APPENDIX E

Water Quality Management Plan and Hydrology and Hydraulic Report

Preliminary Water Quality Management Plan (WQMP)

Project Name:

Five Lagunas

Prepared for:

Merlone Geier Management, LLC

3580 Carmel Mountain Road, Suite 260

San Diego, California 92130

(858) 350-1977

Prepared by:

Psomas

Engineer David S. Martin Registration No. C74143

28480 Avenue Stanford

Santa Clarita

(661) 219-6000

May 11, 2015

1st Revision: September 30, 2015
2nd Revision: December 23, 2015

Project Owner's Certification			
Permit/Application No.		Grading Permit No.	
Tract/Parcel Map No.		Building Permit No.	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract)			

This Water Quality Management Plan (WQMP) has been prepared for Merlone Geier Management, LLC by Psomas. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan. The project site is subdivided into two areas: Residential and Commercial and it will be designed as two separate projects. Hence, in this WQMP, we have identified the two sites separately and the treatment volumes are calculated accordingly for each project.

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 current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region or <San Diego Region>. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Owner:			
Title	David Geiser		
Company	Merlone Geier Managment, LLC		
Address	3580 Carmel Mountain Road, Suite 260 San Diego, California 92130		
Email	Dgeiser@merlonegeier.com		
Telephone #	(858) 350-1977		
Signature		Date	

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Attachments

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Section I Discretionary Permit(s) and Water Quality Conditions

Provide discretionary permit and water quality information. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available from the Orange County Stormwater Program (ocwatersheds.com).*

Project Infomation			
Permit/Application No.		Tract/Parcel Map No.	
Additional Information/ Comments:	Laguna Hills Mall 24155 Laguna Hills Mall Laguna Hills, CA 92653		
Water Quality Conditions			
Water Quality Conditions (list verbatim)	N/A at this time.		
Watershed-Based Plan Conditions			
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	The project's runoff is tributary to the Aliso Creek. This impaired waterbody has a TMDL for indicator bacteria, selenium, nitrogen, and toxicity as listed on the 2010 303(d) list.		

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas;
- Land uses;
- Land cover;
- Design elements;
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the TGD for information that must be included in the project description.*

Description of Proposed Project		
Development Category (Verbatim from WQMP):	8. Those redevelopment projects that create, add, or replace at least 5,000 square feet of impervious surface on an already developed site and the existing development or redevelopment project falls under another Priority Development Project Category. Where redevelopment results in the addition or replacement of less than 50 percent of the impervious surfaces of a previously existing development site, and the existing development was not subject to WQMP requirements, the numeric sizing criteria discuss below only applies to the addition or replacement, and not the entire development. Where redevelopment results in an addition or replacement of more than 50 percent of the impervious surfaces, the Project WQMP requirements apply to the entire development.	
Project Area (ft^2): 32.6 acres	Number of Dwelling Units: _____	SIC Code: _____
Narrative Project Description:	Three multi-family apartment buildings are proposed to the southeast of the existing Lagunas Hills Mall. New retail buildings are proposed around the existing mall. The southeastern portion of the mall will be demolished.	
Project Area	Pervious	Impervious

	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions				
Post-Project Conditions				
Drainage Patterns/Connections	Existing drainage patterns will remain.			

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the TGD for guidance.*

Pollutants of Concern			
Pollutant	Circle One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	E	N	
Nutrients	E	N	
Heavy Metals	E	N	
Pathogens (Bacteria/Virus)	E	N	
Pesticides	E	N	
Oil and Grease	E	N	Project will have uncovered parking
Toxic Organic Compounds	E	N	
Trash and Debris	E	N	

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are determined to be potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the TGD for* NOC *or Section 2.2.3.2 for* <SOC>.

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the TGD.*

Project site is susceptible to hydromodification impacts.

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the TGD.*

Post development drainage patterns will remain the same. New and/or replaced areas of imperviousness will be treated by bioretention BMPs. In addition, detention basins will store water in compliance with hydromodification requirements.

II.5 Property Ownership/Management

Describe property ownership/management. *Refer to Section 2.2.5 in the TGD.*

The project site is owned by Merlone Geier Management, LLC. No infrastructure is to transfer to public agencies within the property. Owner is to maintain the stormwater quality management devices. The stormwater quality management devices will be inspected and maintained annually before the rainy season begins. Contact information for maintenance is David Geiser (858) 350-1977.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the TGD.*

Planning Area/ Community Name	Urban Village
Location/Address	Five Lagunas
	The project address is 24155 Laguna Hills Mall Laguna Hills, CA 92653
Land Use	COM - Commercial
Zoning	
Acreage	32.6
Predominant Soil Type	D

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. Refer to Section 2.3.2 in the TGD.

Precipitation Zone	0.85 inches
Topography	Level/ gentle sloping
Drainage Patterns/Connections	Existing drainage patterns will remain.
Soil Type, Geology, and Infiltration Properties	Sandy clay and claey sand alluvial soils to depth of 50 to 60 feet with artificial fills in the top 8 feet. Groundwater was encountered between 9 and 20 feet. Infiltration is not feasible due to clay soils and high groundwater.

Site Characteristics (continued)	
Hydrogeologic (Groundwater) Conditions	*Groundwater was found at depths between 9 and 20 feet.*
Geotechnical Conditions (relevant to infiltration)	*Clayey soils and high groundwater.*
Off-Site Drainage	
Utility and Infrastructure Information	There are existing storm drain mains, sewer mains, and water mains throughout the existing project site.

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the TGD.*

Receiving Waters	Aliso Creek
303(d) Listed Impairments	Indicator Bacteria, Selenium, Total Nitrogen as N, and Toxicity
Applicable TMDLs	Phosphorus, Benthic Community Effects, Selenium, Total Nitrogen as N, Toxicity, Diazinon, and Indicator Bacteria
Pollutants of Concern for the Project	Suspended-Solid/Sediment, Nutrients, Pathogens, Pesticides, Oil and Grease, Trash & Debris
Environmentally Sensitive and Special Biological Significant Areas	N/A

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

Describe project performance criteria. Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. The local Permittee planning or NPDES staff should be consulted regarding the existence of an approved WIHMP or equivalent.
- Determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP.*
- Determine applicable LID performance criteria. *Refer to Section 7.II-2.4.3 of the Model WQMP.*
- Determine applicable treatment control BMP performance criteria. *Refer to Section 7.II-*3.2.2 *of the Model WQMP.*
- Calculate the LID design storm capture volume for the project. *Refer to Section 7.II-2.4.3 of the Model WQMP.*

(NOC Permit Area only) Is there an approved WIHMP or equivalent for the project area that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis?	YES ☐	NO ☒
If yes, describe WIHMP feasibility criteria or regional/sub-regional LID opportunities.		

Project Performance Criteria (continued)	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	All PDPs must ensure that post-project runoff flow rates and durations for the PDP shall not exceed pre-development, naturally occurring, runoff flow rates and durations by more than 10% of the time, from 10% of the 2-year runoff event up to the 10-year runoff event.
List applicable LID performance criteria (Section 7.II-2.4.3 from MWQMP)	The following performance criteria for LID implementation are stated in the South Orange County MS4 Permit: -Priority Development Projects must infiltrate, harvest and use, evapotranspire, or biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume). -A properly designed biofiltration system may only be considered if infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biofiltration may be provided for the remaining design capture volume.
List applicable treatment control BMP performance criteria (Section 7.II-3.2.2 from MWQMP)	-The unmet volume as calculated in TGD Appendix VI. Treatment control sizing, or -If no controls have been provided upstream of treatment control BMPs, permit based sizing criteria may be used: o Capture and infiltrate, filter, or treat 80 percent of average annual runoff volume, OR o Capture and infiltrate, filter, or treat the runoff from the 24-hour, 85th percentile storm event, as determined from the County of Orange's 85th Percentile Precipitation Isopluvial Map and draw down the stored volume in no more than 48 hours following the end of precipitation, OR o Treat the maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity, as determined from the local historical rainfall record, multiplied by a factor of two, OR o The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event.

Calculate LID design storm capture volume for Project.	See attached spreadsheet.

IV.2. SITE DESIGN AND DRAINAGE PLAN

Describe site design and drainage plan including

- A narrative of site design practices utilized or rationale for not using practices;
- A narrative of how site is designed to allow BMPs to be incorporated to the MEP
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP plot plan.
- Calculation of Design Capture Volume (DCV) for each drainage area.
- A listing of GIS coordinates for LID and Treatment Control BMPs (unless not required by local jurisdiction).

Refer to Section 2.4.2 in the TGD.

The site is designed to incorporate bioretention BMPs for treatment of the required impervious areas. Infiltration, harvest and reuse, and evapotranspiration are not feasible. See attached calculation spreadsheets for the DCV and sizing of LID BMPs for each DMA.

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

Each sub-section below documents that the proposed design features conform to the applicable project performance criteria via check boxes, tables, calculations, narratives, and/or references to worksheets. *Refer to Section 2.4.2.3 in the TGD for selecting LID BMPs and Section 2.4.3 in the TGD for conducting conformance analysis with project performance criteria.*

IV.3.1 Hydrologic Source Controls

If required HSCs are included, fill out applicable check box forms. If the retention criteria are otherwise met with other LID BMPs, include a statement indicating HSCs not required.

Name	Included?
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐
Impervious area reduction (e.g. permeable pavers, site design)	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐
Other:	☐

IV.3.2 Infiltration BMPs

Identify infiltration BMPs to be used in project. If design volume cannot be met state why BMPs cannot be met

Name	Included?
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration BMPs. If not document how much can be met with infiltration and document why it is not feasible to meet the full volume with infiltration BMPs.

Infiltration is not feasible.

IV.3.3 Evapotranspiration, Rainwater Harvesting BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, describe any evapotranspiration, rainwater harvesting BMPs.

Name	Included?
All HSCs; *See Section IV.3.1*	☐
Surface-based infiltration BMPs	☐
Biotreatment BMPs	☐
Above-ground cisterns and basins	☐
Underground detention	☐
Other:	☐
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with evapotranspiration, rainwater harvesting BMPs in combination with infiltration BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

Evapotranspiration BMPs and rainwater harvesting BMPs are not feasible.

IV.3.4 Biotreatment BMPs

If the full Design Storm Capture Volume cannot be met with infiltration BMPs, and/or evapotranspiration and rainwater harvesting BMPs, describe biotreatment BMPs. Include sections for selection, suitability, sizing, and infeasibility, as applicable.

Name	Included?
Bioretention with underdrains	☒
Stormwater planter boxes with underdrains	☒
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☒
Other:	☐
Other:	☐

Show calculations below to demonstrate if the LID Design Strom Capture Volume can be met with infiltration, evapotranspiration, rainwater harvesting and/or biotreatment BMPs. If not document how much can be met with either infiltration BMPs, evapotranspiration, rainwater harvesting BMPs, or a combination, and document why it is not feasible to meet the full volume with either of these BMPs categories.

See attached calculation spreadsheets for preliminary BMP sizing.

IV.3.5 Hydromodification Control BMPs

Describe hydromodification control BMPs. See Section 5 TGD. Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval.

Hydromodification Control BMPs	
BMP Name	**BMP Description**
Detention Basin A	Detention basin will be located in the basement of the residential parking structure. The detention basin will have a volume of 2.3 ac-ft. The tributary area is 10.4 acres. Sizing is based on calculations performed using HMS 3.5 program. See Attachment B for Hydromodification Plan.
Detention Basin B	Detention basin will be located in the basement of the residential parking structure. The detention basin will have a volume of 2.3 ac-ft. The tributary area is 10.7 acres. Sizing is based on calculations performed using HMS 3.5 program. See Attachment B for Hydromodification Plan.
Detention Basin C	Detention basin will be located in the basement of the commercial parking structure. The detention basin will have a volume of 3.9 ac-ft. The tributary area is 16.3 acres. Sizing is based on calculations performed using HMS 3.5 program. See Attachment B for Hydromodification Plan.

IV.3.6 Regional/Sub-Regional LID BMPs

Describe regional/sub-regional LID BMPs in which the project will participate. *Refer to Section 7.II-2.4.3.2 of the Model WQMP*.

Regional/Sub-Regional LID BMPs
Not Applicable at this time

IV.3.7 Treatment Control BMPs

Treatment control BMPs can only be considered if the project conformance analysis indicates that it is not feasible to retain the full design capture volume with LID BMPs. Describe treatment control BMPs including sections for selection, sizing, and infeasibility, as applicable.

Treatment Control BMPs	
BMP Name	**BMP Description**

IV.3.8 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N1	Education for Property Owners, Tenants and Occupants	☒	☐	
N2	Activity Restrictions	☒	☐	
N3	Common Area Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	
N6	Local Industrial Permit Compliance	☐	☐	
N7	Spill Contingency Plan	☒	☐	
N8	Underground Storage Tank Compliance	☐	☐	
N9	Hazardous Materials Disclosure Compliance	☐	☒	N/A
N10	Uniform Fire Code Implementation	☐	☒	N/A
N11	Common Area Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N13	Housekeeping of Loading Docks	☒	☐	
N14	Common Area Catch Basin Inspection	☒	☐	
N15	Street Sweeping Private Streets and Parking Lots	☒	☐	
N16	Retail Gasoline Outlets	☐	☒	N/A

IV.3.9 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if Structural source controls were not used.

Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
S1	Provide storm drain system stenciling and signage	☒	☐	
S2	Design and construct outdoor material storage areas to reduce pollution introduction	☐	☒	
S3	Design and construct trash and waste storage areas to reduce pollution introduction	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S5	Protect slopes and channels and provide energy dissipation	☐	☒	N/A
	Incorporate requirements applicable to individual priority project categories (from SDRWQCB NPDES Permit)	☒	☐	
S6	Dock areas	☒	☐	
S7	Maintenance bays	☐	☒	N/A
S8	Vehicle wash areas	☐	☒	N/A
S9	Outdoor processing areas	☐	☒	N/A
S10	Equipment wash areas	☐	☒	N/A
S11	Fueling areas	☐	☒	N/A
S12	Hillside landscaping	☐	☒	N/A
S13	Wash water control for food preparation areas	☒	☐	
S14	Community car wash racks	☐	☒	N/A

IV.4 ALTERNATIVE COMPLIANCE PLAN (IF APPLICABLE)

IV.4.1 Water Quality Credits

Determine if water quality credits are applicable for the project. *Refer to Section 3.1 of the Model WQMP for description of credits and Appendix VI of the TGD for calculation methods for applying water quality credits.*

Description of Proposed Project				
Project Types that Qualify for Water Quality Credits (Select all that apply):				
☐Redevelopment projects that reduce the overall impervious footprint of the project site.	☐Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped.		☐ Higher density development projects which include two distinct categories (credits can only be taken for one category): those with more than seven units per acre of development (lower credit allowance); vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2 or those having more than 18 units per acre (greater credit allowance).	
☐ Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution).		☐ Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned		☐ Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping).
☐Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses.	☐ Developments in a city center area.	☐ Developments in historic districts or historic preservation areas.	☐ Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories.	☐In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.
Calculation of Water Quality Credits (if applicable)	Not Applicable at this time			

IV.4.2 Alternative Compliance Plan Information

Describe an alternative compliance plan (if applicable). Include alternative compliance obligations (i.e., gallons, pounds) and describe proposed alternative compliance measures. *Refer to Section 7.II 3.0 in the WQMP.*

Not Applicable at this time

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**
Detention Basins	Merlone Geier Management	Clean out detention basins	Annually or as needed
Raised Planters	Merlone Geier Management	Clean out planters	Annually or as needed
At Grade Planters	Merlone Geier Management	Clean out planters	Annually or as needed
Modular Wetlands	Merlone Geier Management	Clean out settling tank, replace filters	Annually or as needed

BMP Inspection/Maintenance			
BMP	**Reponsible Party(s)**	**Inspection/ Maintenance Activities Required**	**Minimum Frequency of Activities**

Section VI Site Plan and Drainage Plan

VI.1 SITE PLAN AND DRAINAGE PLAN

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Drainage connections
- BMP details

VI.2 ELECTRONIC DATA SUBMITTAL

The minimum requirement is to provide submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open.

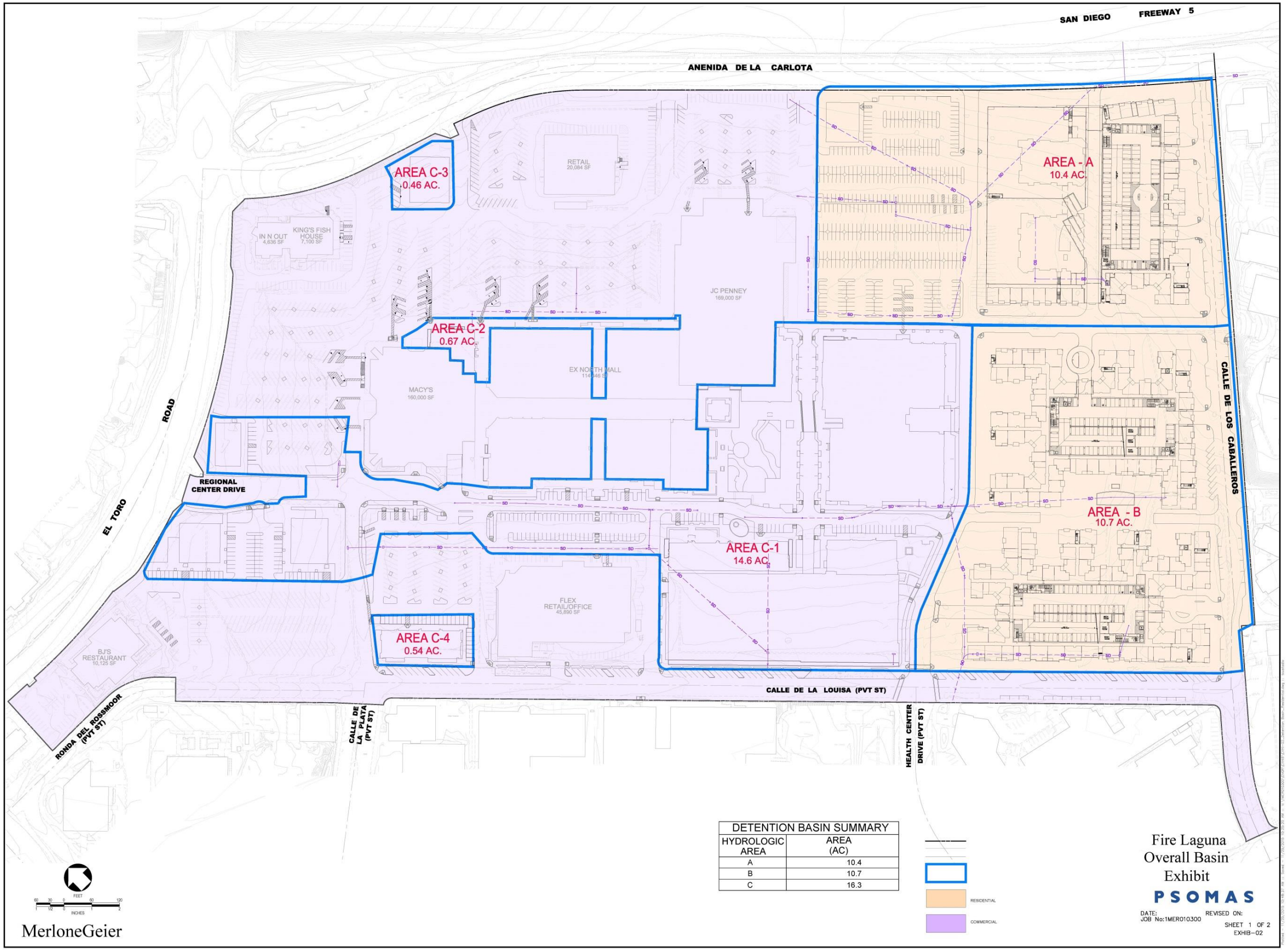
If the local jurisdiction requires specialized electronic document formats (CAD, GIS) to be submitted, this section will be used to describe the contents (e.g., layering, nomenclature, georeferencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. For the copy submitted to the Permittee, only attach the educational materials specifically applicable to the project. Other materials specific to the project may be included as well and must be attached.

Education Materials			
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**	**Business Material (http://www.ocwatersheds.com)**	**Check If Applicable**
The Ocean Begins at Your Front Door	☒	Tips for the Automotive Industry	☐
Tips for Car Wash Fund-raisers	☐	Tips for Using Concrete and Mortar	☐
Tips for the Home Mechanic	☐	Tips for the Food Service Industry	☐
Homeowners Guide for Sustainable Water Use	☐	Proper Maintenance Practices for Your Business	☐
Household Tips	☒	**Other Material**	**Check If Attached**
Proper Disposal of Household Hazardous Waste	☒		
Recycle at Your Local Used Oil Collection Center (North County)	☐	Children's Brochure	☒
Recycle at Your Local Used Oil Collection Center (Central County)	☐		☐
Recycle at Your Local Used Oil Collection Center (South County)	☐		☐
Tips for Maintaining a Septic Tank System	☐		☐
Responsible Pest Control	☒		☐
Sewer Spill	☐		☐
Tips for the Home Improvement Projects	☒		☐
Tips for Horse Care	☐		☐
Tips for Landscaping and Gardening	☒		☐
Tips for Pet Care	☒		☐
Tips for Pool Maintenance	☐		☐
Tips for Residential Pool, Landscape and Hardscape Drains	☒		☐
Tips for Projects Using Paint	☒		☐

ATTACHMENT B



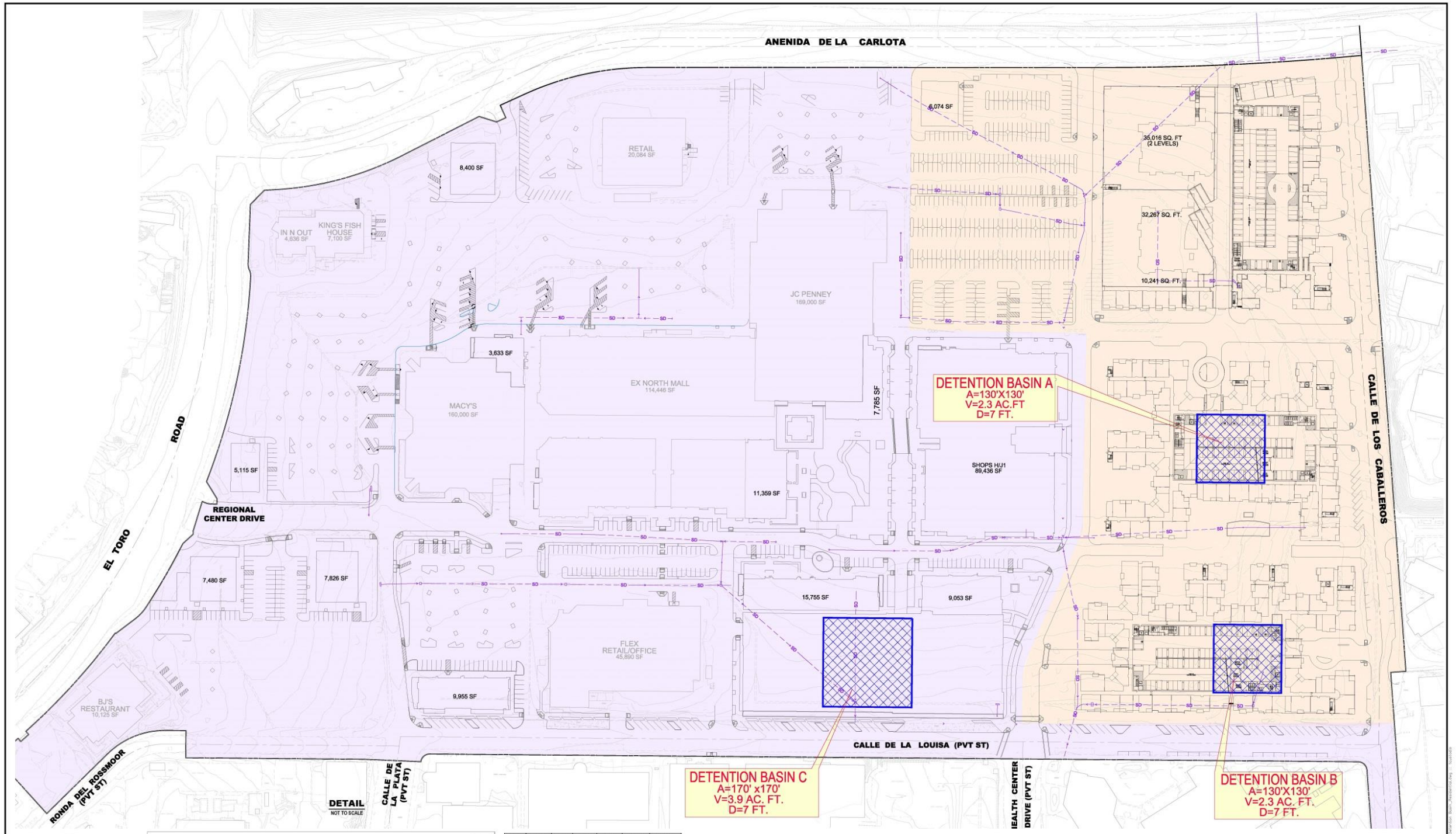
DETENTION BASIN SUMMARY	
HYDROLOGIC AREA	AREA (AC)
A	10.4
B	10.7
C	16.3

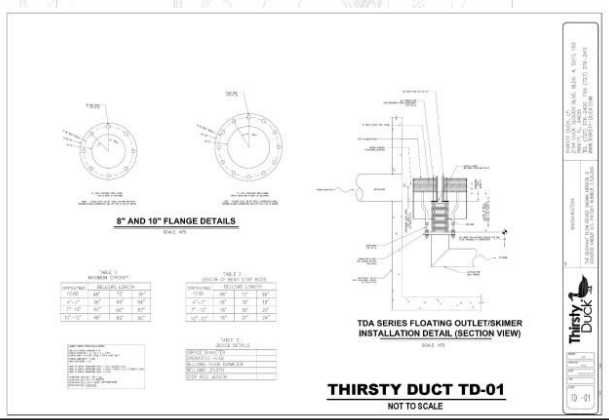
MerloneGeier

Fire Laguna
Overall Basin
Exhibit

PSOMAS

DATE:
JOB No:1MER010300
REVISED ON:
SHEET 1 OF 2
EXHIB-02





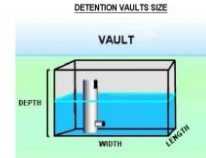
THIRSTY DUCT TD-01
NOT TO SCALE

Basin	Foot Print (feet X feet)	Depth (feet)	Riser Height (feet)	Riser Diameter (in)	Freeboard (feet)	Riser Type
A	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
B	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
C	170X170	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice

DETENTION VAULTS SIZE

Basin	Orifice No.	Type	Riser Notch Height (feet)	Riser Notch Width (feet)	Riser Type
A	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
B	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
C	1	Thirsty Duck (P-184)	2	2	Notched Rectangular

DETENTION VAULTS OUTLET STRUCTURES



VAULT DETAIL
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VAULT OUTLET STRUCTURE DETAIL
NOT TO SCALE

DETENTION BASIN SUMMARY		
HYDROLOGIC AREA	AREA (AC)	VOLUME (AC- FT)
A	10.4	2.3 AC - FT
B	10.7	2.3 AC - FT
C	16.3	3.9 AC - FT

LEGEND:

- EXISTING PROPERTY BOUNDARY
- EXISTING IMPROVEMENTS
- PROPOSED SITE PLAN IMPROVEMENTS
- PROPOSED DETENTION BASIN
- RESIDENTIAL
- COMMERCIAL

Fire Laguna
HMP Detention Basin
Exhibit

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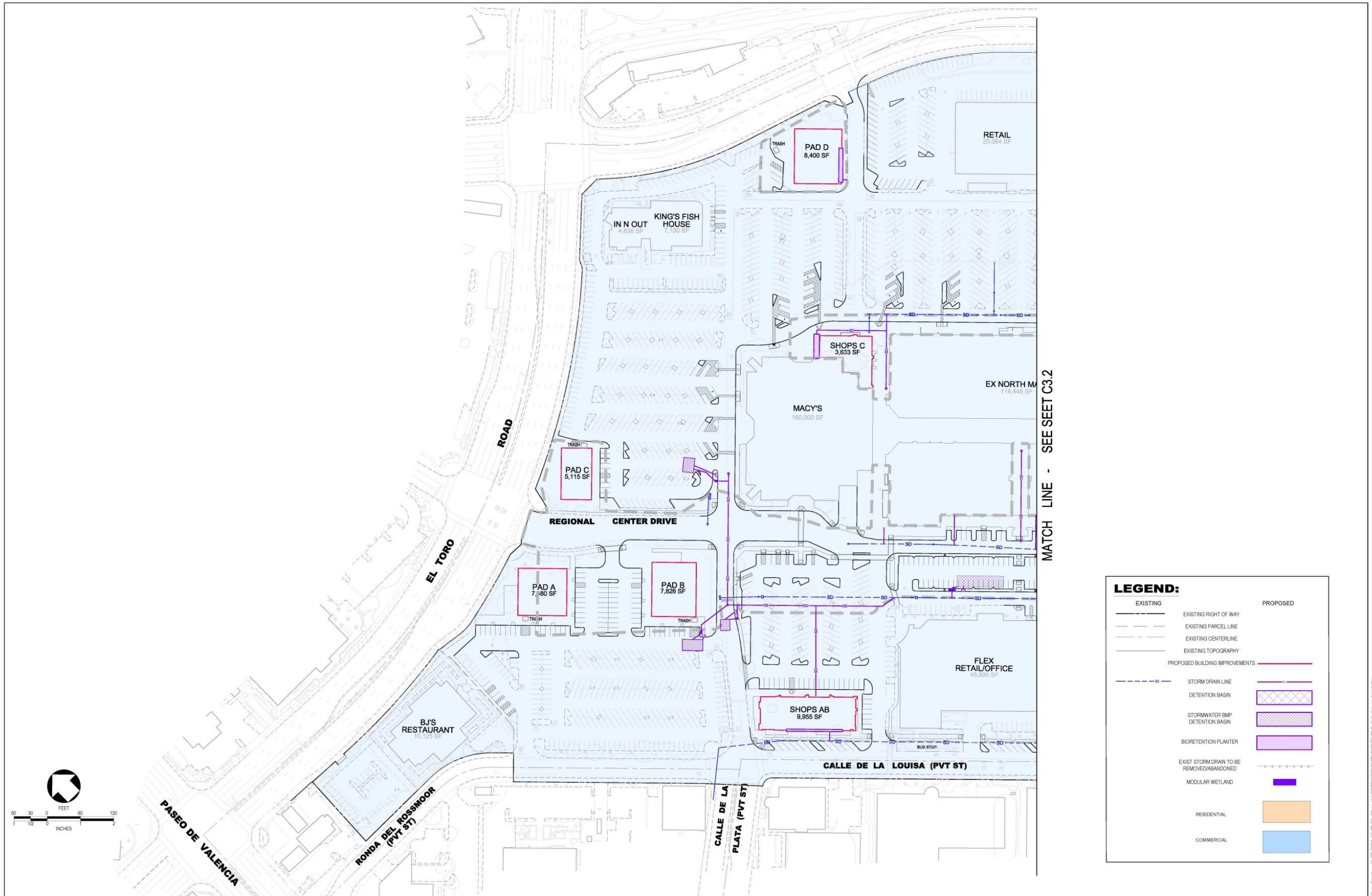
SHEET 2 OF 2
EXHIB-02

MerloneGeier



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STORM DRAIN PLAN (SHEET 1 OF 2)
11.03.2015

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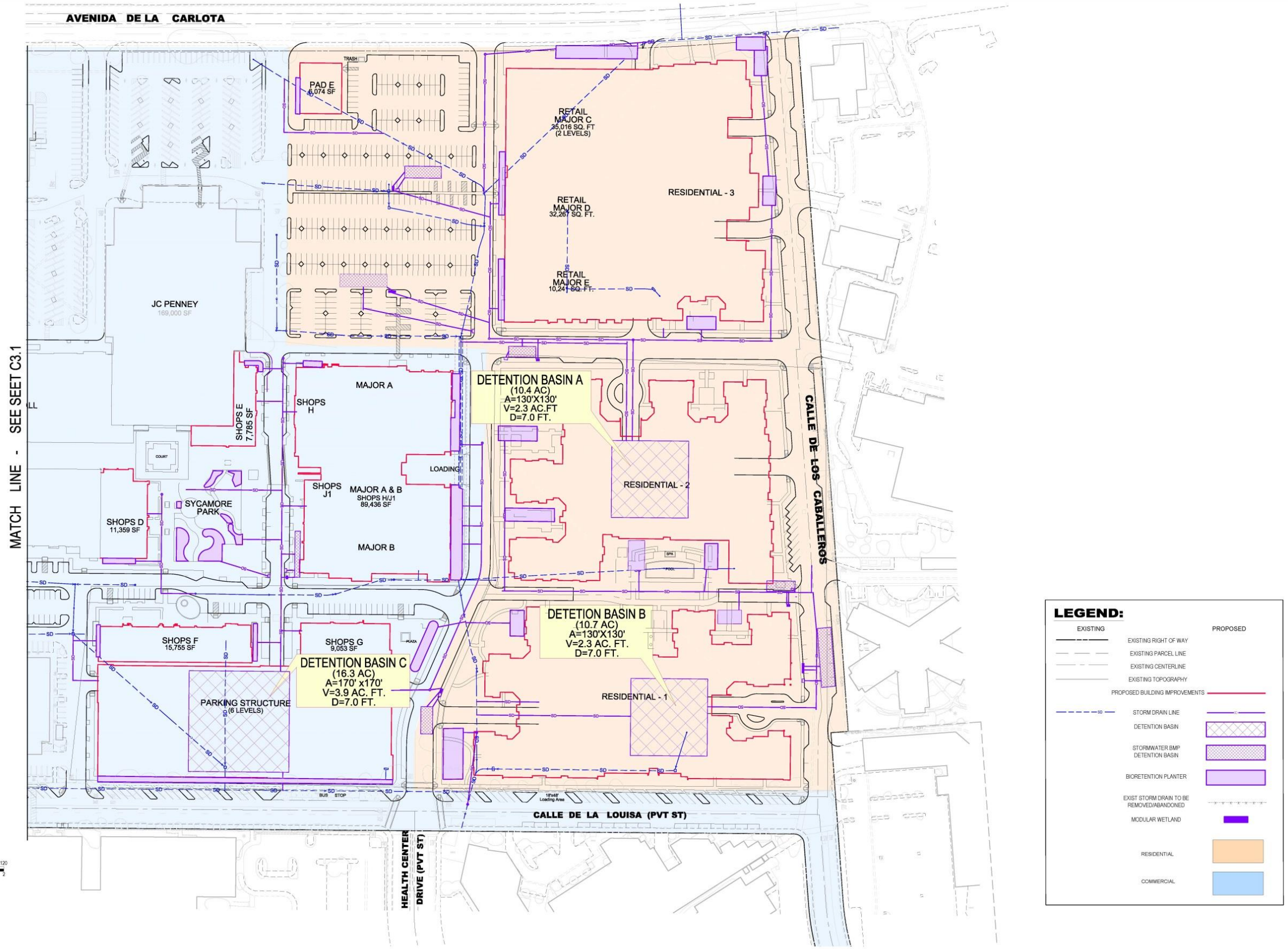

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STORM DRAIN PLAN (SHEET 2 OF 2)
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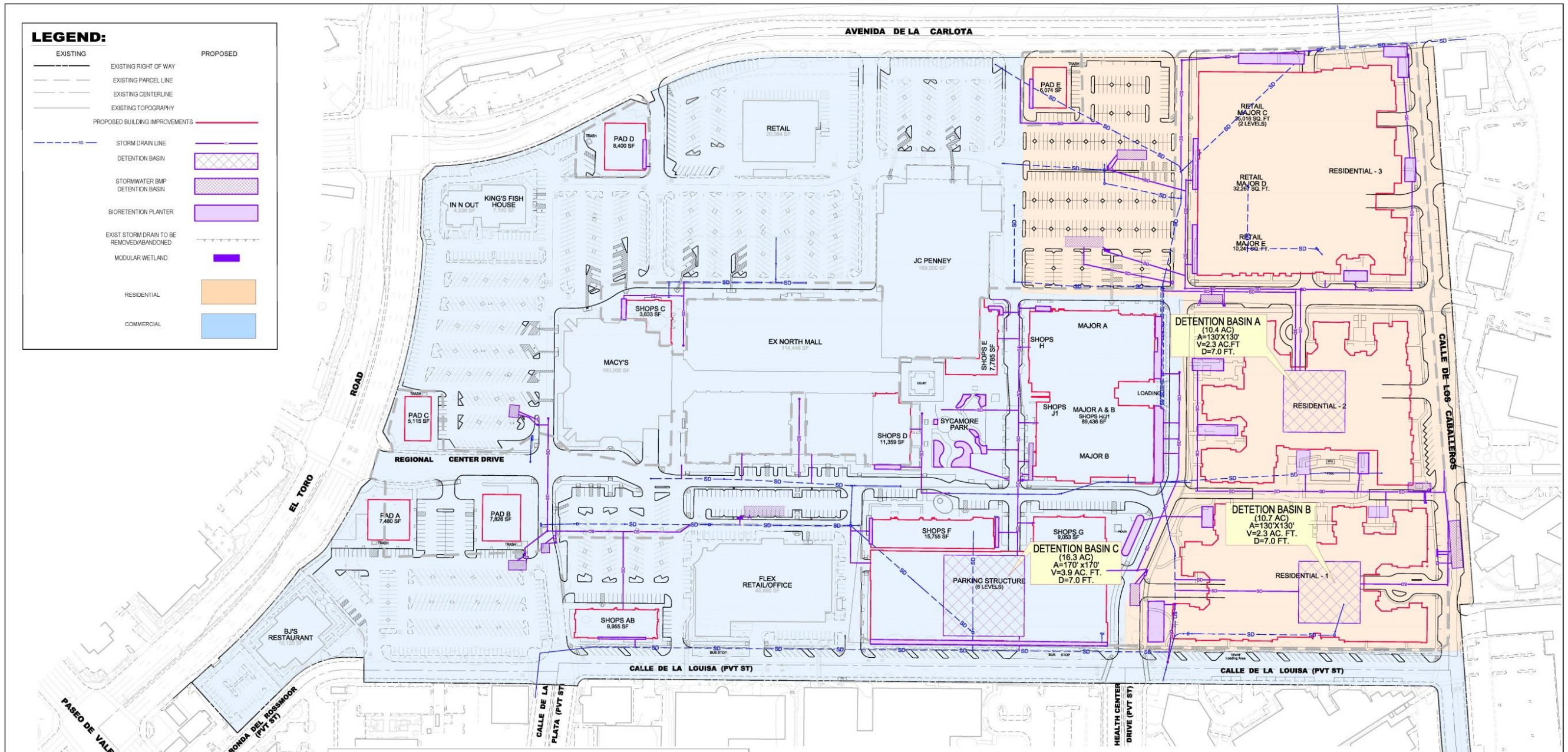
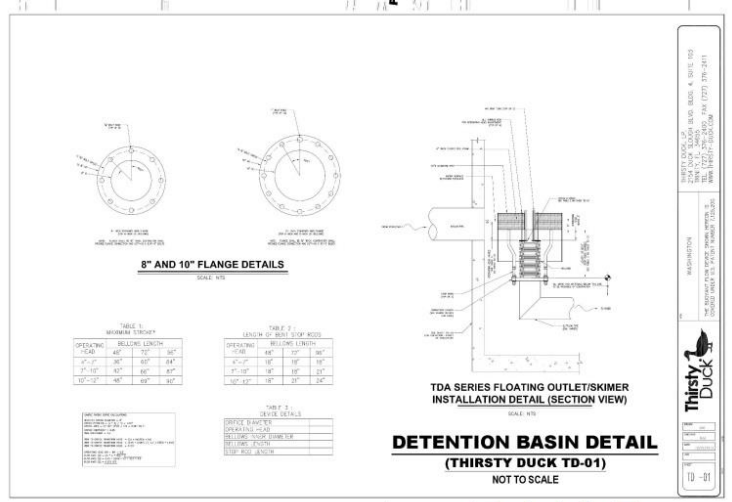




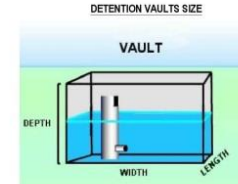
Basin	Foot Print (feet X feet)	Depth (feet)	Riser Height (feet)	Riser Diameter (in)	Freeboard (feet)	Riser Type
A	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
B	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
C	170X170	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice

DETENTION VAULTS SIZE

Basin	Orifice No.	Type	Riser Notch Height (feet)	Riser Notch Width (feet)	Riser Type
A	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
B	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
C	1	Thirsty Duck (P-184)	2	2	Notched Rectangular

DETENTION VAULTS OUTLET STRUCTURES

DETENTION BASIN SUMMARY		
HYDROLOGIC AREA	AREA (AC)	VOLUME (AC- FT)
A	10.4	2.3 AC - FT
B	10.7	2.3 AC - FT
C	16.3	3.9 AC - FT



VAULT DETAIL
NOT TO SCALE

VAULT OUTLET STRUCTURE DETAIL
NOT TO SCALE

FEET 80 40 0 80 160
INCHES 1 1/2 0 1 2

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OVERALL STORM DRAIN PLAN
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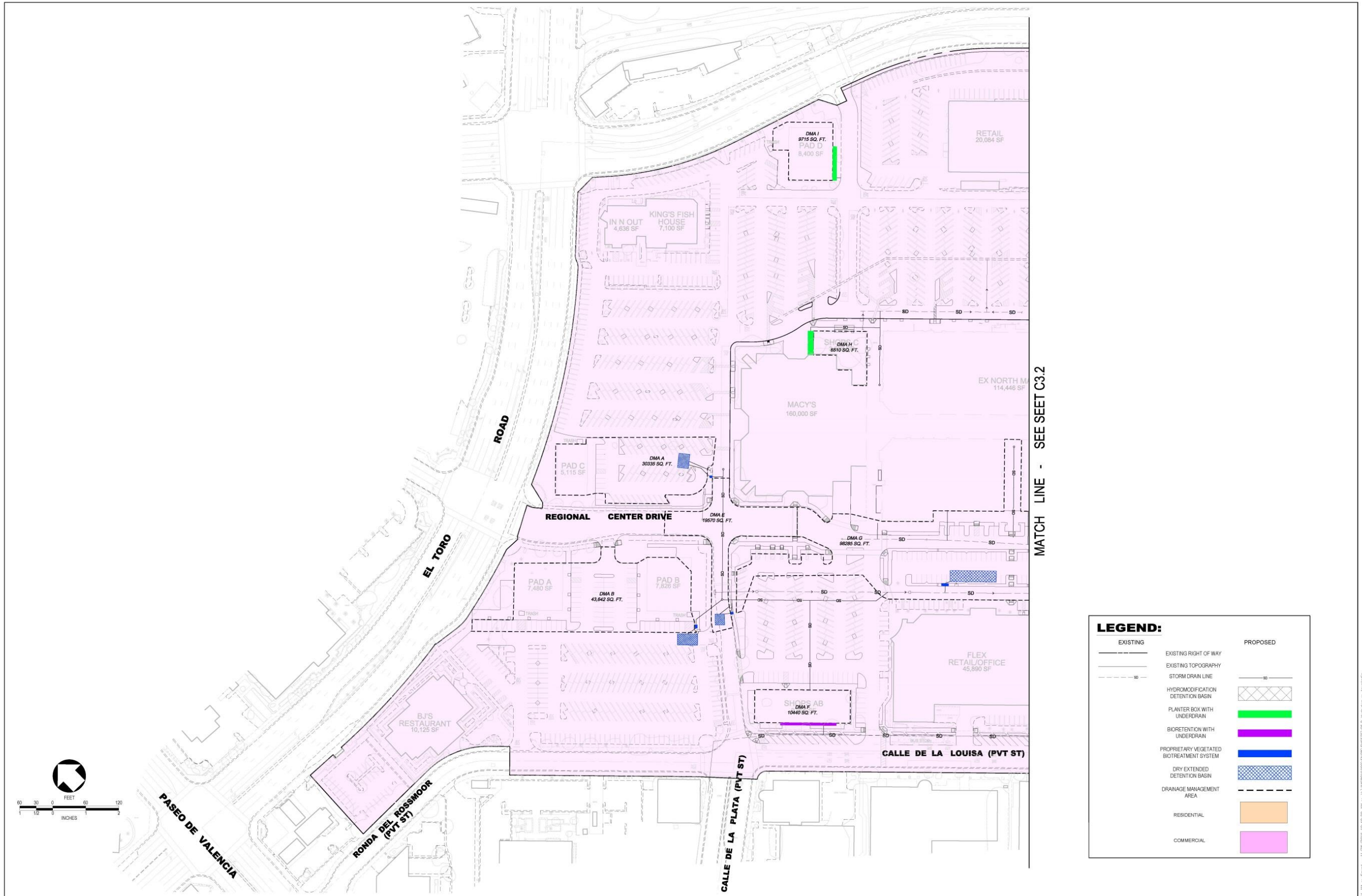

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WQMP PLAN (SHEET 1 OF 2)

11.03.2015

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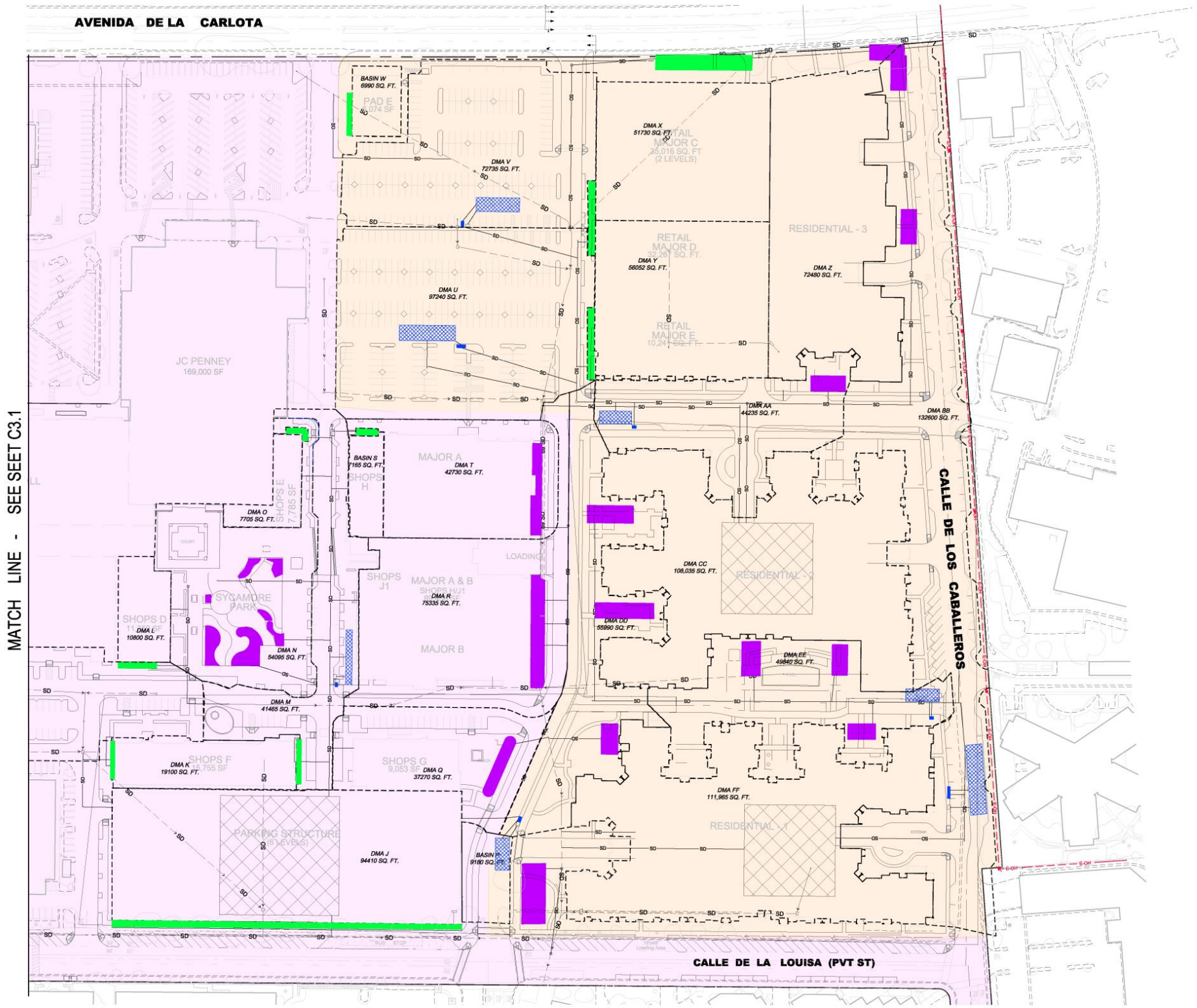

LEGEND:

EXISTING		PROPOSED
	EXISTING RIGHT OF WAY	
	EXISTING TOPOGRAPHY	
SD	STORM DRAIN LINE	SD
	HYDROMODIFICATION DETENTION BASIN	
	PLANTER BOX WITH UNDERDRAIN	
	BIORETENTION WITH UNDERDRAIN	
	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM	
	DRY EXTENDED DETENTION BASIN	
	DRAINAGE MANAGEMENT AREA	
	RESIDENTIAL	
	COMMERCIAL	

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WQMP PLAN (SHEET 2 OF 2)
11.03.2015

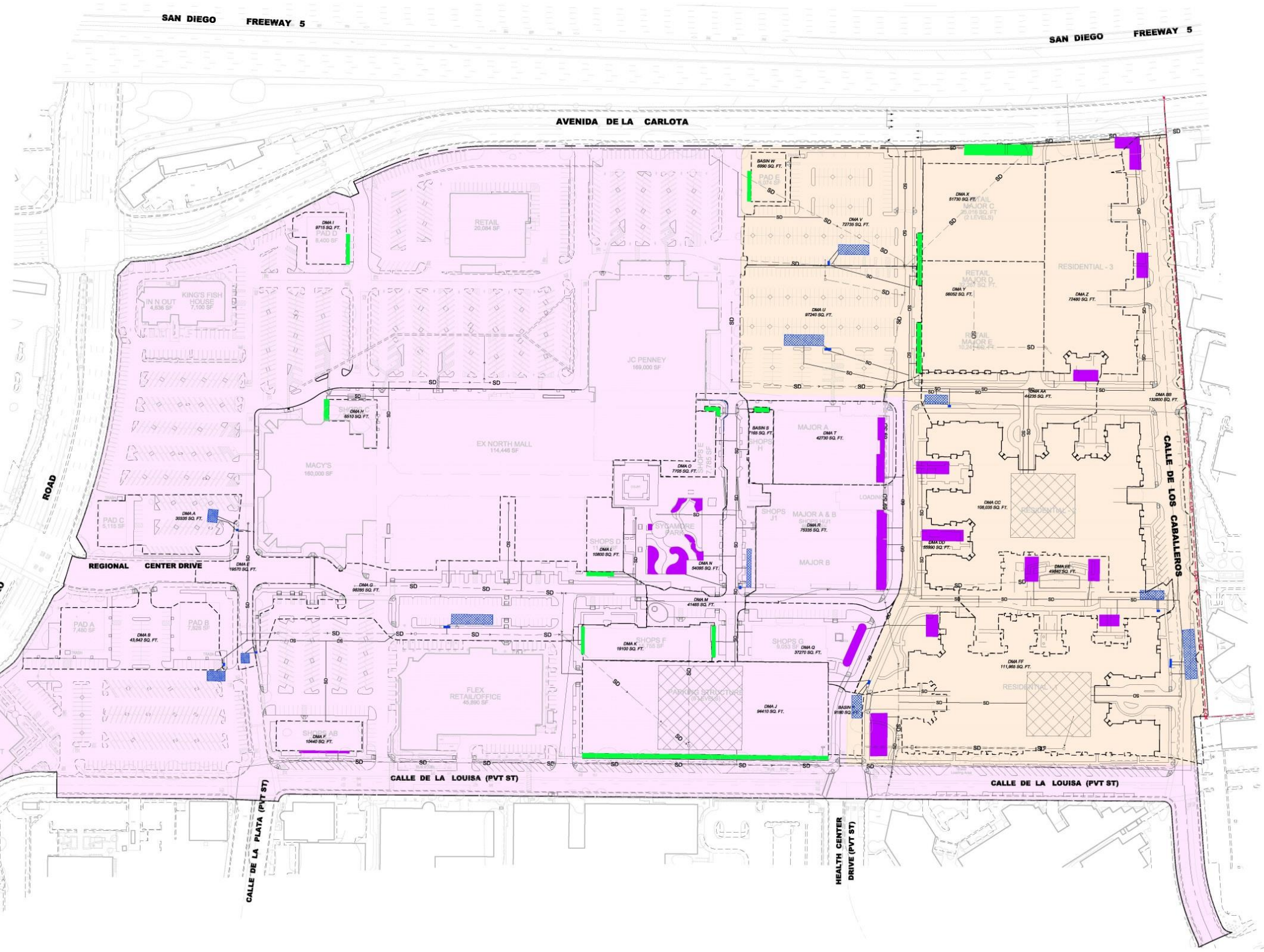
C6.2

LEGEND:

EXISTING		PROPOSED
	EXISTING RIGHT OF WAY	
	EXISTING TOPOGRAPHY	
SD	STORM DRAIN LINE	SD
	HYDROMODIFICATION DETENTION BASIN	
	PLANTER BOX WITH UNDERDRAIN	
	BIORETENTION WITH UNDERDRAIN	
	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM	
	DRY EXTENDED DETENTION BASIN	
	DRAINAGE MANAGEMENT AREA	
	RESIDENTIAL	
	COMMERCIAL	

WQMP BMP's BY DRAINAGE MANAGEMENT AREA

DMA	AREA (sq. ft.)	DCV (cu. ft.)	BMP
A	30335	1773	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
B	43642	2550	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
E	19570	1144	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
F	10440	610	BIORETENTION WITH UNDERDRAIN
G	98300	5744	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
H	8510	497	PLANTER BOX WITH UNDERDRAIN
I	9715	568	PLANTER BOX WITH UNDERDRAIN
J	94410	5517	PLANTER BOX WITH UNDERDRAIN
K	19100	1116	PLANTER BOX WITH UNDERDRAIN
L	10800	631	PLANTER BOX WITH UNDERDRAIN
M	41465	2423	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
N	54095	3161	BIORETENTION WITH UNDERDRAIN
O	7700	450	PLANTER BOX WITH UNDERDRAIN
Q	37270	2178	BIORETENTION WITH UNDERDRAIN
R	75335	4402	BIORETENTION WITH UNDERDRAIN
S	7230	423	PLANTER BOX WITH UNDERDRAIN
T	42730	2497	BIORETENTION WITH UNDERDRAIN
U	97240	5682	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
V	72735	4250	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
W	7000	409	PLANTER BOX WITH UNDERDRAIN
X	51730	3023	PLANTER BOX WITH UNDERDRAIN
Y	56052	3276	PLANTER BOX WITH UNDERDRAIN
Z	72480	4236	BIORETENTION WITH UNDERDRAIN
AA	44235	2585	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
BB	132500	7749	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
CC	108035	6313	BIORETENTION WITH UNDERDRAIN
DD	55600	3249	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
EE	49840	2913	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
FF	111965	6543	BIORETENTION WITH UNDERDRAIN



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OVERALL WQMP PLAN

11.03.2015

C6.0

HYDROMODIFICATION PLAN
FIVE LAGUNAS

Prepared for:

Merlone Geier Management, LLC
3580 Carmel Mountain Road, Suite 260
San Diego, CA 92130

Prepared by:

PSOMAS
David Martin
28480 Avenue Stanford
Suite 200
Santa Clarita, CA 91355

1st Submission: September 21, 2015
2nd Submission: November 13, 2015

David Martin RCE 74143

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APPENDICIES

Appendix A HYDROLOGY PARAMETERS AND EXHIBITS
Appendix B HMS RESULTS
Appendix C HMP: DETENTION BASIN AND CONTROL STRUCTURE EXHIBIT
Appendix D DVD INCLUDING HMS MODEL, SOHM MODEL AND DURATION ANALYSIS

1.0 Introduction

Project Description

The project is located in the City of Laguna Hills west of Avenida de la Carlota and south of El Toro road. The site consists of the existing Laguna Hills Mall. A portion of the existing mall will be demolished and new commercial/retail buildings and residential buildings will be constructed. Two parking structures serving the residential portion of the project are proposed along with one parking structure serving the commercial uses. Regrading of existing parking lots will be kept to a minimum. Existing drainage patterns will remain. The site generally drains from east to west to an existing 69" storm drain that bisects the site, running from east to west.

Storm water quality mitigation measures and Hydrology and Hydraulics reports are submitted separately. See "Preliminary Water Quality Management Plan, Five Lagunas"& "Hydrology and Hydraulics Five Lagunas", dated September 30, 2015 by Psomas.

Purpose and Scope

This project falls under the jurisdiction of the City of Laguna Hills. The purpose of this report is to document the hydromodification plan to comply with the requirements of South Orange County Hydromodification Management Plan, April 1, 2015.

Existing Conditions

The existing site, consists of the main mall building and six separate standalone buildings, currently drains to an onsite storm drain system. The system has multiple lines which all eventually connect to an existing 69" storm drain main which exits the site at Calle de la Louisa and Health Center Drive.

Proposed Conditions

The proposed development will maintain existing drainage patterns, however, runoff from the site will be treated and detained in conformance with Orange County WQMP and hydromodification requirements. These requirements will result in a significant decrease of flows in the proposed conditions.

The three Basins A, B and C were delineated and included as Exhibit 1 under Appendix A including proposed improvements on the project site.

The proposed development will collect runoff into a subsurface storm drain which is to be connected to the existing subsurface storm drain. Surface flows from the parking and drive aisle will flow to a modular wetland detention basins and planter boxes. It is assumed that each BMP will increase the time of concentration of flow path by additional 10 minutes. The runoff from the impervious area will be first collected in the BMPs and then the treated runoff will be disposed to the storm drains. These facilities disconnects the impervious area and increases the travel time of runoff though the BMPs by detention and infiltration techniques, hence the flow path is increased overall contributing to increased time of concentration. The increased time of concentration was used in HMS model to determine the post development flows. See Appendix B and D for HMS Calculations and Model. Detailed storm water quality improvement plan is also included in Appendix A.

2.0 Hydromodification Plan (HMP)

The following lists the requirements from the South Orange County Hydromodification Plan, April 1, 2015, which are determined applicable to our project.

1. Priority Development Projects (PDPs) are required to implement hydrologic control measures and onsite management controls so that post-project runoff flow rates and durations do not exceed pre-development, i.e. naturally occurring conditions, flow rates and durations where they would result in an increased potential for erosion or significant impacts to beneficial uses (Permit Section F.1.h.).

2. HMP Criteria: The HMP criteria are designed to manage increases in runoff discharge rates and durations from all Priority Development Projects (PDPs) and they apply to all PDPs. The HMP criteria include the following:
• *All PDPs must use continuous simulation to ensure that post-project runoff flow rates and durations for the PDP shall not exceed pre-development, naturally occurring, runoff flow rates and durations by more than 10% for peak flow rates, from 10% of the 2-year runoff event up to the 10-year runoff event.*

3. Continuous Simulation Modeling Software: The following public domain software models may be used to assess Hydromodification Controls for storm water facilities to meet the hydromodification criteria:
• Hydrologic Simulation Program – FORTRAN (HSPF), distributed by U.S. EPA
• Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS), distributed by the U.S. Army Corps of Engineers Hydrologic Engineering Center
• Storm Water Management Model (SWMM); distributed by U.S. EPA

HMP analysis for this report is limited to the onsite development areas affected by the proposed development. The affected areas are comprised primarily of existing buildings and paved surface parking lots.

2.1 Data Collection

The hydrologic input data was collected from the Orange County as listed below:

- South Orange County Hydromodification Model (SOHM) .wdm files for precipitation input
- SOHM manual for derivation of other hydrologic parameters

Our correspondence regarding the input data and parameters are included in Appendix A.

2.2 Approach

The HMS model version 3.5 was used in this study to perform the continuous simulations to assess hydromodication controls for storm water facilities, which also follows the methodology used in the Orange County Flood Division Hydrology Manual.

On-site drainage areas and slopes were determined by a review of the grades (see Hydrology Map, Appendix A). For the purposes of this preliminary hydrology study, an imperviousness of 90% was assumed for the site. A time of concentration was computed using NRCS formula for small watershed for each drainage area. Soil type (B) was found for the project site from the Orange County Soil Plate B (see Appendix B). The curve numbers was computed using the Orange County Hydrology Manual. The pre-development conditions were identified from the old historic USGS maps, which shows the area as primarily open brushes and scrubs with moderate slopes. Several detention sizes were evaluated in HMS until the HMP peak flow and duration criteria was satisfied. The detention sizes were evaluated via rating curves in the HMS model. The input parameters, flow-duration analysis, rating curves of the outlet structure and dimensions are included in Appendix B.

2.3 Size of Detention Vaults

The following are the recommended sizes and volumes of detention basin vaults for Basins A, B and C, based on the HMS and SOHM models. The detention basin and control structure exhibits are included in Appendix C.

Table 1: Detention Vaults Volume

Basin	Drainage Area in acres	HMS Recommended Detention Volume (acre- ft)	SOHM Recommended Detention Volume (acre- ft)
A	10	2.3	4.0
B	10	2.3	4.0
C	17	3.9	9.4

Notes: The above SOHM results are based on the July 2015 older model version.

Table 2: Detention Vaults Size

Basin	Foot Print (feet X feet)	Depth (feet)	Riser Height (feet)	Riser Diameter (in)	Freeboard (feet)	Riser Type
A	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
B	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
B	170X170	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice

Table 3: Detention Vaults Outlet Structures

Basin	Orifice No.	Type	Riser Notch Height (feet)	Riser Notch Width (feet)	Riser Type
A	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
B	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
C	1	Thirsty Duck (P-184)	2	2	Notched Rectangular

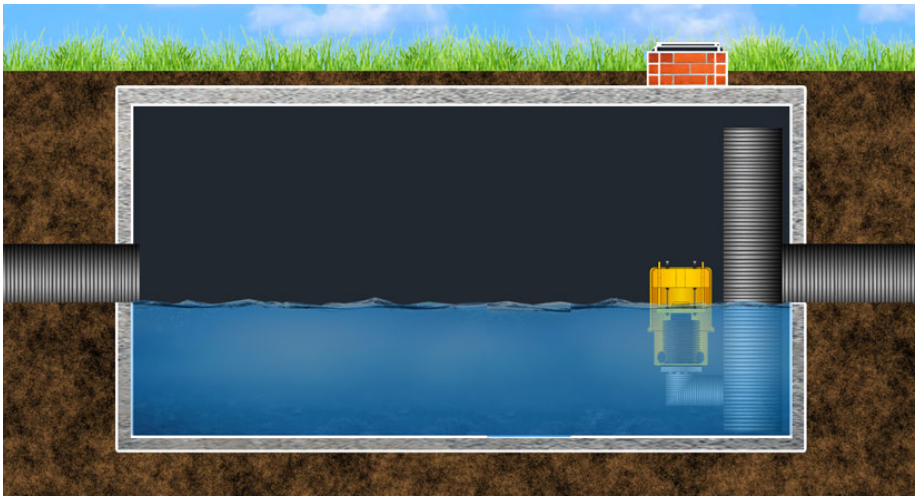


Figure 1- Conceptual Outlet Structure

2.4 Discussions

Initially, the detention vaults were designed using the SOHM model, but found that due to some bugs and errors in the tools, an extremely large detention sizes were predicted by the SOHM tool, which seemed impractical since the HMP criteria's focuses on smaller recurrence interval events, hence need was roused to use a more robust hydrologic model and perform the frequency duration analysis separately.

Based on the County HMP manual, we chose USACE HMS tool to model storm water detention basin. Various methodologies were evaluated to perform continuous simulations such as Soil Moisture Accounting tool, Deficit and Constant method and SCS method. All the methods produced similar peak flows. We chose SCS method since it was the most conservative approach due to the fact that initial abstractions are applied for the overall duration of the simulations and produced similar peaks compared to the SOHM model. We verified the pre-development conditions flows using the SOHM runoff output and adjusted our parameter in HMS such as lag time to match the pre-development flows between the SOHM and HMS, since there is no other reference or calibration data available for the project area.

3.0 Conclusions

The post-development flows from the proposed detentions computed using HMS model will meet the HMP criteria set forth by the County. A detailed flow duration analysis was performed to check the HMP criteria -*that post-project runoff flow rates and durations for the PDP shall not exceed pre-development, naturally occurring, runoff flow rates and durations by more than 10% for peak flow rates, from 10% of the 2-year runoff event up to the 10-year runoff event.*

4.0 Limitations

This report was prepared to comply with the guidelines established by the South Orange County. Evaluation of the appropriateness of these guidelines and the accuracy of the City and County data were beyond the scope of this work.

Usage of this report is limited to address the purpose and scope previously defined. PSOMAS shall not be responsible for any unauthorized application of this report and the contents therein.

The opinions represented in this report have been derived in accordance current standards of civil engineering practice. No other warranty is expressed or implied.

5.0 References

Orange County Flood Division, Orange County Hydrology Manual (OCFD 1986)

Orange County Flood Division, Orange County Hydrology Manual Soil Maps (OCFD 1986)

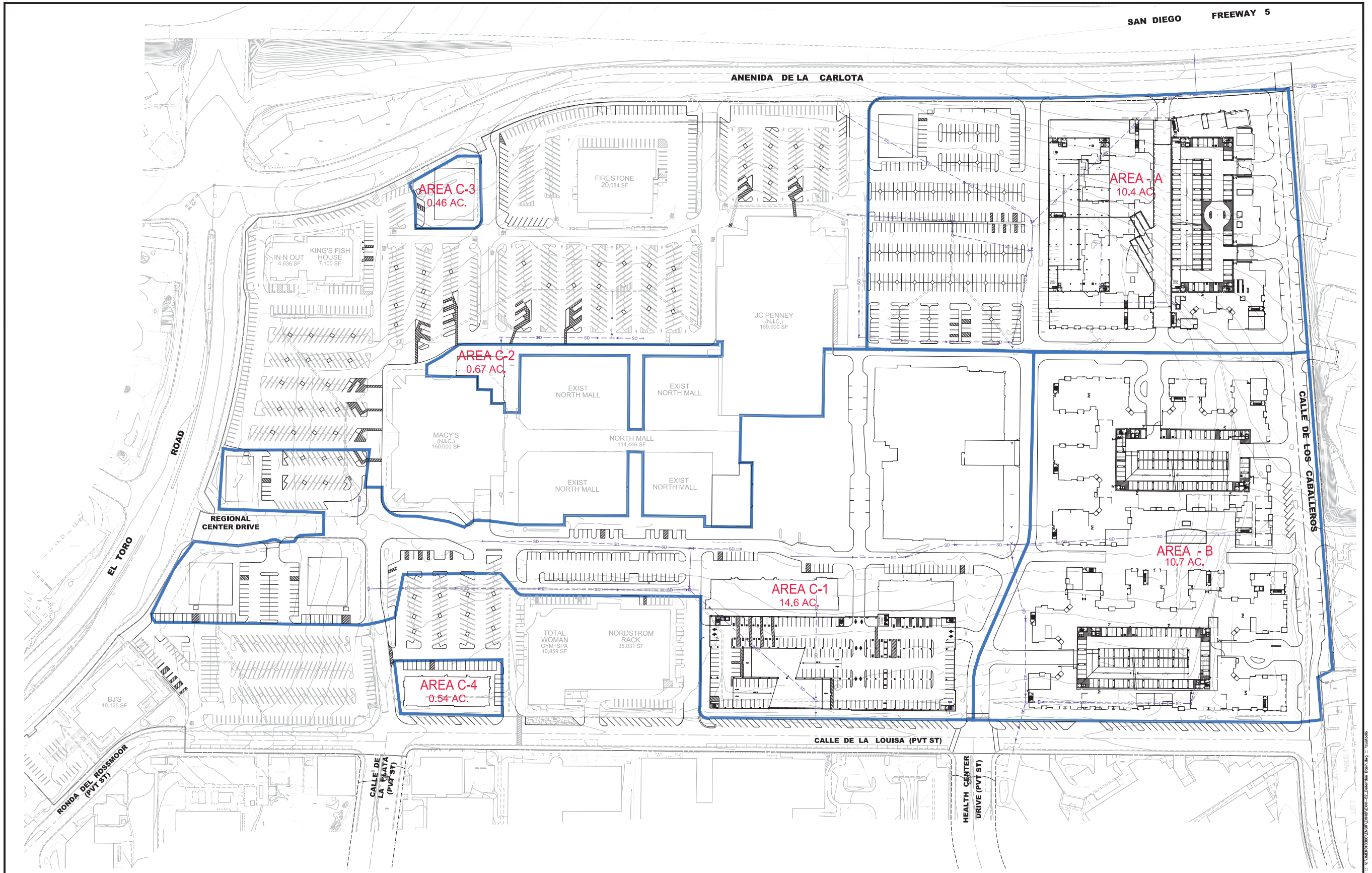
South Orange County Hydromodification Management Plan, April 1, 2015

South Orange County Hydromodification Model Manual, 2011

Overland Flow Time of Concentration on Very Flat Terrains, Ming-Han Li, Parmjeet Chibber, Journal of the Transportation Research Board, December 2008

Appendix A

HYDROLOGY DATA AND MAPS



DETENTION BASIN SUMMARY	
HYDROLOGIC AREA	AREA (AC)
A	10.4
B	10.7
C	16.3

LEGEND:

- EXISTING PROPERTY BOUNDARY
- EXISTING IMPROVEMENTS
- PROPOSED SITE PLAN IMPROVEMENTS
- AREA BOUNDARY

Laguna Hills Mall
Basin Area
Exhibit

PSOMAS

DATE:
JOB No:1MER010300
REVISED ON:

SHEET 1 OF 2
EXHIB-01

MerloneGeier

Five Laguna
Hydrologic Input Data

Basin	Total Drainage Area (in acres)	Area (in sq. miles	% impervious	Soil Type	Longest Flow Path Length(feet)	Longest Flow Path Slope (feet/feet)	Adjusted Lag(Mitigated)	Adjusted Lag(predeveloped)	CN (Mitigated)	CN (Predeveloped)
Area A	10.4	0.01625	90	B	1183	0.00591716	50	264	90	63
Area B	10.7	0.01671875	90	B	717	0.01255230	60	240	90	63
Area C	16.2	0.0253125	90	B	1105	0.009954751	150	385	90	63

Note- Predeveloped lag time was calculated using NRCS equation for small watershed and then adjusted to match the SOHM Qs.
Mitigated lag time was adjusted per proposed BMPs on the project site.

LEGEND:

EXISTING		PROPOSED
	EXISTING RIGHT OF WAY	
	EXISTING TOPOGRAPHY	
SD	STORM DRAIN LINE	SD
	HYDROMODIFICATION DETENTION BASIN	
	PLANTER BOX WITH UNDERDRAIN	
	BIORETENTION WITH UNDERDRAIN	
	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM	
	DRY EXTENDED DETENTION BASIN	
	DRAINAGE MANAGEMENT AREA	

WQMP BMP's BY DRAINAGE MANAGEMENT AREA

DMA	AREA (sq. ft.)	DCV (cu. ft.)	BMP
A	30335	1773	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
B	43642	2550	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
E	19570	1144	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
F	10440	610	BIORETENTION WITH UNDERDRAIN
G	98300	5744	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
H	8510	497	PLANTER BOX WITH UNDERDRAIN
I	9715	568	PLANTER BOX WITH UNDERDRAIN
J	94410	5517	PLANTER BOX WITH UNDERDRAIN
K	19100	1116	PLANTER BOX WITH UNDERDRAIN
L	10800	631	PLANTER BOX WITH UNDERDRAIN
M	41465	2423	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
N	54095	3161	BIORETENTION WITH UNDERDRAIN
O	7700	450	PLANTER BOX WITH UNDERDRAIN
Q	37270	2178	BIORETENTION WITH UNDERDRAIN
R	75335	4402	BIORETENTION WITH UNDERDRAIN
S	7230	423	PLANTER BOX WITH UNDERDRAIN
T	42730	2497	BIORETENTION WITH UNDERDRAIN
U	97240	5682	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
V	72735	4250	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
W	7000	409	PLANTER BOX WITH UNDERDRAIN
X	51730	3023	PLANTER BOX WITH UNDERDRAIN
Y	56052	3276	PLANTER BOX WITH UNDERDRAIN
Z	72480	4236	BIORETENTION WITH UNDERDRAIN
AA	44235	2585	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
BB	132600	7749	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
CC	108035	6313	BIORETENTION WITH UNDERDRAIN
DD	55600	3249	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
EE	49840	2913	PROPRIETARY VEGETATED BIOTREATMENT SYSTEM
FF	111965	6543	BIORETENTION WITH UNDERDRAIN

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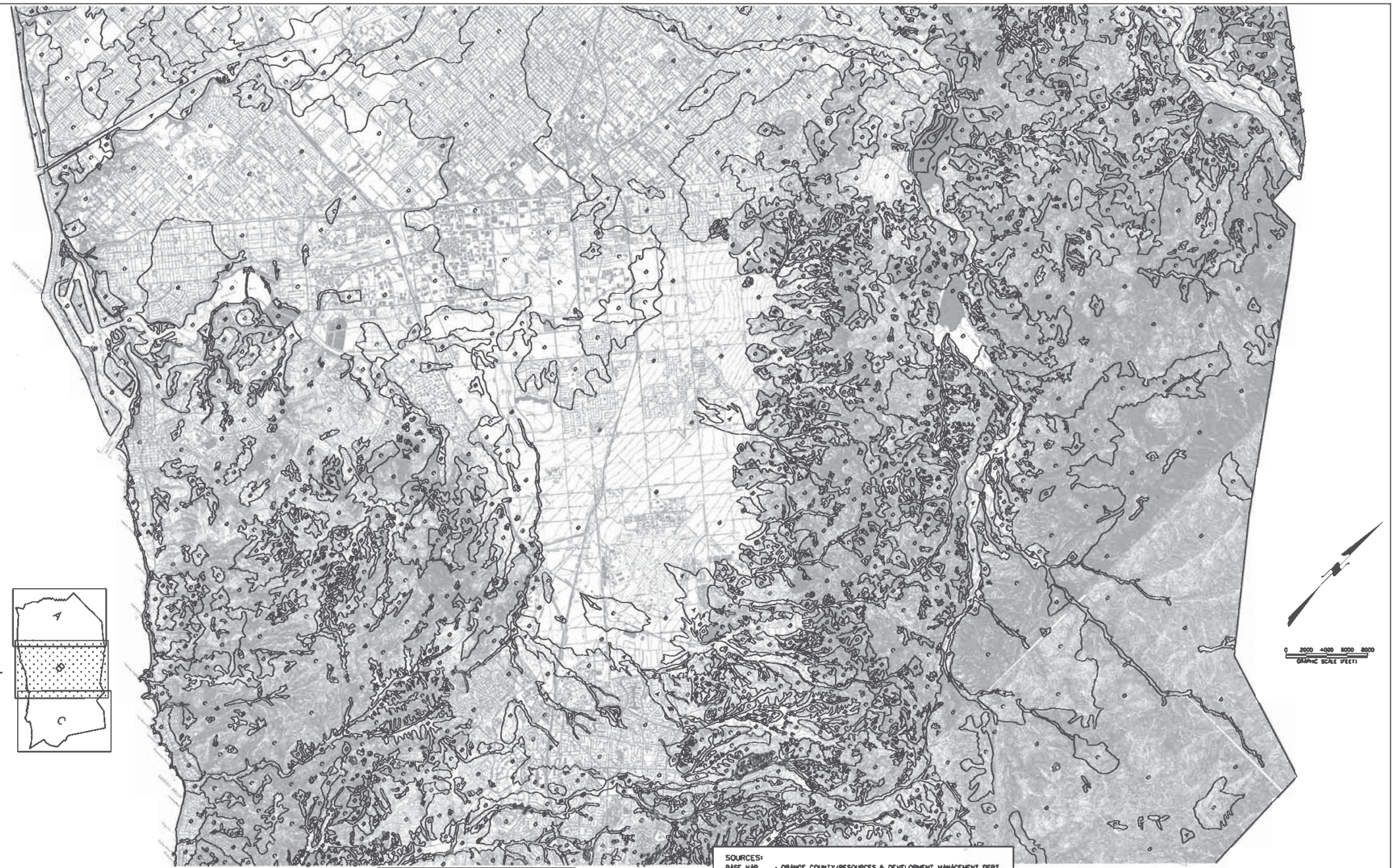
OVERALL WQMP PLAN

05.18.2015

C6.0

Plotted: 9/21/2015 2:16:29 PM :: Saved: 5/15/2015 9:43:06 AM :: X:\ME0010300\ENGR\SHEETS\C6.0.dwg :: tsustudio



ORANGE COUNTY
HYDROLOGY MANUAL

LEGEND
A B C D HYDROLOGIC SOIL GROUPS
HYDROLOGIC SOIL GROUP BOUNDARY

SOURCES:
BASE MAP - ORANGE COUNTY/RESOURCES & DEVELOPMENT MANAGEMENT DEPT GEOMATICS AND LAND INFORMATION SYSTEMS DIVISION
SOIL GROUPS - SOIL SURVEY OF ORANGE COUNTY AND WESTERN PART OF RIVERSIDE COUNTY, CALIFORNIA, USDA, SOIL CONSERVATION SERVICE, 1978.

HYDROLOGIC CLASSIFICATION OF SOILS
ORANGE COUNTY, CALIFORNIA

PLATE B

Shweta Chervu

From: Doug Beyerlein <beyerlein@clearcreeksolutions.com>
Sent: Tuesday, August 11, 2015 7:50 AM
To: Shweta Chervu
Cc: Apt, Daniel; Richard.Boon@ocpw.ocgov.com
Subject: FW: SOCHM: Rainfall-runoff data

Shweta,

I have just returned from vacation and read your email of 7/30.

To answer your questions regarding SOHM:

-Meteorological data/ precipitation data
The precip data are available in the HSPF WDM file that is included in SOHM. Originally the precip data were provided to us by RBF.

-Measured pan evaporation data
The PET data are available in the HSPF WDM file that is included in SOHM. Originally the PET data were provided to us by RBF. I do not know if the original source of the PET data is measured pan evap or not.

-Existing Vegetation information
SOHM includes vegetation groups/categories selected by Orange County. We do not have any site-specific vegetation data in SOHM. That info must be provided by the user for their individual project site.

- Regional HSPF parameters
The HSPF parameters used in SOHM are available for viewing in the Tools menu.

-Calibration info (Observed streamflow gage data)
We have no calibration data for Orange County.

-Historic landuse data
We have no historic landuse data for Orange County.

If you need any additional information on SOHM please let me know.

Thanks.

Doug Beyerlein, PE, PH, D.WRE
Clear Creek Solutions, Inc.
15800 Village Green Drive #3
Mill Creek, WA 98012
425-225-5997 (office)
beyerlein@clearcreeksolutions.com
www.clearcreeksolutions.com

From: Apt, Daniel [mailto:DAPT@mbakerintl.com]
Sent: Friday, July 31, 2015 10:41 AM
To: Doug Beyerlein <beyerlein@clearcreeksolutions.com>
Subject: FW: SOCHM: Rainfall-runoff data

Doug,

Please see the email below and let me know your thoughts and if this information is available. Also I left a message for you about doing a training for Orange County on the South Orange County Hydrology Model so please let me know if you are interested. Thanks.

Daniel

Daniel Apt, CPSWQ, CPESC | Vice President | RBF Consulting, a Michael Baker International Company
14725 Alton Parkway | Irvine, CA 92618-2027 | [O] 949-330-4117 | [M] 949-533-9785
dapt@mbakerintl.com | www.mbakerintl.com

Michael Baker INTERNATIONAL
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We Make a Difference

From: Shweta Chervu [mailto:shweta.chervu@psomas.com]
Sent: Thursday, July 30, 2015 2:31 PM
To: Apt, Daniel
Cc: David Martin; Richard.Boon@ocpw.ocgov.com
Subject: SOCHM: Rainfall-runoff data

Hi Daniel,

We got your contact information from Richard Boon, Chief of Orange County Stormwater Program.

We are working on a Redevelopment project and wanted to evaluate the hydromodification plan for our project using HEC-HMS or EPA SWMM. We are interested in obtaining the input parameters for the rainfall-runoff model. It looks like following information was used in the SOCHM/ HSPF model, which can be shared with us.

-Meteorological data/ precipitation data
-Measured pan evaporation data
-Existing Vegetation information
- Regional HSPF parameters
-Calibration info (Observed streamflow gage data)
-Historic landuse data

Would you be able to send us any of the above data or direct us to the websites or ftps to download this information.

Best Regards,

Shweta Chervu, CFM
PSOMAS | Balancing the Natural and Built Environment
661.705.4434
www.Psomas.com

Appendix B

HMS

RESULTS

Flow Exceedance Table

Labels
Units CFS

Type	PROB	LOG
1	0.01667	9.1221
2	0.03333	8.892
3	0.05	8.4116
4	0.06667	7.4707
5	0.08333	7.2608
6	0.1	6.5696
7	0.11667	6.4003
8	0.13333	6.2759
9	0.15	6.1998
10	0.16667	6.178
11	0.18333	6.1181
12	0.2	5.9545
13	0.21667	5.8923
14	0.23333	5.7924
15	0.25	5.6449
16	0.26667	5.4788
17	0.28333	5.1123
18	0.3	5.0799
19	0.31667	4.8423
20	0.33333	4.827
21	0.35	4.7745
22	0.36667	4.7319
23	0.38333	4.7112
24	0.4	4.7111
25	0.41667	4.6981
26	0.43333	4.6972
27	0.45	4.5962
28	0.46667	4.3642
29	0.48333	4.2159
30	0.5	4.1962
31	0.51667	4.0025
32	0.53333	3.89
33	0.55	3.8564
34	0.56667	3.812
35	0.58333	3.781
36	0.6	3.7513
37	0.61667	3.6988
38	0.63333	3.5219
39	0.65	3.3076
40	0.66667	3.277
41	0.68333	3.2765
42	0.7	3.2299
43	0.71667	3.2091
44	0.73333	3.0959
45	0.75	3.0955
46	0.76667	2.9488
47	0.78333	2.8082
48	0.8	2.5451
49	0.81667	2.4541
50	0.83333	2.4117
51	0.85	2.361
52	0.86667	2.3367
53	0.88333	2.3287
54	0.9	2.1996
55	0.91667	2.1858
56	0.93333	2.1858
57	0.95	1.9016
58	0.96667	1.7094
59	0.98333	0.2689

Return Period	Exceedence Probability	Q cfs
0.2	5	0.41962
2	0.5	4.1962
5	0.2	5.9545
10	0.1	6.5696

Basin A

Rating Curve

Stage	Area	Storage	Discharge
ft	acres	acre-ft	cfs
0	0.387971	0	0
0.077778	0.387971	0.077778	0.059109
0.155556	0.387971	0.155556	0.100225
0.233333	0.387971	0.233333	0.12276
0.311111	0.387971	0.311111	0.141756
0.388889	0.387971	0.388889	0.158489
0.466667	0.387971	0.466667	0.173615
0.544444	0.387971	0.544444	0.187527
0.622222	0.387971	0.622222	0.194143
0.7	0.387971	0.7	0.19456
0.777778	0.387971	0.777778	0.194963
0.855556	0.387971	0.855556	0.195603
0.933333	0.387971	0.933333	0.196126
1.011111	0.387971	1.011111	0.196597
1.088889	0.387971	1.088889	0.197039
1.166667	0.387971	1.166667	0.19746
1.244444	0.387971	1.244444	0.197862
1.322222	0.387971	1.322222	0.198249
1.4	0.387971	1.4	0.198622
1.477778	0.387971	1.477778	0.198981
1.555556	0.387971	1.555556	0.199328
1.633333	0.387971	1.633333	0.199665
1.711111	0.387971	1.711111	0.19999
1.788889	0.387971	1.788889	0.200306
1.866667	0.387971	1.866667	0.200612
1.944444	0.387971	1.944444	0.200909
2.022222	0.387971	2.022222	0.201198
2.1	0.387971	2.1	0.201478
2.177778	0.387971	2.177778	0.201751
2.255556	0.387971	2.255556	0.202017
2.333333	0.387971	2.333333	0.202276
2.411111	0.387971	2.411111	0.202528
2.488889	0.387971	2.488889	0.202774
2.566667	0.387971	2.566667	0.203014
2.644444	0.387971	2.644444	0.203249
2.722222	0.387971	2.722222	0.203479
2.8	0.387971	2.8	0.203704
2.877778	0.387971	2.877778	0.203925
2.955556	0.387971	2.955556	0.204142
3.033333	0.387971	3.033333	0.204354
3.111111	0.387971	3.111111	0.204564
3.188889	0.387971	3.188889	0.20477
3.266667	0.387971	3.266667	0.204973
3.344444	0.387971	3.344444	0.205174
3.422222	0.387971	3.422222	0.205372
3.5	0.387971	3.5	0.205568

Volume 2.3ac-ft

Basin A

Rating Curve

Stage	Area	Storage	Discharge
ft	acres	acre-ft	cfs
3.577778	0.387971	3.577778	0.205763
3.655556	0.387971	3.655556	0.205957
3.733333	0.387971	3.733333	0.206149
3.811111	0.387971	3.811111	0.206341
3.888889	0.387971	3.888889	0.206532
3.966667	0.387971	3.966667	0.206722
4.044444	0.387971	4.044444	0.269316
4.122222	0.387971	4.122222	0.491682
4.2	0.387971	4.2	0.802985
4.277778	0.387971	4.277778	1.182525
4.355556	0.387971	4.355556	1.619686
4.433333	0.387971	4.433333	2.107677
4.511111	0.387971	4.511111	2.641665
4.588889	0.387971	4.588889	3.217983
4.666667	0.387971	4.666667	3.833722
4.744444	0.387971	4.744444	4.486503
4.822222	0.387971	4.822222	5.174332
4.9	0.387971	4.9	5.895507
4.977778	0.387971	4.977778	6.648551
5.055556	0.387971	5.055556	7.432168
5.133333	0.387971	5.133333	8.24521
5.211111	0.387971	5.211111	9.086649
5.288889	0.387971	5.288889	9.955556
5.366667	0.387971	5.366667	10.85109
5.444444	0.387971	5.444444	11.77248
5.522222	0.387971	5.522222	12.71902
5.6	0.387971	5.6	13.69007
5.677778	0.387971	5.677778	14.68501
5.755556	0.387971	5.755556	15.70329
5.833333	0.387971	5.833333	16.74438
5.911111	0.387971	5.911111	17.8078
5.988889	0.387971	5.988889	18.89308
6.066667	0.387971	6.066667	19.41522
6.144444	0.387971	6.144444	20.21229
6.222222	0.387971	6.222222	21.25599
6.3	0.387971	6.3	22.47222
6.377778	0.387971	6.377778	23.79678
6.455556	0.387971	6.455556	25.16434
6.533333	0.387971	6.533333	26.5082
6.611111	0.387971	6.611111	27.76407
6.688889	0.387971	6.688889	28.87605
6.766667	0.387971	6.766667	29.80421
6.844444	0.387971	6.844444	30.5334
6.922222	0.387971	6.922222	31.08307
7	0.387971	7	31.51815

Basin A

Flow Duration Analysis

	Q	Predeveloped	Mitigated	% Time Exceeding
	< 0.41	849	1523	NA
1	0.41962	7551	1388	0.184
2	0.481741	3802	711	0.187
3	0.543862	3518	516	0.147
4	0.605983	3056	444	0.145
5	0.668104	2744	430	0.157
6	0.730225	2239	411	0.184
7	0.792346	1978	367	0.186
8	0.854467	1773	301	0.170
9	0.916588	1684	267	0.159
10	0.978709	1516	259	0.171
11	1.04083	1441	223	0.155
12	1.102951	1205	201	0.167
13	1.165072	1101	238	0.216
14	1.227193	1058	185	0.175
15	1.289314	1020	165	0.162
16	1.351435	843	182	0.216
17	1.413556	745	172	0.231
18	1.475677	696	167	0.240
19	1.537798	652	156	0.239
20	1.599919	635	151	0.238
21	1.66204	613	151	0.246
22	1.724161	561	128	0.228

Basin A

Flow Duration Analysis

	Q	Predeveloped	Mitigated	% Time Exceeding
23	1.786282	507	111	0.219
24	1.848403	481	107	0.222
25	1.910524	418	125	0.299
26	1.972645	398	124	0.312
27	2.034766	356	115	0.323
28	2.096887	337	111	0.329
29	2.159008	334	110	0.329
30	2.221129	285	98	0.344
31	2.28325	299	100	0.334
32	2.345371	297	88	0.296
33	2.407492	240	95	0.396
34	2.469613	218	66	0.303
35	2.531734	219	86	0.393
36	2.593855	171	85	0.497
37	2.655976	153	71	0.464
38	2.718097	143	55	0.385
39	2.780218	178	63	0.354
40	2.842339	149	54	0.362
41	2.90446	138	42	0.304
42	2.966581	150	57	0.380
43	3.028702	145	71	0.490
44	3.090823	139	51	0.367
45	3.152944	115	49	0.426

Basin A

Flow Duration Analysis

	Q	Predeveloped	Mitigated	% Time Exceeding
46	3.215065	102	71	0.696
47	3.277186	131	40	0.305
48	3.339307	283	41	0.145
49	3.401428	254	51	0.201
50	3.463549	248	51	0.206
51	3.525671	239	43	0.180
52	3.587792	245	30	0.122
53	3.649913	246	28	0.114
54	3.712034	219	44	0.201
55	3.774155	187	25	0.134
56	3.836276	189	38	0.201
57	3.898397	187	32	0.171
58	3.960518	179	35	0.196
59	4.022639	173	45	0.260
60	4.08476	142	37	0.261
61	4.146881	165	30	0.182
62	4.209002	149	32	0.215
63	4.271123	137	37	0.270
64	4.333244	133	31	0.233
65	4.395365	126	22	0.175
66	4.457486	117	15	0.128
67	4.519607	113	24	0.212
68	4.581728	93	32	0.344

Basin A

Flow Duration Analysis

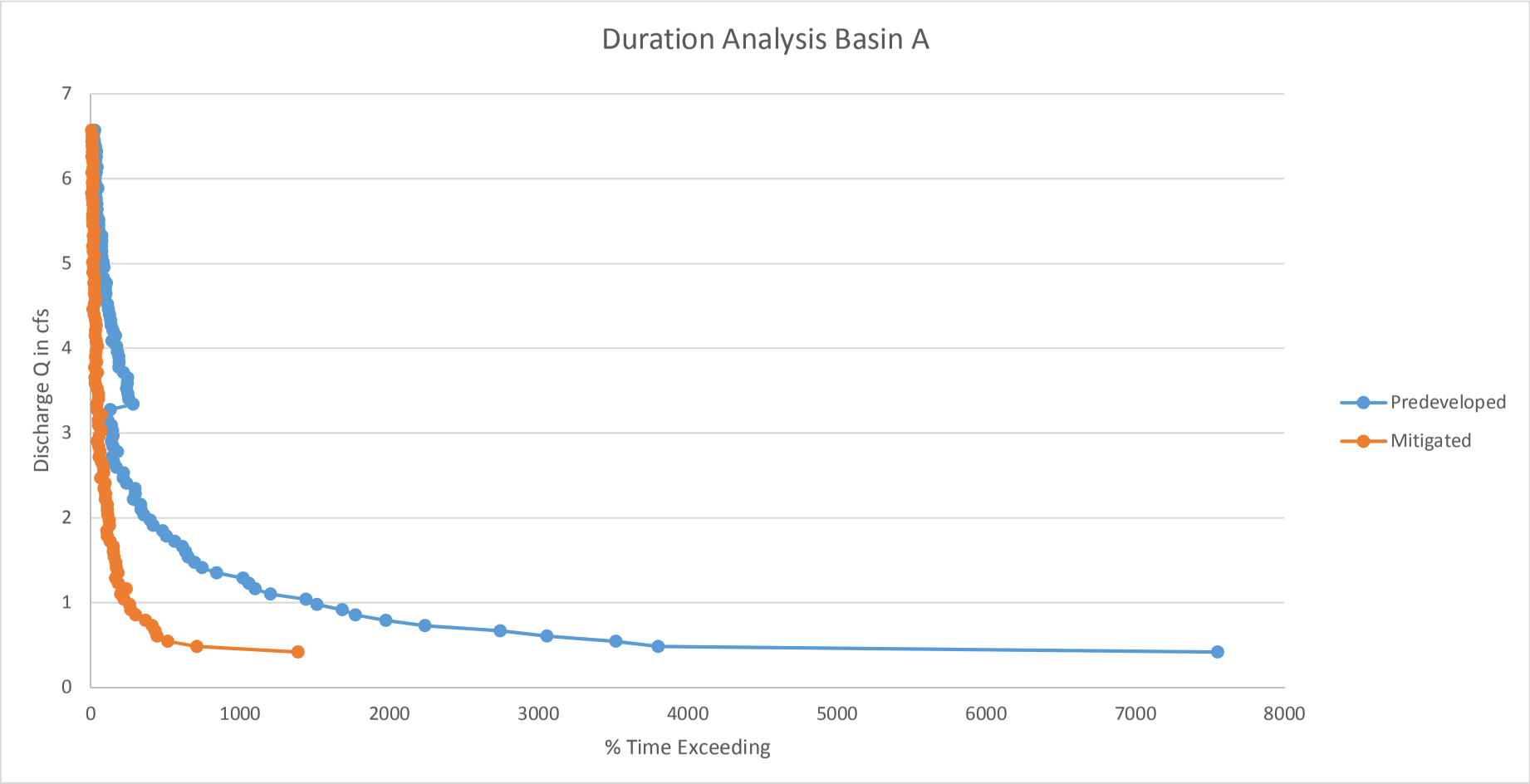
	Q	Predeveloped	Mitigated	% Time Exceeding
69	4.643849	101	24	0.238
70	4.70597	97	25	0.258
71	4.768091	105	20	0.190
72	4.830212	85	28	0.329
73	4.892333	67	14	0.209
74	4.954454	88	19	0.216
75	5.016575	82	12	0.146
76	5.078696	73	25	0.342
77	5.140817	73	17	0.233
78	5.202938	72	13	0.181
79	5.265059	73	20	0.274
80	5.32718	73	16	0.219
81	5.389301	56	24	0.429
82	5.451422	54	14	0.259
83	5.513543	54	13	0.241
84	5.575664	40	12	0.300
85	5.637785	43	16	0.372
86	5.699906	41	15	0.366
87	5.762027	37	11	0.297
88	5.824148	33	6	0.182
89	5.886269	48	15	0.313
90	5.94839	32	11	0.344
91	6.010511	29	17	0.586

Basin A

Flow Duration Analysis

	Q	Predeveloped	Mitigated	% Time Exceeding
92	6.072632	37	7	0.189
93	6.134753	43	16	0.372
94	6.196874	31	14	0.452
95	6.258995	36	8	0.222
96	6.321116	38	11	0.289
97	6.383237	32	9	0.281
98	6.445358	24	7	0.292
99	6.507479	19	9	0.474
100	6.5696	26	5	0.192

Basin A


Duration Analysis Basin A
Discharge Q in cfs
% Time Exceeding
0
1
2
3
4
5
6
7
0
1000
2000
3000
4000
5000
6000
7000
8000
Predeveloped
Mitigated

Flow Exceedance Table

Labels		
Units		CFS
Type	PROB	LOG
1	0.01667	9.8832
2	0.03333	9.7352
3	0.05	9.0447
4	0.06667	8.3225
5	0.08333	7.7383
6	0.1	7.0045
7	0.11667	7.0035
8	0.13333	6.9483
9	0.15	6.9219
10	0.16667	6.7492
11	0.18333	6.5488
12	0.2	6.5154
13	0.21667	6.4512
14	0.23333	6.2811
15	0.25	6.1275
16	0.26667	6.0342
17	0.28333	5.7063
18	0.3	5.6192
19	0.31667	5.3622
20	0.33333	5.36
21	0.35	5.2771
22	0.36667	5.1565
23	0.38333	5.1324
24	0.4	5.0921
25	0.41667	5.0363
26	0.43333	4.9879
27	0.45	4.8408
28	0.46667	4.68
29	0.48333	4.537
30	0.5	4.5067
31	0.51667	4.4331
32	0.53333	4.312
33	0.55	4.2745
34	0.56667	4.0502
35	0.58333	4.0441
36	0.6	4.0229
37	0.61667	4.0059
38	0.63333	3.8069
39	0.65	3.6262
40	0.66667	3.6195
41	0.68333	3.5726
42	0.7	3.5658
43	0.71667	3.4219
44	0.73333	3.3403
45	0.75	3.3298
46	0.76667	3.2515
47	0.78333	3.0854
48	0.8	2.8121
49	0.81667	2.729
50	0.83333	2.6441
51	0.85	2.6054
52	0.86667	2.5991
53	0.88333	2.5739
54	0.9	2.4717
55	0.91667	2.4088
56	0.93333	2.335
57	0.95	2.1081
58	0.96667	1.8885
59	0.98333	0.2825

Return Period	Exceedence Probability	Q cfs
0.2	5	0.45067
2	0.5	4.5067
5	0.2	6.5154
10	0.1	7.0045

Basin B

Rating Curve

Stage	Area	Storage	Discharge
ft	acres	acre-ft	cfs
0	0.387971	0	0
0.077778	**0.387971**	**0.077778**	0.059109
0.155556	0.387971	0.155556	0.100225
0.233333	0.387971	0.233333	0.12276
0.311111	0.387971	0.311111	0.141756
0.388889	0.387971	0.388889	0.158489
0.466667	0.387971	0.466667	0.173615
0.544444	0.387971	0.544444	0.187527
0.622222	0.387971	0.622222	0.194143
0.7	0.387971	0.7	0.19456
0.777778	0.387971	0.777778	0.194963
0.855556	0.387971	0.855556	0.195603
0.933333	0.387971	0.933333	0.196126
1.011111	0.387971	1.011111	0.196597
1.088889	0.387971	1.088889	0.197039
1.166667	0.387971	1.166667	0.19746
1.244444	0.387971	1.244444	0.197862
1.322222	0.387971	1.322222	0.198249
1.4	0.387971	1.4	0.198622
1.477778	0.387971	1.477778	0.198981
1.555556	0.387971	1.555556	0.199328
1.633333	0.387971	1.633333	0.199665
1.711111	0.387971	1.711111	0.19999
1.788889	0.387971	1.788889	0.200306
1.866667	0.387971	1.866667	0.200612
1.944444	0.387971	1.944444	0.200909
2.022222	0.387971	2.022222	0.201198
2.1	0.387971	2.1	0.201478
2.177778	0.387971	2.177778	0.201751
2.255556	0.387971	2.255556	0.202017
2.333333	0.387971	2.333333	0.202276
2.411111	0.387971	2.411111	0.202528
2.488889	0.387971	2.488889	0.202774
2.566667	0.387971	2.566667	0.203014
2.644444	0.387971	2.644444	0.203249
2.722222	0.387971	2.722222	0.203479
2.8	0.387971	2.8	0.203704
2.877778	0.387971	2.877778	0.203925
2.955556	0.387971	2.955556	0.204142
3.033333	0.387971	3.033333	0.204354
3.111111	0.387971	3.111111	0.204564
3.188889	0.387971	3.188889	0.20477
3.266667	0.387971	3.266667	0.204973
3.344444	0.387971	3.344444	0.205174
3.422222	0.387971	3.422222	0.205372
3.5	0.387971	3.5	0.205568

Volume 2.3ac-ft

Basin B

Rating Curve

Stage	Area	Storage	Discharge
ft	acres	acre-ft	cfs
3.577778	0.387971	3.577778	0.205763
3.655556	0.387971	3.655556	0.205957
3.733333	0.387971	3.733333	0.206149
3.811111	0.387971	3.811111	0.206341
3.888889	0.387971	3.888889	0.206532
3.966667	0.387971	3.966667	0.206722
4.044444	0.387971	4.044444	0.269316
4.122222	0.387971	4.122222	0.491682
4.2	0.387971	4.2	0.802985
4.277778	0.387971	4.277778	1.182525
4.355556	0.387971	4.355556	1.619686
4.433333	0.387971	4.433333	2.107677
4.511111	0.387971	4.511111	2.641665
4.588889	0.387971	4.588889	3.217983
4.666667	0.387971	4.666667	3.833722
4.744444	0.387971	4.744444	4.486503
4.822222	0.387971	4.822222	5.174332
4.9	0.387971	4.9	5.895507
4.977778	0.387971	4.977778	6.648551
5.055556	0.387971	5.055556	7.432168
5.133333	0.387971	5.133333	8.24521
5.211111	0.387971	5.211111	9.086649
5.288889	0.387971	5.288889	9.955556
5.366667	0.387971	5.366667	10.85109
5.444444	0.387971	5.444444	11.77248
5.522222	0.387971	5.522222	12.71902
5.6	0.387971	5.6	13.69007
5.677778	0.387971	5.677778	14.68501
5.755556	0.387971	5.755556	15.70329
5.833333	0.387971	5.833333	16.74438
5.911111	0.387971	5.911111	17.8078
5.988889	0.387971	5.988889	18.89308
6.066667	0.387971	6.066667	19.41522
6.144444	0.387971	6.144444	20.21229
6.222222	0.387971	6.222222	21.25599
6.3	0.387971	6.3	22.47222
6.377778	0.387971	6.377778	23.79678
6.455556	0.387971	6.455556	25.16434
6.533333	0.387971	6.533333	26.5082
6.611111	0.387971	6.611111	27.76407
6.688889	0.387971	6.688889	28.87605
6.766667	0.387971	6.766667	29.80421
6.844444	0.387971	6.844444	30.5334
6.922222	0.387971	6.922222	31.08307
7	0.387971	7	31.51815

Basin B

Flow Duration Analysis

	Q	Predeveloped	Mitigated	% Time Exceeding
	<0.45067	2726	5316	NA
1	0.45067	7512	1444	0.192
2	0.51687	3733	725	0.194
3	0.583071	3171	509	0.161
4	0.649271	2838	470	0.166
5	0.715471	2601	477	0.183
6	0.781672	2196	439	0.200
7	0.847872	1881	362	0.192
8	0.914072	1716	333	0.194
9	0.980272	1595	299	0.187
10	1.046473	1424	241	0.169
11	1.112673	1308	250	0.191
12	1.178873	1188	243	0.205
13	1.245074	1074	193	0.180
14	1.311274	991	208	0.210
15	1.377474	966	196	0.203
16	1.443675	814	211	0.259
17	1.509875	763	167	0.219
18	1.576075	618	183	0.296
19	1.642275	652	167	0.256
20	1.708476	622	155	0.249
21	1.774676	573	118	0.206
22	1.840876	530	129	0.243

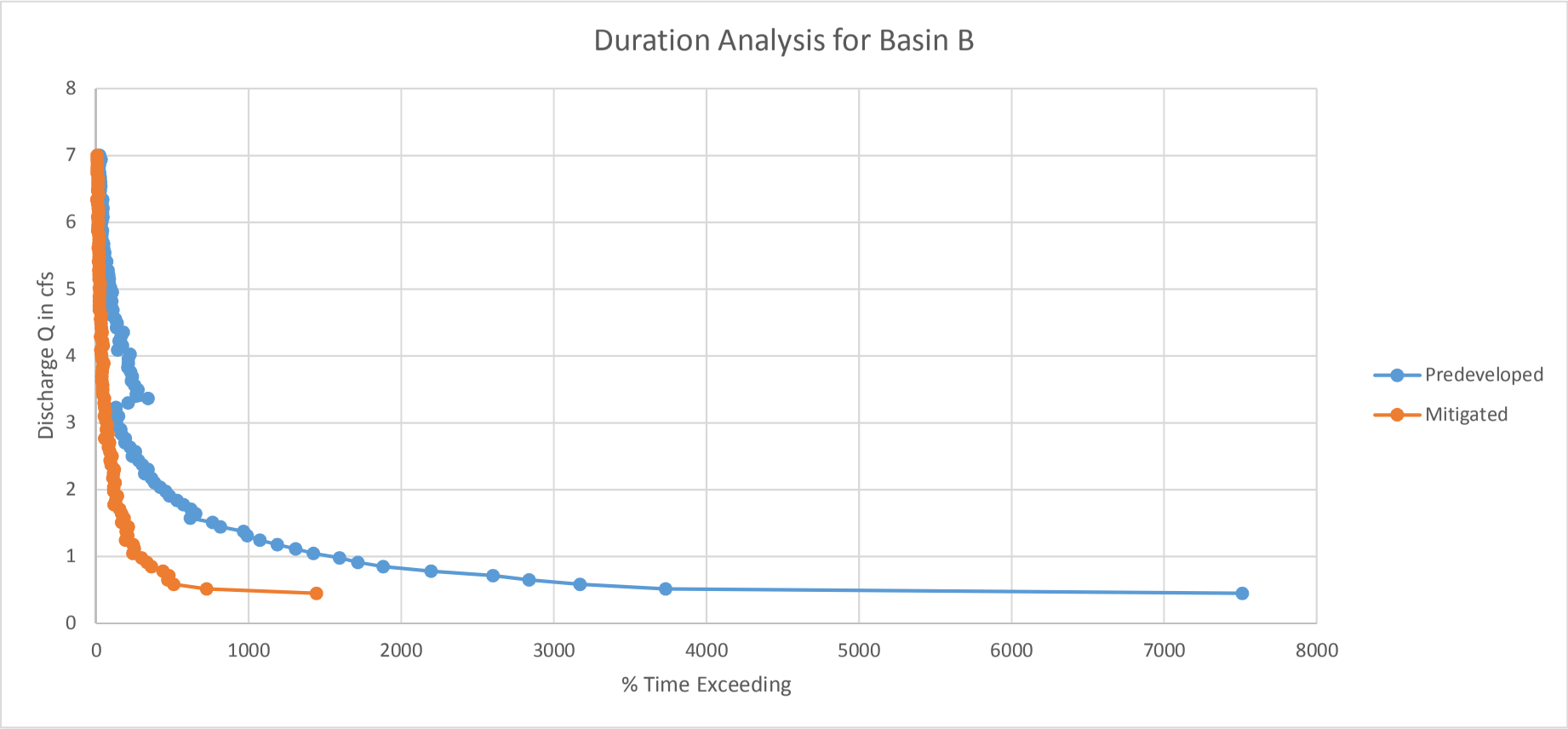
Basin B

23	1.907077	481	139	0.289
24	1.973277	457	115	0.252
25	2.039477	420	116	0.276
26	2.105678	383	124	0.324
27	2.171878	362	109	0.301
28	2.238078	318	114	0.358
29	2.304278	340	120	0.353
30	2.370479	304	98	0.322
31	2.436679	277	91	0.329
32	2.502879	238	104	0.437
33	2.56908	258	90	0.349
34	2.63528	223	80	0.359
35	2.70148	189	87	0.460
36	2.767681	191	57	0.298
37	2.833881	165	78	0.473
38	2.900081	162	68	0.420
39	2.966282	137	74	0.540
40	3.032482	128	64	0.500
41	3.098682	147	55	0.374
42	3.164882	130	62	0.477
43	3.231083	131	57	0.435
44	3.297283	209	52	0.249
45	3.363483	340	55	0.162

46	3.429684	264	44	0.167
47	3.495884	274	44	0.161
48	3.562084	252	43	0.171
49	3.628285	232	37	0.159
50	3.694485	237	38	0.160
51	3.760685	227	40	0.176
52	3.826885	207	44	0.213
53	3.893086	212	50	0.236
54	3.959286	211	37	0.175
55	4.025486	223	34	0.152
56	4.091687	141	30	0.213
57	4.157887	172	47	0.273
58	4.224087	150	41	0.273
59	4.290288	164	29	0.177
60	4.356488	179	39	0.218
61	4.422688	134	34	0.254
62	4.488888	137	33	0.241
63	4.555089	127	29	0.228
64	4.621289	93	34	0.366
65	4.687489	109	21	0.193
66	4.75369	99	21	0.212
67	4.81989	102	22	0.216
68	4.88609	87	22	0.253

69	4.952291	106	25	0.236
70	5.018491	96	22	0.229
71	5.084691	85	26	0.306
72	5.150892	86	20	0.233
73	5.217092	82	20	0.244
74	5.283292	78	17	0.218
75	5.349492	62	22	0.355
76	5.415693	69	15	0.217
77	5.481893	54	20	0.370
78	5.548093	57	19	0.333
79	5.614294	49	14	0.286
80	5.680494	49	18	0.367
81	5.746694	38	19	0.500
82	5.812895	37	18	0.486
83	5.879095	42	11	0.262
84	5.945295	33	12	0.364
85	6.011495	38	14	0.368
86	6.077696	45	11	0.244
87	6.143896	42	16	0.381
88	6.210096	45	14	0.311
89	6.276297	37	10	0.270
90	6.342497	43	4	0.093
91	6.408697	25	15	0.600

92	6.474898	27	10	0.370
93	6.541098	30	13	0.433
94	6.607298	29	12	0.414
95	6.673498	26	12	0.462
96	6.739699	24	7	0.292
97	6.805899	20	7	0.350
98	6.872099	23	9	0.391
99	6.9383	33	6	0.182
100	7.0045	24	7	0.292


Duration Analysis for Basin B
Discharge Q in cfs
% Time Exceeding
0
1
2
3
4
5
6
7
8
0
1000
2000
3000
4000
5000
6000
7000
8000
Predeveloped
Mitigated

Labels		
Units		CFS
Type	PROB	LOG
1	0.01667	11.717
2	0.03333	10.833
3	0.05000	10.345
4	0.06667	9.182
5	0.08333	9.053
6	0.10000	8.386
7	0.11667	7.839
8	0.13333	7.695
9	0.15000	7.678
10	0.16667	7.316
11	0.18333	7.295
12	0.20000	6.923
13	0.21667	6.875
14	0.23333	6.700
15	0.25000	6.435
16	0.26667	6.377
17	0.28333	6.357
18	0.30000	6.304
19	0.31667	6.241
20	0.33333	5.998
21	0.35000	5.893
22	0.36667	5.846
23	0.38333	5.723
24	0.40000	5.663
25	0.41667	5.576
26	0.43333	5.445
27	0.45000	5.325
28	0.46667	5.310
29	0.48333	5.284
30	0.50000	5.147
31	0.51667	5.125
32	0.53333	5.070
33	0.55000	4.728
34	0.56667	4.527
35	0.58333	4.522
36	0.60000	4.507
37	0.61667	4.337
38	0.63333	4.325
39	0.65000	4.285
40	0.66667	4.210
41	0.68333	4.052
42	0.70000	3.915
43	0.71667	3.902
44	0.73333	3.840
45	0.75000	3.839
46	0.76667	3.350
47	0.78333	3.214
48	0.80000	2.981
49	0.81667	2.924
50	0.83333	2.844
51	0.85000	2.733
52	0.86667	2.714
53	0.88333	2.629
54	0.90000	2.588
55	0.91667	2.574
56	0.93333	2.355
57	0.95000	2.255
58	0.96667	2.012
59	0.98333	0.365

Flow Exceedance Table

Return Period	Exceedence Probability	Q cfs
0.2	5	0.5147
2	0.5	5.147
5	0.2	6.923
10	0.1	8.386

Basin C

Rating Curve

Stage	Area	Storage	Discharge
ft	acres	acre-ft	cfs
0	0.663453	0	0
0.077778	0.663453	0.051602	0.059108
0.155556	0.663453	0.103204	0.100224
0.233333	0.663453	0.154806	0.122759
0.311111	0.663453	0.206408	0.141755
0.388889	0.663453	0.258009	0.158488
0.466667	0.663453	0.309611	0.17201
0.544444	0.663453	0.361213	0.172463
0.622222	0.663453	0.412815	0.172902
0.7	0.663453	0.464417	0.173327
0.777778	0.663453	0.516019	0.17374
0.855556	0.663453	0.567621	0.174139
0.933333	0.663453	0.619223	0.174526
1.011111	0.663453	0.670824	0.174902
1.088889	0.663453	0.722426	0.175266
1.166667	0.663453	0.774028	0.175619
1.244444	0.663453	0.82563	0.175962
1.322222	0.663453	0.877232	0.176294
1.4	0.663453	0.928834	0.176616
1.477778	0.663453	0.980436	0.176929
1.555556	0.663453	1.032038	0.177232
1.633333	0.663453	1.083639	0.177527
1.711111	0.663453	1.135241	0.177814
1.788889	0.663453	1.186843	0.178092
1.866667	0.663453	1.238445	0.178363
1.944444	0.663453	1.290047	0.178626
2.022222	0.663453	1.341649	0.178883
2.1	0.663453	1.393251	0.179132
2.177778	0.663453	1.444853	0.179376
2.255556	0.663453	1.496454	0.179614
2.333333	0.663453	1.548056	0.179846
2.411111	0.663453	1.599658	0.180072
2.488889	0.663453	1.65126	0.180294
2.566667	0.663453	1.702862	0.180511
2.644444	0.663453	1.754464	0.180724
2.722222	0.663453	1.806066	0.180933
2.8	0.663453	1.857668	0.181138
2.877778	0.663453	1.909269	0.18134
2.955556	0.663453	1.960871	0.181539
3.033333	0.663453	2.012473	0.181735
3.111111	0.663453	2.064075	0.181929
3.188889	0.663453	2.115677	0.182121
3.266667	0.663453	2.167279	0.182312
3.344444	0.663453	2.218881	0.182501

Volume	3.9 ac-ft

Basin C

3.422222	0.663453	2.270483	0.182688
3.5	0.663453	2.322084	0.182875
3.577778	0.663453	2.373686	0.183062
3.655556	0.663453	2.425288	0.183248
3.733333	0.663453	2.47689	0.183435
3.811111	0.663453	2.528492	0.183622
3.888889	0.663453	2.580094	0.18381
3.966667	0.663453	2.631696	0.183999
4.044444	0.663453	2.683298	0.246591
4.122222	0.663453	2.7349	0.468957
4.2	0.663453	2.786501	0.780263
4.277778	0.663453	2.838103	1.159806
4.355556	0.663453	2.889705	1.596972
4.433333	0.663453	2.941307	2.084969
4.511111	0.663453	2.992909	2.618964
4.588889	0.663453	3.044511	3.195291
4.666667	0.663453	3.096113	3.81104
4.744444	0.663453	3.147715	4.463833
4.822222	0.663453	3.199316	5.151675
4.9	0.663453	3.250918	5.872864
4.977778	0.663453	3.30252	6.625924
5.055556	0.663453	3.354122	7.409559
5.133333	0.663453	3.405724	8.222621
5.211111	0.663453	3.457326	9.06408
5.288889	0.663453	3.508928	9.933009
5.366667	0.663453	3.56053	10.82857
5.444444	0.663453	3.612131	11.74998
5.522222	0.663453	3.663733	12.69655
5.6	0.663453	3.715335	13.66762
5.677778	0.663453	3.766937	14.6626
5.755556	0.663453	3.818539	15.68091
5.833333	0.663453	3.870141	16.72203
5.911111	0.663453	3.921743	17.78548
5.988889	0.663453	3.973345	18.87081
6.066667	0.663453	4.024946	19.39298
6.144444	0.663453	4.076548	20.1901
6.222222	0.663453	4.12815	21.23383
6.3	0.663453	4.179752	22.45011
6.377778	0.663453	4.231354	23.77472
6.455556	0.663453	4.282956	25.14232
6.533333	0.663453	4.334558	26.48623
6.611111	0.663453	4.38616	27.74215
6.688889	0.663453	4.437761	28.85419
6.766667	0.663453	4.489363	29.7824
6.844444	0.663453	4.540965	30.51164
6.922222	0.663453	4.592567	31.06137

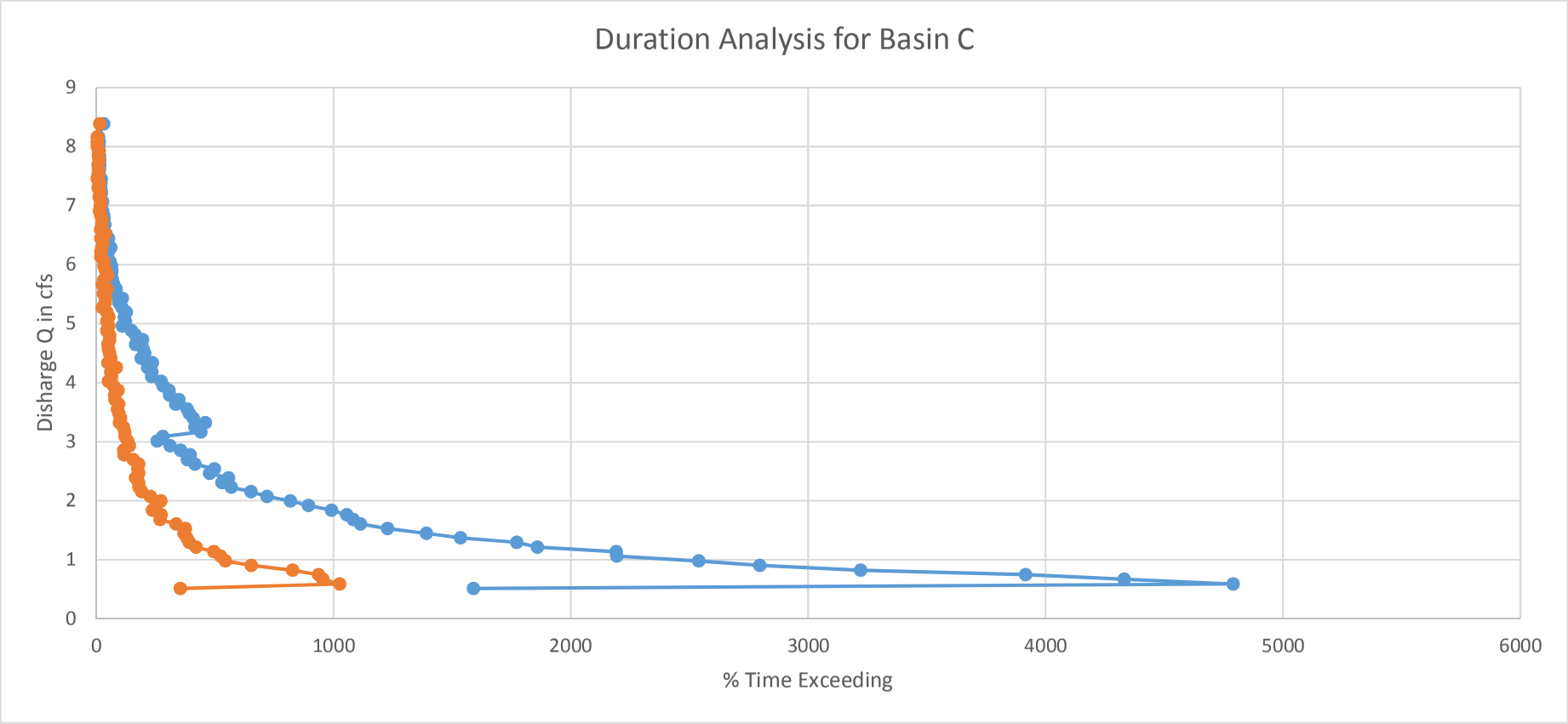
7	0.663453	4.644169	31.49651

Flow Exceedance Table

Labels		
Units		CFS
Type	PROB	LOG
1	0.01667	11.717
2	0.03333	10.833
3	0.05000	10.345
4	0.06667	9.182
5	0.08333	9.053
6	0.10000	8.386
7	0.11667	7.839
8	0.13333	7.695
9	0.15000	7.678
10	0.16667	7.316
11	0.18333	7.295
12	0.20000	6.923
13	0.21667	6.875
14	0.23333	6.700
15	0.25000	6.435
16	0.26667	6.377
17	0.28333	6.357
18	0.30000	6.304
19	0.31667	6.241
20	0.33333	5.998
21	0.35000	5.893
22	0.36667	5.846
23	0.38333	5.723
24	0.40000	5.663
25	0.41667	5.576
26	0.43333	5.445
27	0.45000	5.325
28	0.46667	5.310
29	0.48333	5.284
30	0.50000	5.147
31	0.51667	5.125
32	0.53333	5.070
33	0.55000	4.728
34	0.56667	4.527
35	0.58333	4.522
36	0.60000	4.507
37	0.61667	4.337
38	0.63333	4.325
39	0.65000	4.285
40	0.66667	4.210
41	0.68333	4.052
42	0.70000	3.915
43	0.71667	3.902
44	0.73333	3.840
45	0.75000	3.839
46	0.76667	3.350
47	0.78333	3.214
48	0.80000	2.981
49	0.81667	2.924
50	0.83333	2.844
51	0.85000	2.733
52	0.86667	2.714
53	0.88333	2.629
54	0.90000	2.588
55	0.91667	2.574
56	0.93333	2.355
57	0.95000	2.255
58	0.96667	2.012
59	0.98333	0.365

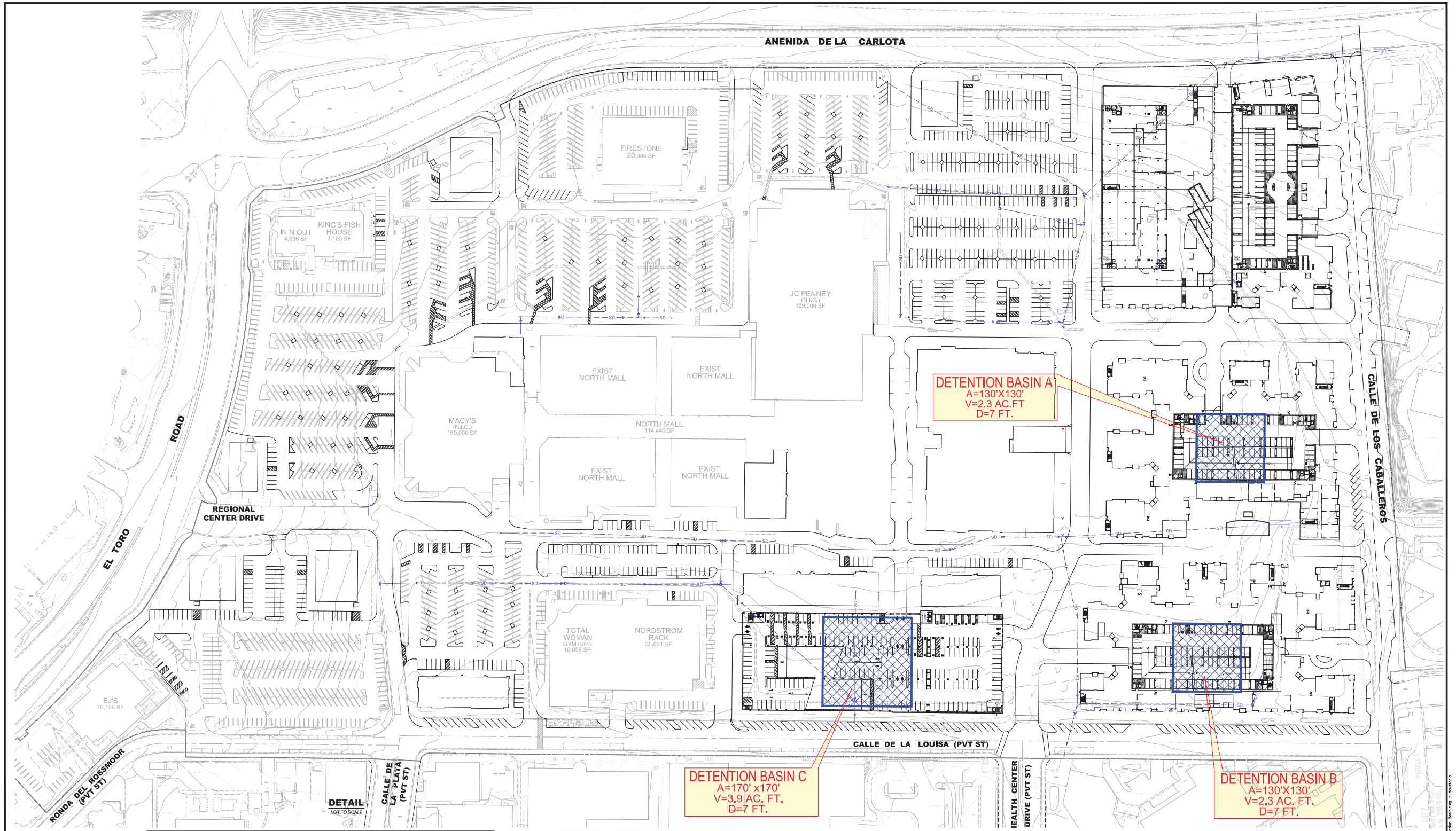
Return Period	Exceedence Probability	Q cfs
0.2	5	0.5147
2	0.5	5.147
5	0.2	6.923
10	0.1	8.386

Basin C

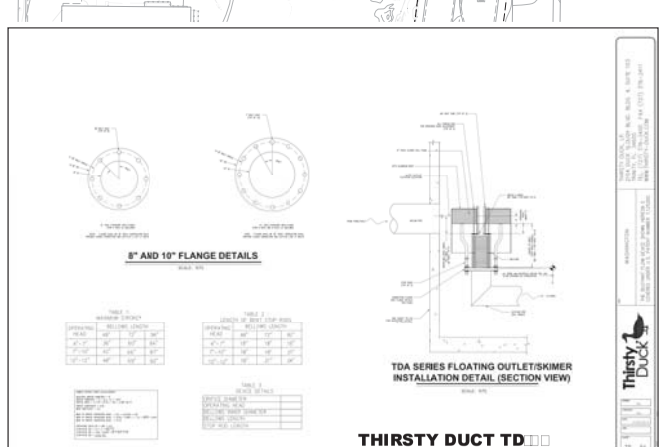

Duration Analysis for Basin C
Disharge Q in cfs
% Time Exceeding
0
1
2
3
4
5
6
7
8
9
0
1000
2000
3000
4000
5000
6000

Appendix C

DETENTION BASIN AND CONTROL STRUCTURE



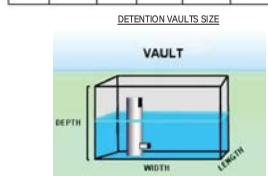
FEET
60 30 0 60 120
1 1/2 0 1 2
INCHES



THIRSTY DUCT TD□□
NOT TO SCALE

Basin	Foot Print (feet X feet)	Depth (feet)	Riser Height (feet)	Riser Diameter (in)	Freeboard (feet)	Riser Type
A	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
B	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
C	170X170	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice

DETENTION VAULTS SIZE



VAULT DETAIL
NOT TO SCALE

Basin	Orifice No.	Type	Riser Notch Height (feet)	Riser Notch Width (feet)	Riser Type
A	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
B	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
C	1	Thirsty Duck (P-184)	2	2	Notched Rectangular

DETENTION VAULTS OUTLET STRUCTURES

VAULT OUTLET STRUCTURE DETAIL
NOT TO SCALE

DETENTION BASIN SUMMARY		
HYDROLOGIC AREA	AREA (AC)	VOLUME (AC- FT)
A	10.4	2.3 AC - FT
B	10.7	2.3 AC - FT
C	16.3	3.9 AC - FT

LEGEND:

- EXISTING PROPERTY BOUNDARY
- EXISTING IMPROVEMENTS
- PROPOSED SITE PLAN IMPROVEMENTS
- PROPOSED DETENTION BASIN

Laguna □ills Mall
□M□ □etention Basin
Exhibit

PSOMAS

DATE:
JOB No:1MER010300

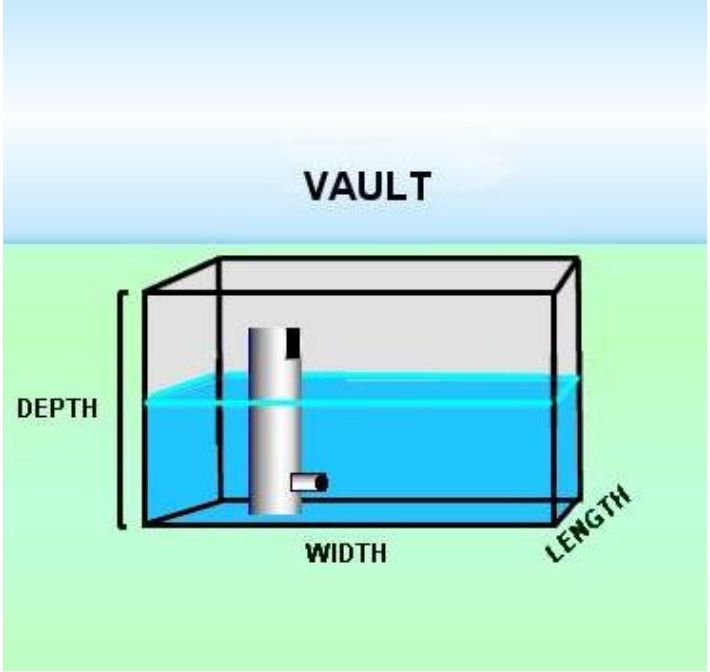
REVISED ON:

SHEET 2 OF 2
EXHIB-02

MerloneGeier

Plotted - 9/17/2015 2:27:13 PM ; Saved - 9/17/2015 2:26:05 PM ; J:\1MER010300\DWG\DWG\Exhi-02_Detention Basin.dwg ; tsutsuda

CONTROL STRUCTURE DETAILS



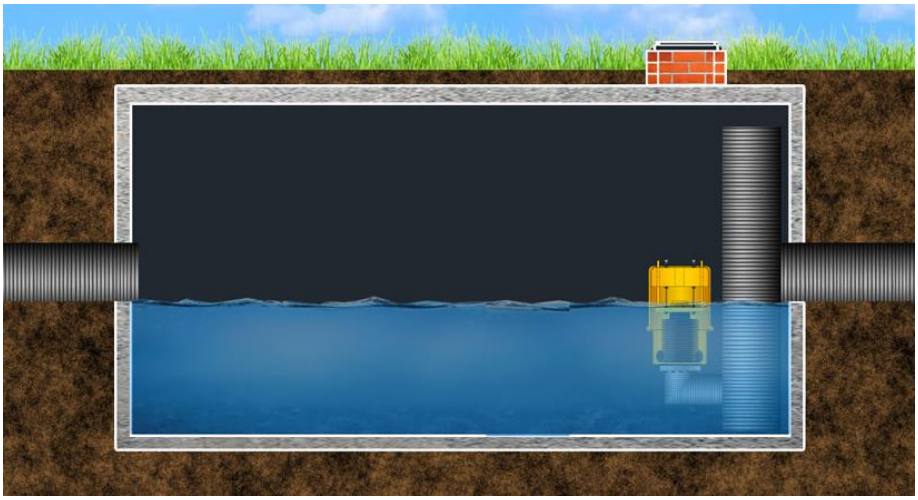


Table 2: Detention Vaults Size

Basin	Foot Print (feet X feet)	Depth (feet)	Riser Height (feet)	Riser Diameter (in)	Freeboard (feet)	Riser Type
A	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
B	130X130	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice
C	170X170	7	6	24	1	1 Notched Rectangular Weir and 1 Orifice

Table 3: Detention Vaults Outlet Structures

Basin	Orifice No.	Type	Riser Notch Height (feet)	Riser Notch Width (feet)	Riser Type
A	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
B	1	Thirsty Duck (P-184)	2	2	Notched Rectangular
C	1	Thirsty Duck (P-184)	2	2	Notched Rectangular

TD SERIES REVOLUTIONARY FLOW CONTROL TECHNOLOGY

Based on the simple science of buoyancy, Thirsty Duck TD Series Flow Regulators employ groundbreaking flow control technology that drains water at a nearly constant rate — minimizing detention volume and therefore reducing stormwater, surge, and flow equalization system size by up to 50%.

HOW DOES IT WORK?

Whereas traditional flow control systems only reach the design discharge when the storage volume is full, a Thirsty Duck TD Series Flow Regulator maintains its flow restriction at a fixed depth below the water surface, producing a nearly constant flow which reduces storage volumes while meeting regulatory and design requirements.

Features:

- Self-skimming body — keeps debris out
- Solid displacement float with access vent
- Field cut flow restriction module
- Variable operating depth
- Standard ANSI pipe flange connection
- No gasket kit required

Specifications:

- UV-stable 935 LLDPE
- 40 mil RF-welded polyurethane bellows
- Bellows reinforcement – AISI grade 304 stainless steel
- 96" extended bellows length
- Brass FNPT vent tube inserts
- Grade 18-8 stainless steel assembly hardware
- Design flow rates from 0.005 cfs to 1.5 cfs (2 gpm to 630 gpm)
- Operating heads from 6" to 12"
- Flow Regulator orifice diameters from 0.5" to 8.0"
- TDP 184 – 8" ANSI flanage connection
- TDP 284 – 10" ANSI flanage connection

MAXIMIZE LAND USE

Thirsty Duck's constant flow rate means stormwater systems require less volume which frees up developable land.

TOTAL COMPLIANCE

Our product is passively operated. It uses the principle of buoyancy and has no mechanical parts, helping you meet regulations.

LOWER EXPENSES

When system volume is minimized, costs are minimized. Ponds need less land, and vaults cost less to construct.

Flow Restrictor module
TDP 184 – 0.5" to 4" orifice

96" length stainless steel reinforced bellows

LET US SHOW YOU THE SAVINGS!

Send us your project for a free, no-obligation design evaluation. All we need is a few parameters specific to your system. Get started today.

CALL:
(844) 376-2400 toll-free
(727) 376-2400 direct

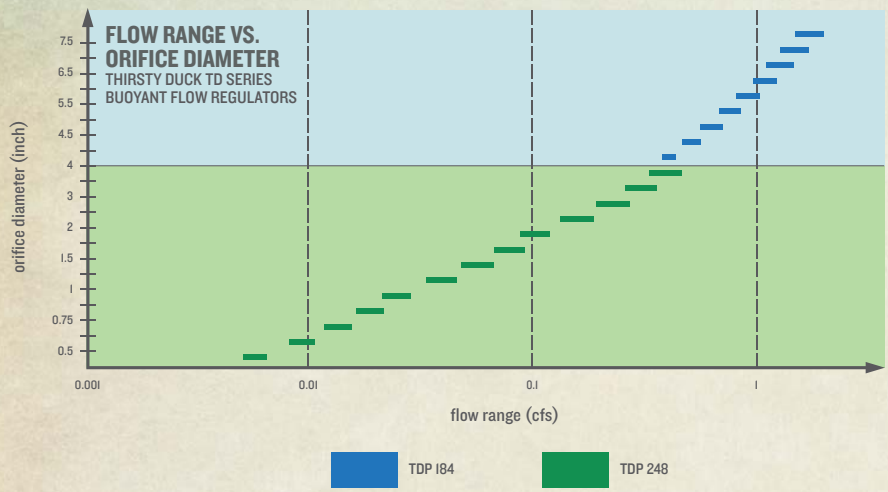
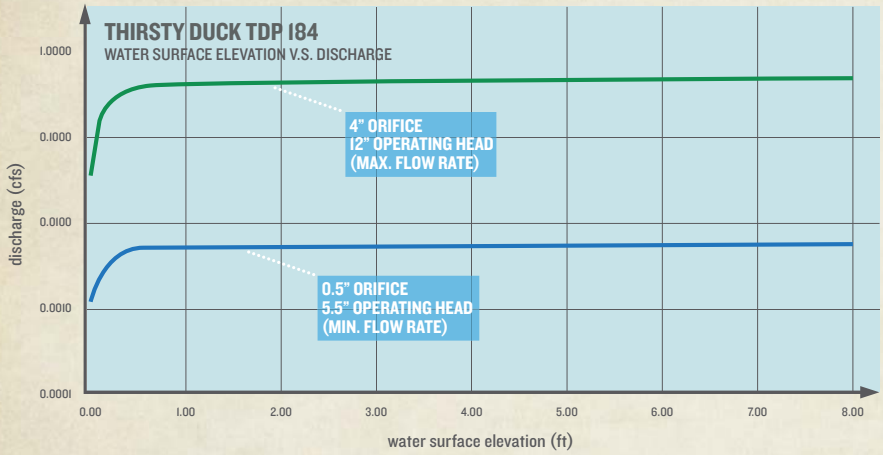
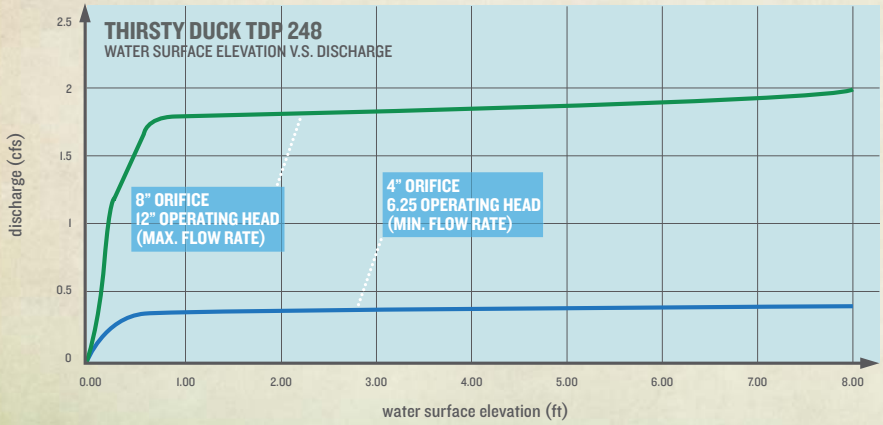
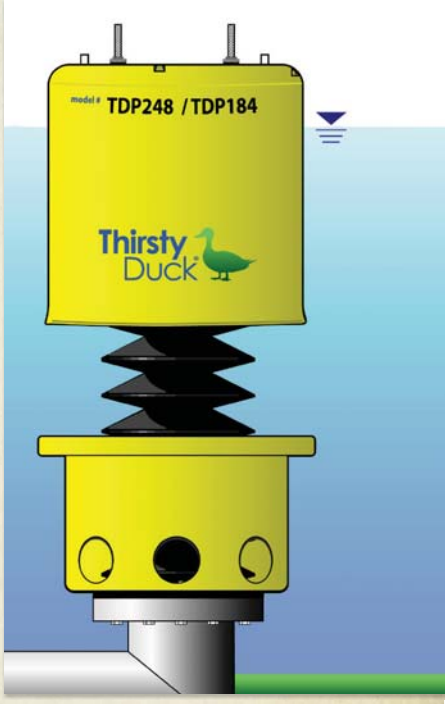
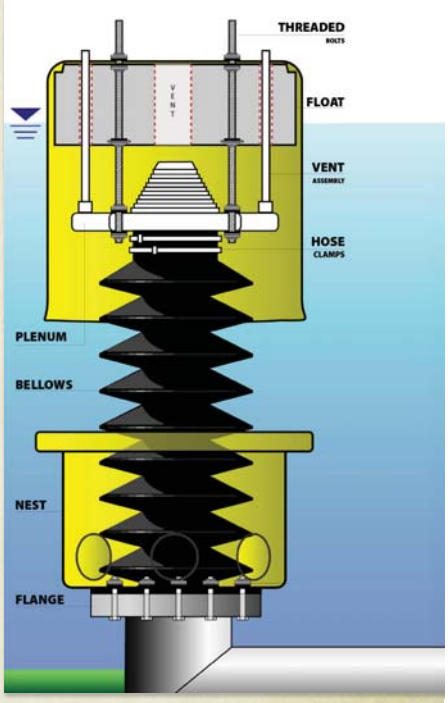
VISIT:
2154 Duck Slough Blvd.
Bldg. 4, Suite 103
Trinity, FL 34655

EMAIL:
design@thirsty-duck.com

LEARN:
thirsty-duck.com

HydroCAD® Stormwater Modeling Supported Product

Thirsty Duck®
Flow Control Technology

SO HOW EXACTLY DOES IT WORK?

Product Selection Guide