ATTACHMENT 2

Backup for PDP Hydromodification Control Measures

☐ Mark this box if this attachment is empty because the project is exempt from PDP hydromodification management requirements.

Project Name/ Nakano

Indicate which Items are Included

Attachment Sequence	Contents	Checklist
Attachment 2A	Hydromodification Management Exhibit (Required)	☒ Included See Hydromodification Management Exhibit Checklist.
Attachment 2B	Management of Critical Coarse Sediment Yield Areas (WMAA Exhibit is required, additional analyses are optional) See Section 6.2 of the BMP Design Manual.	☐ Exhibit showing project drainage boundaries marked on WMAA Critical Coarse Sediment Yield Area Map **(Required)** Optional analyses for Critical Coarse Sediment Yield Area Determination ☒ 6.2.1 Verification of Geomorphic Landscape Units Onsite ☐ 6.2.2 Downstream Systems Sensitivity to Coarse Sediment ☒ 6.2.3 Optional Additional Analysis of Potential Critical Coarse Sediment Yield Areas Onsite
Attachment 2C	Geomorphic Assessment of Receiving Channels (Optional) See Section 6.3.4 of the BMP Design Manual.	☐ Not performed ☒ Included ☐ Submitted as separate stand-alone document
Attachment 2D	Flow Control Facility Design and Structural BMP Drawdown Calculations (Required) Overflow Design Summary for each Structural BMP See Chapter 6 and Appendix G of the BMP Design Manual	☐ Included ☐ Submitted as separate stand-alone document

FOR HYDROMODIFICATION MANAGEMENT EXHIBIT SEE ATTACHMENT A OF HYDROMODIFICATION STUDY IN ATTACHMENT 2D

ATTACHMENT 2B

MANAGEMENT OF CRITICAL COARSE SEDIMENT YIELD AREAS

LEGEND

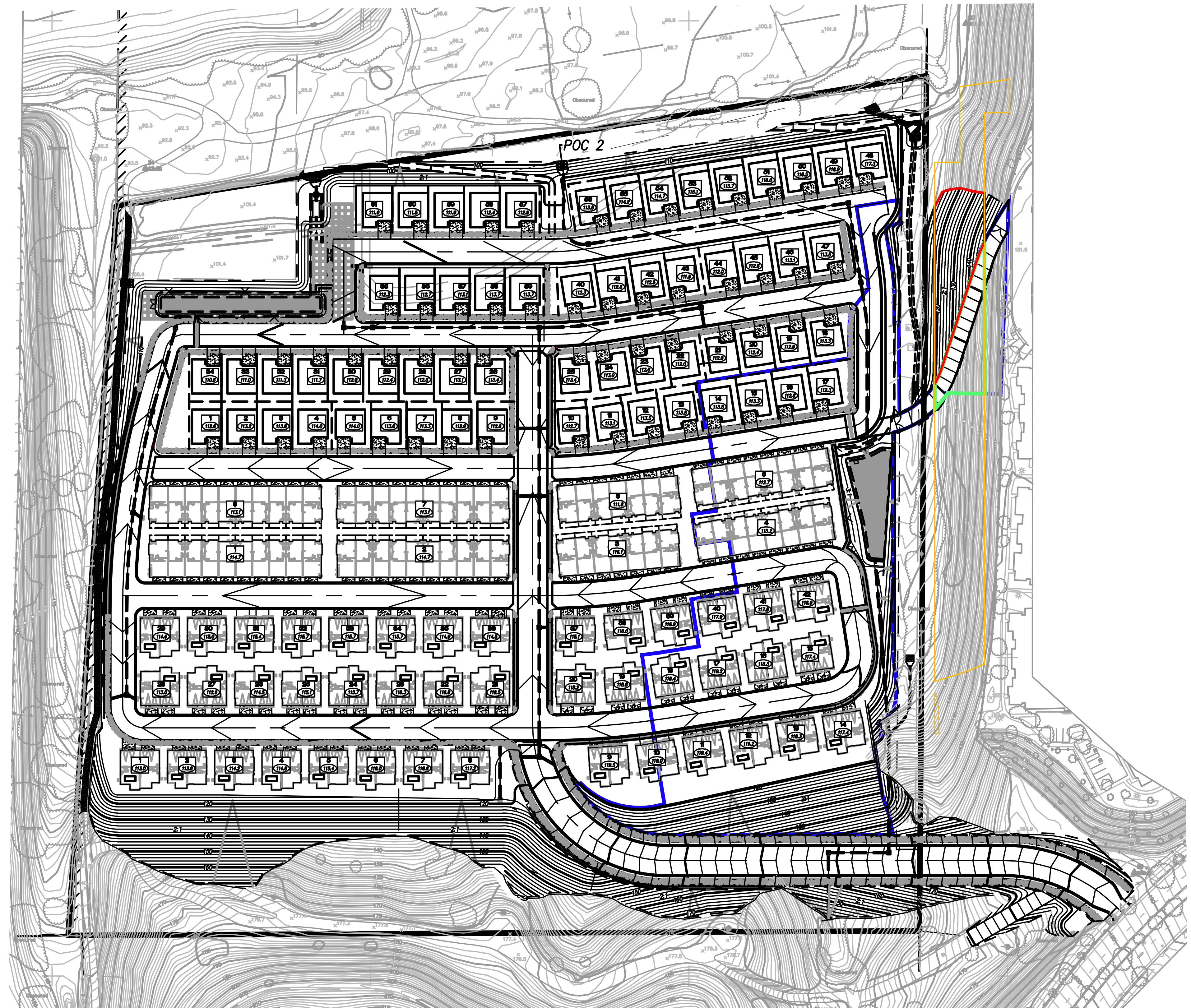
- WMAA CCSYA (yellow)
- BYPASS WMAA CCSYA (red)
- ONSITE WMAA CCSYA (green)
- TOTAL DRAINAGE AREA TO POC 2 (blue)

ONSITE CCSYA SUMMARY		
	AREA	% OF SITE
ONSITE CCSYA AREA 1	6441 SF	3.7
TOTAL DRAINAGE AREA TO POC 2	174,893 SF	
3.7% LESS THAN 5% ALLOWANCE THEREFORE ONSITE CCSYA AREA IS ACCOUNTED FOR VIA H.2.1 AVOIDANCE METRICS IN THE 2021 CITY OF CHULA VISTA BMP DESIGN MANUAL		

BYPASS CCSYA NOTE:

HILLSLOPE CCSYA WILL BE BYPASSED THE PROJECT SITE AND WILL FLOW INTO A DRAINAGE DITCH TO THE NORTHEAST CORNER OF THE PROJECT. THE DRAINAGE DITCH WILL CONVEY BED SEDIMENT FROM HILLSOPES TO DOWNSTREAM WATERS BY MAINTAINING A PEAK VELOCITY GREATER THAN OF 3 FEET PER SECOND FOR THE 2-YEAR, 24 HOUR RUNOFF EVENT.

STEP 1 IDENTIFIED THE CCSYA. STEP 2 AVOIDANCE OF THIS HILLSLOPE WAS NOT POSSIBLE. STEP 3 BYPASS OF CCSYA WAS COMPLETED. NO NET IMPACT ANALYSIS IS NOT REQUIRED BY MEETING THE GUIDANCE FOR STEP 3 BYPASS OF HILLSLOPE CCSYA.



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CITY OF CHULA VISTA

NAKANO

Attachment 2B
CCSYA VICINITY MAP

SCALE: 1" = 150' JOB #: 4409.00 CREATED: 02/09/22

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ATTACHMENT 2D

FLOW CONTROL FACILITY DESIGN AND STRUCTURAL BMP DRAWDOWN CALCULATIONS

Preliminary Hydromodification Management Study

NAKANO

City of Chula Vista TM#PCS21-0001,
City of San Diego PTS 647766

City of Chula Vista CA
November 3, 2022

Prepared for:
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REGISTERED PROFESSIONAL ENGINEER
CHELISA A. PACK
No. 71026
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Prepared by: J. Novoa, PE
Under the supervision of

Chelisa Pack, PE RCE 71026
Registration Expires 06/30/23

1. INTRODUCTION

This report summarizes the preliminary hydromodification design for the Nakano development Project for a Tentative Map (TM) submittal located in the City of Chula Vista, CA. The hydromodification calculations were performed utilizing continuous simulation analysis to size the storm water treatment and control facilities. Storm Water Management Model (SWMM) version 5.1 distributed by USEPA is the basis of both existing and proposed conditions modeling within this report. The biofiltration basin/hydromodification basin sizing and link configuration with the specialized outlet configuration ensures compliance with the Hydromodification Management Plan (HMP) requirements from the San Diego Regional Water Quality Control Board (SDRWQCB).

2. HYDROMODIFICATION MODELING OVERVIEW

2. 1 Model Description

PCSWMM is a proprietary software which utilizes the EPA's Stormwater Management Model (SWMM) as its computational engine, while providing added processing and analytical capabilities to streamline design. PCSWMM is essentially a user-friendly shell for SWMM that allows rapid development and analysis of SWMM models.

PCSWMM was employed for this study based on the ability to efficiently create, edit and compare models, perform detention routing with the same software, and moreover, due to the tendency for SWMM to produce results that have been found to more accurately represent San Diego area watersheds than the alternative San Diego Hydrology Model (SDHM).

SWMM is a semi-distributed hydrologic and hydraulic modeling software that simulates the rainfall-runoff response of a watershed based on linear-reservoir overland flow routing. This overland flow routine accounts for the connectedness of pervious, impervious, and Low Impact Development (LID) BMPs to the drainage system. LID BMPs are represented with a module in SWMM that simulates the water balance through standard LID BMP components, accounting for soil percolation, evapotranspiration, underdrain outflow, various media layer storage and subgrade infiltration (if applicable). These controls provide a wide range of customizability between the various associated parameters and the ability to route underdrain or overflow to other SWMM elements, like Storages Nodes and conduits to represent almost any conceivable LID system.

The outflow from these LID controls, storage components or watersheds is translated into the hydraulic component of the model that utilizes energy and momentum principles to determine flow through conduits, orifices and other structures. The hydraulics may be computed based on either the kinematic or dynamic-wave equations. In this study the former was used because there was no need to take downstream hydraulic grade line effects into consideration.

2.2 Hydromodification Criteria

The San Diego Regional Water Quality Control Board (SDRWQCB) requires the exceedance duration of post-developed flow rates be maintained to within 10% of the pre-developed flow durations. This must occur for flow frequencies ranging from a fraction of the 2-year flow (Q2) to the 10-year flow (Q10). These flow frequency values may be calculated directly from SWMM statistics or estimated based on accepted USGS regression equations. These equations estimate flows based on a correlation with watershed area and the mean annual rainfall developed for the region. For this project the SWMM output was used because of the exceedingly small values calculated by regression equations, which were developed with data from significantly larger watersheds.

The fraction of the Q2 that must be controlled is dependent on the relative erodibility of the channel being discharged to, categorized as either High, Medium, or Low susceptibility. By default it is assumed that all channels have a High susceptibility, and that therefore the low flow threshold of 0.1 of the Q2 must be controlled. A Geomorphic Assessment of Receiving Channels may be performed to indicate whether the channel erosion susceptibility can be categorized as Medium or Low, allowing control to 0.3 or 0.5 of the Q2, respectively.

The low-flow threshold used in the analysis for Nakano project for POCs 1 and 2 are the default 0.1Q2 low-flow threshold, as determined as “high susceptibility”. A geomorphic assessment report may be completed in the future to achieve a low or medium susceptibility, but is not completed as this time.

2.3 Model Development

The inputs required for a SWMM model include rainfall, evapotranspiration rates, watershed characteristics and BMP configurations. The sources for some of these parameters are provided in Table 1 below.

Table 1: Hydrology Criteria

Rain Gage	'Bonita' – from Project Clean Water website
Evapotranspiration	Daily E-T Rates taken from Table G.1-1 in the City of Chula Vista BMP Design Manual based on location in Zone 6 of California irrigation Management Information System "Reference Evapotranspiration Zones"
Overland Flow Path Length	Based on available digital topographic data for pre-development conditions and proposed grading plan for post-project conditions.
Soils/Green-Ampt Parameters	Values for Hydrologic Soil Group 'C and D' taken from Table G.1-4 in the City of San Diego BMP Design Manual. A 25% reduction is applied whenever native soils are compacted.

The drainage area to each point of compliance (POC) was delineated with the project boundary plus adjacent land that drain through the site for both existing and proposed conditions. For the proposed model this drainage area has been broken up into the contributing drainage management (DMA) areas that drain to BMPs. DMAs 1 and 3 flow to POC 1 and outlet via sheet to the flow north. POC 2 contains flow from DMA 2 and outlets east of POC 1 via sheet flow north as well. See the Storm Water Quality Management Plan (SWQMP) for more information regarding the pollutant control strategy and DMAs.

The overland flow path lengths were drawn from a visual inspection of the watershed contours, extending from the upper ridge to the apparent flow path, perpendicular to the contours. The percent imperviousness was calculated based on the estimated imperviousness in the site plan to develop the same values used to calculate the Design Capture Volume provided in Attachment 1e of the SWQMP.

3. Modeling for Hydromodification Compliance

The pre-developed conditions for the site were modelled based on the existing topography and landcover with zero imperviousness. For the post-developed condition, the proposed site footprint was represented as an equivalent imperviousness and a short overland flow path length typical of urban drainage systems. The lined biofiltration basins were modelled by coupling the bioretention LID component to properly represent the media and underdrain, with the storage component to represent the basin surface storage. The parameters utilized for the biofiltration parameters were based on the published values in the City of Chula Vista BMP Design Manual. The basins outlet to new proposed private storm drains that discharges and sheet flow north just before Otay River.

It was determined that this suite of BMPs would be sufficient to provide flow control with the storage depths and outlet size provided herein based on the SWMM modeling results. The Status Report SWMM output files for the existing condition models are provided in Attachment D.

3.1 Flow Frequency Analysis

The SWMM statistics calculator was used to determine the pre-developed and post developed flow rates for the 2, 5, and 10-year recurrence intervals. These are provided below with the resultant low flow threshold. The SWMM output used to calculate these values is provided in Attachment E.

The low-flow threshold used in the analysis for Nakano project for POCs 1 and 2 are the default 0.1Q2 low-flow threshold, as determined as "high susceptibility".

Table 2 – Pre-Developed and Post-Mitigated Flows for POC 1 (BMP Basin 1 & BMP 3 MWS & Vault)

Return Period	Pre-project Qpeak (cfs)	Post-project - Mitigated Q (cfs)
LF = 0.1xQ2	0.326	0.327
2-year	3.263	3.274
5-year	4.477	4.516
10-year	5.760	5.804

Table 3 – Pre-Developed and Post-Mitigated Flows for POC 2 (BMP Basin 2)

Return Period	Pre-project Qpeak (cfs)	Post-project - Mitigated Q (cfs)
LF = 0.1xQ2	0.072	0.028
2-year	0.720	0.277
5-year	1.054	0.945
10-year	1.276	1.257

3.2 Biofiltration Basins

The basins are composed of above ground storage as well as biofiltration media. These components were represented as an LID control ("Bio-retention cell") in series with a storage node as simulated in SWMM. The module allows the user to represent the various stages of a biofiltration basin including ponding, media, and gravel storage above and below the underdrain. These layer depths were assigned per the design developed for pollutant control as shown in Table 4 and the parameter values were assigned with the standard values taken from Table G.1-7 in the BMP Design Manual (with some refinement). The underdrain is offset to allow for the dead storage needed. The drain coefficients are calculated based on media infiltration of 5 in/hr and basin layer depth and listed in Table 4. Drain coefficient calculation is based on C factor calculation equation in the BMP Design Manual (Page G-27).

$$C = c_g \left(\frac{605}{A_{LID}} \right) \left(\frac{\pi D^2}{8} \right) \sqrt{\frac{g}{6}}$$

where,

cg is the orifice discharge coefficient, typically 0.60-0.65 for thin walled plates and higher for thicker walls;
ALID is the cumulative footprint area (ft^2) of all LID controls;
D is the underdrain orifice diameter (in); and
g is the gravitational constant (32.2 ft/s^2).

Table 4 – Biofiltration Model Summary

Biofiltration BMP #	Surface Area (sf)	Layer Depth			Underdrain Orifice (in)	Drain Coefficient
		Ponding (in)	Soil (in)	Gravel Storage (in)		
1	3,608	6	24	12	1	0.0908
2	4,523	6	24	12	0.8	0.0593
Media and storage parameters taken from Table G.1-7 in BMP Design Manual, including media infiltration = 5 in/hr						

To control the flows with this configuration, except for underdrain orifices, a series of flow orifices were connected between the biofiltration basin storage node connected to the point of compliance. The orifice design is summarized in Table 5. Additional screenshots of orifices and weirs are provided in Attachment B. The offset elevation of the above ground orifices are taken from the bottom of the storage node in PCSWMM which is the elevation above the water quality ponding depth, typically 0.75' above the basin bottom (0.5' of WQ ponding and 0.25' of mulch).

Table 5 – Biofiltration Orifice Design

Biofiltration BMP #	Low Flow Orifice		Overflow Weir	
	Dia. (in)	Offset (ft)	Type	Offset (ft)
1	0.8	0.0	Modified G-3 Riser	0.5
2	1	0.0	Modified G-3 Riser	1

3.3 Detention/Hydromodification Underground Vault

A multi-use underground storage vault is utilized for DMA 3. The underground vault will detain flows for the 100-year storm event, provide storage for hydromodification requirements and is also utilized for storage upstream of a modular wetland unit for water quality treatment purposes. The underground vault consists of a 5' depth and approx. 12,736 bottom footprint, which contains a weir wall within the vault. See below for the vault characteristics and parameters.

Table 6 –Underground Vault Storage Summary

Hydromod BMP #	Bottom Footprint (sf)	Depth (ft)
BMP3	12,736	5

BMP #3		
Riser Structure Parameters	Size	Height (ft)
	2.2" orifice (within MWS)*	0.0
	Weir Wall L=8'	4.5

*One single orifice was modeled in the SWMM model. The MWS Unit utilizes two 1.48" orifices. The equivalent flow out was calculated to be the same for the single orifice and two orifices, so they act similarly.

3.4 Flow Duration Curves for Hydromodification Compliance

The pre and post developed flow duration exceedance curves were developed for the hourly flow data using an automatic partial duration series calculator in PCSWMM. These curves are graphed over the flow ranges listed in Tables 2 and 3 and are provided in Attachment F. In all cases the duration of post developed flows are brought to well within that of the pre developed flows within the low flow and high flow thresholds, indicating that the suite of BMPs will provide the flow attenuation required for compliance.

4.0 SUMMARY

The predeveloped conditions of the Nakano project were modelled in SWMM to determine a baseline of flow durations that would need to be controlled in the post-developed conditions. The proposed development was also modelled in SWMM with biofiltration basins with storage as well as detention/hydromodification vault. Based on the SWMM model results for this study it is determined that the combination of two biofiltration basin and a hydromodification vault LID BMPs will be able to satisfy the hydromodification criteria. This study is intended to demonstrate that these controls as sized are capable of providing hydromodification compliance for the project.

Attachments

A – Hydromodification Management Exhibit

B – SWMM Model w/ Subcatchment Schematics

C – SWMM Output – Existing Condition

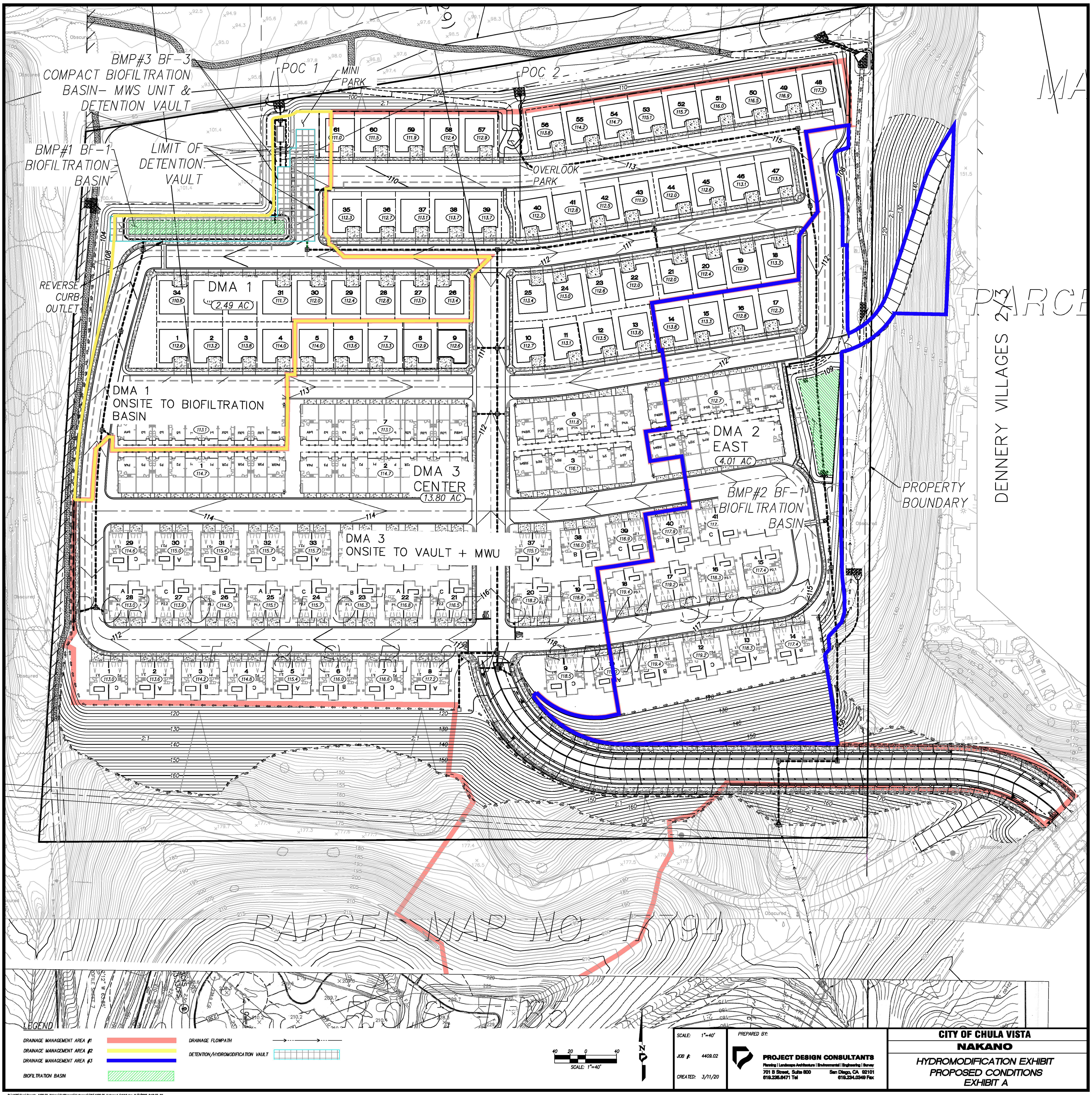
D – SWMM Output – Proposed Conditions

E – Flow Frequency Statistical Analysis results

F – Flow Duration Curves

ATTACHMENT A

Hydromodification Management Exhibit


BMP#3 BF-3
COMPACT BIOFILTRATION BASIN- MWS UNIT & DETENTION VAULT
POC 1
MINI PARK
POC 2
BMP#1 BF-1 BIOFILTRATION BASIN
LIMIT OF DETENTION VAULT
OVERLOOK PARK
REVERSE CURB OUTLET
DMA 1
2.49 AC
DMA 1
ONSITE TO BIOFILTRATION BASIN
DMA 2
EAST
4.01 AC
DMA 3
CENTER
13.80 AC
DMA 3
ONSITE TO VAULT + MWU
BMP#2 BF-1
BIOFILTRATION BASIN
PROPERTY BOUNDARY
DENNERY VILLAGES 2-3
PARCEL MAP NO. 17794
LEGEND
DRAINAGE MANAGEMENT AREA #1
DRAINAGE MANAGEMENT AREA #2
DRAINAGE MANAGEMENT AREA #3
BIOFILTRATION BASIN
DRAINAGE FLOWPATH
DETENTION/HYDROMODIFICATION VAULT
SCALE: 1"=40'
SCALE: 1"=40'
JOB #: 4409.02
CREATED: 3/11/20
PREPARED BY:
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CITY OF CHULA VISTA
NAKANO
HYDROMODIFICATION EXHIBIT
PROPOSED CONDITIONS
EXHIBIT A

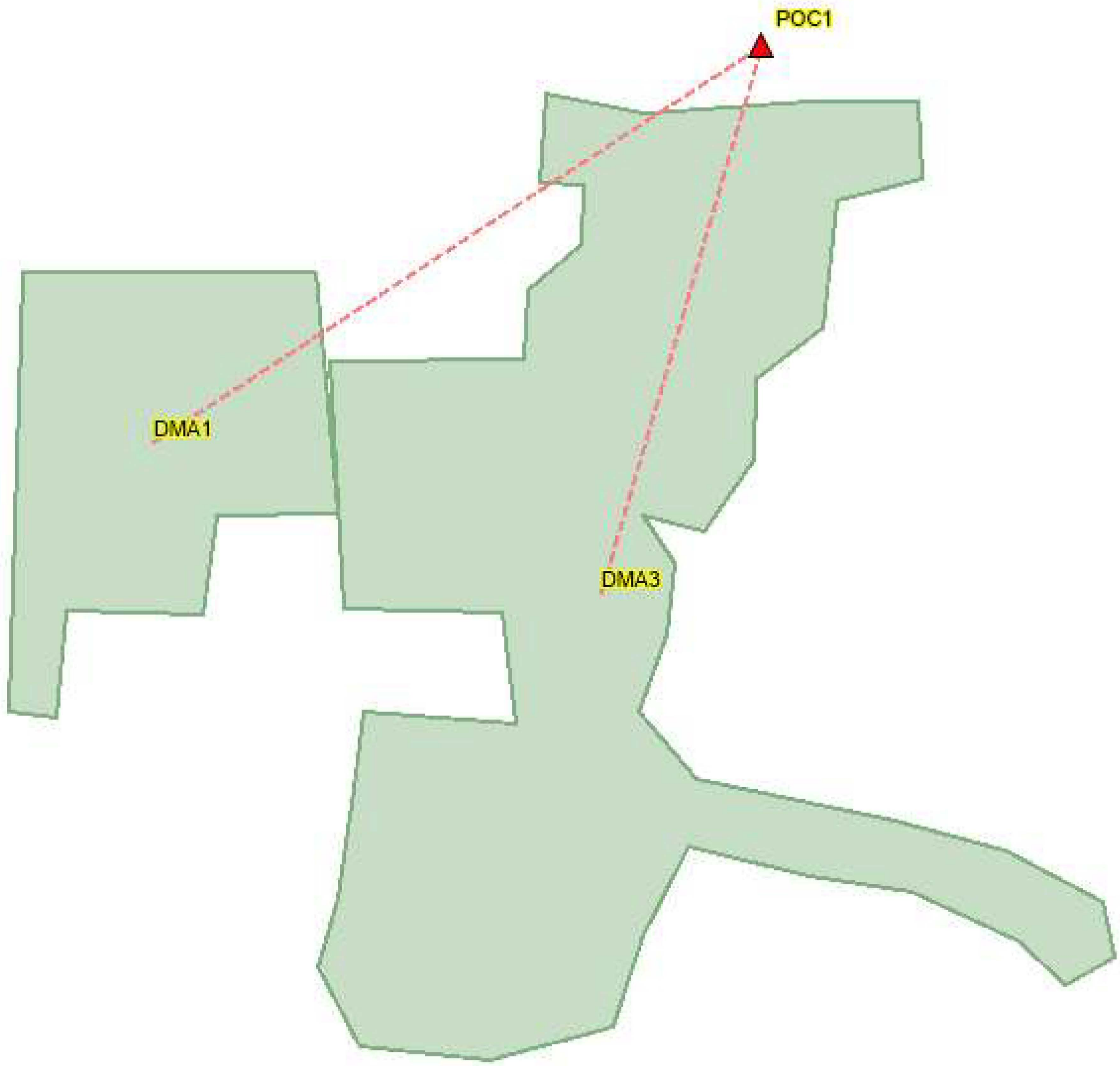
ATTACHMENT B

SWMM Model with

Sub-catchment Parameters and Schematic

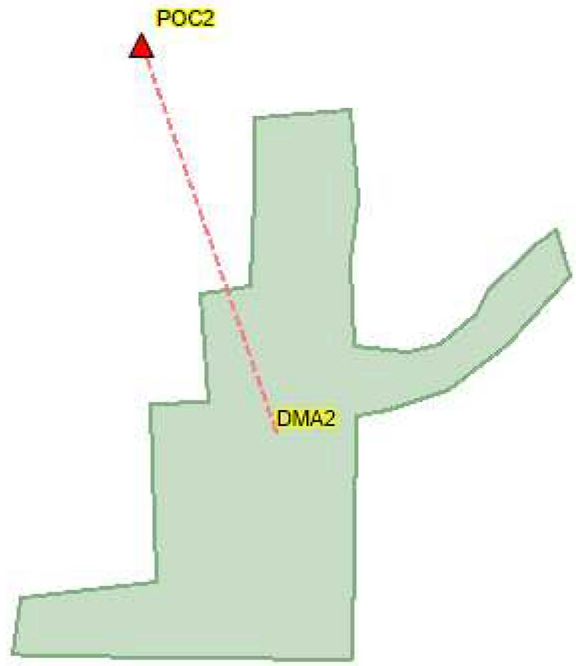
Existing Conditions

POC 1



Name	Rain Gage	Outlet	Area (ac)	Width (ft)	Flow Length (ft)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (in)	Dstore Perv (in)	Infiltration Method	Suction Head (in)	Conductivity (in/hr)	Initial Deficit (frac.)
DMA1	Bonita	POC1	2.49	520	208.5...	5	0	0.012	0.15	0.05	0.1	GREEN_AMPT	6	0.1	0.31
DMA3	Bonita	POC1	13.8	631	952.6...	15	0	0.012	0.15	0.05	0.1	GREEN_AMPT	6	0.1	0.31

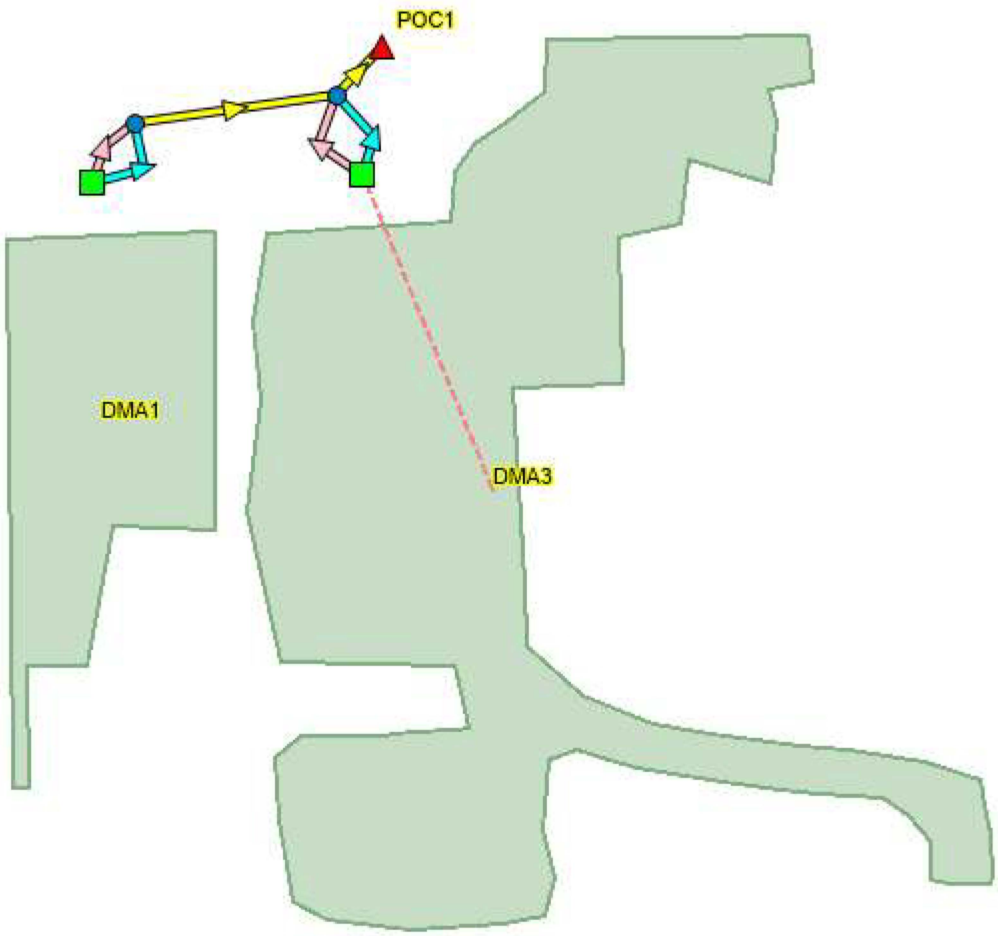
POC 2



Name	Rain Gage	Outlet	Area (ac)	Width (ft)	Flow Length (ft)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (in)	Dstore Perv (in)	Zero Imperv (%)	Subarea Routing	Percent Routed (%)	Suction Head (in)	Conductivity (in/hr)	Initial Deficit (frac.)
DMA2	Bonita	POC2	4.01	342	510.747	9.5	0	0.012	0.15	0.05	0.1	25	OUTLET	100	6	0.1	0.31

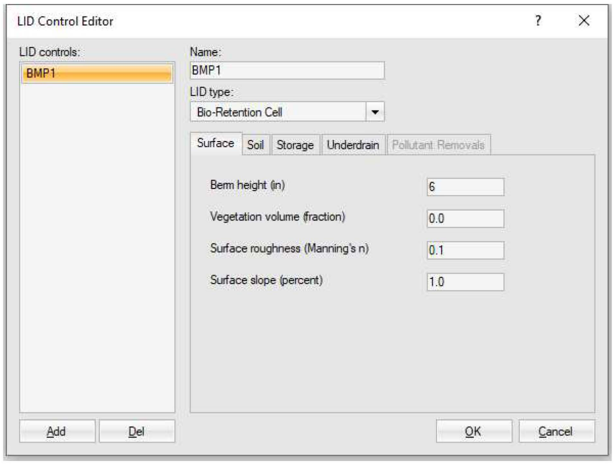
Proposed Conditions

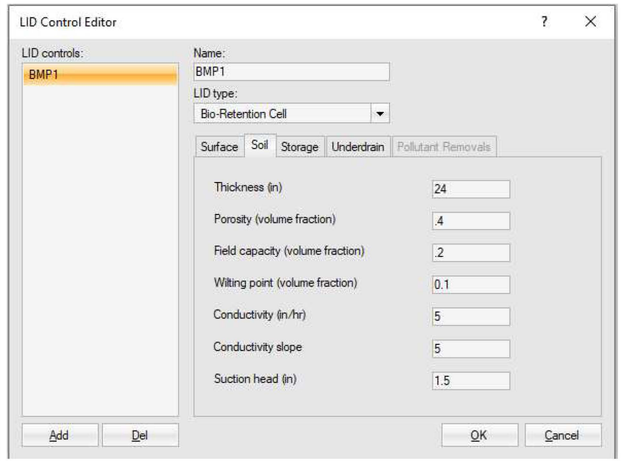
POC 1

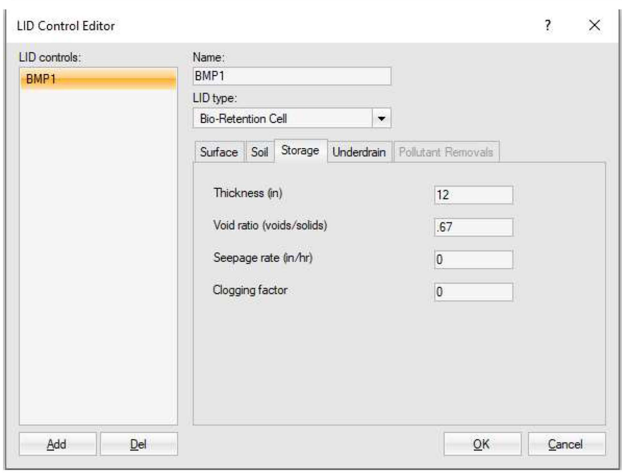


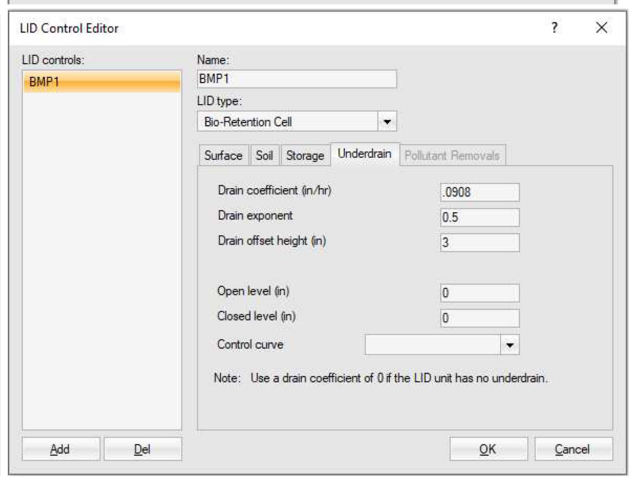
Name	Rain Gage	Outlet	Area (ac)	Width (ft)	Flow Length (ft)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (in)	Dstore Perv (in)	LID Controls	LID Names	Infiltration Method	Suction Head (in)	Conductivity (in/hr)	Initial Deficit (frac.)
DMA1	Bonita	SU1	2.49	520	208.585	3.5	69	0.012	0.15	0.05	0.1	1	BMP1	GREEN_AMPT	6	0.075	0.31
DMA3	Bonita	SU2	13.8	420	1431.257	8.2	64.8	0.012	0.15	0.05	0.1	0		GREEN_AMPT	6	0.075	0.31

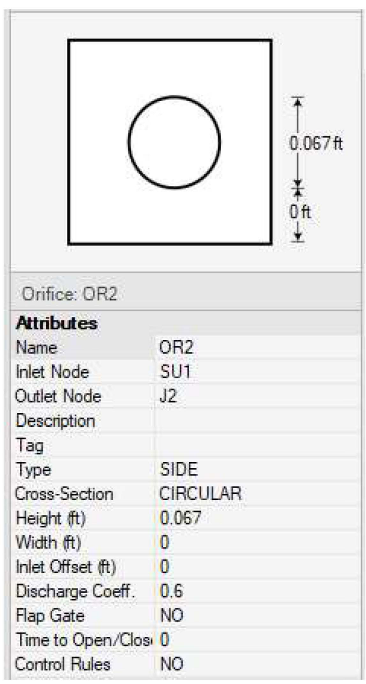
Basin 1 PCSWMM LID & Orifice Parameters

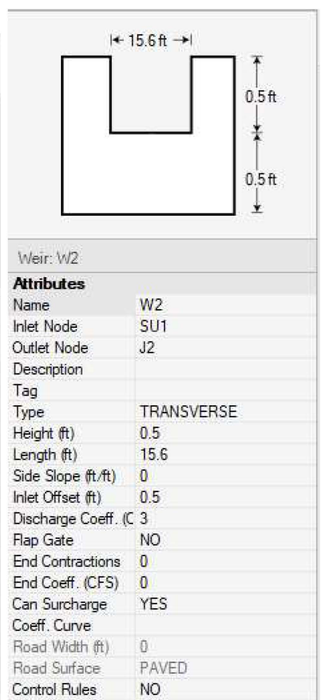












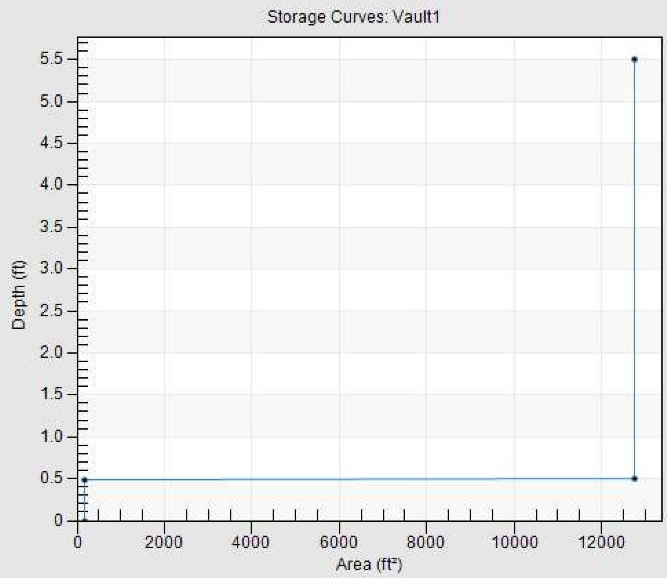
Vault PCSWMM Orifice Parameters

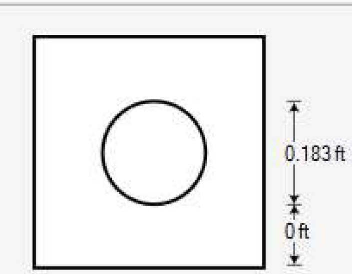
Name: Vault1

Description:

Data:

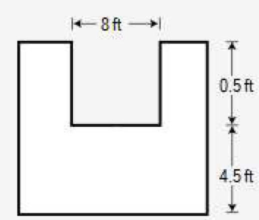
	Depth (ft)	Area (ft²)
1	0	160
2	0.49	160
3	0.5	12736
4	5.5	12736
5		
6		
7		
8		
9		
10		
11		
12		





Orifice: OR1

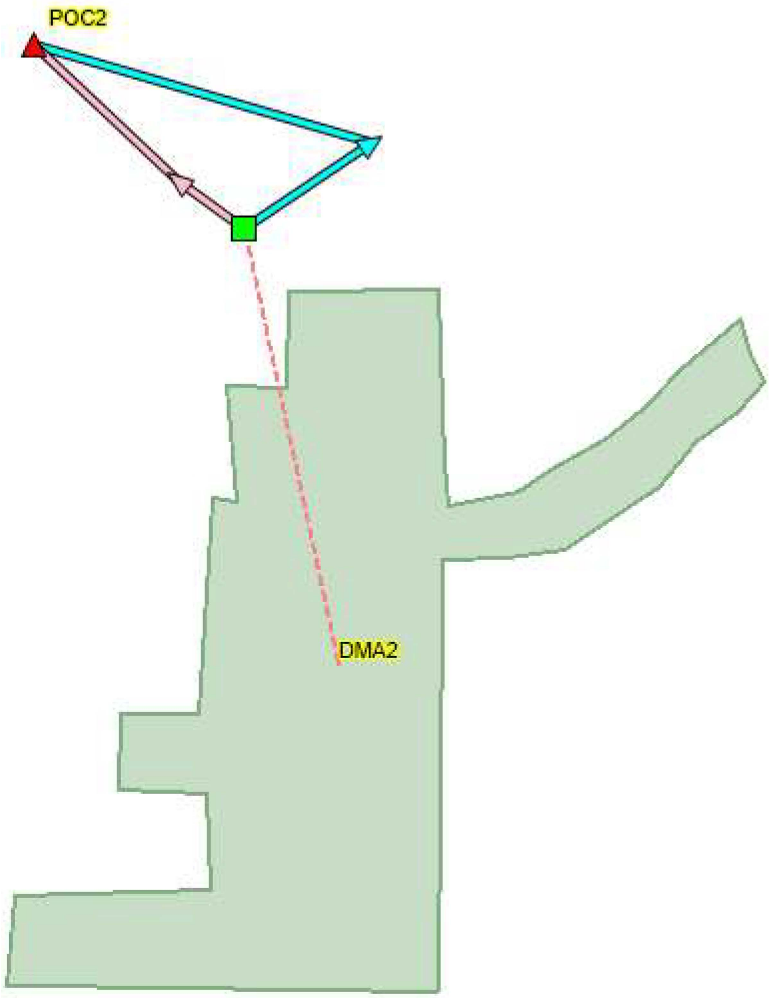
Attributes	
Name	OR1
Inlet Node	SU2
Outlet Node	J1
Description	
Tag	
Type	SIDE
Cross-Section	CIRCULAR
Height (ft)	0.183
Width (ft)	0
Inlet Offset (ft)	0
Discharge Coeff.	0.6
Flap Gate	NO
Time to Open/Clos	0
Control Rules	NO



Weir: W1

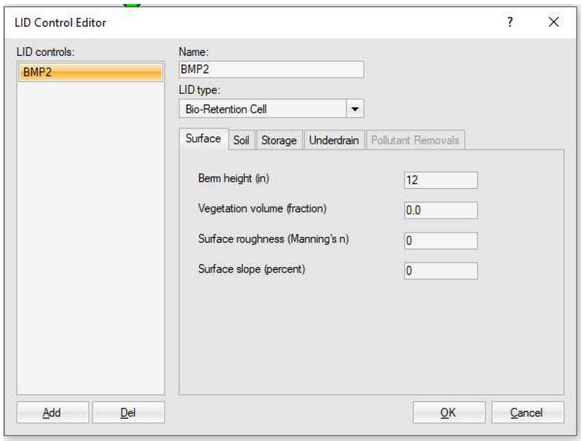
Attributes	
Name	W1
Inlet Node	SU2
Outlet Node	J1
Description	
Tag	
Type	TRANSVERSE
Height (ft)	0.5
Length (ft)	8
Side Slope (ft/ft)	0
Inlet Offset (ft)	4.5
Discharge Coeff. (C	3
Flap Gate	NO
End Contractions	0
End Coeff. (CFS)	0
Can Surcharge	YES
Coeff. Curve	
Road Width (ft)	0
Road Surface	PAVED
Control Rules	NO

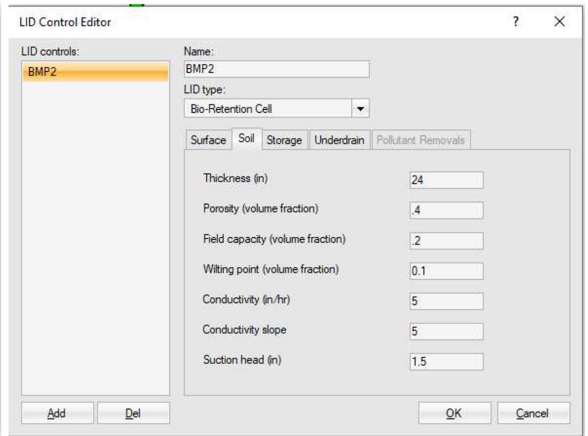
POC 2

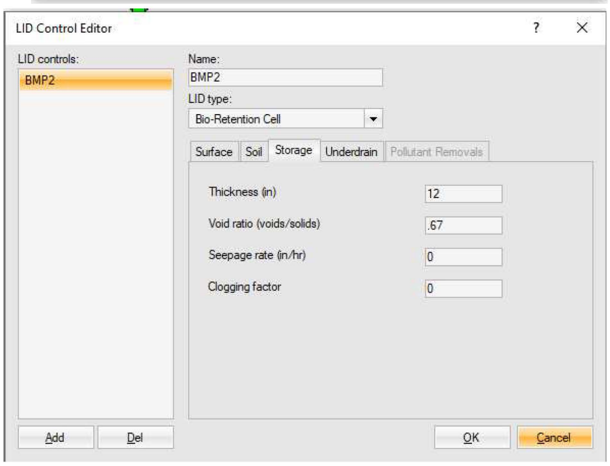


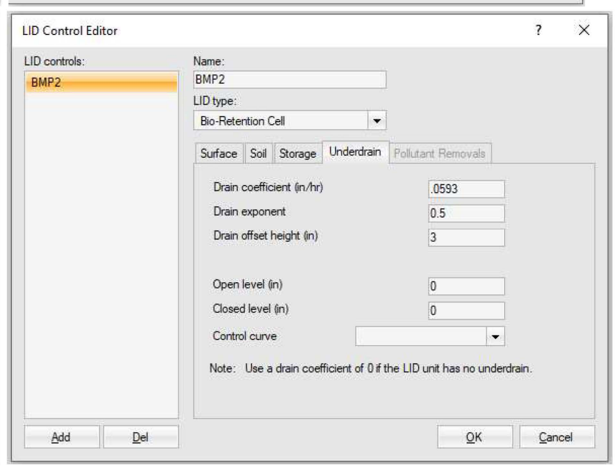
Name	Rain Gage	Outlet	Area (ac)	Width (ft)	Flow Length (ft)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (in)	Dstore Perv (in)	Zero Imperv (%)	LID Controls	LID Names	Suction Head (in)	Conductivity (in/hr)	Initial Deficit (frac.)
DMA2	Bonita	SU1	4.01	329	530.929	5	58	0.012	0.15	0.05	0.1	25	1	BMP2	6	0.075	0.31

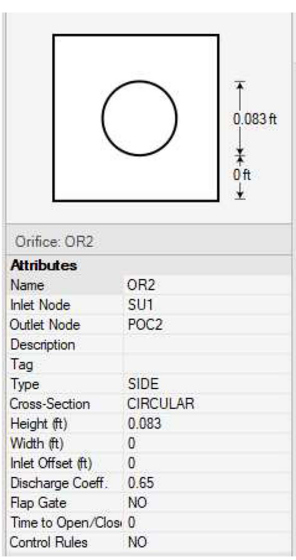
Basin 2 PCSWMM LID & Orifice Parameters

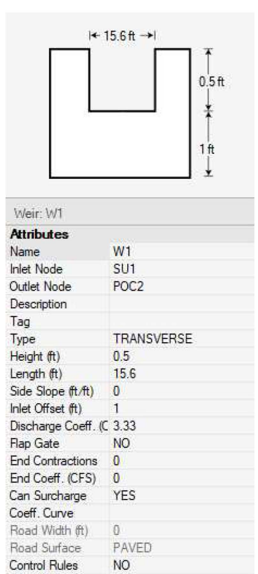


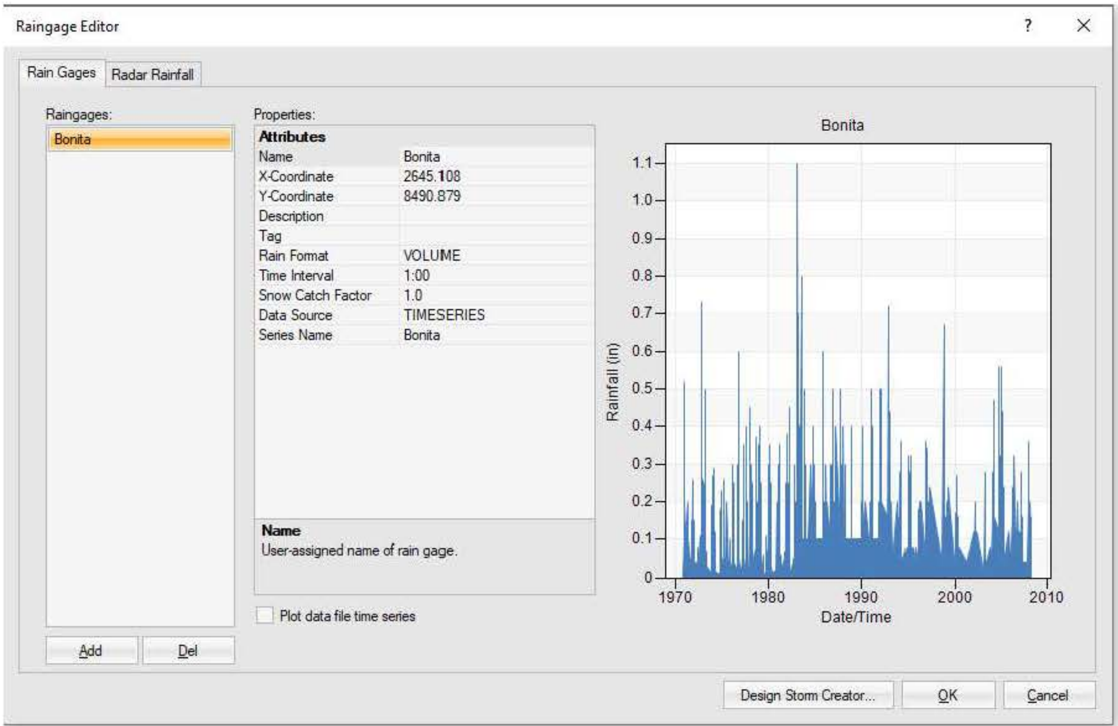











Raingage Editor
Rain Gages
Radar Rainfall
Raingages:
Bonita
Properties:
Attributes
Name Bonita
X-Coordinate 2645.108
Y-Coordinate 8490.879
Description
Tag
Rain Format VOLUME
Time Interval 1:00
Snow Catch Factor 1.0
Data Source TIMESERIES
Series Name Bonita
Name
User-assigned name of rain gage.
Plot data file time series
Add
Del
Bonita
Rainfall (in)
Date/Time
Design Storm Creator...
OK
Cancel

ATTACHMENT C

SWMM Output – Existing Conditions

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------
Pre Condition Nakano POC 1-DMA 1&3

*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ 10/03/1970 05:00:00
Ending Date .............. 05/25/2008 22:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 00:15:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       460.288       339.070
Evaporation Loss .........         2.974         2.191
Infiltration Loss ........       442.120       325.687
Surface Runoff ...........        15.795        11.635
Final Storage ............         0.000         0.000
Continuity Error (%) .....        -0.131


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......        15.795         5.147
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........        15.795         5.147
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Imperv Runoff in	Perv Runoff in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA1	339.07	0.00	2.11	323.95	0.00	13.63	13.63	0.92	2.41	0.040
DMA3	339.07	0.00	2.20	326.00	0.00	11.28	11.28	4.23	11.46	0.033

```
Analysis begun on:  Thu Jun 16 11:03:51 2022
Analysis ended on:  Thu Jun 16 11:04:04 2022
Total elapsed time: 00:00:13
```

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

Pre Condition Nakano POC 2- DMA 2

```
*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Starting Date ............ 10/03/1970 05:00:00
Ending Date .............. 05/25/2008 22:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 00:15:00


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Total Precipitation ......       113.306       339.070
Evaporation Loss .........         0.725         2.169
Infiltration Loss ........       108.638       325.102
Surface Runoff ...........         4.106        12.288
Final Storage ............         0.000         0.000
Continuity Error (%) .....        -0.144


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         4.106         1.338
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         4.106         1.338
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Imperv Runoff in	Perv Runoff in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA2	339.07	0.00	2.17	325.10	0.00	12.29	12.29	1.34	3.64	0.036

```
Analysis begun on:  Thu Jun 16 10:50:43 2022
Analysis ended on:  Thu Jun 16 10:50:55 2022
Total elapsed time: 00:00:12
```

ATTACHMENT D

SWMM Output – Proposed Conditions

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

Post Condition Nakano POC 1- DMA 1&3

*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 10/03/1970 05:00:00
Ending Date .............. 05/25/2008 22:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 00:15:00
Routing Time Step ........ 15.00 sec


**************************        Volume         Depth
Runoff Quantity Continuity     acre-feet        inches
**************************     ---------       -------
Initial LID Storage ......         0.017         0.012
Total Precipitation ......       460.288       339.070
Evaporation Loss .........        64.370        47.418
Infiltration Loss ........       149.852       110.388
Surface Runoff ...........       217.862       160.488
LID Drainage .............        32.164        23.694
Final Storage ............         0.017         0.012
Continuity Error (%) .....        -0.860


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......       250.026        81.475
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........       249.978        81.459
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.019


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    15.00 sec
Average Time Step           :    15.00 sec
Maximum Time Step           :    15.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Imperv Runoff in	Perv Runoff in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA1	339.07	0.00	64.77	95.29	188.48	5.82	183.70	12.42	2.68	0.542
DMA3	339.07	0.00	44.29	113.11	178.91	5.36	184.27	69.05	14.42	0.543

****
LID Performance Summary
****

Subcatchment	LID Control	Total Inflow in	Evap Loss in	Infil Loss in	Surface Outflow in	Drain Outflow in	Initial Storage in	Final Storage in	Continuity Error %
DMA1	BMP1	6180.55	658.30	0.00	862.45	4660.03	2.40	2.40	-0.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
J1	JUNCTION	0.01	0.59	1.59	5532 14:01	0.59
J2	JUNCTION	0.00	0.36	2.36	4532 12:01	0.36
POC1	OUTFALL	0.01	0.59	0.59	5532 14:01	0.59
SU1	STORAGE	0.00	0.64	0.64	4532 12:01	0.64
SU2	STORAGE	0.07	4.91	4.91	5532 14:01	4.91

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
J1	JUNCTION	0.00	7.99	5532 14:01	0	71	0.000
J2	JUNCTION	0.00	2.56	4532 12:01	0	1.94	0.000
POC1	OUTFALL	0.04	8.03	5532 14:01	10.5	81.5	0.000
SU1	STORAGE	2.65	2.65	4532 12:00	1.94	1.94	0.000
SU2	STORAGE	14.42	14.42	4532 12:00	69	69	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
SU1	0.020	1	0	0	3.173	85	4532 12:01	2.56
SU2	0.556	1	0	0	56.348	98	5532 14:01	6.65

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC1	8.37	0.11	8.03	81.453
System	8.37	0.11	8.03	81.453

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	7.99	5532 14:01	8.13	0.08	0.20
C2	CONDUIT	2.56	4532 12:01	5.96	0.04	0.14
OR1	ORIFICE	0.28	5532 14:01			0.00
OR2	ORIFICE	0.01	4532 12:01			0.00
W1	WEIR	6.37	5532 14:01			0.00
W2	WEIR	2.55	4532 12:01			0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Tue Jun 21 14:31:26 2022
Analysis ended on: Tue Jun 21 14:32:43 2022
Total elapsed time: 00:01:17

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------
Post Condition POC 2-DMA 2

*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... KINWAVE
Starting Date ............ 10/03/1970 05:00:00
Ending Date .............. 05/25/2008 22:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 01:00:00
Wet Time Step ............ 00:15:00
Dry Time Step ............ 00:15:00
Routing Time Step ........ 15.00 sec
```

************************** Runoff Quantity Continuity **************************	Volume acre-feet	Depth inches
Initial LID Storage	0.021	0.062
Total Precipitation	113.306	339.070
Evaporation Loss	18.245	54.599
Infiltration Loss	43.736	130.881
Surface Runoff	6.230	18.643
LID Drainage	46.227	138.336
Final Storage	0.021	0.062
Continuity Error (%)	-1.000	

************************** Flow Routing Continuity **************************	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	52.457	17.094
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	52.457	17.094
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

```
********************************
Highest Flow Instability Indexes
********************************
All links are stable.

*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    15.00 sec
Average Time Step           :    15.00 sec
Maximum Time Step           :    15.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00

***************************
Subcatchment Runoff Summary
***************************
```

Subcatchment	Total Precip in	Total Runon in	Total Evap in	Total Infil in	Imperv Runoff in	Perv Runoff in	Total Runoff in	Total Runoff 10^6 gal	Peak Runoff CFS	Runoff Coeff
DMA2	339.07	0.00	54.60	130.88	158.40	6.91	156.98	17.09	4.25	0.463

```
***********************
LID Performance Summary
```

****

Subcatchment	LID Control	Total Inflow in	Evap Loss in	Infil Loss in	Surface Outflow in	Drain Outflow in	Initial Storage in	Final Storage in	Continuity Error %
DMA2	BMP2	6723.76	661.32	0.00	720.02	5342.66	2.40	2.40	-0.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
POC2	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
SU1	STORAGE	0.00	1.16	1.16	4532 12:05	1.11

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
POC2	OUTFALL	0.05	3.28	4532 12:05	15.1	17.1	0.000
SU1	STORAGE	4.20	4.20	4532 12:00	2.03	2.03	0.004

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CFS
SU1	0.022	0	0	0	6.178	92	4532 12:05	3.23

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
POC2	7.80	0.02	3.28	17.093
System	7.80	0.02	3.28	17.093

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
OR2	ORIFICE	0.03	4532 12:05			0.00
W1	WEIR	3.20	4532 12:05			0.00

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Wed Jun 22 08:12:37 2022
Analysis ended on: Wed Jun 22 08:13:14 2022
Total elapsed time: 00:00:37

ATTACHMENT E

Flow Frequency Statistical Analysis

Pre-project Flow Frequency - Long-term Simulation

Statistics - Node POC1 Total Inflow

Rank	Start Date	Event Duration (hours)	Event Peak (CFS)	Exceedance Frequency (percent)	Return Period (years)	(years)			
1	3/1/1983	30	14.967	1.28	39		**10-year Q:**	5.760	cfs
2	11/25/1985	16	6.514	2.56	19.5		**5-year Q:**	4.477	cfs
3	1/11/2005	5	6.181	3.85	13		**2-year Q:**	3.263	cfs
4	3/24/1983	2	5.725	5.13	9.75				
5	12/21/1970	2	5.455	6.41	7.8				
6	1/16/1978	3	5.273	7.69	6.5		**Lower Flow Threshold:**	10%	
7	10/19/2004	32	4.864	8.97	5.57				
8	11/11/1972	1	4.395	10.26	4.88		0.1xQ2	0.326	cfs
9	2/21/2005	3	4.356	11.54	4.33				
10	1/3/2005	21	4.278	12.82	3.9				
11	2/28/1991	11	3.908	14.1	3.55				
12	3/27/1991	2	3.885	15.38	3.25				
13	8/16/1977	6	3.828	16.67	3				
14	4/1/1982	2	3.796	17.95	2.79				
15	2/22/2004	5	3.767	19.23	2.6				
16	3/2/2004	2	3.642	20.51	2.44				
17	1/31/1979	11	3.461	21.79	2.29				
18	3/19/1983	1	3.4	23.08	2.17				
19	12/7/1992	3	3.394	24.36	2.05				
20	2/19/1993	2	3.131	25.64	1.95				
21	1/29/1980	5	2.95	26.92	1.86				
22	11/29/1970	3	2.83	28.21	1.77				
23	2/23/2005	1	2.468	29.49	1.7				
24	1/4/1995	5	2.446	30.77	1.63				
25	12/27/1984	22	2.357	32.05	1.56				
26	3/1/1978	1	2.313	33.33	1.5				
27	3/6/1980	5	2.261	34.62	1.44				
28	4/28/1994	2	2.205	35.9	1.39				
29	3/1/1981	10	2.032	37.18	1.34				
30	1/15/1993	19	1.886	38.46	1.3				
31	3/2/1992	4	1.836	39.74	1.26				
32	12/4/1992	1	1.802	41.03	1.22				
33	3/10/1975	2	1.628	42.31	1.18				
34	3/17/1982	9	1.571	43.59	1.15				
35	2/6/1992	4	1.466	44.87	1.11				
36	3/21/1983	1	1.453	46.15	1.08				
37	11/10/1982	1	1.284	47.44	1.05				
38	12/7/1986	1	1.23	48.72	1.03				
39	3/7/1992	1	1.203	50	1				
40	9/10/1976	14	1.182	51.28	0.98				
41	2/10/1978	2	1.175	52.56	0.95				
42	11/12/1976	1	1.167	53.85	0.93				
43	2/20/1980	21	1.162	55.13	0.91				
44	10/10/1986	4	1.088	56.41	0.89				
45	12/29/1977	1	1.066	57.69	0.87				
46	3/7/1974	1	1.04	58.97	0.85				
47	8/14/1983	1	1.024	60.26	0.83				
48	1/25/1995	2	0.971	61.54	0.81				
49	1/12/1993	3	0.935	62.82	0.8				
50	1/29/1983	2	0.896	64.1	0.78				
51	12/11/1984	4	0.864	65.38	0.76				
52	3/5/2000	1	0.724	66.67	0.75				
53	3/16/1986	1	0.672	67.95	0.74				
54	2/26/1987	1	0.562	69.23	0.72				
55	10/11/1987	1	0.53	70.51	0.71				
56	2/26/2004	1	0.529	71.79	0.7				
57	10/23/1976	1	0.511	73.08	0.68				
58	3/20/1973	1	0.481	74.36	0.67				
59	1/1/1982	2	0.454	75.64	0.66				
60	10/30/1998	1	0.438	76.92	0.65				
61	2/8/1976	5	0.405	78.21	0.64				
62	2/14/1995	1	0.398	79.49	0.63				
63	3/20/1991	1	0.396	80.77	0.62				
64	2/2/1988	2	0.394	82.05	0.61				
65	11/14/1978	1	0.377	83.33	0.6				
66	3/5/1978	1	0.373	84.62	0.59				
69	12/19/1970	1	0.321	88.46	0.57				
69	1/6/1993	17	0.321	88.46	0.57				
69	1/7/1974	25	0.321	88.46	0.57				
70	3/11/1978	3	0.32	89.74	0.56				
71	4/29/1980	1	0.286	91.03	0.55				
72	11/22/1984	1	0.207	92.31	0.54				
73	1/15/1978	1	0.202	93.59	0.53				
74	1/4/1974	1	0.137	94.87	0.53				
75	2/2/1983	1	0.083	96.15	0.52				

Post-project Flow Frequency - Long-term Simulation

Statistics - Node POC1 Total Inflow

Rank	Start Date	Event Duration (hours)	Event Peak (CFS)	Exceedance Frequency (percent)	Return Period (years)
1	3/1/1983	30	14.961	1.28	39
2	11/25/1985	16	6.548	2.56	19.5
3	1/11/2005	5	6.206	3.85	13
4	3/24/1983	2	5.771	5.13	9.75
5	12/21/1970	2	5.485	6.41	7.8
6	1/16/1978	3	5.272	7.69	6.5
7	10/19/2004	32	4.903	8.97	5.57
8	11/11/1972	1	4.434	10.26	4.88
9	2/21/2005	3	4.346	11.54	4.33
10	1/3/2005	21	4.297	12.82	3.9
11	2/28/1991	11	3.944	14.1	3.55
12	3/27/1991	2	3.905	15.38	3.25
13	8/16/1977	6	3.844	16.67	3
14	4/1/1982	2	3.828	17.95	2.79
15	2/22/2004	5	3.793	19.23	2.6
16	3/2/2004	2	3.674	20.51	2.44
17	1/31/1979	11	3.465	21.79	2.29
18	3/19/1983	1	3.431	23.08	2.17
19	12/7/1992	3	3.385	24.36	2.05
20	2/19/1993	2	3.162	25.64	1.95
21	1/29/1980	5	2.948	26.92	1.86
22	11/29/1970	3	2.834	28.21	1.77
23	2/23/2005	1	2.492	29.49	1.7
24	1/4/1995	5	2.45	30.77	1.63
25	12/27/1984	22	2.375	32.05	1.56
26	3/1/1978	1	2.33	33.33	1.5
27	3/6/1980	5	2.256	34.62	1.44
28	4/28/1994	2	2.228	35.9	1.39
29	3/1/1981	10	2.053	37.18	1.34
30	1/15/1993	19	1.89	38.46	1.3
31	3/2/1992	4	1.856	39.74	1.26
32	12/4/1992	1	1.819	41.03	1.22
33	3/10/1975	2	1.635	42.31	1.18
34	3/17/1982	9	1.585	43.59	1.15
35	2/6/1992	4	1.471	44.87	1.11
36	3/21/1983	1	1.467	46.15	1.08
37	11/10/1982	1	1.298	47.44	1.05
38	12/7/1986	1	1.243	48.72	1.03
39	3/7/1992	1	1.216	50	1
40	9/10/1976	14	1.194	51.28	0.98
41	2/10/1978	2	1.184	52.56	0.95
42	11/12/1976	1	1.177	53.85	0.93
43	2/20/1980	21	1.173	55.13	0.91
44	10/10/1986	4	1.099	56.41	0.89
45	12/29/1977	1	1.077	57.69	0.87
46	3/7/1974	1	1.05	58.97	0.85
47	8/14/1983	1	1.031	60.26	0.83
48	1/25/1995	2	0.977	61.54	0.81
49	1/12/1993	3	0.94	62.82	0.8
50	1/29/1983	2	0.905	64.1	0.78
51	12/11/1984	4	0.868	65.38	0.76
52	3/5/2000	1	0.731	66.67	0.75
53	3/16/1986	1	0.677	67.95	0.74
54	2/26/1987	1	0.568	69.23	0.72
55	2/26/2004	1	0.534	70.51	0.71
56	10/11/1987	1	0.533	71.79	0.7
57	10/23/1976	1	0.514	73.08	0.68
58	3/20/1973	1	0.484	74.36	0.67
59	1/1/1982	2	0.457	75.64	0.66
60	10/30/1998	1	0.44	76.92	0.65
61	2/8/1976	5	0.407	78.21	0.64
62	2/14/1995	1	0.402	79.49	0.63
63	3/20/1991	1	0.397	80.77	0.62
64	2/2/1988	2	0.396	82.05	0.61
65	11/14/1978	1	0.38	83.33	0.6
66	3/5/1978	1	0.377	84.62	0.59
67	3/11/1978	3	0.324	85.9	0.58
70	12/19/1970	1	0.323	89.74	0.56
70	1/7/1974	25	0.323	89.74	0.56
70	1/6/1993	17	0.323	89.74	0.56
71	4/29/1980	1	0.287	91.03	0.55
72	11/22/1984	1	0.208	92.31	0.54
73	1/15/1978	1	0.204	93.59	0.53
74	1/4/1974	1	0.137	94.87	0.53
75	2/2/1983	1	0.084	96.15	0.52

10-year Q:	5.804	cfs
5-year Q:	4.516	cfs
2-year Q:	3.274	cfs
Lower Flow Threshold:	10%	
0.1xQ2:	0.327	cfs

Pre-project Flow Frequency - Long-term Simulation

DMA 2 POC 2

Statistics - Node POC2 Total Inflow

Rank	Start Date	Event Duration (hours)	Event Peak (CFS)	Exceedance Frequency (percent)	Return Period (years)
1	3/1/1983	31	3.562	1.32	39
2	11/25/1985	16	1.486	2.63	19.5
3	1/11/2005	5	1.423	3.95	13
4	3/24/1983	2	1.264	5.26	9.75
5	1/16/1978	3	1.252	6.58	7.8
6	12/21/1970	2	1.243	7.89	6.5
7	10/19/2004	32	1.075	9.21	5.57
8	2/21/2005	3	1.049	10.53	4.88
9	1/3/2005	21	0.982	11.84	4.33
10	11/11/1972	1	0.958	13.16	3.9
11	3/27/1991	2	0.886	14.47	3.55
12	8/16/1977	6	0.877	15.79	3.25
13	2/28/1991	11	0.849	17.11	3
14	2/22/2004	5	0.845	18.42	2.79
15	4/1/1982	2	0.833	19.74	2.6
16	12/7/1992	3	0.816	21.05	2.44
17	1/31/1979	11	0.809	22.37	2.29
18	3/2/2004	2	0.797	23.68	2.17
19	3/19/1983	1	0.739	25	2.05
20	1/29/1980	5	0.701	26.32	1.95
21	2/19/1993	2	0.67	27.63	1.86
22	11/29/1970	3	0.663	28.95	1.77
23	1/4/1995	5	0.571	30.26	1.7
24	3/6/1980	5	0.543	31.58	1.63
25	2/23/2005	1	0.527	32.89	1.56
26	12/27/1984	23	0.526	34.21	1.5
27	3/1/1978	1	0.515	35.53	1.44
28	4/28/1994	2	0.463	36.84	1.39
29	1/15/1993	19	0.441	38.16	1.34
30	3/1/1981	10	0.423	39.47	1.3
31	3/2/1992	4	0.379	40.79	1.26
32	3/10/1975	2	0.372	42.11	1.22
33	12/4/1992	1	0.354	43.42	1.18
34	3/17/1982	9	0.343	44.74	1.15
35	2/6/1992	4	0.34	46.05	1.11
36	3/21/1983	1	0.286	47.37	1.08
37	2/10/1978	2	0.263	48.68	1.05
38	11/10/1982	1	0.259	50	1.03
39	12/7/1986	1	0.246	51.32	1
40	3/7/1992	1	0.24	52.63	0.98
41	9/10/1976	14	0.236	53.95	0.95
42	2/20/1980	21	0.234	55.26	0.93
43	11/12/1976	1	0.226	56.58	0.91
44	1/25/1995	2	0.221	57.89	0.89
45	10/10/1986	4	0.215	59.21	0.87
46	12/29/1977	1	0.211	60.53	0.85
47	1/12/1993	3	0.209	61.84	0.83
48	3/7/1974	1	0.205	63.16	0.81
49	12/11/1984	4	0.194	64.47	0.8
50	8/14/1983	1	0.191	65.79	0.78
51	1/29/1983	2	0.174	67.11	0.76
52	3/5/2000	1	0.139	68.42	0.75
53	3/16/1986	1	0.127	69.74	0.74
54	2/26/1987	1	0.113	71.05	0.72
55	2/26/2004	1	0.101	72.37	0.71
56	10/11/1987	1	0.097	73.68	0.7
57	10/23/1976	1	0.095	75	0.68
58	2/8/1976	5	0.09	76.32	0.67
59	3/20/1973	1	0.089	77.63	0.66
60	1/1/1982	2	0.085	78.95	0.65
61	10/30/1998	1	0.08	80.26	0.64
62	2/14/1995	1	0.078	81.58	0.63
63	3/5/1978	1	0.077	82.89	0.62
64	2/2/1988	2	0.072	84.21	0.61
65	3/20/1991	1	0.072	85.53	0.6
66	11/14/1978	1	0.072	86.84	0.59
67	3/11/1978	3	0.067	88.16	0.58
70	12/19/1970	1	0.059	92.11	0.56
70	1/6/1993	17	0.059	92.11	0.56
70	1/7/1974	25	0.059	92.11	0.56
71	4/29/1980	1	0.052	93.42	0.55
72	1/15/1978	1	0.038	94.74	0.54
73	11/22/1984	1	0.037	96.05	0.53
74	1/4/1974	1	0.024	97.37	0.53
75	2/2/1983	1	0.016	98.68	0.52

(years)

10-year Q:	1.276	cfs
5-year Q:	1.054	cfs
2-year Q:	0.720	cfs
Lower Flow Threshold:	10%	
0.1xQ2:	0.072	cfs

Post-project Flow Frequency - Long-term Simulation

DMA 2 POC 2

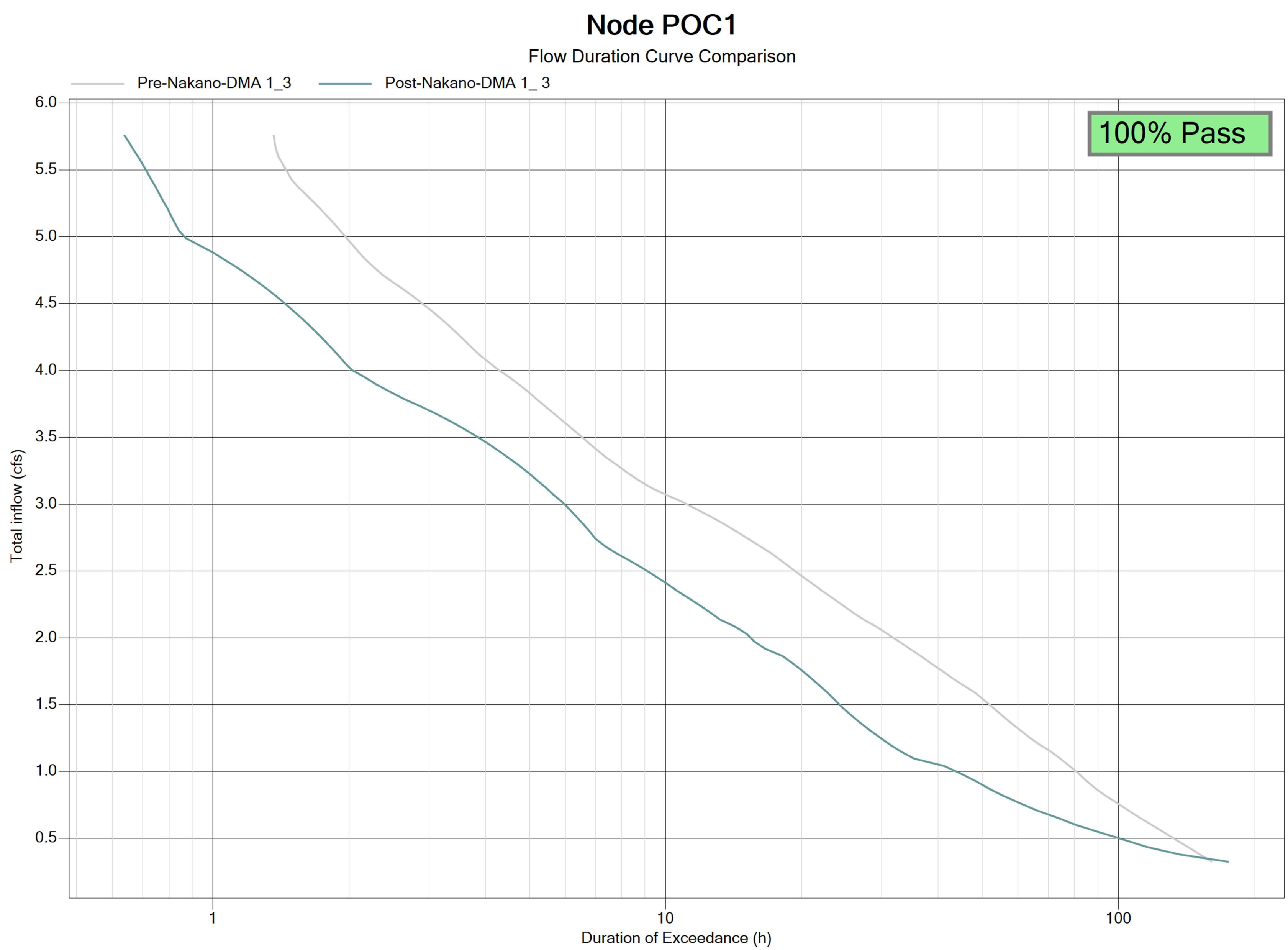
Statistics - Node POC2 Total Inflow

Rank	Start Date	Event Duration (hours)	Event Peak (CFS)	Exceedance Frequency (percent)	Return Period (years)
1	11/24/1985	160	2.06	0.26	39
2	2/24/1983	264	1.541	0.53	19.5
3	12/4/1992	159	1.267	0.79	13
4	1/31/1979	122	1.256	1.06	9.75
5	2/18/2005	195	1.172	1.32	7.8
6	2/21/2004	156	1.083	1.58	6.5
7	10/17/2004	165	0.958	1.85	5.57
8	2/27/1991	117	0.942	2.11	4.88
9	1/28/1980	122	0.917	2.37	4.33
10	1/3/2005	268	0.647	2.64	3.9
11	1/14/1978	159	0.563	2.9	3.55
12	1/12/1993	204	0.548	3.17	3.25
13	12/28/2004	113	0.533	3.43	3
14	3/14/1982	161	0.524	3.69	2.79
15	1/3/1995	145	0.377	3.96	2.6
16	1/6/1993	133	0.364	4.22	2.44
17	2/4/1976	224	0.339	4.49	2.29
18	12/17/1970	182	0.278	4.75	2.17
19	12/27/1984	101	0.277	5.01	2.05
20	2/6/1992	256	0.077	5.28	1.95
21	3/2/1992	87	0.073	5.54	1.86
22	3/6/1980	78	0.072	5.8	1.77
23	2/27/1978	193	0.072	6.07	1.7
24	8/16/1977	83	0.071	6.33	1.63
25	3/25/1991	119	0.071	6.6	1.56
26	11/11/1985	86	0.07	6.86	1.5
27	11/10/1972	158	0.07	7.12	1.44
28	3/4/2005	75	0.07	7.39	1.39
29	3/15/2003	81	0.068	7.65	1.34
30	2/15/1986	78	0.068	7.92	1.3
31	3/19/1991	126	0.068	8.18	1.26
32	12/16/1987	115	0.067	8.44	1.22
33	3/5/1995	85	0.066	8.71	1.18
34	10/27/2004	79	0.065	8.97	1.15
35	12/10/1984	86	0.064	9.23	1.11
36	2/19/2007	118	0.064	9.5	1.08
37	2/14/1995	84	0.064	9.76	1.05
38	11/21/1996	78	0.064	10.03	1.03
39	11/12/1976	72	0.063	10.29	1
40	3/17/1983	241	0.063	10.55	0.98
41	2/28/1981	181	0.062	10.82	0.95
42	1/24/1995	111	0.059	11.08	0.93
43	2/2/1988	81	0.059	11.35	0.91
44	1/25/1999	105	0.058	11.61	0.89
45	11/29/1970	72	0.057	11.87	0.87
46	3/6/1975	208	0.055	12.14	0.85
47	2/18/1993	215	0.054	12.4	0.83
48	1/5/1979	75	0.054	12.66	0.81
49	8/14/1983	127	0.05	12.93	0.8
50	11/30/2007	74	0.05	13.19	0.78
51	12/17/1978	118	0.05	13.46	0.76
52	1/20/1982	81	0.05	13.72	0.75
53	12/6/1986	98	0.05	13.98	0.74
54	2/19/1980	106	0.05	14.25	0.72
55	3/20/1973	69	0.05	14.51	0.71
56	11/9/1982	82	0.05	14.78	0.7
57	1/5/2008	109	0.05	15.04	0.68
58	1/5/1987	92	0.05	15.3	0.67
59	2/2/1983	84	0.05	15.57	0.66
60	2/11/2005	98	0.049	15.83	0.65
61	12/4/1972	128	0.049	16.09	0.64
62	3/10/1980	65	0.049	16.36	0.63
63	5/8/1977	70	0.049	16.62	0.62
64	12/25/1988	83	0.049	16.89	0.61
65	4/1/1982	62	0.049	17.15	0.6
66	2/24/1987	102	0.049	17.41	0.59
67	3/11/1995	76	0.048	17.68	0.58
68	10/9/1986	66	0.048	17.94	0.57
69	3/2/2004	58	0.048	18.21	0.57
70	10/11/1987	81	0.048	18.47	0.56
71	9/25/1986	58	0.048	18.73	0.55
72	9/10/1976	72	0.048	19	0.54
73	1/4/1974	159	0.048	19.26	0.53
74	1/5/1992	88	0.048	19.53	0.53
75	1/12/1997	110	0.048	19.79	0.52

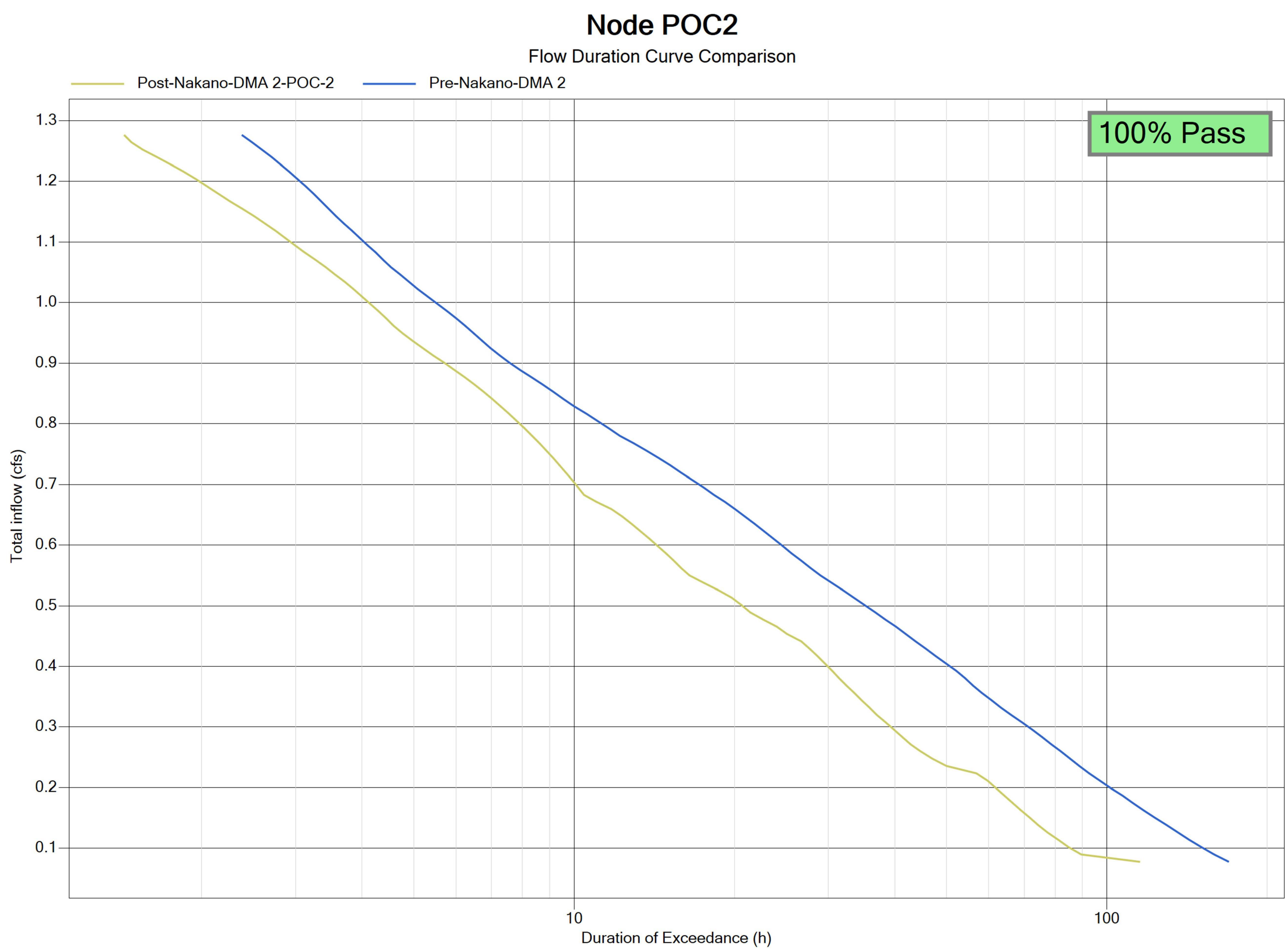
10-year Q:	1.257	cfs
5-year Q:	0.945	cfs
2-year Q:	0.277	cfs
Lower Flow Threshold:	10%	
0.1xQ2:	0.028	cfs

ATTACHMENT F

Flow Duration Comparison Curve



Node POC1
Flow Duration Curve Comparison
Pre-Nakano-DMA 1_3
Post-Nakano-DMA 1_ 3
100% Pass
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Total inflow (cfs)
1
10
100
Duration of Exceedance (h)



Node POC2
Flow Duration Curve Comparison
Post-Nakano-DMA 2-POC-2
Pre-Nakano-DMA 2
100% Pass
Total inflow (cfs)
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
10
100
Duration of Exceedance (h)

ATTACHMENT 3

Structural BMP Maintenance Information
Hydromodification Control Measures

Nakano

Project Name/____

Use this checklist to ensure the required information has been included in the Structural BMP Maintenance Information Attachment:

Attachment 3: For private entity operation and maintenance, Attachment 3 must include a Storm Water Management Facilities Maintenance Agreement with Grant of Access and Covenant's ("Maintenance Agreement") Template can be found at the following link (also refer to Chapter 8.2.1 for more information's):

The following information must be included in the exhibits attached to the Maintenance Agreement:

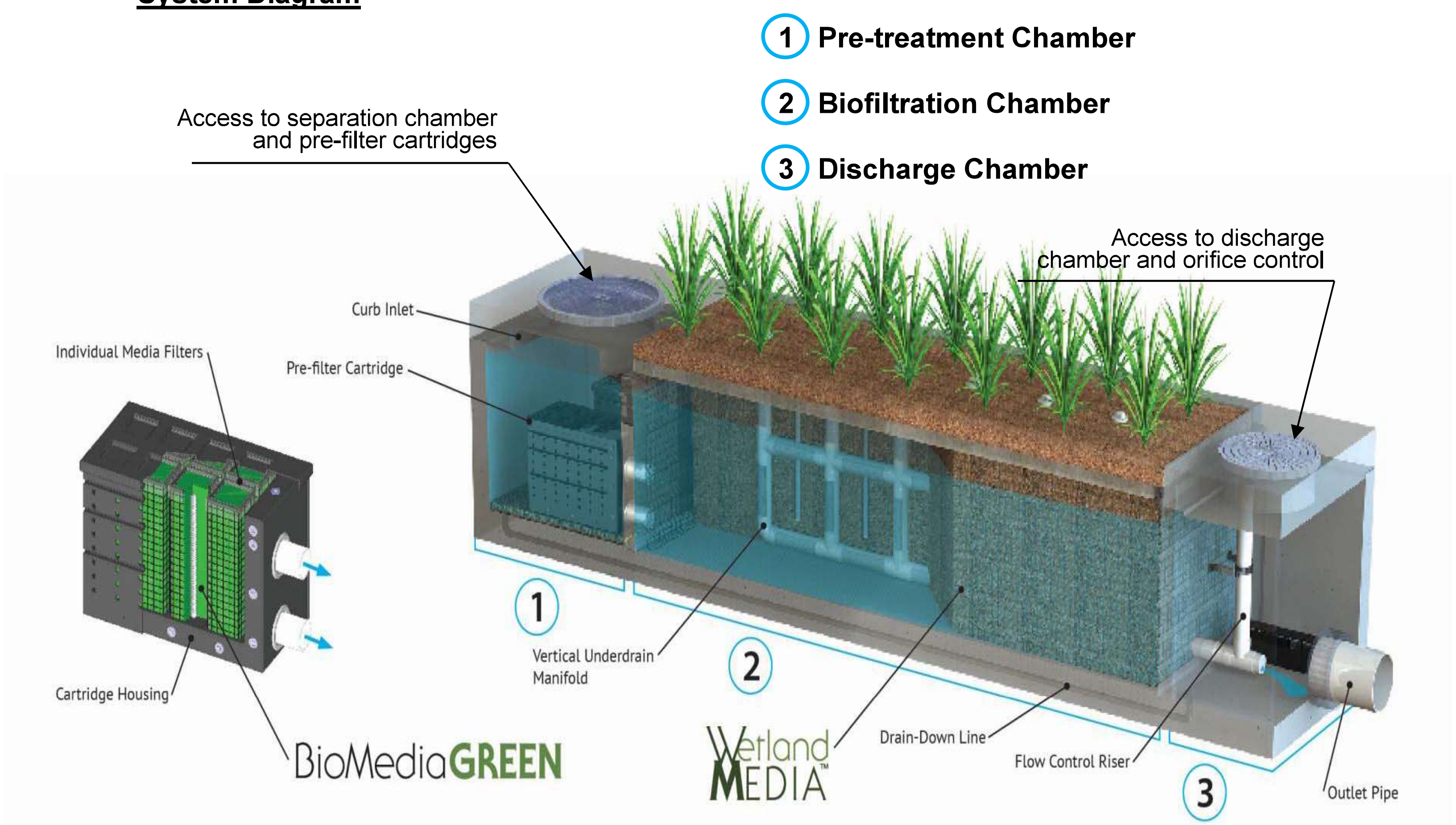
- ☐ Vicinity map (Depiction of Project Site)
- ☒ Legal Description for Project Site
- ☐ Site design BMPs for which DCV reduction is claimed for meeting the pollutant
- ☒ control obligations.
- ☐ BMP and HMP type, location, type, manufacture model, and dimensions, specifications, cross section
- ☒ LID features such as (permeable paver and LS location, dim, SF).
- ☐ Maintenance recommendations and frequency

Inspection Guidelines for Modular Wetland System - Linear

Inspection Summary

- Inspect Pre-Treatment, Biofiltration and Discharge Chambers – average inspection interval is 6 to 12 months.
  - (1*5 minute average inspection time*).
- NOTE: Pollutant loading varies greatly from site to site and no two sites are the same. Therefore, the first year requires inspection monthly during the wet season and every other month during the dry season in order to observe and record the amount of pollutant loading the system is receiving.

System Diagram



Inspection Overview

As with all stormwater BMPs inspection and maintenance on the MWS Linear is necessary. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess the site specific loading conditions. This is recommended because pollutant loading and pollutant characteristics can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding on roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years to ensure appropriate maintenance is provided. Without appropriate maintenance a BMP will exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the MWS Linear:

- Modular Wetland Inspection Form
- Flashlight
- Manhole hook or appropriate tools to remove access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure.
- Protective clothing and eye protection.
- 7/16” open or closed ended wrench.
- Large permanent black marker (initial inspections only – first year)
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system.

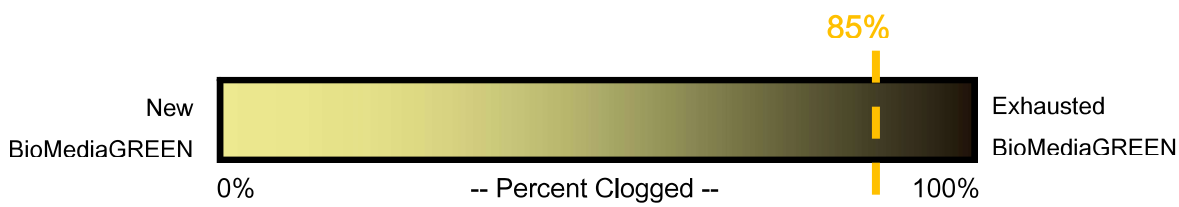
Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the MWS Linear are quick and easy. As mentioned above the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long term inspection and maintenance interval requirements.

The MWS Linear can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and near-by pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the inside of the system through the access hatches. If minimal light is available and vision into the unit is impaired utilize a flashlight to see inside the system and all of its chambers.
- Look for any out of the ordinary obstructions in the inflow pipe, pre-treatment chamber, biofiltration chamber, discharge chamber or outflow pipe. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of trash, debris and sediment accumulated in the pre-treatment chamber. Utilizing a tape measure or measuring stick estimate the amount of trash, debris and sediment in this chamber. Record this depth on the inspection form.

- Through visual observation inspect the condition of the pre-filter cartridges. Look for excessive build-up of sediments on the cartridges, any build-up on the top of the cartridges, or clogging of the holes. Record this information on the inspection form. The pre-filter cartridges can further be inspected by removing the cartridge tops and assessing the color of the BioMediaGREEN filter cubes (requires entry into pre-treatment chamber – see notes above regarding confined space entry). Record the color of the material. New material is a light green in color. As the media becomes clogged it will turn darker in color, eventually becoming dark brown or black. Using the below color indicator record the percentage of media exhausted.



- The biofiltration chamber is generally maintenance free due to the system's advanced pre-treatment chamber. For units which have open planters with vegetation it is recommended that the vegetation be inspected. Look for any plants that are dead or showing signs of disease or other negative stressors. Record the general health of the plants on the inspection and indicate through visual observation or digital photographs if trimming of the vegetation is needed.
- The discharge chamber houses the orifice control structure and is connected to the outflow pipe. It is important to check to ensure the orifice is in proper operating conditions and free of any obstructions. Generally, the discharge chamber will be clean and free of debris. Inspect the water marks on the side walls. If possible, inspect the discharge chamber during a rain event to assess the amount of flow leaving the system while it is at 100% capacity (pre-treatment chamber water level at peak HGL). The water level of the flowing water should be compared to the watermark level on the side walls which is an indicator of the highest discharge rate the system achieved when initially installed. Record on the form is there is any difference in level from watermark in inches.

- NOTE: During the first few storms the water level in the outflow chamber should be observed and a 6" long horizontal watermark line drawn (using a large permanent marker) at the water level in the discharge chamber while the system is operating at 100% capacity. The diagram below illustrates where a line should be drawn. This line is a reference point for future inspections of the system:

Using a permanent marker draw a 6 inch long horizontal line, as shown, at the higher water level in the MWS Linear discharge chamber.

- Water level in the discharge chamber is a function of flow rate and pipe size. Observation of water level during the first few months of operation can be used as a benchmark level for future inspections. The initial mark and all future observations shall be made when system is at 100% capacity (water level at maximum level in pre-treatment chamber). If future water levels are below this mark when system is at 100% capacity this is an indicator that maintenance to the pre-filter cartridges may be needed.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components or cartridges.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatables in the pre-treatment chamber in which the length and width of the chamber is fully impacted more than 18".

- Excessive accumulation of sediment in the pre-treatment chamber of more than 6" in depth.

- Excessive accumulation of sediment on the BioMediaGREEN media housed within the pre-filter cartridges. The following chart shows photos of the condition of the BioMediaGREEN contained within the pre-filter cartridges. When media is more than 85% clogged replacement is required.

- Overgrown vegetation.

- Water level in discharge chamber during 100% operating capacity (pre-treatment chamber water level at max height) is lower than the watermark by 20%.

Inspection Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

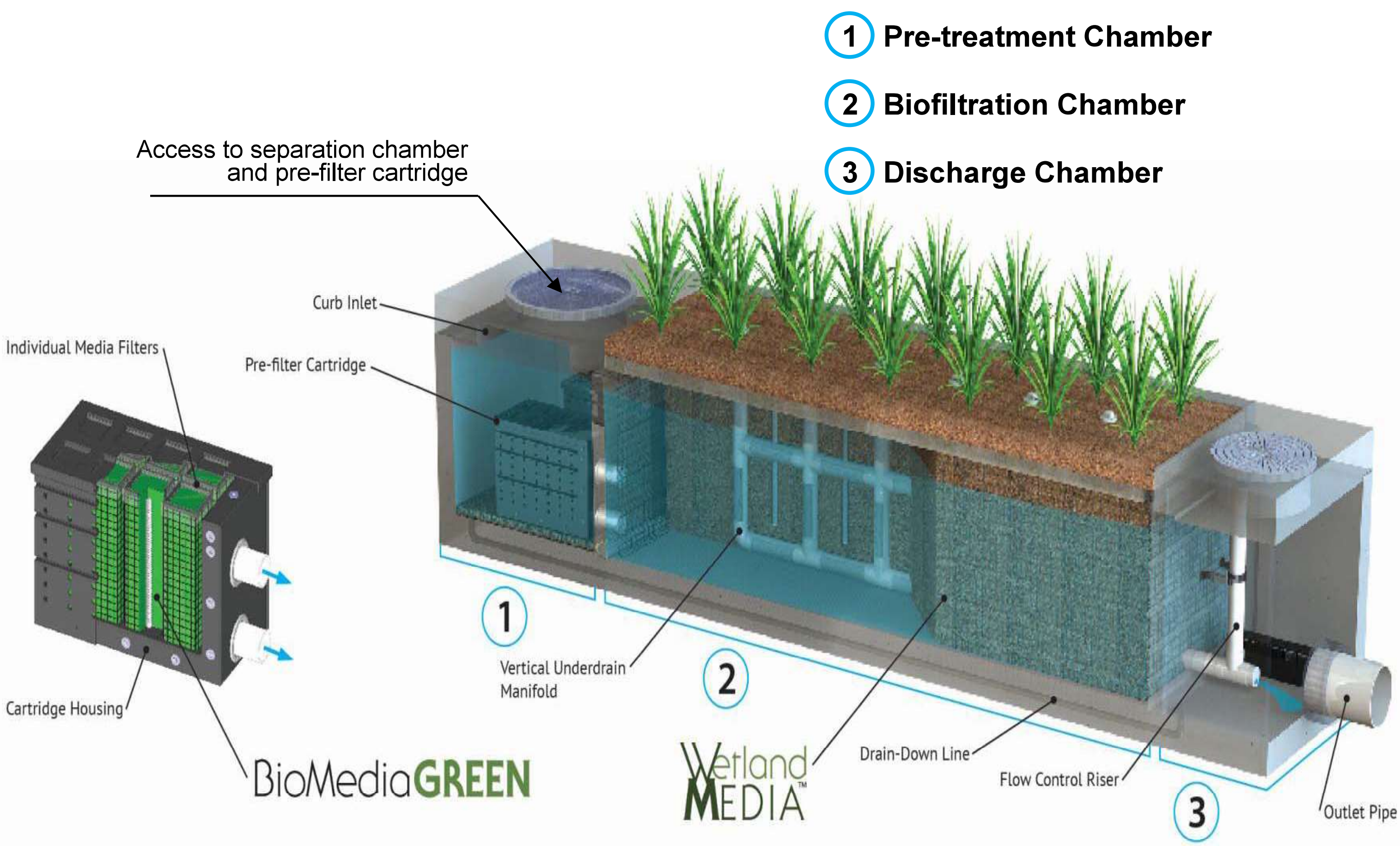
6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may not require irrigation after initial establishment.

Maintenance Guidelines for
Modular Wetland System - Linear

Maintenance Summary

- Remove Sediment from Pre-Treatment Chamber – average maintenance interval is 12 to 24 months.
    - (*10 minute average service time*).
- Replace Pre-Filter Cartridge Media – average maintenance interval 12 to 24 months.
    - (*10-15 minute per cartridge average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
    - (*Service time varies*).

System Diagram



Maintenance Overview

The time has come to maintain your Modular Wetland System Linear (MWS Linear). To ensure successful and efficient maintenance on the system we recommend the following. The MWS Linear can be maintained by removing the access hatches over the systems various chambers. All necessary pre-maintenance steps must be carried out before maintenance occurs, especially traffic control and other safety measures to protect the inspector and near-by pedestrians from any dangers associated with an open access hatch or manhole. Once traffic control has been set up per local and state regulations and access covers have been safely opened the maintenance process can begin. It should be noted that some maintenance activities require confined space entry. All confined space requirements must be strictly followed before entry into the system. In addition the following is recommended:

- Prepare the maintenance form by writing in the necessary information including project name, location, date & time, unit number and other info (see maintenance form).
- Set up all appropriate safety and cleaning equipment.
- Ensure traffic control is set up and properly positioned.
- Prepare a pre-checks (OSHA, safety, confined space entry) are performed.

Maintenance Equipment

Following is a list of equipment required for maintenance of the MWS Linear:

- Modular Wetland Maintenance Form
- Manhole hook or appropriate tools to access hatches and covers
- Protective clothing, flashlight and eye protection.
- 7/16" open or closed ended wrench.
- Vacuum assisted truck with pressure washer.
- Replacement BioMediaGREEN for Pre-Filter Cartridges if required (order from manufacturer).

Maintenance Steps

1. Pre-treatment Chamber (bottom of chamber)

   A. Remove access hatch or manhole cover over pre-treatment chamber and position vacuum truck accordingly.

   B. With a pressure washer spray down pollutants accumulated on walls and pre-filter cartridges.

   C. Vacuum out Pre-Treatment Chamber and remove all accumulated pollutants including trash, debris and sediments. Be sure to vacuum the floor until pervious pavers are visible and clean.

   D. If Pre-Filter Cartridges require media replacement move onto step 2. If not, replace access hatch or manhole cover.

Removal of access hatch to gain access below.

Insertion of vacuum hose into separation chamber.

Removal of trash, sediment and debris.

Fully cleaned separation chamber.

2. Pre-Filter Cartridges (attached to wall of pre-treatment chamber)

A. After finishing step 1 enter pre-treatment chamber.
B. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.

Pre-filter cartridges with tops on.

Inside cartridges showing media filters ready for replacement.

C. Place the vacuum hose over each individual media filter to suck out filter media.

Vacuuming out of media filters.

D. Once filter media has been sucked use a pressure washer to spray down inside of the cartridge and it's containing media cages. Remove cleaned media cages and place to the side. Once removed the vacuum hose can be inserted into the cartridge to vacuum out any remaining material near the bottom of the cartridge.

E. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase. Utilize the manufacture provided refilling trey and place on top of cartridge. Fill trey with new bulk media and shake down into place. Using your hands slightly compact media into each filter cage. Once cages are full removed refilling trey and replace cartridge top ensuring bolts are properly tightened.

Refilling trey for media replacement.

Refilling trey on cartridge with bulk media.

F. Exit pre-treatment chamber. Replace access hatch or manhole cover.

3. <u>Biofiltration Chamber (middle vegetated chamber)</u>

A. In general, the biofiltration chamber is maintenance free with the exception of maintaining the vegetation. Using standard gardening tools properly trim back the vegetation to healthy levels. The MWS Linear utilizes vegetation similar to surrounding landscape areas therefore trim vegetation to match surrounding vegetation. If any plants have died replace plants with new ones:

Inspection Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may not require irrigation after initial establishment.

Inspection Form

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name ______________________

Project Address ______________________ (city) (Zip Code)

Owner / Management Company ______________________

Contact ______________________ Phone ( ) –

Inspector Name ______________________ Date ___/___/___ Time ______ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________ Additional Notes ______________________

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): ______________ Size (22', 14' or etc.): ______________

Structural Integrity:	Yes	No	Comments
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	Yes	No
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: ______________________

Maintenance Report

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

Project Name ______________________________

Project Address ______________________________
(city) (Zip Code)

Owner / Management Company ______________________________

Contact ______________________________ Phone ( ) –

Inspector Name ______________________________ Date ____/____/______ Time __________ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition ______________________________ Additional Notes ______________________________

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

ATTACHMENT 4
Copy of Plan Sheets Showing Permanent Storm Water BMPs

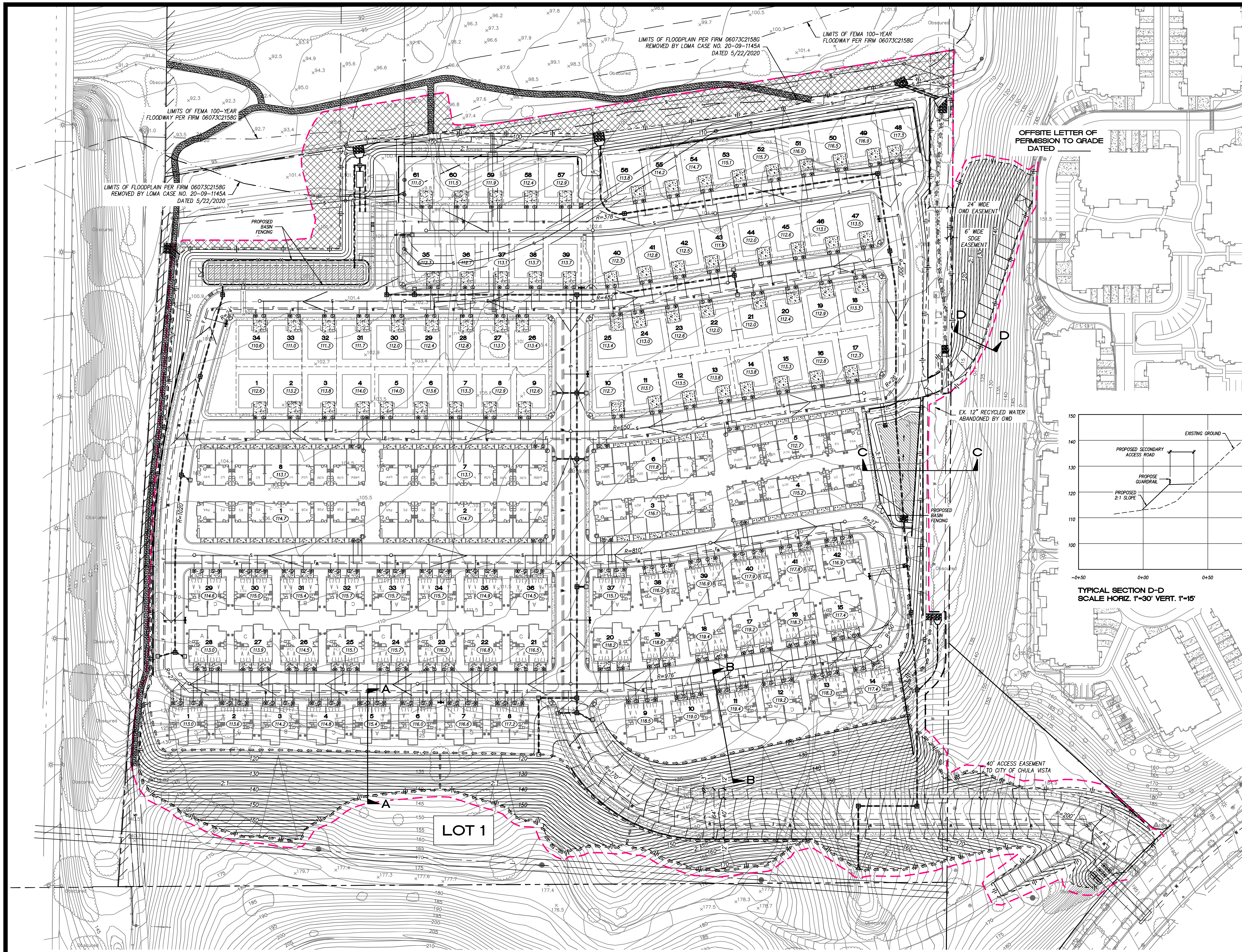
Nakano

Project Name/____

Use this checklist to ensure the required information has been included on the plans:

The plans must identify:

- ☐ Structural BMP(s) with ID numbers matching Form I-6 Summary of PDP Structural BMPs
- ☒ The grading and drainage design shown on the plans must be consistent with the delineation of DMAs shown on the DMA exhibit
- ☐ Details and specifications for construction of structural BMP(s)
- ☒ Signage indicating the location and boundary of structural BMP(s) as required by the City Engineer
- ☐ How to access the structural BMP(s) to inspect and perform maintenance
- ☒ Features that are provided to facilitate inspection (e.g., observation ports, cleanouts, silt posts, or other features that allow the inspector to view necessary components of the structural BMP and compare to maintenance thresholds)
- ☐ Manufacturer and part number for proprietary parts of structural BMP(s) when applicable
- ☒ Maintenance thresholds specific to the structural BMP(s), with a location-specific frame of reference (e.g., level of accumulated materials that triggers removal of the materials, to be identified based on viewing marks on silt posts or measured with a survey rod with respect to a fixed benchmark within the BMP)
- ☒ Recommended equipment to perform maintenance
- ☒ When applicable, necessary special training or certification requirements for inspection and maintenance personnel such as confined space entry or hazardous waste management
- ☒ Include landscaping plan sheets showing vegetation requirements for vegetated structural BMP(s)
- ☐ All BMPs must be fully dimensioned on the plans
- ☒ When proprietary BMPs are used, site specific cross section with outflow, inflow and model number shall be provided. Broucher photocopies are not allowed.

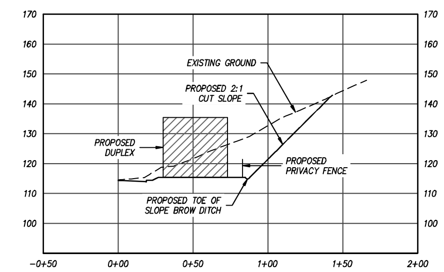


LEGEND

(symbol)	SLOPES 2:1 MAX
(symbol)	TM BOUNDARY
(symbol)	PROPOSED LOT LINE
(symbol)	PROPOSED DAYLIGHT LINE
(symbol)	PROPOSED 6" CURB AND GUTTER
(symbol)	PROPOSED 6" CURB
(symbol)	PROPOSED RETAINING WALL

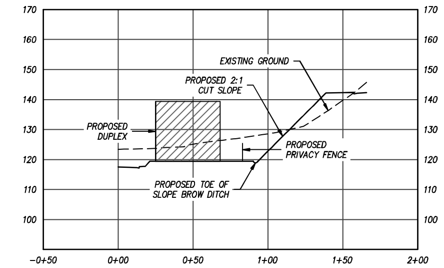
GRADING NOTES / BMP NOTES

1. BMP MAINTENANCE – PRIOR TO THE ISSUANCE OF ANY CONSTRUCTION PERMIT, THE OWNER/PERMITTEE SHALL ENTER INTO A MAINTENANCE AGREEMENT FOR THE ONGOING PERMANENT BMP MAINTENANCE, SATISFACTORY TO THE CITY ENGINEER.
2. CONSTRUCTION BMP – PRIOR TO ISSUANCE OF ANY CONSTRUCTION PERMIT, THE OWNER/PERMITTEE SHALL INCORPORATE ANY CONSTRUCTION BEST MANAGEMENT PRACTICES NECESSARY TO COMPLY WITH CHAPTER 14, ARTICLE 2, DIVISION1 (GRADING REGULATIONS) OR SAN DIEGO MUNICIPAL CODE, INTO THE CONSTRUCTION PLANS OR SPECIFICATIONS.

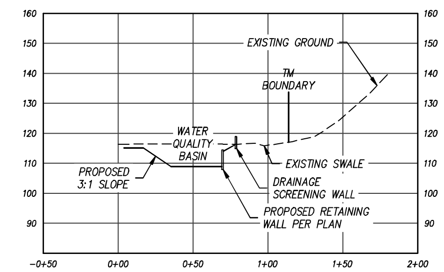


TYPICAL SECTION A-A
SCALE HORIZ. 1"=50' VERT. 1"=25'

TYPICAL SECTION D-D
SCALE HORIZ. 1"=30' VERT. 1"=15'



TYPICAL SECTION B-B
SCALE HORIZ. 1"=50' VERT. 1"=25'



TYPICAL SECTION C-C
SCALE HORIZ. 1"=50' VERT. 1"=25'

0 25 50 100 150
(IN FEET)
1 inch = 50 ft.

PREPARED BY:

CIVIL SENSE INC
13475 Danielson Street, Suite 150 | Poway, CA 92064
Office: 858-842-4353

HENRY H. PENG DATE
R.C.E. 63686

REGISTERED PROFESSIONAL ENGINEER HENRY H. PENG No. 63686 Exp. 09-30-22 CIVIL STATE OF CALIFORNIA

NAME: CIVIL SENSE, INC.
ADDRESS: 13475 DANIELSON STREET, SUITE 150
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PHONE: 858-843-4253

PROJECT ADDRESS:
NORTHSIDE OF DENNERY RD BETWEEN
REGATTA LANE AND SAND STAR WAY

PROJECT NAME:
NAKANO

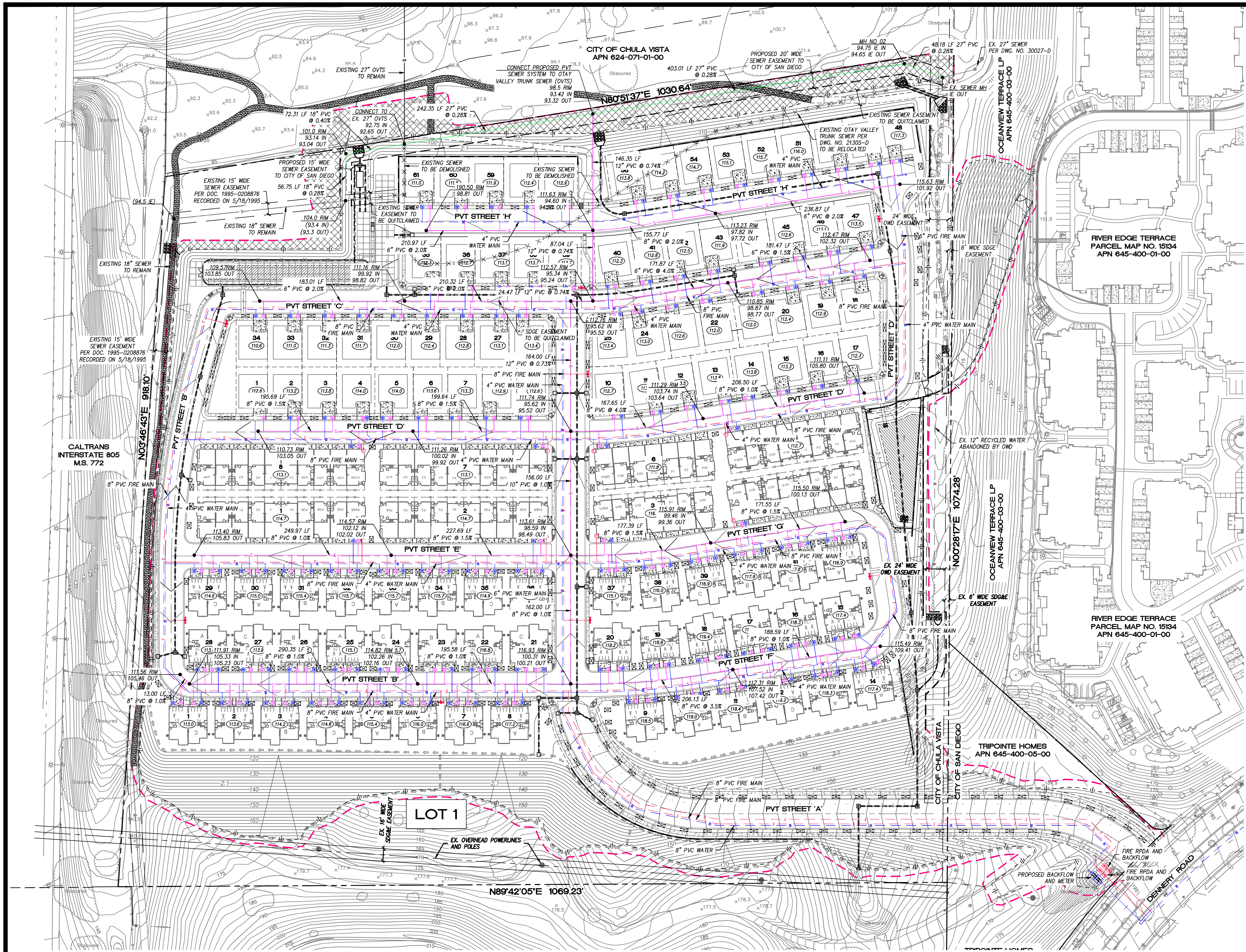
SHEET TITLE:
GRADING AND STORM DRAIN

REVISION 12:
REVISION 11:
REVISION 10:
REVISION 9:
REVISION 8:
REVISION 7:
REVISION 6:
REVISION 5:
REVISION 4:
REVISION 3: 11/04/2022
REVISION 2: 6/24/2022
REVISION 1: 2/17/2022

ORIGINAL DATE: 9/15/2021

SHEET 5 **OF** 19

DEP #



LEGEND

- VTM BOUNDARY
- PROPOSED PRIVATE WATER MAIN (SIZE PER PLAN)
- PROPOSED PRIVATE FIRE MAIN (SIZE PER PLAN) PER NFPA PAMPHLET 24 (2016 EDITION)
- PROPOSED PRIVATE WATER SERVICE
- PROPOSED PRIVATE FIRE SERVICE PER NFPA PAMPHLET 24 (2016 EDITION)
- PROPOSED FIRE REDUCE PRESSURE DETECTOR ASSEMBLY
- PROPOSED DUAL WATER METERS AND BACK FLOW DEVICE
- PROPOSED PRIVATE SEWER AND SEWER MANHOLE
- PROPOSED PUBLIC SEWER AND SEWER MANHOLE
- PROPOSED SEWER FLOW (SLOPE PER PLAN)
- PROPOSED PRIVATE SEWER LATERAL CALIFORNIA PLUMBING CODE
- PROPOSED PRIVATE IRRIGATION SERVICE, METER, AND BACKFLOW PREVENTION DEVICE.
- PROPOSED FIRE HYDRANT
- PROPOSED 40 SF STREET TREE

NOTE: ALL SEWER, WATER, AND STORM DRAIN UTILITIES ARE PRIVATE UNLESS OTHERWISE NOTED.

MINIMUM TREE SEPARATION DISTANCE

IMPROVEMENT	MIN. DISTANCE TO STREET TREE
TRAFFIC SIGNAL, STOP SIGN	20 FEET
UNDERGROUND UTILITY LINES (EXCEPT SEWER)	5 FEET
SEWER LINES	10 FEET
ABOVE GROUND UTILITY STRUCTURES (TRANSFORMERS, HYDRANTS, UTILITY POLES, ETC)	10 FEET
DRIVEWAYS	10 FEET *
INTERSECTIONS (INTERSECTING CURB LINES OF TWO STREETS)	25 FEET

* 5 FEET ON RESIDENTIAL LOCAL STREETS WITH A DESIGN SPEED OF 25MPH OR SLOWER

UTILITY TABLE

UTILITY	OVERHEAD/UNDERGROUND
GAS	UNDERGROUND
ELECTRIC	UNDERGROUND
TELEPHONE (AT&T)	UNDERGROUND
CABLE TELEVISION (COX)	UNDERGROUND
SEWER	UNDERGROUND
STORM DRAIN	UNDERGROUND
FIRE	UNDERGROUND
WATER	UNDERGROUND

NOTE: THE SUBDIVIDER SHALL ENSURE THAT ALL ONSITE UTILITIES SERVING THE SUBDIVISION SHALL BE UNDERGROUNDED WITH ALL OF THE APPROPRIATE PERMITS.

UTILITY NOTES

1. NO TREES OR SHRUBS EXCEEDING THREE FEET IN HEIGHT AT MATURITY SHALL BE INSTALLED WITHIN TEN FEET OF ANY SEWER AND FIVE FEET OF ANY WATER FACILITIES.
2. MINIMUM 10 FOOT SEPARATION FROM SEWER MAINS TO WATER MAINS. 10 FOOT SEPARATION TO BE MEASURED FROM OUTSIDE EDGE OF PIPE TO OUTSIDE EDGE OF PIPE.
3. ALL WATER SERVICES TO THE SITE, INCLUDING DOMESTIC, IRRIGATION AND FIRE, WILL REQUIRE PRIVATE, ABOVE GROUND BACK FLOW PREVENTION DEVICES (BFPDS). BFPDS ARE TYPICALLY LOCATED ON PRIVATE PROPERTY, IN LINE WITH THE SERVICE AND IMMEDIATELY ADJACENT TO THE RIGHT-OF-WAY. THE PUBLIC UTILITIES DEPARTMENT WILL NOT PERMIT THE REQUIRED BFPDS TO BE LOCATED BELOW GRADE OR WITHIN THE STRUCTURE.
4. IF A 3" OR LARGER METER IS REQUIRED FOR THIS PROJECT, THE OWNER/PERMITTEE SHALL CONSTRUCT THE NEW METER AND PRIVATE BACKFLOW DEVICE ON SITE, ABOVE GROUND, WITHIN AN ADEQUATELY SIZED WATER EASEMENT, IN A MANNER SATISFACTORY TO THE PUBLIC UTILITIES DIRECTOR AND THE CITY ENGINEER.
5. PRIOR TO THE ISSUANCE OF ANY BUILDING PERMITS, THE OWNER/PERMITTEE SHALL OBTAIN AN ENCROACHMENT MAINTENANCE REMOVAL AGREEMENT, FROM THE CITY ENGINEER, FOR THE PRIVATE SEWER LATERAL IN THE STREET A RIGHT-OF-WAY.

PREPARED BY:

CIVIL SENSE INC
13475 Danielson Street, Suite 150 | Poway, CA 92064
Office: 858-842-4353

HENRY H. PENG DATE
R.C.E. 63686

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PROJECT ADDRESS:
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SHEET TITLE:
UTILITY PLAN

REVISION 12:	
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ORIGINAL DATE: 9/15/2021

SHEET 6 OF 19

DEP #

Bio Clean
A Forterra Company

Modular Wetlands® System Linear

A Stormwater Biofiltration Solution

OVERVIEW

The Bio Clean Modular Wetlands® System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint, higher treatment capacity, and a wide range of versatility. While most biofilters use little or no pretreatment, the Modular Wetlands® incorporates an advanced pretreatment chamber that includes separation and pre-filter cartridges. In this chamber, sediment and hydrocarbons are removed from runoff before entering the biofiltration chamber, reducing maintenance costs and improving performance.

Horizontal flow also gives the system the unique ability to adapt to the environment through a variety of configurations, bypass orientations, and diversion applications.

The Urban Impact

For hundreds of years, natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as cities grow and develop, our environment's natural filtration systems are blanketed with impervious roads, rooftops, and parking lots.

Bio Clean understands this loss and has spent years re-establishing nature's presence in urban areas, and rejuvenating waterways with the Modular Wetlands® System Linear.

PERFORMANCE

The Modular Wetlands® continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons, and bacteria. Since 2007 the Modular Wetlands® has been field tested on numerous sites across the country and is proven to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. In fact, the Modular Wetlands® harnesses some of the same biological processes found in natural wetlands in order to collect, transform, and remove even the most harmful pollutants.

66% REMOVAL OF DISSOLVED ZINC	69% REMOVAL OF TOTAL ZINC	38% REMOVAL OF DISSOLVED COPPER	64% REMOVAL OF TOTAL PHOSPHORUS	
45% REMOVAL OF NITROGEN	50% REMOVAL OF TOTAL COPPER	95% REMOVAL OF MOTOR OIL	67% REMOVAL OF ORTHO PHOSPHORUS	85% REMOVAL OF TSS

APPROVALS

The Modular Wetlands® System Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation and perhaps the world. Here is a list of some of the most high-profile approvals, certifications, and verifications from around the country.

State of Washington TAPE GULD Basic Enhanced/Metals Phosphorus

Washington State Department of Ecology TAPE Approved
The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

CA

California Water Resources Control Board, Full Capture Certification
The Modular Wetlands® System is the first biofiltration system to receive certification as a full capture trash treatment control device.

VA

Virginia Department of Environmental Quality, Assignment
The Virginia Department of Environmental Quality assigned the MWS Linear the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) regulation technical criteria.

MD

Maryland Department of the Environment, Approved ESD
Granted Environmental Site Design (ESD) status for new construction, redevelopment, and retrofitting when designed in accordance with the design manual.

MA

MASTEP Evaluation
The University of Massachusetts at Amherst – Water Resources Research Center issued a technical evaluation report noting removal rates up to 84% TSS, 70% total phosphorus, 68.5% total zinc, and more.

RI

Rhode Island Department of Environmental Management, Approved BMP
Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% pathogens, 30% total phosphorus, and 30% total nitrogen.

ADVANTAGES

- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR

OPERATION

The Modular Wetlands® System Linear is the most efficient and versatile biofiltration system on the market, and it is the only system with horizontal flow which:

- Improves performance
- Reduces footprint
- Minimizes maintenance

Figure 1 & Figure 2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

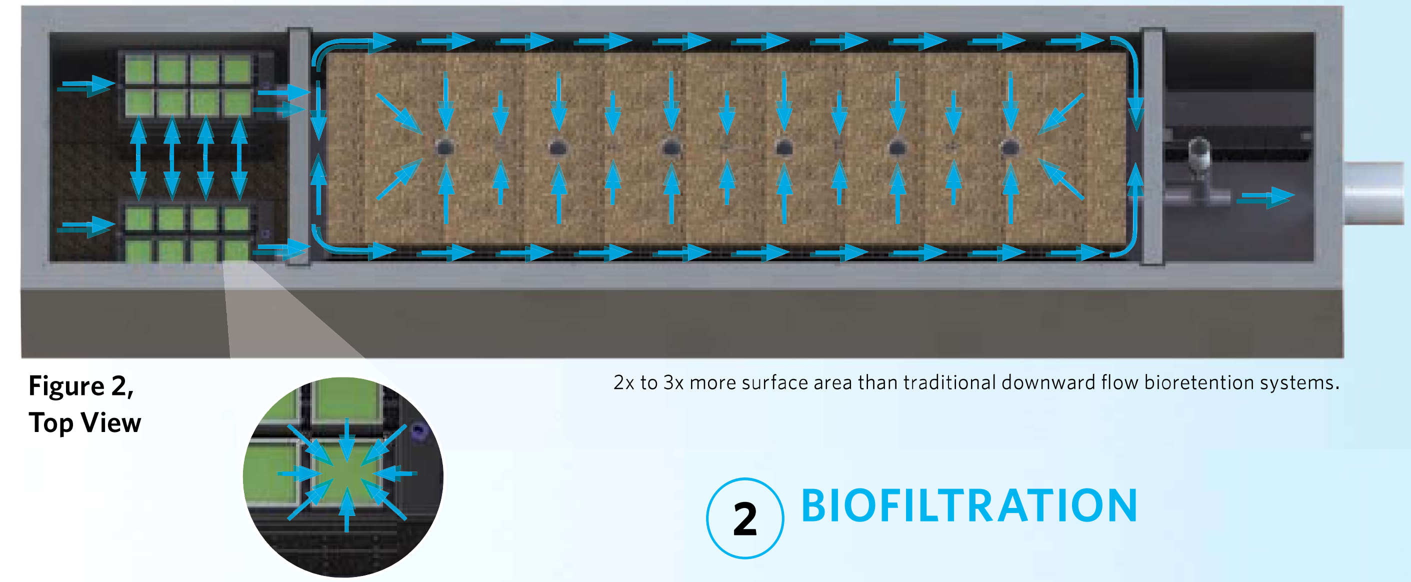


Figure 2, Top View

1 PRETREATMENT

SEPARATION

- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

PRE-FILTER CARTRIDGES

- Over 25 sq. ft. of surface area per cartridge
- Utilizes BioMediaGREEN™ filter material
- Removes over 80% of TSS and 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber

2 BIOFILTRATION

HORIZONTAL FLOW

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

PATENTED PERIMETER VOID AREA

- Vertically extends void area between the walls and the WetlandMEDIA™ on all four sides
- Maximizes surface area of the media for higher treatment capacity

WETLANDMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and lightweight

3 DISCHARGE

FLOW CONTROL

- Orifice plate controls flow of water through WetlandMEDIA™ to a level lower than the media's capacity
- Extends the life of the media and improves performance

DRAINDOWN FILTER

- The draindown is an optional feature that completely drains the pretreatment chamber
- Water that drains from the pretreatment chamber between storm events will be treated

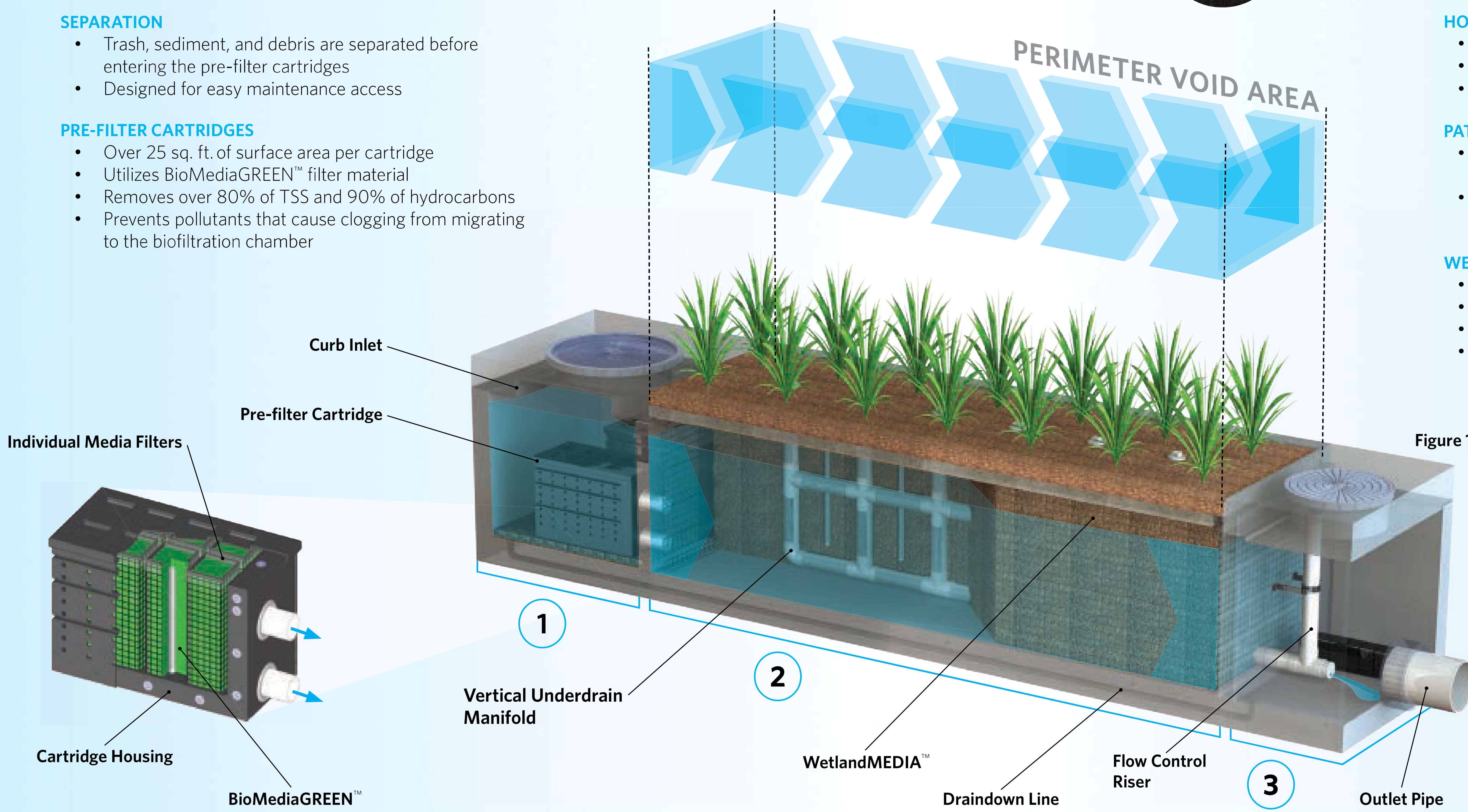
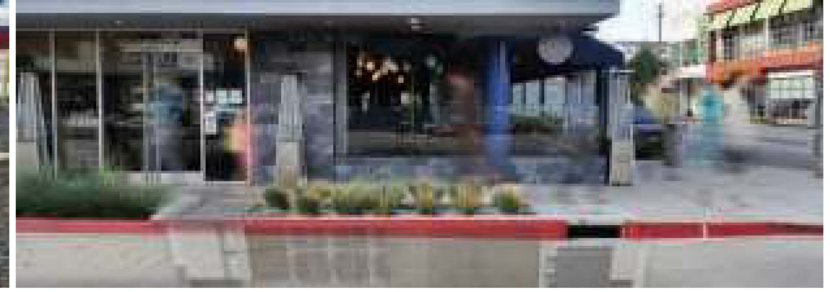


Figure 1

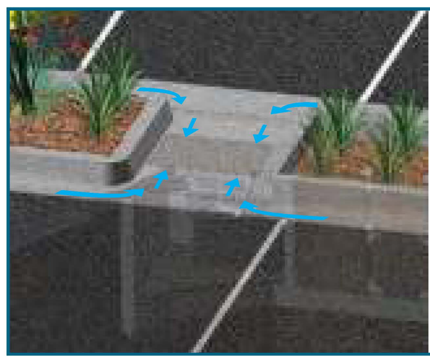


CONFIGURATIONS

The Modular Wetlands® System Linear is the preferred biofiltration system of civil engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your storm drain design.

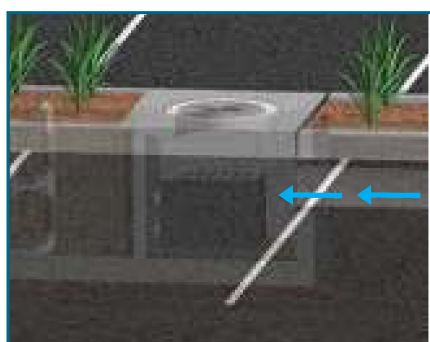
CURB TYPE

The Curb Type configuration accepts sheet flow through a curb opening and is commonly used along roadways and parking lots. It can be used in sump or flow-by conditions. Length of curb opening varies based on model and size.



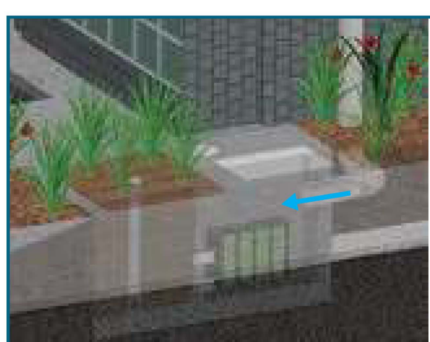
GRATE TYPE

The Grate Type configuration offers the same features and benefits as the Curb Type but with a grated/drop inlet above the systems pretreatment chamber. It has the added benefit of allowing pedestrian access over the inlet. ADA-compliant grates are available to assure easy and safe access. The Grate Type can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



VAULT TYPE

The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pretreatment chamber, meaning the Modular Wetlands® can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/bioretention systems. Another benefit of the "pipe-in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.



DOWNSPOUT TYPE

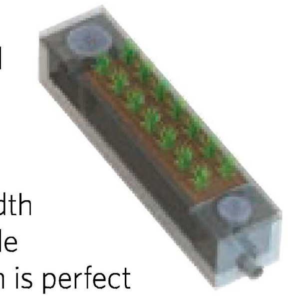
The Downspout Type is a variation of the Vault Type and is designed to accept a vertical downspout pipe from rooftop and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter, and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

ORIENTATIONS

SIDE-BY-SIDE

The Side-By-Side orientation places the pretreatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.

END-TO-END



The End-To-End orientation places the pretreatment and discharge chambers on opposite ends of the biofiltration chamber, therefore minimizing the width of the system to 5 ft. (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is that bypass must be external.

BYPASS

INTERNAL BYPASS WEIR (SIDE-BY-SIDE ONLY)

The Side-By-Side orientation places the pretreatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pretreatment chamber directly to the discharge chamber.

EXTERNAL DIVERSION WEIR STRUCTURE

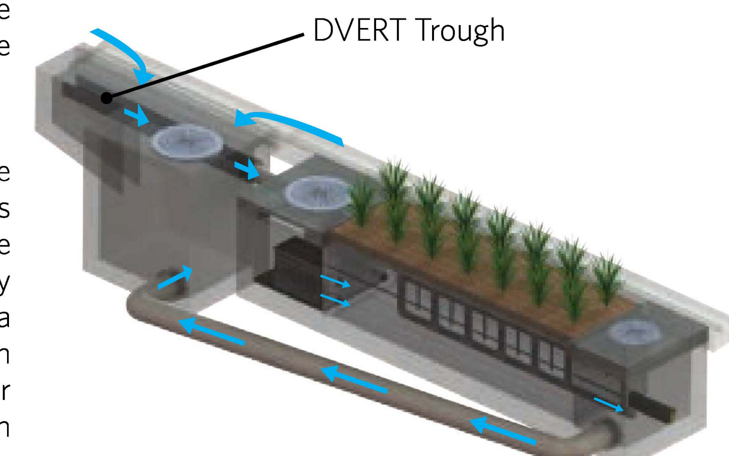
This traditional offline diversion method can be used with the Modular Wetlands® in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the Modular Wetlands® for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

FLOW-BY-DESIGN

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the Modular Wetlands® and into the standard inlet downstream.

DVERT LOW FLOW DIVERSION

This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the Modular Wetlands® via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over



to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allow the Modular Wetlands® to be installed anywhere space is available.

SPECIFICATIONS

FLOW-BASED DESIGNS

The Modular Wetlands® System Linear can be used in stand-alone applications to meet treatment flow requirements. Since the Modular Wetlands® is the only biofiltration system that can accept inflow pipes several feet below the surface, it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

MODEL #	DIMENSIONS	WETLANDMEDIA SURFACE AREA (sq. ft.)	TREATMENT FLOW RATE (cfs)
MWS-L-4-4	4' x 4'	23	0.052
MWS-L-4-6	4' x 6'	32	0.073
MWS-L-4-8	4' x 8'	50	0.115
MWS-L-4-13	4' x 13'	63	0.144
MWS-L-4-15	4' x 15'	76	0.175
MWS-L-4-17	4' x 17'	90	0.206
MWS-L-4-19	4' x 19'	103	0.237
MWS-L-4-21	4' x 21'	117	0.268
MWS-L-6-8	7' x 9'	64	0.147
MWS-L-8-8	8' x 8'	100	0.230
MWS-L-8-12	8' x 12'	151	0.346
MWS-L-8-16	8' x 16'	201	0.462
MWS-L-8-20	9' x 21'	252	0.577
MWS-L-8-24	9' x 25'	302	0.693
MWS-L-10-20	10' x 20'	302	0.693

VOLUME-BASED DESIGNS

HORIZONTAL FLOW BIOFILTRATION ADVANTAGE

Modular Wetlands® with Box Culvert Prestorage

The Modular Wetlands® System Linear offers a unique advantage in the world of biofiltration due to its exclusive horizontal flow design: Volume-Based Design. No other biofilter has the ability to be placed downstream of detention ponds, extended dry detention basins, underground storage systems and permeable paver reservoirs. The systems horizontal flow configuration and built-in orifice control allows it to be installed with just 6" of fall between inlet and outlet pipe for a simple connection to projects with shallow downstream tie-in points. In the example above, the Modular Wetlands® is installed downstream of underground box culvert storage. Designed for the water quality volume, the Modular Wetlands® will treat and discharge the required volume within local draindown time requirements.

Modular Wetlands® with Arch Plastic Chambers

DESIGN SUPPORT

Bio Clean engineers are trained to provide you with superior support for all volume sizing configurations throughout the country. Our vast knowledge of state and local regulations allow us to quickly and efficiently size a system to maximize feasibility. Volume control and hydromodification regulations are expanding the need to decrease the cost and size of your biofiltration system. Bio Clean will help you realize these cost savings with the Modular Wetlands®, the only biofilter than can be used downstream of storage BMPs.

ADVANTAGES

- LOWER COST THAN FLOW-BASED DESIGN
- MEETS LID REQUIREMENTS
- BUILT-IN ORIFICE CONTROL STRUCTURE
- WORKS WITH DEEP INSTALLATIONS

APPLICATIONS

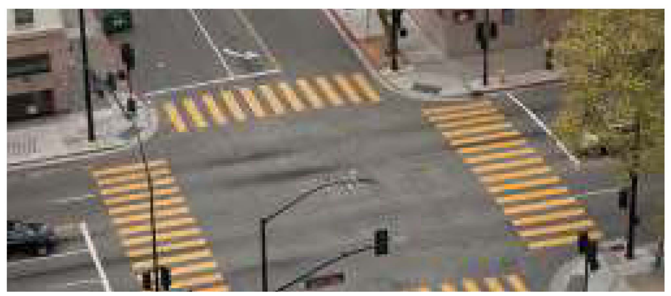
The Modular Wetlands® System Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.

INDUSTRIAL

Many states enforce strict regulations for discharges from industrial sites. The Modular Wetlands® has helped various sites meet difficult EPA-mandated effluent limits for dissolved metals and other pollutants.

RESIDENTIAL

Low to high density developments can benefit from the versatile design of the Modular Wetlands®. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.

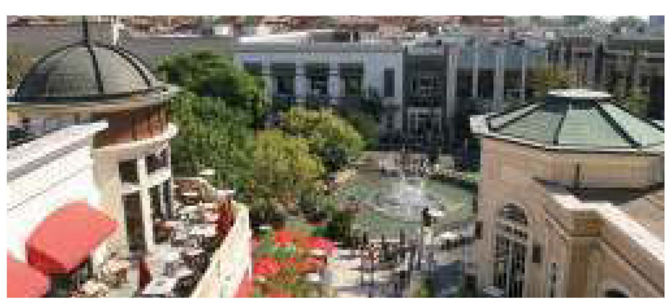


STREETS

Street applications can be challenging due to limited space. The Modular Wetlands® is very adaptable, and it offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

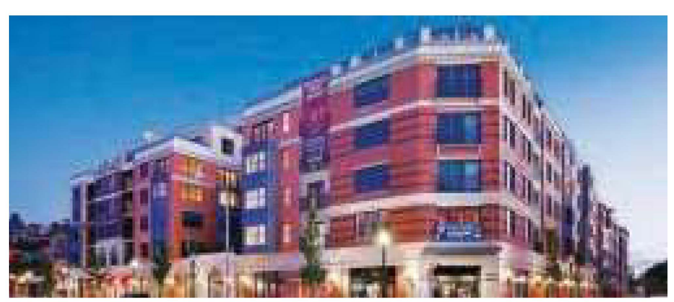
PARKING LOTS

Parking lots are designed to maximize space and the Modular Wetlands'® 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.



COMMERCIAL

Compared to bioretention systems, the Modular Wetlands® can treat far more area in less space, meeting treatment and volume control requirements.



MIXED USE

The Modular Wetlands® can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications include:

- Agriculture
- Reuse
- Low Impact Development
- Waste Water

PLANT SELECTION

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the Modular Wetlands® System Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade, the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the Modular Wetlands®, giving the plants more contact time so that pollutants are more successfully decomposed, volatilized, and incorporated into the biomass of the Modular Wetlands'® micro/macro flora and fauna.

A wide range of plants are suitable for use in the Modular Wetlands®, but selections vary by location and climate. View suitable plants by visiting biocleanenvironmental.com/plants.

INSTALLATION

The Modular Wetlands® is simple, easy to install, and has a space-efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles precast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians is available to supervise installations and provide technical support.

MAINTENANCE

Reduce your maintenance costs, man hours, and materials with the Modular Wetlands®. Unlike other biofiltration systems that provide no pretreatment, the Modular Wetlands® is a self-contained treatment train which incorporates simple and effective pretreatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pretreatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pretreatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long-term operation, and there is absolutely no need to replace expensive biofiltration media.

Bio Clean

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