DRAINAGE ANALYSIS – ENTRY CULVERT

DE PORTOLA WINERY
APN: 941-180-032

NEC DE PORTOLA ROAD AND MONTE DE ORO
TEMECULA, CALIFORNIA 92592
PAR01536

PREPARED FOR:

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Original Date: *January 23, 2018*

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions code, and that the design is consistent with current standards.

WILFREDO VENTURA
R.C.E. NO. 66532
EXPIRES 6/30/18

1/23/18

DATE

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1.0 INTRODUCTION

The purpose of this report is to calculate the limited hydrology and hydraulic conditions associated with the existing entry area culverts and their repair due to the undermining and destruction of the vineyards in the exit area of the culverts entering the property from the northside runoff from De Portola Road. Although not being submitted to an agency for review at this time, these calculations have been created using the Riverside County Flood Control and Water Conservation District Hydrology Manual (April 1978) as discussed further in Section 3.0.

2.0 LOCATION

The project site is located at northeast corner of De Portola Road and Monte de Oro in Temecula, California 92592. A vicinity map is provided for reference in Attachment 4.

3.0 METHODOLOGY

This report has calculated 100-Year Maximum Peak Runoff based on the Riverside County Flood Control and Water Conservation District Hydrology Manual (April 1978) rational methodology and routes is through the ditches, culverts, and pipes as requested by the owner. In addition, this manual will be referred to as the 'Standards' throughout this report. Clean copies of the excerpts from the standards have been included in Attachment 1: Standards Excerpts for reference. The calculations are provided in Attachment 2: Calculations. Exhibits are provided for reference in Attachment 3: Hydrology Exhibits.

4.0 OPTION ANALYSIS

Two options with two different pipe options have been analyzed. The options overall considerations can be summarized as:

Option 1A – Run North then West – 1 Pipe: This will require (1) 24" pipe
Option 1B – Nun North then West – 2 Pipes: This will require (2) 18" pipes

Option 2A – Run South then West – 1 Pipe: This will require (1) 24" pipe
Option 2B – Nun South then West – 2 Pipes: This will require (2) 18" pipes

5.0 FEMA ANALYSIS

No FEMA or flooding analysis has been performed by these calculations.

6.0 REFERENCES

The following references were utilized in the creation of this hydrology report:

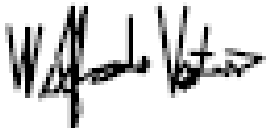
Brater & King, *Handbook of Hydraulics*, 6th ed.

Hydrology Manual, Riverside County Flood Control & Water Conservation District, April 1978

7.0 DECLARATION OF RESPONSIBLE CHARGE

I hereby declare that I am the engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the agency is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.



1/23/18

Wilfredo Ventura

Date

8.0 ATTACHMENTS

The following attachment sections are provided for reference:

8.1 ATTACHMENT 1: STANDARD EXCERPTS

This attachment contains excerpts from the standards. Please refer to the attached references.

8.2 ATTACHMENT 2: CALCULATIONS

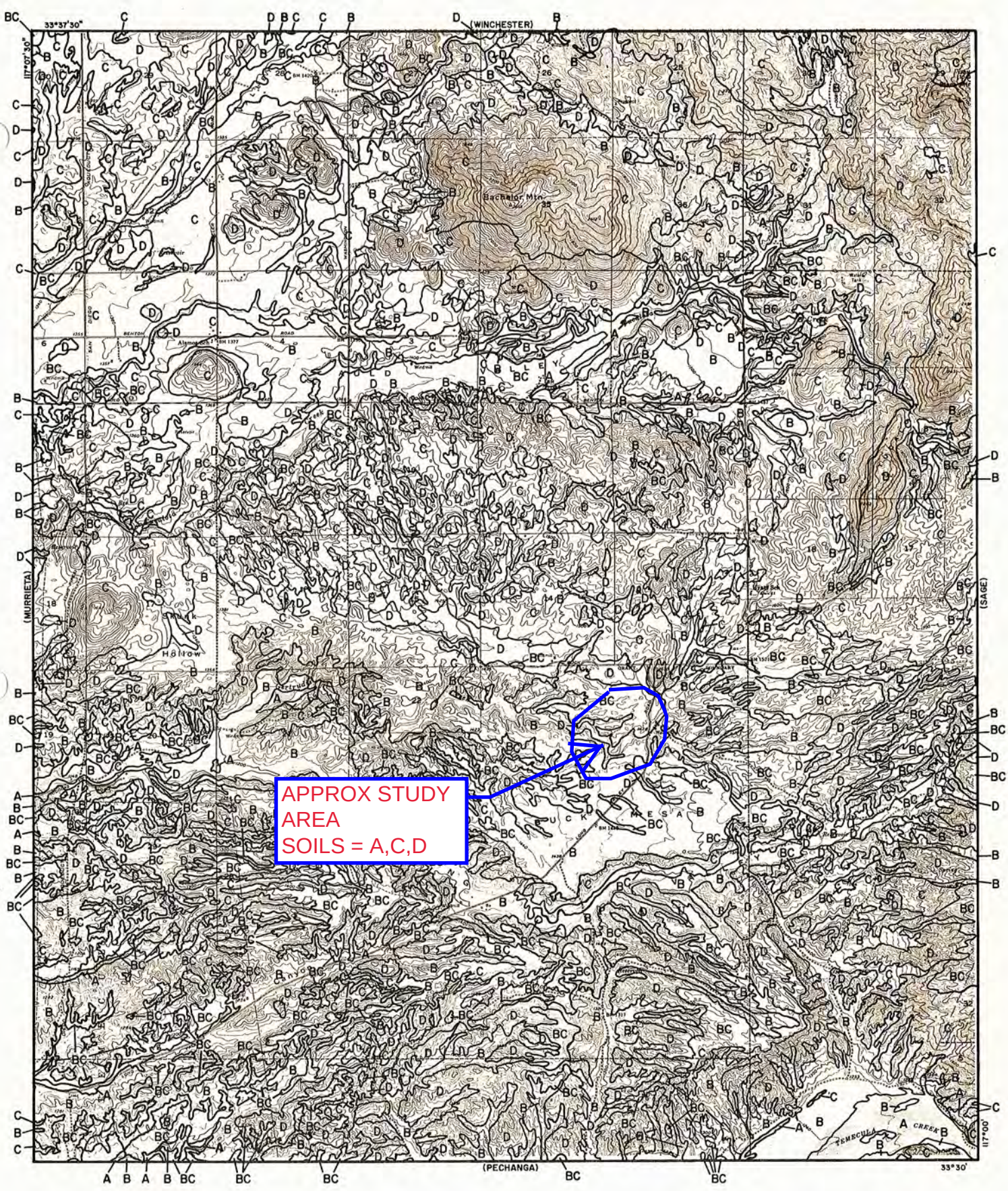
This attachment contains the calculations. Calculations are provided here for reference.

8.3 ATTACHMENT 3: HYDROLOGY EXHIBITS

This attachment contains select exhibits that are provided here for reference.

ATTACHMENT 1: STANDARD EXCERPTS

This attachment contains various excerpts from the Riverside County Flood Control & Water Conservation District Hydrology Manual (April 1978 edition). Please see the attached excerpts from the standards.



LEGEND

SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

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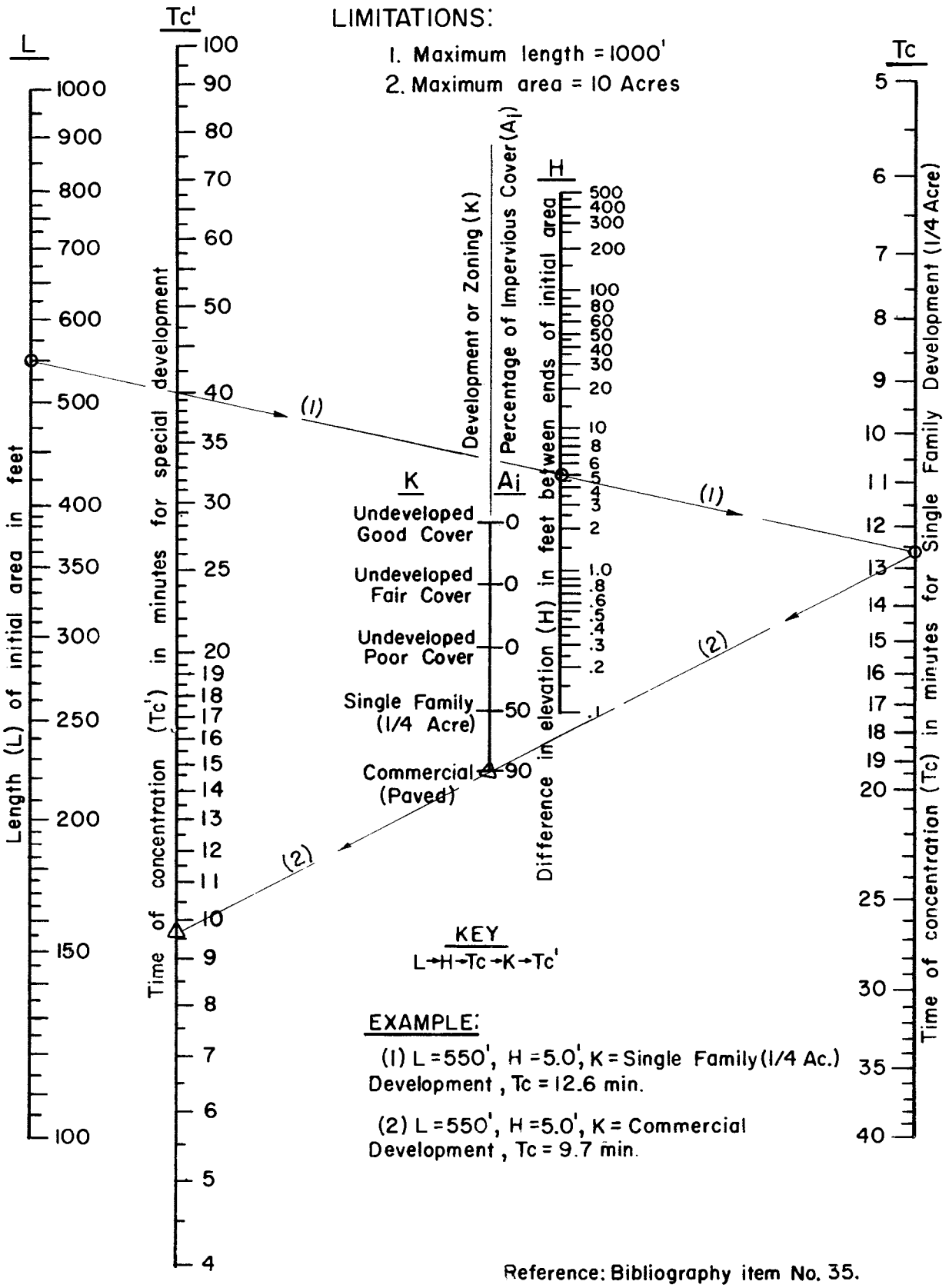
HYDROLOGIC SOILS GROUP MAP FOR BACHELOR MTN.

PLATE C-1.53



Reference: Bibliography item No. 35.

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TIME OF CONCENTRATION
FOR INITIAL SUBAREA

PLATE D-3

RAINFALL INTENSITY–INCHES PER HOUR

MIRA LOMA			MURRIETA - TEMECULA & RANCHO CALIFORNIA			NORCO			PALM SPRINGS			PERRIS VALLEY		
DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY		DURATION MINUTES	FREQUENCY	
	10 YEAR	100 YEAR		10 YEAR	100 YEAR		10 YEAR	100 YEAR		10 YEAR	100 YEAR		10 YEAR	100 YEAR
5	2.84	4.48	5	3.45	5.10	5	2.77	4.16	5	4.23	6.76	5	2.64	3.78
6	2.58	4.07	6	3.12	4.61	6	2.53	3.79	6	3.80	6.08	6	2.41	3.46
7	2.37	3.75	7	2.87	4.24	7	2.34	3.51	7	3.48	5.56	7	2.24	3.21
8	2.21	3.49	8	2.67	3.94	8	2.19	3.29	8	3.22	5.15	8	2.09	3.01
9	2.08	3.28	9	2.50	3.69	9	2.07	3.10	9	3.01	4.81	9	1.98	2.84
10	1.96	3.10	10	2.36	3.48	10	1.96	2.94	10	2.83	4.52	10	1.88	2.69
11	1.87	2.95	11	2.24	3.30	11	1.87	2.80	11	2.67	4.28	11	1.79	2.57
12	1.78	2.82	12	2.13	3.15	12	1.79	2.68	12	2.54	4.07	12	1.72	2.46
13	1.71	2.70	13	2.04	3.01	13	1.72	2.58	13	2.43	3.88	13	1.65	2.37
14	1.64	2.60	14	1.96	2.89	14	1.66	2.48	14	2.33	3.72	14	1.59	2.29
15	1.58	2.50	15	1.89	2.79	15	1.60	2.40	15	2.23	3.58	15	1.54	2.21
16	1.53	2.42	16	1.82	2.69	16	1.55	2.32	16	2.15	3.44	16	1.49	2.14
17	1.48	2.34	17	1.76	2.60	17	1.50	2.25	17	2.08	3.32	17	1.45	2.08
18	1.44	2.27	18	1.71	2.52	18	1.46	2.19	18	2.01	3.22	18	1.41	2.02
19	1.40	2.21	19	1.66	2.45	19	1.42	2.13	19	1.95	3.12	19	1.37	1.97
20	1.36	2.15	20	1.61	2.38	20	1.39	2.08	20	1.89	3.03	20	1.34	1.92
22	1.29	2.04	22	1.53	2.26	22	1.32	1.98	22	1.79	2.86	22	1.28	1.83
24	1.24	1.95	24	1.46	2.15	24	1.26	1.90	24	1.70	2.72	24	1.22	1.75
26	1.18	1.87	26	1.39	2.06	26	1.22	1.82	26	1.62	2.60	26	1.18	1.69
28	1.14	1.80	28	1.34	1.98	28	1.17	1.76	28	1.56	2.49	28	1.13	1.63
30	1.10	1.73	30	1.29	1.90	30	1.13	1.70	30	1.49	2.39	30	1.10	1.57
32	1.06	1.67	32	1.24	1.84	32	1.10	1.64	32	1.44	2.30	32	1.06	1.52
34	1.03	1.62	34	1.20	1.78	34	1.06	1.59	34	1.39	2.22	34	1.03	1.48
36	1.00	1.57	36	1.17	1.72	36	1.03	1.55	36	1.34	2.15	36	1.00	1.44
38	.97	1.53	38	1.13	1.67	38	1.01	1.51	38	1.30	2.09	38	.98	1.40
40	.94	1.49	40	1.10	1.62	40	.98	1.47	40	1.27	2.02	40	.95	1.37
45	.89	1.40	45	1.03	1.52	45	.92	1.39	45	1.18	1.89	45	.90	1.29
50	.84	1.32	50	.97	1.44	50	.88	1.31	50	1.11	1.78	50	.85	1.22
55	.80	1.26	55	.92	1.36	55	.84	1.25	55	1.05	1.68	55	.81	1.17
60	.76	1.20	60	.88	1.30	60	.80	1.20	60	1.00	1.60	60	.78	1.12
65	.73	1.15	65	.84	1.24	65	.77	1.15	65	.95	1.53	65	.75	1.08
70	.70	1.11	70	.81	1.19	70	.74	1.11	70	.91	1.46	70	.72	1.04
75	.68	1.07	75	.78	1.15	75	.72	1.07	75	.88	1.41	75	.70	1.00
80	.65	1.03	80	.75	1.11	80	.69	1.04	80	.85	1.35	80	.68	.97
85	.63	1.00	85	.73	1.07	85	.67	1.01	85	.82	1.31	85	.66	.94
SLOPE = .530			SLOPE = .550			SLOPE = .500			SLOPE = .580			SLOPE = .490		

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STANDARD INTENSITY–DURATION CURVES DATA

PLATE D-4.1 (4 of 6)

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparrel, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparrel, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	28	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		76	85	90	92

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RUNOFF INDEX NUMBERS FOR PERVIOUS AREA

PLATE D-5.5 (1 of 2)

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
AGRICULTURAL COVERS (cont.) -					
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Deciduous (Apples, apricots, pears, walnuts, etc.)		See Note 4			
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland (Annual grasses)	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Pasture, Irrigated (Legumes and perennial grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small Grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87
Vineyard		See Note 4			

Notes:

1. All runoff index (RI) numbers are for Antecedent Moisture Condition (AMC) II.

2. Quality of cover definitions:
   Poor-Heavily grazed or regularly burned areas. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.
   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.
   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.

3. See Plate C-2 for a detailed description of cover types.

4. Use runoff index numbers based on ground cover type. See discussion under "Cover Type Descriptions" on Plate C-2.

5. Reference Bibliography item 17.

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent(2)
Natural or Agriculture	0 - 10	0
Single Family Residential: (3)		
40,000 S. F. (1 Acre) Lots	10 - 25	20
20,000 S. F. (½ Acre) Lots	30 - 45	40
7,200 - 10,000 S. F. Lots	45 - 55	50
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 -100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area should always be made, and a review of aerial photos, where available may assist in estimating the percentage of impervious cover in developed areas.

3. For typical horse ranch subdivisions increase impervious area 5 percent over the values recommended in the table above.

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IMPERVIOUS COVER FOR DEVELOPED AREAS

PLATE E-6.3

ATTACHMENT 2: CALCULATIONS

This attachment contains the project's calculations. Please see the attached calculations.

100 YEAR DESIGN STORM EVENT ROUTING

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2014 Version 9.0
Rational Hydrology Study Date: 01/24/18 File:2017045D1CULVERTS.out

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********* Hydrology Study Control Information **********

English (in-lb) Units used in input data file

Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) = 100.00 Antecedent Moisture Condition = 3

Standard intensity-duration curves data (Plate D-4.1)
For the [Perris Valley] area used.
10 year storm 10 minute intensity = 1.880(In/Hr)
10 year storm 60 minute intensity = 0.780(In/Hr)
100 year storm 10 minute intensity = 2.690(In/Hr)
100 year storm 60 minute intensity = 1.120(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity = 1.120(In/Hr)
Slope of intensity duration curve = 0.4900

++

Process from Point/Station 1.110 to Point/Station 1.230
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 580.000(Ft.)
Top (of initial area) elevation = 1548.000(Ft.)
Bottom (of initial area) elevation = 1539.000(Ft.)
Difference in elevation = 9.000(Ft.)
Slope = 0.01552 s(percent)= 1.55
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 15.541 min.
Rainfall intensity = 2.171(In/Hr) for a 100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3) = 95.60
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 0.684(CFS)
Total initial stream area = 0.360(Ac.)
Pervious area fraction = 1.000

++
Process from Point/Station 1.110 to Point/Station 1.310
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 1
Stream flow area = 0.360(Ac.)
Runoff from this stream = 0.684(CFS)
Time of concentration = 15.54 min.
Rainfall intensity = 2.171(In/Hr)

++
Process from Point/Station 1.210 to Point/Station 1.220
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 525.000(Ft.)
Top (of initial area) elevation = 1547.000(Ft.)
Bottom (of initial area) elevation = 1539.000(Ft.)
Difference in elevation = 8.000(Ft.)
Slope = 0.01524 s(percent)= 1.52
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 14.988 min.
Rainfall intensity = 2.210(In/Hr) for a 100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3) = 95.60
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 7.702(CFS)
Total initial stream area = 3.980(Ac.)
Pervious area fraction = 1.000

++
Process from Point/Station 1.220 to Point/Station 1.310
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1539.000(Ft.)
Downstream point/station elevation = 1534.000(Ft.)
Pipe length = 80.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 7.702(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 7.702(CFS)
Normal flow depth in pipe = 6.68(In.)
Flow top width inside pipe = 17.39(In.)
Critical Depth = 12.90(In.)
Pipe flow velocity = 12.91(Ft/s)
Travel time through pipe = 0.10 min.
Time of concentration (TC) = 15.09 min.

++
Process from Point/Station 1.210 to Point/Station 1.310
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 3.980(Ac.)
Runoff from this stream = 7.702(CFS)
Time of concentration = 15.09 min.
Rainfall intensity = 2.203(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	0.684	15.54	2.171
2	7.702	15.09	2.203

Largest stream flow has longer or shorter time of concentration
Qp = 7.702 + sum of

Qa	Tb/Ta	
0.684 *	0.971 =	0.664

Qp = 8.367

Total of 2 streams to confluence:
Flow rates before confluence point:
0.684 7.702
Area of streams before confluence:
0.360 3.980
Results of confluence:
Total flow rate = 8.367(CFS)
Time of concentration = 15.092 min.
Effective stream area after confluence = 4.340(Ac.)

++
Process from Point/Station 1.310 to Point/Station 1.520
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 8.675(CFS)
Depth of flow = 1.675(Ft.), Average velocity = 1.785(Ft/s)
******* Irregular Channel Data **********

Information entered for subchannel number 1 :

Point number	'X' coordinate	'Y' coordinate
1	0.00	2.00
2	5.00	1.00
3	6.00	0.00
4	7.00	1.00
5	13.00	2.00

Manning's 'N' friction factor = 0.020

Sub-Channel flow = 8.675(CFS)
' ' flow top width = 9.430(Ft.)
' ' velocity= 1.785(Ft/s)
' ' area = 4.860(Sq.Ft)

' ' Froude number = 0.438

Upstream point elevation = 1534.000(Ft.)
Downstream point elevation = 1533.000(Ft.)
Flow length = 630.000(Ft.)
Travel time = 5.88 min.
Time of concentration = 20.97 min.
Depth of flow = 1.675(Ft.)
Average velocity = 1.785(Ft/s)
Total irregular channel flow = 8.675(CFS)
Irregular channel normal depth above invert elev. = 1.675(Ft.)
Average velocity of channel(s) = 1.785(Ft/s)
Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3) = 95.60
Pervious area fraction = 1.000; Impervious fraction = 0.000
Rainfall intensity = 1.874(In/Hr) for a 100.0 year storm
Subarea runoff = 0.523(CFS) for 0.320(Ac.)
Total runoff = 8.889(CFS) Total area = 4.660(Ac.)
Depth of flow = 1.685(Ft.), Average velocity = 1.795(Ft/s)

++
Process from Point/Station 1.110 to Point/Station 1.520
**** CONFLUENCE OF MINOR STREAMS ****
_____
Along Main Stream number: 1 in normal stream number 1
Stream flow area = 4.660(Ac.)
Runoff from this stream = 8.889(CFS)
Time of concentration = 20.97 min.
Rainfall intensity = 1.874(In/Hr)

++
Process from Point/Station 1.410 to Point/Station 1.420
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 745.000(Ft.)
Top (of initial area) elevation = 1540.000(Ft.)
Bottom (of initial area) elevation = 1536.000(Ft.)
Difference in elevation = 4.000(Ft.)
Slope = 0.00537 s(percent)= 0.54
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 21.240 min.
Rainfall intensity = 1.863(In/Hr) for a 100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3) = 95.60
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 9.398(CFS)
Total initial stream area = 5.790(Ac.)
Pervious area fraction = 1.000

++
Process from Point/Station 1.420 to Point/Station 1.520
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 1536.000(Ft.)
Downstream point/station elevation = 1533.000(Ft.)
Pipe length = 60.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 9.398(CFS)
Given pipe size = 18.00(In.)
Calculated individual pipe flow = 9.398(CFS)
Normal flow depth in pipe = 7.92(In.)
Flow top width inside pipe = 17.87(In.)
Critical Depth = 14.22(In.)
Pipe flow velocity = 12.55(Ft/s)
Travel time through pipe = 0.08 min.
Time of concentration (TC) = 21.32 min.

++
Process from Point/Station 1.410 to Point/Station 1.520
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 5.790(Ac.)
Runoff from this stream = 9.398(CFS)
Time of concentration = 21.32 min.
Rainfall intensity = 1.860(In/Hr)

++
Process from Point/Station 1.510 to Point/Station 1.520
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 250.000(Ft.)
Top (of initial area) elevation = 1539.000(Ft.)
Bottom (of initial area) elevation = 1533.000(Ft.)
Difference in elevation = 6.000(Ft.)
Slope = 0.02400 s(percent)= 2.40
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.172 min.
Rainfall intensity = 2.672(In/Hr) for a 100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.880
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
RI index for soil(AMC 3) = 95.60
Pervious area fraction = 1.000; Impervious fraction = 0.000
Initial subarea runoff = 0.282(CFS)
Total initial stream area = 0.120(Ac.)
Pervious area fraction = 1.000

++
Process from Point/Station 1.510 to Point/Station 1.520
**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 3
Stream flow area = 0.120(Ac.)
Runoff from this stream = 0.282(CFS)
Time of concentration = 10.17 min.
Rainfall intensity = 2.672(In/Hr)
Summary of stream data:

Stream No.	Flow rate (CFS)	TC (min)	Rainfall Intensity (In/Hr)
1	8.889	20.97	1.874
2	9.398	21.32	1.860
3	0.282	10.17	2.672

Largest stream flow has longer time of concentration
Qp = 9.398 + sum of
Qb Ia/Ib
8.889 * 0.992 = 8.819
Qb Ia/Ib
0.282 * 0.696 = 0.196
Qp = 18.413

Total of 3 streams to confluence:
Flow rates before confluence point:
8.889 9.398 0.282
Area of streams before confluence:
4.660 5.790 0.120

Results of confluence:
Total flow rate = 18.413(CFS)
Time of concentration = 21.320 min.
Effective stream area after confluence = 10.570(Ac.)
End of computations, total study area = 10.57 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged RI index number = 89.0

100-YEAR DESIGN STORM EVENT COMPLIANCE POINT A SUMMARY	
DATA	***100-YEAR***
AMC	3
STUDY NODE POINT	1.52
INTENSITY (IN/HR)	2.672
TOTAL DISCHARGE (cfs)	18.4
TIME OF CONCENTRATION (MIN)	21.32
AREA (ACRES)	10.57

OPTION 1A: RUN NORTH THEN WEST – (1) 24" PIPE

```
 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004 - 2014  Version 9.0
------------------------------------------------------------------
                  *** Improved Channel Analysis ***

          Upstream (headworks) Elevation =   1533.000(Ft.)
          Downstream (outlet) Elevation =   1517.000(Ft.)
          Runoff/Flow Distance =    590.000(Ft.)
          Maximum flow rate in channel(s) =     18.400(CFS)
------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*** CALCULATED DEPTH DATA AT FLOW =   18.40(CFS) ***
Pipe length  =   590.00(Ft.)
Manning's N = 0.013   No. of pipes = 1
Required pipe flow  =    18.400(CFS)
Pipe size =     24.00(In.)
Calculated individual pipe flow  =    18.400(CFS)
Normal flow depth in pipe =   11.92(In.)
Flow top width inside pipe =   24.00(In.)
Critical Depth =   18.54(In.)
Pipe flow velocity =     11.82(Ft/s)
```

OPTION 1B: RUN NORTH THEN WEST – (2) 18" PIPE

```
 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004 - 2014  Version 9.0
------------------------------------------------------------------
                  *** Improved Channel Analysis ***

          Upstream (headworks) Elevation =   1533.000(Ft.)
          Downstream (outlet) Elevation =   1517.000(Ft.)
          Runoff/Flow Distance =    590.000(Ft.)
          Maximum flow rate in channel(s) =     18.400(CFS)
------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*** CALCULATED DEPTH DATA AT FLOW =   18.40(CFS) ***
Pipe length  =   590.00(Ft.)
Manning's N = 0.013   No. of pipes = 2
Required pipe flow  =    18.400(CFS)
Pipe size =     18.00(In.)
Calculated individual pipe flow  =     9.200(CFS)
Normal flow depth in pipe =    9.34(In.)
Flow top width inside pipe =   17.99(In.)
Critical Depth =   14.08(In.)
Pipe flow velocity =      9.94(Ft/s)
------------------------------------------------------------------
```

OPTION 2A: RUN SOUTH THEN WEST – (1) 24" PIPE

```
 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004 - 2014  Version 9.0
------------------------------------------------------------------
                *** Improved Channel Analysis ***

              Upstream (headworks) Elevation =   1533.000(Ft.)
              Downstream (outlet) Elevation =   1517.000(Ft.)
              Runoff/Flow Distance =    600.000(Ft.)
              Maximum flow rate in channel(s) =     18.400(CFS)
------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*** CALCULATED DEPTH DATA AT FLOW =   18.40(CFS) ***
Pipe length  =   600.00(Ft.)
Manning's N = 0.013   No. of pipes = 1
Required pipe flow  =    18.400(CFS)
Pipe size =     24.00(In.)
Calculated individual pipe flow  =    18.400(CFS)
Normal flow depth in pipe =   11.98(In.)
Flow top width inside pipe =   24.00(In.)
Critical Depth =   18.54(In.)
Pipe flow velocity =     11.75(Ft/s)
------------------------------------------------------------------
```

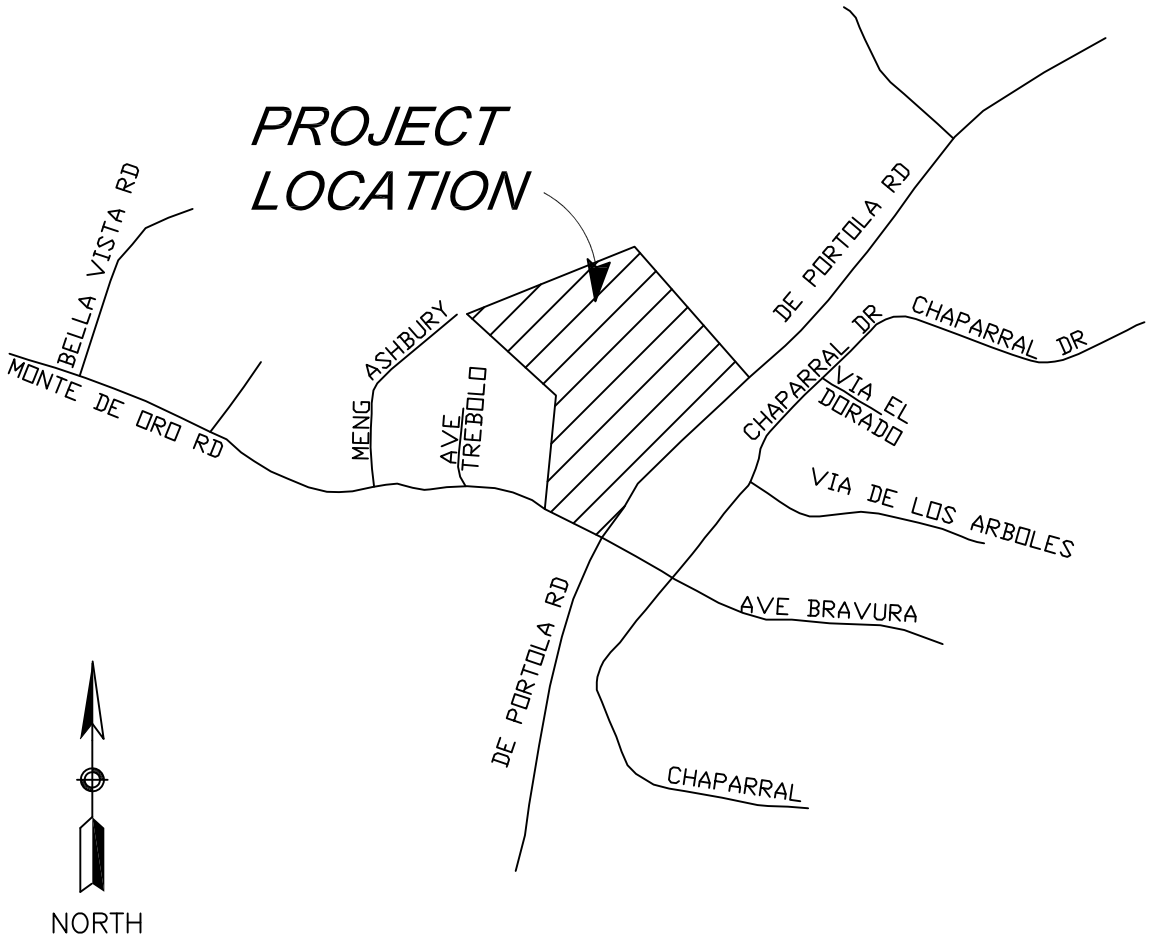
OPTION 2B: RUN SOUTH THEN WEST – (2) 18" PIPE

```
 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004 - 2014  Version 9.0
------------------------------------------------------------------
                *** Improved Channel Analysis ***

              Upstream (headworks) Elevation =   1533.000(Ft.)
              Downstream (outlet) Elevation =   1517.000(Ft.)
              Runoff/Flow Distance =    600.000(Ft.)
              Maximum flow rate in channel(s) =     18.400(CFS)
------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

*** CALCULATED DEPTH DATA AT FLOW =   18.40(CFS) ***
Pipe length  =   600.00(Ft.)
Manning's N = 0.013   No. of pipes = 2
Required pipe flow  =    18.400(CFS)
Pipe size =     18.00(In.)
Calculated individual pipe flow  =     9.200(CFS)
Normal flow depth in pipe =    9.39(In.)
Flow top width inside pipe =   17.98(In.)
Critical Depth =   14.08(In.)
Pipe flow velocity =      9.88(Ft/s)
------------------------------------------------------------------
```

ATTACHMENT 3: EXHIBITS

This attachment contains the vicinity map and other exhibits used in this report. Please see the attached exhibits.

VICINITY MAP



T7S R1W SEC 29
T7S R1W SEC 30

VICINITY MAP

NOT TO SCALE

100-YEAR DESIGN STORM EVENT COMPLIANCE POINT A SUMMARY	
DATA	100-YEAR
AMC	3
STUDY NODE POINT	1.52
INTENSITY (IN/HR)	2.672
TOTAL DISCHARGE (cfs)	18.4
TIME OF CONCENTRATION (MIN)	21.32
AREA (ACRES)	10.57

GENERAL HYDROLOGY

STUDY BASIC INFORMATION	
STORM EVENT	100-YEAR
PLATE	PERRIS VALLEY
AMC	3 (100-YR)
SOIL TYPE	D

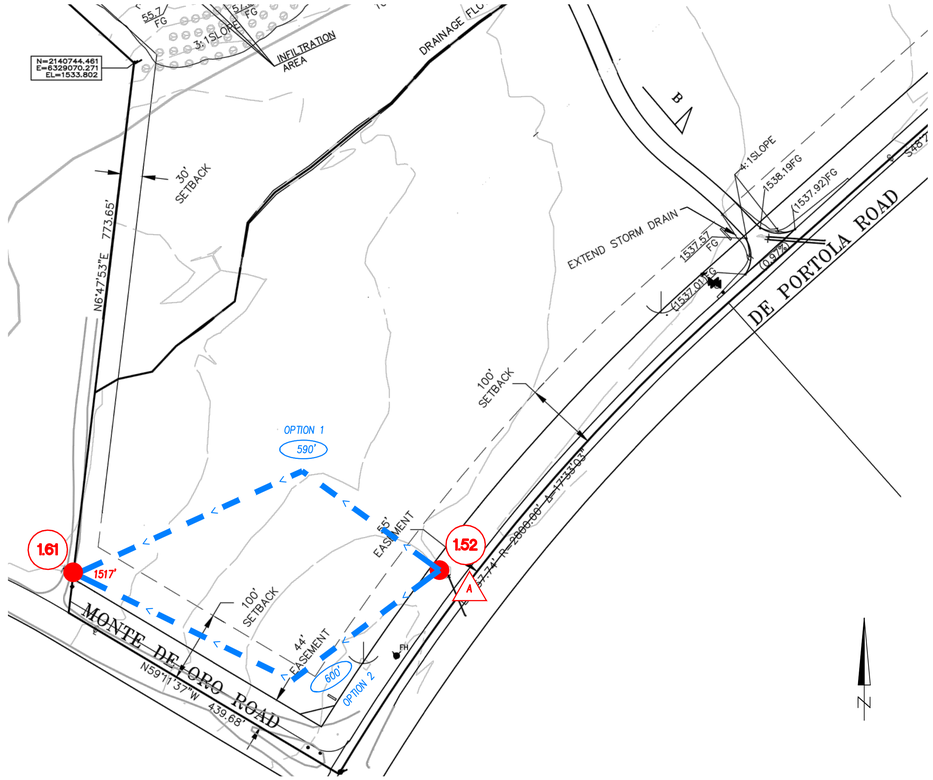
LEGEND

DRAINAGE AREA SUB BOUNDARY, NUMBER, AND ACREAGE

FLOW PATH, DIRECTION, LENGTH

STUDY NODE NUMBER

CONFLUENCE POINT



OPTION ANALYSIS

0 50 100 200 300
(IN FEET)
1 inch = 100 ft.

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APN: 941-180-032

ENTRY CULVERT AREA