PRELMINARY
STORMWATER CONTROL PLAN
for
THE LEUNG PROPERTY
CONTRA COSTA COUNTY

October 11, 2024

Carlson, Barbee & Gibson, Inc.

Justin Joseph
Project Manager
2633 Camino Ramon, Suite 350
San Ramon, California 94583

prepared by:

Balance Hydrologics, Inc.
800 Bancroft Way, Suite 101
Berkeley, California 94710

TABLE OF CONTENTS

Tables

Figures

Appendix

A. Stormwater Control Plan Exhibit

B. IMP Sizing Calculator Output

C. BAHM Project Report

D. Map of DMAs

This Stormwater Control Plan was prepared using the template dated March 2024.

I. PROJECT DATA

Table 1. Project Data

Project Name/Number	Leung Property
Application Submittal Date	October, 2024
Project Location	0.50 miles southwest of the intersection of Deer Creek Road and Sand Creek Road, City of Antioch
Name of Developer	Richland Communities
Project Phase No.	TBD
Project Type and Description	278 single family detached lots, 156 townhome units, trail system, open space areas
Project Watershed	Sand Creek
Total Project Site Area (acres)	159.90
Total Area of Land Disturbed (acres)	62.45
Total New Impervious Surface Area (sq. ft.)	1,495,714
Total Replaced Impervious Surface Area	0
Total Pre-Project Impervious Surface Area	0
Total Post-Project Impervious Surface Area	1,495,714
50% Rule	Does not apply (no pre-project impervious cover)
Project Density	4 units/acre
Applicable Special Project Categories [Complete even if all treatment is LID]	None
Percent LID and non-LID treatment	100% LID
HM Compliance	Applies

II. SETTING

II.A. Project Location and Description

The project site is located in the City of Antioch in Contra Costa County (see **Figure 1** for a vicinity map). The entire site is located within the boundaries of Future Urban Area 1 (FUA-1). The proposed project will include 279 residential lots of which 248 will be single family detached lots and 31 will be townhomes. The Project also includes open space areas and an associated trail system.

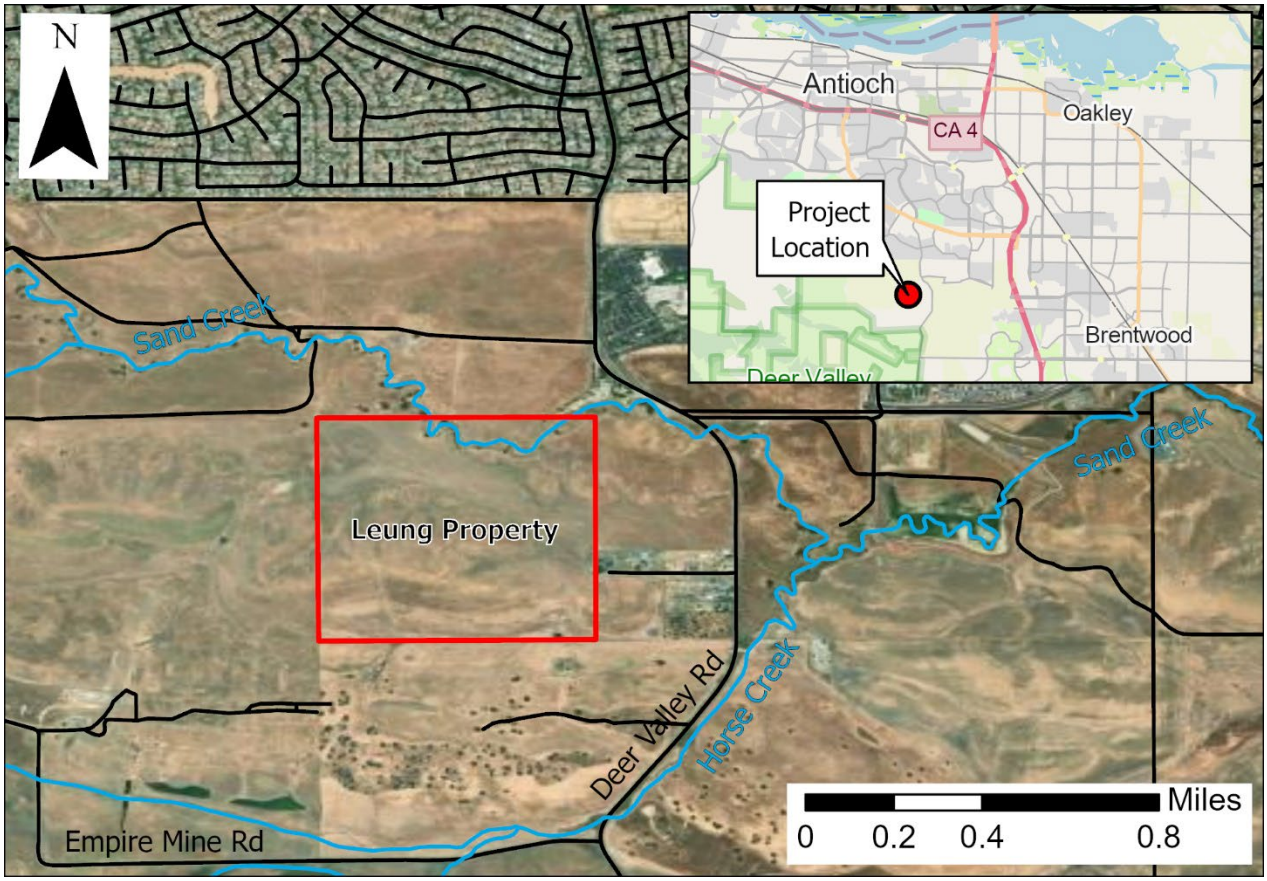


Figure 1. Project vicinity map.

II.B. Existing Site Features and Conditions

The project site covers a total area of 160 acres with land use consisting of open space that has traditionally been used for grazing. The portions of the overall project area that are proposed for development are located on relatively level land that slopes generally parallel to Sand Creek, bounded by hills to the south and west. Sand Creek, which forms the Northern boundary, has a deeply incised channel and is hydrologically disconnected from the project site. Land elevations range between 217 to 282 feet (NAVD88)[1].

Under current conditions, the site receives runoff from the surrounding hillslopes as well as an area to the southwest routed through a former stock pond. The site drains to the east toward Horse Creek, immediately upstream of its confluence with Sand Creek. A roughly 50-foot buffer area around the

[1] Unless otherwise noted, all elevations reference the North American Vertical Datum of 1988 (NAVD88).

Sand Creek channel is mapped as Zone A by the Federal Emergency Management Agency, indicating a 1% annual chance of flooding.

The climate characteristics of the site reflect the Mediterranean climate of central coastal regions of California. This climate regime is characterized by cool, wet winters and hot, dry summers. The lower elevation areas in eastern Contra Costa County lie within the rain shadow of the coastal mountain ranges that remove much of the moisture from incoming storm systems. The Mean Seasonal Isohyets Map prepared by Contra Costa County indicates that the mean annual precipitation at the site is on the order of 14.3 inches per year. Although the average rainfall is quite low, the site does experience the wide range in annual precipitation that accompany drought years and wet years such as those related to the El Niño Southern Oscillation (ENSO). For example, the minimum annual precipitation recorded at the nearby Antioch Pumping Plant was 5.6 inches (in Water Year 1976) and the maximum was 27.1 inches (in Water Year 1983).

Annual temperature patterns are typical of interior areas of the state, although somewhat tempered by cooling breezes originating at sea and in the San Francisco Bay system. Evaporation rates are quite high in summer, exceeding rainfall in all but the wettest winter months. Mean annual pan evaporation is likely on the order of 71 inches, or over five times mean annual precipitation, based on the record from the Antioch Pumping Plant (1955-1978).

The underlying soils are identified as Altamont clay, Altamont-Fontana complex, Capay clay, Rincon clay loam, and Briones loamy sand in mapping prepared by the Natural Resources Conservation Service. Approximately 99% of the project area is classified in Hydrologic Soil Group (HSG)[2] C and 1% in HSG A. All areas to be developed are located classified in HSG C.

II.C. Opportunities and Constraints for Stormwater Control

The project presents several important constraints with respect to stormwater management, including the following:

- *Low soil permeability*. The soils underlying the project site are almost exclusively designated as HSG C, indicating very low infiltration potential. This significantly limits those integrated management practices (IMPs) that rely on direct infiltration of stormwater runoff as a water-quality control measure.
- *Off-site western watershed.* A 178.0-acre section of land to the west of the site is not within the Project boundary but drains to the site through a former stock pond. The Project will need to provide drainage infrastructure (but not C.3 treatment) for this additional off-site watershed area.
- *Rerouted flow*. Under current conditions, runoff from the site and off-site western watershed flow east toward Horse Creek as sheet flow. This runoff will be rerouted to a new outfall into Sand Creek in the northeast corner of the site.
- *No existing creek outfalls*. The outfall from IMP 1 will require a new outfall into Sand Creek, with an associated limited amount of hardened surfaces to be added to the creek.

[2] The NRCS hydrologic soil groups (HSGs) divide all soil types into four categories based on the potential to produce runoff. Type A soils have the lowest runoff potential and typically have high infiltration rates. Type D soils have the highest runoff potential and typically have low infiltration rates and/or are shallow.

- *Wetland areas.* Some areas of seasonal wetlands have been identified in the west and southeast parts of the site. This requires configuring project and associated stormwater management infrastructure to avoid impacts to the maximum extent practicable.

These constraints are offset by several notable opportunities that include:

- *Open space.* The roughly 97.5 acres of open space throughout the Project will provide wildlife habitat areas and a wildlife corridor, while significantly limiting the total amount of new impervious cover that will be constructed.
- *Sufficient hydraulic head.* The relief at the site allows stormwater runoff from the developed areas to be routed to, through, and away from treatment controls without pumping.
- *Mitigate flows to Deer Valley Road crossing.* Under current conditions, runoff from the site flows to an off-site ditch which crosses Deer Valley Road at a culvert before entering Horse Creek. The proposed rerouting of flow from the site to Sand Creek would minimize impacts to this aging culvert infrastructure and the downslope community along Deer Hill Road.
- *Reduce peak flow to Upper Sand Creek Basin.* Under current conditions, unmitigated runoff from the site enters Horse Creek immediately upstream of its confluence with Sand Creek (approximately 924 feet upstream of Upper Sand Creek Basin). The proposed rerouting of flow from the site to Sand Creek (and associated IMP 1) has to the potential to modulate the timing and magnitude of peak flows to Upper Sand Creek Basin.

III. LOW IMPACT DEVELOPMENT DESIGN STRATEGIES

III.A. Optimization of Site Layout

III.A.1. Limitation of development envelope. The site design limits the development envelope in a manner that concentrates residential lots in the smallest practicable area. Doing so provides space for construction of stormwater detention basins.

III.A.2. Setbacks from creeks, wetlands, and riparian habitats. The project site plan avoids encroachment of developed areas on Sand Creek and existing seasonal wetlands.

III.A.3. Minimization of imperviousness. The site design limits the development envelope in a manner that concentrates residential lots in the smallest practicable area. The aforementioned provision of areas for stormwater treatment basins and seasonal wetlands results in an overall impervious cover of approximately 21% for the site as a whole.

III.A.4. Use of drainage as a design element. IMP 1 will be located at the lower elevations of the project site to facilitate gravity flow and will be designed as aesthetic features for the neighboring development, with the facilities designed to integrate into the surrounding open space using curvilinear forms and appropriate landscaping.

III.B. Use of Permeable Pavements

The project does not propose the use of permeable pavers given the very low infiltration capacity of the underlying soils.

III.C. Dispersal of Runoff to Pervious Areas

The compact configuration of the site plan and goal preserving and enhancing existing wetland habitats limits opportunities for dispersal of runoff to pervious areas. That said, the majority of the site will be self-treating from a stormwater management perspective.

III.D. Bioretention or other Integrated Management Practices

To meet the requirements of the pertinent stormwater regulations, the Project will construct an IMP that provides for full bioretention treatment of all on-site runoff. To meet this objective, the Project is divided into six main drainage management areas (DMAs) as shown in **Appendix D**. Within each on-site DMA, a gravity-flow storm drain system will collect stormwater and covey it to the IMP 1 feature which is specifically sized for the pertinent amount of impervious and pervious cover. The IMP 1 utilizes the "cistern + bioretention" sizing criteria taken directly from the Stormwater C.3 Guidebook (9th edition) and verified using the Bay Area Hydrology Model (BAHM) as specified in the Stormwater C.3 Guidebook (9th edition). The term "cistern" in this case should be recognized as signifying a separate storage volume, in the form of a traditional open basin, which is used to meter flow out to a separate bioretention area in a controlled manner.

The location of the project site in the middle reaches of the Sand Creek watershed also calls for strict compliance with the hydrograph modification plan (HMP) requirements established in Contra Costa County. Full HMP compliance is achieved across the board by sizing IMP 1 per calculations using the Clean Water Program's IMP Calculator Version 1.3.1.0 and simulations using BAHM (see **Appendices B** and **C**) for treatment + flow control. Although the Clean Water Program has released a newer version of the IMP Calculator (Version 1.4), the cistern + bioretention IMP type is not available; therefore we used the older Version 1.3.1.0 for initial sizing and verified that the facility is HMP compliant using BAHM.

IMP 1 is designed with full capacity to achieve the traditional C.3 functions for water-quality remediation (through bioretention treatment) and hydromodification management. With the planned addition of debris screens on the IMP outlets, the proposed facility will provide full compliance with the currently effective trash total maximum daily load (TMDL) requirements.

The Project will configure IMP 1 to provide mitigation for any potential increase in peak flow rates from storms larger than the 10-year event (smaller storms are mitigated by the flow control sizing included in the hydromodification control design). This functionality is provided for Contra Costa County Flood Control design storms up to the 100-year event by proper allowances for high-stage storage and appropriate sizing of the high-flow release structures in the facility. The associated modeling and results are discussed in **Appendix C**.

IV. DOCUMENTATION OF DRAINAGE DESIGN

IV.A. Descriptions of each Drainage Management Area

IV.A.1. Table of Drainage Management Areas

Table 2. Drainage Management Areas

DMA Name	*Area (sq ft)*	*Surface Type / Description*	*DMA Type / Drains to*
DMA 1	996,260	Roof, asphalt roadway, landscaping, hillslope	Drains to IMP 1
DMA 2	1,772,920	Roof, asphalt roadway, landscaping	Drains to IMP 1
DMA 3	1,668,850	Hillslope	Self-treating + drains to Sand Creek
DMA 4	7,751,870	Hillslope, open space	Self-treating + drains to Sand Creek
DMA 5	452,830	Hillslope, river channel	Self-treating + drains to Sand Creek
DMA 6	102,770	Hillslope	Drains to IMP 1

IV.A.2. Drainage Management Area Descriptions

See **Appendix A** for the Project's Stormwater Control Exhibit.

DMA 1, totaling 996,260 square feet (447,880 impervious), drains residential units and open space hillslope to IMP 1.

DMA 2, totaling 1,772,920 square feet (1,178,641 impervious), drains residential units to IMP 1.

DMA 3, totaling 1,668,850 square feet, self-treating, drains on-site open space hillslope to Sand Creek.

DMA 4, totaling 7,751,870 square feet, self-treating, drains off-site open space hillslope to Sand Creek.

DMA 5, totaling 452,830 square feet, self-treating, drains riparian corridor to Sand Creek.

DMA 6, totaling 102,770 square feet, drains open space hillslope to IMP 1.

IV.B. Integrated Management Practice Descriptions

The project will include one dual-bay detention and bioretention IMP (IMP 1) that will be constructed per the design guidelines for bioretention basins as presented in the C.3 Guidebook 9th edition.

IMP 1 will include the requisite 18 inches of specially formulated biosoil over a drain rock layer that includes underdrain pipes. Surface ponding depth will be a minimum of 6 inches before overflow grates for high flow conditions would be engaged.

IV.B.1. *Areas Draining to Non-LID Treatment*

There are no areas draining to Non-LID treatment.

IV.C. Tabulation and Sizing Calculations

Sizing calculations in the form of the IMP Calculator output report and BAHM output report are included as **Appendices B** and **C**, respectively.

V. SOURCE CONTROL MEASURES

V.A. Site activities and potential sources of pollutants

As a medium-low density residential development, the project can be expected to have a few notable sources of stormwater pollutants, primarily those associated with vehicle use and landscaping.

V.B. Source Control Table

Table 3. Source Controls

Potential source of runoff pollutants	*Permanent source control BMPs*	*Operational source control BMPs*
Parking / vehicle washing	Street sweeping and maintenance, particularly prior to first seasonal rains. Routing of all runoff to maintained treatment measures.	• Distribute stormwater pollution prevention information to new owners.
On-site storm drain inlets	All inlets will be marked with wording, "**No Dumping! Drains to Delta**" or similar.	• Inlet markings will be repainted or replaced as needed. • Homeowner information will include a clause similar to "Residents shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."
Interior floor drains	Interior floor drains will be plumbed to the sanitary sewer.	Drains will be inspected and maintained to prevent overflow.
Landscaping and outdoor pesticide use	Landscaping will be designed to minimize irrigation and runoff and will utilize plant species appropriate for the setting.	• Landscaping will be maintained using minimum pesticides. • Integrated pest management information will be provided to new lessees.
Refuse areas	Dumpster areas will be covered and include signage with language similar to "Do not dump hazardous materials here".	Receptacles will be routinely inspected and repaired as needed to avoid leakage.
Fire sprinkler test water	Interior drainage will direct all fire sprinkler test water to the sanitary sewer.	Drains will be inspected and maintained to prevent overflow.

V.C. Features, Materials, and Methods of Construction of Source Control BMPs

There are no special features, materials, or methods of construction of note.

VI. STORMWATER FACILITY MAINTENANCE

VI.A. Ownership and Responsibility for Maintenance in Perpetuity

Source control measures associated with the residential development will be the responsibility of the HOA in all cases, subject to inspection and verification by staff of the HOA. Treatment control facilities will be owned by the HOA with routine maintenance carried out by the HOA, subject to inspection and verification by staff of the Contra Costa Public Works Department.

All funding for maintenance activities will be financed out of HOA fees collected by the HOA.

VI.B. Summary of Maintenance Requirements for Each Stormwater Facility

Operation and maintenance activities will be described, scheduled, and recorded per the Stormwater Facilities Operation and Maintenance Plan document that will be prepared and reviewed by Public Works Staff prior to final project approvals.

VII. CONSTRUCTION PLAN C.3 CHECKLIST

Table 4. Construction Plan C.3 Checklist

Stormwater Control Plan Page #	*BMP Description*	*See Plan Sheet #s*
7	Bioretention IMPs	TBD
8	Marked storm drain inlets	TBD
8	Interior floor drains to sanitary sewer	TBD
8	Covered trash receptacles	TBD
8	Fire sprinkler test water to sanitary sewer	TBD

VIII. CERTIFICATIONS

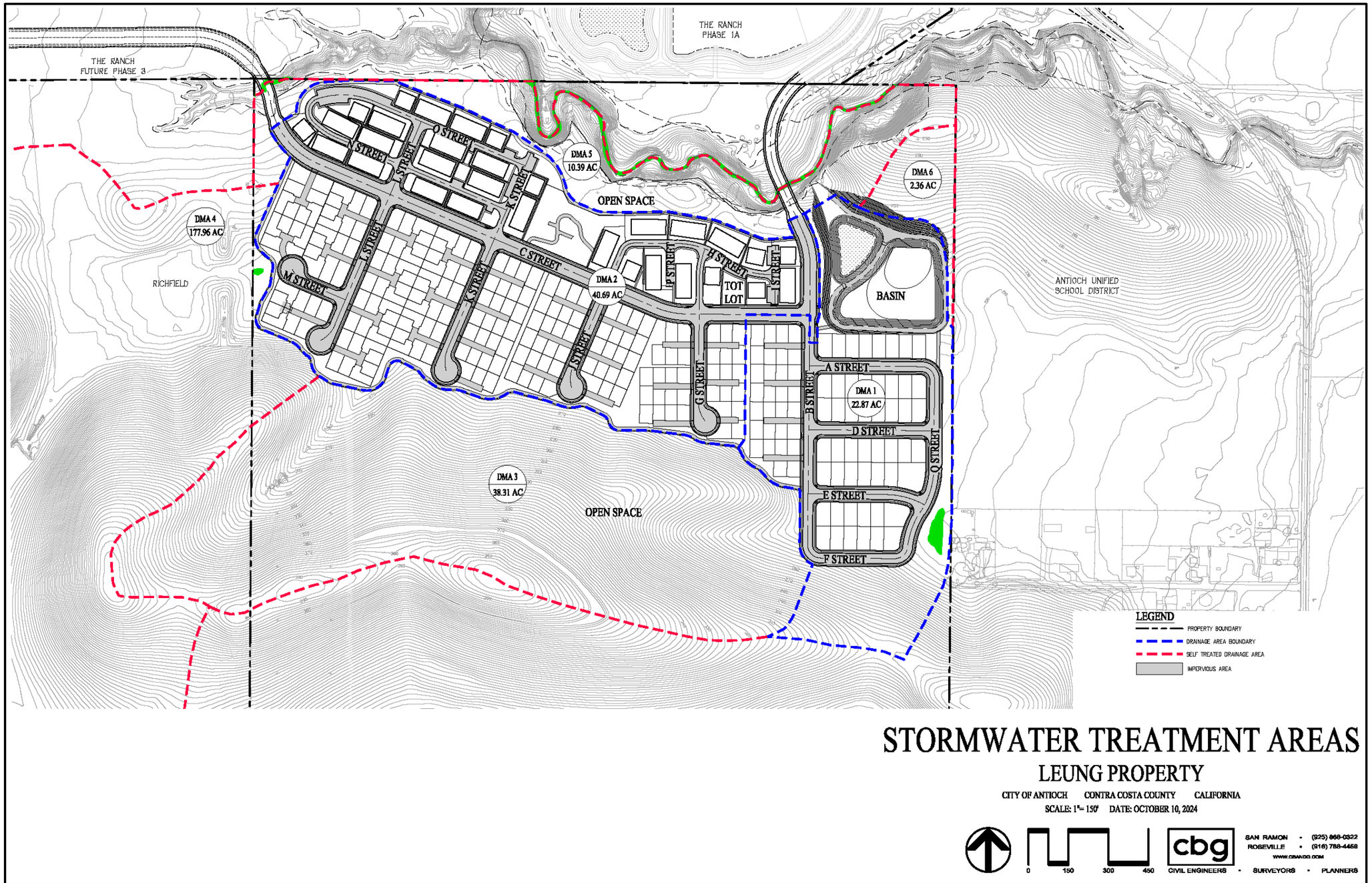
The selection, sizing, and preliminary design of stormwater treatment and other control measures in this plan meet the requirements of Regional Water Quality Control Board Order R2-2015-0049.

By

DRAFT

Edward D. Ballman, P.E.

Appendix A. Stormwater Control Plan Exhibit



STORMWATER TREATMENT AREAS

LEUNG PROPERTY

CITY OF ANTIOCH CONTRA COSTA COUNTY CALIFORNIA

SCALE: 1"= 150' DATE: OCTOBER 10, 2024

SAN RAMON - (925) 866-0322
ROSEVILLE - (916) 788-4456
www.cbandg.com
CIVIL ENGINEERS - SURVEYORS - PLANNERS

Appendix B. IMP Sizing Calculator Output

Project Name: 224051 Leung Property IMP Sizing August 2024
Project Type: Treatment and Flow Control
APN: N/A
Drainage Area: 2,737,545
Mean Annual Precipitation: 14.3

IV. Areas Draining to IMPs

IMP Name: IMP1
IMP Type: Cistern + Bioretention Facility
Soil Group: IMP1

DMA Name	Area (sq ft)	Post Project Surface Type	DMA Runoff Factor	DMA Area x Runoff Factor
DMA1 Conventional Roof	133,193	Conventional Roof	1.00	133,193
DMA1 Concrete or Asphalt	183,880	Concrete or Asphalt	1.00	183,880
DMA1 Landscape	458,041	Landscape	0.50	229,021
DMA2 Conventional Roof	593,781	Conventional Roof	1.00	593,781
DMA2 Concrete or Asphalt	584,860	Concrete or Asphalt	1.00	584,860
DMA2 Landscape	783,789	Landscape	0.50	391,895
			Total	2,116,629

IMP Sizing	IMP Sizing Factor	Rain Adjustment Factor	Minimum Area or Volume	Proposed Area or Volume
Area	0.013	0.610	16,794	17,600
Volume	0.105	1.218	270,733	275,000

Maximum Underdrain Flow (cfs)	2.37
Orifice Diameter (in)	6.57

Report generated on 8/22/2024 12:00:00 AM by the Contra Costa Clean Water Program IMP Sizing Tool software (version 1.3.1.0).

Appendix C. BAHM Project Report

BAHM2023

PROJECT REPORT

General Model Information

BAHM2023 Project Name: 224051 Leung BAHM September 2024

Site Name:	Leung Property
Site Address:	
City:	Antioch
Report Date:	10/4/2024
Gage:	Brentwood
Data Start:	1959/10/01
Data End:	2021/09/30
Timestep:	Hourly
Precip Scale:	1.040
Version Date:	2024/06/19

POC Thresholds

Low Flow Threshold for POC1:	10 Percent of the 2 Year
High Flow Threshold for POC1:	10 Year
Low Flow Threshold for POC2:	10 Percent of the 2 Year
High Flow Threshold for POC2:	10 Year

Landuse Basin Data
Pre-Project Land Use

Pre-project (DMAs 1, 2, 6)

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Flat(0-5%)	63.572
C D,Grass,Ste(10-20)	2.359
Pervious Total	65.931
Impervious Land Use	acre
Impervious Total	0
Basin Total	65.931

Element Flow Componants:

Surface	Interflow	Groundwater
Componant Flows To:		
POC 1	POC 1	

DMA 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Ste(10-20)	38.311473
Pervious Total	38.311473
Impervious Land Use	acre
Impervious Total	0
Basin Total	38.311473

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Mitigated Land Use

DMAs 1, 2, 6

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Flat(0-5%)	25.603
C D,Grass,Ste(10-20)	2.359
Pervious Total	27.962
Impervious Land Use	acre
Roads,Flat(0-5%)	17.648
Roof Area	16.689
Impervious Total	34.337
Basin Total	62.299

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

Detention Basin	Detention Basin

DMA3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C D,Grass,Ste(10-20)	38.311473
Pervious Total	38.311473
Impervious Land Use	acre
Impervious Total	0
Basin Total	38.311473

Element Flow Componants:

Surface	Interflow	Groundwater

Componant Flows To:

POC 2	POC 2

Routing Elements
Pre-Project Routing

Mitigated Routing

Detention Basin

Depth: 222 ft.
Element Outlets:
Outlet 1 Outlet 2
Outlet Flows To:
Surface ention Basin

SSD Table Hydraulic Table

Stage (feet)	Area (ac.)	Volume (ac-ft.)	Manual	Manual	NotUsed	NotUsed	NotUsed
215.5	1.297	0.000	0.000	0.000	0.000	0.000	0.000
216.0	1.339	0.659	0.412	0.000	0.000	0.000	0.000
217.0	1.687	2.172	0.606	0.000	0.000	0.000	0.000
218.0	1.789	3.910	0.751	0.000	0.000	0.000	0.000
218.3	1.815	4.361	0.784	0.000	0.000	0.000	0.000
218.5	1.841	4.818	0.814	1.500	0.000	0.000	0.000
219.0	1.894	5.752	0.873	7.794	0.000	0.000	0.000
219.5	1.947	6.712	0.928	16.77	0.000	0.000	0.000
220.0	2.001	7.699	0.980	27.78	0.000	0.000	0.000
220.5	2.055	8.713	1.029	40.50	0.000	0.000	0.000
221.0	2.110	9.754	1.076	54.72	0.000	0.000	0.000
221.5	2.165	10.82	1.121	70.31	0.000	0.000	0.000
222.0	2.221	11.92	1.164	87.14	0.000	0.000	0.000

Bioretention Basin

Bottom Length:	169.00 ft.
Bottom Width:	100.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	BAHM 5
Material thickness of second layer:	1
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	1
Orifice Diameter (in.):	4.875
Offset (in.):	0
Flow Through Underdrain (ac-ft.):	2014.724
Total Outflow (ac-ft.):	2036.881
Percent Through Underdrain:	98.91
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	36 in.
Orifice 1 Diameter:	8.000 in. Elevation:1 ft.
Element Outlets:	
Outlet 1	Outlet 2
Outlet Flows To:	

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.3880	0.0000	0.0000	0.0000
0.1044	0.3880	0.0154	0.0000	0.0000
0.2088	0.3880	0.0308	0.0000	0.0000
0.3132	0.3880	0.0462	0.0000	0.0000
0.4176	0.3880	0.0616	0.0767	0.0000
0.5220	0.3880	0.0770	0.1180	0.0000
0.6264	0.3880	0.0923	0.1613	0.0000
0.7308	0.3880	0.1077	0.2204	0.0000
0.8352	0.3880	0.1231	0.2663	0.0000
0.9396	0.3880	0.1385	0.3051	0.0000
1.0440	0.3880	0.1539	0.3395	0.0000
1.1484	0.3880	0.1693	0.3705	0.0000
1.2527	0.3880	0.1847	0.3992	0.0000
1.3571	0.3880	0.2001	0.4259	0.0000
1.4615	0.3880	0.2155	0.4510	0.0000
1.5659	0.3880	0.2323	0.4747	0.0000
1.6703	0.3880	0.2491	0.4974	0.0000
1.7747	0.3880	0.2659	0.5190	0.0000
1.8791	0.3880	0.2827	0.5399	0.0000
1.9835	0.3880	0.2995	0.5599	0.0000
2.0879	0.3880	0.3163	0.5793	0.0000
2.1923	0.3880	0.3331	0.5982	0.0000
2.2967	0.3880	0.3499	0.6167	0.0000
2.4011	0.3880	0.3667	0.6356	0.0000
2.5000	0.3880	0.3827	0.6607	0.0000

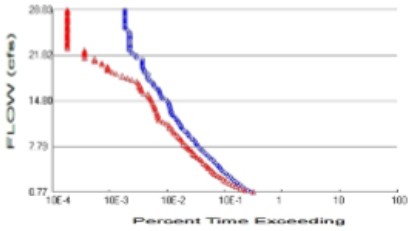
Bioretention Surface Hydraulic Table

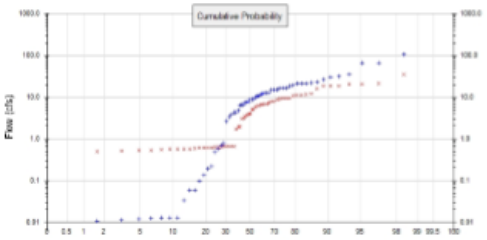
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
2.5000	0.3880	0.3827	0.0000	1.9560	0.0000

2.6044	0.3931	0.4234	0.0000	1.9560	0.0000
2.7088	0.3983	0.4648	0.0000	2.2283	0.0000
2.8132	0.4036	0.5066	0.0000	2.3644	0.0000
2.9176	0.4089	0.5490	0.0000	2.5006	0.0000
3.0220	0.4142	0.5920	0.0000	2.6367	0.0000
3.1264	0.4195	0.6355	0.0000	2.7728	0.0000
3.2308	0.4249	0.6796	0.0000	2.9090	0.0000
3.3352	0.4303	0.7242	0.0000	3.0451	0.0000
3.4396	0.4357	0.7694	0.0000	3.1812	0.0000
3.5440	0.4411	0.8152	0.3641	3.3174	0.0000
3.6484	0.4466	0.8615	0.6689	3.4535	0.0000
3.7527	0.4522	0.9084	0.8731	3.5896	0.0000
3.8571	0.4577	0.9559	1.0379	3.7258	0.0000
3.9615	0.4633	1.0040	1.1799	3.8619	0.0000
4.0659	0.4689	1.0527	1.3065	3.9980	0.0000
4.1703	0.4746	1.1019	1.4219	4.1342	0.0000
4.2747	0.4803	1.1518	1.5287	4.2703	0.0000
4.3791	0.4860	1.2022	1.6284	4.4064	0.0000
4.4835	0.4917	1.2532	1.7224	4.5426	0.0000
4.5879	0.4975	1.3049	1.8115	4.6787	0.0000
4.6923	0.5033	1.3571	1.8964	4.8148	0.0000
4.7967	0.5092	1.4100	1.9777	4.9510	0.0000
4.9011	0.5151	1.4634	2.0558	5.0871	0.0000
5.0055	0.5210	1.5175	2.1310	5.2232	0.0000
5.1099	0.5269	1.5722	2.2036	5.3594	0.0000
5.2143	0.5329	1.6275	2.2739	5.4955	0.0000
5.3187	0.5389	1.6835	2.3422	5.6316	0.0000
5.4231	0.5449	1.7400	2.4084	5.7678	0.0000
5.5275	0.5510	1.7972	2.6180	5.9039	0.0000
5.6319	0.5571	1.8551	4.0587	6.0400	0.0000
5.7363	0.5632	1.9136	6.2408	6.1762	0.0000
5.8407	0.5694	1.9727	8.9324	6.3123	0.0000
5.9451	0.5756	2.0325	11.994	6.4484	0.0000
6.0495	0.5818	2.0929	15.300	6.5846	0.0000
6.1538	0.5881	2.1539	18.720	6.7207	0.0000
6.2582	0.5944	2.2157	22.125	6.8568	0.0000
6.3626	0.6007	2.2780	25.384	6.9930	0.0000
6.4670	0.6071	2.3411	28.377	7.1291	0.0000
6.5714	0.6135	2.4048	31.008	7.1721	0.0000
6.6758	0.6199	2.4692	33.213	7.1721	0.0000
6.7802	0.6263	2.5342	34.980	7.1721	0.0000
6.8846	0.6328	2.6000	36.358	7.1721	0.0000
6.9890	0.6393	2.6664	37.484	7.1721	0.0000
7.0934	0.6459	2.7334	39.074	7.1721	0.0000
7.1978	0.6525	2.8012	40.275	7.1721	0.0000
7.3022	0.6591	2.8697	41.441	7.1721	0.0000
7.4066	0.6657	2.9388	42.574	7.1721	0.0000
7.5110	0.6724	3.0087	43.677	7.1721	0.0000
7.6154	0.6791	3.0792	44.752	7.1721	0.0000
7.7198	0.6859	3.1505	45.801	7.1721	0.0000
7.8242	0.6926	3.2224	46.827	7.1721	0.0000
7.9286	0.6995	3.2951	47.830	7.1721	0.0000
8.0330	0.7063	3.3685	48.812	7.1721	0.0000
8.1374	0.7132	3.4426	49.775	7.1721	0.0000
8.2418	0.7201	3.5174	50.719	7.1721	0.0000
8.3462	0.7270	3.5929	51.646	7.1721	0.0000
8.4505	0.7340	3.6692	52.556	7.1721	0.0000
8.5549	0.7410	3.7462	53.450	7.1721	0.0000

8.6593	0.7480	3.8239	54.330	7.1721	0.0000
8.7637	0.7551	3.9023	55.195	7.1721	0.0000
8.8681	0.7622	3.9815	56.047	7.1721	0.0000
8.9725	0.7693	4.0615	56.886	7.1721	0.0000
9.0769	0.7764	4.1422	57.713	7.1721	0.0000
9.1813	0.7836	4.2236	58.528	7.1721	0.0000
9.2857	0.7909	4.3058	59.331	7.1721	0.0000
9.3901	0.7981	4.3887	60.124	7.1721	0.0000
9.4945	0.8054	4.4724	60.907	7.1721	0.0000
9.5000	0.8058	4.4768	61.679	7.1721	0.0000

Analysis Results
POC 1





\+ Pre-Project x Mitigated

Pre-Project Landuse Totals for POC #1
Total Pervious Area: 65.931
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 27.962
Total Impervious Area: 34.337

Flow Frequency Method: Weibull

Flow Frequency Return Periods for Pre-Project. POC #1

Return Period	**Flow(cfs)**
2 year	7.7455
5 year	19.861429
10 year	28.834767
25 year	66.057157

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	3.792998
5 year	10.849857
10 year	18.357067
25 year	20.903538

Annual Peaks

Annual Peaks for Pre-Project and Mitigated. POC #1

Year	**Pre-Project**	**Mitigated**
1960	10.341	3.019
1961	0.133	0.605
1962	65.569	18.330
1963	25.801	21.208
1964	4.717	3.131
1965	7.411	6.012
1966	6.427	1.948
1967	19.011	15.903
1968	4.274	4.935
1969	15.076	8.849
1970	11.753	6.466
1971	10.895	9.477
1972	0.058	0.642
1973	12.210	7.209

1974	21.799	11.351
1975	8.726	0.642
1976	0.011	0.512
1977	0.009	0.489
1978	21.244	9.290
1979	10.061	7.752
1980	14.828	11.593
1981	2.569	3.900
1982	22.475	20.716
1983	105.018	34.198
1984	7.860	0.642
1985	12.457	3.689
1986	30.352	20.178
1987	4.356	6.712
1988	3.337	0.592
1989	6.529	0.542
1990	0.711	0.635
1991	0.190	0.560
1992	31.741	6.725
1993	34.827	4.017
1994	0.481	0.527
1995	66.851	18.533
1996	8.691	6.373
1997	16.460	3.443
1998	16.261	12.180
1999	0.011	0.526
2000	0.034	0.623
2001	0.219	0.570
2002	7.634	5.637
2003	21.327	18.370
2004	0.098	0.600
2005	12.333	1.717
2006	14.745	10.593
2007	0.013	0.576
2008	0.787	0.642
2009	0.059	0.571
2010	3.782	11.268
2011	6.612	0.636
2012	0.012	0.602
2013	21.247	7.928
2014	0.013	0.608
2015	8.786	9.477
2016	11.986	5.137
2017	16.647	9.051
2018	0.559	6.470
2019	18.285	1.911
2020	0.013	0.492
2021	0.012	0.642

Ranked Annual Peaks

Ranked Annual Peaks for Pre-Project and Mitigated. POC #1

Rank	Pre-Project	Mitigated
1	105.0180	34.1982
2	66.8509	21.2078
3	65.5687	20.7163
4	34.8267	20.1783
5	31.7413	18.5326
6	30.3516	18.3704

7	25.8011	18.3304
8	22.4746	15.9031
9	21.7994	12.1796
10	21.3272	11.5925
11	21.2470	11.3506
12	21.2437	11.2679
13	19.0108	10.5926
14	18.2846	9.4774
15	16.6470	9.4769
16	16.4598	9.2904
17	16.2609	9.0509
18	15.0759	8.8486
19	14.8277	7.9285
20	14.7447	7.7521
21	12.4569	7.2086
22	12.3328	6.7253
23	12.2097	6.7116
24	11.9859	6.4699
25	11.7534	6.4663
26	10.8951	6.3733
27	10.3408	6.0118
28	10.0606	5.6372
29	8.7860	5.1369
30	8.7264	4.9345
31	8.6911	4.0168
32	7.8604	3.9003
33	7.6342	3.6890
34	7.4111	3.4427
35	6.6116	3.1313
36	6.5293	3.0191
37	6.4268	1.9476
38	4.7166	1.9107
39	4.3555	1.7171
40	4.2736	0.6418
41	3.7822	0.6418
42	3.3375	0.6418
43	2.5689	0.6418
44	0.7874	0.6418
45	0.7114	0.6362
46	0.5587	0.6352
47	0.4813	0.6233
48	0.2188	0.6080
49	0.1897	0.6053
50	0.1326	0.6019
51	0.0978	0.5999
52	0.0595	0.5921
53	0.0585	0.5761
54	0.0336	0.5712
55	0.0129	0.5704
56	0.0127	0.5599
57	0.0126	0.5418
58	0.0122	0.5266
59	0.0118	0.5258
60	0.0110	0.5124
61	0.0109	0.4925
62	0.0090	0.4891

Duration Flows

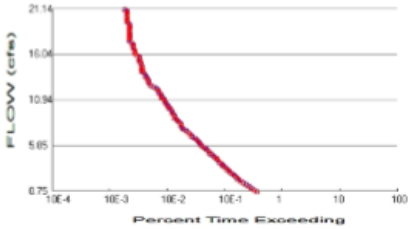
The Facility PASSED

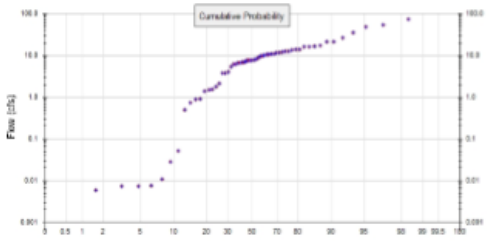
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.7746	1563	1692	108	Pass
1.0580	1349	1228	91	Pass
1.3414	1203	1029	85	Pass
1.6249	1076	851	79	Pass
1.9083	980	734	74	Pass
2.1917	892	638	71	Pass
2.4752	805	562	69	Pass
2.7586	739	513	69	Pass
3.0420	682	456	66	Pass
3.3255	621	405	65	Pass
3.6089	569	365	64	Pass
3.8924	518	335	64	Pass
4.1758	478	312	65	Pass
4.4592	449	286	63	Pass
4.7427	422	269	63	Pass
5.0261	402	250	62	Pass
5.3095	369	227	61	Pass
5.5930	341	212	62	Pass
5.8764	315	199	63	Pass
6.1598	289	178	61	Pass
6.4433	269	163	60	Pass
6.7267	249	152	61	Pass
7.0102	229	145	63	Pass
7.2936	213	132	61	Pass
7.5770	199	125	62	Pass
7.8605	185	115	62	Pass
8.1439	177	105	59	Pass
8.4273	168	102	60	Pass
8.7108	160	97	60	Pass
8.9942	148	91	61	Pass
9.2776	135	84	62	Pass
9.5611	127	78	61	Pass
9.8445	121	71	58	Pass
10.1280	112	69	61	Pass
10.4114	104	67	64	Pass
10.6948	97	60	61	Pass
10.9783	93	59	63	Pass
11.2617	90	53	58	Pass
11.5451	85	46	54	Pass
11.8286	81	40	49	Pass
12.1120	77	39	50	Pass
12.3954	72	37	51	Pass
12.6789	67	37	55	Pass
12.9623	64	36	56	Pass
13.2458	63	35	55	Pass
13.5292	61	33	54	Pass
13.8126	60	33	55	Pass
14.0961	59	32	54	Pass
14.3795	58	31	53	Pass
14.6629	56	30	53	Pass
14.9464	51	29	56	Pass
15.2298	44	28	63	Pass
15.5132	43	26	60	Pass

15.7967	41	25	60	Pass
16.0801	40	21	52	Pass
16.3636	39	19	48	Pass
16.6470	37	19	51	Pass
16.9304	34	18	52	Pass
17.2139	32	18	56	Pass
17.4973	31	17	54	Pass
17.7807	29	16	55	Pass
18.0642	26	13	50	Pass
18.3476	25	11	44	Pass
18.6311	25	9	36	Pass
18.9145	25	7	28	Pass
19.1979	22	6	27	Pass
19.4814	22	5	22	Pass
19.7648	21	5	23	Pass
20.0482	20	5	25	Pass
20.3317	20	4	20	Pass
20.6151	20	4	20	Pass
20.8985	20	3	15	Pass
21.1820	20	3	15	Pass
21.4654	16	2	12	Pass
21.7489	16	2	12	Pass
22.0323	14	2	14	Pass
22.3157	13	2	15	Pass
22.5992	12	2	16	Pass
22.8826	12	1	8	Pass
23.1660	12	1	8	Pass
23.4495	12	1	8	Pass
23.7329	12	1	8	Pass
24.0163	12	1	8	Pass
24.2998	12	1	8	Pass
24.5832	12	1	8	Pass
24.8667	12	1	8	Pass
25.1501	12	1	8	Pass
25.4335	12	1	8	Pass
25.7170	11	1	9	Pass
26.0004	10	1	10	Pass
26.2838	10	1	10	Pass
26.5673	10	1	10	Pass
26.8507	10	1	10	Pass
27.1341	10	1	10	Pass
27.4176	10	1	10	Pass
27.7010	10	1	10	Pass
27.9845	10	1	10	Pass
28.2679	10	1	10	Pass
28.5513	10	1	10	Pass
28.8348	10	1	10	Pass

Water Quality

POC 2





\+ Pre-Project x Mitigated

Pre-Project Landuse Totals for POC #2
Total Pervious Area: 38.311473
Total Impervious Area: 0

Mitigated Landuse Totals for POC #2
Total Pervious Area: 38.311473
Total Impervious Area: 0

Flow Frequency Method: Weibull

Flow Frequency Return Periods for Pre-Project. POC #2

Return Period	**Flow(cfs)**
2 year	7.524656
5 year	13.894376
10 year	21.135367
25 year	49.103224

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	7.524656
5 year	13.894376
10 year	21.135367
25 year	49.103224

Annual Peaks

Annual Peaks for Pre-Project and Mitigated. POC #2

Year	**Pre-Project**	**Mitigated**
1960	7.476	7.476
1961	1.514	1.514
1962	52.425	52.425
1963	21.193	21.193
1964	6.508	6.508
1965	12.645	12.645
1966	6.130	6.130
1967	12.469	12.469
1968	7.933	7.933
1969	11.410	11.410
1970	8.513	8.513
1971	9.833	9.833
1972	0.741	0.741
1973	10.243	10.243
1974	16.156	16.156

1975	7.510	7.510
1976	0.005	0.005
1977	0.007	0.007
1978	15.931	15.931
1979	7.744	7.744
1980	10.016	10.016
1981	3.733	3.733
1982	13.825	13.825
1983	73.686	73.686
1984	7.580	7.580
1985	9.865	9.865
1986	21.021	21.021
1987	6.012	6.012
1988	7.540	7.540
1989	6.707	6.707
1990	3.753	3.753
1991	1.786	1.786
1992	25.778	25.778
1993	34.529	34.529
1994	1.372	1.372
1995	47.059	47.059
1996	6.913	6.913
1997	12.178	12.178
1998	11.686	11.686
1999	0.027	0.027
2000	0.495	0.495
2001	0.857	0.857
2002	13.230	13.230
2003	16.755	16.755
2004	1.502	1.502
2005	10.462	10.462
2006	10.965	10.965
2007	0.007	0.007
2008	2.082	2.082
2009	0.913	0.913
2010	6.937	6.937
2011	5.334	5.334
2012	0.011	0.011
2013	17.295	17.295
2014	0.051	0.051
2015	6.588	6.588
2016	9.176	9.176
2017	10.791	10.791
2018	3.995	3.995
2019	14.008	14.008
2020	0.007	0.007
2021	0.006	0.006

Ranked Annual Peaks

Ranked Annual Peaks for Pre-Project and Mitigated. POC #2

Rank	Pre-Project	Mitigated
1	73.6859	73.6859
2	52.4246	52.4246
3	47.0593	47.0593
4	34.5293	34.5293
5	25.7782	25.7782
6	21.1927	21.1927
7	21.0207	21.0207

8	17.2950	17.2950
9	16.7545	16.7545
10	16.1556	16.1556
11	15.9309	15.9309
12	14.0076	14.0076
13	13.8247	13.8247
14	13.2304	13.2304
15	12.6445	12.6445
16	12.4693	12.4693
17	12.1784	12.1784
18	11.6863	11.6863
19	11.4096	11.4096
20	10.9651	10.9651
21	10.7909	10.7909
22	10.4622	10.4622
23	10.2432	10.2432
24	10.0156	10.0156
25	9.8646	9.8646
26	9.8333	9.8333
27	9.1761	9.1761
28	8.5128	8.5128
29	7.9332	7.9332
30	7.7445	7.7445
31	7.5801	7.5801
32	7.5397	7.5397
33	7.5101	7.5101
34	7.4760	7.4760
35	6.9374	6.9374
36	6.9130	6.9130
37	6.7070	6.7070
38	6.5883	6.5883
39	6.5082	6.5082
40	6.1303	6.1303
41	6.0124	6.0124
42	5.3343	5.3343
43	3.9951	3.9951
44	3.7529	3.7529
45	3.7329	3.7329
46	2.0820	2.0820
47	1.7861	1.7861
48	1.5143	1.5143
49	1.5018	1.5018
50	1.3720	1.3720
51	0.9128	0.9128
52	0.8572	0.8572
53	0.7410	0.7410
54	0.4954	0.4954
55	0.0514	0.0514
56	0.0274	0.0274
57	0.0106	0.0106
58	0.0074	0.0074
59	0.0073	0.0073
60	0.0072	0.0072
61	0.0059	0.0059
62	0.0053	0.0053

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.7525	1976	1976	100	Pass
0.9584	1746	1746	100	Pass
1.1642	1561	1561	100	Pass
1.3701	1401	1401	100	Pass
1.5760	1266	1266	100	Pass
1.7819	1123	1123	100	Pass
1.9878	1006	1006	100	Pass
2.1937	922	922	100	Pass
2.3996	849	849	100	Pass
2.6055	786	786	100	Pass
2.8113	716	716	100	Pass
3.0172	660	660	100	Pass
3.2231	608	608	100	Pass
3.4290	563	563	100	Pass
3.6349	516	516	100	Pass
3.8408	482	482	100	Pass
4.0467	443	443	100	Pass
4.2526	411	411	100	Pass
4.4584	388	388	100	Pass
4.6643	359	359	100	Pass
4.8702	326	326	100	Pass
5.0761	301	301	100	Pass
5.2820	282	282	100	Pass
5.4879	260	260	100	Pass
5.6938	240	240	100	Pass
5.8997	220	220	100	Pass
6.1056	204	204	100	Pass
6.3114	190	190	100	Pass
6.5173	180	180	100	Pass
6.7232	164	164	100	Pass
6.9291	148	148	100	Pass
7.1350	137	137	100	Pass
7.3409	128	128	100	Pass
7.5468	118	118	100	Pass
7.7527	103	103	100	Pass
7.9585	100	100	100	Pass
8.1644	94	94	100	Pass
8.3703	93	93	100	Pass
8.5762	86	86	100	Pass
8.7821	80	80	100	Pass
8.9880	74	74	100	Pass
9.1939	73	73	100	Pass
9.3998	70	70	100	Pass
9.6056	67	67	100	Pass
9.8115	66	66	100	Pass
10.0174	60	60	100	Pass
10.2233	57	57	100	Pass
10.4292	55	55	100	Pass
10.6351	52	52	100	Pass
10.8410	51	51	100	Pass
11.0469	48	48	100	Pass
11.2527	44	44	100	Pass
11.4586	43	43	100	Pass

11.6645	42	42	100	Pass
11.8704	39	39	100	Pass
12.0763	38	38	100	Pass
12.2822	35	35	100	Pass
12.4881	31	31	100	Pass
12.6940	28	28	100	Pass
12.8999	26	26	100	Pass
13.1057	26	26	100	Pass
13.3116	25	25	100	Pass
13.5175	24	24	100	Pass
13.7234	23	23	100	Pass
13.9293	22	22	100	Pass
14.1352	20	20	100	Pass
14.3411	20	20	100	Pass
14.5470	20	20	100	Pass
14.7528	20	20	100	Pass
14.9587	19	19	100	Pass
15.1646	19	19	100	Pass
15.3705	18	18	100	Pass
15.5764	18	18	100	Pass
15.7823	18	18	100	Pass
15.9882	16	16	100	Pass
16.1941	15	15	100	Pass
16.3999	15	15	100	Pass
16.6058	15	15	100	Pass
16.8117	14	14	100	Pass
17.0176	14	14	100	Pass
17.2235	14	14	100	Pass
17.4294	13	13	100	Pass
17.6353	12	12	100	Pass
17.8412	12	12	100	Pass
18.0470	12	12	100	Pass
18.2529	12	12	100	Pass
18.4588	12	12	100	Pass
18.6647	12	12	100	Pass
18.8706	12	12	100	Pass
19.0765	12	12	100	Pass
19.2824	12	12	100	Pass
19.4883	12	12	100	Pass
19.6942	11	11	100	Pass
19.9000	11	11	100	Pass
20.1059	11	11	100	Pass
20.3118	11	11	100	Pass
20.5177	11	11	100	Pass
20.7236	11	11	100	Pass
20.9295	11	11	100	Pass
21.1354	10	10	100	Pass

Water Quality

Model Default Modifications

Total of 0 changes have been made.

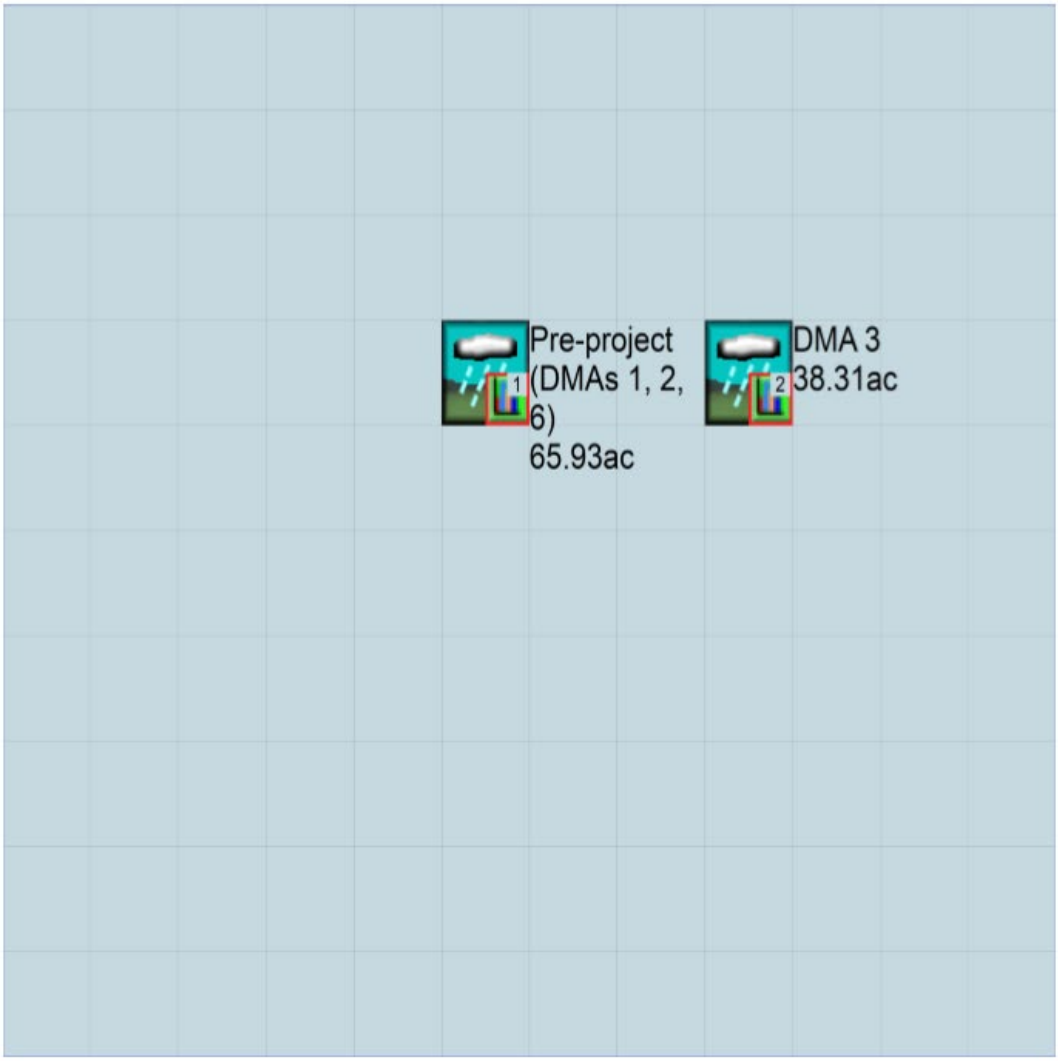
PERLND Changes

No PERLND changes have been made.

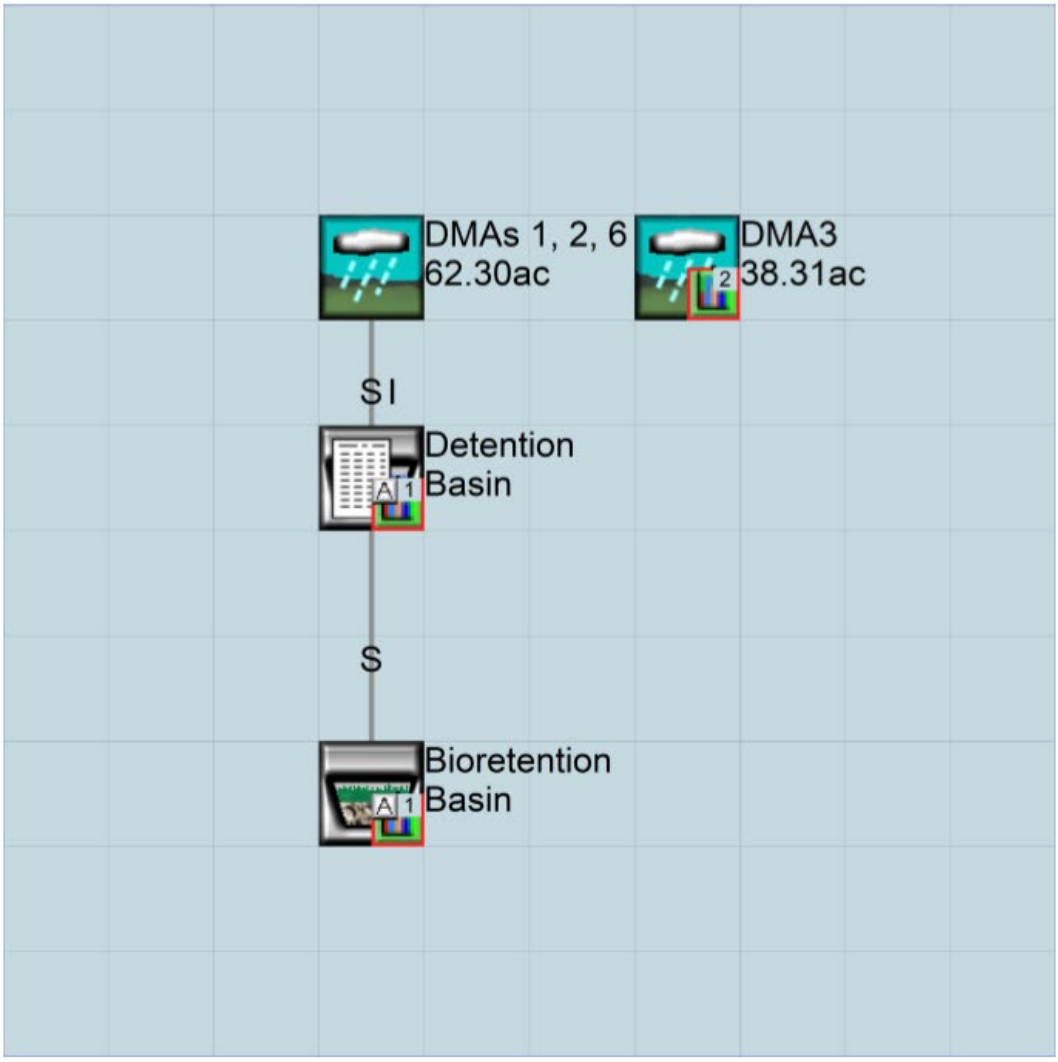
IMPLND Changes

No IMPLND changes have been made.

Appendix
Pre-Project Schematic



Mitigated Schematic



Disclaimer

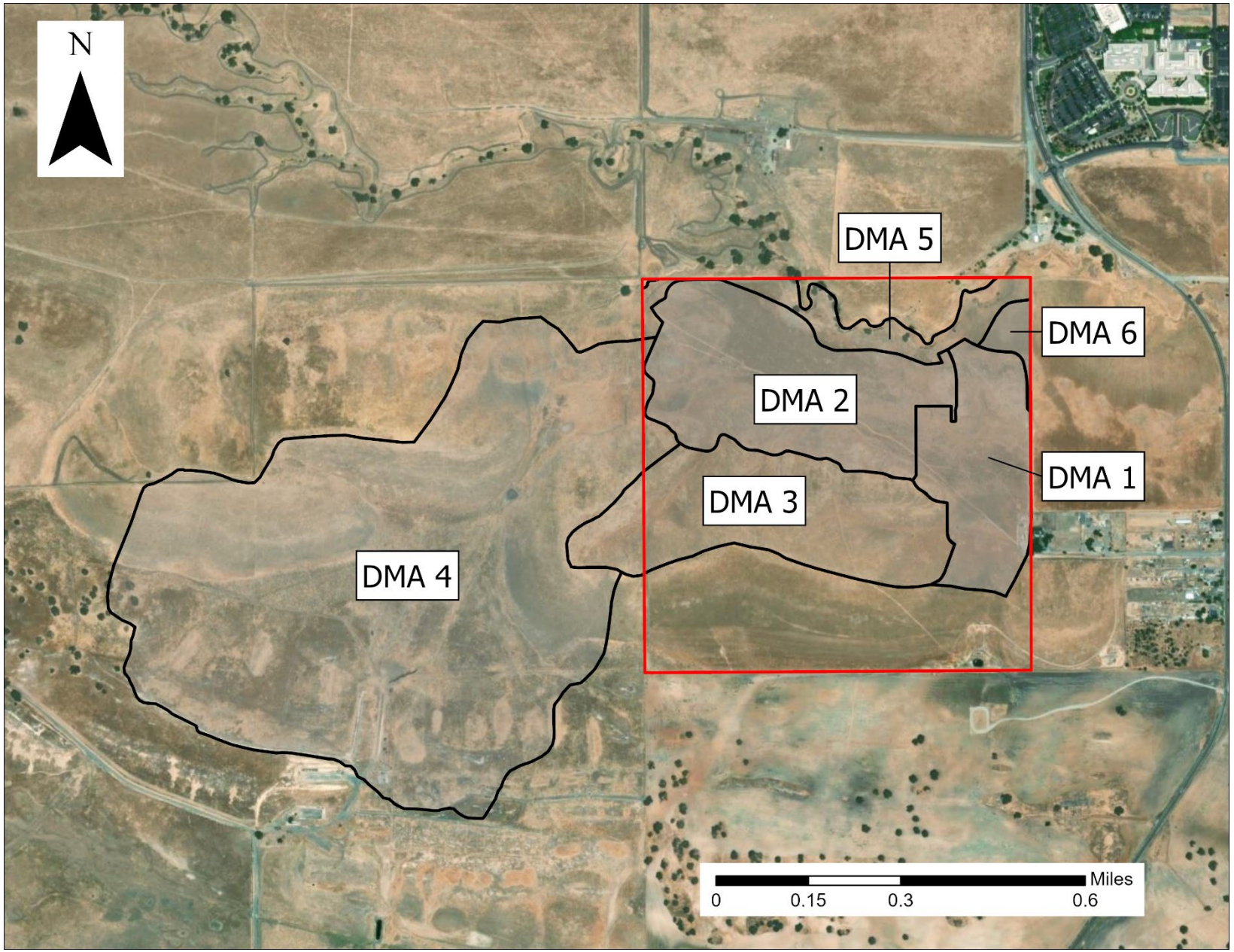
Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind.The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc, Applied Marine SciencesIncorporated, the Alameda County Flood Control and Water Conservation District, EOA Incorporated, member agencies of the Alameda Countywide Clean Water Program, member agencies of the San Mateo Countywide Water Pollution Prevention Program, member agencies of the Santa Clara Valley Urban Runoff Pollution Prevention Program or any other LOU Participants or authorized representatives of LOU Participants be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information,business interruption, and the like) arising out of the use of, or inability to use this programeven if Clear Creek Solutions Inc., Applied Marine Sciences Incorporated, the Alameda County Flood Control and Water Conservation District, EOA Incorporated or any member agencies of the LOU Participants or their authorized representatives have been advised of the possibility of such damages. Software Copyright © by Clear Creek Solutions, Inc. 2005-2024; All Rights Reserved.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Appendix D. Map of DMAs


N
DMA 5
DMA 6
DMA 2
DMA 1
DMA 3
DMA 4
Miles
0
0.15
0.3
0.6