Civil Engineering

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(PRELIMINARY)
HYDROLOGY AND DRAINAGE CALCULATIONS
2525 E. HILLCREST DRIVE
CITY OF THOUSAND OAKS, CALIFORNIA

Prepared For:

CONEJO VALLEY CHURCH OF CHRIST
2525 E. Hillcrest Drive
Thousand Oaks, CA 91362

Date: March 12, 2015

Project: 6014.60-15

Approved: _____
Robert W. Anderson, PE, JD, CPESC, CPSWQ, CMS4S, CESSWI, RCE 58383, Exp. 12-31-16

HYDROLOGY AND DRAINAGE STUDY
CONEJO VALLEY CHURCH OF CHRIST
2525 E. HILLCREST DRIVE
THOUSAND OAKS, CALIFORNIA

EXECUTIVE SUMMARY

RJR Engineering Group (RJR) has prepared this Hydrology and Drainage study in regards to the proposed driveway and parking improvements for Conejo Valley Church of Christ located at 2525 E. Hillcrest Drive in Thousand Oaks.

The scope of this drainage study is to characterize the hydrologic and hydraulic conditions of the onsite drainage scheme based on the proposed landscape/hardscape improvements and the conveyance of storm flows from the proposed project. As part of this study, RJR has prepared Grading and Drainage plans outlining the proposed improvements.

The proposed site improvements will consist of the reconfiguration of the existing driveway and associated apron; the addition of an asphalt concrete driveway and parking area; the addition of courtyard grass area; the improvement of the site drainage system and associated landscaping. The onsite drainage improvements include area drains, landscape drains, and private drainage pipes to convey and discharge runoff.

The proposed storm water facilities and improvements have all been designed for the interception and conveyance of the surface water runoff for a 100 year storm event in accordance with the County of Ventura requirements. Runoff is conveyed through on-site drainage pipes to the existing drainage system on E. Hillcrest Drive. Overall surface drainage surrounding the residence will be improved to limit the risk of water intrusion into the threshold of the structure.

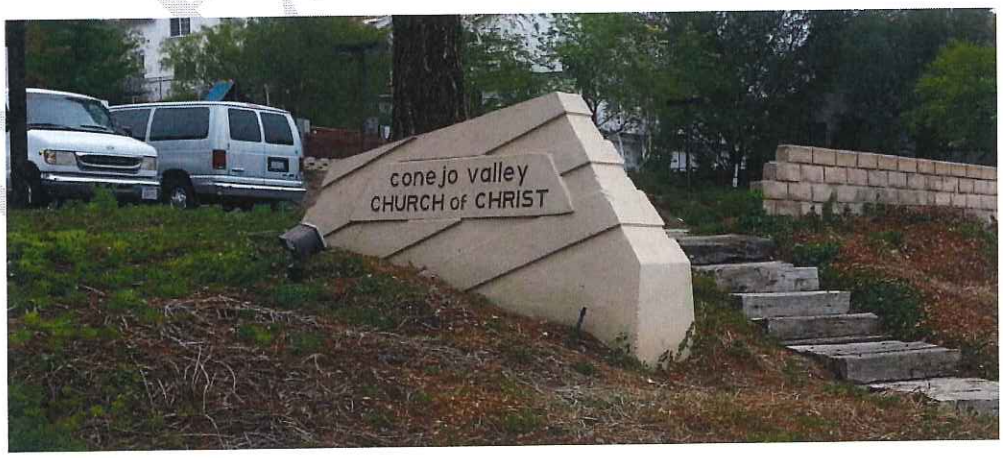
It should be noted that this report has been prepared solely as a hydrologic and hydraulic analysis for the proposed site and drainage improvements. This analysis pertains solely to the conveyance of surface water, the related drainage devices and the storm water management system and does not include any analysis or assumptions relating to downstream conditions. All recommendations described herein are based on hydraulic and hydrologic analysis. Any changes in design or failure to address the outlined recommendations can alter the subsequent calculations and render this report void.

1.0. SITE DESCRIPTION

The property is located at 2525 E. Hillcrest Drive within a suburban hillside community in the City of Thousand Oaks, Ventura County. The hillside development is situated in the Conejo Valley and borders moderately sloping terrain to the north. The property totals approximately 188,210 sq. ft. (4.32 acres).

Photograph #1: Existing Site

Photograph #2: Existing Site



Photograph #3: Existing Site

2.0. HYDROLOGY INFORMATION (VENTURA COUNTY HYDROLOGY MANUAL)

HYDROLOGY CALCULATIONS

All flow rates were determined in accordance with the 2010 Ventura County Watershed Protection District Design Hydrology Manual.

According to County of Ventura, Design Hydrology Manual (see Appendix A) the site contains the following characteristics:

Location:	Thousand Oaks
Rainfall:	8.5" Zone K (100 yr Storm)
Soil Number:	02
Time of Concentration (Tc):	5 min. (Assumed)
Frequency:	10, 25, 50, 100 years
Total Disturbed Area:	1.83 Acres (79,650s.f.)
Perviousness (Existing):	74,545s.f. (93%)
Perviousness (Proposed):	28,240s.f. (35%)

Table 2.0.1 – Hydrology Summary Table

Storm Freq. (yr)	Tc (min.)	Cu	I (in/hr)
10	5	0.89	3.72
25	5	0.90	4.27
50	5	0.91	4.55
100	5	0.92	5.10

2.1 Sub-Area Flows

Intensity:

$$I_t = I_{1440} * \left(\frac{1440}{t}\right)^{0.47} \rightarrow I_5 = \frac{8.5"}{24hr} * \left(\frac{1440}{5\ min}\right)^{0.47} = 5.10\ in/hr$$

Existing Runoff Coefficients:

$C = (I - f) / I$
Soil Type 2: f = 0.4in/hr

$C_{10} = (3.72 - 0.4) / 3.72$
$\boldsymbol{C_{10} = 0.89}$

$C_{25} = (4.27 - 0.4) / 4.27$
$\boldsymbol{C_{25} = 0.90}$

$C_{50} = (4.55 - 0.4) / 4.55$
$\boldsymbol{C_{50} = 0.91}$

$C_{100} = (5.10 - 0.4) / 5.10$
$\boldsymbol{C_{100} = 0.92}$

Tributary Area

Using the above data RJR calculated the corresponding flow per acre values to be **4.69cfs/acre** for the *100 year* undeveloped frequency (Tc=5min.) and **5.15 cfs/acre** for the 100 *year* developed frequency (Tc=5min.). The tributary areas were divided into sub areas corresponding to the site topography and drainage device locations. Each sub-area's contributing storm flows were calculated using the above mentioned flow per acre values.

The runoff areas, tributary to the project site, were divided into six main areas. Area 'A', 'B', 'C' and 'D' include the top/rear portion of the property, making up the main portion of the drainage area which will be conveyed onto the existing drainage system. Area 'E' and 'F' include the drainage area adjacent to the street.

The Tributary Area to the project site consists of approximately 4.32 acres. The runoff will be captured through a system of proposed area drains, concrete swales and bio-infiltration systems where applicable and beneficial. The storm runoff, that will not be infiltrated, will then be conveyed to the existing curb and gutter. The storm flows will then enter the main drainage line within E. Hillcrest Drive.

The following table has been comprised to illustrate the resulting flows:

Table 1 - Sub-Area Breakout Table

Sub-Area	Area (Acres)	Q_{100} (cfs)	Q_{10} (cfs)
A1	0.78	3.66	2.58
$A1_{OFF}$	15.2	71.3	50.3
B1	0.75	3.54	2.50
C1	1.24	5.82	4.11
D1	0.41	1.95	1.37
E1	1.25	5.87	4.14
F1	0.50	2.38	1.68

3.0. STORMWATER MITIGATION

The addition and proposed reconfiguration of the parking area and driveway will result in the increase of impervious area within the proposed development. Impervious area will increase from 7% to 65%. The increase of impervious surface area will increase storm water runoff from the property by approximately 0.84 cfs during a 100 year storm event. Therefore storm water runoff from the developed site will have a slightly higher impact on the existing city storm drain system if unmitigated. The site storm water will be routed through a more extensive drainage system than currently exists, and covers the entire driveway/ parking, courtyard and landscape areas

Proposed Condition Runoff Coefficient

Cu = 0.92
Imperviousness = 65%

$$C_D = (0.9 * IMP) + (1.0 - IMP) * C_U$$
$$C_D = (0.9 * 0.65) + (1.0 - 0.65) * 0.92 = 0.90$$

$q_{50} = C_D IA = 0.90*5.10$ in/hr*1 acre = 4.59 cfs/acre (scale factor = 1.0)
q_{100} = 5.15 cfs/acre (scale factor = 1.122)

Proposed Condition Average Flow Rate: q_{100} = **5.15 cfs/acre**

See Curve Numbers for developed land in Appendix B.

4.0. HYDRAULIC ANALYSIS

Storm Drain Facility Design

One dimensional supportive calculations for various drainage structures (PVC pipes, area drains, v-ditches etc.) on site not discussed in this report are included in Appendix B. All the drainage structures have been sufficiently designed to convey the Q_{100} flows to the corresponding inlet structures.

The Hydrology Map in Appendix C illustrates the total drainage areas and the corresponding flow rates (Q's) for the specific conditions and flood frequencies, as well as the proposed catch basins, v-ditches, pipes, detention basin locations and any other relevant information.

5.0. POST CONSTRUCTION STORWATER QUALITY MITIGATION

The City is a co-permittee under the Ventura County National Pollutant Discharge Elimination System (NPDES) Municipal Permit and as such is obligated to implement a Standard Urban Storm Water Mitigation Plan (SUSMP) or equivalent, post-construction best management practices (BMPs) and total maximum daily loads (TMDLs) to reduce the entry of pollutants into the City storm drain system and to reduce the overall amount of urban runoff entering Calleguas Creek and the Pacific Ocean through Mugu Lagoon.

In Order to reduce runoff pollution and volume from private and publicly-owned properties planned for development, a program is required to ensure that new developments/ redevelopments or construction projects incorporate design elements, such as post-construction BMPs, construction BMPs, and low impact development strategies, and that existing properties adopt good housekeeping practices.

The following projects and associated triggers within new development and redevelopment projects/activities are subject to the requirements of permit.

New/ Redevelopment Projects

- *Any Construction project on a vacant parcel.*
- *Any construction project that (a) adds fifty percent or more of the square footage of the structure, (b) is a substantial remodel, (c) adds or replaces fifty percent or more of the exterior footprint of a structure or parcel, or (d) creates, adds, or replaces at least five-thousand square feet of impervious surface.*

- *Any construction project that involves a separate structure with an exterior footprint of 400 square feet or more, including an accessory building, on one parcel with existing structures.*

- *Any construction project located in or directly adjacent to, or discharging directly to, an Environmentally Sensitive Area.*

Since the project is an existing development which involves land-disturbing activity that results in the addition of 5,000 square feet or more of impervious surface area on an already developed site, the re-development project will require mitigation under the permit

Existing Water Quality Facilities

The Existing site development does not include stormwater quality BMP measures. The majority of the site utilizes surface drainage with the exception of a grated catch basin at the existing sidewalk/ parking lot transition.

Required Mitigation Volume

To conform to the Ventura Countywide Stormwater Quality Management Program a stormwater quality design volume was calculated based on a 0.75" storm event.

Hydrologic Analysis Parameters:

Area	**0.83 acres**
Percent Impervious, (IMP)	**90%**
Soil Number	**02**
Flow Path Slope	**9.1%**
50 year Rainfall Depth	**0.75"**
Design Storm Frequency	**50 year**

The following equation was used to calculate the stormwater quality design volume:

$$SQDV = 43560\ (ft^2/\ acre) \times C \times P\ (ft) \times A_{retain}\ (acre)$$

Where:

C = runoff coefficient
P = rainfall depth
A_{retain} = total area of retained runoff

$$SQDV = 43560\ (ft^2/\ acre) \times 0.87 \times 0.0625\ (ft) \times 0.71\ (acre)$$
$$SQDV = 1{,}682\ ft^3$$

SQDV: 1,682 cu.ft.

Potential Stormwater Quality Concerns

As a commercial development, the proposed project will be subject to pollutants associated with parking lots, landscaping maintenance as well as faculty and guest traffic. Pollutants of concern will consist of pollutants listed in Table 1 & 2, below.

Table 1: Predominate Pollutants of Concern

Low Impact Development Standards Manual

Table 7-3. Typical Pollutants of Concern by Land Use [1]

Land Use	Pollutants of Concern [2]								
	Suspended Solids	Total Phosphorus	Total Nitrogen	Total Kjeldahl Nitrogen	Cadmium, Total	Chromium, Total	Copper, Total	Lead, Total	Zinc, Total
High Density Single Family Residential	X	X			[4]	[4]	X	X	X
Multi-Family Residential	X				[4]	[4]	X		X
Mixed Residential	X	X	X		[4]	[4]	X	X	X
Commercial	X	X	X	X	[4]	[4]	X	X	X
Industrial	X	X	X	X	[4]	[4]	X	X	X
Critical Facilities [3]	X	[4]	[4]	[4]	[4]	[4]	X	X	X
Transportation (streets, roads)	X	X	X	X	[4]	[4]	X	X	X
Institutional (educational facilities)	X				[4]	[4]	X		X

[1] Adapted from Table A-3 of the *Technical Manual for Stormwater Best Management Practices in the County of Los Angeles* (February 2004) and the Southern California Coastal Water Research Project Land Use Specific Storm Water Monitoring Data. X = exceedance of "standard" by observed median/average concentration; blank = no exceedance of "standard" by observed median/average concentration.

[2] Derived from Table 11 of the 2012 Los Angeles County MS4 Permit (page 104).

[3] Critical facilities include automobile dismantling (SIC 50xx), automobile repair (SIC 75xx), metal fabrication (SIC 34xx), motor freight (SIC 42xx), automobile dealerships (SIC 55xx), chemical manufacturing (SIC 28xx), and machinery manufacturing (SIC 35xx).

[4] No available data to determine if these pollutants of concern originate from this land use. Pollutant is assumed to be produced by this land use unless otherwise proven by the project applicant.

Table 2: Specific Pollutants Typically Associated with Commercial Developments

Class of Pollutant	Specific Pollutants		
Sediment (TSS and Turbidity)	Sedimentation/Siltation		
Nutrients	Ammonia Nitrate and Nitrite Nitrate Nitrogen	Organic Enrichment/ Low Dissolved Oxygen	Algae Eutrophic
Metals/Metalloids	Boron Copper Copper, Dissolved	Lead Mercury Nickel	Selenium Zinc
Pesticides	ChemA (tissue) Chlordane Chlordane (tissue & sediment) Chlordane (tissue) Chlorpyrifos Chlorpyrifos (tissue) DDT DDT (sediment) DDT (tissue & sediment)	DDT (tissue) Diazinon Dieldrin Dieldrin (tissue) Organophosphorous Pesticides Toxaphene Toxaphene (tissue & sediment) Toxaphene (tissue)	
Trash and Debris (Gross Solids and Floatables)	Trash and Debris		
Other Organics	PCBs		
Bacteria and Viruses	Coliform Bacteria	Indicator Bacteria	
Salinity	Chloride		
Toxicity	Sediment Toxicity	Toxicity	
Miscellaneous	pH	Scum/Foam - unnatural	Sulfates

Proposed Stormwater Quality Mitigation Measures

The subject project proposes the use of both bio-filtration planters and impermeable pavers within the parking lot area to mitigate stormwater quality issues. As demonstrated on the site plan, adequate storm water treatment mitigation area has been included in the design. In order to provide sufficient storage capacity and infiltration effectiveness, each Infiltration area shall include the following;

- A subsurface storage area.
- An 18 to 60 inch gravel storage layer consisting of clean soil, sand and rock with an average void ratio between 30% to 40.

The combination of the proposed BMP measures will meet/exceed the required $SWQD_V$ of 1,682 ft^3. All design and calculations for the proposed BMP measures will follow the Ventura County Technical Guidance Manual worksheets.

6.0. CONCLUSION

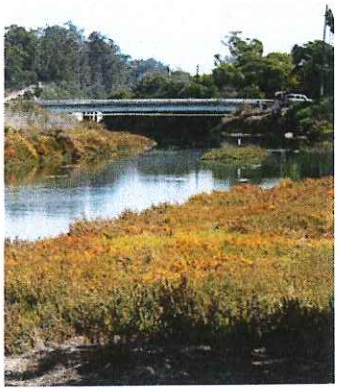
Based on the available data and analysis, it is of the opinion of RJR that the proposed storm drain system is hydraulically adequate to provide the necessary conveyance of water of the 100 year storm event. In addition, the proposed system will mitigate any potential issues with downstream properties as well as post construction stormwater quality mitigation.

Again, it should be noted that this report has been prepared solely as a surficial hydrology and hydraulic analysis for the grading and drainage improvements. The hydrology and hydraulic calculations are based on the survey provided, visual field measurements, civil plans designed by RJR, and the architectural and landscape structures designed by others. All recommendations described herein are based on hydraulic analysis associated with the above referenced grading and drainage design, and any changes in design or failure to address the outlined recommendations can alter the subsequent calculations and render this report void.

REFERENCES

1. Ventura County Watershed Protection District, Hydrology Manual, December 2010.

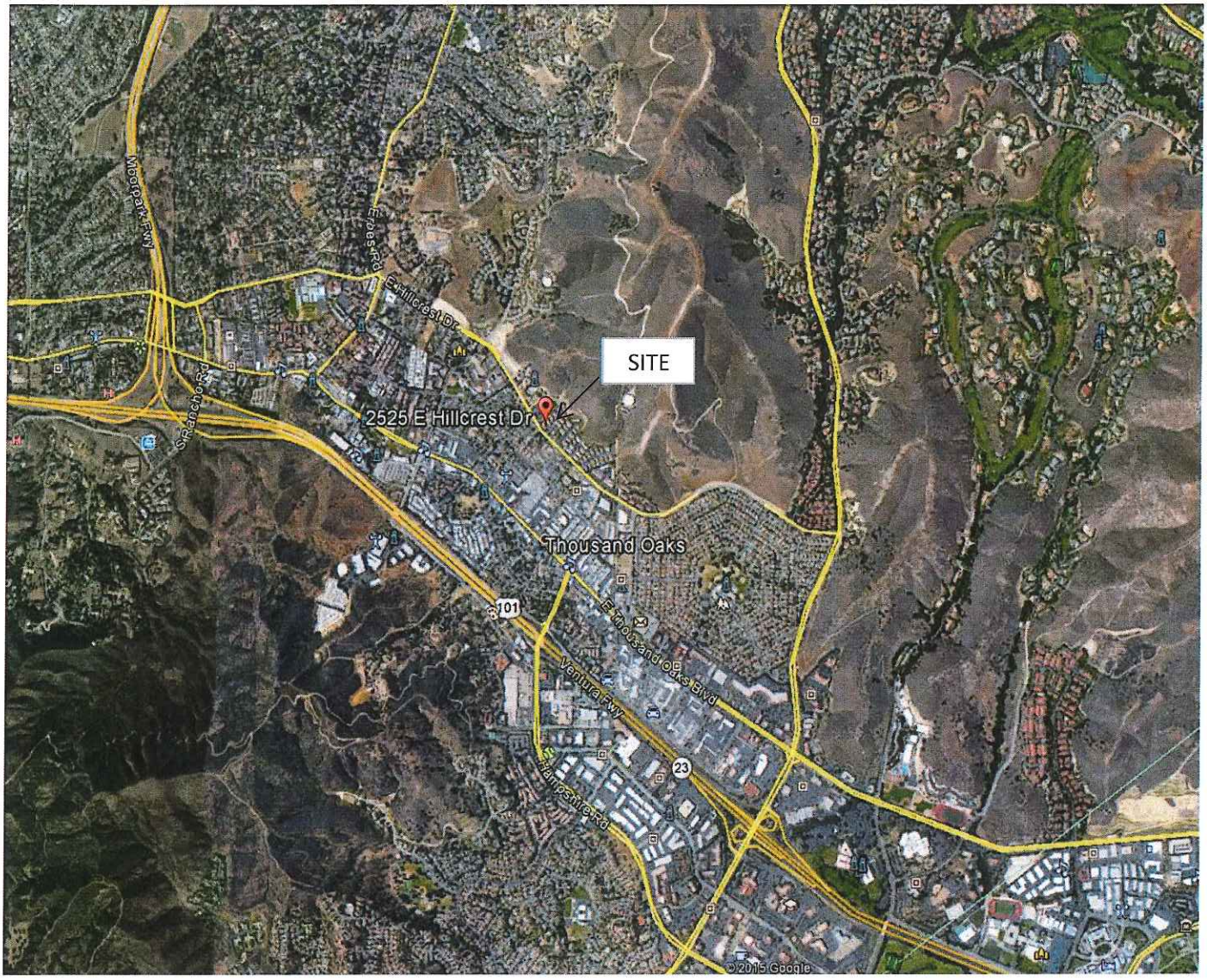
2. Ventura County Technical Guidance Manual for Stormwater Quality Control Measures, 2011



APPENDIX A

General Project Site Information

1. **Site Location Map**
2. **Proposed Site Plan**
3. **Hydrology Calculation Plates and figures**



REFERENCE: Google Earth

P.N. 6014.60

NORTH

SITE LOCATION MAP

CONEJO VALLEY CHURCH OF CHRIST
2525 E. HILLCREST DRIVE
THOUSAND OAKS, CA

Scale: N.T.S.

EXHIBIT 1A. DESIGN STORM RAINFALL CONTOURS - 100-YR STORM

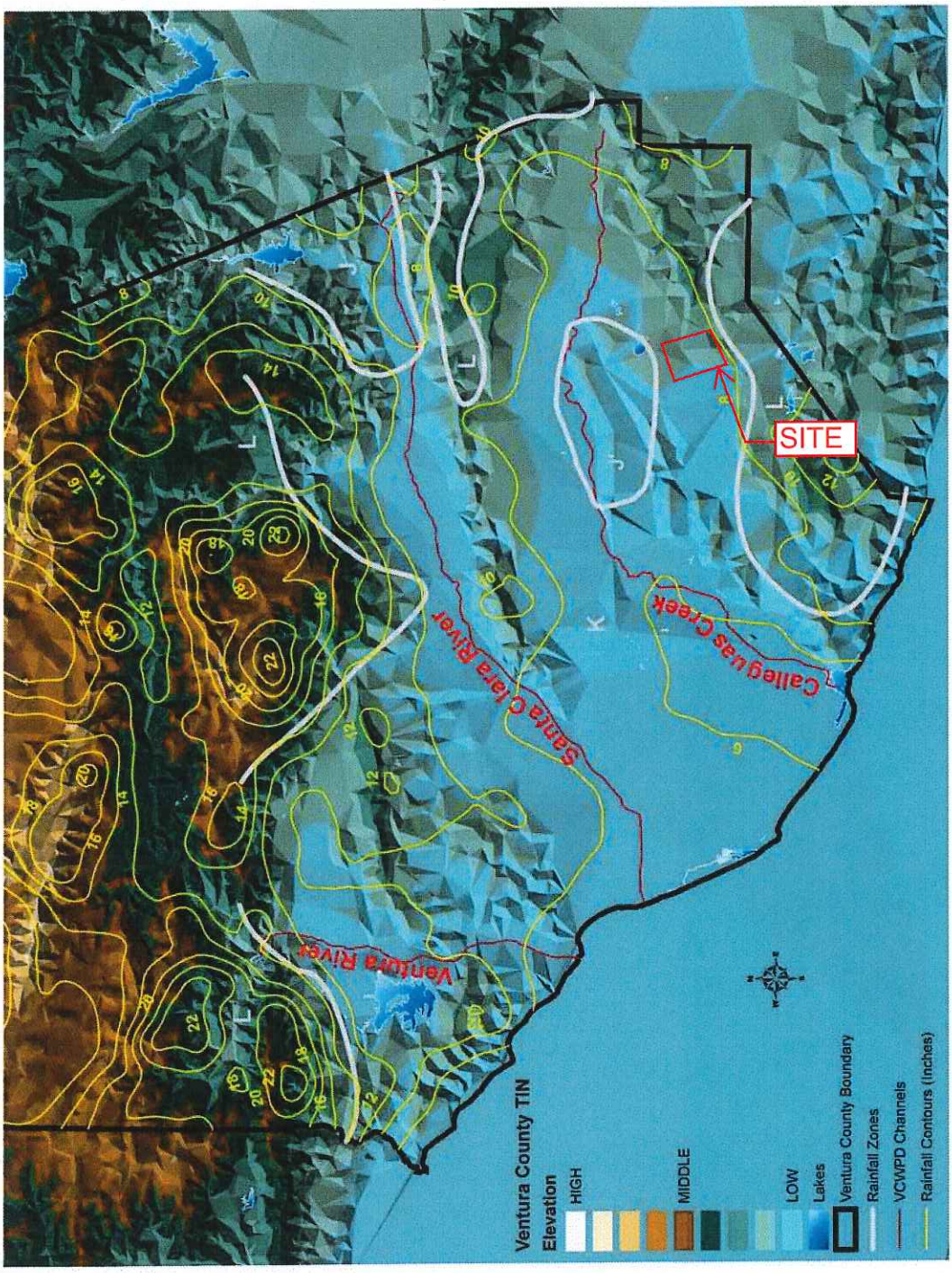


EXHIBIT 2. MAXIMUM RAINFALL INTENSITIES

Zone	J	Jp	K	L	J	Jp	K	L	J	Jp	K	L	J	Jp	K	L
Year	10	10	10	10	25	25	25	25	50	50	50	50	100	100	100	100
Cum. Rain (in.)	3.17	4.38	5.53	7.21	3.91	5.28	6.41	8.81	5.0	6.0	8.0	11.0	7.0	6.66	10.6	15.0
Tc (min)	Maximum Rainfall Intensity (in/hr)															
5	2.16	2.16	3.72	4.31	2.64	3.34	4.27	4.94	2.94	3.79	4.55	5.58	3.23	4.06	5.10	6.11
6	2.02	2.01	3.40	3.90	2.52	2.94	3.80	4.39	2.80	3.34	4.10	5.05	2.90	3.55	4.59	5.43
7	1.86	1.90	3.09	3.56	2.30	2.65	3.45	3.99	2.55	3.01	3.77	4.63	2.67	3.19	4.23	4.95
8	1.74	1.82	2.86	3.30	2.14	2.58	3.19	3.69	2.36	2.93	3.52	4.28	2.50	2.99	3.95	4.58
9	1.63	1.76	2.68	3.07	1.99	2.44	2.99	3.45	2.21	2.77	3.33	4.00	2.36	2.87	3.74	4.30
10	1.53	1.70	2.52	2.86	1.87	2.29	2.81	3.24	2.08	2.60	3.16	3.76	2.25	2.78	3.57	4.07
11	1.45	1.64	2.40	2.70	1.76	2.17	2.66	3.07	1.95	2.46	3.02	3.56	2.13	2.67	3.39	3.88
12	1.38	1.59	2.29	2.56	1.66	2.07	2.53	2.92	1.85	2.35	2.90	3.39	2.02	2.58	3.23	3.72
13	1.33	1.55	2.20	2.44	1.58	1.98	2.43	2.80	1.76	2.25	2.80	3.25	1.94	2.49	3.10	3.59
14	1.28	1.51	2.12	2.34	1.52	1.90	2.34	2.70	1.68	2.16	2.72	3.13	1.86	2.42	2.99	3.47
15	1.23	1.47	2.04	2.25	1.46	1.84	2.26	2.60	1.62	2.09	2.62	3.02	1.80	2.36	2.89	3.37
16	1.18	1.43	1.98	2.18	1.40	1.78	2.18	2.50	1.56	2.02	2.54	2.92	1.73	2.29	2.79	3.25
17	1.14	1.39	1.92	2.11	1.36	1.73	2.12	2.42	1.50	1.96	2.47	2.83	1.67	2.22	2.70	3.14
18	1.11	1.35	1.86	2.04	1.31	1.68	2.06	2.34	1.45	1.90	2.41	2.75	1.61	2.16	2.62	3.05
19	1.07	1.32	1.82	1.99	1.27	1.63	2.01	2.28	1.41	1.86	2.35	2.68	1.56	2.11	2.55	2.96
20	1.04	1.29	1.77	1.94	1.24	1.60	1.96	2.22	1.37	1.81	2.29	2.62	1.52	2.07	2.49	2.88
21	1.02	1.26	1.73	1.90	1.20	1.55	1.91	2.17	1.33	1.76	2.23	2.55	1.48	2.03	2.43	2.82
22	0.99	1.23	1.68	1.85	1.17	1.51	1.87	2.12	1.30	1.72	2.17	2.49	1.44	1.99	2.36	2.76
23	0.97	1.21	1.65	1.82	1.14	1.48	1.83	2.07	1.27	1.68	2.12	2.44	1.41	1.95	2.31	2.70
24	0.95	1.19	1.62	1.78	1.12	1.44	1.79	2.03	1.24	1.64	2.07	2.39	1.38	1.92	2.26	2.65
25	0.93	1.16	1.58	1.75	1.09	1.41	1.76	1.99	1.21	1.61	2.03	2.34	1.35	1.89	2.22	2.60
26	0.90	1.14	1.56	1.72	1.07	1.39	1.73	1.96	1.18	1.57	1.98	2.29	1.32	1.86	2.17	2.56
27	0.88	1.13	1.53	1.68	1.05	1.36	1.70	1.92	1.16	1.54	1.94	2.25	1.29	1.83	2.13	2.51
28	0.87	1.11	1.50	1.66	1.03	1.34	1.67	1.89	1.14	1.52	1.90	2.21	1.27	1.80	2.09	2.46
29	0.85	1.09	1.48	1.63	1.01	1.31	1.64	1.87	1.12	1.49	1.87	2.17	1.24	1.77	2.05	2.42
30	0.83	1.08	1.46	1.61	0.99	1.29	1.61	1.84	1.10	1.47	1.84	2.13	1.22	1.74	2.02	2.38

EXHIBIT 6B. RUNOFF COEFFICIENT CURVE- SOIL NUMBER 2 (NRCS TYPE C)

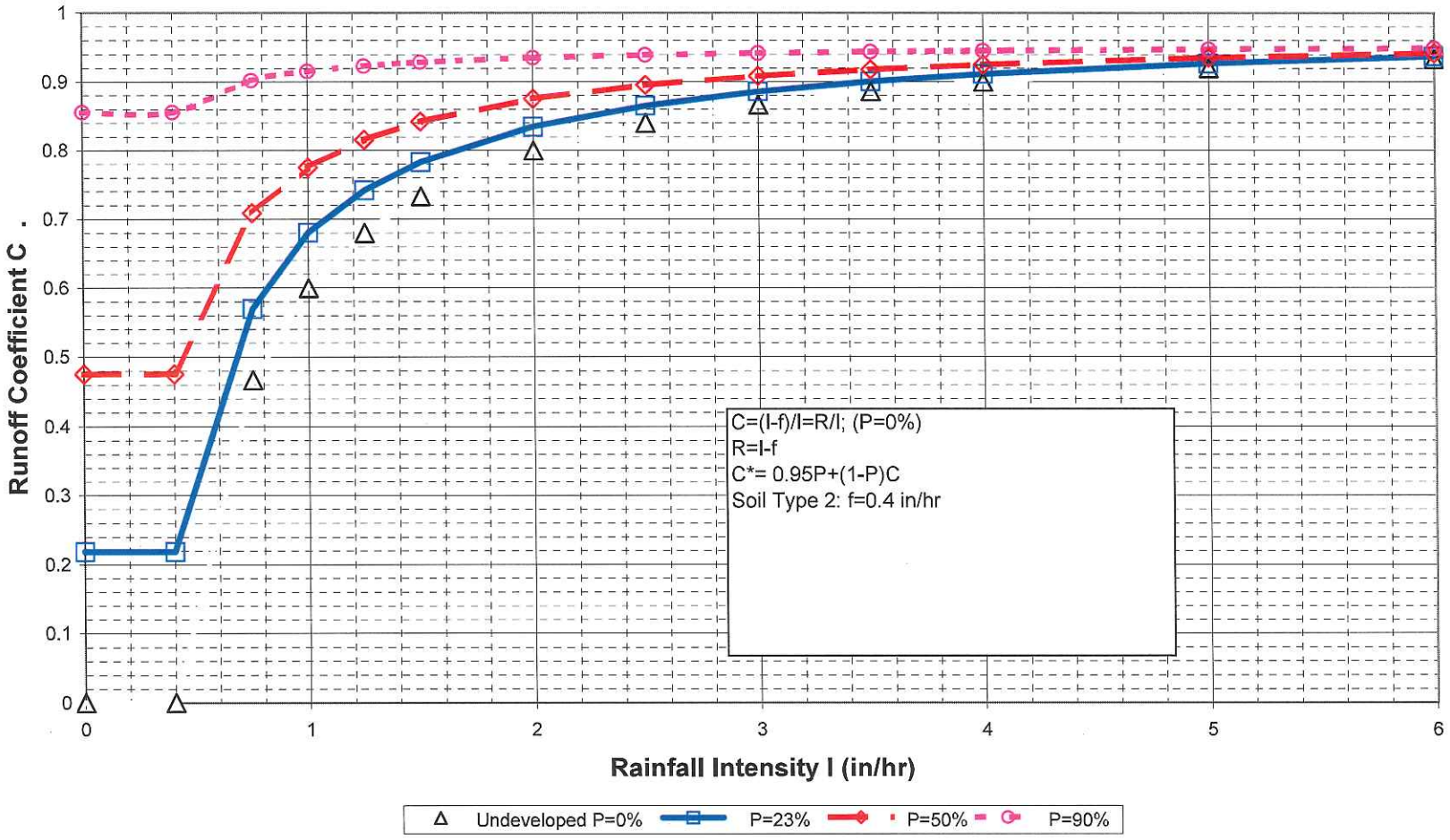


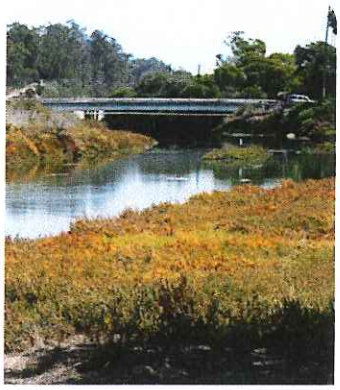
EXHIBIT 14A. AMC II NRCS CURVE NUMBERS FOR UNDEVELOPED LAND

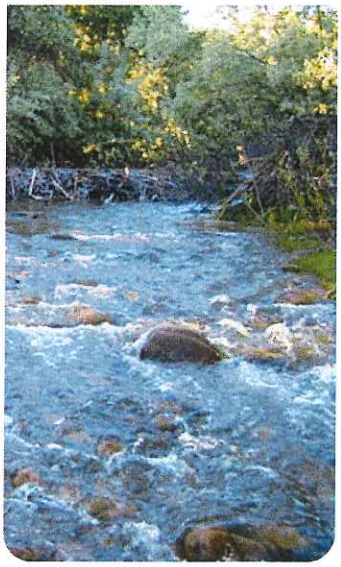
UNDEVELOPED LAND USE AND CONDITION Poor: Less than 50% Cover Fair: From 50% to 75% Cover Good: More Than 75% Cover		% Impervious		HYDROLOGIC SOIL GROUP AND VCWPD NUMBERS						
				A (1), (2)		B		C		D (3)
		Effective	Average	7	6	5	4	3	2	1
Grassland (Annual Grass)	Poor	0	0	46	57	60	63	68	72	76
"	Fair	0	0	21	42	47	53	60	66	70
"	Good	0	0	-	-	41	47	54	59	64
Open Brush (Sagebrush, Flattop Buckwheat)	Poor	0	0	31	51	55	60	66	70	75
"	Fair	0	0	22	40	44	49	54	58	61
"	Good	0	0	-	-	33	39	46	51	56
Big Brush (Scrub Oak, Manzanita, Ceanothis)	Fair	0	0	23	39	42	46	51	54	59
"	Good	0	0	-	-	29	34	41	46	51
Chamise (Narrow Leaf Chaparral)	Fair	0	0	21	43	48	55	63	68	75
"	Good	0	0	-	-	44	49	55	60	64
Oak Savannah (Sparse Oaks & Annual Grass)	Poor	0	0	34	53	57	62	67	71	-
"	Fair	0	0	22	41	45	51	57	61	-
Orchard	Poor	0	0	42	56	59	62	65	67	71
Woodland	Fair	0	0	-	-	35	39	43	47	-
Pinon & Juniper	Fair	0	0	-	-	43	48	54	58	62
Forest	Fair	0	0	22	41	45	50	56	60	64
Pasture or Range	Poor	0	0	61	76	78	81	84	87	89
"	Fair	0	0	40	61	65	71	77	81	84
"	Good	0	0	29	52	57	64	71	76	80
	NOTE: WPD MODIFIED RATIONAL METHOD USES SOIL TYPES 1-7 AND EFFECTIVE IMPERVIOUS PERCENTAGE IN VCRat MODEL									
Note (1)	Curve numbers for soil types 6 and 7 not all available									
Note (2)	For CNs<30, ensure that P-0.2*S > 0									
Note (3)	Curve numbers for soil type 1 not all available									
Reference:	Boyle, 1967. Revised Hydrologic Analysis, Zone II except Pasture from NRCS TR-55 Table 2-2c. For other land use types see TR-55									

Exhibit 14b. AMC II NRCS Curve Numbers for Developed Land

DEVELOPED LAND USE	Condition (1)	% IMPERVIOUS		HYDROLOGIC SOIL GROUP (5)						
				A		B		C		D
		EFFEC-TIVE	AVER-AGE	7	6	5	4	3	2	1
Open Spaces, Lawns, Parks, Golf Courses, Cemeteries, etc.	Good	0	0	29	52	57	64	71	76	80
"	Fair	0	0	42	61	65	71	77	81	84
Residential 1 ac. Lot	-	10	20	45	62	66	71	76	80	84
Residential 1/2 ac. Lot	-	13	25	45	65	68	73	78	81	85
Residential 1/3 ac. Lot	-	15	30	48	67	70	75	79	82	86
Residential 1/4 ac. Lot	-	19	38	53	70	73	77	81	84	87
Residential 1/5 ac. Lot	-	23	47	59	74	77	80	84	86	89
Residential 1/6 ac. Lot	-	28	56	66	79	81	84	86	88	90
Residential 1/8 ac. Lot	-	32	65	72	83	84	87	89	90	92
Residential - Condos	-	37	69	74	84	86	88	90	92	93
Industrial Unpaved Yards, etc.	-	36	72	77	86	87	89	91	92	93
Commercial & Business	-	50	85	88	90	91	93	93	95	95
Industrial Parks, Paved Parking, etc.	-	70	93	93	94	95	96	96	97	97
Parking Lots, Roofs, Driveways, Paved Streets with Curbs & Drains	-	90	100	98	98	98	98	98	98	98
Public Facilities & Institutions; Includes Schools, Government CenterS, Military Bases, etc. (2)	-	23	47	59	74	77	80	84	86	89
Transportation and utilities (3)	-	70	93	79	87	88	90	91	92	93
Newly graded/under construction - No veg.	-	0	0	71	83	85	88	90	92	94
Paved Streets with open ditches including right-of-way (3)	-	70	93	79	87	88	90	91	92	93
Gravel streets including right-of-way	-	0	0	71	82	84	86	88	90	91
Dirt street including right-of-way	-	0	0	66	79	81	83	86	88	89
Natural desert landscaping- native vegetation	-	0	0	55	72	75	79	83	86	88
Farmsteads- buildings, lanes, driveways, and surrounding lots (2)	-	23	47	51	69	72	76	80	83	86
Agriculture- Straight Row + Crop Residue Cover on >5% of surface	Good	0	0	57	72	74	77	80	83	85
Agriculture- Straight Row + Crop Residue Cover on <5% of surface	Poor	0	0	64	78	80	83	86	88	90

DEVELOPED LAND USE	Condition (1)	% IMPERVIOUS		HYDROLOGIC SOIL GROUP (5)						
		EFFEC-TIVE	AVER-AGE	A		B		C		D
				7	6	5	4	3	2	1
Agriculture- Straight Row Good	Good	0	0	60	75	77	80	84	86	89
Agriculture- Straight Row Poor	Good	0	0	65	79	81	84	87	89	91
Strawberries, 36" beds on 48" centers, beds covered with plastic (4)	-	72	72	90	94	94	95	96	96	97
Fallow - Bare Soil or Newly Graded Lands	-	0	0	71	83	85	88	90	92	94
Fallow - with crop residue cover on >5% of surface	Good	0	0	68	80	82	84	87	88	90
Orchard or Tree Farm, 50/50 woods-grass	Poor	0	0	39	60	64	69	75	79	83
Orchard or Tree Farm, 50/50 woods-grass	Fair	0	0	26	48	53	59	67	72	77
Orchard or Tree Farm, 50/50 woods-grass	Good	0	0	21	42	47	54	61	66	72
	NOTE: WPD MODIFIED RATIONAL METHOD USES SOIL TYPES 1-7 AND EFFECTIVE IMPERVIOUS PERCENTAGE IN VCRat MODEL									
Note (1)	Poor is < 50% cover; Fair is from 50 to 75% cover; Good is >75% cover; also consider density of canopy and vegetative cover and degree of surface roughness									
Note (2)	% Impervious and CNs assumed same as residential 1/5 ac lots									
Note (3)	Assumed same as industrial parks									
Note (4)	Calculated assuming planted on 200'x208' parcel with 8' road along one boundary.									
Note (5)	TR-55 Notes: CNs developed using average % imperviousness with CN=98, pervious areas equivalent to open space in good condition. Greater than 30% impervious area considered directly connected.									
Reference:	TR-55 Manual Table 2-2. For other land use types, see TR-55 Manual.									





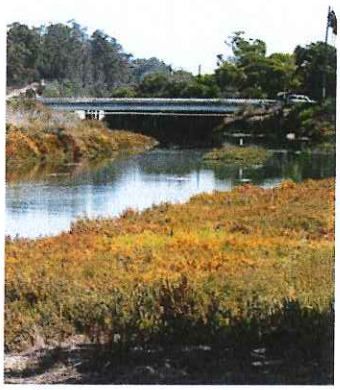
APPENDIX B

General Project Site Information

1. Composite Runoff Coefficient Curve Data

B-1.3 Composite Runoff Coefficient Curve Data

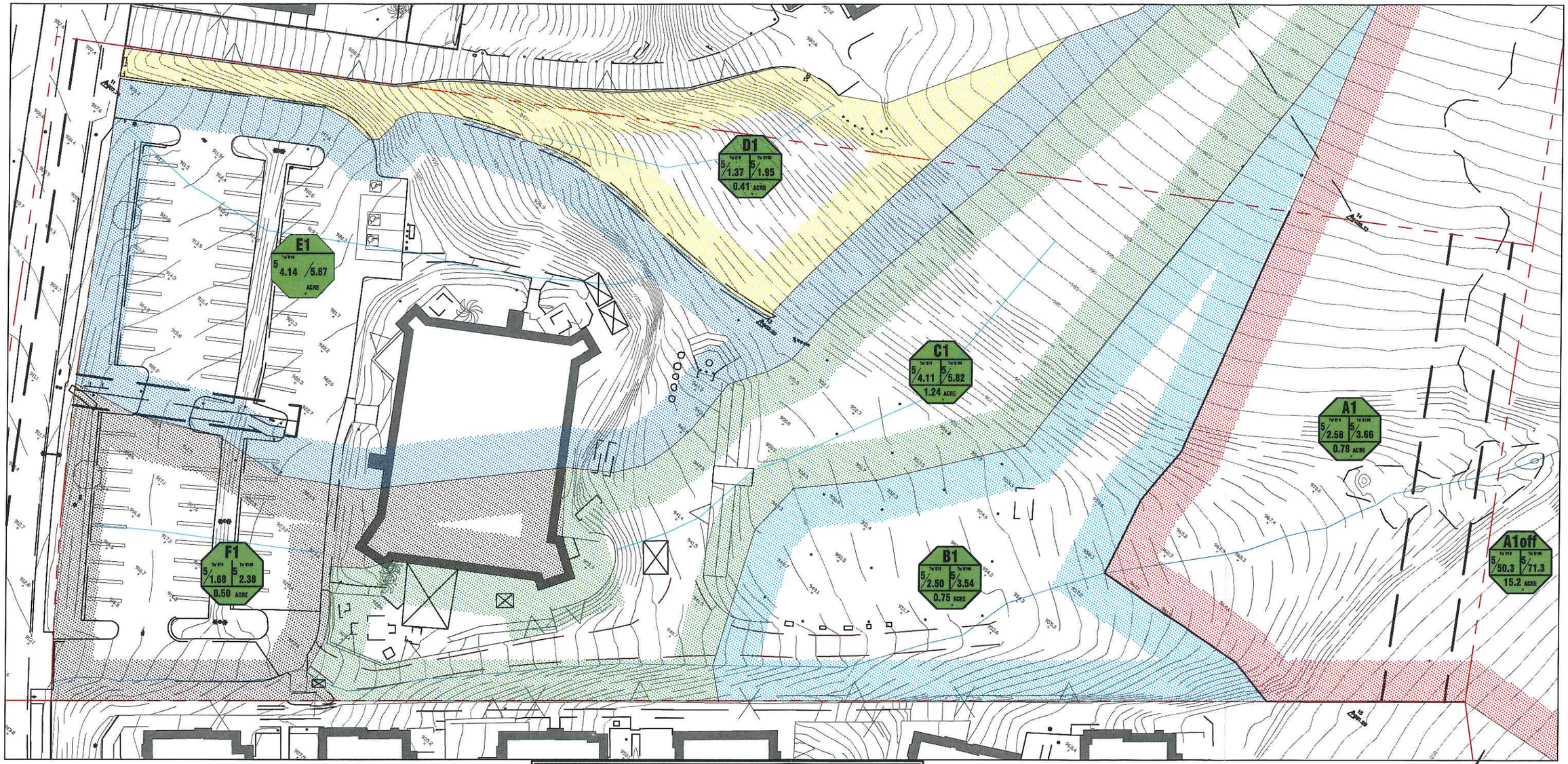
	Soil Number						
	4			5			
	Undeveloped	Single Family 1/4 ac. lots	Commercial	Undeveloped	Single Family 1/4 ac. lots	Commercial	
	Effective Imperviousness (%)						
	0	23	-	-	23	-	
	Land Use Area (ac)						Total Area
	1.3	12.2	-	-	10.5	-	24.0
	Percent of Total Area (%)						Total Percent
	5.4	50.8	-	-	43.8	-	100.0
	Pervious Area Infiltration Rate (in/hr)						
	0.65			0.80			
Intensity (in/hr)	Runoff Coefficients						Composite Runoff Coeff.
0	0.000	0.219	-		0.219	-	0.207
0.5	0.000	0.219	-		0.219	-	0.207
0.65	0.000	0.219	-		0.219	-	0.207
0.8	0.188	0.363	-		0.219	-	0.290
1	0.350	0.488	-		0.373	-	0.430
1.5	0.567	0.655	-		0.578	-	0.616
2	0.675	0.738	-		0.681	-	0.710
2.5	0.740	0.788	-		0.742	-	0.765
3	0.783	0.822	-		0.783	-	0.803
3.5	0.814	0.846	-		0.813	-	0.829
4	0.838	0.863	-		0.835	-	0.849
4.5	0.856	0.877	-		0.852	-	0.865
5	0.870	0.888	-		0.865	-	0.877
5.5	0.882	0.898	-		0.877	-	0.887



APPENDIX C

General Project Site Information

1. Hydrology Map



HYDROLOGY AREA INFORMATION

AREA NUMBER	AREA (Acres)	T.O.C. (Min.)	Q_{100} (cfs)	Q_{10} (cfs)
A1	0.78	5	3.68	2.60
$A1_{OFF}$	15.2	5	71.3	50.3
B1	0.70	5	3.34	2.36
C1	0.86	5	4.08	2.88
D1	0.38	5	1.78	1.26
E1	1.18	5	5.60	3.95
F1	0.50	5	2.38	1.68

HYDROLOGY INFORMATION

LOCATION: THOUSAND OAKS
RAINFALL: 10.6"
IMPERVIOUS AREA: 1.78 ACRE
SOIL NUMBER: 2

GRAPHIC SCALE

0 1" 2"
0 25 50 100
1" = 50'

HYDROLOGY MAP

CONEJO VALLEY CHURCH OF CHRIST
2525 E. HILLCREST DRIVE
THOUSAND OAKS, CALIFORNIA

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