PRELIMINARY WATER QUALITY MANAGEMENT PLAN

"Tentative Tract Map 20317"

Project Address:
South of Shady View Drive and Wrangler Road
City of Chino Hills, CA

Prepared for:

TRUMARK HOMES

450 Newport Center Drive, Suite 300
Newport Beach, CA 92660
(949) 999-9820

Prepared by:

Hunsaker & Associates Irvine, Inc.
3 Hughes
Irvine, CA 92618
(949) 583-1010

WQMP Date:
November 5, 2019
Revised March 27, 2020

W.O. 3593-38

PRELIMINARY WATER QUALITY MANAGEMENT PLAN

"Tract Map 20317"

City of Chino Hills, CA

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WATER QUALITY MANAGEMENT PLAN

"TENTATIVE TRACT MAP NO. 20317"

Prepared for:

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(949) 999-9820

Prepared by:

Hunsaker & Associates Irvine, Inc.

3 Hughes

Irvine, CA 92618

(949) 581-1010

Submittal Date: November 5, 2019

Revision Date: March 27, 2020

Approval Date: ______________________

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Trumark Homes by Hunsaker and Associates Irvine, Inc. The WQMP is intended to comply with the requirements of the City of Chino Hills and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	N/A
Tract/Parcel Map Number(s)	TTM 20317	Building Permit Number(s):	N/A
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 1057-261-06

Owner's Signature			
Owner Name: Trumark Homes			
Name/Title	Joe Martin, Vice President of Land Development		
Company	Trumark Homes		
Address	450 Newport Center Drive, Suite 300 Newport Beach, CA 92660		
Email	jmartin@trumarkco.com		
Telephone #	(949) 999-9820		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	N/A
Tract/Parcel Map Number(s)	TTM 20317	Building Permit Number(s):	N/A
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 1057-261-06

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of the Regional Water Quality Control Board Order No. R8-2010-0036."

<table>
<tr><td colspan="2">Engineer: David Francke</td><td rowspan="8">PE Stamp Below</td></tr>
<tr><td>Title</td><td>Project Manager</td></tr>
<tr><td>Company</td><td>Hunsaker and Associates Irvine, Inc.</td></tr>
<tr><td>Address</td><td>3 Hughes, Irvine, CA 92618</td></tr>
<tr><td>Email</td><td>dfrancke@hunsaker.com</td></tr>
<tr><td>Telephone #</td><td>(949) 583-1010</td></tr>
<tr><td>Signature</td><td></td></tr>
<tr><td>Date</td><td></td></tr>
</table>

Table of Contents

Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Infomation

<table>
<tr><td colspan="2">Project Name:</td><td colspan="4">“Shady View” – TTM 20317</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="4">Trumark Homes – Joe Martin</td></tr>
<tr><td>Mailing Address:</td><td>450 Newport Center Drive, Ste. 300
Newport Beach, CA 92660</td><td>E-mail Address:</td><td>jmartin@trumarkco.com</td><td>Telephone:</td><td>(949) 999-9820</td></tr>
<tr><td colspan="2">Permit/Application Number(s):</td><td>TBD</td><td>Tract/Parcel Map Number(s)</td><td colspan="2">TTM 20317</td></tr>
<tr><td colspan="2">Additional Information/ Comments:</td><td colspan="4">None.</td></tr>
</table>

Description of Project:

The proposed project, Tentative Tract Map 20317, is a single-family residential development that encompasses approximately 129.8 (+/-) acres located in the southeastern portion City of Chino Hills, just south of existing Butterfield Ranch Development and the intersection of Shady View Drive and Wrangler Road.

Specifically, site is bound to the north by existing residential homes and Wrangler Road/ Coyote Street beyond; to the east by State Route 71 (SR-71); and to the south and west by vacant land/open space. Entrance to the site will be provided via proposed entrances from Via La Cresta to the northwest and Shady View Drive to the north.

The proposed project will include 159 single-family residences, a community recreation area, private streets, landscaping, walkways, curb, sidewalk and gutter and storm drain improvements and related infrastructure improvements. Land use summary for the project is as provided in the following table.

Lot	Use	Area
1-106	Residential (65’x111 Lots)	21.56
107-159	Residential (60’x120’ Lots)	10.61
160	Recreation Center	1.02
161	Tank Site	0.99
A-K	Private Street	14.50
L	Sewer Lot	0.05
M-O	Storm Drain Lots	0.19
P-W, MM-PP	Open Space	1.46
X-Y	Natural Open Space	52.03
Z-DD, II-LL	Manufactured/ Restored Natural Open Space	20.26
EE-HH	Basins	7.10
Total	--	129.8

Architecture/ unit plan mix for proposed residential units include 6 plan types and range from 2,381 ft^2 to 3,888 ft^2 of living area. Additional architecture information for each unit, including total living area, bedroom and bathroom facilities, will be provided in the Final WQMP.

Parking will be provided via covered garage and uncovered street parking. Each residential lots is anticipated to have a two-car or three-car garage, with two driveway spaces (4 or 5 spaces per lot). Total parking proposed is 739 spaces minimum, which is consistent with City requirements.

<table>
<tr><td></td><td>Summary of the units is as follows:

Plan Type	# of Units	Dwelling Sq. Ft.	Garage Parking/ Unit	Driveway Parking/ Unit
1	26	2,381	2	2
2	16	2,880	2	2
3	14	3,005	2	2
4	34	3,300	3	2
5	34	3,496	3	2
6	35	3,888	3	2
Total	159	--	318	318

Open space/landscaping areas will consist of common open space/ landscape lots and slopes (Lots P-DD, II), basins (Lots EE-HH), street/ parkway landscaping and limited area with each residential lot. Total open space/landscaping area is anticipated to consists of approximately 66.6% of the project site (86.5 acres).

Anticipated paved/impervious areas include project streets, parking areas, driveway and the building footprint of each unit. Total paved/impervious area is anticipated to consist of approximately 33.4% of the project site (43.30 acres) Common area amenities include parkway landscaping, common landscape lots and the recreation park.

Typical household wastes are anticipated to be generated daily from the residential portion of the project. Each residential unit will have trash and recycle bins located/stored within the private areas of each unit, to be removed by the local contracting waste hauler on a weekly basis for disposal.</td></tr>
<tr><td>Provide Summary of Conceptual WQMP Conditions (if previously submitted and approved). Attach complete copy.</td><td>Not applicable. Project is currently in Preliminary WQMP Phase.</td></tr>
</table>

Section 2 Project Description

2.1 Project Description

Form 2.1-1 Description of Proposed Project			
[1] Development Category			
☐ Significant re-development involving the addition or replacement of 5,000 ft^2 or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft^2 or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7352-7354, 7356-7359	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft^2 or more
☒ Hillside developments of 5,000 ft2 or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft^2 of impervious surface or more adjacent to (within 200 ft) or discharging into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters	☒ Parking lots of 5,000 ft^2 or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft^2 or more, or have a projected average daily traffic of 100 or more vehicles per day
☐ Non-Priority / Non-Category Project – *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.*			

[2] Project Area (ft2):	5,653,468	[3] Number of Dwelling Units:	159	[4] SIC Code:	N/A. Residential Development
[5] Is Project going to be phased? ☐ Yes ☒ No *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*					
[6] Does project include roads? ☒ Yes ☐ No *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*					

2.2 Potential Stormwater Pollutants

The following section describes site ownership/management for all portions of the project site.

Form 2.2-1 Property Ownership/Management
Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:
In the developed condition, a Home Owner's Association (HOA) will be created. The HOA shall be responsible for the long term funding and implementation of all elements of this WQMP and as it pertains the HOA's jurisdiction. This responsibility shall be identified in the project's Covenants, Conditions and Restrictions (CC&Rs). Individual homeowners shall be responsible for all areas within each private lot. The HOA shall be responsible for the maintenance of all project drainage facilities, including main storm drain lines, catch basins, proposed BMPs (including project LID BMPs and detention/debris basin BMPs), slope drains, project slopes, recreation/park area, streets and common area open space and landscape lots. Maintenance responsibilities for the Tank Site (Lot 161) and all improvements therein, shall be that of the owner of the tank site, to be determined at a later date. Prior to the formation of the HOA, the developer for the project, Trumark Homes, shall be the entity responsible for all site improvements.

2.3 Potential Stormwater Pollutants

The project's expected stormwater pollutants of concern are provided in the following table. The pollutants were selected based on land use and site activities, as prescribed in Table 3-3 of the County of San Bernardino Technical Guidance Document (TGD) for WQMP.

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Potential sources of pathogens from the project include pet wastes, open space areas (natural), sediment, landscaping and food wastes.
Nutrients – Phosphorous	E ☒	N ☐	Potential sources of phosphorus from the project include fertilizer use from the project's landscaping areas (landscaped lots, slopes, park area and homeowners).
Nutrients – Nitrogen	E ☒	N ☐	Potential sources of nitrogen from the project include fertilizer use from the project's landscaping areas (landscaped lots, slopes, park area and homeowners).
Noxious Aquatic Plants	E ☐	N ☒	
Sediment	E ☒	N ☐	Potential sources of sediment for the project include landscaping areas and open space areas.
Metals	E ☒	N ☐	Potential sources include vehicles from uncovered parking areas.
Trash / Debris	E ☒	N ☐	Potential sources of trash / debris include common litter and trash cans from homeowners and visitors.
Pesticides / Herbicides	E ☒	N ☐	Potential sources of pesticides from the project include fertilizer use from the project's landscaping areas (landscaped lots, slopes, park area and homeowners).
Organic Compounds	E ☒	N ☐	Potential sources of organic compounds onsite include the project's landscaping and landscaping maintenance activities, as well as leaked vehicle fluids and improperly stored or spilled solvents/cleaners from homeowner vehicles.
Oxygen Demanding Compounds	E ☒	N ☐	Oxygen demanding compounds for the project include nutrients that have the potential to cause eutrophication of downstream water bodies and reduce oxygen levels.
Oil and Grease	E ☒	N ☐	Anticipated sources of oil and grease include driveways, project streets and leaking vehicles from homeowners and visitors.

The project discharges the existing storm drain system to the north and to the east. Runoff is conveyed easterly across SR-71 prior to discharging to the Chino Creek Reach 1B, Chino Creek Reach 1A, the Prado Basin Management Zone of the Santa Ana River and Reach 3 of the Santa Ana River.

Based on the 2014-16 303(d) List, Chino Creek Reach 1B is impaired for Chemical Oxygen Demand (COD) and Nutrients, with an established TMDL for indicator bacteria. Chino Creek Reach 1A is impaired for nutrients, with an established TMDL for indicator bacteria. The Prado Basin Management Zone is currently listed as impaired for pH, with no established TMDLs. Reach 3 of the Santa Ana River is impaired for Copper and Lead, with an established TMDL for Indicator Bacteria.

Based on the downstream receiving water's impairments, the project's primary pollutants of concern are pathogens, nutrients and metals.

2.4 Water Quality Credits

The project does not propose the use of water quality credits to meet LID requirements.

Form 2.4-1 Water Quality Credits			
[1] Project Types that Qualify for Water Quality Credits: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit=% impervious reduced]	☐ Higher density development projects ☐ Vertical density 20%] ☐ 7 units / acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not be realized through single use projects) [20%]	☐ Brownfield redevelopment (redevelop property complicated by presence of potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces , 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments, (variety of developments designed to support residential and vocational needs) [20%]
[2] Total Credit % 0 *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)	Not applicable.		

Section 3 Site and Watershed Description

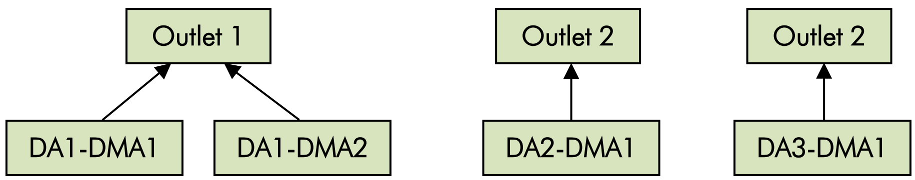
General descriptions of the project site and watershed are provided in the following tables.

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude: 33.923384°	Longitude: -117.660474°	Thomas Bros Map Page: N/A

[1] San Bernardino County climatic region: ☒ Valley ☐ Mountain

[2] Does the site have more than one drainage area (DA): Yes ☒ No ☐ ***If no, proceed to form 3-2.*** *If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s).*



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1-DMA1 through DMA3 all flow to Outlet 1.	DA1-DMA1 & DMA 2 – Runoff conveyed as sheet flow to gutter flow to proprietary biotreatment (Modular Wetland System or equivalent) located at northwestern project site prior to discharging to the backbone storm drain system and then offsite at Outlet 1. DA1-DMA3 – Runoff conveyed as sheet flow to gutter flow to backbone storm drain prior to discharging to downstream proprietary biotreatment (Modular Wetland System or equivalent) located at northeast project site and then offsite at Outlet 1.
DA2-DMA1	Runoff conveyed as sheet flow to gutter flow to backbone storm drain prior to discharging to downstream proprietary biotreatment (Modular Wetland System or equivalent) located at central-eastern project site and then offsite at Outlet 2.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1, 2 & 3				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DA1-DMA1	DA1-DMA2	DA2-DMA1	DA2-DMA3
1 DMA drainage area (ft^2)	**8,798 ft^2**	**8,969 ft^2**	**793,080 ft^2**	**1,729,246 ft^2**
2 Existing site imperious area (ft^2)	**0 ft^2**	**0 ft^2**	**0 ft^2**	**0 ft^2**
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC I, II	AMC I, II	AMC I, II	AMC I, II
4 Hydrologic soil group *refer to Watershed Mapping Tool –* *http://sbcounty.permitrack.com/WAP*	B	B	B	B
5 Longest flowpath length (ft)	See Project Hydrology Report			
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Barren	Barren	Barren	Barren
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%. Attach photos of site to support rating*	Poor	Poor	Poor	Poor

In the existing condition, the site consists vacant natural land that slopes to the north and northeast.

Per the project's hydrology study, there are six drainage areas within the studied area in the existing condition. Drainage Areas "A" and "B" contains majority of the project site including the off-site canyon watershed. Drainage Areas "A" and "B" confluence at the downstream of the project property and discharge into the existing 8'x6' RCB across Freeway 71.

Drainage Areas "C" and "D" are discharging into the existing storm drain system for Parcel Map No. 10141 improvements. Drainage Area "C" is discharging into the existing 27" storm drain along Coyote Street and Drainage Area "D" is discharging into the existing 42" storm drain at the northeast of the project site. The existing storm drain for Parcel Map No. 10141 joins the existing 8'x6' RCB that crosses Freeway 71 as well.

Drainage Areas "E" and "F" are discharging into the existing storm drain system crossing 71 Freeway. Drainage Area "E" is discharging into the existing 72" CSP and Drainage Area "F" is discharging into the existing 24" AP.

All runoff is then discharged to Chino Creek Reach 1B, the Prado Basin Management Zone of the Santa Ana River and Reach 3 of the Santa Ana River

In the developed condition, drainage from the project will be conveyed in the same general direction as in existing conditions to the north and northeast via the proposed storm drain system. In general, runoff will be conveyed as sheet flow to project gutters, then as gutter flow to the storm drain system. Runoff is then northeasterly and offsite to the existing storm drain system and then to Chino Creek to the east, as in pre-project conditions.

Form 3-3 Watershed Description for Drainage Area	
Receiving waters *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	Chino Creek Reach 1B Chino Creek Reach 1A Prado Management Zone Sana Ana River Reach 3
Applicable TMDLs *Refer to Local Implementation Plan*	Chino Creek Reach 1A & 1B – Pathogens Prado Management Zone – None Santa Ana River (Reach 3) – Indicator Bacteria
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP and SWRCB website*	Chino Creek Reach 1B – Chemical Oxygen Demand, Nutrients Chino Creek Reach 1A – Nutrients Prado Management Zone – pH Santa Ana River Reach 3 – Copper, Lead
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	Based on the information provided by the Watershed Mapping Tool, there are sensitive habitats (Least Bell's Vireo, Coastal Sage Scrub) within 200' of the site.
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	Portions of Chino Creek downstream of project site are unlined.
Hydrologic Conditions of Concern	☒ Yes. *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include forms 4.2-2 through Form 4.2-5 and Hydromodification BMP form 4.3-10 in submittal.* ☐ No
Watershed-based BMP included in a RWQCB approved WAP	☐ Yes. *Attach verification of regional BMP evaluation criteria in WAP* - *More Effective than On-site LID* - *Remaining Capacity for Project DCV* - *Upstream of any Water of US* - *Operation at Project Completion* - *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMPs)

4.1 Source Control BMP

4.1.1 Pollution Prevention

Non-structural and structural source control BMPs are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs selected for the project and provide explanations for BMPs that are not applicable to the project. The source control BMP list provided in Table 7-3 of the TGD was reviewed by the preparer of this WQMP. The Table was used to determine all applicable non-structural and structural source controls for the proposed project based on the project's proposed use/type.

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	The HOA shall periodically provide environmental awareness education materials to all HOA members and residents. Materials to include proper use of household chemicals, proper disposal of household wastes, awareness of storm drain conveyance systems and good housekeeping practices. The educational materials available from the County Stormwater Program can be downloaded at http://www.sbcountystormwater.org.
N2	Activity Restrictions	☒	☐	Conditions, Covenants, and Restrictions (CC&Rs) shall be prepared for the purpose of surface water quality protection required of each property owner. Requirements of the final CC&Rs will be provided in the in this WQMP when available. The requirements shall be enforced by the HOA.
N3	Common Area Landscape Management	☒	☐	Ongoing maintenance shall be consistent with City and County water conservation guidelines. Any fertilizer and/or pesticide usage shall be consistent with City and County use guidelines and per manufacturer's recommendations. HOA shall be the mechanism to ensure compliance with N3. Landscaping areas shall be inspected for signs of erosion, vegetation health and mulch depth regularly with landscaping maintenance activities or at minimum once per month. Identified eroded areas, decaying or dying vegetation and bare areas shall be repaired, replaced and/or mulched as soon as possible to minimize exposed sediment and potential for erosion.
N4	BMP Maintenance	☒	☐	The Home Owners Association (HOA) shall be responsible for the inspection and maintenance of structural BMPs within their boundaries. All records shall be maintained for a minimum of five years after generation.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Proposed facility will not generate waste subject to Title 22 CCR compliance.
N6	Local Industrial Permit Compliance	☐	☒	Not applicable to residential developments or parks.
N7	Spill Contingency Plan	☐	☒	Proposed facilities will not generate waste or store materials subject to the requirements of Chapter 6.95 of the CA Health and Safety Code.
N8	Underground Storage Tank Compliance	☐	☒	None proposed.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Proposed project will not store or generate hazardous materials subject to agency requirements.
N10	Uniform Fire Code Implementation	☐	☒	Proposed facility does not propose to store toxic or highly toxic compressed gases.

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N11	Common Area Litter Control	☒	☐	Litter patrol, emptying of trash receptacles in common areas, and noting trash disposal violations by residents and reporting the violations to the HOA for investigation shall be conducted.
N12	Employee Training	☐	☒	Proposed project is residential. N12 is intended for employees of business facilities.
N13	Housekeeping of Loading Docks	☐	☒	No loading docks proposed.
N14	Common Area Catch Basin Inspection	☒	☐	HOA shall have at least 80% of all privately maintained drainage facilities inspected and if necessary, cleaned and maintained, on an annual basis. 100% of the facilities shall be inspected within a two-year period. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. Drainage facilities include catch basins, storm drain lines, slope drains, common area drains (park site), detention basins and water quality basins.
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	HOA shall have all project streets and parking lots swept on a regular basis, based on facility use and field observation of accumulated sediment. At minimum, all areas shall be swept in late summer or early fall, just prior to the rainy season, and per City's sweeping frequency.
N16	Other Non-Structural Measures for Public Agency Projects	☐	☒	Project is private development.
N17	Comply with all other applicable NPDES Permits	☐	☒	No individual permit required for the operation of the proposed project and facilities.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, if not applicable, state reason
S1	Provide storm drain system stenciling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	All storm drain inlets and catch basins, constructed or modified, within the Project area shall be stenciled or labeled. Signs ("No Dumping – Drains to River" or similar language) which prohibit illegal dumping shall be posted legibly adjacent to each catch basin. Legibility of stencils and signs shall be maintained by the HOA.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	Project does not proposed outdoor storage areas for residential development.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☐	☒	No designated trash storage areas/enclosures proposed. Trash shall be stored within the private areas of each residential lot.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Stateside Model Landscape Ordinance: CASQA New Development BMP Handbook SD-12)	☒	☐	The timing and application methods of irrigation water in common areas shall minimize the runoff of excess irrigation water into the stormwater conveyance system through the use of automatic controllers that monitor weather conditions and/or soil moisture. Inspect system for leaks and broken parts. The HOA, through its landscape maintenance contractor, shall ensure that irrigation systems are functioning as intended and repaired as needed
S5	Finish grade of landscaped areas at a minimum of 1-2" below top of curb, sidewalk or pavement	☒	☐	Where feasible, landscaping areas (such as parkway landscaping) will be depressed to retain some runoff from infiltration and evapotranspiration.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Project slopes will be equipped with slope drains to convey runoff and minimize slope erosion.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	No dock areas proposed for project.

Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No maintenance bays proposed.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No community wash areas proposed. Project's Covenants, Conditions and Restrictions (CC&Rs) to prohibit individual owners from washing personal vehicles and equipment onsite.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas proposed.
S11	Equipment wash areas with spill containment (CASQA New Development BMP Handbook SD-33)	☐	☒	No wash areas proposed. Project's Covenants, Conditions and Restrictions (CC&Rs) to prohibit individual owners from washing personal vehicles and equipment onsite.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas proposed.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☒	☐	Hillside landscaping onsite will consist of native and/or deep rooted drought tolerant plant species to ensure vegetation establishment and slope stabilization. Dying/deceased vegetation shall be identified during routine inspection activities (in accordance with N3) and planting replaced as soon as possible, with temporary measures installed (e.g. mulch) until such time the vegetation and any erosion is replaced/repaired.
S14	Wash water control for food preparation areas	☐	☒	No food service facilities proposed.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community wash areas proposed. Project's Covenants, Conditions and Restrictions (CC&Rs) to prohibit individual owners from washing personal vehicles and equipment onsite.

4.1.2 Preventive LID Site Design Practices

Site design practices associated with LID requirements in the MS4 should be considered in the earliest phases of the project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. The following section identifies all site design BMPs utilized onsite and the rational for measures not incorporated.

Form 4.1-3 Preventative LID Site Design Practices Checklist
Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Project will minimize impervious area by incorporating multi-story units, constructing road widths and sidewalks to minimum widths allowable wherever feasible. Majority of the project site (approximately 66.6%) will remain as open space or landscaping area.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: Site will allow incidental infiltration of runoff collected within parkway areas and other landscape areas.
Preserve existing drainage patters and time of concentration: Yes ☒ No ☐ Explanation: Project design has been prepared to be consistent with the site's existing runoff patterns, with detention of the project's 2-year event to ensure project does not exceed existing peak runoff flow and time of concentration for the post-development 2-year event.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Project site will consist of parkway landscaping, open space lots and slopes to disconnect the amount of impervious area onsite.
Protect existing vegetation and sensitive areas: Yes ☒ No ☐ Explanation: Project includes open space areas to the south that will remain as existing, in natural conditions.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: Project will re-vegetate and stabilize all disturbed areas prior to completion.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☐ No ☒ Explanation: Project does not propose infiltration facilities. If feasible, runoff within lot areas may be directed to landscaping areas for filtration, evapotranspiration and some infiltration. However, no dedicated infiltration BMPs have been proposed due site topography (considered hillside).
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Swales would not have the capacity to convey runoff from the project.
Stake off areas that will be used for landscaping to minimize compaction during construction: Yes ☒ No ☐ Explanation: When feasible, compaction within dedicated landscaping areas will be minimized.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration and peak runoff for protection of any downstream waterbody segments with a HCOC.

The methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires the use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2.1.
- For HCOC pre- and post-development hydrologic calculations, the San Bernardino County Stormwater Program quires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach.

<table>
<tr><th colspan="3">Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume
(DA 1, DA 2 & DA 3)</th></tr>
<tr><td>1 Project Area (ft²):
DA1 = 17,767
DA2 = 793,080
DA3 = 1,729,246</td><td>2 Imperviousness after applying preventative site design practices (Imp%): 65(1)</td><td>3 Runoff Coefficient (Rc): 0.449
Rc = 0.858(imp%)³-0.78(imp%)²+0.774(imp%)+0.04</td></tr>
<tr><td colspan="3">4 Determine 1-hour rainfall depth for a 2-year return period P2yr-1hr (in): 0.593”</td></tr>
<tr><td colspan="3">5 Compute P6, Mean 6-hr Precipitation (inches): 0.878”
P6 = Item 4 * C1, where C1 is a function of site climatic region specified in Form 3-1 Item 1
(Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)</td></tr>
<tr><td colspan="2">6 Drawdown Rate
Use 48 hours as the default condition. Selection and use of the 24-hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.</td><td>24-hrs ☒
48-hrs ☐</td></tr>
<tr><td colspan="3">7 Compute design capture volume, DCV (ft³):
DA-1 = 923.8 ft³ (0.02 acre-ft); DA-2 = 41,236.6 ft³ (0.95 acre-ft); DA-3 = 89,913 ft³ (2.06 acre-ft)
DCV = 1/12 * [Item 1* Item 3* Item 5* C2], where C2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)
Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2</td></tr>
</table>

(1) *65% impervious area used to determine DCV and Q_{BMP} based on typical land use values for Low Density Residential (conservative estimate).*

Form 4.2-2 Summary of HCOC Assessment

Does the project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☒ No ☐

Go to: http//sbcounty.permitrack.com/WAP

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)*

If "No", then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 *Form 4.2-3 Item 12*	2 *Form 4.2-4 Item 13*	3 *Form 4.2-5 Item 10*
Post-developed	4 *Form 4.2-3 Item 13*	5 *Form 4.2-4 Item 14*	6 *Form 4.2-5 Item 14*
Difference	7 *Item 4 – Item 1*	8 *Item 5 – Item 2*	9 *Item 6 – Item 3*
Difference (as % of pre-developed)	10 *Item 7 / Item 1*	11 *Item 8 / Item 2*	12 *Item 9 / Item 3*

Per Figure F-1 of the WQMP TGD and http://sbcounty.pemitrack.com/WAP, the project does have the potential to cause or contribute to an HCOC in a downstream Channel as portions of Chino Creek downstream are unlined.

In place of Form 4.2-3 to 4.2-5 for HCOC Assessment for Runoff Volume and Peak Runoff, refer to the project's Hydrology Report. Based on the findings of the project's hydrology study, post-development flows and volumes for all storm events analyzed (2-year, 10-year, 100-year) are less than the pre-development (existing) condition. Therefore, the project would not have hydromodification impacts on downstream receiving waters.

In the developed condition, drainage from the project will be conveyed in the same general direction as in existing conditions to the north and northeast via the proposed storm drain system. In general, runoff will be conveyed as sheet flow to project gutters, then as gutter flow to the storm drain system. Runoff is then northeasterly and offsite to the existing storm drain system and then to Chino Creek to the east, as in pre-project conditions.

The following tables from the project's Hydrology Report provide a summary of the project's pre- and post-development drainage. The complete report is provided under a separate cover. A summary of the project's hydrology report is provided in the following table:

Table 1 Hydrology Analysis Summary Free Drain Without Detention
Tract 20317 - Shady View
City of Chino Hills

Existing Condition					Proposed Condition					Difference (Proposed-Existing)			
Area	Area (acre)	2-yr (cfs)	25-yr (cfs)	100-yr (cfs)	Area	Area (acre)	2-yr (cfs)	25-yr (cfs)	100-yr (cfs)	Area (acre)	2-yr (cfs)	25-yr (cfs)	100-yr (cfs)
A	32.9	26.4	76.6	109.1	A	-	-	-	-	-32.9	-26.4	-76.6	-109.1
B	222.1	88.6	358.0	535.5	B	260.3	139.0	424.6	625.8	38.2	50.4	66.6	90.3
C	14.2	9.6	31.3	45.1	C	7.8	5.7	17.0	24.5	-6.4	-3.9	-14.3	-20.6
D	17.1	11.3	35.0	50.4	D	21.5	14.6	42.5	62.5	4.4	3.3	7.5	12.1
E	2.8	2.5	6.8	9.6	E	0.8	0.8	2.4	3.5	-2.0	-1.7	-4.4	-6.1
F	2.4	2.1	5.7	8.1	F	1.1	0.4	1.9	2.9	-1.3	-1.7	-3.8	-5.2
Overall	291.5	140.5	513.4	757.8	Overall	291.5	160.5	488.4	719.2	0.0	20.0	-25.0	-38.6

Note:
1. The proposed condition flow rates are free drain condition without detention basin mitigation functions
2. Drainage Area "C" and "D" are draining into the existing storm drain per Parcel Map 10141 improvements. The Drainage Areas "C" and "D" are combining as one discharge point for the flow rate comparisons

Table 2 Hydrology Analysis Summary for Areas to Existing PM 10141 Storm Drain
Drainage Area "C" and "D" - Tract 20317 - Shady View
City of Chino Hills

Existing Condition					Proposed Condition					Difference (Proposed-Existing)			
Area	Area (acre)	2-yr (cfs)	25-yr (cfs)	100-yr (cfs)	Area	Area (acre)	2-yr (cfs)	25-yr (cfs)	100-yr (cfs)	Area (acre)	2-yr (cfs)	25-yr (cfs)	100-yr (cfs)
C	14.2	9.6	31.3	45.1	C	7.8	5.7	17.0	24.5	-6.4	-3.9	-14.3	-20.6
D	17.1	11.3	35.0	50.4	D	21.5	14.6	42.5	62.5	4.4	3.3	7.5	12.1
Overall	31.3	20.9	66.3	95.5	Overall	29.3	20.3	59.5	87.0	-2.0	-0.6	-6.8	-8.5

Table 3 Basin Routing Summary for Tract 20317
in City of Chino Hills

Storm	Inflow (cfs)	outflow (cfs)	flow reduction (cfs)	overall flow increase per Table 1 (cfs)	flow reduction more than flow increase
2-year	91.9	34.1	57.8	50.4	yes
25-year	326.8	248.9	77.9	66.6	yes
100-year	480.6	381.1	99.5	90.3	yes

Note: the inflow used in the basin routing analysis was from Node 16

4.3 Project Conformance Analysis

Per the 4th Term MS4 Storm Water Permit, Low Impact Development (LID) BMPs must be incorporated into design features and source controls to reduce project related storm water pollutants. The incorporation of LID BMPs into project design requires evaluation of LID measures in the following hierarchy of BMP selection, as required by the Permit (Section 5.3.1 in the TGD for WQMP).

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvest and Use (Form 4.3-4)
- Biotreatment (Form 4.3-5)

Form 4.3-1 Infiltration BMP Feasibility (DA 1)	
Feasibility Criterion – Complete evaluation for each DA on the Project Site	
1 Would infiltration BMP pose significant risk for groundwater related concerns? *Refer to Section 5.3.2.1 of the TGD for WQMP*	Yes ☐ No ☒
If Yes, Provide basis:	
2 Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than eight feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.	Yes ☒ No ☐
If Yes, Provide basis: Project site incorporates numerous retaining walls in project design and is also located in hillside.	
3 Would infiltration of runoff on a Project site violate downstream water rights?	Yes ☐ No ☒
If Yes, Provide basis:	
4 Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils?	Yes ☐ No ☒
If Yes, Provide basis: (attach)	
5 Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)?	Yes ☐ No ☒
If Yes, Provide basis: No infiltration test results available.	
6 Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? *See Section 3.5 of the TGD for WQMP and WAP*	Yes ☐ No ☒
If Yes, Provide basis: (attach)	
7 Any answer from Item 1 through Item 3 is "Yes": *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.*	Yes ☒ No ☐
8 Any answer from Item 4 through Item 6 is "Yes": *If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.*	Yes ☐ No ☒
9 All answers to Item 1 through Item 6 are "No": *Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Hydrologic Source Control BMP.*	

Form 4.3-1 Infiltration BMP Feasibility (DA 2)
Feasibility Criterion – Complete evaluation for each DA on the Project Site
[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒ *Refer to Section 5.3.2.1 of the TGD for WQMP*
If Yes, Provide basis:
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☒ No ☐ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than eight feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: Project site incorporates numerous retaining walls in project design and is also located in hillside.
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis:
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒
If Yes, Provide basis: No infiltration test results available.
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ *See Section 3.5 of the TGD for WQMP and WAP*
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is “Yes”: Yes ☒ No ☐ *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.*
[8] Any answer from Item 4 through Item 6 is “Yes”: Yes ☐ No ☒ *If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.*
[9] All answers to Item 1 through Item 6 are “No”: *Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Hydrologic Source Control BMP.*

Form 4.3-1 Infiltration BMP Feasibility (DA 3)
Feasibility Criterion – Complete evaluation for each DA on the Project Site
[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒ *Refer to Section 5.3.2.1 of the TGD for WQMP*
If Yes, Provide basis:
[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☒ No ☐ (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than eight feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.
If Yes, Provide basis: Project site incorporates numerous retaining walls in project design and is also located in hillside.
[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒
If Yes, Provide basis:
[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒
If Yes, Provide basis: (attach)
[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒
If Yes, Provide basis: No infiltration test results available.
[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒ *See Section 3.5 of the TGD for WQMP and WAP*
If Yes, Provide basis: (attach)
[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☒ No ☐ *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.*
[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒ *If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP. If no, then proceed to Item 9, below.*
[9] All answers to Item 1 through Item 6 are "No": *Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP. Proceed to Form 4.3-2, Hydrologic Source Control BMP.*

4.3.1 Site Design Hydrologic Source Control BMPs

Section XI.E. of the Permit emphasizes the use of LID preventive measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs.

The project does not propose the use of HSC credits to meet onsite LID requirements at this time.

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1, 2 & 3)			
1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): 0 ft^3 *$V_{retention}$ =Sum of Item 4 for all BMPs*			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) *$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): 0 ft^3 *$V_{retention}$ =Sum of Item 12 for all BMPs*			
14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*			

17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) *$V_{retention}$ = Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3): 0 ft^3 *$V_{retention}$ =Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) *$V_{retention}$ = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3): 0 ft^3 *$V_{retention}$ = Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) *$V_{retention}$ = Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): 0 ft^3 *$V_{retention}$ =Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: 0 ft^3 *Sum of Items 5, 13, 20, 25 and 29*			

4.3.2 Infiltration BMPs

Infiltration BMPs were considered but determined to be infeasible due to the project location on a hillside. Where feasible, site design practices will be employed to allow for some infiltration of runoff travelling over vegetated surfaces.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1, 2 & 3)			
1 Remaining LID DCV not met by site design HSC BMP (ft^3): *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30* DA-1 = 923.8 ft^3 – 0 ft^3 – 0 ft^3 = 923.8 ft^3 (0.02 acre-ft) DA-2 = 41,236.6 ft^3 – 0 ft^3 – 0 ft^3 = 41,236.6 ft^3 (0.95 acre-ft) DA-3 = 89,913.0 ft^3 – 0 ft^3 – 0 ft^3 = 89,913.0 ft^3 (2.06 acre-ft)			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*			
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*			
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*			
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*			
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*			
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*			
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity			
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*			
12 Gravel porosity			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*			
16 Total Retention Volume from LID Infiltration BMPs: 0 ft^3 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 0 % *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☐ No ☒ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

4.3.3 Harvest and Use BMPs

The project does not propose harvest and use BMPs as there are sources of reclaimed water available for project use.

Form 4.3-4 Harvest and Use BMPs (DA 1, 2 & 3)			
1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft³): *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16* DA-1 = 923.8 ft³ (0.02 acre-ft) DA-2 = 41,236.6 ft³ (0.95 acre-ft) DA-3 = 89,913.0 ft³ (2.06 acre-ft)			
BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Describe cistern or runoff detention facility			
3 Storage volume for proposed detention type (ft³) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft²)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft³/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			
8 Retention Volume (ft³) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*			
9 Total Retention Volume (ft³) from Harvest and Use BMP: 0 ft³ (*Sum of Item 8 for all harvest and use BMP included in plan)*			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☐ No ☒ *If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.*			

4.3.4 Biotreatment BMPs

The project proposes the use of proprietary biotreatment facilities (Modular Wetland Systems) to treat the project's pollutants of concern.

<table>
<tr><th colspan="3">Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1, 2 & 3)</th></tr>
<tr><td colspan="2">1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3):
DA-1 = 923.8 ft^3 (0.02 acre-ft)
DA-2 = 41,236.6 ft^3 (0.95 acre-ft)
DA-3 = 89,913.0 ft^3 (2.06 acre-ft)
Form 4.2-1 Item 7 – Form 4.3-2 Item 30 – Form 4.3-3 Item 16 – Form 4.3-4 – Item 9</td><td>List pollutants of concern Copy from Form 2.3-1.
Pathogens, Phosphorous, Nitrogen, Sediment, Trash / Debris, Pesticides / Herbicides, Organic Compounds, Metals, Oxygen Demanding Compounds, Oil and Grease</td></tr>
<tr><td rowspan="2">2 Biotreatment BMP Selected
(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)</td><td>Volume-based biotreatment
Use forms 4.3-6 and 4.3-7 to compute treated volume</td><td>Flow-based biotreatment
Use form 4.3-8 to compute treated volume</td></tr>
<tr><td>☐ Bioretention with underdrain
☐ Planter box with underdrain
☐ Constructed wetland
☐ Wet extended detention
☐ Dry extended detention</td><td>☐ Vegetated swale
☐ Vegetated filter strip
☒ Proprietary biotreatment</td></tr>
<tr><td>3 Volume biotreated in volume based biotreatment BMP (ft^3): 0 ft^3
Form 4.3-6 Item 15 + Form 4.3-7 Item 13</td><td>4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3):
DA-1 = 923.8 ft^3 (0.02 acre-ft)
DA-2 = 41,236.6 ft^3 (0.95 acre-ft)
DA-3 = 89,913.0 ft^3 (2.06 acre-ft)
Item 1 – Item 3</td><td>5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP:
100 %
Item 4 / Item 1</td></tr>
<tr><td colspan="3">6 Flow-based biotreatment BMP capacity provided (cfs): Per TGD, flow rate of 0.135 cfs/impervious acre used to size flow based proprietary biotreatment BMPs.
Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)</td></tr>
<tr><td colspan="3">7 Metrics for MEP determination:
▪ Provided a WQMP with the portion of site area used to suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐
If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.</td></tr>
</table>

Due to onsite and the topography of the project site (hillside development), infiltration based BMPs and volume based biotreatment BMPs were considered, but determined to be infeasible. Therefore, the project proposes the use of flow-based proprietary biotreatment BMPs, consisting of Modular Wetland System (MWS) BMPs, to address storm water pollutants from the project's development areas (DA1-DMA1 & DMA2, DA2-DMA1, DA3-DMA1)

In general, runoff from each DMA will be conveyed as gutter flow prior to discharging to project catch basins and the proposed storm drain system. Runoff is then conveyed to MWS units, in which runoff will first be conveyed through a pre-treatment chamber, where debris, fines, oil and grease and other materials are removed; then conveyed to the biofiltration portion of the BMP, consisting of proprietary filtration media and select vegetation that work together to further remove runoff pollutants via filtration and plant/microbial uptake, prior to discharging to the storm drain system.

MWS proprietary BMPs were selected as the preferred treatment system to ensure that the project's proposed BMPs are effective in addressing the identified pollutants of concern with medium to high removal rates and the ability to incorporate the BMP system into project design, while avoiding the geotechnical concerns associated with infiltration and traditional biotreatment BMPs.

Based on the project's selected flow-based proprietary biotreatment BMP, Forms 4.3-6 and 4.3-7 for volume-based biotreatment BMPs, as well as the design aspects of Form 4.3-8 (intended for swales and strips), are not applicable to the proposed BMPs. Form 4.3-8 has been completed to the extent applicable to the proposed proprietary BMPs. Remaining design information from the MWS units are provided on the following page.

Form 4.3-8 Flow Based Biotreatment (DA 1)			
Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA 1 – DMA 1 & 2 BMP Type Proprietary Biotreatment	DA 2 – DMA 1 BMP Type Proprietary Biotreatment	DA 2 – DMA 1 BMP Type Proprietary Biotreatment
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*	Pathogens, Phosphorous, Nitrogen, Sediment, Trash/Debris, Organic Compounds (Hydrocarbon Based), Metals, Oil and Grease	Pathogens, Phosphorous, Nitrogen, Sediment, Trash/Debris, Organic Compounds (Hydrocarbon Based), Metals, Oil and Grease	Pathogens, Phosphorous, Nitrogen, Sediment, Trash/Debris, Organic Compounds (Hydrocarbon Based), Metals, Oil and Grease
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
4 Manning's roughness coefficient	N/A	N/A	N/A
5 Bottom width (ft) *b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item $2^{1.67}$ * Item $3^{0.5}$)*	N/A	N/A	N/A
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^{2})*	N/A	N/A	N/A
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*	N/A	N/A	N/A
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	N/A	N/A	N/A
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*	N/A	N/A	N/A
11 Water surface area at water quality flow depth (ft^2) *SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10*	N/A	N/A	N/A

Per 5.5.5.2 of the San Bernardino County Technical Guidance Document, the design flow capacity for addressing remaining LID volume has been determined to be 0.135 cfs per impervious acre. The design treatment flow and details of the proposed BMP units are provided in the following table.

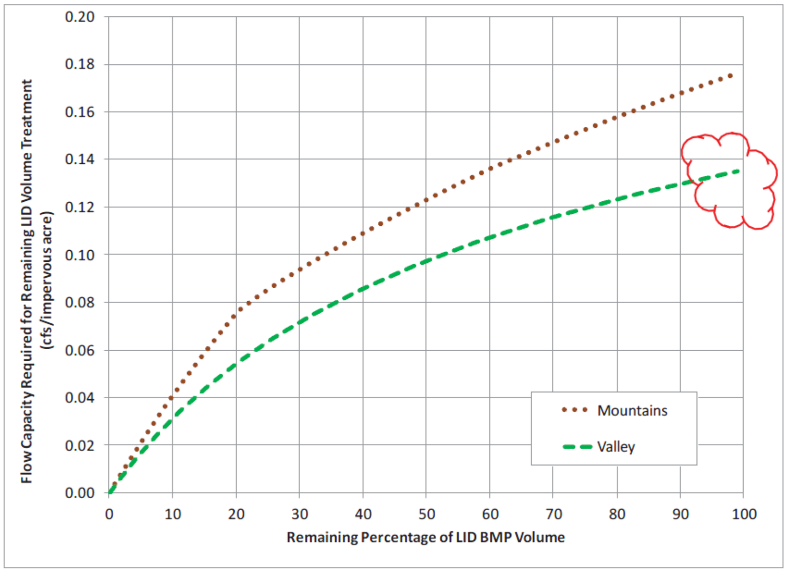


Figure 5-2. Nomograph for Determining Flow-based BMP Capacity Requirement to meet Remaining Unmet DCV

DA-1 & DA-2 DMA Design Summary

DA-DMA	AC	IMP ACRE AT 0.65[(1)]	Q intensity (0.135 cfs/imp acre)	MWS sizing
1-1	0.206	0.134	0.018	4' X 4'
1-2	0.202	0.131	0.018	4' X 4'
2-1	18.21	11.837	1.598	8' X 16' (qty. 3)
3-1	39.7	25.805	3.484	10' X 20' (qty 5)
Total	58.32			

[(1)] 65% IMPERVIOUS AREA USED TO DETERMINE DCV AND Q_{BMP} BASED ON TYPICAL LAND USE VALUES FOR LOW DENSITY RESIDENTIAL (CONSERVATIVE ESTIMATE).

4.3.5 Conformance Summary

Form 4.3-9 demonstrates how the project conforms with onsite LID DCV requirements via the project's proposed measures.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA1, 2 & 3)
1 Total LID DCV for project (ft^3): DA-1 = 923.8 ft^3 (0.02 acre-ft) DA-2 = 41,236.6 ft^3 (0.95 acre-ft) DA-3 = 89,913.0 ft^3 (2.06 acre-ft) *Copy Item 7 in Form 4.2-1*
2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 ft^3 *Copy Item 30 in Form 4.3-2*
3 On-site retention with LID infiltration BMP (ft^3): 0 ft^3 *Copy Item 16 in Form 4.3-3*
4 On-site retention with LID harvest and use BMP (ft^3): 0 ft^3 *Copy Item 9 in Form 4.3-4*
5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 ft^3 *Copy Item 3 in Form 4.3-5*

[6] Flow capacity provided by flow based biotreatment BMP (cfs): **0.135 cfs per impervious acre (See DA-1 DA-2 & DA-3 DMA Design Summary above)** *Copy Item 6 in Form 4.3-5*
[7] LID BMP performance criteria area achieved if answer to any of the following is "Yes": ▪ Full retention of LID DCV with site design HSC, infiltration or harvest and use BMP: Yes ☐ No ☒ *If yes, sum of Items 2, 3 and 4 is greater than Item 1* ▪ Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for remaining LID DCV: Yes ☐ No ☒ *If yes, a) sum of Items 2, 3, 4 and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3-5 Item 6 and Items 2, 3 and 4 are maximized* ▪ On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☒ No ☐ *If yes, Form 4.3-1 Items 7 and 8 were both checked yes*
[8] If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance: ▪ Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐ *Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 1, 2, 3, 4 and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance,* V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 – Form 2.4-1 Item 2)%* ▪ An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed at an off-site facility: ☐ *Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed*

4.3.6 Hydromodification Control BMP

Per Figure F-1 of the WQMP TGD and http://permitrack.sbcounty.gov/wap/, the project does have the potential to cause or contribute to an HCOC in a downstream Channel.

See the project's hydrology report (specifically 2-year pre- and post-construction results) in regards to hydromodification determination and mitigation.

Form 4.3-10 Hydromodification Control BMPs (DA 1, 2 & 3)	
1 Volume reduction needed for HCOC performance criteria (ft^3): *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐
  BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐
  BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

4.4 Alternative Compliance Plan (if applicable)

The project is able to meet onsite treatment of the DCV via onsite proprietary biotreatment BMPs. Therefore, an alternative compliance plan is not applicable to this project.

Section 5 Inspection and Maintenance Responsibility for Post Construction BMPs

All BMPs included as part of this WQMP are required to be maintained through regular scheduled inspection and maintenance. Form 5-1 summarizes all of the BMPs included in the WQMP as well as their respective inspection and maintenance activities and frequencies. An Operation and Maintenance Plan is provided in Section 6.3.

Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies.

Form 5-1 BMP Inspection and Maintenance			
BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
Non-Structural Source Control BMPs			
N1 Education of Property Owners, Tenants and Occupants on Stormwater BMPs	HOA	HOA will insure that all owners & tenants will be given a copy of the recorded CC&R's which will contain a section outlining the environmental awareness education materials at the close of escrow. HOA shall distribute appropriate materials to owners, tenants and/or occupants via contract language, mailings, website or meeting. Materials can be downloaded from http://www.sbcountystormwater.org.	Information to be initially provided to owners & tenants upon sale or lease agreement. Educational materials will be provided to owners and/or tenants annually, thereafter.
N2 Activity Restrictions	HOA	Within the CC&R's or lease agreement, the following activity restrictions shall be enforced: Proper disposal of hazardous materials, requirements on vehicle washing, household material use and storage, pet waste and littering.	Continuous
N3 Common Area Landscape Management	HOA	Landscape Management Includes: • Mitigation of the potential dangers of fertilizer and pesticide usage through the incorporation of an Integrated Pest Management Program (IPM). • Monitor for runoff and efficiency regularly. • Implementation of a water budget. • Irrigation systems shall be automatically controlled and designed, installed, and maintained so as to minimize overspray and runoff onto streets, sidewalks, driveways, structures, windows, walls, and fences. • Use of native and drought tolerant species when replanting. • Inspect for signs of erosion, vegetation health and mulch depth. • Repair/replant bare areas.	Inspected once a month or with scheduled landscaping service.

Form 5-1 BMP Inspection and Maintenance			
BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
N4 BMP Maintenance	HOA	HOA shall inspect/maintain project BMPs per table herein. Retain all records for a minimum 5 years after generation.	BMPs maintained per specified BMP.
N11 Common Area Litter Control	HOA	Weekly sweeping and trash pickup as necessary within all project areas and common landscape areas. Daily inspection of trash receptacles to ensure that lids are closed and pick up any excess trash on the ground, noting trash disposal violations by homeowners, proper disposal of pet, green and household wastes, and reporting the violations to the HOA.	Daily inspection and bi-weekly sweeping and clean-up or as needed
N14 Common Area Catch Basin Inspection	HOA	The project's catch basins, slope drains, common area drainage system (park) and main storm drain system shall be private, owned, inspected and maintained by the HOA. All facilities shall be inspected and maintained as needed to ensure adequate capacity and flow.	At a minimum, 80% of all facilities shall be inspected annually, with 100% of all facilities inspected within a 2-year period.
N15 Street Sweeping Private Streets and Parking Lots	HOA	Vacuum street sweeping will occur on a regular basis, prior to the rainy season, and on an as needed basis by contractors of the HOA.	Once every 2 weeks and as needed.
Structural Source Control BMPs			
S1 Provide storm drain system stenciling and signage (CASQA New Development BMP Handbook SD-13)	HOA	All catch basins where applicable in paved areas, will be marked or stenciled with "No Dumping - Drains to River, No Descargue Basura" or similar language. This will be done in a location that can be clearly seen by all and will be routinely inspected and re-labeled, as necessary. Thereafter, the HOA shall routinely inspect and re-label the catch basins, as necessary.	Catch basin labels will be inspected once annually and relabeled as necessary to maintain legibility.
S4 Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Stateside Model Landscape Ordinance: CASQA New Development BMP Handbook SD-12)	HOA	Minimize timing and application methods for watering project landscaping in common areas to limit amount of non-storm water discharge. Inspect irrigation system with landscaping maintenance to ensure timers, shut off valves and other automatic irrigation devices are functioning adequately. Inspect system for broken parts and replace as needed to prevent leaks. BMP shall be implemented by the HOA, through the landscape maintenance contractor.	Monthly with landscaping maintenance activities.

Form 5-1 BMP Inspection and Maintenance

BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
S5 Finish grade of landscaped areas at a minimum of 1-2" below top of curb, sidewalk or pavement	HOA	Maintain vegetation height to ensure area has ponding capacity. Inspect area for standing water, saturated soil or other nuisance conditions. Repair as needed.	Monthly with landscaping maintenance activities and after irrigation or storm events.
S6 Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	HOA	Use native/drought tolerant vegetation onsite to limit water use to ensure plant viability to dry climates and good plant establishment. Group vegetation with similar water requirements. Replace dead/dying vegetation with same grouping as planting area. Repair rills and other signs of erosion as soon as possible. HOA shall ensure proper implementation by its contractors.	Monthly with landscaping maintenance activities.
S13 Hillside landscaping (CASQA New Development BMP Handbook SD-10)	HOA	Use native/drought tolerant vegetation onsite to limit water use to ensure plant viability to dry climates and good plant establishment. Group vegetation with similar water requirements. Replace dead/dying vegetation with same grouping as planting area. Repair rills and other signs of erosion as soon as possible. HOA shall ensure proper implementation by its contractors.	Monthly with landscaping maintenance activities.
Biotreatment BMPs			
Proprietary Biotreatment (Modular Wetland System)	HOA	Inspect unit for accumulated debris and sediment and plant health	1st Year Operation – Monthly during rainy season, bi-monthly during dry season. After 1st Year – Every 6 – 12 months based on inspection findings.
		Trim vegetation (See Hardy Zone 9 plantings per manufacturer's recommendation in Section 6.3a)	Monthly with landscaping activities.
		Remove trash from screening device and separation chamber Remove sediment from pre-chamber, replace pre-filter cartridge media and drain down filter media.	Perform maintenance per inspection findings.
		Replace wetland media	20 years, or as needed based on inspection results.

<table>
<tr><th colspan="4">Form 5-1 BMP Inspection and Maintenance</th></tr>
<tr><th>BMP</th><th>Responsible Party(s)</th><th>Inspection / Maintenance Activities Required</th><th>Minimum Frequency of Activities</th></tr>
<tr><td colspan="4">Detention/Debris Basin BMPs</td></tr>
<tr><td rowspan="3">Detention/Debris Basin</td><td rowspan="3">HOA</td><td>Inspect for standing water or saturated conditions that lasts for more than 72 hours. Inspect for vegetation growth and health, presence of burrows, sediment, debris, obstructions and signs of erosion. Inspect for basin capacity.</td><td>1st Year Operation – Monthly during rainy season and after storm event of 0.5” and greater.
After 1st Year – Semi-annual inspections prior to rainy season and after rainy season. After storm event of 0.5” and greater.</td></tr>
<tr><td>Replace plantings as needed, remove trash and repair as needed. Trim vegetation to prevent establishment of woody and other non-desired vegetation</td><td>At beginning and end of wet season.</td></tr>
<tr><td>Remove accumulated sediment and debris when accumulation level exceeds 10% of basin volume.</td><td>Per inspection findings.</td></tr>
</table>

Section 6 WQMP Attachments

6.1 Site Plan and Drainage Plan

The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well. Exhibits provided include the following:

- WQMP Vicinity Map
- WQMP Site Plan

6.2 Electronic Data Submittal

In addition to hard copies, the WQMP shall also be provided, at minimum, in PDF format.

6.3 Post Construction

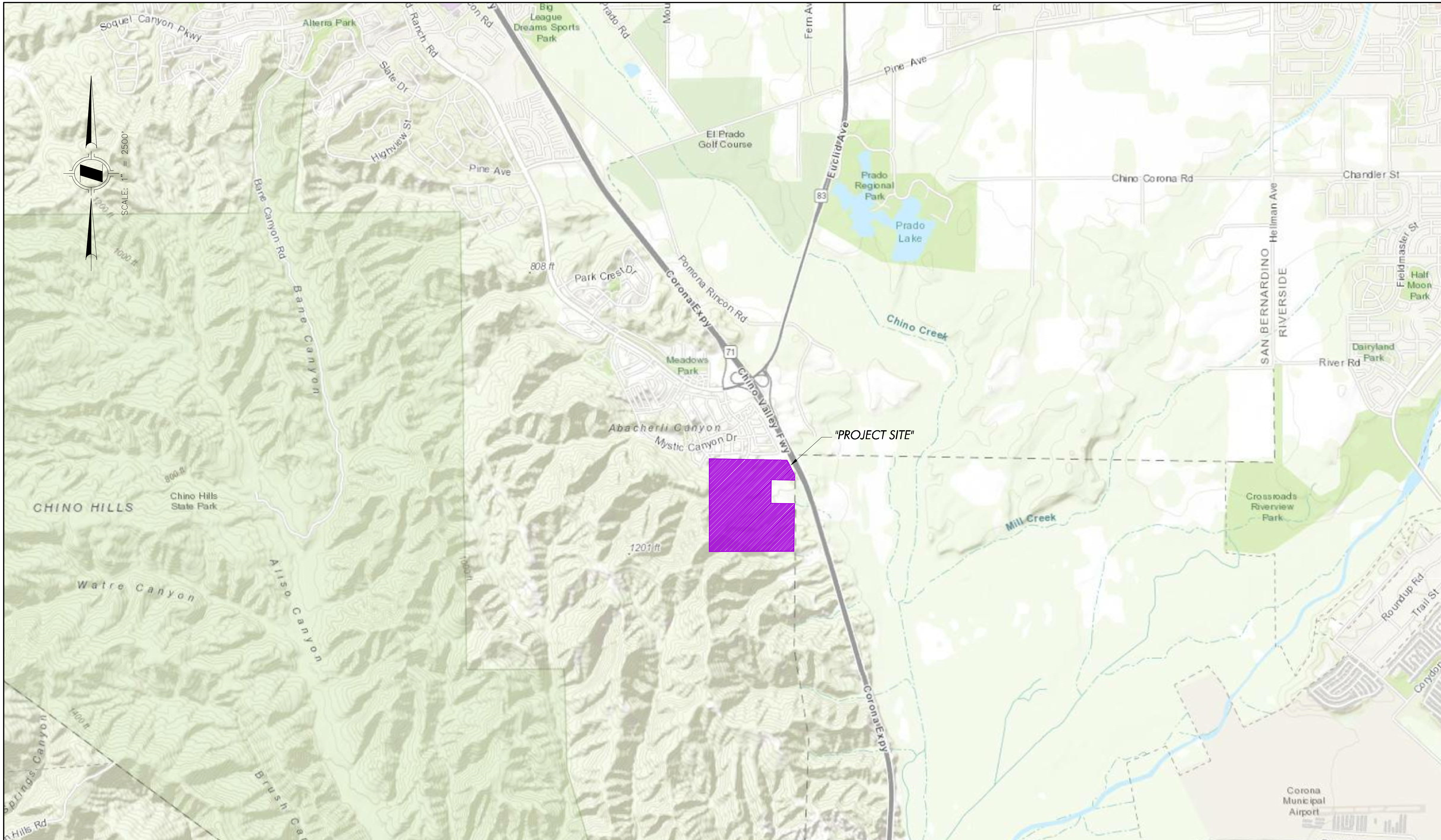
An Operation and Maintenance Plan has been provided as Form 5-1 of this WQMP. The manual includes maintenance guidelines and responsible parties for all BMPs proposed for this project, including the project's LID BMPs and detention/debris basins. A BMP Maintenance Agreement will be provided as an attachment upon approval of the Final WQMP.

6.4 Other Supporting Documentation

The following items are also provided in this WQMP:

- Educational Materials (in Final WQMP)
- Covenants, Conditions and Restrictions (in Final WQMP)
- Permitrack WAP Supporting Information
- Project Hydrology Study (Separate Cover)
- MWS Details
- Project Geotechnical Investigation (Separate Cover)

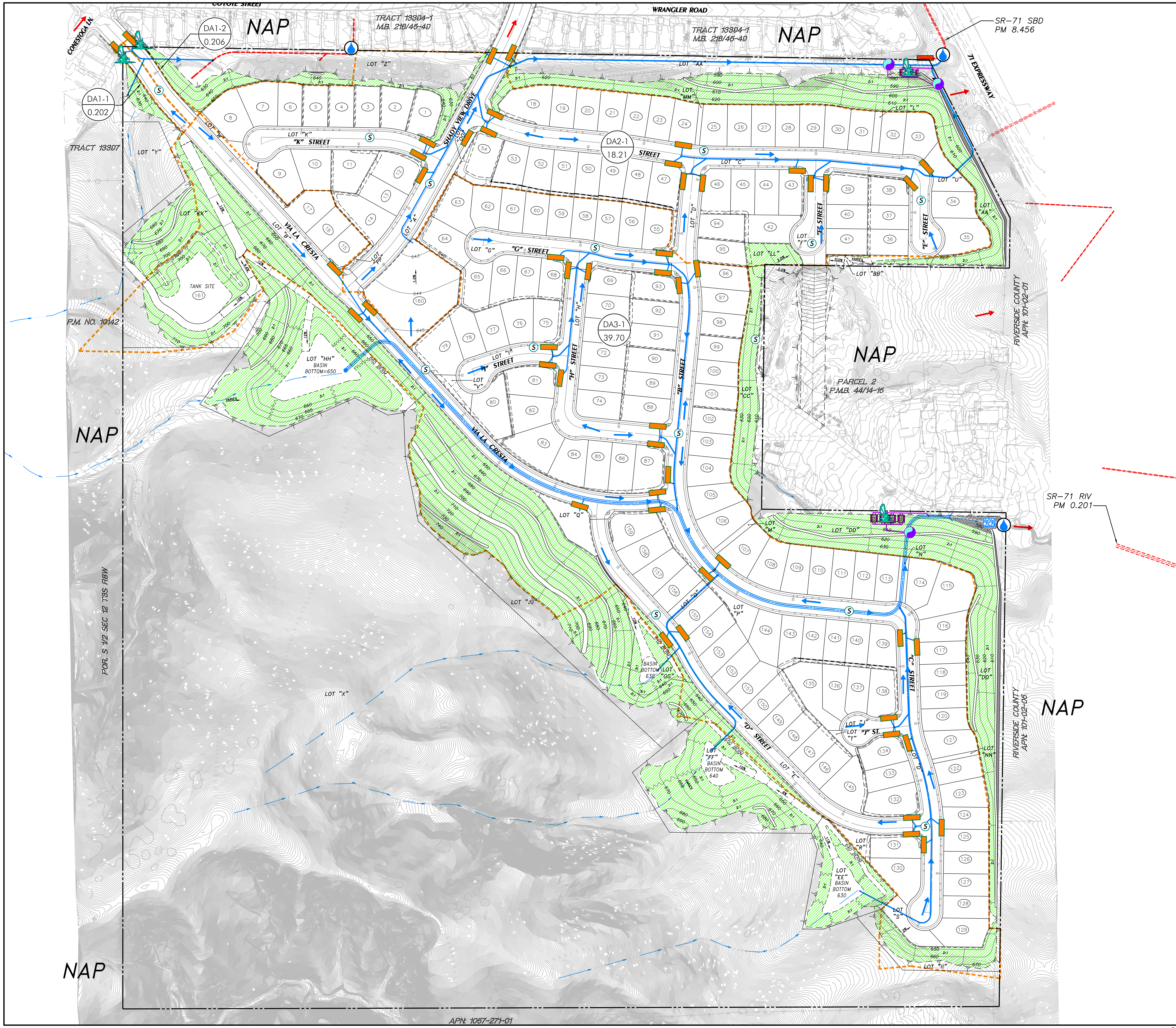
WQMP Vicinity Map



DRAWN BY: TIH DATE: 10/28/2019 W.O.: 3593-38	PREPARED BY: HUNSAKER & ASSOCIATES IRVINE, INC. PLANNING ■ ENGINEERING ■ SURVEYING Three Hughes, Irvine, CA 92618 ■ PH: (949) 583-1010 ■ FX: (949) 583-0759	PREPARED FOR: TRUMARK HOMES 450 NEWPORT CENTER DRIVE, SUITE 300 NEWPORT BEACH, CA 92660 (949) 999-9820	TRACT MAP NO. 20317 SOUTH OF SHADY VIEW DRIVE & WRANGLER ROAD CITY OF CHINO HILLS COUNTY OF SAN BERNARDINO, CA	PRELIMINARY WQMP VICINITY MAP

PLOTTED BY: Tommy Hsu DATE: Oct. 28, 2019 02:44:54 PM FILE: F:\1062\Planning\SY_WQ\WQMP\Exhibits\PWQMP_VIC ShadyView.dwg

WQMP Site Plan



LEGEND

- TRACT BOUNDARY
- NAP — NOT A PART
- DRAINAGE MANAGEMENT AREA BOUNDARY
- DA#-# ACRE — DISCHARGE AREA – DRAINAGE MANAGEMENT AREA DESIGNATION AND ACREAGE
- EXISTING STORM DRAIN SYSTEM
- PROPOSED STORM DRAIN SYSTEM (PRIVATE) MAINTAINED BY HOA
- PROPOSED LOW FLOW & WQ STORM DRAIN SYSTEM (PRIVATE) MAINTAINED BY HOA
- FLOW DIRECTION (ONSITE)
- FLOW DIRECTION (OFFSITE)
- PROJECT LANDSCAPING AREA WITH BMPS: N3 COMMON AREA LANDSCAPE MANAGEMENT S6 PROTECT SLOPES S13 HILLSIDE LANDSCAPING HOA MAINTAINED
- S — N15 STREET SWEEPING PRIVATE STREETS
- EXISTING CATCH BASIN (PUBLIC)
- PROJECT CATCH BASIN WITH BMPS: S1 (SD-13) STORM DRAIN STENCILING N14 CATCH BASIN INSPECTION MAINTAINED BY HOA
- PROPRIETARY BIOFILTRATION MODULAR WETLAND SYSTEM HOA MAINTAINED
- LOW FLOW & WQ DIVERSION STRUCTURE HOA MAINTAINED
- PROJECT DISCHARGE POINT/ POINT OF COMPLIANCE
- ENERGY DISSIPATER

DA-DMA SUMMARY

DA-DMA	AC	IMP ACRE AT 0.65(1)	Q intensity (0.135 cfs/imp acre)	MWS sizing
1-1	0.206	0.134	0.018	4' X 4'
1-2	0.202	0.131	0.018	4' X 4'
2-1	18.21	11.837	1.598	8' X 16' (qty. 3)
3-1	39.7	25.805	3.484	10' X 20' (qty 5)
Total	58.318			

65% IMPERVIOUS AREA USED TO DETERMINE DCV AND Q_{BMP} BASED ON TYPICAL LAND USE VALUES FOR MEDIUM DENSITY RESIDENTIAL (CONSERVATIVE ESTIMATE).

N

GRAPHIC SCALE
0 60 120 240
(IN FEET)
1 INCH = 120 FT.

PRELIMINARY
WATER QUALITY MANAGEMENT PLAN - SITE PLAN

APPLICANT:

450 NEWPORT CENTER DRIVE, SUITE 300
NEWPORT BEACH, CA 92660
(949) 999-9820

PREPARED BY:

HUNSAKER & ASSOCIATES
I R V I N E , I N C .
PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes • Irvine, CA 92618 • PH: (949) 583-1010 • FX: (949) 583-0759

TENTATIVE TRACT MAP NO. 20317
SOUTH OF SHADY VIEW DRIVE AND WRANGLER ROAD
CITY OF CHINO HILLS
SAN BERNARDINO COUNTY, CA

DRAFTED BY: TJH	DATE: 03/25/2020	W.O. NO: 3593-38	SHEET NO: 1 OF 1

DATE: Mar. 26, 2020 10:57:24 AM FILE: F:\1062\Planning\SY_WQ\WQMP\Exhibits\PWQMP SP_ShadyView.dwg

WQMP and Stormwater Best Management Practices Transfer, Access and Maintenance Agreement

(To be provided after final WQMP approval)

Educational Materials

(Provided in Final WQMP)

BMPs for Homeowner's Associations, Property managers and Property Owners
A Safe Garden
Hazardous Waste Centers
Household Hazardous Waste Collection Centers
Landscape Maintenance
Cooking Oil Recycling
Pool Discharge Tips
Carwash Tips
Pick Up After Your Pet
Home Painting
Concrete Use

Covenants, Conditions and Restrictions

(Provided in Final WQMP)

Permitrack WAP Supporting Information

WQMP Project Report

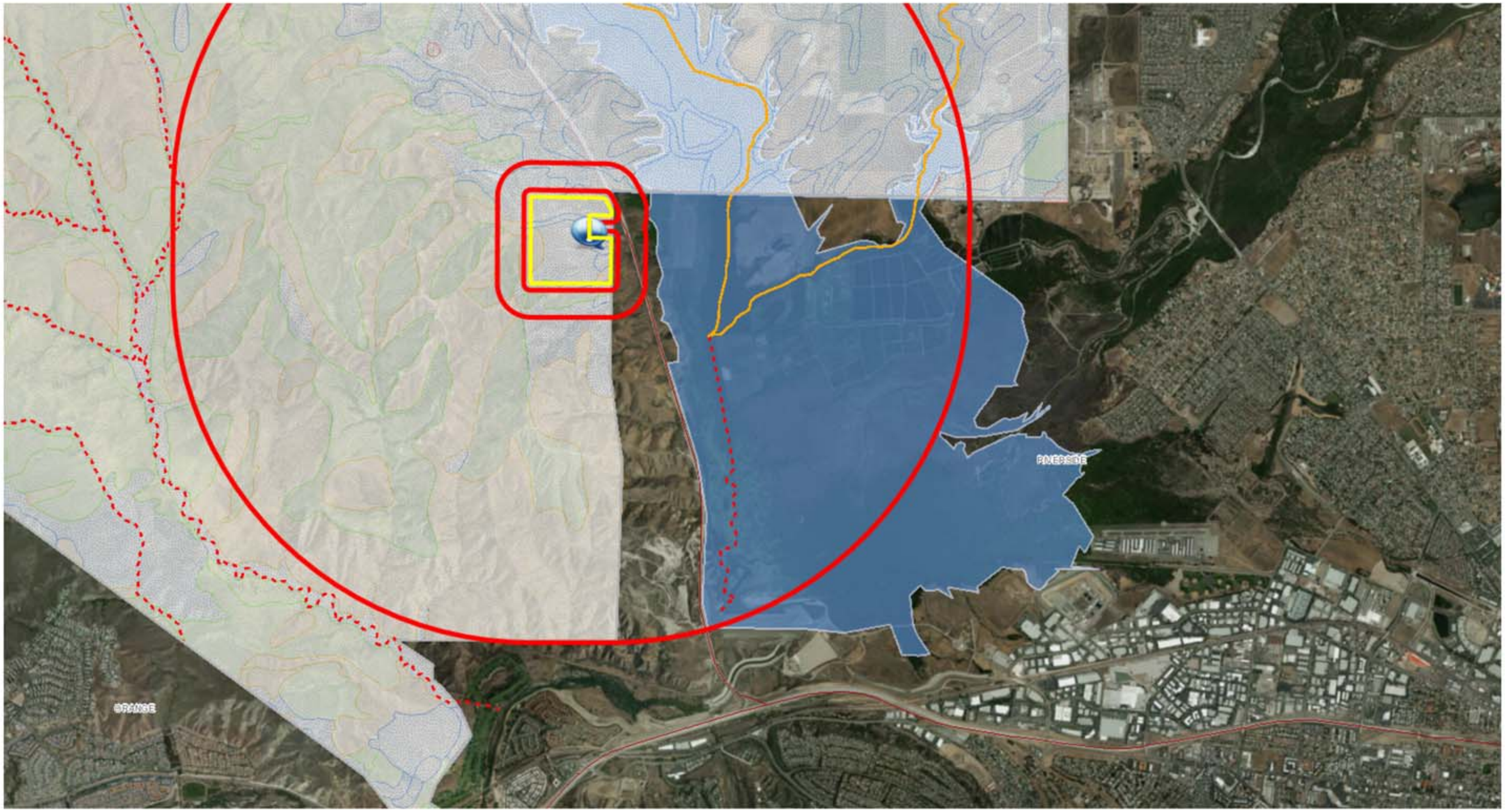
County of San Bernardino Stormwater Program

Santa Ana River Watershed Geodatabase

Monday, November 04, 2019

Note: The information provided in this report and on the Stormwater Geodatabase for the County of San Bernardino Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

Project Site Parcel Number(s):	105726106
Project Site Acreage:	127.18
HCOC Exempt Area:	No
Closest Receiving Waters: **(Applicant to verify based on local drainage facilities and topography.)**	**System Number** - 101 **Facility Name** - San Antonio Channel **Owner** - SBCFCD
Closest channel segment's susceptibility to Hydromodification:	M
Highest downstream hydromodification susceptibility:	High
Is this drainage segment subject to TMDLs?	Yes
Are there downstream drainage segments subject to TMDLs?	Yes
Is this drainage segment a 303d listed stream?	Yes
Are there 303d listed streams downstream?	Yes
Are there unlined downstream waterbodies?	Yes
Project Site Onsite Soil Group(s):	B, C, D
Environmentally Sensitive Areas within 200':	LEAST BELL'S VIREO,Coastal Sage Scrub
Groundwater Depth (FT):	No data available
Parcels with potential septic tanks within 1000':	Yes
Known Groundwater Contamination Plumes within 1000':	No
Studies and Reports Related to Project Site:	CSDP Project No. 1 CSDP 1 Comprehensive Storm Drain CSDP Drainage Study Calculations Tech Memo No.4 CCMP West San Bernardino SD Master Plan (Proof)



1 Miles

RBF CONSULTING GIS

Site Address: permitrack.sbcounty.gov/wap

County of San Bernardino
Stormwater Facility Mapping
TTM 20317

Hydrology Study

(Under Separate Cover)

LEGEND

MAJOR DRAINAGE BOUNDARY
MINOR DRAINAGE BOUNDARY
NODE NUMBER
AREA DESIGNATION
AREA ACREAGE (IN ACRES)
PEAK FLOW RATE
TIME OF CONCENTRATION
PEAK CONFLUENCE FLOW RATE
TIME OF CONCENTRATION
EXISTING STORM DRAIN
SOIL GROUP

PREPARED FOR:

TRUMARK HOMES
450 NEWPORT CENTER DRIVE, SUITE 300
NEWPORT BEACH, CA 92660
PHONE: (949)999-9820

PREPARED BY:

HUNSAKER & ASSOCIATES
IRVINE, INC.
PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes ▪ Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759

EXISTING CONDITION
HYDROLOGY MAP
VTTM 20317
CITY OF CHINO HILLS
SAN BERNARDINO COUNTY

WO: 3593-38X
HYDROLOGY MAP FOR SHADY VIEW PROJECT

PLOTTED BY: Gary Guan DATE: Mar. 24, 2020 TIME: 06:15 PM F:\1062\Engineering\SY_Hydrology\Existing Hydrology Study.dwg

LEGEND

	MAJOR DRAINAGE BOUNDARY
	MINOR DRAINAGE BOUNDARY
100	NODE NUMBER
A1 / 1.0	AREA DESIGNATION AREA ACREAGE (IN ACRES)
Q_{100}=8.0cfs t=15.0	PEAK FLOW RATE TIME OF CONCENTRATION
	PROPOSED STORM DRAIN
ΣQ_{100}=10.0cfs t=15.0	PEAK CONFLUENCE FLOW RATE TIME OF CONCENTRATION
	EXISTING STORM DRAIN
B	SOIL GROUP

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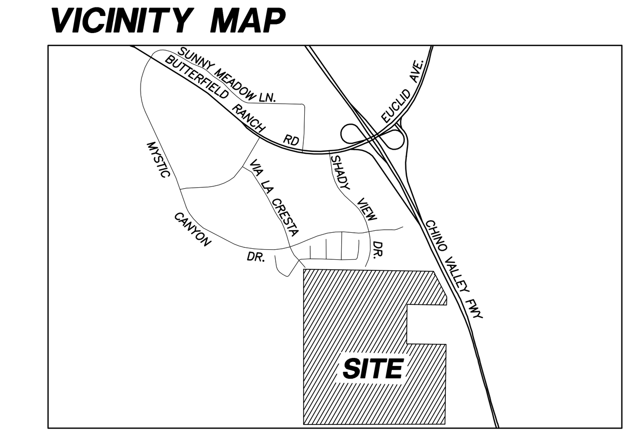
1"=120'

120 60 0 120 240
GRAPHIC SCALE: 1"=120'

VICINITY MAP



PROPOSED CONDITION HYDROLOGY MAP VTTM 20317

CITY OF CHINO HILLS SAN BERNARDINO COUNTY

WO: 3593-38X
HYDROLOGY MAP FOR SHADY VIEW PROJECT

PLOTTED BY: Gary Guan DATE: Mar. 27, 2020 TIME: 08:20 AM F:\1062\Engineering\SY_Hydrology\Proposed Hydrology – Tract 20317.dwg

Proprietary Biotreatment – Modular Wetland System

MODULAR WETLANDS™

*Advanced **Stormwater** Biofiltration*

MWS Linear

Contents

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 our cities grow and develop, these natural wetlands have perished under countless roads, rooftops, and parking lots.

Plant A Wetland

Without natural wetlands our cities are deprived of water purification, flood control, and land stability. Modular Wetlands and the MWS Linear re-establish nature's presence and rejuvenate water ways in urban areas.

MWS Linear

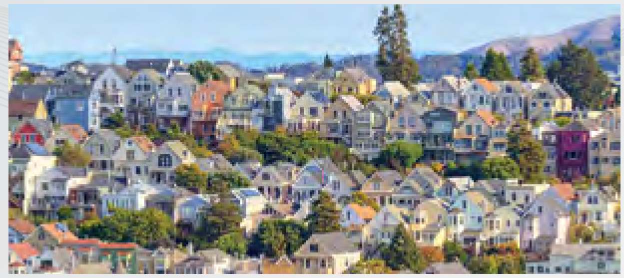
The Modular Wetland System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint and higher treatment capacity. While most biofilters use little or no pre-treatment, the MWS Linear incorporates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

Applications

The MWS 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 MWS Linear 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 MWS Linear. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.

Streets

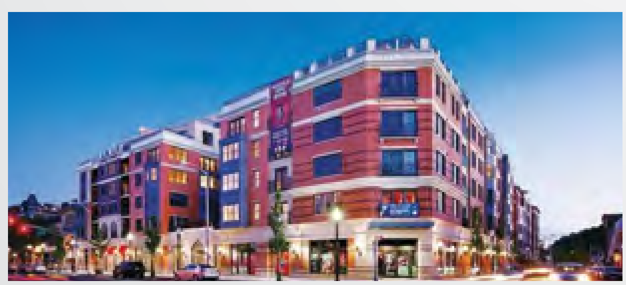
Street applications can be challenging due to limited space. The MWS Linear is very adaptable, and offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

Parking Lots

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

Commercial

Compared to bioretention systems, the MWS Linear can treat far more area in less space - meeting treatment and volume control requirements.



Mixed Use

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

More applications are available on our website: www.ModularWetlands.com/Applications

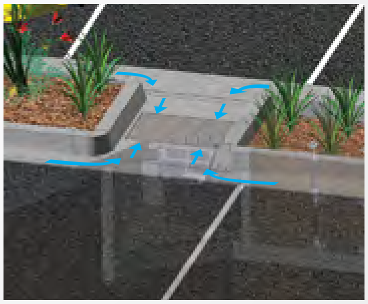
- Agriculture
- Reuse
- Low Impact Development
- Waste Water


Configurations

The MWS 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 stormdrain design.

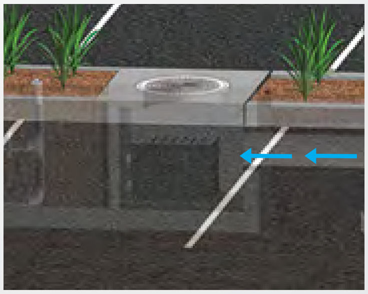
Curb Type

The *Curb Type* configuration accepts sheet flow through a curb opening and is commonly used along road ways 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 pre-treatment chamber. It has the added benefit of allowing for 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 pre-treatment chamber, meaning the MWS Linear 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 roof top 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.

Advantages & Operation

The MWS Linear is the most efficient and versatile biofiltration system on the market, and the only system with horizontal flow which improves performance, reduces footprint, and minimizes maintenance. Figure-1 and Figure-2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

Featured Advantages

- Horizontal Flow Biofiltration
- Greater Filter Surface Area
- Pre-Treatment Chamber
- Patented Perimeter Void Area
- Flow Control
- No Depressed Planter Area

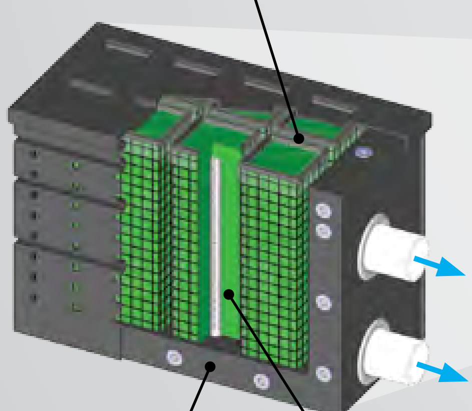
1 Pre-Treatment

Separation

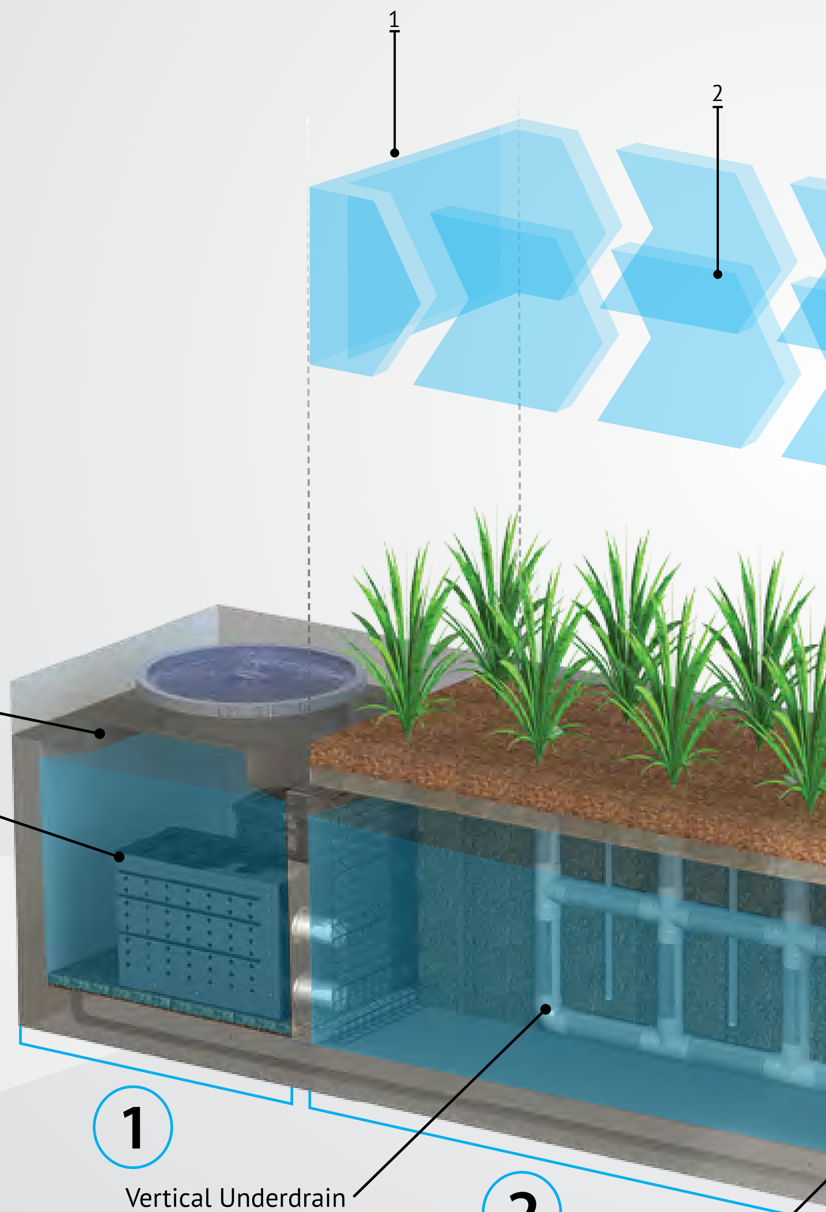
- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

Pre-Filter Cartridges

- Over 25 ft^2 of surface area per cartridge
- Utilizes BioMediaGREEN filter material
- Removes over 80% of TSS & 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber



BioMediaGREEN



Wetland MEDIA™

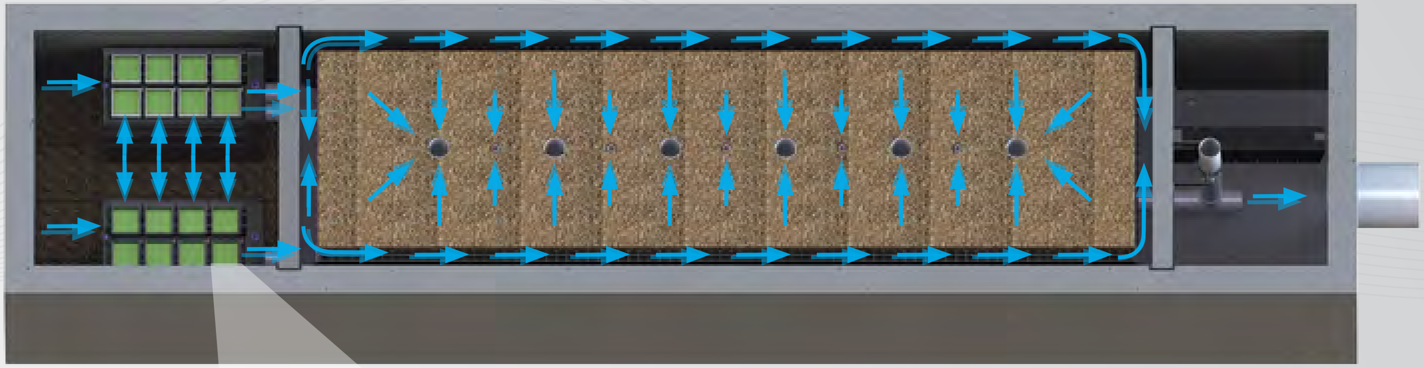


Fig. 2 - Top View

2x to 3x More Surface Area Than Traditional Downward Flow Bioretention Systems.

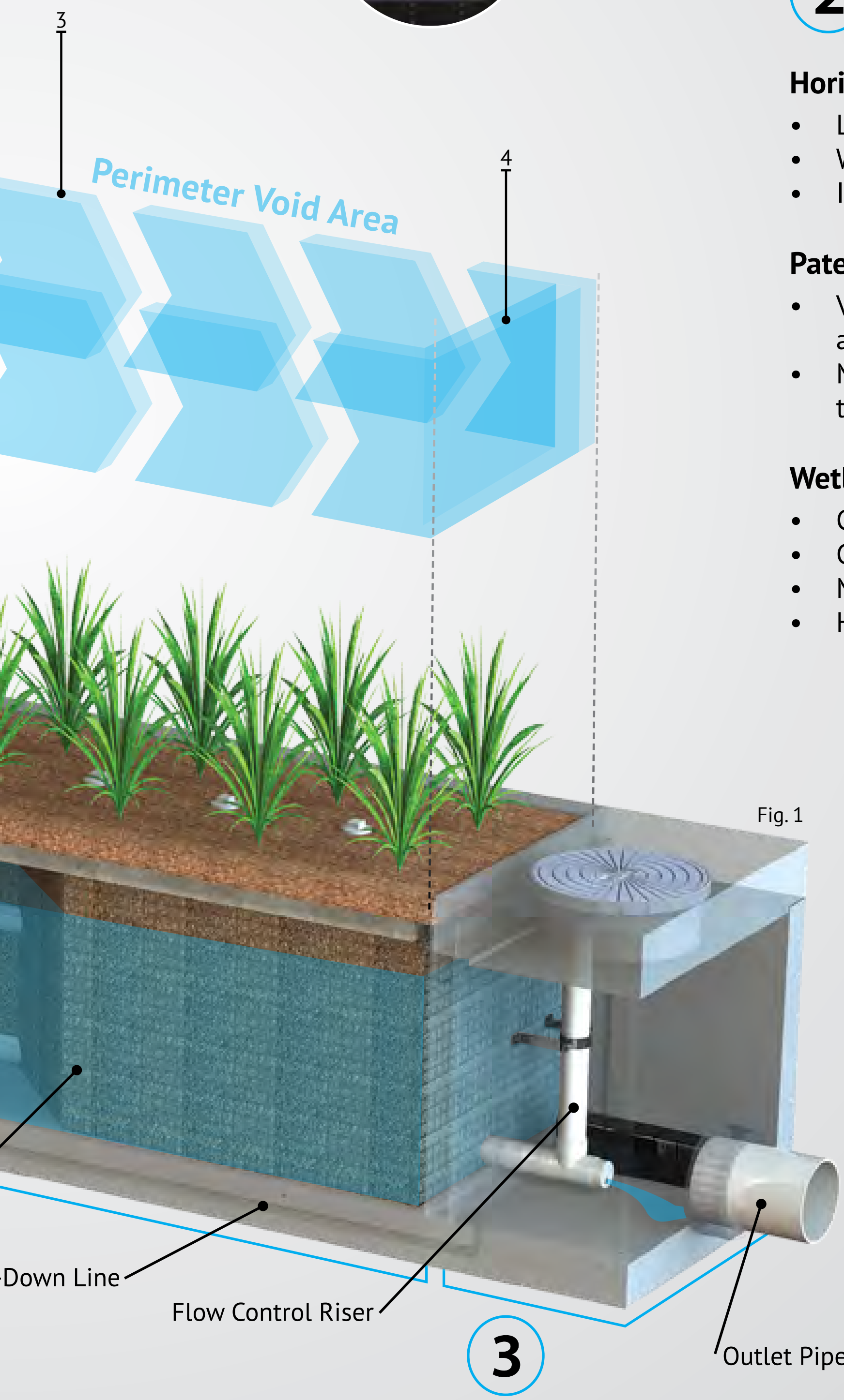


Fig. 1

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 light weight

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

Drain-Down Filter

- The Drain-Down is an optional feature that completely drains the pre-treatment chamber
- Water that drains from the pre-treatment chamber between storm events will be treated

Orientations

Side-By-Side

The *Side-By-Side* orientation places the pre-treatment 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 pre-treatment 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 bypass must be external.

Bypass

Internal Bypass Weir (Side-by-Side Only)

The *Side-By-Side* orientation places the pre-treatment 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 pre-treatment chamber directly to the discharge chamber.

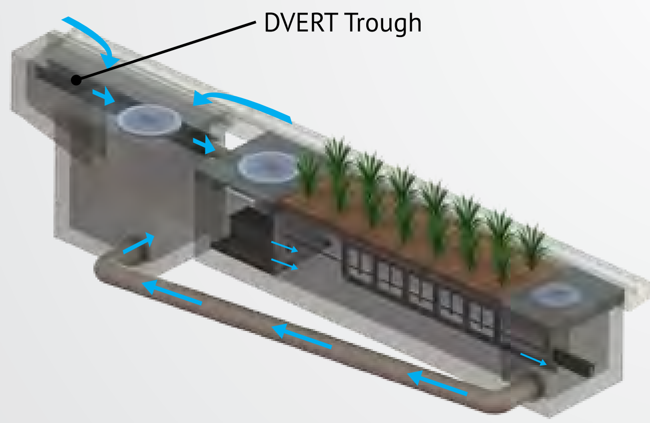
External Diversion Weir Structure

This traditional offline diversion method can be used with the MWS Linear 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 MWS Linear 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 MWS Linear 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 MWS Linear 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 allows the MWS Linear to be installed anywhere space is available.

Performance

The MWS Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons and bacteria. Since 2007 the MWS Linear has been field tested on numerous sites across the country. With it's advanced pre-treatment chamber and innovative horizontal flow biofilter, the system is able to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. With the same biological processes found in natural wetlands, the MWS Linear harnesses natures ability to process, transform, and remove even the most harmful pollutants.

Approvals

The MWS 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.

WA

Washington State DOE 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.

TSS	Total Phosphorus	Ortho Phosphorus	Nitrogen	Dissolved Zinc	Dissolved Copper	Total Zinc	Total Copper	Motor Oil
85%	64%	67%	45%	66%	38%	69%	50%	95%

VA

DEQ 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) Technical Criteria.

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 DEM Approved

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% Pathogens, 30% Total Phosphorus for discharges to freshwater systems, and 30% Total Nitrogen for discharges to saltwater or tidal systems.

Flow Based Sizing

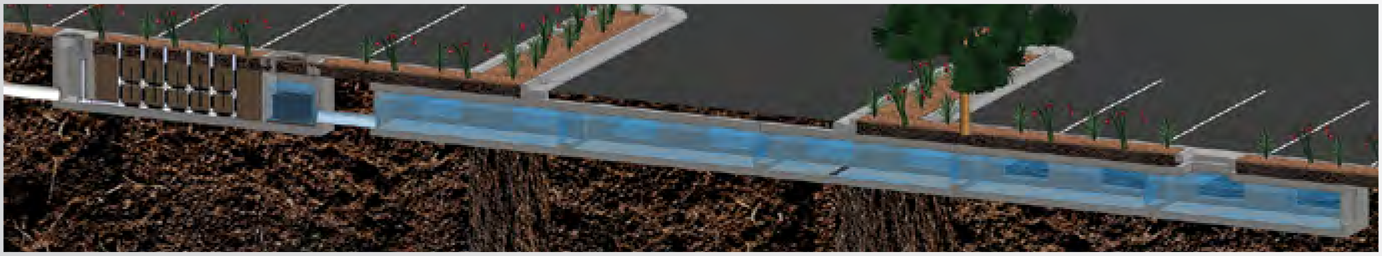
The MWS Linear can be used in stand alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface it can be used not only in decentralized design applications but also as a large central end-of-the-line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

Treatment Flow Sizing Table

Model #	Dimensions	WetlandMedia Surface Area	Treatment Flow Rate (cfs)
MWS-L-4-4	4’ x 4’	23 ft^2	0.052
MWS-L-4-6	4’ x 6’	32 ft^2	0.073
MWS-L-4-8	4’ x 8’	50 ft^2	0.115
MWS-L-4-13	4’ x 13’	63 ft^2	0.144
MWS-L-4-15	4’ x 15’	76 ft^2	0.175
MWS-L-4-17	4’ x 17’	90 ft^2	0.206
MWS-L-4-19	4’ x 19’	103 ft^2	0.237
MWS-L-4-21	4’ x 21’	117 ft^2	0.268
MWS-L-8-8	8’ x 8’	100 ft^2	0.230
MWS-L-8-12	8’ x 12’	151 ft^2	0.346
MWS-L-8-16	8’ x 16’	201 ft^2	0.462

Volume Based Sizing

Many states require treatment of a water quality volume and do not offer the option of flow based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume based design installed downstream of ponds, detention basins, and underground storage systems.



Treatment Volume Sizing Table

Model #	Treatment Capacity (cu. ft.) @ 24-Hour Drain Down	Treatment Capacity (cu. ft.) @ 48-Hour Drain Down
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145

Installation

The MWS Linear 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 pre-cast 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 are available to supervise installations and provide technical support.

Maintenance

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

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pre-treatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pre-treatment 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.

Plant Selection

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the MWS 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 MWS Linear, giving the plants more "contact time" so that pollutants are more successfully decomposed, volatilized and incorporated into the biomass of The MWS Linear's micro/macro flora and fauna.

A wide range of plants are suitable for use in the MWS Linear, but selections vary by location and climate. View suitable plants by selecting the list relative to your project location's hardy zone.

Please visit www.ModularWetlands.com/Plants for more information and various plant lists.

MWS-LINEAR 2.0 STORMWATER FILTRATION SYSTEM

NATURE AND TECHNOLOGY WORKING TOGETHER IN PERFECT HARMONY.

The need for a new stormwater treatment system is evident. Federal and state requirements on cities and industry to reduce stormwater runoff increase every year as our population explodes. The EPA is now reporting that stormwater runoff represents the nation's number one water quality problem, and is the reason why nearly half of our rivers and lakes are not even clean enough to support fishing or swimming. ***Nearly half.***

MODULAR WETLANDS

To combat this catastrophe, we turned to the expert in this field: **Nature.** By developing technology that imitates the processes found in nature, we've created the most advanced stormwater filtration system available. Years ahead of current EPA requirements, our clients understand that when they invest in our new technology, they are investing in the future. For all of us.

GRATE TYPE

CURB TYPE

MWS–LINEAR TESTED REMOVAL EFFICIENCIES

TSS	Nitrate	Copper	Zinc	Oils & Grease	Bacteria	Turbidity
82% - 98%	74%	>53% - 93%	79% - 81%	84% - 99%	60% - 89%	>90%

Washington State DOE Approved

SIZING

Model #	Dimensions (ft)	WetlandMedia Surface Area (sq ft)	Treatment Flow Rate (cfs)
MWS-L-3-6	3 x 6	34	0.076
MWS-L-4-8	4 x 8	50	0.116
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	0.236
MWS-L-4-21	4 x 21	117	0.267

VOLUME SIZING

The Modular Wetland System is the only biofilter that can be installed downstream of detention systems.

T 760.433.7640 E info@modularwetlands.com www.modularwetlands.com

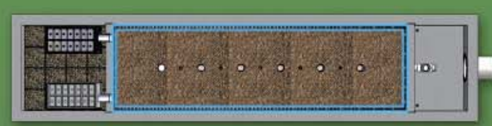
SYSTEM OPERATIONS

Pre-Filter Cartridge

35 sq ft surface area per cartridge ensures higher effectiveness and lower maintenance requirements.

This pre-filter eliminates maintenance in the Wetland Chamber.

TOP VIEW



Perimeter Wetland Chamber

Pre-filtered runoff entering the wetland chamber flows into a peripheral void area, maximizing the media surface area.

Over 2x to 3x more surface area than traditional downward flow bioretention systems.

INTERNAL HIGH FLOW BYPASS CONFIGURATION AVAILABLE

FEATURES

1 **PRE-TREATMENT CHAMBER**
Captures incoming runoff and contains the first three stages of treatment.

2 **GRATE TYPE CATCH BASIN INLET**
A standard 41" x 24" grate type traffic rated catch basin opening directs stormwater into the system.

3 **CATCH BASIN INSERT FILTER**
Provides the first stage of treatment by capturing trash & litter, gross solids, and sediment.

4 **SETTLING CHAMBER**
Provides the second stage of treatment by separating out larger suspended solids.

5 **PRE-FILTER CARTRIDGE**
Provides the third stage of treatment by physically and chemically capturing fine TSS, metals, nutrients, and bacteria.

6 **WETLAND CHAMBER**
Provides the final stage of treatment through a combination of physical, chemical and biological processes.

7 **DISCHARGE CHAMBER**
Contains flow control, high flow bypass and optional drain down filter.

8 **MULTI-LEVEL FLOW CONTROL**
Orifice plates and/or valves are used to control the flow through the treatment stages.

MODULAR WETLANDS

T 760.433.7640 E info@modularwetlands.com www.modularwetlands.com

PERFORMANCE

MWS – Linear

Hybrid Stormwater Filtration System

MODULAR WETLANDS™

Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92049

www.modularwetlands.com
P 760-433-7640
F 760-433-3179

PERFORMANCE TESTING

Following are the summaries of laboratory testing for both BioMediaGreen and the MWS – LINEAR utilizing BioMediaGreen. For a full copy of the test reports, including the laboratory results please contact a Modular Wetland System, Inc. representative.

Note: Metals are in dissolved form. Removal of particulate metals will be significantly higher. The TSS used in these lab tests is Sil-Co-Sil 106 which has a mean particle size of 19 microns and contains 80% silt.

Bio Media-Green

Pollutant Removal Performance Summary

Test Run	pH		TSS (mg/L)		TKN (mg/L)		Dissolved Phosphorus (mg/L)		Ortho Phosphorus (mg/L)		Dissolved Cadmium (mg/L)		Dissolved Copper (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	7.07	7.21	73	17							0.584	0.48	0.951	0.34
2	7.13	9.49	52	15			3.81	0.46			0.503	0.01	0.906	0.009
3	7.13	9.53	52	13			3.81	0.39			0.503	0.006	0.906	0.005
4	8.65	8.65	100	3	10.4	8.29	1.37	0.68	3.98	3.13	0.302	0.192	0.354	0.115
5	8.65	8.7	100	5	10.4	8.64	1.37	0.75	3.98	2.15	0.302	0.193	0.354	0.119
6	8.65	8.69	100	1	10.4	10.9	1.37	0.72	3.98	2.2	0.302	0.206	0.354	0.13
7	8.65	8.69	100	6	10.4	10.1	1.37	0.69	3.98	2.11	0.302	0.203	0.354	0.11
8	8.65	8.69	100	2	10.4	7.4	1.37	0.7	3.98	2.04	0.302	0.193	0.354	0.117
Averages	8.0725	8.70625	84.63	12.40	10.40	9.07	2.07	0.63	3.98	2.33	0.39	0.19	0.57	0.12
Average Removal Efficiency (%)			**85.35%**		**12.83%**		**69.66%**		**41.56%**		**52.16%**		**79.15%**	
			Using Sil-Co-Sil 106 Mean particle size = 19 microns											

Test Run	Dissolved Lead (mg/L)		Dissolved Zinc (mg/L)		Dissolved Mercury (mg/L)		Oil & Grease (mg/L)		TPH (mg/L)		Turbidity (NTU)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	0.201	0.015	1.33	0.93	0.009	0.002	360	11				
2	0.192	0.005	1.32	0.05	0.006	0.002	67	1				
3	0.192	0.005	1.32	0.05	0.006	0.002	67	1				
4	0.492	0.008	0.4	0.06	n/d	n/d	13	7	1.4	0	36	0.2
5	0.492	0.007	0.4	0.06	n/d	n/d	13	3	1.4	0	36	0.5
6	0.492	0.005	0.4	0.05	n/d	n/d	13	7	1.4	0	36	0.2
7	0.492	0.005	0.4	0.05	n/d	n/d	13	10	1.4	0	36	0.5
8	0.492	0.005	0.4	0.05	n/d	n/d	13	12	1.4	0	36	0.2
Averages	0.38	0.01	0.75	0.16	0.01	0.00	69.88	6.50	1.40	0.00	36.00	0.32
Average Removal Efficiency (%)	**98.19%**		**78.22%**		**71.43%**		**90.70%**		**100.00%**		**99.11%**	

Test Run	Total Coliform (MPN/100 mL)		Fecal Coliform (MPN/100 mL)	
	Influent	Effluent	Influent	Effluent
1	1600000	1600000	1250000	500000
2	1600000	500000	1250000	300000
3	1600000	500000	1250000	300000
4	1600000	900000	1250000	500000
Averages	1600000	875000	1250000	400000
Average Removal Efficiency (%)	**45.31%**		**68.00%**	

*Laboratory Testing - Average Removal Efficiencies. Tested at Flow Rate of 3 GPM Per Square Foot Media Surface Area & Minimum Head.

MWS - LINEAR

Pollutant Removal Performance Summary

Test Run	pH		TSS (mg/L)		Dissolved Phosphorus (mg/L)		Dissolved Cadmium (mg/L)		Dissolved Copper (mg/L)		Dissolved Lead (mg/L)		Dissolved Mercury (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	7.26	7.68	270	6	0.68	0.12	0.61	0.02	0.757	0.028	0.543	0.1	0.018	0.002
2	7.26	7.43	270	3	0.68	0.65	0.61	0.07	0.757	0.055	0.543	0.1	0.018	0.002
3	7.26	7.35	270	2	0.68	0.77	0.61	0.2	0.757	0.066	0.543	0.1	0.018	0.002
4	7.26	7.36	270	1	0.68	0.58	0.61	0.33	0.757	0.072	0.543	0.1	0.018	0.002
5														
6														
7														
8														
Averages	7.26	7.455	270	3	0.68	0.53	0.61	0.155	0.757	0.05525	0.543	0.1	0.018	0.002
Average Removal Efficiency (%)			**98.89%**		**22.06%**		**74.59%**		**92.70%**		**81.58%**		**88.89%**	

Using Sil-Co-Sil 106

Mean particle size = 19 microns

Test Run	Dissolved Nickel (mg/L)		Dissolved Zinc (mg/L)		Oil & Grease (mg/L)		TPH (mg/L)		Turbidity (NTU)		Fecal Coliform (MPN/100 mL)		E.Coli (MPN/100 mL)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1	0.37	0.01	0.95	0.05	10	1	19	0	21	0.5				
2	0.37	0.25	0.95	0.05	10	1	19	0	21	1.5				
3	0.37	0.3	0.95	0.21	10	2.5	19	0	21	1.5				
4	0.37	0.34	0.95	0.43	10	2	19	0	21	2.8				
5														
6											1600	170	1600	110
7														
8											1600	900	1600	900
													1600	900
Averages	0.37	0.225	0.95	0.185	10	1.625	19	0	21	1.575	1600	535	1600	636.66667
Average Removal Efficiency (%)	**39.19%**		**80.53%**		**83.75%**		**100.00%**		**92.50%**		**66.56%**		**60.21%**	

Red text indicates concentrations are greater than testing limits of 1600 MPN/100mL

Testing of Quarter Scale Model - at Flow Rate of 1.9 GPM. This flow rate is equal to 121.6 GPM for full size system.

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MWS - LINEAR (Field Test)

Pollutant Removal Performance Summary

Test Run	Nitrate-N (mg/L)		TSS (mg/L)		Copper (mg/L)		Lead (mg/L)		Zinc (mg/L)		TPH - Gasoline (mg/L)		TPH - Diesel (mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
5/30/2008			43	3	0.03	0.02	0.1	0.1	0.36	0.05	0.14	0	0	0
6/12/2008			40	0.13	0.06	0.03	0.1	0.1	0.18	0.05	0	0	0	0
6/14/2008			22	4	0.04	0.02	0.1	0.1	0.11	0.05	0	0	0	0
6/20/2008			68	4	0.04	0.02	0.1	0.1	0.28	0.05	0	0	0	0
7/7/2008	0.97	0.16	92	17	0.02	0.02	0.1	0.1	0.25	0.05	0	0	0	0
7/18/2008	0.93	0.28	52	17			0.1	0.1	0.23	0.05	0	0	0	0
8/1/2008	0.05	0.07	35	5	0.04	0.02	0.1	0.1	0.38	0.06	0	0	2.65	0
8/15/2008	0.85	0.17	32	6	0.02	0.02	0.1	0.1	0.23	0.05	1.29	0.65	0	0
8/28/2008	0.92	0.21	27	18	0.04	0.02	0.1	0.1	0.18	0.05	0.55	0.49	0	0
Averages	0.74	0.18	45.67	8.24	0.04	0.02	0.10	0.10	0.24	0.05	0.22	0.13	0.29	0.00
Average Removal Efficiency (%)	**76.08%**		**81.96%**		**52.78%**		**0.00%**		**79.09%**		**42.42%**		**100.00%**	
			82% > 5-15 microns		0.02 in red was less than decetable limit		0.1 in red was less than decetable limit		0.05 in red was less than decetable limit					
			Mean particle size < 8 microns											

Test Run	TPH - Motor Oil (mg/L)		Fecal Coliform (MPN/100 mL)		E.Coli (MPN/100 mL)		Enterococci (MPN/100 mL)		pH	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
5/30/2008	0.43	0							8	8.08
6/12/2008	0.5	0							7.15	7.13
6/14/2008	0	0							7.35	7.41
6/20/2008	0	0							7.25	7.31
7/7/2008	0	0	50000	8000	250	52	2851	860	7.68	7.67
7/18/2008	0	0							7.93	7.84
8/1/2008	6.13	0							7.97	7.84
8/15/2008	0.06	0							7.57	7.46
8/28/2008	0.39	0							6.77	6.74
Averages	0.83	0.00	50000.00	8000.00	250.00	52.00	2851.00	860.00	7.52	7.50
Average Removal Efficiency (%)	**100.00%**		**84.00%**		**79.20%**		**69.84%**		**0.28%**	

Independent Third Party Field Testing - at Oceanside Harbor Boat Wash Drainage Area - 2008

Modular Wetland System - Linear is manufactured by Modular Wetland Sytems, Inc. 760-433-7640 www.modularwetlands.com

TAPE PERFORMANCE SUMMARY

MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

Modular Wetland System Linear 2.0 (MWS-L 2.0) is an advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff. Superior pollutant removal efficiencies are achieved by treating runoff through a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is transferred to the biofiltration chamber which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms and uptakes pollutants through an array of physical, chemical, and biological mechanisms.

MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.

TAPE PERFORMANCE

Modular Wetland System Linear 2.0 (MWS-L 2.0) completed its TAPE field testing in the spring of 2013. The Washington DOE has approved the system under the TAPE protocol. The MWS-Linear has met the performance benchmarks for the three major pollutant categories as defined by TAPE: Basic Treatment (TSS), Phosphorus and Enhanced (dissolved zinc and copper). It is the first system tested under the protocol to meet the benchmarks for all three categories.

Pollutant	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Total Suspended Solids	75.0	15.7	85%	Summary of all data meeting TAPE parameters pertaining to this pollutant. Mean of 8 microns.
Total Phosphorus	0.227	0.074	64%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Ortho Phosphorus	0.093	0.031	67%	Summary of all data meeting TAPE parameters for total phosphorus.
Nitrogen	1.40	0.77	45%	Utilizing the Kjeldahl method (Total Kjeldahl nitrogen). Summary of all data during testing.
Dissolved Zinc	0.062	0.024	66%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Dissolved Copper	0.0086	0.0059	38%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Total Zinc	0.120	0.038	69%	Summary of all data during testing.
Total Copper	0.017	0.009	50%	Summary of all data during testing.
Motor Oil	24.157	1.133	95%	Summary of all data during testing.

NOTES:
1. The MWS-Linear was proven effective at infiltration rates of up to 121 in/hr.
2. A minimum of 10 aliquots were collected for each event.
3. Sampling was targeted to capture at least 75 percent of the hydrograph.

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment

   - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves monitoring for the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic

loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

- Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.
   - Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
   - Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
   - Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.

- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

<u>Laboratory Testing</u>

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

<u>Field Testing</u>

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system's influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

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Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
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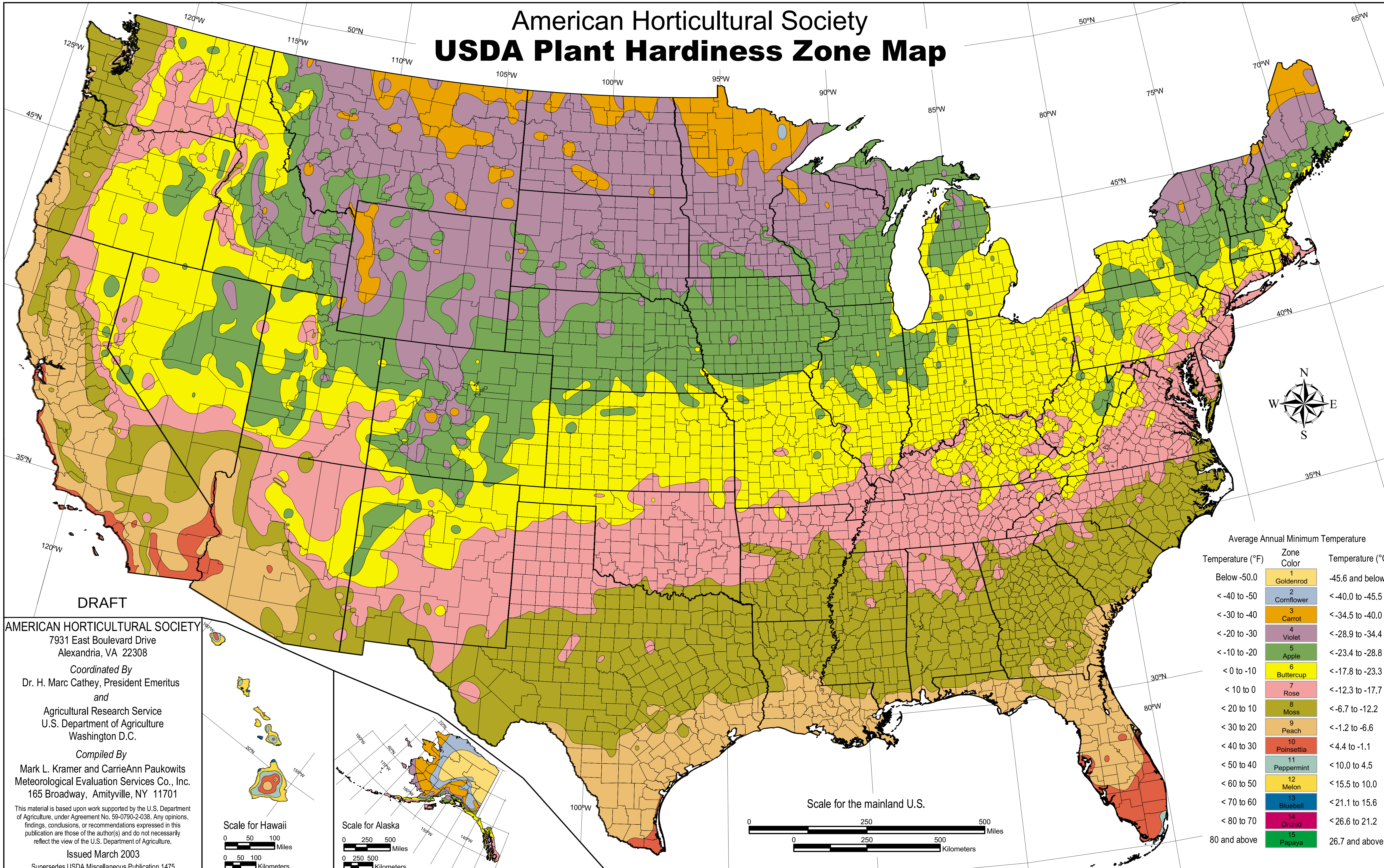
Revision History

Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment

American Horticultural Society
USDA Plant Hardiness Zone Map



Average Annual Minimum Temperature

Temperature (°F)	Zone Color	Temperature (°C)
Below -50.0	1 Goldenrod	-45.6 and below
< -40 to -50	2 Cornflower	< -40.0 to -45.5
< -30 to -40	3 Carrot	< -34.5 to -40.0
< -20 to -30	4 Violet	< -28.9 to -34.4
< -10 to -20	5 Apple	< -23.4 to -28.8
< 0 to -10	6 Buttercup	< -17.8 to -23.3
< 10 to 0	7 Rose	< -12.3 to -17.7
< 20 to 10	8 Moss	< -6.7 to -12.2
< 30 to 20	9 Peach	< -1.2 to -6.6
< 40 to 30	10 Poinsettia	< 4.4 to -1.1
< 50 to 40	11 Peppermint	< 10.0 to 4.5
< 60 to 50	12 Melon	< 15.5 to 10.0
< 70 to 60	13 Bluebell	< 21.1 to 15.6
< 80 to 70	14 Orchid	< 26.6 to 21.2
80 and above	15 Papaya	26.7 and above

Modular Wetland System - Linear® Plants for Hardy Zone 9

Common Name ***Latin Name***	**Sun**	**Hardy Range**	**Height**	**Flower Color**
Japanese sweet flag, Japanese rush *Acorus gramineus*	full sun to partial shade	USDA Zones 6-9	.5 to 1.5 feet	green
papyrus, Egyptian papyrus, bulrushes *Cyperus papyrus*	full sun to partial shade	USDA Zones 9-11	2 to 10 feet	white
drooping sedge, weeping sedge *Carex pendula*	partial shade	USDA Zones 5-9	2 to 4 feet	green
Japanese blood grass, cogongrass, kunai *Imperata cylindrica*	full sun to partial shade	USDA Zones 5-9	2 to 4 feet	green
cattail, reed-mace *Typha latifolia*	full sun	USDA Zones 2-11	3 to 9 feet	brown
Oshima sedge, Oshima kan sedge *Carex oshimensis*	full sun to partial shade	USDA Zones 5-9	1 to 2 feet	brown
little bluestem, seacoast bluestem *Schizachyrium scoparium*	full sun to partial shade	USDA Zones 3-9	.5 to 3 feet	brown
canna, canna tropicana, canna lilly *Canna X generalis*	full sun to partial shade	USDA Zones 8-11	2.5 to 8 feet	yellow, orange, red
Lily-of-the-Nile, African Lily, African Blue Lily *Agapanthus spp*	full sun to partial shade	USDA Zones 8-11	2 to 4 feet	blue
Vetiveria zizanioides (L.) Nash Vetiver Grass	full sun	USDA Zones 5-11	2 to 8 feet	green
giant wild rye *Leymus condensatus*	full sun	USDA Zones 3-11	4 to 8 feet	brown
society garlic, pink agapanthus *Tulbaghia violacea*	full sun to full shade	USDA Zones 7-10	1.5 to 3 feet	lavender

Gulf muhlygrass, mist grass, hairawn muhly *Muhlenbergia capillaris*	full sun to partial shade	USDA Zones 5-10	2 to 3 feet	pinkish purple
Lindheimer's muhlygrass, blue muhlygrass *Muhlenbergia lindheimeri*	full sun	USDA Zones 7-11	2 to 4 feet	purple to gray
horsetail, scouring rush, E. prealtum *Equisetum hyemale*	full sun to light shade	USDA Zones 3-11	2 to 4 feet	n/a
lavender *Lavandula L.*	sun	USDA Zones 5-10	1 to 2 feet	purple
big bluestem, turkey foot bluestem *Andropogon gerardii*	sun	USDA Zones 3-9	4 to 6 feet	red
palm sedge *Carex phyllocephala*	full sun to full shade	USDA Zones 7-10	1 to 2 feet	green
umbrella sedge, umbrella plant *Cyperus involucratus*	full sun to partial shade	USDA Zones 8-11	2 to 6 feet	green/white
feather grass, Mexican needle grass *Nassella tenuissima*	full sun to partial shade	USDA Zones 7-11	2 to 3 feet	green/brown
switchgrass, prairie switchgrass *Panicum virgatum*	full sun to partial shade	USDA Zones 4-9	3 to 4 feet	green/white
indiangrass, yellow indiangrass *Sorghastrum nutans*	full sun to partial shade	USDA Zones 3-9	2 to 6 feet	redish/brown
sea oats, Chasmanthium paniculatum *Uniola paniculata*	full sun to partial shade	USDA Zones 6-10	3 to 6 feet	golden/brown
Cape lily, Powell's crinum lily *Crinum X powellii*	full sun to partial shade	USDA Zones 6-11	3 to 4 feet	white/pink
African iris, fortnight lily, morea iris *Dietes iridioides*	full sun to partial shade	USDA Zones 8-10	2 to 4 feet	white/purple
purple coneflower *Echinacea purpurea*	full sun to partial shade	USDA Zones 3-9	2 to 3 feet	pink
Joe Pye weed, queen-of-the-meadow *Eupatorium fistulosum*	full sun to partial shade	USDA Zones 3-9	3 to 10 feet	pink/purple

whirling butterflies, white gaura *Gaura lindheimeri*	full sun to partial shade	USDA Zones 5-10	2 to 4 feet	white/pink
oxeye sunflower, false sunflower *Heliopsis helianthoides*	full sun to partial shade	USDA Zones 2-9	3 to 5 feet	yellow
daylily *Hemerocallis hybrids*	full sun to partial shade	USDA Zones 2-10	1 to 3.5 feet	various
summer snowflake, giant snowflake *Leucojum aestivum*	full sun to partial shade	USDA Zones 4-9	1 to 2 feet	white
Russian sage *Perovskia atriplicifolia*	full sun	USDA Zones 5-9	3 to 5 feet	purple
Adam's needle, bear grass, weak-leaf yucca *Yucca filamentosa*	full sun	USDA Zones 5-10	3 to 5 feet	white
brome hummock sedge *carex bromoides*	full sun to partial shade	USDA Zones 2-10	1 ft	green

The Modular Wetland System - Linear® standard 22' long system will require 18 to 20 plants. Different size systems will require different plant quanitities; please contact us for detailed information.

The plants listed are tolerant to drought and have deep roots to allow for ehanced pollutant removal.

These plants are subject to availability in local areas. If you would like to use a different plant please contact us. We will work with you to ensure the chosen plants work with the projects current landscape theme.

The Modular Wetland System - Linear® should be irrigated like any other planter area. The plants in the system must receive adequate irrigation to ensure plant survival during periods of drier weather. As with all landscape areas the plants within the Modular Wetland System - Linear will require more frequent watering during the establishment period.

For more information please contact at: 760-433-7640 or email: info@modularwetlands.com

Geotechnical Investigation

(Under Separate Cover)

W.O. 3593-38