PRELIMINARY STORMWATER TECHNICAL INFORMATION REPORT

LEICHNER CAMPUS MASTER PLAN
AREA 1

Prepared for
CLARK COUNTY
August 25, 2017
Project No. 9059.07.03

Prepared by
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MAUL
FOSTER
ALONGI

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LEICHNER CAMPUS MASTER PLAN

To the best of my knowledge and understanding, all information required by Clark County Stormwater and Erosion Control Ordinance Chapter 40.386 is included in this report, and the proposed stormwater facilities are feasible.

The material and data in this report were prepared under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.

Zachary Pyle, PE, CA
Staff Engineer

This digital seal certifies the signatory and document content.

8/25/17

Stacy J. Frost, PE
Senior Engineer

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SECTION A PROJECT OVERVIEW

A.1 Describe the site location.

The project site is located in northeast Vancouver, Washington at 8713 NE 94th Avenue. The Leichner Campus is composed of four parcels (account numbers 105740000, 199863000, 199864000, and 199845000). The Leichner Campus is part of the larger Master Planned Development application area. The Leichner Campus will eventually be sold to a private developer and redeveloped for light industrial uses allowed as described in Section 6, Application Narrative. Development in the other areas of the Master Planned Development application area will be determined at a future date.

A.2 Describe the topography, natural drainage patterns, vegetative ground cover, and presence of critical areas (CCC Chapter 40.440). Critical areas that receive runoff from the site shall be described to a minimum of ¼ mile away from the site boundary.

The portion of the site that will be developed, the Leichner Canpus, is largely flat, with a maximum slope of 3 percent. The eastern half of the site had been used as a borrow area for cover soil for the landfill. This has left steep slopes, approximately 30 percent, on the eastern and northeastern boundary of the site. Ground cover generally consists of a grassy field. There are no critical areas on site.

A.3 Identify and discuss existing on-site stormwater systems and their functions.

There are no existing on-site stormwater systems

A.4 Identify and discuss site parameters that influence stormwater system design.

The stormwater system design was influenced by site soils, existing topography, adjacency to a closed landfill, and proposed development improvements.

A.5 Describe drainage to and from adjacent properties.

Clark County GIS (Geographical Information Systems) contours were used to identify existing drainage patterns. Due to the flat area and good infiltration rates, obvious drainage patterns are not prevalent. See Pre-developed Drainage Basin Map in Appendix A.

A.6 For agricultural sites with drain tiles, discuss the impact of construction on the drain tiles, site drainage, and the impact of the drainage tiles on proposed stormwater facilities.

Not applicable; the site has no known drain tiles.

A.7 Describe adjacent areas, including streams, lakes, wetland areas, residential areas, and roads that might be affected by the construction project.

No streams, lakes, wetland areas, or residential areas will be affected.

A.8 Generally describe proposed site construction, size of improvements, and proposed methods of mitigating stormwater runoff quantity and quality impacts.

The proposed improvements include the construction of an internal private road network on the Leichner Campus. The network includes approximately 2,200 lineal feet of road, with two cul-de-sacs. Stormwater, sanitary sewer, and potable water will be provided within the roadway. Stormwater quality treatment will be provided using roadside bioretention facilities (Best Management Practice [BMP] T5.14B). After treatment, stormwater will be infiltrated on-site. This stormwater technical information report refers only to Area 1-Leichner Campus and does not address the remaining master plan development area that has not yet been designed.

SECTION B MINIMUM REQUIREMENTS

B.1 Describe the land-disturbing activity and document the applicable minimum requirements for the project site.

Include the following information in table format:

1. The amount of existing impervious surface.

2. The amount of new impervious surface.

3. The amount of replaced impervious surface.

4. The amount of native vegetation converted to lawn or landscaping.

5. The amount of native vegetation converted to pasture.

6. The total amount of land-disturbing activity.

Table 1: Leichner Camppus Site Characteristics

Land-Disturbing Activity	Area (Acres)
Existing Impervious Surface	0.00
New Impervious Surface	2.62
Bioretention	0.72
Replaced Impervious Surface	0.00
Native Vegetation Converted to Lawn or Landscaping	0.00
Native Vegetation Converted to Pasture	0.00
Total Amount of Land-Disturbing Activity	3.34

B.2 Provide a statement that confirms the minimum requirements that will apply to the development activity.

In accordance with the Clark County Stormwater Manual, minimum requirements 1 through 9 apply to this project, and are being addressed as follows:

1. Preparation of Stormwater Site Plans

Plans detailing the collection, conveyance, treatment, and infiltration of stormwater runoff will be prepared as part of the final design. A preliminary plan showing the approximate location of stormwater system components is included in the preliminary site plan submittal packet.

2. Construction Stormwater Pollution Prevention

A stormwater pollution prevention plan addressing Elements 1 through 15 outlined in Volume I, Section 2.5.2 of the 2012 Stormwater Management Manual for Western Washington (SMMWW) will be completed prior to construction.

3. Source Control of Pollution

See Section D.

4. Preservation of Natural Drainage Systems and Outfalls

Natural drainage systems will be preserved to the extent practicable. There are no existing outfalls on the site.

5. Onsite Stormwater Management (Low Impact Development)

See Section E.

6. Runoff Treatment

All stormwater will be treated using on-site bioretention facilities prior to infiltration. Overflow discharge will occur through a connection to existing stormwater facilities in NE 94th Avenue. See Section F.

7. Flow Control

Stormwater runoff will be infiltrated on-site after treatment. See Section G.

8. Wetlands Protection

Not applicable.

9. Operation and Maintenance

The bioretention facilities will be privately owned and maintained; access easements will be provided to the County. Maintenance will be in accordance with the Clark County Public Works Department Stormwater Facility Maintenance Manual.

B.3 For land-disturbing activities where minimum requirements 1 through 9 must be met:

B.3.1 Provide the amount of effective impervious area in each threshold discharge area (TDA), and document through an approved continuous runoff simulation model the increase in the 100-year flood frequency from pre-developed to developed conditions for each TDA.

Table 2: Effective Impervious Area

TDA	Effective Impervious Area (Square Feet)
TDA 1 (internal road network)	98,700 SQ. FT.

B.3.2 List the TDAs that must meet the runoff control requirements listed in Minimum Requirement 6.

TDA 1 must meet the runoff control requirements in Minimum Requirement 6.

B.3.3 List the TDAs that must meet the flow control requirements listed in Minimum Requirement 7.

Not applicable.

B.3.4 List the TDAs that must meet the wetlands protection requirements listed in Minimum Requirement 8.

Not applicable.

SECTION C SOILS EVALUATION

C.1 Describe the site's suitability for stormwater infiltration for flow control, runoff treatment, and low impact development (LID) measures.

According to the Web Soil Survey, all of the soil found on the site is sifton gravelly loam. These soils make infiltration very suitable, as the soils are described as "well drained; very slow runoff; very rapid permeability." Infiltration testing completed by Hart Crowser for the County's NE 94th Avenue improvements found an in-situ tested infiltration rate of 20 in/hour.

C.2 Identify water table elevations, flow directions (where available), and data on seasonal water table fluctuations with minimum and maximum water table elevations where these may affect stormwater facilities.

The "Geotechnical Data Review and Geologic Reconnaissance" completed by PBS Environmental on June 17, 2015 states that groundwater was observed at 12-19 feet below ground surface (bgs) in the eastern portion of the site and 17-37 feet bgs in the western part of the site.

C.3 Identify and describe soil parameters and design methods for use in hydrologic and hydraulic design of proposed facilities.

According to the Web Soil Survey, all of the soil found on the site is sifton gravelly loam. These soils make infiltration very suitable, as the soils are described as "well drained; very slow runoff; very rapid permeability." Infiltration testing completed by Hart Crowser for the County's NE 94th Avenue improvements found an in-situ tested infiltration rate of 20 in/hour.

For purposes of the Western Washington Hydrology Model (WWHM), the limiting factor in infiltration is assumed to be standard bioretention soil media mix.

C.4 Report findings of testing and analysis used to determine the infiltration rate.

No infiltration testing was performed.

C.5 Where unstable or complex soil conditions exist that may significantly affect the design of stormwater facilities, the responsible official may require a preliminary soils report that addresses stormwater design considerations arising from soil conditions.

A preliminary geotechnical report was conducted by PBS in June, 2015. Prior to final design, further geotechnical study will be conducted as deemed necessary by a professional engineer.

SECTION D SOURCE CONTROL

D.1 If the development activity includes any of the activities listed in Section 2.2 of Volume IV of the SMMWW, identify the source control BMPs to be used with the land-disturbing activity.

The following source control BMPs will be used with the land-disturbing activity:

BMPs for Landscaping and Lawn/Vegetation Management

- Collected vegetation will be properly disposed of, and will not be placed in waterways or storm drainage facilities.

BMPs for Maintenance of Stormwater Drainage and Treatment Systems

- Inspect and clean bioretention facilities as needed; determine whether improvements in operation and maintenance are needed.
- Promptly repair any deterioration threatening the structural integrity of the facilities.
- Ensure that storm sewer capacities are not exceeded and that heavy sediment discharges to the sewer system are prevented.

BMPs for Urban Streets

- Regularly sweep paved areas to collect dirt, waste, and debris.

SECTION E ONSITE STORMWATER MANAGEMENT BMPs

E.1 On the preliminary development plan or other maps, show the site areas where onsite stormwater management BMPs will be effectively implemented. The plan must show the areas of retained native vegetation and required flow lengths and vegetated flow paths, as required for proper implementation of each onsite stormwater BMP. Arrows must show the stormwater flow path to each BMP.

Stormwater runoff in the disturbed areas will be directed to roadside bioretention facilities. See Sheet C2.3 for the location of those facilities.

E.2 Identify and describe geotechnical studies or other information used to complete the analysis and design of each onsite stormwater BMP.

PBS produced a geotechnical report stating historical groundwater data collected as part of the Leichner Landfill post-closure monitoring program indicate groundwater occurs beneath the property between depths ranging from 12 to 19 feet bgs in the eastern portion and 17 to 37 feet bgs in the western portion with flow generally toward the west-southwest.

According to the Web Soil Survey, all of the soil found on the site is sifton gravelly loam. These soils make infiltration very suitable, as the soils are described as "well drained; very slow runoff; very rapid permeability." This information was used to determine bioretention facilities were feasible on site.

Infiltration testing was completed by Hart Crowser for the County's NE 94th Avenue improvements. They found an in-situ tested infiltration rate of 20 in/hour. For design purposes, a safety factor or 4 was applied.

E.3 Identify the criteria (and their sources) used to complete analyses for each onsite stormwater BMP.

Bioretention facilities are designed in accordance with the Clark County Stormwater Manual (BMP T5.14B).

E.4 Describe how design criteria will be met for each proposed onsite stormwater management BMP.

Bioretention facilities will be sized based on WWHM modeling at the time of final proposal. Preliminary sizing to ensure feasibility was conducted for this proposal. See the WWHM report (Appendix B) of this application.

E.5 Describe any onsite application of LID measures planned for the project. Provide a plan that shows the proposed location and approximate size of each LID facility.

Stormwater runoff in the disturbed areas will be directed to roadside bioretention facilities. See Sheet C2.3 for the location of those facilities.

E.6 Identify and describe any assumptions used to complete the analysis.

Assumptions used to preliminarily design the bioretention facilities include the use of the Web Soil Survey data. Infiltration testing completed by Hart Crowser for the County's NE 94th Avenue improvements found am in-situ tested infiltration rate of 20 in/hour. These assumptions suggest infiltration is feasible on site.

E.7 Describe site suitability, including hydrologic soil groups, slopes, area of native vegetation, and adequate location of each BMP.

According to the Web Soil Survey, all of the soil found on the site is sifton gravelly loam. These soils make infiltration very suitable, as the soils are described as "well drained; very slow runoff; very rapid permeability." This information was used to determine bioretention facilities were feasible on site. Infiltration testing completed by Hart Crowser for the County's NE 94th Avenue improvements found am in-situ tested infiltration rate of 20 in/hour.

SECTION F RUNOFF TREATMENT ANALYSIS AND DESIGN

F.1 For land-disturbing activities where the thresholds within Minimum Requirement 6 indicate that runoff treatment facilities are required:

F.1.1 Document the level of treatment required (basic, enhanced, phosphorus, oil/water separation), based on procedures in Volume V, Chapter 2 of the SMMWW.

Consistent with the flowchart in Figure 2.1, Volume V of the SMMWW, the following steps were analyzed to determine level of treatment required:

Step 1: Determine Receiving Waters and Pollutants of Concern

The site will act as a single basin (TDA 1) that is collected in to roadside bioretention facilities, treated, and infiltrated on site. In the instance of an emergency overflow, runoff will be directed to existing stormwater infrastructure within the NE 94th Avenue right-of-way.

Step 2: Determine if an Oil Control Facility is required

The site does not trigger any of the requirements for an oil control facility.

Step 3: Determine if Infiltration for Pollutant Removal is Practicable

Infiltration is feasible and being utilized at the site.

Step 4: Determine if Phosphorus Control is required

The site does not meet the criteria for phosphorus control outlined in Volume V, Chapter 2 of the SMMWW.

Step 5: Determine if Enhanced Treatment is required

Enhanced treatment will be utilized by designing the bioretention facilities to infiltrate 91% of runoff through the imported soil mix.

Step 6: Select a Basic Treatment Facility

The site will act as a single basin (TDA 1) that is collected in to roadside bioretention facilities, treated, and infiltrated on site. In the event of a storm event that causes bypassing of the bioretention facilities, runoff will be directed to existing stormwater infrastructure within the NE 94th Avenue right-of-way.

SECTION G FLOW CONTROL ANALYSIS AND DESIGN

G.1 For land-disturbing activities where the thresholds within Minimum Requirement 7 indicate that flow control facilities are required:

G.1.1 Identify the site's suitability for stormwater infiltration for flow control, including tested infiltration rates, logs of soil borings, and other information.

According to the Web Soil Survey, all of the soil found on the site is sifton gravelly loam. These soils make infiltration very suitable, as the soils are described as "well drained; very slow runoff; very rapid permeability." Infiltration testing completed by Hart Crowser for the County's NE 94th Avenue improvements found an in-situ tested infiltration rate of 20 in/hour.

G.2 Identify and describe geotechnical or other studies used to complete the analysis and design.

The findings from the Web Soil Survey were used to determine that infiltration is feasible at the site. Infiltration testing completed by Hart Crowser for the County's NE 94th Avenue improvements found an in-situ tested infiltration rate of 20 in/hour.

G.3 If infiltration cannot be provided for flow control, provide the following additional information:

G.3.1 Identify the areas where flow control credits can be obtained for dispersion, LID, or other measures, per the requirements in the SMMWW.

The entire site is suitable for LID stormwater control measures.

G.3.2 Provide the approximate sizing and location of flow control facilities for each TDA, per Volume III of the SMMWW.

See Appendix A for preliminary stormwater plan and detail sheets.

Complete a hydrologic analysis for existing and developed site conditions, in accordance with the requirements of CCC Section 40.386.020(C) and Chapter 2, Volume III of the SMMWW, using an approved continuous runoff simulation model (the Clark County version of WWHM). Compute existing and developed flow durations for all subbasins. Provide an output table from the continuous flow model.

See attached WWHM output report in Appendix B.

G.3.3 Include and reference all hydrologic computations, equations, graphs, and any other aids necessary to clearly show the methodology and results.

See attached WWHM output report in Appendix B.

G.3.4 Include all maps, exhibits, graphics, and references used to determine existing and developed site hydrology.

See Appendix A.

G.4 Submit electronic copies of the WWHM (.wdm, .prj, .usi) project files upon request.

Electronic copies of the WWHM files will be furnished upon request.

SECTION H WETLANDS PROTECTION

H.1 For projects with stormwater discharges to a wetland, either directly or indirectly through a conveyance system, the preliminary TIR shall describe wetland protection measures to be implemented in accordance with Minimum Requirement 8. The narrative shall describe the measures that will maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated uses.

Not applicable.

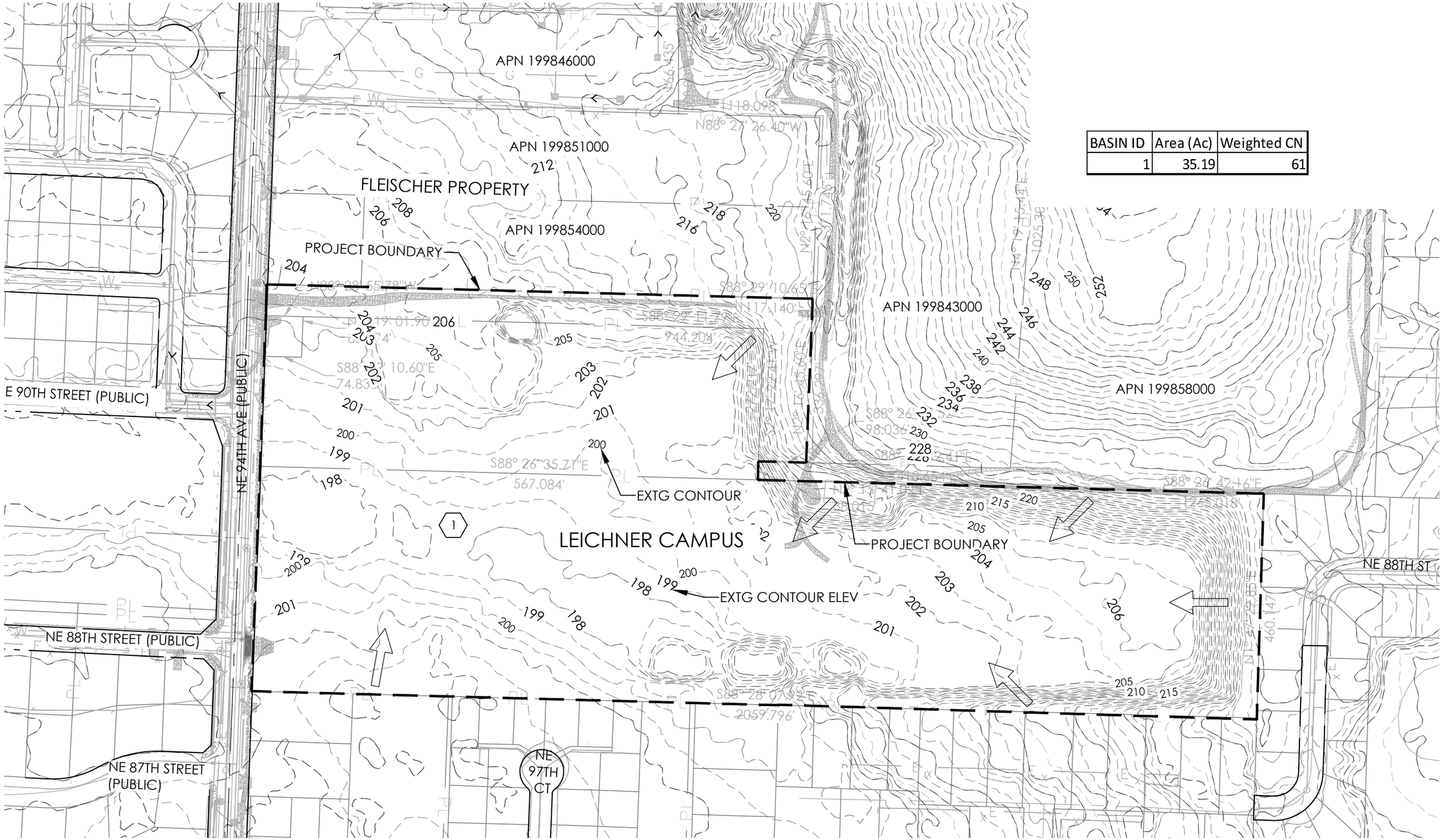
LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

APPENDIX A

PRE-DEVELOPMENT DRAINAGE BASIN MAP
POST-DEVELOPMENT DRAINAGE BASIN MAP
PRELIMINARY STORMWATER PLAN



BASIN ID	Area (Ac)	Weighted CN
1	35.19	61

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Date:8/25/2017 10:28:30 AM

MFA JOB #:	9059.07.03
ISSUE DATE:	08/21/2017
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DRAWN:	Z. PYLE

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PRE-DEVELOPED
STORMWATER BASIN MAP

LEICHNER CAMPUS MASTER PLAN

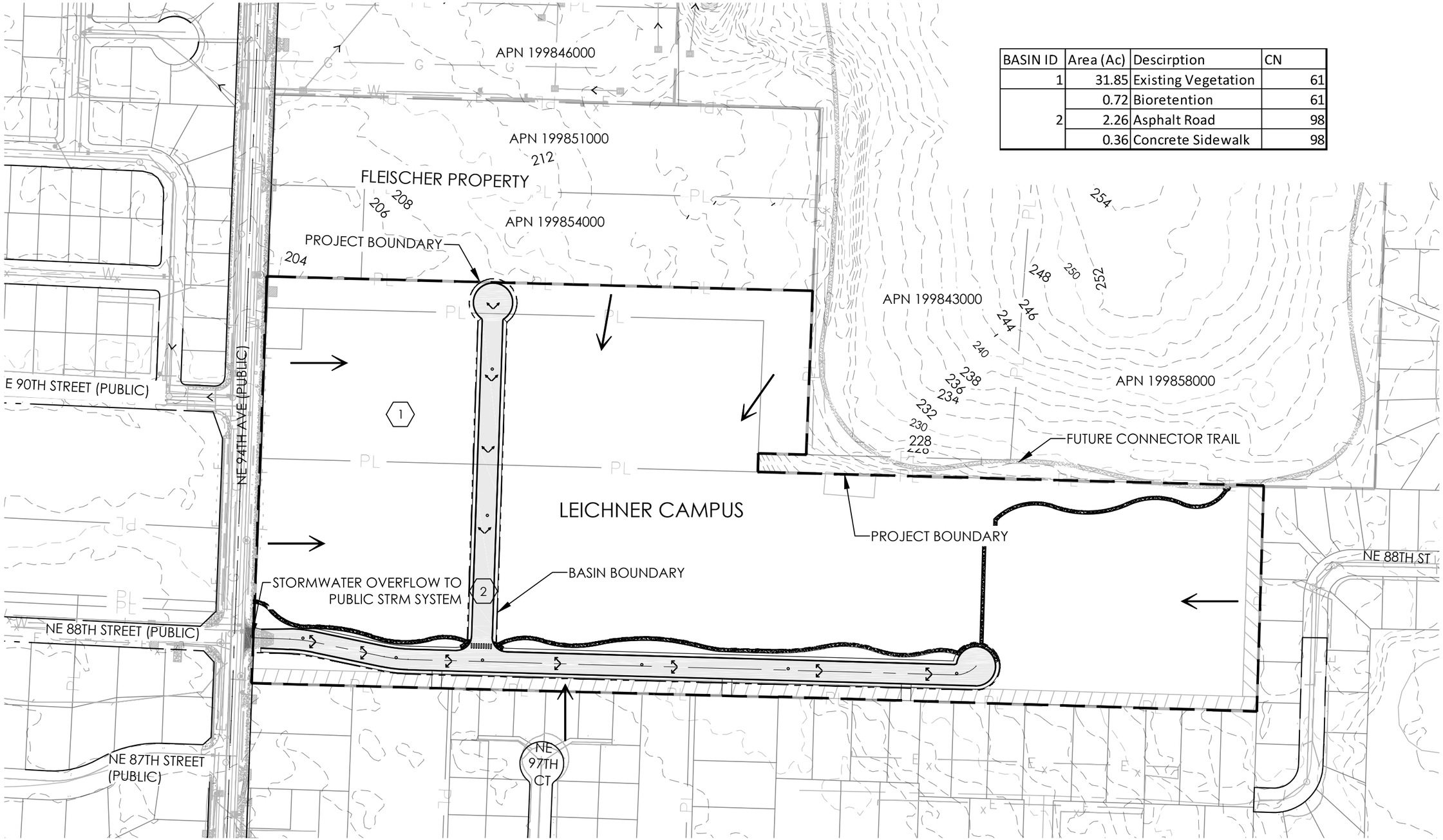
CLARK COUNTY
CLARK COUNTY, WA

0 200' 400'

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

EXHIBIT
1

BASIN ID	Area (Ac)	Descirption	CN
1	31.85	Existing Vegetation	61
2	0.72	Bioretention	61
	2.26	Asphalt Road	98
	0.36	Concrete Sidewalk	98



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POST-DEVELOPMENT
STORMWATER BASIN MAP

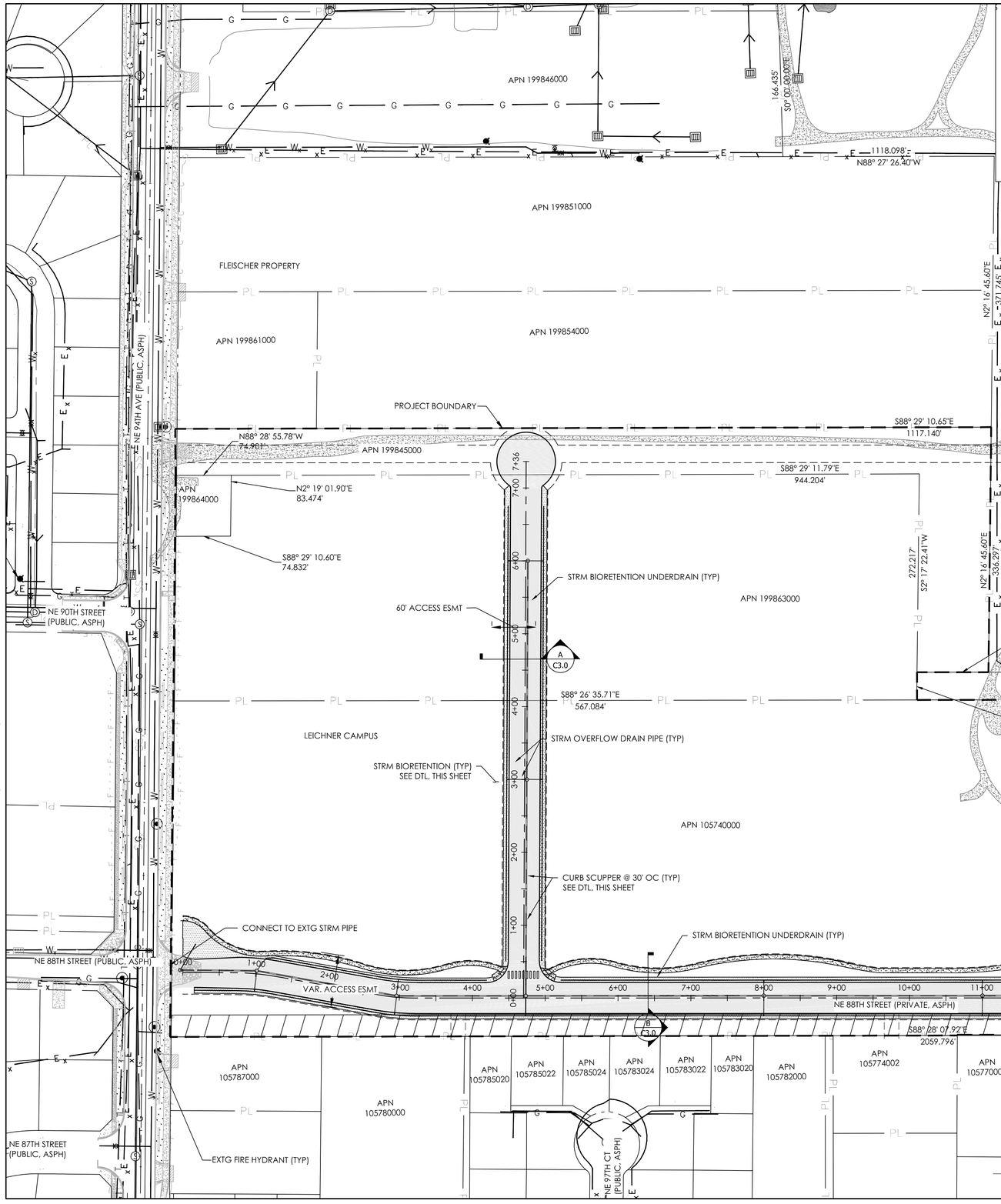
LEICHNER CAMPUS MASTER PLAN

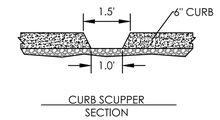
CLARK COUNTY
CLARK COUNTY, WA

0 200' 400'

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

EXHIBIT 2



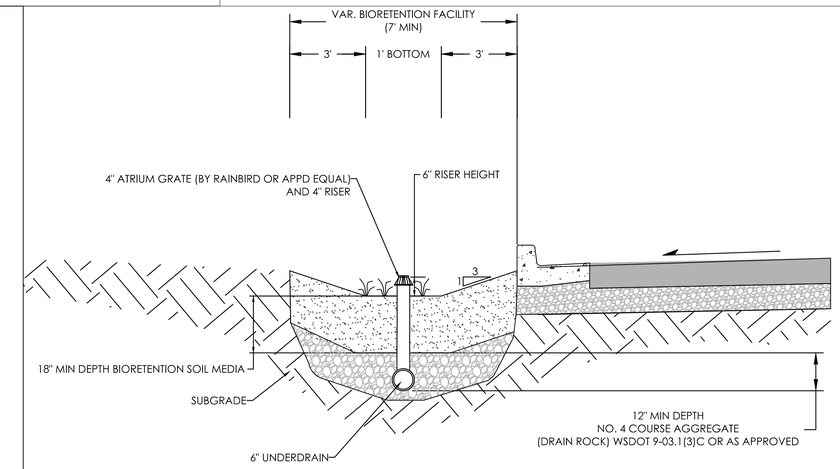


CURB SCUPPER SECTION

QUANTITIES

TOTAL PROJECT AREA: 35.19 AC (1,533,000 SQ. FT.)
EXISTING IMPERVIOUS AREA: 0.00 AC (0 SQ. FT.)
MAINTAIN EXISTING VEGETATION: 31.84 (1,387,000 SQ. FT.)
NEW IMPERVIOUS AREA: 2.62 (114,000 SQ. FT.)
TOTAL IMPERVIOUS AREA: 2.62 AC (114,000 SQ. FT.)

STORMWATER BIORETENTION FACILITY AREA: 0.72 AC (31,500 SQ. FT.)



PRELIMINARY BIORETENTION DESIGN

NTS

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CLARK COUNTY, WASHINGTON

LEICHNER CAMPUS MASTER PLAN

CLARK COUNTY WA
VANCOUVER, WA

ISSUE	DATE	DESCRIPTION
C	08/21/2017	MASTER PLAN SUBMITTED FOR APPROVAL
B	09/14/2016	MASTER PLAN RESUBMITTAL
A	07/26/2016	MASTER PLAN APPLICATION

PROJECT: 9059.07.03
DESIGNED: Z. PYLE
DRAWN: Z. PYLE
CHECKED: S. FROST

SCALE
0 80' 160
NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

SHEET TITLE
PRELIMINARY STORMWATER PLAN

SHEET
C2.3

PLOTTED ON: 2017-08-24 12:37 PM PLOTTED BY: Zachary Pyle FILENAME: G:\00_MFA Civil 3D\00_PROJECTS\9059.07 Leichner\PLANS\Conceptual Site Plans\C2.X Exhg Cond & Site Plans_Rev.dwg

APPENDIX B

WWHM REPORT

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Master Plan Stormwater Analysis
Site Name:	Leichner
Site Address:	9411 NE 94th Avenue
City:	Vancouver
Report Date:	8/24/2017
Gage:	Orchards
Data Start:	1948/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	0.00 (adjusted)
Version:	2015/07/29

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
A B, Pasture, Flat	35.19
Pervious Total	35.19
Impervious Land Use	Acres
Impervious Total	0
Basin Total	35.19

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	Acres
A B, Pasture, Flat	31.85
A B, Lawn, Flat	0.72
Pervious Total	32.57
Impervious Land Use	Acres
ROADS FLAT	2.26
SIDEWALKS FLAT	0.36
Impervious Total	2.62
Basin Total	35.19

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Bioretention 1

Bottom Length:	4160.00 ft.
Bottom Width:	1.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW 12 in/hr
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Infiltration On	
Infiltration rate:	20
Infiltration safety factor:	0.25
Total Volume Infiltrated (ac-ft):	447.322
Total Volume Through Riser (ac-ft):	11
Total Volume Through Facility (ac-ft):	458.322
Percent Infiltrated:	97.6
Total Precip Applied to Facility:	18.128
Total Evap From Facility:	10.947
Underdrain not used	
Vertical orifice Outlet Structure	
Vertical orifice Diameter (in):	4
Vertical orifice Elevation (in):	6
Width of overroad flow (ft):	5
Element Flows To:	
Outlet 1 Outlet 2	

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0955	0.0000	0.0000	0.0000
0.0531	0.0955	0.0023	0.0000	0.0000
0.1062	0.0955	0.0046	0.0000	0.0000
0.1593	0.0955	0.0070	0.0000	0.0001
0.2125	0.0955	0.0093	0.0000	0.0005
0.2656	0.0955	0.0116	0.0000	0.0012
0.3187	0.0955	0.0139	0.0000	0.0023
0.3718	0.0955	0.0162	0.0000	0.0040
0.4249	0.0955	0.0186	0.0000	0.0062
0.4780	0.0955	0.0209	0.0000	0.0091
0.5311	0.0955	0.0232	0.0000	0.0126
0.5842	0.0955	0.0255	0.0000	0.0169
0.6374	0.0955	0.0278	0.0000	0.0219
0.6905	0.0955	0.0302	0.0000	0.0277
0.7436	0.0955	0.0325	0.0000	0.0344
0.7967	0.0955	0.0348	0.0000	0.0420
0.8498	0.0955	0.0371	0.0000	0.0504
0.9029	0.0955	0.0394	0.0000	0.0599
0.9560	0.0955	0.0418	0.0000	0.0655
1.0092	0.0955	0.0441	0.0000	0.0703
1.0623	0.0955	0.0464	0.0000	0.0817
1.1154	0.0955	0.0487	0.0000	0.0942
1.1685	0.0955	0.0510	0.0000	0.1078
1.2216	0.0955	0.0534	0.0000	0.1225
1.2747	0.0955	0.0557	0.0000	0.1383

1.3278	0.0955	0.0580	0.0000	0.1553
1.3810	0.0955	0.0603	0.0000	0.1587
1.4341	0.0955	0.0626	0.0000	0.1734
1.4872	0.0955	0.0649	0.0000	0.1928
1.5403	0.0955	0.0671	0.0000	0.2135
1.5934	0.0955	0.0692	0.0000	0.2354
1.6465	0.0955	0.0713	0.0000	0.2585
1.6996	0.0955	0.0734	0.0000	0.2830
1.7527	0.0955	0.0755	0.0000	0.2889
1.8059	0.0955	0.0776	0.0000	0.2889
1.8590	0.0955	0.0797	0.0000	0.2889
1.9121	0.0955	0.0818	0.0000	0.2889
1.9652	0.0955	0.0839	0.0000	0.2889
2.0183	0.0955	0.0860	0.0000	0.2889
2.0714	0.0955	0.0881	0.0000	0.2889
2.1245	0.0955	0.0902	0.0000	0.2889
2.1777	0.0955	0.0923	0.0000	0.2889
2.2308	0.0955	0.0944	0.0000	0.2889
2.2839	0.0955	0.0965	0.0000	0.2889
2.3370	0.0955	0.0986	0.0000	0.2889
2.3901	0.0955	0.1007	0.0000	0.2889
2.4432	0.0955	0.1028	0.0000	0.2889
2.4963	0.0955	0.1049	0.0000	0.2889
2.5000	0.0955	0.1051	0.0000	0.2889

Bioretention Hydraulic Table

Stage(ft)	Area(ac)	Volume(ac-ft)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
2.5000	0.0955	0.1051	0.0000	0.2889	0.0000
2.5531	0.0955	0.1102	0.0000	0.2889	0.0000
2.6062	0.0955	0.1152	0.0000	0.2889	0.0000
2.6593	0.0955	0.1203	0.0000	0.2889	0.0000
2.7125	0.0955	0.1254	0.0000	0.2889	0.0000
2.7656	0.0955	0.1305	0.0000	0.2889	0.0000
2.8187	0.0955	0.1355	0.0000	0.2889	0.0000
2.8718	0.0955	0.1406	0.0000	0.2889	0.0000
2.9249	0.0955	0.1457	0.0000	0.2889	0.0000
2.9780	0.0955	0.1507	0.0000	0.2889	0.0000
3.0311	0.0955	0.1558	0.0220	0.2889	0.0000
3.0842	0.0955	0.1609	0.0530	0.2889	0.0000
3.1374	0.0955	0.1660	0.0950	0.2889	0.0000
3.1905	0.0955	0.1710	0.1440	0.2889	0.0000
3.2436	0.0955	0.1761	0.1990	0.2889	0.0000
3.2967	0.0955	0.1812	0.2580	0.2889	0.0000
3.3498	0.0955	0.1862	0.3190	0.2889	0.0000
3.4029	0.0955	0.1913	0.3830	0.2889	0.0000
3.4560	0.0955	0.1964	0.4480	0.2889	0.0000
3.5092	0.0955	0.2015	0.5140	0.2889	0.0000
3.5623	0.0955	0.2065	0.5820	0.2889	0.0000
3.6154	0.0955	0.2116	0.6490	0.2889	0.0000
3.6685	0.0955	0.2167	0.7170	0.2889	0.0000
3.7216	0.0955	0.2218	0.7850	0.2889	0.0000
3.7747	0.0955	0.2268	1.0064	0.2889	0.0000
3.8278	0.0955	0.2319	1.4245	0.2889	0.0000
3.8810	0.0955	0.2370	1.9580	0.2889	0.0000
3.9341	0.0955	0.2420	2.5832	0.2889	0.0000
3.9872	0.0955	0.2471	3.2868	0.2889	0.0000
4.0403	0.0955	0.2522	4.0602	0.2889	0.0000
4.0934	0.0955	0.2573	4.8960	0.2889	0.0000

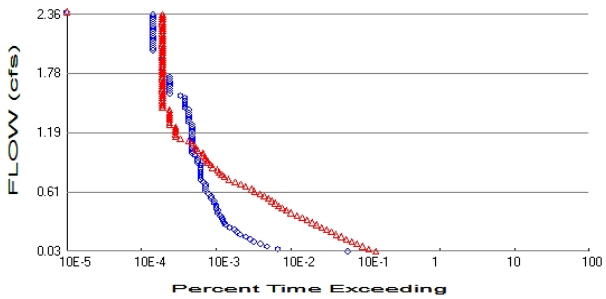
4.1465	0.0955	0.2623	5.7914	0.2889	0.0000
4.1996	0.0955	0.2674	6.7405	0.2889	0.0000
4.2527	0.0955	0.2725	7.7400	0.2889	0.0000
4.3059	0.0955	0.2775	8.7894	0.2889	0.0000
4.3590	0.0955	0.2826	9.8842	0.2889	0.0000
4.4121	0.0955	0.2877	11.024	0.2889	0.0000
4.4652	0.0955	0.2928	12.206	0.2889	0.0000
4.5183	0.0955	0.2978	13.428	0.2889	0.0000
4.5714	0.0955	0.3029	14.689	0.2889	0.0000
4.6245	0.0955	0.3080	15.990	0.2889	0.0000
4.6777	0.0955	0.3131	17.327	0.2889	0.0000
4.7308	0.0955	0.3181	18.700	0.2889	0.0000
4.7839	0.0955	0.3232	19.020	0.2889	0.0000
4.8333	0.0955	0.3279	19.020	0.2889	0.0000

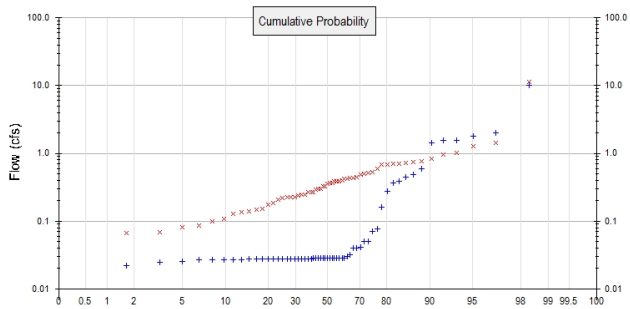
Surface retention 1

Element Flows To:

Outlet 1	Outlet 2
	Bioretention 1

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 35.19
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 32.57
Total Impervious Area: 2.62

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.050874
5 year	0.197061
10 year	0.450347
25 year	1.194262
50 year	2.364274
100 year	4.531166

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.317402
5 year	0.71171
10 year	1.09528
25 year	1.7464
50 year	2.369571
100 year	3.125943

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.028	0.387
1950	0.050	0.228
1951	1.770	0.429
1952	0.028	0.502
1953	0.040	0.146
1954	0.050	0.270
1955	0.028	0.107
1956	1.424	1.435
1957	0.028	0.329
1958	0.028	0.838

1959	0.028	0.069
1960	0.027	0.437
1961	0.041	0.381
1962	0.028	0.296
1963	0.028	0.299
1964	0.028	0.177
1965	0.030	0.324
1966	0.027	0.264
1967	0.028	0.208
1968	0.027	0.761
1969	0.386	1.007
1970	10.115	11.457
1971	0.028	0.139
1972	1.569	0.135
1973	0.028	0.355
1974	0.367	0.677
1975	0.040	0.150
1976	0.275	0.403
1977	0.021	0.082
1978	0.077	0.424
1979	0.025	0.589
1980	0.028	0.066
1981	0.032	0.451
1982	0.593	0.698
1983	1.546	0.958
1984	0.027	0.099
1985	0.028	0.266
1986	0.028	0.426
1987	0.028	0.223
1988	0.028	0.185
1989	0.027	0.248
1990	0.027	0.220
1991	0.028	0.226
1992	0.028	0.130
1993	0.028	0.674
1994	0.028	0.292
1995	0.028	0.707
1996	2.006	1.276
1997	0.492	0.749
1998	0.028	0.523
1999	0.159	0.391
2000	0.028	0.014
2001	0.028	0.086
2002	0.441	0.361
2003	0.028	0.368
2004	0.026	0.482
2005	0.022	0.244
2006	0.028	0.241
2007	0.070	0.514
2008	0.027	0.718

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	10.1150	11.4569
2	2.0056	1.4350
3	1.7699	1.2762
4	1.5690	1.0067

5	1.5463	0.9581
6	1.4238	0.8380
7	0.5928	0.7606
8	0.4921	0.7487
9	0.4411	0.7184
10	0.3856	0.7070
11	0.3668	0.6982
12	0.2754	0.6767
13	0.1589	0.6735
14	0.0775	0.5889
15	0.0697	0.5232
16	0.0498	0.5144
17	0.0496	0.5015
18	0.0409	0.4817
19	0.0404	0.4511
20	0.0402	0.4371
21	0.0317	0.4291
22	0.0299	0.4256
23	0.0284	0.4239
24	0.0284	0.4033
25	0.0284	0.3913
26	0.0284	0.3869
27	0.0283	0.3813
28	0.0283	0.3679
29	0.0283	0.3614
30	0.0283	0.3547
31	0.0282	0.3290
32	0.0282	0.3242
33	0.0282	0.2990
34	0.0281	0.2955
35	0.0281	0.2916
36	0.0281	0.2698
37	0.0280	0.2664
38	0.0280	0.2641
39	0.0280	0.2479
40	0.0280	0.2443
41	0.0279	0.2411
42	0.0279	0.2283
43	0.0278	0.2262
44	0.0278	0.2231
45	0.0278	0.2197
46	0.0276	0.2075
47	0.0276	0.1845
48	0.0275	0.1767
49	0.0275	0.1498
50	0.0275	0.1465
51	0.0274	0.1393
52	0.0271	0.1353
53	0.0271	0.1297
54	0.0270	0.1067
55	0.0268	0.0988
56	0.0268	0.0859
57	0.0258	0.0817
58	0.0246	0.0686
59	0.0222	0.0663
60	0.0207	0.0136

Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0254	1231	2895	235	Fail
0.0491	141	2329	1651	Fail
0.0727	101	1941	1921	Fail
0.0963	82	1612	1965	Fail
0.1199	67	1398	2086	Fail
0.1436	60	1174	1956	Fail
0.1672	52	1012	1946	Fail
0.1908	44	862	1959	Fail
0.2144	40	740	1850	Fail
0.2381	37	632	1708	Fail
0.2617	32	544	1700	Fail
0.2853	28	466	1664	Fail
0.3089	27	409	1514	Fail
0.3326	26	351	1350	Fail
0.3562	25	302	1208	Fail
0.3798	24	256	1066	Fail
0.4034	22	213	968	Fail
0.4271	22	184	836	Fail
0.4507	21	161	766	Fail
0.4743	21	144	685	Fail
0.4979	20	131	655	Fail
0.5216	20	117	585	Fail
0.5452	18	105	583	Fail
0.5688	18	93	516	Fail
0.5924	17	82	482	Fail
0.6161	15	69	460	Fail
0.6397	15	63	419	Fail
0.6633	15	52	346	Fail
0.6869	15	45	300	Fail
0.7106	14	38	271	Fail
0.7342	13	31	238	Fail
0.7578	13	27	207	Fail
0.7814	13	25	192	Fail
0.8050	13	23	176	Fail
0.8287	13	22	169	Fail
0.8523	13	19	146	Fail
0.8759	13	18	138	Fail
0.8995	12	16	133	Fail
0.9232	12	16	133	Fail
0.9468	12	15	125	Fail
0.9704	11	14	127	Fail
0.9940	10	14	140	Fail
1.0177	10	12	120	Fail
1.0413	10	11	110	Pass
1.0649	10	11	110	Pass
1.0885	10	10	100	Pass
1.1122	10	9	90	Pass
1.1358	10	7	70	Pass
1.1594	10	6	60	Pass
1.1830	10	6	60	Pass
1.2067	10	6	60	Pass
1.2303	10	6	60	Pass
1.2539	10	6	60	Pass
1.2775	10	5	50	Pass

1.3012	9	5	55	Pass
1.3248	9	5	55	Pass
1.3484	9	5	55	Pass
1.3720	9	5	55	Pass
1.3957	9	5	55	Pass
1.4193	9	5	55	Pass
1.4429	8	4	50	Pass
1.4665	8	4	50	Pass
1.4902	8	4	50	Pass
1.5138	8	4	50	Pass
1.5374	8	4	50	Pass
1.5610	7	4	57	Pass
1.5847	5	4	80	Pass
1.6083	5	4	80	Pass
1.6319	5	4	80	Pass
1.6555	5	4	80	Pass
1.6792	5	4	80	Pass
1.7028	5	4	80	Pass
1.7264	5	4	80	Pass
1.7500	5	4	80	Pass
1.7737	4	4	100	Pass
1.7973	4	4	100	Pass
1.8209	4	4	100	Pass
1.8445	4	4	100	Pass
1.8682	4	4	100	Pass
1.8918	4	4	100	Pass
1.9154	4	4	100	Pass
1.9390	4	4	100	Pass
1.9627	4	4	100	Pass
1.9863	4	4	100	Pass
2.0099	3	4	133	Fail
2.0335	3	4	133	Fail
2.0572	3	4	133	Fail
2.0808	3	4	133	Fail
2.1044	3	4	133	Fail
2.1280	3	4	133	Fail
2.1517	3	4	133	Fail
2.1753	3	4	133	Fail
2.1989	3	4	133	Fail
2.2225	3	4	133	Fail
2.2462	3	4	133	Fail
2.2698	3	4	133	Fail
2.2934	3	4	133	Fail
2.3170	3	4	133	Fail
2.3406	3	4	133	Fail
2.3643	3	4	133	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.
The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.537 acre-feet
On-line facility target flow:	3.3878 cfs.
Adjusted for 15 min:	3.3878 cfs.
Off-line facility target flow:	2.2473 cfs.
Adjusted for 15 min:	2.2473 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
retention 1 POC	☐	416.79			☐	97.67			
Total Volume Infiltrated		416.79	0.00	0.00		97.67	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic

Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                               ***
WDM        26   Master Plan Stormwater Analysis.wdm
MESSU      25   PreMaster Plan Stormwater Analysis.MES
           27   PreMaster Plan Stormwater Analysis.L61
           28   PreMaster Plan Stormwater Analysis.L62
           30   POCMaster Plan Stormwater Analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       4
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
    4     A/B, Pasture, Flat      1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    4         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

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

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    4         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    4              0         5       1.5       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    4              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    4           0.15       0.5       0.3         0       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    4              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
  END GEN-INFO
  *** Section IWATER***

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

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

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

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

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

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

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   4                       35.19     COPY   501     12
PERLND   4                       35.19     COPY   501     13

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

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



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

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

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

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

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

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

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.14           PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.14           IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.8            IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

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

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

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


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2008 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                    UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                                ***
WDM        26   Master Plan Stormwater Analysis.wdm
MESSU      25   MitMaster Plan Stormwater Analysis.MES
           27   MitMaster Plan Stormwater Analysis.L61
           28   MitMaster Plan Stormwater Analysis.L62
           30   POCMaster Plan Stormwater Analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       4
      PERLND       7
      IMPLND       1
      IMPLND       8
      RCHRES       1
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Surface retention  1        MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                           in  out           ***
    4     A/B, Pasture, Flat      1    1    1    1   27    0
    7     A/B, Lawn, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    4         0    0    1    0    0    0    0    0    0    0    0    0
    7         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    4         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    7         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    4         0    0    0    0    0    0    0    0    0    0    0
    7         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    4              0         5       1.5       400      0.05       0.3     0.996
    7              0         5       0.8       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    4              0         0         2         2         0         0         0
    7              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                  ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    4          0.15       0.5       0.3         0       0.7       0.4
    7           0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    4              0         0         0         0         3         1         0
    7              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    8         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    8         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    8         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    8              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   4                       31.85     RCHRES   1      2
PERLND   4                       31.85     RCHRES   1      3
PERLND   7                        0.72     RCHRES   1      2
PERLND   7                        0.72     RCHRES   1      3
IMPLND   1                        2.26     RCHRES   1      5
IMPLND   8                        0.36     RCHRES   1      5

******Routing******
RCHRES   1                           1     RCHRES   2      8
RCHRES   2                           1     COPY   501     17
RCHRES   1                           1     COPY   501     17
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                          in  out                            ***
    1     Surface retentio-014    3    1    1    1   28    0    1
    2     Bioretention  1         2    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
```

```
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  5  6  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1              1      0.01       0.0       0.0       0.5       0.0
    2              2      0.79       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1            0         4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2            0         4.0  5.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      2
   49    5
     Depth      Area    Volume  Outflow1  Outflow2  Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.095500  0.000000  0.000000  0.000000
  0.053114  0.095500  0.002320  0.000000  0.000000
  0.106227  0.095500  0.004639  0.000000  0.000000
  0.159341  0.095500  0.006959  0.000000  0.000113
  0.212454  0.095500  0.009278  0.000000  0.000470
  0.265568  0.095500  0.011598  0.000000  0.001185
  0.318681  0.095500  0.013918  0.000000  0.002340
  0.371795  0.095500  0.016237  0.000000  0.004005
  0.424908  0.095500  0.018557  0.000000  0.006239
  0.478022  0.095500  0.020876  0.000000  0.009097
  0.531136  0.095500  0.023196  0.000000  0.012630
  0.584249  0.095500  0.025516  0.000000  0.016885
  0.637363  0.095500  0.027835  0.000000  0.021904
  0.690476  0.095500  0.030155  0.000000  0.027730
  0.743590  0.095500  0.032474  0.000000  0.034402
  0.796703  0.095500  0.034794  0.000000  0.041957
  0.849817  0.095500  0.037114  0.000000  0.050432
  0.902930  0.095500  0.039433  0.000000  0.059862
  0.956044  0.095500  0.041753  0.000000  0.065488
  1.009158  0.095500  0.044072  0.000000  0.070278
  1.062271  0.095500  0.046392  0.000000  0.081715
  1.115385  0.095500  0.048711  0.000000  0.094203
  1.168498  0.095500  0.051031  0.000000  0.107771
  1.221612  0.095500  0.053351  0.000000  0.122451
  1.274725  0.095500  0.055670  0.000000  0.138269
  1.327839  0.095500  0.057990  0.000000  0.155254
```

```
  1.380952  0.095500  0.060309  0.000000  0.158708
  1.434066  0.095500  0.062629  0.000000  0.173431
  1.487179  0.095500  0.064949  0.000000  0.192827
  1.540293  0.095500  0.067054  0.000000  0.213464
  1.593407  0.095500  0.069159  0.000000  0.235365
  1.646520  0.095500  0.071264  0.000000  0.258541
  1.699634  0.095500  0.073369  0.000000  0.282961
  1.752747  0.095500  0.075474  0.000000  0.288889
  1.805861  0.095500  0.077579  0.000000  0.288889
  1.858974  0.095500  0.079684  0.000000  0.288889
  1.912088  0.095500  0.081789  0.000000  0.288889
  1.965201  0.095500  0.083894  0.000000  0.288889
  2.018315  0.095500  0.085999  0.000000  0.288889
  2.071429  0.095500  0.088104  0.000000  0.288889
  2.124542  0.095500  0.090209  0.000000  0.288889
  2.177656  0.095500  0.092314  0.000000  0.288889
  2.230769  0.095500  0.094419  0.000000  0.288889
  2.283883  0.095500  0.096524  0.000000  0.288889
  2.336996  0.095500  0.098629  0.000000  0.288889
  2.390110  0.095500  0.100734  0.000000  0.288889
  2.443223  0.095500  0.102839  0.000000  0.288889
  2.496337  0.095500  0.104944  0.000000  0.288889
  2.500000  0.095500  0.210179  0.000000  0.288889
  END FTABLE  2
  FTABLE      1
   45    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)   (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.095500  0.000000  0.000000  0.000000  0.000000
  0.053114  0.095500  0.005072  0.000000  0.288889  0.000000
  0.106227  0.095500  0.010145  0.000000  0.288889  0.000000
  0.159341  0.095500  0.015217  0.000000  0.288889  0.000000
  0.212454  0.095500  0.020289  0.000000  0.288889  0.000000
  0.265568  0.095500  0.025362  0.000000  0.288889  0.000000
  0.318681  0.095500  0.030434  0.000000  0.288889  0.000000
  0.371795  0.095500  0.035507  0.000000  0.288889  0.000000
  0.424908  0.095500  0.040579  0.000000  0.288889  0.000000
  0.478022  0.095500  0.045651  0.000000  0.288889  0.000000
  0.531136  0.095500  0.050724  0.022000  0.288889  0.000000
  0.584249  0.095500  0.055796  0.053000  0.288889  0.000000
  0.637363  0.095500  0.060868  0.095000  0.288889  0.000000
  0.690476  0.095500  0.065941  0.144000  0.288889  0.000000
  0.743590  0.095500  0.071013  0.199000  0.288889  0.000000
  0.796703  0.095500  0.076086  0.258000  0.288889  0.000000
  0.849817  0.095500  0.081158  0.319000  0.288889  0.000000
  0.902930  0.095500  0.086230  0.383000  0.288889  0.000000
  0.956044  0.095500  0.091303  0.448000  0.288889  0.000000
  1.009158  0.095500  0.096375  0.514000  0.288889  0.000000
  1.062271  0.095500  0.101447  0.582000  0.288889  0.000000
  1.115385  0.095500  0.106520  0.649000  0.288889  0.000000
  1.168498  0.095500  0.111592  0.717000  0.288889  0.000000
  1.221612  0.095500  0.116664  0.785000  0.288889  0.000000
  1.274725  0.095500  0.121737  1.006441  0.288889  0.000000
  1.327839  0.095500  0.126809  1.424546  0.288889  0.000000
  1.380952  0.095500  0.131882  1.958050  0.288889  0.000000
  1.434066  0.095500  0.136954  2.583194  0.288889  0.000000
  1.487179  0.095500  0.142026  3.286809  0.288889  0.000000
  1.540293  0.095500  0.147099  4.060182  0.288889  0.000000
  1.593407  0.095500  0.152171  4.895993  0.288889  0.000000
  1.646520  0.095500  0.157243  5.791382  0.288889  0.000000
  1.699634  0.095500  0.162316  6.740462  0.288889  0.000000
  1.752747  0.095500  0.167388  7.740030  0.288889  0.000000
  1.805861  0.095500  0.172461  8.789390  0.288889  0.000000
  1.858974  0.095500  0.177533  9.884228  0.288889  0.000000
  1.912088  0.095500  0.182605  11.02353  0.288889  0.000000
  1.965201  0.095500  0.187678  12.20553  0.288889  0.000000
  2.018315  0.095500  0.192750  13.42765  0.288889  0.000000
  2.071429  0.095500  0.197822  14.68948  0.288889  0.000000
```

```
  2.124542  0.095500  0.202895  15.98973  0.288889  0.000000
  2.177656  0.095500  0.207967  17.32726  0.288889  0.000000
  2.230769  0.095500  0.213039  18.70000  0.288889  0.000000
  2.283883  0.095500  0.218112  19.01970  0.288889  0.000000
  2.333333  0.095500  0.222834  19.01970  0.288889  0.000000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1.14           PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1.14           IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.8            PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.8            IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1.14           RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.8            RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO     1 1        1      WDM   1000 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      1 1        1      WDM   1001 FLOW     ENGL      REPL
RCHRES   2 HYDR   O      2 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1004 STAG     ENGL      REPL
RCHRES   1 HYDR   O      1 1        1      WDM   1005 FLOW     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

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

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

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

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX C

PRELIMINARY GEOTECHNICAL REPORT

APPENDIX D

OPERATIONS & MAINTENANCE MANUAL