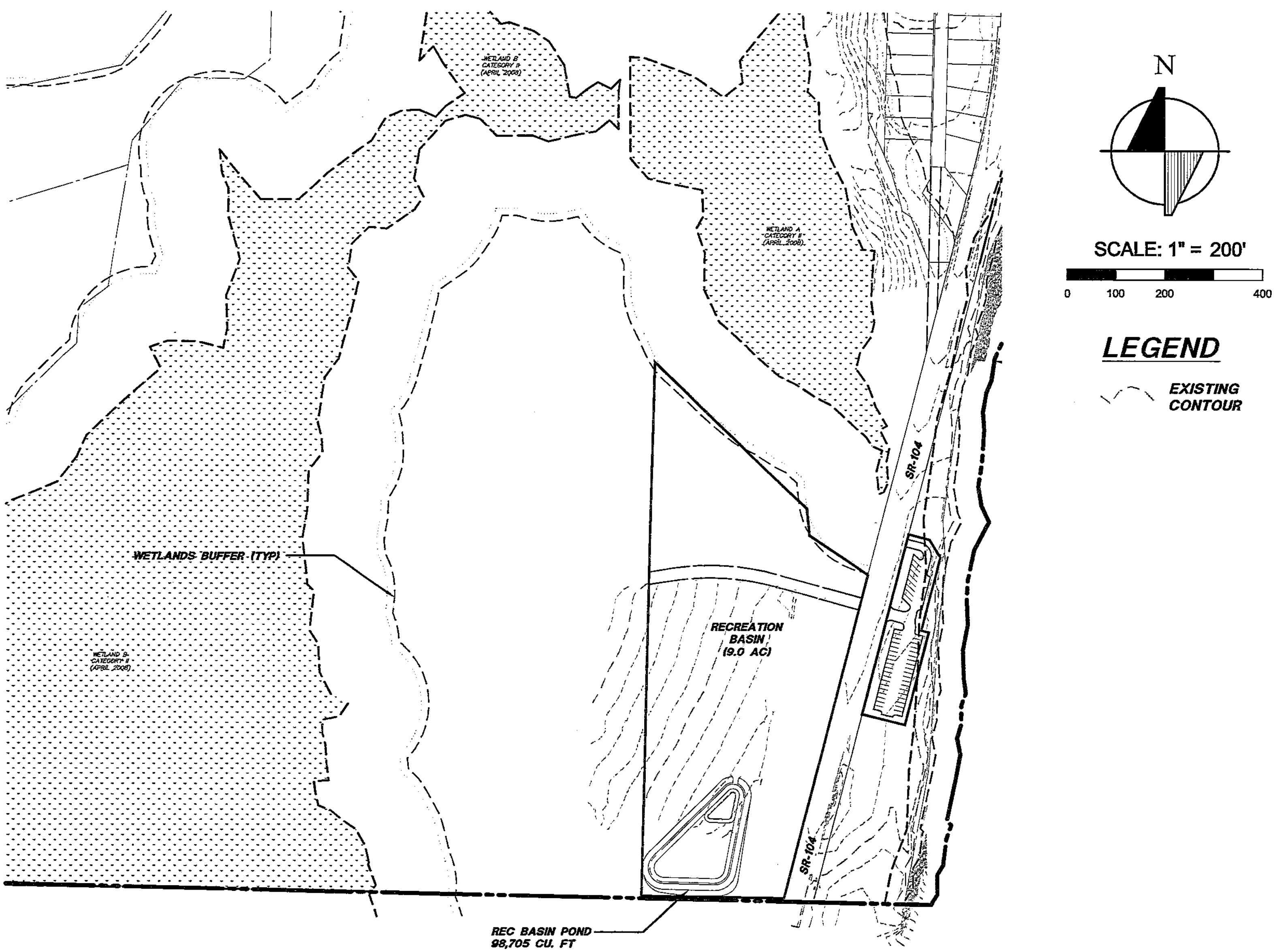
0.0570	297	19	6	Pass
0.0579	286	18	6	Pass
0.0588	273	16	5	Pass
0.0597	267	14	5	Pass
0.0606	259	13	5	Pass
0.0615	249	13	5	Pass
0.0624	240	12	5	Pass
0.0633	233	12	5	Pass
0.0642	227	11	4	Pass
0.0651	221	10	4	Pass
0.0660	213	9	4	Pass
0.0669	200	9	4	Pass
0.0678	194	8	4	Pass
0.0687	183	8	4	Pass
0.0696	173	8	4	Pass
0.0706	169	7	4	Pass
0.0715	159	6	3	Pass
0.0724	155	6	3	Pass
0.0733	148	5	3	Pass
0.0742	145	5	3	Pass
0.0751	144	5	3	Pass
0.0760	140	5	3	Pass
0.0769	139	5	3	Pass
0.0778	136	4	2	Pass
0.0787	133	4	3	Pass
0.0796	130	4	3	Pass
0.0805	123	4	3	Pass
0.0814	122	3	2	Pass
0.0823	121	2	1	Pass
0.0832	118	2	1	Pass
0.0841	117	2	1	Pass
0.0851	115	2	1	Pass
0.0860	114	2	1	Pass
0.0869	114	2	1	Pass
0.0878	112	2	1	Pass
0.0887	109	2	1	Pass
0.0896	107	2	1	Pass
0.0905	105	2	1	Pass
0.0914	104	2	1	Pass
0.0923	101	2	1	Pass
0.0932	99	2	2	Pass
0.0941	98	2	2	Pass
0.0950	96	2	2	Pass
0.0959	93	2	2	Pass
0.0968	91	2	2	Pass
0.0977	90	2	2	Pass
0.0987	89	2	2	Pass
0.0996	86	2	2	Pass
0.1005	84	2	2	Pass
0.1014	82	1	1	Pass
0.1023	80	1	1	Pass
0.1032	78	1	1	Pass
0.1041	76	1	1	Pass
0.1050	75	1	1	Pass
0.1059	74	1	1	Pass
0.1068	74	1	1	Pass
0.1077	73	1	1	Pass

0.1086	72	1	1	Pass
0.1095	72	0	0	Pass
0.1104	71	0	0	Pass
0.1113	71	0	0	Pass
0.1122	70	0	0	Pass

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

Perlnd and Implnd Changes

No changes have been made.



Ujw, Oct 23, 2017 - 10:15am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0831 REC pond.dwg, ED REC PONDS

triad
20300 Woodinville Snohomish Rd NE
Suite A • Woodinville, WA 98072
p: 425.415.2000 f: 425.486.5059
w: triadassociates.net

RECREATION POND EXHIBIT

PORT GAMBLE
REDEVELOPMENT PLAN

KITSAP COUNTY, WASHINGTON

NO.	DATE	REVISION	BY	CK

REVIEWED BY: DATE:

ALAN D. FURE, PE
PROJECT MANAGER
ROBERT E. WALLIS, PLS
PROJECT SURVEYOR
BEAU A. WILLOTT, PE
PROJECT ENGINEER
DENISE LIFTIN, PLA
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.: 1"=200' VERT.:

STAMP NOT VALID UNLESS SIGNED AND DATED

JOB NO. 08-029

SHEET NO. 1 of 1

Western Washington Hydrology Model
PROJECT REPORT

Project Name: Rec Pond
Site Address:
City :
Report Date : 9/5/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 1.00
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Rec Pond
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	9.02

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Rec Pond
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	4.51

Impervious Land Use	Acres
ROADS MOD	4.51

Element Flows To:

Surface	Interflow	Groundwater
Rec Pond,	Rec Pond,	

Name : Rec Pond
Bottom Length: 108.5ft.

Bottom Width: 108.6ft.
Depth : 7ft.
Volume at riser head : 2.0353ft.
Side slope 1: 2 To 1
Side slope 2: 2 To 1
Side slope 3: 2 To 1
Side slope 4: 2 To 1
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.
NotchType : Rectangular
Notch Width : 0.020 ft.
Notch Height: 1.742 ft.
Orifice 1 Diameter: 1.272 in. **Elevation:** 0 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Pond Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.271	0.000	0.000	0.000
0.078	0.272	0.021	0.012	0.000
0.156	0.274	0.042	0.017	0.000
0.233	0.275	0.064	0.021	0.000
0.311	0.277	0.085	0.024	0.000
0.389	0.278	0.107	0.027	0.000
0.467	0.280	0.128	0.029	0.000
0.544	0.281	0.150	0.031	0.000
0.622	0.283	0.172	0.034	0.000
0.700	0.285	0.194	0.036	0.000
0.778	0.286	0.216	0.037	0.000
0.856	0.288	0.239	0.039	0.000
0.933	0.289	0.261	0.041	0.000
1.011	0.291	0.284	0.043	0.000
1.089	0.293	0.307	0.044	0.000
1.167	0.294	0.329	0.046	0.000
1.244	0.296	0.352	0.047	0.000
1.322	0.298	0.375	0.049	0.000
1.400	0.299	0.399	0.050	0.000
1.478	0.301	0.422	0.052	0.000
1.556	0.302	0.445	0.053	0.000
1.633	0.304	0.469	0.054	0.000
1.711	0.306	0.493	0.056	0.000
1.789	0.307	0.516	0.057	0.000
1.867	0.309	0.540	0.058	0.000
1.944	0.311	0.565	0.059	0.000
2.022	0.312	0.589	0.060	0.000
2.100	0.314	0.613	0.062	0.000
2.178	0.316	0.638	0.063	0.000
2.256	0.317	0.662	0.064	0.000
2.333	0.319	0.687	0.065	0.000
2.411	0.321	0.712	0.066	0.000
2.489	0.322	0.737	0.067	0.000
2.567	0.324	0.762	0.068	0.000

2.644	0.326	0.787	0.069	0.000
2.722	0.327	0.813	0.070	0.000
2.800	0.329	0.838	0.071	0.000
2.878	0.331	0.864	0.072	0.000
2.956	0.333	0.890	0.073	0.000
3.033	0.334	0.916	0.074	0.000
3.111	0.336	0.942	0.075	0.000
3.189	0.338	0.968	0.076	0.000
3.267	0.340	0.994	0.077	0.000
3.344	0.341	1.021	0.078	0.000
3.422	0.343	1.047	0.079	0.000
3.500	0.345	1.074	0.080	0.000
3.578	0.347	1.101	0.080	0.000
3.656	0.348	1.128	0.081	0.000
3.733	0.350	1.155	0.082	0.000
3.811	0.352	1.182	0.083	0.000
3.889	0.354	1.210	0.084	0.000
3.967	0.355	1.237	0.085	0.000
4.044	0.357	1.265	0.085	0.000
4.122	0.359	1.293	0.086	0.000
4.200	0.361	1.321	0.087	0.000
4.278	0.363	1.349	0.088	0.000
4.356	0.364	1.377	0.091	0.000
4.433	0.366	1.406	0.094	0.000
4.511	0.368	1.434	0.098	0.000
4.589	0.370	1.463	0.103	0.000
4.667	0.372	1.492	0.108	0.000
4.744	0.373	1.521	0.113	0.000
4.822	0.375	1.550	0.118	0.000
4.900	0.377	1.579	0.124	0.000
4.978	0.379	1.609	0.130	0.000
5.056	0.381	1.638	0.135	0.000
5.133	0.383	1.668	0.141	0.000
5.211	0.384	1.698	0.147	0.000
5.289	0.386	1.728	0.154	0.000
5.367	0.388	1.758	0.161	0.000
5.444	0.390	1.788	0.168	0.000
5.522	0.392	1.818	0.176	0.000
5.600	0.394	1.849	0.183	0.000
5.678	0.396	1.880	0.216	0.000
5.756	0.397	1.910	0.227	0.000
5.833	0.399	1.941	0.237	0.000
5.911	0.401	1.973	0.248	0.000
5.989	0.403	2.004	0.259	0.000
6.067	0.405	2.035	0.513	0.000
6.144	0.407	2.067	1.064	0.000
6.222	0.409	2.099	1.793	0.000
6.300	0.411	2.130	2.664	0.000
6.378	0.413	2.162	3.656	0.000
6.456	0.415	2.195	4.756	0.000
6.533	0.416	2.227	5.955	0.000
6.611	0.418	2.259	7.245	0.000
6.689	0.420	2.292	8.619	0.000
6.767	0.422	2.325	10.07	0.000
6.844	0.424	2.358	11.60	0.000
6.922	0.426	2.391	13.21	0.000
7.000	0.428	2.424	14.88	0.000

7.078	0.430	2.457	16.62	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.175601
5 year	0.26737
10 year	0.339298
25 year	0.443765
50 year	0.532025
100 year	0.629728

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.111548
5 year	0.216577
10 year	0.324701
25 year	0.523612
50 year	0.731698
100 year	1.006359

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1950	0.063	0.078
1951	0.284	0.123
1952	0.137	0.079
1953	0.128	0.079
1954	0.165	0.075
1955	0.248	0.086
1956	0.328	0.237
1957	0.223	0.246
1958	0.319	0.131
1959	0.232	0.089
1960	0.183	0.091
1961	0.172	0.098
1962	0.166	0.183
1963	0.227	0.072
1964	0.346	0.085
1965	0.166	0.067
1966	0.169	0.106
1967	0.088	0.080
1968	0.233	0.082
1969	0.244	0.104
1970	0.111	0.086
1971	0.130	0.082
1972	0.197	0.342
1973	0.176	0.082
1974	0.126	0.135
1975	0.163	0.107
1976	0.132	0.072

1977	0.135	0.088
1978	0.102	0.074
1979	0.137	0.077
1980	0.430	0.076
1981	0.144	0.079
1982	0.163	0.072
1983	0.171	0.135
1984	0.159	0.089
1985	0.164	0.392
1986	0.242	0.200
1987	0.581	1.364
1988	0.241	0.648
1989	0.130	0.128
1990	0.200	0.072
1991	0.171	0.122
1992	0.184	0.113
1993	0.144	0.117
1994	0.086	0.064
1995	0.073	0.116
1996	0.167	0.153
1997	0.329	0.149
1998	0.726	1.984

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.7260	1.9844
2	0.5812	1.3637
3	0.4300	0.6481
4	0.3461	0.3916
5	0.3294	0.3417
6	0.3276	0.2459
7	0.3186	0.2375
8	0.2839	0.2000
9	0.2483	0.1828
10	0.2444	0.1534
11	0.2419	0.1492
12	0.2408	0.1355
13	0.2326	0.1351
14	0.2316	0.1306
15	0.2265	0.1284
16	0.2227	0.1233
17	0.1998	0.1221
18	0.1970	0.1171
19	0.1839	0.1162
20	0.1832	0.1135
21	0.1757	0.1067
22	0.1721	0.1060
23	0.1712	0.1045
24	0.1711	0.0979
25	0.1688	0.0908
26	0.1670	0.0893
27	0.1663	0.0887
28	0.1661	0.0883
29	0.1650	0.0858
30	0.1642	0.0856
31	0.1634	0.0847

32	0.1631	0.0821
33	0.1587	0.0820
34	0.1439	0.0818
35	0.1438	0.0798
36	0.1368	0.0790
37	0.1366	0.0788
38	0.1348	0.0785
39	0.1316	0.0784
40	0.1298	0.0770
41	0.1295	0.0758
42	0.1284	0.0747
43	0.1262	0.0739
44	0.1115	0.0724
45	0.1016	0.0723
46	0.0878	0.0722
47	0.0858	0.0717
48	0.0731	0.0668
49	0.0629	0.0637

POC #1
The Facility PASSED

The Facility PASSED.

Flow(CFS)	**Predev**	**Dev**	**Percentage**	**Pass/Fail**
0.0878	4420	4330	97	Pass
0.0923	3902	3393	86	Pass
0.0968	3538	2980	84	Pass
0.1013	3099	2580	83	Pass
0.1057	2790	2283	81	Pass
0.1102	2460	1995	81	Pass
0.1147	2233	1806	80	Pass
0.1192	1984	1595	80	Pass
0.1237	1783	1440	80	Pass
0.1282	1550	1275	82	Pass
0.1327	1383	1148	83	Pass
0.1372	1238	1037	83	Pass
0.1416	1132	955	84	Pass
0.1461	1007	847	84	Pass
0.1506	910	765	84	Pass
0.1551	799	664	83	Pass
0.1596	725	611	84	Pass
0.1641	632	546	86	Pass
0.1686	561	497	88	Pass
0.1731	497	437	87	Pass
0.1775	460	389	84	Pass
0.1820	418	321	76	Pass
0.1865	389	303	77	Pass
0.1910	356	290	81	Pass
0.1955	331	279	84	Pass
0.2000	311	268	86	Pass
0.2045	285	256	89	Pass
0.2090	270	250	92	Pass
0.2134	255	245	96	Pass
0.2179	238	239	100	Pass
0.2224	215	221	102	Pass

0.2269	199	208	104	Pass
0.2314	183	192	104	Pass
0.2359	166	175	105	Pass
0.2404	159	153	96	Pass
0.2448	150	139	92	Pass
0.2493	142	122	85	Pass
0.2538	139	105	75	Pass
0.2583	128	85	66	Pass
0.2628	126	82	65	Pass
0.2673	123	78	63	Pass
0.2718	118	77	65	Pass
0.2763	115	73	63	Pass
0.2807	112	70	62	Pass
0.2852	109	68	62	Pass
0.2897	108	67	62	Pass
0.2942	105	65	61	Pass
0.2987	105	64	60	Pass
0.3032	102	63	61	Pass
0.3077	101	62	61	Pass
0.3122	95	61	64	Pass
0.3166	92	59	64	Pass
0.3211	85	58	68	Pass
0.3256	85	57	67	Pass
0.3301	79	55	69	Pass
0.3346	78	55	70	Pass
0.3391	75	54	72	Pass
0.3436	74	51	68	Pass
0.3481	71	46	64	Pass
0.3525	70	46	65	Pass
0.3570	69	44	63	Pass
0.3615	67	44	65	Pass
0.3660	67	43	64	Pass
0.3705	65	42	64	Pass
0.3750	62	40	64	Pass
0.3795	61	40	65	Pass
0.3840	60	39	65	Pass
0.3884	60	38	63	Pass
0.3929	56	36	64	Pass
0.3974	56	35	62	Pass
0.4019	56	34	60	Pass
0.4064	53	33	62	Pass
0.4109	53	33	62	Pass
0.4154	51	32	62	Pass
0.4198	50	32	64	Pass
0.4243	49	32	65	Pass
0.4288	48	32	66	Pass
0.4333	45	30	66	Pass
0.4378	42	30	71	Pass
0.4423	41	30	73	Pass
0.4468	41	30	73	Pass
0.4513	39	30	76	Pass
0.4557	38	30	78	Pass
0.4602	37	30	81	Pass
0.4647	36	29	80	Pass
0.4692	34	29	85	Pass
0.4737	33	29	87	Pass
0.4782	33	29	87	Pass

0.4827	32	28	87	Pass
0.4872	32	28	87	Pass
0.4916	31	28	90	Pass
0.4961	29	28	96	Pass
0.5006	28	27	96	Pass
0.5051	28	27	96	Pass
0.5096	27	27	100	Pass
0.5141	26	25	96	Pass
0.5186	26	25	96	Pass
0.5231	23	23	100	Pass
0.5275	22	23	104	Pass
0.5320	21	23	109	Pass

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

Perlnd and Implnd Changes
No changes have been made.

6 Water Quality

Stormwater runoff from the Port Gamble project requires basic water quality treatment based on the requirements of the 2010 Kitsap County Stormwater Design Manual (2010 KCSDM). The Port Gamble project proposes to include commercial development, as described in the 2010 KCSDM, commercial tracts are required to use enhanced treatment. However, all commercial development for this project is proposed to direct discharge to salt water, and therefore only Basic treatment is required. Basic water quality treatment, as defined by Chapter 6 of the 2010 KCSDM, is proposed to be provided by three methods for this development: water quality wetponds, Contech Stormfilters and rain gardens. Specific areas have been delineated for the use of each of these water quality facilities. The specific facilities may change due to grading, site planning or other factors within the final engineering phase of the project.

Water quality treatment is being provided per the requirements of the Kitsap County drainage manual for both existing and proposed impervious surfaces. Therefore, the quality of runoff reaching Hood Canal and Port Gamble Bay would be improved over existing conditions.

6.1 Water Quality Ponds

The proposed water quality pond, for the west portion of the site, will serve approximately 35.4 acres of development and 25.9 acres of undisturbed forest. Equation 6-4 from section 6.11 of the 2010 KCSWDM was used to determine the required volume. Delineations from AutoCAD, for the inputs within the equation, were determined to calculate areas of lots and roadways tributary to the water quality pond. A percentage of impervious surface and till soil lawn (pervious surface) for each lot and roadway was assumed based on the type of land use. Lot area was assumed to be 60% impervious, whilst right-of-way was assumed to be 70% impervious. This delineation has been attached to the end of this section. The rainfall event (in Inches) was interpolated from Figure 6.11 of the KCSWDM, also attached at the end of this section, and was found to be 0.45 inches.

(Equation 6-4): $V_r = (0.9A_i + 0.25A_{tg} + 0.10\ A_{tf} + 0.01A_0) \times R$

A_i= Area Impervious = 924,944 sf

A_{tg}= Area till grass = 616,629 sf

A_{tf}= Area till forest = 1,127,028 sf

A_o= Area outwash grass or forest = 0 sf

R = Annual Rain fall (feet) = 0.45 inches = 0.0375 ft

$V_r = (0.9(924{,}944) + 0.25(616{,}629) + 0.10(1{,}127{,}028) + 0.01(0))\ 0.0375$

The required water quality pond volume was found to be 41,224 cubic feet. The proposed water quality pond will have a volume of 45,983 cubic feet. A flow splitter immediately downstream of the water quality pond will limit discharge (2-year storm event maximum) to Machias Creek via a level spreader, while the remaining stormwater will direct discharge under SR104 to Hood Canal via a diffuser tee outfall. For more information regarding the flow splitter, refer to Section 5.

The detention pond serving the Recreation Tract in the southeast corner of the site will also serve as a water quality pond. It will provide a water quality storage volume that is in addition to the detention/flow control volume. To determine the required water quality volume, equation 6-4 was used. The pond has a tributary area of 9.02 acres, assumed to be 50% impervious and 50% till grass. The required water quality volume for the Recreation Tract pond was found to be 8,472 cubic feet. A water quality volume of 9,037 cubic feet has been designed for the Recreation Tract pond. A basin map exhibit has been attached at the end Section 5.

6.2 Stormfilters

Stormfilters were designed using Contech's specifications and recommendations. All proposed Stormfilters specified will be the 27-inch tall model with a stated treatment flow rate of 11.25 gallons per minute, which is equal to 0.025 cubic feet per second. To size the Stormfilter facilities, the tributary area each filter can treat was determined using WWHM. From WWHM, 1 acre of moderately sloped roads produced a 15-minute on-line BMP water quality flow requirement of 0.141 cubic feet per second. This equates to 5.64 Stormfilters per acre of impervious surface. Pervious surfaces were modeled as 1 acre of moderately sloped lawn over type C soils. WWHM calculated that 1 acre of lawn produces a 0.01218 cubic feet per second on-line BMP flow requirement. This equates to 0.64 Stormfilter cartridges per acre of pervious surfaces.

AutoCAD was used to delineate the project area into watersheds tributary to each Stormfilter treatment structure. The cartridges required for each structure were determined by equating the treatment capacity of a Stormfilter to the impervious and pervious areas within the tributary area. This process is summarized in a table attached to the end of this section.

Stormfilter cartridges will be housed in either manholes or vaults. Contech has designed a 48-inch diameter manhole to accommodate up to 3 Stormfilters, a 60-inch manhole to accommodate up to 4 Stormfilters and a 72-inch manhole to accommodate up to 7 Stormfilters. Vaults can generally be sized based on the required number of cartridges. A vault measuring 8' x 11' can accommodate up to 26 Stormfilters. The 27-inch Stormfilter cartridges being used in this project require 3.05 feet of hydraulic drop to operate; this has been incorporated into our stormwater design. The project will require a total of 93 Stormfilters in 3 manholes and 7 vaults.

6.3 Rain Gardens

Several rain gardens will be used to provide basic water quality treatment for portions of the project site. Rain gardens were designed in accordance with the 2009 Kitsap County LID Guidance Manual. Rain gardens were designed with a maximum ponding depth of 10 inches, 6 inches of freeboard and a bioretention soil depth of 18 inches. Rain gardens will have side slopes of 3 horizontal to 1 vertical. Per the manual, the rain gardens were designed to infiltrate 91% of the modeled runoff volumes through bioretention soils at a long term infiltration rate of 3 inches per hour.

WWHM was used to size a rain garden to treat 1 acre of impervious surface. It was found that a rain garden with the above characteristics and a bottom area of 565 square feet can treat 1 acre of impervious surface. It was also found that a rain garden with a bottom area of 63 square feet was sufficient to treat 1 acre of moderately sloped lawn over type C soils. WWHM calculations documenting these determinations are presented at the end of this section. Similar to the calculations for Stormfilters, AutoCAD was then used to delineate areas tributary to each rain garden, and land use was correlated to percentages of pervious and impervious surfaces. The treatment areas and capacities were compared to determine the required size of each rain garden. In final engineering these rain gardens may be divided into multiple rain gardens of equal total area.

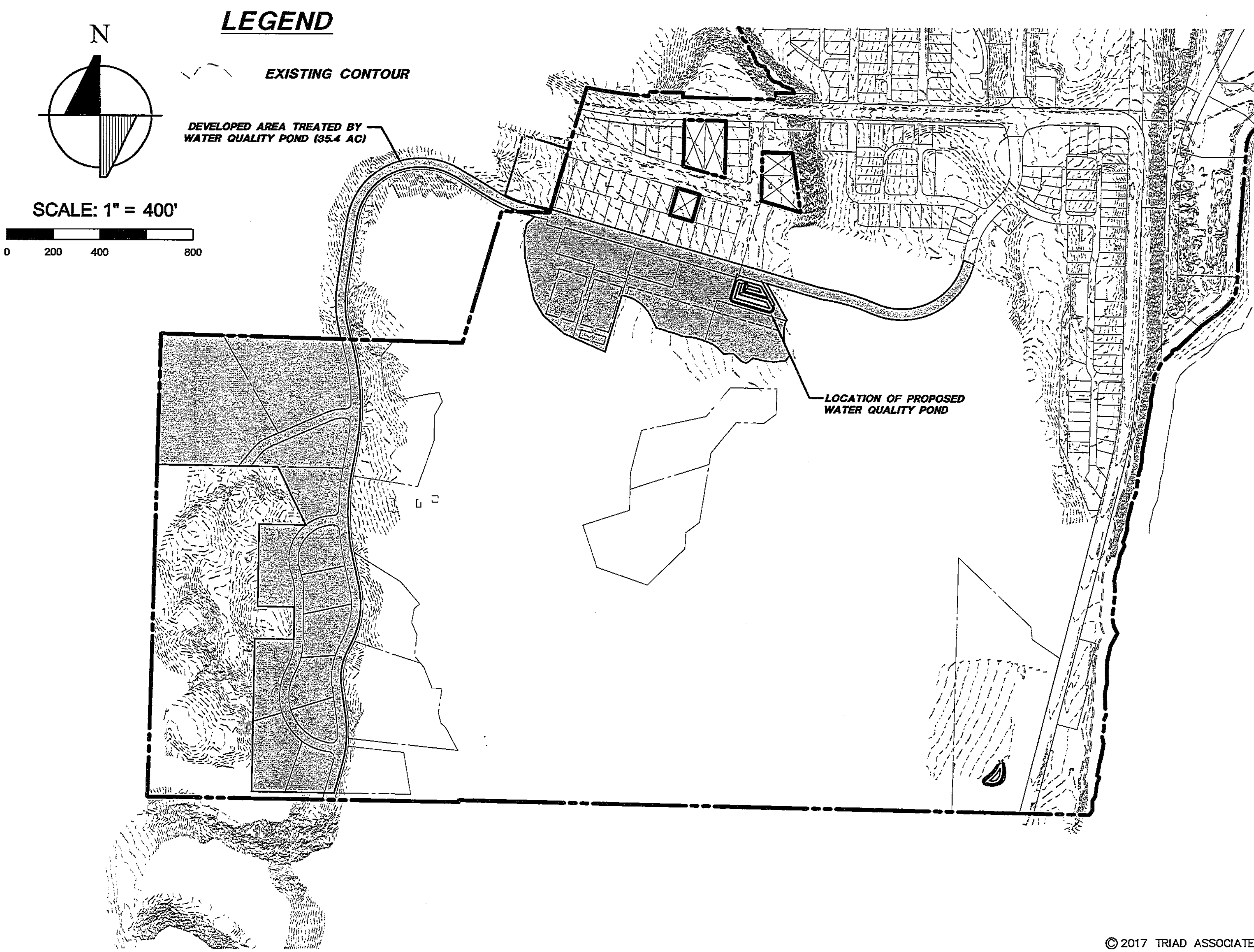
Stormwater runoff for the site has been designed to enter the rain garden via curb cuts; only surface flow will be accepted by the proposed rain gardens. Areas, tracts, and lots tributary to rain gardens were assumed to be graded towards the roads and therefore towards the rain gardens. Rain gardens will be equipped with an under drain and an overflow structure. The rain gardens will discharge flow into a clean stormwater conveyance system that will outfall to either Hood Canal or Port Gamble.

The rain gardens shown on the plan set are approximate based on preliminary grading of the site. Actual locations, sizes and numbers of rain gardens will be greatly affected by the final site and grading plans. It is likely that many of the rain gardens shown will be divided into multiple, smaller rain gardens in the final design.

6.4 Agrarian, Riparian, and Critical Area Protection

Several lots along the western portion of the property are designated as livestock areas. Livestock operations will need to take special precautions to avoid stormwater runoff contamination into existing downstream wetland and riparian areas. The Department of Ecology (DOE) released a report entitled "Clean Water and Livestock Operations: Assessing

Risks to Water Quality" in it they determined that, "the best way to ensure water quality compliance is to combine good upland management practices with the exclusion of livestock from the stream and riparian area." To comply with DOE's conclusions regarding livestock management, all riparian areas, wetlands, and their buffers will be fenced off to prevent livestock from entering. Manure will be promptly collected and disposed of, or stored in such a way to ensure the water quality of any runoff will not pollute downstream surface waters.



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w: triadassociates.net

WATER QUALITY POND BASIN EXHIBIT

PORT GAMBLE
REDEVELOPMENT PLAN

KITSAP COUNTY, WASHINGTON

ALAN D. FURE, PE
PROJECT MANAGER
ROBERT E. WALLIS, PLS
PROJECT SURVEYOR
BEAU J. WILLERT, PE
PROJECT ENGINEER
DENISE LIFTIN, PLA
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.: 1"=400' VERT.:

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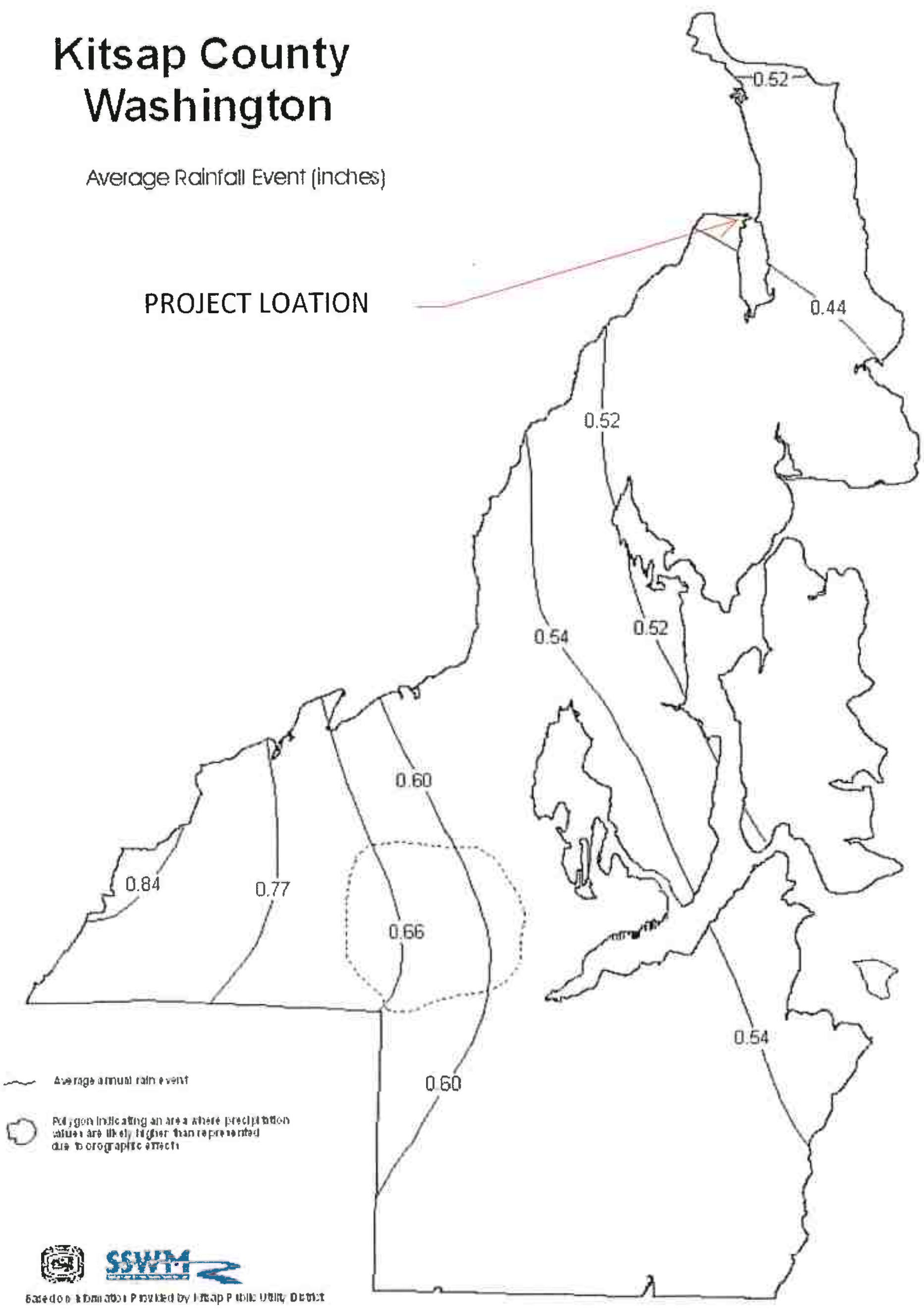
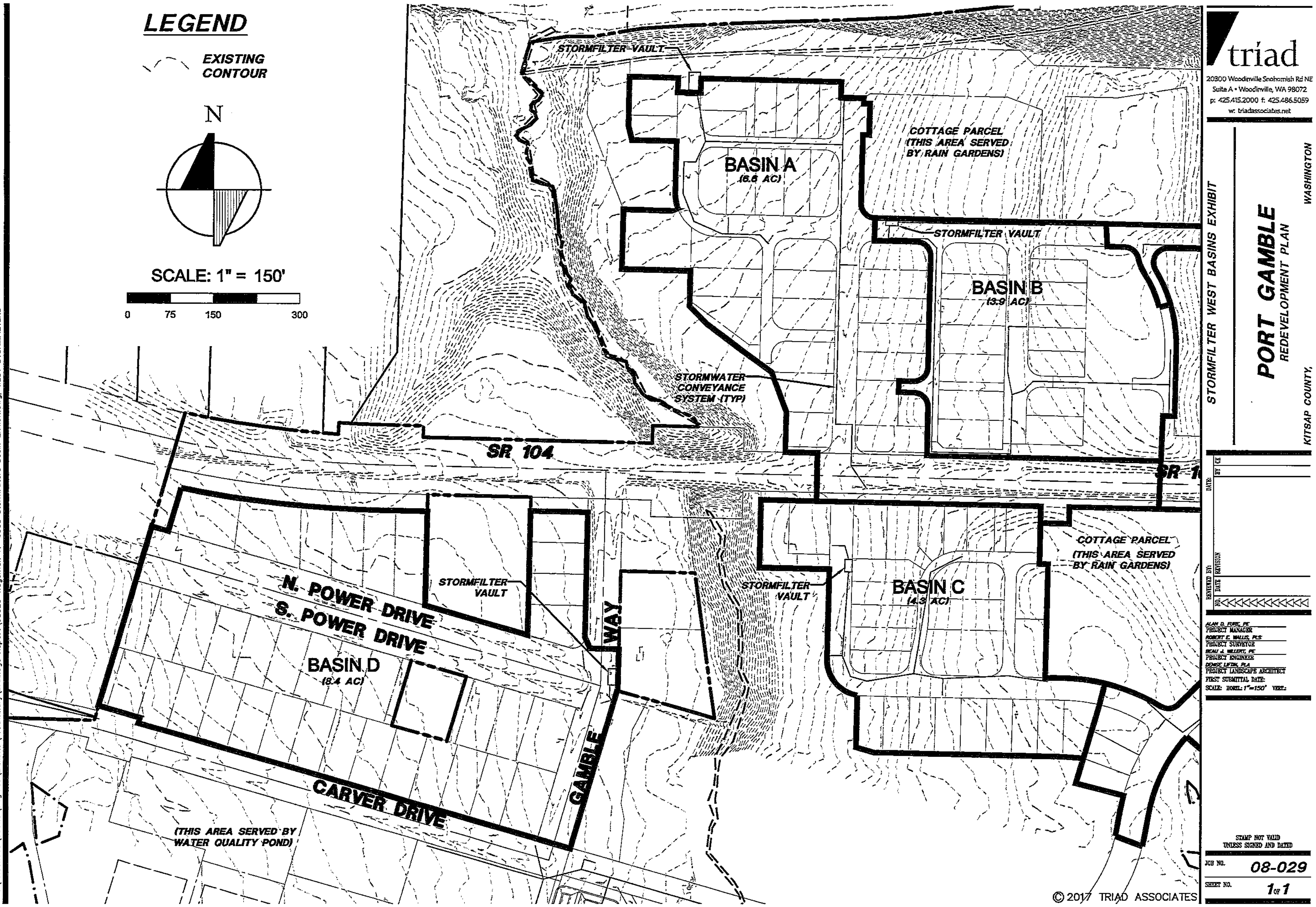
JOB NO. 08-029
SHEET NO. 1 OF 1

Ljw, Oct 03, 2017 – 11:34am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0831 WQ pond exhibit.dwg, WATER QUALITY POND

Figure 6.11 — Kitsap Mean Annual Storm





Ujw, Oct 31, 2017 – 8:40am
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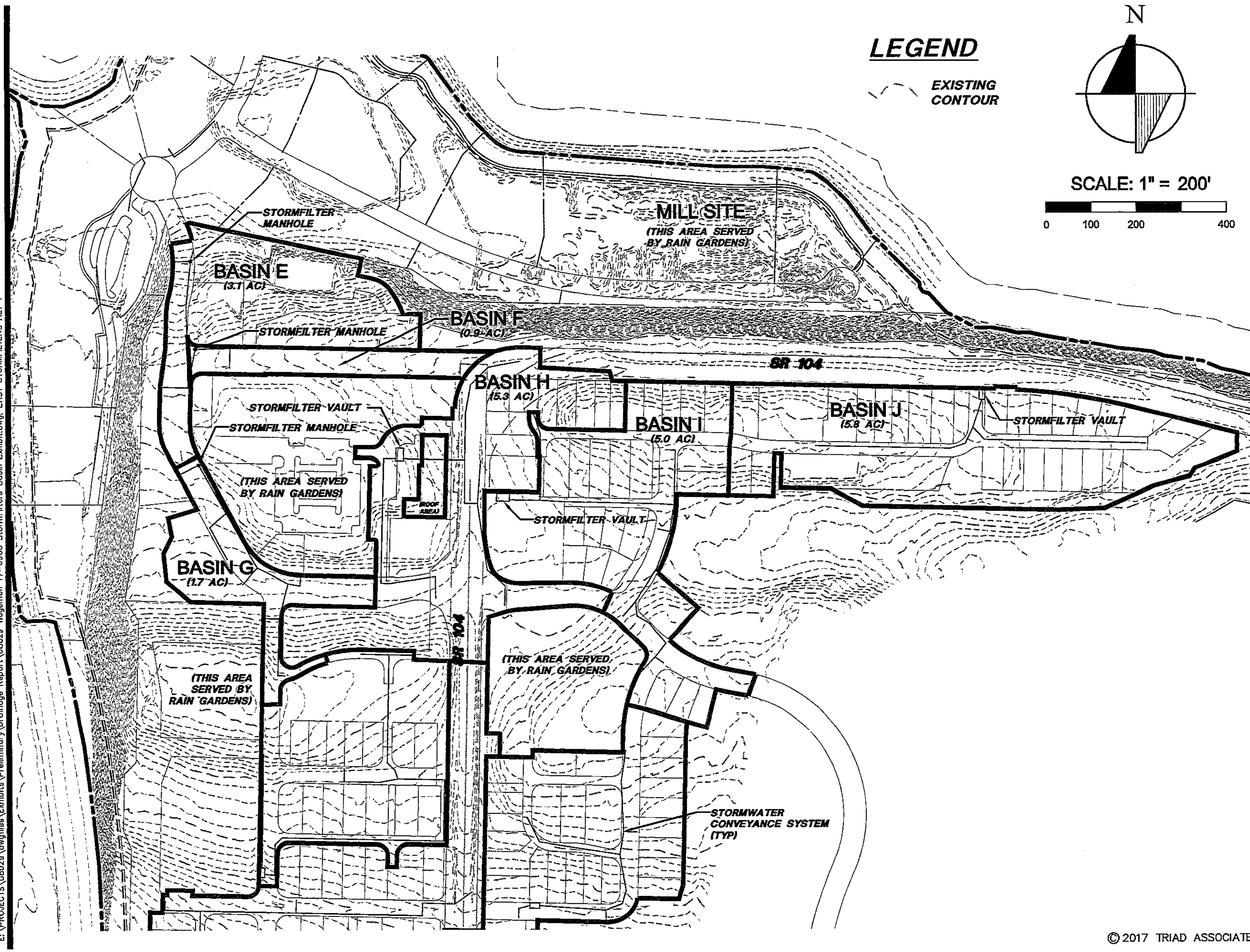

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STORMFILTER EAST BASINS EXHIBIT
ALTERNATIVE 1 SITE PLAN

PORT GAMBLE
REDEVELOPMENT PLAN
KITSAP COUNTY, WASHINGTON

NO.	DATE	REVISION	BY	CK

REVIEWED BY: DATE:

ALAN D. FURE, PE
PROJECT MANAGER
ROBERT E. WALLIS, PLS
PROJECT SURVEYOR
BEAU J. WILLOTT, PE
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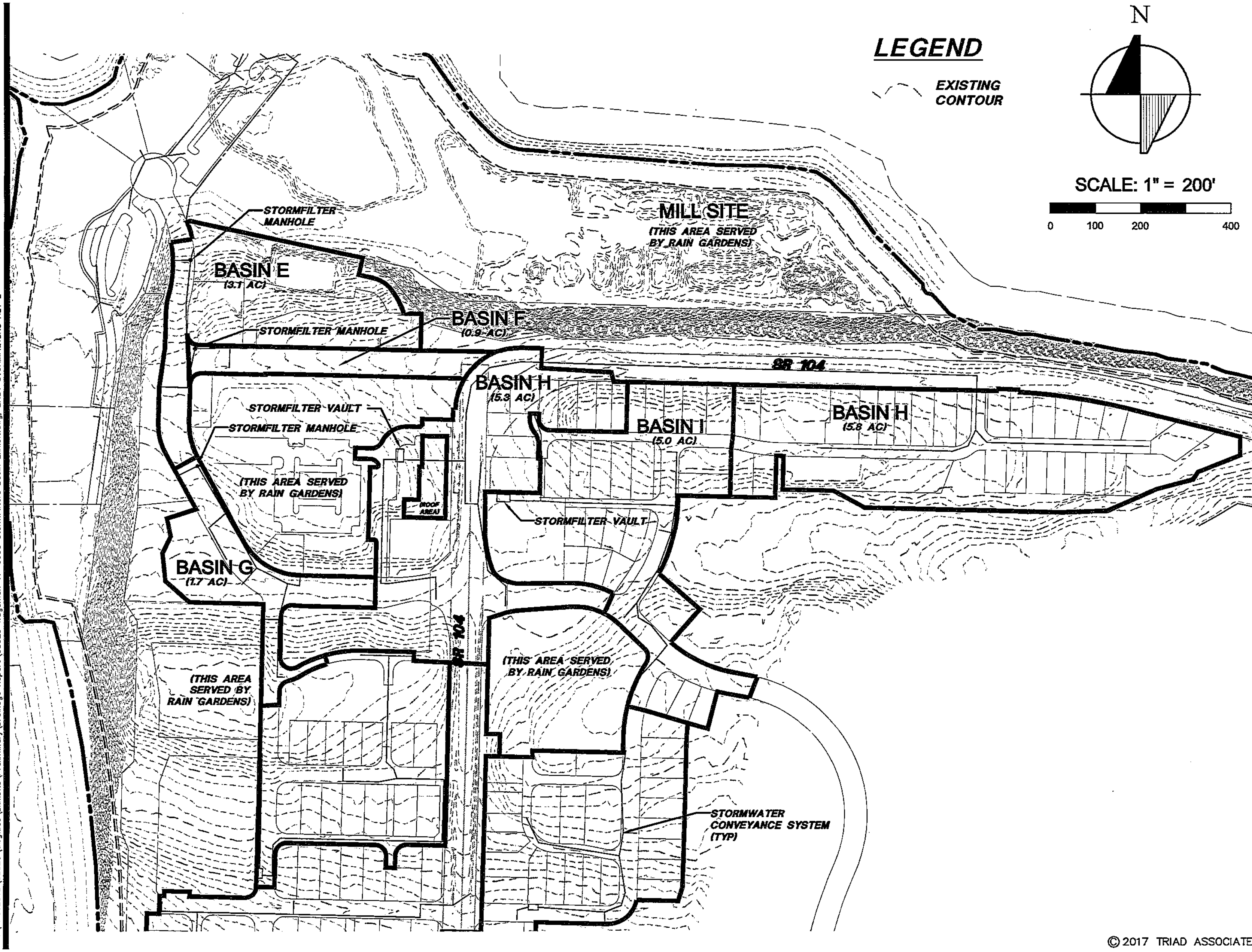

lw, Oct 31, 2017 – 8:48am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0905 StormFilters Basin Exhibit.dwg, EAST STORMFILTERS ALT 2

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STORMFILTER EAST BASINS EXHIBIT
ALTERNATIVE 2 SITE PLAN

PORT GAMBLE
REDEVELOPMENT PLAN
KITSAP COUNTY, WASHINGTON

NO.	DATE	REVISION	BY	CK

REVIEWED BY: DATE:

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PROJECT MANAGER
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SHEET NO. 1 OF 1

Western Washington Hydrology Model
PROJECT REPORT

Project Name: 12-1210 wq Stormfilter Capacity Impervious
Site Address:
City :
Report Date : 12/10/2012
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 0.80
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	1

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres

Impervious Land Use	Acres
ROADS MOD	1

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.010471
5 year	0.016805
10 year	0.020318
25 year	0.023936
50 year	0.026105
100 year	0.027896

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.257031
5 year	0.344028
10 year	0.405828
25 year	0.488849
50 year	0.554373
100 year	0.623125

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.0811 acre-feet
On-line facility target flow: 0.01 **cfs.**
Adjusted for 15 min: 0.141 **cfs.**
Off-line facility target flow: 0.0713 **cfs.**
Adjusted for 15 min: 0.0806 **cfs.**

Perlnd and Implnd Changes
No changes have been made.

Western Washington Hydrology Model
PROJECT REPORT

Project Name: 12-1210 wq Stormfilter Capacity Pervious
Site Address:
City :
Report Date : 12/10/2012
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 0.80
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Forest, Mod	1

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C, Lawn, Mod	1

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.010471
5 year	0.016805
10 year	0.020318
25 year	0.023936
50 year	0.026105
100 year	0.027896

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.033805
5 year	0.056921
10 year	0.076473
25 year	0.106656
50 year	0.133543
100 year	0.164576

The development has an increase in flow durations from 1/2 predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.0279 acre-feet
On-line facility target flow: 0.01 cfs.
Adjusted for 15 min: 0.0159 cfs.
Off-line facility target flow: 0.0091 cfs.
Adjusted for 15 min: 0.0091 cfs.

Perlnd and Implnd Changes

No changes have been made.

08-029 Port Gamble Preliminary Plat
Stormfilter Sizing Table
17-1031

Stormfilter Capacities:

Cover	Area ac	Water Quality Flow Rate (cfs)	27" Stormfilters per acre*
mod road	1	0.141	5.64
mod lawn	1	0.0159	0.64

Landuse:	Assumed Cover: Road %	Lawn %	Water Quality Flow Rate (cfs)	27" Stormfilters per acre*	Note:
Typical Lot	10	40	0.020	0.82	Assumed 50% roof.
80/20 R.O.W.	80	20	0.116	4.64	Typical street.
100% R.O.W.	100	0	0.141	5.64	Typical driveway.
Park	20	80	0.041	1.64	Parks and open space.

* From Contech: 1x27" Stormfilter has a treatment rate of 0.025 cfs

08-029 Port Gamble Preliminary Plat
Stormfilter Sizing Table, Alternative 1 Site Plan
17-1031

Basin A

Landuse	Area ac	Required Filters #
Lots	3.97	3.25
80/20 ROW	2.05	9.51
100 ROW	0.29	1.64
lawn	0.30	0.19
Total:	6.61	15

Basin B

Landuse	Area ac	Required Filters #
Lots	1.63	1.33
80/20 ROW	0.70	3.25
100 ROW	0.34	1.92
lawn	1.28	0.81
Total:	3.95	8

Basin C

Landuse 1	Area ac	Required Filters #
Lots	3.29	2.69
80/20 ROW	0.70	3.25
100 ROW	0.29	1.64
lawn	0.04	0.03
Total:	4.32	8

Basin D

Landuse	Area ac	Required Filters #
Lots	6.10	4.99
80/20 ROW	2.32	10.76
100 ROW	0.00	0.00
lawn	0.00	0.00
Total:	8.42	16

Basin E

Landuse	Area ac	Required Filters #
Lots	2.02	1.65
80/20 ROW	0.65	3.02
lawn	0.41	0.26
Total:	3.08	5

Basin F

Landuse	Area ac	Required Filters #
Lots	0.00	0.00
80/20 ROW	0.89	4.13
lawn	0.00	0.00
Total:	0.89	5

Basin G

Landuse	Area ac	Required Filters #
Lots	0.58	0.47
80/20 ROW	1.03	4.78
100 ROW	0.06	0.34
lawn	0.00	0.00
Total:	1.67	6

Basin H

Landuse	Area ac	Required Filters #
Lots	1.61	1.32
80/20 ROW	2.48	11.51
100 ROW	0.43	2.43
Park	0.27	0.44
lawn	0.48	0.31
Total:	5.27	16

Basin I

Landuse	Area ac	Required Filters #
Lots	3.34	2.73
80/20 ROW	1.01	4.69
100 ROW	0.28	1.58
Park	0.25	0.41
Lawn	0.15	0.10
Total:	5.03	10

Basin J

Landuse	Area ac	Required Filters #
Lots	3.91	3.20
80/20 ROW	0.72	3.34
Park	1.10	1.80
lawn	0.10	0.06
Total:	5.83	9

Site Total Stormfilter: 93

08-029 Port Gamble Preliminary Plat
Stormfilter Sizing Table, Alternative 2 Site Plan
17-1031

Basin A

Landuse	Area ac	Required Filters #
Lots	3.97	3.25
80/20 ROW	2.05	9.51
100 ROW	0.29	1.64
lawn	0.30	0.19
Total:	6.61	15

Basin B

Landuse	Area ac	Required Filters #
Lots	1.63	1.33
80/20 ROW	0.70	3.25
100 ROW	0.34	1.92
lawn	1.28	0.81
Total:	3.95	8

Basin C

Landuse 1	Area ac	Required Filters #
Lots	3.29	2.69
80/20 ROW	0.70	3.25
100 ROW	0.29	1.64
lawn	0.04	0.03
Total:	4.32	8

Basin D

Landuse	Area ac	Required Filters #
Lots	6.10	4.99
80/20 ROW	2.32	10.76
100 ROW	0.00	0.00
lawn	0.00	0.00
Total:	8.42	16

Basin E

Landuse	Area ac	Required Filters #
Lots	2.02	1.65
80/20 ROW	0.65	3.02
lawn	0.41	0.26
Total:	3.08	5

Basin F

Landuse	Area ac	Required Filters #
Lots	0.00	0.00
80/20 ROW	0.89	4.13
lawn	0.00	0.00
Total:	0.89	5

Basin G

Landuse	Area ac	Required Filters #
Lots	0.58	0.47
80/20 ROW	1.03	4.78
100 ROW	0.06	0.34
lawn	0.00	0.00
Total:	1.67	6

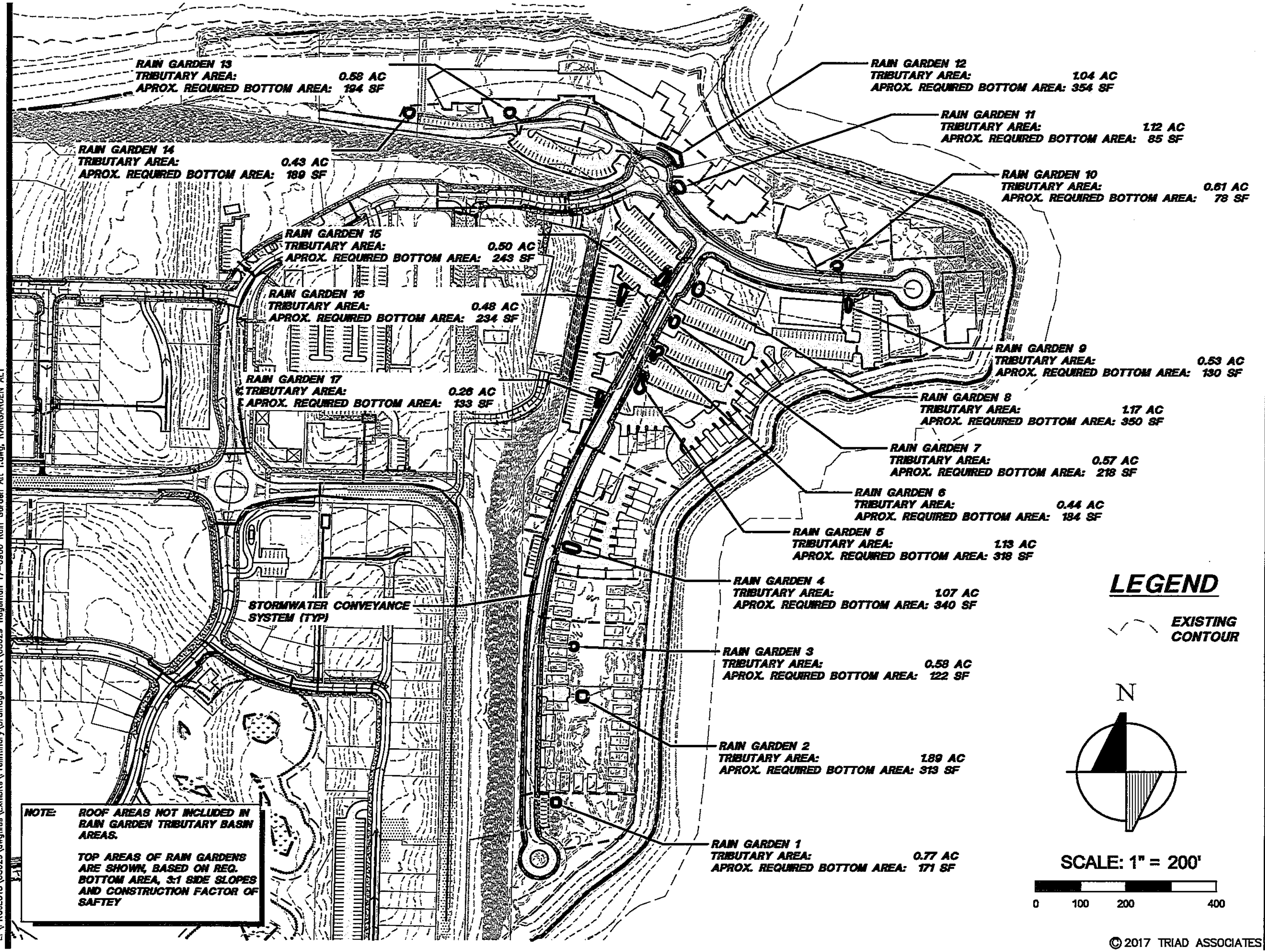
Basin H

Landuse	Area ac	Required Filters #
Lots	5.52	4.52
80/20 ROW	3.20	14.85
100 ROW	0.43	2.43
Park	1.37	2.24
lawn	0.58	0.37
Total:	11.10	25

Basin I

Landuse	Area ac	Required Filters #
Lots	3.34	2.73
80/20 ROW	1.01	4.69
100 ROW	0.28	1.58
Park	0.25	0.41
Lawn	0.15	0.10
Total:	5.03	10

Site Total Stormfilter: 93



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RAIN GARDEN EXHIBIT, ALTERNATE 1 SITE PLAN

PORT GAMBLE
REDEVELOPMENT PLAN

KITSAP COUNTY, WASHINGTON

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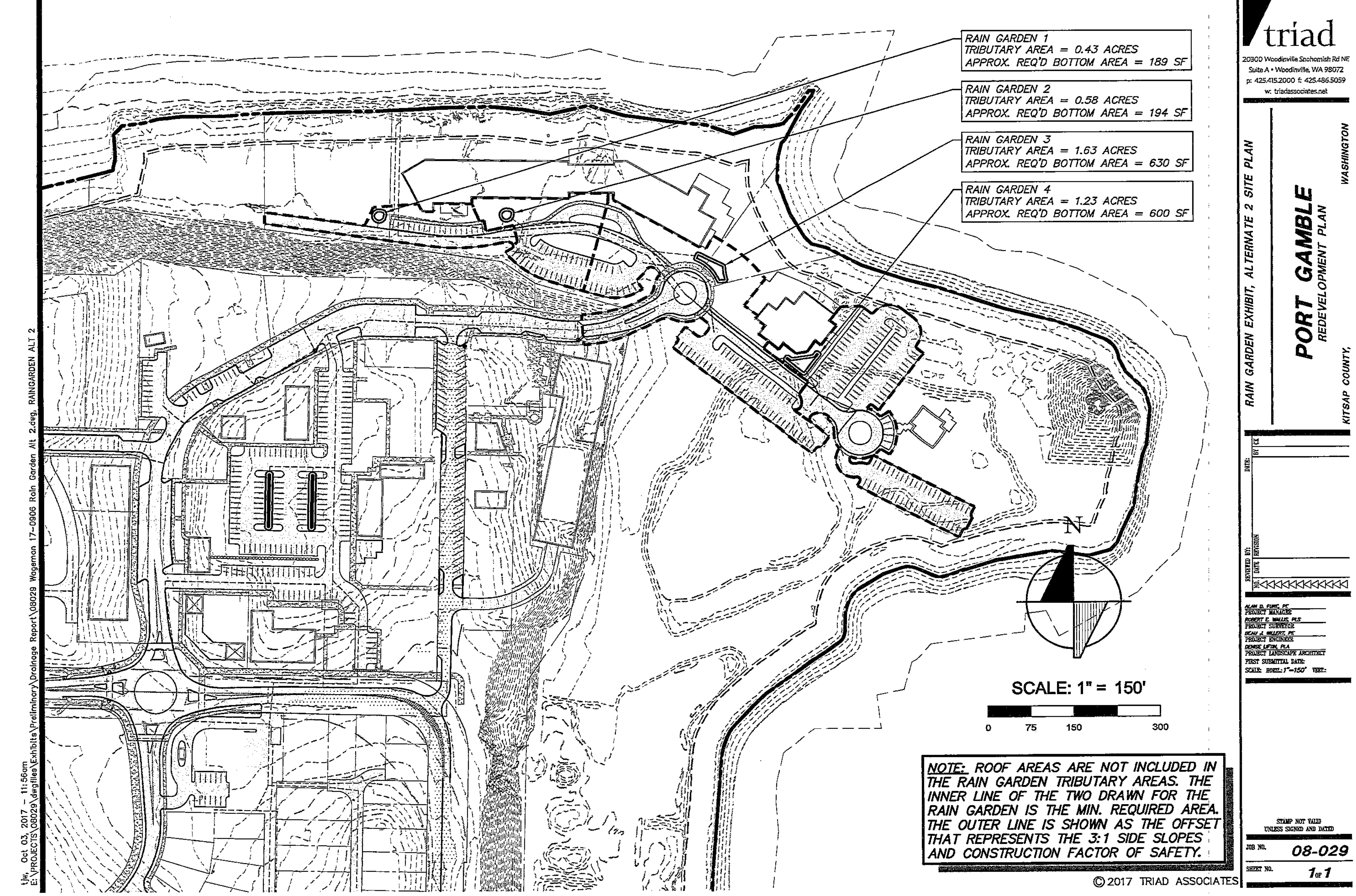
I:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0906 Rain Garden Alt 1.dwg, RAINGARDEN ALT
Oct 03, 2017 - 1:43pm


RAIN GARDEN 1
TRIBUTARY AREA = 0.43 ACRES
APPROX. REQ'D BOTTOM AREA = 189 SF
RAIN GARDEN 2
TRIBUTARY AREA = 0.58 ACRES
APPROX. REQ'D BOTTOM AREA = 194 SF
RAIN GARDEN 3
TRIBUTARY AREA = 1.63 ACRES
APPROX. REQ'D BOTTOM AREA = 630 SF
RAIN GARDEN 4
TRIBUTARY AREA = 1.23 ACRES
APPROX. REQ'D BOTTOM AREA = 600 SF
N
SCALE: 1" = 150'
0 75 150 300
NOTE: ROOF AREAS ARE NOT INCLUDED IN THE RAIN GARDEN TRIBUTARY AREAS. THE INNER LINE OF THE TWO DRAWN FOR THE RAIN GARDEN IS THE MIN. REQUIRED AREA. THE OUTER LINE IS SHOWN AS THE OFFSET THAT REPRESENTS THE 3:1 SIDE SLOPES AND CONSTRUCTION FACTOR OF SAFETY.
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RAIN GARDEN EXHIBIT, ALTERNATE 2 SITE PLAN
PORT GAMBLE
REDEVELOPMENT PLAN
KITSAP COUNTY, WASHINGTON
DATE:
BY CK
REVIEWED BY:
NO. DATE REVISION
ALAN D. FURE, PE
PROJECT MANAGER
ROBERT E. WALLIS, PLS
PROJECT SURVEYOR
BEAU J. WILLERT, PE
PROJECT ENGINEER
DENISE LIFTIN, PLA
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
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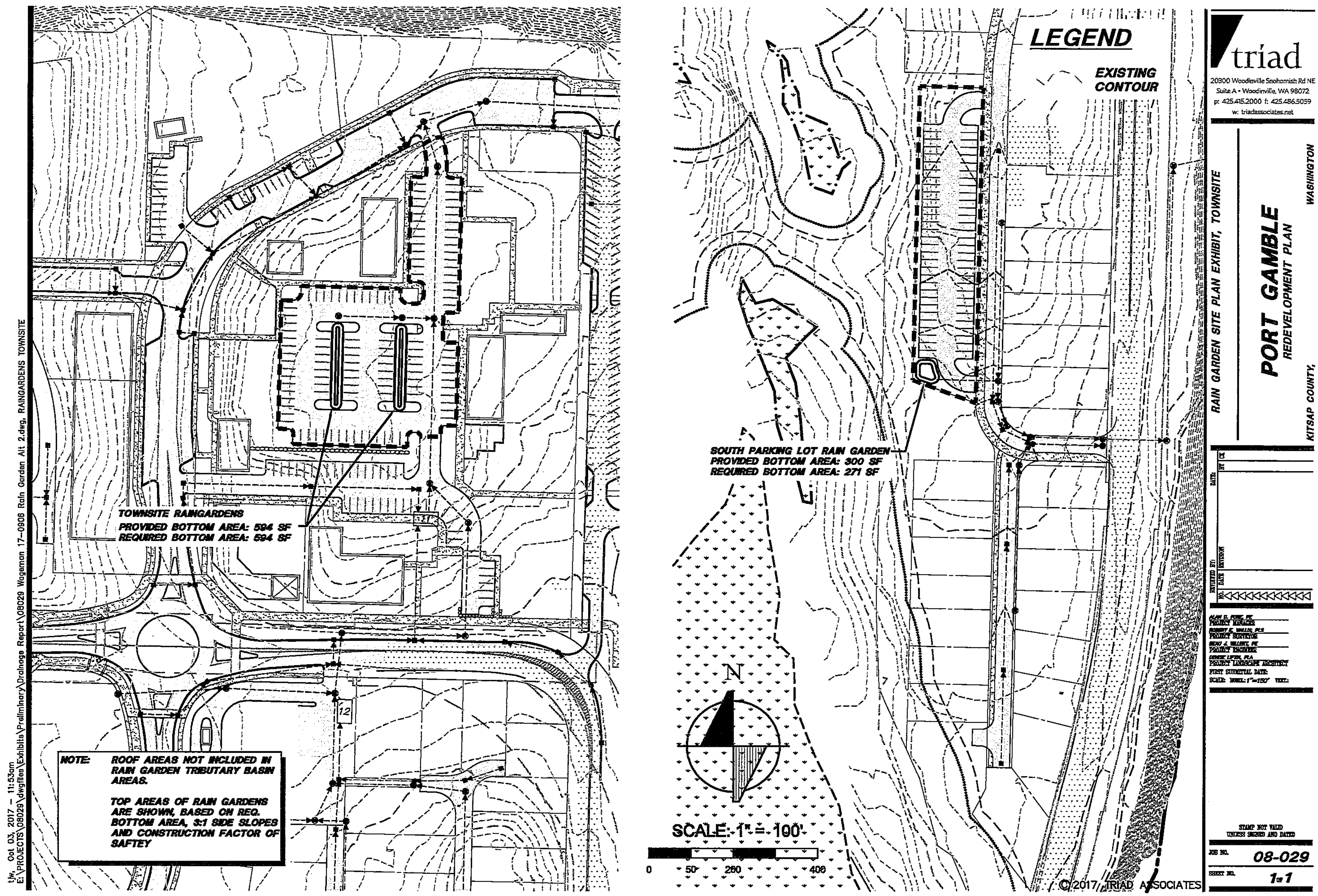
ljw, Oct 03, 2017 - 11:56am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0906 Rain Garden Alt 2.dwg, RAINGARDEN ALT 2



TOWNSITE RAINGARDENS
PROVIDED BOTTOM AREA: 594 SF
REQUIRED BOTTOM AREA: 594 SF
NOTE:
ROOF AREAS NOT INCLUDED IN RAIN GARDEN TRIBUTARY BASIN AREAS.
TOP AREAS OF RAIN GARDENS ARE SHOWN, BASED ON REQ. BOTTOM AREA, 3:1 SIDE SLOPES AND CONSTRUCTION FACTOR OF SAFTEY
SOUTH PARKING LOT RAIN GARDEN
PROVIDED BOTTOM AREA: 300 SF
REQUIRED BOTTOM AREA: 271 SF
LEGEND
EXISTING CONTOUR
N
SCALE: 1" = 100'
0 50 200 400
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RAIN GARDEN SITE PLAN EXHIBIT, TOWNSITE
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tjw, Oct 03, 2017 – 11:53am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0908 Rain Garden Alt 2.dwg, RAINGARDENS TOWNSITE

Basin 1 Mitigated

Subbasin Name: Basin 1 — Designate as Bypass for POC

	Surface	Interflow	Groundwater
Flows To:	Trapezoidal Pond 1	Trapezoidal Pond 1	

Area in Basin — Show Only Selected

Available Pervious: C, Lawn, Mod — 0

Available Impervious: ROADS MOD — 1

5. Trapezoidal Pond 1 Mitigated

Facility Name: Trapezoidal Pond 1

	Outlet 1	Outlet 2	Outlet 3
Downstream Connections	0	0	0

Facility Type: Trapezoidal Pond

Precipitation Applied to Facility — Auto Pond — Quick Pond

Evaporation Applied to Facility

Facility Bottom Elevation (ft): 0

Facility Dimensions

Bottom Length (ft)	16.8
Bottom Width (ft)	33.6
Effective Depth (ft)	1.33
Left Side Slope (H/V)	3
Bottom Side Slope (H/V)	3
Right Side Slope (H/V)	3
Top Side Slope (H/V)	3

Outlet Structure

Riser Height (ft)	0.83
Riser Diameter(in)	12
Riser Type	Flat
Notch Type	

16.8' × 33.6' = 564.48 ft²

Facility Dimension Diagram

Infiltration	YES
Measured Infiltration Rate (in/hr)	3
Reduction Factor(infilt*factor)	1
Use Wetted Surface Area (sidewalls)	YES
Total Volume Infiltrated(acre-ft)	115.212
Total Volume Through Riser(acre-ft)	11.346
Total Volume Through Facility(acre-ft)	126.56
Percent Infiltrated	91.03

Orifice Number	Diameter (In)	Height (Ft)	QMax (cfs)
1	0	0	0
2	0	0	0
3	0	0	0

Pond Volume at Riser Head (acre-ft) .014

Pond Increment 0.10

Show Pond Table: Open Table

Use Tide Gate? NO

Subbasin Name Basin 2 — Designate as Bypass for POC

	Surface	Interflow	Groundwater
Flows To:	Trapezoidal Pond 2	Trapezoidal Pond 2	

Area in Basin — Show Only Selected

Available Pervious: C, Lawn, Mod — 1

Available Impervious: ROADS/MOD — 0

Trapezoidal Pond 2 Mitigated

Facility Name: Trapezoidal Pond 2

	Outlet 1	Outlet 2	Outlet 3
Downstream Connections	0	0	0

Facility Type: Trapezoidal Pond

Precipitation Applied to Facility — Auto Pond — Quick Pond

Evaporation Applied to Facility

Facility Bottom Elevation (ft): 0

Facility Dimensions

Bottom Length (ft)	5.6
Bottom Width (ft)	11.2
Effective Depth (ft)	1.33
Left Side Slope (H/V)	3
Bottom Side Slope (H/V)	3
Right Side Slope (H/V)	3
Top Side Slope (H/V)	3

Outlet Structure

Riser Height (ft)	0.83
Riser Diameter(in)	12
Riser Type	Flat
Notch Type	

5.6' x 11.2' = 62.72 ft²

Facility Dimension Diagram

Infiltration: YES

Measured Infiltration Rate (in/hr)	3
Reduction Factor(infilt*factor)	1
Use Wetted Surface Area (sidewalls)	YES

Orifice Number	Diameter (In)	Height (Ft)	QMax (cfs)
1	0	0	0
2	0	0	0
3	0	0	0

Total Volume Infiltrated(acre-ft)	50.447
Total Volume Through Riser(acre-ft)	4.916
Total Volume Through Facility(acre-ft)	55.36
Percent Infiltrated	91.12

Pond Volume at Riser Head (acre-ft) .002

Pond Increment 0.10

Show Pond Table Open Table

Use Tide Gate? NO

08-029 Port Gamble Preliminary Plat
Mill Site Rain Garden Sizing Table
Alternate 1 Site Plan
10/3/2017

Required Bottom Area Factor Table	
Land Use	Req'd Rain Garden SF Bottom per Acre
Pervious	63
Impervious	565

Rain Garden #1

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	22,948	33
Impervious	10,620	138
Total Area Required		171
Total Area Provided		174
Factor of Safety		2%

Rain Garden #2

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	65,623	95
Impervious	16,821	218
Total Area Required		313
Total Area Provided		320
Factor of Safety		2%

Rain Garden #3

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	18,094	26
Impervious	7,387	96
Total Area Required		122
Total Area Provided		128
Factor of Safety		5%

Rain Garden #4

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	22,739	33
Impervious	23,691	307
Total Area Required		340
Total Area Provided		348
Factor of Safety		2%

Rain Garden #5

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	27,967	40
Impervious	21,399	278
Total Area Required		318
Total Area Provided		322
Factor of Safety		1%

Rain Garden #6

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	5,481	8
Impervious	13,611	177
Total Area Required		184
Total Area Provided		195
Factor of Safety		6%

Rain Garden #7

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	9,094	13
Impervious	15,755	204
Total Area Required		218
Total Area Provided		223
Factor of Safety		3%

Rain Garden #8

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	26,860	39
Impervious	24,014	311
Total Area Required		350
Total Area Provided		355
Factor of Safety		1%

Rain Garden #9

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	14,595	21
Impervious	8,397	109
Total Area Required		130
Total Area Provided		135
Factor of Safety		4%

Rain Garden #10

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	16,683	24
Impervious	9,725	126
Total Area Required		150
Total Area Provided		170
Factor of Safety		13%

Rain Garden #11

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	30,964	45
Impervious	17,994	233
Total Area Required		278
Total Area Provided		293
Factor of Safety		5%

Rain Garden #12

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	20,059	29
Impervious	25,036	325
Total Area Required		354
Total Area Provided		637
Factor of Safety		80%

Rain Garden #13

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	11,489	17
Impervious	13,648	177
Total Area Required		194
Total Area Provided		203
Factor of Safety		5%

Rain Garden #14

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	4,534	7
Impervious	14,072	183
Total Area Required		189
Total Area Provided		203
Factor of Safety		7%

Rain Garden #15

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	3,651	5
Impervious	18,303	237
Total Area Required		243
Total Area Provided		245
Factor of Safety		1%

Rain Garden #16

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	3,170	5
Impervious	17,721	230
Total Area Required		234
Total Area Provided		236
Factor of Safety		1%

Rain Garden #17

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	1,143	2
Impervious	10,122	131
Total Area Required		133
Total Area Provided		135
Factor of Safety		2%

08-029 Port Gamble Preliminary Plat
Mill Site Rain Garden Sizing Table
Alternate 2 Site Plan
10/3/2017

Required Bottom Area Factor Table	
Land Use	Req'd Rain Garden SF Bottom per Acre
Pervious	63
Impervious	565

Rain Garden #1

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	4534	7
Impervious	14,072	183
Total Area Required		189
Total Area Provided		203
Factor of Safety		7%

Rain Garden #2

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	11489	17
Impervious	13,648	177
Total Area Required		194
Total Area Provided		209
Factor of Safety		8%

Rain Garden #3

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	25153	36
Impervious	45,757	593
Total Area Required		630
Total Area Provided		637
Factor of Safety		1%

Rain Garden #4

Land Use	Area (SF)	Req. Bottom Area (SF)
Pervious	8444	12
Impervious	45,282	587
Total Area Required		600
Total Area Provided		612
Factor of Safety		2%

7 Conveyance

7.1 Clean and Water Quality Treatment Stormwater Conveyance Systems

Two conveyance systems are proposed; one system will convey runoff from pollution generating surfaces to water quality facilities. A separate system will convey treated stormwater and stormwater from non-pollution generating surfaces- 'clean water' to stormwater outfalls.

The water quality treatment stormwater conveyance system will consist of catch basins, curbs, gutters, ditches, and pipes. Catch basins will be placed within the road along the flow line. The water quality treatment stormwater will be conveyed to a water quality facility. After treatment, the water quality treatment stormwater system will be connected to the clean water system

The clean water conveyance system will consist of pipes accessed by stormwater manholes. The stormwater manholes in the clean water system will have solid lids to prevent runoff from entering the clean water system. The clean water system will discharge via outfalls in Port Gamble and Hood Canal with no flow control. A portion of the clean water system from the water quality pond will discharge into Machias Creek via an energy dissipating structure.

7.2 Stormwater Outfall Sizing

The stormwater outfalls were designed using flow information generated by Western Washington Hydrologic Model 2012 (WWHM2012). The project site was broken up into basins based on the conveyance system layout. Each basin was assumed to be 60% impervious and a 100 year peak flow was obtained by using WWHM2012. Pipes and outfalls were sized using this peak flow information along with an assumption of a 0.5% minimum slope near the outfalls. See attached *Conveyance System Exhibits* and associated WWHM modeled flows, attached to the end of this section.

The Mill Site will utilize two outfall locations in Alternative 1 and one outfall in Alternative 2. The first outfall is located to the north of the Mill Site (North Outfall), which both Alternative

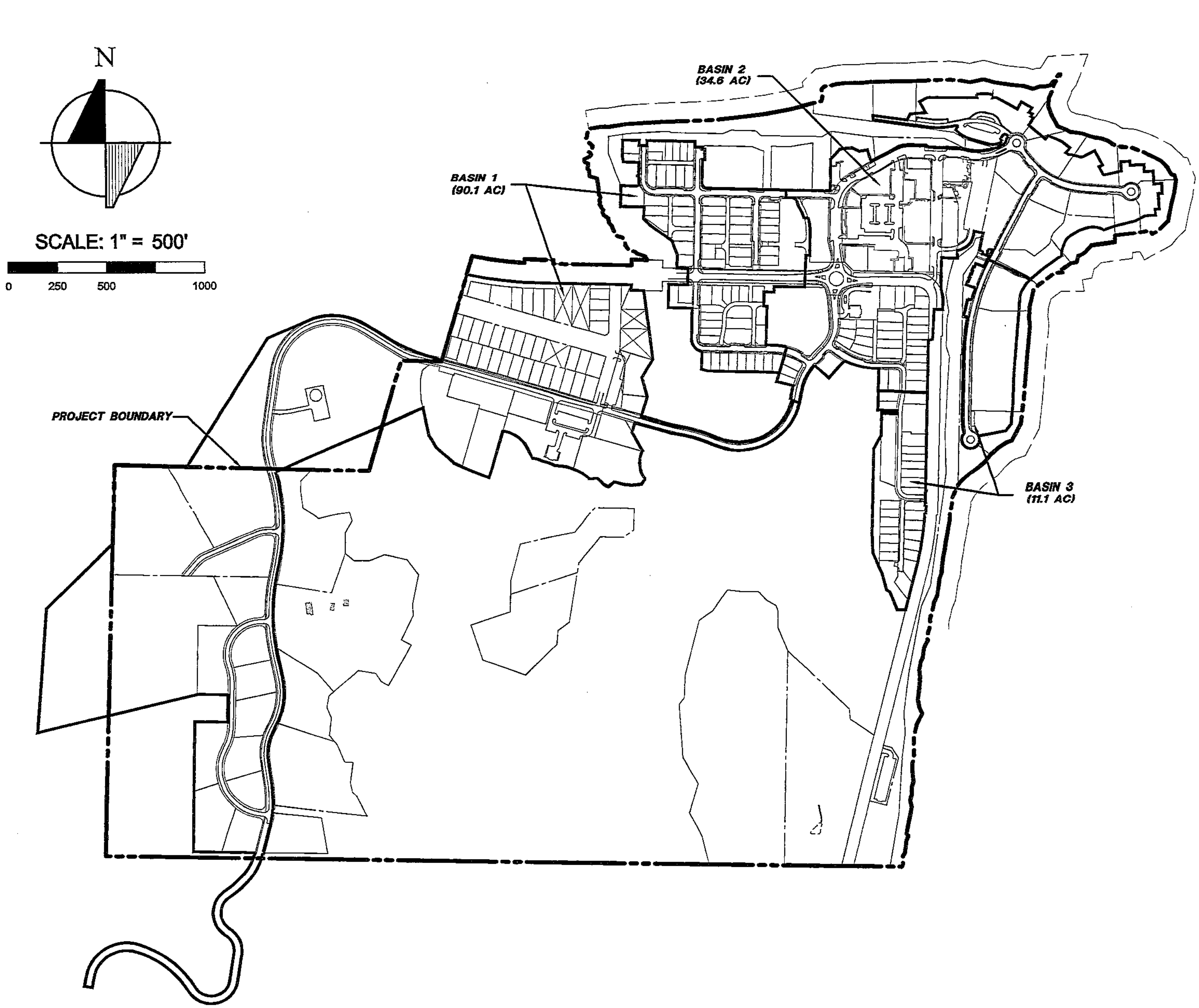
1 and 2 will use, and the other along the southeastern portion of the Mill Site (South Outfall), which is only in the Alternative 1 site plan. Manning's equation was used to determine the required pipe diameter at each outfall for the Mill Site in Alternatives 1 and 2. In the Alternative 1 site plan, the North Outfall is required to be a 24-inch diameter outfall, while the South Outfall is required to be an 18-inch diameter outfall. In the Alternate 2 site plan, the North Outfall is required to be a 24-inch diameter outfall. These outfalls will be further designed in the final engineering stage of the project.

A stormwater outfall is also proposed near the outlet of Machias Creek to Hood Canal (Hood Canal Outfall). The Hood Canal Outfall is being designed by David Evans and Associates Inc. They are proposing three alternative designs. In the first alternative, a 36-inch pipe will descend at-grade down a 60% slope to a single diffuser tee. The second alternative will have two separate outfalls. A flow splitter will divert high magnitude flows (between a 10-year and 100-year storm event) to a 24-inch pipe following the same route as in the first alternative. Flows less than a 10-year storm will be directed to an 18-inch pipe. Both pipes will utilize at-grade diffuser tees. The third alternative incorporates a 36-inch buried pipe descending at a 30% slope to a buried manhole and flow splitter. The high flows will follow a 24-inch buried pipe to an at-grade diffuser tee. Low flows will follow a 24-inch buried pipe to a buried diffuser tee. See the attached report; entitled "Port Gamble Stormwater Outfall and Pocket Beach Alternatives Analysis" dated October 4, 2017, for more information regarding the different outfall alternatives.

7.3 Mill Site Grading and Surface Overflow

The Mill Site grades for both site plans have been designed to provide surface overflow paths in the event that the conveyance system is overwhelmed. For the Alternative 1 site plan, the Mill Site has been graded with a high point creating two over flow routes, each discharging above the proposed, repurposed outfalls for the conveyance tightline systems. For the Alternative 2 site plan, the entire Mill Site has been graded to provide a surface overflow path toward Hood Canal that outfalls above the existing, repurposed outfall for the conveyance tightline system.

The surface grade above the conveyance outfalls were determined using the Mean Higher High Water (MHHW) and the typical rain garden section. MHHW for Hood Canal is 8.2. This elevation was used to set the invert of the underdrain of a rain garden adjacent to the outfall. Assuming a 6-inch underdrain, 1 foot of underdrain rock, 1.5 feet of bioretention soil, 10 inches of storage depth and 0.5 feet of freeboard, the top of the rain garden would need to be approximately 5 feet above the MHHW elevation to limit the backwater on the conveyance system at MHHW. As such, the surface elevation at the conveyance outfalls has been designed at or above elevation 14.



triad
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Suite A • Woodinville, WA 98072
p: 425.415.2000 f: 425.486.5059
w: triadassociates.net

CONVEYANCE BASINS EXHIBIT
ALTERNATE 1 SITE PLAN

PORT GAMBLE
REDEVELOPMENT PLAN

KITSAP COUNTY, WASHINGTON

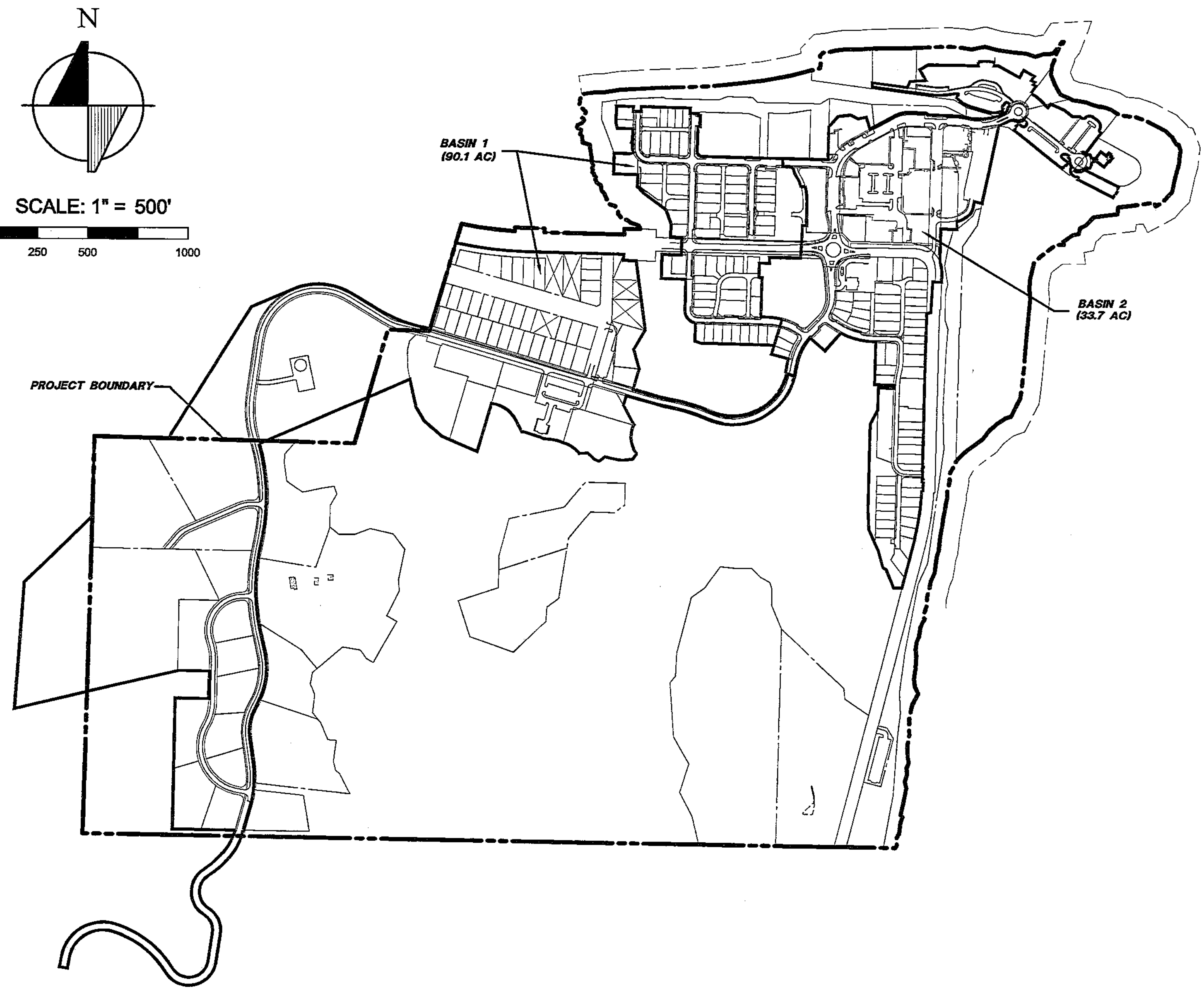
DATE: BY CK
REVIEWED BY:
NO. DATE REVISION

ALAN D. FURE, PE
PROJECT MANAGER
ROBERT E. WALLIS, PLS
PROJECT SURVEYOR
BEAU J. WILLERT, PE
PROJECT ENGINEER
DENISE LFTIN, PLA
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.:1"=500' VERT.:

STAMP NOT VALID
UNLESS SIGNED AND DATED

JOB NO. 08-029
SHEET NO. 1 of 1

tjw, Feb 07, 2018 -- 8:31am
E:\PROJECTS\08029\dwgfiles\Exhibits\Preliminary\Drainage Report\08029 Wageman 17-0920 Conveyance Exhibit.dwg, CONVEYANCE ALT 1



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CONVEYANCE BASINS EXHIBIT
ALTERNATE 2 SITE PLAN

PORT GAMBLE
REDEVELOPMENT PLAN

KITSAP COUNTY, WASHINGTON

NO.	DATE	REVISION	BY	CK

REVIEWED BY: DATE:

ALAN D. FURE, PE
PROJECT MANAGER
ROBERT E. WALLIS, PLS
PROJECT SURVEYOR
BEAU J. WILLERT, PE
PROJECT ENGINEER
DENISE LIFTIN, PLA
PROJECT LANDSCAPE ARCHITECT
FIRST SUBMITTAL DATE:
SCALE: HORIZ.: 1"=500' VERT.:

STAMP NOT VALID UNLESS SIGNED AND DATED

JOB NO. 08-029
SHEET NO. 1 OF 1

WWHM2012
PROJECT REPORT

Project Name: Conveyance Outfall PF 1.0
Site Name:
Site Address:
City:
Report Date: 9/20/2017
Gage: Everett
Data Start: 1948/10/01
Data End: 2009/09/30
Precipitation Scale: 1.00
Version Date: 2016/02/25
Version: 4.2.12

Low Flow Threshold for POC 1: 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

MITIGATED LAND USE
Name: Basin 1
Bypass: No
Ground Water: No

Pervious Land Use	acre
C, Forest, Mod	21.77
C, Lawn, Mod	13.17
Pervious Total	34.94

Impervious Land Use	acre
ROADS MOD	19.75
Impervious Total	19.75

Basin Total	54.69

ANALYSIS RESULTS
Stream Protection Duration

Mitigated Land use Totals for POC #1
Total Pervious Area: 34.94
Total Impervious Area: 19.75

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow (cfs)
2 year	10.094903
5 year	13.033484
10 year	15.063995
25 year	17.732967
50 year	19.799606
100 year	21.935802

WWHM2012
PROJECT REPORT

Project Name: Conveyance Outfall PF 0.8
Site Name:
Site Address:
City:
Report Date: 9/20/2017
Gage: Everett
Data Start: 1948/10/01
Data End: 2009/09/30
Precipitation Scale: 0.80
Version Date: 2016/02/25
Version: 4.2.12

Low Flow Threshold for POC 1: 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

MITIGATED LAND USE

Name: Basin 1
Bypass: No
Ground Water: No

Pervious Land Use	acre
C, Lawn, Mod	14.18
Pervious Total	14.18

Impervious Land Use	acre
ROADS MOD	21.27
Impervious Total	21.27
Basin Total	35.45

Name: Basin 2 Alt 1
Bypass: No
Ground Water: No

Pervious Land Use	acre
C, Lawn, Mod	13.83
Pervious Total	13.83

Impervious Land Use	acre
ROADS MOD	20.74
Impervious Total	20.74
Basin Total	34.57

Name: Basin 2 Alt 2
Bypass: No
Ground Water: No

Pervious Land Use	acre
C, Lawn, Mod	13.47
Pervious Total	13.47

Impervious Land Use	acre
ROADS MOD	20.20
Impervious Total	20.20
Basin Total	33.67

Name: Basin 3 Alt 1
Bypass: No
Ground Water: No

Pervious Land Use	acre
C, Lawn, Mod	4.45
Pervious Total	4.45

Impervious Land Use	acre
ROADS MOD	6.67
Impervious Total	6.67
Basin Total	11.12

ANALYSIS RESULTS

Stream Protection Duration

Mitigated Land use Totals for POC #1
Total Pervious Area: 14.18
Total Impervious Area: 21.27

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow (cfs)
2 year	7.753033
5 year	9.892357
10 year	11.357222
25 year	13.268993
50 year	14.740071
100 year	16.253211

Mitigated Land use Totals for POC #2
Total Pervious Area: 13.83
Total Impervious Area: 20.74

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow (cfs)
2 year	7.559955
5 year	9.64603
10 year	11.074437
25 year	12.938629
50 year	14.373098
100 year	15.848585

Mitigated Land use Totals for POC #3
Total Pervious Area: 13.47
Total Impervious Area: 20.2

Flow Frequency Return Periods for Mitigated. POC #3

Return Period	Flow (cfs)
2 year	7.363122
5 year	9.394881
10 year	10.786095
25 year	12.601749
50 year	13.998867
100 year	15.435936

Mitigated Land use Totals for POC #4
Total Pervious Area: 4.45
Total Impervious Area: 6.67

Flow Frequency Return Periods for Mitigated. POC #4

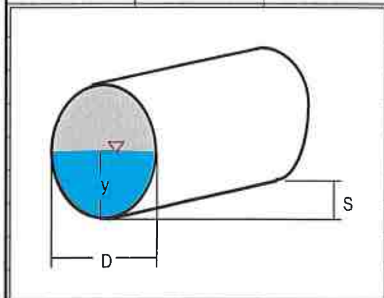
Return Period	Flow (cfs)
2 year	2.431362
5 year	3.102284
10 year	3.561689
25 year	4.161254
50 year	4.622611
100 year	5.097163

08-029 Port Gamble Preliminary Plat
Outfall Summary Table
17-0921

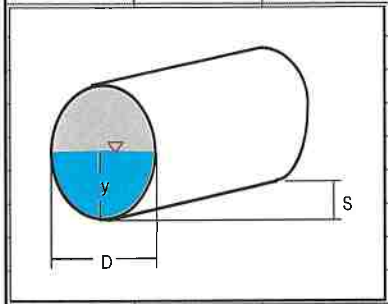
Basin #	Outfall Name	100-Year Peak Flow cfs	Pipe Diameter inch
1	* Hood Canal	38.19	-
2 Alt 1	Mill Site North	15.85	24
2 Alt 2	Mill Site North	15.44	24
3 Alt 1	Mill Site South	5.10	18

* Refer to the report entitled, "Port Gamble Stormwater Outfall and Pocket Beach Alternatives Analysis" prepared by David Evans and Assocaites, Inc., dated October 4, 2017

	Input	Output							
Q (cfs)	0.00	16.94							
n	0.012	0.012							
d (ft)	2.00	2.00		2	0	/16	inches		
y (ft)	1.60	1.60							
S (ft/ft)	0.005	0.005							
						A (sf)	2.694		
						Pw (ft)	4.429	**V (ft/s)**	6.287
						R (ft)	0.608		
						Critical y (ft) =			
						Qmax @ y (ft) =	1.8764		
						Vmax @ y (ft) =	1.6256		
Job:	Port Gamble 08-029		**Description:**	Mill Site North Outlet Alt 1					
By:	Travis Wageman		**Date:**	9/21/2017					



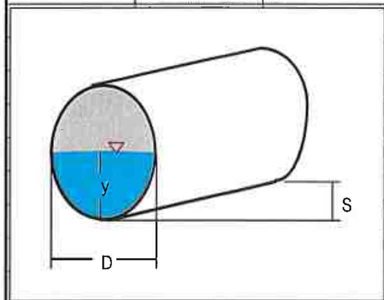
	Input	Output					
Q (cfs)	0.00	16.94					
n	0.012	0.012					
d (ft)	2.00	2.00	2	0	/16	inches	
y (ft)	1.60	1.60					
S (ft/ft)	0.005	0.005					



A (sf)	2.694		
Pw (ft)	4.429	V (ft/s)	6.287
R (ft)	0.608		
Critical y (ft) =			
Qmax @ y (ft) =	1.8764		
Vmax @ y (ft) =	1.6256		

Job:	Port Gamble 08-029	Description:	Mill Site North Outlet Alt 2
By:	Travis Wageman	Date:	9/21/2017

	Input	Output							
Q (cfs)	0.00	7.86							
n	0.012	0.012							
d (ft)	1.50	1.50		1	8	/16	inches		
y (ft)	1.20	1.20							
S (ft/ft)	0.005	0.005							



A (sf)	1.516		
Pw (ft)	3.321	V (ft/s)	5.190
R (ft)	0.456		
Critical y (ft) =			
Qmax @ y (ft) =	1.4073		
Vmax @ y (ft) =	1.2192		

Job:	Port Gamble 08-029	Description:	Mill Site South Outfall Alt 1
By:	Travis Wageman	Date:	9/21/2017

8 Special Reports and Studies

8.1 *List of Special Reports*

"Geotechnical Setback Review, Port Gamble Redevelopment" prepared by Terracon, dated September 27, 2017. **(Under separate cover.)**

"Geotechnical Overview Update" prepared by Terracon, dated September 27, 2017. **(Under separate cover.)**

"Wetland and Stream Baseline Data Report" prepared by GeoEngineers, dated January 27, 2015. **(Under separate cover.)**

"Clean Water and Livestock Operations: Assessing Risks to Water Quality" prepared by Department of Ecology State of Washington, dated June 2015.

"Port Gamble Stormwater Outfall and Pocket Beach Alternatives Analysis" prepared by David Evans and Associates, Inc., dated October 4, 2017.

DEPARTMENT OF ECOLOGY
State of Washington

Clean Water and Livestock Operations:
Assessing Risks to Water Quality

Livestock and Clean Water

This document provides information on livestock related water quality impacts to help landowners and producers make informed management decisions to protect water quality. Because Washington is geographically diverse, proper management practices can vary across the state. Therefore, this document can only provide general guidance.

Livestock production is an important industry in Washington State. It occurs in all areas of the state and contributes significantly to our state's economy and culture. Water resources, and the quality of state waters, are critical to our health and welfare, our environment, and our economy. Washingtonians rely on clean water for drinking water, recreation, and the harvesting of fish and other food. Livestock production also depends on the state's water resources. Two primary statutes protect the quality of Washington's waters: the federal Clean Water Act and the state Water Pollution Control Act, both implemented by the Department of Ecology.

Many livestock operators use good management practices to protect water quality and pose no threat to Washington State waters. However, some livestock and manure handling practices pollute our surface and ground waters, in violation of state and federal law. The most concerning impacts are from the direct deposition of livestock manure into and near surface waters, the degradation of the riparian area by livestock, and mismanagement of livestock manure. Even a small number of livestock can deposit significant amounts of manure and associated pollutants when they have extended access to surface water. While livestock manure can be a valuable nutrient, it can also cause significant human health and environmental impacts if management practices do not limit it from reaching state waters.

Bacteria and pathogens in manure are not the only water quality problems that can be caused by livestock. Livestock may also denude and compact riparian area soils, and destabilize stream banks. These livestock impacts in turn, decrease infiltration rates, and increase runoff, sedimentation, and bank sloughing and retreat. A degraded riparian area also loses its natural ability to filter pollutants and stabilize the soil. Increasing overland flow encourages transport of pathogens and nutrients. This increased flow can also impact the structure of the stream by increasing stream velocity, sediment loading, and the erosive power of the stream. These impacts increase the distance that pollutants can be transported from pollution sources. The farther the pollutants travel, the more likely they will compound other pollution problems and impair water quality.

Risk Management and Livestock Operations

Water quality problems are common when animals have extended or concentrated access to streams and riparian areas. Improper livestock grazing can have serious and wide-ranging effects on riparian ecosystems and the streams they depend on.

Assessing site conditions is the best way to evaluate potential livestock related pollution problems. This document discusses aspects of livestock operations that operators can evaluate for themselves to avoid pollution problems.

The following site conditions should not be evaluated in isolation. Instead, multiple site conditions should be considered together to make a determination of possible impacts to state waters. By considering multiple site conditions and signs, a landowner or producer can get a better idea of whether their property is impacting water quality or if it is likely to impact water quality.

Key Principles

- Improve compliance with state and federal law and the water quality standards.
- Recognize the importance of the livestock industry to Washington State.
- Clearly articulate examples of good and bad site conditions.
- Help landowners and livestock producers make informed decisions about their operations related to protecting water quality.

Livestock producers and landowners are encouraged to consult with Ecology, their local conservation district or other technical assistance providers to identify options and conservation programs available to promote water quality compliance. If Ecology identifies a property as having pollution problems, management choices need to ensure compliance with state law and the water quality standards, and should be made in consultation with Ecology.

Risk of Causing Pollution

As depicted below some conditions are clear violations of the law, while other conditions are associated with a healthy stream. Most situations, however, fall somewhere in-between. In those situations multiple site conditions must be evaluated to determine the risk of polluting state waters.

Compliance	Lower Risk	Medium Risk	Higher risk	Violation
Desirable site conditions and management practices ensure compliance	Mostly desirable site conditions and no significant undesirable site conditions present	Undesirable site conditions are present	Significant undesirable site conditions are present or multiple undesirable site conditions are present	Immediate action is required to achieve compliance

Discharges are usually the result of degraded site conditions, poor management decisions and inadequate or absent management practices. In general, when evaluating a site for nonpoint pollution problems Ecology considers the following questions:

- Are there sources of nonpoint pollution?
- Is surface water present at the site or in proximity to the site?
- Are there groundwater concerns?
- Are there pathways for pollution to get to state waters?
- Is there evidence that pollutants have entered state waters?
- Are management practices in place for nonpoint pollution sources to prevent delivery of pollution to state waters?

Watershed and Other Environmental Considerations

Factors related to the physical characteristics and physical setting of the site, climatic conditions, and additional information should be considered in conjunction with the factors described in this document. These include:

- Soil conditions and characteristics (runoff class, permeability, leaching potential, saturation, etc.)
- Slope of the land surface
- Precipitation and climate
- Anticipated flooding/flooding frequency
- Depth to groundwater-shallow groundwater is more vulnerable to pollution

Site Conditions

While all potential sources of pollution should be evaluated to assess a property, these guidelines organize site conditions under the following general locations: Riparian Area, Confinement Areas, Manure Storage Areas and Upland Pasture Areas. Example conditions are presented in a sequence from healthy conditions to clear violations for each location.

Riparian Areas

Protecting stream and riparian areas is key to keeping waters from being polluted. While a clear identification of stream and riparian area boundaries is difficult because these areas are not fixed in time and space, as used here *riparian area* is intended to refer to the stream channel, and the transition zones between upland areas and surface water. The riparian area is functionally part of the stream, and impacts in this area can directly affect stream health and water quality.

Healthy Riparian Area

Healthy, undisturbed riparian areas generally contain a combination of indigenous trees, shrubs, woody debris, riparian vegetation, litter layers, and soils to filter and attenuate incoming sediments and pollutants. This helps to protect water quality. Vegetation in riparian areas shades streams maintaining cool temperatures needed by most fish. Plant roots stabilize stream banks and control erosion and sedimentation. Riparian vegetation moderates stream volumes by reducing peak flows during flooding periods and by storing and slowly releasing water into streams during low flows. Signs that the riparian area is healthy include:

- Streamside vegetation sufficient to filter out pollutants before they reach the stream.

- No signs of significant livestock impacts:no bare ground, manure deposited in or near surface water, livestock paths and trails, soil compaction, and only minimal signs of livestock grazing activities.
- No slumping or eroding stream banks associated with livestock.
- No signs of sheet or rill erosion associated with livestock.
- Indigenous woody vegetation present (diverse age class and species composition).
- Presence of both overstory and understory woody species in a mix of species and densities that would be indigenous to the location.
- Floodplain is connected and consistently accessed by the stream to reduce scour and bank erosion.
- Streambanks are well–vegetated at all times of the year. Plant communities consist of healthy indigenous species and are able to hold banks in place.

Signs of Concern

Signs that livestock may be causing or leading to a water quality violation. The presence of any one or combination of the following signs, if associated with or caused by livestock activity, can be a concern:

- Absence of woody vegetation that would be natural in the region
- Destabilized, slumping and/or eroding stream banks
- Soil compaction
- Stream sedimentation
- Widening and shallowing of the stream
- Vegetation overutilized or absent
- Visible signs of overutilization of grasses
- Manure deposited near surface water
- Livestock paths and trails in riparian areas

Clear Violation

- Bare ground associated with livestock activity
- Manure accumulation near and/or in surface water
- Livestock paths and trails in riparian areas exhibiting erosion leading to surface waters
- Contaminated run-off (evidence of past run-off, active, or foreseeable runoff with precipitation)
- Sheet or rill erosion associated with livestock activity
- Active bank erosion associated with livestock activity

Confinement and Winter Feeding Areas

If properly sited and maintained, confinement and winter feeding areas can help prevent pollutants from reaching surface water, and groundwater. Conversely, confinement and winter feeding areas that are not properly sited and maintained can cause considerable pollution because animals, their manure and their impacts are concentrated into relatively small areas.

Well Managed Confinement Areas

- Confinement areas are located away from surface water.
- Clean water is diverted around confinement areas.
- Heavy use area protection is utilized.
- No signs of mud or manure leaving the confinement area.

- No signs of erosion.
- No accumulations of manure outside the confinement area.
- Located on level areas and outside of riparian areas.

Signs of Concern

Signs that livestock may be causing or leading to a water quality violation. The presence of any one or combination of the following signs can be a concern:

- Confinement areas close to surface water or a vulnerable groundwater source.
- Inadequate wellhead protection near confinement and winter feeding areas.
- Stock watering tanks close to surface water.
- Overflow from stock watering tanks flowing through mud or manure toward surface waters.
- Lack of gutters on structures to divert precipitation away from confinement areas.
- Presence of drainage structures or features (French drains, swales, drain tiles, stormwater conveyances) that cause or may cause polluted runoff to leave the area or enter groundwater.
- Polluted runoff or signs of polluted run-off leaving the confinement area.
- Poor stormwater management up gradient or adjacent to the confinement areas that causes or may cause polluted runoff to leave the area.
- Presence of mud and manure close to surface water.
- Sheet or rill erosion in or down gradient of the confinement area.
- Stockpiles of manure or other indications of excess manure accumulations that could cause leaching to groundwater.

Clear Violation

- Confinement or feeding areas straddling, abutting or otherwise directly connected to surface water.
- Presence of drainage structures or features that connect to surface water (French drains, swales, drain tiles, stormwater conveyances) that cause or may cause polluted runoff to enter surface or ground water.
- Polluted runoff or signs of polluted run-off from confinement area and/or stock watering tanks reaching surface water.

Manure Storage

Proper collection, disposal, storage, and use of manure are important to ensure water quality is protected.

Properly Managed Manure Storage

- Manure storage located away from surface water and stormwater conveyances.
- No signs of polluted runoff leaving the collection or storage area.
- Manure storage facilities are covered (non-lagoon).
- Manure stored on an impermeable surface.
- Manure storage is appropriately sized to collect and store all manure and all contaminated water.

Signs of Concern

Signs that livestock may be causing or leading to a water quality violation. The presence of any one or combination of the following signs can be a concern:

- Manure storage close to surface water or with likely conveyance to surface or ground water.

- Presence of stormwater conveyances in or near the collection or storage areas that may cause polluted runoff to enter surface or ground water.
- Polluted runoff or signs of polluted runoff leaving the collection or storage area.
- Uncovered manure storage.
- Manure stored on bare ground or permeable surface.
- Insufficiently sized manure storage—considering the number of animals and amount of storage needed.
- Improperly designed, maintained or constructed impoundments that are used to store manure.

Clear Violation

- Manure storage with a conveyance that causes polluted runoff to enter surface or ground waters.
- Polluted runoff or signs of polluted runoff leaving the collection or storage area and reaching surface water.

Upland Pasture Areas

Good management in upland areas can support well functioning riparian areas, and help prevent pollution from entering riparian areas, surface waters, or conduits to surface waters. Conversely, upland areas can cause impacts to surface water if not managed properly. Significant manure accumulations or signs of erosion in upland areas combined with conveyances or drainages leading to surface water, can impact water quality. Polluted runoff or signs of polluted runoff from upland pasture areas reaching surface water is a clear violation and can occur if upland areas are over utilized, even if there is a healthy riparian area. Additionally, if areas are frequently flooded, inundated, or saturated during periods of the year, the risk of water quality impacts increases. However, landowners and producers can help prevent water quality violations by protecting the riparian area and utilizing good practices in the upland areas.

Conclusion

State Water Quality Law prohibits the discharge of pollutants to state waters without a permit. The law addresses multiple water quality parameters, including nutrients, bacteria, dissolved oxygen, pH, temperature, and sediment. Ecology is responsible for implementing both state and federal water quality law.

When making water quality determinations Ecology evaluates conditions in and near the stream. Those site conditions are the best way to determine if pollution is occurring or if there is a risk of pollution occurring. The presence of livestock in the riparian area will not result in an enforcement action if the livestock are managed to avoid pollution. Ecology will not take action without evidence of pollutants in the water or signs of livestock impacts.

Ecology has determined that the best way to ensure water quality compliance is to combine good upland management practices with the exclusion of livestock from the stream and riparian area. Techniques that rely on management in the riparian area may also be used but are less reliable than exclusion. These techniques may reduce the likelihood, frequency, or amount of pollutant discharge and subsequent risk of noncompliance, but require significant active management efforts.

Landowners should consider how their management decisions may cause pollution and consider the risks of violating state law when choosing approaches for livestock management. Producers and landowners are encouraged to consult with Ecology, their local conservation district or other technical assistance providers to identify options and conservation programs available to promote water quality compliance. Formal compliance determinations can only be made in consultation with Ecology staff.

For more information

For more information on this publication contact Ben Rau – Ecology at 360-407-6551 or ben.rau@ecy.wa.gov.

To request ADA accommodation including materials in a format for the visually impaired, call the Water Quality program at 360-407-6600. Persons with impaired hearing may call Washington Relay Service at 711. Persons with a speech disability may call 877-833-6341.

9 Other Permits

The following permits will be obtained in support of this project:

- Performance Bond Development Preliminary Plat
- Shoreline Substantial Development
- Joint Aquatic Resource Permit Application (JARPA)
- Site Development Activity Permit
- NPDES Permit

10 Construction Stormwater Pollution Prevention Plan

A Temporary Erosion and Sediment Control (TESC) Plan will be designed for this project per Kitsap County requirements to provide construction stormwater pollution prevention. The TESC plan is intended to prevent the transport of sediment from the site to significant drainage features and adjacent properties. The following 12 items will be addressed on the TESC Plan:

Mark Clearing Limits

To protect adjacent properties and to reduce the area of soil exposed to construction, the limits of construction will be clearly marked before land-disturbing activities begin. Trees that are to be preserved, as well as all sensitive areas and their buffers, will be clearly delineated, both in the field and on the plans. In general, natural vegetation and native topsoil shall be retained in an undisturbed state to the maximum extent possible.

Clearing limits will be shown on the TESC plan and will be established in the field prior to construction using silt fence and orange construction fencing.

Establish Construction Access

Construction access or activities occurring on unpaved areas shall be minimized, yet where necessary, access points shall be stabilized to minimize the tracking of sediment onto public roads, and wheel washing, street sweeping, and street cleaning shall be employed to prevent sediment from entering state waters. All wash wastewater will be controlled on site.

Control Flow Rates

In order to protect the properties and waterways downstream of the project site, stormwater discharges from the site will be controlled where it does not discharge directly to salt water. Sediment traps are proposed to be utilized for settlement and to control flow rates prior to construction of the proposed water quality features, when necessary.

Install Sediment Controls

All stormwater runoff from disturbed areas shall pass through an appropriate sediment removal BMP before leaving the construction site. Silt fence is proposed to be installed along the downhill edge of the proposed clearing limits in order to minimize the amount of sediment conveyed offsite. Onsite, temporary swales with check dams will be used to convey runoff to temporary sediment traps as necessary.

In addition, sediment will be removed from paved areas in and adjacent to construction work areas manually or using mechanical sweepers, as needed, to minimize tracking of sediments on vehicle tires away from the site and to minimize wash off of sediments from adjacent streets in runoff.

Stabilize Soils

Exposed and unworked soils will be stabilized with some combination of mulching and/or temporary seeding.

Protect Slopes

Exposed and unworked slopes will be stabilized with some combination of mulching and/or temporary seeding.

Protect Drain Inlets

Storm drain inlets made operable during construction will be protected to prevent unfiltered or untreated water from entering the drainage conveyance system.

Stabilize Channels and Outlets

The outfall from the temporary sediment traps and will be armored to minimize downstream erosion.

Control Pollutants

All pollutants, including waste materials and demolition debris, that occur onsite shall be handled and disposed of in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures will be taken to ensure that the site will be kept clean, well organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants will be discussed prior to construction.

Control De-watering

All dewatering water from open cut excavation, tunneling, foundation work, trench, or underground vaults shall be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond. Clean, non-turbid dewatering water will not be routed through stormwater sediment ponds, and will be discharged to systems tributary to the downstream receiving waters in a manner that does not cause erosion, flooding, or a violation of State water quality standards in the receiving water. Highly turbid dewatering water from soils known or suspected to be contaminated, or from use of construction equipment, will require additional monitoring and treatment as required for the specific pollutants based on the receiving waters into which the discharge is occurring. Such monitoring is the responsibility of the contractor.

However, the dewatering of soils known to be free of contamination will trigger BMPs to trap sediment and reduce turbidity. At a minimum, geotextile fabric socks/bags/cells will be used to filter this material.

Maintain BMPs

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with each particular BMP's specifications. Visual monitoring of the BMPs will be conducted at least once every calendar week and within 24 hours of any rainfall event that causes a discharge from the site. If the site becomes inactive, and is temporarily stabilized, the inspection frequency will be reduced to once every month.

All temporary erosion and sediment control BMPs shall be removed within 30 days after the final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Manage the Project

The Project will be managed and a CESCL will be selected for the project prior to start of construction. The CESCL will be responsible for the operation and maintenance of site BMPs. The CESCL will also be responsible for monitoring water quality of discharges from the site in accordance with the NPDES permit for the project.

NPDES Permit

The project proposes to disturb more than an acre of land area and will therefore be required to apply for coverage under the general NPDES permit. As part of this permit process, a SWPPP notebook will be prepared containing the above information as well as a summary of many portions of this drainage report, monitoring and reporting requirements etc.

11 Operation and Maintenance

Operation and maintenance procedures will be developed during the final engineering phase of this project.