APPENDIX D

HYDROLOGY, WATER QUALITY, AND ONSITE WASTEWATER TREATMENT SYSTEM REPORTS

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ADVANCED ONSITE WASTEWATER TREATMENT SYSTEM

4000 MALIBU CANYON ROAD
MALIBU, CA

PREPARED BY:
ENSITU ENGINEERING, INC.
JOHN N YAROSLASKI
12/3/2012

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RWQCB Res. 02-022 Amendment to Basin Plan to Incorporate Wet Weather TMDL Santa Monica Bay
California Health Laws Related to Recycling Water (Title 22)
WQCPLA Ocean Plan 2001
WDR-Order01-031

Appendix C

LIBR - Landscape Water Requirement Plan, Rancho Malibu Resort Malibu, CA, December 3, 2011
GBR Update Letter Report
GBR – Geologic and Geotechnical Engineering Review of proposed OWTS April 2, 2012

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GSC Response to City of Malibu Geotechnical Review Sheet Dated October 31, 2007
GSC Response to City Geo Review Sheet Dated Oct 31 2007
VBB Report

Appendix D

Engineering Plans

Appendix E

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Flow and Waste Strength
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Process Parameters
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Irrigation System Design
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Tanks Response time and HRT Summary
Tank Volume Calculation Sheets
GE Zenon Technology Update

Appendix F

Title 22 Approved Technology Report

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SECTION 1 OVERVIEW

This Report, prepared by Ensitu Engineering Inc. of Morro Bay, CA, ("EEI") outlines the design, installation, and operation of an advanced onsite wastewater treatment system ("the System") proposed for a hotel and resort located at 4000 Malibu Canyon Road, Malibu, CA 90265(**Figure 1**, page 9).

Along with its appendices and other submissions, this Report is intended to provide the Regional Water Quality Control Board Los Angeles Region ("RWQCB"), with the information necessary to demonstrate that the operation of the System will meet the RWQCB and State water quality guidelines and is eligible to enroll under the RWQCB WDR or WRR and State Health Department Title 22 guidelines for water reclamation for reuse.

Mindful of the project's proximity to the Ocean, and the variety of external influences in Malibu that have the potential to deleteriously affect surrounding waters, EEI has selected an advanced biological treatment system and provides disinfected tertiary filtered recycled water in accordance with State health Department Title 22 Sections 60301.230 Disinfected tertiary recycled water and 60301.320 Filtered wastewater. The system will treat wastewater to levels outlined by the California Ocean Plan ("Ocean Plan"), the Los Angeles Basin Plan ("Basin Plan"), and the WDR. As directed by Title 22 these effluent levels will be achieve and monitored before the effluent is reclaimed onsite for irrigation (see Section 61.03.A). The system is designed to recycle all water onsite through irrigation. The system is designed so it will not discharge wastewater into the soil for disposal

To ensure that the System will be maintained and operated to achieve the water quality levels specified in this Report, the System operators will employ an extensive monitoring program and follow a carefully developed operations and maintenance plan.

Figure 1 Site Plan

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To most effectively demonstrate the System's ability to meet water quality objectives, the Report is structured as follows:

- Section 2, page 11 provides general project data, design data, and design calculations
- Section 3, page 15 provides numeric effluent limits.
- Section 4, page 17, provides design data
- Section 5, page 21 describes general a general overview of the project and site
- Section 6, page 23 outlines selected applicable regulations, standards, and other requirements the System has been designed to meet.
- 0, page 33 describes the current hydrologic conditions of the Site and the effects the System will have on those conditions.
- Section 8, page 37 provides detailed system description, function, and design characteristics of the system.
- Section 9, page 47 provides a summary of the irrigation system recycling design
- Section 10, page 55 provides a summary of the Title 22 Engineering Report that will be provided to California State Health
- Section 11, page 59 offers information about how the System will be operated and monitored to ensure that ongoing operation of the System will continue to meet State Health requirements for water recycling (Title 22).
- Section 12, page 61 provides conclusions to the Report.
- The Appendixes provide the regulations and standards the System was designed to meet, a detailed Geological Report for the Site, complete engineering drawings, System component descriptions and ratings, System component regulatory approvals, and other scientific information.

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SECTION 2 PROJECT DATA

PART 1 - GENERAL DATA

1.01. Project Information and Reports

Table 1 General Data, Project Information and Reports

Owner:	1-	Green acres, LLC
Project Address:	2-	4000 Malibu Canyon Road, Malibu, CA 90265
Project Description:	3-	Construction of Advanced Wastewater Treatment Facility and Appurtenances
Watershed Location	4-	USGS HUC12-180701040204
Wastewater Engineer	5-	Ensitu Engineering Inc. 685 Main Street, Suite A Morro Bay, Ca 93442 Tel: (805) 772-0150 Contact: John Yaroslaski, PE email: jyaroslaski@ensitu.com
Civil Engineer	6-	Psomas 555 South Flower Street, Suite 4400 Los Angeles, CA 90071 Tel: (213) 223-1400 Contact: Andrew Nickerson, PE email: anickerson@psomas.com
Geotechnical Consultant:	7-	GeoSoils Consultants, Inc. 6634 Valjean Avenue Van Nuys, CA 91406 Tel: (818) 785-2158 Contact: Rudy Ruberti CEG Karen Miller GE email: rruberti@geosoils.com
Geotechnical Baseline Report "GBR"	8-	Geologic and Geotechnical Engineering Review of proposed On-Site Wastewater Treatment System, April 2, 2012 See **Appendix C** this report
Landscape Irrigation Consultant	9-	Independent Irrigation Consultants, Inc. 512 Civic Center Drive Oceanside, CA 92054 Contact: Steve Baker email: steve@independentirrigation.com
Landscape Irrigation Baseline Report "LIBR"	10-	Landscape Water Requirement Plan, Rancho Malibu Resort Malibu, CA, December 3, 2011 See **Appendix C** this report
Hydrogeological Consultant:	11-	Earth Forensics Inc. 12532 Vista Panorama North Tustin, CA 92705 Contact: Dr. W. Richard Laton CHg, PG wlaton@fullerton.edu
Hydrogeological Baseline Report "HGBR"	12-	Hydrogeologic Assessment of the Proposed Rancho Malibu, April 13, 2012 See **Appendix C** this report
Local Governing Agency	13-	City of Malibu

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State Agency	14- Regional Water Quality Control Board Los Angeles Region ("RWQCB")

1.02. Elevations

Table 2 General Data, Site Elevations

15-	Average Site Elevation	210± ft
16-	Minimum Site Elevation	230± ft
17-	Maximum Site Elevation at Extent of Work	120± ft

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PART 2 - BASIS FOR EFFLUENT LIMITS

2.01. Environmental Protection Agency ("EPA")

Table 3 EPA Watershed

Project Watershed	18- USGS HUC12-180701040204
Water bodies in Watershed	19- Santa Monica Bay
Applicable TMDLs	20- RWQCB Resolutions Nos. 01-018, 02-004 (dry weather), and 02-022 (wet weather) 21- Rolling 30-day Geometric Mean Limits 22- Total coliform density shall not exceed 1,000/100 ml. 23- Fecal coliform density shall not exceed 200/100 ml. 24- Enterococcus density shall not exceed 35/100 ml. 25- Single Sample Limits 26- Total coliform density shall not exceed 10,000/100 ml. 27- Fecal coliform density shall not exceed 400/100 ml. 28- Enterococcus density shall not exceed 104/100 ml. 29- Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1.

2.02. State Health Department Title 22

Table 4 State Health, Title 22, Uses

Recycled Water Uses	30- Section 60304 Use of Recycled Water for irrigation See Section 61.04.A

Table 5 Regional Water Quality Control Board

Basis Plan Figure:	31- Figure 1-2, See **Appendix A, Figure 6,** and **Figure 7** this report
Hydraulic Unit:	32- 404-21 See **Appendix A, Figure 6,** and **Figure 7** this report
Watershed 1 Title	33- Dan Blocker Memorial (Corral) Beach
Watershed 1 Beneficial Uses	34- NAV – E 35- REC1 – E 36- REC2 – E 37- COMM – E 38- MAR – E 39- WILD – E 40- SPWN – P 41- SHELL – E
Beneficial Use Definitions	NAV – Navigation REC1 – Water Contact Recreational REC2 – Non-contact Water Recreational COMM – Commercial and Sport Fishing MAR – Marine Habitat WILD – Wildlife Habitat SPWN – Spawning, Reproduction, and/or Early Development SHELL – Shellfish Harvesting E – Existing Beneficial Use P – Potential Beneficial Use I – Intermittent Beneficial Use

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SECTION 3 NUMERIC EFFLUENT LIMITS

1.01. Effluent Limits

Table 6 Effluent Limits for Site Surface Irrigation not considered a Landscape Impoundment

Description	Unit	Geometric 30-day Mean (Design / Working)	7-day Max (Peak Design)	Max
42- Total Suspended Solids (TSS)	mg/L	<30		
43- Biochemical Oxygen Demand (BOD_5)	mg/L	<30		
44- Ammonia (NH_3-N)	mg/L	<2.2		
45- Total Coliform[1]	mpn/100mL	1,000	--	1,000
46- Fecal Coliform[1]	mpn/100mL	200	--	400
47- Enterococcus[1]	mpn/100mL	35	--	104
48- Total Nitrogen n[2]	mg/L	10	--	15
49- Turbidity[2]	NTU	--	--	2

[1]Total Coliform, fecal coliform, and enterococcus limit based on RWQCB Resolutions Nos. 01-018, 02-004 (dry weather), and 02-022 (wet weather)
[2]Total Nitrogen limit based on similar projects in basin. Limit exceeds TMDL and ocean plan limits
[3]Total Nitrogen to include Nitrate-N, Nitrite-N, Ammonia-N, and Organic Nitrogen
[4]Turbidity Based on 60301.320. Filtered wastewater has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following: 0.2 NTU more than 5 percent of the time within a 24-hour period; and 0.5 NTU at any time

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SECTION 4 DESIGN DATA

PART 1 - TYPICAL RAW WASTEWATER CHARACTERISTICS

Table 7 Design Data, Typical Raw Wastewater Characteristics

Constituent		Unit	Design Value	Actual Values (Malibu Winter Canyon WWTF)		
				Max	Min	Ave
50-	Total Suspended Solids (TSS)	mg/L	130	219	59	130
51-	Biochemical Oxygen Demand (BOD_5)	mg/L	480	380	274	318
52-	Chemical Oxygen Demand (COD)	mg/L	1111	1250	914	1111
53-	Ammonia (NH_3-N)	mg/L	52	64	34	52
54-	Total Kjeldahl Nitrogen (TKN)	mg/L	54	68	35	54
55-	Organic Nitrogen	mg/L	2	4	1	2

PART 2 - FLOW CHARACTERISTICS

Table 8 Design Data, Flow Characteristics

56-	Peak Design Flow	39,000 gpd
57-	Average Flow (Design/Working Flow)	26,000 gpd
58-	Peak Hour Flow	43,000 gpd
59-	Min Flow	10,000 gpd

PART 3 - TANKAGE

3.01. General

Table 9 Design Data, Tankage –General

60-	Total Tank Capacity		215,000 gallons ("gal")
61-	Total Number of Tanks		10
62-	Grease Interceptor ("GI") Capacity High High ("HH")	TK-101	25,500 gal
63-	TK-101 Working Capacity		24,700 gal
64-	TK-101 Capacity Low Low ("LL")		22,400 gal
65-	Trash Trap ("TT") Capacity HH	TK-201	40,600 gal
66-	TK-201 Working Capacity		39,270 gal
67-	TK-201 Capacity LL		35,600 gal
68-	Equalization Tank ("EQ") Capacity HH	TK-301	40,600 gal
69-	TK-301 Capacity High		37,579 gal
70-	TK-301 Capacity Working		26,000 gal
71-	TK-301 Capacity Low		4,700 gal
72-	TK-301 Capacity LL		2,800 gal
73-	Anoxic Tank Capacity HH	TK-401	15,150 gal
74-	TK-401 Capacity Working		14,660 gal
75-	TK-401 Capacity LL		13,300 gal
76-	Aerobic Tank Capacity HH	TK-501	25,450 gal
77-	TK-501 Capacity Working		24,600 gal
78-	TK-501 Capacity LL		22,300 gal

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79-	Clear Well Capacity HH	TK-801	25,564 gal
80-	TK-801 Capacity High		23,700 gal
81-	TK-801 Capacity Working		16,400 gal
82-	TK-801 Capacity LL		1,760 gal
83-	Clear Well Capacity HH	TK-901	25,564 gal
84-	TK-901 Capacity High		23,700 gal
85-	TK-901 Capacity Working		16,400 gal
86-	TK-901 Capacity LL		1,760 gal

3.02. TK-101

Table 10 Design Data, TK-101

87-	TK-101 Hydraulic Retention Time ("HRT") Working Capacity and Design Flow	HRT_W	68.1 hours
88-	TK-101 HRT Peak Flow Working Capacity	HRT_P	47.5 hours
89-	TK-101 Emergency Storage Volume at Working Capacity		1,083 gal
90-	TK-101 Emergency Response Time at Working Capacity and Design Flow		1 hours

3.03. TK-201

Table 11 Design Data, TK-201

91-	TK-201 Hydraulic Retention Time ("HRT") Working Capacity and Design Flow	HRT_W	24.1 hours
92-	TK-201 HRT Peak Flow Working Capacity	HRT_P	21.9 hours
93-	TK-201 Emergency Storage Volume at Working Capacity		1,730 gal
94-	TK-201 Emergency Response Time at Working Capacity and Design Flow		1.6 hours
95-	TK-201 Effluent Filter Mesh Size		1/16 inch

PART 4 - SYSTEM RESPONSE TIMES

Table 12 System Response Times

96-	TK-101 through 901 Emergency Storage Volume at Working Capacity		38,330 gal
97-	TK-101 through 901 Emergency Response Time at Working Capacity and Design Flow		35.4 hours
98-	TK-101 through 901 Emergency Response Time at Working Capacity and Peak Flow		23.6 hours
99-	TK-101 through 901 Emergency Response Time at Working Capacity and Peak One-Day Flow		21.4 hours

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PART 5 - PROCESS DESIGN

5.01. Membrane Bio-Reactor ("MBR")

Table 13 Design Data, MBR

100- MBR Design Flow	26,000 gpd
101- MBR Average Flow	26,000 gpd
102- MBR Peak Flow	39,000 gpd
103- MBR Min Flow	10,000 gpd
104- MBR Peak One Day Flow	43,000 gpd

5.02. Ultraviolet Disinfection ("UV")

Table 14 Design Data, UV

105- Number of Units	2
106- Design Flow to UV	40 gpm
107- Minimum Flow to UV	10 gpm
108- Peak Flow to UV	80 gpm
109- Manufacturer	Wedeco

PART 6 - IRRIGATION FIELD DESIGN

Table 15 Design Calculations, Irrigation Field See Section 9 and Appendix C

110- LIBR	Landscape Water Requirement Plan, Rancho Malibu Resort Malibu, CA, December 3, 2011
111- Weather Station	Santa Monica #99
112- Location	Latitude: 34.04 Longitude -118.48
113- Date Station Was Activated	December 11, 1992
114- Sample Data Set Range	December 11, 1992-August 30, 2012
115- Design Wastewater Flow	26,000 gpd
116- CWeighted Composite Landscape Coefficient K_T (see Landscape Water Requirement Plan, Rancho Malibu Resort Malibu, CA, December 3, 2011)	1.2964
117- Assumed Precipitation Available for Irrigation after Runoff	40%
118- Design Flow to Irrigation Field	26,000 gpd
119- Total Irrigation Area	904,497 ft^2
120- Storage Required	482,510 gallons

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SECTION 5 PROJECT AND SITE OVERVIEW

1.01. Site Description

The site is located south of Pacific Coast Highway ("PCH") at 4000 Malibu Canyon Road, Malibu, CA 90265 ("Site"). The proposed Rancho Malibu Resort occupies approximately 28 acres at the northeast corner of Pacific Coast Highway and Malibu Canyon Road. Civic Center Drive borders the site to the north and northeast, while a wastewater treatment and disposal field borders the site to the east (See **Figure 2 and Figure 3** page 22). The majority of the site is located on one of several uplifted terraces in the Malibu area. The terrace surface slopes gently toward the east. A hillside, about 60 feet high, separates the proposed development area from Winter Canyon to the east. The slopes along the eastern edge of the Project Site are scarps related to landslides. Cut slopes have been constructed along Malibu Canyon Road, Civic Center Drive and Pacific Coast Highway.

The Project Site is currently vacant and covered with grass, brush and trees. The site was previously used as a commercial nursery and numerous metal planting cans and wooden crates were observed scattered throughout the site, on the surface. Remnant, unpaved, access roads have been graded throughout the site.

1.02. Future Development

The proposed resort at Rancho Malibu will include a three story hotel including basement, 21 detached structures (casitas), swimming pools, retaining walls, street and parking areas, and hardscape and landscaped areas. Cut and fill grading is proposed to create building and street pads. Other grading will be completed to accommodate repairs to existing gullies associated with the slope areas.

The planned wastewater reclamation system includes onsite treatment, so that only reclaimed water meeting Title 22 guidelines is reclaimed. The reclaimed water will be dispersed through an onsite irrigation system allowing for onsite irrigation.

The proposed wastewater treatment process for the facility is a membrane bioreactor (MBR) system, explained in greater detail in Section 8 of this Report. The reclaimed water will irrigate approximately 904,497 ft2 (See **Appendix C** this report). The peak flow from the treatment system is approximately 39,000 gpd with an average flow of 26,000 gpd. The peak design reuse flow to the irrigation system is approximately 26,000 gpd (see Section 61.04.A).

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Figure 2 Vicinity Map 1

Figure 3 Vicinity Map 2

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SECTION 6 APPLICABLE REGULATIONS AND STANDARDS

PART 1 - SELECTED APPLICABLE REGULATIONS, STANDARDS, AND REQUIREMENTS

1.01. General

The System, utilizes tertiary treatment, membrane filtration, and UV disinfection. The System is designed to meet California State Laws Related to Recycled Water, Title 22. The system is also designed to meet Regional, State, and Federal regulations, standards, and other requirements to ensure that the System produces reclaimed water that can be utilized for irrigation (see Section 61.04.A) preventing reclaimed water from entering the groundwater.

1.02. U.S. Environmental Protection Agency ("EPA") total maximum daily loads ("TMDL")

A. Determining Applicable TMDLs

1. Our first step was to determine watershed information. As shown on Figure 4, page 24 and Figure 5, page 24 our project is located in USGS HUC12-180701040204 watershed which drains to Santa Monica Bay. It is our opinion that Santa Monica Bay TMDLs as implemented in RWQCB Resolution No. 01-018 should be implemented for this project.

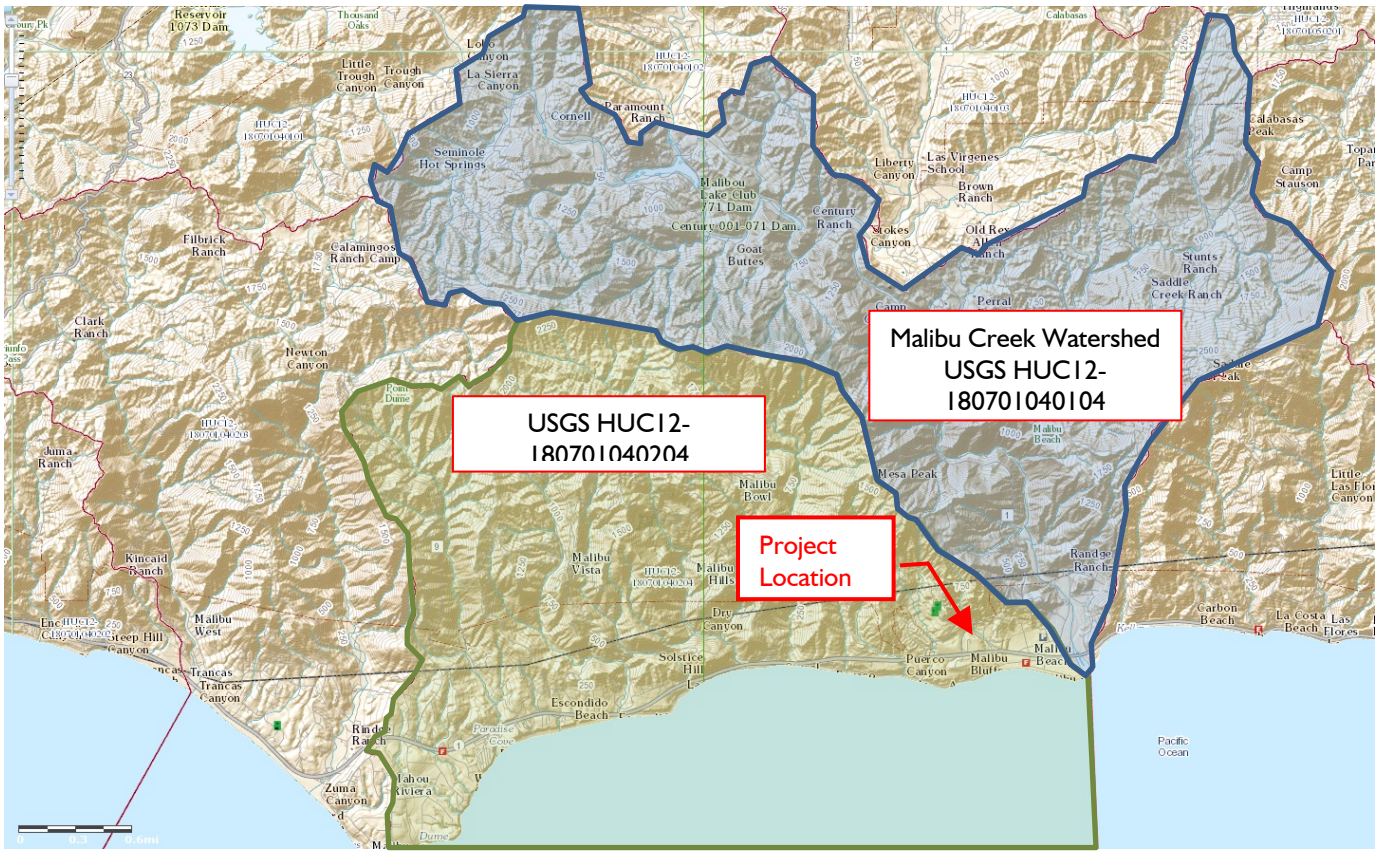

Figure 4 Malibu Creek Watershed and Project Location

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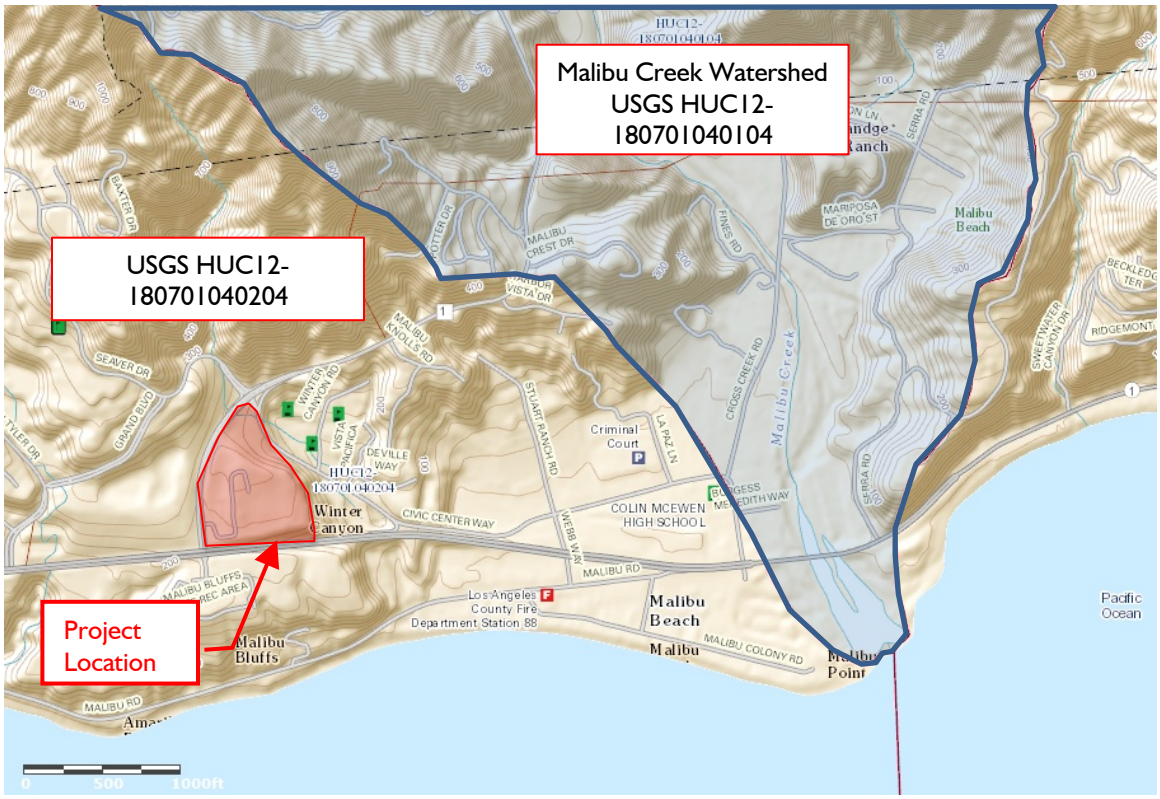

Figure 5 Malibu Creek Watershed and Project Location 2

B. Applicable TMDLs

1. RWQCB Resolutions Nos. 01-018, 02-004 (dry weather), and 02-022 (wet weather)

C. TMDL Limits

1. Rolling 30-day Geometric Mean Limits

a. Total coliform density shall not exceed 1,000/100 ml.
b. Fecal coliform density shall not exceed 200/100 ml.
c. Enterococcus density shall not exceed 35/100 ml.

2. Single Sample Limits

a. Total coliform density shall not exceed 10,000/100 ml.
b. Fecal coliform density shall not exceed 400/100 ml.
c. Enterococcus density shall not exceed 104/100 ml.
d. Total coliform density shall not exceed 1,000/100 ml, if the ratio of fecal-to-total coliform exceeds 0.1.

1.03. "California Health Laws Related to Recycled Water, Title 22" See Appendix B

A. 60304. Use of recycled water for irrigation

1. Recycled water used for the surface irrigation of the following shall be;

a. a disinfected tertiary recycled water, except that for filtration pursuant to Section 60301.320(a) coagulation need not be used as part of the treatment process provided that the filter effluent turbidity does not exceed 2 NTU, the turbidity of the influent to the filters is continuously measured, the influent turbidity does not exceed 5 NTU for more than 15 minutes and never exceeds 10 NTU, and that there is the capability to automatically activate chemical

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addition or divert the wastewater should the filter influent turbidity exceed 5 NTU for more than 15 minutes:

1). Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop,
2). Parks and playgrounds,
3). Residential landscaping, and
4). Any other irrigation use not specified in this section and not prohibited by other sections of the California Code of Regulations.

B. 60301.230. Disinfected tertiary recycled water

1. "Disinfected tertiary recycled water" means a filtered and subsequently disinfected wastewater that meets the following criteria:

a. The filtered wastewater has been disinfected by either:

1). A chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or
2). A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.

2. The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

C. 60301.320. Filtered wastewater;

1. "Filtered wastewater" means an oxidized wastewater that meets the criteria in subsection (Section 61.03.C.1.a) or (Section 61.03.C.1.b):

a. Has been coagulated and passed through natural undisturbed soils or a bed of filter media pursuant to the following:

1). At a rate that does not exceed 5 gallons per minute per square foot of surface area in mono, dual or mixed media gravity, upflow or pressure filtration systems, or does not exceed 2 gallons per minute per square foot of surface area in traveling bridge automatic backwash filters; and
2). So that the turbidity of the filtered wastewater does not exceed any of the following:
a). An average of 2 NTU within a 24-hour period;
b). 5 NTU more than 5 percent of the time within a 24-hour period; and
c). 10 NTU at any time

b. Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:

1). 0.2 NTU more than 5 percent of the time within a 24-hour period; and
2). 0.5 NTU at any time

D. 60301.800. Spray irrigation

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"Spray irrigation" means the application of recycled water to crops to maintain vegetation or support growth of vegetation by applying it from sprinklers.

E. 60321. Sampling and analysis

1. Disinfected tertiary recycled water shall be sampled at least once daily for total coliform bacteria. The samples shall be taken from the disinfected effluent and shall be analyzed by an approved laboratory.

2. Disinfected tertiary recycled water shall be continuously sampled for turbidity using a continuous turbidity meter and recorder following filtration. Compliance with the daily average operating filter effluent turbidity shall be determined by averaging the levels of recorded turbidity taken at four-hour intervals over a 24-hour period. Compliance with turbidity pursuant to section 60301.320 (a)(2)(B) and (b)(1) shall be determined using the levels of recorded turbidity taken at intervals of no more than 1.2-hours over a 24- hour period. Should the continuous turbidity meter and recorder fail, grab sampling at a minimum frequency of 1.2-hours may be substituted for a period of up to 24-hours. The results of the daily average turbidity determinations shall be reported quarterly to the regulatory agency.

3. The producer or supplier of the recycled water shall conduct the sampling required in subsections (Section 61.03.E.1) and (Section 61.03.E.2).

1.04. Beneficial Uses

A. Uses for Water Recycling See Appendix B

1. Irrigation of landscape areas within project site

2. Decorative fountains and water features

B. Regional Water Quality Control Board Beneficial Uses See Appendix A

The System has been designed to consider beneficial uses as defined by the RWQCB. The system is designed to fully recycle all wastewater produced onsite therefore Title 22 requirements have been employed to protect the beneficial uses of the waters in the vicinity of the Site. The beneficial uses considered were determined by reference to the Water Quality Control Plan, Los Angeles Region Basin Plan ("The Basin Plan") adopted by the RWQCB on June 13, 1994 and as amended subsequently. The Hydraulic Unit number was determined based on the project location (see **Figure 6 and Figure 7,** page 27 and 27). Malibu Hydrologic Unit 404-21 was identified corresponding to the following coastal features: Dan Blocker Memorial (Corral) Beach. Table 16, page 27, represents the beneficial uses set out in the Basin Plan for the feature.

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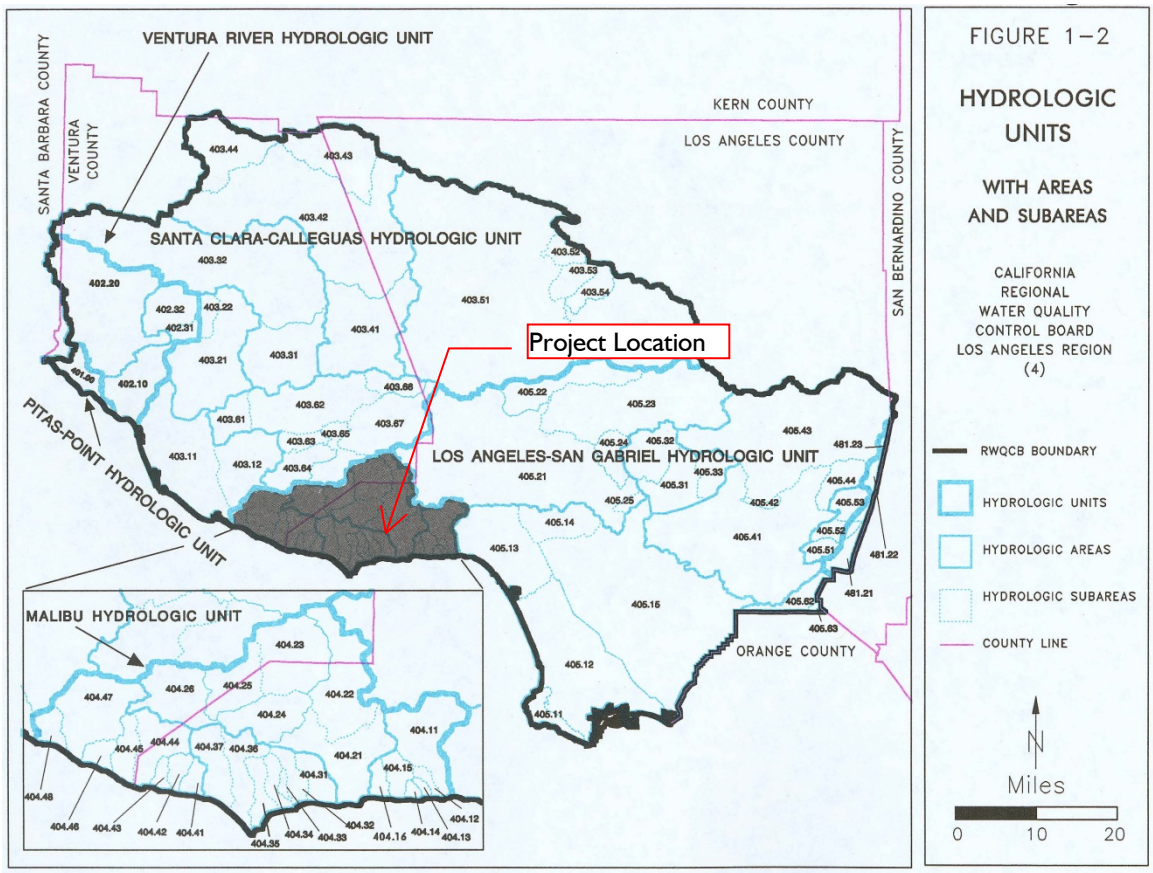

Figure 6 Basin Plan Figure 1-2 Miscellaneous Streams and Coastal Features, Los Angeles County

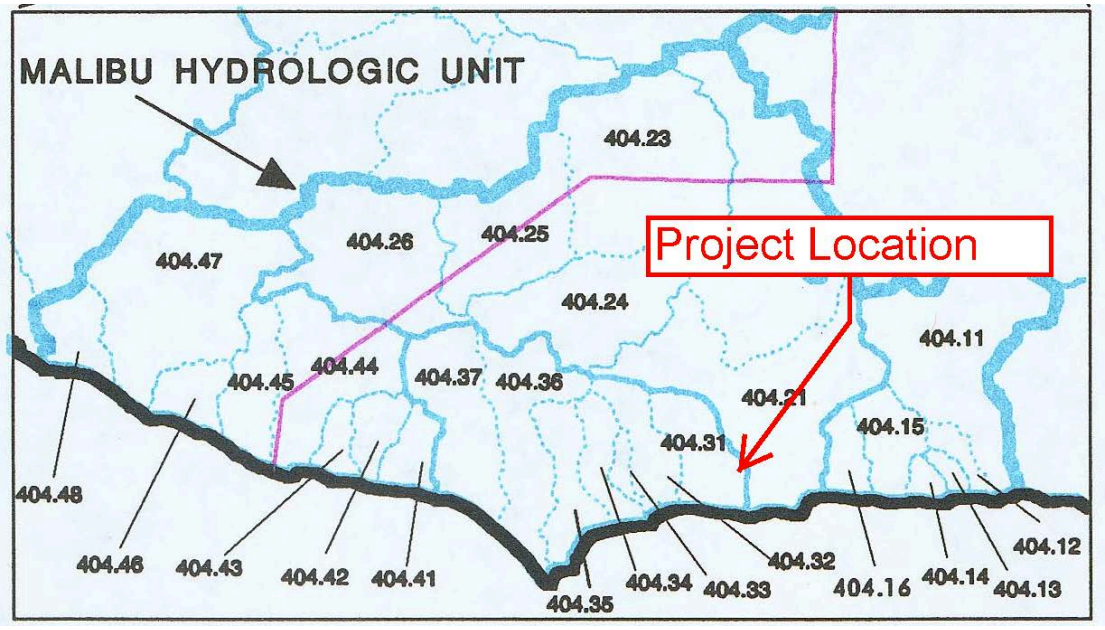

Figure 7 Basin Plan Figure 1-2 Malibu Hydraulic Unit, Los Angeles County

Table 16 Beneficial Uses of Coastal Features in the Vicinity of the Project Site (WQCBLA Table 2-3 see Appendix A, pages 2 and 3)

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Coastal Feature	Hydro Unit No.	Beneficial Uses		
Dan Blocker Memorial (Corral) Beach	404-21	NAV – E REC1 – E REC2 – E	COMM – E MAR – E WILD – E	SPWN – P SHELL – E

NAV – Navigation
REC1 – Water Contact Recreational
REC2 – Non-contact Water Recreational
COMM – Commercial and Sport Fishing
MAR – Marine Habitat
WILD – Wildlife Habitat
SPWN – Spawning, Reproduction, and/or Early Development
SHELL – Shellfish Harvesting
E – Existing Beneficial Use
P – Potential Beneficial Use
I – Intermittent Beneficial Use

As demonstrated in **Figure** 7, potential beneficial uses in the area of the project include; navigation, water contact recreation, non-contact water recreation, commercial and sport fishing, marine habitat, wildlife habitat, spawning, reproduction, and/or early development, and shellfish harvesting.

1.05. Ocean Plan (See Appendix B)

The System has been designed to consider beneficial uses as defined by the Ocean Plan. The system is designed to fully recycle all wastewater produced onsite therefore Title 22 requirements have been employed to protect the beneficial uses of the waters in the vicinity of the Site.

A. Bacterial Characteristics/Shellfish Harvesting Standards

The System's water reclamation system will ensure that the effluent discharge does not contribute additional coliform or bacterial density to the water column in violation of the Ocean Plan's water-contact and shellfish harvesting standards. For specific requirements and standards, please see the Ocean Plan at **Appendix B**.

B. Physical Characteristics

The System is designed and will be operated so it will meet the following physical characteristics of the Ocean Plan's water quality objectives:

1. Floating particulates and grease and oil will not be visible.
2. The discharge of waste will not cause aesthetically undesirable discoloration of the ocean surface.
3. Natural light will not be significantly reduced at any point outside the initial dilution zone as the result of the discharge of waste.
4. The rate of deposition of inert solids and the characteristics of inert solids in ocean sediments will not be changed such that benthic communities are degraded.

C. Chemical Characteristics

The System is designed and will be operated so it will also meet the following chemical characteristics of the Ocean Plan's water quality objectives:

1. The dissolved oxygen ("DO") concentration will not at any time be depressed more than 10 percent from that which occurs naturally, as the result of the discharge of oxygen demanding waste materials.

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2. The pH will not be changed at any time more than 0.2 units from that which occurs naturally.
3. The dissolved sulfide concentration of waters in and near sediments will not be significantly increased above that present under natural conditions.
4. The concentration of substances set forth in Chapter II, Table B, in marine sediments will not be increased to levels which would degrade indigenous biota.
5. The concentration of organic materials in marine sediments will not be increased to levels that would degrade marine life.
6. Nutrient materials will not cause objectionable aquatic growths or degrade indigenous biota.
7. For additional specific numerical water quality objectives and requirements please see the Ocean Plan at **Appendix B.**

D. Biological Characteristics

Similarly, the System is designed and will be operated to meet the following biological characteristics of the Ocean Plan's water quality objectives:

1. Marine communities, including vertebrate, invertebrate, and plant species, will not be degraded.
2. The natural taste, odor, and color of fish, shellfish, or other marine resources used for human consumption will not be altered.
3. The concentration of organic materials in fish, shellfish or other marine resources used for human consumption will not bioaccumulate to levels that are harmful to human health.

E. Ocean Plan Implementation Requirements

For a specific discussion of how the System will be implemented to achieve the Ocean Plan requirements, see this Report generally explaining consistency with RWQCB Resolutions Nos. 01-018, 02-004 (dry weather), and 02-022 (wet weather) along with Ocean Plan, and Title 22 requirements, and Section 9 describing the hydrogeological characteristics of the Site, the System's design, and the monitoring and operation guidelines.

1.06. General WDR Order No .01-031 and RWQCB Resolutions Nos. 01-018, 02-004 (dry weather), and 02-022 (wet weather) Limits (See Appendix B Pages 89-106)

It is expected that the System will be enrolled under a specific Waste Discharge Requirement with Title 22 quality and monitoring requirements as well as RWQCB water quality requirements. The requirements in this report are modeled based on Title 22 requirements, TMDL, RWQCB Resolutions Nos. 01-018, 02-004 (dry weather), and 02-022 (wet weather), and General WDR Order No .01-031. The following section outlines the specific requirements that the System is designed to address. Note that 0 of this Report provides greater detail about the hydrogeological conditions of the Site and System's design.

A. Influent Limitations:

1. Only commercial wastes will be discharged into the System (no industrial wastes will be discharged).
2. The maximum daily flow of influent from the collection system will not exceed 43,000 gpd. As explained further in this Part and Section 8, it is expected that between 10,000 gpd and 43,000 gpd will be discharged to the System daily. Furthermore, the System has protocols in place to ensure this limitation will not be exceeded. See this Report generally.

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B. Additional Requirements and Standards

1. Pretreatment Education

Dischargers will provide documentation that they have taken steps to prevent chemicals added to the water (such as plumbing agents, cleaning agents and cosmetic/grooming products) from interfering with biological processes in the treatment system. The Dischargers and operator will control chemical additives in the influent through the education of tenants and customers to minimize the presence of pollutants of concern in the wastewater stream and violation of the effluent limits. This will be provided with the O&M Manual.

2. Restaurant Waste Management:

The Dischargers will provide a summary of:

a. The adequacy of the capacity and design of the Best Management Practices (BMPS) to trap and manage fats, oils, and grease before entering the primary separation tank. This will be provided with the O&M Manual.
b. An operation and maintenance plan for all restaurants and food services establishments, that is capable of preventing fats, oils and grease from entering the treatment system, and also controlling cleaning agents in wastewaters that enter the treatment system. This will be provided with the O&M Manual.

3. Water Conservation:

Water conservation technology and practices will be used by tenants and customers throughout the redevelopment to decrease the additional potable water added to Malibu Valley Groundwater Basin and the impact on the water balance. The reduction in water consumption will be predicted and quantified in the Water Conservation Report, which will include the number and flow standards of all plumbing fixtures and water usage assumptions, and submitted for approval by the Executive Officer within 30 days of adoption of the waste discharge requirements.

1.07. Additional Proposed Influent and Effluent Limits

The System is designed and will be operated to meet the following additional influent and effluent limits and regulations:

A. Influent

1. Domestic Waste:

No water softener or garbage disposal discharge will be allowed into the collection systems that flow to the treatment unit.

2. Zero Discharge:

The influent flow to the treatment system can be reduced through operational changes, such as elimination of use, increased water recycling, irrigation, or water conservation. See this Report generally.

3. Continuous Flow Measurement:

To ensure that influent limits will not be exceeded, influent daily flows will be measured mechanically with an in-stream flow meter after the equalization tank. The flow measurements will be confirmed with the submission of average and maximum daily use in monthly potable water bills.

B. Effluent

1. Basis

The System is designed and will be operated to meet Title 22 limits for recycling of wastewater as well as TMDLs for site location. These limits are outlined in Section 6.

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Please see this Report Section 8 and Section 9 for a technical explanation of how the System will meet these limits.

2. Monitoring Points:

   The effluent will be sampled and effluent requirements will apply before discharge to the irrigation system. See this report generally for additional information.

3. Zero Discharge:

   The system is designed to fully reclaim all wastewater produced onsite through irrigation. The system is designed to meet reliability requirements outlined in Article 9 and 10 of the "California Health Laws Related to Recycled Water." In addition the system is designed to store recycled water during rain events (See Section 9). See this Report generally.

4. Maximum Flows:

   The System is designed and will be operated so that the maximum daily flow from the System will not exceed the flows listed in Table 8. Effluent daily flows shall be measured after the flow equalization tank. See this Report generally.

5. pH:

   The System is designed and will be operated so that at all times the pH of wastes discharged will be between 6.5 to 8.5 pH. See this Report Generally.

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SECTION 7 SITE GEOLOGY (SEE APPENDIX C PAGES 107-626)

PART 1 - SOILS CLASSIFICATION AND TESTING

1.01. Soils Classification (See Appendix C, Pages 109-228)

According to the report "Geologic And Geotechnical Engineering Review" by GeoSoils Consultants Inc. dated April 2, 2012, a total of 38 sieve analyses and hydrometer tests were performed on samples obtained from a total of 21 backhoe test pits. Samples were obtained in the upper 1 to 2 feet of each test pit. In addition, samples were obtained at depth in the test pits where a potential exists for different soils types below the area of proposed seepage. The purpose of the sampling was to determine the soil types in accordance with the USDA classification system, as well as to determine if confining layers exist in the test pits. See Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, and Figure 13 and Appendix C.

Test Pit Number	Sample Depth #1 ft	USDA Soil Classification	Maximum Percolation Rate (EPA) gal/ft^2-day	Sample Depth #2 ft	USDA Soil Classification	Maximum Percolation Rate gal/ft^2-day	Design Percolatio Rate	
							Average Flow gal/ft^2-day	Peak Flow gal/ft^2-day
TP-1	1'-2'	Sandy Loam, Blocky, Weak	0.7	5'-6'	Sandy Loam, Massive, Structureless	0.6	–	–
TP-2	1'-2'	Sandy Loam, Blocky, Strong	1	3'	Sandy Clay Loam, Blocky, Moderate	0.3	–	–
TP-3	1'-2'	Silt Loam, Blocky, Weak	0.6	4'-5'	Silt Loam (Bedrock)	0.8	0.19	0.29
TP-4	1'-2'	Loam, Massive, Structureless	0.5				0.19	0.29
TP-5	1'-2'	Sandy Loam, Blocky, Moderate	1	2'-3'	Sandy Clay Loam, Blocky, Moderate to Strong	0.3	–	–
TP-6	1'-2'	Sandy Loam, Blocky, Weak	0.7	2'-3'	Sandy Clay Loam, Blocky, Strong	0.3	–	–
TP-7	6'-7'	Sandy Clay Loam, Blocky, Moderate	0.3				–	–
TP-8	1'-2'	Sandy Clay Loam, Blocky, Moderate	0.3				0.19	0.29
TP-9	1'-2'	Sandy Loam, Blocky, Moderate	0.5	5'-6'	Sandy Loam, Massive, Structureless	0.5	0.19	0.29
TP-10	1'-2'	Sandy Loam, Massive, Structureless	0.5				0.19	0.29
TP-11	1'-2'	Sandy Loam, Massive, Structureless	0.5	13'	Sandy Loam, Massive, Structureless	0.5	0.19	0.29
TP-12	1'-2'	Sandy Loam, Massive, Structureless	0.5	10'	Sandy Loam/Sandy Clay Loam, Massive, Structureless	0.5	–	–
TP-13	1'-2'	Sandy Clay Loam, Massive, Structureless	0				–	–
TP-14	1'-2'	Sandy Clay Loam, Massive, Structureless	0	5'-6'	Sandy Loam/Sandy Clay Loam, Massive, Structureless	0.5	–	–
TP-15	1'-2'	Sandy Loam, Blocky, Moderate	1	4'	Sandy Clay Loam, Blocky, Weak	0	–	–
TP-16	1'-2'	Sandy Loam, Blocky, Moderate to Strong	1				–	–
TP-17	1'-2'	Sandy Clay Loam, Blocky, Strong	0.3	10'	Sandy Loam, Massive, Structureless	0.5	–	–
TP-18	1'-2'	Sandy Clay Loam, Blocky, Strong	0.3	10'	Sandy Loam, Massive, Structureless	0.5	–	–
TP-19	1'-2'	Sandy Clay, Blocky, Strong	0	7'	Sandy Clay Loam, Massive, Structureless	0	–	–
TP-20	1'-2'	Sandy Loam, Blocky, Strong	1				–	–
TP-21	1'-2'	Sandy Clay Loam/Clay Loam, Blocky, Moderate to Strong	0.3	10'	Clay Loam, Massive, Structureless	0	–	–

Figure 8 LP Geological Section A-A (See Appendix C page 53, Plate 2)

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EPA Publication 625/R-00/008, Chapter 4, Table 4-3. Suggested hydraulic and organic loading rates for sizing infiltration surfaces

	Texture	Structure		Hydraulic loading (gal/ft^2-day)		Organic loading (lb BOD/1000ft^2-day)	
		Shape	Grade	BOD=150	BOD=30	BOD=150	BOD=30
A	Coarse sand, sand, loamy coarse sand, loamy sand	Single grain	Structureless	0.8	1.8	1	0.4
B	Fine sand, very find sand, loamy fine sand, loamy very	Single grain	Structureless	0.4	1	0.5	0.25
C	Coarse sandy loam, sandy loam	Massive	Structureless	0.2	0.6	0.25	0.15
D		Platy	Weak	0.2	0.5	0.25	0.13
E			Moderate, Strong				
F		Prismatic, blocky, granular	Weak	0.4	0.7	0.5	0.18
G			Moderate, strong	0.6	1	0.75	0.25
H	Fine sandy loam, very fine sandy loam	Massive	Structureless	0.2	0.5	0.25	0.13
I		Platy	Weak, mod., strong				
J		Prismatic, blocky, granular	Weak	0.2	0.6	0.25	0.15
K			Moderate, strong	4	0.8	0.5	0.2
L	Loam	Massive	Structureless	0.2	0.5	0.25	0.13
M		Platy	Weak, mod., strong				
N		Prismatic, blocky, granular	Weak	0.4	0.6	0.5	0.15
O			Moderate, strong	0.6	0.8	0.75	0.2
P	Silt loam	Massive	Structureless		0.2	0	0.05
Q		Platy	Weak, mod., strong				
R		Prismatic, blocky, granular	Weak	0.4	0.6	0.5	0.15
S			Moderate, strong	0.6	0.8	0.75	0.2
T	Sandy clay loam, clay loam, silty clay loam	Massive	Structureless				
U		Platy	Weak, mod., strong				
V		Prismatic, blocky, granular	Weak				
W			Moderate, strong	0.2	0.3	0.25	0.08

Source: Adapted from Tyler, 2000.

Figure 9 LP Geological Section B-B (See Appendix C page 53, Plate 2)

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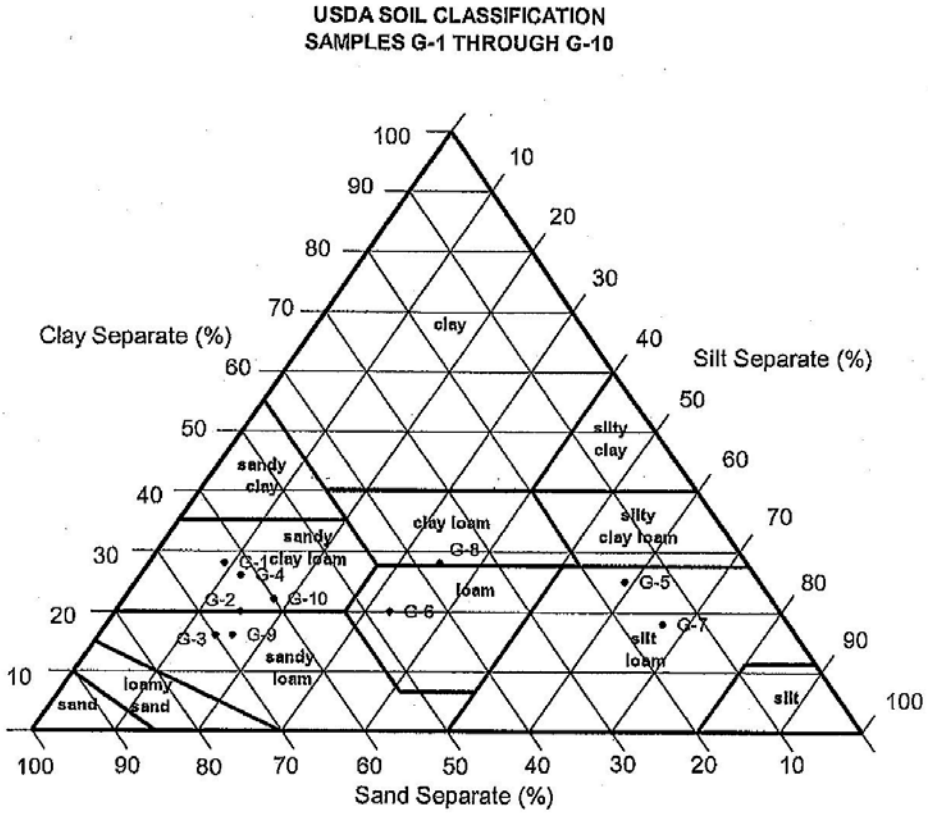

Figure 10 USDA Soil Classification Samples G-1 through G-10

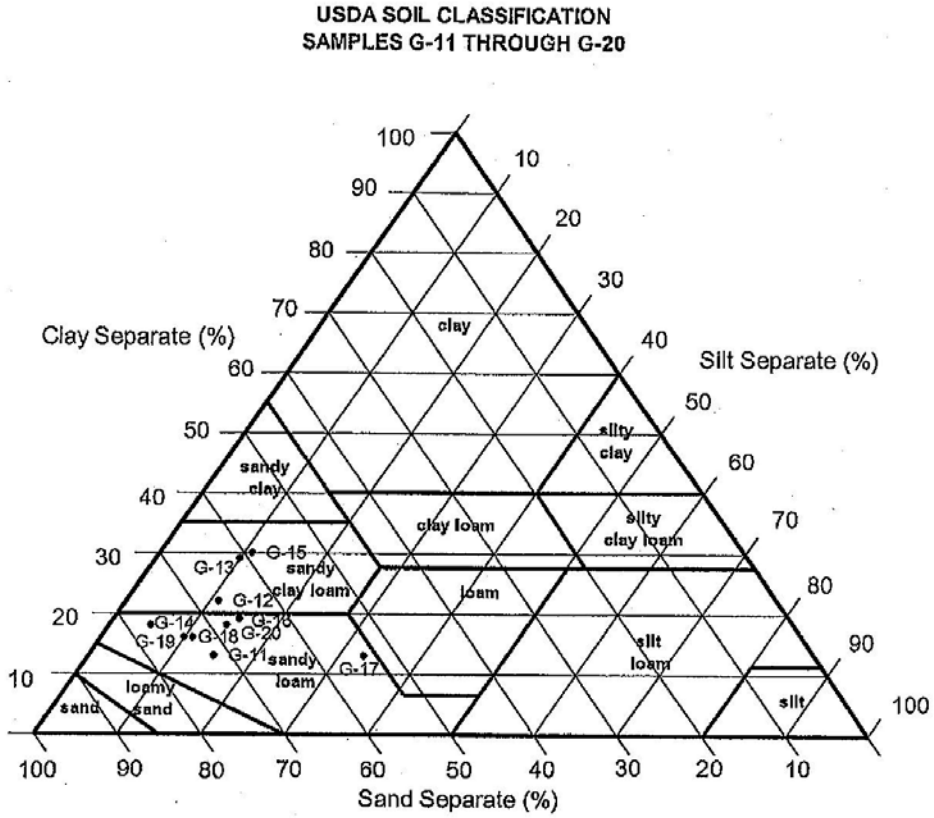

Figure 11 USDA Soil Classification Samples G-11 through G-20

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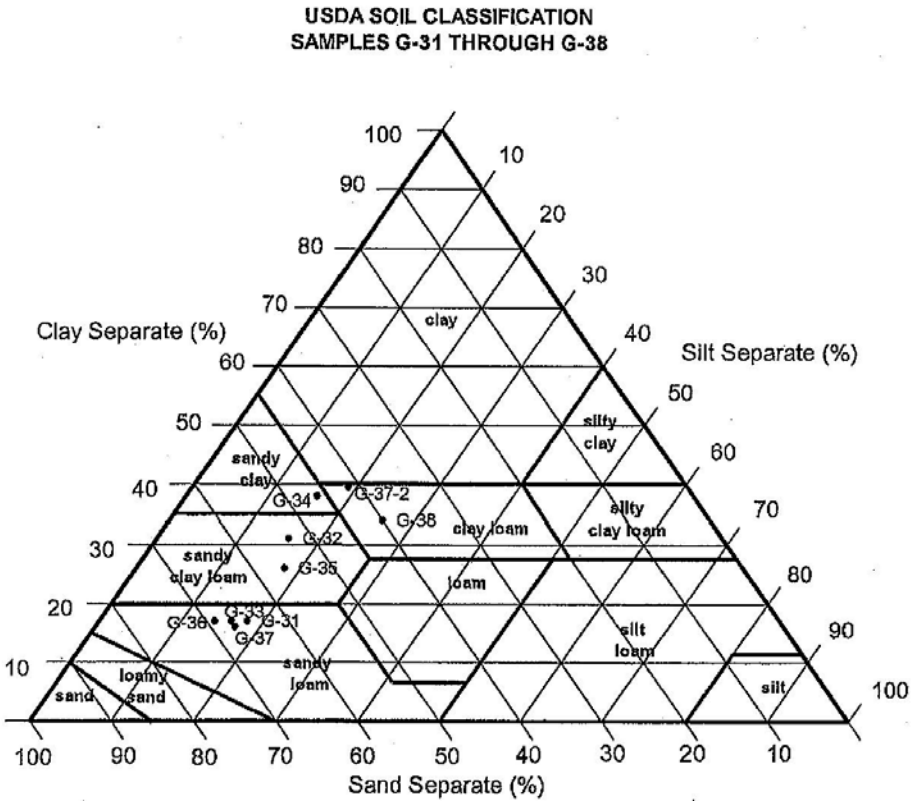

Figure 12 USDA Soil Classification Samples G-31 through G-38

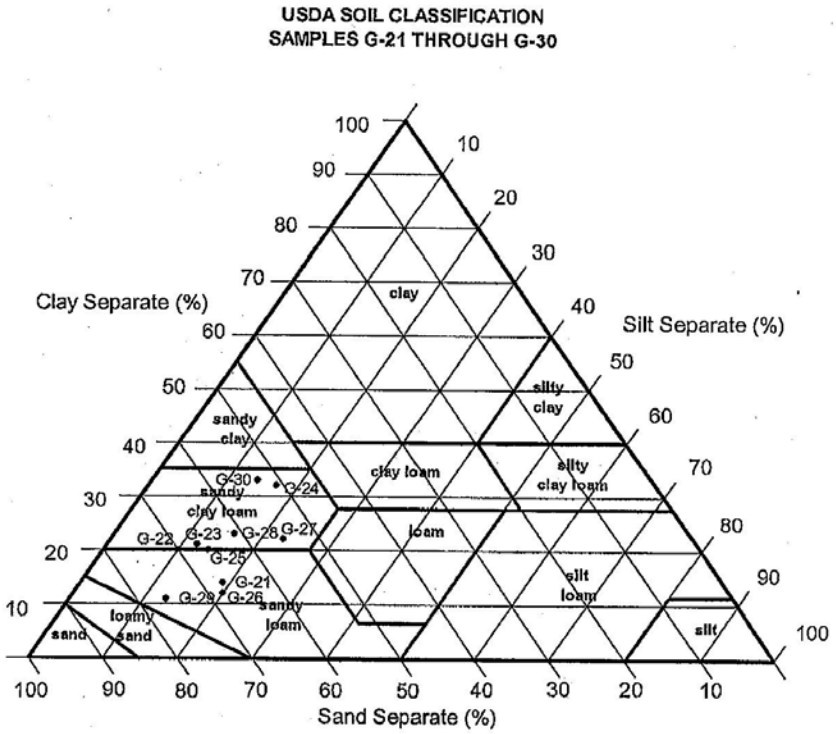

Figure 13 USDA Soil Classification Samples G-21 through G-30

SECTION 8 WASTEWATER TREATMENT SYSTEM DESIGN

PART 1 - WASTEWATER TREATMENT SYSTEM DESIGN GENERAL

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The wastewater treatment system is designed to meet all limits outlined in this report. The System also contains a minimum of one half design flow as equalization to compensate for diurnal variations in flow.

1.01. Raw Wastewater Characterization

Wastewater generated from the proposed resort will be characterized as commercial strength wastewater. Wastewater concentration strengths estimated for the design of commercial facilities in Malibu as well as typical domestic sources are presented in **Table 7,** page 17.

Wastewater strength varies based on the type of source. Office spaces, retail buildings, restaurants, and other commercial facilities generally produce high concentrated wastewater due to the lack of high-volume water sources such as showers, baths, laundry machines, and dishwashers. Wastewater strength generally remains consistent with the type of water use, even though wastewater flow can vary widely during the day, week, and year. The design strength estimated for the subject site is consistent with similar sites within the area.

1.02. Treatment Process Description

Treatment process design relies on many factors, which may include design flow, wastewater characteristics, treatment level requirements, environmental constraints, reliability, operation and maintenance, space availability, and resource availability.

Membrane bioreactor (MBR) technology was selected as the main approach to achieve tertiary treatment levels given the site-specific challenges including effluent quality, system performance and reliability, cost-effectiveness, and limited installation area.

The MBR system combines both biological and physical processes to effectively treat the wastewater effluent to the required organic and nutrient removal standards. An immersed MBR system combines the functions of an activated sludge aeration system, secondary clarifiers, and tertiary filtration. Advantages of the MBR system include exceptional effluent quality compared to conventional activated sludge systems, reduced system footprint, modularity, operationally robust such as mixed liquor and solid retention time variability, and reduced downstream disinfection requirements. See **Appendix E,** Pages 1-70 for manufacturer's description.

1.03. System Tank Capacity

The System's total tank capacity will be 215,000 gallons ("gal") consisting of 10 traffic rated fiberglass septic tanks. The total emergency water storage capacity of the treatment system tankage, if operated at working volume and design flow, is 38,330 gal, or 35.4 hours (See Table 12).

1.04. Treatment Process Performance

In conjunction with the associated disinfection process described below, we are confident the System will meet established water quality standards because the MBR process is compliant with California Water Recycling Criteria, Title 22, See Appendix for compliance Report.

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PART 2 - COMPONENTS

The System is configured much like a conventional municipal wastewater treatment system and consists of the following components, as shown on **Figure 14:**

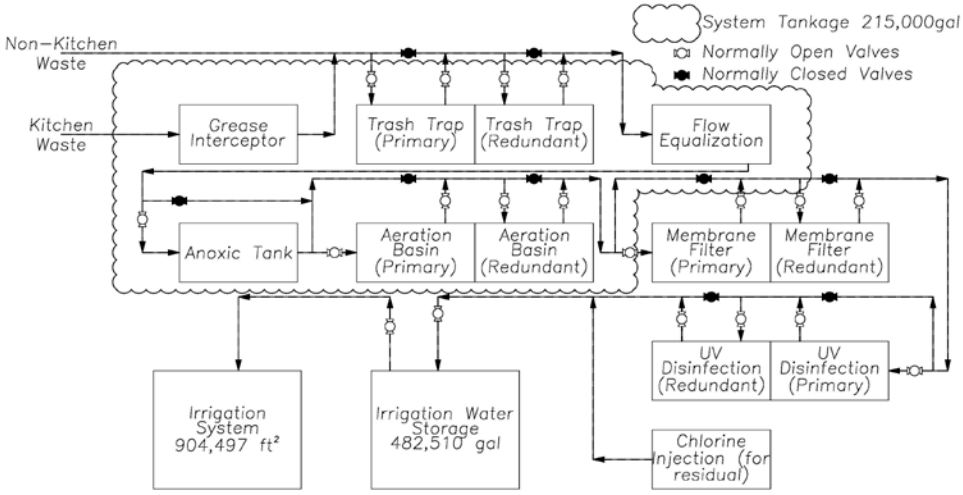

Figure 14 Process Schematic

The major equipment used in the bioreactor is similar to the equipment used in the bioreactor of a conventional activated sludge process. This includes process aeration blowers, biological process aeration, and mixers.

2.01. Collection

A gravity flow system brings wastewater from the restaurant to the grease interceptor (TK-101). In gravity flow systems raw wastewater flows, by gravity at a minimum scour velocity of 2 feet per second, from the source to the grease interceptor. Effluent then travels by gravity flow to the trash trap (TK-201).

Wastewater from the hotel units (non-commercial kitchen waste) flows by gravity to four lift stations (LS-101 through LS-401) equipped with grinder and solids handling pumps. The wastewater then is pumped from the lift stations to the trash trap (TK-201).

2.02. Primary Settling

Following collection, wastewater settles into the trash trap and primary settling tank. The primary settling tank acts as trash trap, primary clarifier, sludge storage tank, and anaerobic sludge digesters for the wastewater treatment system. Material that enters the wastewater such as debris, grit, rags, and plastics that are not allowed into the membrane bioreactor need to be removed prior to treatment. The trash trap provides the first settling compartment after the collection system. Large objects and sediments settle to the bottom of the trash trap and shall be removed via pump truck when necessary in accordance with applicable regulations.

The primary settling tank reduces the wastewater load on the membrane bioreactor through the following four processes:

- Sedimentation
- Facilitative and Anaerobic Decomposition
- Flotation

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- Physical Screening

The processes of the primary settling design are illustrated on **Figure 15**.

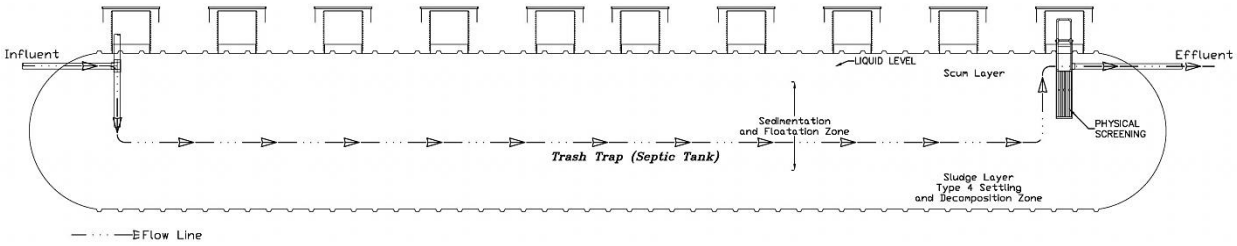

Figure 15 Process Illustration of Primary Settling Tank

Sludge wasting via pump truck from the primary settling tank is the main removal of the solids from the wastewater system. The sludge will be disposed of offsite to a legal point of disposal that is in full compliance with the requirements that have been established by the RWQCB.

A. Sedimentation

Sedimentation is the gravity separation from water of suspended particles that are heavier than water. The terms sedimentation and settling are used interchangeably. Three types of settling processes are at work in a septic tank:

1. Type 1 (Discrete Particle): This process refers to large particles settling as individual entities without a significant reaction to other particles. This type of settling occurs for grit and sand.
2. Type 2 (Flocculation): This process refers to a rather dilute suspension of particles that coalesce or flocculate during the settling operation thus increasing in mass and settling faster. This process removes a portion of the suspended solids in untreated wastewater.
3. Type 4 (Compression): This process refers to settling in which particles are of such concentration that a structure is formed, and further settling occurs by compression of the structure. This occurs at the bottom of the sludge zone in the septic tank.
4. Facilitative and Anaerobic Decomposition

   The organic material, at the bottom of the tank, undergoes facultative and aerobic decomposition and is converted to more stable compounds and gases such as carbon dioxide, methane, and hydrogen sulfide.

5. Flotation

   Oil, fat, greases and other light materials float to the surface, where a scum layer is formed much like in a grease interceptor described later in this section.

   Scum and solids handling will be removed via pump truck based on determinations from operator inspections. Scum and solids will be disposed of offsite to a legal point of disposal that is in full compliance with the requirements that have been established by the RWQCB.

2.03. Physical Screening

Septic tank effluent filters are used to screen the wastewater prior to exiting the septic tank. The effluent filter has a 1/16" mesh size.

2.04. Grease Interceptor

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Grease interceptors (GI) are used separate oil, fat, and grease from waste streams, such as restaurants and markets, prior to entering the septic tank. Grease interceptors for membrane processes are generally designed for a minimum hydraulic retention time of 9 hours. The HRT is critical; the GI must retain the waste long enough for the heat to dissipate through dilution and transfer to the relatively cool sidewalls of the GI. Grease interceptors are much more effective than commercial oil and grease traps and are an integral part of the System. A schematic diagram of the grease interceptor is shown on **Figure 16.** The grease interceptor tank shall be plumbed only to fixtures as described in the Malibu Plumbing Code for grease-laden wastes.

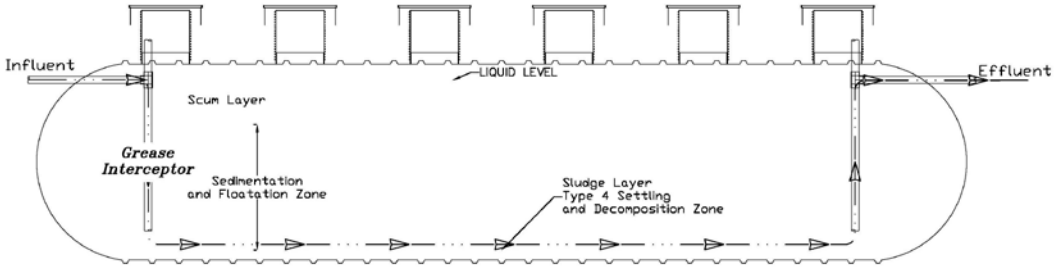

Figure 16 Grease Interceptor Tank

2.05. Flow Equalization

Flow equalization is used to dampen the flowrate variations so that a constant or nearly constant outlet flowrate is achieved. The System utilizes an online flow equalization tank approximately equal to one day design flow. The flow equalization tank allows for equalization of daily flow and more controlled influent to the treatment portion of the process. Flow equalization is used to overcome the operational problems associated with flowrate variations, to improve performance of the downstream process, and to reduce the size and cost of the downstream treatment facilities. A schematic diagram of the equalization tank is shown on **Figure 17**. The effluent pumps in the equalization tank act to handle diurnal variations of flow from the proposed resort, providing additional control for the MBR treatment process.

The flow equalization tank also provides storage capacity for the System in the event discharge cannot occur. In the rare event narrative limits cannot be met, the flow equalization tank provides storage for up to 24 hours. In conjunction with other management practices, variable discharge technology, water reduction strategies, and restaurant management procedures, the flow equalization tank is a critical component of the System's ability to protect receiving water quality in the event of an emergency or other unanticipated on or off-site occurrences.

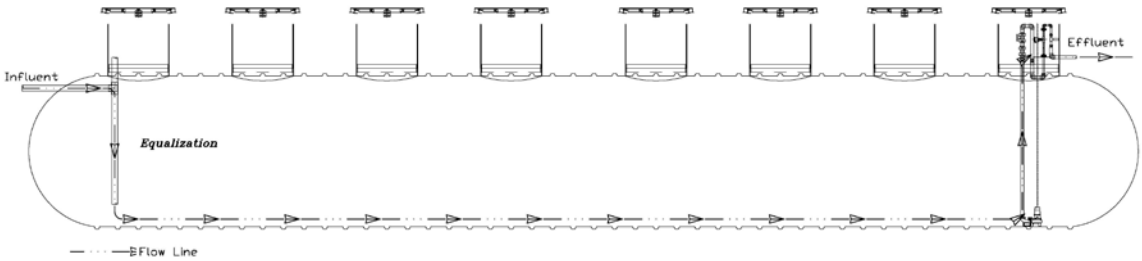

Figure 17 Equalization Tank

2.06. Biological System

For the subject project EEI is proposing a Zenon Environmental Membrane Bioreactor System. The Zenon system as configured is a two-stage biological nutrient removal (BNR)

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process followed by membrane filtration. The biological process for the MBR system is a suspended growth activated sludge process designed for energy efficiency and ultimate nitrogen removal. Each of the two process stages is described below and shown in **Figure 18**, page 41**.**

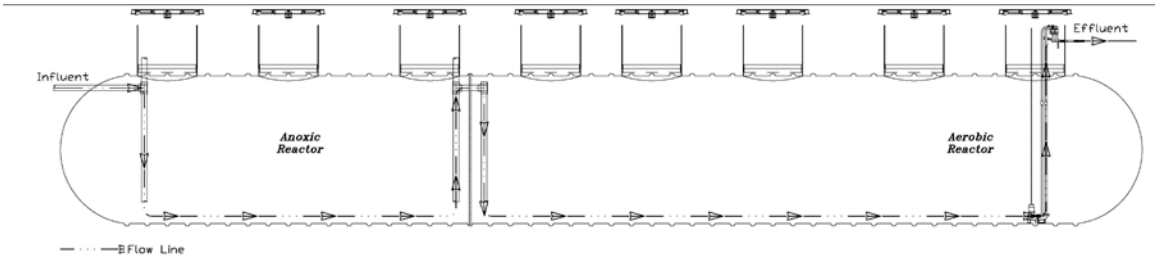

Figure 18 BNR Treatment Tank: Anoxic and Aerobic Compartments

A. First Stage – Anoxic Reactor

The activated sludge begins with an upstream anoxic reactor. The anoxic reactor is maintained in an oxygen deficient environment to promote denitrification. Denitrification utilizes facultative heterotrophic bacteria to reduce nitrate into nitrogen gas. In an oxygen deficient environment, bacteria will use oxygen contained in the nitrate or nitrite molecules to metabolize organic carbon. Denitrification also produces bicarbonate as a product which helps to buffer pH.

The anoxic reactor is mixed to ensure complete denitrification in the reactor. An oxidation-reduction potential ("ORP") probe will continuously monitor the electropotential to help determine if the return activated sludge ("RAS") can be returned to this reactor. When practical, returning the RAS to the anoxic reactor is the most energy-efficient mode of operation resulting in very efficient nitrogen removal.

B. Second Stage – Aerobic Reactor

In the jet swing reactor, a low DO concentration will generally be maintained. At low DO (< 1.0 mg/L), simultaneous nitrification/denitrification can occur. In the nitrification process, ammonia is biologically converted into nitrite and then nitrate. This conversion is performed by aerobic chemoautotrophic bacterial present in wastewaters. Because hydrogen ions are a product of the nitrification process, alkalinity is also consumed and pH can become a concern if the natural alkalinity is not sufficient to support a stable pH for nitrification (6.5 to 7.0 S.U.). Organic carbon will also be consumed by the aerobic heterotrophic bacteria present in the wastewater.

The aerobic zone is equipped with Wilfley Webber Dura-Disc fine bubble diffusers (**Figure 18**, page 42). The Dura-Disc diffuser assembly includes a 33% glass reinforced polypropylene diffuser base and a curved EPDM diffuser mounting saddle. The EPDM membrane media is a high pressure molded compound with superior rebound memory. The membrane includes perforated "I" slits that resist tearing and stay cleaner, longer. They open when airflow is present, and close when airflow is stopped reducing the chance for backflow of solids to clog the diffuser.

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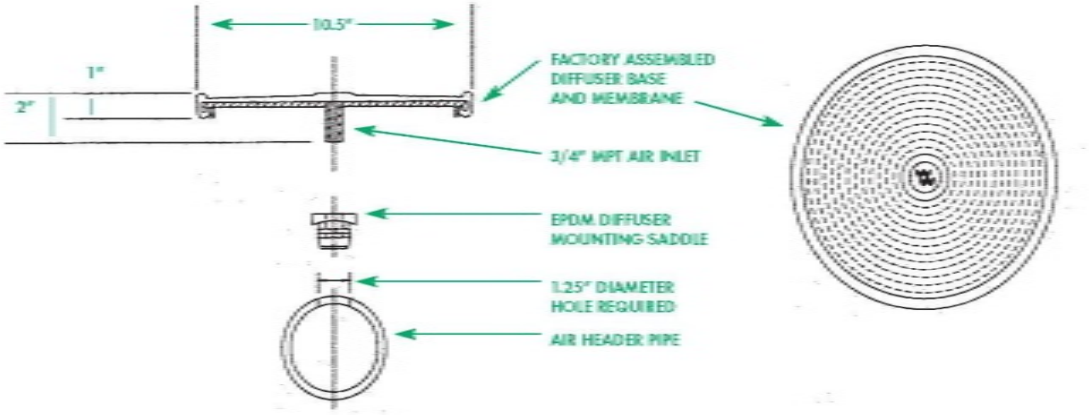

Figure 19 Wilfley Weber Dura-Disc Fine Bubble Diffuser

C. Mixed Liquor Recirculation

The biological process for the membrane bioreactor system is designed with a recirculation loop. The loop consists of overflow from the membrane system and is gravity returned to the anoxic reactor. The RAS from the membrane tank has an elevated DO concentration and provides an overall oxygen credit to the biological aeration system. However, too much oxygen can inhibit denitrification, so returning to the anoxic reactor should only occur when sufficient organic load is present to take up the excess oxygen.

2.07. Membrane Operating System ("MOS")

The membrane operating system replaces secondary clarifiers used in conventional wastewater treatment systems and provides a more stable and advanced treatment process within a much smaller footprint. Membrane fibers provide an absolute barrier to all wastewater solids greater than 0.1 micron in size, ensuring a consistently high quality effluent.

A. Membrane Sub-Module

The central component of the membrane system is the membrane module. The membrane module is comprised of thousands of vertically strung membrane fibers that have millions of microscopic pores in each strand. Water is filtered by applying a slight vacuum to the end of each fiber which draws the water through the tiny pores and into the fibers themselves. The individual modules are joined together to form a cassette, which is the smallest operable unit of the filtration system (**Figure 20,** page 43).

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Figure 20 Membrane Cassette Assembly

B. Filtration

During filtration, filtrate is drawn from the membrane tank through the membrane fibers by suction pressure into the center or lumen of each fiber. As filtrate passes through the membranes, mixed liquor solids remain in the membrane basin and continually overflow back to the biological system as RAS. Filtrate flows up the lumen of each hollow fiber membrane into the filtrate manifold and is then discharged through the filtrate pump. The filtrate flow rate from the membrane system is controlled through the PLC by maintaining a level set point in the biological system.

To maintain the proper biological conditions, the pH balance may need to be adjusted using chemical injection into the process tanks. Sodium hydroxide solution shall be used to control pH levels as determined by the operator. The O&M Manual will provide guidelines to ensure that the proper biological conditions are maintained.

2.08. Biological System Conclusions

The MBR technology outlined above has been proven successful under similar circumstances in meeting water quality objectives. Furthermore, Siemens' modeling at both high and low flows demonstrate that the System is anticipated to reduce nitrogen, ammonia, and other pollutants in effluent to levels sufficiently below the limits established by the California Health Laws Relater to Recycled Water Title 22 and meet TMDL limits outlined in Section 3 and Section 6.

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2.09. Disinfection

A. GENERAL

In addition to the extensive biological process outlined above, the System utilizes California Department of Health Services Title 22 approved disinfection to achieve established water quality objectives. Ultraviolet ("UV") disinfection was selected for the subject site rather than chlorine or ozone disinfection for several reasons:

1. The design UV system is approved by California DHS
2. UV disinfection is effective at inactivating most viruses, spores, and cysts.
3. UV Disinfection is a physical process rather than chemical. This eliminates the need to generate, handle, transport, or store toxic/hazardous or corrosive chemicals.
4. There is no residual effect that can be harmful to humans or aquatic life.
5. UV Disinfection has a shorter contact time (20 to 30 seconds with low pressure lamps).
6. UV disinfection equipment requires less space.

The filtrate from the membrane system will be conveyed to an in-line UV disinfection system. The proposed disinfection system is a WEDECO LBX90 UV System. The unit consists of two parallel units, each designed with a 350 gpm treatment capacity, allowing for full treatment with one unit on stand-by. The proposed Wedeco UV system has a self-cleaning feature to minimize operation and maintenance. If the transmittance or bulb strength falls below preset levels, an alarm will notify operator that the system requires maintenance page Figure 20, page 54).

B. Ultraviolet (UV) Radiation Disinfection

To achieve the levels of disinfection outlined above, the System relies on the germicidal properties of the radiation emitted from UV, which has used in a wide variety of applications since its use was pioneered in the early 1900's. First used on high-quality water supplies, ultraviolet light as a wastewater disinfectant has evolved during the 1990s with the development of new lamps, ballasts, and ancillary equipment. With the proper dosage, ultraviolet radiation has proved to be an effective bactericide and virucide for wastewater, while not contributing to the formation of toxic byproducts.

C. Source of UV Radiation

The portion of the electromagnetic spectrum in which UV radiation occurs is between 100 and 400nm. The UV radiation range is characterized further according to wavelength as long-wave (UV-A), also known as near-ultraviolet radiation, middle-wave (UV-B), and short-wave (UV-C), also known as far UV. The germicidal portion of the UV radiation band is between about 220 and 320 nm, principally in the UV-C range. To produce UV radiation, lamps that contain mercury vapor are charged by striking an electric arc. The energy generated by the excitation of the mercury vapor contained in the lamp results in the emission of UV light

D. UV Disinfection System Components and Configurations

The principal components of a UV disinfection system consist of (1) the UV lamps, (2) the quartz sleeves in which the UV lamp is placed, (3) the supporting structure for the UV lamps and the quartz sleeves, (4) the ballasts used to supply regulated power to the UV lamps, and (5) the power supply which is used to power the ballasts. Three types of ballasts are used: (1) standard (core coil), (2) energy-efficient (core coil), and (3) electronic (solid-state). Ballasts are used to limit the current to a lamp. Because UV lamps are arc-discharge devices, the more current in the arc, the lower the resistance becomes.

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E. Closed-Channel Disinfection Systems

A number of low- and medium-pressure high-intensity UV disinfection systems are design to operate in closed channels. In our case the wastewater flows parallel to the UV lamps.

F. Germicidal Effectiveness of UV Radiation

Ultraviolet light is a physical rather than a chemical disinfecting agent. Radiation penetrates the cell wall of the microorganism and is absorbed by the nucleic acid, which either prevents replication or causes death of the cell to occur. The effectiveness of the UV disinfection process depends on a number of variables including the characteristics of the UV disinfection system, the overall system hydraulics, the presence of particles, the characteristics of the microorganisms, and the chemical characteristics of the wastewater. They System's O&M Manual will provide specific steps to ensure continued effectiveness of the UV disinfection process.

Figure 21 UV Disinfection Unit

2.10. Odor Control

To avoid any odors of sewage origin in accordance with the General WDR, the active odor control system is designed to capture of the air flow from the aerated treatment tank using vapor-phase granular activated carbon. The active odor control system shall operate continuously as the System operates. Once the carbon filter reaches the total adsorption capacity, the carbon canister is replaced, or "changed-out." Spent carbon is disposed or regenerated off-site for future use.

The odor control unit shall operate at least twice the treatment air flow rate to maintain sufficient capturing of the anticipated odors. The odor control unit selected operates up to 400 cfm. The skid-mounted side-fan odor control unit provided by Calgon Carbon Model HF-400 is sufficient to meet this flow rate.

Carbon loading by odor compounds in the ventilated air is anticipated due to the adsorption properties of the granular activated carbon. For simplicity, hydrogen sulfide is assumed to represent the various other compounds that cause malodors, such as volatile organic

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compounds ("VOCs"), amines and mercaptans. On the basis of a hydrogen sulfide concentration of 5 parts per million ("ppm") emitting from the trickling filter air stream, the mass loading rate (and therefore, the change-out schedule) of the carbon can be estimated. Carbon canister change-outs for the Calgon Corp Model HF-400 should be scheduled quarterly unless determined otherwise.

Carbon canister servicing shall follow the manufacturer's instructions including maintenance, operation, carbon regeneration, handling and disposal. Operation and maintenance ("O&M") personnel shall maintain a scheduled change-out or regeneration event at a minimum of every three months. However, fluctuations of humidity, temperature, and system loading may significantly affect the necessary change-out schedule. In addition to observable conditions of prevalent odors from the exhaust vent, O&M personnel can collect readings in the air stream using real-time concentration monitors. Specifically, a portable monitor capable of detecting hydrogen sulfide (H_2S) would provide an indication of saturated conditions of the carbon. An increased concentration of 50% from background levels for H_2S provides an initial indicator that the carbon media has reached breakthrough and should be changed-out. The O&M Manual will specify the procedures to ensure proper carbon canister serving.

Figure 22 Odor Control Unit

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SECTION 9 WATER RECYCLING SYSTEM DESIGN SUMMARY

PART 1 - IRRIGATION SYSTEM

1.01. General

The irrigation system is designed to utilize all recycled water for irrigation of site landscaping. The system was designed for full evapotranspiration. All of the recycled water applied to the irrigation areas will be used utilized by the landscaping.

1.02. Weather Station Data

A. Evapotranspiration data was downloaded from California Irrigation Management Information System ("CIMIS") station #99 located in Santa Monica at Latitude 34.04, longitude -118.48. The station was activated on December 11, 1992 data was downloaded from December 1992 to August 30, 2012 for evaluation. (see Appendix E for data).

1.03. Reclaimed Water Storage and Use Calculations (Water Balance)

A. General

1. List of Assumptions

a. Average crop coefficient combined with irrigation efficiency 1.2964 (see LIBR)
b. Assumed Precipitation Available for Irrigation after Runoff 40%

B. Calculations (see Appendix E for complete data set)

1. Table 17 shows a sample data set of the period requiring maximum storage. Storage Calculations were performed using a water balance approach. The following steps were used:

a. Step 1: ET_o was converted to ET_c, by multiplying ETo by Weighted Composite Landscape Coefficient. Precipitation Available was subtracted from ET_c to give a net water loss or gain for that day.
b. Step 2: Precipitation was looked at if precipitation was greater than zero, the total irrigation application rate was stored. If precipitation was zero Net was added to Irrigation Application Rate resulting in either water loss (draw down storage) or water gain (add to storage). Storage was not allowed to be less than zero.
c. Step 3: (Actually built into Step 2) Water loss or gain column looks at three days net precipitation prior to determine if water can be applied to the irrigation system. January 3, 1993 did not have precipitation but because net precipitation on Jan 2, 1993 was greater than 0.25 inches water was stored.

C. Evapotranspiration and precipitation data was used to develop a reclaimed water storage curve (see Figure 23).

1.04. Controls

A. The irrigation system will utilize a series of monitoring points to determine saturation of soil in irrigation zones as well as evapotranspiration. Data will be sent to the main Irrigation Control PLC. The PLC will open and close valves to zones based on ET and field saturation. PLC will integrate with main PLC (see Figure 26 and Figure 28).

B. Irrigation zones will operate based on moisture in each zone allowing water to be used more efficiently.

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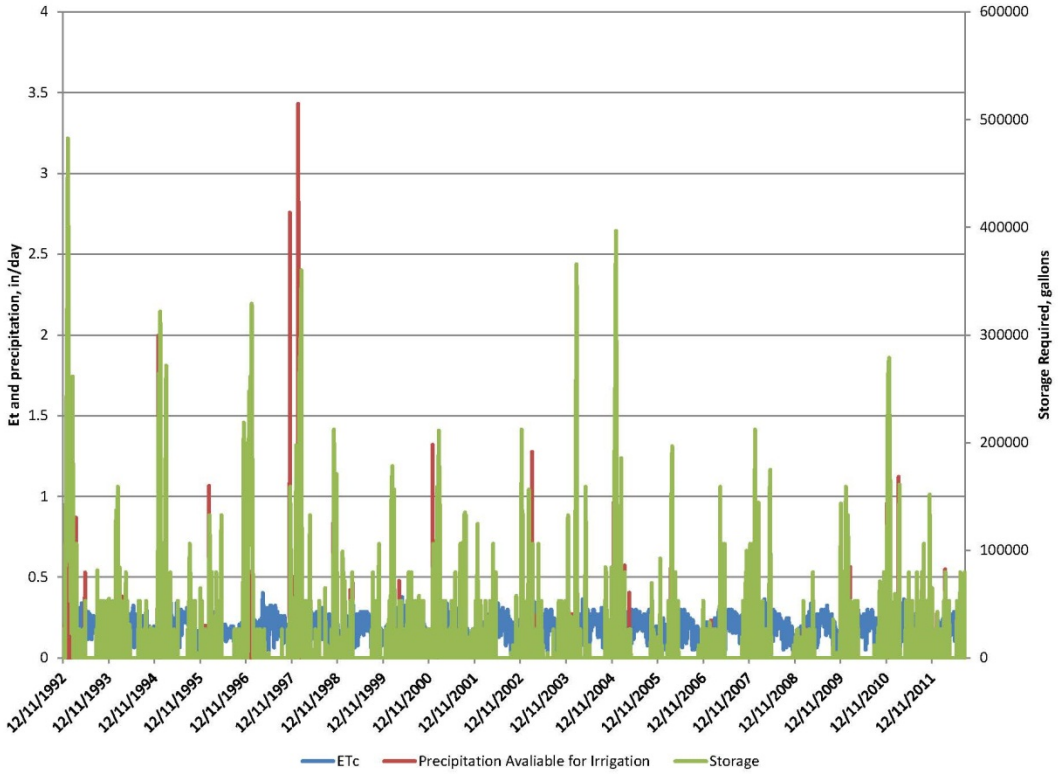

Figure 23 Irrigation and Storage Chart All Data

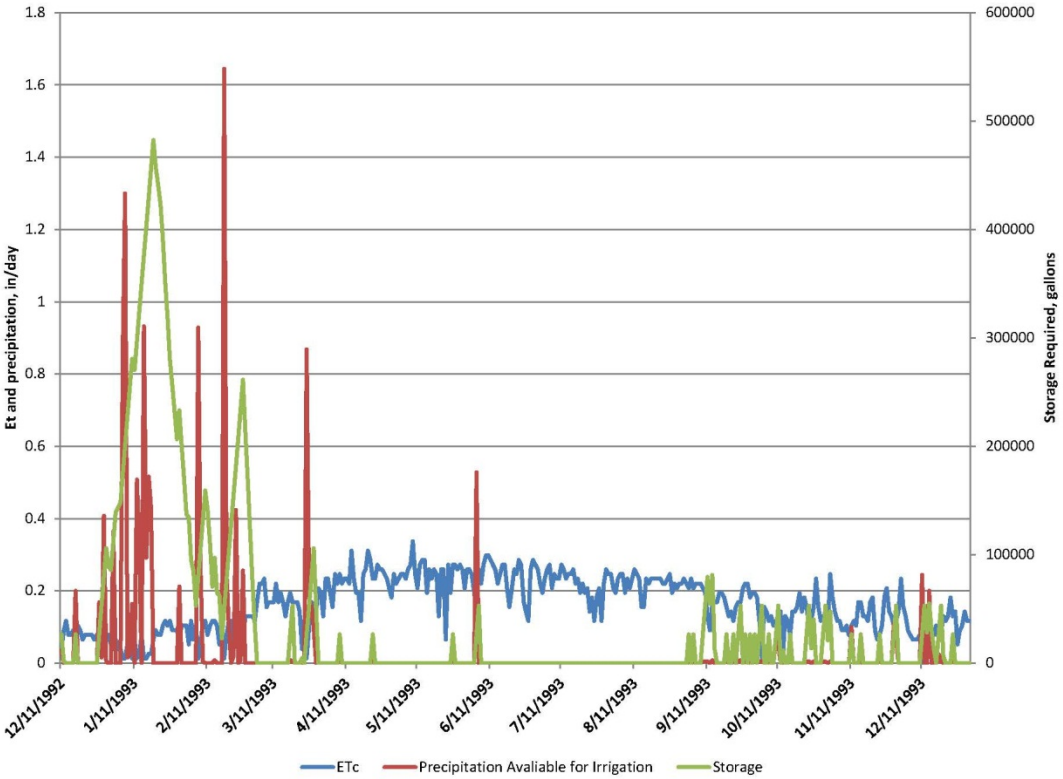

Figure 24 Irrigation and Storage Chart Wettest Year

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Table 17 Storage Calculation Representing Maximum Storage

Date	Eto	Etc	Precipitation	Precipitation Avaliable for Irrigation	Net	Irrigation Application Rate	Water Loss or Gain	Storage Required
	in/day	in/day	in/day	in/day	in/day	in/day	in/day	Gallons
12/25/1992	0.05	0.065	0	0	-0.06482	0.047	-0.018	0
12/26/1992	0.06	0.078	0	0	-0.07778	0.047	-0.031	0
12/27/1992	0.06	0.078	0.42	0.168	0.090216	0.047	0.047	26500.52
12/28/1992	0.03	0.039	0.04	0.016	-0.02289	0.047	0.047	53001.04
12/29/1992	0.05	0.065	1.02	0.408	0.34318	0.047	0.047	79501.56
12/30/1992	0.06	0.078	0.01	0.004	-0.07378	0.047	0.047	106002.1
12/31/1992	0.06	0.078	0	0	-0.07778	0.047	-0.031	88644.8
1/1/1993	0.04	0.052	0	0	-0.05186	0.047	-0.005	85906.79
1/2/1993	0.04	0.052	0.91	0.364	0.312144	0.047	0.047	112407.3
1/3/1993	0.05	0.065	0	0	-0.06482	0.047	0.047	138907.8
1/4/1993	0.03	0.039	0	0	-0.03889	0.047	0.008	143479.4
1/5/1993	0.03	0.039	0	0	-0.03889	0.047	0.008	148051.1
1/6/1993	0.01	0.013	2.19	0.876	0.863036	0.047	0.047	174551.6
1/7/1993	0.01	0.013	3.25	1.3	1.287036	0.047	0.047	201052.1
1/8/1993	0.04	0.052	0.04	0.016	-0.03586	0.047	0.047	227552.6
1/9/1993	0.02	0.026	0.06	0.024	-0.00193	0.047	0.047	254053.1
1/10/1993	0.01	0.013	0.41	0.164	0.151036	0.047	0.047	280553.7
1/11/1993	0.05	0.065	0	0	-0.06482	0.047	-0.018	270506
1/12/1993	0.01	0.013	1.27	0.508	0.495036	0.047	0.047	297006.5
1/13/1993	0.02	0.026	0.8	0.32	0.294072	0.047	0.047	323507.1
1/14/1993	0.06	0.078	0	0	-0.07778	0.047	0.047	350007.6
1/15/1993	0.01	0.013	2.33	0.932	0.919036	0.047	0.047	376508.1
1/16/1993	0.01	0.013	0.73	0.292	0.279036	0.047	0.047	403008.6
1/17/1993	0.02	0.026	1.29	0.516	0.490072	0.047	0.047	429509.1
1/18/1993	0.02	0.026	1.07	0.428	0.402072	0.047	0.047	456009.6
1/19/1993	0.05	0.065	0	0	-0.06482	0.047	0.047	482510.2
1/20/1993	0.07	0.091	0	0	-0.09075	0.047	-0.044	457843.3
1/21/1993	0.06	0.078	0	0	-0.07778	0.047	-0.031	440486
1/22/1993	0.06	0.078	0	0	-0.07778	0.047	-0.031	423128.7
1/23/1993	0.08	0.104	0	0	-0.10371	0.047	-0.057	391152.2

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Table 18 Storage Calculation Representing Maximum Storage

Site Undeveloped Area, Usable	904,497	sf
	20.76439	Acres
Design Flow	26000.0	gal/day
Weighted composite landscape coefficient	1.2964	
Assume Soil is Saturated for one day after rain event if NET is greater than	0.25	in/day
Assume Soil is Saturated for two days after rain event if NET is greater than	0.50	in/day
Assume Soil is Saturated for three days after rain event if NET is greater than	0.75	in/day
Percent Rain Availiable for Irrigation	40%	
Wastewater Flow	26,000	gal/day
	3475.5	ft3/day
Appication To Usable Area	0.00384	ft/day
	0.047	in/day
	0.8558	in/usable area-day
Storage Required	64502.4	ft3
	482510	Gallons
Data Start Date	12/11/1992	
Data End Date	8/30/2012	
Station Location	Santa Monica	
Peak Months		
Peak Season Begin	Jun-01	
Peak Season Ends	Sep-30	
Design Flow (peak)	43000.0	gal/day
Percent Water Used for Toilet Flushing	0%	
Crop Coefficient	1.3	
Wastewater Flow (Peak)	43,000	gal/day
	5747.9	ft3/day
Appication To Usable Area	0.00635	ft/day
	0.077	in/day
	0.60	in/usable area-day
Storage Required Busy Summer Months	45217.3	ft3
	338271	Gallons

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Composite Weighted Landscape Coefficient (CWLC) for OWTS
Production, Consumption and Storage for:
Rancho Malibu Resort

CWLC= SUM PRODUCT OF (ZONE Kt x ZONE AREA) / SUM OF THE AREA

HYDROZONE DESCRIPTION	HYDRO ZONE #	Ks	x	Kd	x	Kmc	=	Kt	LA	
RADIENT HEAT EXPOSURE										
Turf	1	0.9	x	1.0	x	1.25	=	1.8000	12,801	
Spray				0.63						
Turf	0	0.9	x	1.0	x	1.25	=	1.6071	0	
Rotor				0.70						
Ground Cover	2	0.7	x	1.0	x	1.25	=	1.4000	3,714	
Spray				0.63						
Ground Cover	0	0.7	x	1.0	x	1.25	=	1.2500	0	
Rotor				0.70						
Shrub	3	0.8	x	1.3	x	1.25	=	2.0800	38,838	
Spray				0.63						
Tree Canopy	0	0.8	x	1.0	x	1.25	=	1.6000	0	
Spray				0.63						SUBTOTAL RADIENT HEAT EXPOSURE 1.9696 CWLC
SUN EXPOSURE										
Turf	4	0.9	x	1.0	x	1.00	=	1.4400	21,696	
Spray				0.63						
Ground Cover	5	0.8	x	1.0	x	1.00	=	1.2800	7,525	
Spray				0.63						
Shrub	6	0.8	x	1.3	x	1.00	=	1.6640	67,362	
Spray				0.63						
Tree Canopy	7	0.8	x	1.0	x	1.00	=	1.2800	179,056	
Spray				0.63						
G.C. Roof	8	0.9	x	1.0	x	1.00	=	1.4400	45,924	
Spray				0.63						
Tree Canopy Roof	9	0.8	x	1.0	x	1.00	=	1.1429	16,860	
Spray				0.70						
Refined Slope	10	0.8	x	1.3	x	1.00	=	1.4857	15,148	
Rotor				0.70						
Semi-Refined Slope	11	0.7	x	1.3	x	1.00	=	1.3000	76,777	
Rotor				0.70						
Detention Basin	12	0.7	x	1.3	x	1.00	=	1.3000	8,022	
Rotor				0.70						
Water Feature	13	0.9	x	1.0	x	1.00	=	1.0000	1,187	
Fill Line				0.90						SUBTOTAL SUN EXPOSURE 1.3684 CWLC
PART SUN EXPOSURE										
Turf	14	0.9	x	1.0	x	0.85	=	1.2240	4,616	
Spray				0.63						
Ground Cover	15	0.8	x	1.0	x	0.85	=	1.0880	599	
Spray				0.63						
Shrub	16	0.8	x	1.3	x	0.85	=	1.4144	1,264	
Spray				0.63						
Refined Slope	17	0.8	x	1.3	x	0.85	=	1.2629	29,365	
Rotor				0.70						
Semi-Refined Slope	18	0.7	x	1.3	x	0.85	=	1.1050	280,670	
Rotor				0.70						
Semi-Refined Slope Add	19	0.7	x	1.3	x	0.85	=	1.1050	55,140	
Rotor				0.70						
Water Feature	20	0.9	x	1.0	x	0.85	=	0.8500	2,007	
Fill Line				0.90						SUBTOTAL PART SUN EXPOSURE 1.1185 CWLC
SHADE EXPOSURE										
Turf	21	0.9	x	1.0	x	0.75	=	1.0800	315	
Spray				0.63						
Ground Cover	22	0.8	x	1.0	x	0.75	=	0.9600	150	
Spray				0.63						
Shrub	23	0.8	x	1.3	x	0.75	=	1.2480	30,037	
Spray				0.63						SUBTOTAL SHADE EXPOSURE 1.2448 CWLC
ATRIUM EXPOSURE										
Ground Cover	0	0.6	x	0.5	x	1.00	=	0.4286	0	
Spray				0.70						
Shrub	0	0.8	x	1.3	x	1.00	=	1.4857	0	
Spray				0.70						
Tree Canopy	24	0.8	x	1.0	x	1.00	=	1.1429	5,424	
Spray				0.70						
Pot or Urn	0	0.8	x	1.3	x	1.00	=	1.4857	0	
Micro Spray				0.70						SUBTOTAL ATRIUM EXPOSURE 1.1429 CWLC
										TOTAL AREA SQ.FT. 904,497 1.2964 CWLC
										TOTAL AREA ACRES 20.7644

The Composite Landscape Coefficient

Where:
- Kt = Landscape Coefficient (Ks x Kd x Kmc)
- Kt = Composite Landscape Coefficient (Ks x Kd x Kmc)
- LA = Landscape Area

IE = Irrigation Efficency**

Defined as a range of:	L	M	H
Drip	0.80	0.85	0.90
Rotor	0.70	0.80	0.85
Rotator	0.70	0.75	0.80
Spray	0.50	0.63	0.71

Ks = Defined as a range of:

	L	M	H
Very Low	0.05	0.07	0.09
Low	0.1	0.2	0.3
Med	0.4	0.5	0.6
High	0.7	0.8	0.9

Kd = Defined as a range of:

Sparce	0.5
Medium/Sparce	0.8
Medium/Dense	1.0
Dense	1.3

Kmc = Defined as a range of:

Radient Heat	1.25
Sun	1.0
Part Sun	0.9
Shade	0.8

The Weighted Composite Landscape Coefficient
is equal to the sum of the products (ETL x A) for all hydrozones divided by the sum of A for all hydrozones as follows:

$$\frac{(K_{T1} x L_{A1}) + (K_{T2} x L_{A2}) + \ldots\ldots\ldots\ldots + (K_{Tn} x L_{An})}{\text{sum of LA}}$$

Figure 25 Composite Weighted landscape Coefficient ("CWLC") See Appendix C

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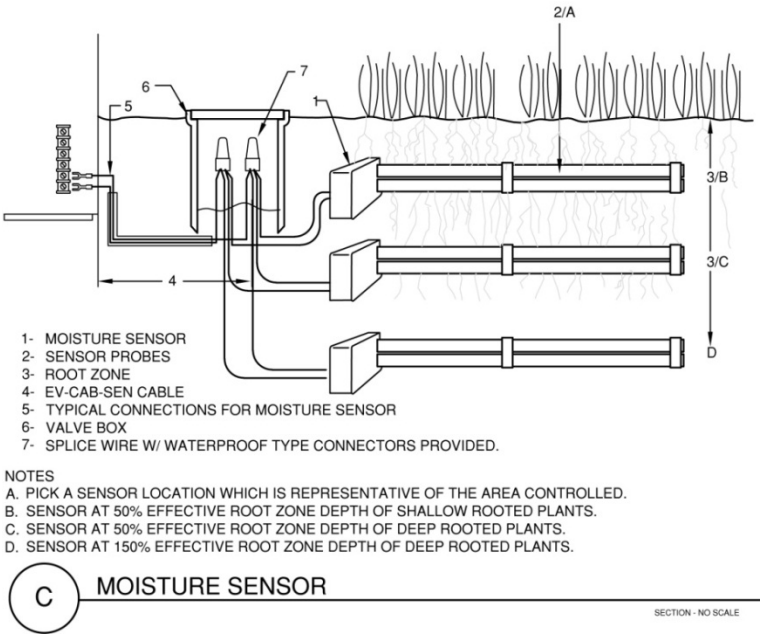

Figure 26 Soil Moisture Sensors See Appendix C

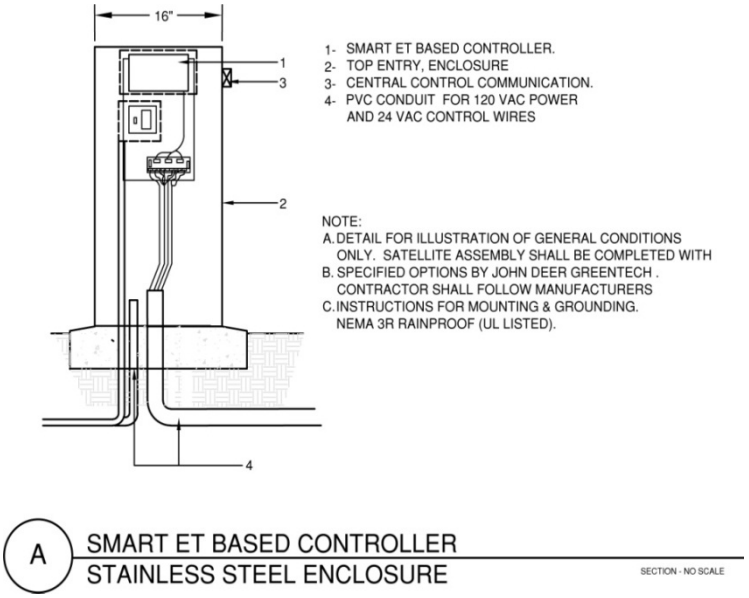

Figure 27 Irrigation Controller

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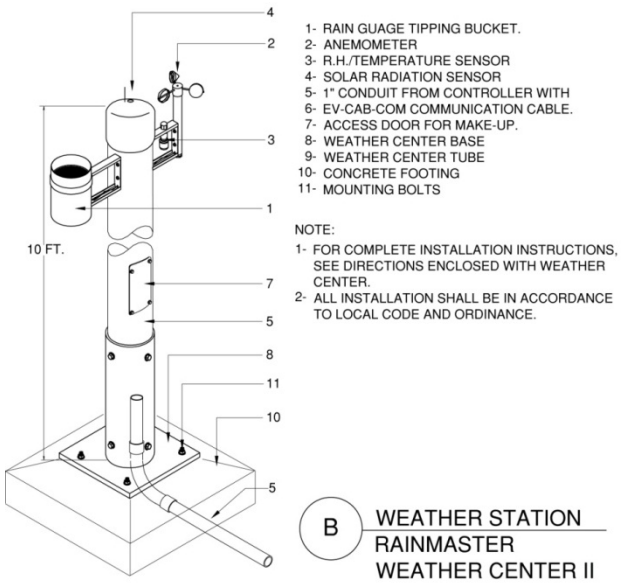

Figure 28 Weather Station

1.05. Conclusions

A. The calculations show that our irrigation needs will allow for a full evapotranspiration system. Water will need to be store during wet periods in a 482,510 gallons onsite storage tank. For design purposes we assumed this would be in an underground tank.

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SECTION 10 TITLE 22 ENGINEERING REPORT SUMMARY

PART 1 - PLANT RELIABILITY REQUIREMENTS ARTICLE 10 OF TITLE 22

1.01. 603341. Emergency storage or disposal

A. Where short-term retention or disposal provisions are used as a reliability feature, these shall consist of facilities reserved for the purpose of storing or disposing of untreated or partially treated wastewater for at least a 24-hour period. The facilities shall include all the necessary diversion devices, provisions for odor control, conduits, and pumping and pump back equipment. All of the equipment other than the pump back equipment shall be either independent of the normal power supply or provided with a standby power source.

B. Diversion to a less demanding reuse is an acceptable alternative to emergency disposal of partially treated wastewater provided that the quality of the partially treated wastewater is suitable for the less demanding reuse.

C. Subject to prior approval by the regulatory agency, diversion to a discharge point which requires lesser quality of wastewater is an acceptable alternative to emergency disposal of partially treated wastewater.

D. Automatically actuated short-term retention or disposal provisions shall include all the necessary sensors, instruments, valves and other devices to enable fully automatic diversion of untreated or partially treated wastewater to approved emergency storage or disposal in the event of failure of a treatment process and a manual reset to prevent automatic restart until the failure is corrected.

1.02. 60343. Primary treatment

A. All primary treatment unit processes shall be provided with one of the following reliability features:

1. Multiple primary treatment units capable of producing primary effluent with one unit not in operation.

2. Standby primary treatment unit process.

1.03. 60345. Biological treatment

A. All biological treatment unit processes shall be provided with one of the following reliability features:

1. Alarm and multiple biological treatment units capable of producing oxidized wastewater with one unit not in operation.

2. Alarm, short-term retention or disposal provisions, and standby replacement equipment.

1.04. 60351. Filtration

A. All filtration unit processes shall be provided with one of the following reliability features:

1. Alarm and multiple filter units capable of treating the entire flow with one unit not in operation.

2. Alarm, short-term retention or disposal provisions and standby replacement equipment.

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1.05. 60353. Disinfection

A. All disinfection unit processes where chlorine is not used as the disinfectant shall be provided with one of the following reliability features:

1. Alarm and standby disinfection unit;

2. Alarm and multiple point disinfection, each with independent power source.

PART 2 - PLANT RELIABILITY UTILIZED

2.01. Primary Treatment Reliability

Primary Treatment System (trash trap) shall be capable of meeting two reliability requirements outlined in Section 60343. Primary treatment (only one is required); Section 101.02.A.1, page 55 and Section 101.02.A.2, page 55.

A. Protocol for meeting Section 101.02.A.1, page 55

1. System shall utilize a two compartment primary tank capable of functioning with either unit out of service.

B. Protocol for meeting Section 101.02.A.2, page 55

1. Operator shall store, on-site an additional filter unit.

2.02. Biological Treatment Reliability

Biological Treatment System (aeration tank) shall be capable of meeting two reliability requirements outlined in Section 60345. Biological treatment (only one is required); Section 101.03.A.1, page 55 and Section 101.03.A.2, page 55.

A. Protocol for meeting Section 101.03.A.1, page 55

1. System shall utilize a two compartment aeration tank capable of functioning with either unit out of service.

2. System shall utilize two process blowers both capable of functioning with either unit out of service

B. Protocol for meeting Section 101.03.A.2, page 55

1. Operator shall store, on-site additional aeration equipment (diffusers, valves, and fittings).

2. System includes an equalization tank capable of storing 35.4 hours of wastewater at design flow.

2.03. Filtration Reliability

Filtration system shall be capable of meeting two reliability requirements outlined in Section 60351. Filtration (only one is required); Section 101.04.A.1, page 55 and Section 101.04.A.2, page 55

A. Protocol for meeting Section 101.04.A.1, page 55

1. System shall utilize a two compartment membrane tank capable of functioning with either unit out of service.

2. System shall utilize two process blowers both capable of functioning with either unit out of service

B. Protocol for meeting Section 101.04.A.2, page 55

1. System shall utilize alarms monitoring turbidity if one filter is off-spec it shall be automatically taken out of service and operator shall be alarmed. Flow shall be diverted to short-term storage and redundant filter shall be placed on-line.

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2.04. Disinfection System Reliability

Disinfection system shall be capable of meeting two reliability requirements outlined in 60353. Disinfection (only one is required); Section 101.05.A.1, page 56 and Section 101.05.A.2, page 56.

A. Protocol for meeting Section 101.05.A.1, page 56

1. System shall utilize a multiple disinfection units capable of functioning with a unit out of service.

2. If a unit is out of compliance the unit shall be automatically taken out of service and operator shall be alarmed.

B. Protocol for meeting Section 111.05.B.5, page 58.

1. Each UV unit shall have separate power source and ballast

PART 3 - USE AREAS

3.01. Irrigation Uses

A. Landscaping shall be considered Section 60304, Paragraph a, unrestricted irrigation

PART 4 - CONTINGENCY PLAN

4.01. General

A. The project shall utilize a tiered approach to contingency depending on the conditions.

B. The project shall employ automated contingency control.

4.02. Minor conditions (conditions that can be resolved in less than 24 hours) such as equipment failures or process maintenance

A. Effluent shall be diverted to the equalization tank and re-processed once the condition has been resolved.

4.03. Environmental events such as rain

A. Reclaimed water shall be stored in the reclaimed water storage tank (see Section 9 Water Recycling System Design Summary, page 47).

4.04. Catastrophic failure to irrigation area (landslide, fire, or earthquake). Wastewater shall be automatically diverted to City of Malibu Wastewater Treatment Facility. Prior to construction of City WWTF catastrophic failures shall be handled by diversion of effluent to an off-site facility through hauling.

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SECTION 11 MONITORING, DESIGN ASSUMPTIONS, OPERATION & MAINTENANCE, AND OTHER REQUIRED REPORTS

1.01. General

A. The System has been designed to address a variety of potential operational concerns through an automatic control and monitoring system. Specifically, the System has been designed to address the following (among other) areas of concern potentially detrimental to water quality:

1. Flow over 43,000 gpd
2. Manufacturer process points (turbidity)
3. Disinfection system malfunction (low transmittance)

In the event the System identifies one of these concerns, the System will initiate an "off-spec" water protocol for those critical system parameters. The off-spec water protocol is designed to address and prevent water quality issues before they occur.

The off-spec water protocol opens a valve located after disinfection and recycles all of the water to the equalization/off-spec water tank, when a critical parameter is recognized, preventing discharge to the irrigation system. For example, it the event discharge was approaching 43,000 gpd, the off-spec water protocol would automatically be triggered and water would be recycled and stored in the equalization tank until such time discharge was possible. This system in turn allows for 35.4 hours response time for any conditions not brought into compliance by recirculating the water.

B. Groundwater Elevation Monitoring Narrative

Groundwater elevations will be constantly monitored by pressure transducers placed at the perimeter of the field. Groundwater wells will be installed consistent with applicable codes and regulations and under the direction of a licensed geologist.

1.02. Groundwater Monitoring Program

A. Groundwater Elevation Monitoring Narrative

Groundwater elevations will be constantly monitored by pressure transducers. Groundwater wells will be installed consistent with applicable codes and regulations and under the direction of a licensed geologist.

B. Monitoring Well Locations

To ensure that the System does not have deleterious impacts on receiving waters, we propose utilizing three groundwater monitoring wells as part of the monitoring program. All monitoring wells shall be tested to ensure groundwater samples can be extracted from the wells prior to baseline sampling. The monitoring wells were and will be installed in accordance with California Well Standards and LA County Well Requirements.

1.03. Design Assumptions

Design assumptions may be more conservative than RWQCB effluent limitation and should not be misinterpreted as average effluent quality or expected effluent quality.

1.04. Operation and Maintenance

In accordance with General WDR requirements and to ensure that the operation of the System does not harm the beneficial uses of surrounding water or contribute to the degradation of the receiving water, the System operators will develop and follow an O&M Manual. A copy of this O&M Manual will be made available to the RWQCB.

A. Design Parameters

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Design parameters shall be monitored to adjust the MBR treatment for optimum performance. Remote telemetry and O&M guidance shall be provided to determine the operational conditions of the System. The O&M Manual shall describe the procedures necessary to operate and maintain the treatment system within the design control parameters. Due to the variability of ancillary equipment as well as allowing "or equal" items for non-process equipment the O&M Manual cannot be provided until after start-up but prior to final sign-off by The City of Malibu. O&M contract will also be provided at that time.

The minimum qualifications recommended for the wastewater treatment operator to operate the treatment system is Grade III as classified by the California State Water Resources Control Board (Title 23 CCR Division 3 Chapter 26). **The System will be operated by a Grade V licensed operator.**

Inspections and maintenance that require entry into the treatment system tanks (e.g., replacing the fine air diffusers) shall only be performed by trained personnel under the permit-required confined space entry procedures required by Cal/OSHA regulations (Title 8 CCR Section 5157). Inspections and maintenance will be performed by trained personnel who will follow the procedures required by State and Federal law. System shutdowns are expected on a regular basis for routine maintenance. System shutdowns may also be experience during unexpected situations such as emergency situations such as power failure, weather-related events, and equipment failure. Routine maintenance items that may require a system shutdown have been identified in the O&M Manual. The wastewater treatment operator shall coordinate all routine maintenance events with the facility staff sufficiently in advance. Planned dates for these events shall utilize low wastewater flow periods in case there are delays in the maintenance.

In the event of emergency shutdowns due to equipment failure, service personnel shall be available to respond to the failure and repair the equipment to minimize the time that the System is not operational.

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SECTION 12 CONCLUSIONS

1.01. Generally

To summarize, the System is a small commercial advanced onsite wastewater treatment system designed to full recycle all wastewater onsite, The system will not exceed a peak flow of 43,000 gpd. It is sited out of the sensitive Malibu Civic Center watershed and is not within 100 feet of any water body.

1.02. Effluent Treatment in the System

The System employs MBR technology which allows the Operator to address site-specific discharge challenges including effluent quality, system performance and reliability, cost effectiveness, and limited installation area. The System also utilizes an advanced UV Light System for disinfection, rather than relying on toxic or hazardous chemicals which would be stored onsite. Through this advanced system, effluent will actually exceed applicable water quality standards when the effluent exits the System. As demonstrated in the Report, it is expected that the MBR and disinfection process will reduce nitrogen ammonia, bacteria, viruses, and other pollutants to level significantly lower than required by Title 22, Ocean Plan, the Basin Plan, RWQCB Resolutions Nos. 01-018, 02-004 (dry weather), and 02-022 (wet weather).

1.03. Effluent Recycling

The system is designed to recycle all water onsite through irrigation. The system is designed so it will not discharge wastewater into the soil for disposal.

1.04. Monitoring and Operations and Maintenance

To ensure that the System will be maintained and operated to achieve the water quality levels specified in this Report, the operators of the System will employ an extensive monitoring program and follow a carefully developed operations and maintenance plan. The System will be overseen by a Grade V rated operator and will be run in conjunction with a variety of water conservation efforts and best management practices and plans so that the effluent from ongoing Site operations will have insignificant effects on receiving waters.

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APPENDIX A

Water Quality Control Plan Los Angeles Region (WQCPLA) Hydraulic Units Figure 1-2
WQCPLA Beneficial Uses Table 2-3
WQCPLA Chapter 2: Beneficial Uses
WQCPLA Chapter 3: Water Quality Objectives
Priority Pollutants

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APPENDIX B

RWQCB Resolution 01-018
RWQCB Res. 02-004 Amendment to Basin Plan to Incorporate Dry Weather TMDL Santa Monica Bay
RWQCB Res. 02-022 Amendment to Basin Plan to Incorporate Wet Weather TMDL Santa Monica Bay
California Health Laws Related to Recycling Water (Title 22)
WQCPLA Ocean Plan 2001
WDR-Order01-031

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APPENDIX C

LIBR - Landscape Water Requirement Plan, Rancho Malibu Resort Malibu, CA, December 3, 2011
6489, Green Acres, LLC, Update G&G Engineer Rpt, dtd 11-16-12, MDN 14252
GBR Update Letter Report
GBR – Geologic and Geotechnical Engineering Review of proposed OWTS April 2, 2012
GSC Response to City of Malibu Geotechnical Review Sheet Dated October 31, 2007
GSC Response to City Geo Review Sheet Dated Oct 31 2007
VBB Report

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APPENDIX D

Engineering Plans

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APPENDIX E

Calculation Sheets:
Flow and Waste Strength
Project Data Summary
Process Parameters
MBR Kinetics
Irrigation System Design
ZenoGem Flow-Through Kinetics
Tanks Response time and HRT Summary
Tank Volume Calculation Sheets
GE Zenon Technology Update

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APPENDIX F

Title 22 Approved Technology Report

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March 22, 2013

Andrew Sheldon
Environmental Health Administrator
City of Malibu
23825 Stuart Ranch Road
Malibu, California 90265

1017/143884

Subject: Letter Report – Review of Water Balance for Rancho Malibu Hotel

Dear Mr. Sheldon:

Thank you for the continued opportunity to assist the City of Malibu (City) to provide peer review of the Rancho Malibu Hotel wastewater reclamation and effluent dispersal plan. Brown and Caldwell (BC) concludes that the analysis prepared by Ensitu Engineering Inc. was well conceived and well documented. Detailed review comments are provided below.

Review Comments

The scope of work consisted of providing third-party peer review of those aspects of the proponent's wastewater engineering report pertaining to "zero discharge" wastewater disposal. BC reviewed the landscape design report dated February 13, 2013 and the request for exception to the Landscape Design Standards. BC evaluated the design for conformance with City standards. No independent analysis was performed.

BC confirmed that the project wastewater engineering report supports the engineer's conclusion that the project can be carried out without runoff being generated as a result of reclaimed water application exceeding landscape plants' water demands. This conclusion applies to the daily irrigation application rates given in the engineer's report. Appropriate instantaneous application rates to prevent runoff will be a function of detailed irrigation system design and operation, which were not part of BC's review scope. BC's recommendation is to accept the project design as meeting the City's requirements (as we understand them) for demonstrating project feasibility.

One critical component was the composite weighted landscape coefficient (CWLC). The recalculated CWLC value of 1.097 remains reasonable based on the evaluation details and the use of irrigation efficiency in the calculation.

As a consequence of distribution uniformity considerations, there may be more deep percolation on a site-wide basis than is implied by the model. In practice, the use of the irrigation controllers will limit the deep percolation as much as possible. The 0.1 inches per day assumed limit on rainfall infiltration for plant use is low, but the ramification is that there is also likely to be more deep percolation due to rainfall than implied by the spreadsheet model. From an applied water perspective, the minimization of percolation infiltration for plant use allows the calculation to show a greater need for recycled water and increases the maximum recycled water storage required for recycled water equalization during periods of increased precipitation. Therefore, these assumptions are conservative.

Based upon a comparison of the provided information and the required methodology in the City Ordinance 343, the Maximum Applied Water Allowance (MAWA) for a Special Landscape Area (SLA) is 24,535,321 gallons per year (GPY). The applicant calculated the MAWA for using potable water at 17,174,725 GPY (according to the City ordinance) and added the annual reclaimed water discharge of 12,595,500 GPY to get a total MAWA of 29,767,225 GPY.

Potable irrigation makeup water is estimated at 14,167,383 GPY based on the provided information and City ordinance calculations. Because this 14,167,383 GPY is less than the allowable 17,174,725 GPY for potable water alone, the project will not use more potable water as designed than it would without the reclaimed water component.

Conclusions

BC determined that the assumptions for reclaimed water use are reasonable and would result in no runoff from the site. BC's review is a feasibility/planning level review whose goal is to evaluate whether it is feasible for the proposed method of wastewater (effluent) disposal to be carried out as described in the wastewater engineering report(s) reviewed.

In addition, BC determined that while the applicant used a different method to calculate the water use for irrigation, the use of potable water in their plan does not exceed the allowable water use if the project relied on potable water alone.

Suggestions for Building Plan Check Items

Additional engineering review should be performed during the Building Plan Check stage. Items that should be submitted for review include:

1. Complete Landscape Design
2. Soils Management Plan
3. Irrigation Plan
4. Wastewater Treatment Plant Design and Storage Tank Design
5. Monitoring and Reporting Plan for Runoff Control

Please call Ron Crites at 530-204-5204 if you have questions.

Very truly yours,

Brown and Caldwell,
a California Corporation

Ronald W. Crites

Ronald W. Crites, P.E. (#21532)
Project Manager

RC:iu

Updated Hydrogeologic Assessment of the Proposed Rancho Malibu Resort Tentative Tract Map 69653, 4000 Malibu Canyon Road, Malibu, California

August 7, 2013

Prepared for:
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Updated Hydrogeologic Assessment of the Proposed Rancho Malibu Resort Tentative Tract Map 69653, 4000 Malibu Canyon Road, Malibu, California

1.0 INTRODUCTION

A hydrogeologic assessment was conducted on the Rancho Malibu Resort to evaluate the cumulative impacts to groundwater from treated water dispersal at the development proposed for the parcel at 4000 Malibu Canyon Road (referred to herein as the "Project Site"), pursuant to the requirements of Chapter 18.5 of the City of Malibu LCP-LIP (2002). The project is located north of Pacific Coast Highway (PCH) on Winter Mesa (see Figure 1).

The objective of the assessment was to evaluate the potential effect of treated water dispersal on groundwater levels at the Project Site and adjacent properties down gradient. This work is based upon a literature review, site visit of the Project Site and surrounding properties, and groundwater levels collected from onsite wells over the last year. We also utilized geological and geotechnical data from the following sources:

- Regional geologic publications: Yerkes and Campbell (1980), and Dibblee (1993).
- Previous consulting reports specific to the Rancho Malibu Resort Site: Van Beveren & Butelo (2007), Leighton and Associates (1989), Ensitu Engineering (2008), and Young (2007).
- Recent project-specific reports/plans for the Rancho Malibu Resort Site: Young (2007), Ensitu Engineering (2012 and 2013), GeoSoils (2011, 2012 and 2013), Rubicon Engineering Corporation (2013) and Independent Irrigation Consultants, Inc. (2012 and 2013).
- Consulting reports for nearby properties: Aquifer Science and Technology (2008), Glen Lukos Associates (2008), Young (2008b), Ensitu Engineering (2009), Leighton and Associates, Inc. (2007b, 2009), and Psomas (2009).

Subsurface data from the reports listed above were obtained from more than 120 borings drilled on and adjacent to the Project Site. The borings included those made for geotechnical analyses, groundwater monitoring, and percolation testing. The data were used to evaluate where groundwater exists beneath the Project Site as well as the geologic conditions that exist at and near the Project Site. References for the reports and publications are listed Appendix A.

2.0 PROPOSED DEVELOPMENT

The proposed resort at Rancho Malibu will include a three story hotel with a basement, 21 detached structures (casitas), swimming pools, retaining walls, street and parking structures, and hardscape and landscaped areas (GeoSoils Consultants, Inc., 2011). Cut and fill grading is

proposed to create building and street pads. Other grading will be completed to accommodate repairs to existing gullies associated with the slope areas.

The planned wastewater dispersal system includes onsite treatment, so that only treated, disinfected, and dechlorinated water is discharged (Ensitu Engineering, 2008). The treated effluent will be dispersed through sprinkler irrigation systems installed in various separate zones around and within the Project Site (see Figure 2 for locations of the irrigation zones). The sprinkler irrigation system will dispose of treated effluent by providing irrigation to landscape plants. The landscape plants were "chosen for water consuming characteristics defined by WUCOLS as High and/or Medium" (Independent Irrigation Consultants, Inc., 2012).

The proposed wastewater treatment process for the facility is a membrane bioreactor (MBR) system. MBR systems can provide an effluent quality to meet tertiary treatment standards for recycled water, according to California Code of Regulations (CCR) Title 22 Division 4 regulations. Tertiary treated effluent from this system would be suitable for recycled water uses such as irrigation for landscape and non-edible plants, commercial air conditioning and cooling, or recycled plumbing use.

The treated effluent will be dispersed over a total of 20.55 acres of plant transpirational area that includes some of the natural slope areas around the site. The proposed dispersal areas are shown on Figure 2. The peak flow from the treatment system will be approximately 43,000 gallons per day (gpd) with an off-season peak flow of 26,000 gpd. These amounts equate to approximately 0.006 feet per day at peak flow and 0.004 feet per day for off-season peak flow. In addition to the subsurface disposal, a 900,000 gallon equalization/storage tank is proposed to help regulate fluctuations in daily flow (GeoSoils Consultants, Inc., 2013a). In addition, a 72,000 cubic foot stormwater storage tank is also proposed (GeoSoils Consultants, Inc., 2013a).

Generally, wastewater flows are expected to fluctuate on seasonal, weekly, and daily basis. The proposed irrigation system will require that OWTS-treated water be stored during periods of precipitation because irrigation is not permitted during and for a short period after a rain event.

3.0 PHYSIOGRAPHIC AND GEOLOGIC SETTING

The proposed Rancho Malibu Resort occupies approximately 28 acres at the northeast corner of Pacific Coast Highway and Malibu Canyon Road. Civic Center Drive borders the site to the north and northeast, while a wastewater treatment and disposal field borders the site to the east. The majority of the site is located on one of several uplifted terraces in the Malibu area. The terrace surface slopes gently toward the east. A steep hillside, about 50 feet high, separates the proposed development area from Winter Canyon to the east. The steep slopes along the eastern edge of the Project Site are scarps related to landslides. Cut slopes have been constructed along Malibu Canyon Road, Civic Center Drive and Pacific Coast Highway.

The Project Site is currently vacant and covered with grass, brush and trees. The site was previously used as a commercial nursery. Remnant, unpaved, access roads have been graded

throughout the site. Four groundwater wells are currently present on-site (see Figures 3a and 3b). Three of these well (MW01, MW02 and MW03) were previously installed by others and no well completion logs were found in the literature search. Well MW04 was installed in August 2012 during percolation testing in the western portion of the site. No well completion log has located for review. Geological boring logs across the site were reviewed.

3.1 Geologic Materials

The Project Site is underlain by different bedrock types. The Monterey Formation, Trancas, Sespe, Vaqueros, and Conejo Volcanics are present at depths to 84 feet, with all but the Monterey exposed at the surface.

Unconsolidated marine and non-marine sediments, collectively referred to as terrace deposits, cap the bedrock. Marine deposits consist of gray to light brown well graded sand and gravelly sand, while non-marine deposits consist of reddish to yellowish brown, dense, silty sand and sand with varying amounts of gravel.

A landslide is located along the eastern part of the site.

Groundwater is present in the weathered portions of the bedrock. As there were no available well completion logs or survey information for the wells on-site, all measurements were measured from the land surface downward and then approximate elevations were determined from existing site maps.

3.2 Geologic Structure

Bedrock has been strongly deformed by tectonic processes and generally dips to the southeast with minor local folding and variations in dip orientation (Van Beveren & Butelo, 2007).

Many faults and shears (minor faults) were reported in Leighton and Associates' bucket auger borings and trenches in the easterly project limits. These features are exhibited by offset bedding and dragged (folded) bedding planes and are common in the Monterey Formation. The faults and shears encountered appear to be randomly oriented and do not display a preferred orientation. Fractures and joints are also common within the Monterey Formation. These joints as encountered in the explorations were observed to be randomly oriented.

The Malibu Coast fault, a major structure in the region, trends east-west through the southern portion of the site. The fault has significantly offset the various bedrock units in the area, however it does not impact the upper part of the older terrace deposits (Leighton and Associates, 1989; Van Beveren & Butelo, 2007)

4.0 HYDROGEOLOGIC SETTING

At the Project Site, the top of the mesa slopes gently to the east and south, then becoming gradually steeper (up to about a 4:1 slope gradient) at the northern and eastern perimeter. There are no drainages, natural or manmade, contributing surface flow to the Project Site. Precipitation that falls on the site travels by sheet flow to the eastern and northern perimeter slopes.

To the east and north of the Project Site, the Winter Canyon watershed trends southeast, and encompasses approximately 150 acres. The overall relief of the watershed is 1,325 feet and is divided into two channel gradients of 0.22 feet per foot in the foothills and 0.07 feet per foot in the lower reaches of the channel, from the foothills to the ocean. The lower reaches of the Winter Canyon have experienced significant man-made alterations over the years by grading and by placement of various stormwater control measures.

Although they are adjacent, Winter Canyon and Malibu Creek are separate watersheds. A low ridge on the eastern side of Winter Canyon functions as a drainage divide for surface and subsurface waters, thereby separating the Project Site and Winter Canyon hydrologically from the Malibu Creek/Civic Center area groundwater basin. The lack of hydraulic conductivity between the two basins is further supported by their very different water levels and flow gradients (illustrated in Figures 3 and 4, Stone Environmental, 2004). In addition, the California Department of Water Resources excludes Winter Canyon from their map of the Malibu Valley Groundwater Basin (DWR Basin Number 4-22, dated October 2003).

Based on the four existing monitoring wells on the Project Site and the neighboring Pepperdine University property to the west, at least two groundwater systems are present in the area. It should be noted that only three of the on-site monitoring wells had water within the well. Onsite well MW01 was noted as being either dry or had an obstruction in the well.

Several of the groundwater monitoring wells on the Pepperdine site are set at different depths to define the groundwater elevations of an upper system within alluvial/fill deposits and a deeper system within bedrock. The groundwater levels in the three onsite wells with water (MW02, MW03 and MW04) coincide with the groundwater elevations in the Pepperdine wells set in the alluvial/fill deposits. The groundwater elevations of the deep Pepperdine wells coincide with the groundwater elevations of the monitoring wells located to the northeast and south of the Project Site. The onsite monitoring wells appear to be set within a perched groundwater system. The extent of the perched groundwater system has not been defined. Groundwater flow in the deep groundwater system flows in an east-southeast direction. Groundwater level data is plotted both as groundwater contour maps (see Figures 3a and 3b) and as a hydrograph (see Figure 4).

4.1 Existing Groundwater Conditions

There are four existing on-site groundwater monitoring wells. Depth to groundwater is 62.31 feet in MW02, 72.84 feet in well MW03, 47.48 feet in well MW04 and dry (deeper than 50 feet) in MW01. Wells MW02 and MW03 were determined to contain only about 3 inches of water, while MW04 contains several feet of water. The groundwater in these wells appears to be

perched groundwater above the deeper principal regional aquifer. The extent of the perched groundwater system has not been determined. Perched groundwater is defined as; Groundwater separated from an underlying body of groundwater by an unsaturated zone (ASCE, 1985).

Based on the these onsite monitoring wells and wells located on the neighboring Pepperdine University property to the west and the Crummer property to the south, at least two groundwater systems are present in the area. One is a perched groundwater system that presents itself in localized areas, but not extensively across the entire property. The second is a more regional groundwater system that exists at depth beneath the property and the surrounding area (see Figure 3a). The regional system ranges from 62 to greater than 72 feet below ground surface. It should be noted that both of these water systems reside in bedrock and are not in the overlying alluvium unit.

Pressure transducers were set in wells MW02 and MW03 on August 20, 2012 and in well MW04 on September 6, 2012. The transducers were set to record water levels on an hourly basis. The pressure transducer data (between August 2012 and July 2013) for these wells revealed that water levels varied by only 0.27 feet in well MW02, 0.18 feet in well MW03 and 1.33 feet in well MW04. Because well completion logs and elevation survey data were not provided for these wells, EF used the ground surface elevations from contour maps for the site to estimate the groundwater elevations present in Table 1 below.

Three groundwater monitoring well locations in the eastern portion of the Pepperdine property to the west and northwest were also used to evaluate the groundwater conditions at the Project Site. Two of these three well locations are screened at various depths. The water levels in the upper groundwater system wells (MW-5C, MW-8A and MW-11B) coincide with the water levels of the onsite wells, while the levels in the deeper wells (MW-5A and MW-11A) do not. Additional wells to the south and east of the Project Site were utilized to determine the deep groundwater conditions in the area.

Table 1 below lists the maximum and minimum groundwater elevations reported for the wells used in this analysis.

Table 1: Groundwater Monitoring Results.

Well Name	Highest Elevation (ft amsl)	Lowest Elevation (ft amsl)	Comments
MW-1 (on-site)	NA	NA	Dry since April 2012
MW-2 (on-site)	158.89	158.61	Not monitored prior to April 2012
MW-3 (on-site)	148.05	147.33	Not monitored prior to April 2012
MW-4 (on-site)	178.73	177.39	Installed in August 2012, not surveyed
LMW-1 (Crummer)	119.32	114.70	
LMW-2 (Crummer)	104.38	99.21	
LMW-6 (Crummer)	140.96	138.36	
MW-5A (Pepperdine)	168.12	154.26	
MW-5C (Pepperdine)	213	201.14	
MW-8A (Pepperdine)	211.88	208.81	
MW-11A (Pepperdine)	159.99	128.65	
LAMW-5S	57.90	51.29	

Note: All groundwater elevations are based on "mean sea level" (NAVD88).

Groundwater level data is plotted both as a groundwater contour map (see Figure3a) and as a hydrograph (see Figure 4). Groundwater in the deep system flows in an east-southeasterly direction with an average gradient of 0.06 ft/ft.

4.2 Sources for Groundwater

There are two primary sources of groundwater to the site. Recharge from upland areas and direct infiltration from precipitation. The proposed landscape and irrigation systems have been designed to maximize the evapotranspiration of treated effluent water by planting vegetation that uses moderate to large amounts of water. The proposed monitoring system will include sensors at three depths (shallow root zone, deep root zone and below the deep root zone level) that are designed to maintain soil moisture below the saturation point. The monitoring of soil moisture in the irrigation zones will ensure that irrigation water is diverted before the soil reaches saturation point, thereby eliminating deep percolation of irrigation water.

For the Project Site, Malibu Canyon Road and Civic Center Way effectively intercept runoff from upland sources and direct it away from the site and towards Winter Canyon. Therefore, there is little to no recharge due to upland surface water runoff at the site.

The Project Site sits topographically above Winter Canyon. As groundwater beneath the site moves south and east across the Project Site (Figure 3a), the only groundwater seepage to the site is from the direction of Pepperdine University to the west and northwest of the Project Site.

From previous studies by Stone Environmental (2004) and ECI (2009), it was noted that upland areas within the Winter Canyon watershed (directly east of the Project Site) provide recharge to the canyon's groundwater flow system. This recharge includes two components: 1) surface flow that reaches the principal Winter Canyon drainage ditch and then percolates down into the alluvium; and 2) groundwater that moves down gradient from bedrock areas to recharge alluvium in the lower reaches of the canyon. A recharge volume of 4,274 cubic feet per day (ft^3/d) was estimated for the Winter Canyon groundwater basin by Stone Environmental (2004). This volume was based on their assumption that for Malibu's average annual rainfall of 14 in/yr, 2 in/yr (or 14.28%) becomes recharge to Winter Canyon groundwater. In general, direct precipitation is assumed to be a small portion of the total precipitation as most rainfall within the area arrives as winter storms with considerable surface runoff. Additionally, the depth to groundwater on the Project Site is from 47 feet (MW04) to more than 72 feet below ground surface (MW02).

Currently there is no wastewater discharge on the Project Site.

4.3 Sinks for Groundwater

Groundwater sinks are areas where groundwater discharges out of the alluvium or bedrock groundwater flow systems. Potential groundwater sinks include natural discharge to surface waters (such as rivers or oceans), evapotranspiration from vegetation, and pumping wells within the groundwater basin.

The Pacific Ocean is located approximately 1,500 feet (average) south of the Project Site and is ultimately the recipient of all subsurface flow beneath the site, as well as the subsurface flow down-through Winter Canyon. This was confirmed by ECI (2000b) and Stone Environmental (2004) as well as the current groundwater elevation map developed for analysis of the Project Site.

Evapotranspiration from groundwater can occur where the root zone of vegetation is at or below the water table. This is not likely to take place on the Project Site as the depth to a perched groundwater layer is over 47 feet below land surface and greater than 70 feet in other areas. However, evapotranspiration will play a large role in eliminating the amount of treated wastewater that is to be sprayed (through sprinklers) on landscape plants from percolating through the soil column.

There are no known pumping wells within the area.

There are no known or observed springs on the site.

5.0 WASTEWATER DISPOSAL

The treated effluent will be dispersed over a total of 20.55 acres of plant transpirational area that includes some of the natural slope areas around the site. The proposed dispersal areas are shown

on Figure 2. The peak flow from the treatment system will be approximately 43,000 gpd with an off-season average peak flow of 26,000 gpd. These amounts equate to approximately 0.006 feet per day at peak flow to 0.004 feet per at off-season peak flow. In addition to the subsurface disposal a 900,000 gallon equalization/storage tank is proposed to help regulate fluctuations in daily flow (GeoSoils Consultants, Inc., 2013a). In addition, a 72,000 cubic foot stormwater storage tank is also proposed (GeoSoils Consultants, Inc., 2013a).

Generally, wastewater flows are expected to fluctuate on seasonal, weekly, and daily basis. The proposed irrigation system will require that OWTS-treated water be stored during periods of precipitation because irrigation is not permitted during and for a short period after a rain event. This practice will eliminate deep percolation of irrigation water.

The sprinkler irrigation system will dispose of treated effluent by providing irrigation to landscape plants. The landscape plants were "chosen for water consuming characteristics defined by WUCOLS as High and/or Medium" (Independent Irrigation Consultants, Inc., 2012). Soil moisture sensors will be placed a three depths (shallow root zone, deep root zone and below the deep root zone level) that are designed to maintain soil moisture below the saturation point. The monitoring of soil moisture in the irrigation zones will ensure that irrigation water is diverted before the soil reaches saturation point, thereby eliminating treated wastewater from percolating to the groundwater.

6.0 SUMMARY AND CONCLUSIONS

Based on our review of previous work on the Project Site and adjacent properties along with our site visit, the impacts to the groundwater from the proposed treated water dispersal via spray irrigation appear to be less than significant. The depth to groundwater beneath the site is greater than 47 feet. Based on the water budget calculated by Ensitu and IIC, treated wastewater from the OWTS that will be used for irrigation at the site will not produce deep percolation that will impact groundwater levels at the site or down gradient of the site. The zero-discharge irrigation system has been designed to consume all of the wastewater processed by the OWTS.

EF recommends that five groundwater monitoring wells (See Figure 3 for proposed well locations) be installed at the site after construction to confirm that the proposed OWTS irrigation system is not impacting groundwater levels and water quality.

Analysis of the Rancho Malibu Resort, which is based on a literature review and site visits, indicates no cumulative impact on groundwater levels, both onsite and offsite, will occur as a result of the operation of the proposed wastewater treatment system.

Respectfully submitted,

EARTH FORENSICS, Inc.

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Senior Consultant

Otto Figueroa, PG 8351
Project Consultant

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APPENDIX B - FIGURES

1,000 500 0 1,000 2,000
Feet

Aerial Photo: USGS High Resolution State Orthoimagery for Los Angeles County, California, 2006.

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Rancho Malibu Location Map

Proposed Rancho Malibu Development
Malibu, California

Figure 1

Project: 2012.125

300 150 0 300 600 Feet

Irrigation zones: IIC, April 2013

Aerial Photo: USGS High Resolution State Orthoimagery for Los Angeles County, California, 2006.

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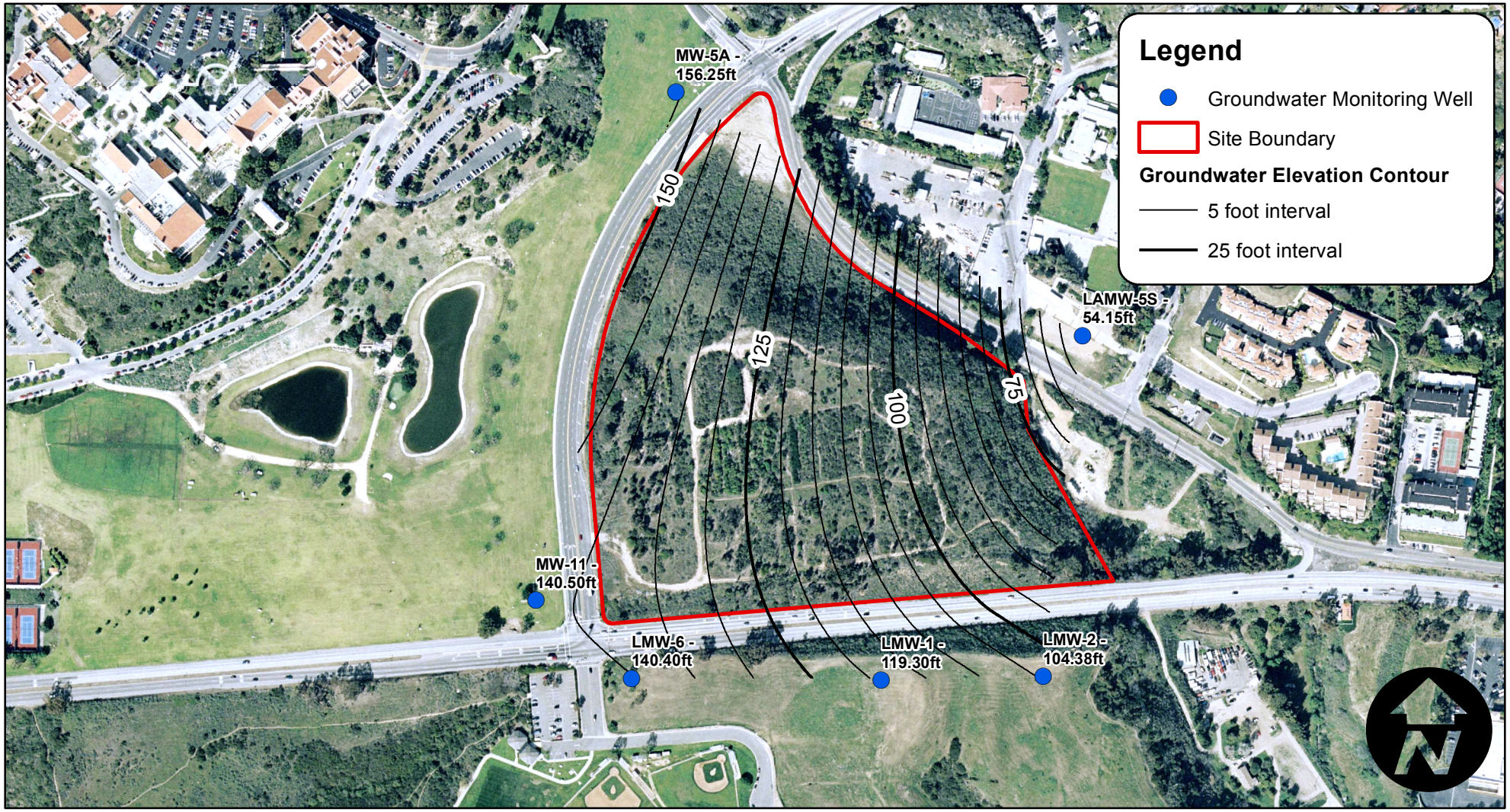
Irrigation Map

Proposed Rancho Malibu Development
Malibu, California

Figure 2

Project: 2012.125 7/30/2013



400 200 0 400 800 Feet

Note: Elevation has been estimated for monitoring wells on Rancho Malibu using lidar data from the USGS.

Aerial Photo: USGS High Resolution State Orthoimagery for Los Angeles County, California, 2006.

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Groundwater Elevation Contour Map (Deep Wells)

Proposed Rancho Malibu Development
Malibu, California

Figure 3a

Project: 2012.125 7/30/2013

Note: Elevation has been estimated for monitoring wells on Rancho Malibu using lidar data from the USGS.

Aerial Photo: USGS High Resolution State Orthoimagery for Los Angeles County, California, 2006.

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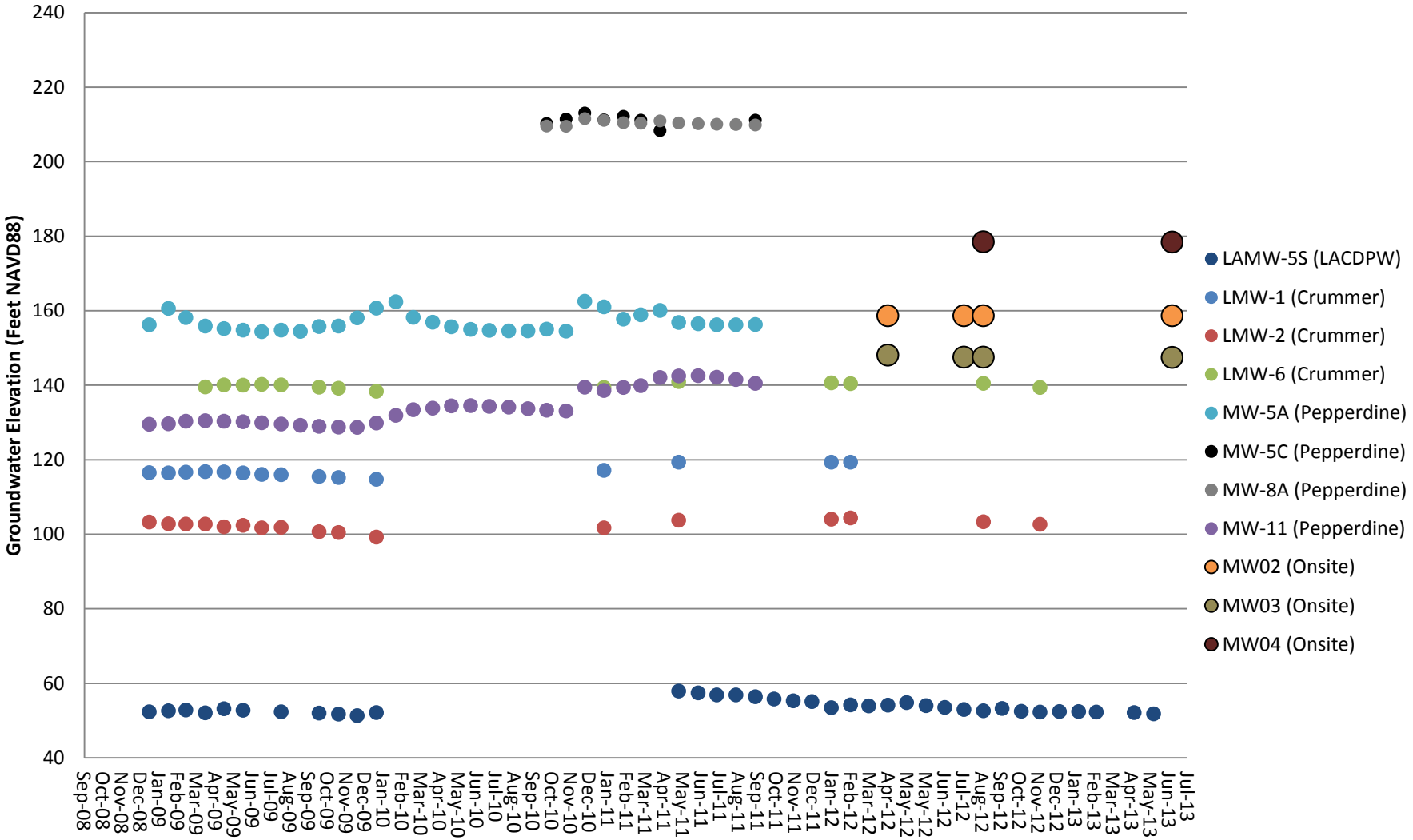
Perched Groundwater
Proposed Rancho Malibu Development
Malibu, California

Figure 3b

Project: 2012.125 7/30/2013



earthforensics, inc.

Groundwater Hydrographs

Proposed Rancho Malibu Development
Malibu, California

Figure 4

Project: 2012.125 7/30/2013

HYDROLOGY STUDY

For

Rancho Malibu Resort

Psomas Project No.: 1GRE220100
September 27, 2011

Prepared for:

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1.0 PROJECT SUMMARY

1.1 PROJECT PURPOSE AND SCOPE

The purpose of this study is to demonstrate that the proposed project site can be designed to provide adequate flood protection for onsite improvements without adversely impacting existing off-site drainage facilities or adjacent properties.

Psomas has been retained by Green acres, LLC to prepare a hydrology report for the proposed Rancho Malibu Resort project. The project consists of a 24.8-acre site located in the City of Malibu. Of these 24.8 acres, 7.4 acres are considered undisturbed area that overland flows away from the proposed development. The study area is bordered by Pacific Coast Highway to the south, Civic Center Way to the northeast, and Malibu Canyon Road to the west.

1.2 HYDROLOGIC ANALYSIS

In order to determine the appropriate design flows to be utilized to study the adequacy of the existing drainage facilities, the tributary area was divided into five sub-areas with the overall tributary area for the existing and proposed conditions remaining constant.

The hydrologic methods used in this study were based on procedures described in the Los Angeles County Department of Public Works Hydrology Manual. The methods used are the "Rational Method" (for sub-area time of concentration computation) and the "Modified Rational Method" (for flow routing through the drainage watershed and runoff computation using sub-area times of concentration computed by the Rational Method).

The *LACDPW TC (TC_calc_depth.xls, July 2004)* program was used to calculate the time of concentration and peak runoff flow rate for the existing and proposed conditions. Tc calculations are provided in Section 2. In accordance with LACDPW requirements, since this proposed development is on a hillside community, the 100-year storm event was used as the main design storm in this analysis for detention system and pipes sizing.

The Rancho Malibu Resort project is located in the City of Malibu and in the Malibu Beach quadrant of Isohyetal Map figure LACDPW 1-H1.15, in Appendix 1. The 50-year 24-hour rainfall Isohyet nearest the project area is 7.00. The County's Multiplication Factor of 1.122 was used to convert the 50-year 24-hour rainfall Isohyet to a 100-year 24-hour rainfall Isohyet. Similarly, Multiplication factors of 0.387 and 0.714 were used to calculate the 2 and 10-year 24-hour rainfall Isohyet, per City of Malibu requirements.

The soil of the watershed is classified as Type 029, as shown on figure LACDPW 1-H1.15, in Appendix 1. The project area to be disturbed by the proposed development is 17.7 acres in size. The total tributary watershed area to be studied is 32.7 acres in size.

Debris production rates were also calculated. Based on the Los Angeles County Sedimentation Manual 2nd Edition, the maximum allowable capacity of sediments in DPW Zone 7 for an desilting inlet is 999 cubic yards; any volume greater will require a debris basin. As shown in Section 5, the debris production rate was calculated to be 28,000 cubic yards/ square mile. Therefore the total debris this site will produce post development is 88 cubic yards for subarea C and 281 cubic yards for subarea D. The existing conditions produced a total of 138 cubic yards for subarea C and 321 cubic yards for subarea D. Therefore the total amount of debris for each subarea is being reduced thereby decreasing the quantity of debris going to the existing desilting basin located offsite, downstream of the site. The debris production charts and calculations are shown in Section 5 of this report.

1.3 EXISTING AND PROPOSED DRAINAGE CONDITIONS

EXISTING DRAINAGE CONDITIONS

The existing site is made up of undeveloped areas with fairly steep slopes ranging from 5% to 90%. An existing east-west ridge within the project site directs roughly one third of the site to the north and two thirds of the site to the south.

The northern third of the site which drains to the north of the main ridge is collected in the gutters of Malibu Canyon Road and Civic Center Way. The Existing Hydrology Exhibit shows this condition and sub-areas 1D, 2D, 3D and 1E. This water is collected in storm drains in Civic Center Way and directed to the Winter Drain storm drain system.

The southerly two thirds of the site, which drains to the south of the main ridge, drains to three sub-watersheds as follows:

The western sub-watershed, identified as sub-areas 1A and 2A on the Existing Hydrology Exhibit, drains to a catch basin on Malibu Canyon Road near the intersection of Pacific Coast Highway. The runoff that enters that catch basin is directed westerly in a storm drain system under Malibu Canyon Road, into a storm drain located at the southeastern corner of Pepperdine University, and then southerly under Pacific Coast Highway into a storm drain at Bluffs Park that ultimately discharges into the Pacific Ocean.

The middle sub-watershed, identified as sub-area 1B on the Existing Hydrology Exhibit, sheet flows across a plateau and becomes concentrated at several locations where erosion has occurred over the years along the steeper perimeter slopes. The majority of this sub-watershed drains to the Pacific Coast Highway existing edge of pavement, flows easterly along Pacific Coast Highway, and is then directed back onto the southeast corner of the Rancho Malibu site via storm drain inlet and storm drain pipe. All of the drainage from sub-area 1B collects in a small canyon as concentrated drainage before crossing the property line to the adjacent property. Note the 100-year storm currently yields a flow of approximately 49 cfs as the flow crosses the property line at this location; because the existing slope is approximately 12%, and the drainage channel is approximately 15' wide, the expected velocity is approximately 6.5 ft/sec. This water is collected in storm drains in the adjacent

property and directed to the Winter Drain storm drain system that ultimately discharges into the Pacific Ocean.

The eastern sub-watershed, identified as sub-area 1C on the Existing Hydrology Exhibit, sheet flows to the east. This water is collected in storm drains in the adjacent property and is also directed to the Winter Drain storm drain system that ultimately discharges into the Pacific Ocean.

Existing condition hydrology results for the 2, 10, 50 and 100-year storm events are summarized in Tables 1.0 and 1.1 below.

Table 1.0: Existing Condition Hydrology Summary 2-Year & 10-Year Storm Events

Area	Sub area	Area (ac)	2 - Year Storm Event		10 - Year Storm Event	
			Time of Conc. (min)	Total Q_2 (cfs)	Time of Conc. (min)	Total Q_{10} (cfs)
A	1A	4.06	13	3.18	8	8.44
	2A	1.56	13	1.40	9	3.14
	A Total	**5.62**	--	**4.58**	--	**11.58**
B	1B	15.24	21	9.25	12	25.65
	B Total	**15.24**	--	**9.25**	--	**25.65**
C	1C	3.15	9	3.02	6	7.60
	C Total	**3.15**	--	**3.02**	--	**7.60**
D	1D	0.65	7	0.72	5	1.7
	2D	5.41	14	4.06	9	10.51
	3D	1.28	7	1.41	5	3.36
	D Total	**7.34**	--	**6.19**	--	**15.57**
E	1E	1.39	12	1.31	8	2.99
	E Total	**1.39**	--	**1.31**	--	**2.99**
	Total	32.74		24.35		63.39

Table 1.1: Existing Condition Hydrology Summary 50-Year & 100-Year Storm Events

Area	Sub area	Area (ac)	50 - Year Storm Event		100 - Year Storm Event	
			Time of Conc. (min)	Total Q_{50} (cfs)	Time of Conc. (min)	Total Q_{100} (cfs)
A	1A	4.06	6	13.99	6	15.71
	2A	1.56	7	5.01	6	6.04
	A Total	**5.62**	**--**	**19.00**	**--**	**21.75**
B	1B	15.24	10	40.96	9	48.69
	B Total	**15.24**	**--**	**40.96**	**--**	**48.69**
C	1C	3.15	5	11.85	5	13.27
	C Total	**0.52**	**--**	**11.85**	**--**	**13.27**
D	1D	0.65	5	2.45	5	2.74
	2D	5.41	7	17.38	6	20.94
	3D	1.28	5	4.82	5	5.39
	D Total	**7.34**	**--**	**24.65**	**--**	**29.07**
E	1E	1.39	6	4.79	6	5.38
	E Total	**1.39**	**--**	**4.79**	**--**	**5.38**
	Total	**30.11**		**101.25**		**118.16**

PROPOSED DRAINAGE CONDITIONS

Future site development will consist of a resort hotel. The associated site improvements will also include paved parking areas, driveways, curb, sidewalks, landscaping, and site grading.

For developed areas A and B as shown on the Proposed Hydrology Exhibit, greater flow rates would be generated due to increases in impervious area and increases in tributary areas. The additional flow must be detained in a storm water detention facility. Calculations for the proposed 2, 10 and 100 year storm events are presented in Tables 2.0 & 2.1 below. When compared with the existing flows as shown in Table 3, it is determined that the 2-year storm requires the largest amount of detention at 0.261 ac-ft (11,370 cubic feet), composed of 0.018 ac-ft (784 cubic feet) from Area A and 0.243 ac-ft (10,585 cubic feet) from Area B. This detention will be provided by routing this required storm water volume from Areas A and B,

through a storm water diversion structure (wier), to a sub-terranean vault located under the proposed parking garage.

In addition to the detention required to attenuate the peak flow in the pre-develpment vs. post-development condition, detention will be provided based on the amont of developable area per City of Malibu code. Specifically, the City of Malibu requires that 1" of rainfall over the proposed impervious surfaces plus 0.5" of rainfall over the proposed permeable surfaces be detained. Therefore, the development area for this site requires an additional detention volume of 58,859 cf. These City of Malibu detention volume calculations are provided in Appendix Section 6.0.

The combination of the pre vs. post volume and the City of Malibu developable area volume will result in a detention facility able to detain a volume of 70,229 cf. This sub-terranean vault will also double as a holding tank for the stormwater quality treatement required as discussed in the next section. Once the detention facility fills with water and the detention requirement has been met, any excess runoff will pass through the dentention facility, continue in the main storm drain line, and be discharged to the pre-development drainage course.

Hydraulic calculations of the new on-site storm drain mainline pipes are provided in Section 8.0. The storm drain mainlines are composed of 8", 10", 12", 18" and 30" diameter pipes and the locations of these pipes are identified on the Proposed Hydrology Exhbit.

For developed areas A and B, the construction of a new storm drain system would increase storm water velocities within the historic drainage course. The velocity must be decreased to at least pre-development conditions before the storm water exits the storm drain to prevent downstream erosion, scour and related impacts. This velocity reduction will be accomplished with an energy dissipator and rip rap apron at the strom drain outlet. After the energy dissipator, the rip rap will be sloped in a relatively flat slope. Note the 100-year storm will be partially detained to yield a flow of approximately 49 cfs as the flow crosses the property line at this location. The energy dissipator will reduce the velocity of storm water in the pipe to approximately 5.5 ft/sec. The rip rap will be sloped longitudinally at approximately 2%, and extend the width of the natural channel bottom. This will slow the velocity of the storm water further and allow the water to spread towards the edges of the natural drainage channel. Therefore, the erosive forces to the natural channel bottom will be reduced from the existing condition. The energy dissipator and rip rap calcuations are provided in Appendix Section 7.0. As required by CEQA, the concentrated flow leaving the project site will not exceed the existing flow rate or velocity.

The hydraulic tribuary areas have been designed so that undeveloped areas C, D and E experience equal or smaller flow rates and velocities to the same watershed discharge points, accomplished by a reduction in tribuary area. Calculations for the 2, 10 and 100 year storm events are also presented in Tables 2.0 & 2.1 below, and in Table 3 for comparison.

Lastly, consistent with common drainage design, the drainage course locations from this project site to the adjacent downstream properties will not be altered.

Table 2.0: Proposed Condition Hydrology Summary 2-Year & 10-Year Storm Event

Area	Sub area	Area (ac)	2 - Year Storm Event		10 - Year Storm Event	
			Time of Conc. (min)	Total Q_2 (cfs)	Time of Conc. (min)	Total Q_{10} (cfs)
A	1A	6.31	17	5.05	11	11.57
	A Total	**6.31**	**--**	**5.05**	**--**	**11.57**
B	1C	10.21	17	8.18	11	18.72
	2C	4.03	18	3.16	12	7.10
	3C	0.81	9	0.79	5	2.12
	4B	1.6	10	1.67	6	3.95
	B Total	**16.65**	**--**	**13.80**	**--**	**31.89**
C	1C	2.02	6	2.45	5	5.30
	C Total	**2.02**	**--**	**2.45**	**--**	**5.30**
D	1D	6.42	20	3.94	12	10.68
	D Total	**6.42**	**--**	**3.94**	**--**	**10.68**
E	1E	1.34	12	1.26	8	2.88
	E Total	**1.34**	**--**	**1.26**	**--**	**2.88**
	Total	**32.74**		**26.50**		**62.32**

Table 2.1: Proposed Condition Hydrology Summary 50-Year & 100-Year Storm Event

Area	Sub area	Area (ac)	50 - Year Storm Event		100 - Year Storm Event	
			Time of Conc. (min)	Total Q_{50} (cfs)	Time of Conc. (min)	Total Q_{100} (cfs)
A	1A	6.31	9	18.00	8	21.35
	A Total	**6.31**	--	**18.00**	--	**21.35**
B	1B	10.21	9	29.13	8	34.55
	2B	4.03	10	10.95	9	12.88
	3B	0.81	5	3.05	5	3.41
	4B	1.6	5	6.02	5	6.74
	B Total	**16.65**	--	**49.15**	--	**57.58**
C	1C	2.02	5	7.60	5	8.51
	C Total	**2.02**	--	**7.60**	--	**8.51**
D	1D	6.42	9	18.11	8	21.73
	D Total	**6.42**	--	**18.11**	--	**21.73**
E	1E	1.34	6	4.62	6	5.19
	E Total	**1.34**	--	**4.62**	--	**5.19**
	Total	**32.74**		**97.48**		**114.36**

Water Quality- Stormwater Treatment:

New development projects are required to treat storm water quality. Structural or Treatment Control Best Management Practices (BMPs) are required for this project under the Standard Urban Stormwater Mitigation Plan (SUSMP). Volume-based or flow-based design standards may be used separately or in combination. Volume-based criteria are used in the sizing of detention or infiltration structures while flow-based criteria are used on swales, catch basin devices or wetlands. The SUSMP requirements, approved by the Regional Water Quality Control Board, currently call for the treatment of the peak mitigation flow rate of runoff produced by a 0.75 inches of rainfall. We expect the County of Los Angeles will adopt new MS4 environmental regulations in time, and we expect larger storm water treatment volumes and water re-use may be required at the time of plans permitting. Consequently, the underground detention vault can be expanded to hold larger volumes and equipment if the need arises.

Water quality calculations based on current codes were performed for the developed portion of the site. Since the geotechnical engineer has determined that the interbedded silt, clay, and sand soil may not percolate and infiltrate very well, a bio-retention system is the best BMP

for water treatment. Storm water will be routed by storm drain pipe to the detention facility located under the parking garage. The detention facility will allow for the removal of trash and sediment. The detention facility will be equipped with sump pumps and a backup energy supply to pump the storm water into a bio-retention basin located at the southwest corner of the site between the garage and Pacific Coast Highway. This basin will remove the expected pollutants and discharge treated storm water to the existing gutters on Malibu Canyon Road and Pacific Coast Highway.

See the Psomas Water Quality Mitigation Plan (WQMP) report for additional details.

1.4 CONCLUSIONS

The hydrology calculations demonstrate that the proposed site and downstream properties can be protected from flooding through the use of a detention basin without exceeding the allowable discharges in the downstream storm drain system. The following table summarizes the calculated flow rates and allowable discharge rates for the 2, 10 and 100-year storms:

Table 3.0 – Existing vs. Proposed Condition Hydrology Comparison Summary:

2-Year Storm Event						
Drainage Area	**Area Exist. (ac)**	**Area Prop. (ac)**	**Q_2 Exist. (cfs)**	**Q_2Prop. (cfs)**	**Q_2 Detained (cfs)**	**Required Detention (ac-ft)**
A	5.62	6.31	4.58	5.05	1	0.018
B	15.24	16.65	9.25	13.8	7	0.243
C	3.15	2.02	3.02	2.45	0	0
D	7.34	6.42	6.19	3.94	0	0
E	1.39	1.34	1.31	1.26	0	0
Total	**32.7**	**32.7**	**-**	**-**	**8**	**0.261**
10-Year Storm Event						
Drainage Area	**Area Exist. (ac)**	**Area Prop. (ac)**	**Q_{10} Exist. (cfs)**	**Q_{10} Prop. (cfs)**	**Q_{10} Detained (cfs)**	**Required Detention (ac-ft)**
A	5.62	6.31	11.58	11.57	0	0
B	15.24	16.65	25.65	31.89	9	0.118
C	3.15	2.02	7.60	5.30	0	0
D	7.34	6.42	15.57	10.68	0	0
E	1.39	1.34	2.99	2.88	0	0
Total	**32.7**	**32.7**	**-**	**-**	**9.0**	**0.118**

100-Year Storm Event						
Drainage Area	Area Exist. (ac)	Area Prop. (ac)	Q_{100} Exist. (cfs)	Q_{100} Prop. (cfs)	Q_{100} Detained (cfs)	Required Detention (ac-ft)
A	5.62	5.62	21.75	21.35	0	0
B	15.24	15.24	48.69	57.58	15	0.125
C	3.15	3.15	13.27	8.51	0	0
D	7.34	7.34	29.07	21.73	0	0
E	1.39	1.39	5.38	5.19	0	0
Total	**32.7**	**32.7**	**-**	**-**	**15.0**	**0.125**

The 2, 10 and 100-year storm events from the developed areas were calculated for this comparison. Because of hydrologic re-routing and detention, the peak flows for all drainage areas will not increase in the proposed condition.

1.5 LIMITATIONS

- This report was prepared to comply with the guidelines established by the Los Angeles County Department of Public Works and their representatives. Evaluation of the appropriateness of these guidelines and the accuracy of County data was beyond the scope of this work.

- Usage of this report is limited to address the purpose and scope previously defined by the project owner. Psomas shall not be held responsible for any unauthorized application of this report and the contents herein.

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

Section 2.0

RATIONAL METHOD Tc CALCULATIONS

Table 4.1: Existing 2-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	4.06	0.2	2	29	747	0.047	2.71	13	1.03	0.73	0.76	3.18
2A	1.56	0.85	2	29	817	0.032	2.71	13	1.03	0.73	0.87	1.4
1B	15.24	0.25	2	29	1747	0.078	2.71	21	0.82	0.68	0.74	9.25
1C	3.15	0.15	2	29	645	0.169	2.71	9	1.23	0.76	0.8	3.02
1D	0.65	0.15	2	29	331	0.076	2.71	7	1.38	0.78	0.8	0.72
2D	5.41	0.15	2	29	998	0.075	2.71	14	1	0.72	0.75	4.06
3D	1.28	0.15	2	29	449	0.241	2.71	7	1.38	0.78	0.8	1.41
1E	1.39	0.9	2	29	763	0.038	2.71	12	1.07	0.74	0.88	1.31
TOTAL	**32.74**											**24.35**

Table 4.2: Proposed 2-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	6.31	0.9	2	29	1247	0.035	2.71	17	0.91	0.71	0.88	5.05
1B	10.21	0.9	2	29	1209	0.034	2.71	17	0.91	0.71	0.88	8.18
2B	4.03	0.9	2	29	1538	0.049	2.71	18	0.89	0.71	0.88	3.16
3B	0.81	0.2	2	29	579	0.166	2.71	9	1.23	0.76	0.79	0.79
4B	1.6	0.9	2	29	573	0.047	2.71	10	1.17	0.75	0.89	1.67
1C	2.02	0.2	2	29	343	0.212	2.71	6	1.48	0.8	0.82	2.45
1D	6.42	0.2	2	29	1526	0.069	2.71	20	0.84	0.69	0.73	3.94
1E	1.34	0.9	2	29	763	0.038	2.71	12	1.07	0.74	0.88	1.26
TOTAL	**32.74**											**26.50**

Table 4.3: Existing 10-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	4.06	0.2	10	29	747	0.047	5	8	2.39	0.86	0.87	8.44
2A	1.56	0.85	10	29	817	0.032	5	9	2.26	0.85	0.89	3.14
1B	15.24	0.25	10	29	1747	0.078	5	12	1.98	0.83	0.85	25.65
1C	3.15	0.15	10	29	645	0.169	5	6	2.74	0.88	0.88	7.6
1D	0.65	0.15	10	29	331	0.076	5	5	2.98	0.88	0.88	1.7
2D	5.41	0.15	10	29	998	0.075	5	9	2.26	0.85	0.86	10.51
3D	1.28	0.15	10	29	449	0.241	5	5	2.98	0.88	0.88	3.36
1E	1.39	0.9	10	29	763	0.038	5	8	2.39	0.86	0.9	2.99
TOTAL	**32.74**											**63.39**

Table 4.4: Proposed 10-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	6.31	0.9	10	29	1247	0.035	5	11	2.06	0.84	0.89	11.57
1B	10.21	0.9	10	29	1209	0.034	5	11	2.06	0.84	0.89	18.72
2B	4.03	0.9	10	29	1538	0.049	5	12	1.98	0.83	0.89	7.1
3B	0.81	0.2	10	29	579	0.166	5	5	2.98	0.88	0.88	2.12
4B	1.6	0.9	10	29	573	0.047	5	6	2.74	0.88	0.9	3.95
1C	2.02	0.2	10	29	343	0.212	5	5	2.98	0.88	0.88	5.3
1D	6.42	0.2	10	29	1526	0.069	5	12	1.98	0.83	0.84	10.68
1E	1.34	0.9	10	29	763	0.038	5	8	2.39	0.86	0.9	2.88
TOTAL	**32.74**											**62.32**

Table 4.5: Existing 50-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	4.06	0.2	50	29	747	0.047	7	6	3.83	0.91	0.9	13.99
2A	1.56	0.85	50	29	817	0.032	7	7	3.57	0.9	0.9	5.01
1B	15.24	0.25	50	29	1747	0.078	7	10	3.02	0.89	0.89	40.96
1C	3.15	0.15	50	29	645	0.169	7	5	4.18	0.91	0.9	11.85
1D	0.65	0.15	50	29	331	0.076	7	5	4.18	0.91	0.9	2.45
2D	5.41	0.15	50	29	998	0.075	7	7	3.57	0.9	0.9	17.38
3D	1.28	0.15	50	29	449	0.241	7	5	4.18	0.91	0.9	4.82
1E	1.39	0.9	50	29	763	0.038	7	6	3.83	0.91	0.9	4.79
TOTAL	**32.74**											**101.25**

Table 4.6: Proposed 50-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	6.31	0.9	50	29	1247	0.035	7	9	3.17	0.89	0.9	18
1B	10.21	0.9	50	29	1209	0.034	7	9	3.17	0.89	0.9	29.13
2B	4.03	0.9	50	29	1538	0.049	7	10	3.02	0.89	0.9	10.95
3B	0.81	0.2	50	29	579	0.166	7	5	4.18	0.91	0.9	3.05
4B	1.6	0.9	50	29	573	0.047	7	5	4.18	0.91	0.9	6.02
1C	2.02	0.2	50	29	343	0.212	7	5	4.18	0.91	0.9	7.6
1D	6.42	0.2	50	29	1526	0.069	7	9	3.17	0.89	0.89	18.11
1E	1.34	0.9	50	29	763	0.038	7	6	3.83	0.91	0.9	4.62
TOTAL	**32.74**											**97.48**

Table 4.7: Existing 100-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	4.06	0.20	50	29	747	0.047	7.85	6	4.3	0.91	0.9	15.71
2A	1.56	0.85	50	29	817	0.032	7.85	6	4.3	0.91	0.9	6.04
1B	15.24	0.25	50	29	846	0.049	7.85	9	3.55	0.9	0.9	48.69
1C	3.15	0.15	50	29	247	0.040	7.85	5	4.68	0.92	0.9	13.27
1D	0.65	0.15	50	29	331	0.076	7.85	5	4.68	0.92	0.9	2.74
2D	5.41	0.15	50	29	998	0.075	7.85	6	4.3	0.91	0.9	20.94
3D	1.28	0.15	50	29	449	0.241	7.85	5	4.68	0.92	0.9	5.39
1E	1.39	0.90	50	29	763	0.038	7.85	6	4.3	0.91	0.9	5.38

TOTAL 32.74

Table 4.8: Proposed 100-Year Storm Results

Sub-area	Area (acres)	%imp	Frequency	Soil Type	Length (ft)	Slope (ft/ft)	Isohyet (in.)	Tc-calculated (min.)	Intensity (in/hr)	Cu	Cd	Flowrate (cfs)
1A	6.31	0.90	50	29	1,247	0.035	7.85	8	3.76	0.9	0.9	21.35
1B	10.21	0.90	50	29	1,209	0.034	7.85	8	3.76	0.9	0.9	34.55
2C	4.03	0.90	50	29	1,538	0.049	785	9	3.55	0.92	0.9	12.88
3B	0.81	0.20	50	29	579	0.166	7.85	5	4.68	0.9	0.9	3.41
4B	1.60	0.90	50	29	573	0.047	7.85	5	4.68	0.92	0.9	6.74
1C	2.02	0.20	50	29	343	0.212	7.85	5	4.68	0.91	0.9	8.51
1D	6.42	0.20	50	29	1,526	0.069	7.85	8	3.76	0.91	0.9	21.73
1E	1.34	0.90	50	29	763	0.038	7.85	6	4.3	0.92	0.9	5.19

TOTAL 32.74

Section 3.0

MODIFIED RATIONAL METHOD (F0601A) CALCULATIONS

Section 3.1

DETENTION VOLUME

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

MODIFIED RATIONAL METHOD HYDROLOGY

RANCHO MALIBU RESORT AREA 1A PROPOSED 2-YEAR HYDROLOGY

STORM DAY 4

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
1	5A (1A)	6.	5.	6.	5.	0	0.	0.00000	0.00	0.00	0.	29	17	A14	0.90
1	6AF	0.	1.	6.	4.	0	0.	0.00000	0.00	0.00	4.	29	0	A14	0.00
1	7A	0.	0.	6.	4.	0	0.	0.00000	0.00	0.00	0.	29	99	A14	0.00
1	8F	0.	0.	0.	1.	0	0.	0.00000	0.00	0.00	0.	29	99	A14	0.00

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
MODIFIED RATIONAL METHOD HYDROLOGY
DETENTION BASIN HYDROGRAPH

HYDROGRAPH AT 1 7A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	0.	200	0.	300	0.	400	0.
500	0.	600	0.	700	1.	800	1.	900	1.
1000	1.	1050	1.	1100	1.	1110	1.	1120	2.
1130	2.	1131	2.	1132	2.	1133	2.	1134	2.
1135	2.	1136	2.	1137	2.	1138	2.	1139	2.
1140	2.	1141	2.	1142	3.	1143	3.	1144	3.
1145	3.	1146	3.	1147	3.	1148	3.	1149	4.
1150	4.	1151	4.	1152	4.	1153	4.	1154	4.
1155	4.	1156	4.	1157	4.	1158	4.	1159	4.
1160	4.	1161	4.	1162	4.	1163	4.	1164	4.
1165	4.	1166	4.	1167	4.	1168	3.	1169	3.
1170	2.	1171	2.	1172	2.	1173	2.	1174	2.
1175	1.	1176	1.	1177	1.	1178	1.	1179	1.
1180	1.	1181	1.	1182	1.	1183	1.	1184	1.
1185	1.	1186	1.	1187	1.	1188	1.	1189	1.
1190	1.	1191	1.	1192	1.	1193	1.	1194	1.
1195	1.	1196	1.	1197	1.	1198	1.	1199	1.
1200	1.	1201	1.	1202	1.	1203	1.	1204	1.
1205	1.	1206	1.	1207	1.	1208	1.	1209	1.
1210	1.	1211	1.	1212	1.	1213	1.	1214	1.
1215	1.	1216	1.	1217	1.	1218	1.	1219	1.
1220	1.	1221	1.	1222	1.	1223	1.	1224	1.
1225	1.	1226	1.	1227	1.	1228	1.	1229	1.
1230	1.	1231	1.	1232	1.	1233	1.	1234	1.
1235	1.	1236	1.	1237	1.	1238	1.	1239	1.
1240	1.	1241	1.	1242	1.	1243	1.	1244	1.
1245	1.	1246	1.	1247	1.	1248	1.	1249	1.
1250	1.	1251	1.	1252	1.	1253	1.	1254	1.
1255	1.	1256	1.	1257	1.	1258	1.	1259	1.
1260	1.	1261	1.	1262	1.	1263	1.	1264	1.
1265	1.	1266	1.	1267	1.	1268	1.	1269	1.
1270	1.	1271	1.	1272	1.	1273	1.	1274	1.
1275	1.	1276	1.	1277	1.	1278	1.	1279	1.
1280	1.	1281	1.	1282	1.	1283	1.	1284	1.
1285	1.	1286	1.	1287	1.	1288	0.	1289	1.
1290	0.	1291	1.	1292	0.	1293	1.	1294	0.
1295	0.	1296	0.	1297	0.	1298	0.	1299	0.
1300	0.	1310	0.	1320	0.	1330	0.	1340	0.
1350	0.	1360	0.	1370	0.	1380	0.	1390	0.
1400	0.	1420	0.	1440	0.	1460	0.	1500	0.

Total Runoff = 1.029 Acre-Ft.
Peak Q = 4 CFS
Time to Peak Q = 1149 Minutes

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
MODIFIED RATIONAL METHOD HYDROLOGY
OUTLET HYDROGRAPH

HYDROGRAPH AT 1 8F STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	0.	200	0.	300	0.	400	0.
500	0.	600	0.	700	0.	800	0.	900	0.

1000	0.	1050	0.	1100	0.	1110	0.	1120	0.
1130	0.	1131	0.	1132	0.	1133	0.	1134	0.
1135	0.	1136	0.	1137	0.	1138	0.	1139	0.
1140	0.	1141	0.	1142	0.	1143	0.	1144	0.
1145	0.	1146	0.	1147	0.	1148	0.	1149	0.
1150	0.	1151	0.	1152	1.	1153	1.	1154	1.
1155	1.	1156	1.	1157	1.	1158	1.	1159	1.
1160	1.	1161	1.	1162	1.	1163	1.	1164	1.
1165	0.	1166	0.	1167	0.	1168	0.	1169	0.
1170	0.	1171	0.	1172	0.	1173	0.	1174	0.
1175	0.	1176	0.	1177	0.	1178	0.	1179	0.
1180	0.	1181	0.	1182	0.	1183	0.	1184	0.
1185	0.	1186	0.	1187	0.	1188	0.	1189	0.
1190	0.	1191	0.	1192	0.	1193	0.	1194	0.
1195	0.	1196	0.	1197	0.	1198	0.	1199	0.
1200	0.	1201	0.	1202	0.	1203	0.	1204	0.
1205	0.	1206	0.	1207	0.	1208	0.	1209	0.
1210	0.	1211	0.	1212	0.	1213	0.	1214	0.
1215	0.	1216	0.	1217	0.	1218	0.	1219	0.
1220	0.	1221	0.	1222	0.	1223	0.	1224	0.
1225	0.	1226	0.	1227	0.	1228	0.	1229	0.
1230	0.	1231	0.	1232	0.	1233	0.	1234	0.
1235	0.	1236	0.	1237	0.	1238	0.	1239	0.
1240	0.	1241	0.	1242	0.	1243	0.	1244	0.
1245	0.	1246	0.	1247	0.	1248	0.	1249	0.
1250	0.	1251	0.	1252	0.	1253	0.	1254	0.
1255	0.	1256	0.	1257	0.	1258	0.	1259	0.
1260	0.	1261	0.	1262	0.	1263	0.	1264	0.
1265	0.	1266	0.	1267	0.	1268	0.	1269	0.
1270	0.	1271	0.	1272	0.	1273	0.	1274	0.
1275	0.	1276	0.	1277	0.	1278	0.	1279	0.
1280	0.	1281	0.	1282	0.	1283	0.	1284	0.
1285	0.	1286	0.	1287	0.	1288	0.	1289	0.
1290	0.	1291	0.	1292	0.	1293	0.	1294	0.
1295	0.	1296	0.	1297	0.	1298	0.	1299	0.
1300	0.	1310	0.	1320	0.	1330	0.	1340	0.
1350	0.	1360	0.	1370	0.	1380	0.	1390	0.
1400	0.	1420	0.	1440	0.	1460	0.	1500	0.

Total Runoff = 0.018 Acre-Ft.
Peak Q = 1 CFS
Time to Peak Q = 1152 Minutes

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

MODIFIED RATIONAL METHOD HYDROLOGY

RANCHO MALIBU RESORT PROPOSED 2-YEAR HYDROLOGY STORM DAY 4

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
1	5A (1B)	10.	9.	10.	9.	0	0.	0.00000	0.00	0.00	0.	29	17	A14	0.90
1	6AF	0.	7.	10.	2.	0	0.	0.00000	0.00	0.00	2.	29	0	A14	0.00
1	7A	0.	0.	10.	2.	0	0.	0.00000	0.00	0.00	0.	29	99	A14	0.00
1	8B (4B)	2.	2.	2.	2.	0	0.	0.00000	0.00	0.00	0.	29	10	A14	0.90
1	9AB	2.	2.	12.	4.	4	571.	0.14830	2.50	0.00	0.	29	0	A14	0.00
1	10A (3C)	1.	1.	13.	5.	0	0.	0.00000	0.00	0.00	0.	29	9	A14	0.20
1	11A (2C)	4.	4.	17.	9.	0	0.	0.00000	0.00	0.00	0.	29	18	A14	0.90
1	12A	0.	0.	17.	9.	0	0.	0.00000	0.00	0.00	0.	29	99	A14	0.00
1	13F	0.	0.	0.	7.	0	0.	0.00000	0.00	0.00	0.	29	99	A14	0.00

DETENTION BASIN HYDROGRAPH

HYDROGRAPH AT 1 12A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	1.	200	1.	300	1.	400	1.
500	1.	600	1.	700	1.	800	2.	900	2.
1000	2.	1050	3.	1100	3.	1110	4.	1120	4.
1130	4.	1131	4.	1132	4.	1133	4.	1134	4.
1135	4.	1136	4.	1137	5.	1138	5.	1139	5.
1140	5.	1141	5.	1142	5.	1143	5.	1144	5.
1145	5.	1146	5.	1147	6.	1148	6.	1149	6.
1150	7.	1151	7.	1152	8.	1153	9.	1154	9.
1155	9.	1156	9.	1157	9.	1158	9.	1159	8.
1160	8.	1161	7.	1162	7.	1163	7.	1164	6.
1165	6.	1166	6.	1167	5.	1168	5.	1169	5.
1170	4.	1171	4.	1172	4.	1173	4.	1174	4.
1175	4.	1176	3.	1177	3.	1178	3.	1179	3.
1180	3.	1181	3.	1182	3.	1183	3.	1184	3.
1185	3.	1186	3.	1187	3.	1188	3.	1189	3.
1190	3.	1191	3.	1192	3.	1193	3.	1194	3.
1195	3.	1196	2.	1197	2.	1198	2.	1199	2.
1200	2.	1201	2.	1202	2.	1203	2.	1204	2.
1205	2.	1206	2.	1207	2.	1208	2.	1209	2.
1210	2.	1211	2.	1212	2.	1213	2.	1214	2.
1215	2.	1216	2.	1217	2.	1218	2.	1219	2.
1220	2.	1221	2.	1222	2.	1223	2.	1224	2.
1225	2.	1226	2.	1227	2.	1228	2.	1229	2.
1230	2.	1231	2.	1232	2.	1233	2.	1234	2.
1235	2.	1236	2.	1237	2.	1238	2.	1239	2.
1240	2.	1241	2.	1242	2.	1243	2.	1244	2.
1245	2.	1246	2.	1247	2.	1248	2.	1249	2.
1250	2.	1251	2.	1252	2.	1253	2.	1254	2.
1255	2.	1256	2.	1257	2.	1258	2.	1259	2.
1260	2.	1261	2.	1262	2.	1263	1.	1264	1.
1265	1.	1266	1.	1267	1.	1268	1.	1269	1.
1270	1.	1271	1.	1272	1.	1273	1.	1274	1.
1275	1.	1276	1.	1277	1.	1278	1.	1279	1.
1280	1.	1281	1.	1282	1.	1283	1.	1284	1.
1285	1.	1286	1.	1287	1.	1288	1.	1289	1.
1290	1.	1291	1.	1292	1.	1293	1.	1294	1.
1295	1.	1296	1.	1297	1.	1298	1.	1299	1.
1300	1.	1310	1.	1320	1.	1330	1.	1340	1.
1350	1.	1360	1.	1370	1.	1380	1.	1390	1.
1400	1.	1420	1.	1440	1.	1460	1.	1500	1.

Total Runoff = 3.148 Acre-Ft.
Peak Q = 9 CFS
Time to Peak Q = 1153 Minutes

OUTLET HYDROGRAPH

HYDROGRAPH AT 1 13F STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	0.	200	0.	300	0.	400	0.
500	0.	600	0.	700	0.	800	0.	900	0.

1000	0.	1050	0.	1100	0.	1110	0.	1120	1.
1130	1.	1131	1.	1132	1.	1133	1.	1134	1.
1135	2.	1136	2.	1137	2.	1138	2.	1139	2.
1140	2.	1141	2.	1142	2.	1143	2.	1144	2.
1145	3.	1146	3.	1147	3.	1148	3.	1149	4.
1150	5.	1151	5.	1152	6.	1153	7.	1154	7.
1155	7.	1156	7.	1157	7.	1158	7.	1159	7.
1160	7.	1161	7.	1162	6.	1163	6.	1164	6.
1165	5.	1166	5.	1167	4.	1168	3.	1169	2.
1170	1.	1171	1.	1172	1.	1173	1.	1174	1.
1175	0.	1176	0.	1177	0.	1178	0.	1179	0.
1180	0.	1181	0.	1182	0.	1183	0.	1184	0.
1185	0.	1186	0.	1187	0.	1188	0.	1189	0.
1190	0.	1191	0.	1192	0.	1193	0.	1194	0.
1195	0.	1196	0.	1197	0.	1198	0.	1199	0.
1200	0.	1201	0.	1202	0.	1203	0.	1204	0.
1205	0.	1206	0.	1207	0.	1208	0.	1209	0.
1210	0.	1211	0.	1212	0.	1213	0.	1214	0.
1215	0.	1216	0.	1217	0.	1218	0.	1219	0.
1220	0.	1221	0.	1222	0.	1223	0.	1224	0.
1225	0.	1226	0.	1227	0.	1228	0.	1229	0.
1230	0.	1231	0.	1232	0.	1233	0.	1234	0.
1235	0.	1236	0.	1237	0.	1238	0.	1239	0.
1240	0.	1241	0.	1242	0.	1243	0.	1244	0.
1245	0.	1246	0.	1247	0.	1248	0.	1249	0.
1250	0.	1251	0.	1252	0.	1253	0.	1254	0.
1255	0.	1256	0.	1257	0.	1258	0.	1259	0.
1260	0.	1261	0.	1262	0.	1263	0.	1264	0.
1265	0.	1266	0.	1267	0.	1268	0.	1269	0.
1270	0.	1271	0.	1272	0.	1273	0.	1274	0.
1275	0.	1276	0.	1277	0.	1278	0.	1279	0.
1280	0.	1281	0.	1282	0.	1283	0.	1284	0.
1285	0.	1286	0.	1287	0.	1288	0.	1289	0.
1290	0.	1291	0.	1292	0.	1293	0.	1294	0.
1295	0.	1296	0.	1297	0.	1298	0.	1299	0.
1300	0.	1310	0.	1320	0.	1330	0.	1340	0.
1350	0.	1360	0.	1370	0.	1380	0.	1390	0.
1400	0.	1420	0.	1440	0.	1460	0.	1500	0.

Total Runoff = 0.243 Acre-Ft.
Peak Q = 7 CFS
Time to Peak Q = 1153 Minutes

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

MODIFIED RATIONAL METHOD HYDROLOGY

RANCHO MALIBU RESORT PROPOSED 10-YEAR HYDROLOGY STORM DAY 4

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
1	5A (1B)	10.	20.	10.	20.	0	0.	0.00000	0.00	0.00	0.	29	11	A25	0.90
1	6AF	0.	9.	10.	11.	0	0.	0.00000	0.00	0.00	11.	29	0	A25	0.00
1	7A	0.	0.	10.	11.	0	0.	0.00000	0.00	0.00	0.	29	99	A25	0.00
1	8B (4B)	2.	5.	2.	5.	0	0.	0.00000	0.00	0.00	0.	29	6	A25	0.90
1	9AB	2.	5.	12.	16.	4	571.	0.14830	2.50	0.00	0.	29	0	A25	0.00
1	10A (3C)	1.	3.	13.	19.	0	0.	0.00000	0.00	0.00	0.	29	5	A25	0.20
1	11A (2C)	4.	8.	17.	26.	0	0.	0.00000	0.00	0.00	0.	29	12	A25	0.90
1	12A	0.	0.	17.	26.	0	0.	0.00000	0.00	0.00	0.	29	99	A25	0.00
1	13F	0.	0.	0.	9.	0	0.	0.00000	0.00	0.00	0.	29	99	A25	0.00

DETENTION BASIN HYDROGRAPH

HYDROGRAPH AT 1 12A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	2.	200	2.	300	2.	400	2.
500	2.	600	2.	700	2.	800	3.	900	3.
1000	4.	1050	5.	1100	6.	1110	8.	1120	9.
1130	10.	1131	10.	1132	11.	1133	11.	1134	11.
1135	11.	1136	11.	1137	12.	1138	12.	1139	12.
1140	13.	1141	13.	1142	14.	1143	14.	1144	15.
1145	16.	1146	16.	1147	17.	1148	18.	1149	20.
1150	22.	1151	23.	1152	25.	1153	26.	1154	26.
1155	26.	1156	25.	1157	23.	1158	22.	1159	21.
1160	20.	1161	19.	1162	18.	1163	16.	1164	14.
1165	11.	1166	10.	1167	9.	1168	9.	1169	8.
1170	8.	1171	8.	1172	7.	1173	7.	1174	7.
1175	7.	1176	6.	1177	6.	1178	6.	1179	6.
1180	6.	1181	6.	1182	6.	1183	6.	1184	5.
1185	5.	1186	5.	1187	5.	1188	5.	1189	5.
1190	5.	1191	5.	1192	5.	1193	5.	1194	5.
1195	4.	1196	4.	1197	4.	1198	4.	1199	4.
1200	4.	1201	4.	1202	4.	1203	4.	1204	4.
1205	4.	1206	4.	1207	4.	1208	4.	1209	4.
1210	4.	1211	4.	1212	4.	1213	4.	1214	4.
1215	4.	1216	4.	1217	4.	1218	4.	1219	3.
1220	3.	1221	3.	1222	3.	1223	3.	1224	3.
1225	3.	1226	3.	1227	3.	1228	3.	1229	3.
1230	3.	1231	3.	1232	3.	1233	3.	1234	3.
1235	3.	1236	3.	1237	3.	1238	3.	1239	3.
1240	3.	1241	3.	1242	3.	1243	3.	1244	3.
1245	3.	1246	3.	1247	3.	1248	3.	1249	3.
1250	3.	1251	3.	1252	3.	1253	3.	1254	3.
1255	3.	1256	3.	1257	3.	1258	3.	1259	3.
1260	3.	1261	3.	1262	3.	1263	3.	1264	3.
1265	3.	1266	3.	1267	3.	1268	3.	1269	3.
1270	3.	1271	3.	1272	3.	1273	3.	1274	3.
1275	3.	1276	3.	1277	3.	1278	2.	1279	2.
1280	2.	1281	2.	1282	2.	1283	2.	1284	2.
1285	2.	1286	2.	1287	2.	1288	2.	1289	2.
1290	2.	1291	2.	1292	2.	1293	2.	1294	2.
1295	2.	1296	2.	1297	2.	1298	2.	1299	2.
1300	2.	1310	2.	1320	2.	1330	2.	1340	2.
1350	2.	1360	2.	1370	2.	1380	2.	1390	2.
1400	2.	1420	2.	1440	2.	1460	1.	1500	1.

Total Runoff = 6.061 Acre-Ft.
Peak Q = 26 CFS
Time to Peak Q = 1153 Minutes

OUTLET HYDROGRAPH

HYDROGRAPH AT 1 13F STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	0.	200	0.	300	0.	400	0.
500	0.	600	0.	700	0.	800	0.	900	0.

1000	0.	1050	0.	1100	0.	1110	0.	1120	0.
1130	0.	1131	0.	1132	0.	1133	0.	1134	0.
1135	0.	1136	0.	1137	0.	1138	0.	1139	0.
1140	0.	1141	0.	1142	0.	1143	0.	1144	0.
1145	0.	1146	0.	1147	0.	1148	0.	1149	2.
1150	4.	1151	5.	1152	7.	1153	9.	1154	9.
1155	9.	1156	9.	1157	8.	1158	8.	1159	7.
1160	5.	1161	3.	1162	1.	1163	0.	1164	0.
1165	0.	1166	0.	1167	0.	1168	0.	1169	0.
1170	0.	1171	0.	1172	0.	1173	0.	1174	0.
1175	0.	1176	0.	1177	0.	1178	0.	1179	0.
1180	0.	1181	0.	1182	0.	1183	0.	1184	0.
1185	0.	1186	0.	1187	0.	1188	0.	1189	0.
1190	0.	1191	0.	1192	0.	1193	0.	1194	0.
1195	0.	1196	0.	1197	0.	1198	0.	1199	0.
1200	0.	1201	0.	1202	0.	1203	0.	1204	0.
1205	0.	1206	0.	1207	0.	1208	0.	1209	0.
1210	0.	1211	0.	1212	0.	1213	0.	1214	0.
1215	0.	1216	0.	1217	0.	1218	0.	1219	0.
1220	0.	1221	0.	1222	0.	1223	0.	1224	0.
1225	0.	1226	0.	1227	0.	1228	0.	1229	0.
1230	0.	1231	0.	1232	0.	1233	0.	1234	0.
1235	0.	1236	0.	1237	0.	1238	0.	1239	0.
1240	0.	1241	0.	1242	0.	1243	0.	1244	0.
1245	0.	1246	0.	1247	0.	1248	0.	1249	0.
1250	0.	1251	0.	1252	0.	1253	0.	1254	0.
1255	0.	1256	0.	1257	0.	1258	0.	1259	0.
1260	0.	1261	0.	1262	0.	1263	0.	1264	0.
1265	0.	1266	0.	1267	0.	1268	0.	1269	0.
1270	0.	1271	0.	1272	0.	1273	0.	1274	0.
1275	0.	1276	0.	1277	0.	1278	0.	1279	0.
1280	0.	1281	0.	1282	0.	1283	0.	1284	0.
1285	0.	1286	0.	1287	0.	1288	0.	1289	0.
1290	0.	1291	0.	1292	0.	1293	0.	1294	0.
1295	0.	1296	0.	1297	0.	1298	0.	1299	0.
1300	0.	1310	0.	1320	0.	1330	0.	1340	0.
1350	0.	1360	0.	1370	0.	1380	0.	1390	0.
1400	0.	1420	0.	1440	0.	1460	0.	1500	0.

Total Runoff = 0.118 Acre-Ft.
Peak Q = 9 CFS
Time to Peak Q = 1153 Minutes

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

MODIFIED RATIONAL METHOD HYDROLOGY

RANCHO MALIBU RESORT PROPOSED 100-YEAR HYDROLOGY STORM DAY 4

LOCATION		SUBAREA AREA	SUBAREA Q	TOTAL AREA	TOTAL Q	CONV TYPE	CONV LNGTH	CONV SLOPE	CONV SIZE	CONV Z	CONTROL Q	SOIL NAME	TC	RAIN ZONE	PCT IMPV
1	5A (1B)	10.	37.	10.	37.	0	0.	0.00000	0.00	0.00	0.	29	8	A39	0.90
1	6AF	0.	15.	10.	22.	0	0.	0.00000	0.00	0.00	22.	29	0	A39	0.00
1	7A	0.	0.	10.	22.	0	0.	0.00000	0.00	0.00	0.	29	99	A39	0.00
1	8B (AB)	2.	9.	2.	9.	0	0.	0.00000	0.00	0.00	0.	29	5	A39	0.90
1	9AB	2.	9.	12.	31.	4	571.	0.14830	2.50	0.00	0.	29	0	A39	0.00
1	10A (3C)	1.	4.	13.	35.	0	0.	0.00000	0.00	0.00	0.	29	5	A39	0.20
1	11A (2C)	4.	14.	17.	49.	0	0.	0.00000	0.00	0.00	0.	29	9	A39	0.90
1	12A	0.	0.	17.	49.	0	0.	0.00000	0.00	0.00	0.	29	99	A39	0.00
1	13F	0.	0.	0.	15.	0	0.	0.00000	0.00	0.00	0.	29	99	A39	0.00

DETENTION BASIN HYDROGRAPH

HYDROGRAPH AT 1 12A STORM DAY 4 REDUCTION FACTOR = 1.000

TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	3.	200	3.	300	3.	400	3.
500	3.	600	4.	700	4.	800	4.	900	5.
1000	6.	1050	8.	1100	10.	1110	12.	1120	14.
1130	16.	1131	17.	1132	17.	1133	17.	1134	18.
1135	18.	1136	19.	1137	19.	1138	20.	1139	21.
1140	21.	1141	22.	1142	23.	1143	23.	1144	24.
1145	26.	1146	27.	1147	29.	1148	30.	1149	35.
1150	40.	1151	43.	1152	46.	1153	49.	1154	48.
1155	47.	1156	44.	1157	42.	1158	38.	1159	36.
1160	31.	1161	25.	1162	20.	1163	18.	1164	16.
1165	15.	1166	14.	1167	14.	1168	13.	1169	12.
1170	12.	1171	11.	1172	11.	1173	11.	1174	10.
1175	10.	1176	10.	1177	10.	1178	9.	1179	9.
1180	9.	1181	9.	1182	9.	1183	9.	1184	8.
1185	8.	1186	8.	1187	8.	1188	8.	1189	8.
1190	8.	1191	8.	1192	7.	1193	7.	1194	7.
1195	7.	1196	7.	1197	7.	1198	7.	1199	7.
1200	7.	1201	7.	1202	7.	1203	6.	1204	6.
1205	6.	1206	6.	1207	6.	1208	6.	1209	6.
1210	6.	1211	6.	1212	6.	1213	6.	1214	6.
1215	6.	1216	6.	1217	6.	1218	6.	1219	6.
1220	6.	1221	6.	1222	5.	1223	5.	1224	5.
1225	5.	1226	5.	1227	5.	1228	5.	1229	5.
1230	5.	1231	5.	1232	5.	1233	5.	1234	5.
1235	5.	1236	5.	1237	5.	1238	5.	1239	5.
1240	5.	1241	5.	1242	5.	1243	5.	1244	5.
1245	5.	1246	5.	1247	5.	1248	5.	1249	5.
1250	5.	1251	5.	1252	5.	1253	4.	1254	4.
1255	4.	1256	4.	1257	4.	1258	4.	1259	4.
1260	4.	1261	4.	1262	4.	1263	4.	1264	4.
1265	4.	1266	4.	1267	4.	1268	4.	1269	4.
1270	4.	1271	4.	1272	4.	1273	4.	1274	4.
1275	4.	1276	4.	1277	4.	1278	4.	1279	4.
1280	4.	1281	4.	1282	4.	1283	4.	1284	4.
1285	4.	1286	4.	1287	4.	1288	4.	1289	4.
1290	4.	1291	4.	1292	4.	1293	4.	1294	4.
1295	4.	1296	4.	1297	4.	1298	4.	1299	4.
1300	4.	1310	4.	1320	3.	1330	3.	1340	3.
1350	3.	1360	3.	1370	3.	1380	3.	1390	3.
1400	3.	1420	3.	1440	3.	1460	2.	1500	2.

Total Runoff = 9.696 Acre-Ft.
Peak Q = 49 CFS
Time to Peak Q = 1153 Minutes

OUTLET HYDROGRAPH

HYDROGRAPH AT 1 13F STORM DAY 4 REDUCTION FACTOR = 1.000

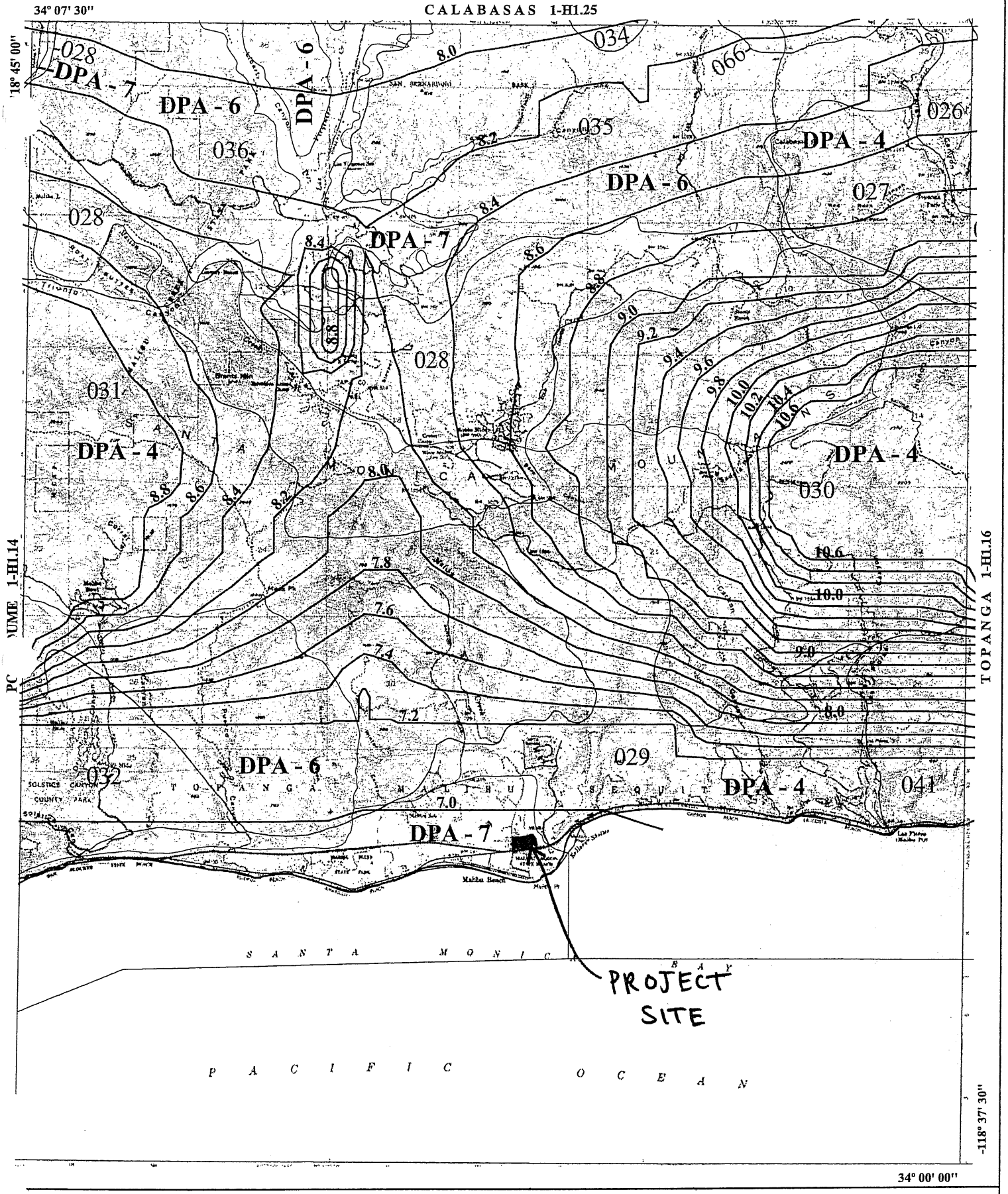
TIME	Q	TIME	Q	TIME	Q	TIME	Q	TIME	Q
0	0.	100	0.	200	0.	300	0.	400	0.
500	0.	600	0.	700	0.	800	0.	900	0.

1000	0.	1050	0.	1100	0.	1110	0.	1120	0.
1130	0.	1131	0.	1132	0.	1133	0.	1134	0.
1135	0.	1136	0.	1137	0.	1138	0.	1139	0.
1140	0.	1141	0.	1142	0.	1143	0.	1144	0.
1145	0.	1146	0.	1147	0.	1148	0.	1149	0.
1150	4.	1151	7.	1152	11.	1153	15.	1154	14.
1155	14.	1156	13.	1157	9.	1158	4.	1159	0.
1160	0.	1161	0.	1162	0.	1163	0.	1164	0.
1165	0.	1166	0.	1167	0.	1168	0.	1169	0.
1170	0.	1171	0.	1172	0.	1173	0.	1174	0.
1175	0.	1176	0.	1177	0.	1178	0.	1179	0.
1180	0.	1181	0.	1182	0.	1183	0.	1184	0.
1185	0.	1186	0.	1187	0.	1188	0.	1189	0.
1190	0.	1191	0.	1192	0.	1193	0.	1194	0.
1195	0.	1196	0.	1197	0.	1198	0.	1199	0.
1200	0.	1201	0.	1202	0.	1203	0.	1204	0.
1205	0.	1206	0.	1207	0.	1208	0.	1209	0.
1210	0.	1211	0.	1212	0.	1213	0.	1214	0.
1215	0.	1216	0.	1217	0.	1218	0.	1219	0.
1220	0.	1221	0.	1222	0.	1223	0.	1224	0.
1225	0.	1226	0.	1227	0.	1228	0.	1229	0.
1230	0.	1231	0.	1232	0.	1233	0.	1234	0.
1235	0.	1236	0.	1237	0.	1238	0.	1239	0.
1240	0.	1241	0.	1242	0.	1243	0.	1244	0.
1245	0.	1246	0.	1247	0.	1248	0.	1249	0.
1250	0.	1251	0.	1252	0.	1253	0.	1254	0.
1255	0.	1256	0.	1257	0.	1258	0.	1259	0.
1260	0.	1261	0.	1262	0.	1263	0.	1264	0.
1265	0.	1266	0.	1267	0.	1268	0.	1269	0.
1270	0.	1271	0.	1272	0.	1273	0.	1274	0.
1275	0.	1276	0.	1277	0.	1278	0.	1279	0.
1280	0.	1281	0.	1282	0.	1283	0.	1284	0.
1285	0.	1286	0.	1287	0.	1288	0.	1289	0.
1290	0.	1291	0.	1292	0.	1293	0.	1294	0.
1295	0.	1296	0.	1297	0.	1298	0.	1299	0.
1300	0.	1310	0.	1320	0.	1330	0.	1340	0.
1350	0.	1360	0.	1370	0.	1380	0.	1390	0.
1400	0.	1420	0.	1440	0.	1460	0.	1500	0.

Total Runoff = 0.125 Acre-Ft.
Peak Q = 15 CFS
Time to Peak Q = 1153 Minutes

Section 4.0

LACDPW ISOHYET/SOILS MAPS


34° 07' 30"
CALABASAS 1-H1.25
-118° 45' 00"
DPA - 7
DPA - 6
DPA - 4
028
036
035
034
066
026
027
031
030
029
032
041
8.0
8.2
8.4
8.6
8.8
9.0
9.2
9.4
9.6
9.8
10.0
10.2
10.4
10.6
7.8
7.6
7.4
7.2
7.0
SANTA MONICA MOUNTAINS
TOPANGA
MALIBU
SEQUIT
SOLSTICE CANYON
COUNTY PARK
Malibu Beach
SANTA MONICA BAY
PROJECT SITE
PACIFIC OCEAN
TOPANGA 1-H1.16
1-H1.14
-118° 37' 30"
34° 00' 00"
1 0 1 2 Miles
N
W
E
S
016
SOIL CLASSIFICATION AREA
7.2
INCHES OF RAINFALL
DPA - 6
DEBRIS POTENTIAL AREA
25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714
MALIBU BEACH
50-YEAR 24-HOUR ISOHYET
1-H1.15
LOS ANGELES COUNTY
PUBLIC WORKS
Public Service That Works

$C_D = (0.9 * IMP) + (1.0 - IMP) * Cu$

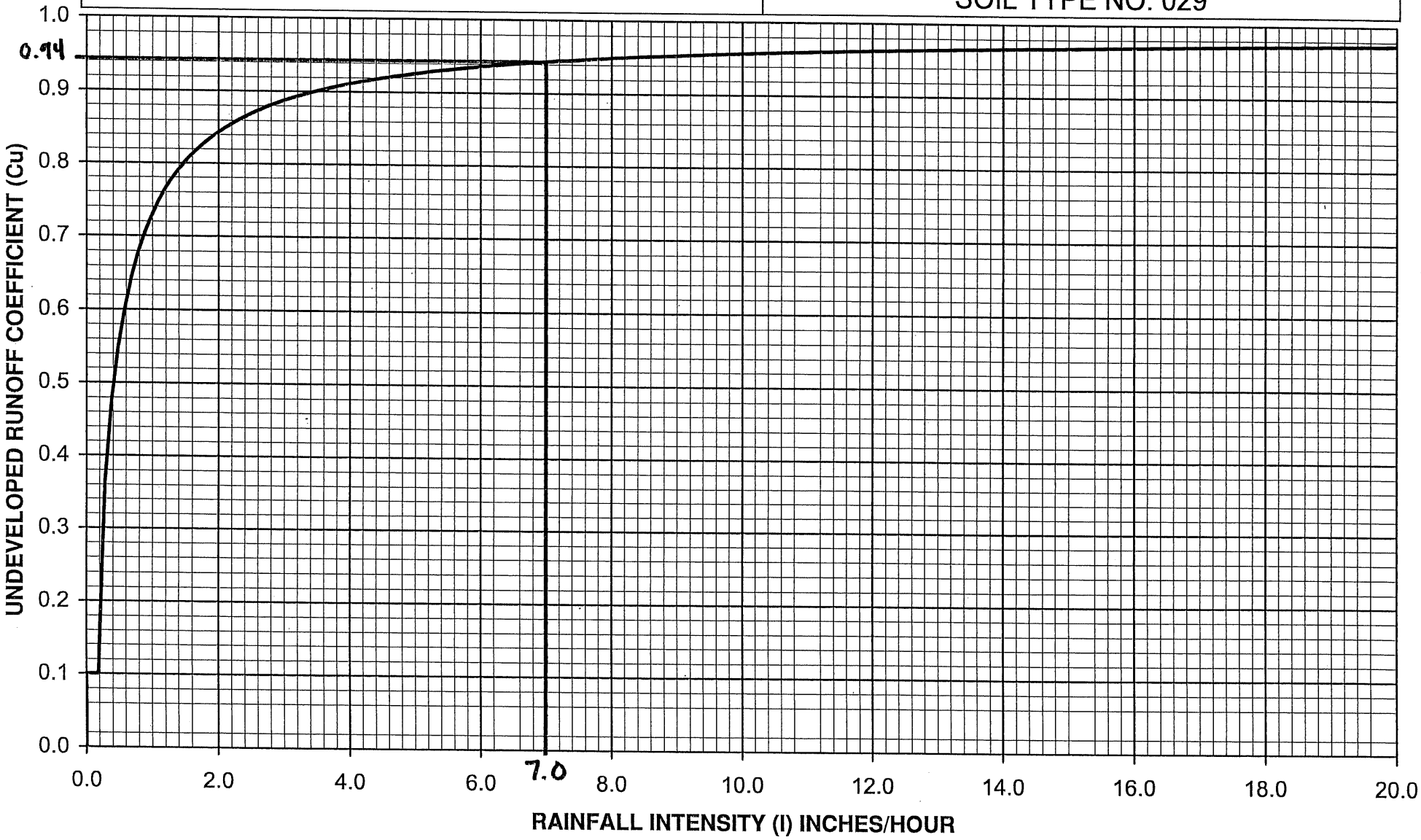
Where: C_D = Developed Runoff Coefficient

IMP = Proportion Impervious

C_U = Undeveloped runoff coefficient

Los Angeles County Department of Public Works

RUNOFF COEFFICIENT CURVE
SOIL TYPE NO. 029



Section 5.0

DEBRIS PRODUCTION CALCULATIONS

Rancho Malibu Resort

50-Year Capital Flood Analysis

Offsite Conditions – Undeveloped Area

Per Los Angeles County Sedimentation Manual the Debris Production rate is: 28,000 cubic yards per square mile.

Existing Conditions

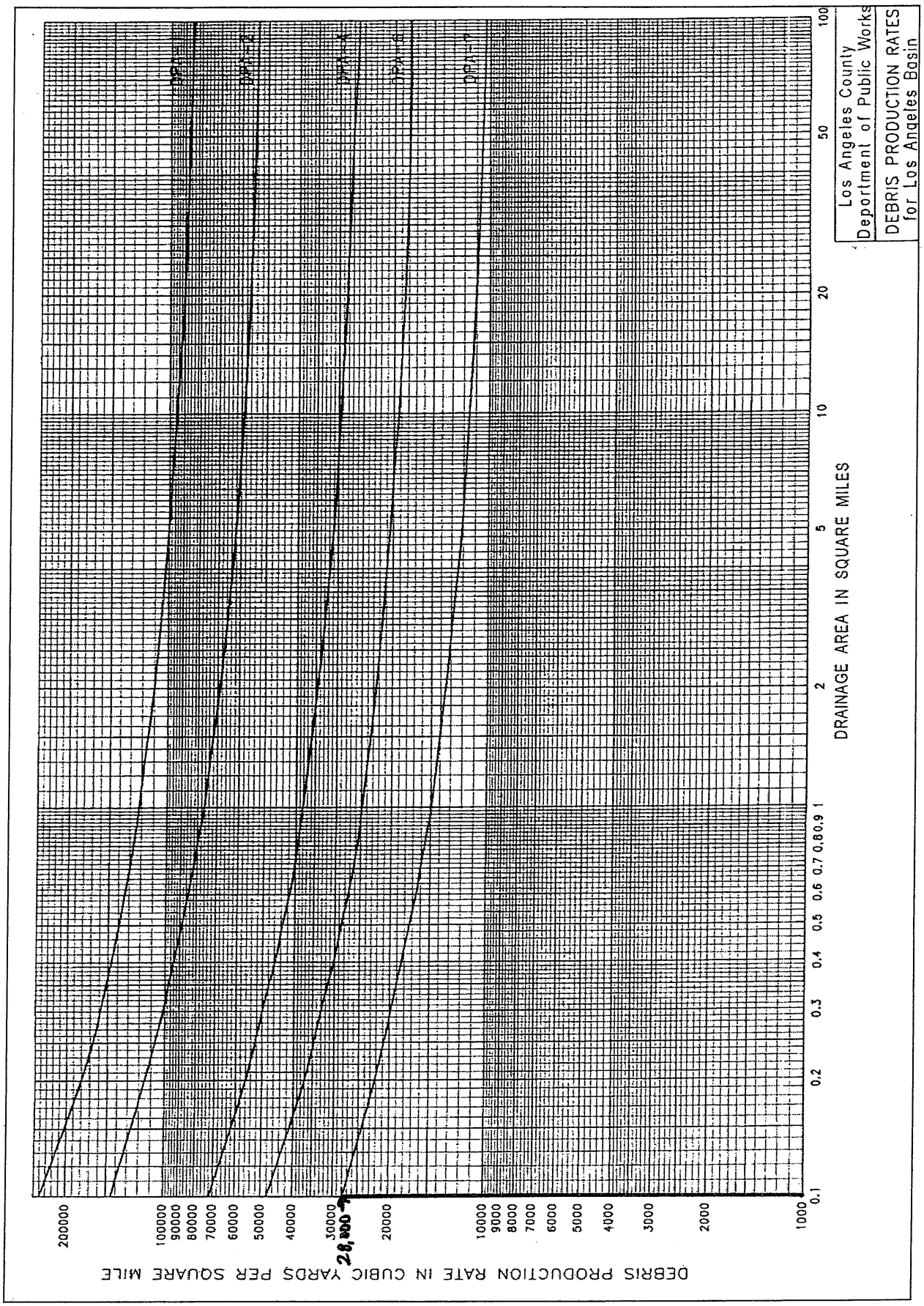
Sub area	Area (ac)	Debris Production (cy)	Q_{50}, clear (cfs)[1]
1C	3.15	138	12.19
1D	0.65	28	2.67
2D	5.41	237	17.10
3D	1.28	56	4.95
Total	**10.69**	**459**	**37.67**

Notes:
[1] TC calculation

Proposed Conditions

Sub area	Area (ac)	Debris Production (cy)	Q_{50}, clear (cfs)[1]
1C	2.02	88	7.62
1D	6.42	281	18.00
Total	**8.44**	**369**	**25.62**

Notes:
[1] TC calculation


DEBRIS PRODUCTION RATES
for Los Angeles Basin
Los Angeles County
Department of Public Works
DRAINAGE AREA IN SQUARE MILES
DEBRIS PRODUCTION RATE IN CUBIC YARDS PER SQUARE MILE
28,800
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2
5
10
20
50
100
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000
200000

Section 6.0

DETENTION VOLUME CALCULATIONS

Rancho Malibu Resort

VOLUME OF DETENTION SYSTEM

BASED ON 1/2" RAINFALL OVER PEARMEABLE SURFACES AND 1" RAINFALL OVER IMPERMEABLE SURFACES.

$V = 1x\ A_I /12 + 0.5x\ A_P /12$

TRIBUTARY AREA:

$A_I =$ 640,768 SF

$A_P =$ 131,072 SF

VOLUME OF DETENTION SYSTEM:

$V = 1x\ A_I /12 + 0.5x\ A_P /12$

$V =$ 1x 640768 /12 + 0.5 x 131,072 /12 = **58859 CF**

DETENTION SYSTEM VOLUME

V = A X H

A = 8,750 SF

H= 8 FT

V= 8,750 SF x 8 FT = 70,000 CF

Section 7.0

ENERGY DISSIPATER CALCULATIONS

PSOMAS

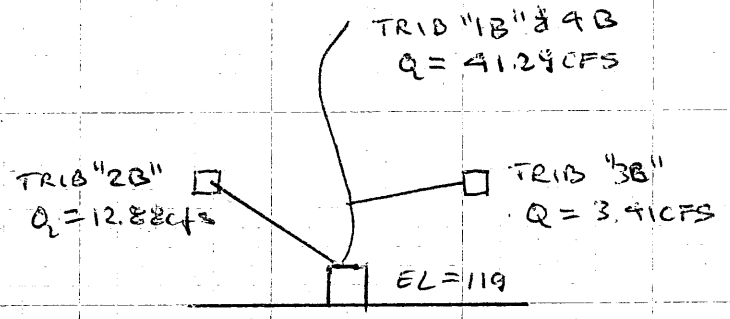
Costa Mesa 714/751-7373 | Riverside 909/787-8421 | Roseville 916/788-8122 | Sacramento 916/929-7100 | Salt Lake City 801/270-5777 | San Diego 858/576-9200 | Santa Clarita 661/219-6000 | West Los Angeles 310/954-3700

Job No. 1GRE220100 Sheet ___ of ___ Prepared by I-C Date 9/22/11

Project Name RANCHO MALIBU RESORT Reviewed by ___ Date ___

Title ENERGY DISSIPATER CALCS FWA No. ___

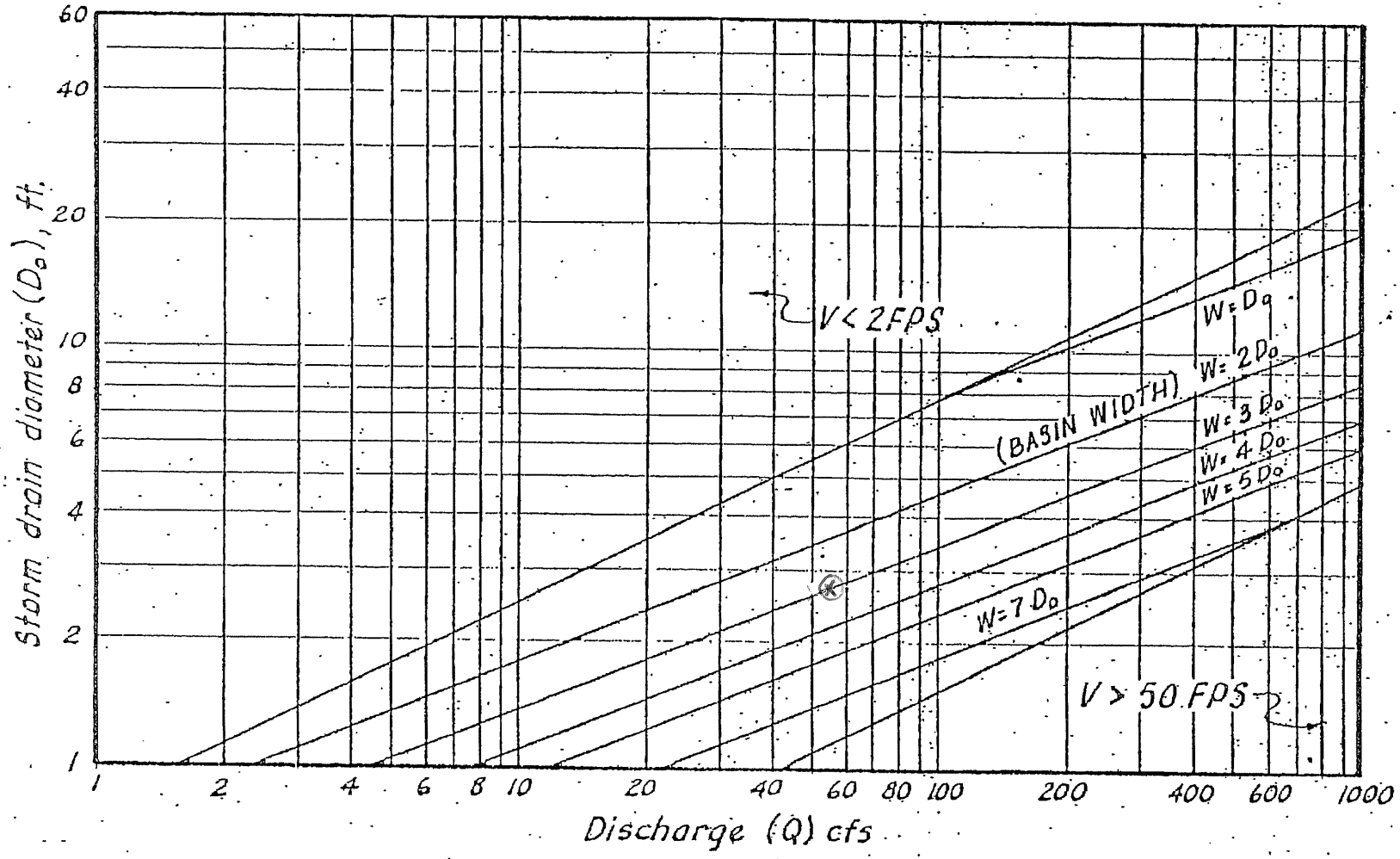
PRELIMINARY SD DESIGN FOR ED CALCS



SD PIPE SIZED AS 30"

$W = 3 D_o$ (SEE FIGURE 10.1.1)

$W = 8'$



STORM DRAIN DIAMETER VS. DISCHARGE

Project	Rancho Malibu Resort
Description	Rip Rap Sizing Calculations
Reference	County of Los Angeles Energy Dissipation Structure Package

Storm Drain	Line A		
Basin Width	8	ft	
Q	48.69	cfs	
Velocity	52.9	ft/s	from wspg
Pipe outlet diameter	30	inch	

Q/W = 6.1

From Figure 10.1.2, Impact Basin Flow Depth, **Dc = 1.1'**, for discharge over end sill

Area = Dc * W = **8.8** sq. ft.

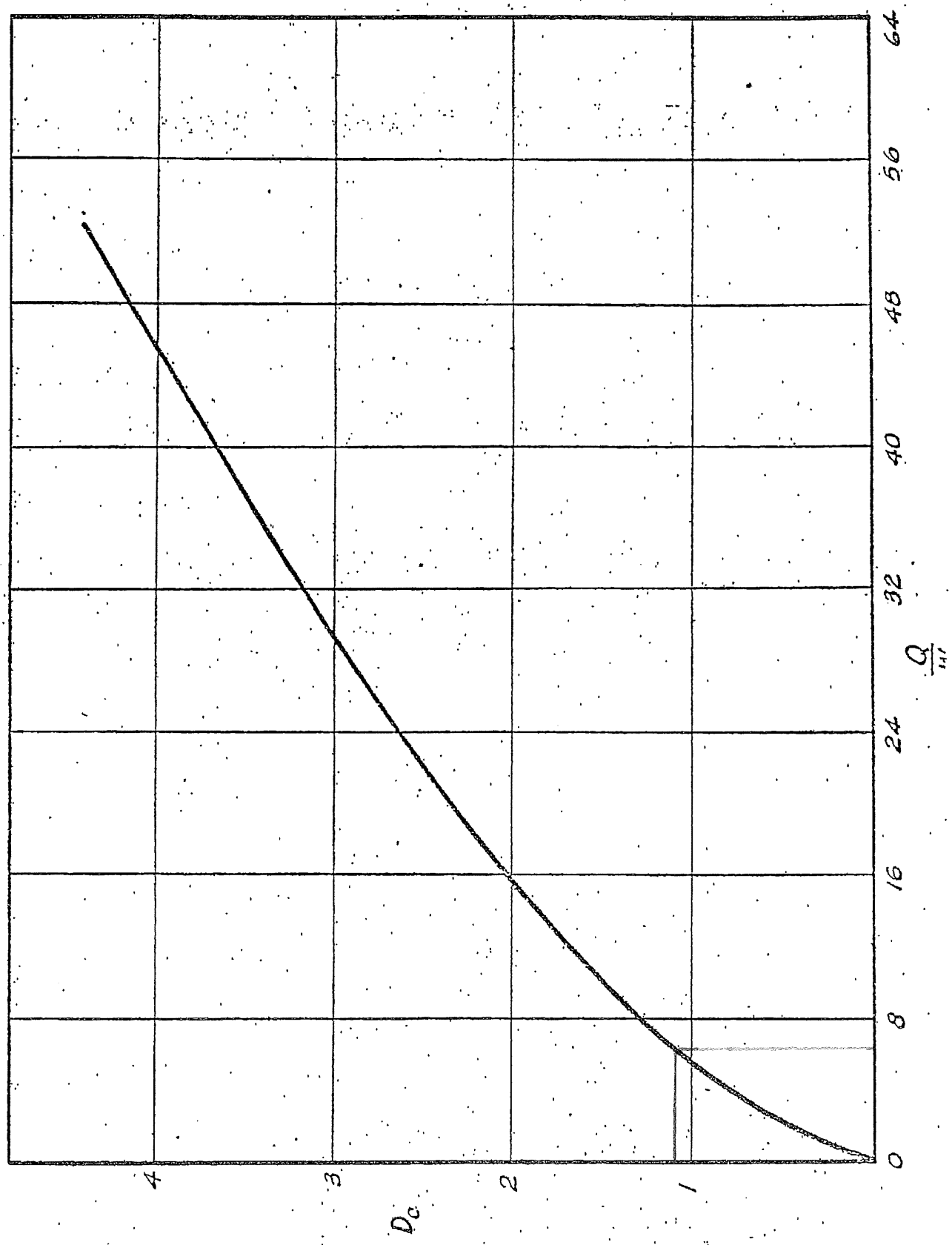
Outlet Velocity = Q / A = **5.5** fps

From Figure 10.1.3, use **12-inch rock rip-rap**

Rip rap length may be reduced to **4 times of pipe outlet diameter (per Los Angeles County Energy Dissipation Stuctures recommendations)**

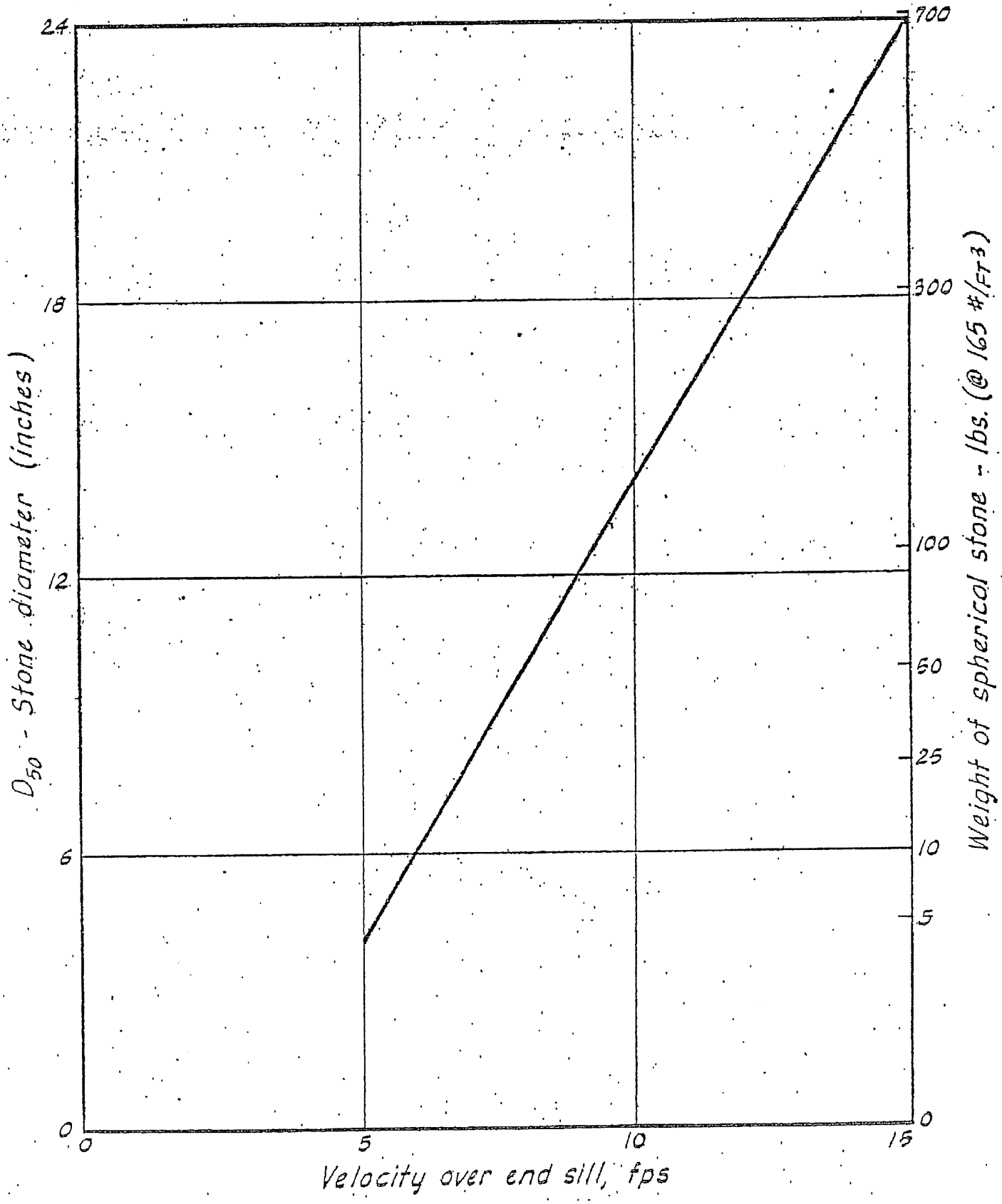
Rip Rap Length Required = **10** ft

Rip Rap Length Provided = **12** ft



IMPACT BASIN FLOW DEPTH OVER END SILL

FIGURE 10.12



IMPACT BASIN ROCK RIP-RAP SIZE

FIGURE 10.1.3

Section 8.0

HYDRAULIC CALCULATIONS

Worksheet for 6" PVC PIPE AREA 1A

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00110	ft/ft
Normal Depth	0.50	ft
Diameter	0.50	ft

Results

Discharge	0.24	ft^3/s
Flow Area	0.20	ft^2
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.13	ft
Top Width	0.00	ft
Critical Depth	0.25	ft
Percent Full	100.0	%
Critical Slope	0.00456	ft/ft
Velocity	1.23	ft/s
Velocity Head	0.02	ft
Specific Energy	0.52	ft
Froude Number	0.00	
Maximum Discharge	0.26	ft^3/s
Discharge Full	0.24	ft^3/s
Slope Full	0.00110	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 6" PVC PIPE AREA 1A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.25	ft
Channel Slope	0.00110	ft/ft
Critical Slope	0.00456	ft/ft

Cross Section for 6" PVC PIPE AREA 1A

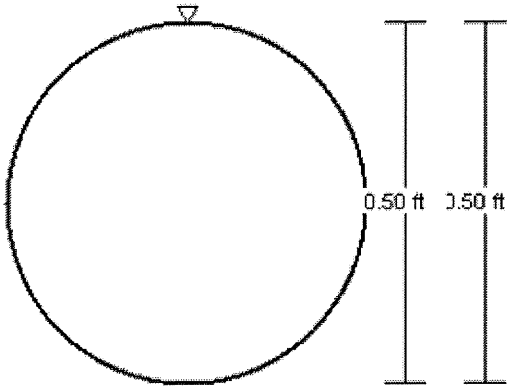
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00110	ft/ft
Normal Depth	0.50	ft
Diameter	0.50	ft
Discharge	0.24	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for 12" PVC PIPE AREA 1A

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft

Results

Discharge	3.27	ft^3/s
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.25	ft
Top Width	0.00	ft
Critical Depth	0.77	ft
Percent Full	100.0	%
Critical Slope	0.00559	ft/ft
Velocity	4.17	ft/s
Velocity Head	0.27	ft
Specific Energy	1.27	ft
Froude Number	0.00	
Maximum Discharge	3.52	ft^3/s
Discharge Full	3.27	ft^3/s
Slope Full	0.00500	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 12" PVC PIPE AREA 1A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.77	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00559	ft/ft

Cross Section for 12" PVC PIPE AREA 1A

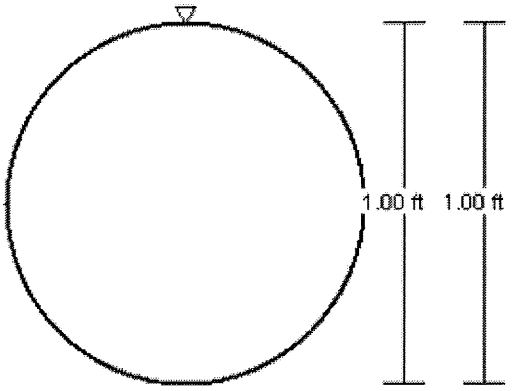
Project Description

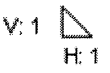
Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00500	ft/ft
Normal Depth	1.00	ft
Diameter	1.00	ft
Discharge	3.27	ft^3/s

Cross Section Image





Worksheet for 18" PVC PIPE AREA 1A

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.02320	ft/ft
Normal Depth	1.40	ft
Diameter	1.50	ft

Results

Discharge	22.37	ft^3/s
Flow Area	1.72	ft^2
Wetted Perimeter	3.93	ft
Hydraulic Radius	0.44	ft
Top Width	0.75	ft
Critical Depth	1.48	ft
Percent Full	93.3	%
Critical Slope	0.02439	ft/ft
Velocity	13.03	ft/s
Velocity Head	2.64	ft
Specific Energy	4.04	ft
Froude Number	1.52	
Maximum Discharge	22.37	ft^3/s
Discharge Full	20.80	ft^3/s
Slope Full	0.02684	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	93.33	%
Downstream Velocity	Infinity	ft/s

Worksheet for 18" PVC PIPE AREA 1A

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.40	ft
Critical Depth	1.48	ft
Channel Slope	0.02320	ft/ft
Critical Slope	0.02439	ft/ft

Cross Section for 18" PVC PIPE AREA 1A

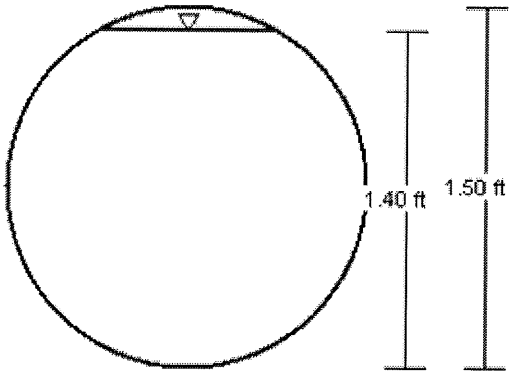
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.02320	ft/ft
Normal Depth	1.40	ft
Diameter	1.50	ft
Discharge	22.37	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for 10" PVC PIPE AREA 1B

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00500	ft/ft
Normal Depth	0.83	ft
Diameter	0.83	ft
Discharge	1.99	ft^3/s

Results

Discharge	1.99	ft^3/s
Normal Depth	0.83	ft
Flow Area	0.54	ft^2
Wetted Perimeter	2.61	ft
Hydraulic Radius	0.21	ft
Top Width	0.00	ft
Critical Depth	0.63	ft
Percent Full	100.0	%
Critical Slope	0.00577	ft/ft
Velocity	3.68	ft/s
Velocity Head	0.21	ft
Specific Energy	1.04	ft
Froude Number	0.00	
Maximum Discharge	2.14	ft^3/s
Discharge Full	1.99	ft^3/s
Slope Full	0.00500	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 10" PVC PIPE

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.83	ft
Critical Depth	0.63	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00577	ft/ft

Cross Section for 10" PVC PIPE AREA 1B

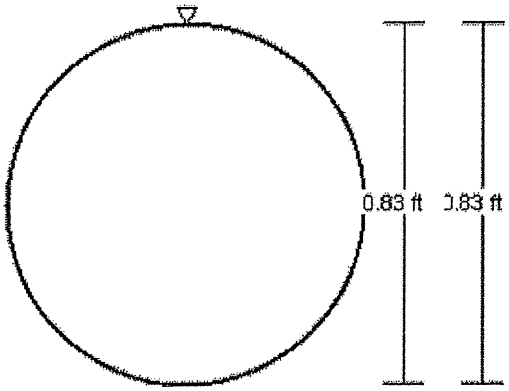
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00500	ft/ft
Normal Depth	0.83	ft
Diameter	0.83	ft
Discharge	1.99	ft^3/s

Cross Section Image



V: 1
H: 1

Cross Section for 10" PVC PIPE AREA 1B

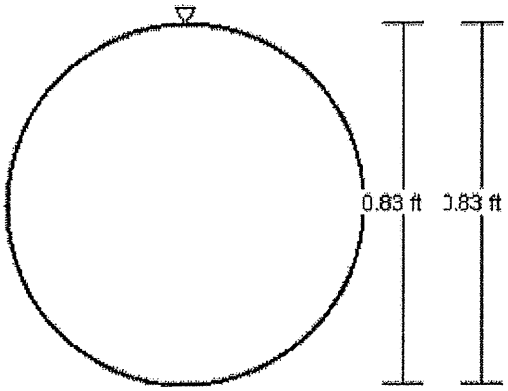
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00500	ft/ft
Normal Depth	0.83	ft
Diameter	0.83	ft
Discharge	1.99	ft³/s

Cross Section Image



V: 1
H: 1

Worksheet for 12" PVC PIPE AREA 1B

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.03580	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	25.84	ft^3/s

Results

Discharge	25.84	ft^3/s
Normal Depth	1.50	ft
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	1.49	ft
Percent Full	100.0	%
Critical Slope	0.03325	ft/ft
Velocity	14.62	ft/s
Velocity Head	3.32	ft
Specific Energy	4.82	ft
Froude Number	0.00	
Maximum Discharge	27.79	ft^3/s
Discharge Full	25.84	ft^3/s
Slope Full	0.03580	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 12" PVC PIPE

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.49	ft
Channel Slope	0.03580	ft/ft
Critical Slope	0.03325	ft/ft

Cross Section for 12" PVC PIPE AREA 1B

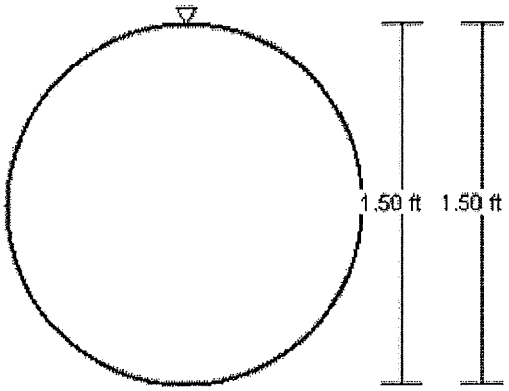
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.03580	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	25.84	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for 18" PVC PIPE AREA 1B

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00600	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	10.58	ft^3/s

Results

Discharge	10.58	ft^3/s
Normal Depth	1.50	ft
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Hydraulic Radius	0.38	ft
Top Width	0.00	ft
Critical Depth	1.25	ft
Percent Full	100.0	%
Critical Slope	0.00583	ft/ft
Velocity	5.99	ft/s
Velocity Head	0.56	ft
Specific Energy	2.06	ft
Froude Number	0.00	
Maximum Discharge	11.38	ft^3/s
Discharge Full	10.58	ft^3/s
Slope Full	0.00600	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 18" PVC PIPE AREA 1B

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.50	ft
Critical Depth	1.25	ft
Channel Slope	0.00600	ft/ft
Critical Slope	0.00583	ft/ft

Cross Section for 18" PVC PIPE AREA 1B

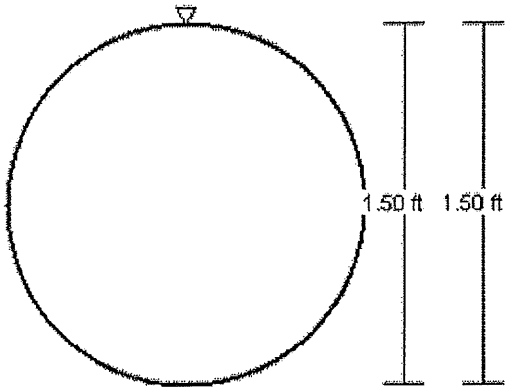
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.00600	ft/ft
Normal Depth	1.50	ft
Diameter	1.50	ft
Discharge	10.58	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for 30" PVC PIPE AREA 1B

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.01000	ft/ft
Normal Depth	2.50	ft
Diameter	2.50	ft
Discharge	53.32	ft^3/s

Results

Discharge	53.32	ft^3/s
Normal Depth	2.50	ft
Flow Area	4.91	ft^2
Wetted Perimeter	7.85	ft
Hydraulic Radius	0.63	ft
Top Width	0.00	ft
Critical Depth	2.34	ft
Percent Full	100.0	%
Critical Slope	0.00864	ft/ft
Velocity	10.86	ft/s
Velocity Head	1.83	ft
Specific Energy	4.33	ft
Froude Number	0.00	
Maximum Discharge	57.36	ft^3/s
Discharge Full	53.32	ft^3/s
Slope Full	0.01000	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

Worksheet for 30" PVC PIPE AREA 1B

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.50	ft
Critical Depth	2.34	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00864	ft/ft

Cross Section for 30" PVC PIPE AREA 1B

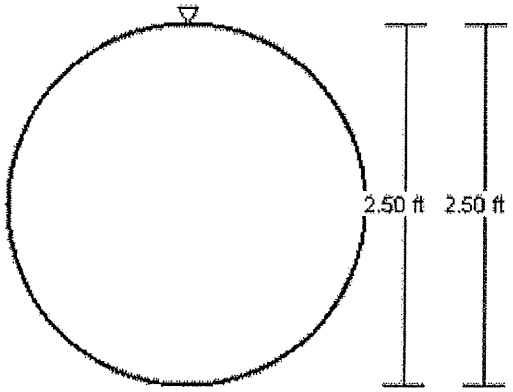
Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.01000	ft/ft
Normal Depth	2.50	ft
Diameter	2.50	ft
Discharge	53.32	ft^3/s

Cross Section Image



V: 1
H: 1

Worksheet for 30" PVC PIPE AREA B OUTLET

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.50000	ft/ft
Diameter	2.50	ft
Discharge	48.69	ft^3/s

Results

Normal Depth	0.61	ft
Flow Area	0.92	ft^2
Wetted Perimeter	2.58	ft
Hydraulic Radius	0.36	ft
Top Width	2.14	ft
Critical Depth	2.28	ft
Percent Full	24.3	%
Critical Slope	0.00727	ft/ft
Velocity	52.91	ft/s
Velocity Head	43.50	ft
Specific Energy	44.11	ft
Froude Number	14.24	
Maximum Discharge	405.57	ft^3/s
Discharge Full	377.02	ft^3/s
Slope Full	0.00834	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	24.27	%
Downstream Velocity	Infinity	ft/s

Worksheet for 30" PVC PIPE AREA B OUTLET

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.61	ft
Critical Depth	2.28	ft
Channel Slope	0.50000	ft/ft
Critical Slope	0.00727	ft/ft

Cross Section for 30" PVC PIPE AREA B OUTLET

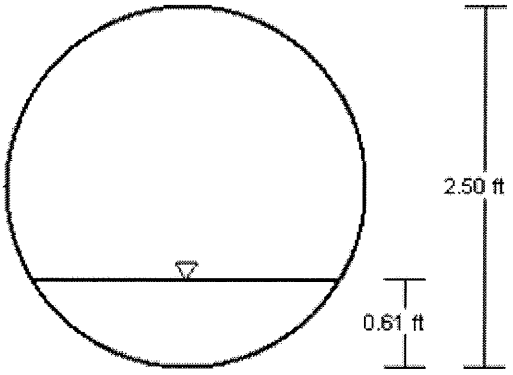
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.010	
Channel Slope	0.50000	ft/ft
Normal Depth	0.61	ft
Diameter	2.50	ft
Discharge	48.69	ft^3/s

Cross Section Image



V: 1
H: 1

Cross Section for Natural channel

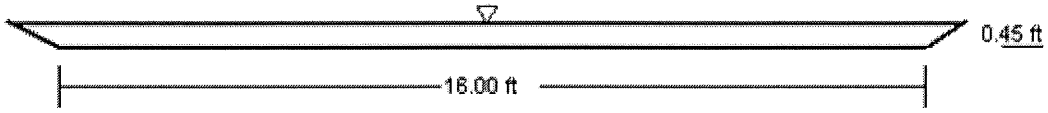
Project Description

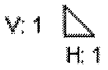
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.12000	ft/ft
Normal Depth	0.45	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	16.00	ft
Discharge	48.69	ft^3/s

Cross Section Image





Worksheet for Natural channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	16.00	ft
Discharge	48.69	ft^3/s

Results

Normal Depth	0.45	ft
Flow Area	7.55	ft^2
Wetted Perimeter	17.82	ft
Hydraulic Radius	0.42	ft
Top Width	17.57	ft
Critical Depth	0.64	ft
Critical Slope	0.03578	ft/ft
Velocity	6.45	ft/s
Velocity Head	0.65	ft
Specific Energy	1.10	ft
Froude Number	1.74	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.64	ft
Channel Slope	0.12000	ft/ft

Worksheet for Natural channel

GVF Output Data

Critical Slope	0.03578	ft/ft

Worksheet for Natural channel

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.12000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	16.00	ft
Discharge	48.69	ft^3/s

Results

Normal Depth	0.45	ft
Flow Area	7.55	ft^2
Wetted Perimeter	17.82	ft
Hydraulic Radius	0.42	ft
Top Width	17.57	ft
Critical Depth	0.64	ft
Critical Slope	0.03578	ft/ft
Velocity	6.45	ft/s
Velocity Head	0.65	ft
Specific Energy	1.10	ft
Froude Number	1.74	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.64	ft
Channel Slope	0.12000	ft/ft

Worksheet for Natural channel

GVF Output Data

Critical Slope	0.03578	ft/ft

Cross Section for Natural channel

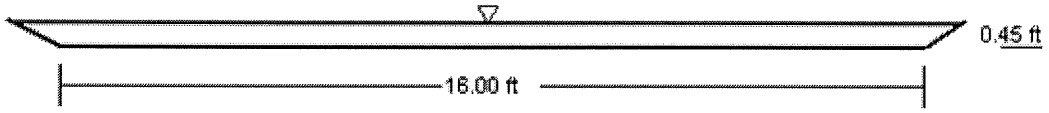
Project Description

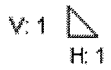
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.12000	ft/ft
Normal Depth	0.45	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	1.50	ft/ft (H:V)
Bottom Width	16.00	ft
Discharge	48.69	ft^3/s

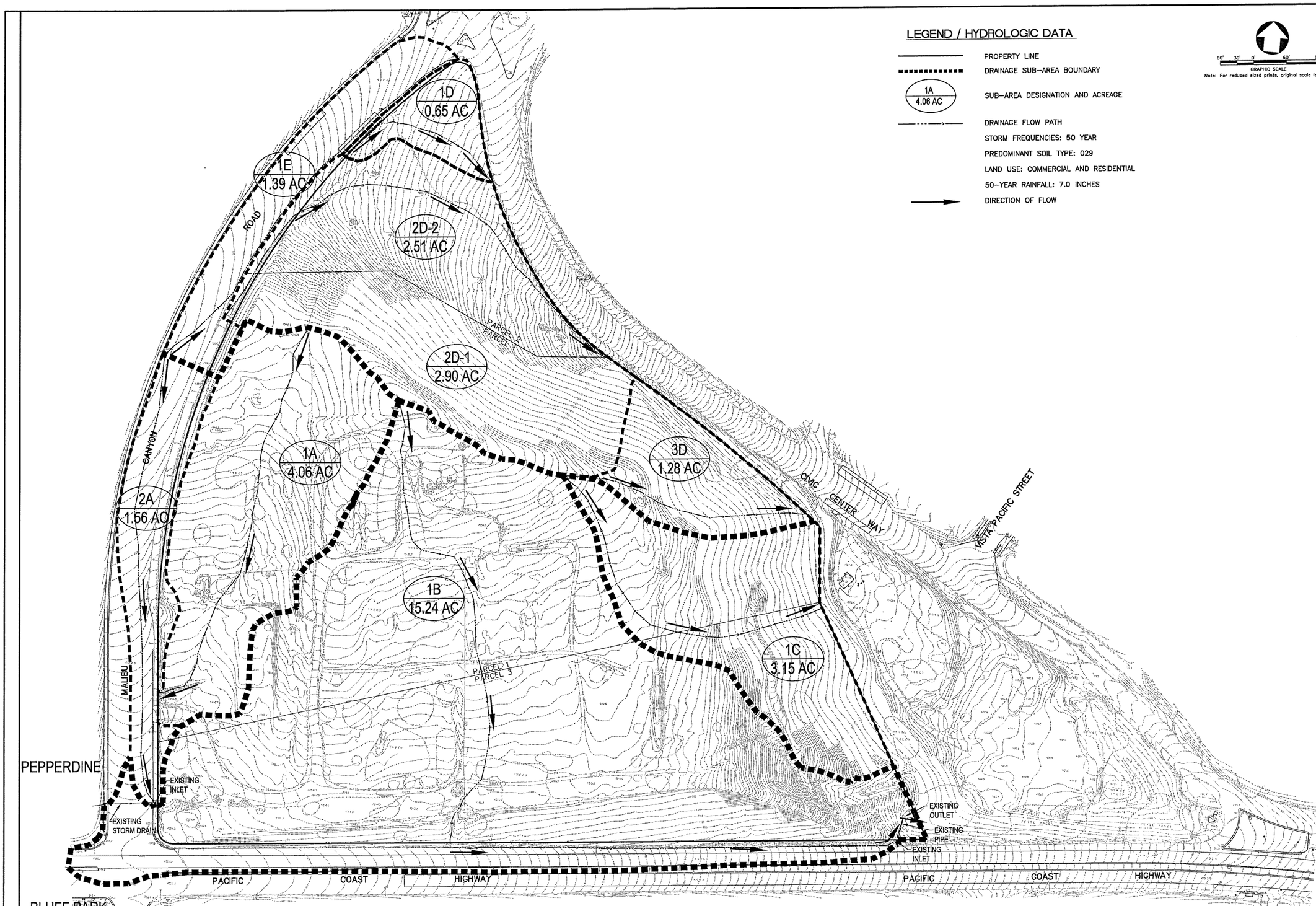
Cross Section Image





Appendix A

EXHIBITS (EXISTING & PROPOSED DRAINAGE MAPS)



REGISTERED PROFESSIONAL ENGINEER MARK A. NICKERSON No. C056808 Exp. 06-30-13 CIVIL STATE OF CALIFORNIA	DESIGNED IC					BENCHMARK N/A	
	DRAFTED IC						
SEAL	CHECKED A.N.	REV	DATE	DESCRIPTION	BY	APP'D	ELEV. N/A ADJUSTMENT

PSOMAS
555 South Flower Street, Suite 4400
Los Angeles, CA 90071
(213) 223-1400 (213) 223-1444 fax
www.psomas.com

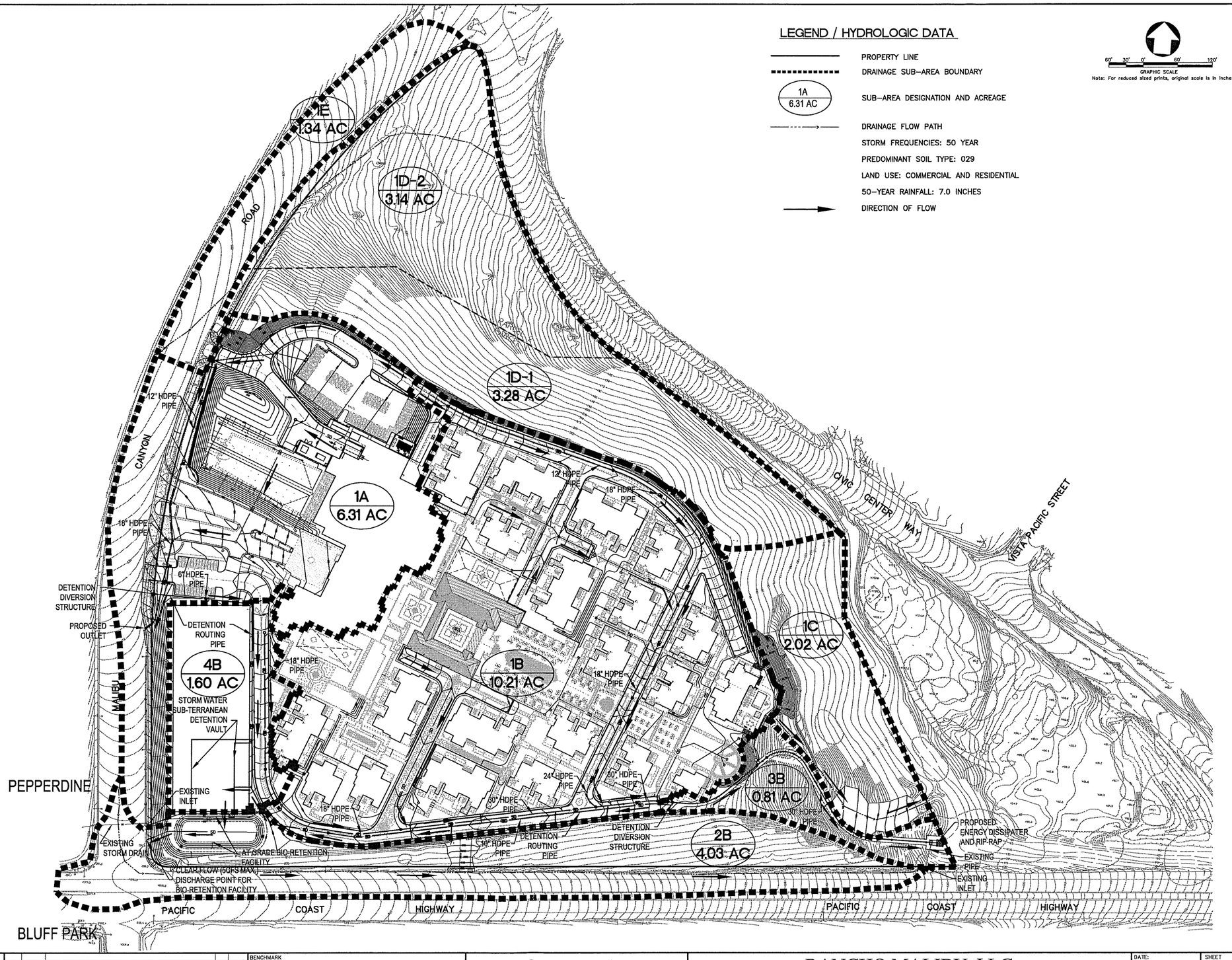
RANCHO MALIBU, LLC
EXISTING HYDROLOGY
EXHIBIT

DATE: 09-22-11
SCALE: 1" = 60'
PROJECT NUMBER: 1GRE220100
SHEET 1 OF 1

LEGEND / HYDROLOGIC DATA

- PROPERTY LINE
- DRAINAGE SUB-AREA BOUNDARY
- 1A / 6.31 AC — SUB-AREA DESIGNATION AND ACREAGE
- DRAINAGE FLOW PATH
- STORM FREQUENCIES: 50 YEAR
- PREDOMINANT SOIL TYPE: 029
- LAND USE: COMMERCIAL AND RESIDENTIAL
- 50-YEAR RAINFALL: 7.0 INCHES
- DIRECTION OF FLOW

60' 30' 0' 60' 120'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches



REGISTERED PROFESSIONAL ENGINEER — STEVEN A. NORDEEN — No. C056808 — Exp. 06-30-13 — CIVIL — STATE OF CALIFORNIA — SEAL	DESIGNED: IC DRAFTED: IC CHECKED: A.N.	REV / DATE / DESCRIPTION / BY / APP'D	BENCHMARK: N/A ELEV. N/A ADJUSTMENT	PSOMAS 555 South Flower Street, Suite 4400 Los Angeles, CA 90071 (213) 223-1400 (213) 223-1444 fax www.psomas.com	RANCHO MALIBU, LLC PROPOSED HYDROLOGY EXHIBIT	DATE: 09-22-11 SCALE: 1" = 60' PROJECT NUMBER: 1GRE220100	SHEET 1 OF 1

Plotted: 07/02/07 10:54:51 M:\1GRE\220100\GRAPHICS\EXHIBITS\HYDRO\HYDRO_HYDROLOGY.dwg

PSOMAS

RANCHO MALIBU RESORT
WATER QUALITY MANAGEMENT PLAN
(WQMP)

September 27, 2011

WATER QUALITY MANAGEMENT PLAN

For:
Rancho Malibu

Psomas Project No: 1GRE220100

Submitted to:
City of Malibu
Department of Public Works
23815 Stuart Ranch Road
Malibu, CA 90265

Prepared for:
Green Acres, LLC
P.O. Box 6528
Malibu, CA 90264

Project Site Location/Address:
4000 Malibu Canyon Road
Malibu, CA 90265

SUSMP Prepared by:
Andrew Nickerson, PE
PSOMAS
555 S. Flower Street, Suite 4400
Los Angeles, California 90071
213-223-1400
213-223-1444 Fax

WQMP Preparation Date:
September 27, 2011

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Sample Storm Drain Stencils

Operations and Maintenance Plan

1.0 Introduction

1.1 Project Background

The project is currently located at 24111 Pacific Coast Highway in Malibu, California 90265. Upon completion of the project, the street address is proposed to be revised to 4000 Malibu Canyon Road. The project site is bordered by Pacific Coast Highway to the south, Civic Center Way to the northeast, and Malibu Canyon Road to the west. See location and vicinity map in *Appendix 2*. The existing site is currently undeveloped, with vegetated slopes and existing access roads. A resort hotel is proposed for the site. Adjacent improvements to the area include site grading, paved parking areas, driveways, curbs, sidewalks, and landscaping.

1.2 Purpose and Scope

The project falls under the jurisdiction of the City of Malibu. The Los Angeles County Department of Public Works (LACDPW) methodology and calculations are adopted by the City of Malibu. The purpose of this drainage concept report is:

- To meet City of Malibu development requirements in allowing final design and construction to proceed in a timely manner;
- To determine the proposed development's impact (increase peak flow rates) on existing hydrologic conditions;
- To provide sufficient detailed information to support detailed hydraulic design of storm drainage facilities; and
- To document that the Los Angeles County Standard Urban Stormwater Mitigation Plan (SUSMP) requirements will be met.
- The geotechnical engineer has determined that the interbedded silt, clay, and sand soil may not percolate and infiltrate very well. Due to the hillside areas and historic landslides in the area, storm water infiltration does not seem appropriate. Therefore, a bio-retention system is the best BMP for water treatment.
- We expect the County of Los Angeles will adopt new MS4 environmental regulations in time, and we expect larger storm water treatment volumes and water re-use may be required at the time of plans permitting. Consequently, the underground detention vault can be expanded to hold larger volumes and equipment if the need arises.

It should be noted that detailed storm drain sizing analyses are beyond the scope of this WQMP.

2.0 Site Characterization

Current Property Use: Forested area/open space with access roads.

Proposed Property Use: Resort hotel.

Availability of Soils Report: The soil of the watershed is classified as Type 029, as shown in the Malibu Beach quadrant of Hydrologic Map figure LACDPW 1-H1.15, found in *Appendix 1*. The project area to be disturbed is 22.3 acres in size. The total tributary watershed area to be studied is 32.7 acres in size.

Phase I Site Assessment: Not applicable

Receiving Waters: The project site is conveyed to the Pacific Ocean via the Los Angeles County Winter Drain storm drain. The outlet is located at Amarillo Beach.

As shown in Table 1, Amarillo Beach is listed on the 2002 CWA Section 303(d) list (approved by USEPA July 2003) as having fish consumption advisories for DDT and PCBs. Currently, the beneficial uses listed for this waterway are navigation, water contact and non-water contact recreation, commercial and sport fishing, marine and wildlife habitat, and shellfish harvesting.

Table 1: Receiving Waters for Urban Runoff from Site[1]

Receiving Waters	303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Uses
Amarillo Beach	DDT, PCBs	Existing: NAV, REC1, REC2, COMM, MAR, WILD, SHELL	Not applicable

1 California Regional Water Quality Control Board, Los Angeles Region. Water Quality Control Plan Los Angeles Region. June 13, 1994.

3.0 Pollutants of Concern

The proposed project will consist of a resort hotel.

Table 2 lists the pollutants anticipated to be generated by a proposed land use. Because the project is considered a detached residential development, the following pollutants are anticipated[2]: sediment/turbidity, nutrients, trash and debris, oxygen demanding substances, bacteria/viruses, oil and grease, and pesticides. Additionally, since there will be parking lots and streets located within the project site, metals are also an expected pollutant.

Table 2: Potential Pollutants Generated by Land Use Type

Type of Development (Land Use)	Sediment/ Turbidity	Nutrients	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Bacteria & Viruses	Oil & Grease	Pesticides	Metals
Detached Residential Development	E	E	N	E	E	E	E	E	N
Attached Residential Development	E	E	N	E	P(1)	P	P(2)	E	N
Commercial/ Industrial	P (1)	P (1)	P(3)	E	P (1)	P(2)	E	P (1)	P
Automotive Repair Shops	N	N	E(4,5)	E	N	N	E	N	P
Restaurants	N	N	N	E	E	E	E	N	N
Hillside Development	E	E	N	E	E	E	E	E	N
Parking Lots	P(1)	P(1)	E(4)	E	P(1)	P(5)	E	P(1)	E
Streets, Highways, & Freeways	E	P(1)	E(4)	E	P(1)	P(6)	E	P(1)	E

Abbreviations: E= Expected P=Potential N=Not expected

Source: Riverside County Flood Control and Conservation District, Riverside County Water Quality Management Plan for Urban Runoff (September 17, 2004).

Notes:
(1) A potential pollutant if landscaping or open area exists on the Project site
(2) A potential pollutant if land use involves animal waste
(3) Specifically, petroleum hydrocarbons
(4) Specifically, solvents
(5) Bacterial indicators are routinely detected in pavement runoff.

A comparison of the pollutants existing in Amarillo Beach based on the State 303(d) list and pollutants associated with the planned land use activities of the site shows an overlap of pesticide as a pollutant. This common pollutant is considered the

2 Source: Riverside County Flood Control and Conservation District, Riverside County Water Quality Management Plan for Urban Runoff (September 17, 2004).

pollutant of concern. Stormwater best management practices (BMPs) proposed for the project will be designed to address this pollutant of concern.

Bioretention areas are proposed to be installed on-site to capture runoff from building roofs and hardscape. Table 3 summarizes the efficiency of general categories of BMPs in treating different types of pollutants. As shown below, bioretention areas (which fall under the "Sand Filter or Filtration" category) have an unknown efficiency in treating pesticides; however, this BMP in general has medium to high efficiency in treating a variety of pollutants and thus is considered a suitable treatment method for the development.

Table 3: Treatment Control BMP Selection Matrix

Pollutant of Concern		Treatment Control BMP Categories							
		Veg. Swale /Veg. Filter Strips	Detention Basins	Infiltration Basins & Trenches/ Porous Pavement	Wet Ponds or Wetlands	Sand Filter or Filtration	Water Quality Inlets	Hydro-dynamic Separator Systems	Manufactured/ Proprietary Devices
Sediment/Turbidity		H/M	M	H/M	H/M	H/M	L	H/M (L for turbidity)	U
Yes/No?	Yes					✓			
Nutrients		L	M	H/M	H/M	L/M	L	L	U
Yes/No?	Yes					✓			
Organic Compounds		U	U	U	U	H/M	L	L	U
Yes/No?	No					✓			
Trash & Debris		L	M	U	U	H/M	M	H/M	U
Yes/No?	Yes					✓			
Oxygen Demanding Substances		L	M	H/M	H/M	H/M	L	L	U
Yes/No?	Yes					✓			
Bacteria & Viruses		U	U	H/M	U	H/M	L	L	U
Yes/No?	Yes					✓			
Oil & Grease		H/M	M	U	U	H/M	M	L/M	U
Yes/No?	Yes					✓			
Pesticides (non-soil bound)		U	U	U	U	U	L	L	U
Yes/No?	Yes					✓			
Metals		H/M	M	H	H	H	L	L	U
Yes/No?	No					✓			

Abbreviations:
L: Low removal efficiency H/M: High or medium removal efficiency U: Unknown removal efficiency

4.0 Hydrology

4.1 General Approach

The watershed of the project was identified and characterized for both existing and proposed conditions. Computer modeling was used to estimate the runoff flowrate for the 2-year, 10-year, and 100-year storm events. For a detailed analysis of the project hydrology, see the "Hydrology Study: Rancho Malibu Resort" prepared by Psomas.

4.2 Data Sources

The primary sources of data were the *LACDPW Hydrology / Sedimentation Manual and Appendices* (LACDPW 1991, 1992, 1993, 2002) and the LA County *Standard Urban Stormwater Mitigation Plan* (March 2000).

4.3 Watershed Characteristics

The Rancho Malibu project is located in Los Angeles County and in the Malibu Beach quadrant of Isohyetal Map figure LACDPW 1-H1.15, found in *Appendix 1*. The 50-year 24-hour rainfall Isohyet nearest the project area is 7.0. The project site is tributary to the LACDPW Winter Drain, which discharges to the Pacific Ocean through Amarillo Beach.

The *LACDPW TC (TC_calc_depth.xls, July 2004)* program was used to calculate the time of concentration and peak runoff flow rate for existing and proposed conditions. In accordance with LACDPW requirements, the 100-year storm event was used as the main design storm in this analysis.

4.4 Existing Condition Results

The existing condition hydrologic analysis was based on the Existing Condition Site Plan prepared by Psomas, included in *Appendix 4*. The proportion of impervious site area for the project's entire tributary area was determined to be 28%. Existing condition hydrology results for the 100-year storm event are summarized in Table 4 below.

Table 4: Existing Condition Hydrology Summary

Area	Sub area	Area (ac)	100 - Year Storm Event	
			Time of Conc. (min)	Total Q_{100} (cfs)
A	1A	4.06	6	15.71
	2A	1.56	6	6.04
	A Total	**5.62**	**--**	**21.75**
B	1B	15.24	9	48.69
	B Total	**15.24**	**--**	**48.69**
C	1C	3.15	5	13.27
	C Total	**3.15**	**--**	**13.27**
D	1D	0.65	5	2.74
	2D	5.41	6	20.94
	3D	1.28	5	5.39
	D Total	**7.34**	**--**	**29.07**
E	1E	1.39	6	5.38
	E Total	**1.39**	**--**	**5.38**
	Total	**32.74**		**118.16**

4.5 Proposed Condition Results

The proposed condition hydrologic analysis was based on the proposed (developed) Condition WQMP Site Plan prepared by Psomas, included in *Appendix 4*.

The proportion of the impervious site area, based on proposed site conditions, was determined to be 70%. *Appendix 4* also includes an impervious area exhibit that shows the various types of impervious land uses onsite.

Proposed condition hydrology results for the 100-year event are summarized in Table 5 below.

Table 5: Proposed Condition Hydrology Summary

Area	Sub area	Area (ac)	100 - Year Storm Event	
			Time of Conc. (min)	Total Q_{100} (cfs)
A	1A	6.31	8	21.35
	A Total	**6.31**	**--**	**21.35**
B	1B	10.21	8	34.55
	2B	4.03	9	12.88
	3B	0.81	5	3.41
	4B	1.6	5	6.74
	B Total	**16.65**	**--**	**57.58**
C	1C	2.02	5	8.51
	C Total	**2.02**	**--**	**8.51**
D	1D	6.42	8	21.73
	D Total	**6.42**	**--**	**21.73**
E	1E	1.34	6	5.19
	E Total	**1.34**	**--**	**5.19**
	Total	**32.74**		**114.36**

4.6 Baseline Hydrology Comparison

A comparison of existing and proposed peak flow rates is provided in Table 6 below.

Table 6: Existing vs. Proposed Condition Hydrology Comparison Summary

100-Year Storm Event						
Drainage Area	**Area Exist. (ac)**	**Area Prop. (ac)**	**Q_{100} Exist. (cfs)**	**Q_{100} Prop. (cfs)**	**Q_{100} Detained (cfs)**	**Required Detention (ac-ft)**
A	5.62	5.62	21.75	21.35	0	0
B	15.24	15.24	48.69	57.58	15	0.125
C	3.15	3.15	13.27	8.51	0	0
D	7.34	7.34	29.07	21.73	0	0
E	1.39	1.39	5.38	5.19	0	0
Total	**32.7**	**32.7**	**-**	**-**	**15.0**	**0.125**

Although the peak flow rate increases from the existing condition to the proposed condition because of an increase in imperviousness, the detention facility located under the parking garage. will detain the increase in flow.

5.0 Best Management Practices

Source and Treatment Control Best Management Practices (BMPs) are required for this project.

5.1 Site Design BMPs

5.1.1 Minimize Stormwater Pollutants of Concern

The project site will minimize pollutants of concern by maximizing the reduction of pollutant loadings to the Maximum Extent Practicable. Pollutants of concern are addressed through a bioretention area located at the southwest corner of the site, as shown on the Rancho Malibu Resort SUSMP Exhibit in *Appendix 4.*

5.1.2 Conserve Natural Areas

The total impervious area for the project site is 14.7 acres (59%) and the total pervious area is 10.1 acres (41%). A significant portion of the project site will remain pervious since natural open space areas will be conserved around the perimeter of the site.

5.2 Source Control BMPs

5.2.1 Protect Slopes and Channels

The existing project site consists of undeveloped, vacant open space and hillside areas. Natural slopes will be protected by gutters, drainage swales, and detention basins. Along the northerly and easterly limits of grading, gutters located next to the streets adjacent to natural slopes will convey runoff into on-site storm drains. The proposed storm drain system safely conveys runoff from the tops of slopes. Disturbed slopes will be stabilized using retaining walls and manufacturing. Natural drainage patterns will be preserved at the southwest and southeast corners of the site. Flows in these directions will be mitigated using bioretention areas, then released gradually onto Malibu Canyon Road through curb.

5.2.2 Provide Storm Drain System Stenciling and Signage

As a Source Control BMP, Stenciling and Signage will be required for areas with catch basins. Sample stencils are also included in *Appendix 5*. All catch basins draining to the storm drain system will be stenciled with "No Dumping, Drains to Ocean" or equivalent wording approved by the City of Malibu. The owner or the owner's representative will be responsible for maintaining the legibility of "No Dumping, Drains to Ocean" stenciling and the inspection of which will be done annually.

5.2.4. Properly Design Trash Storage Areas

Trash enclosures will be covered and walled. Drainage from adjoining roofs and pavement will not enter the trash storage area. All trash container areas within the project will be covered and located at appropriate locations. The trash bin areas will not contain drains that connect directly to the storm drain system. The trash bins will be leak proof and have attached covers or lids.

5.3 Treatment Control BMPs

5.3.1 Mitigation Design (Volumetric or Flow based)

Volume-based or flow-based design standards may be used separately or in combination. Volume-based criteria are used in the sizing of detention or infiltration structures while flow-based criteria are used on swales, catch basin devices or wetlands. The County of Los Angeles' Standard Urban Stormwater Mitigation Plan (SUSMP) requirements, approved by the Regional Water Quality Control Board, call for the treatment of the peak mitigation flow rate or volume of runoff produced by a 0.75" 24-hr rainfall event.

The SUSMP calculation methodology was used to calculate the required treatment flows and volumes for each of the discharge points from the site. The runoff coefficient curve for Soil Type 029 and the LACDPW intensity-duration data and calculations are included in *Appendix 4*. The results are summarized in the table below. The percent imperviousness was calculated to be 33%, which can be seen on the WQMP exhibit in *Appendix 4*.

Table 7: Peak Mitigation Flow and Volume Comparison Summary

Drainage Area	Total Area (Ac)	% Impervious	Q_{pm} (cfs)	V_{pm} (cu ft)	V_{pm} (Ac-ft)
1A	4.62	90%	0.75	10,381	0.24
1B	1.60	90%	0.23	3,620	0.08
1C	10.12	90%	1.63	22,734	0.52
Total	16.34	90%	---	36,735	0.84

The WQMP Site Plan is included in *Appendix 4* and shows the sub-areas and proposed BMPs. As shown in the WQMP Site Plan in *Appendix 4*, a bioretention area is proposed to treat the first ¾" of stormwater runoff from the project site. The remainder of the project area is retained as natural area with a high level of perviousness.

5.3.2 Bioretention Basin

The geotechnical engineer has determined that the interbedded silt, clay, and sand soil may not percolate and infiltrate very well, a bio-retention system is the best BMP for water treatment.

Storm water will be routed by storm drain pipe to the detention facility located under the parking garage. The detention facility will allow for the removal of trash and sediment. The detention facility will be equipped with sump pumps and a backup energy supply to pump the storm water at a steady rate into a bio-retention basin located at the southwest corner of the site between the garage and Pacific Coast Highway. This basin will remove the expected pollutants and discharge treated storm water to the existing gutters on Malibu Canyon Road and Pacific Coast Highway.

The remainder of the project area is retained as natural or manufactured and vegetated slope with a high level of perviousness.

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. Bioretention areas are vegetated shallow depressions that provide storage, filtration and evapotranspiration, and also provide for pollutant removal by filtering stormwater through the vegetation and soils. Pore spaces and organic material in the soils help to retain water in the form of soil moisture and to promote the adsorption of pollutants (i.e. dissolved metals and petroleum hydrocarbons) into the soil matrix. Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease.

Plants and plant grades shall conform to the standards of the current edition of American Standard for Nursery Stock as approved by the American Standards Institute, Inc. All plant material shall have normal, well developed branches and a vigorous root system. They shall be healthy plants free from physical defects, plant diseases, and insect pests. Shade and flowering trees

shall be symmetrically balanced. Major branches shall not have V shaped crotches capable of causing structural weakness. Trunks shall be free of unhealed branch removal wounds greater than a 1 in. diameter. Shade trees shall have a single main trunk. Trunks shall be free of branches below the following heights:

- 1-1/2 to 2-1/2 inches = 5 ft
- 3 inches = 6 ft

Plant materials shall be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 hours.

It is recommended that a minimum of three tree, three shrubs, and three herbaceous groundcover species be incorporated to protect against facility failure due to disease and insert infestations of a single species. Plant rooting depths shall not damage underdrain if present. Slotted or perforated underdrain pipes should be more than 5 feet from tree locations (if space allows). Native plant species and/or hardy cultivars that are not invasive and do not require chemical inputs shall be used to the maximum extent practicable.

Filtration occurs as runoff passes through the bioretention soil. Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Plants utilize soil moisture and promote the drying of the soil through transpiration. Underdrains may be used where space is limited, as they allow for a smaller bioretention area footprint, or where low infiltration soils are present.

Detailed bioretention sizing is provided in *Appendix 3*. A summary of the calculations is shown below in Table 8.

Table 8: Bioretention Sizing Calculations

Drainage Area	Area (sq ft)	C Factor (% imp)	Filtration Rate (in/hr)	Treatment Surface Area Required (sq ft)	Treatment Surface Area Shown On Plan (sq ft)
1A, 1B,1C	16.34	90%	5.0	4,107	4,192

BMP design details are shown on the WQMP Site Plan in *Appendix 4*. Operation and Maintenance guidelines and sample storm drain stencils are provided in *Appendix 6*.

6.0 Master Covenant and Agreement (C&A)

6.1 Proof of Ongoing BMP Maintenance

The Operations and Maintenance of the Treatment Control BMPs will be the responsibility of the owner. The current contact information for the responsible party is:

Contact: Mr. J.J. O'Brien, Green Acres, LLC

Address: P.O. Box 6528
Malibu, CA 90264

Phone: Phone: (310) 457-8962

It will be the responsibility of the property owner to provide maintenance, inspection and repair of the Treatment Control BMPs.

The developer accepts responsibility for all structural and treatment control BMP maintenance until the time the property is transferred. The transfer of property to a private or public entity (owner) will requires the recipient to assume responsibility for maintenance of any Structural or Treatment Control BMP to be included in the sales or lease agreement for that property, and will be the owner's responsibility. The condition of transfer shall include a provision that the property owners conduct maintenance inspection of all Structural or Treatment Control BMPs at least once a year and retain proof of inspection. For residential properties where Structural or Treatment Control BMPs are located within a common area which will be maintained by a home owner's association, language regarding the responsibility for maintenance will be included in the projects conditions, covenants, and restrictions (CC&Rs). Printed educational materials are required to accompany the first deed transfer to highlight the existence of the requirement and to provide information on what storm water management facilities are present, signs that maintenance is needed, how the necessary maintenance can be performed, and assistance that the Permittee can provide. The transfer of this information is also required with any subsequent sale of the property.

If Structural or Treatment Control BMPs are located within a public area proposed for transfer, they will be the responsibility of the developer until they are accepted for transfer by the County or other appropriate public agency. Structural or Treatment Control BMPs proposed for transfer must meet design standards adopted by the public entity for the BMP installed and should be approved by the County or other appropriate public agency. Structural or Treatment Control BMPs proposed for transfer must meet design standards adopted by the public entity for the BMP installed and should be approved by the County or other appropriate public agency prior to its installation.

7.0 Limitations

This report was prepared to comply with the guidelines established by the County of Los Angeles and their representatives. Evaluation of the appropriateness of these guidelines and the accuracy of the County data were beyond the scope of this work.

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

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

8.0 References

Los Angeles County Department of Public Works, *LACDPW Hydrology/ Sedimentation Manual and Appendices* (1991, 1992, 1993, 2002)

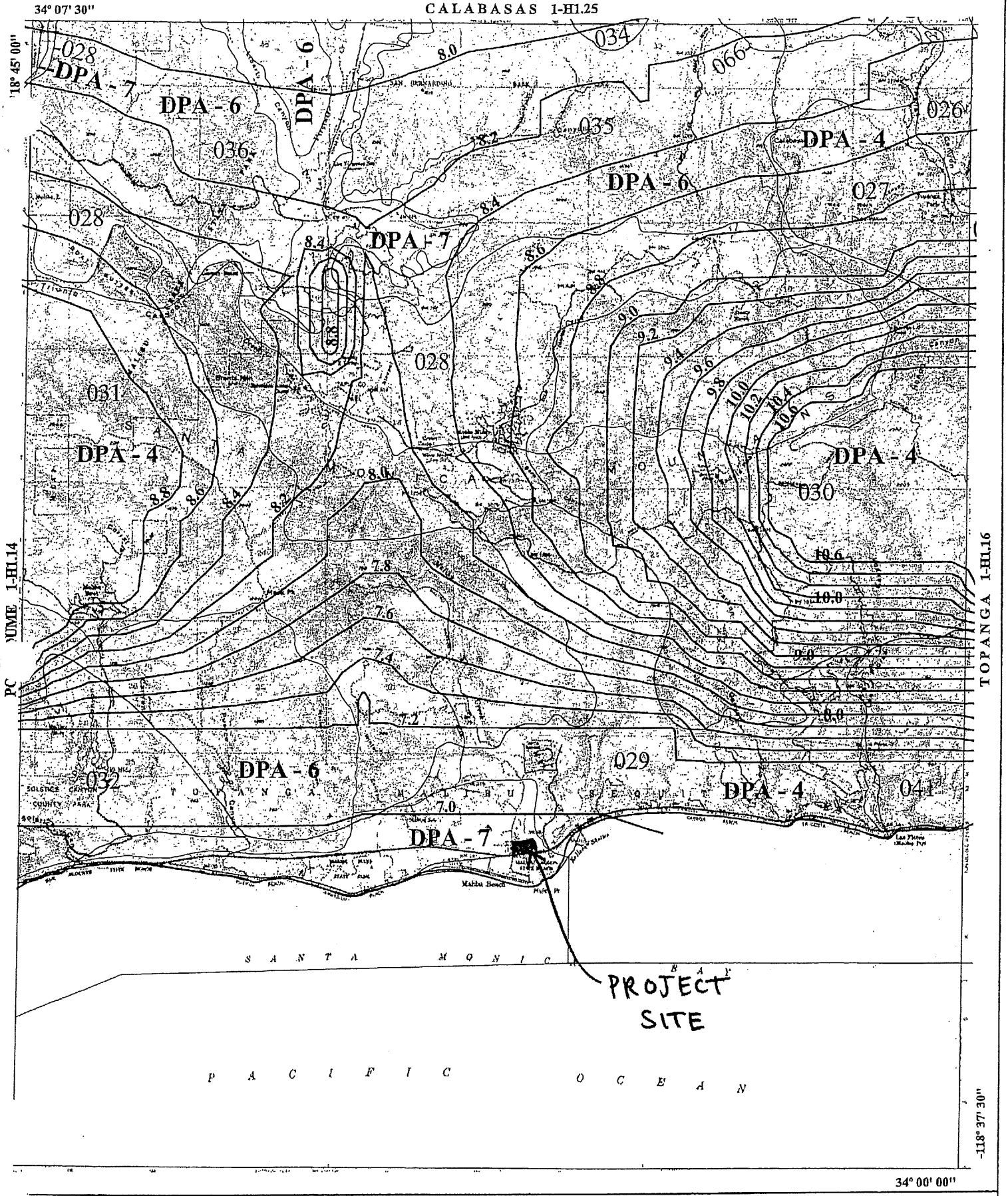
Los Angeles County Department of Public Works, *LACDPW TC v1.0 Manual, TC_calc_depth.xls* (December 1991, June 2002, July 13, 2004)

Los Angeles Regional Water Quality Control Board, *Standard Urban Stormwater Mitigation Plan for Los Angeles County and Cities in Los Angeles County* (March 2000)

9.0 Appendices

Appendix 1 LACDPW Hydrology Data

Isohyet and Hydrologic Soil Classification Map



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W E
S

016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

1 0 1 2 Miles

25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

MALIBU BEACH
50-YEAR 24-HOUR ISOHYET

1-H1.15

LOS ANGELES COUNTY PUBLIC WORKS
Public Service That Works

$C_D = (0.9 * IMP) + (1.0 - IMP) * Cu$

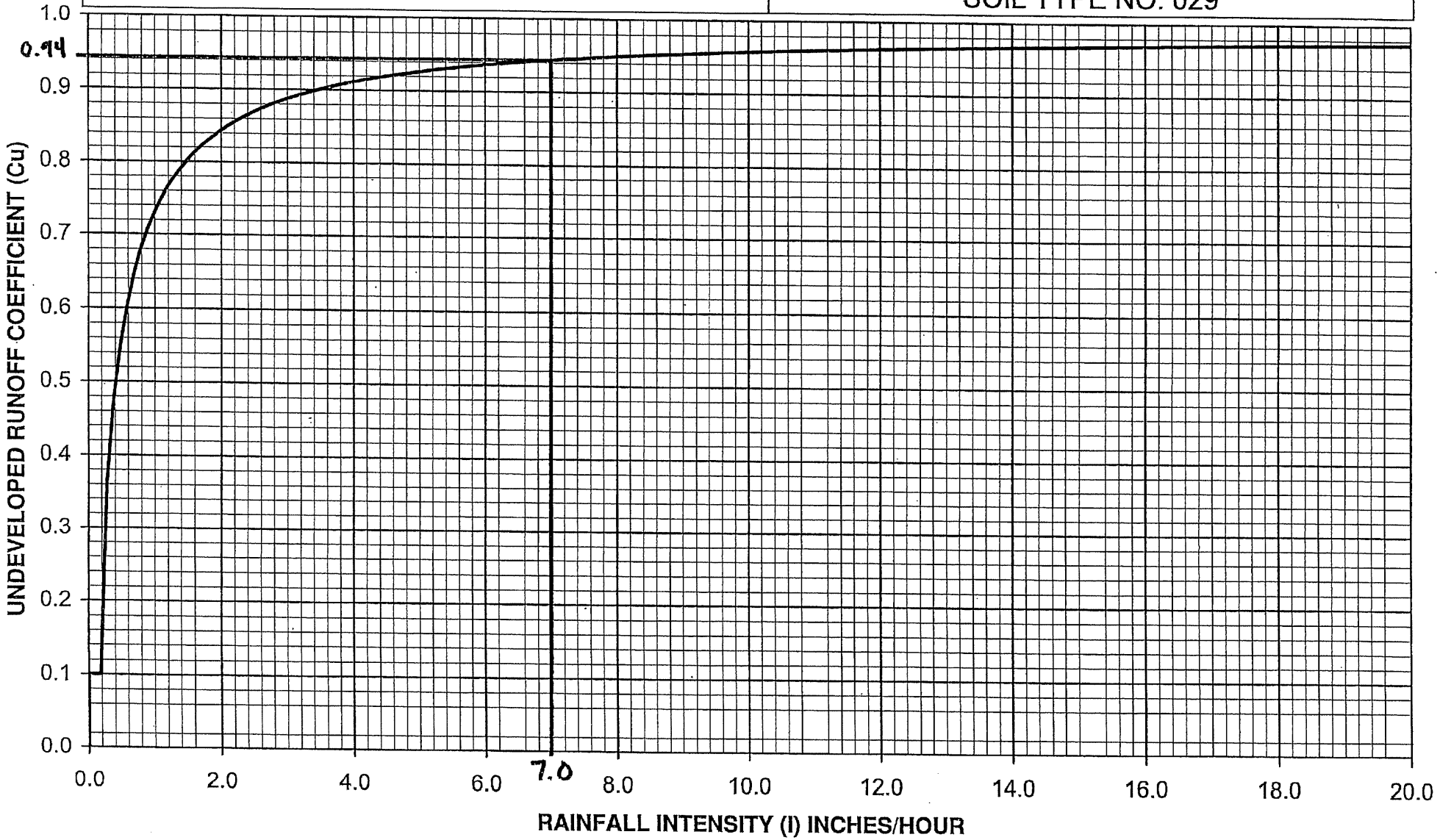
Where: C_D = Developed Runoff Coefficient

IMP = Proportion Impervious

C_U = Undeveloped runoff coefficient

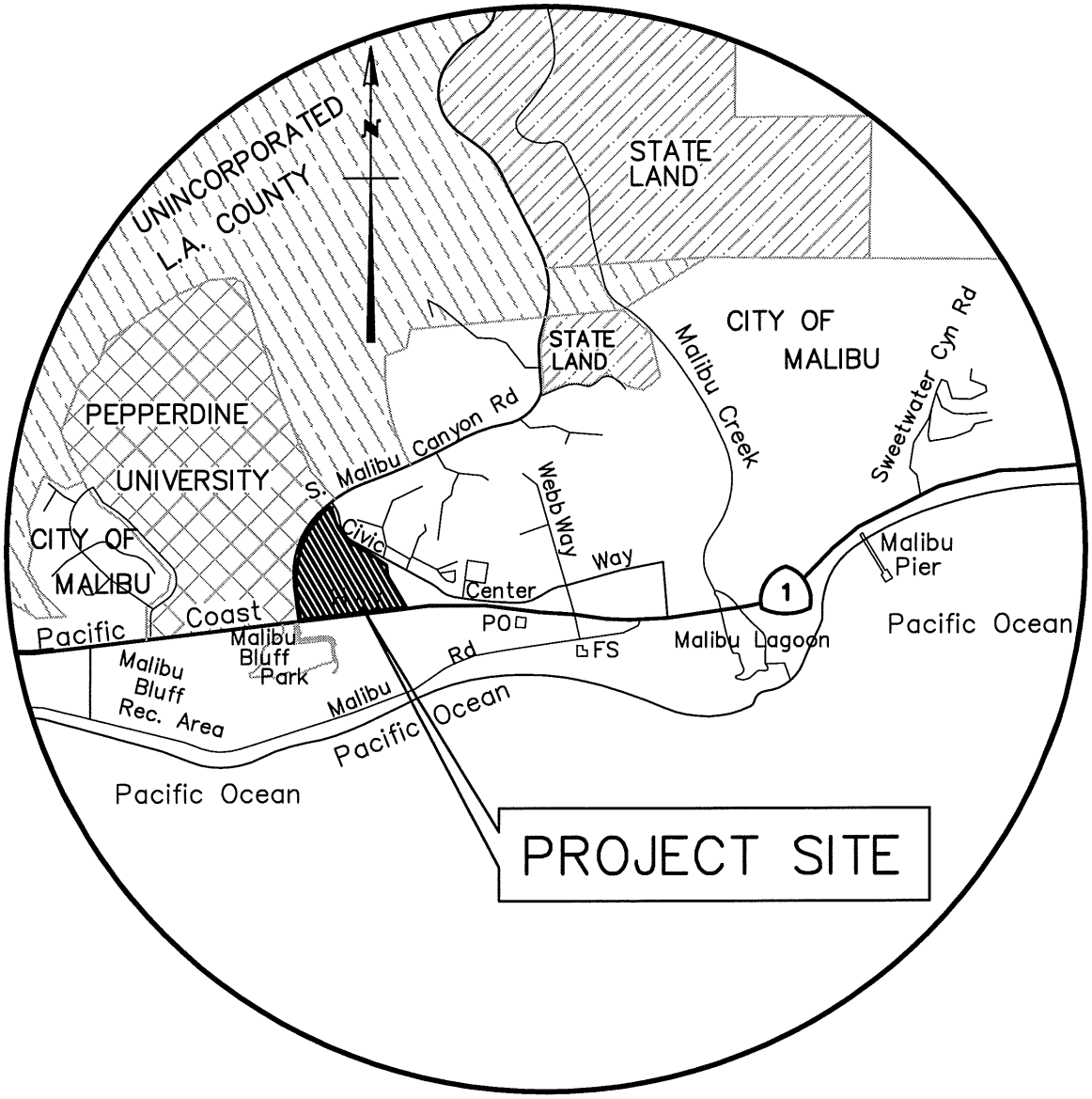
Los Angeles County Department of Public Works

RUNOFF COEFFICIENT CURVE
SOIL TYPE NO. 029



Appendix 2 WQMP Project Site

Location and Vicinity Map



VICINITY MAP

NOT TO SCALE

PSOMAS

Appendix 3 SUSMP Calculations

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

A.1 METHOD FOR CALCULATING STANDARD URBAN STORMWATER MITIGATION PLAN FLOW RATES AND VOLUMES BASED ON 0.75-INCHES OF RAINFALL: WORKSHEET

PROJECT NAME

RANCHO MALIBU (AREA 1A)

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

NOMENCLATURE

A_I = Impervious Area (acres)
A_P = Pervious Area (acres)
A_U = Contributing Undeveloped Upstream Area (acres)
A_{Total} = Total Area of Development and Contributing Undeveloped Upstream Area (acres)
C_D = Developed Runoff Coefficient
C_U = Undeveloped Runoff Coefficient
I_X = Rainfall Intensity (inches / hour)
Q_{PM} = Peak Mitigation Flow Rate (cfs)
T_C = Time of Concentration (minutes, must be between 5-30 min.)
V_M = Mitigation Volume (ft^3)

EQUATIONS

$A_{Total} = A_I + A_P + A_U$
$A_I = (A_{Total} * \%$ of Development which is Impervious)
$A_P = (A_{Total} * \%$ of Development which is Pervious)
$A_U = (A_{Total} * \%$ of Contributing Undeveloped Upstream Area***)

$C_D = (0.9 * Imp.) + [(1.0 - Imp.) * C_U]$ If $C_D < C_U$, use $C_D = C_U$

$Q_{PM} = C_D * I_X * A_{Total} * (1$ hour / 3,600 seconds) * (1 ft / 12 inches) * (43,560 ft^2 / 1 acre)
$= C_D * I_X * A_{Total} * (1.008333\ ft^3$-hour / acre-inches-seconds)

$T_C = 10^{-0.507} * (C_D * I_X)^{-0.519} * Length^{0.483} * Slope^{-0.135}$

$V_M = (0.75$ inches) * [(A_I)(0.9) + ($A_P + A_U$)(C_U)] * (1 ft / 12 inches) * (43,560 ft^2 / 1 acre)
$= (2{,}722.5\ ft^3$ / acre) * [(A_I)(0.9) + ($A_P + A_U$)(C_U)]

***** Contributing Undeveloped Upstream Area is an area where stormwater runoff from an undeveloped upstream area will flow directly or indirectly to the Post-Construction Best Management Practices (BMPs) proposed for the development. This additional flow must be included in the flow rate and volume calculations to appropriately size the BMPs.**

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

PROVIDE PROPOSED PROJECT CHARACTERISTICS

A_{Total}	4.62	Acres
Type of Development	Commercial	
Predominate Soil Type #	29	
% of Project Impervious	90%	
% of Project Pervious	10%	
% of Project Contributing Undeveloped Area	0%	
A_I	4.16	Acres
A_P	0.46	Acres
A_U	0.00	Acres

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

DETERMINING THE PEAK MITIGATED FLOW RATE (Q_{PM}):

In order to determine the peak mitigated flow rate (Q_{PM}) from the new development, use the Los Angeles County Department of Public Works *Hydrology Manual*. Use the Modified Rational Method for calculating the peak mitigation Q_{PM} for compliance with the Standard Urban Stormwater Mitigation Plan (SUSMP). Use attached **Table 1** for all maximum intensity (I_X) values used.

By trial and error, determine the time of concentration (T_C), as shown below:

CALCULATION STEPS:

1. Assume an initial T_C value between 5 and 30 minutes.

T_C 15 minutes

2. Using Table 1, look up the assumed T_C value and select the corresponding I_X intensity in inches/hour.

I_X 0.267 inches/hour

3. Determine the value for the Undeveloped Runoff Coefficient, C_U, using the runoff coefficient curve corresponding to the predominant soil type.

C_U 0.15

4. Calculate the Developed Runoff Coefficient, $C_D = (0.9 * \text{Imp.}) + [(1.0 - \text{Imp.}) * C_U]$

C_D 0.83 Imp = 90%

5. Calculate the value for $C_D * I_X$

$C_D * I_X$ 0.22

6. Calculate the time of concentration, $T_C = 10^{-0.507} * (C_D * I_X)^{-0.519} * \text{Length}^{0.483} * \text{Slope}^{-0.135}$

Calculated T_C 29 minutes L= 911' S= 0.034'

7. Calculate the difference between the initially assumed T_C and the calculated T_C, if the difference is greater than 0.5 minutes. Use the calculated T_C as the assumed initial T_C in the second iteration. If the T_C value is within 0.5 minutes, round the acceptable T_C value to the nearest minute.

TABLE FOR ITERATIONS:

Iteration No.	Initial T_C (min)	I_X (in/hr)	C_U	C_D	$C_D * I_X$ (in/hr)	Calculated T_C (min)	Difference (min)
1	15	0.267	0.15	0.83	0.22	29	14
2	30	0.193	0.15	0.83	0.16	34	4
3							
4							
5							
6							
7							
8							
9							
10							

Acceptable T_C value 30 minutes

8. Calculate the Peak Mitigation Flow Rate,
   $Q_{PM} = C_D * I_X * A_{Total} * (1.008333\ ft^3\text{-hour / acre-inches-seconds})$

Q_{PM} 0.75 cfs

$C_D = 0.83$
$I_X = 0.193$
$A_t = 4.62$

TABLE 1

INTENSITY - DURATION DATA FOR 0.75-INCHES OF RAINFALL
FOR ALL RAINFALL ZONES

Duration, T_C (min)	Rainfall Intensity, I_X (in/hr)
5	0.447
6	0.411
7	0.382
8	0.359
9	0.339
10	0.323
11	0.309
12	0.297
13	0.286
14	0.276
15	0.267
16	0.259
17	0.252
18	0.245
19	0.239
20	0.233
21	0.228
22	0.223
23	0.218
24	0.214
25	0.210
26	0.206
27	0.203
28	0.199
29	0.196
30	0.193

DETERMINING THE VOLUME (V_M)

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

In order to determine the volume (V_M) of stormwater runoff to be mitigated from the new development, use the following equation:

$$V_M = (2{,}722.5\ ft^3 / acre) * [(A_I)(0.9) + (A_P + A_U)(C_U)]$$

$V_M = 10{,}381\ ft^3 = 0.24\ acre\text{-}ft$

$A_I = 4.16$ acres

$A_P = 0.46$ acres

$C_U = 0.15$

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

A.1 METHOD FOR CALCULATING STANDARD URBAN STORMWATER MITIGATION PLAN FLOW RATES AND VOLUMES BASED ON 0.75-INCHES OF RAINFALL: WORKSHEET

PROJECT NAME

RANCHO MALIBU (AREA 1B)

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

PROVIDE PROPOSED PROJECT CHARACTERISTICS

A_{Total}	1.60	Acres
Type of Development	Commercial	
Predominate Soil Type #	29	
% of Project Impervious	90%	
% of Project Pervious	10%	
% of Project Contributing Undeveloped Area	0%	
A_I	1.44	Acres
A_P	0.16	Acres
A_U	0.00	Acres

DETERMINING THE PEAK MITIGATED FLOW RATE (Q_{PM}):

In order to determine the peak mitigated flow rate (Q_{PM}) from the new development, use the Los Angeles County Department of Public Works *Hydrology Manual*. Use the Modified Rational Method for calculating the peak mitigation Q_{PM} for compliance with the Standard Urban Stormwater Mitigation Plan (SUSMP). Use attached **Table 1** for all maximum intensity (I_X) values used.

By trial and error, determine the time of concentration (T_C), as shown below:

CALCULATION STEPS:

1. Assume an initial T_C value between 5 and 30 minutes.

T_C 15 minutes

2. Using Table 1, look up the assumed T_C value and select the corresponding I_X intensity in inches/hour.

I_X 0.267 inches/hour

3. Determine the value for the Undeveloped Runoff Coefficient, C_U, using the runoff coefficient curve corresponding to the predominant soil type.

C_U 0.21

4. Calculate the Developed Runoff Coefficient, $C_D = (0.9 * \text{Imp.}) + [(1.0 - \text{Imp.}) * C_U]$

Imp= 90%

C_D 0.83

5. Calculate the value for $C_D * I_X$

$C_D * I_X$ 0.22

6. Calculate the time of concentration, $T_C = 10^{-0.507} * (C_D * I_X)^{-0.519} * \text{Length}^{0.483} * \text{Slope}^{-0.135}$

L= 573'
S= 0.047

Calculated T_C 22 minutes

7. Calculate the difference between the initially assumed T_C and the calculated T_C, if the difference is greater than 0.5 minutes. Use the calculated T_C as the assumed initial T_C in the second iteration. If the T_C value is within 0.5 minutes, round the acceptable T_C value to the nearest minute.

TABLE FOR ITERATIONS:

Iteration No.	Initial T_C (min)	I_X (in/hr)	C_U	C_D	$C_D * I_X$ (in/hr)	Calculated T_C (min)	Difference (min)
1	15	0.267	0.21	0.83	0.22	22	7
2	22	0.223	0.21	0.83	0.19	24	2
3	24	0.214	0.21	0.83	0.18	25	1
4	25	0.210	0.21	0.83	0.17	25	0
5							
6							
7							
8							
9							
10							

Acceptable T_C value 25 minutes

8. Calculate the Peak Mitigation Flow Rate,
   $Q_{PM} = C_D * I_X * A_{Total} * (1.008333\ ft^3\text{-hour / acre-inches-seconds})$

Q_{PM} 0.23 cfs

$C_D = 0.83$
$I_x = 0.17$
$A_t = 1.60$ acres

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

In order to determine the volume (V_M) of stormwater runoff to be mitigated from the new development, use the following equation:

$$V_M = (2{,}722.5\ ft^3 / acre) * [(A_I)(0.9) + (A_P + A_U)(C_U)]$$

$V_m = 3{,}620\ ft^3 = 0.08\ ac\text{-}ft$

$A_I = 1.44\ ac$

$A_P = 0.16\ ac$

$C_U = 0.21$

APPENDIX A VOLUME & FLOW RATE CALCULATIONS

A.1 METHOD FOR CALCULATING STANDARD URBAN STORMWATER MITIGATION PLAN FLOW RATES AND VOLUMES BASED ON 0.75-INCHES OF RAINFALL: WORKSHEET

PROJECT NAME

RANCHO MALIBU (AREA 1C)

PROVIDE PROPOSED PROJECT CHARACTERISTICS

A_{Total}	10.12	Acres
Type of Development	Commercial	
Predominate Soil Type #	29	
% of Project Impervious	90%	
% of Project Pervious	10%	
% of Project Contributing Undeveloped Area	0%	
A_I	9.11	Acres
A_P	1.01	Acres
A_U	0.00	Acres

DETERMINING THE PEAK MITIGATED FLOW RATE (Q_{PM}):

In order to determine the peak mitigated flow rate (Q_{PM}) from the new development, use the Los Angeles County Department of Public Works *Hydrology Manual*. Use the Modified Rational Method for calculating the peak mitigation Q_{PM} for compliance with the Standard Urban Stormwater Mitigation Plan (SUSMP). Use attached **Table 1** for all maximum intensity (I_X) values used.

By trial and error, determine the time of concentration (T_C), as shown below:

CALCULATION STEPS:

1. Assume an initial T_C value between 5 and 30 minutes.

T_C 15 minutes

2. Using Table 1, look up the assumed T_C value and select the corresponding I_X intensity in inches/hour.

I_X 0.267 inches/hour

3. Determine the value for the Undeveloped Runoff Coefficient, C_U, using the runoff coefficient curve corresponding to the predominant soil type.

C_U 0.15

4. Calculate the Developed Runoff Coefficient, $C_D = (0.9 * \text{Imp.}) + [(1.0 - \text{Imp.}) * C_U]$

C_D 0.83 Imp = 90%

5. Calculate the value for $C_D * I_X$

$C_D * I_X$ 0.22

6. Calculate the time of concentration, $T_C = 10^{-0.507} * (C_D * I_X)^{-0.519} * \text{Length}^{0.483} * \text{Slope}^{-0.135}$

L = 1209'
S = 0.034

Calculated T_C 33 minutes

7. Calculate the difference between the initially assumed T_C and the calculated T_C, if the difference is greater than 0.5 minutes. Use the calculated T_C as the assumed initial T_C in the second iteration. If the T_C value is within 0.5 minutes, round the acceptable T_C value to the nearest minute.

TABLE FOR ITERATIONS:

Iteration No.	Initial T_C (min)	I_X (in/hr)	C_U	C_D	$C_D * I_X$ (in/hr)	Calculated T_C (min)	Difference (min)
1	15	0.267	0.15	0.83	0.22	33	18
2	30	0.193	0.15	0.83	0.16	39	9
3							
4							
5							
6							
7							
8							
9							
10							

Acceptable T_C value 30 minutes

8. Calculate the Peak Mitigation Flow Rate,
   $Q_{PM} = C_D * I_X * A_{Total} * (1.008333\ ft^3\text{-hour / acre-inches-seconds})$

Q_{PM} 1.63 cfs

$C_D = 0.83$

$I_x = 0.193$

$A_t = 10.12$ acres

In order to determine the volume (V_M) of stormwater runoff to be mitigated from the new development, use the following equation:

$$V_M = (2{,}722.5\ ft^3 / acre) * [(A_I)(0.9) + (A_P + A_U)(C_U)]$$

$V_M = 22{,}734\ ft^3 = 0.52$

$A_I = 9.11$ acres

$A_P = 1.01$ acres

$C_U = 0.15$

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Costa Mesa 714/751-7373 | Riverside 909/787-8421 | Roseville 916/788-8122 | Sacramento 916/929-7100 | Salt Lake City 801/270-5777 | San Diego 858/576-9200 | Santa Clarita 661/219-6000 | West Los Angeles 310/954-3700

Job No. 16RE220100 Sheet 1 of _____ Prepared by _____ Date _____

Project Name RANCHO MALIBU RESORT Reviewed by _____ Date _____

Title _____ FWA No. _____

1.) INFILTRATION RATE CALCULATION

ASSUMED PERC RATE OF POTTING SOIL: 5IN/HR

SURFACE AREA @ ELEV 208.4 : 5,820 SF (A BIOETENTION)

$$Q_{INFILTRATION} = \frac{5IN}{HR} \times \frac{1FT}{12IN} * \frac{1HR}{3,600S} \times 5,820SF = 0.67CFS$$

2.) TIME REQUIRE TO INFILTRATE THE DETENTION VOLUME

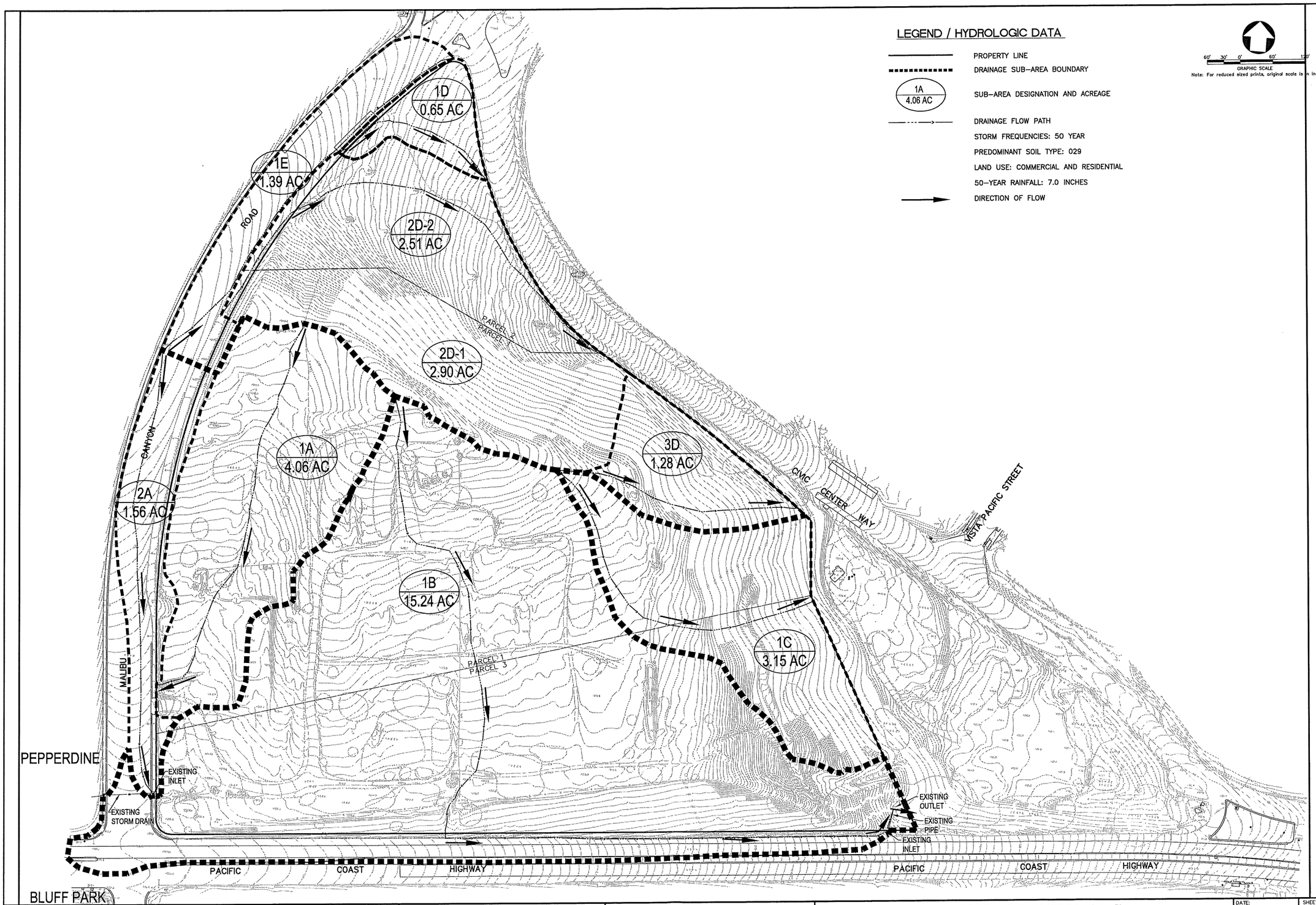
V = 70,000 CF

$$T = 70,000CF * \frac{1}{0.67CFS} * \frac{1HR}{3,6000} = 29.02HRS$$

T = 29.02 HRS < 36 HRS

Appendix 4 Site Plans

Existing Condition
Proposed Condition
WQMP Site Plan – See Binder Pocket



REGISTERED PROFESSIONAL ENGINEER
MARK A. NICKERSON
No. C056808
Exp. 06-30-13
CIVIL
STATE OF CALIFORNIA

SEAL

DESIGNED	IC
DRAFTED	IC
CHECKED	A.N.

REV	DATE	DESCRIPTION	BY	APP'D

BENCHMARK N/A

ELEV. N/A ADJUSTMENT

PSOMAS
555 South Flower Street, Suite 4400
Los Angeles, CA 90071
(213) 223-1400 (213) 223-1444 fax
www.psomas.com

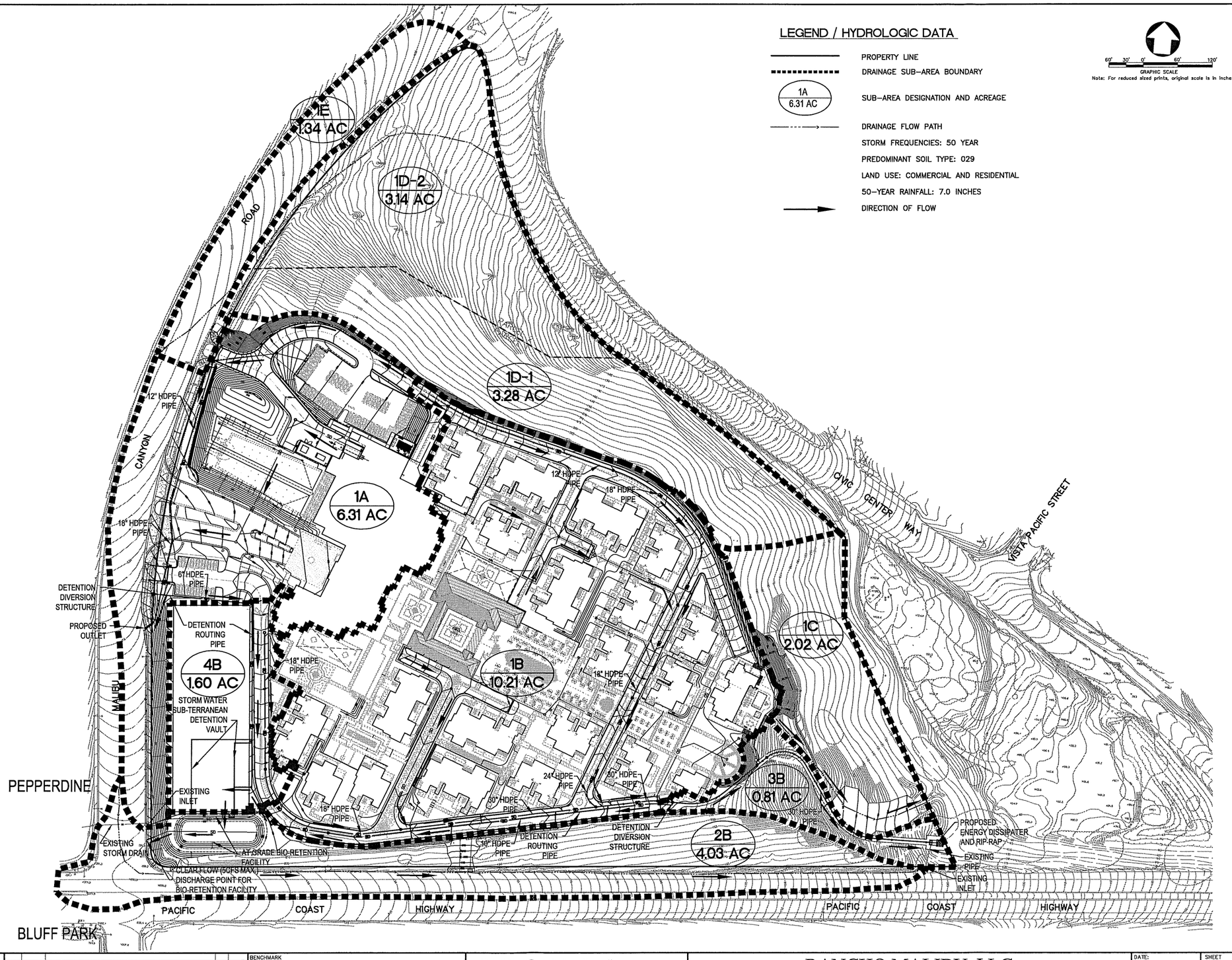
RANCHO MALIBU, LLC
EXISTING HYDROLOGY
EXHIBIT

DATE: 09-22-11
SCALE: 1" = 60'
PROJECT NUMBER: 1GRE220100
SHEET 1 OF 1

LEGEND / HYDROLOGIC DATA

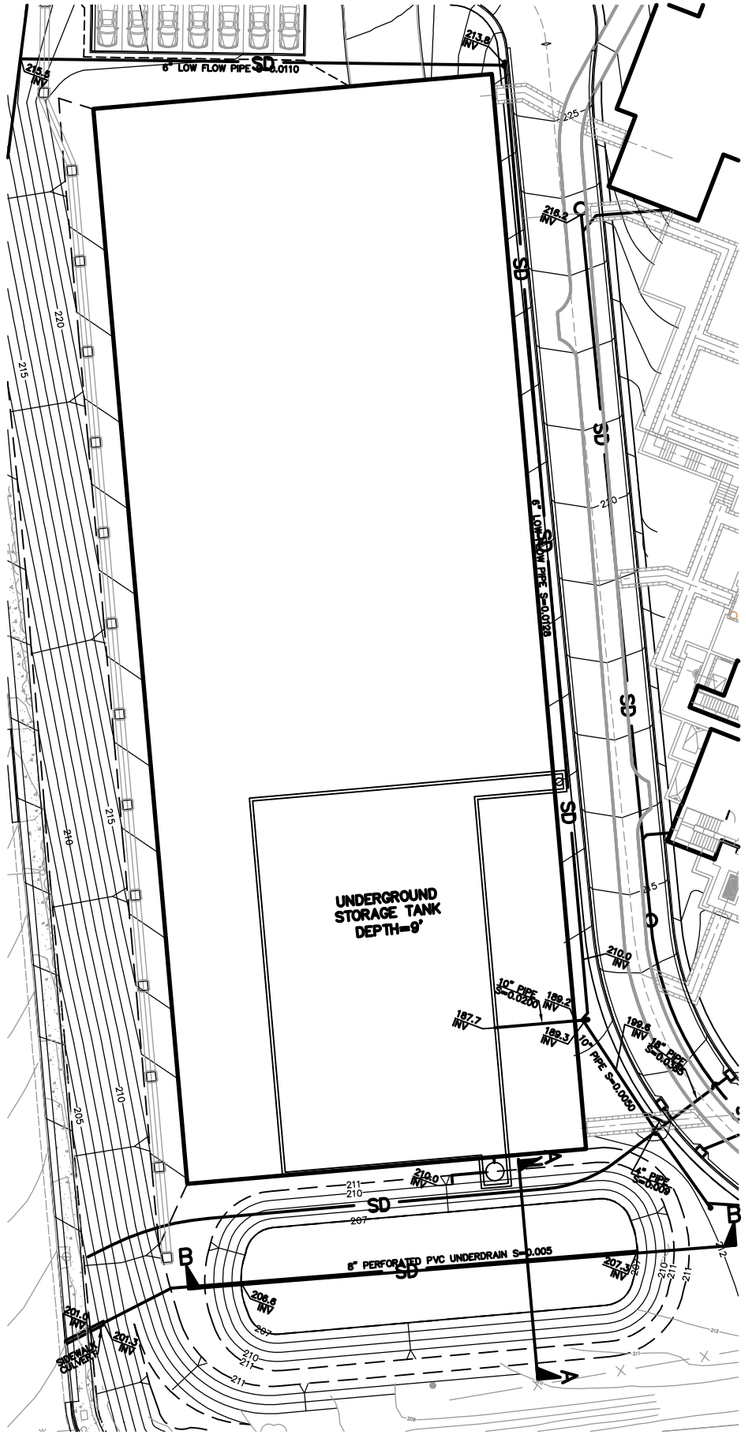
- PROPERTY LINE
- DRAINAGE SUB-AREA BOUNDARY
- 1A / 6.31 AC — SUB-AREA DESIGNATION AND ACREAGE
- DRAINAGE FLOW PATH
- STORM FREQUENCIES: 50 YEAR
- PREDOMINANT SOIL TYPE: 029
- LAND USE: COMMERCIAL AND RESIDENTIAL
- 50-YEAR RAINFALL: 7.0 INCHES
- DIRECTION OF FLOW

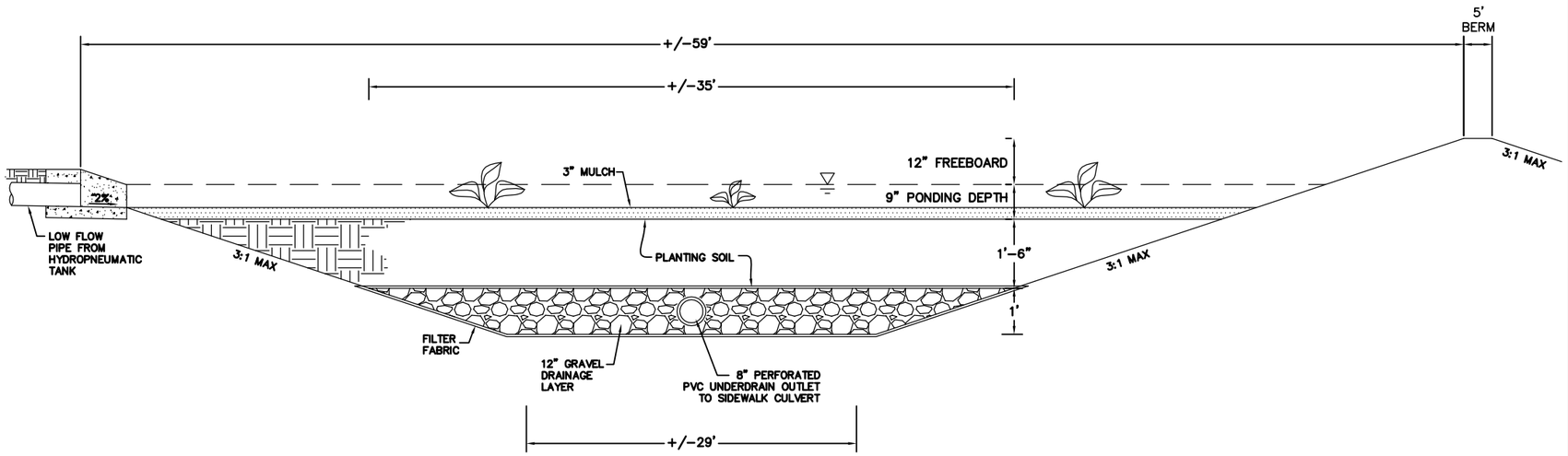
60' 30' 0' 60' 120'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches



REGISTERED PROFESSIONAL ENGINEER — STEVEN A. NORDEEN — No. C056808 — Exp. 06-30-13 — CIVIL — STATE OF CALIFORNIA — SEAL	DESIGNED: IC DRAFTED: IC CHECKED: A.N.	REV / DATE / DESCRIPTION / BY / APP'D	BENCHMARK: N/A ELEV. N/A ADJUSTMENT	PSOMAS 555 South Flower Street, Suite 4400 Los Angeles, CA 90071 (213) 223-1400 (213) 223-1444 fax www.psomas.com	RANCHO MALIBU, LLC PROPOSED HYDROLOGY EXHIBIT	DATE: 09-22-11 SCALE: 1" = 60' PROJECT NUMBER: 1GRE220100	SHEET 1 OF 1

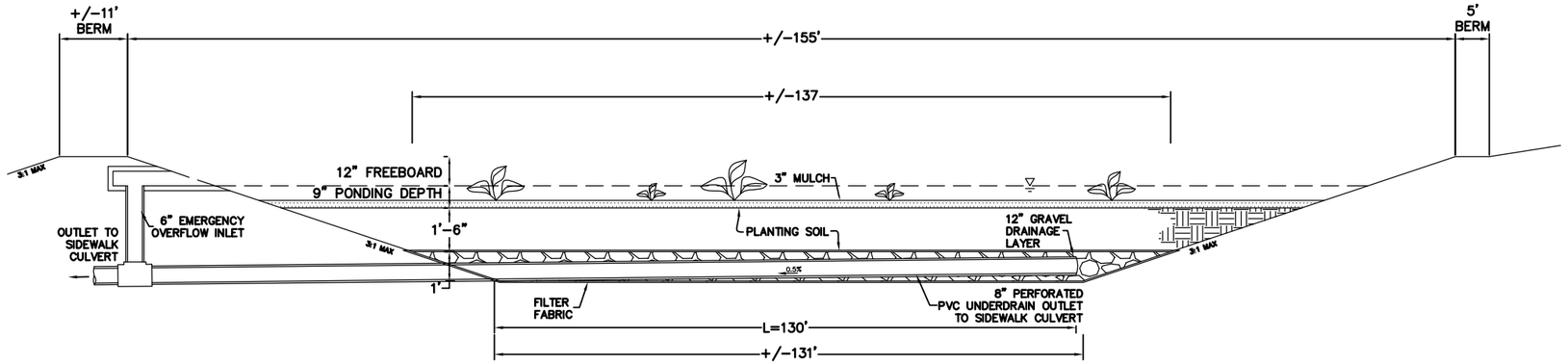
Plotted: 07/02/07 10:54:51 M:\1GRE\220100\GRAPHICS\EXHIBITS\HYDRO\HYDRO_HYDROLOGY.dwg





SECTION A-A (TYP)

NTS



SECTION B-B (TYP)

NTS

50.0' 25.0' 0' 50.0'

GRAPHIC SCALE

Note: For reduced sized prints, original scale is in inches

GREEN ACRES, LLC

WQMP EXHIBIT

PSOMAS

DATE: 09-22-11 REVISED ON:

JOB No:1GRE2201

Appendix 5 Covenant and Agreement (C & A)

Master C&A
Termination of C & A
Vesting Tentative Tract Map

Appendix 6 Supplemental Information

Operations and Maintenance Plan

Operation and Maintenance Plan for Treatment Control BMPs

Bioretention (Filtration)

Operation:

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. Bioretention are vegetated shallow depressions that provide storage, filtration, evapotranspiration, and pollutant removal by filtering stormwater through the vegetation and soils. Pore spaces and organic material in the soils help to retain water in the form of soil moisture and to promote the adsorption of pollutants (i.e. dissolved metals and petroleum hydrocarbons) into the soil matrix. Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the filtration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. The growing medium is underlain by a level of gravel and an underdrain connecting to an on-site storm drain system.

Plant materials shall be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for 48 hours. Native plant species and/or hardy cultivars that are not invasive and do not require chemical inputs shall be used to the maximum extent practicable.

Maintenance:

Inspect the filtration bioretention prior to forecast rain, daily during extended rain events, after rain events, weekly during rainy season, and at two-week intervals during the non-rainy season. Also examine structural walls for seepage and soundness. Check outlet structure for any damage or obstructions. Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one half the designated sediment storage volume. Sediment removed during maintenance shall be disposed of at appropriate locations. Remove standing water from basin within 72 hours after accumulation. BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities. To minimize vector production remove accumulation of live and dead floating vegetation in basins during every inspection, and

remove excessive emergent and perimeter vegetation as needed or as advised by local or state vector control agencies.

The primary maintenance requirement for bioretention areas includes inspection and repair or replacement of the treatment area's components. This will be accomplished through routine periodic maintenance, as required for any landscaped area. Appropriately selected soils will aide in reducing overall maintenance requirements. Over time, the biologic and physical processes will lengthen the bioretention life span and reduce the need for extensive maintenance.

Estimated Landscape Water Requirements
for
Compliance with Water Efficient Landscape Ordinance

Rancho Malibu Resort
Malibu, CA

Prepared By: Independent Irrigation Consultants, Inc.
512 Civic Center Drive
Oceanside, CA 92054
February 8, 2013

LANDSCAPE WATER REQUIREMENTS

Statement of Purpose

This statement with associated Hydrozone Plan as Appendix D and calculations is to provide illustration of method and explanation of compliance to ordinance 343, the Landscape Water Conservation Ordinance, of the City of Malibu which added Chapter 9.22 to Title 9 of the Malibu Municipal Code.

Project and Background

Prior to development of the complete landscape documentation package as described in Section 9.22.080 of the above mentioned chapter, the Rancho Malibu project was required to develop concepts and designs for a site specific Onsite Waste Water Treatment System (OWTS) for approval by the Regional Water Quality Control Board (RWQCB). Approval of the planned OWTS has been dependent on many issues, one of which is that production water from the OWTS be contained on-site and the production dispersed and consumed by the landscape via evapotranspiration.

In the development of a landscape system as a vehicle of OWTS production we explored variables by use of the same methods and techniques as are used in the water budget calculations defined by The City of Malibu Municipal Code. However, there are slight differences between our method and that of the municipal code for the simple reason that the landscape requirements of this proposed project are twofold. The landscape of Rancho Malibu Resort must be a beautiful environment as expected for this type of development while being a definite part of the OWTS.

The challenge of this project has been to balance the OWTS production with the landscape water requirement during seasonal changes of water supply and consumption, and the sizing of a reservoir as a buffer to relieve the differences. That work, submitted to the RWQCB as part of a greater body of work for the design of the OWTS and reservoir was titled “Landscape Water Requirement Report and Plan”.

Exemptions

For the calculations and conclusions included in that report the Landscape Coefficient Method (LCM) of estimating landscape water requirement was employed. This, being one of the requested exceptions from the municipal code, the LCM method recognized by the California Department of Water Resources, allows a more detailed analysis of landscape water consumption by including important factors beyond the simple Species Factor (Plant Factor in the Malibu Municipal Code). For this submittal that same work, has been expanded and reformatted to be substantially equal to the method described in the municipal code with the resulting values for MAWA (Maximum Applied Water Allowance) and ETWU (Estimated Total Water Use)

Further, this statement requests a slight exception in the determination of MAWA. The municipal code allows the increase of MAWA by defining any landscape area irrigated by non-potable water as a ‘Special Landscape Area’ (SLA). This allowance effectively increases the ET Adjustment Factor (ETAF) from 0.7 to 1.0. This project is using non-potable water from the OWTS and the irrigated area can certainly be defined as an SLA. However, due to other requirements, the entire OWTS production must be used. For this reason, the included calculations add the planned OWTS annual production to the MAWA.

Compliance

The result of balancing the selection of a consumptive landscape pallet and irrigation methods for a specific purpose beyond aesthetics is shown in the included ‘Landscape Water Consumption Calculations’ with ETWU equal to 90.47% of MAWA thereby also complying with the Landscape Water Conservation Ordinance.

Landscape Water Consumption Calculations for:
Rancho Malibu Resort

MAWA= Maximum Applied Water Allowance

BASIC MAWA=	Eto	x	ETAF	x	LA (sq.ft.)	x	Const.	=	MAWA	GPY
S.LA MAWA=	Eto	x	S.ETAF	x	LA (sq.ft.)	x	Const.	=	S.LA MAWA	GPY

Project MAWA Calculations with OWTS production Added

BASIC MAWA=	44.2	x	0.7	x	895,319	x	0.62	=	17,174,725	GPY
S.L.A. MAWA=	44.2	x	0.3	x	0	x	0.62	=	0	GPY
								BASIC MAWA=	**17,174,725**	**GPY**

				OWTS PRODUCTION=	APGPD	x	DPY			
					34500	x	365	=	**12,592,500**	**GPY**
								TOTAL MAWA=	**29,767,225**	**GPY**

Where:
- Eto = Reference Evapotranspiration (CIMIS Station #99; Santa Monica)
- ETAF = ET Adjustment Factor (70% for MAWA calculation)
- S.ETAF = ET Adjustment Factor add for Special Landscape Area (30% for MAWA calculation)*
- LA = Landscape Area
- S.LA = Special Landscape Area*
  Defined as areas:
  Dedicated to edible plants, active recreation, recycled water.
- Const = Constant to convert to gallons per year (GPY)
- GPY = Gallons Per Year

Where:
- OWTS = Onsite Wastwater Treatment System
- APGPD = Average Production in Gallons Per Day
- DPY = Days Per Year
- TOTAL MAWA = Basic MAWA + OWTS Production

Project Estimated Total Water Use (ETWU) Calculations by Hydrozones

ETWU= ETo x (Ks x Kd x Kmc) / IE x LA(sq.ft.) x Const. = ETWU GPY

HYDROZONE DESCRIPTION RADIENT HEAT EXPOSURE	HYDRO ZONE #							
Turf (30% total turf) Spray	1	44.2	(0.8 x 1.00 x 1.25) / 0.63	x	13,682	x 0.62 =	599,906 GPY
Turf (70% total turf) Rotor	2	44.2	(0.8 x 1.00 x 1.25) / 0.70	x	31,925	x 0.62 =	1,249,818 GPY
Shrub / Ground Cover Spray	3	44.2	(0.7 x 1.15 x 1.25) / 0.63	x	23,248	x 0.62 =	1,025,712 GPY
						SUBTOTAL RADIENT HEAT EXPOSURE	2,875,437 GPY
SUN EXPOSURE							
Turf (30% total turf) Spray	4	44.2	(0.8 x 1.00 x 1.00) / 0.63	x	13,521	x 0.62 =	474,278 GPY
Turf (70% total turf) Rotor	5	44.2	(0.8 x 1.00 x 1.00) / 0.70	x	31,550	x 0.62 =	988,110 GPY
Shrub / Ground Cover Spray	6	44.2	(0.7 x 1.15 x 1.00) / 0.63	x	45,714	x 0.62 =	1,613,537 GPY
G.C. Roof Spray	7	44.2	(0.7 x 1.00 x 1.00) / 0.63	x	37,382	x 0.62 =	1,147,346 GPY
Tree Canopy Roof Spray	8	44.2	(0.6 x 1.00 x 1.00) / 0.63	x	5,730	x 0.62 =	150,744 GPY
Refined Slope Rotor	9	44.2	(0.8 x 1.30 x 1.00) / 0.70	x	18,062	x 0.62 =	735,386 GPY
Semi-Refined Slope Rotor	10	44.2	(0.8 x 1.15 x 1.00) / 0.70	x	7,706	x 0.62 =	277,545 GPY
Detention Basin Rotor	11	44.2	(0.7 x 1.30 x 1.00) / 0.70	x	8,088	x 0.62 =	288,137 GPY
Atrium Tree Canopy Spray	12	44.2	(0.7 x 1.15 x 1.00) / 0.63	x	1,467	x 0.62 =	51,780 GPY
Landscape Tree Canopy Spray	13	44.2	(0.6 x 1.00 x 1.00) / 0.63	x	236,930	x 0.62 =	6,233,117 GPY
Recreational /Swimming Pool Fill Line	14	44.2	(0.9 x 1.00 x 1.00) / 0.90	x	5,357	x 0.62 =	146,803 GPY
						SUBTOTAL SUN EXPOSURE	12,106,782 GPY
PART SUN EXPOSURE							
Turf Spray	15	44.2	(0.8 x 1.00 x 0.85) / 0.63	x	11,708	x 0.62 =	349,080 GPY
Shrub / Ground Cover Spray	16	44.2	(0.7 x 1.15 x 0.85) / 0.63	x	6,927	x 0.62 =	207,823 GPY
Refined Slope Rotor	17	44.2	(0.8 x 1.30 x 0.85) / 0.70	x	12,046	x 0.62 =	416,880 GPY
Semi-Refined Slope Rotor	18	44.2	(0.8 x 1.15 x 0.85) / 0.70	x	272,745	x 0.62 =	8,349,865 GPY
Landscape Tree Canopy Spray	19	44.2	(0.6 x 1.00 x 0.85) / 0.63	x	78,572	x 0.62 =	1,757,001 GPY
Decorative Water Feature OWTS Fill Line	20	44.2	(0.9 x 1.00 x 0.85) / 0.90	x	1,237	x 0.62 =	28,814 GPY
						SUBTOTAL PART SUN EXPOSURE	11,109,464 GPY
SHADE EXPOSURE							
Turf Spray	21	44.2	(0.8 x 1.00 x 0.75) / 0.63	x	3,542	x 0.62 =	93,182 GPY
Shrub / Ground Cover Spray	22	44.2	(0.7 x 1.15 x 0.75) / 0.63	x	28,180	x 0.62 =	745,988 GPY
						SUBTOTAL SHADE EXPOSURE	839,171 GPY

Total Transpirational Area = 895,319 Sq.Ft.
20.5537 Acres

ETWU = 26,930,852 GPY
ETWU = 90.47% of MAWA

The following are factors used in the development of the Landscape Coefficient Method and calculation shown on the previous page.

Where:

Eto = Reference Evapotranspiration (CIMIS)
KL = Landscape Coefficient (Ks x Kd x Kmc)
LA = Landscape Area
Const = Convert to units of gallons
GPY = Gallons Per Year
IE = Irrigation Efficency**

Defined as a range of:	L	M	H
Drip	0.80	0.85	0.90
Rotor	0.70	0.80	0.85
Rotator	0.70	0.75	0.80
Spray	0.50	0.63	0.71

Ks = Species Factor

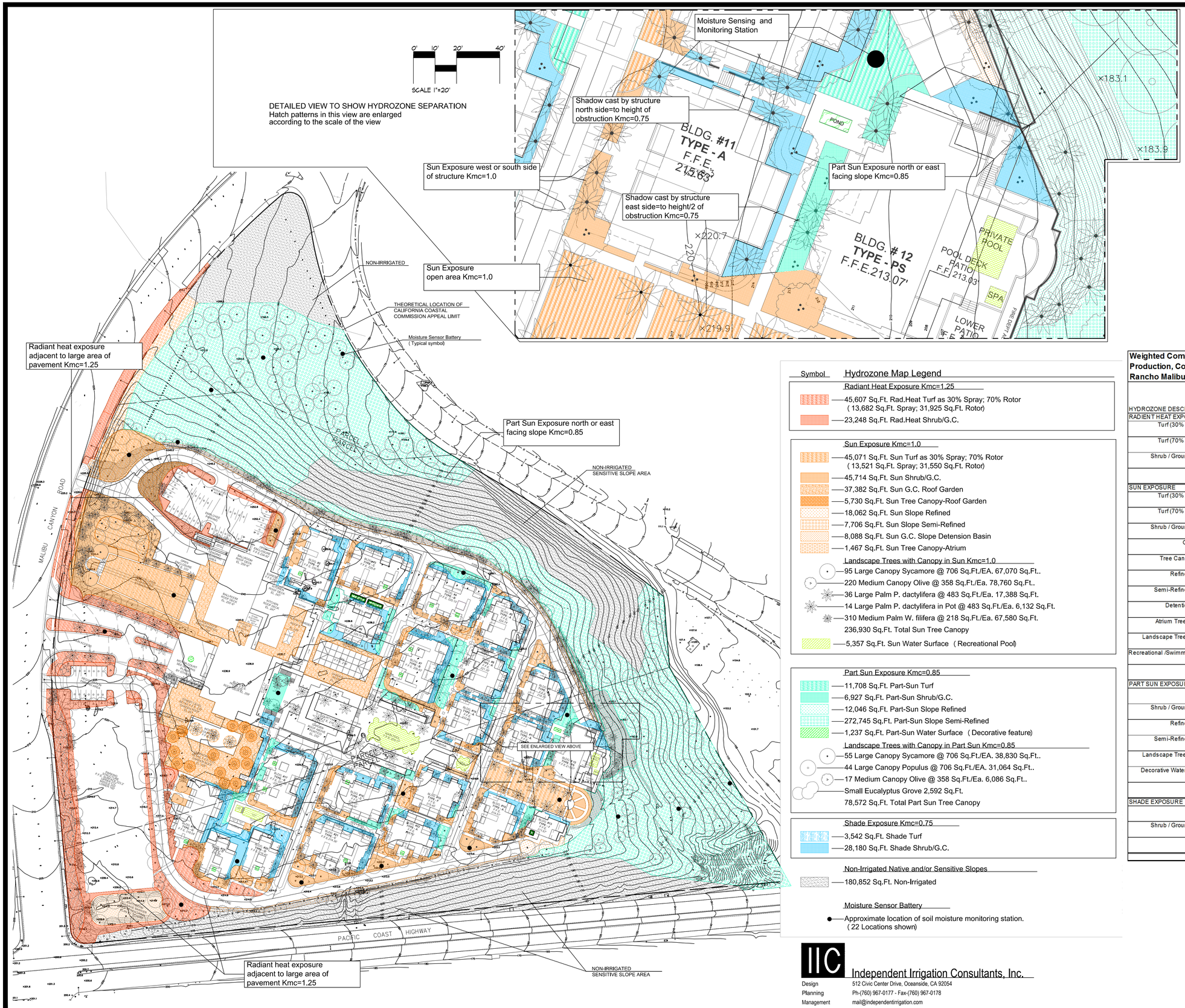
Defined as a range of:	L	M	H
Very Low	0.05	0.07	0.09
Low	0.1	0.2	0.3
Med	0.4	0.5	0.6
High	0.7	0.8	0.9

Kd = Density Factor

Defined as a range of:	
Sparce	0.50
Medium/Sparce	0.75
Average Density	1.00
Medium/Dense	1.15
Dense	1.30

Kmc = Microclimate Factor

Defined as a range of:	
Radient Heat	1.25
Sun	1.0
Part Sun	0.85
Shade	0.75



Hydrozone Map Legend

Radiant Heat Exposure Kmc=1.25

- 45,607 Sq.Ft. Rad.Heat Turf as 30% Spray; 70% Rotor (13,682 Sq.Ft. Spray; 31,925 Sq.Ft. Rotor)
- 23,248 Sq.Ft. Rad.Heat Shrub/G.C.

Sun Exposure Kmc=1.0

- 45,071 Sq.Ft. Sun Turf as 30% Spray; 70% Rotor (13,521 Sq.Ft. Spray; 31,550 Sq.Ft. Rotor)
- 45,714 Sq.Ft. Sun Shrub/G.C.
- 37,382 Sq.Ft. Sun G.C. Roof Garden
- 5,730 Sq.Ft. Sun Tree Canopy-Roof Garden
- 18,062 Sq.Ft. Sun Slope Refined
- 7,706 Sq.Ft. Sun Slope Semi-Refined
- 8,088 Sq.Ft. Sun G.C. Slope Detension Basin
- 1,467 Sq.Ft. Sun Tree Canopy-Atrium

Landscape Trees with Canopy in Sun Kmc=1.0

- 95 Large Canopy Sycamore @ 706 Sq.Ft./EA. 67,070 Sq.Ft..
- 220 Medium Canopy Olive @ 358 Sq.Ft./Ea. 78,760 Sq.Ft..
- 36 Large Palm P. dactylifera @ 483 Sq.Ft./Ea. 17,388 Sq.Ft.
- 14 Large Palm P. dactylifera in Pot @ 483 Sq.Ft./Ea. 6,132 Sq.Ft.
- 310 Medium Palm W. filifera @ 218 Sq.Ft./Ea. 67,580 Sq.Ft.

236,930 Sq.Ft. Total Sun Tree Canopy

- 5,357 Sq.Ft. Sun Water Surface (Recreational Pool)

Part Sun Exposure Kmc=0.85

- 11,708 Sq.Ft. Part-Sun Turf
- 6,927 Sq.Ft. Part-Sun Shrub/G.C.
- 12,046 Sq.Ft. Part-Sun Slope Refined
- 272,745 Sq.Ft. Part-Sun Slope Semi-Refined
- 1,237 Sq.Ft. Part-Sun Water Surface (Decorative feature)

Landscape Trees with Canopy in Part Sun Kmc=0.85

- 55 Large Canopy Sycamore @ 706 Sq.Ft./EA. 38,830 Sq.Ft..
- 44 Large Canopy Populus @ 706 Sq.Ft./EA. 31,064 Sq.Ft..
- 17 Medium Canopy Olive @ 358 Sq.Ft./Ea. 6,086 Sq.Ft..
- Small Eucalyptus Grove 2,592 Sq.Ft.

78,572 Sq.Ft. Total Part Sun Tree Canopy

Shade Exposure Kmc=0.75

- 3,542 Sq.Ft. Shade Turf
- 28,180 Sq.Ft. Shade Shrub/G.C.

Non-Irrigated Native and/or Sensitive Slopes

- 180,852 Sq.Ft. Non-Irrigated

Moisture Sensor Battery

- Approximate location of soil moisture monitoring station. (22 Locations shown)

Weighted Composite Landscape Coefficient (WCLC) for OWTS Production, Consumption and Storage for: Rancho Malibu Resort

WCLC= SUM PRODUCT OF (ZONE K_T x ZONE AREA) / SUM OF THE AREA

HYDROZONE DESCRIPTION	HYDRO ZONE #	Ks x Kd x Kmc =	K_T	LA
RADIENT HEAT EXPOSURE				
Turf (30% total turf) Spray	1	(0.8 x 1.00 x 1.25) / 0.63 =	1.6000	13,682
Turf (70% total turf) Rotor	2	(0.8 x 1.00 x 1.25) / 0.70 =	1.4286	31,925
Shrub / Ground Cover Spray	3	(0.7 x 1.15 x 1.25) / 0.63 =	1.6100	23,248
			SUBTOTAL	
			RADIENT HEAT EXPOSURE	1.5239 CWLC
SUN EXPOSURE				
Turf (30% total turf) Spray	4	(0.8 x 1.00 x 1.00) / 0.63 =	1.2800	13,521
Turf (70% total turf) Rotor	5	(0.8 x 1.00 x 1.00) / 0.70 =	1.1429	31,550
Shrub / Ground Cover Spray	6	(0.7 x 1.15 x 1.00) / 0.63 =	1.2880	45,714
G.C. Roof Spray	7	(0.7 x 1.00 x 1.00) / 0.63 =	1.1200	37,382
Tree Canopy Roof Spray	8	(0.6 x 1.00 x 1.00) / 0.63 =	0.9600	5,730
Refined Slope Rotor	9	(0.8 x 1.30 x 1.00) / 0.70 =	1.4857	18,062
Semi-Refined Slope Rotor	10	(0.8 x 1.15 x 1.00) / 0.70 =	1.3143	7,706
Detention Basin Rotor	11	(0.7 x 1.30 x 1.00) / 0.70 =	1.3000	8,088
Atrium Tree Canopy Spray	12	(0.6 x 1.15 x 1.00) / 0.63 =	1.1040	1,467
Landscape Tree Canopy Spray	13	(0.6 x 1.00 x 1.00) / 0.63 =	0.9600	236,930
Recreational /Swimming Pool Fill Line	14	(0.9 x 1.00 x 1.00) / 0.90 =	1.0000	5,357
			SUBTOTAL SUN EXPOSURE	1.0729 CWLC
PART SUN EXPOSURE				
Turf Spray	15	(0.8 x 1.00 x 0.85) / 0.63 =	1.0880	11,708
Shrub / Ground Cover Spray	16	(0.7 x 1.15 x 0.85) / 0.63 =	1.0948	6,927
Refined Slope Rotor	17	(0.8 x 1.30 x 0.85) / 0.70 =	1.2629	12,046
Semi-Refined Slope Rotor	18	(0.8 x 1.15 x 0.85) / 0.70 =	1.1171	272,745
Landscape Tree Canopy Spray	19	(0.6 x 1.00 x 0.85) / 0.63 =	0.8160	78,572
Decorative Water Feature Fill Line	20	(0.9 x 1.00 x 0.85) / 0.90 =	0.8500	1,237
			SUBTOTAL PART SUN EXPOSURE	1.0578 CWLC
SHADE EXPOSURE				
Turf Spray	21	(0.8 x 1.00 x 0.75) / 0.63 =	0.9600	3,542
Shrub / Ground Cover Spray	22	(0.7 x 1.15 x 0.75) / 0.63 =	0.9660	28,180
			SUBTOTAL SHADE EXPOSURE	0.9653 CWLC
		TOTAL AREA SQ.FT.	**895,319**	**1.097** WCLC
		TOTAL AREA ACRES	20.5537	

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NORTH

0' 40' 80' 160'
SCALE 1"=80'

1st edit 12-20-12
2nd edit 02-08-13

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Hydrozone Plan - Appendix D for LARRP
Water Requirement by Composite Weighted Landscape Coefficient Method

Append. D