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ENGINEERING •SURVEYING •PLANNING

STORMWATER REPORT FOR

INVENTECH MARINE SOLUTIONS

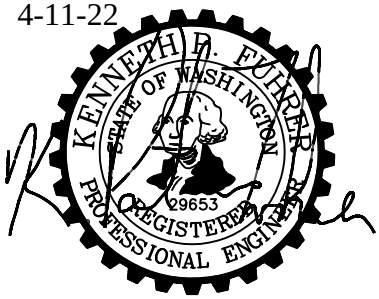
CITY OF BREMERTON SITE PLAN REVIEW & SITE DEVELOPMENT PERMIT APPLICATIONS

SE¼ SW ¼ SECTION 11, TOWNSHIP 23 NORTH,

RANGE 1 WEST, W.M.

PROJECT ENGINEER:	K. Pat Fuhrer, P.E. MAP, Ltd. (Job #6823)
PREPARED FOR:	INVENTECH MARINE SOLUTIONS 5626 Imperial Way SW Bremerton, WA 98312
CONTACT:	Micah Blowers (360)674-7019 x-200 micah@inventechmarine.com
DATE:	August 3, 2021
REVISED PER CITY COMMENTS:	**April 11, 2022** △

4-11-22



NOTE: THIS DOCUMENT IS INSCRIBED WITH A DIGITIZED SIGNATURE BY THE ENGINEER AS PROVIDED BY WAC 196-23-070(2)

REFERENCES

LID Technical Guidance Manual for Puget Sound, WSU Extension & Puget Sound Partnership, 2012

Stormwater Management Manual for Western Washington. Washington State Department of Ecology, 2014

USDA Natural Resources Conservation Services National Cooperative Soil Survey

Western Washington Hydrology Model 2012. Clear Creek Solutions, 2019

Norseland Site Development Information to Support Site Development Activity Permit Application, Golder and Associates, August, 1999.

Regional Stormwater Detention Facilities Stormwater Runoff Study, Cosmopolitan Engineering Group, April 1999.

Bremerton Motorsports Park- Initial Geotechnical, Groundwater and Methane Evaluation, Aspect Consulting, December 12, 2011.

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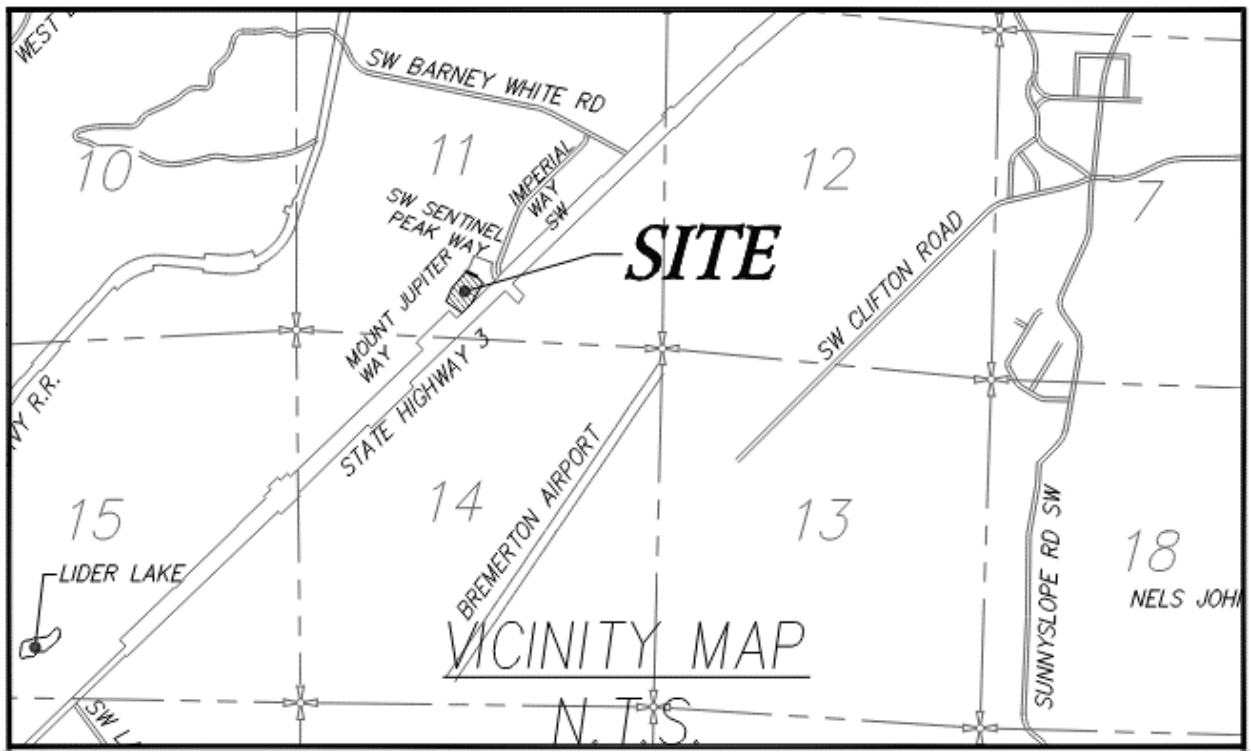
STORMWATER REPORT FOR INVENTECH MARINE SOLUTIONS SITE PLAN REVIEW/SDP APPLICATION

I. PROJECT OVERVIEW

A. SIZE AND LOCATION

The subject property is 4.41 acres in size and is leased land from the Port of Bremerton. It is located southwesterly of SW Sentinel Peak Way and west of State Route 3 on property previously containing the Norseland Mobile Home Park prior to it's abandonment and reclamation of the adjacent landfill cap in 2001.

B. VICINITY MAP



C. PROJECT DESCRIPTION

This property is located within the Puget Sound Industrial Center which is regulated by the PSIC Subarea Plan. Within the PSIC subarea plan, this property is located within the Port Industrial Mix (PIM) zone. As such, permitted uses are those that comply with the intent of the zone: to promote a wide range of light industrial, support retail and services uses, government uses and compatible service uses within a business park built form, as well as recreational uses that are designed and operated in a manner that is compatible with industrial uses.

The applicant is proposing to construct a new 58,520 s.f. light manufacturing building and offices together with company and employee vehicle parking on the 4.41-acre leased property located at the Port of Bremerton. A maximum number of employees is estimated at 100, and the hours of operation are 7 am – 5 pm with occasional nights and weekends.

A total of 102 parking spaces are proposed, and site landscaping will comprise a minimum of 15% of the total lease area in accordance with BMC 20.50.060. Also, pursuant to the PSIC, the maximum hard surface area proposed and the maximum impervious surface area proposed do not exceed 75% and 65% of the total leased site area, respectively.

Regional storm water facilities were developed for this site approximately 20 years ago, with the western basin draining to the storm water detention facility constructed during the Norseland Site Reclamation and Landfill Cap project, and the eastern part of the site draining toward the northeast to regional detention facilities also constructed approximately 15 years ago north and east of Imperial Way. Water quantity mitigation is provided by these two regional storm water facilities, and water quality mitigation meeting Minimum Requirement #6 of the 2019 DOE Manual and the City of Bremerton will be provided on-site.

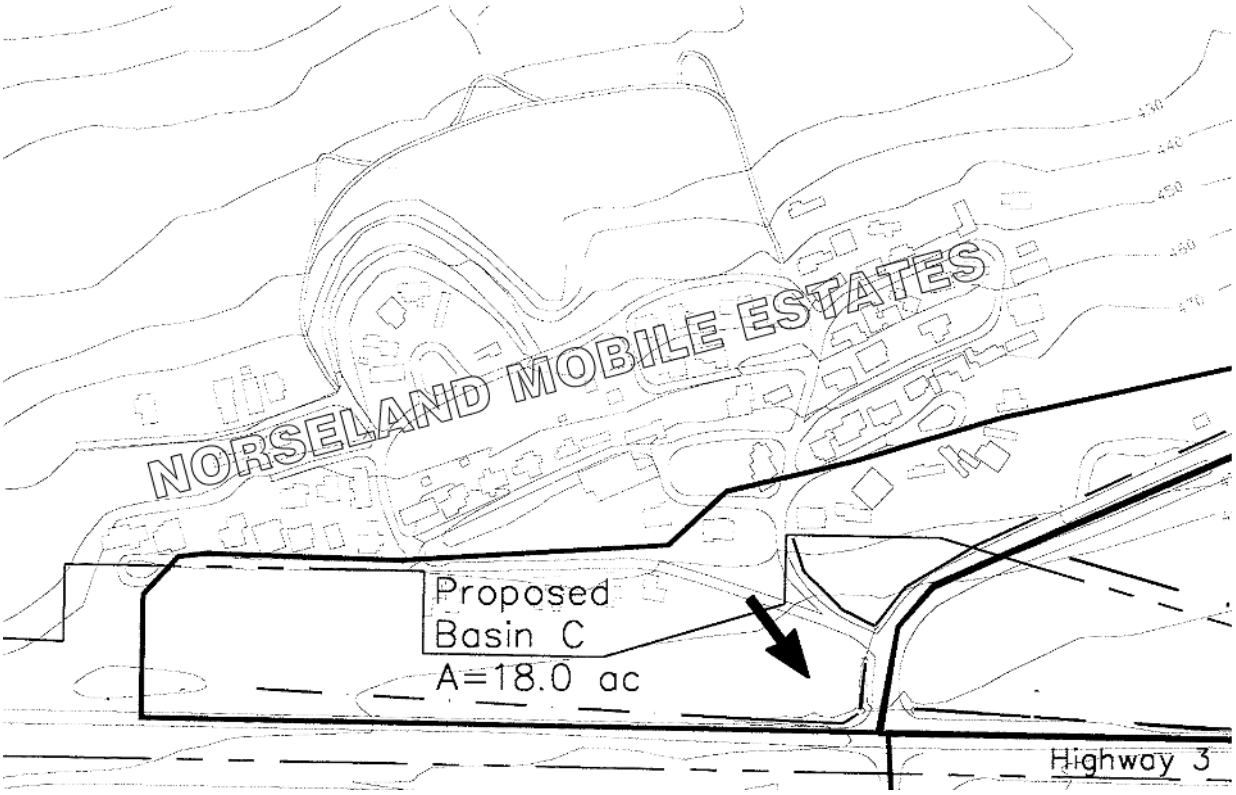
A sanitary sewer lift station will be constructed and maintained by the Port of Bremerton, and both domestic water and fire flow provided by the City of Bremerton. Approximately 7400 cubic yards of material will be excavated, and 8100 cubic yards of fill needed to meet the intended site grades specified on the grading plan.

II. EXISTING SITE CONDITIONS

A. TOPOGRAPHY AND FEATURES

The area around the site was previously developed first in 1942 by the US Army and they constructed barracks, officer's quarters and several other outbuildings and was known as Camp Christie. All buildings were removed or burned prior to the Army transferring ownership back to Kitsap County in 1948. Subsequently, the land east of this project site was leased to a company that operated it as a landfill between 1951 and 1961, mostly as a "burn dump" and salvage operation, and was closed in 1961. In 1962 the land was leased to a developer who created

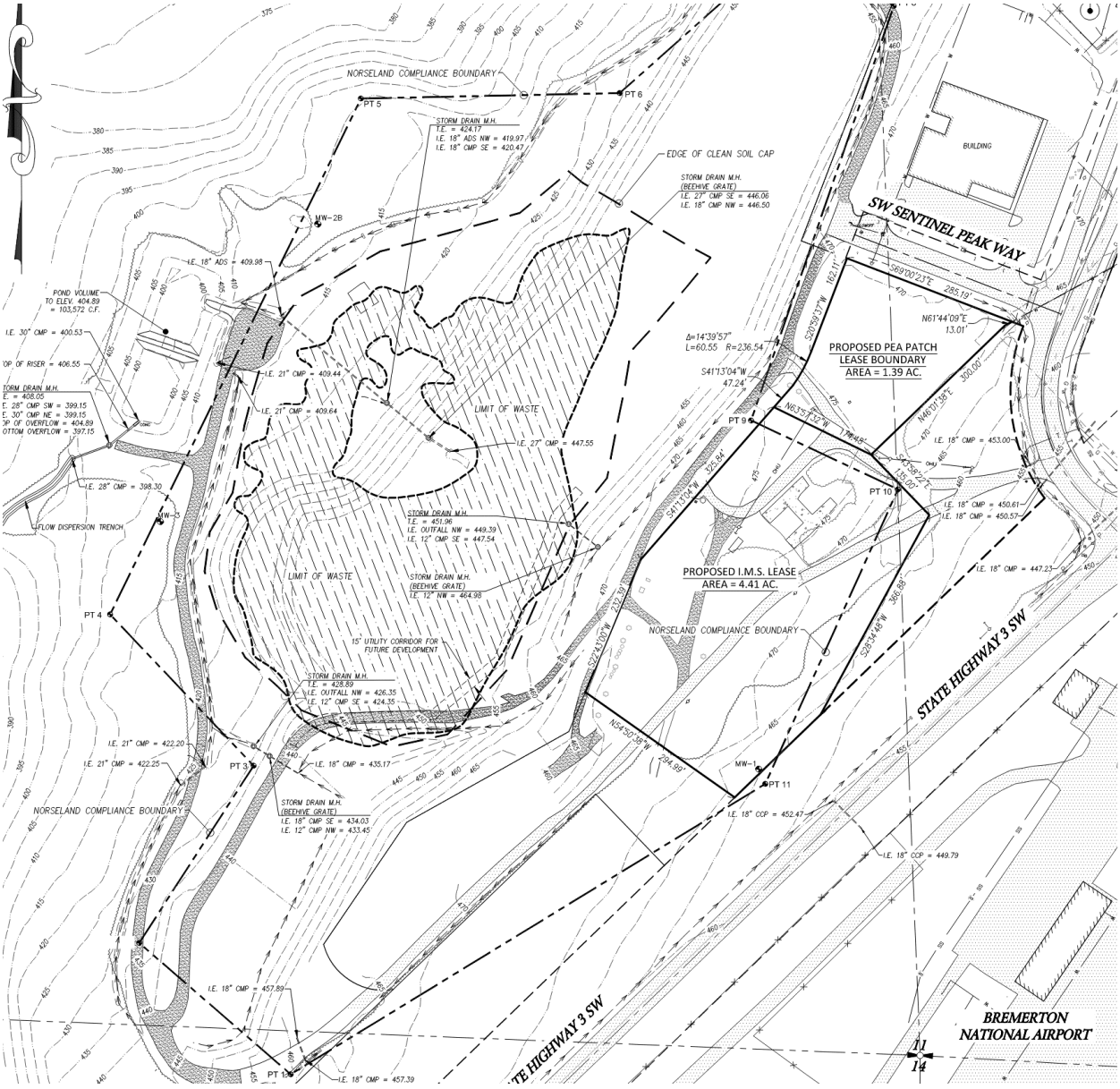
"Norseland Mobile Estates", and was operated until 1992-2000, when the mobile home park was moved to another site after health effects attributed to odors were reported by residents. A Remedial Investigation/Feasibility Study (RI/FS) of the landfill area was performed in 1997 by Golder and Associates, and a Restrictive Covenant placed on the landfill as part of the Remedial Action. The "Norseland Compliance Boundary" is shown on the site plan, as well as the "Waste Area Edge" and the "Landfill Cap Edge" southwesterly of the site. The Norseland compliance Boundary requires that the integrity of the Remedial Action and protection of human health and the environment be maintained, and Ecology is to be notified of any development activities within this Restrictive covenant area.



The site area is fairly flat in the areas of the developed mobile home park, and the old road network still remains and will be demolished and removed as part of this project. The adjacent Pea Patch area will be used for a site construction laydown area, and any excess cut material will be "filled" on the Pea Patch area. Areas of native second growth conifers are shown on the plans, and tree retention will be maximized and applied to the landscaped area required.

An Existing Conditions and Demolition Plan is contained on Sheet C2.0 of the Site Development Activity Permit plans.

B. SITE TOPOGRAPHY



C. OFF-SITE DRAINAGE

There is no offsite area contributing to this site. It is located at a topographic high point, shedding any runoff to the west or east to man-made conveyances to Regional Storm Water Facilities.

D. EXISTING DRAINAGE

West Basin

The western portion of the site sheet flows to an off-site swale that lies along the top of a man-made 2:1 slope and to a conveyance system consisting of 12", 18", and 27" piping and rock-lined stabilized channels that were installed as part of the Norseland Remediation project and is conveyed to the regional storm water detention facility constructed for this area of the Port property. This regional pond facility discharges to a flow dispersion trench at the SW corner of the pond via a 30" outfall pipe from the pond. The dispersion trench is located over 1000 feet upgradient from a wetland which is located south of the Port's LOSS. Please refer to Appendix B for the as-built drawing of this system, which was part of the Norseland remediation project approved by the WA State Dept of Ecology. It is planned in the future as part of the Circuit of the Northwest project construction to retrofit this pond facility into a regional retention pond, and the catchment area from the Inventech project will be accounted for in the sizing of the facility.

East Basin

The east basin also flows as sheet flow through the previously-developed Norseland mobile home park portion of the site before dispersing into the native vegetation understory and forested area parallel to SR 3 in the WSDOT SR 3 right-of-way. Runoff enters one of two 18" culverts located near the intersection of Imperial Way and SR 3, and then flowing to the north along SR 3 in existing channels that discharge to the regional storm water detention facility constructed for this area of the Port property. This regional detention pond facility discharges to the East Fork of the Union River as shown in figure 2.1 of Exhibit C.

E. SENSITIVE AREAS

The Kitsap County Parcel Viewer indicates that a moderate erosion hazard exists off-site approximately 30ft west of the proposed Mount Jupiter Way and presumably on the man-made 16-ft high, 2:1 slope west of the project, as well as a Category II Critical Aquifer Recharge Area at the toe of the man-made slope in the area of the Norseland Landfill cap approximately 80 feet west of the proposed Mount Jupiter Way.

F. EXISTING VEGETATION

The site is mainly cleared with sparse grasses covering the non-impervious areas, but areas of standing conifers in good health are shown on the plans primarily along SR 3 and will provide a great screening buffer of the site from the highway.

G. EXISTING ON-SITE DRAINAGE PROBLEMS

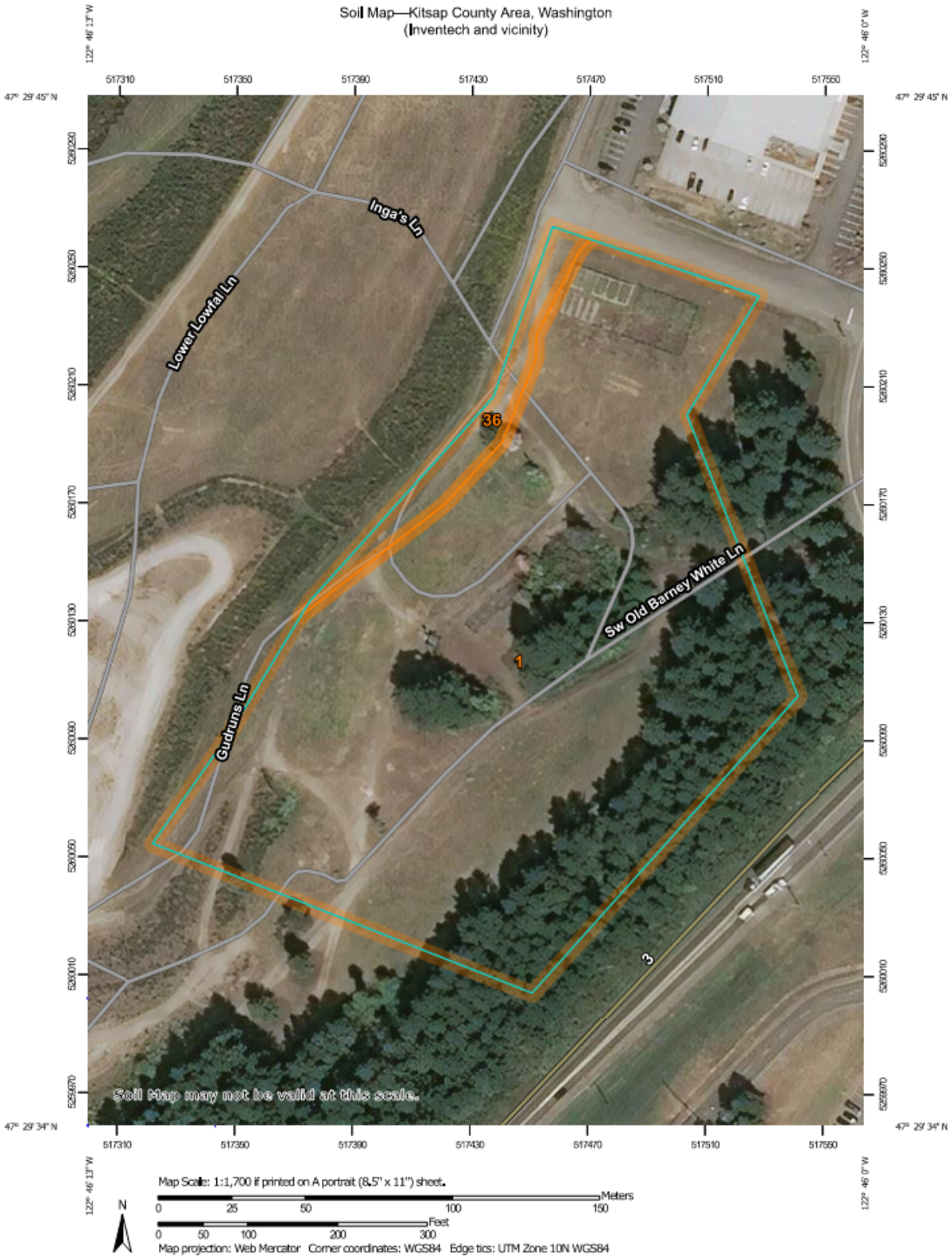
There are no known drainage or erosion problems associated with this site.

H. EXISTING OFF-SITE DRAINAGE PROBLEMS

There are no known off-site drainage or erosion problems upstream or downstream of this project and the two regional storm water facilities that the Port of Bremerton owns, operates, and maintains.

I. GENERAL SOIL AND GROUNDWATER CONDITIONS

According to soils reports from surrounding projects and NRCS Soil Maps, the underlying soils, which have been greatly disturbed and compacted from previous land use activities, generally consist of gravelly sandy loam, and more specifically Alderwood-series soils for this portion of the site, which are not conducive to infiltrating site runoff. The site lies at a topographic high point, and compacted glacial till soils are present.



USDA **Natural Resources Conservation Service** Web Soil Survey National Cooperative Soil Survey 7/27/2021 Page 1 of 3

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Alderwood gravelly sandy loam, 0 to 8 percent slopes	7.0	95.2%
36	Neilton gravelly loamy sand, 15 to 30 percent slopes	0.4	4.8%
Totals for Area of Interest		**7.4**	**100.0%**

III. PROPOSED SITE CONDITION

A. TABULATION OF PROPOSED LAND COVER

The following developed and disturbed areas within the clearing limits are accounted for in the sizing of the piped conveyance storm water system and the storm water quality structures discussed further in this report.

Description of Improvements:

Project Lease Area: The project applicant is proposing a lease area of 4.41 Acres from the Port of Bremerton as shown on the plans. The work on Mount Jupiter Way and the "Pea Patch" are not included in the Project Lease Area.

Building Rooftop: The area of building rooftop 58,520 s.f., and is designed so that half of the rooftop flows to the west basin and east basin, as those catchment areas to their respective regional detention ponds approximately split the building in half.

Conventional Asphalt on-site: This describes the area on-site proposed to receive a 3" depth of Hot Mix Asphalt as detailed on the plans for the drive aisles and parking areas within the Project Lease Area.

Conventional Asphalt Mount Jupiter Way: This describes the area of Mount Jupiter Way to receive a 3" depth of Hot Mix Asphalt as detailed on the plans. Almost all of Mount Jupiter Way will drain to a water quality vault for treatment prior to discharge to the regional Norseland detention pond facility.

Pervious Asphalt on-site: This describes the area within the Project Lease area that pervious asphalt is proposed to meet the hard cover surfacing threshold zoning requirements of the Puget Sound Industrial Center plan. The specification of this surfacing is not intended or feasible as a storm water BMP, and an underdrain is provided so that storm water runoff does not pond and/or cause sub-grade failure in the adjacent conventional asphalt parking and aisleway.

Sidewalk on-site: This describes the at-grade concrete sidewalk area as proposed around the building.

Sidewalk within mount Jupiter Way: This describes the sidewalk areaproposed along Mount Jupiter Way.

Retained Trees & New Landscape: This describes the area to be landscaped as shown on Sheet C-8.0, as well as the native tree retention area along the SR 3 right-of-way.

Other pervious on-site: This describes the areas within the Project Lease Area that are disturbed and are to receive post-construction amended soils

DESCRIPTION	AREA (S.F.)	AREA (AC.)
Project Lease Area	192,100	4.41
Building Rooftop	58,520	1.3434
Conventional Asphalt on-site	61,830	1.4194
Conventional Asphalt Mount Jupiter Way	36,920	0.6528
Pervious Asphalt on-site	18,930	0.4346
Sidewalk on-site	5,076	0.1165
Sidewalk Mt Jupiter Way	3,992	0.0916
Landscaped on-site	30,585	0.7021
Other pervious on-site	20,229	0.4644

WEST BASIN CATCHMENT

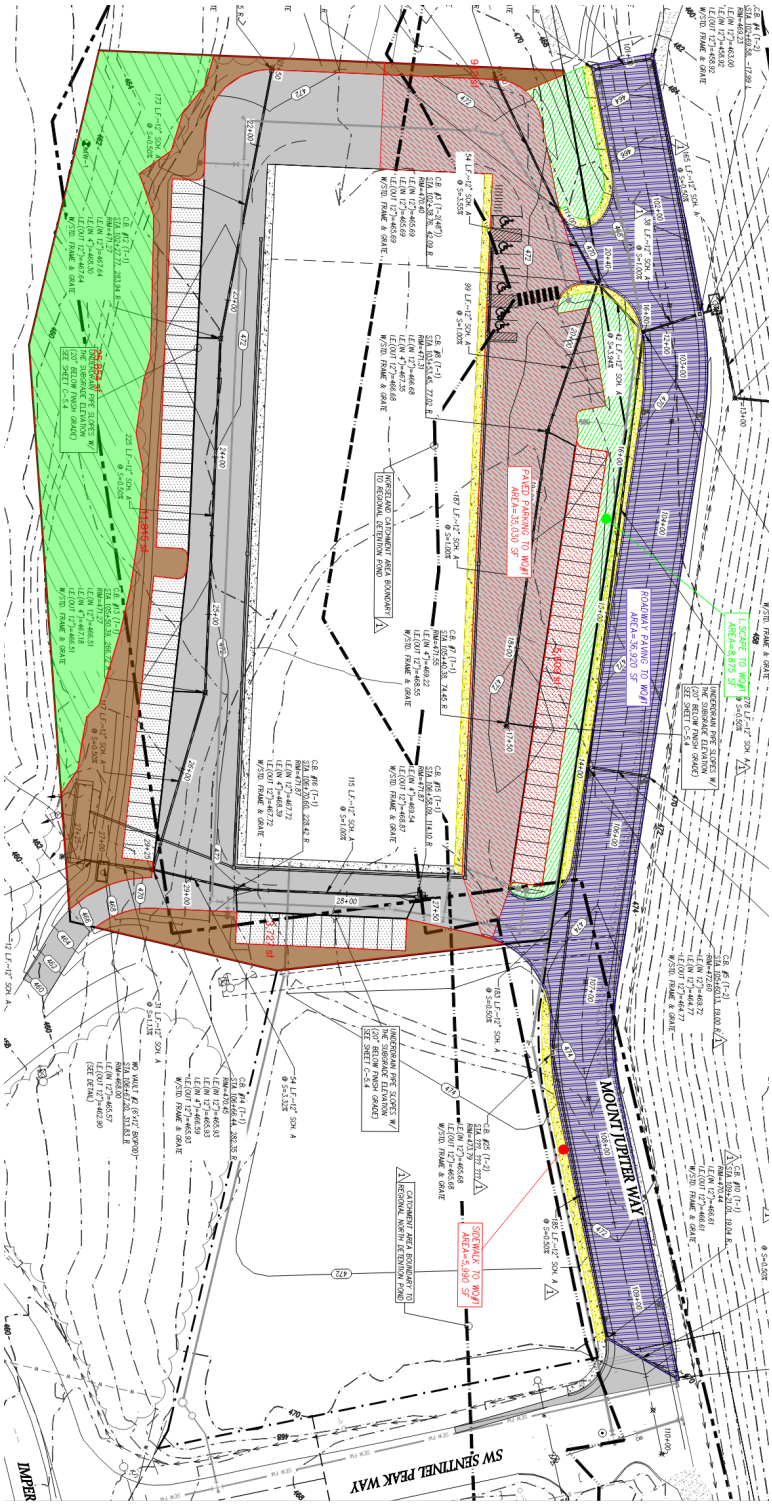
Building Rooftop(1/2)*	29,260	0.6717
Conventional Asphalt on-site*	29,421	0.6754
Conventional Asphalt Mount Jupiter Way*	36,920	0.8476
Pervious Asphalt on-site*	5,609	0.1288
Sidewalk on-site*	2,347	0.0539
Sidewalk Mt Jupiter Way*	3,643	0.0836
Landscaped Mt Jupiter Way	3,070	0.0705
Landscaped on-site	5,805	0.1333
Other pervious on-site	912	0.0209

*Impervious total to Norseland Regional Pond = 107,200 s.f.

EAST BASIN CATCHMENT

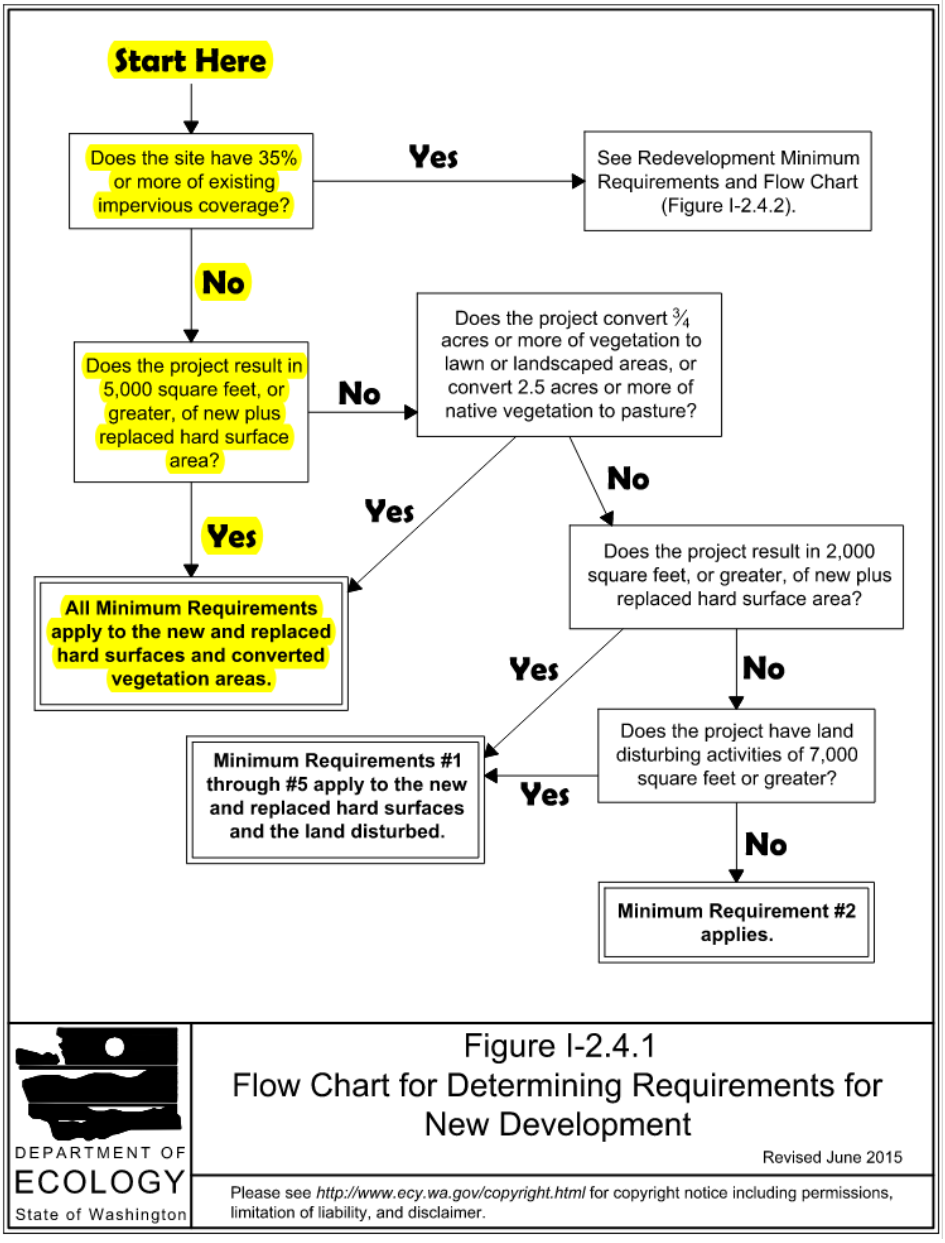
Building Rooftop(1/2)	29,260	0.6717
Conventional Asphalt on-site	32,409	0.7440
Pervious Asphalt on-site	13,321	0.3058
Sidewalk on-site	2,729	0.0626
Landscaped on-site	25,854	0.5935
Other pervious on-site	15,572	0.3568

B. DEVELOPED BASIN MAP



IV. MINIMUM REQUIREMENTS

The minimum requirements are determined based on the Flow Chart for New Development. According to the Flow Chart, all minimum requirements apply to the new and replaced hard surfaces and converted vegetation areas for this project. This project is considered vested by the City of Bremerton for MR #5 and MR #7 based upon the prior regional storm water facilities development permits, please see the email from the City Engineer for other Port of Bremerton projects below under MR #5.



1 *Minimum Requirement #1: Preparation of Stormwater Site Plans*

The Stormwater Site Plan will be prepared for review and approval by the City of Bremerton for the Site Development Permit concurrently with the Site Plan Review step. It includes the existing conditions analysis, with map and descriptions of areas, the developed site with map and descriptions, and an offsite analysis. Designs for the stormwater system are included in the Drainage Report, along with specifications, details and construction requirements. MR #1 is satisfied.

2 *Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP)*

Silt and erosion control measures will include silt fencing at the toe of all fill slopes, a rocked construction entrance, inlet protection barriers, and temporary sediment ponds. The contractor will use either straw mulch, temporary hydroseeding or plastic sheeting to cover exposed soils during inclement weather. As the area to be cleared is greater than 1 acre, the applicant will be required to obtain a Construction Stormwater General Permit from the Washington State Department of Ecology prior to any clearing or grading activity on site. Additionally the contractor will be required to have a Certified Sediment and Control Lead (CESCL) to monitor and report on the site. MR #2 is satisfied.

3 *Minimum Requirement #3: Source Control of Pollution*

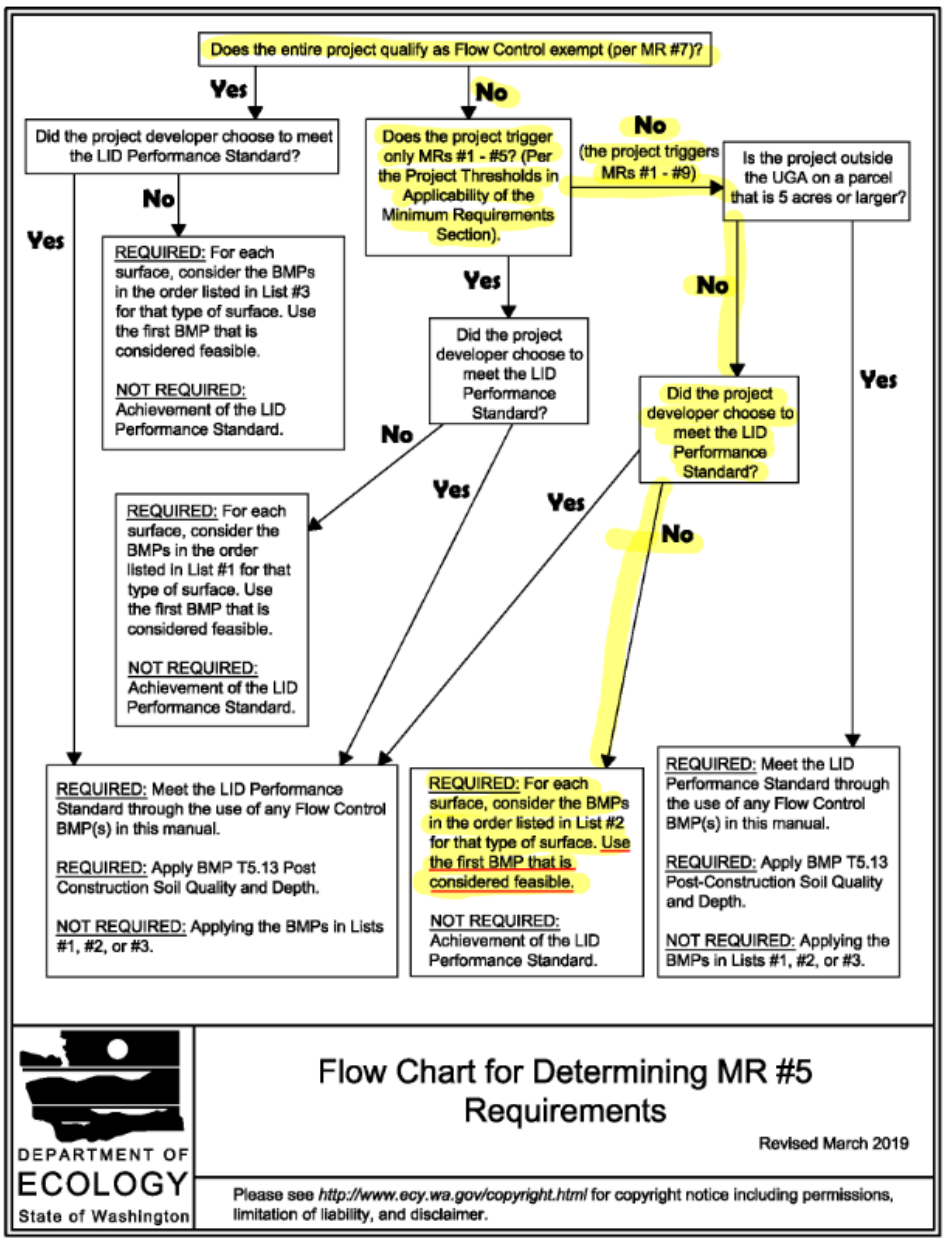
Source control of pollution means schedules of activities, prohibition of practices, maintenance procedures, and other physical, structural, and/or managerial practices that prevent or reduce the release of pollutants and other adverse impacts to water of Washington State. Best Management Practices can be used singularly or in combination. For this project, outdoor vehicle parking is the primary potential for pollution. Source control BMP's for this activity include a spill-control type oil-water separator tee in the most downstream catch basin prior to WQ treatment. MR #3 is satisfied.

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

The proposed drainage system connects to existing storm conveyance systems that drain to regional detention ponds that were sized and constructed to serve this project. MR #4 is satisfied

△ 5 *Minimum Requirement #5: On-site Stormwater Management*

Figure I-3.3: Flow Chart for Determining MR #5 Requirements



2019 Stormwater Management Manual for Western Washington

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Projects such as these within the Port of Bremerton are considered vested by the City under the stormwater codes that were in place when the *Norseland Site Remediation* and the *Regional Stormwater Detention Facilities Stormwater Runoff Study* improvements were constructed, see email tree below:

From: Paul Wandling <Paul.Wandling@ci.bremerton.wa.us>
Subject: RE: Port of Brem Stormwater - Lot 2 Commercial Development
Date: September 25, 2018 at 3:06:20 PM PDT
To: 'John Piccone' <jpiccone@soundwesteng.com>
Cc: Joe Keller <Joe.Keller@ci.bremerton.wa.us>, Ben James <Ben.James@ci.bremerton.wa.us>

My understanding of the attached email is that as long as your project stays under the parameters of the approved stormwater permit for the existing storm system (80% impervious and 20% landscaping) …
your current building permit would not require storm water mitigation (as long as it does not exceed the thresholds of the original design)

However … this approval would not vest for every use given that there are specific stormwater source control BMP's required for specific business uses. (ie … spill containment, covered waste containers, etc …) These uses would not have been addressed in the original stormwater design.

The stormwater quantity sizing for each of the previous site development projects are outlined below in the MR #7 discussion and the pertinent portions of the reports included in the appendices.

Even though vested, the List #2 Feasibilities for this developed and past graded/compacted site are discussed and are determined by the Project Engineer to be Feasible or Infeasible as follows:

a) Lawn and Landscaped areas:

- *Post-Construction Soil Quality and Depth in Accordance with BMP T5.13 of Volume 5*

Soil amendment will be provided for all landscaped and disturbed grade areas with grades less than 25% (4H:1V).

Roofs:

- *Full dispersion:* **No horizontal flow path available.**

- *Rain Gardens:* **Infiltration under rain gardens is not feasible on this site due to the previous site grading/disturbance and proximity to man-made 50% slopes.**

- *Downspout dispersion* **Not feasible on this site due to the previous site grading/disturbance and proximity to slopes > 50%.**

- Perforated stub-out connections **Not feasible on this site due to the previous site grading/disturbance and proximity to slopes > 50%**

Other Hard Surfaces:

- *Full Dispersion* **Not feasible on this site due to limited area available on-site and lack of native vegetation in areas slopes < 15%.**
- *Rain Gardens* **Infiltration under rain gardens is not feasible on this site due to the previous site grading/disturbance and proximity to man-made 50% slopes.**
- *Permeable pavement* **Permeable pavement is not feasible due to the previous site grading/disturbance, proximity to slopes, and the applicant's concerns over short service life. Permeable pavement is proposed in the parking areas as a means of conformance with land use coverage code requirements contained in the PSIC, but has no stormwater management integrity and will need to be under-drained.**
- *Sheet flow dispersion* **No horizontal flow path available.**

△ **Minimum Requirement #5 will be met for this site with the use of soil amendment for landscaped and other pervious disturbed areas having a grade less than or equal to 25% (4H:1V). Roof and pavement BMP's from List #2 are infeasible for this project as discussed above**

6 *Minimum Requirement #6: Runoff Treatment*

The following require construction of stormwater treatment facilities:

Projects in which the total of, pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area or,

Projects in which the total of pollution-generating pervious surfaces (PGPS)- not including permeable pavements- is three quarters of an acre or more in a threshold discharge area, and from which there will be a surface discharge in a natural or man made conveyance system from the site.

△ **Since the project proposes 98,750 s.f. of PGHS AND flows to regional detention ponds designed for this project that ultimately discharge to fresh water, water quality mitigation for roadway and parking lot runoff is proposed via Oldcastle-manufactured Biopod®**

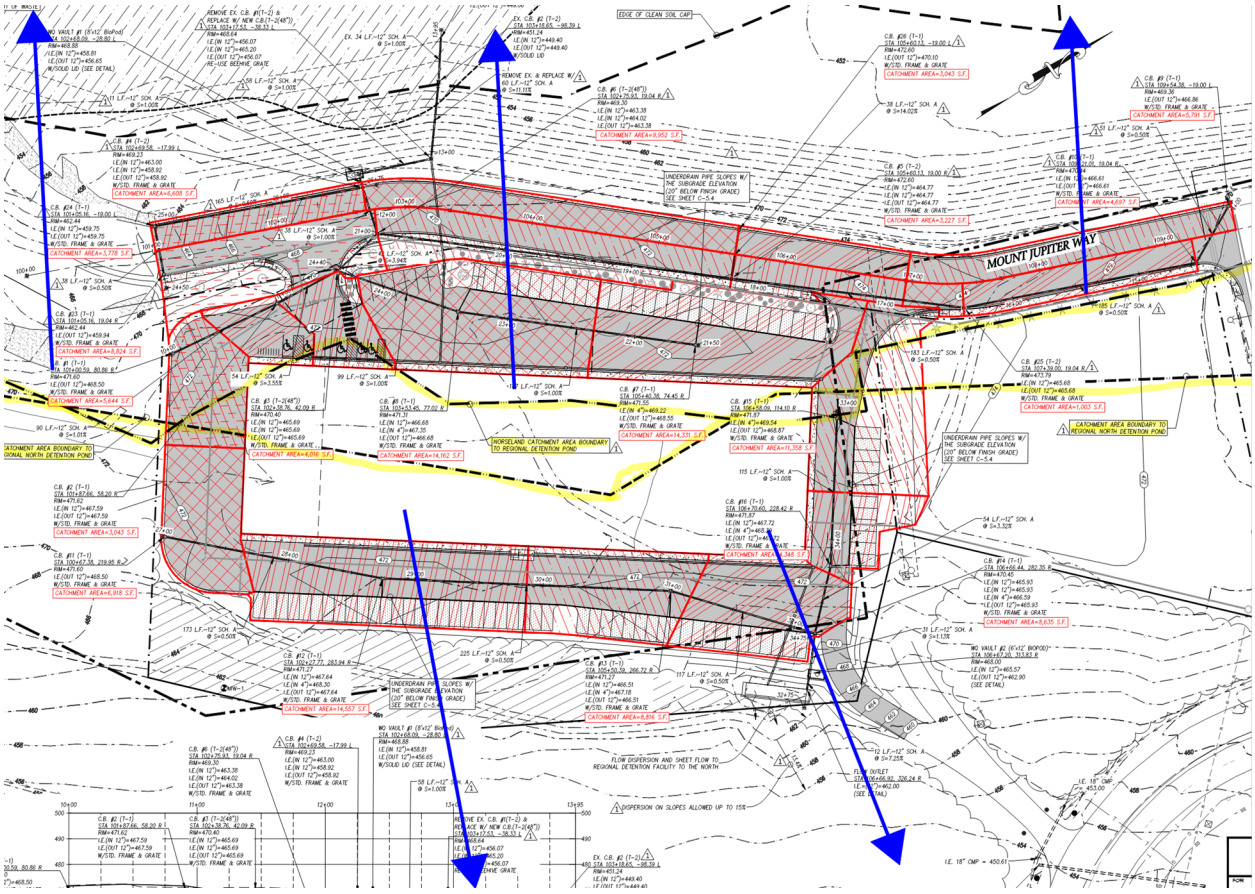
vaults , which are WSDOE GULD approved manufactured devices for Enhanced Treatment. Please refer to the sizing calculations beginning on page 19.

Minimum Requirement #6 has been satisfied.

△7 *Minimum Requirement: #7: Flow Control*

WEST BASIN:

The west basin of the Inventech site drains to the Norseland Regional Detention Pond which was sized based on an assumed Impervious Surface coverage of 66% from the regional pond facility upstream catchment area of 30.6 acres. The catchment boundary is shown on the project plans and highlighted below:

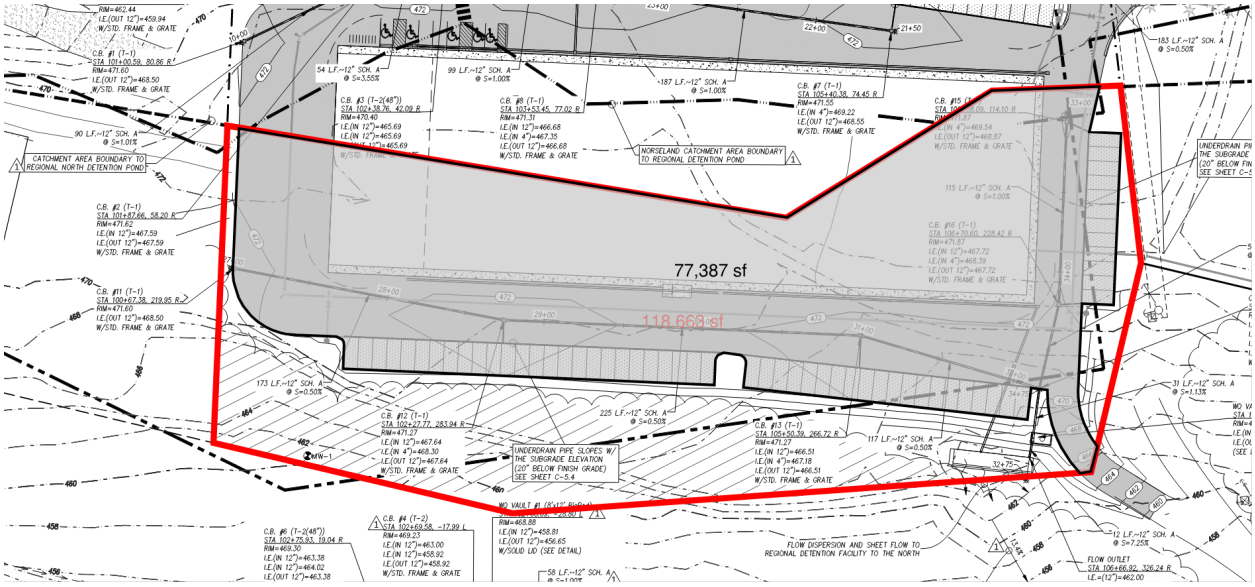


Referenced calculation pages and plans from the Norseland Pond Golder report are included in the appendices. Since this project is the first project constructed in the Norseland Regional Pond catchment area, the proposed impervious surface area draining to it (107,200 s.f.-Page 10) amounts to 8% of the allocated 66%, so 58% impervious is available impervious surface area remaining in the 30.6 acre basin. As noted earlier, this detention facility is proposed to be

converted to a regional retention pond with the construction of the Circuit of the Northwest project, and this part of the basin will be included in the design.

EAST BASIN:

The east basin of the Inventech lies in Basin C which drains to the Regional Detention Pond lying north of Imperial Way which was sized based on an assumed 85% impervious surface coverage from Basin C's 10.3 acre upstream "Industrial Area" catchment designation. This catchment area "C" boundary on the Inventech site is shown on the illustration on the previous page, and was taken from Figure 2.4 in appendix C. As shown below, the amount of impervious area of the proposed project that lies within the industrial portion area of Basin C (118,668 s.f.) is 77,387 s.f, or 65%, well below the 85% coverage assumed for sizing the Northern Regional pond.



Referenced calculation pages and plans from the Phase 1 Regional Stormwater Detention Facilities Cosmopolitan Engineering Group report are included in the Appendix C.

Since both regional pond facilities were sized for greater than the impervious surface coverage from this part of their respective basin areas, this site plan meets the criteria. Minimum requirement #7 has been satisfied.

8 *Minimum Requirement #8 Wetland Protection*

There are no wetlands associated with this project. The project does not discharge into a wetland, either directly or indirectly through a conveyance system.

Minimum requirement #8 does not apply.

9 *Minimum Requirement #9: Operation & Maintenance*

An Operation and Maintenance Manual with a Maintenance Schedule is provided in the appendices herein.

Minimum Requirement #9 is met.

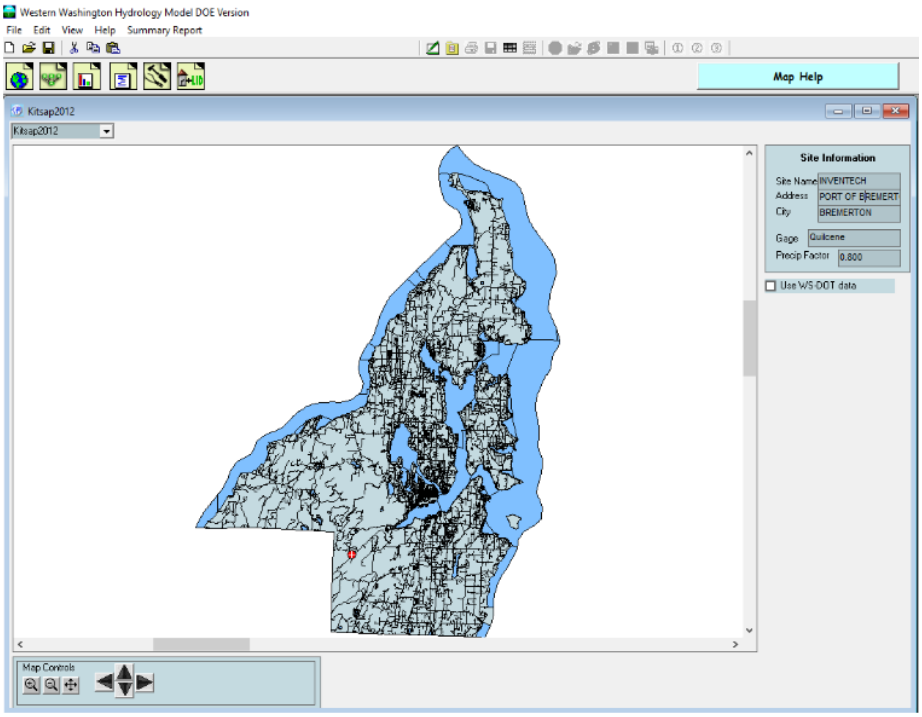
V. DOWNSTREAM ANALYSIS

A downstream analysis is not warranted for this project due to the site development plans and regional detention pond construction.

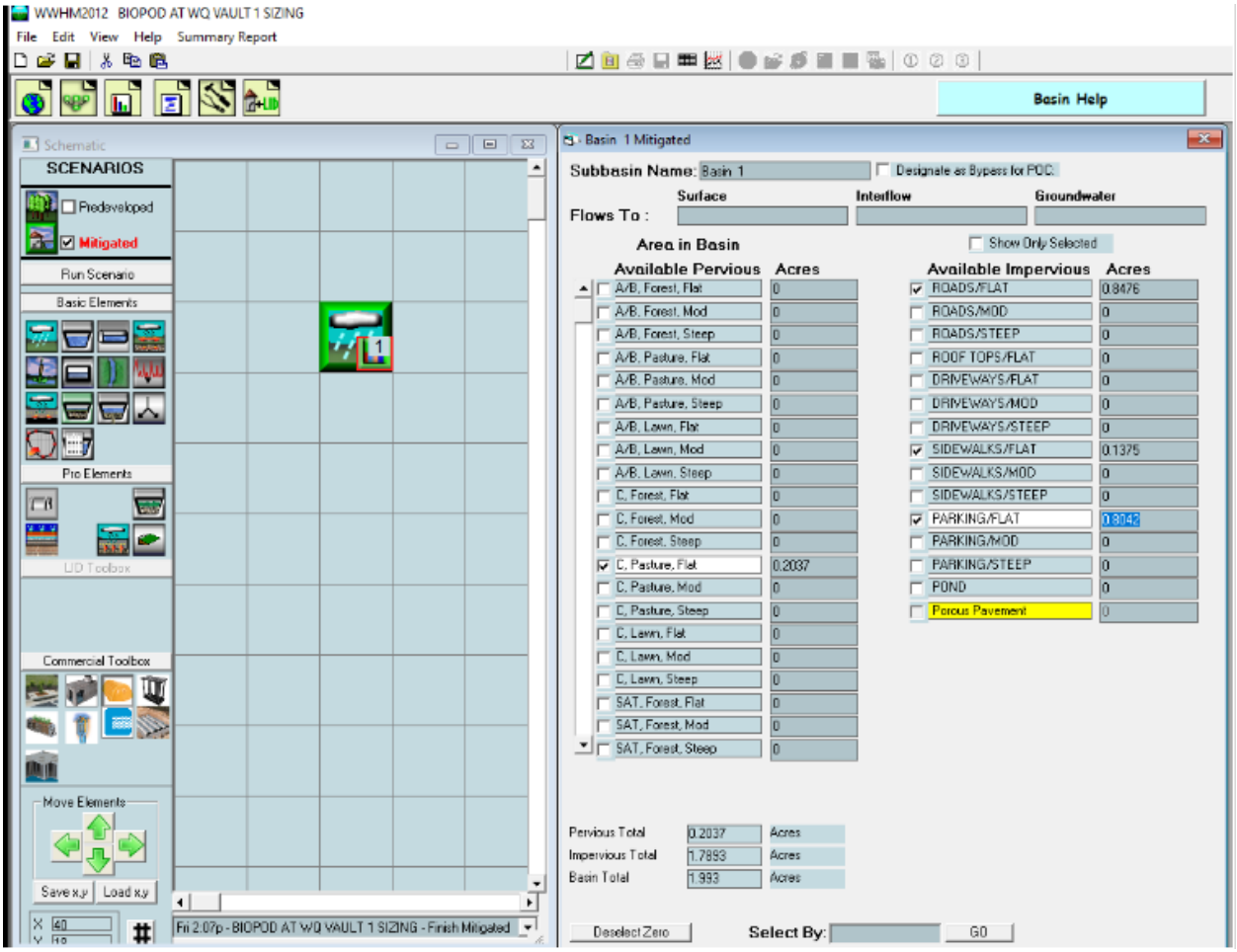
VI. HYDROLOGIC ANALYSIS

A. WATER QUALITY FLOW/WEST BASIN

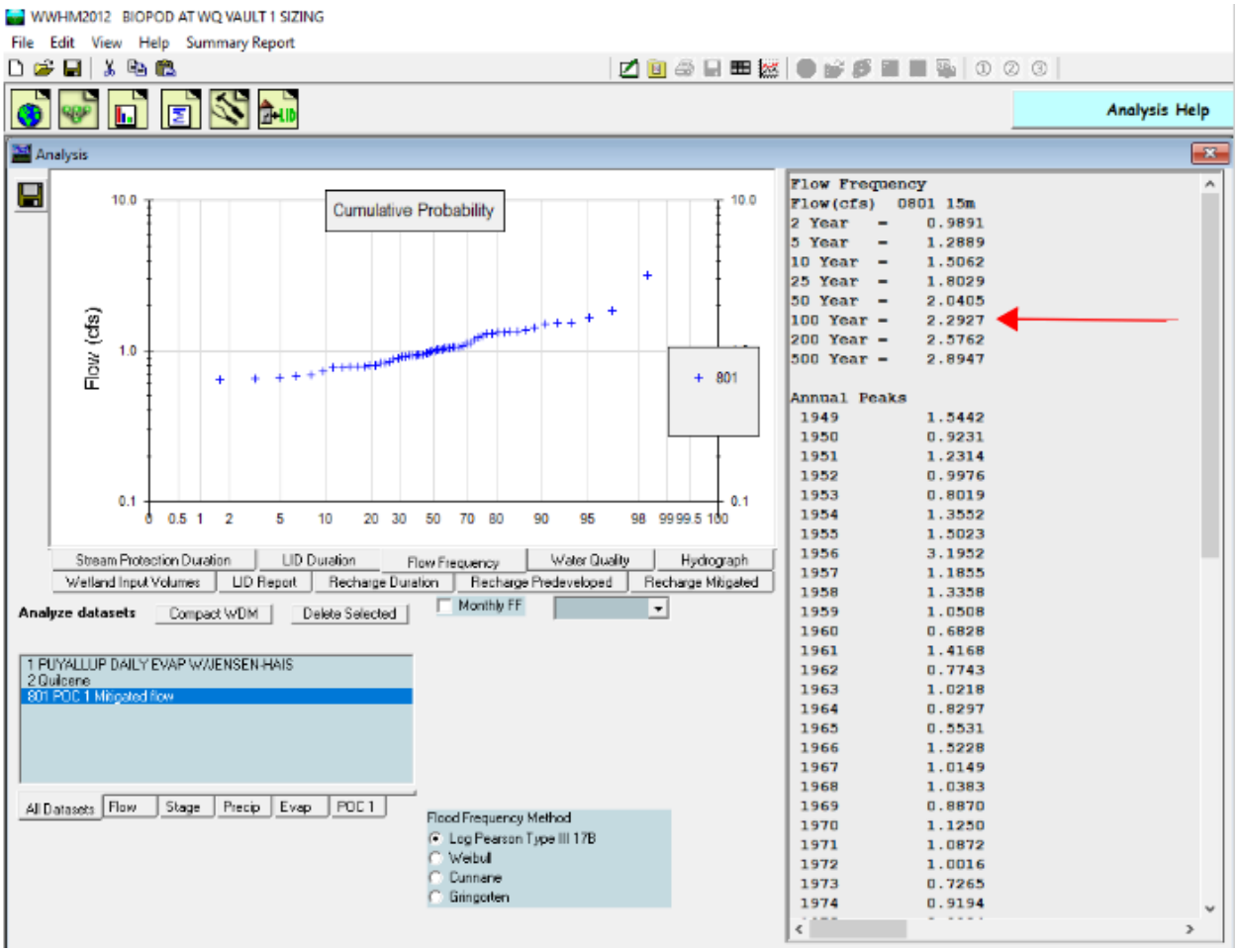
The off-line water quality flow rate estimated from the 2012 WWHM is presented below and then used to specify the Biopod™ vault configuration. This vault contains an internal bypass that bypasses flows greater than the WQ design flow therefore the off-lime water quality flow rate is used from the 2012 WWHM model



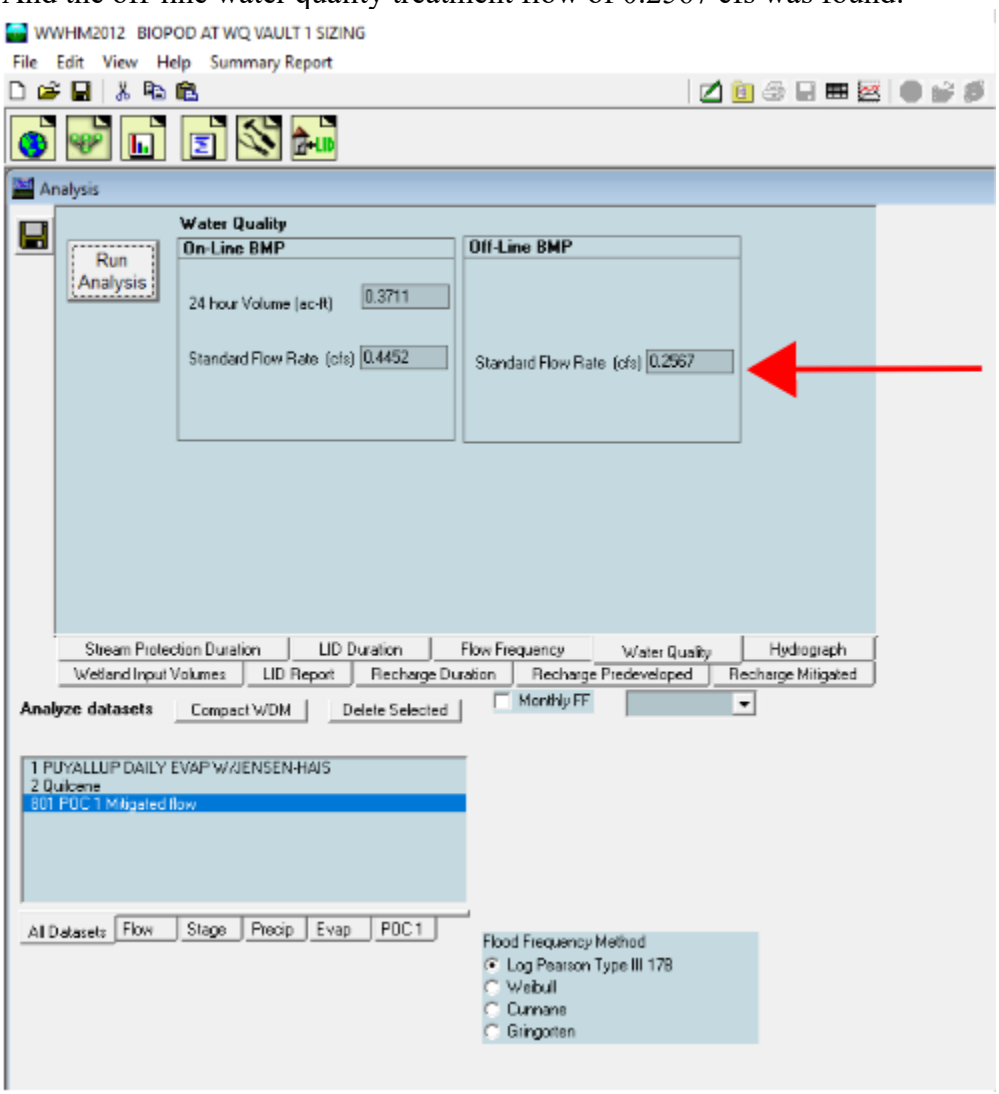
The pervious and impervious surface areas from the west basin shown on pages 9 & 10 are inputted here: 0.2037 Ac. Pasture (Landscaping & Amended Soils), 0.8476 Ac Roadway Flat, 0.1375 Ac. Sidewalk Flat, and 0.8042 Ac. Parking Flat



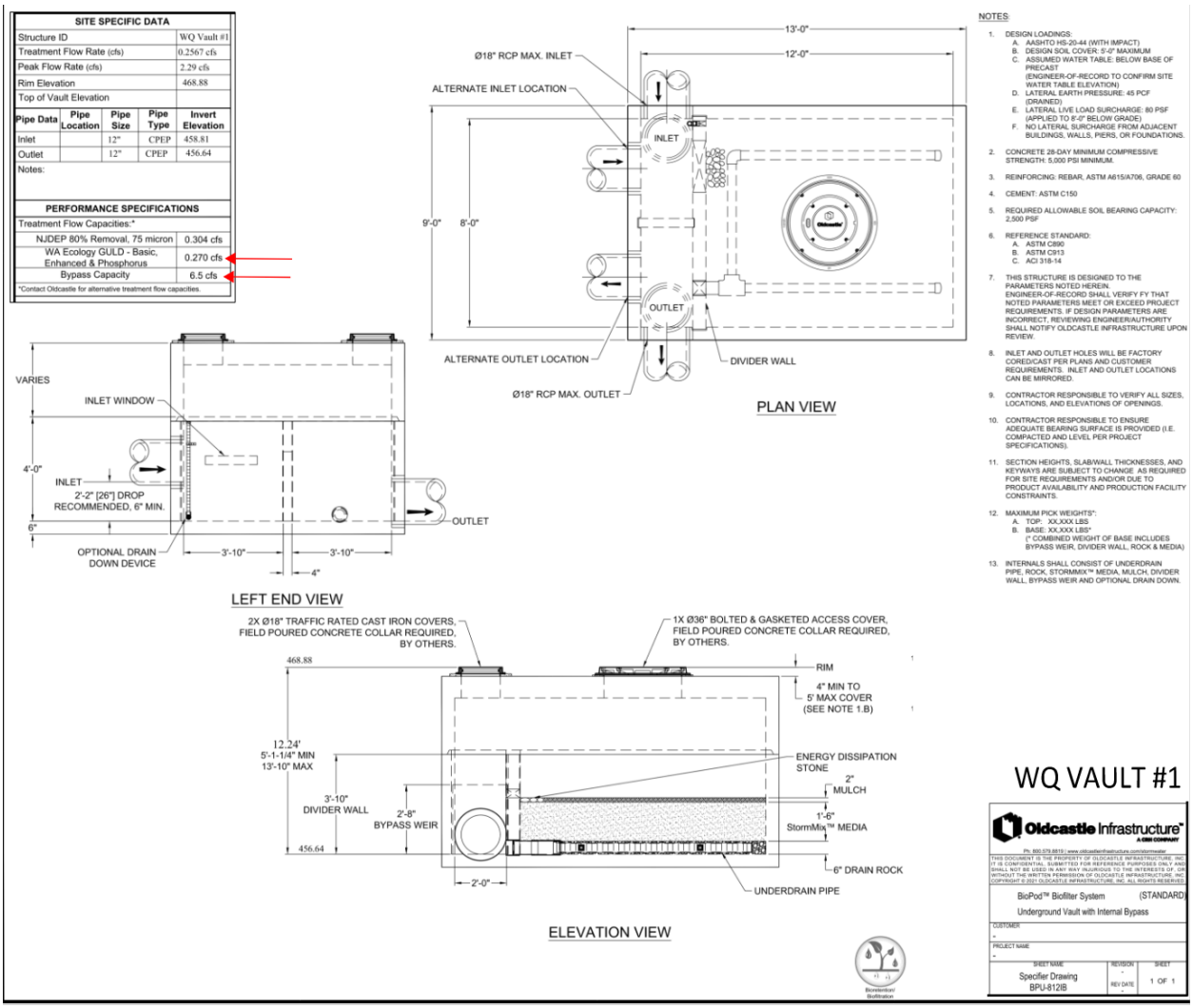
The 100-yr required vault bypass flow rate from the west basin was then determined (2.29 cfs):



And the off-line water quality treatment flow of 0.2567 cfs was found:

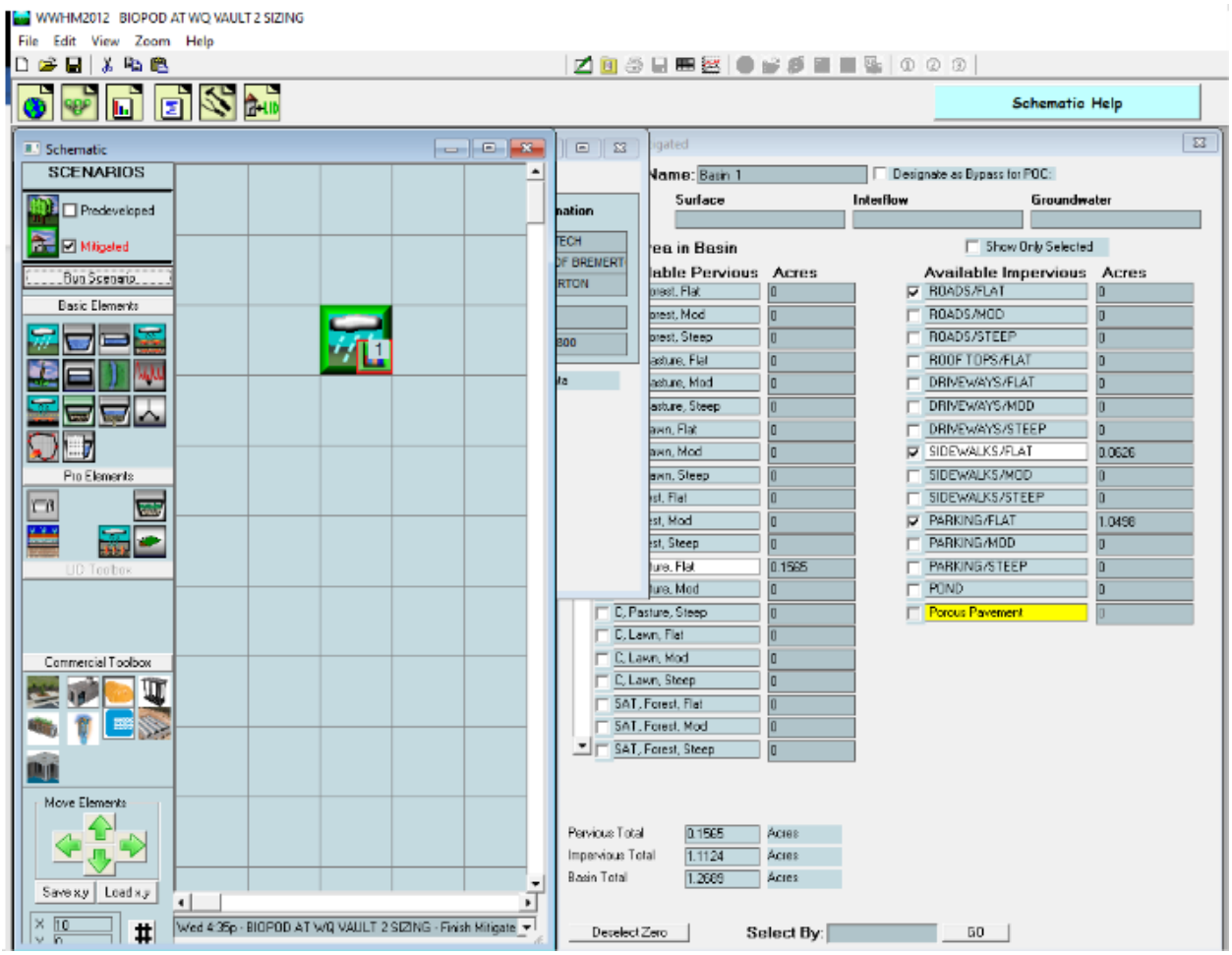


The Biopod Biofilter Underground vault has an internal bypass, so the off-line flow rate of 0.2567 cfs will be used to size the vault and cartridge configuration. A model BPU-812IB 6'x12' vault was found to meet this criteria, with a treatment capacity of 0.27 cfs. Note that the internal bypass capacity of this vault is 6.5 cfs, greater than the 100-yr peak flow from the west basin of 2.29 cfs.

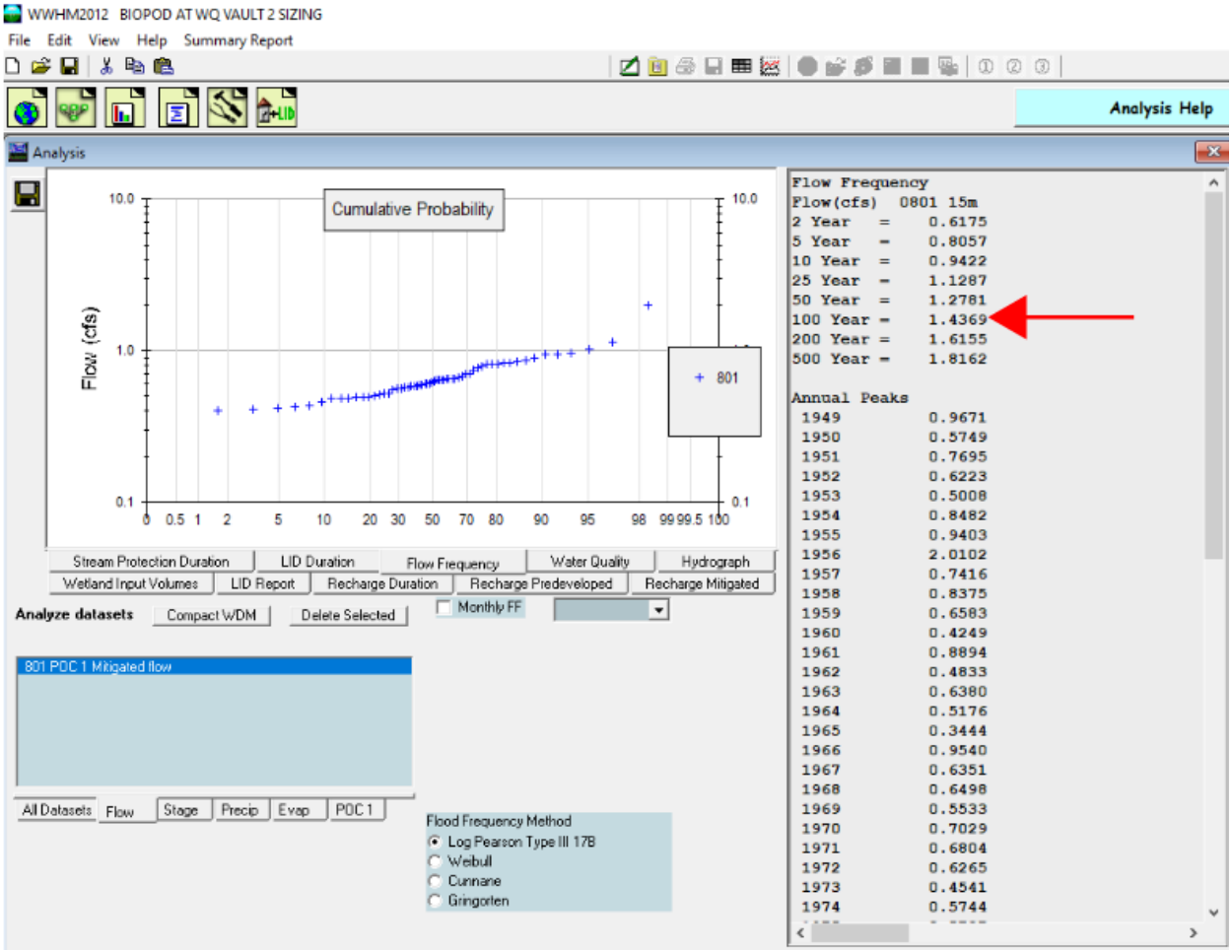


B. WATER QUALITY FLOW/EAST BASIN

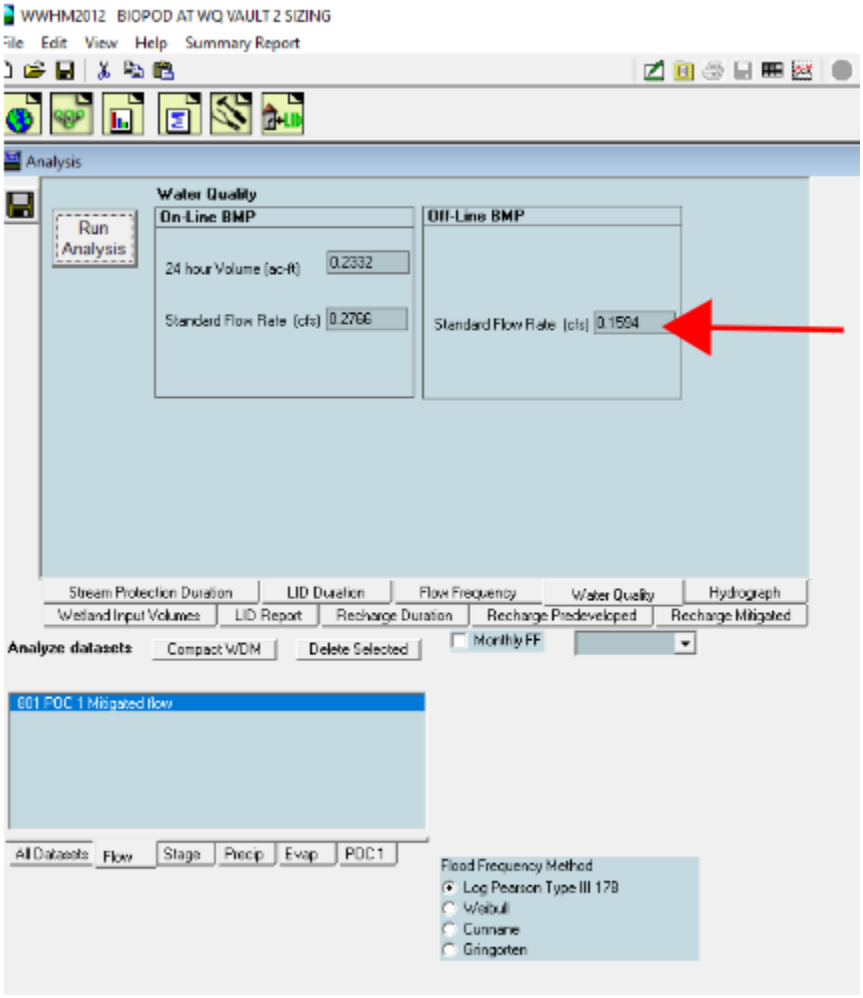
The pervious and impervious surface areas from the west basin were taken from the areas from Pages 9 & 10 and inputted here: 0.1565 Ac. Pasture (Amended Soils), 0.0626 Ac. Sidewalk, and 1.0498 Ac. Parking Flat


WWHM2012 BIOPOD AT WQ VAULT 2 SIZING
File Edit View Zoom Help
Schematic Help
Schematic
SCENARIOS
Predeveloped
Mitigated
Run Scenario
Basic Elements
Pro Elements
LID Toolbox
Commercial Toolbox
Move Elements
Save x,y
Load x,y
Name: Basin 1
Designate as Bypass for POC:
Surface
Interflow
Groundwater
Show Only Selected
Available Pervious
Acres
Available Impervious
ROADS/FLAT
ROADS/MOD
ROADS/STEEP
ROOFTOPS/FLAT
DRIVEWAYS/FLAT
DRIVEWAYS/MOD
DRIVEWAYS/STEEP
SIDEWALKS/FLAT
SIDEWALKS/MOD
SIDEWALKS/STEEP
PARKING/FLAT
PARKING/MOD
PARKING/STEEP
POND
Porous Pavement
C, Pasture, Steep
C, Lawn, Flat
C, Lawn, Mod
C, Lawn, Steep
SAT, Forest, Flat
SAT, Forest, Mod
SAT, Forest, Steep
Pervious Total 0.1585 Acres
Impervious Total 1.1124 Acres
Basin Total 1.2709 Acres
Deselect Zero
Select By:
GO

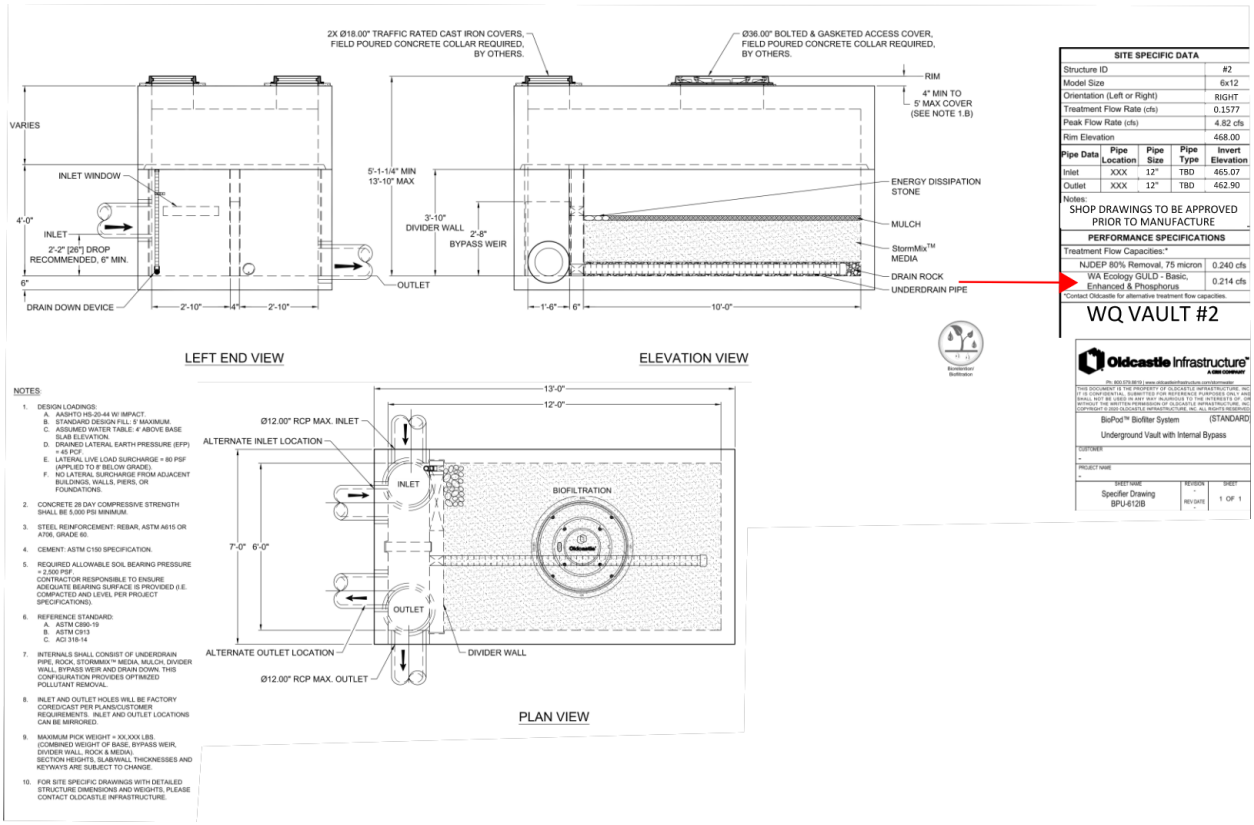
The 100-yr required vault bypass flow from the east basin was then determined 1.44 cfs:



And the off-line water quality treatment flow of 0.1594 cfs was found:



The Biopod Biofilter Underground vault has an internal bypass, so the off-line flow rate of 0.1594 cfs will be used to size the vault and cartridge configuration. Note that the internal bypass capacity of this vault is 4.82 cfs, greater than the 100-yr peak flow from the east basin of 1.44 cfs. Model BPU-612IB 6'x12' vault was found to meet this criteria with a treatment flow rate capacity of 0.214 cfs and is specified on the plans as WQ Vault #2.



C. *STORM SEWER PIPE DESIGN CALCULATIONS*

The Santa Barbara Urban Hydrograph method was used in the Autodesk Storm Analysis 2021 computer model to perform a backwater flow analysis and verify gravity-flow pipe capacities for the project for a 100-yr, 24 hour peak rainfall event of 6.5" on pages 28-43 .

WASTE

WQ VAULT #1 (8'x12' BioPod)
STA 102+68.09, -28.80 L
RIM=468.88
I.E.(IN 12")=458.81
I.E.(OUT 12")=456.65
W/SOLID LID (SEE DETAIL)

REMOVE EX. C.B. #1(T-2) & REPLACE W/ NEW C.B.(T-2(48"))
STA 103+17.53, -38.33 L
RIM=468.64
I.E.(IN 12")=456.07
I.E.(IN 12")=465.20
I.E.(OUT 12")=456.07
RE-USE BEEHIVE GRADE

EX. 34 L.F.~12" SCH. A @ S=1.00%

58 L.F.~12" SCH. A @ S=1.00%

11 L.F.~12" SCH. A @ S=1.00%

EX. C.B. #2 (T-2)
STA 103+18.65, -98.39 L
RIM=451.24
I.E.(IN 12")=449.40
I.E.(OUT 12")=449.40
W/SOLID LID

REMOVE EX. & REPLACE W/ 60 L.F.~12" SCH. A @ S=11.11%

EDGE OF CLEAN SOIL CAP

C.B. #6 (T-2(48"))
STA 102+75.93, 19.04 R
RIM=469.30
I.E.(IN 12")=463.38
I.E.(IN 12")=464.02
I.E.(OUT 12")=463.38
CATCHMENT AREA=9,952 S.F.

C.B. #26 (T-1)
STA 105+60.13, -19.00 L
RIM=472.60
I.E.(OUT 12")=470.10
W/STD. FRAME & GRATE
CATCHMENT AREA=3,043 S.F.

38 L.F.~12" SCH. A @ S=14.02%

C.B. #9 (T-1)
STA 109+54.38, -19.00 L
RIM=469.36
I.E.(OUT 12")=466.86
W/STD. FRAME & GRATE
CATCHMENT AREA=5,791 S.F.

51 L.F.~12" SCH. A @ S=0.50%

C.B. #4 (T-2)
STA 102+69.58, -17.99 L
RIM=469.23
I.E.(IN 12")=463.00
I.E.(IN 12")=458.92
I.E.(OUT 12")=458.92
W/STD. FRAME & GRATE
CATCHMENT AREA=6,608 S.F.

UNDERDRAIN PIPE SLOPES W/ THE SUBGRADE ELEVATION (20" BELOW FINISH GRADE) SEE SHEET C-5.4

C.B. #5 (T-2)
STA 105+60.13, 19.00 R
RIM=472.60
I.E.(IN 12")=464.77
I.E.(IN 12")=464.77
I.E.(OUT 12")=464.77
W/STD. FRAME & GRATE
CATCHMENT AREA=3,227 S.F.

C.B. #10 (T-1)
STA 109+21.01, 19.04 R
RIM=470.44
I.E.(IN 12")=466.61
I.E.(OUT 12")=466.61
W/STD. FRAME & GRATE
CATCHMENT AREA=4,697 S.F.

C.B. #24 (T-1)
STA 101+05.16, -19.00 L
RIM=462.44
I.E.(IN 12")=459.75
I.E.(OUT 12")=459.75
W/STD. FRAME & GRATE
CATCHMENT AREA=3,778 S.F.

165 L.F.~12" SCH. A @ S=0.50%

38 L.F.~12" SCH. A @ S=1.00%

42 L.F.~12" SCH. A @ S=3.94%

38 L.F.~12" SCH. A @ S=0.50%

5,453 sf

2,719 sf

874 sf

2,533 sf

1,549 sf

MOUNT JUPITER WAY

C.B. #23 (T-1)
STA 101+05.16, 19.04 R
RIM=462.44
I.E.(OUT 12")=459.94
W/STD. FRAME & GRATE
CATCHMENT AREA=8,824 S.F.

C.B. #1 (T-1)
STA 101+00.59, 80.86 R
RIM=471.60
I.E.(OUT 12")=468.50
W/STD. FRAME & GRATE
CATCHMENT AREA=5,644 S.F.

54 L.F.~12" SCH. A @ S=3.55%

99 L.F.~12" SCH. A @ S=1.00%

187 L.F.~12" SCH. A @ S=1.00%

183 L.F.~12" SCH. A @ S=0.50%

C.B. #25 (T-2)
STA 107+39.00, 19.04 R
RIM=473.79
I.E.(IN 12")=465.68
I.E.(OUT 12")=465.68
W/STD. FRAME & GRATE
CATCHMENT AREA=1,003 S.F.

185 L.F.~12" SCH. A @ S=0.50%

90 L.F.~12" SCH. A @ S=1.01%

CATCHMENT AREA BOUNDARY TO REGIONAL NORTH DETENTION POND

C.B. #3 (T-2(48"))
STA 102+38.76, 42.09 R
RIM=470.40
I.E.(IN 12")=465.69
I.E.(IN 12")=465.69
I.E.(OUT 12")=465.69
W/STD. FRAME & GRATE
CATCHMENT AREA=4,016 S.F.

C.B. #8 (T-1)
STA 103+53.45, 77.02 R
RIM=471.31
I.E.(IN 12")=466.68
I.E.(IN 4")=467.35
I.E.(OUT 12")=466.68
W/STD. FRAME & GRATE
CATCHMENT AREA=14,162 S.F.

NORSELAND CATCHMENT AREA BOUNDARY TO REGIONAL DETENTION POND

C.B. #7 (T-1)
STA 105+40.38, 74.45 R
RIM=471.55
I.E.(IN 4")=469.22
I.E.(OUT 12")=468.55
W/STD. FRAME & GRATE
CATCHMENT AREA=14,331 S.F.

C.B. #15 (T-1)
STA 106+58.09, 114.10 R
RIM=471.87
I.E.(IN 4")=469.54
I.E.(OUT 12")=468.87
W/STD. FRAME & GRATE
CATCHMENT AREA=11,358 S.F.

5,435 sf

UNDERDRAIN PIPE SLOPES W/ THE SUBGRADE ELEVATION (20" BELOW FINISH GRADE) SEE SHEET C-5.4

CATCHMENT AREA BOUNDARY TO REGIONAL NORTH DETENTION POND

115 L.F.~12" SCH. A @ S=1.00%

C.B. #16 (T-1)
STA 106+70.60, 228.42 R
RIM=471.87
I.E.(IN 12")=467.72
I.E.(IN 4")=468.39
I.E.(OUT 12")=467.72
W/STD. FRAME & GRATE
CATCHMENT AREA=4,348 S.F.

1,086 sf

54 L.F.~12" SCH. A @ S=3.32%

C.B. #2 (T-1)
STA 101+87.66, 58.20 R
RIM=471.62
I.E.(IN 12")=467.59
I.E.(OUT 12")=467.59
W/STD. FRAME & GRATE
CATCHMENT AREA=3,043 S.F.

C.B. #11 (T-1)
STA 100+67.38, 219.95 R
RIM=471.60
I.E.(OUT 12")=468.50
W/STD. FRAME & GRATE
CATCHMENT AREA=6,918 S.F.

C.B. #14 (T-1)
STA 106+66.44, 282.35 R
RIM=470.45
I.E.(IN 12")=465.93
I.E.(IN 12")=465.93
I.E.(IN 4")=466.59
I.E.(OUT 12")=465.93
W/STD. FRAME & GRATE
CATCHMENT AREA=8,635 S.F.

31 L.F.~12" SCH. A @ S=1.13%

WQ VAULT #2 (6'x12' BIOPOD)
STA 106+67.20, 313.83 R
RIM=468.00
I.E.(IN 12")=465.57
I.E.(OUT 12")=462.90
(SEE DETAIL)

173 L.F.~12" SCH. A @ S=0.50%

C.B. #12 (T-1)
STA 102+27.77, 283.94 R
RIM=471.27
I.E.(IN 12")=467.64
I.E.(IN 4")=468.30
I.E.(OUT 12")=467.64
W/STD. FRAME & GRATE
CATCHMENT AREA=14,557 S.F.

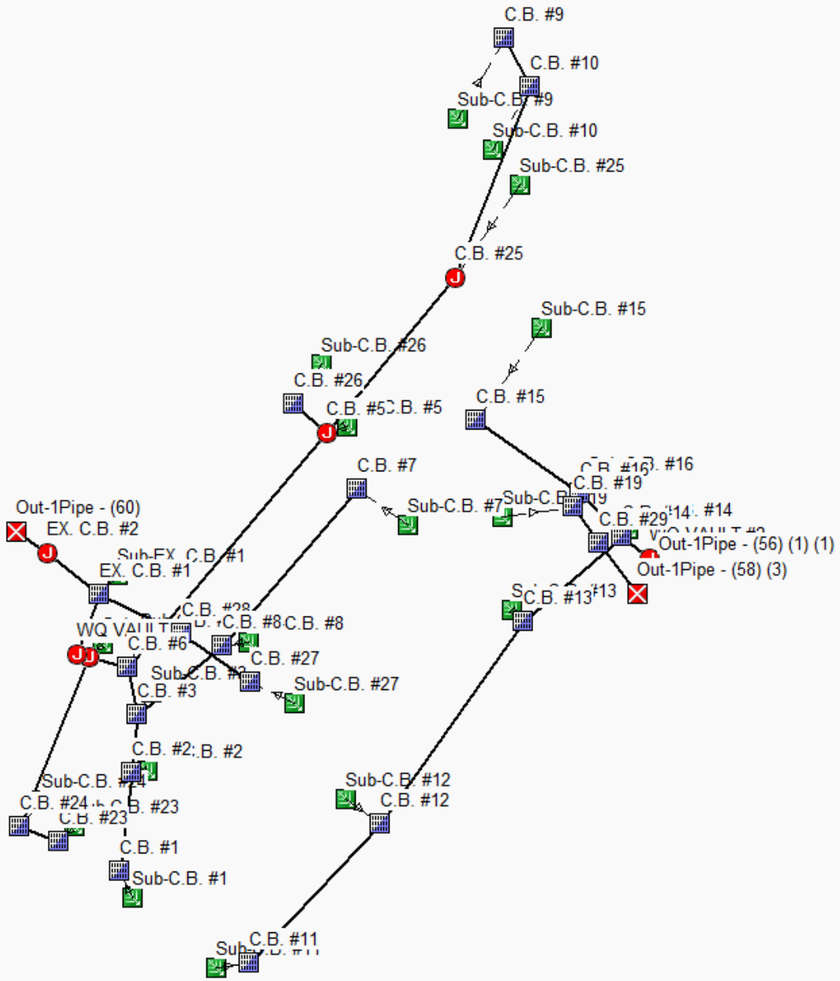
225 L.F.~12" SCH. A @ S=0.50%

C.B. #13 (T-1)
STA 105+50.39, 266.72 R
RIM=471.27
I.E.(IN 12")=466.51
I.E.(IN 4")=467.18
I.E.(OUT 12")=466.51
W/STD. FRAME & GRATE
CATCHMENT AREA=8,816 S.F.

117 L.F.~12" SCH. A @ S=0.50%

MW-1

WQ VAULT #1 (8'x12' BioPod)
STA 102+68.09, -28.80 L


C.B. #9
C.B. #10
Sub-C.B. #9
Sub-C.B. #10
Sub-C.B. #25
C.B. #25
Sub-C.B. #15
Sub-C.B. #26
C.B. #26
C.B. #5
C.B. #15
C.B. #7
Sub-C.B. #7
C.B. #19
Out-1Pipe - (60)
EX. C.B. #2
EX. C.B. #1
C.B. #29
Out-1Pipe - (56) (1) (1)
Out-1Pipe - (58) (3)
C.B. #13
C.B. #8
C.B. #6
C.B. #27
Sub-C.B. #27
C.B. #3
C.B. #2
Sub-C.B. #12
C.B. #12
C.B. #24
C.B. #23
C.B. #1
Sub-C.B. #1
C.B. #11

Project Description

File Name ..... INVENTECH BACKWATER ANALYSIS.SPF

Project Options

Flow Units ..... CFS
Elevation Type ..... Elevation
Hydrology Method ..... Santa Barbara UH
Time of Concentration (TOC) Method ..... User-Defined
Link Routing Method ..... Hydrodynamic
Enable Overflow Ponding at Nodes ..... NO
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On	Apr 04, 2022	00:00:00
End Analysis On	Apr 05, 2022	00:00:00
Start Reporting On	Apr 04, 2022	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	23
Nodes.....	31
Junctions	6
Outfalls	3
Flow Diversions	0
Inlets	22
Storage Nodes	0
Links.....	28
Channels	0
Pipes	28
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	TS-01	Cumulative	inches	Washington	Kitsap	100	6.50	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Impervious Area	Impervious Area Curve Number	Pervious Area Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)	(%)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-C.B. #1	0.13	100.00	98.00	76.00	6.49	6.24	0.81	0.20	0 00:06:00
2	Sub-C.B. #10	0.11	100.00	98.00	76.00	6.49	6.24	0.69	0.17	0 00:06:00
3	Sub-C.B. #11	0.16	100.00	98.00	76.00	6.49	6.24	0.99	0.24	0 00:06:00
4	Sub-C.B. #12	0.33	100.00	98.00	76.00	6.49	6.24	2.09	0.51	0 00:06:00
5	Sub-C.B. #13	0.20	100.00	98.00	76.00	6.49	6.24	1.26	0.31	0 00:06:00
6	Sub-C.B. #14	0.20	100.00	98.00	76.00	6.49	6.24	1.24	0.30	0 00:06:00
7	Sub-C.B. #15	0.26	52.00	98.00	85.00	6.49	5.53	1.44	0.36	0 00:06:00
8	Sub-C.B. #16	0.10	75.00	98.00	85.00	6.49	5.87	0.59	0.14	0 00:06:00
9	Sub-C.B. #19	0.67	100.00	98.00	76.00	6.49	6.24	4.19	1.02	0 00:06:00
10	Sub-C.B. #2	0.20	100.00	98.00	76.00	6.49	6.24	1.26	0.31	0 00:06:00
11	Sub-C.B. #23	0.20	79.00	98.00	85.00	6.49	5.93	1.20	0.30	0 00:06:00
12	Sub-C.B. #24	0.09	100.00	98.00	76.00	6.49	6.24	0.54	0.13	0 00:06:00
13	Sub-C.B. #25	0.02	100.00	98.00	76.00	6.49	6.24	0.14	0.04	0 00:06:00
14	Sub-C.B. #26	0.07	100.00	98.00	76.00	6.49	6.24	0.44	0.11	0 00:06:00
15	Sub-C.B. #27	0.67	100.00	98.00	76.00	6.49	6.24	4.19	1.02	0 00:06:00
16	Sub-C.B. #3	0.09	100.00	98.00	76.00	6.49	6.24	0.58	0.14	0 00:06:00
17	Sub-C.B. #4	0.15	100.00	98.00	76.00	6.49	6.24	0.95	0.23	0 00:06:00
18	Sub-C.B. #5	0.07	100.00	98.00	76.00	6.49	6.24	0.44	0.11	0 00:06:00
19	Sub-C.B. #6	0.23	73.00	98.00	85.00	6.49	5.84	1.33	0.33	0 00:06:00
20	Sub-C.B. #7	0.33	89.00	98.00	85.00	6.49	6.08	2.00	0.49	0 00:06:00
21	Sub-C.B. #8	0.33	94.00	98.00	85.00	6.49	6.15	2.00	0.49	0 00:06:00
22	Sub-C.B. #9	0.13	100.00	98.00	76.00	6.49	6.24	0.83	0.20	0 00:06:00
23	Sub-EX. C.B. #1	0.13	0.00	98.00	85.00	6.49	4.76	0.62	0.16	0 00:06:00

Node Summary

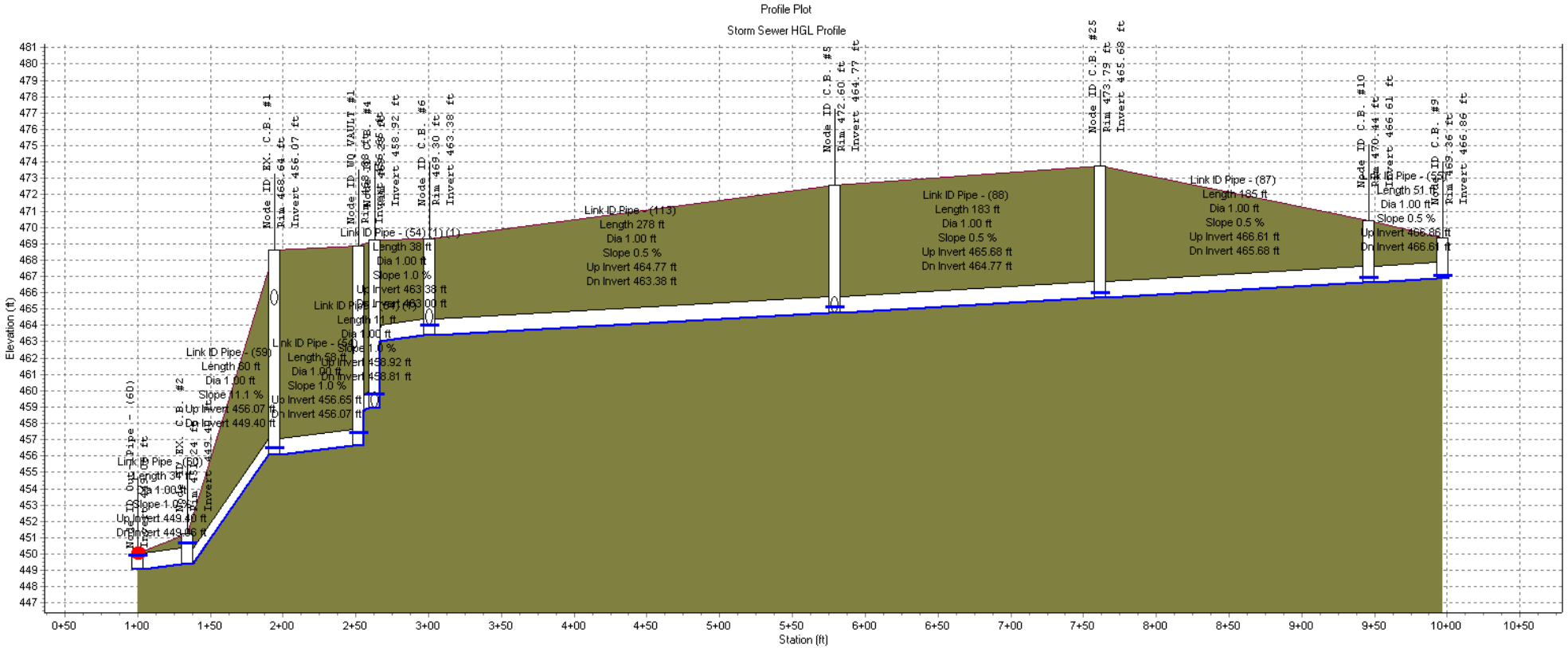
SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	C.B. #25	Junction	465.68	473.79	465.68	473.79	0.00	0.40	465.94	0.00	7.85	0 00:00	0.00	0.00
2	C.B. #4	Junction	458.92	469.23	458.92	469.23	0.00	2.59	459.75	0.00	9.48	0 00:00	0.00	0.00
3	C.B. #5	Junction	464.77	472.60	464.77	472.60	0.00	0.62	465.09	0.00	7.51	0 00:00	0.00	0.00
4	EX. C.B. #2	Junction	449.40	451.24	449.40	451.24	0.00	3.77	450.62	0.00	0.62	0 00:00	0.00	0.00
5	WQ VAULT #1	Junction	456.65	468.88	456.65	468.88	0.00	2.59	457.37	0.00	11.51	0 00:00	0.00	0.00
6	WQ VAULT #2	Junction	462.90	468.00	462.90	468.00	0.00	1.86	463.31	0.00	4.69	0 00:00	0.00	0.00
7	Out-1Pipe - (56) (1) (1)	Outfall	462.00					1.86	462.29					
8	Out-1Pipe - (58) (3)	Outfall	462.00					1.02	462.25					
9	Out-1Pipe - (60)	Outfall	449.06					3.77	449.86					

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Pipe - (113)	Pipe	C.B. #5	C.B. #6	278.38	464.77	463.38	0.5000	12.000	0.0120	0.62	2.73	0.23	1.72	0.47	0.47	0.00	Calculated
2	Pipe - (44)	Pipe	C.B. #1	C.B. #2	89.97	468.50	467.59	1.0100	12.000	0.0120	0.20	3.88	0.05	2.30	0.17	0.17	0.00	Calculated
3	Pipe - (45)	Pipe	C.B. #2	C.B. #3	53.58	467.59	465.69	3.5500	12.000	0.0120	0.51	7.27	0.07	3.81	0.23	0.23	0.00	Calculated
4	Pipe - (46)	Pipe	C.B. #8	C.B. #3	99.29	466.68	465.69	1.0000	12.000	0.0120	0.49	3.85	0.13	3.00	0.26	0.26	0.00	Calculated
5	Pipe - (47)	Pipe	C.B. #7	C.B. #8	186.95	468.55	466.68	1.0000	12.000	0.0120	0.49	3.86	0.13	3.24	0.25	0.25	0.00	Calculated
6	Pipe - (48)	Pipe	C.B. #3	C.B. #6	42.39	465.69	464.02	3.9400	12.000	0.0120	0.99	7.66	0.13	6.19	0.26	0.26	0.00	Calculated
7	Pipe - (49)	Pipe	C.B. #11	C.B. #12	172.69	468.50	467.64	0.5000	12.000	0.0120	0.24	2.72	0.09	1.35	0.28	0.28	0.00	Calculated
8	Pipe - (50)	Pipe	C.B. #12	C.B. #13	224.97	467.64	466.51	0.5000	12.000	0.0120	0.75	2.74	0.27	2.55	0.40	0.40	0.00	Calculated
9	Pipe - (51)	Pipe	C.B. #13	C.B. #14	117.10	466.51	465.93	0.5000	12.000	0.0120	1.06	2.72	0.39	2.60	0.51	0.51	0.00	Calculated
10	Pipe - (53)	Pipe	C.B. #16	C.B. #14	54.09	467.72	465.93	3.3100	12.000	0.0120	0.50	7.02	0.07	1.82	0.38	0.38	0.00	Calculated
11	Pipe - (54)	Pipe	WQ VAULT #1	EX. C.B. #1	57.81	456.65	456.07	1.0000	12.000	0.0120	2.59	3.87	0.67	5.88	0.55	0.55	0.00	Calculated
12	Pipe - (54) (1)	Pipe	C.B. #4	WQ VAULT #1	10.93	458.92	458.81	1.0100	12.000	0.0120	2.59	3.87	0.67	4.30	0.72	0.72	0.00	Calculated
13	Pipe - (54) (1) (1)	Pipe	C.B. #6	C.B. #4	37.56	463.38	463.00	1.0100	12.000	0.0120	1.93	3.88	0.50	4.33	0.55	0.55	0.00	Calculated
14	Pipe - (55)	Pipe	C.B. #9	C.B. #10	50.60	466.86	466.61	0.4900	12.000	0.0120	0.20	2.71	0.07	1.59	0.22	0.22	0.00	Calculated
15	Pipe - (56)	Pipe	C.B. #14	WQ VAULT #2	31.49	465.93	465.57	1.1400	12.000	0.0120	1.86	4.13	0.45	4.42	0.53	0.53	0.00	Calculated
16	Pipe - (56) (1) (1)	Pipe	WQ VAULT #2	Out-1Pipe - (56) (1) (1)	12.41	462.90	462.00	7.2500	12.000	0.0120	1.86	10.40	0.18	7.56	0.35	0.35	0.00	Calculated
17	Pipe - (58)	Pipe	C.B. #19	C.B. #29	40.16	467.40	465.19	5.5000	12.000	0.0120	1.02	9.05	0.11	7.03	0.24	0.24	0.00	Calculated
18	Pipe - (58) (3)	Pipe	C.B. #29	Out-1Pipe - (58) (3)	57.79	464.31	462.00	4.0000	12.000	0.0120	1.02	7.72	0.13	6.40	0.26	0.26	0.00	Calculated
19	Pipe - (59)	Pipe	EX. C.B. #1	EX. C.B. #2	60.07	456.07	449.40	11.1000	12.000	0.0120	3.77	12.86	0.29	6.57	0.69	0.69	0.00	Calculated
20	Pipe - (60)	Pipe	EX. C.B. #2	Out-1Pipe - (60)	34.30	449.40	449.06	0.9900	12.000	0.0120	3.77	3.84	0.98	5.05	0.90	0.90	0.00	Calculated
21	Pipe - (61)	Pipe	C.B. #15	C.B. #16	115.00	468.87	467.72	1.0000	12.000	0.0120	0.36	3.86	0.09	3.21	0.20	0.20	0.00	Calculated
22	Pipe - (84)	Pipe	C.B. #24	C.B. #4	165.11	459.75	458.92	0.5000	12.000	0.0120	0.43	2.74	0.16	0.98	0.55	0.55	0.00	Calculated
23	Pipe - (85)	Pipe	C.B. #23	C.B. #24	38.04	459.94	459.75	0.5000	12.000	0.0120	0.29	2.73	0.11	1.87	0.25	0.25	0.00	Calculated
24	Pipe - (86)	Pipe	C.B. #26	C.B. #5	38.00	470.10	464.77	14.0300	12.000	0.0120	0.11	14.46	0.01	1.04	0.19	0.19	0.00	Calculated
25	Pipe - (87)	Pipe	C.B. #10	C.B. #25	184.70	466.61	465.68	0.5000	12.000	0.0120	0.37	2.74	0.13	2.32	0.26	0.26	0.00	Calculated
26	Pipe - (88)	Pipe	C.B. #25	C.B. #5	182.58	465.68	464.77	0.5000	12.000	0.0120	0.40	2.72	0.15	2.12	0.29	0.29	0.00	Calculated
27	Pipe - (89)	Pipe	C.B. #27	C.B. #28	76.35	468.56	468.18	0.5000	12.000	0.0120	1.02	2.72	0.38	3.91	0.37	0.37	0.00	Calculated
28	Pipe - (90)	Pipe	C.B. #28	EX. C.B. #1	82.90	468.18	465.20	3.5900	12.000	0.0120	1.02	7.32	0.14	6.27	0.26	0.26	0.00	Calculated

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Pipe - (113)	0.62	0 07:58	2.73	0.23	1.72	2.70	0.47	0.47	0.00		Calculated
2	Pipe - (44)	0.20	0 07:54	3.88	0.05	2.30	0.65	0.17	0.17	0.00		Calculated
3	Pipe - (45)	0.51	0 07:54	7.27	0.07	3.81	0.23	0.23	0.23	0.00		Calculated
4	Pipe - (46)	0.49	0 07:56	3.85	0.13	3.00	0.55	0.26	0.26	0.00		Calculated
5	Pipe - (47)	0.49	0 07:55	3.86	0.13	3.24	0.96	0.25	0.25	0.00		Calculated
6	Pipe - (48)	0.99	0 07:56	7.66	0.13	6.19	0.11	0.26	0.26	0.00		Calculated
7	Pipe - (49)	0.24	0 07:55	2.72	0.09	1.35	2.13	0.28	0.28	0.00		Calculated
8	Pipe - (50)	0.75	0 07:56	2.74	0.27	2.55	1.47	0.40	0.40	0.00		Calculated
9	Pipe - (51)	1.06	0 07:57	2.72	0.39	2.60	0.75	0.51	0.51	0.00		Calculated
10	Pipe - (53)	0.50	0 08:00	7.02	0.07	1.82	0.50	0.38	0.38	0.00		Calculated
11	Pipe - (54)	2.59	0 07:58	3.87	0.67	5.88	0.16	0.55	0.55	0.00		Calculated
12	Pipe - (54) (1)	2.59	0 07:58	3.87	0.67	4.30	0.04	0.72	0.72	0.00		Calculated
13	Pipe - (54) (1) (1)	1.93	0 07:58	3.88	0.50	4.33	0.14	0.55	0.55	0.00		Calculated
14	Pipe - (55)	0.20	0 07:54	2.71	0.07	1.59	0.53	0.22	0.22	0.00		Calculated
15	Pipe - (56)	1.86	0 07:57	4.13	0.45	4.42	0.12	0.53	0.53	0.00		Calculated
16	Pipe - (56) (1) (1)	1.86	0 07:57	10.40	0.18	7.56	0.03	0.35	0.35	0.00		Calculated
17	Pipe - (58)	1.02	0 07:54	9.05	0.11	7.03	0.10	0.24	0.24	0.00		Calculated
18	Pipe - (58) (3)	1.02	0 07:54	7.72	0.13	6.40	0.15	0.26	0.26	0.00		Calculated
19	Pipe - (59)	3.77	0 07:58	12.86	0.29	6.57	0.15	0.69	0.69	0.00		Calculated
20	Pipe - (60)	3.77	0 07:58	3.84	0.98	5.05	0.11	0.90	0.90	0.00		Calculated
21	Pipe - (61)	0.36	0 08:00	3.86	0.09	3.21	0.60	0.20	0.20	0.00		Calculated
22	Pipe - (84)	0.43	0 07:55	2.74	0.16	0.98	2.81	0.55	0.55	0.00		Calculated
23	Pipe - (85)	0.29	0 07:54	2.73	0.11	1.87	0.34	0.25	0.25	0.00		Calculated
24	Pipe - (86)	0.11	0 07:54	14.46	0.01	1.04	0.61	0.19	0.19	0.00		Calculated
25	Pipe - (87)	0.37	0 07:55	2.74	0.13	2.32	1.33	0.26	0.26	0.00		Calculated
26	Pipe - (88)	0.40	0 07:57	2.72	0.15	2.12	1.44	0.29	0.29	0.00		Calculated
27	Pipe - (89)	1.02	0 07:54	2.72	0.38	3.91	0.33	0.37	0.37	0.00		Calculated
28	Pipe - (90)	1.02	0 07:54	7.32	0.14	6.27	0.22	0.26	0.26	0.00		Calculated

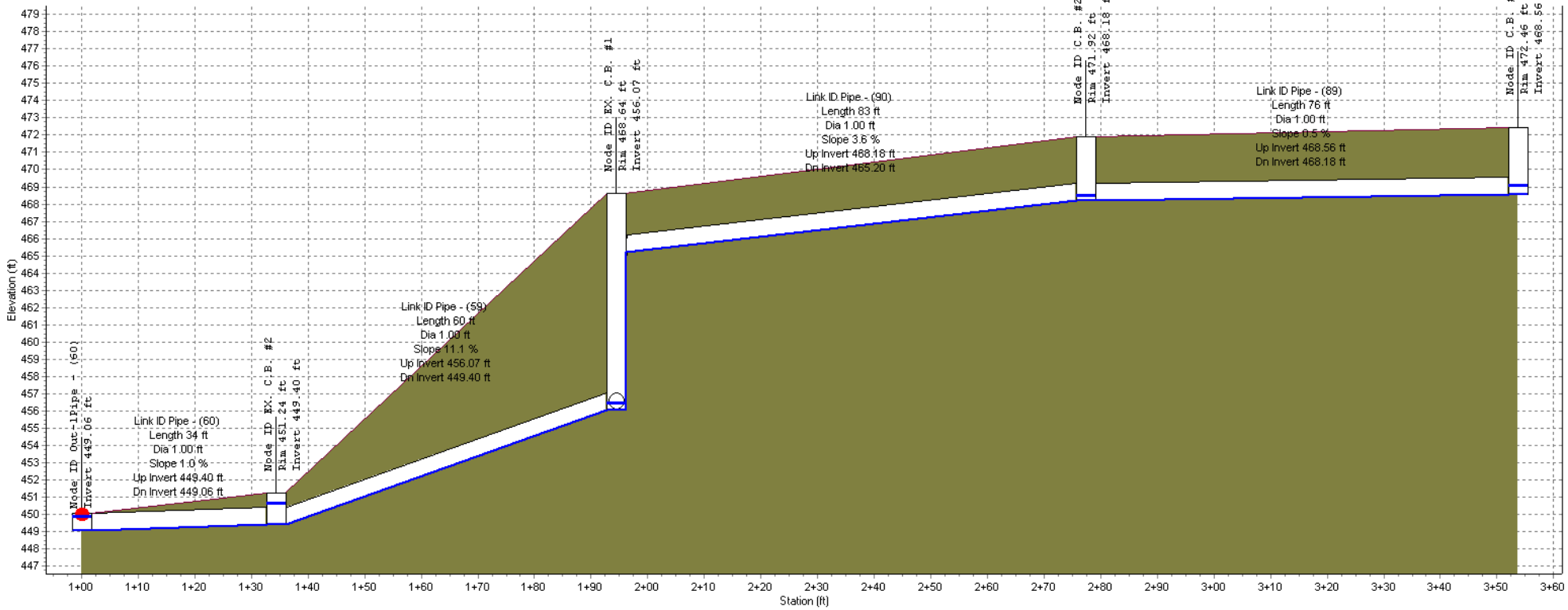


Node ID:	Out-1Pipe - (60)	EX. C.B. #2	EX. C.B. #1	WQ VAULT #1	C.B. #6	C.B. #5	C.B. #25	C.B. #10	C.B. #9
Rim (ft):		451.24	468.64	468.23	469.30	472.60	473.79	470.44	469.36
Invert (ft):	449.06	449.40	456.07	458.92	463.38	464.77	465.68	466.61	466.86
Min Pipe Cover (ft):		0.84		9.05.23		6.83	7.11		
Max HGL (ft):	449.86	450.62	456.44	457.52.75	463.99	465.09	465.94	466.86	467.04

Link ID:	Pipe - (60)	Pipe - (59)	Pipe - (58)	Pipe - (54)	Pipe - (54) (1) (1)	Pipe - (113)	Pipe - (88)	Pipe - (87)	Pipe - (55)
Length (ft):	34	60	58	11	38	278	183	185	51
Dia (ft):	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Slope (%):	1.0	11.1	1.0	1.0	1.0	0.5	0.5	0.5	0.5
Up Invert (ft):	449.40	456.07	456.65	458.92	463.38	464.77	465.68	466.61	466.86
Dn Invert (ft):	449.06	449.40	456.07	458.81	463.00	463.38	464.77	465.68	466.61
Max Q (cfs):	3.77	3.77	2.59	2.59	1.93	0.62	0.40	0.37	0.20
Max Vel (ft/s):	5.05	6.57	5.88	4.30	4.33	1.72	2.12	2.32	1.59
Max Depth (ft):	0.90	0.69	0.55	0.72	0.55	0.47	0.29	0.26	0.22

Profile Plot

Storm Sewer HGL Profile

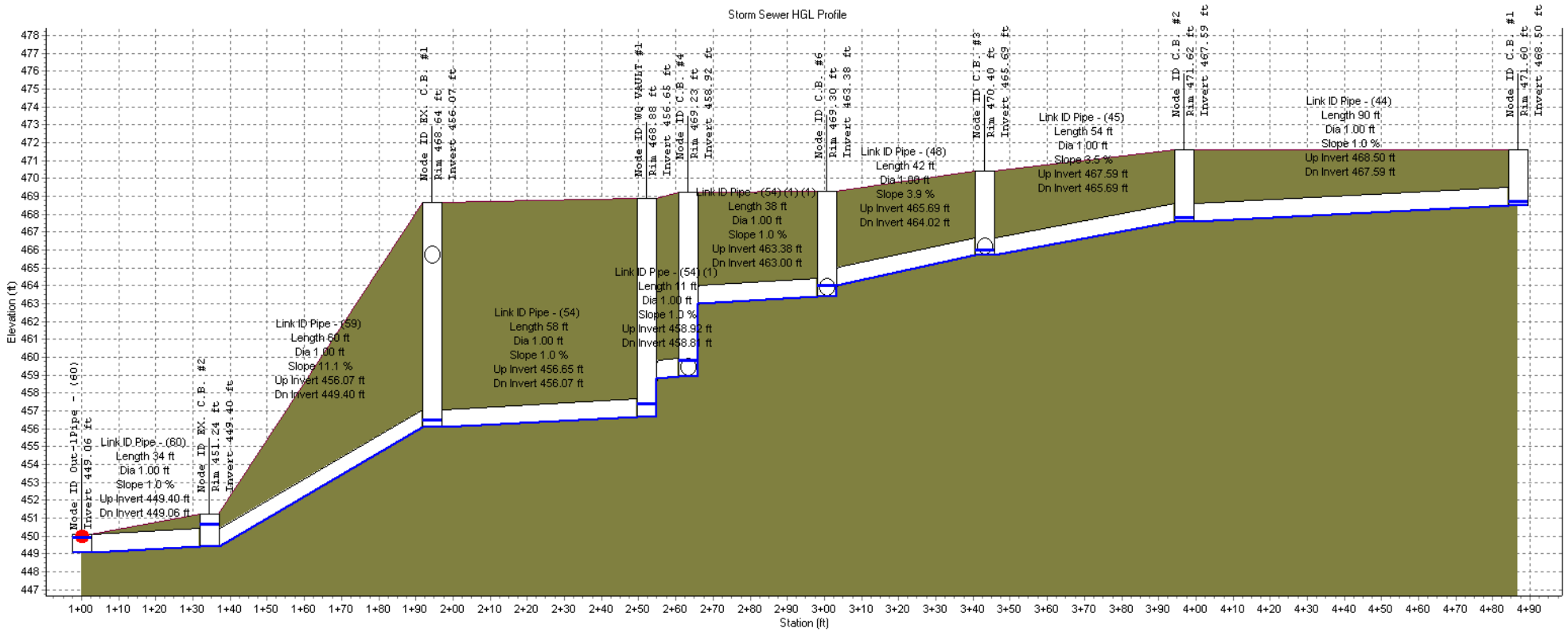


Node ID:		EX. C.B. #2	EX. C.B. #1	C.B. #28	C.B. #27
Rim (ft):		451.24	468.64	471.92	472.46
Invert (ft):	449.06	449.40	456.07	468.18	468.56
Min Pipe Cover (ft):		0.84			
Max HGL (ft):	449.86	450.62	456.44	468.45	469.02

Link ID:	Pipe - (60)	Pipe - (59)	Pipe - (90)	Pipe - (89)
Length (ft):	34	60	83	76
Dia (ft):	1.00	1.00	1.00	1.00
Slope (%):	1.0	11.1	3.6	0.5
Up Invert (ft):	449.40	456.07	468.18	468.56
Dn Invert (ft):	449.06	449.40	465.20	468.18
Max Q (cfs):	3.77	3.77	1.02	1.02
Max Vel (ft/s):	5.05	6.57	6.27	3.91
Max Depth (ft):	0.90	0.69	0.26	0.37

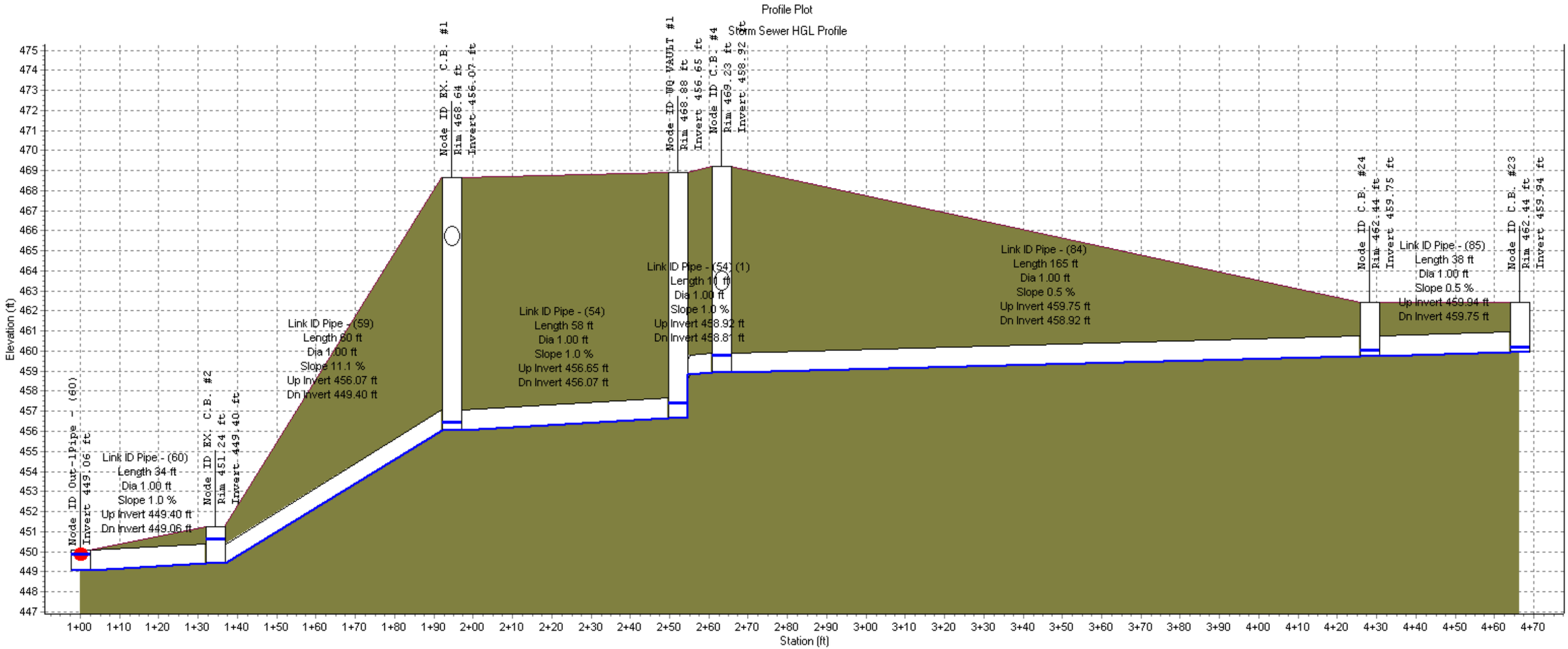
Profile Plot

Storm Sewer HGL Profile



Node ID:		EX. C.B. #2	EX. C.B. #1	WQ VAULT #1	C.B. #4	C.B. #6	C.B. #3	C.B. #2	C.B. #1
Rim (ft):		451.24	468.64	468.88	469.23	469.30	470.40	471.62	471.60
Invert (ft):	449.06	449.40	456.07	456.65	458.92	463.38	465.69	467.59	468.50
Min Pipe Cover (ft):		0.84		9.07	5.23				
Max HGL (ft):	449.86	450.62	456.44	457.37	459.75	463.99	465.96	467.77	468.65

Link ID:	Pipe - (60)	Pipe - (59)	Pipe - (54)	Pipe - (54) (1)	Pipe - (54) (1) (1)	Pipe - (48)	Pipe - (45)	Pipe - (44)
Length (ft):	34	60	58	11	38	42	54	90
Dia (ft):	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Slope (%):	1.0	11.1	1.0	1.0	1.0	3.9	3.5	1.0
Up Invert (ft):	449.40	456.07	456.65	458.92	463.38	465.69	467.59	468.50
Dn Invert (ft):	449.06	449.40	456.07	458.81	463.00	464.02	465.69	467.59
Max Q (cfs):	3.77	3.77	2.59	2.59	1.93	0.99	0.51	0.20
Max Vel (ft/s):	5.05	6.57	5.88	4.30	4.33	6.19	3.81	2.30
Max Depth (ft):	0.90	0.69	0.55	0.72	0.55	0.26	0.23	0.17

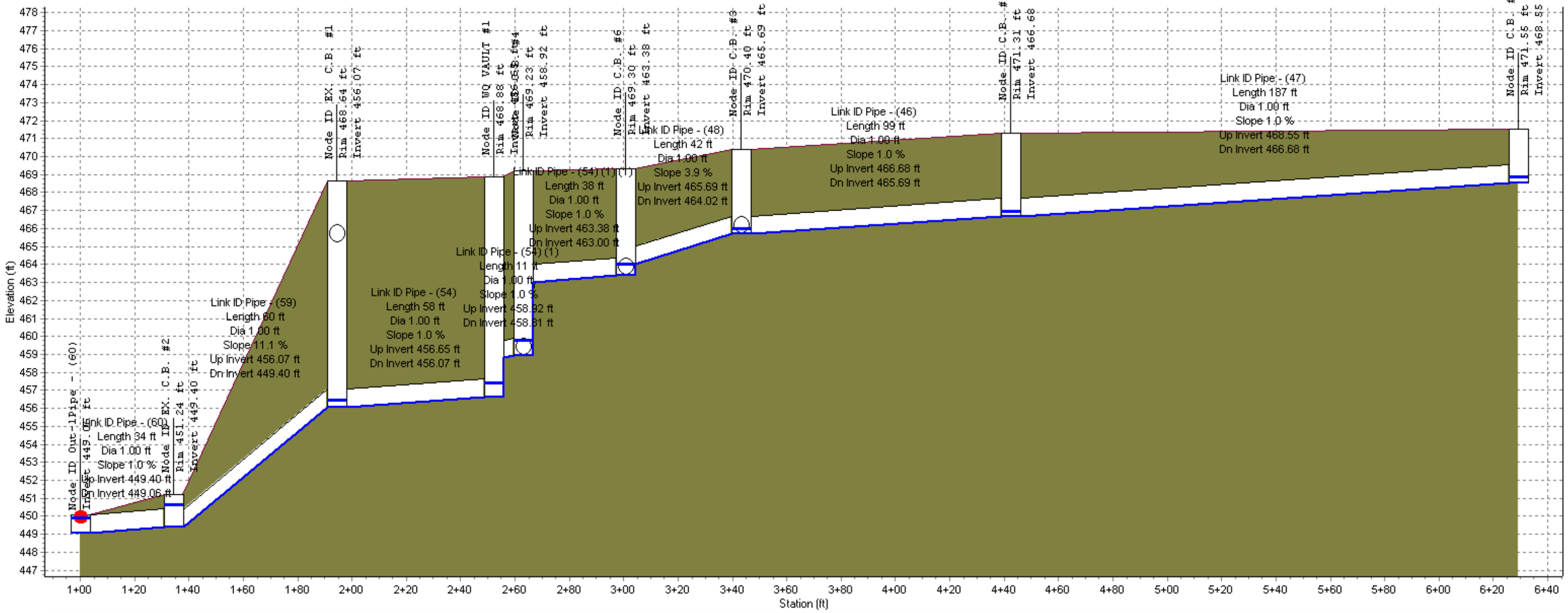


Node ID:		EX. C.B. #2	EX. C.B. #1	WQ VAULT #1	C.B. #4	C.B. #24	C.B. #23
Rim (ft):		451.24	468.64	468.88	469.23	462.44	462.44
Invert (ft):	449.06	449.40	456.07	456.65	458.92	459.75	459.94
Min Pipe Cover (ft):		0.84		9.07	5.23		
Max HGL (ft):	449.86	450.62	456.44	457.37	459.75	460.02	460.18

Link ID:	Pipe - (60)	Pipe - (59)	Pipe - (54)	Pipe - (54) (1)	Pipe - (84)	Pipe - (85)
Length (ft):	34	60	58	11	165	38
Dia (ft):	1.00	1.00	1.00	1.00	1.00	1.00
Slope (%):	1.0	11.1	1.0	1.0	0.5	0.5
Up Invert (ft):	449.40	456.07	456.65	458.92	459.75	459.94
Dn Invert (ft):	449.06	449.40	456.07	458.81	458.92	459.75
Max Q (cfs):	3.77	3.77	2.59	2.59	0.43	0.29
Max Vel (ft/s):	5.05	6.57	5.88	4.30	0.98	1.87
Max Depth (ft):	0.90	0.69	0.55	0.72	0.55	0.25

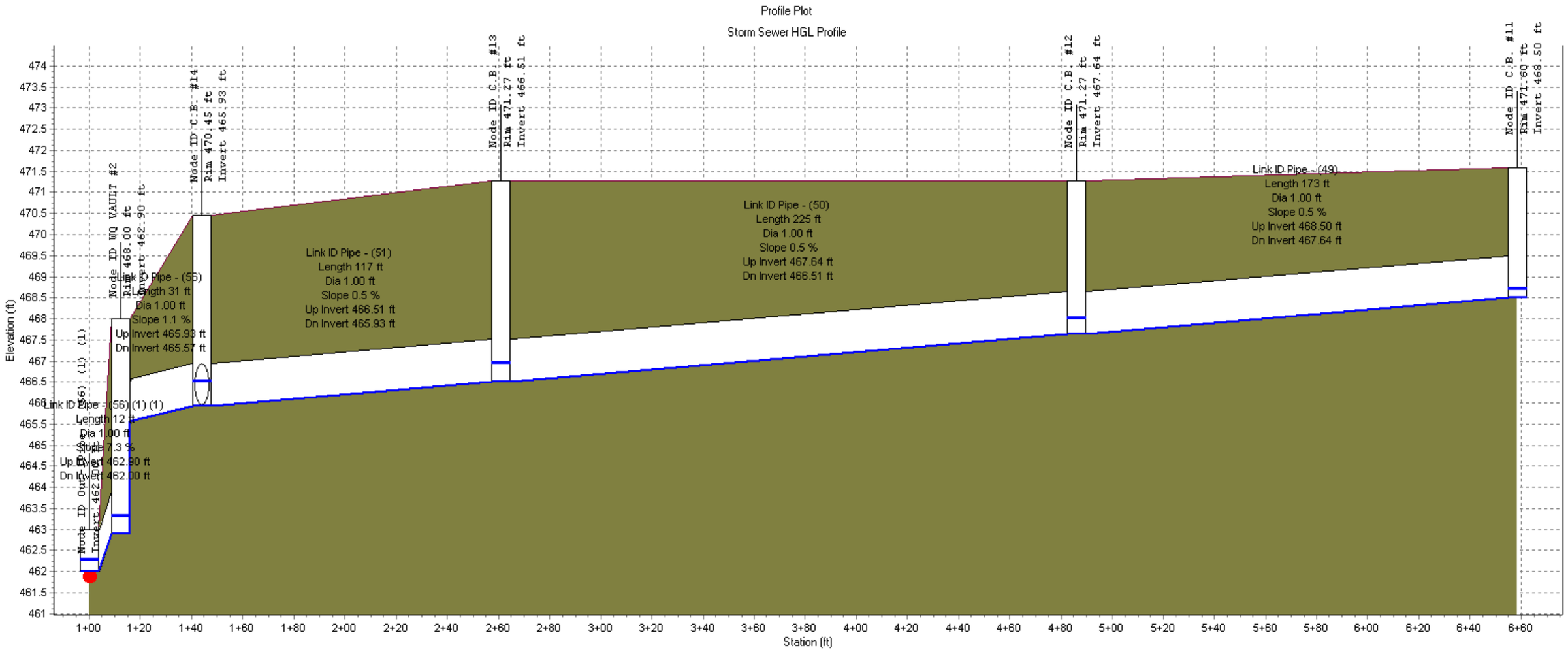
Profile Plot

Storm Sewer HGL Profile



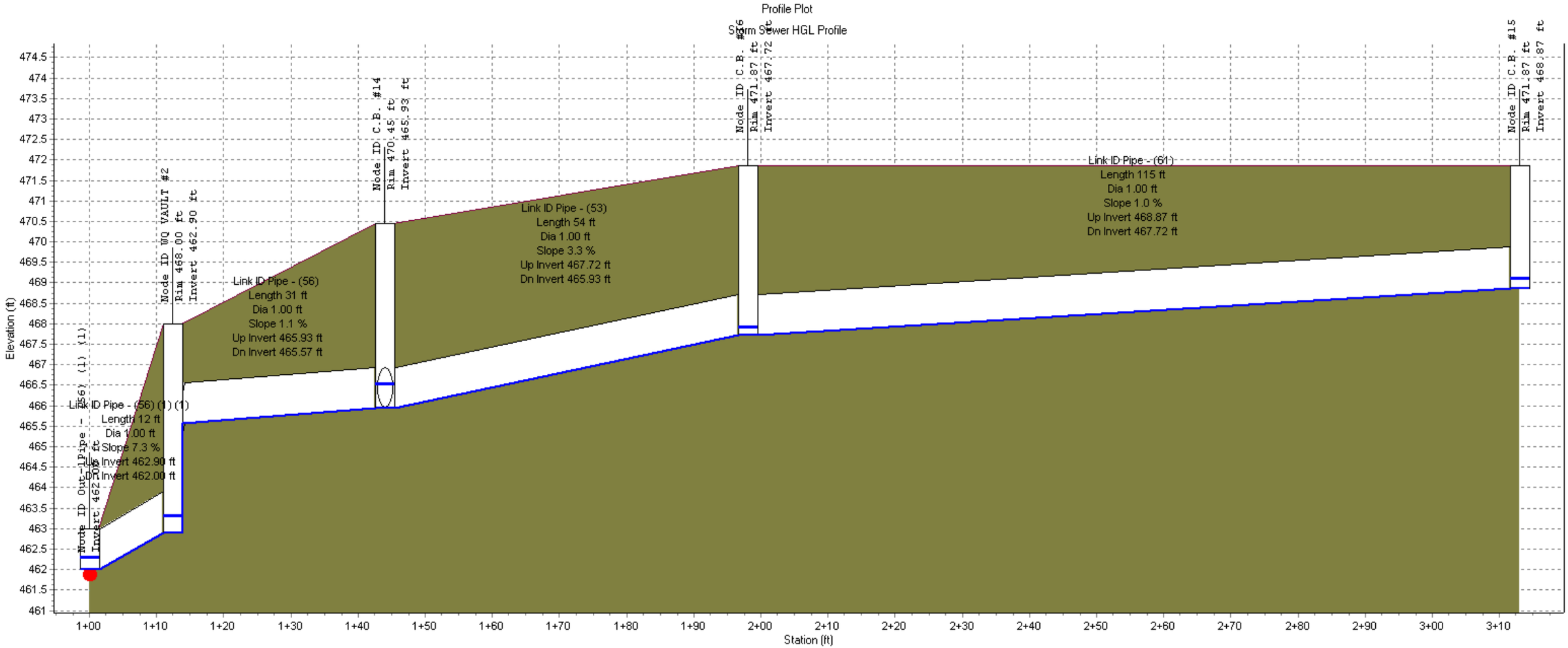
Node ID:		EX. C.B. #2	EX. C.B. #1	WQ VAULT #1	C.B. #4	C.B. #6	C.B. #3	C.B. #8	C.B. #7
Rim (ft):		451.24	468.64	468.88	469.23	469.30	470.40	471.31	471.55
Invert (ft):	449.06	449.40	456.07	456.65	458.92	463.38	465.69	466.68	468.55
Min Pipe Cover (ft):		0.84		9.07	5.23				
Max HGL (ft):	449.86	450.62	456.44	457.37	459.75	463.99	465.96	466.93	468.80

Link ID:	Pipe - (60)	Pipe - (59)	Pipe - (54)	Pipe - (54) (1)	Pipe - (54) (1) (1)	Pipe - (48)	Pipe - (46)	Pipe - (47)
Length (ft):	34	60	58	11	38	42	99	187
Dia (ft):	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Slope (%):	1.0	11.1	1.0	1.0	1.0	3.9	1.0	1.0
Up Invert (ft):	449.40	456.07	456.65	458.92	463.38	465.69	466.68	468.55
Dn Invert (ft):	449.06	449.40	456.07	458.81	463.00	464.02	465.69	466.68
Max Q (cfs):	3.77	3.77	2.59	2.59	1.93	0.99	0.49	0.49
Max Vel (ft/s):	5.05	6.57	5.88	4.30	4.33	6.19	3.00	3.24
Max Depth (ft):	0.90	0.69	0.55	0.72	0.55	0.26	0.26	0.25



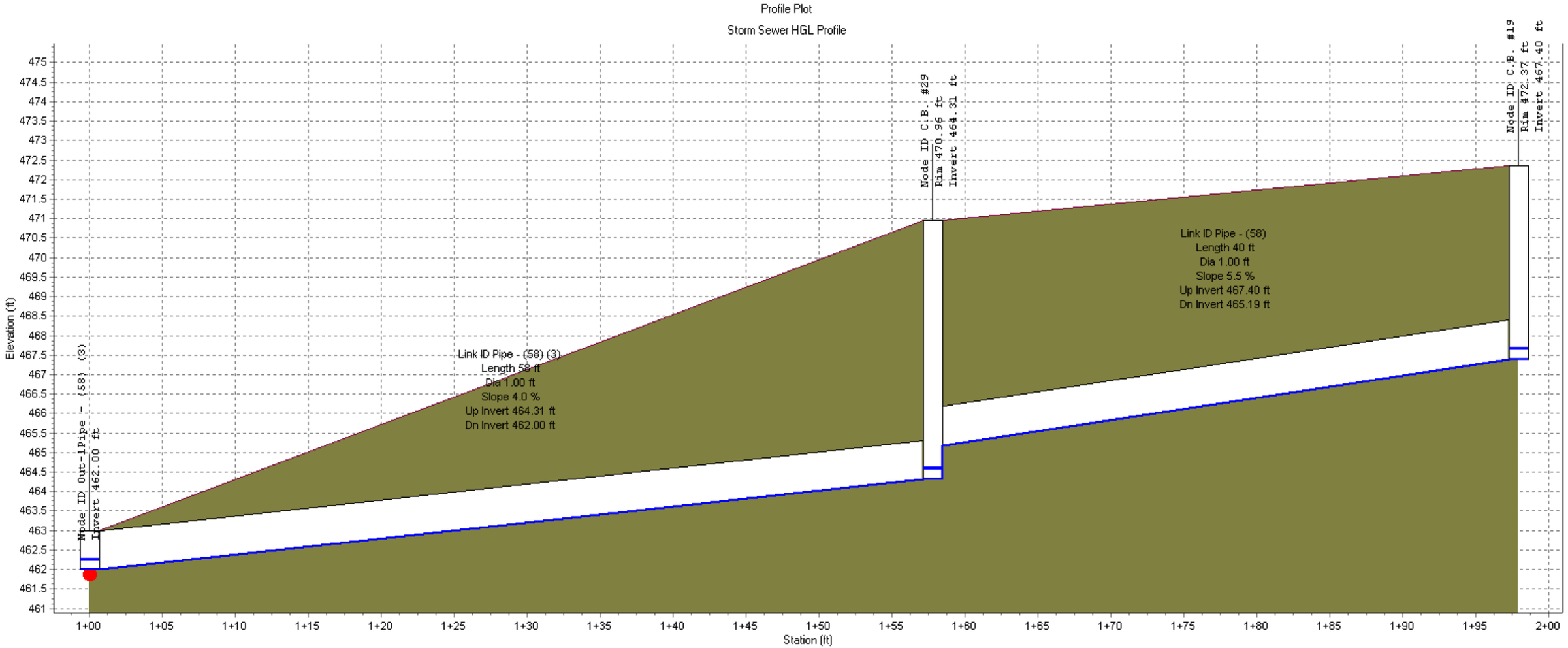
Node ID:	WQ VAULT #2	C.B. #14	C.B. #13	C.B. #12	C.B. #11
Rim (ft):	468.00	470.45	471.27	471.27	471.60
Invert (ft):	462.00 462.90	465.93	466.51	467.64	468.50
Min Pipe Cover (ft):	1.43				
Max HGL (ft):	462.29 463.31	466.51	466.95	468.00	468.70

Link ID:	Pipe - (56) (1) (1)	Pipe - (56)	Pipe - (51)	Pipe - (50)	Pipe - (49)	
Length (ft):	12	31	117	225	173	
Dia (ft):	1.00	1.00	1.00	1.00	1.00	
Slope (%):	7.3	1.1	0.5	0.5	0.5	
Up Invert (ft):	462.90	465.93	466.51	467.64	468.50	
Dn Invert (ft):	462.00	465.57	465.93	466.51	467.64	
Max Q (cfs):	1.86	1.86	1.06	0.75	0.24	
Max Vel (ft/s):	7.56	4.42	2.60	2.55	1.35	
Max Depth (ft):	0.35	0.53	0.51	0.40	0.28	



Node ID:		WQ VAULT #2	C.B. #14	C.B. #16	C.B. #15
Rim (ft):		468.00	470.45	471.87	471.87
Invert (ft):	462.00	462.90	465.93	467.72	468.87
Min Pipe Cover (ft):		1.43			
Max HGL (ft):	462.29	463.31	466.51	467.90	469.09

Link ID:	Pipe - (56) (1) (1)	Pipe - (56)	Pipe - (53)	Pipe - (61)
Length (ft):	12	31	54	115
Dia (ft):	1.00	1.00	1.00	1.00
Slope (%):	7.3	1.1	3.3	1.0
Up Invert (ft):	462.90	465.93	467.72	468.87
Dn Invert (ft):	462.00	465.57	465.93	467.72
Max Q (cfs):	1.86	1.86	0.50	0.36
Max Vel (ft/s):	7.56	4.42	1.82	3.21
Max Depth (ft):	0.35	0.53	0.38	0.20



Node ID:		C.B. #29	C.B. #19
Rim (ft):		470.96	472.37
Invert (ft):	462.00	464.31	467.40
Min Pipe Cover (ft):			
Max HGL (ft):	462.25	464.58	467.65

Link ID:	Pipe - (58) (3)	Pipe - (58)
Length (ft):	58	40
Dia (ft):	1.00	1.00
Slope (%):	4.0	5.5
Up Invert (ft):	464.31	467.40
Dn Invert (ft):	462.00	465.19
Max Q (cfs):	1.02	1.02
Max Vel (ft/s):	6.40	7.03
Max Depth (ft):	0.26	0.24

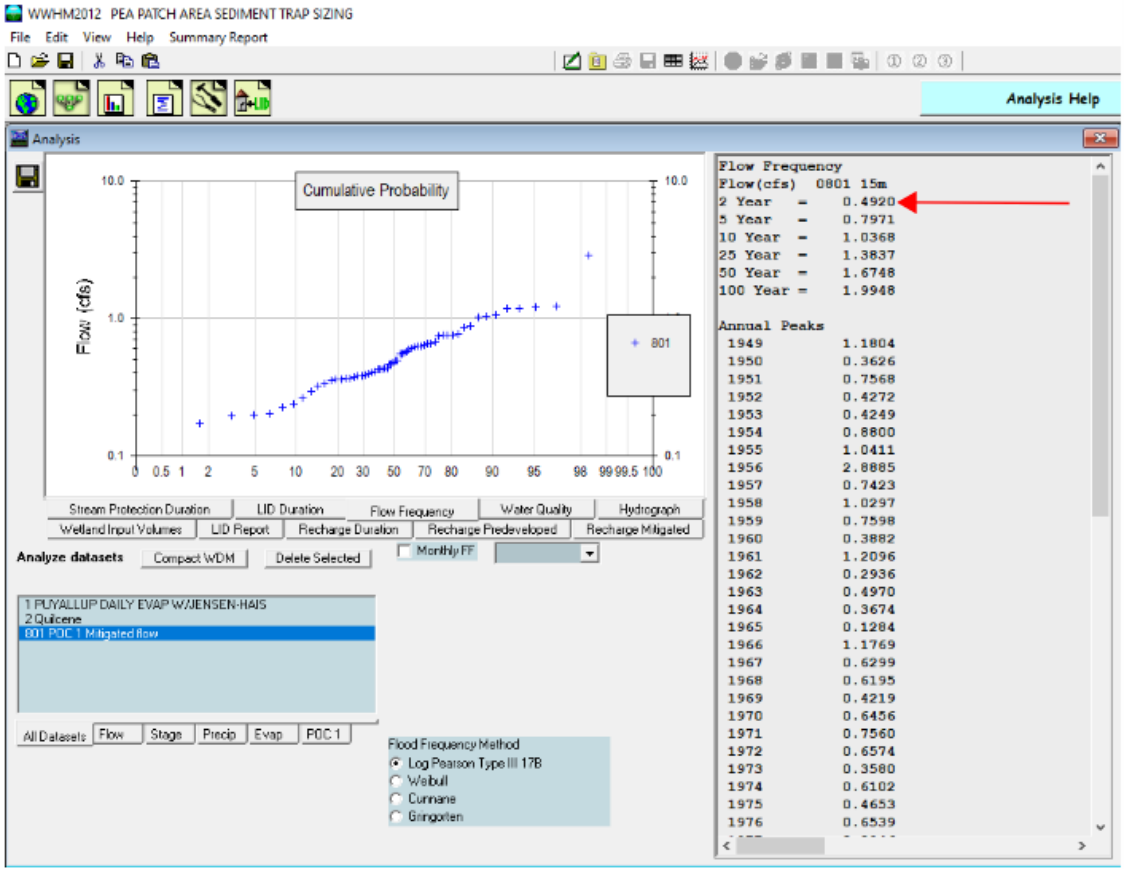
VII. SILT AND EROSION CONTROL

A Storm Water Pollution Prevention Plan and Narrative will be included with the Site Development Permit construction plan set. Best Management Practices (BMP's) include, but are not limited to: stabilized construction entrance, filter fabric fencing at toe of all fill slopes, straw bale mulching, inlet protection, and sediment traps, etc. As the disturbed area is greater than 1 acre, a Construction Stormwater General Permit will be required through the WSDOE, with site monitoring and inspection by a Certified Erosion and Sediment Control Lead (CESCL).

A. PEA PATCH EROSION CONTROL AREA

The Pea Patch erosion control catchment area consists of 1.82 acres as shown on Sheet C-3.0, and slopes towards the northeast towards SW Sentinel Peak Way and Imperial Way and a constructed swale alongside Imperial Way to a cross-culvert sloping to the north and flowing to the Northern Regional Detention Pond.

A Sediment Trap is proposed for this 1.82 acre catchment, and using "C, Lawn Flat" as the upstream catchment area developed condition, and the 2012 WWHM estimates a 2-yr peak flow of 0.492 cfs:

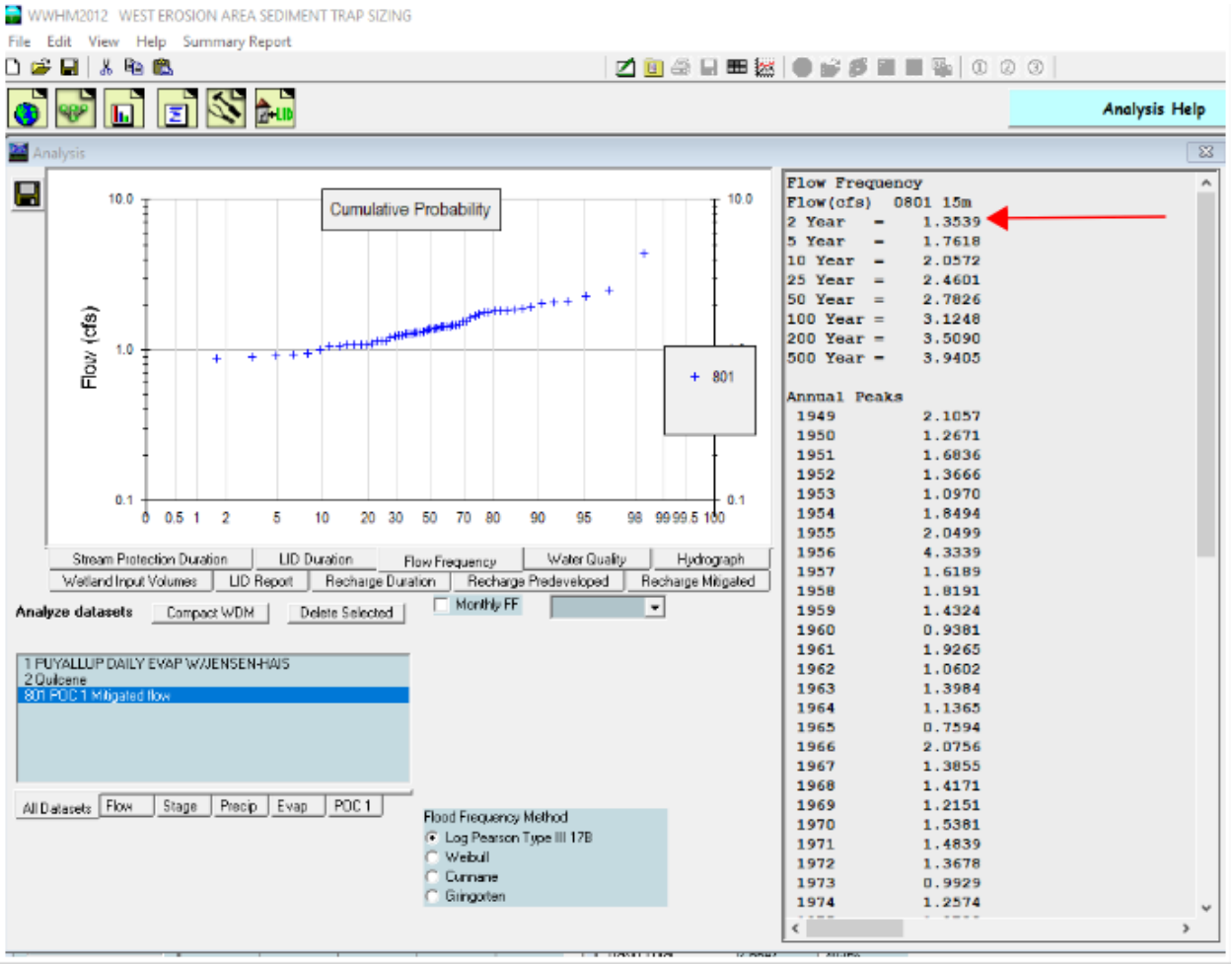


Sizing the required Sediment Trap surface area size per BMP C240, the surface area at the overflow weir elevation is 2080 square feet per cfs of inflow, or (2080)(0.492)=**1,023 s.f. minimum**, and is shown on Sheet C-3.0

B. WEST EROSION CONTROL AREA

The West Erosion control catchment area consists of 2.66 acres as shown on Sheet C-3.0, and slopes towards the existing swale that runs along the top of the slope and conveys runoff to the existing Type 2 CB and beehive grate.

A Sediment Trap is proposed for this 2.66 acre catchment, and using the developed condition coverage used to size WQ Vault #1 and adding one-half of the roof area as the upstream catchment area during construction, and the 2012 WWHM estimates a 2-yr peak flow of 1.36 cfs:

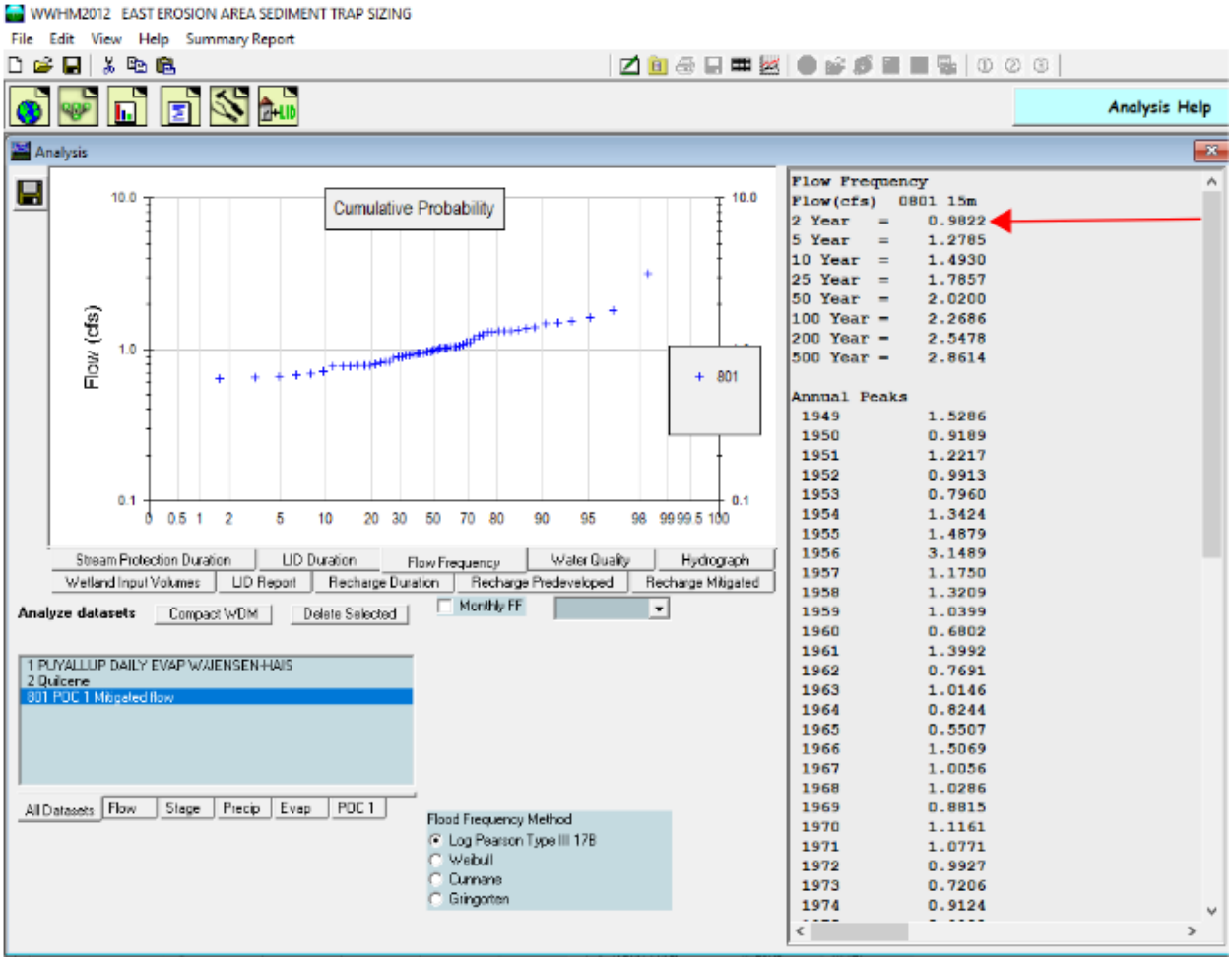


Sizing the required Sediment Trap surface area size per BMP C240, the surface area at the overflow weir elevation is 2080 square feet per cfs of inflow, or (2080)(1.36)=**2,828 s.f. minimum**, and is shown on Sheet C-3.0

C. EAST EROSION CONTROL AREA

The East Erosion control catchment area consists of 2.47 acres as shown on Sheet C-3.0, and slopes towards the native vegetation area and previous sedimentation trap for the Norseland project. This runoff flows through existing man-made swales and culverts under Imperial Way and an existing channel northerly to the regional detention pond.

A Sediment Trap is proposed for this 2.47 acre catchment, and using the developed area used to size WQ Vault #2 plus one-half of the roof area as the upstream catchment area during construction, the 2012 WWHM estimates a 2-yr peak flow of 0.982 cfs:

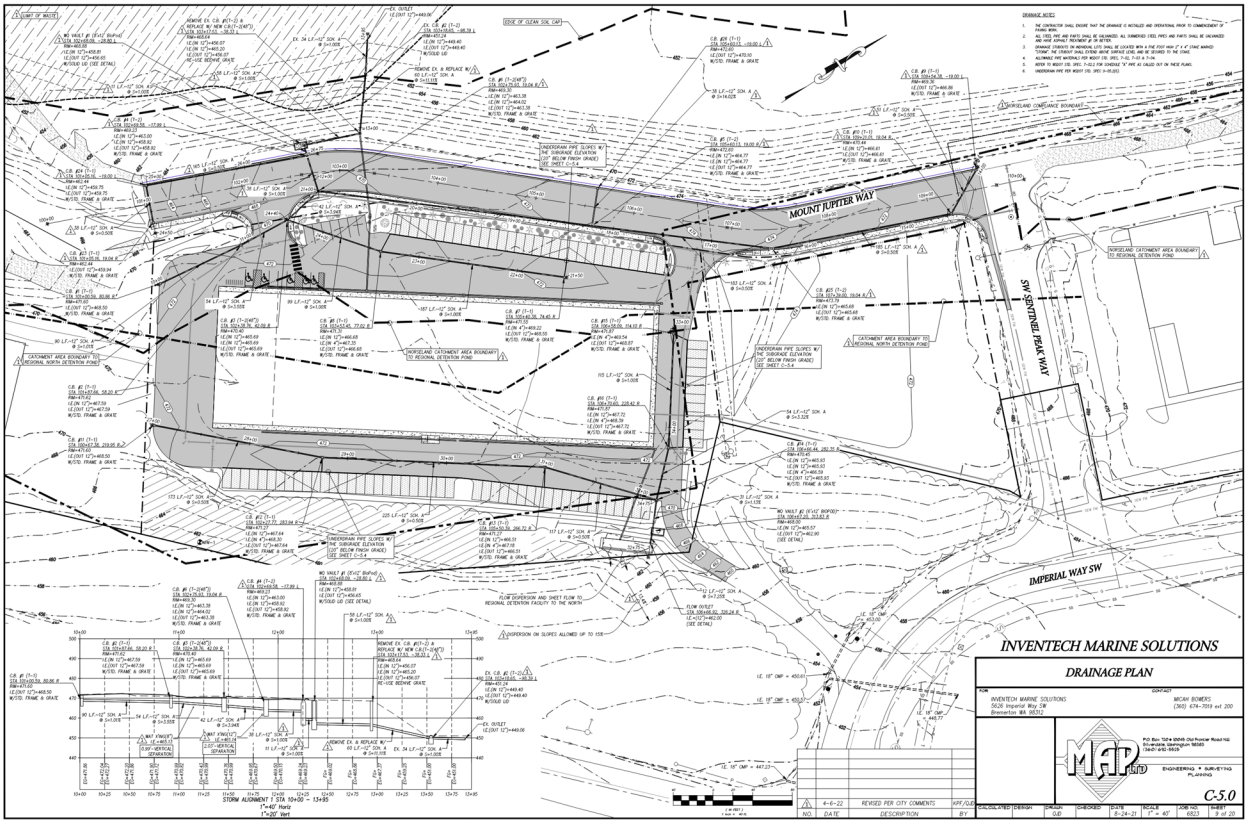


Sizing the required Sediment Trap surface area size per BMP C240, the surface area at the overflow weir elevation is 2080 square feet per cfs of inflow, or (2080)(0.982)=**2,043 s.f. minimum**, and is shown on Sheet C-3.0

VIII. STORM WATER OPERATIONS AND MAINTENANCE MANUAL

A Storm Water Operations and Maintenance Manual is included in the appendices for the project's catch basins and water quality vaults and includes recommended inspection intervals and an inspection record by the responsible parties.

Appendix A Inventech Stormwater Plan



Refer to Sheet C-5.0 for full size sheet

Appendix B NORSELAND REGIONAL POND CALCULATIONS

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

Golder Associates

DRAFT REPORT

NORSELAND SITE DEVELOPMENT INFORMATION
TO SUPPORT SITE DEVELOPMENT ACTIVITY PERMIT APPLICATION

Prepared for:

The Port of Bremerton
Port Orchard, Washington

and

Kitsap County
Port Orchard, Washington

Submitted by:

Golder Associates Inc.
Seattle, Washington

August 12, 1999

933-1280.4030

Golder Associates
Port of Bremerton/Norseland Site
933-1280.4030
Surface Water Calculations

Objective:

Design a temporary sediment detention pond to be used at the Norseland Site during construction of the cap and site regrading. In addition, provide outlet works which will allow the construction pond to be used for detention during future industrial development.

Discussion:

The temporary pond is sized based on the Department of Ecology's Stormwater Management Manual for the Puget Sound. The design criteria is the settle a medium silt during the 10 year design storm.

1. Determine the 10 year design storm flow.

10 Year Design Storm = 4.7 inches
Type 1A storm

The stormwater routing network is summarized in the SEDCAD 4 output. Sedcad is a stormwater runoff software which uses the SCS curve number approach to calculate runoff. The attached map depicts the areas used in the storm routing.

The areas for during construction and for the developed site are shown on the attached map and summarized in the attached spreadsheet. The during construction storm routing assumes earthlined waterways.

The times of concentration calculations for du ring construction are shown in the attached spreadsheet. A Manning's roughness of 0.06 was used for sheet flow (cultivated soil), with a channel roughness of 20 was used channel flow (for earth lined waterways).

Soil Type – Neilton (Kitsap County Soil Survey Map). This soil type is classified as Type A. However, based on review of the test pits dug at and near the site, a more conservative Type B soil is assumed for surface water calculations. Based on the Kitsap County Stormwater Management Manual (KCSM), the curve number for soil type B, cultivated land, is CN = 91.

The 10 year runoff during construction was estimated to be 19.48 cfs. See the attached spreadsheet and SEDCAD output for supporting documentation. The outlet words are described in more detail below, and on the design drawings.

2. Size the temporary Pond

To determine the size of the construction pond required, the following Department of Ecology method was employed:

$SA = 1.2\ Q_{10}/V_{sed}$

Where the SA = the surface area of the pond at the dewatering outlet, V_{sed} = the settling velocity of medium silt (0.00096 fps), and Q_{10} is the 10 year design flow. The 10 year design flow of 18.9 cfs resulted in a required area of 24,350 sf (0.56 acres). The sediment depth required is a minimum of 3 feet, while the settling depth is a minimum of 2 feet. (Check criteria that L/SD < 200 feet: ~300/2 < 200, therefore OK).

With 4H:1V sideslopes, the pond area elevation curve should be a minimum of:

0 ft: 16,420 sf
3 ft: 24,350 sf
5 ft: 30,150 sf

1.5 feet above the overflow outlet is provided.
1.5 feet from the emergency spillway base to the crest of the pond is provided.

This results in a pond that is approximately 5.0 ac-ft at the crest. The outlet works provided are per Ecology and Kitsap County and are shown on Drawing 7 of the drawing package.

3. Convert Temporary Pond to Permanent Pond

2 Year Design Storm = 3.3 inches
10 Year Design Storm = 4.7 inches
100 Year Design Storm = 6.5 inches
Type 1A storm

Pre-Development Flows

The first step in converting the temporary pond to a permanent pond is to determine the pre development flows for the 2 year, the 10 year and the 100 year storms. The during construction pond was designed based on an area of 28.6 acres. Calculating the area that the proposed pond can treat is an iterative process. The end result is that the construction pond can capture and treat the construction area, plus an additional 2 acres. Therefore, the pre-development runoff numbers are calculated based on an area of 30.6 acres. The pre-development time of concentration was calculated on the attached spreadsheet. A Manning's roughness of 0.1 was used, a cross between grassed area and cultivated soil, and a shallow concentrated flow value of 11 was used for short grass, pavement, and lawns.

The pre development curve number, for soil type B, is a composite value. There are an estimated 3.4 acres of buildings, pads and roads (CN = 98), 0.5 acres of dirt roads (CN = 82), 5.5 acres of brush (CN = 72) and 21.2 acres of open space, landscaping, shrubs (CN = 80). This resulted in a composite curve number of 81.

See the attached spreadsheet with a summary of input and times of concentration calculations. The storm routing and results are summarized in the SEDCAD output. The estimated pre development stormwater flows are:

Q_2 = 7.56 cfs
Q_{10} = 14.48 cfs
Q_{100} = 24.07 cfs

Post Development Flows

The volume of the pond used in the stormwater routing is reduced by 36% to account for the impervious surface correction factor. The height of the pond is left constant. In addition, the low level outlet in the pond is set at 0.5 feet above the pond bottom. Therefore, there is zero pond storage volume in the first 0.5 feet of the pond. The area elevation curve is also reduced to account for this sediment storage. The SEDCAD stormwater routing is completed with the reduced pond volume of 3.49 ac-ft.

The stormwater routing network is summarized in the SEDCAD 4 output. Stormwater routing by way of Muskingham routing was used. The post development storm routing assumed grass lined

waterways. The lengths and slopes of surfacewater flow were determined from the attached map. Note that no travel time was assumed where drop structures are proposed, nor between the two drop structure on the main flat bench. This is because this flow may eventually be tightlined.

The curve numbers were determined using KCSM. It is assumed that approximately 66% of the surface water collected will come from impervious surfaces. For type B soils, the following curve numbers were used:

CN = 98 paved
CN = 80 open spaces, lawns, landscaping

The times of concentration (t_c) are summarized on the attached spreadsheet. Determination of t_c were similar to the during construction t_c , with the following adjustments for Manning's and channel roughness. A Manning's roughness of 0.011 was used for sheet flow on pavement, 0.15 for sheet flow on grass/lawn. A channel roughness of 17 was used for grassed waterways, which is the proposed ditch/swale lining. Note that riprap will be used where velocities exceed 5 fps or where slopes exceed 6%.

The detention facility must meet the following criteria:

Discharge <= 50% of the pre development 2 year flow during the 2 year event (streambank erosion BMP)
Discharge <= pre development 10 year flow during the developed 10 year event
Discharge <= pre development 100 year flow during the developed 100 year event

The emergency spillway was sized in SEDCAD assuming a 15 foot wide broad crested weir spillway, with 3H:1V sideslopes. This method was checked with the KCSM weir equation. For a flow of 36.9 cfs and a 15 foot wide spillway, a flow height of 0.79 feet results. The spillway invert is at 6.75 feet above the pond bottom (El. 406.75), resulting in a emergency spillway water surface of 7.5 feet above the pond surface. This provides 0.5 feet of freeboard.

Results:

The following outlet works meet the above criteria:

9" diameter low flow inlet at 0.5 feet above the pond base (400.5 ft)
27" outlet conduit at 405.0 ft
Emergency spillway, 10 feet wide, 3H:1V sideslopes at 406.75 feet
The piping inlet into the control structure will be 30" diameter

The developed flows out of the pond are:

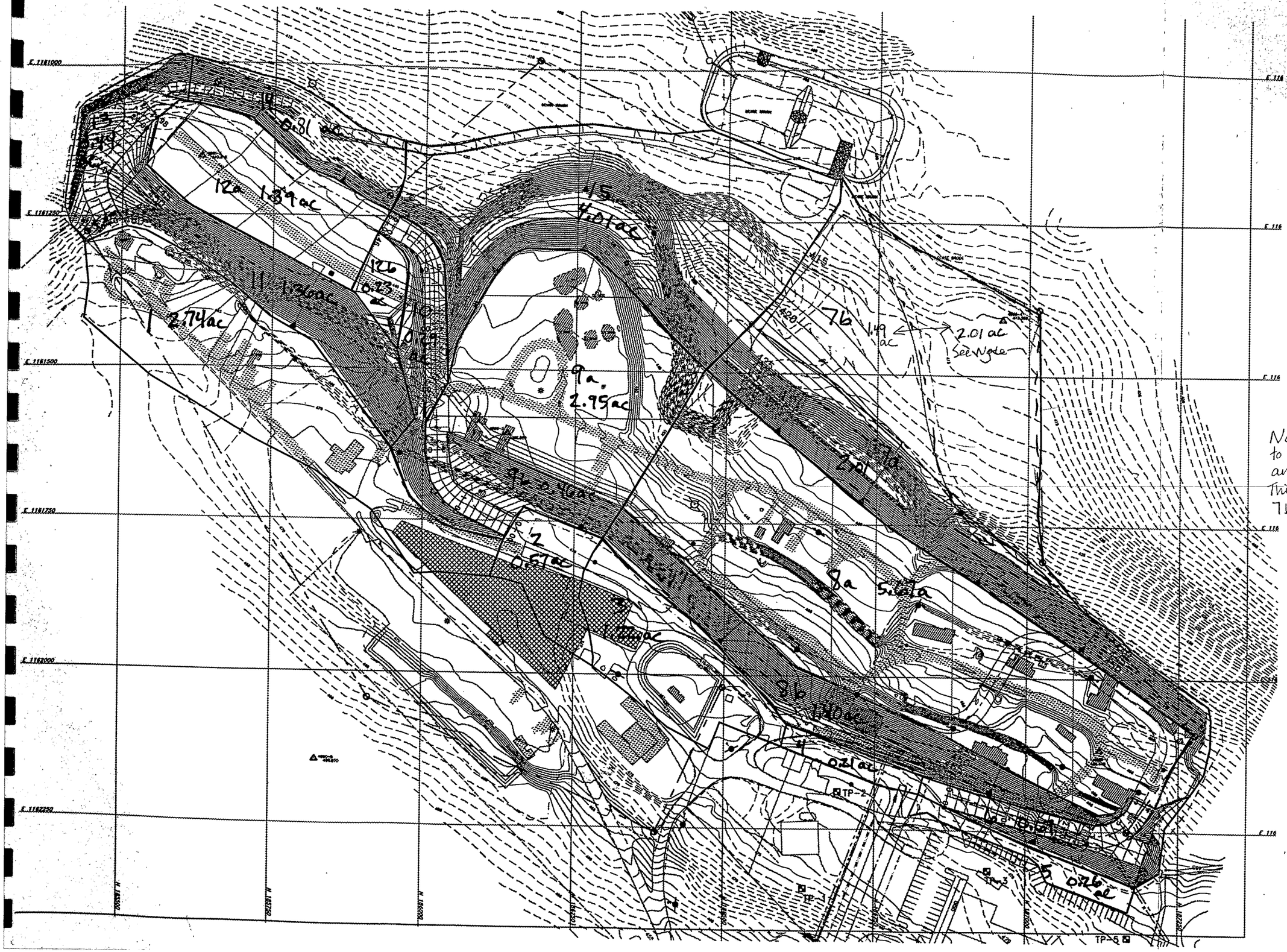
Q_2 = 3.74 cfs (<3.78 cfs = 50% of 7.56 cfs)
Q_{10} = 13.1 cfs (<14.5 cfs)
Q_{100} = 24.1 cfs (~24.07cfs)

See the construction drawings for more details. The control structure will be located outside the pond embankment. The temporary outlet works will be modified for the permanent detention facility. The temporary perforated riser stack will be removed and replaced by an inlet pipe with debris barrier. A filter window will be placed in the center of the pond with a peak elevation of 405.6 ft, per the design drawings.

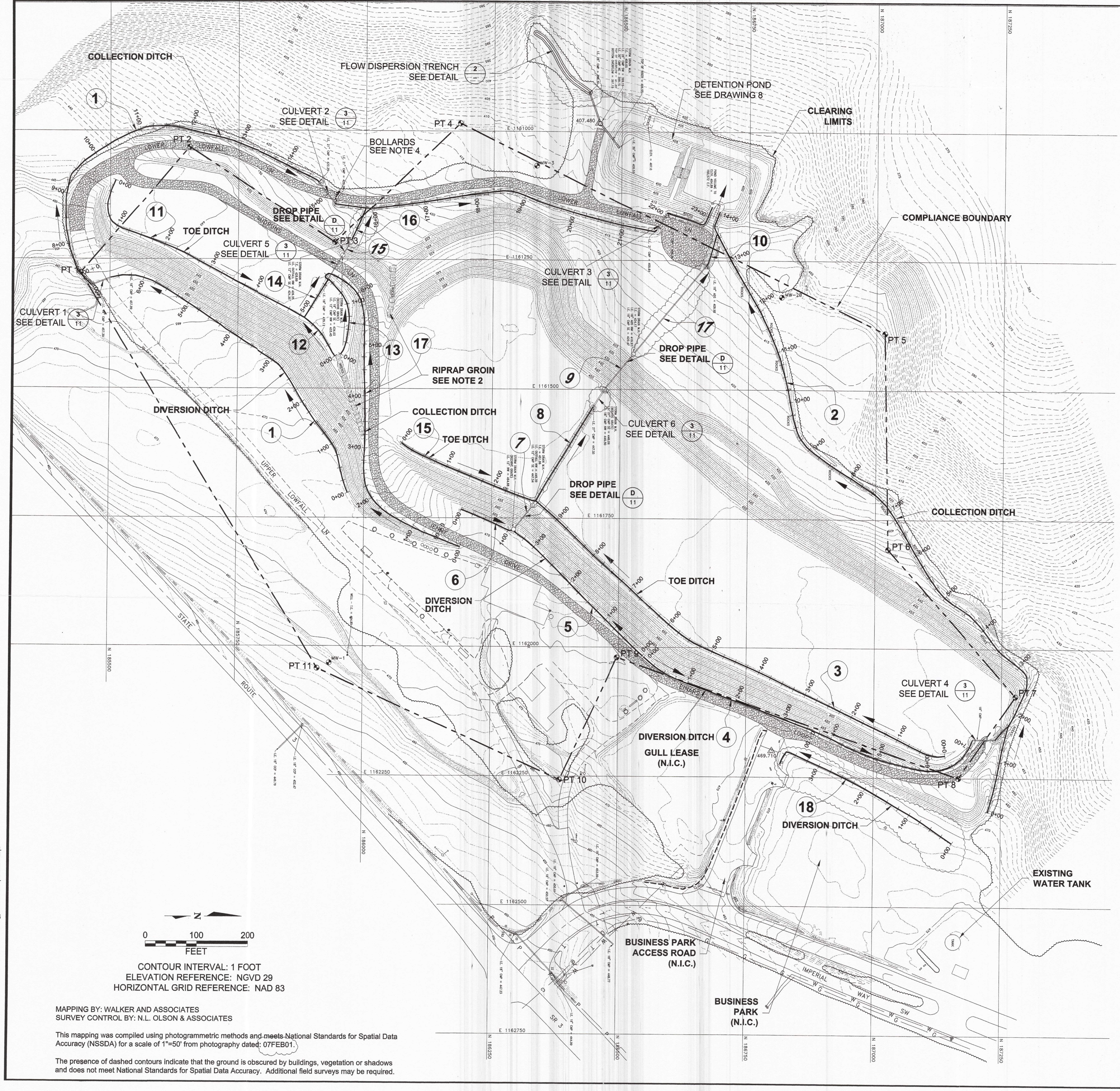
References:

Department of Ecology, *Stormwater Management Manual for the Puget Sound Basin*, February 1992.

United States Department of Agriculture and the Soil Conservation Service, *Soil Survey of Kitsap County Area*, Washington, September 1980.



Note: The pond is designed to handle Areas 1 → 15, plus an additional 2.01 acres. This area is added to Area 7b for modeling purposes.



CONTOUR INTERVAL: 1 FOOT
ELEVATION REFERENCE: NGVD 29
HORIZONTAL GRID REFERENCE: NAD 83

MAPPING BY: WALKER AND ASSOCIATES
SURVEY CONTROL BY: N.L. OLSON & ASSOCIATES

This mapping was compiled using photogrammetric methods and meets National Standards for Spatial Data Accuracy (NSSDA) for a scale of 1"=50' from photography dated: 07FEB01.

The presence of dashed contours indicate that the ground is obscured by buildings, vegetation or shadows and does not meet National Standards for Spatial Data Accuracy. Additional field surveys may be required.

LEGEND:

- 469.710 SURVEY BENCHMARK / ELEVATION
- FINAL CONTOUR - 5 FT
- FINAL CONTOUR - 1 FT
- EDGE OF TREES / BRUSH / CLEARING LIMITS
- SURFACE WATER FLOW DIRECTION
- MW-1 EXISTING MONITORING WELL
- 17 SURFACE WATER COLLECTION DITCH LOCATION AND DESIGNATION
- 9 SURFACE WATER COLLECTION DROP PIPE LOCATION AND DESIGNATION

NOTES:

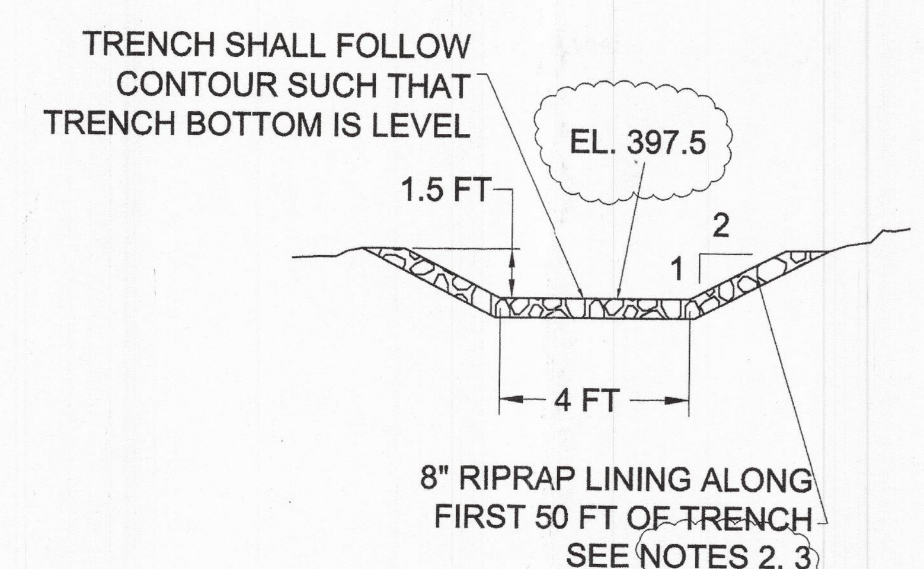
1. SEE DRAWING 11 FOR DITCH SIZING SCHEDULE, INCLUDING DITCH LINING REQUIREMENTS.

2. RIPRAP GROINS AS SHOWN ON DRAWING. RIPRAP SHALL BE 6" MEDIAN DIAMETER, WITH A MINIMUM STONE SIZE OF 2" AND A MAXIMUM STONE SIZE OF 8".

3. RIPRAP SHALL CONSIST OF BROKEN STONE FREE OF ROCK FINES, SOIL, OR OTHER EXTRANEOUS MATERIAL. STONE SHALL BE FREE OF SEGREGATION, SEAMS, CRACKS, AND OTHER DEFECTS TENDING TO DEGRADE ITS RESISTANCE TO WEATHER. STONE SHALL MEET THE FOLLOWING REQUIREMENTS:

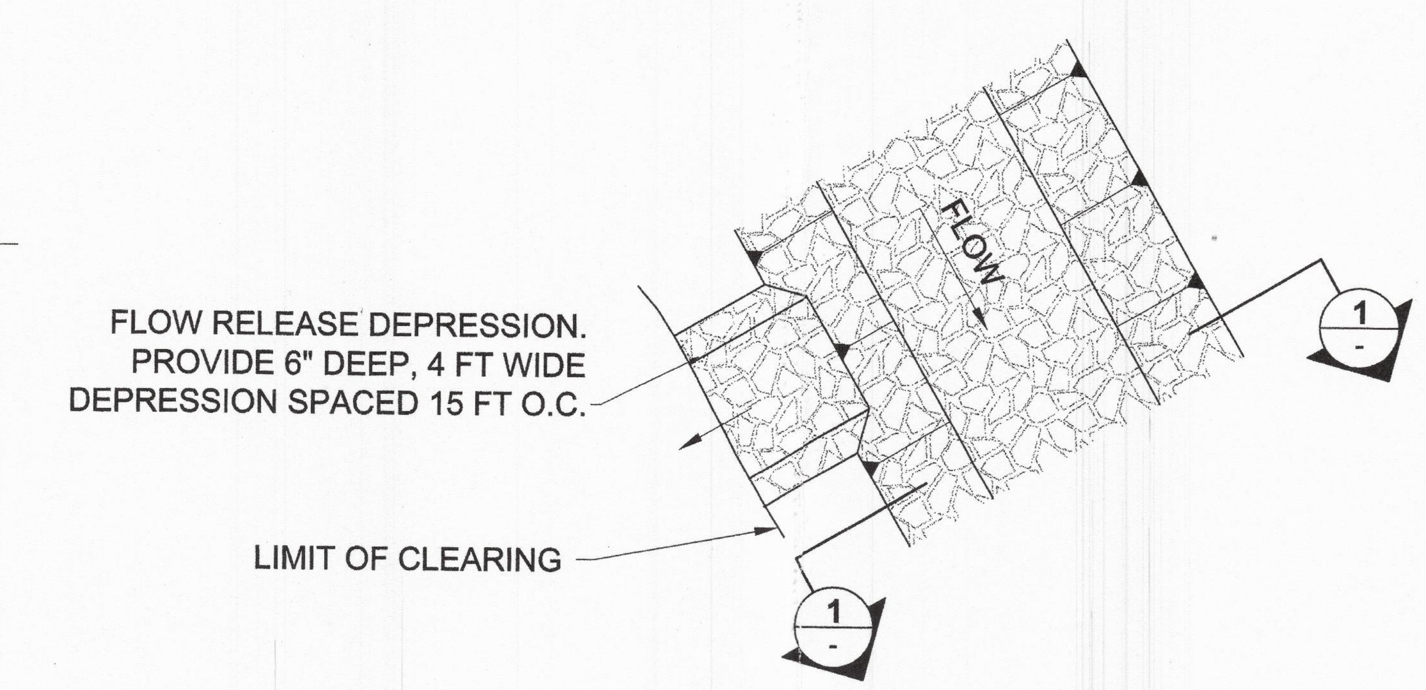
DEGRADATION FACTOR:	15 MINIMUM
LOS ANGELES WEAR, 500 REV.	50% MAXIMUM
SPECIFIC GRAVITY	2.55 MINIMUM

4. ACCESS TO POND ACCESS ROAD SHALL BE LIMITED BY BOLLARDS, PER KITSAP COUNTY STORMWATER MANAGEMENT MANUAL.



1 FLOW DISPERSION TRENCH SECTION

NOT TO SCALE



2 FLOW DISPERSION TRENCH DETAIL

NOT TO SCALE

RECORD DRAWING

Rev.	Date	Drawn	Chkd.	Appd.	Description
0	5/31/00	JSS	CRS	FSS	ISSUED FOR CONSTRUCTION
1	7/20/00	FSS	CRS	DJM	ADD CONSTRUCTION STAKING POINTS
2	6/15/01	FSS	CRS	DJM	AS-BUILT

FRANK S. SHURI, STATE OF WASHINGTON, PROFESSIONAL ENGINEER

Golder Associates
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
(425) 883-0777

PORT OF BREMERTON - NORSELAND SITE

SURFACE WATER FACILITIES PLAN

Drawing No. 7

11

Appendix C NORTHERN REGIONAL DETENTION POND CALCS

DRAFT

Port of Bremerton

Regional Stormwater Detention Facilities

Stormwater Runoff Study

Prepared for:

Port of Bremerton
8850 SW State Highway
Port Orchard, Washington 98366

Prepared by:

Cosmopolitan Engineering Group
117 South 8th Street
Tacoma, Washington 98402

April 1999
POB002

COSMOPOLITAN ENGINEERING GROUP

Civil, Environmental, and Recreational Consulting

8th & Pacific
117 South 8th Street
Tacoma, WA 98402
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Fax: (253) 272-7250

reviewed 4/8/03

Port of Bremerton

Regional Stormwater Detention Facilities

Stormwater Runoff Study

Prepared for:

Port of Bremerton
8850 SW State Highway
Port Orchard, Washington 98366

Prepared by:

Cosmopolitan Engineering Group
117 South 8th Street
Tacoma, Washington 98402

April 1999
POB002

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SECTION 1 – INTRODUCTION

1.1 BACKGROUND

The Port of Bremerton Industrial Park is located along State Highway 3 across from the Bremerton National Airport as shown in Figure 1.1. The full site covers approximately 520 acres and lies completely within Kitsap County. Only the Phase I development area, which encompasses approximately 81 acres, will be evaluated for this Study. The Phase I area is illustrated in Figure 1.2.

1.2 PURPOSE

The purpose of this study is to present findings of an evaluation and modeling analysis of the Phase I area. The study describes regional stormwater detention facilities in compliance with Kitsap County stormwater requirements.

Note that this study does not address water quality issues, which will be handled on individual sites prior to discharge to the regional detention facilities.

1.3 APPROACH

Results from the evaluation are presented in Section 3.2 of this report. The hydrologic/hydraulic evaluation of the drainage characteristics of the basin was accomplished using *WaterWorks*™ *Software for Hydrology*, developed by Engenious Systems, Inc.

This report presents the results of the drainage basin evaluation for two separate land use conditions (existing and proposed future land use) in conjunction with four design storm events (2-, 10-, 25-, and 100-year, 24-hour design storm events).

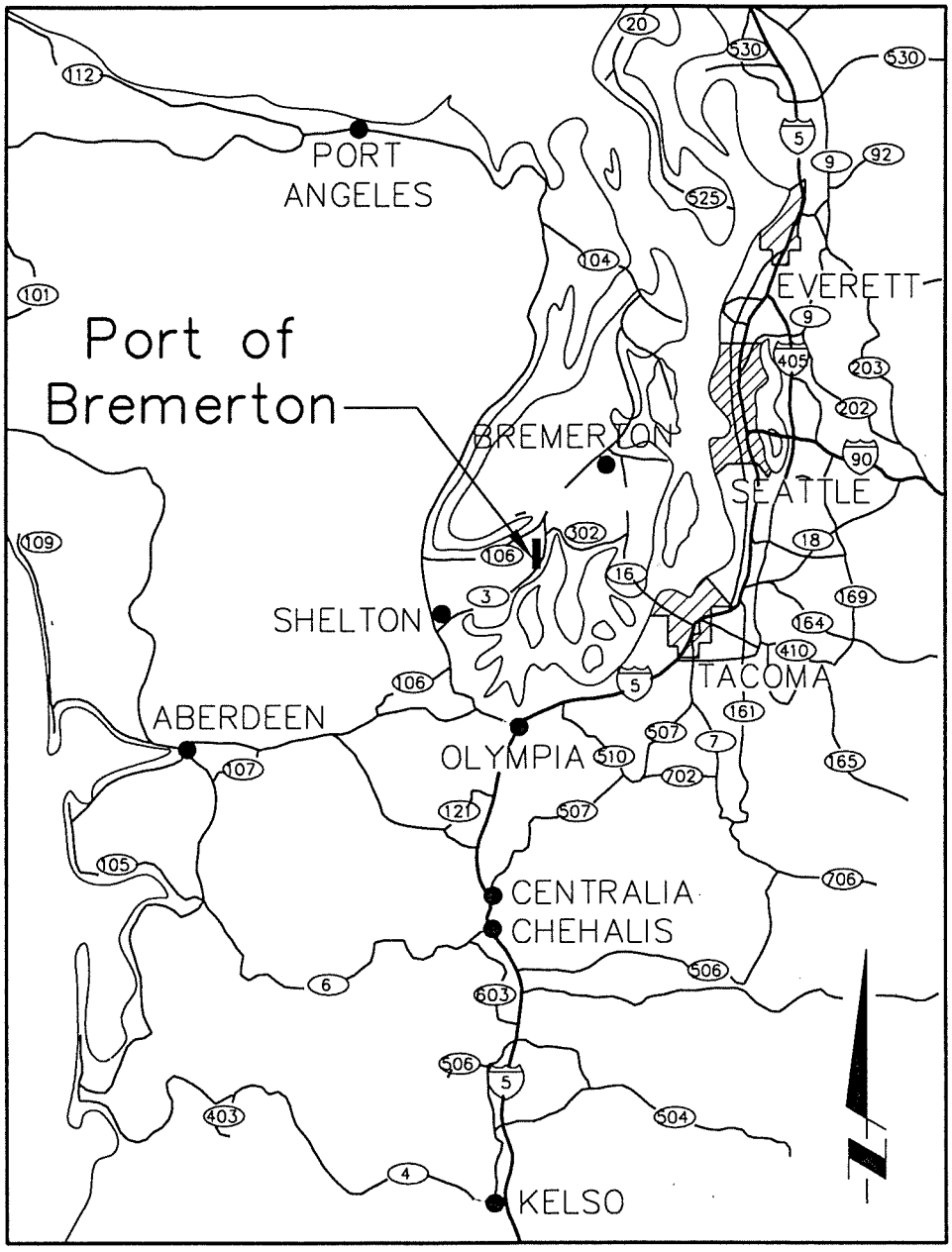

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Figure 1.1 Port of Bremerton Drainage Basin Location

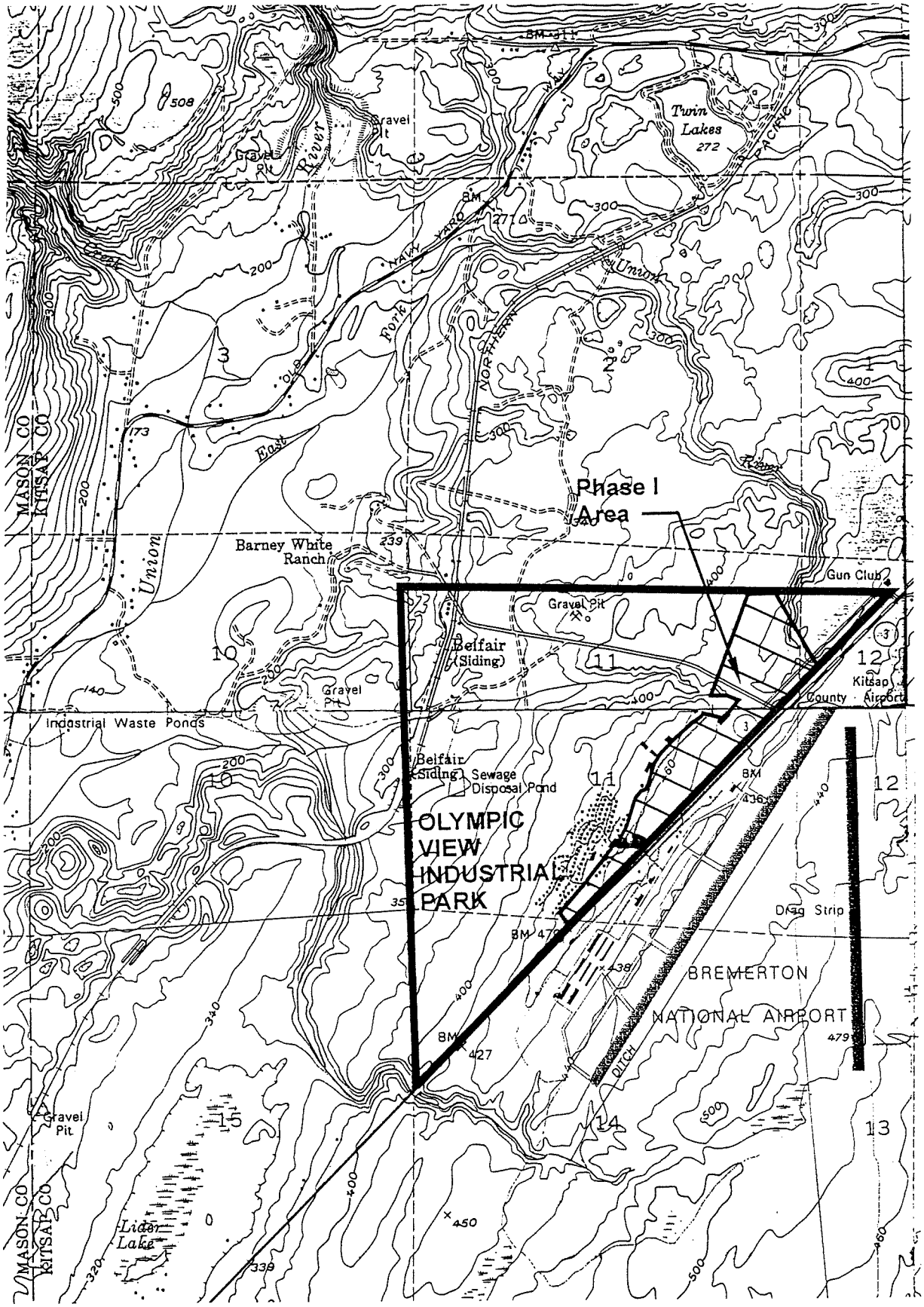

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FIGURE 1.2
PROJECT VICINITY

SECTION 2 – STUDY AREA AND EXISTING CONDITIONS

2.1 TOPOGRAPHY AND DRAINAGE BASINS

The Port of Bremerton Phase I project site is contained in two drainage basins which include the area along Highway 3 and generally drain to the east. ?

The major southerly portion of the Phase I area is gently rolling and covers 85 acres. Surface water flows northeast along Highway 3 through a channel and into a wetland area. Discharge is to the East Fork of the Union River. Elevations range from approximately 470 along Imperial Way to 425 at the wetland located in the northeast end of the basin. The basin includes 14.9 acres of offsite area on the airport property.

The small northerly portion of the Phase I area covers 11 acres and drains directly to the East Fork of the Union River, bypassing the natural wetland. The entire Phase I drainage basin is shown in Figure 2.1.

2.2 SOIL CONDITIONS

Soil conditions in the Port of Bremerton Basins vary through the hill formations, drainage ways, and terraces that are evident on the property. For drainage studies, the near surface soils have the most influence on system requirements. Information regarding near surface soils within the study area are based on soil mapping obtained from the U.S. Department of Agriculture Soil Conservation Service (SCS). For storm runoff analyses, the hydrologic soil classification is used to estimate runoff potential from precipitation. The SCS has classified over 4,000 soils throughout the United States into four categories based on soil infiltration rates. These categories include:

- **Group A:** Soils having high infiltration rates even when thoroughly wet, consisting of well-drained soils comprised of mostly sands and gravel (low runoff potential).
- **Group B:** Soils having moderate infiltration rates even when thoroughly wet, consisting of moderately well-drained soils of reasonable, fine to course material.

- **Group C:** Soils having slow infiltration rates consisting of fine to moderately fine grained materials.
- **Group D:** Soils having very slow infiltration rates comprised of clay soils or shallow soils covering impervious surfaces (high runoff potential).

The hydrologic soil groups within the study area as shown on Figure 2.2, are entirely Group C soils with a moderate runoff potential. The Group C soils have a slow infiltration rate and the majority of precipitation can be expected to flow off the ground surface rather than infiltrate the surface soils.

2.3 BASIN AREAS AND LAND USE

2.3.1 Basin Areas

For the analysis of Phase I, the project area can be divided into five distinct drainage basins, based both on site topography and discharge location. Drainage basin boundaries are the same under existing and proposed conditions. Figure 2.3 illustrates the basin boundaries under existing conditions. Figure 2.4 illustrates the proposed condition basin boundaries.

2.3.2 Land Use

For the hydrologic study, land uses within the Port of Bremerton basins were divided into six different categories:

- Rural Residential (5% impervious)
- Forested Area, Second Growth (0% impervious)
- Young Second Growth or Brush (0% impervious)
- Meadow/Pasture Area (0% impervious)
- Wetlands (100% impervious)
- Industrial/Commercial (85% impervious)

Figures 2.3 and 2.4 delineate the land use categories for existing and proposed conditions, respectively.

Aerial mapping of the Phase I area under existing conditions show a portion of the basin fully developed with the remainder forested. Approximately 23% of the Phase I onsite drainage basin is currently in the Industrial/Commercial category, while the remaining 77% of the basin can be considered Rural/Forest/Pasture.

Proposed land use conditions (ultimate development) were developed assuming the forested right-of-way areas of State Highway 3 would remain in their existing state. While all other Forest, Rural and Pasture categories will become Industrial/Commercial development. As a result, proposed land uses for the basins show that 63% of the Phase I area can be categorized as Industrial/Commercial land use, while 37% of the area will remain Forested.

Table 2.1 summarizes the basin areas and land uses. Per the table, development of the Phase I area to the maximum extent would increase industrial area by 32 acres.

Table 2.1 Land Use Summary

Basin ID	Comments	Existing Condition		Proposed Condition	
		Total Area	Industrial Area	Total Area	Industrial Area
A		17.8	5.6	17.8	5.6
B		34.4	8.1	34.4	24.0
C		18.0	5.3	18.0	10.3
D		10.9	0.0	10.9	10.9
E	Offsite	14.9	11.0	14.9	11.0
TOTAL		**96.0**	**30.0**	**96.0**	**61.8**
TOTAL ONSITE		**81.1**	**19.0**	**81.1**	**50.8**

2.4 EXISTING FACILITIES INVENTORY

Existing drainage facilities in the Phase I area consists of both natural watercourses and constructed improvements as shown in Figure 2.5.

The stormwater from Basins C, B, and E collect in a channel along Highway 3 and discharge under Barney White Road into a wetland where it combines with stormwater from Basin A, and

discharges into the East Fork of the Union River. Stormwater from Basin D flows overland through brush and trees directly into the East Fork of the Union River, bypassing the wetland.

Culverts located within the Phase I area are typically 12-inch to 18-inch diameter concrete, CMP, or corrugated PE pipe. Constructed channels are typically 1 to 2 feet wide at the bottom with sideslopes approximately 1H:1V or 2H:1V. The channels have grass or brush on the sideslopes and exposed soil or cobbles on the bottom.

The wetland area is located at the northeast corner of the Phase I area. Ground cover is brushy with a few trees. The wetland area covers approximately 1.8 acres of Basin A.

Stormwater west of Imperial Way is collected and flows northeasterly through a constructed channel to the top of the gully. Stormwater continues through the gully and beyond to the Union River.

The gully is naturally-occurring. In its upper reaches, the channel is one to five feet wide with a grass or exposed soil bottom. The channel disappears into a broad valley. Surface water or groundwater meanders from pond to pond, with a indistinct channel between. Vegetation in the valley is brush and grasses. Sideslopes are vegetated with second growth forest and underbrush at a typical 1H:1V or 2H:1V sideslope.

2.5 PROPOSED FACILITIES INVENTORY

Proposed drainage facilities in the Phase I area consist of both existing natural watercourses and constructed improvements as shown in Figure 2.6.

The stormwater from developed portions of Basins C and B would collect in a new constructed channel along the westerly right-of-way for Highway 3 and would be detained in a new detention basin south of Barney-White Road. Discharge from Detention Basin 1 will flow under Barney-White Road into the natural wetland and beyond to the East Fork of the Union River. Discharge from Detention Basin 1 will be designed such that the existing wetland is neither dried up due to limited flow nor flooded with excessive flow. Rather, the basin and discharge structure will be

designed such that the water level in the existing wetland is maintained for each of the design storms.

Stormwater runoff from the remaining portion of Basins C and B, and Basin E would be collected in the existing channel along Highway 3. This channel also feeds into Detention Basin 1 and discharges as described above.

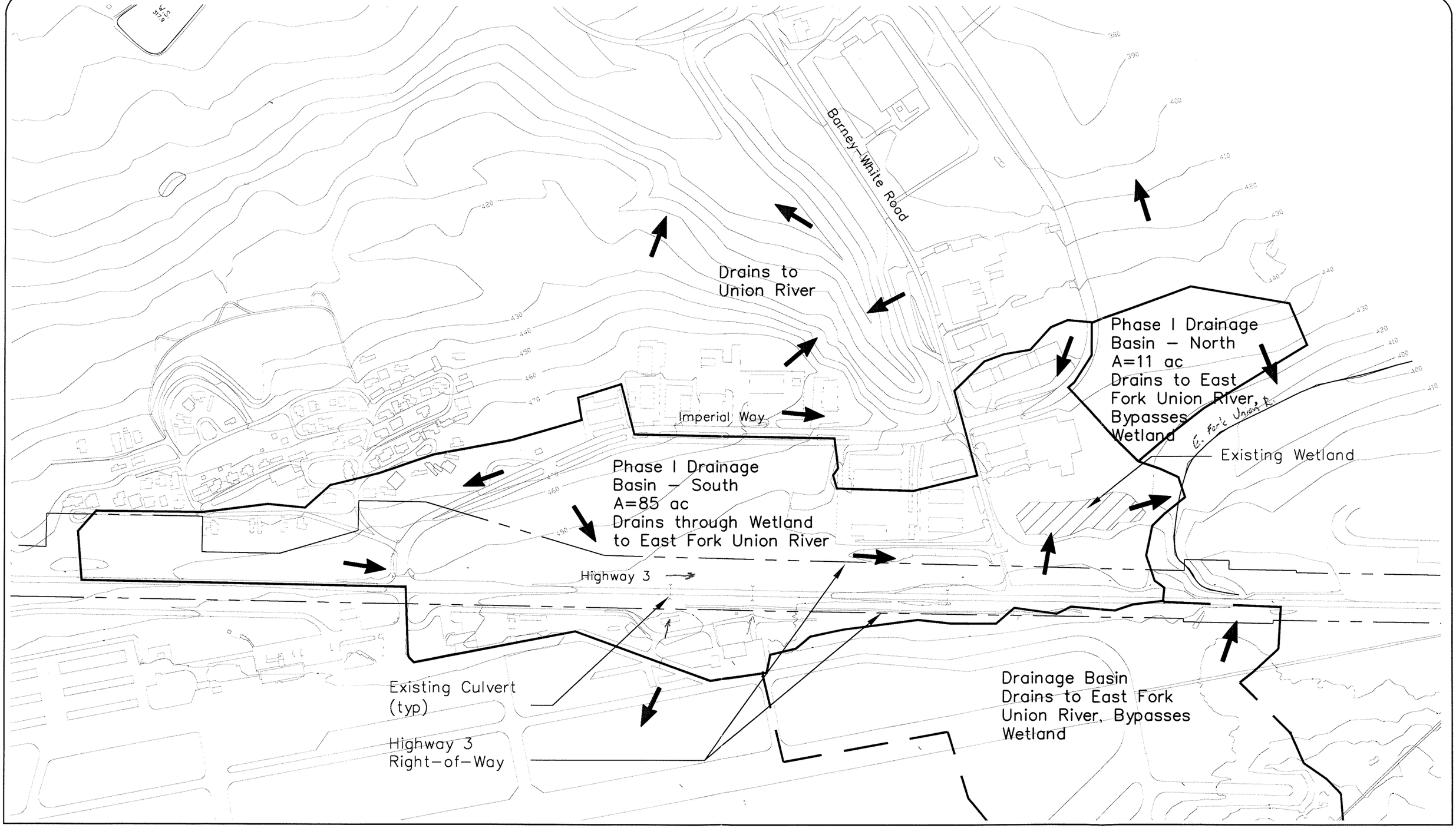
No proposed development occurs in Basin A. Stormwater will flow in existing channels at existing rates into the wetland. The wetland will not be altered.

Stormwater runoff from the developed portion of Basin D will flow through new channels and underground piping to proposed Detention Basin 2. Discharge from Detention Basin 2 will be to the East Fork of the Union River.

Proposed culverts located within the Phase I area will be 12-inch to 18-inch diameter concrete. Constructed channels will be up to 20 feet wide at the bottom with sideslopes approximately 3H:1V. The channels will be grass-lined.

No development is proposed outside of the Phase I area northwest of Imperial Way. Stormwater in these areas will continue to flow through existing channels into the gully and discharge into the Union River.

There are no proposed regional water quality facilities included in the Phase I project. Water quality will be addressed on a per site basis as the industrial park is developed.



JOB: P08002

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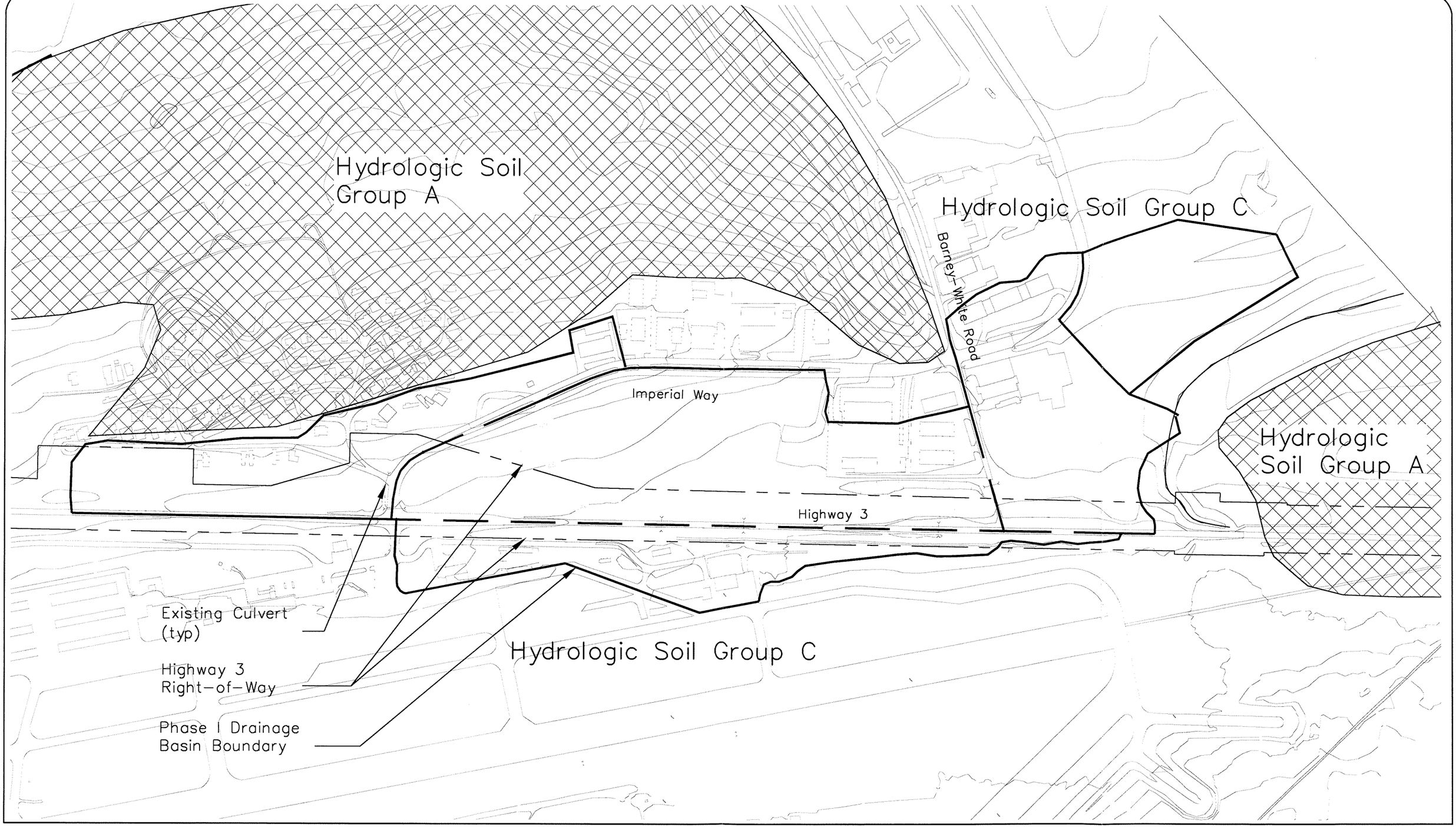
COSMOPOLITAN
Civil, Environmental and Recreational Consulting

N

0 200 400
SCALE IN FEET

Figure 2.1 Existing Conditions Phase I Drainage Basins



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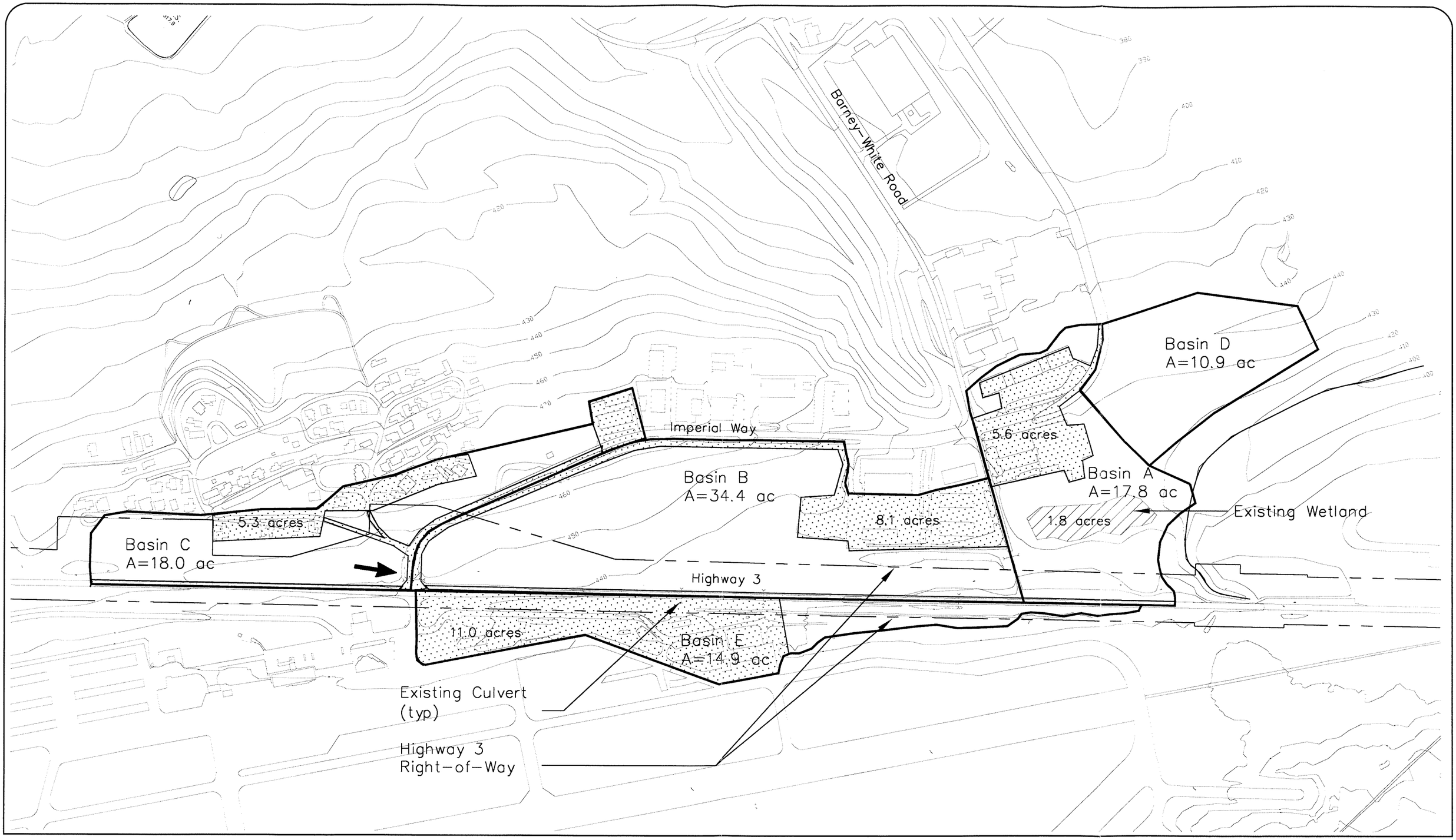
0 200 400
SCALE IN FEET

Figure 2.2 Hydrologic Soil Groups



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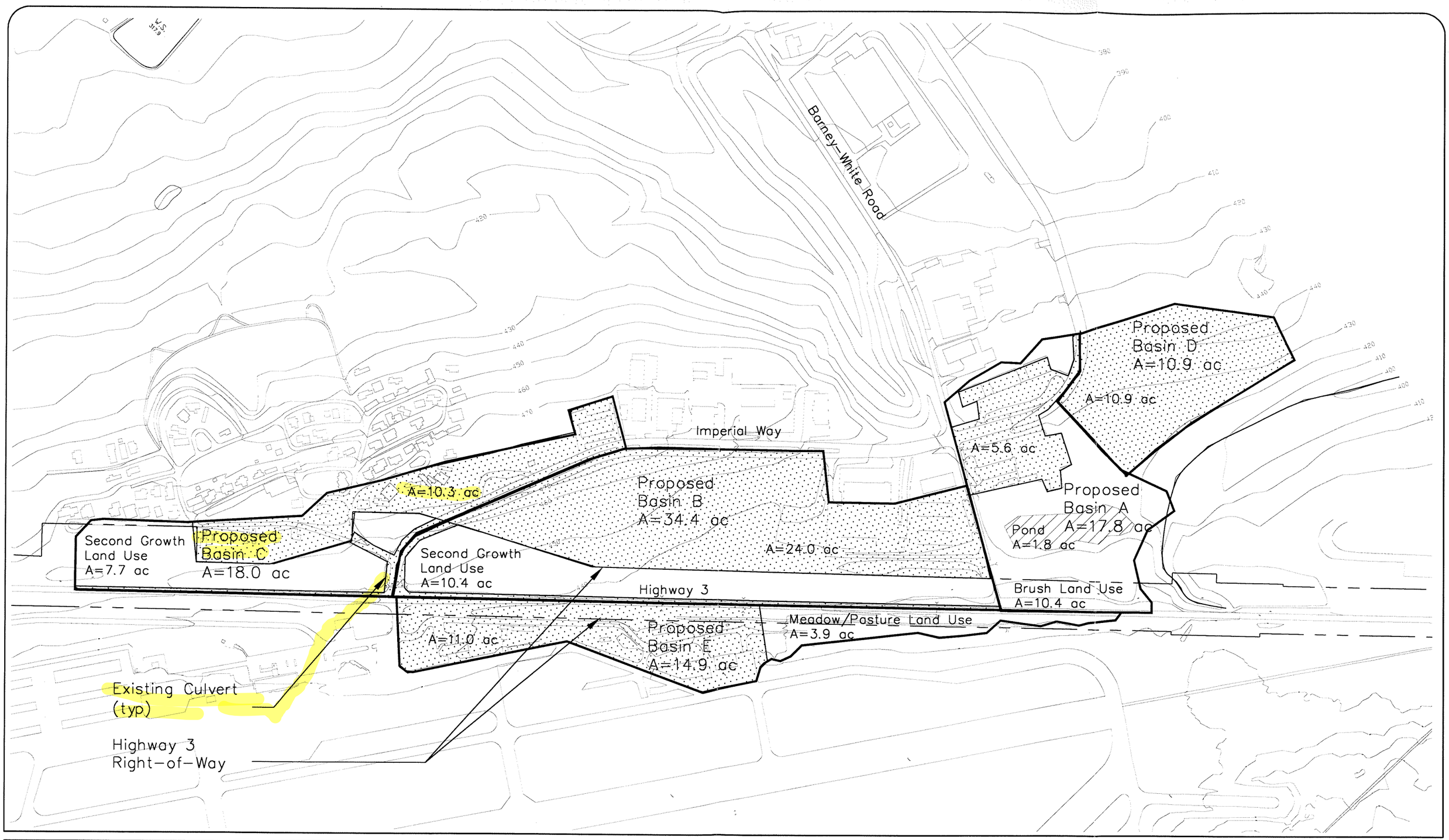
Industrial/Commercial Land Use

N

0 200 400
SCALE IN FEET

Figure 2.3 Existing Land Use Conditions



JOB: P08002

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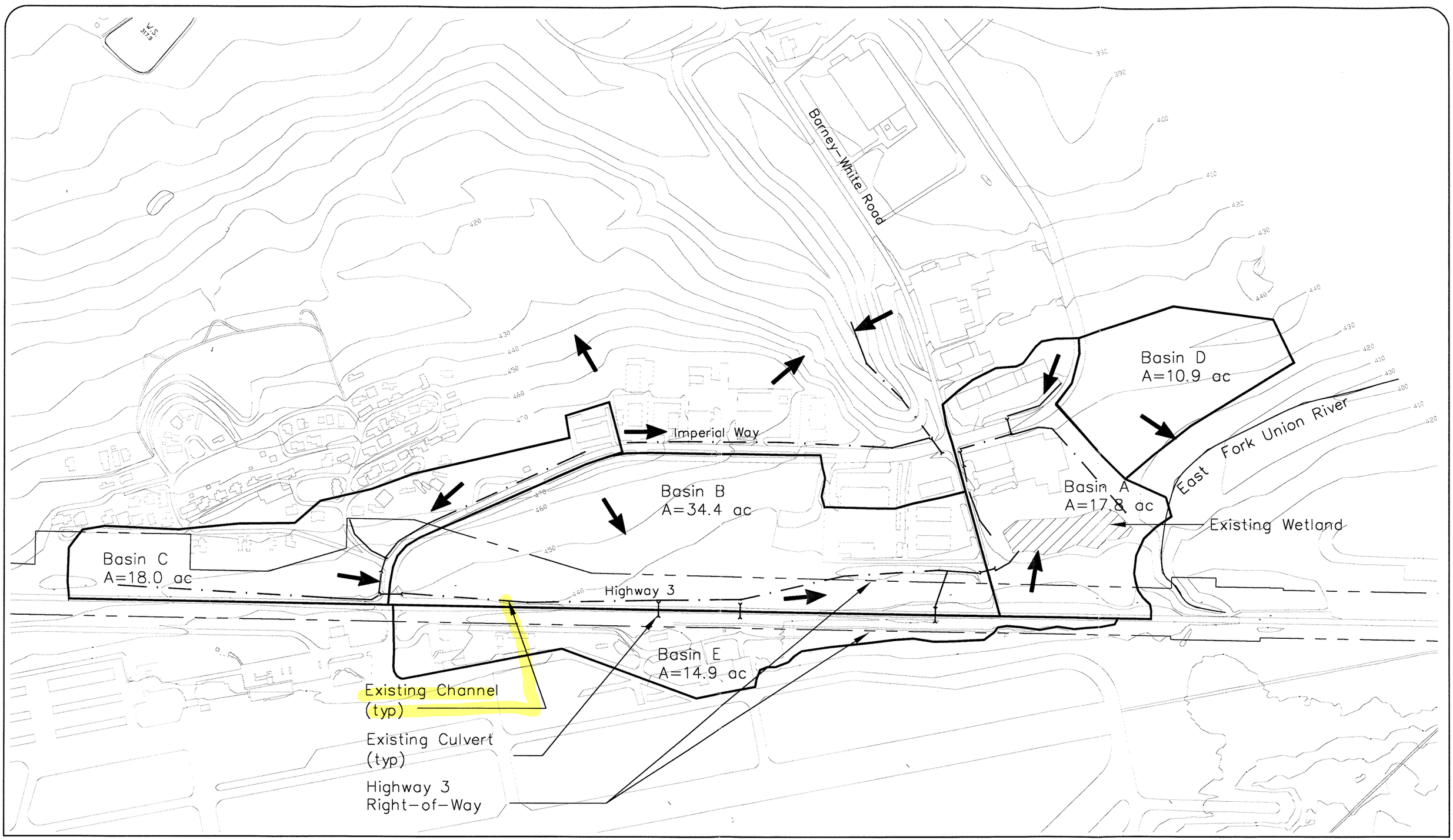
Industrial/Commercial Land Use

N

0 200 400
SCALE IN FEET

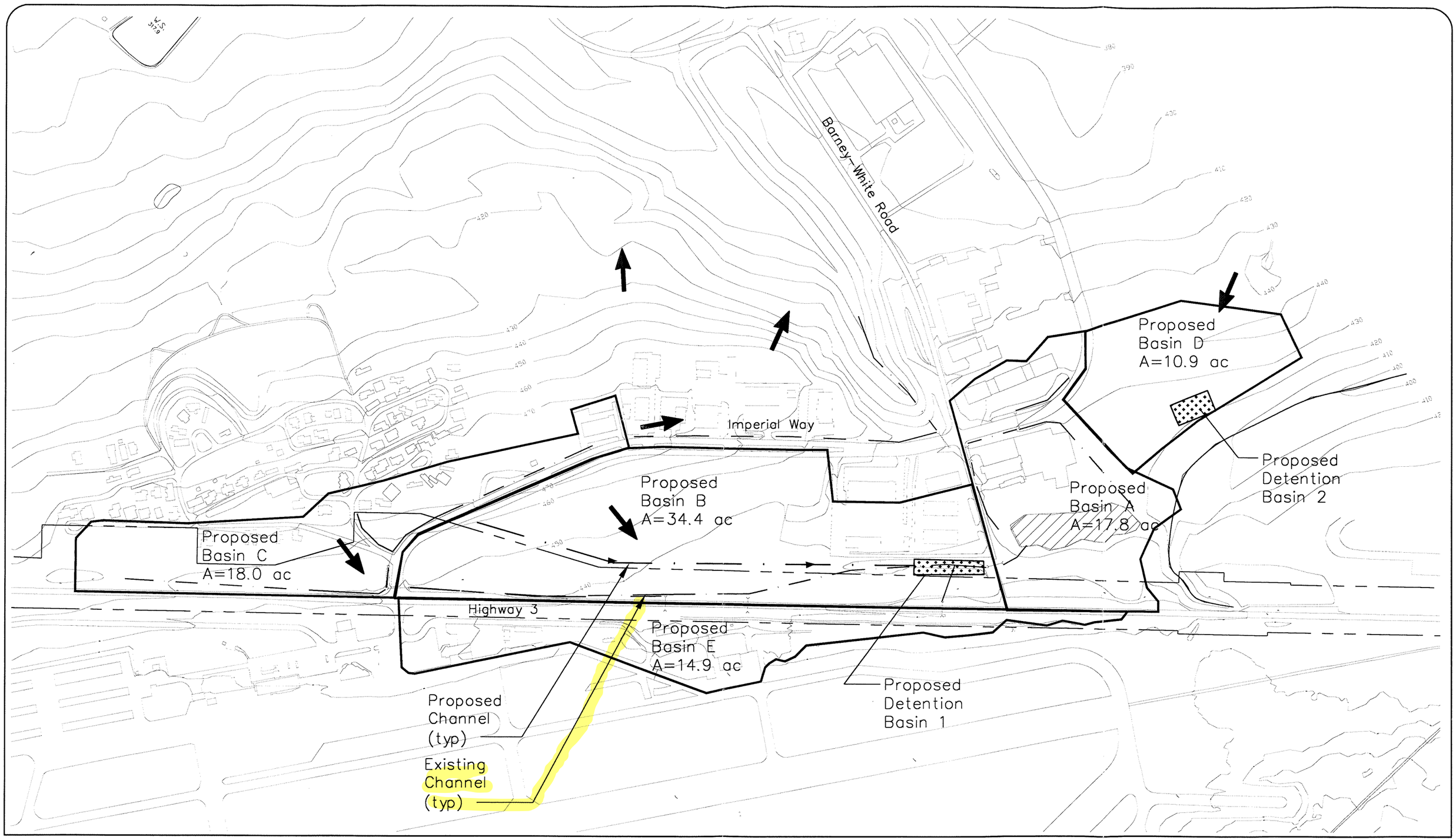
Figure 2.4 Proposed Land Use Conditions



JOB: P08002

COSMOPOLITAN ENGINEERING GROUP
Civil, Environmental and Recreational Consulting

Figure 2.5 Existing Conditions and Features



JOB: P08002

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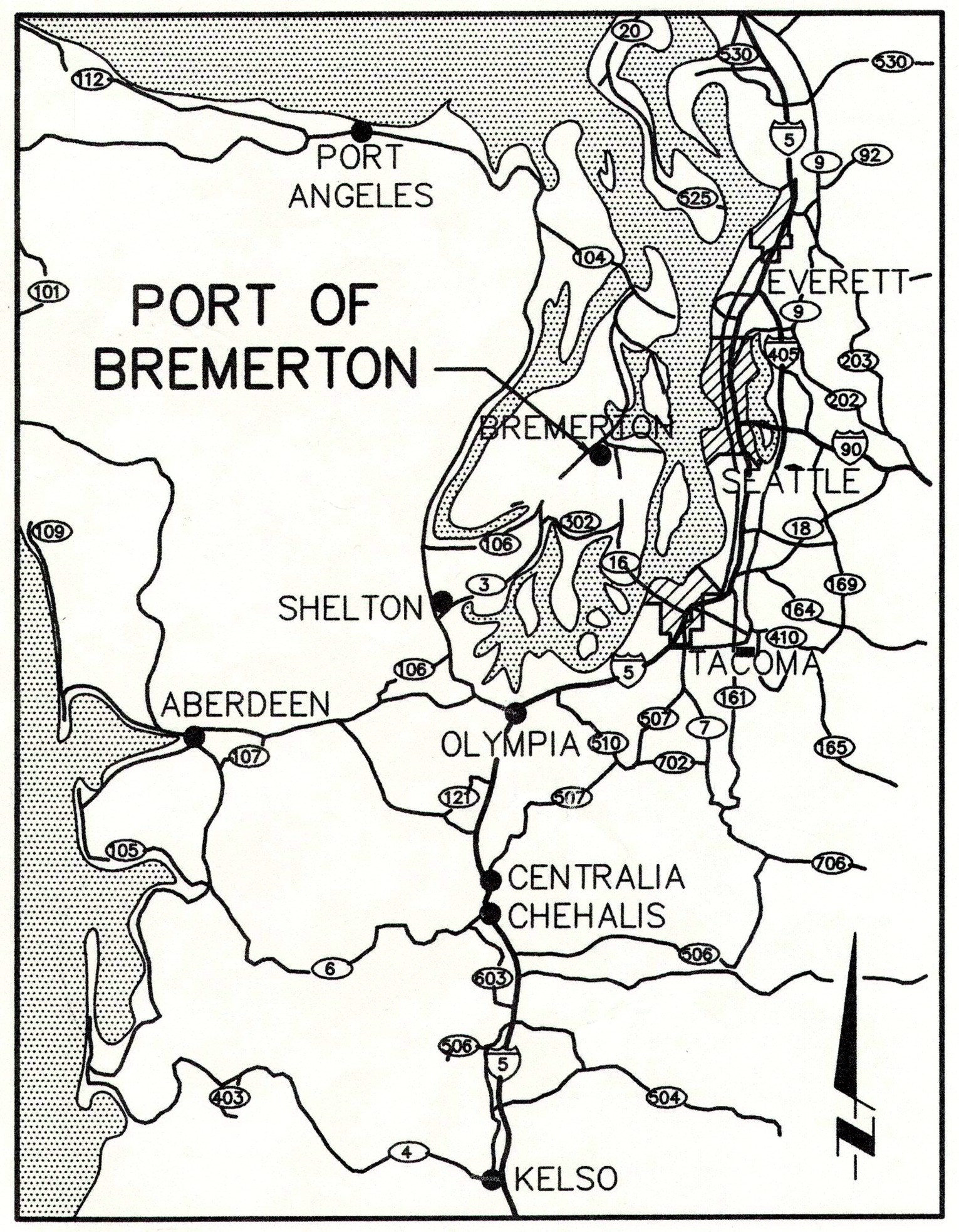
Figure 2.6 Proposed Facilities

PORT OF BREMERTON
REGIONAL STORMWATER DETENTION FACILITIES
PHASE I

KITSAP COUNTY, WASHINGTON

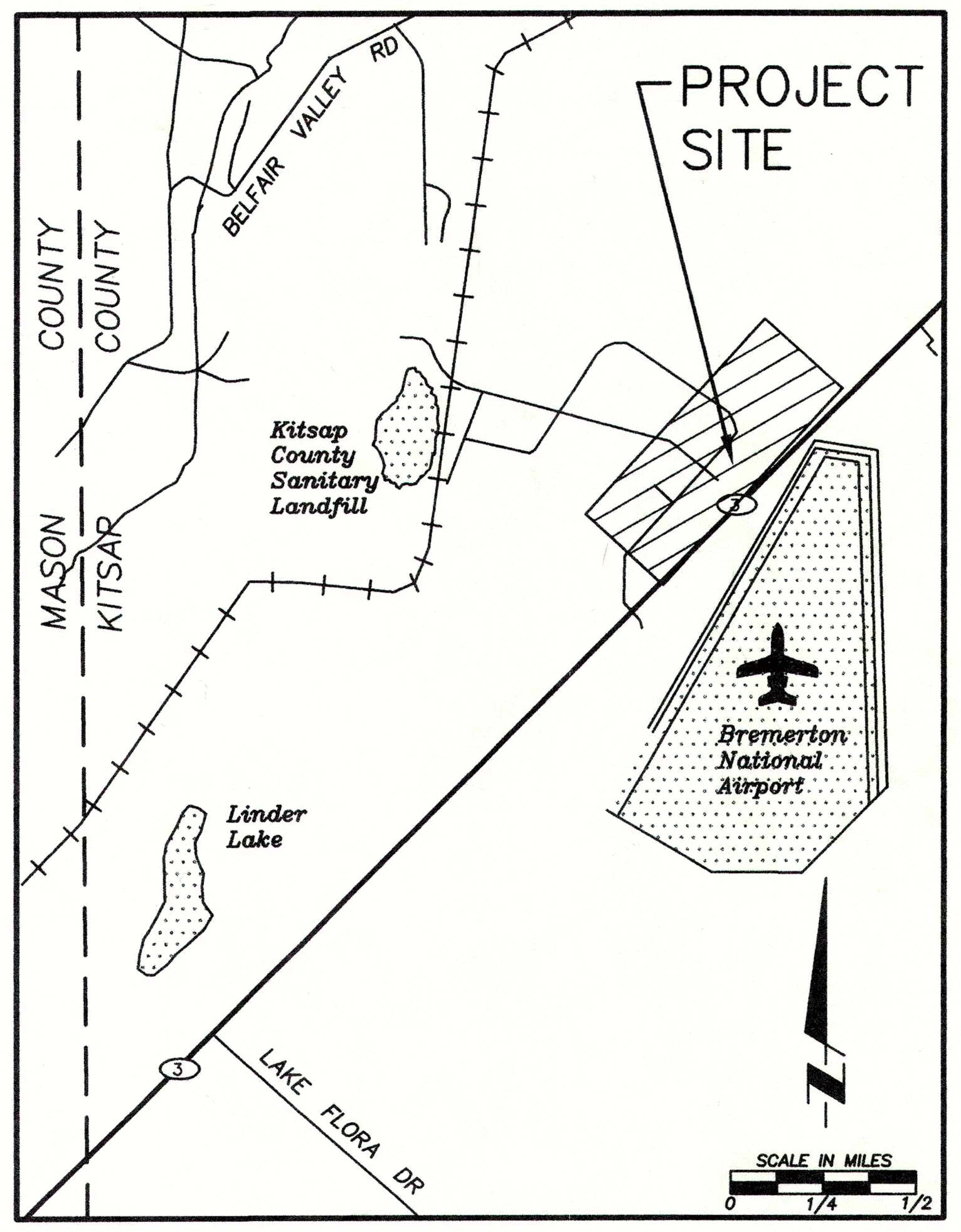
VICINITY MAP



DATUM:
HORIZONTAL: NAD 83/91
VERTICAL: NGVD 29

BENCHMARK:
TBM – PK NAIL AT INTERSECTION OF IMPERIAL WAY AND BARNEY WHITE ROAD
N 188613.08
E 1163869.33
ELEVATION = 430.61

LOCATION MAP



SEC 11, T23N, R1W

SHEET INDEX

NO.	DESCRIPTION
C1	MAPS, LEGEND AND INDEX
C2	GENERAL NOTES
C3	SITE PLAN
C4	EROSION CONTROL – BASIN #1
C5	EROSION CONTROL – STOCKPILE
C6	CHANNEL(SOUTH) – PLAN & PROFILE
C7	BASIN #1 – PLAN & PROFILE
C8	GRADING & DRAINAGE – BASIN #1
C9	GRADING & DRAINAGE – BASIN #1
C10	DETAILS
C11	DETAILS
C12	DETAILS
C13	SECTIONS – CHANNEL(SOUTH)
C14	SECTIONS – DETENTION BASIN #1
C15	SECTIONS – DETENTION BASIN #1
L1	LANDSCAPE PLANTING – BASIN #1

LEGEND

EXISTING	PROPOSED	
— — —	— — —	RIGHT-OF-WAY/PROPERTY LINE
— — —	— — —	EASEMENT LINE
TV	TV	CABLE TELEVISION
FM	FM	FORCE MAIN
4"G	4"G	GAS (SIZE)
P	P	POWER
8"S	8"S	SEWER (SIZE)
12"D	12"D	STORM DRAIN (SIZE)
T	T	TELEPHONE
6"W	6"W	WATER (SIZE)
		UTILITY POLE (WITH GUY)
°CO	•CO	CLEANOUT
○	●	CATCH BASIN TYPE 2
□	■	CATCH BASIN TYPE 1
		FIRE HYDRANT
		GATE VALVE
WM	WM	WATER METER
125	125	CONTOUR
+124.75	⊗ 980.69	SPOT ELEVATION
		STREET LIGHT ASSY.
		RIPRAP
		QUARRY SPALLS

BID

FILE SET

NOTE:

1. THE LOCATION OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR.S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

COSMOPOLITAN ENGINEERING GROUP
Civil, Environmental and Recreational Consulting
117 S. 8th Street
Tacoma, WA 98402
(253)272-7220
Fax:(253)272-7250

LORNA J. ... REGISTERED PROFESSIONAL ENGINEER 24637
EXPIRES 1-12-01

NO.	REVISIONS	DATE	BY

FOR PERMITTING ONLY
NOT FOR BIDDING OR CONSTRUCTION

JOB NO. POB002 DRAWING NO. POB00201

REGIONAL DETENTION FACILITIES
MAPS, LEGEND, AND INDEX

PORT OF BREMERTON
8850 SW STATE hWY 3
PORT ORCHARD, WA 98367
MR. JEFFERY ROBB (360)674-2381

DESIGNED	LJM
DRAWN	SLW
CHECKED	WSH, JKD
APPROVED	
SCALE	AS NOTED
DATE	JULY 1999
SHEET NO.	C1

1 / 16

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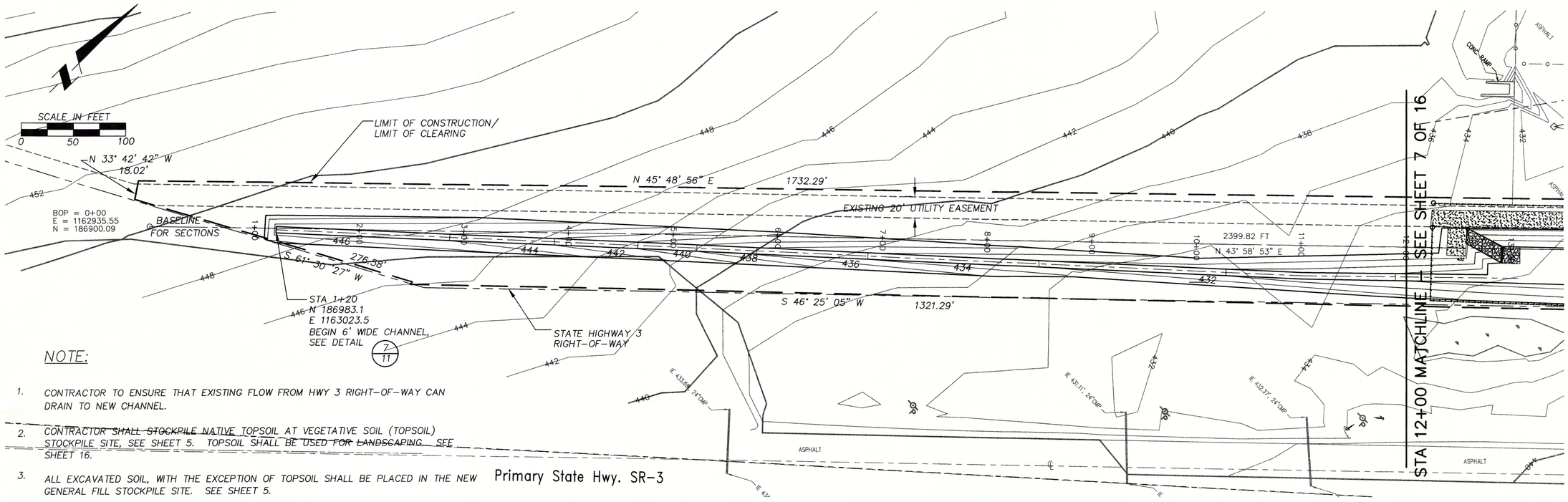
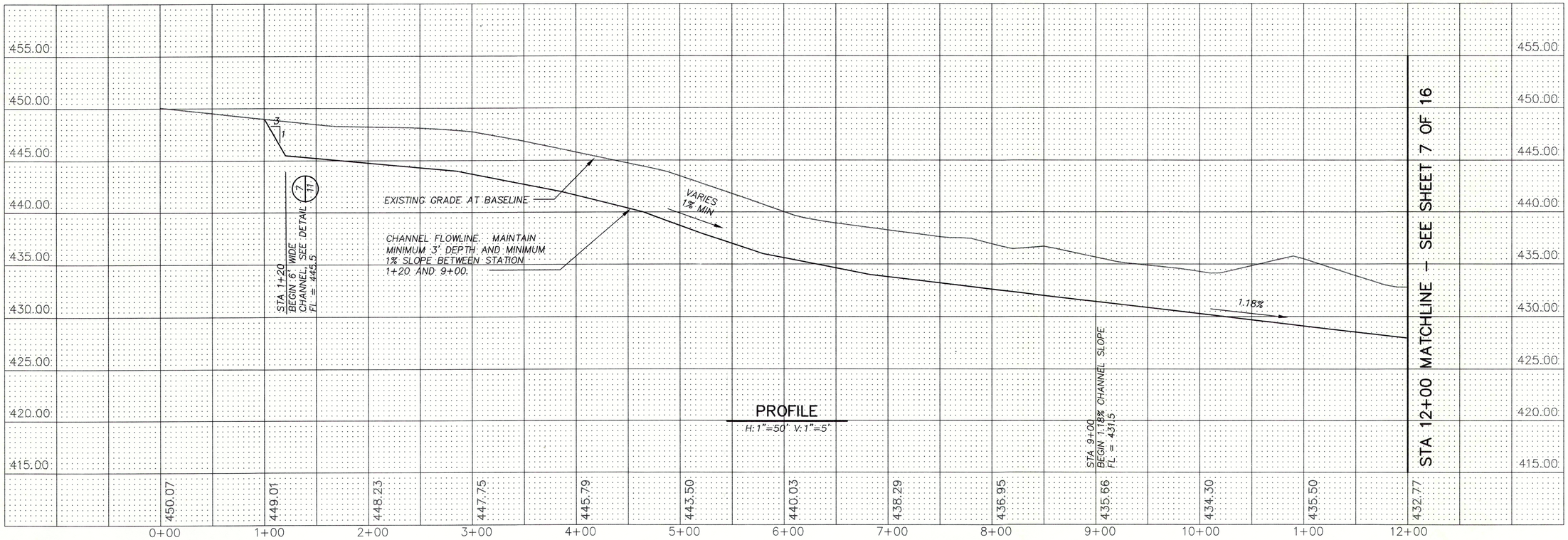


PLAN
1"=50'

NOTE:

1. CONTRACTOR TO ENSURE THAT EXISTING FLOW FROM HWY 3 RIGHT-OF-WAY CAN DRAIN TO NEW CHANNEL.
2. CONTRACTOR SHALL STOCKPILE NATIVE TOPSOIL AT VEGETATIVE SOIL (TOPSOIL) STOCKPILE SITE, SEE SHEET 5. TOPSOIL SHALL BE USED FOR LANDSCAPING. SEE SHEET 16.
3. ALL EXCAVATED SOIL, WITH THE EXCEPTION OF TOPSOIL SHALL BE PLACED IN THE NEW GENERAL FILL STOCKPILE SITE. SEE SHEET 5.
4. ALL FILL SHALL BE PLACED AS STRUCTURAL FILL AS DEFINED IN GEOTECHNICAL NOTES SHEET 2, UNLESS OTHERWISE DIRECTED BY THE ENGINEER OR NOTED ON PLANS.
5. SEE SHEET 13 FOR CHANNEL SECTIONS.

CUT AND FILL QUANTITIES
CUT = 3500 CY*
FILL = 0 CY*
*QUANTITIES DETERMINED IN-SITU FROM SECTIONS



PROFILE
H: 1"=50' V: 1"=5'

COSMOPOLITAN ENGINEERING GROUP
Civil, Environmental and Recreational Consulting
117 S. 8th Street
Tacoma, WA 98402
(253)272-7220
Fax:(253)272-7250

J. MARTIN LEE — REGISTERED PROFESSIONAL ENGINEER — STATE OF WASHINGTON
EXPIRES 1-12-01

NO.	REVISIONS	DATE	BY

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DRAWING NO. POB0206
POB002
JOB NO.

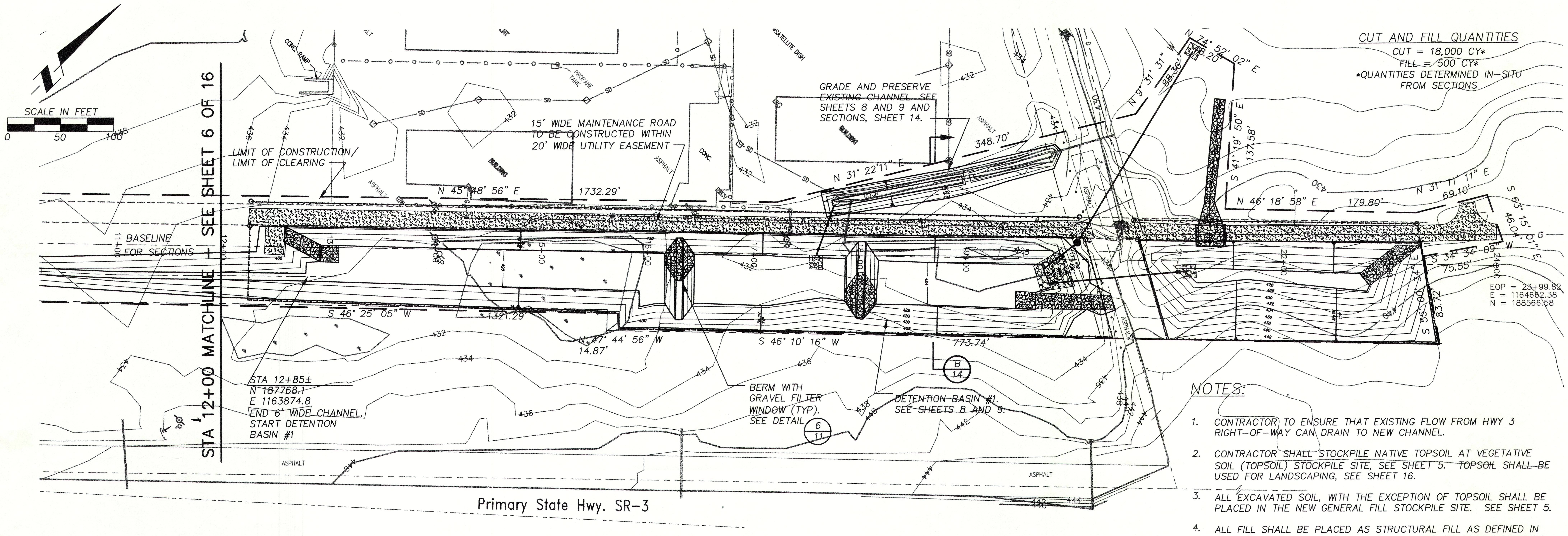
REGIONAL DETENTION FACILITIES
CHANNEL (S) - PLAN & PROFILE

PORT OF BREMERTON
8850 SW STATE HWY 3
PORT ORCHARD, WA 98367
MR. JEFFERY ROBB (253)674-2381

DESIGNED LJM
DRAWN SLW
CHECKED WSH, JKD
APPROVED
SCALE AS NOTED
DATE JULY 1999

SHEET NO. C6

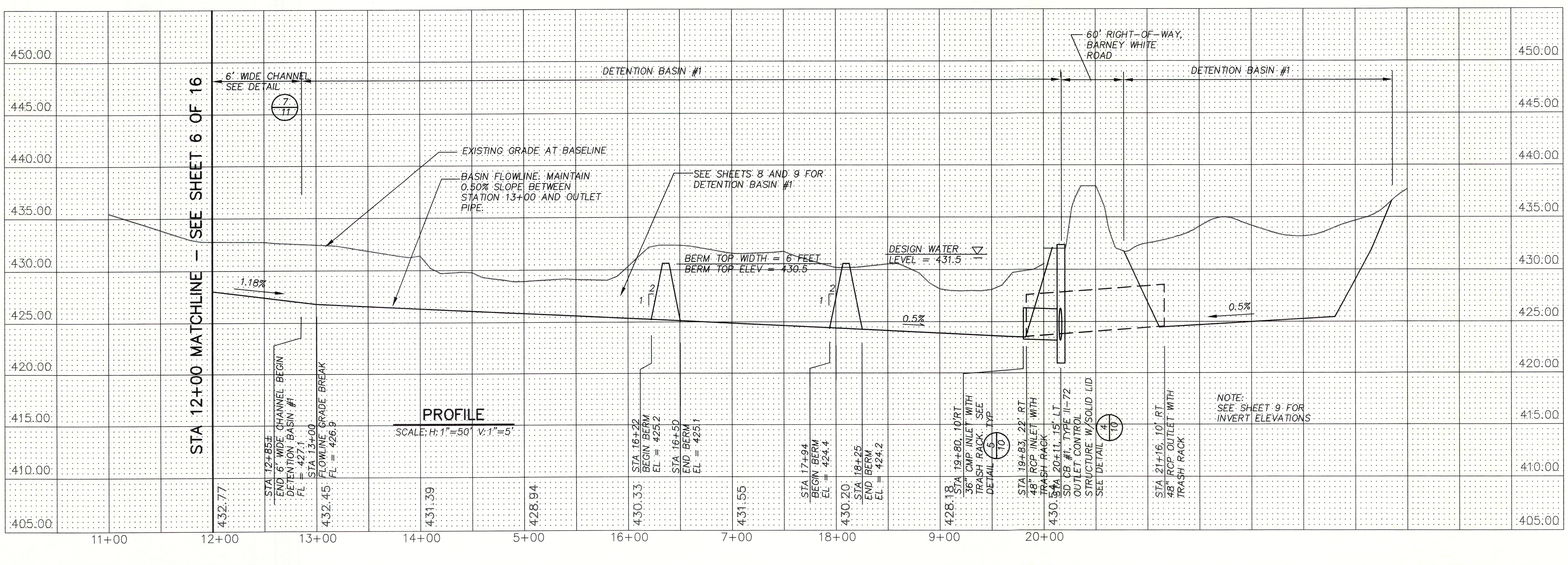
6/16



NOTES:

1. CONTRACTOR TO ENSURE THAT EXISTING FLOW FROM HWY 3 RIGHT-OF-WAY CAN DRAIN TO NEW CHANNEL.
2. CONTRACTOR SHALL STOCKPILE NATIVE TOPSOIL AT VEGETATIVE SOIL (TOPSOIL) STOCKPILE SITE, SEE SHEET 5. ~~TOPSOIL SHALL BE USED FOR LANDSCAPING, SEE SHEET 16.~~
3. ALL EXCAVATED SOIL, WITH THE EXCEPTION OF TOPSOIL SHALL BE PLACED IN THE NEW GENERAL FILL STOCKPILE SITE. SEE SHEET 5.
4. ALL FILL SHALL BE PLACED AS STRUCTURAL FILL AS DEFINED IN THE GEOTECHNICAL NOTES SHEET 2, UNLESS OTHERWISE DIRECTED BY THE ENGINEER OR NOTED ON PLANS.
5. SEE SHEETS 14 AND 15 FOR SECTIONS.

PLAN
SCALE: 1"=50'



PROFILE
SCALE: H: 1"=50' V: 1"=5'

COSMOPOLITAN ENGINEERING GROUP
Civil, Environmental and Recreational Consulting
117 S. 8th Street
Tacoma, WA 98402
(253)272-7220
Fax:(253)272-7250

EXPIRES 1-12-01

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JOB NO. POB002 | DRAWING NO. POB00207

REGIONAL DETENTION FACILITIES
BASIN #1 – PLAN & PROFILE

PORT OF BREMERTON
8850 SW STATE HWY 3
PORT ORCHARD, WA 98367
MR. JEFFERY ROBB (360)674-2381

DESIGNED	LJM
DRAWN	SLW
CHECKED	WSH, JKD
APPROVED	
SCALE	AS NOTED
DATE	JULY 1999
SHEET NO.	C7

7/16

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Appendix D STORM WATER OPERATIONS AND MAINTENANCE MANUAL

P.O. Box 720 ● 10045 Old Frontier Road NW
Silverdale, Washington 98383
(360) 692-5525 ● Seattle (206) 682-5574
www.map-limited.com

ENGINEERING • SURVEYING • PLANNING

Stormwater Maintenance Manual

Inventech Marine Solutions
Port of Bremerton
Site Address: 8651 Mount Jupiter Way SW

Prepared by:

MAP, Ltd.
P.O. Box 720
Silverdale, WA 98383

(360) 692-5525

8-3-21

NOTE: THIS DOCUMENT IS INSCRIBED WITH A DIGITIZED SIGNATURE BY THE ENGINEER AS PROVIDED BY WAC 196-23-070(2)

#6823.00

Manual Purpose:

The purpose of this manual and the enclosed inspection sheets is to provide a maintenance plan to ensure the continued proper operation of all stormwater facilities associated with your property. Lack of maintenance could lead to local flooding, water damage and costly repairs or replacements of these or other infrastructure.

Project Description:

The stormwater system that serves this site was designed to accommodate (see site plan attached):

DESCRIPTION	AREA (S.F.)	AREA (AC.)
Project Lease Area	192,100	4.41
Building Rooftop	58,520	1.3434
Conventional Asphalt on-site	61,830	1.4194
Conventional Asphalt Mount Jupiter Way	36,920	0.6528
Pervious Asphalt on-site	18,930	0.4346
Sidewalk on-site	5,076	0.1165
Sidewalk Mt Jupiter Way	3,992	0.0916
Landscaped on-site	30,585	0.7021
Other pervious on-site	20,229	0.4644

Stormwater System Description:

The stormwater system consists of the following items that are labeled on the enclosed site drawing with the following symbols:

CB: Catch Basin
BP: BioPod™ Water Quality Vaults manufactured by Oldcastle Infrastructure

Maintenance Intervals:

CB: Twice per year (April and September are recommended)
BP: Twice per year (April and September are recommended)

Project Construction Information:

Contractor: TBD

Date of Construction: TBD

Emergency Operations:

24-hour contact

Name: OWNER
Phone: 360-674-7019 x-200

Maintenance Checklist for Catch Basins

#5 – Maintenance Checklist for Catch Basins

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Maintenance Activities and Conditions That Should Exist
A	General					"Dump no pollutants" Stencil or stamp not visible	Stencil or stamp should be visible and easily read	Warning signs (e.g., "Dump No Waste-Drains to Stream") shall be painted or embossed on or adjacent to all storm drain inlets.
M,S	General					Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10 percent.	No trash or debris located immediately in front of catch basin or on grate opening.
M	General					Trash and Debris	Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
M	General					Trash and Debris	Trash or debris in any inlet or outlet pipe blocking more than one-third of its height.	Inlet and outlet pipes free of trash or debris.
M	General					Trash and Debris	Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
M	General					Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
A	General					Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than one-fourth inch (intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
A	General					Structure Damage to Frame and/or Top Slab	Frame not sitting flush on top slab, i.e., separation of more than three-fourth inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Maintenance Activities and Conditions That Should Exist
A	General					Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
A	General					Fractures or Cracks in Basin Walls/ Bottom	Grout fillet has separated or cracked wider than one-half-inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
A	General					Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
M	General					Vegetation	Vegetation growing across and blocking more than 10 percent of the basin opening.	No vegetation blocking opening to basin.
M	General					Vegetation	Vegetation growing in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart.	No vegetation or root growth present.
M	General					Contamination and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants.	No contaminants or pollutants present. (Coordinate removal/cleanup with Department of Ecology Spill Response 800-424-8802.)
A	Catch Basin Cover					Cover Not in Place	Cover is missing or only partially in place.	Any open catch basin requires maintenance. Catch basin cover is closed
A	Catch Basin Cover					Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than one-half-inch of thread.	Mechanism opens with proper tools.
A	Catch Basin Cover					Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
A	Ladder					Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
	Grates					Grate opening Unsafe	Grate with opening wider than seven-eighths of an inch.	Grate opening meets design standards.

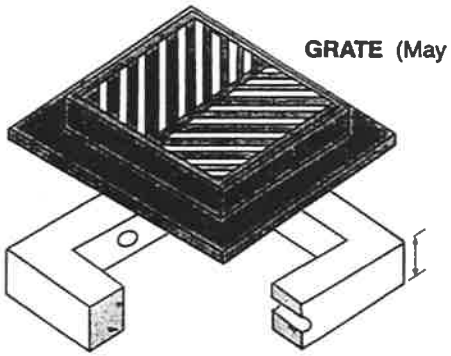
		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Maintenance Activities and Conditions That Should Exist
M,S	Grates					Trash and Debris	Trash and debris that is blocking more than 20 percent of grate surface inletting capacity.	Grate free of trash and debris.
A	Grates					Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

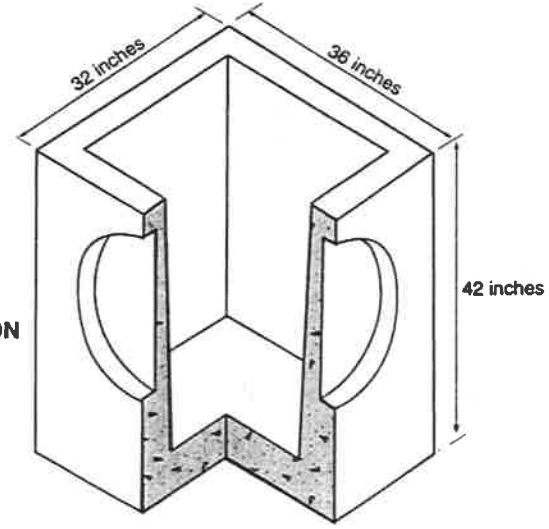
If you are unsure whether a problem exists, please contact a professional engineer.

Key:

(M) Monthly from October through April.
(A) Once in late summer (preferably September)
(S) After any major storm (use 1 inch in 24 hours as a guideline).

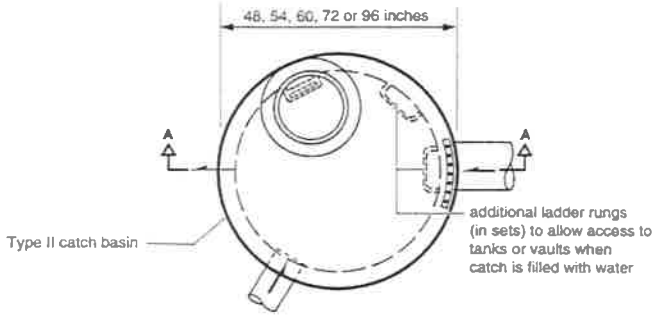
Type I Catch Basin



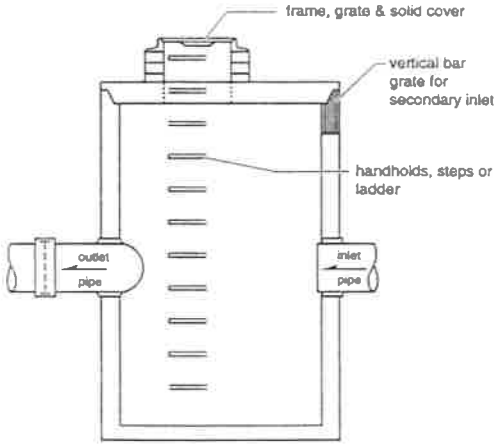


Type II Catch Basin

(Round concrete structure)



PLAN VIEW
not to scale



SECTION A-A
not to scale

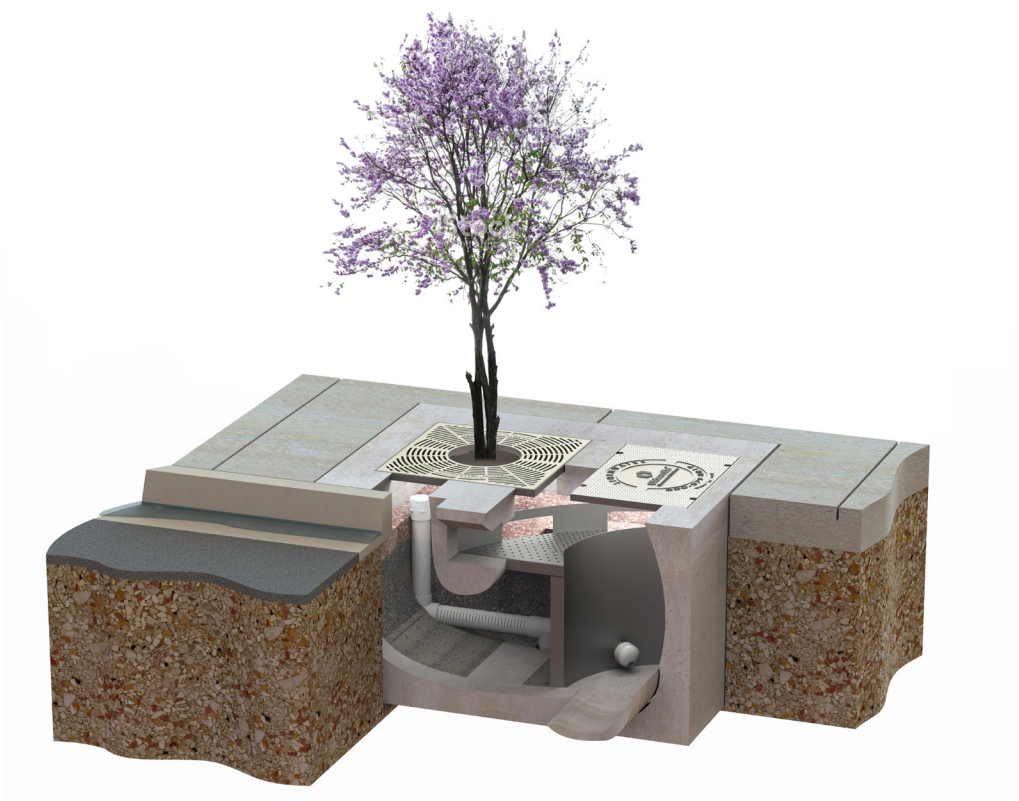
Maintenance Requirements for BioPod™ Water Quality Vaults by Oldcastle Infrastructure

Oldcastle Infrastructure™
A CRH COMPANY

BIOPOD™ SYSTEM

WITH STORMMIX™ MEDIA

Inspection and Maintenance Guide



Water

BioPod™ Biofilter with StormMix™ Biofiltration Media

Description

The BioPod™ Biofilter System (BioPod) is a stormwater biofiltration treatment system used to remove pollutants from stormwater runoff. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater and pollute downstream receiving waters unless treatment is provided. The BioPod system uses proprietary StormMix™ biofiltration media to capture and retain pollutants including total suspended solids (TSS), metals, nutrients, gross solids, trash and debris as well as petroleum hydrocarbons.

Function

The BioPod system uses engineered, high-flow rate filter media to remove stormwater pollutants, allowing for a smaller footprint than conventional bioretention systems. Contained within a compact precast concrete vault, the BioPod system consists of a biofiltration chamber and an optional integrated high-flow bypass with a contoured inlet rack to minimize scour. The biofiltration chamber is filled with horizontal layers of aggregate (which may or may not include an underdrain), biofiltration media and mulch. Stormwater passes vertically down through the mulch and biofiltration media for treatment. The mulch provides pretreatment by retaining most of the solids or sediment. The biofiltration media provides further treatment by retaining finer sediment and dissolved pollutants. The aggregate allows the media bed to drain evenly for discharge through an underdrain pipe or by infiltration.

Configuration

The BioPod system can be configured with either an internal or external bypass. The internal bypass allows both water quality and bypass flows to enter the treatment vault. The water quality flows are directed to the biofiltration chamber while the excess flows are diverted over the bypass weir without entering the biofiltration chamber. Both the treatment and bypass flows are combined in the outlet area prior to discharge from the structure. BioPod units without an internal bypass are designed such that only treatment flows enter the treatment structure. When the system has exceeded its treatment capacity, ponding will force bypass flows to continue down the gutter to the nearest standard catch basin or other external bypass structure.

The BioPod system can be configured as a tree box filter with tree and grated inlet, as a planter box filter with shrubs, grasses and an open top, or as an underground filter with access risers, doors and a subsurface inlet pipe. The optional internal bypass may be incorporated with any of these configurations. In addition, an open bottom configuration may be used to promote infiltration and groundwater recharge. The configuration and size of the BioPod system is designed to meet the requirements of a specific project.

Inspection & Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a regular basis and maintained as necessary to ensure performance and protect downstream receiving waters. Without maintenance, excessive pollutant buildup can limit system performance by reducing the operating capacity of the system and increasing the potential for scouring of pollutants during periods of high flow.

Some configurations of the BioPod may require periodic irrigation to establish and maintain vegetation. Vegetation will typically become established about two years after planting. Irrigation requirements are ultimately dependent on climate, rainfall and the type of vegetation selected.

Maintenance Frequency

Periodic inspection is essential for consistent system performance and is easily completed. Inspection is typically conducted a minimum of twice per year, but since pollutant transport and deposition varies from site to site, a site-specific maintenance frequency should be established during the first two or three years of operation.

Inspection Equipment

The following equipment is helpful when conducting BioPod inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure

Inspection Procedures

BioPod inspections are visual and are conducted without entering the unit. To complete an inspection, safety measures including traffic control should be deployed before the access covers or tree grates are removed. Once the covers have been removed, the following items should be checked and recorded (see form provided on page 6) to determine whether maintenance is required:

- If the BioPod unit is equipped with an internal bypass, inspect the contoured inlet rack and outlet chamber and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Stormwater at (800) 579-8819 to determine appropriate corrective action.
- Note whether the curb inlet, inlet pipe, or – if the unit is equipped with an internal bypass – the inlet rack is blocked or obstructed.
- If the unit is equipped with an internal bypass, observe, quantify and record the accumulation of trash and debris in the inlet rack. The significance of accumulated trash and debris is a matter of judgment. Often, much of the trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted.
- If it has not rained within the past 24 hours, note whether standing water is observed in the biofiltration chamber.
- Finally, observe, quantify and record presence of invasive vegetation and the amount of trash and debris and sediment load in the biofiltration chamber. Erosion of the mulch and biofiltration media bed should also be recorded. Sediment load may be rated light, medium or heavy depending on the conditions. Loading characteristics may be determined as follows:
    - Light sediment load – sediment is difficult to distinguish among the mulch fibers at the top of the mulch layer; the mulch appears almost new.
    - Medium sediment load – sediment accumulation is apparent and may be concentrated in some areas; probing the mulch layer reveals lighter sediment loads under the top 1” of mulch.
    - Heavy sediment load – sediment is readily apparent across the entire top of the mulch layer; individual mulch fibers are difficult to distinguish; probing the mulch layer reveals heavy sediment load under the top 1” of mulch.

Often, much of the invasive vegetation and trash and debris may be removed manually at the time of inspection if a separate maintenance visit is not yet warranted.

Maintenance Indicators

Maintenance should be scheduled if any of the following conditions are identified during inspection:

- The concrete structure is damaged or the tree grate or access cover is damaged or missing.
- The curb inlet or inlet rack is obstructed.
- Standing water is observed in the biofiltration chamber more than 24 hours after a rainfall event (use discretion if the BioPod is located downstream of a storage system that attenuates flow).
- Trash and debris in the inlet rack cannot be easily removed at the time of inspection.
- Trash and debris, invasive vegetation or sediment load in the biofiltration chamber is heavy or excessive erosion has occurred.

Maintenance Equipment

The following equipment is helpful when conducting BioPod maintenance:

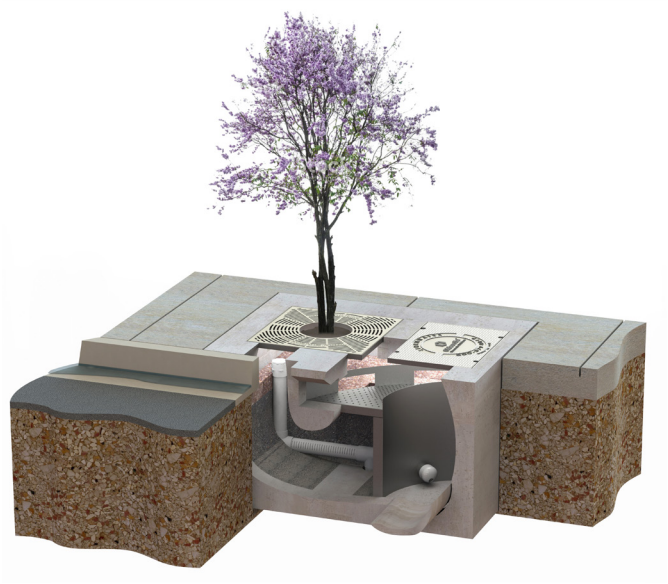
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Rake, hoe, shovel and broom
- Bucket
- Pruners
- Vacuum truck (optional)

Maintenance Procedures

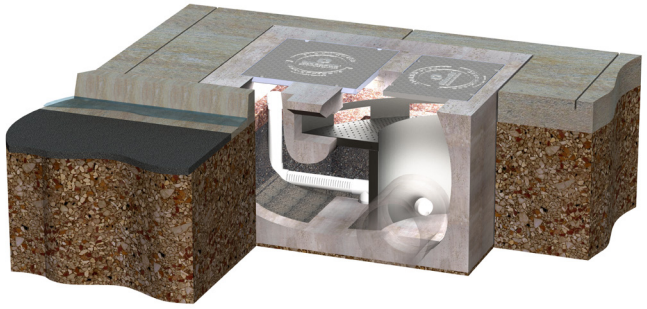
Maintenance should be conducted during dry weather when no flows are entering the system. All maintenance may be conducted without entering the BioPod structure. Once safety measures such as traffic control are deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove all trash and debris from the curb inlet and inlet rack manually or by using a vacuum truck as required.
- Remove all trash and debris and invasive vegetation from the biofiltration chamber manually or by using a vacuum truck as required.
- If the sediment load is medium or light but erosion of the biofiltration media bed is evident, redistribute the mulch with a rake or replace missing mulch as appropriate. If erosion persists, rocks may be placed in the eroded area to help dissipate energy and prevent recurring erosion.
- If the sediment load is heavy, remove the mulch layer using a hoe, rake, shovel and bucket, or by using a vacuum truck as required. If the sediment load is particularly heavy, inspect the surface of the biofiltration media once the mulch has been removed. If the media appears clogged with sediment, remove and replace one or two inches of biofiltration media prior to replacing the mulch layer.
- Prune vegetation as appropriate and replace damaged or dead plants as required.
- Replace the tree grate and/or access covers and sweep the area around the BioPod to leave the site clean.
- All material removed from the BioPod during maintenance must be disposed of in accordance with local environmental regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.

Natural, shredded hardwood mulch should be used in the BioPod. Timely replacement of the mulch layer according to the maintenance indicators described above should protect the biofiltration media below the mulch layer from clogging due to sediment accumulation. However, whenever the mulch is replaced, the BioPod should be visited 24 hours after the next major storm event to ensure that there is no standing water in the biofiltration chamber. Standing water indicates that the biofiltration media below the mulch layer is clogged and must be replaced. Please contact Oldcastle Infrastructure at (800) 579-8819 to purchase the proprietary StormMix™ biofiltration media.

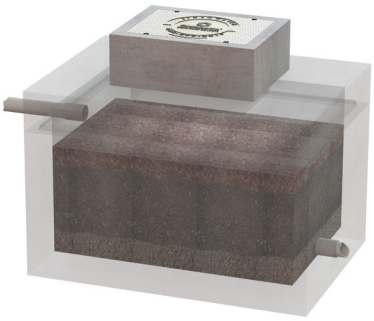


BioPod Tree Module



BioPod Media Module

BioPod Planter Module



BioPod Media Vault

BioPod Inspection & Maintenance Log

BioPod Model_____ **Inspection Date**_____

Location_____

Condition of Internal Components Notes:

☐ Good ☐ Damaged ☐ Missing

Curb Inlet or Inlet Rack Blocked Notes:

☐ Yes ☐ No

Standing Water in Biofiltration Chamber Notes:

☐ Yes ☐ No

Trash and Debris in Inlet Rack Notes:

☐ Yes ☐ No

Trash and Debris in Biofiltration Chamber Notes:

☐ Yes ☐ No

Invasive Vegetation in Biofiltration Chamber Notes:

☐ Yes ☐ No

Sediment in Biofiltration Chamber Notes:

☐ Light ☐ Medium ☐ Heavy

Erosion in Biofiltration Chamber Notes:

☐ Yes ☐ No

Maintenance Requirements

☐ **Yes - Schedule Maintenance** ☐ **No - Schedule Re-Inspection**

DATE	INSPECTED BY	TASK PERFORMED	COMMENT

DATE	INSPECTED BY	TASK PERFORMED	COMMENT