LAND TECHNOLOGIES, INC.
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MAKING A "WAY" OUT OF "NO WAY"

104th St LLC

unaddressed-north & east of 4131 104th St NE after BLA

PN PA22041

1st: October 2022

2nd: May 2023

Stormwater Site Plan Report for 104th Rezone Dell's Nursery

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Acronyms

The following acronyms and abbreviations may or may not be called out within the body of this report.

- ASTM - American Society for Testing and Materials
- BMPs - Best Management Practices
- CB - Catch Basin
- CAO - Critical Areas Ordinance
- CESCL - Certified Erosion and Sediment Control Lead
- DOE - Department of Ecology
- EDDS - Engineering Design & Development Standards
- FEMA - Federal Emergency Management Agency
- HSPF - Hydrological Simulation Program—Fortran
- LiDAR - Light Detecting And Ranging
- LDA - Land disturbing activity
- LID - Low Impact Development
- LID Manual - DOE 2005 LID Technical Guidance Manual for Puget Sound
- MRs - Minimum Requirements (for Stormwater Management)
- MS4 - Municipal Separate Storm Sewer System
- MSL - Mean Sea Level
- NAVD88 - North American Vertical Datum of 1888
- NGVD29 - National Geodetic Vertical Datum of 1929
- NPDES - National Pollutant Discharge Elimination System
- NRCS - Natural Resources Conservation Service
- NPGIS - Non-Pollutant Generating Impervious Surface
- O&M - Operations and Maintenance
- PGIS - Pollutant Generating Impervious Surface
- PGPS - Pollutant Generating Pervious Surface
- PLSS - Public Land Survey System
- POC - Point of Compliance
- RCW - Revised Code of Washington
- ROW - Right-of-Way
- SCDM-2010 - Snohomish County 2010 Drainage Manual
- SMMWW - DOE 2005 Stormwater Management Manual for Western Washington
- SWPPP - Stormwater Pollution Prevention Plan
- TDA - Threshold Discharge Area
- TESC - Temporary Erosion and Sediment Controls
- USDA - United States Department of Agriculture
- US EPA - United States Environmental Protection Agency
- WSDOT - Washington State Department of Transportation
- WWHM - Western Washington Hydrology Model

Section 1 – Report Summary

1.1 Project Description

104th St LLC is proposing the development of 3.19-*acres* of land in northwest Marysville, WA near 104th St NE. The proposed development will be warehouse/office facilities.

The parcel is currently undeveloped and heavily vegetated with grasses, bushes, shrubs and variable diameter trees. Quilceda Creek and significant Critical Area Buffers border the property on the west side.

The development of the parcel will result in two office/warehouse commercial structures with drive aisle, parking areas and stormwater management systems.

The site will be accessed from 104th St NE. No right of way dedication is required for 104th St NE.

The 2019 DOE Stormwater Management Manual for Western Washington will be used for stormwater management. Stormwater management will rely largely on infiltration of treated stormwater.

Highly permeably sandy soils area found throughout the site. These sandy soils are representative of Vashon Recessional Outwash deposits.

Per NRCS mappings, type "B/D" Norma Loam soils and type "A" Ragnar Fine Sandy Loam soils are found throughout the site. Soils investigation performed by Cobalt Geosciences, LLC corroborates the NRCS findings. Groundwater is assumed to be located around 30 *feet* BPG.

The entire developable project area is in a single natural discharge area with a single discharge location to the tributary of Quilceda Creek. Stormwater BMPs will be employed to mitigate polluted and unpolluted surface water flows.

1.2 Project Data Summary

Existing and proposed project areas are presented for determination of stormwater management requirements based on prescribed thresholds as outlined in the Marysville Municipal Code (MMC 22C) and the 2019 SMMWW Vol-1, Ch-2, Section 2.4 are summarized in the following tables.

Table 1 - Project Parcel Summary

Project Data:	
Applicant	104th St LLC
Site Owner	104th St LLC
Project Name	104th Rezone Dell's Nursery
Project T.S.R. Location	Twn 30 N, Rng 5 E, Sec 16, Qtr-NW
Project Address	unaddressed-north & east of 4131 104th St NE after BLA
Parcel ID(s)	300516-002-001-00, 300516-002-003-00
Watershed	Snohomish
Basin	Quilceda Creek
Sub-Basin	Hayho Creek
WRIA Number	7
Analysis Standard	2019 DOE SMMWW

Table 2 - Project Area Analysis & Activities Summary

Existing Conditions:		
Total Site Area	139,003	sf (3.19 ac)
Existing Impervious Area	0	sf (0.00 ac) 0%
Proposed Activity:		
Proposed Activity	Commercial Site (Office/Warehouse)	
Total Proposed Disturbance Area	76,310	sf (1.75 ac)
Proposed Grading Area	76,310	sf (1.75 ac)
Proposed New NPGIS (roof)	31,492	sf (0.72 ac)
Proposed New PGIS (Road and Driveway/Parking)	30,891	sf (0.71 ac)
Proposed Replaced Impervious Area	0	sf (0.00 ac)
Native Vegetation convert to Lawn	0	sf (0.00 ac)
Native Vegetation convert to Pasture	0	sf (0.00 ac)
Total New Impervious Area	62,383	sf (1.43 ac)
Total Site Impervious Area (new+exist)	62,383	sf (1.43 ac)
Grading is ≤ 2 feet from P/L	No	
Any excavation 4+' at <1:1 slope to P/L	No	
Fill Slopes 4+' and >33% slope	No	

Section 2 - Minimum Requirements

2.1 Assessment of Minimum Requirements and Thresholds

Minimum requirements and thresholds are established by City of Marysville Municipal Code 14.15.050 – Minimum Requirements. Minimum Requirements for new development and Redevelopment are based on a development's disturbance area. Existing and proposed project areas for determination of stormwater management requirements are presented in Table 2.

The existing impervious area is less than 35% so this project qualifies as 'new development'. The proposed condition of the fully developed site will have impervious area in excess of 5,000 sf. This requires construction activities and stormwater management to comply with Minimum Requirements 1 through 9. A full construction SWPPP is also required.

Minimum Requirements per the SCMD:

MR-1: Prepare Stormwater Site Plan. MMC 14.15.050 (1)

MR-2: Stormwater Pollution Prevention Plan (SWPPP). MMC 14.15.050 (2)

MR-3: Water pollution source control for new development. MMC 14.15.050 (3)

MR-4: Preservation of natural drainage systems and outfalls. MMC 14.15.050 (4)

MR-5: On-site stormwater management. MMC 14.15.050 (5)

MR-6: Runoff treatment. MMC 14.15.050 (6)

MR-7: Flow control requirements. MMC 14.15.050 (7)

MR-8: Detention or treatment in wetlands and wetland buffers. MMC 14.15.050 (8)

MR-9: Inspection, operation and maintenance requirements. MMC 14.15.050 (9)

Each Minimum Requirements is described in the following sections. There are no additional requirements to be met.

2.2 MR #1: Preparation of Stormwater Site Plans

This document is the Stormwater Site Plan Report that addresses the requirements of MR-1. This section presents the portion of the Stormwater Site Plan that includes recommendations, calculations, and procedures required to adhere to Minimum Requirement #1. The evaluation of the existing site conditions follows.

2.2.1 Site Location

The site is located in the NW quarter of Section 16 of Township 30 North, Range 5 East. The street address is unaddressed-north & east of 4131 104th St NE after BLA and the parcel is located on the north side of 136th St NE. See Figure 1 for a vicinity map.

2.2.2 Site Description, Existing Conditions

The project site is 3.19-*acres* parcel. The parcel is owned by 104th St LLC. The Snohomish County parcel number is 300516-002-001-00, 300516-002-003-00. They are zoned R4.5 and a rezone proposal to General Commercial has been submitted.

The parcel is undeveloped forest. The existing drainage system(s) are undetermined but largely surface runoff flows west to an offsite Type F pond type feature and some infiltration.

All maps and figures are presented in the Support Data section of this document.

A vicinity map that shows the site location is shown as Figure 1.

A site map that shows the property lines is shown in Figure 2.

A topographic map that shows the site boundaries, study area boundaries, and the downstream flow-paths is also presented in Figure 3.

2.2.3 Existing Basin Analysis

The project is defined by the development within the subject parcel. Existing project flow paths are shown in Figure 2.

The study area is located in the Hayho Creek sub-basin of the Quilceda Creek Basin in the Snohomish watershed (WRIA-7), which drains to the Puget Sound.

All existing flow assessment and site related basin delineations were established by tracing analysis of a LIDAR surface model.

2.2.4 Other Information on the Study Area

The site is not in or adjacent to a USEPA Sole Source Aquifer.

The site is not in a well-head protection area.

The site is not in a floodway or floodplain.

2.2.5 Critical Areas

A site reconnaissance performed by Sewell Wetland Consulting, Inc. in 2020 indicated that critical areas are found along western boundary of the site. A riverine type wetland is along the western boundary of the site. The wetland is Category II and carries a 100' buffer. The tributary of Quilceda Creek that passes through the site. The tributary is located off-site within the wetland.

2.2.6 Topography

The site and surrounding topography was analyzed using survey topographic points provided by the Puget Sound Lidar Consortium. A 3D surface model was generated.

The site has mostly flat slopes with slightly sloping downward to the west. There are steep slopes extending downward to the west near property lines.

Slopes average in the range of 0 to 50 percent for the majority of the developable area. The site has an average slope of 17.36%.

2.2.7 Soils

Per NRCS mappings, type "B/D" Norma loam are found through the west of the site. Type "A" Ragnar Fine Sandy Loam are located in the east portion of the site. Norma loam soils have a 0-10 *inch* first layer of fine ashy loam with the remaining profile being sandy loam. Ragnar fine sandy loam soils have 0 to 24 inch first layer of ashy sandy loam with the remaining profile being loamy sand.

Soils investigation performed by Cobalt Geosciences, LLC corroborates the NRCS findings. Groundwater is assumed to be located around 30 *feet* BPG. Grain Size Analysis infiltration testing by Cobalt yielded a 3 to 5 inch/hour infiltration rate. 4 inch/hour long-term infiltration rate will be used.

Detailed physical and chemical properties of these soils are presented in Section 4.1. The NRCS mapping can be seen in Figure 5.

2.2.8 Field Inspection

The site has not been visited recently. All site evaluation conducted per remote sensing.

2.2.9 Upstream Analysis

A relative high point at 66 *feet* MSL is located offsite directly west of the site at the centerline of BNSF R/R. The upstream area to the site is directly to the east of the site from Burlington Northern Santa FE Railroad. The upstream area is around 0.8 acres in size.

2.2.10 Downstream Analysis

The downstream area was established by tracing analysis of a LIDAR surface model and evaluation of various GIS data, aerial imagery, and City of Marysville Drainage Inventory. The development area flows across the property boundary line to the west and to a tributary of Quilceda Creek. Stormwater along the tributary of Quilceda Creek crosses 103rd St NE through an existing culvert. After traveling around 800 ft, the tributary of Quilceda Creek becomes West Fork Quilceda Creek. Quilceda Creek drains to the Puget Sound.

Figure 3 shows a portion of the downstream flow path.

2.3 MR #2: Stormwater Pollution Prevention Plans (SWPPPs)

MMC 14.15.050 (2) specifies the requirements for development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. Volume I, Chapter 2.5.2 of the 2019 SMMWW specifies that all new development and redevelopment implement a Stormwater Pollution Prevention Plans (SWPPP), which is a list of 13 elements that present measures and methods for all permanent and temporary erosion and sediment control (TESC), pollution prevention, inspection/monitoring activities, and recordkeeping required during the proposed construction project.

Based on the MR#2 thresholds, this project generates more than 2,000 *square feet* of impervious area, so a full SWPPP is required. Required elements for the SWPPP:

- SWPPP element 1: Preserve vegetation/mark clearing limits
- SWPPP element 2: Establish construction access
- SWPPP element 3: Control flow rates
- SWPPP element 4: Install sediment controls
- SWPPP element 5: Stabilize soils
- SWPPP Element 6: Protect slopes
- SWPPP element 7: Protect permanent drain inlets
- SWPPP element 8: Stabilize channels and outlets
- SWPPP element 9: Control pollutants
- SWWP element 10: Control dewatering
- SWPPP element 11: Maintain best management practices
- SWPPP element 12: Manage the project
- SWPPP element 13: Protect On-Site Stormwater Management BMPs for Runoff from Roofs and Other Hard Surfaces

The SWPPP is assembled as a separate document for portability and reproduction purposes. The document is titled "**Stormwater Pollution Prevention Plan for Bayview Electric**", dated 3 May 2023. This document will be provided with Construction Plan Submittal.

2.4 MR #3: Source Control of Pollution

MMC 14.15.050 (3) specifies the requirements for water pollution source control for new development or redevelopment activities in accordance with Volume IV of the SMMWW. These activities are primarily commercial industrial developments that represent significant pollutant generation potential and the associated source control BMPs are designed to suit those activities.

Per Chapter 2.5.3, MR#3 does not apply to this industrial development. Hence such source controls are not specified for this project.

2.5 MR #4: Preservation of Natural Drainage Systems and Outfalls

MMC 14.15.050 (4) specifies the requirements for preservation of natural drainage systems or outfalls for all new development and redevelopment activities under Minimum Requirement 4 in the 2019 SMMWW.

Natural drainage patterns as they once existed shall be retained. Existing conditions experience a sheet drainage pattern to the site's west property boundary. Stormwater generated onsite reaches the property boundary through surface runoff during only extreme storm events (exceeding 100-year storm).

2.6 MR #5: On-Site Stormwater Management

MMC 14.15.050 (5) specifies requirements for on-site stormwater BMPs. This requirement mandates that on-site stormwater runoff be infiltrated, dispersed, and/or retained to the maximum extent feasible without causing flooding or erosion impacts. Projects triggering Minimum Requirements 1 through 5 must use On-site stormwater management BMPs from List #1 for all surfaces or demonstrate compliance with the LID Performance Standard. Projects triggering Minimum Requirements 1 through 9 must meet the requirements of Table 2.5.1 in Vol. 1 of the 2019 SMMWW. Table 2.5.1 specifies the requirements for new or redevelopment depending on UGA and parcel size to meet the requirements of the LID Performance Standard and/or List #2. List #1 and List #2 specify stormwater BMPs in order of preference. The first BMP determined feasible is required.

This project trigger MR's 1-9. This project is within the City's UGA. This project is required to adhere to the LID Performance Standard or List #2 per Table 2.5.1.

List #1 and #2 contain appropriate BMPs to mitigate a particular developed surface. The surfaces included in the list are Lawn and Landscaped Areas, Roofs, and other hard surfaces (road/driveway/parking).

> Lawn/Landscape is required to utilize BMP T5.13, Post-Construction Soil Quality and Depth.
>
> Roofs are required to employ BMP T5.30 Full Dispersion or Downspout Infiltration, Rain Gardens or Bioretention, BMP T5.10A Downspout Dispersion Systems, or perforated stub-out connections. The first feasible BMP in this list must be used.
>
> Other Hard surfaces (Roads, Driveways, Parking Lots, Etc.) must utilize BMP T5.30 Full Dispersion, BMP T5.15 Permeable Pavement, Bioretention, Sheet Flow Dispersion, or Concentrated Flow Dispersion. The first feasible BMP in this list must be used.
>
> Lawn/landscape will utilize BMP T5.13, Post Construction Soil Quality and Depth.

Roofs will not be able to provide BMP T5.30 Full Dispersion. Full Dispersion requires 100 *foot* flow paths within native areas. The project will not be able to maintain 65% open space.

Roofs will be able to provide BMP T5.10A Full Infiltration. Infiltration requires suitable soils with depth. Onsite soils of medium sand are expected. Rooftops will be conveyed to onsite infiltration trenches sized in accordance with BMP T5.10A with 30-lf of trench per 1,000sf of rooftop. 945 lf of trench will be provided for the full infiltration of rooftop generated stormwater. Land segments fully infiltrated by BMPs will be discounted from the stormwater model.

Road and Driveway/Parking will be routed to Bioretention areas, BMP T7.30. (See BMP T7.30 and Section 3.4 for specific design criteria) The Bioretention cells will treat stormwater through filtering, phytoremediation, and microbial action from within the compost.

A combination of the bioretention cell and rockbed will treat 100% of incoming stormwater generated from the PGIS (Per MR#6). See Minimum Requirement #6.

Permeable pavement may not be used as due to the site use is a commercial/industrial activity defined by 40 CFR 122.26(b)(14).

A site plan showing the stormwater management and development can be seen in Figure 4.

2.7 MR #6: Runoff Treatment

Minimum Requirement #6 in MMC 14.15.050 (6) specifies the requirements for providing runoff treatment. The threshold for requiring a treatment BMP is 5,000 *square feet* of PGIS (Pollution Generating Impervious Surface) or a total of more than ¾ of an acre of PGPS (Pollution Generating Pervious Surface).

This project is expected to generate 30,891 *square feet* (0.71 *acres*) of PGIS based on road, driveway, sidewalk, and parking areas, therefore treatment facility BMPs are required for this project.

Runoff treatment facility selection is outlined in Vol. I, Ch. 4.2, Step V of the 2019 SMMWW. Step V outlines the treatment facility selection flow chart based on the intended use of a project. Treatment selection is based on if the site is a high-use site, if the downstream receiving waters are phosphorous sensitive, and/or if the site is required to provide enhanced treatment. The definitions of high-use, phosphorous control, and enhanced treatment can be found in Step V in Section 4.2 of the 2019 SMMWW.

The project is not a high use site and infiltration is practicable for the site.

The project is not required to treat for phosphorous.

Enhanced treatment is not required for the project.

Basic treatment is provided through the use of a bioretention facility per Vol. III Section 3.3.12 of the 2019 SMMWW. The bioretention specified will provide enhanced treatment. The bio-cell treats stormwater through the infiltration of stormwater through soils and their ability to absorb pollutants. See Vol III. Section 3.3.12 of the 2019 SMMWW for specific soil design criteria.

The bioretention cell mitigates polluted stormwater through physical, chemical and biological treatment processes. The treatment process will break down heavy metals that are not easily separated by physical means. Stormwater percolates through compost amended soils and plantings to obtain treatment. Stormwater flows through this part of the cell at a rate of 4.0 *inches/hour*. Infiltration is allowed to occur below the bio-cells. The total percolated runoff through the bio-cell's amended soils is well over the 91% total runoff volume treatment requirement. See Section 7.

2.8 MR #7: Flow Control

Minimum Requirement #7 in MMC 14.15.050 (7) specifies the requirements for runoff flow control. The threshold for requiring Minimum Requirement #7 is 5,000 *square feet* of impervious surface. Flow control shall be provided if the project creates more than 10,000 *square feet* of effective impervious area in a threshold discharge area, converts ¾ of an acre or more of native vegetation to lawn, 2.5 *acres* or more native vegetation is converted to pasture, or a combination of impervious and converted pervious surfaces cause a 0.1 *cfs* increase in the 100-*year* flow frequency from a continuous simulation runoff model.

The project exceeds this requirement and is required to provide flow control. Flow Control is provided by infiltration. A small portion of a drive aisle bypasses facilities for infiltration. A small portion of pasture also is treated as bypass. The bypassed area flows to the existing pathway as has existed in years past. Separation limits prohibit this stormwater from being infiltrated. See Figure 6 for delineation of areas unable to drain to bioretention cell for full infiltration.

The project uses bioretention cells to detain and treat all incoming stormwater flow from PGIS. The bioretention cell marginally detains stormwater but provides 100% treatment of stormwater generated by PGIS. The bio-cells are comprised of 1.5 *feet* of amended soils, 0.5 *feet* of clean chip filter and 2.0 *feet* or rock storage. The bio-cell utilizes a 0.75 *foot* ponded area with 0.5 *feet* of freeboard to allow stormwater to infiltrate through the amended soils.

Table 3 – Bioretention Cells Specification

	min. Req'd Size	Side Slope	Free Board	Riser Height	Compost Amended Soils X	Sand Y	Gravel Z
Cell A	560.0 sf	0.5	0.5 ft	1.0 ft	1.5 ft	0.5 ft	2.0 ft
Cell B	500.0 sf	0.5	0.5 ft	1.0 ft	1.5 ft	0.5 ft	2.0 ft
Cell C	500.0 sf	0.5	0.5 ft	1.0 ft	1.5 ft	0.5 ft	2.0 ft

Roofs will be able to provide BMP T5.10A Full Infiltration. Infiltration requires suitable soils with depth. Onsite soils of medium sand are expected. A total of 945 lineal feet of Infiltration trench will be provided for full infiltration of the stormwater generated by the rooftops.

See Section 7 for bio-cell and rooftop infiltration modeling parameters. See Figure 6 for Basin Mapping.

2.9 MR #8: Wetlands Protection

MMC 14.15.050 (8) specifies requirements for discharge of stormwater in wetlands and wetland buffers as well as discharge of stormwater to a stream.

Since there is no detention or treatment in the critical areas, MR-8 does not apply to this project.

2.10 MR # 9: Operation and Maintenance

Minimum Requirement #9 specified MMC 14.15.050 (9) contains requirements for inspection, operation and maintenance of stormwater facilities and BMPs. Specific maintenance standards and requirements are outlined in Volume V of the 2019 SMMWW. The 2019 SMMWW requires the regular maintenance and inspection of drainage facilities.

For portability and reproduction purposes, the Operations and Maintenance Manual is presented in a separate stand-alone document titled "**Operations and Maintenance Manual for 104th Rezone Dell's Nursery"**, dated **3 May 2023.** This document will be provided with the construction plan submittal.

Section 3 - Maps & Figures

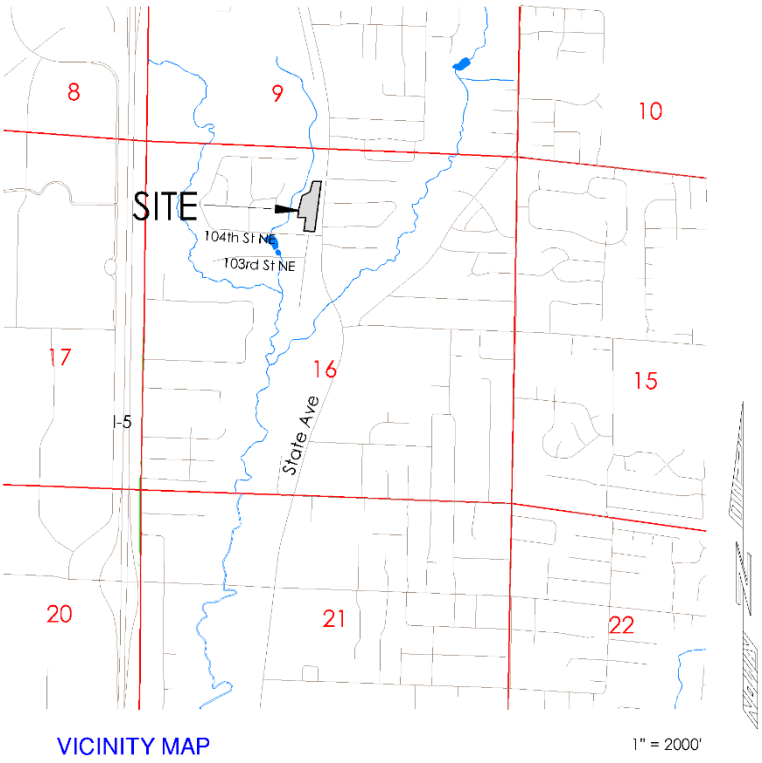

Figure 1 - Vicinity Map

Figure 2 - Existing Conditions (not to scale)

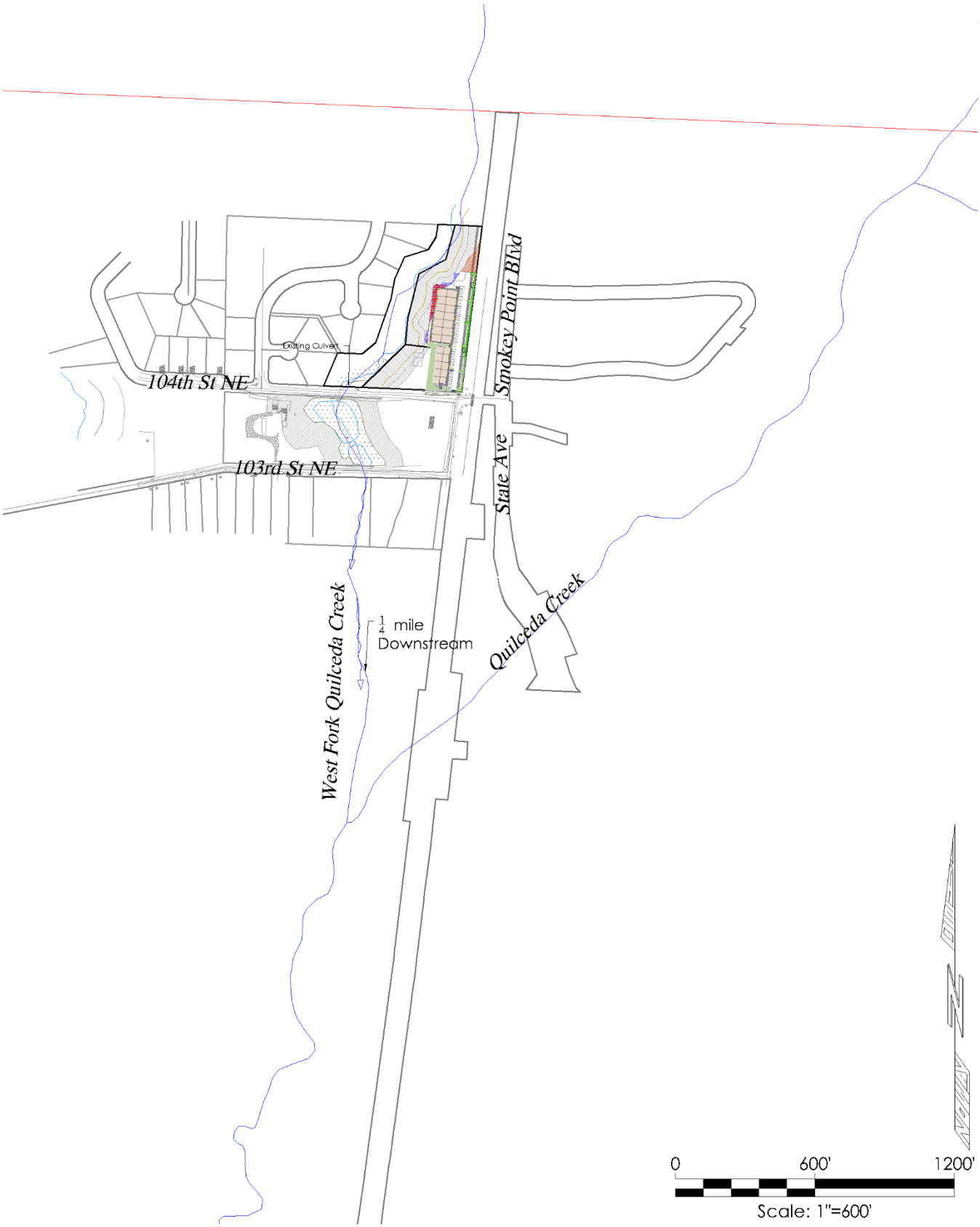

Figure 3 – Downstream Flow Path

Figure 4 - Site Plan

Figure 5 – Soil Map (Not to Scale)

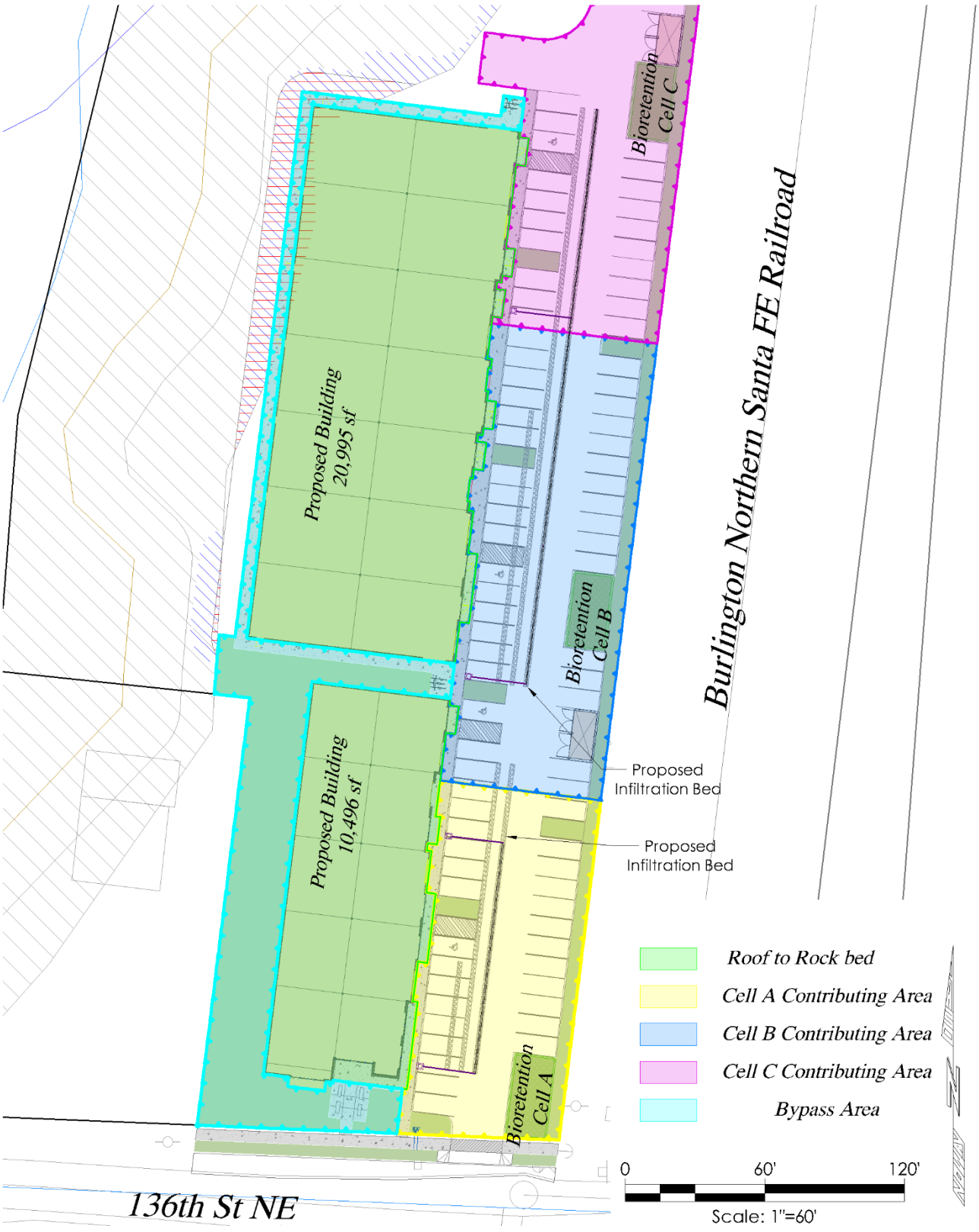

Figure 6 - Basin Map

Section 4 - Support Data

4.1 Soils Data

39—Norma loam

Map Unit Setting
National map unit symbol: 2hyx
Elevation: 0 to 1,000 feet
Mean annual precipitation: 35 to 60 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Prime farmland if drained
Map Unit Composition
*Norma, undrained, and similar soils:*85 percent
*Minor components:*15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Norma, Undrained
Setting
*Landform:*Drainageways, depressions
*Parent material:*Alluvium
Typical profile
H1 - 0 to 10 inches: ashy loam
H2 - 10 to 28 inches: sandy loam
H3 - 28 to 60 inches: sandy loam
Properties and qualities
*Slope:*0 to 3 percent
*Depth to restrictive feature:*More than 80 inches
*Drainage class:*Poorly drained
*Capacity of the most limiting layer to transmit water (Ksat):*Moderately high to high (0.57 to 1.98 in/hr)
*Depth to water table:*About 0 inches
*Frequency of flooding:*None
*Frequency of ponding:*Frequent
Available water supply, 0 to 60 inches: Moderate (about 9.0 inches)
Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F002XA007WA - Puget Lowlands Wet Forest
Forage suitability group: Wet Soils (G002XN102WA)
Other vegetative classification: Wet Soils (G002XN102WA)
Hydric soil rating: Yes
Minor Components
Terric medisaprists, undrained
*Percent of map unit:*5 percent
*Landform:*Depressions
*Other vegetative classification:*Wet Soils (G002XN102WA)
Hydric soil rating: Yes

Bellingham, undrained
*Percent of map unit:*5 percent
*Landform:*Depressions
*Other vegetative classification:*Wet Soils (G002XN102WA)
Hydric soil rating: Yes
Norma, drained
*Percent of map unit:*5 percent
*Landform:*Depressions
*Other vegetative classification:*Seasonally Wet Soils (G002XN202WA)
Hydric soil rating: Yes

57—Ragnar fine sandy loam, 0 to 8 percent slopes

Map Unit Setting
National map unit symbol: 2hzk
Elevation: 300 to 1,000 feet
Mean annual precipitation: 35 to 65 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 210 days
Farmland classification: All areas are prime farmland
Map Unit Composition
*Ragnar and similar soils:*100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ragnar
Setting
*Landform:*Outwash plains
*Parent material:*Glacial outwash
Typical profile
H1 - 0 to 2 inches: ashy fine sandy loam
H2 - 2 to 24 inches: ashy sandy loam
H3 - 24 to 60 inches: loamy sand
Properties and qualities
*Slope:*0 to 8 percent
*Depth to restrictive feature:*20 to 40 inches to strongly contrasting textural stratification
*Drainage class:*Well drained
*Capacity of the most limiting layer to transmit water (Ksat):*High (1.98 to 5.95 in/hr)
*Depth to water table:*More than 80 inches
*Frequency of flooding:*None
*Frequency of ponding:*None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)
Interpretive groups
Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F002XA004WA - Puget Lowlands Forest
Forage suitability group: Droughty Soils (G002XN402WA)
Other vegetative classification: Droughty Soils (G002XN402WA)
Hydric soil rating: No

Section 5 Works Cited

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Sewall Wetland Consulting, Inc. (2020). *BLA Critical Areas Report - Parcels # 30051600200100, 200 & 300 SWC Job #20-149.* Fall City .

Snohomish County Planning and Development Services. (2007, October 1). Aquifer Recharge/Wellhead Protection. Everett, WA.

Snohomish County Surface Water Management Division. (2002, December). Snohomish UGA Drainage Needs Report. Everett, Washington.

5.1 Topographic Data

- The various on and off site topography, utilities, and drainage elements were professionally surveyed by Pacific Coast Surveying in 2015.
- Snohomish County 2003 LiDAR survey was used to augment the existing site topography and the downstream and surrounding areas.

The modeled coordinate system:
Lateral - Washington State Plan Plane - North, FIPS 4601;
Vertical – NAVD 88

Section 6 - Continuous Simulation Modeling

6.1 Continuous Simulation Background

HSPF based continuous simulation modeling was used to evaluate the hydrologic performances of the pre-developed and developed sub-basins in order to accurately assess flow rates.

The currently adopted continuous simulation models use the HSPF (Hydraulic Simulation Program in FORTRAN) software engine. The HSPF model uses a robust and detail accounting of the 'water budget', including evaporation, evapotranspiration, interception, interflow, and groundwater. The modeling accounts for and assesses land segment areas that include vegetation or impervious cover, soil types, and slopes. The modeling also uses utilized over 50 years of continuous rainfall data (precipitation) and evaporation data for the area. The HSPF continuous modeling is considered the best available science for hydrologic analysis.

6.2 Modeling Methodology

HSPF modeling was managed via the Western Washington Hydrology Model (WWHM) interface program. The current professional version of WWHM by Clearcreek Solutions, Inc., WWHM-2012 was used. The current data precipitation and evaporation set provided by DOE with the WWHM-2012 software interface was used that includes quantized data in 15-minute time steps from October 1948 to October 2009.

The WWHM program comes packaged with generic, well considered HSPF modeling parameters. These settings allow for the modeling of the majority of the topological conditions found in the Puget Sound area. Where conditions fall reasonably outside the range of the default HSPF parameters, adjustments should be made to more accurately reflect those conditions. These is generally limited to the pervious land segments (IMPLNDS) and are mostly limited to slopes (SLSUR), infiltration rates (INFILT), and length of flow path (LSUR). For this project, HSPF parameters were not adjusted to reflect site conditions.

6.2.1 Existing Conditions

The surface vegetative cover is assumed fully forested with an average slope of 1% in the area of development, based on the LIDAR based TIN analysis. The LIDAR model represents the pre-graded conditions and is in accordance with the predeveloped requirements to be represented as native vegetation and soils that existed at a site prior to the influence of Euro-American settlement.

The NRCS soil mapping of Norma Loam within the modeled area is Type B/D hydrologic soils by NRCS and DOE.

6.2.2 Developed Conditions

Default mapping for flat road was used for the road, driveway, and parking areas. The intent of the modeling of this site was to determine the infiltration of the bio-retention cell. Flow control modeling took place for the bypass area that is unable to be introduced to street system or infiltrate due to separation from groundwater.

The bio-cell is to be placed in fill that is 3 to 4 ft depths and has infiltration properties consistent with the native soils. In some instances, the bio-cells are placed above present grade and will require soils with similar hydraulic properties to the native soils.

It should be noted that when ponds, bio-swales, or other open detention facilities are used, the corresponding WWHM analysis module includes the ponded area. Consequently, this area is not included in the basin land segment mappings, so the total area is often different between the developed and pre-developed conditions.

The current DOE specification for amended soils in 2019 is labeled as 'SMMWW' in the Bio-Swale and other WWHM modules that employ amended soils. The parameters for modeling the SMMWW are preset and based on current state-of-the-art modeling using a combination of the Darcy's and Van Genuchten's equations to account for the variability of permeability and water content as the soils transition from dry or partly damp to saturated conditions as the bio-cell cycles through the process of filling, emptying, and drying out. The SMMWW settings based on the WSU amended soils.

Section 7 - Software Output

The following WWHM reports in this section represent individual sub-basin analysis for hydrologic flow evaluations. The following heading is common to all reports.

Western Washington Hydrology Model,

PROJECT REPORT

Project Name: Separated Cells 0503 updated
Site Name: Dell's Nursery 104th
Site Address: 4131 104th Street NE
City : Marysville
Report Date: 5/3/2023
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.20
Version Date: 2019/09/13
Version : 4.2.17

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

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	1.29
Pervious Total	1.29

Impervious Land Use	acre
Impervious Total	0
Basin Total	1.29

Element Flows To:

Surface	Interflow	Groundwater

Name : Frontage

Bypass: No

GroundWater: No

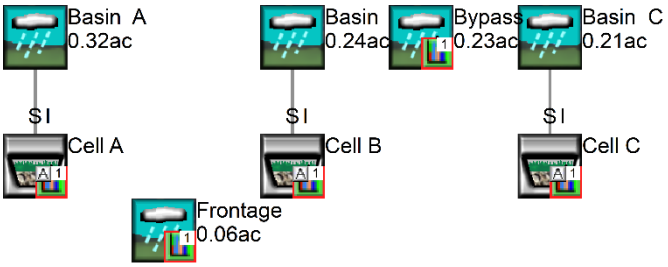
Pervious Land Use	acre
C, Forest, Flat	.062
Pervious Total	0.062

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.062

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE



Name : Basin A
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Pasture, Flat	.04
Pervious Total	0.04

Impervious Land Use	acre
ROADS FLAT	0.258
SIDEWALKS FLAT	0.019
Impervious Total	0.277
Basin Total	0.317

Element Flows To:

Surface	Interflow	Groundwater
Surface Cell A	Surface Cell A	

Name : Cell A
Bottom Length: 140.00 ft.
Bottom Width: 4.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW 12 in/hr

Material thickness of second layer: 0.5
Material type for second layer: Sand
Material thickness of third layer: 2
Material type for third layer: GRAVEL
Infiltration On
Infiltration rate: 4
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 54.868
Total Volume Through Riser (ac-ft.): 0.001
Total Volume Through Facility (ac-ft.): 54.869
Percent Infiltrated: 100
Total Precip Applied to Facility: 2.736
Total Evap From Facility: 1.46
Underdrain not used
Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 6 in.

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

Cell A Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0129	0.0000	0.0000	0.0000
0.0604	0.0129	0.0004	0.0000	0.0000
0.1209	0.0129	0.0007	0.0000	0.0000
0.1813	0.0129	0.0011	0.0000	0.0000
0.2418	0.0129	0.0014	0.0000	0.0000
0.3022	0.0129	0.0018	0.0000	0.0000
0.3626	0.0129	0.0021	0.0013	0.0013
0.4231	0.0129	0.0025	0.0018	0.0018
0.4835	0.0129	0.0028	0.0022	0.0022
0.5440	0.0129	0.0032	0.0036	0.0036
0.6044	0.0129	0.0036	0.0053	0.0053
0.6648	0.0129	0.0039	0.0053	0.0053
0.7253	0.0129	0.0043	0.0076	0.0076
0.7857	0.0129	0.0046	0.0079	0.0079
0.8462	0.0129	0.0050	0.0103	0.0103
0.9066	0.0129	0.0053	0.0122	0.0122
0.9670	0.0129	0.0057	0.0135	0.0135
1.0275	0.0129	0.0060	0.0174	0.0174
1.0879	0.0129	0.0064	0.0196	0.0196
1.1484	0.0129	0.0068	0.0218	0.0218
1.2088	0.0129	0.0071	0.0229	0.0229
1.2692	0.0129	0.0075	0.0268	0.0268
1.3297	0.0129	0.0078	0.0325	0.0325
1.3901	0.0129	0.0082	0.0380	0.0380
1.4505	0.0129	0.0085	0.0382	0.0382
1.5110	0.0129	0.0088	0.0388	0.0388
1.5714	0.0129	0.0091	0.0459	0.0459
1.6319	0.0129	0.0095	0.0519	0.0519
1.6923	0.0129	0.0098	0.0519	0.0519
1.7527	0.0129	0.0101	0.0519	0.0519
1.8132	0.0129	0.0104	0.0519	0.0519

1.8736	0.0129	0.0107	0.0519	0.0519
1.9341	0.0129	0.0110	0.0519	0.0519
1.9945	0.0129	0.0113	0.0519	0.0519
2.0549	0.0129	0.0116	0.0519	0.0519
2.1154	0.0129	0.0120	0.0519	0.0519
2.1758	0.0129	0.0123	0.0519	0.0519
2.2363	0.0129	0.0126	0.0519	0.0519
2.2967	0.0129	0.0129	0.0519	0.0519
2.3571	0.0129	0.0133	0.0519	0.0519
2.4176	0.0129	0.0136	0.0519	0.0519
2.4780	0.0129	0.0139	0.0519	0.0519
2.5385	0.0129	0.0142	0.0519	0.0519
2.5989	0.0129	0.0145	0.0519	0.0519
2.6593	0.0129	0.0149	0.0519	0.0519
2.7198	0.0129	0.0152	0.0519	0.0519
2.7802	0.0129	0.0155	0.0519	0.0519
2.8407	0.0129	0.0158	0.0519	0.0519
2.9011	0.0129	0.0162	0.0519	0.0519
2.9615	0.0129	0.0165	0.0519	0.0519
3.0220	0.0129	0.0168	0.0519	0.0519
3.0824	0.0129	0.0171	0.0519	0.0519
3.1429	0.0129	0.0175	0.0519	0.0519
3.2033	0.0129	0.0178	0.0519	0.0519
3.2637	0.0129	0.0181	0.0519	0.0519
3.3242	0.0129	0.0184	0.0519	0.0519
3.3846	0.0129	0.0187	0.0519	0.0519
3.4451	0.0129	0.0191	0.0519	0.0519
3.5055	0.0129	0.0194	0.0519	0.0519
3.5659	0.0129	0.0197	0.0519	0.0519
3.6264	0.0129	0.0200	0.0519	0.0519
3.6868	0.0129	0.0204	0.0519	0.0519
3.7473	0.0129	0.0207	0.0519	0.0519
3.8077	0.0129	0.0210	0.0519	0.0519
3.8681	0.0129	0.0213	0.0519	0.0519
3.9286	0.0129	0.0216	0.0519	0.0519
3.9890	0.0129	0.0220	0.0519	0.0519
4.0000	0.0129	0.0220	0.0519	0.0519

Surface Cell A Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
4.0000	0.0129	0.0220	0.0000	0.1556	0.0000
4.0604	0.0131	0.0228	0.0000	0.1556	0.0000
4.1209	0.0133	0.0236	0.0000	0.1681	0.0000
4.1813	0.0135	0.0244	0.0000	0.1744	0.0000
4.2418	0.0137	0.0252	0.0000	0.1806	0.0000
4.3022	0.0139	0.0261	0.0000	0.1869	0.0000
4.3626	0.0141	0.0269	0.0000	0.1932	0.0000
4.4231	0.0143	0.0278	0.0000	0.1994	0.0000
4.4835	0.0145	0.0286	0.0000	0.2057	0.0000
4.5440	0.0147	0.0295	0.0000	0.2120	0.0000
4.6044	0.0149	0.0304	0.0000	0.2182	0.0000
4.6648	0.0151	0.0313	0.0000	0.2245	0.0000
4.7253	0.0153	0.0322	0.0000	0.2308	0.0000
4.7857	0.0155	0.0331	0.0000	0.2370	0.0000
4.8462	0.0157	0.0341	0.0000	0.2433	0.0000
4.9066	0.0159	0.0350	0.0000	0.2496	0.0000
4.9670	0.0161	0.0360	0.0000	0.2558	0.0000
5.0275	0.0163	0.0370	0.0000	0.2621	0.0000

5.0879	0.0165	0.0380	0.0000	0.2684	0.0000
5.1484	0.0167	0.0390	0.0000	0.2746	0.0000
5.2088	0.0169	0.0400	0.0000	0.2809	0.0000
5.2692	0.0171	0.0410	0.0000	0.2872	0.0000
5.3297	0.0173	0.0421	0.0000	0.2934	0.0000
5.3901	0.0175	0.0431	0.0000	0.2997	0.0000
5.4505	0.0177	0.0442	0.0000	0.3060	0.0000
5.5000	0.0179	0.0451	0.0000	0.3111	0.0000

Name : Surface Cell A

Element Flows To:

Outlet 1	**Outlet 2**
Cell A	

Name : Basin B
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
A B, Pasture, Flat	**.017**
Pervious Total	**0.017**

Impervious Land Use	**acre**
ROADS FLAT	**0.204**
SIDEWALKS FLAT	**0.015**
Impervious Total	**0.219**
Basin Total	**0.236**

Element Flows To:

Surface	**Interflow**	**Groundwater**
Surface Cell B	Surface Cell B	

Name : Cell B
Bottom Length: 125.00 ft.
Bottom Width: 4.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW 12 in/hr
Material thickness of second layer: 0.5
Material type for second layer: Sand
Material thickness of third layer: 2
Material type for third layer: GRAVEL
Infiltration On
Infiltration rate: 4
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 43.499

Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 43.499
Percent Infiltrated: 100
Total Precip Applied to Facility: 2.439
Total Evap From Facility: 1.296
Underdrain not used
Discharge Structure
Riser Height: 1 ft.
Riser Diameter: 6 in.

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

Cell B Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0115	0.0000	0.0000	0.0000
0.0604	0.0115	0.0003	0.0000	0.0000
0.1209	0.0115	0.0006	0.0000	0.0000
0.1813	0.0115	0.0010	0.0000	0.0000
0.2418	0.0115	0.0013	0.0000	0.0000
0.3022	0.0115	0.0016	0.0000	0.0000
0.3626	0.0115	0.0019	0.0011	0.0011
0.4231	0.0115	0.0022	0.0016	0.0016
0.4835	0.0115	0.0025	0.0020	0.0020
0.5440	0.0115	0.0029	0.0032	0.0032
0.6044	0.0115	0.0032	0.0047	0.0047
0.6648	0.0115	0.0035	0.0048	0.0048
0.7253	0.0115	0.0038	0.0068	0.0068
0.7857	0.0115	0.0041	0.0071	0.0071
0.8462	0.0115	0.0044	0.0092	0.0092
0.9066	0.0115	0.0048	0.0109	0.0109
0.9670	0.0115	0.0051	0.0121	0.0121
1.0275	0.0115	0.0054	0.0155	0.0155
1.0879	0.0115	0.0057	0.0175	0.0175
1.1484	0.0115	0.0060	0.0194	0.0194
1.2088	0.0115	0.0063	0.0204	0.0204
1.2692	0.0115	0.0067	0.0239	0.0239
1.3297	0.0115	0.0070	0.0290	0.0290
1.3901	0.0115	0.0073	0.0339	0.0339
1.4505	0.0115	0.0076	0.0341	0.0341
1.5110	0.0115	0.0079	0.0347	0.0347
1.5714	0.0115	0.0082	0.0410	0.0410
1.6319	0.0115	0.0084	0.0463	0.0463
1.6923	0.0115	0.0087	0.0463	0.0463
1.7527	0.0115	0.0090	0.0463	0.0463
1.8132	0.0115	0.0093	0.0463	0.0463
1.8736	0.0115	0.0096	0.0463	0.0463
1.9341	0.0115	0.0098	0.0463	0.0463
1.9945	0.0115	0.0101	0.0463	0.0463
2.0549	0.0115	0.0104	0.0463	0.0463
2.1154	0.0115	0.0107	0.0463	0.0463
2.1758	0.0115	0.0110	0.0463	0.0463
2.2363	0.0115	0.0113	0.0463	0.0463
2.2967	0.0115	0.0116	0.0463	0.0463

2.3571	0.0115	0.0118	0.0463	0.0463
2.4176	0.0115	0.0121	0.0463	0.0463
2.4780	0.0115	0.0124	0.0463	0.0463
2.5385	0.0115	0.0127	0.0463	0.0463
2.5989	0.0115	0.0130	0.0463	0.0463
2.6593	0.0115	0.0133	0.0463	0.0463
2.7198	0.0115	0.0136	0.0463	0.0463
2.7802	0.0115	0.0139	0.0463	0.0463
2.8407	0.0115	0.0141	0.0463	0.0463
2.9011	0.0115	0.0144	0.0463	0.0463
2.9615	0.0115	0.0147	0.0463	0.0463
3.0220	0.0115	0.0150	0.0463	0.0463
3.0824	0.0115	0.0153	0.0463	0.0463
3.1429	0.0115	0.0156	0.0463	0.0463
3.2033	0.0115	0.0159	0.0463	0.0463
3.2637	0.0115	0.0162	0.0463	0.0463
3.3242	0.0115	0.0164	0.0463	0.0463
3.3846	0.0115	0.0167	0.0463	0.0463
3.4451	0.0115	0.0170	0.0463	0.0463
3.5055	0.0115	0.0173	0.0463	0.0463
3.5659	0.0115	0.0176	0.0463	0.0463
3.6264	0.0115	0.0179	0.0463	0.0463
3.6868	0.0115	0.0182	0.0463	0.0463
3.7473	0.0115	0.0185	0.0463	0.0463
3.8077	0.0115	0.0187	0.0463	0.0463
3.8681	0.0115	0.0190	0.0463	0.0463
3.9286	0.0115	0.0193	0.0463	0.0463
3.9890	0.0115	0.0196	0.0463	0.0463
4.0000	0.0115	0.0197	0.0463	0.0463

Surface Cell B Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
4.0000	0.0115	0.0197	0.0000	0.1389	0.0000
4.0604	0.0117	0.0204	0.0000	0.1389	0.0000
4.1209	0.0118	0.0211	0.0000	0.1501	0.0000
4.1813	0.0120	0.0218	0.0000	0.1557	0.0000
4.2418	0.0122	0.0225	0.0000	0.1613	0.0000
4.3022	0.0124	0.0233	0.0000	0.1669	0.0000
4.3626	0.0126	0.0240	0.0000	0.1725	0.0000
4.4231	0.0127	0.0248	0.0000	0.1781	0.0000
4.4835	0.0129	0.0256	0.0000	0.1837	0.0000
4.5440	0.0131	0.0263	0.0000	0.1893	0.0000
4.6044	0.0133	0.0271	0.0000	0.1949	0.0000
4.6648	0.0135	0.0280	0.0000	0.2004	0.0000
4.7253	0.0136	0.0288	0.0000	0.2060	0.0000
4.7857	0.0138	0.0296	0.0000	0.2116	0.0000
4.8462	0.0140	0.0304	0.0000	0.2172	0.0000
4.9066	0.0142	0.0313	0.0000	0.2228	0.0000
4.9670	0.0144	0.0322	0.0000	0.2284	0.0000
5.0275	0.0145	0.0330	0.0000	0.2340	0.0000
5.0879	0.0147	0.0339	0.0000	0.2396	0.0000
5.1484	0.0149	0.0348	0.0000	0.2452	0.0000
5.2088	0.0151	0.0357	0.0000	0.2508	0.0000
5.2692	0.0153	0.0366	0.0000	0.2564	0.0000
5.3297	0.0155	0.0376	0.0000	0.2620	0.0000
5.3901	0.0156	0.0385	0.0000	0.2676	0.0000
5.4505	0.0158	0.0395	0.0000	0.2732	0.0000
5.5000	0.0160	0.0402	0.0000	0.2778	0.0000

Name : Surface Cell B

Element Flows To:

Outlet 1	Outlet 2
Cell B	

Name : Basin C
Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Pasture, Flat	.017
Pervious Total	0.017

Impervious Land Use	acre
ROADS FLAT	0.182
SIDEWALKS FLAT	0.007
Impervious Total	0.189
Basin Total	0.206

Element Flows To:

Surface	Interflow	Groundwater
Surface Cell C	Surface Cell C	

Name : Cell C
Bottom Length: 125.00 ft.
Bottom Width: 4.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW 12 in/hr
Material thickness of second layer: 0.5
Material type for second layer: Sand
Material thickness of third layer: 2
Material type for third layer: GRAVEL
Infiltration On
Infiltration rate: 4
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 37.696
Total Volume Through Riser (ac-ft.): 0
Total Volume Through Facility (ac-ft.): 37.696
Percent Infiltrated: 100
Total Precip Applied to Facility: 2.439
Total Evap From Facility: 1.287
Underdrain not used
Discharge Structure
Riser Height: 1 ft.

Riser Diameter: 6 in.

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

Cell C Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0115	0.0000	0.0000	0.0000
0.0604	0.0115	0.0003	0.0000	0.0000
0.1209	0.0115	0.0006	0.0000	0.0000
0.1813	0.0115	0.0010	0.0000	0.0000
0.2418	0.0115	0.0013	0.0000	0.0000
0.3022	0.0115	0.0016	0.0000	0.0000
0.3626	0.0115	0.0019	0.0011	0.0011
0.4231	0.0115	0.0022	0.0016	0.0016
0.4835	0.0115	0.0025	0.0020	0.0020
0.5440	0.0115	0.0029	0.0032	0.0032
0.6044	0.0115	0.0032	0.0047	0.0047
0.6648	0.0115	0.0035	0.0048	0.0048
0.7253	0.0115	0.0038	0.0068	0.0068
0.7857	0.0115	0.0041	0.0071	0.0071
0.8462	0.0115	0.0044	0.0092	0.0092
0.9066	0.0115	0.0048	0.0109	0.0109
0.9670	0.0115	0.0051	0.0121	0.0121
1.0275	0.0115	0.0054	0.0155	0.0155
1.0879	0.0115	0.0057	0.0175	0.0175
1.1484	0.0115	0.0060	0.0194	0.0194
1.2088	0.0115	0.0063	0.0204	0.0204
1.2692	0.0115	0.0067	0.0239	0.0239
1.3297	0.0115	0.0070	0.0290	0.0290
1.3901	0.0115	0.0073	0.0339	0.0339
1.4505	0.0115	0.0076	0.0341	0.0341
1.5110	0.0115	0.0079	0.0347	0.0347
1.5714	0.0115	0.0082	0.0410	0.0410
1.6319	0.0115	0.0084	0.0463	0.0463
1.6923	0.0115	0.0087	0.0463	0.0463
1.7527	0.0115	0.0090	0.0463	0.0463
1.8132	0.0115	0.0093	0.0463	0.0463
1.8736	0.0115	0.0096	0.0463	0.0463
1.9341	0.0115	0.0098	0.0463	0.0463
1.9945	0.0115	0.0101	0.0463	0.0463
2.0549	0.0115	0.0104	0.0463	0.0463
2.1154	0.0115	0.0107	0.0463	0.0463
2.1758	0.0115	0.0110	0.0463	0.0463
2.2363	0.0115	0.0113	0.0463	0.0463
2.2967	0.0115	0.0116	0.0463	0.0463
2.3571	0.0115	0.0118	0.0463	0.0463
2.4176	0.0115	0.0121	0.0463	0.0463
2.4780	0.0115	0.0124	0.0463	0.0463
2.5385	0.0115	0.0127	0.0463	0.0463
2.5989	0.0115	0.0130	0.0463	0.0463
2.6593	0.0115	0.0133	0.0463	0.0463
2.7198	0.0115	0.0136	0.0463	0.0463
2.7802	0.0115	0.0139	0.0463	0.0463

2.8407	0.0115	0.0141	0.0463	0.0463
2.9011	0.0115	0.0144	0.0463	0.0463
2.9615	0.0115	0.0147	0.0463	0.0463
3.0220	0.0115	0.0150	0.0463	0.0463
3.0824	0.0115	0.0153	0.0463	0.0463
3.1429	0.0115	0.0156	0.0463	0.0463
3.2033	0.0115	0.0159	0.0463	0.0463
3.2637	0.0115	0.0162	0.0463	0.0463
3.3242	0.0115	0.0164	0.0463	0.0463
3.3846	0.0115	0.0167	0.0463	0.0463
3.4451	0.0115	0.0170	0.0463	0.0463
3.5055	0.0115	0.0173	0.0463	0.0463
3.5659	0.0115	0.0176	0.0463	0.0463
3.6264	0.0115	0.0179	0.0463	0.0463
3.6868	0.0115	0.0182	0.0463	0.0463
3.7473	0.0115	0.0185	0.0463	0.0463
3.8077	0.0115	0.0187	0.0463	0.0463
3.8681	0.0115	0.0190	0.0463	0.0463
3.9286	0.0115	0.0193	0.0463	0.0463
3.9890	0.0115	0.0196	0.0463	0.0463
4.0000	0.0115	0.0197	0.0463	0.0463

Surface Cell C Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
4.0000	0.0115	0.0197	0.0000	0.1389	0.0000
4.0604	0.0117	0.0204	0.0000	0.1389	0.0000
4.1209	0.0118	0.0211	0.0000	0.1501	0.0000
4.1813	0.0120	0.0218	0.0000	0.1557	0.0000
4.2418	0.0122	0.0225	0.0000	0.1613	0.0000
4.3022	0.0124	0.0233	0.0000	0.1669	0.0000
4.3626	0.0126	0.0240	0.0000	0.1725	0.0000
4.4231	0.0127	0.0248	0.0000	0.1781	0.0000
4.4835	0.0129	0.0256	0.0000	0.1837	0.0000
4.5440	0.0131	0.0263	0.0000	0.1893	0.0000
4.6044	0.0133	0.0271	0.0000	0.1949	0.0000
4.6648	0.0135	0.0280	0.0000	0.2004	0.0000
4.7253	0.0136	0.0288	0.0000	0.2060	0.0000
4.7857	0.0138	0.0296	0.0000	0.2116	0.0000
4.8462	0.0140	0.0304	0.0000	0.2172	0.0000
4.9066	0.0142	0.0313	0.0000	0.2228	0.0000
4.9670	0.0144	0.0322	0.0000	0.2284	0.0000
5.0275	0.0145	0.0330	0.0000	0.2340	0.0000
5.0879	0.0147	0.0339	0.0000	0.2396	0.0000
5.1484	0.0149	0.0348	0.0000	0.2452	0.0000
5.2088	0.0151	0.0357	0.0000	0.2508	0.0000
5.2692	0.0153	0.0366	0.0000	0.2564	0.0000
5.3297	0.0155	0.0376	0.0000	0.2620	0.0000
5.3901	0.0156	0.0385	0.0000	0.2676	0.0000
5.4505	0.0158	0.0395	0.0000	0.2732	0.0000
5.5000	0.0160	0.0402	0.0000	0.2778	0.0000

Name : Surface Cell C

Element Flows To:

Outlet 1	Outlet 2
Cell C	

Name : Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	acre
A B, Pasture, Flat	.17
Pervious Total	**0.17**

Impervious Land Use	acre
SIDEWALKS FLAT	0.059
Impervious Total	**0.059**
Basin Total	**0.229**

Element Flows To:

Surface	Interflow	Groundwater

Name : Frontage
Bypass: Yes

GroundWater: No

Pervious Land Use	acre
A B, Pasture, Flat	.011
Pervious Total	**0.011**

Impervious Land Use	acre
ROADS FLAT	0.035
SIDEWALKS FLAT	0.016
Impervious Total	**0.051**
Basin Total	**0.062**

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.352
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.255
Total Impervious Area:0.795

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.045428
5 year	0.069688
10 year	0.088397
25 year	0.115166
50 year	0.13746
100 year	0.161841

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.058943
5 year	0.079597
10 year	0.094678
25 year	0.115396
50 year	0.132078
100 year	0.149866

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0227	19607	2582	13	Pass
0.0239	16989	2184	12	Pass
0.0250	14666	1854	12	Pass
0.0262	12722	1614	12	Pass
0.0274	10919	1405	12	Pass
0.0285	9443	1204	12	Pass
0.0297	8173	1053	12	Pass
0.0308	7078	910	12	Pass
0.0320	6130	802	13	Pass
0.0331	5311	705	13	Pass
0.0343	4654	607	13	Pass
0.0355	4066	544	13	Pass
0.0366	3548	480	13	Pass
0.0378	3136	420	13	Pass
0.0389	2757	368	13	Pass
0.0401	2449	333	13	Pass
0.0413	2145	299	13	Pass
0.0424	1894	273	14	Pass

0.0436	1657	250	15	Pass
0.0447	1508	231	15	Pass
0.0459	1370	207	15	Pass
0.0471	1249	187	14	Pass
0.0482	1154	170	14	Pass
0.0494	1069	160	14	Pass
0.0505	1009	142	14	Pass
0.0517	948	129	13	Pass
0.0528	888	121	13	Pass
0.0540	825	111	13	Pass
0.0552	777	97	12	Pass
0.0563	733	88	12	Pass
0.0575	686	82	11	Pass
0.0586	648	79	12	Pass
0.0598	622	76	12	Pass
0.0610	602	72	11	Pass
0.0621	583	67	11	Pass
0.0633	561	61	10	Pass
0.0644	538	57	10	Pass
0.0656	507	51	10	Pass
0.0668	487	50	10	Pass
0.0679	473	43	9	Pass
0.0691	457	41	8	Pass
0.0702	440	39	8	Pass
0.0714	424	34	8	Pass
0.0726	408	30	7	Pass
0.0737	394	27	6	Pass
0.0749	380	24	6	Pass
0.0760	368	23	6	Pass
0.0772	353	20	5	Pass
0.0783	341	19	5	Pass
0.0795	333	16	4	Pass
0.0807	322	14	4	Pass
0.0818	313	13	4	Pass
0.0830	302	11	3	Pass
0.0841	293	11	3	Pass
0.0853	284	11	3	Pass
0.0865	276	11	3	Pass
0.0876	265	11	4	Pass
0.0888	257	11	4	Pass
0.0899	241	11	4	Pass
0.0911	234	10	4	Pass
0.0923	226	10	4	Pass
0.0934	212	10	4	Pass
0.0946	205	9	4	Pass
0.0957	195	8	4	Pass
0.0969	187	8	4	Pass
0.0981	177	8	4	Pass
0.0992	166	8	4	Pass
0.1004	160	8	5	Pass
0.1015	150	8	5	Pass
0.1027	146	8	5	Pass
0.1038	135	7	5	Pass
0.1050	128	6	4	Pass
0.1062	121	6	4	Pass
0.1073	111	6	5	Pass
0.1085	100	6	6	Pass
0.1096	86	6	6	Pass

0.1108	75	6	8	Pass
0.1120	63	6	9	Pass
0.1131	59	6	10	Pass
0.1143	56	5	8	Pass
0.1154	50	5	10	Pass
0.1166	42	5	11	Pass
0.1178	40	4	10	Pass
0.1189	37	4	10	Pass
0.1201	36	4	11	Pass
0.1212	30	4	13	Pass
0.1224	28	3	10	Pass
0.1236	26	3	11	Pass
0.1247	19	3	15	Pass
0.1259	16	3	18	Pass
0.1270	13	3	23	Pass
0.1282	9	3	33	Pass
0.1293	6	3	50	Pass
0.1305	5	3	60	Pass
0.1317	4	3	75	Pass
0.1328	4	2	50	Pass
0.1340	3	2	66	Pass
0.1351	3	2	66	Pass
0.1363	3	2	66	Pass
0.1375	3	2	66	Pass