Hydrologic Analysis
Proposed New Vineyard Planting
Acquisition 1510 Vineyard
1510 Diamond Mountain Road
Calistoga, CA 94515
APN 020-400-013
May 23, 2023

The following analysis evaluates a vineyard planting proposal, to determine the project's potential to increase runoff or peak flow from the site. The project proposes development of two small vineyard blocks totaling approximately 2.4 acres on an approximately 36.3-acre parcel. This analysis, prepared by David Steiner, CPESC, CPSWQ, at the request of and in consultation with Mike Muelrath of Applied Civil Engineering, relies on the basic methodology of USDA Technical Release 55, as modeled in Version 1.00.10 of WinTR-55 "Small Watershed Hydrology", a Windows-based application. The two drainage basins in the analysis, which total approximately 14.3 acres, are designated Watersheds AB and C, the former further divided into Sub-Areas A and B. The project drains southward to Diamond Mountain Creek, thence east and north to its confluence with the Napa River, southeast (downstream) of the city of Calistoga.

The "headwaters" of both watersheds, a ridge uphill of the proposed project, is part of a rural residential development within Calistoga's city limits. These six parcels were already under development at the time of this observer's site visit on January 26, 2023. Although significant clearing and grading—and very little attempted winterization—were in evidence at that time, the analysis designates those parcels as "farmsteads", with a Curve Number of 74, under both pre- and post-project conditions. (Both watersheds are in areas designated as Hydrologic Soil Group "B", in the USDA Web Soil Survey.) The area proposed for vineyard development, as well as areas east and west of the project, is designated as "Woods" in good hydrologic condition, with a Curve Number of 55. Post-project, the existing vineyards downhill (south) of the proposal, as well as the proposed project itself, are designated as "Vineyard (annual grass)" in good condition, CN 61. As Vineyards are not included among WinTR-55's land use alternatives, the application's "Custom Curve Number" field is adapted for use in the analysis. The option selected is found in a California-specific table in the NRCS Engineering Field Handbook.[1] This table's guidance calls for vineyard Curve Numbers equivalent to those of annual grass.

The precipitation data for the modeled **24-hour storms** of 2, 10, 50, and 100-year return intervals were taken from the median of each event's range of likely depths, as per NOAA Atlas 14. A printout of the NOAA website's database page also accompanies this analysis. Pre- and post-project peak flow calculations for this location were derived from these values, using the appropriate "CA-1" distribution curve, implicit in the 2013 updates of the Atlas.

Times of Concentration (Tc) for each of the watersheds were determined by plotting flowpaths from the hydrologically most remote points to designated outlets, or points of interest. The flowpaths include sheet flow, shallow concentrated flow and channel flow. Each component's data is entered into the model as slope length, gradient, Manning's "N" (roughness)

[1] *Engineering Field Handbook, Part 650, Chapter 2, Supplement 1, USDA/NRCS, Oct 2008.*

factor, with additional characteristics—cross-sectional area and wetted perimeter, or a known velocity— required for channel flow. The "channel flow" components of Sub-Areas A and B, as well as "Reach 1" in Watershed AB, representing flow in existing storm drains, were calculated in outside online calculators (printouts accompany this submital) and entered as velocities, or equivalent, open channel flows. These approximations make very small contributions to the overall Times of Concentration, and are in any event the same, pre- and post-project.

As shown in the accompanying printouts of pre- and post-project runs of WinTR-55, the project as initially conceived is predicted to generate a small increase in peak flow in Watershed AB only. The strategy to eliminate this increase is to extend the Time of Concentration by temporarily storing a calculated volume of runoff at a strategic location on the plotted flowpath, in this case in a buried, 36" pipe, directly on the downhill boundary of the proposed vineyard block that is the source of the predicted increase. To determine the required retention volume, a smaller Sub-Watershed with its outlet on the Tc flowpath, designated B-1, has been plotted and modeled for peak flows (to be temporarily retained in the storage structure). Capacity requirements for the retention structure are calculated as follows:

- A manually-entered Tc increase of .047 hours to Sub-Area B brings the post-project, 100-year peak of WS AB (9.58 cfs) to parity with the pre-project peak (9.33 cfs).
- Sub-WS B-1 will generate a 100-year peak of 2.15 cfs.
- .047 hours x 3600 seconds/hour = 169.2 seconds
- 169.2 seconds x 2.15 cfs = 363.8 cubic feet of required storage volume
- Cross-sectional area of 36" pipe = 7.07 square feet (for buried storage)
- 363.8 cf / 7.07 sf = 51.4 linear feet of pipe, required for retention storage

The accompanying Excel spreadsheet (*Acq 1510 WS AB Retention, rev.xlsx*) makes parallel calculations for the 2-, 10-, 50-, and 100-year storms. This spreadsheet shows that the appropriate design storm is the 100-year storm, for a retention structure in this watershed.

Conclusion:

With installation and maintenance of the specified retention structure in Sub-Watershed AB (Sub-Area B), and adherence to the other specifications of the Erosion Control Plan, the proposed project will result in no increase in peak flow or runoff, compared to pre-project conditions.

DAS

ACQ 1510 WS AB, rev2
Pre-project
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
Sub-Area A	0.79	2.21	3.80	4.49
	12.13	12.13	12.13	12.13
Sub-Area B	1.05	2.54	4.15	4.85
	12.13	12.13	12.13	12.13
REACHES				
Reach 1	1.05	2.54	4.15	4.85
	12.13	12.13	12.13	12.13
Down	1.05	2.54	4.15	4.85
	12.14	12.13	12.14	12.13
OUTLET	1.84	4.74	7.95	9.33

ACQ 1510 WS AB, rev2
Pre-project
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

ACQ 1510 WS AB, rev2
Pre-project
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	0.2	.5 :1

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

ACQ 1510 WS AB, rev2
Pre-project
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	See Pipe Flow Calculator	

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

ACQ 1510 WS AB, rev2
Pre-project
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
					Time of Concentration		.132

ACQ 1510 WS AB, rev2
Pre-project
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	User defined urban (Click button or		B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	User defined urban (Click button or		B	1.5	61
	Woods	(good)	B	2.4	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	63

DAS

ACQ 1510 WS AB, rev2
Pre-project
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	Vineyard (annual grass)	(good)	B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	Vineyard (annual grass)	(good)	B	1.5	61
	Woods	(good)	B	2.4	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	63

DAS

ACQ 1510 WS AB
Post-project, rev2
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period			
	2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
Sub-Area A	0.79	2.21	3.80	4.49
	12.13	12.13	12.13	12.13
Sub-Area B	1.19	2.74	4.40	5.10
	12.14	12.13	12.13	12.13
REACHES				
Reach 1	1.99	4.95	8.20	9.58
	12.13	12.13	12.13	12.13
Down	1.99	4.95	8.20	9.58
	12.14	12.13	12.13	12.13
OUTLET	1.99	4.95	8.20	9.58

ACQ 1510 WS AB
Post-project, rev2
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

ACQ 1510 WS AB
Post-project, rev2
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
					Time of Concentration		.132

ACQ 1510 WS AB
Post-project, rev2
Napa County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	0.2	.5 :1

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

DAS

ACQ 1510 WS AB
Post-project, rev2
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	See Pipe Flow Calculator	

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	3.834	0.2	0.7	
	1.0	16.881	0.7	1.2	
	2.0	85.250	2.4	2.2	
	5.0	837.797	13.5	5.2	
	10.0	5024.853	52	10.2	
	20.0	30981.391	204	20.2	

ACQ 1510 WS AB
Post-project, rev2
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	User defined urban (Click button or		B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	User defined urban (Click button or		B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	Vineyard (annual grass)	(good)	B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	Vineyard (annual grass)	(good)	B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
Sub-Area A	0.79	2.21	3.80	4.49
	12.13	12.13	12.13	12.13
Sub-Area B	1.09	2.51	4.04	4.68
	12.20	12.18	12.18	12.19
REACHES				
Reach 1	1.84	4.63	7.70	9.01
	12.16	12.14	12.15	12.15
Down	1.84	4.63	7.70	9.01
	12.16	12.15	12.15	12.15
OUTLET	1.84	4.63	7.70	9.01

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	0.2	.5 :1

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	See Pipe Flow Calculator	

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL	760					2.000	0.106
					Time of Concentration		.238

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL			Manual Entry				0.106
					Time of Concentration		.238

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	User defined urban (Click button or		B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	User defined urban (Click button or		B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 2
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	Vineyard (annual grass)	(good)	B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	Vineyard (annual grass)	(good)	B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
Sub-Area A	0.79	2.21	3.80	4.49
	12.13	12.13	12.13	12.13
Sub-Area B	1.12	2.58	4.15	4.81
	12.17	12.17	12.17	12.17
REACHES				
Reach 1	1.90	4.74	7.87	9.21
	12.15	12.14	12.14	12.14
Down	1.89	4.74	7.87	9.21
	12.15	12.14	12.15	12.15
OUTLET	1.89	4.74	7.87	9.21

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	0.2	.5 :1

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	See Pipe Flow Calculator	

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL	500					2.000	0.069
					Time of Concentration		0.201

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL			Manual Entry				0.069
					Time of Concentration		0.201

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	User defined urban (Click button or		B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	User defined urban (Click button or		B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 10
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	Vineyard (annual grass)	(good)	B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	Vineyard (annual grass)	(good)	B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
Sub-Area A	0.79	2.21	3.80	4.49
	12.13	12.13	12.13	12.13
Sub-Area B	1.14	2.62	4.21	4.87
	12.16	12.16	12.16	12.16
REACHES				
Reach 1	1.92	4.79	7.95	9.30
	12.15	12.14	12.14	12.14
Down	1.92	4.79	7.95	9.30
	12.15	12.14	12.15	12.14
OUTLET	1.92	4.79	7.95	9.30

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL	380					2.000	0.053
					Time of Concentration		.185

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL			Manual Entry				0.053
					Time of Concentration		.185

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	0.2	.5 :1

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	See Pipe Flow Calculator	

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	User defined urban (Click button or		B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	User defined urban (Click button or		B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 50
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	Vineyard (annual grass)	(good)	B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	Vineyard (annual grass)	(good)	B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
Sub-Area A	0.79	2.21	3.80	4.49
	12.13	12.13	12.13	12.13
Sub-Area B	1.14	2.63	4.22	4.90
	12.15	12.15	12.15	12.15
REACHES				
Reach 1	1.93	4.81	7.98	9.33
	12.15	12.14	12.14	12.14
Down	1.93	4.81	7.98	9.33
	12.15	12.14	12.14	12.14
OUTLET	1.93	4.81	7.98	9.33

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	0.2	.5 :1

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	250	0.012	0.248	See Pipe Flow Calculator	

Reach Identifier	Stage (ft)	Flow (cfs)	End Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	0.2	0.248
	0.5	4.270	0.2	0.7	
	1.0	18.798	0.7	1.2	
	2.0	94.930	2.4	2.2	
	5.0	932.931	13.5	5.2	
	10.0	5595.439	52	10.2	
	20.0	34499.417	204	20.2	

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL	340					2.000	0.047
					Time of Concentration		.179

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub-Area A							
SHEET	100	0.1000	0.240				0.106
SHALLOW	610	0.2700	0.050				0.020
					Time of Concentration		.126
Sub-Area B							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
CHANNEL	80					25.390	0.001
CHANNEL			Manual Entry				0.047
					Time of Concentration		.179

DAS

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	User defined urban (Click button or		B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	User defined urban (Click button or		B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

ACQ 1510 WS AB
Post-project, rev2, Tc inc 100
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub-Area A	Vineyard (annual grass)	(good)	B	3.5	61
	Woods	(good)	B	2.3	55
	Farmsteads		B	.1	74
	Total Area / Weighted Curve Number			5.9	59
Sub-Area B	Dirt (w/ right-of-way)		B	.1	82
	Vineyard (annual grass)	(good)	B	3.4	61
	Woods	(good)	B	.5	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			5.7	65

DAS

ACQ 1510 Sub-WS B-1
Post-project, rev
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
Sub WS B-1	0.61 12.13	1.24 12.13	1.88 12.13	2.15 12.13
REACHES				
OUTLET	0.61	1.24	1.88	2.15

DAS

ACQ 1510 Sub-WS B-1
Post-project, rev
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

DAS

ACQ 1510 Sub-WS B-1
Post-project, rev
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Sub WS B-1							
SHEET	100	0.0900	0.240				0.110
SHALLOW	490	0.1670	0.050				0.021
					Time of Concentration		.131

DAS

ACQ 1510 Sub-WS B-1
Post-project, rev
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub WS B-1	User defined urban (Click button or	B	.5	61
	Farmsteads	B	1.6	74
	Total Area / Weighted Curve Number		2.1	71

DAS

ACQ 1510 Sub-WS B-1
Post-project, rev
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Sub WS B-1	Vineyard (annual grass) (good)	B	.5	61
	Farmsteads	B	1.6	74
	Total Area / Weighted Curve Number		2.1	71

Manning Formula Uniform Pipe Flow at Given Slope and Depth

ACQ 1510 WS AB, Sub-area B Tc storm drain

Storm drain 80' @ 41.3%

Inputs

Pipe diameter, d_0	12	in
Manning roughness, n	0.012	
Pressure slope (possibly ? equal to pipe slope), S_0	.413	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	0.32	fraction

Results

Flow, Q (See notes)	5.5000	cfs
Velocity, v	25.3853	ft/sec
Velocity head, h_v	10.0152	ft H2O
Flow area	0.2167	ft^2
Wetted perimeter	1.2025	ft
Hydraulic radius	0.1802	ft
Top width, T	0.9329	ft
Froude number, F	9.66	
Average shear stress (tractive force), tau	4.6455	psf

Notes:

This is the flow and depth *inside* the pipe.

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

ACQ 1510 WS AB Reach 1

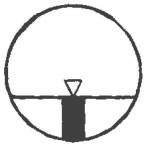
Storm drain 250' @ 24.8%

Inputs

Pipe diameter, d_0	12	in
Manning roughness, n	0.012	
Pressure slope (possibly ? equal to pipe slope), S_0	.20	rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	0.32	fraction

Results

Flow, Q (See notes)	3.8274	cfs
Velocity, v	17.6653	ft/sec
Velocity head, h_v	4.8500	ft H2O
Flow area	0.2167	ft^2
Wetted perimeter	1.2025	ft
Hydraulic radius	0.1802	ft
Top width, T	0.9329	ft
Froude number, F	6.53	
Average shear stress (tractive force), tau	2.2496	psf



Notes:

This is the flow and depth *inside* the pipe.

Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

DAS

ACQ 1510 WS C
Pre-project, rev
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)	10-Yr (cfs)	(hr)	50-Yr (cfs)	(hr)	100-Yr (cfs)	(hr)
SUBAREAS								
Main	0.64	12.17	1.37	12.16	2.14	12.16	2.46	12.16
REACHES								
OUTLET	0.64		1.37		2.14		2.46	

DAS

ACQ 1510 WS C
Pre-project, rev
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

ACQ 1510 WS C
Pre-project, rev
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Main							
SHEET	100	0.0300	0.240				0.171
SHALLOW	470	0.1670	0.050				0.020
CHANNEL	155	0.2580	0.045	5.00	6.00	14.352	0.003
					Time of Concentration		.194

DAS

ACQ 1510 WS C
Pre-project, rev
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Main	Dirt (w/ right-of-way)		B	.1	82
	Woods	(good)	B	.9	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			2.7	68

DAS

ACQ 1510 WS C
Post-project, rev
County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)	10-Yr (cfs)	(hr)	50-Yr (cfs)	(hr)	100-Yr (cfs)	(hr)
SUBAREAS								
Main	0.64	12.17	1.37	12.16	2.14	12.16	2.46	12.16
REACHES								
OUTLET	0.64		1.37		2.14		2.46	

ACQ 1510 WS C
Post-project, rev
County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
4.46	5.68	6.62	7.82	8.69	9.53	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

DAS

ACQ 1510 WS C
Post-project, rev
County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Main							
SHEET	100	0.0300	0.240				0.171
SHALLOW	470	0.1670	0.050				0.020
CHANNEL	155	0.2580	0.045	5.00	6.00	14.352	0.003
					Time of Concentration		.194

DAS

ACQ 1510 WS C
Post-project, rev
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Main	Dirt (w/ right-of-way)	B	.1	82
	User defined urban (Click button or	B	.2	61
	Woods (good)	B	.7	55
	Farmsteads	B	1.7	74
	Total Area / Weighted Curve Number		2.7	68

DAS

ACQ 1510 WS C
Post-project, rev
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Main	Dirt (w/ right-of-way)		B	.1	92
	Vineyard (annual grass)	(good)	B	.2	61
	Woods	(good)	B	.7	55
	Farmsteads		B	1.7	74
	Total Area / Weighted Curve Number			2.7	68

Search

Properties and Qualities Ratings

Open All | Close All

- Soil Chemical Properties
- Soil Erosion Factors
- Soil Health Properties
- Soil Physical Properties
- Soil Qualities and Features
  - AASHTO Group Classification (Surface)
  - AASHTO Group Index
  - Depth to a Selected Soil Restrictive Layer
  - Depth to Any Soil Restrictive Layer
  - Depth to Bedrock
  - Drainage Class
  - Frost Action
  - Frost-Free Days
  - Hydrologic Soil Group

View Description | View Rating

View Options

Map ☑

Table ☑

Description of Rating ☑

Rating Options

Detailed Description ☐

Advanced Options

Aggregation Method: Dominant Condition

Component Percent Cutoff:

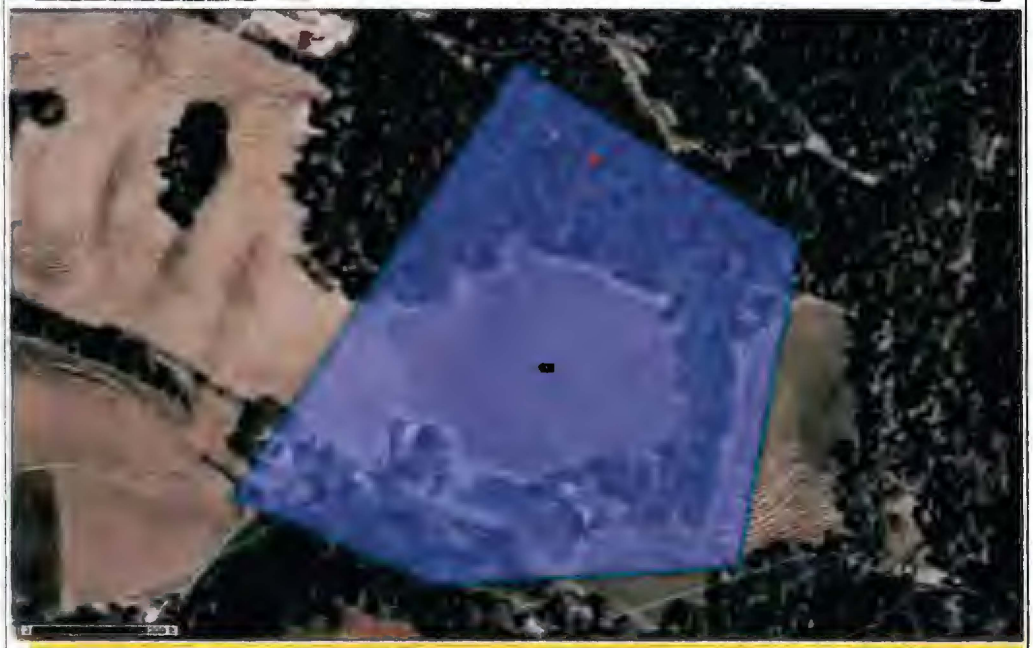
Tie-break Rule: Lower / Higher

View Description | View Rating

- Map Unit Name
- Parent Material Name
- Representative Slope
- Soil Slippage Potential
- Subsidence, Initial
- Subsidence, Total
- Unified Soil Classification (Surface)
- Water Features

Map — Hydrologic Soil Group

Scale (not to scale)



Warning: Soil Ratings Map may not be valid at this scale.

You have zoomed in beyond the scale at which the soil map for this area is intended to be used. Mapping of soils is done at a particular scale. The soil surveys that comprise your AOI were mapped at 1:24,000. The design of map units and the level of detail shown in the resulting soil map are dependent on that map scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Napa County, California (CA055)

Summary by Map Unit — Napa County, California (CA055)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
111	Boomer-Forward-Felta complex, 5 to 30 percent slopes	B	29.7	100.0%
Totals for Area of Interest			**29.7**	**100.0%**

Description — Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options — Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA

Data description

Data type: Precipitation depth | Units: English | Time series type: Partial duration

Select location

1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: 38.569 Longitude: -122.575 Submit

b) By station (list of CA stations): Select station

c) By address: Search

2) Use map (if ESRI interactive map is not loading, try adding the host: https://js.arcgis.com/ to the firewall, or contact us at hdsc.questions@noaa.gov):

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2

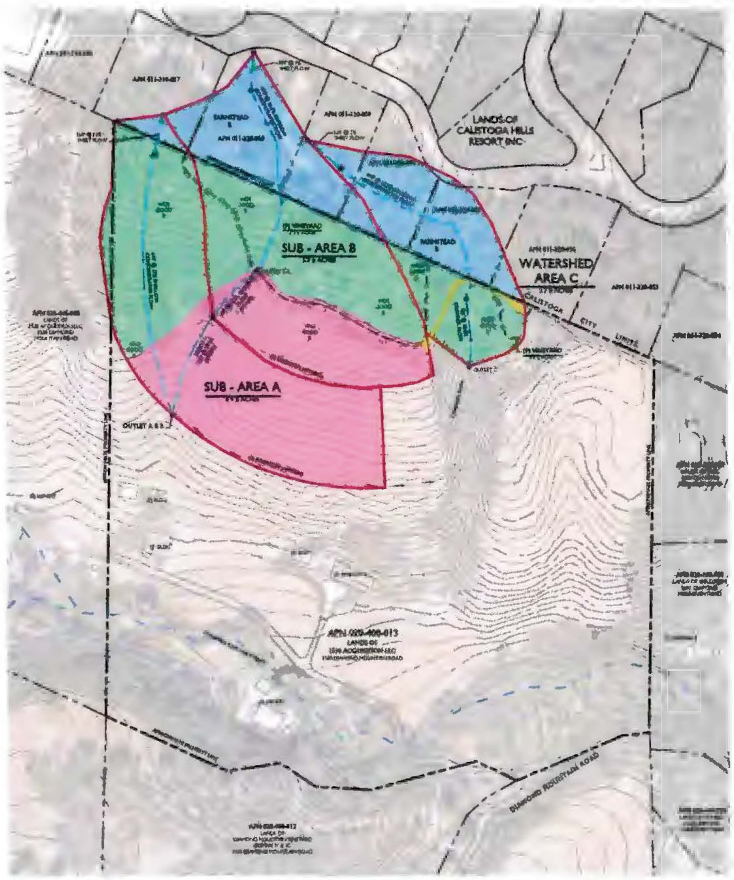
PF tabular | PF graphical | Supplementary information | Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.189 (0.141-0.181)	0.192 (0.171-0.219)	0.235 (0.209-0.269)	0.271 (0.236-0.313)	0.320 (0.270-0.383)	0.356 (0.295-0.439)	0.397 (0.318-0.500)	0.437 (0.339-0.568)	0.493 (0.366-0.673)	0.536 (0.383-0.763)
10-min	0.236 (0.203-0.269)	0.275 (0.245-0.313)	0.336 (0.299-0.385)	0.389 (0.341-0.448)	0.460 (0.387-0.549)	0.513 (0.422-0.629)	0.569 (0.455-0.717)	0.627 (0.486-0.816)	0.707 (0.523-0.986)	0.771 (0.548-1.09)
15-min	0.276 (0.245-0.313)	0.333 (0.296-0.379)	0.408 (0.362-0.468)	0.472 (0.412-0.542)	0.558 (0.468-0.664)	0.623 (0.511-0.761)	0.688 (0.551-0.867)	0.758 (0.588-0.987)	0.855 (0.633-1.17)	0.932 (0.663-1.32)
30-min	0.403 (0.359-0.458)	0.487 (0.433-0.554)	0.596 (0.529-0.682)	0.690 (0.604-0.793)	0.812 (0.686-0.972)	0.906 (0.748-1.11)	1.01 (0.808-1.27)	1.11 (0.861-1.45)	1.25 (0.925-1.71)	1.36 (0.971-1.94)
60-min	0.528 (0.521-0.666)	0.700 (0.629-0.805)	0.868 (0.769-0.992)	1.00 (0.878-1.15)	1.18 (0.996-1.41)	1.32 (1.09-1.62)	1.46 (1.17-1.85)	1.61 (1.26-2.10)	1.83 (1.35-2.48)	1.98 (1.41-2.82)
2-hr	0.694 (0.795-1.01)	1.00 (0.955-1.22)	1.31 (1.16-1.49)	1.49 (1.31-1.72)	1.74 (1.47-2.08)	1.93 (1.59-2.36)	2.12 (1.69-2.67)	2.31 (1.76-3.00)	2.59 (1.89-3.46)	2.75 (1.96-3.91)
3-hr	1.15 (1.02-1.31)	1.36 (1.23-1.57)	1.68 (1.49-1.91)	1.91 (1.68-2.20)	2.22 (1.87-2.66)	2.46 (2.02-3.00)	2.68 (2.14-3.37)	2.89 (2.25-3.78)	3.20 (2.37-4.37)	3.43 (2.44-4.87)
6-hr	1.74 (1.55-1.96)	2.11 (1.87-2.40)	2.66 (2.27-2.92)	2.92 (2.58-3.36)	3.36 (2.68-4.05)	3.72 (3.06-4.66)	4.06 (3.24-5.11)	4.38 (3.39-5.70)	4.80 (3.56-6.55)	5.11 (3.64-7.26)
12-hr	2.49 (2.21-2.82)	3.09 (2.75-3.52)	3.84 (3.40-4.39)	4.42 (3.86-5.09)	5.16 (4.36-6.18)	5.78 (4.69-7.39)	6.22 (4.98-7.84)	6.73 (5.22-8.78)	7.38 (5.46-10.1)	7.85 (5.58-11.2)
24-hr	3.47 (3.12-3.94)	4.44 (4.00-5.07)	5.65 (5.09-6.47)	6.62 (5.99-7.50)	7.82 (6.77-9.22)	8.69 (7.39-10.4)	9.53 (7.94-11.7)	10.4 (8.43-13.0)	11.4 (8.97-14.8)	12.2 (9.31-16.3)
2-day	4.66 (4.09-5.17)	5.80 (5.26-6.66)	7.56 (6.72-8.55)	8.98 (7.83-10.1)	10.6 (9.08-12.4)	11.7 (9.99-14.1)	13.0 (10.8-15.9)	14.2 (11.6-17.8)	15.8 (12.4-20.5)	17.0 (13.0-22.7)
3-day	5.30 (4.76-6.02)	6.60 (6.11-7.73)	8.73 (7.82-9.84)	10.3 (9.13-11.8)	12.3 (10.7-14.5)	13.8 (11.8-16.8)	15.4 (12.8-18.8)	16.9 (13.8-21.2)	19.0 (15.0-24.7)	20.8 (15.7-27.5)
4-day	5.92 (5.32-6.72)	7.38 (6.81-8.62)	9.74 (8.73-11.1)	11.5 (10.2-13.2)	13.8 (11.9-16.2)	15.6 (13.2-18.8)	17.3 (14.4-21.2)	19.1 (15.5-23.9)	21.5 (16.9-27.9)	23.3 (17.8-31.2)
7-day	7.30 (6.56-8.29)	9.24 (8.39-10.6)	12.0 (10.7-13.6)	14.1 (12.5-16.2)	16.9 (14.7-20.0)	19.1 (16.2-22.9)	21.3 (17.7-26.0)	23.5 (19.1-29.4)	26.5 (20.8-34.4)	28.8 (22.0-36.4)
10-day	8.32 (7.47-9.44)	10.6 (9.55-12.1)	13.6 (12.2-15.5)	16.0 (14.2-18.3)	19.1 (16.8-22.5)	21.6 (18.3-26.0)	23.9 (19.9-29.2)	26.3 (21.4-32.9)	29.4 (23.2-38.2)	31.9 (24.3-42.6)
20-day	11.0 (9.86-12.5)	14.1 (12.7-16.0)	17.9 (16.1-20.4)	20.9 (18.6-24.0)	24.7 (21.4-29.1)	27.5 (23.4-33.0)	30.2 (25.3-36.9)	32.8 (26.7-41.1)	36.2 (28.5-47.0)	38.7 (29.8-51.7)
30-day	13.3	17.0	21.5	25.0	29.3	32.3	35.3	38.1	41.6	44.2

1510 ACQUISITION LLC

WATERSHED EXHIBITS



PRE - PROJECT CONDITIONS WATERSHED AREAS A, B, & C

SUB - AREA "A" SUMMARY					
PLAN SYMBOL	LAND USE DESCRIPTION	HYDROLOGIC CONDITION	HYDROLOGIC SOIL GROUP	CURVE NUMBER (CN)	PRE-PROJECT (ACRES)
[illegible]	DIRT ROAD	FAIR	[illegible]	[illegible]	[illegible]
[illegible]	FARMSTEAD	FAIR	[illegible]	[illegible]	[illegible]
[illegible]	WOODS	GOOD	[illegible]	[illegible]	[illegible]
[illegible]	VINEYARD - ANNUAL GRASS [illegible]	GOOD	[illegible]	[illegible]	[illegible]
				TOTALS	[illegible]

SUB - AREA "B" SUMMARY					
PLAN SYMBOL	LAND USE DESCRIPTION	HYDROLOGIC CONDITION	HYDROLOGIC SOIL GROUP	CURVE NUMBER (CN)	PRE-PROJECT (ACRES)
[illegible]	DIRT ROAD	FAIR	[illegible]	[illegible]	[illegible]
[illegible]	FARMSTEAD	FAIR	[illegible]	[illegible]	[illegible]
[illegible]	WOODS	GOOD	[illegible]	[illegible]	[illegible]
[illegible]	VINEYARD - ANNUAL GRASS [illegible]	GOOD	[illegible]	[illegible]	[illegible]
				TOTALS	[illegible]

WATERSHED AREA "C" SUMMARY					
PLAN SYMBOL	LAND USE DESCRIPTION	HYDROLOGIC CONDITION	HYDROLOGIC SOIL GROUP	CURVE NUMBER (CN)	PRE-PROJECT (ACRES)
[illegible]	DIRT ROAD	FAIR	[illegible]	[illegible]	[illegible]
[illegible]	FARMSTEAD	FAIR	[illegible]	[illegible]	[illegible]
[illegible]	WOODS	GOOD	[illegible]	[illegible]	[illegible]
				TOTALS	[illegible]

LOCATION MAP

PROJECT INFORMATION:

PROPERTY OWNER & APPLICANT:
1510 ACQUISITION LLC
1150 CONNECTICUT AVENUE, SUITE 1200
WASHINGTON, DC 20036

SITE ADDRESS:
1510 DIAMOND MOUNTAIN ROAD
CALISTOGA, CA 94515

ASSESSOR'S PARCEL NUMBER:
020-400-013

SHEET INDEX:

C1 PRE-PROJECT CONDITIONS
C2 POST-PROJECT CONDITIONS

NOTES:

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]

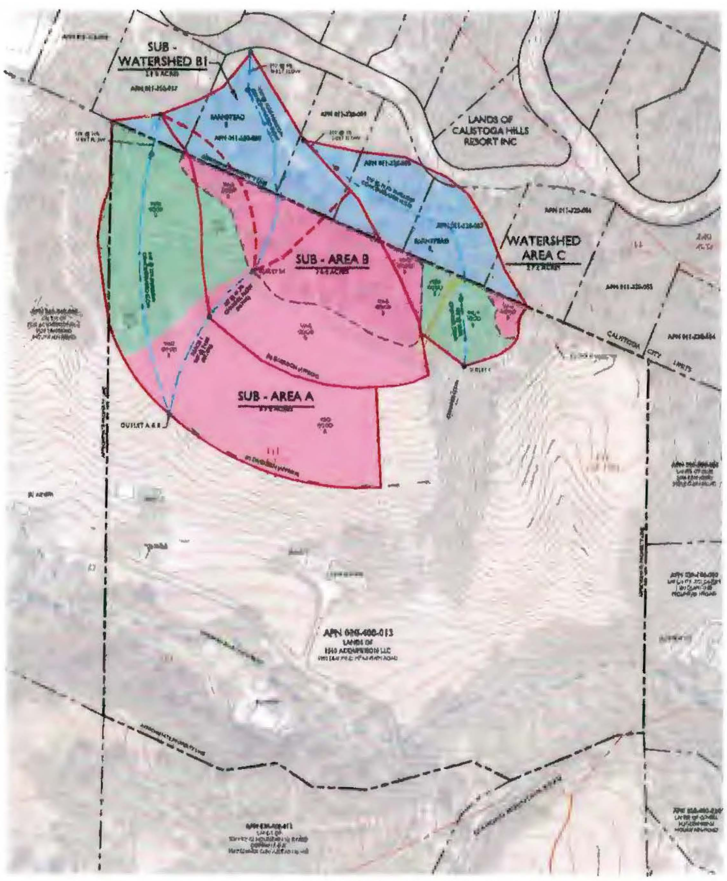
LEGEND:

SOILS TYPE LEGEND:

APPLIED

1510 ACQUISITION LLC
WATERSHED EXHIBITS
PRE - PROJECT CONDITIONS WATERSHED AREAS A, B & C

C1 of 2



POST - PROJECT CONDITIONS WATERSHED AREAS A, B & C

SUB - AREA "A" SUMMARY

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	DIRT ROAD	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	WOODS	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	VINEYARD [illegible]	GOOD	B	[illegible]	[illegible]	[illegible]	[illegible]
				TOTAL	[illegible]	[illegible]	[illegible]

SUB - AREA "B" SUMMARY

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	DIRT ROAD	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	FARMSTEAD	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	VINEYARD [illegible]	GOOD	B	[illegible]	[illegible]	[illegible]	[illegible]
				TOTAL	[illegible]	[illegible]	[illegible]

SUB - WATERSHED "B-1" SUMMARY

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	POST PROJECT
[illegible]	FARMSTEAD	[illegible]	B	[illegible]	[illegible]
[illegible]	VINEYARD [illegible]	GOOD	B	[illegible]	[illegible]
				TOTAL	[illegible]

WATERSHED AREA "C" SUMMARY

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	DIRT ROAD	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	FARMSTEAD	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	WOODS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	VINEYARD [illegible]	[illegible]	B	[illegible]	[illegible]	[illegible]	[illegible]
				TOTALS	[illegible]	[illegible]	[illegible]

LEGEND:

- APPROXIMATE PROPERTY LINE
- SOIL TYPE BOUNDARY
- EXISTING STREAM
- PROPOSED VINEYARD AVENUE / CLEARING LIMITS
- WATERSHED AREA
- TIME OF CONCENTRATION FLOW PATH

SOILS TYPE LEGEND:

APPLIED

1510 ACQUISITION LLC

WATERSHED EXHIBITS

POST - PROJECT CONDITIONS WATERSHED AREAS A, B & C

PREPARED UNDER THE DIRECTION OF

DRAWN BY

CHECKED BY

DATE

JOB NUMBER

FILE

SHEET NUMBER

C2 of 2