Appendix G
Hydrology and Hydraulics Report

VCA ENGINEERS, INC.
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HYDROLOGY AND HYDRAULICS REPORT

17538, 17544, 17550 Tramonto Drive, Los Angeles, CA 920272
17523, 17529 Revello Drive, Los Angeles, CA 920272
17533, 17537, 17541, 17547 Revello Drive, Los Angeles, CA 90272
17532, 17540, 17548 Revello Drive, Los Angeles, CA 90272

July 21, 2020

PREPARED FOR:

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1.0 Introduction

1.1 Scope

This Hydrology and Hydraulics report presents the analysis of: (1) the existing inlet on Revello Drive and the existing storm drain pipe that traverses the hillside from this inlet to the PCH given the existing tributary areas, (2) the analysis of the existing inlet and storm drain pipe given the existing tributary areas as well as the additional tributary areas captured from the proposed four-home development and (3) the analysis for a potentially new catch basin that would replace the existing inlet in consideration of the existing and additional tributary areas.

1.2 Standards

The standards below were used in the analysis and design of the proposed catch basin.

- LA County Department of Public Works Hydrology Manual (2006)
- LA County HydroCalc Calculator

2.0 Site Description

2.1 Project location

The project consists of the development for four single-family homes on the following sites:
(1) 17538, 17544, 17550 Tramonto Drive,
(2) 17523, 17529 Revello Drive,
(3) 17533, 17537, 17541, 17547 Revello Drive,
(4) 17532, 17540, 17548 Revello Drive.
The approximate coordinates, as obtained from Google Earth, are Longitude: 34.040671 and Latitude: 118.558436. The project site is bounded by Tramonto Drive on the North side and Revello Drive dead ends at the Southeast property line of the site. At the dead end of Revello Drive an existing above ground storm drain pipe collects the water from Revello Drive and the contributing hillside. Figure 1 shows the aerial view of the project site and the contributing watershed.

Figure 1. Extent of watershed contributing to storm drain pipe

2.2 Proposed Design

The proposed design of the site involves the construction of 4 single-family residences. As part of the construction, there are three proposed options for the existing drainage inlet on Revello Dr. Assuming field conditions, option one would be to allow the existing inlet to remain. Option two would be to keep the existing inlet but modifying the structure of the inlet to align with the proposed roadway extension to the east of the inlet. Option three would be to remove and replace the existing inlet with a City of LA standard side opening catch basin along Revello Drive to collect the stormwater and convey it to the existing 24-inch CMP. These options will be further developed and reviewed by the City during the B-Permit approval process for the proposed roadway extension of Revello Drive.

2.3 Existing Drainage Pattern

2.3.1 Existing Drainage Pattern for Existing Drain Inlet and Pipe

Figure 2 below delineates the drainage tributary area of the existing drainage inlet on Revello Drive. The flow towards the existing inlet includes streets Bellino Dr., Tramonto Dr., Quadro Vecchio Dr., and Revello Dr. the general drainage pattern consists of 3,000 feet of roadway surface. The drainage flows north to south towards Tramonto Dr, which then drains to the east and south towards Revello Dr.

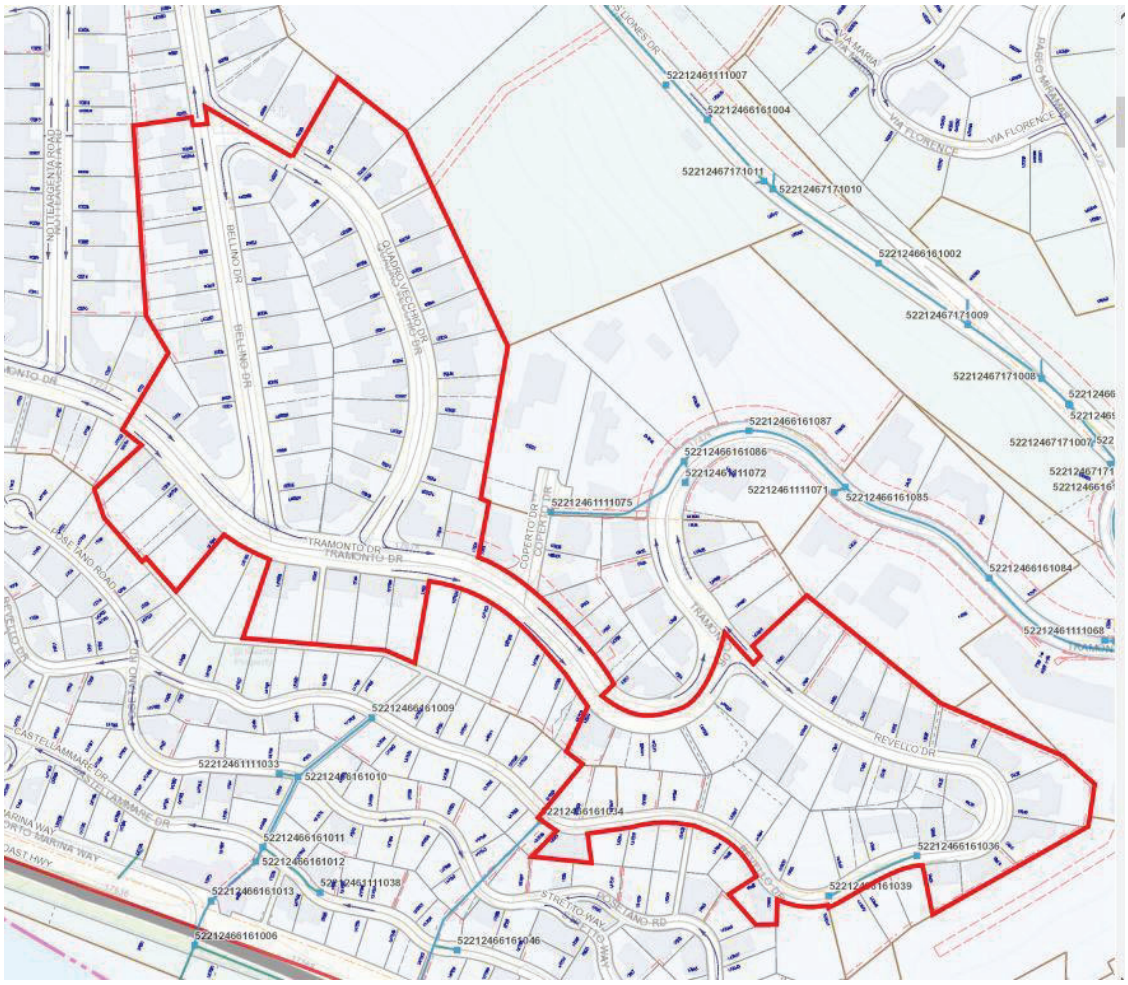


Figure 2. Existing tributary area for existing inlet on Revello Dr.

2.3.2 Existing Drainage Pattern of Proposed Development.

The general drainage pattern consists of 595 ft. extending between Revello Drive and Tramoto Drive. The entire area's runoff flows southeast, down the hillside, towards an existing storm drain inlet, located on the flow line of lot U17526 (as referenced by navigateLA), this inlet may be reconstructed into a new catch basin. Figure 3 shows the existing drainage area.

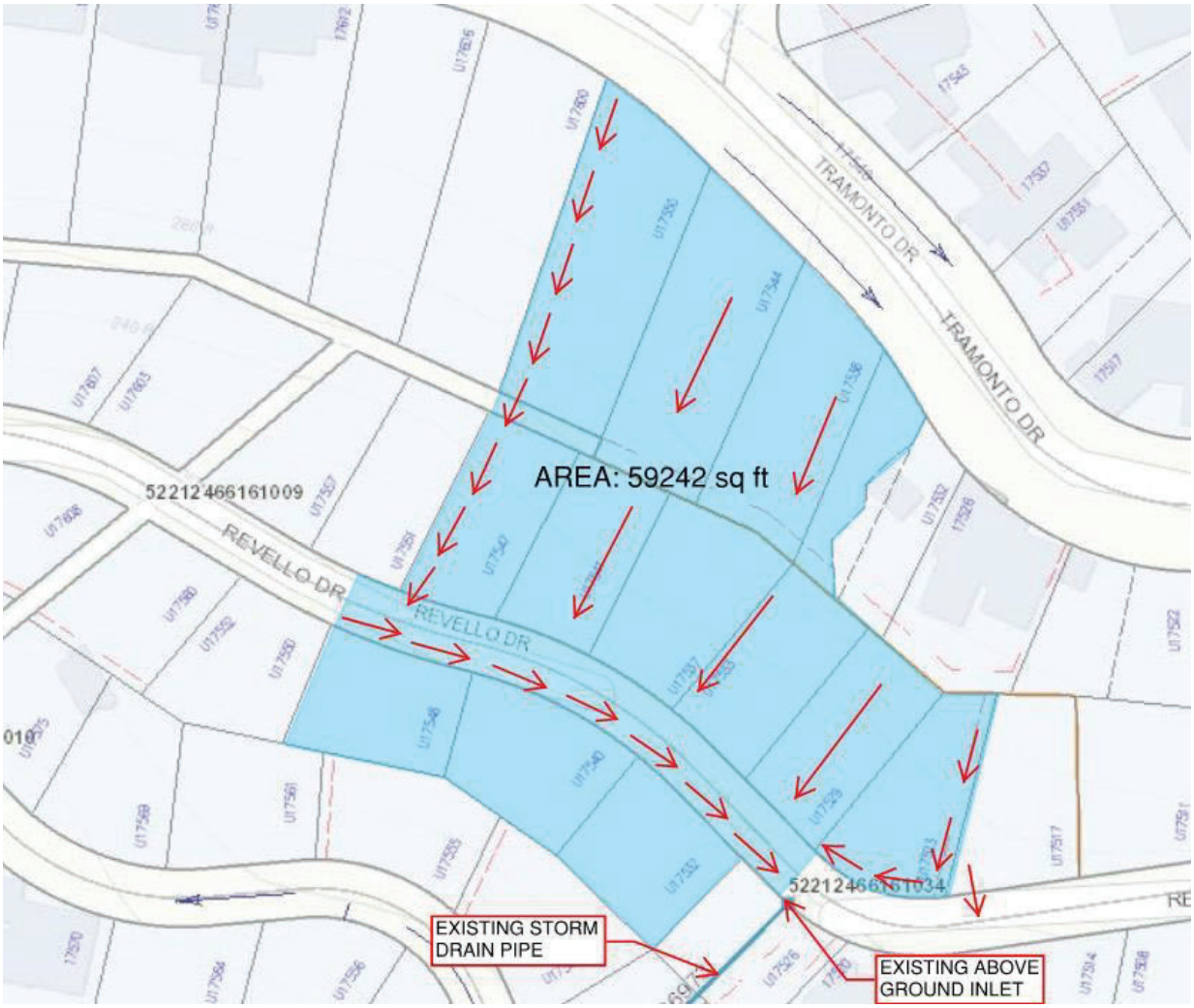


Figure 3. Proposed Development Tributary Area

2.4 Soil Type

"The subject property is underlain at the surface and at shallow depth by bedrock units assigned to the Topanga Formation. The extreme western portion of subject lots is mantled by Landslide deposits originated from Topanga Formation material. Thin fills and residual soils are present but not mapped." "Bedrock strata of the Topanga Formation consists of dark gray to light gray siltstone and sandstone with interbedded shale (Tti) and thickly bedded to massive units of conglomerate (Ttc). While not directly relevant to this study, it is our finding the materials onsite closely reflect the descriptions of the lower Topanga provided by Dibblee. Local mapping indicates the strata appear to be contorted, and severely to moderately weathered in the upper 40 to 50 feet from grade. Below 50 feet, these units are moderately weathered to fresh and moderately soft to hard." "The Tramonto Landslide material is largely comprised of disturbed and disarticulated blocks of the Topanga Formation conglomerate materials. The upper western portions of the mass may be composed of Topanga or Sespe (Ts) sandstone. The landslide material is severely weathered brown, gray to light gray/brown conglomerate, siltstone, and sandstone gravel within a matrix of soil-like sands, silts and clays with cobbles. These materials are described as soft to moderately soft. In general and for stability analyses purposes, the upper 40 to 50 feet of the weathered zone in the bedrock is considered to possess strength properties essentially consistent with the landslide debris mass." (Geology and Soil Reports by Stoney Miller Consultants dated 06/27/2019 for Tramonto/ Revello properties, pgs. 7-8)

3.0 Hydrology Conditions

The hydrology data and design criteria were obtained from LA County Department of Public Works (LACDPW) Hydrology Manual.

3.1 Isohyetal Map

Based on its Google Earth coordinates, the project site was determined to be within the Topanga Map (I-H1.26) of the LACDPW Hydrology Manual, Appendix A Attachment 1 includes the isohyetal map related to this project.

3.2 Design Frequency

Drainage design calculations are based on the 10 year, 24-hour storm event based on Los Angeles County Manual (2006). A 50-year storm event scenario is provided for reference and comparison. (See Appendix A Attachment 3)

3.3 Rainfall Depth

Based on the Isohyet Map, the rainfall for the project site is approximately 4.96 inches for a 10-year 24-hour and 6.95 inches for a 50-year, 24-hour storm.

4.0 Hydrology Analysis

4.1 Tributary Areas

The project site is composed of one major tributary area, which would drain into the proposed catch basin. Table 1 and table 2 provides the 10-year 50-year Peak Flow Rates and Peak Volume for the proposed developed area, respectively. Table 3 and table 4 provides the 10-year 50-year Peak Flow Rates and Peak Volume for the tributary area of the existing storm drain inlet, respectively. Table 5 and table 6 provides the 10-year 50-year Peak Flow Rates and Peak Volume for the total of the existing inlet tributary area and the addition of the new development area, respectively. See Appendix A for the Peak Flow Hydrologic Analysis for each of the tables below.

Table 1: 10-year peak flow for Proposed Development per figure 3

Tributary Area	Isohyet (in)	Soil Type	Sub-Area (acres)	Impervious (%)	Tc (min)	Q (cfs)	24-hr Runoff Volume (acre-ft)	24-hr Runoff Volume (ft3)
A	4.96	38	1.36	40	5	3.31	0.34	14603.9

Table 2: 50-year peak flow for Proposed Development per figure 3

Tributary Area	Isohyet (in)	Soil Type	Sub-Area (acres)	Impervious (%)	Tc (min)	Q (cfs)	24-hr Runoff Volume (acre-ft)	24-hr Runoff Volume (ft3)
A	6.95	38	1.36	40	5	4.77	0.48	20797.8

Table 3: 10-year peak flow for existing drainage inlet for existing tributary area per figure 2

Tributary Area	Isohyet (in)	Soil Type	Sub-Area (acres)	Impervious (%)	Tc (min)	Q (cfs)	24-hr Runoff Volume (acre-ft)	24-hr Runoff Volume (ft3)
A	4.96	38	18.18	51	21	19.80	3.97	172873.2

Table 4: 50-year peak flow for existing drainage inlet for existing tributary area per figure 2

Tributary Area	Isohyet (in)	Soil Type	Sub-Area (acres)	Impervious (%)	Tc (min)	Q (cfs)	24-hr Runoff Volume (acre-ft)	24-hr Runoff Volume (ft3)
A	6.95	38	18.18	51	16	33.94	5.69	248034.0

Table 5: 10-year peak flow for combined existing and proposed development per figures 2 and 3

Tributary Area	Isohyet (in)	Soil Type	Sub-Area (acres)	Impervious (%)	Tc (min)	Q (cfs)	24-hr Runoff Volume (acre-ft)	24-hr Runoff Volume (ft3)
A	4.96	38	19.54	52	21	21.42	4.33	188714.2

Table 6: 50-year peak flow for combined existing and proposed development per figures 2 and 3

Tributary Area	Isohyet (in)	Soil Type	Sub-Area (acres)	Impervious (%)	Tc (min)	Q (cfs)	24-hr Runoff Volume (acre-ft)	24-hr Runoff Volume (ft3)
A	6.95	38	19.54	52	16	36.65	6.21	270542.6

5.0 Hydraulic Analysis

5.1 Proposed Catch Basin Option System

Under this proposed hydraulic system consists of a new side opening catch basin and the existing 24" CMP storm drain line, designed to capture and convey the runoff produced from a 10-year design storm. The proposed catch basin was sized for a 10-year, 24-hour storm frequency with the aid of the Pipe Sizing spreadsheet in Appendix A Attachment D. The sizing was based on high density polyethylene pipe material, with a Manning's roughness coefficient of 0.012.

The catch basin was designed based for a 10-year, 24-hour storm. Based on the results from the calculations it is determined that an opening of 4-inches by 36-inches will meet the flow rate capacity required.

The pipe size calculation included is for the combined flow of the existing drainage area and the addition of the proposed development. The information is provided for both the 10-year and the 50-year storm, at both the steepest existing slope of the pipe and at the shallowest.

6.0 Project Conclusion and Recommendations

After reviewing the results of the hydrology study, VCA Engineers concludes and recommends that:

1. The existing storm drain inlet and CMP is adequately sized to convey the peak flow water runoff during a 10-year, 24-hour rainfall event from both the existing tributary areas as well as the additional tributary areas captured by the proposed four-home development.

2. The existing storm drain inlet and CMP is also adequately sized to convey the peak flow water runoff during a 50-year, 24-hour rainfall event from both the existing and proposed tributary areas, even though the City design standards are for a 10-year storm, 24-hour rainfall event."

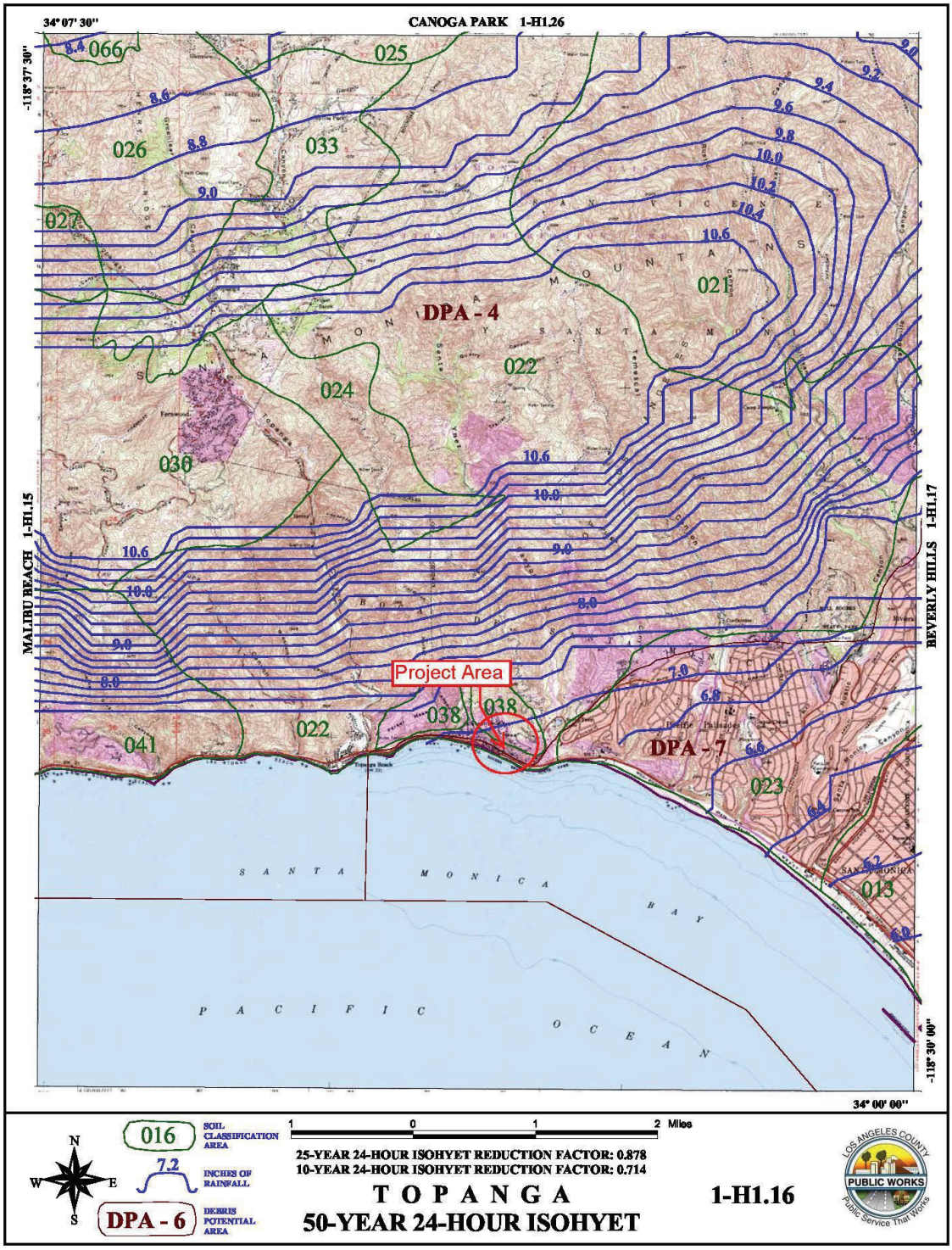
It has been a pleasure to be of professional service to you. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,
VCA ENGINEERS Inc.

VIRGIL C. AOANAN, P.E. S.E.
PRINCIPAL

Appendix A

Hydrology Map



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10-year 24- hour Hydrology Calculation Proposed Area Per Figure 3

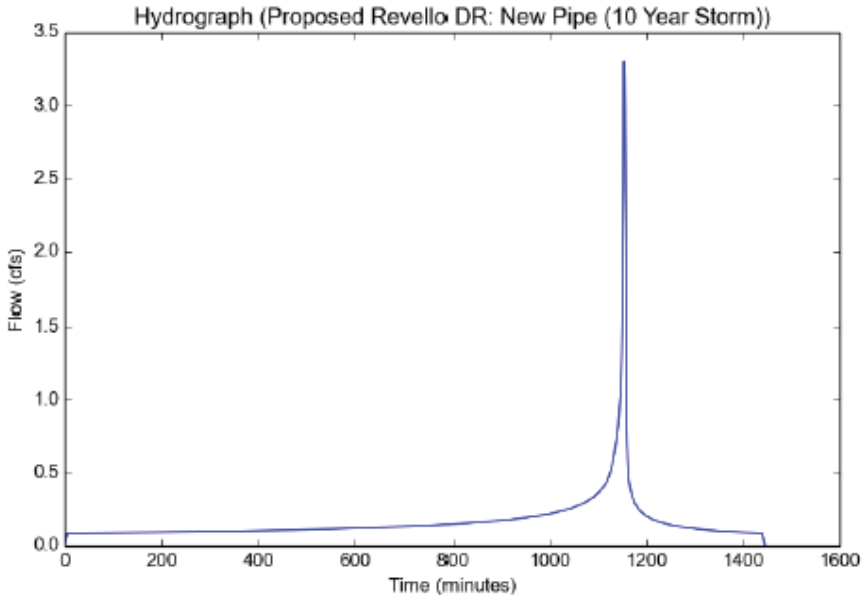
Peak Flow Hydrologic Analysis

Input Parameters

Project Name	Proposed Revello DR
Subarea ID	New Pipe (10 Year Storm)
Area (ac)	1.36
Flow Path Length (ft)	285.0
Flow Path Slope (vft/hft)	0.05
50-yr Rainfall Depth (in)	6.95
Percent Impervious	0.6
Soil Type	38
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.9623
Peak Intensity (in/hr)	2.9606
Undeveloped Runoff Coefficient (Cu)	0.7022
Developed Runoff Coefficient (Cd)	0.8209
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	3.3052
Burned Peak Flow Rate (cfs)	3.3052
24-Hr Clear Runoff Volume (ac-ft)	0.3353
24-Hr Clear Runoff Volume (cu-ft)	14603.8962



50-year 24- hour Hydrology Calculation Proposed Area Per Figure 3

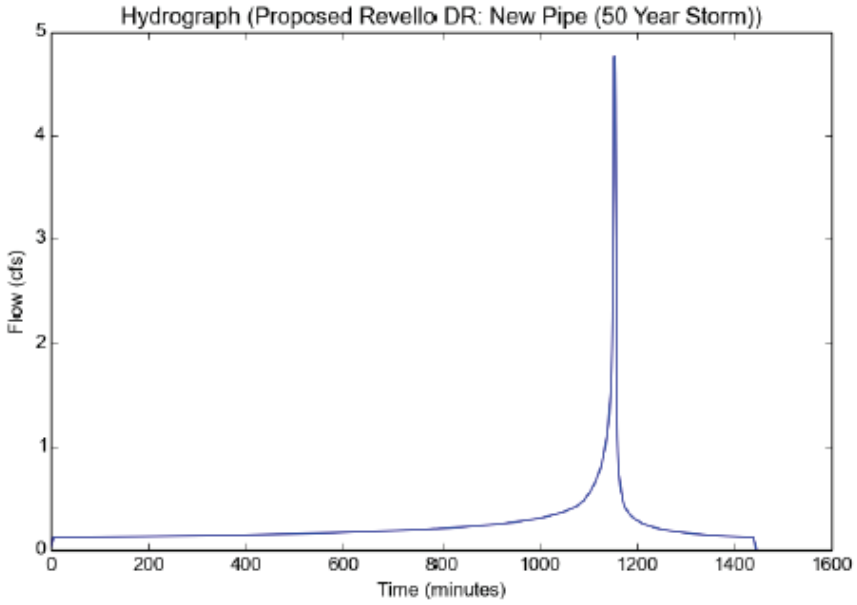
Peak Flow Hydrologic Analysis

Input Parameters

Project Name	Proposed Revello DR
Subarea ID	New Pipe (50 Year Storm)
Area (ac)	1.36
Flow Path Length (ft)	285.0
Flow Path Slope (vft/hft)	0.05
50-yr Rainfall Depth (in)	6.95
Percent Impervious	0.6
Soil Type	38
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.95
Peak Intensity (in/hr)	4.1466
Undeveloped Runoff Coefficient (Cu)	0.7636
Developed Runoff Coefficient (Cd)	0.8455
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	4.7678
Burned Peak Flow Rate (cfs)	4.7678
24-Hr Clear Runoff Volume (ac-ft)	0.4775
24-Hr Clear Runoff Volume (cu-ft)	20797.7714



10-year 24- hour Hydrology Calculation Existing Area Per Figure 2

Peak Flow Hydrologic Analysis

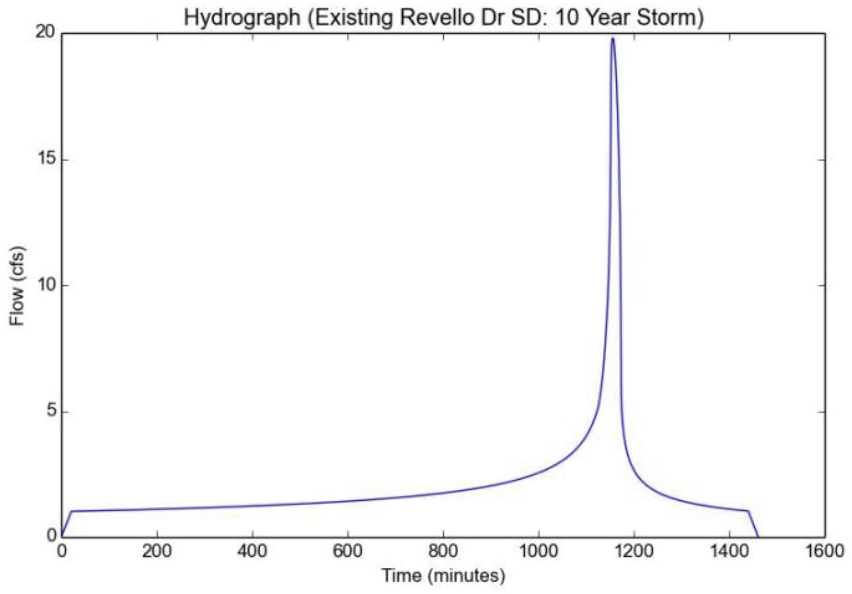
File location: Z:/VCA Projects 5/2013 to XXX/2059-219 17532-17540 Revello Residence/Reports/Hydrology/2019-07-11_Existing Revello D
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Existing Revello Dr SD
Subarea ID	10 Year Storm
Area (ac)	18.18
Flow Path Length (ft)	3000.0
Flow Path Slope (vft/hft)	0.06
50-yr Rainfall Depth (in)	6.95
Percent Impervious	0.51
Soil Type	38
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.9623
Peak Intensity (in/hr)	1.5082
Undeveloped Runoff Coefficient (Cu)	0.5371
Developed Runoff Coefficient (Cd)	0.7222
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	19.8015
Burned Peak Flow Rate (cfs)	19.8015
24-Hr Clear Runoff Volume (ac-ft)	3.9686
24-Hr Clear Runoff Volume (cu-ft)	172873.1845



50-year 24- hour Hydrology Calculation Existing Area Per Figure 2

Peak Flow Hydrologic Analysis

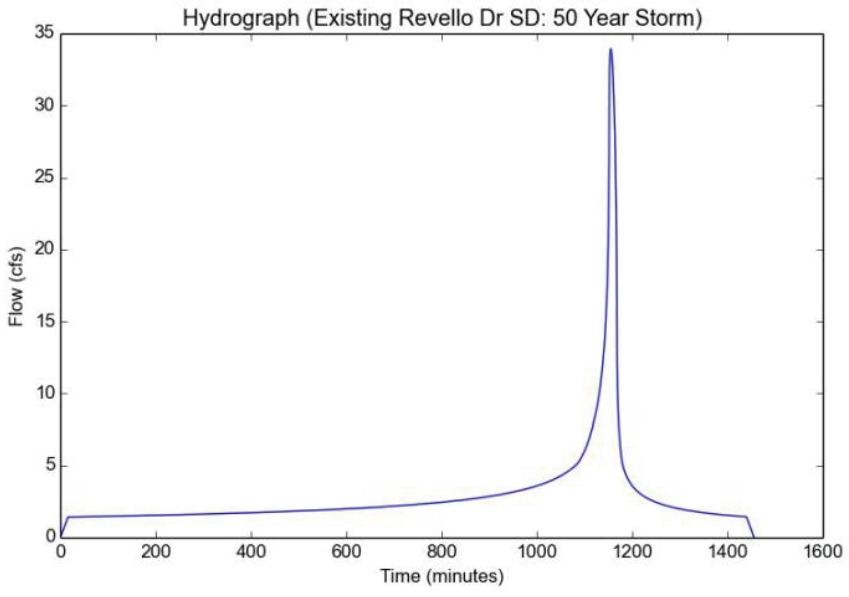
File location: Z:/VCA Projects 5/2013 to XXX/2059-219 17532-17540 Revello Residence/Reports/Hydrology/2019-07-11_Existing Revello D
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Existing Revello Dr SD
Subarea ID	50 Year Storm
Area (ac)	18.18
Flow Path Length (ft)	3000.0
Flow Path Slope (vft/hft)	0.06
50-yr Rainfall Depth (in)	6.95
Percent Impervious	0.51
Soil Type	38
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.95
Peak Intensity (in/hr)	2.4003
Undeveloped Runoff Coefficient (Cu)	0.6507
Developed Runoff Coefficient (Cd)	0.7778
Time of Concentration (min)	16.0
Clear Peak Flow Rate (cfs)	33.9422
Burned Peak Flow Rate (cfs)	33.9422
24-Hr Clear Runoff Volume (ac-ft)	5.6941
24-Hr Clear Runoff Volume (cu-ft)	248033.9879



10-year 24- hour Hydrology Calculation Combined Areas Per Figures 2 and 3

Peak Flow Hydrologic Analysis

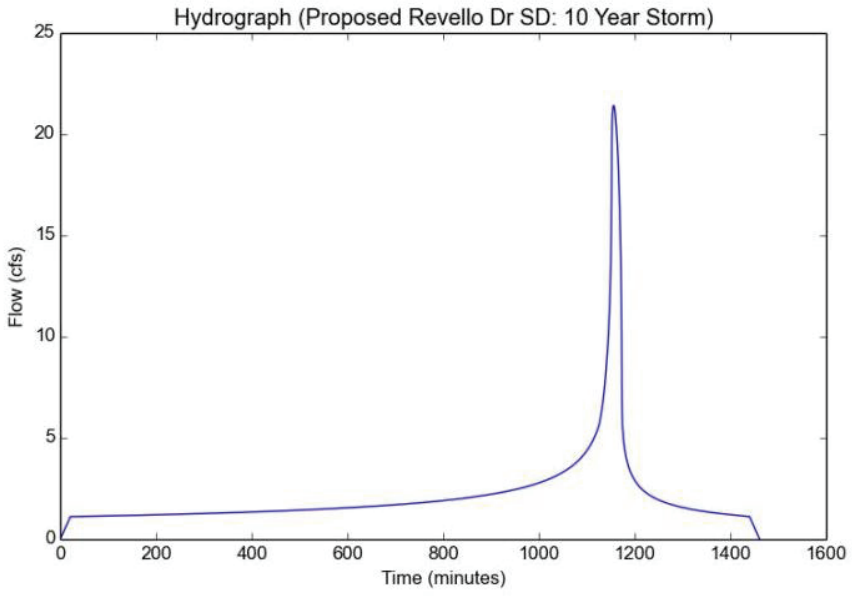
File location: Z:/VCA Projects 5/2013 to XXX/2059-219 17532-17540 Revello Residence/Reports/Hydrology/2019-07-11_Proposed Revello
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Proposed Revello Dr SD
Subarea ID	10 Year Storm
Area (ac)	19.57
Flow Path Length (ft)	3000.0
Flow Path Slope (vft/hft)	0.06
50-yr Rainfall Depth (in)	6.95
Percent Impervious	0.52
Soil Type	38
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	4.9623
Peak Intensity (in/hr)	1.5082
Undeveloped Runoff Coefficient (Cu)	0.5371
Developed Runoff Coefficient (Cd)	0.7258
Time of Concentration (min)	21.0
Clear Peak Flow Rate (cfs)	21.4226
Burned Peak Flow Rate (cfs)	21.4226
24-Hr Clear Runoff Volume (ac-ft)	4.3323
24-Hr Clear Runoff Volume (cu-ft)	188714.2258



50-year 24- hour Hydrology Calculation Combined Areas per figures 2 and 3

Peak Flow Hydrologic Analysis

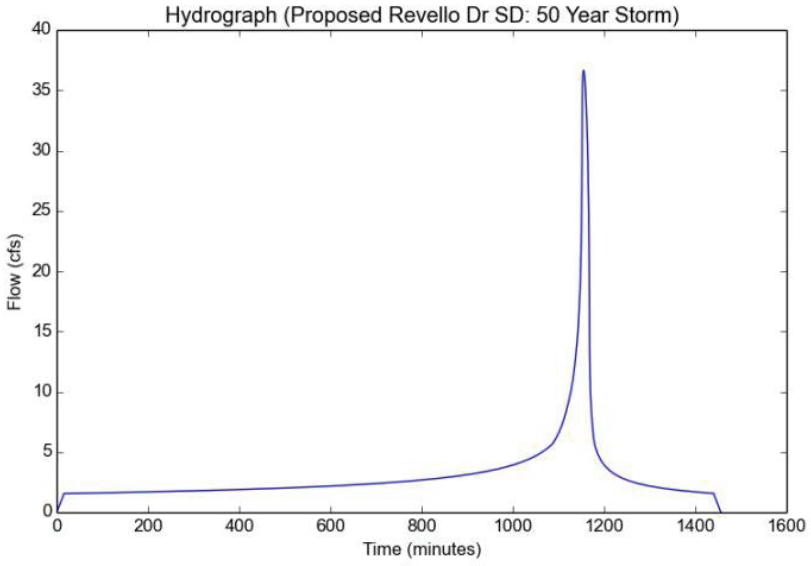
File location: Z:/VCA Projects 5/2013 to XXX/2059-219 17532-17540 Revello Residence/Reports/Hydrology/2019-07-11_Proposed Revello
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Proposed Revello Dr SD
Subarea ID	50 Year Storm
Area (ac)	19.57
Flow Path Length (ft)	3000.0
Flow Path Slope (vft/hft)	0.06
50-yr Rainfall Depth (in)	6.95
Percent Impervious	0.52
Soil Type	38
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.95
Peak Intensity (in/hr)	2.4003
Undeveloped Runoff Coefficient (Cu)	0.6507
Developed Runoff Coefficient (Cd)	0.7803
Time of Concentration (min)	16.0
Clear Peak Flow Rate (cfs)	36.6545
Burned Peak Flow Rate (cfs)	36.6545
24-Hr Clear Runoff Volume (ac-ft)	6.2108
24-Hr Clear Runoff Volume (cu-ft)	270542.5848



Pipe Size Calculator

For combined tributary areas per figures 2 and 3, 50 year storm used analyze the existing CMP, figure below is for the steepest portion of the existing storm water pipe.

PIPE		Accumulated Q at this pipe section =		36.65 cfs	
Calculations for Velocity and Discharge					
D	=	24	2.00 ft		Diameter of Pipe
n	=	0.022			Manning's Roughness Coefficient
S	=	0.3663 ft/ft	36.63 %		Slope of Pipe
d	=	18.24 inches	1.52 ft		Flow Depth
d/D		0.76			Proportional Depth of Flow
theta	=	4.2353 radians			Angle of Flow
a	=	2.56 sq.ft			Area of Flow
p	=	4.24 ft			Wetted Perimeter
r	=	0.60 ft			Hydraulic Radius
Using Manning's Equation, for pipe at flow depth 'd'					
v	=	29.30 fps		Flow Velocity	OK
Q	=	75.06 cfs		Flow Rate	OK Therefore, Pipe Size is OK

For combined tributary areas per figures 2 and 3, 50 year storm used analyze the existing CMP, figure below is for the shallowest portion of the existing storm water pipe.

PIPE		Accumulated Q at this pipe section =		36.65 cfs	
Calculations for Velocity and Discharge					
D	=	24	2.00 ft		Diameter of Pipe
n	=	0.022			Manning's Roughness Coefficient
S	=	0.09 ft/ft	9.00 %		Slope of Pipe
d	=	18.24 inches	1.52 ft		Flow Depth
d/D		0.76			Proportional Depth of Flow
theta	=	4.2353 radians			Angle of Flow
a	=	2.56 sq.ft			Area of Flow
p	=	4.24 ft			Wetted Perimeter
r	=	0.60 ft			Hydraulic Radius
Using Manning's Equation, for pipe at flow depth 'd'					
v	=	14.52 fps		Flow Velocity	OK
Q	=	37.20 cfs		Flow Rate	OK Therefore, Pipe Size is OK

Catch Basin Calculator for combined tributary areas per figure 2 and 3

VCA Engineers, Inc.	Catch Basin Size	
Client:		Job No. 2062
Project: Revello Drive		Date: 11/4/2019
17523, 17529, 17532, 17533, 17537, 17540, 17541, 17547, 17548 Revello Drive		Engineer:
17538, 17544, and 17550 Tramonto Drive, Pacific Palisades, CA 90272		

FOR 10-YEAR STORM

Accumulated Q at this section = 3.31 cfs

Calculations for Velocity and Discharge					
W =	36		3.00 ft		Width of opening
H	4		0.33 ft		Height of opening
n =	0.012				Manning's Roughness Coefficient
S =	0.005	ft/ft	0.50 %		Slope of Sewer Pipe
d/D	0.25		ft		Flow Depth
a =	1.00	sq.ft			Area of Flow
p =	3.50	ft			Wetted Perimeter
r =	0.29	ft			Hydraulic Radius
Using Manning's Equation, for pipe at flow depth 'd'					
v =	3.81	fps		Flow Velocity	OK
Q =	3.81	cfs		Flow Rate	OK Therefore, Opening is OK

FOR 50-YEAR STORM

Accumulated Q at this section = 4.77 cfs

Calculations for Velocity and Discharge					
W =	48		4.00 ft		Width of opening
H	4		0.33 ft		Height of opening
n =	0.012				Manning's Roughness Coefficient
S =	0.005	ft/ft	0.50 %		Slope of Sewer Pipe
d/D	0.25		ft		Flow Depth
a =	1.33	sq.ft			Area of Flow
p =	4.50	ft			Wetted Perimeter
r =	0.30	ft			Hydraulic Radius
Using Manning's Equation, for pipe at flow depth 'd'					
v =	3.90	fps		Flow Velocity	OK
Q =	5.20	cfs		Flow Rate	OK Therefore, Opening is OK