Hydrologic Analysis
Proposed Phase 9 Vineyard Development
Kenzo Estate
8999 Wild Horse Valley Road
Napa, CA
030-220-025

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January 20, 2020

The purpose of this investigation is to determine whether or not a proposed 13.1 acre vineyard development project will increase peak flow/runoff on the referenced site, east of Napa, California, in a 55.87-acre watershed draining to Wild Horse Valley Creek, Green Valley Creek, Cordelia Slough, Suisun Slough, Grizzly Bay, San Pablo Bay and San Francisco Bay. The investigation was carried out by David Steiner, at the request of Mike Muelrath, principal engineer at Applied Civil Engineering, Inc.

This analysis was performed using WinTR-55, a Windows application based on USDA Technical Release 55, Small Watershed Hydrology. The protocol for this method requires plotting a watershed that encompasses the project and drains to an applicable "point of interest" or outlet. The analysis includes pre- and post-project examination of Land Use, Hydrologic Condition, soil type and Hydrologic Soil Group (**HSG**); these factors are combined to determine Runoff Curve Numbers (**CN**), which are entered, along with acreage, into the application's appropriate data entry fields. The watershed's Time of Concentration (**Tc**) is calculated from its hydrologically most remote point to its outlet, based on slope, roughness, and a determination as to the type of flow (sheet, shallow concentrated, or channel). 24-hour storm data for the site's 2-, 5-, 10-, 25-, 50-, and 100-year precipitation depths, as well as distribution curves for CA-1 storm types--per NOAA Atlas 14--are entered into the application's appropriate fields. Results are displayed on the accompanying printouts of the two WinTR-55 runs, pre- and post-project. Descriptions of the various entries are as follows: (Please refer also to the accompanying pre- and post-project watershed maps, which include polygons drawn to delineate the various land uses and hydrologic conditions described.)

Curve Number, Pre-Project Conditions:

- Site conditions have been evaluated during site inspections on February 5, 2018 and April 25, 2019, and through examination of current Google Earth imagery. The timing of site visits afforded the opportunity to assess the substantial, short- and moderate-term effects of the wildfires of October 2017.
- This watershed is dominated by a wooded ridge running the length of its east side. A shallow declivity in the southern half of the area reveals recent or ongoing grading or rock (perhaps cave spoils) storage activity. This 2.61-acre area, essentially devoid of vegetation, has been characterized as "fallow, or barren land" and assigned a runoff curve number (CN) of 91, in Hydrologic Soil Group (HSG) C. (An equally applicable characterization with the same CN would be "recently graded area.")
- The hydrologic condition of the wooded areas themselves varies significantly, in large part as an apparent function of the wildfire's intensity on a particular slope. With a west

to northwest exposure, the entire northeast quadrant of the watershed (13.26 acres) was severely charred. This mature oak woodland still has standing trees, though many of them appear to be dead. The understory was completely devastated, and very little emergent vegetation was in evidence this spring, despite the copious rainfall of the winter of 2018-2019. On the contrary, condition of the soil is such that moderate to severe rilling and "pedestaling" indicates high levels of runoff and soil erosion. Surface cover is estimated at 40%, mandating a characterization as "poor" hydrologic condition. HSG C, CN 77.

- The woods in the southeast quadrant (about 18 acres) were not affected by the fire, and are in "good" hydrologic condition. HSG C, CN 70; HSG D, CN 77.
- Scattered, small areas totaling about 5 acres (including the oak woodland along the Wild Horse Valley Road frontage) lost their understory in the fire, but have enough emergent grass and forb vegetation to warrant characterization of "fair" hydrologic condition. HSG C, CN 73; HSG D, 79.
- Less densely wooded areas (totaling about 2 acres) to the south of the existing access road, and toward the north end of the Wild Horse Valley Road frontage, were similarly burned, i.e. lost most of their understory, but have recovered enough to warrant being labeled in "fair" hydrologic condition. Woods-grass combination: HSG C, CN 76; HSD D, CN 82.
- In the heart of the proposed vineyard area is about 13 acres of former pasture. Although this area was completely denuded in the fires, to protect the land the applicant subsequently applied seed and straw mulch to the open areas. These measures were highly effective, leaving the burned areas in good hydrologic condition. HSG C, CN 74; HSG D, 80.
- The watershed also includes a total of approximately a half-acre of existing asphalt road with roadside ditches, including about a quarter-mile of Wild Horse Valley Road, and the access road to the graded area, to the east. HSG C, CN 92; HSG D, CN 93.
- The pre-project Weighted Curve Number is 75.

Curve Number, Post-Project Conditions

- The proposed vineyard development will affect a 13.1-acre development area. The vineyard will be tilled in alternate rows, with annual winterization applications of seed and straw mulch, to achieve a minimum 80% vegetative cover. The specified tillage precludes a designation of "good" hydrologic condition, so the vineyard block and surrounding avenues are characterized as equivalent to "Annual grass, fair condition." HSG C, CN 79; HSG D, 84. These curve numbers were selected from a California-specific table found in the NRCS Engineering Field Handbook.*
- The area of pasture in good condition (HSG C, CN 74; HSG D, 80) will be reduced to 4.10 acres, including a designated wetland and ephemeral stream corridor, between the proposed vineyard blocks.
- The area of woods in poor condition (HSG C, CN 77) will be reduced from 13.27 acres to 11.23 acres.

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

- The area of woods in fair condition (HSG C, CN 73; HSG D, CN 79) will be reduced from 6.04 acres to 4.46 acres.
- The area of woods-grass combination in fair condition (HSG C, CN 76) will be reduced from 1.59 acres to .93 acres.
- The project will result in no change to the acreage of asphalt roads, the graded (fallow) area, woods in good condition, or woods-grass combination in HSG D.
- The post-project Weighted Curve Number is 76.

Time of Concentration:

- The flowpath begins with 100 feet of sheet flow at 30% slope, through the dense woods covering a ridge in the far southeast corner of the watershed.
- Shallow concentrated flow continues for 555 feet, through the wooded, 28.8% slope to the edge of the graded area.
- The slope flattens to an average of 6.8%, through the graded area, and through a "slot" in the ridge above the pasture to the west. The flowpath continues for a total of 1610 feet as shallow concentrated flow, meandering through the wetland meadow as a designated "ephemeral stream".
- The flowpath ends at its outlet, or point of interest, following a brief channel flow through an existing 24-inch culvert under Wild Horse Valley Road.
- The vineyard development itself will not affect the Time of Concentration.

Results of the Analysis:

- Please see the accompanying WinTR-55 printouts.
- As a result of the increase in post-project Weighted Curve Number from 75 to 76, the initial post-project peak flow was predicted to increase between .72 cfs (2-year, 24-hour storm) and 0.99 cfs (100-year, 24-hour storm).

Offsetting Predicted Peak Flow Increases:

- The strategy for offsetting these modeled flow increases involves construction of a storage structure designed with sufficient capacity to increase the Time of Concentration, thereby reducing post-project peak flow to pre-project levels. Peak flows of larger, less frequent storms are of course many times those of smaller, more frequent storms, but the smaller storms require longer Tc extensions to achieve pre-project peak flow parity. To assure adequacy of the designed structure, hypothetical Tc increases sufficient to achieve peak flow parity have been manually entered into *both* 2-year and 100-year storm models; design capacity of the structure is based on the requirements of *the greater of the two*.
- As shown in the accompanying printouts, hypothetical Tc increases of .063 hours (2-year storm) and .023 hours (100-year storm), manually entered into the application, reduce post-project peak flow predictions to pre-project levels.
- A 9.16-acre drainage basin lying on the watershed's Tc flowpath is designated Sub-watershed 1-A. Post-project modeling of this basin predicts 2- and 100-year peak flows of 2.68 cfs and 10.30 cfs, respectively. The Erosion Control Plan proposes a storage structure, a rock-filled bench, to be constructed at this basin's outlet, or point of interest.

- To determine the storage volume required to offset the 2-year peak flow increase:

.063 hours x 3600 seconds/hour = 226.8 seconds

226.8 seconds x 2.68 cf/second = 607.8 cubic feet (required storage volume, 2-year storm)

- To determine the storage volume required to offset the 100-year peak flow increase:

.023 hours x 3600 seconds/hour = 82.8 seconds

82.8 seconds x 10.30 cf/s = 852.8 cubic feet (required storage volume, 100-year storm)

- The larger storage volume requirement, derived from the 100-year storm, is 852.8 cubic feet.

Bench volume (per ECP specifications) 150'L x 7'W x 2.5'D = 2625 cubic feet.

Available storage volume is 2625 cubic feet x .33 (void ratio in rock fill) = **875 cubic feet ≥ 852.8 cubic feet required.**

The increase in Time of Concentration (with the bench) compensates for the post-project increase in weighted Curve Number, resulting in no increase in peak flow, for all storms modeled.

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Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period					
	2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)
	(hr)	(hr)	(hr)	(hr)	(hr)	(hr)
SUBAREAS						
Main	15.23	24.54	32.29	42.81	50.84	58.77
	12.17	12.17	12.17	12.16	12.16	12.17
REACHES						
OUTLET	15.23	24.54	32.29	42.81	50.84	58.77

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Pre-Project
Napa 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)
4.03	5.29	6.29	7.61	8.61	9.6	.0

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

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Pre-Project
Napa 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	0.3000	0.240				0.072
SHALLOW	555	0.2880	0.050				0.018
SHALLOW	1610	0.0680	0.050				0.106
CHANNEL	40					7.350	0.002
					Time of Concentration		.198

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Pre-Project
Napa 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	Paved; open ditches (w/right-of-way)		C	.37	92
	Paved; open ditches (w/right-of-way)		D	.2	93
	Newly graded area (pervious only)		C	2.61	91
	Pasture, grassland or range	(good)	C	12.48	74
	Pasture, grassland or range	(good)	D	.44	80
	Woods - grass combination	(fair)	C	1.59	76
	Woods - grass combination	(fair)	D	.2	82
	Woods	(poor)	C	13.27	77
	Woods	(fair)	C	5.17	73
	Woods	(fair)	D	.87	79
	Woods	(good)	C	18.32	70
	Woods	(good)	D	.35	77
	Total Area / Weighted Curve Number			55.87	75

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Kenzo
Post-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)	5-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS						
Main	15.95 12.16	25.39 12.16	33.23 12.16	43.72 12.16	51.82 12.16	59.76 12.17
REACHES						
OUTLET	15.95	25.39	33.23	43.72	51.82	59.76

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Post-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)
4.03	5.29	6.29	7.61	8.61	9.6	.0

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

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Post-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)
Main							
SHEET	100	0.3000	0.240				0.072
SHALLOW	555	0.2880	0.050				0.018
SHALLOW	1610	0.0680	0.050				0.106
CHANNEL	40					7.350	0.002
					Time of Concentration		.198

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Post-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
Main	Paved; open ditches (w/right-of-way)		C	.37	92
	Paved; open ditches (w/right-of-way)		D	.2	93
	User defined urban (Click button or		C	12.23	79
	User defined urban (Click button or		D	.87	84
	Newly graded area (pervious only)		C	2.61	91
	Pasture, grassland or range	(good)	C	3.66	74
	Pasture, grassland or range	(good)	D	.44	80
	Woods - grass combination	(fair)	C	.93	76
	Woods - grass combination	(fair)	D	.2	82
	Woods	(poor)	C	11.23	77
	Woods	(fair)	C	4.46	73
	Woods	(good)	C	18.32	70
	Woods	(good)	D	.35	77
	Total Area / Weighted Curve Number			55.87	76

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Kenzo
Sub WS 1-A, Post
County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)
SUBAREAS						
1-A	2.68	4.31	5.67	7.50	8.91	10.30
REACHES						
OUTLET	2.68	4.31	5.67	7.50	8.91	10.30

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Sub WS 1-A, Post
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)
4.03	5.29	6.29	7.61	8.61	9.6	.0

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

Kenzo
Sub WS 1-A, Post
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)
1-A							
SHEET	100	0.3000	0.240				0.072
SHALLOW	555	0.2880	0.050				0.018
SHALLOW	425	0.0680	0.050				0.028
						Time of Concentration	.118

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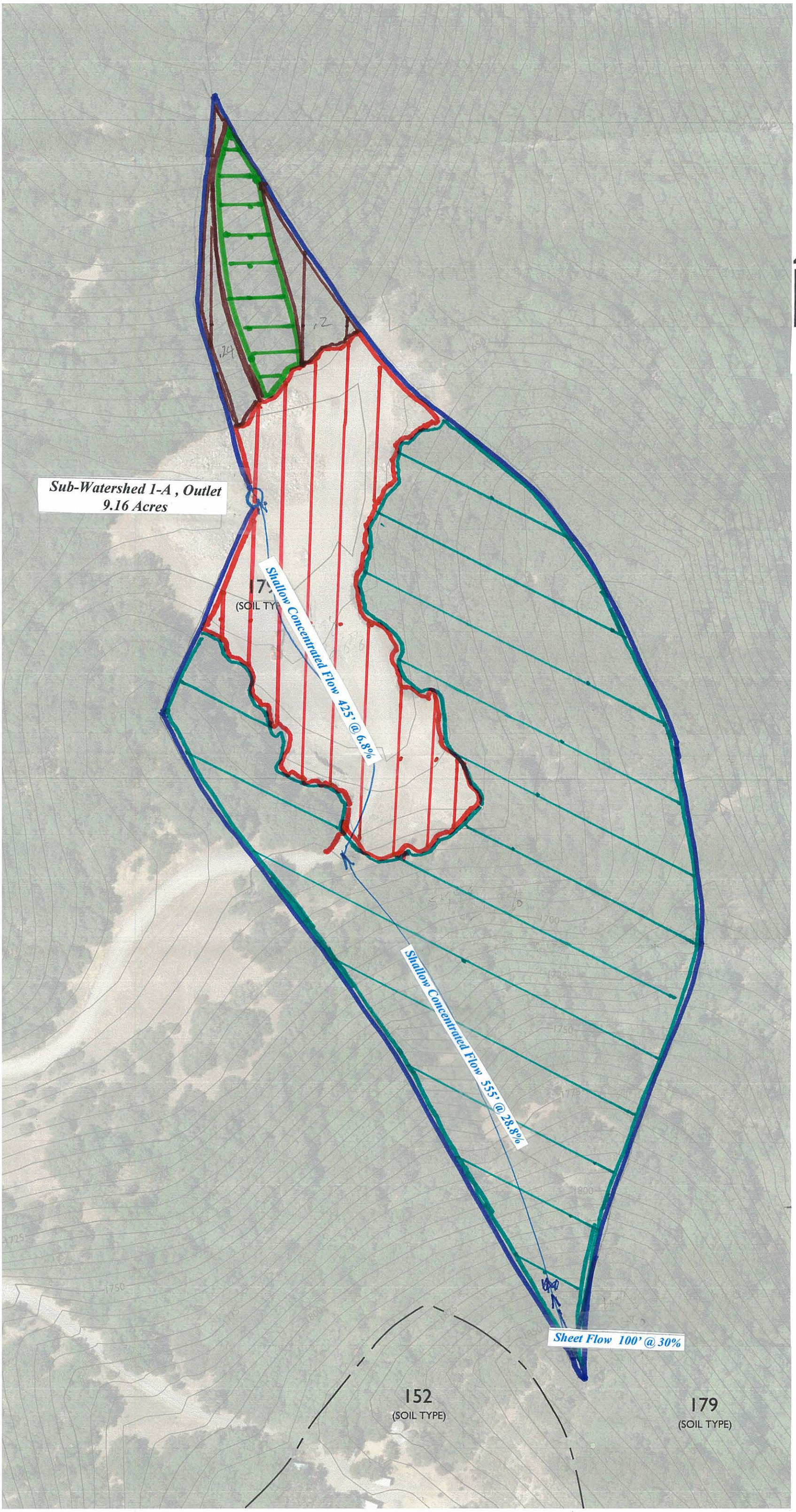
Sub WS 1-A, Post
County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
1-A	Newly graded area (pervious only)		C	2.18	91
	Woods	(poor)	C	.44	77
	Woods	(fair)	C	.44	73
	Woods	(good)	C	6.1	70
	Total Area / Weighted Curve Number			9.16	75


Sub-Watershed 1-A , Outlet
9.16 Acres
Shallow Concentrated Flow 425' @ 6.8%
Shallow Concentrated Flow 555' @ 28.8%
Sheet Flow 100' @ 30%
(SOIL TYPE)
152
(SOIL TYPE)
179
(SOIL TYPE)

SCALE: 1" = 100'

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Kenzo
Post-Project, Tc extended for 2-yr storm
County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)
SUBAREAS						
Main	15.23	24.28	31.77	41.87	49.57	57.24
REACHES						
OUTLET	15.23 (=15.23 pre peak)	24.28	31.77	41.87	49.57	57.24

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Post-Project, Tc extended for 2-yr storm
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)
4.03	5.29	6.29	7.61	8.61	9.6	.0

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

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Kenzo
Post-Project, Tc extended for 2-yr storm
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	0.3000	0.240				0.072	
SHALLOW	555	0.2880	0.050				0.018	
SHALLOW	1610	0.0680	0.050				0.106	
CHANNEL	40					7.350	0.002	
CHANNEL	670	0.0100	0.040	5.00	7.00	2.954	0.063	(manual entry)
					Time of Concentration		.261	

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Post-Project, Tc extended for 2-yr storm
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	Paved; open ditches (w/right-of-way)		C	.37	92
	Paved; open ditches (w/right-of-way)		D	.2	93
	User defined urban (Click button or		C	12.23	79
	User defined urban (Click button or		D	.87	84
	Newly graded area (pervious only)		C	2.61	91
	Pasture, grassland or range	(good)	C	3.66	74
	Pasture, grassland or range	(good)	D	.44	80
	Woods - grass combination	(fair)	C	.93	76
	Woods - grass combination	(fair)	D	.2	82
	Woods	(poor)	C	11.23	77
	Woods	(fair)	C	4.46	73
	Woods	(good)	C	18.32	70
	Woods	(good)	D	.35	77
	Total Area / Weighted Curve Number			55.87	76

DAS

Kenzo
Post-Project, Tc extended for 100-yr storm
County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)	
SUBAREAS							
Main	15.67	24.96	32.65	42.99	50.91	58.76	
REACHES							
OUTLET	15.67	24.96	32.65	42.99	50.91	58.76	(<58.77 pre peak)

Kenzo
Post-Project, Tc extended for 100-yr storm
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)
4.03	5.29	6.29	7.61	8.61	9.6	.0

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

Kenzo
Post-Project, Tc extended for 100-yr storm
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	0.3000	0.240				0.072	
SHALLOW	555	0.2880	0.050				0.018	
SHALLOW	1610	0.0680	0.050				0.106	
CHANNEL	40					7.350	0.002	
CHANNEL	250	0.0100	0.040	5.00	7.00	3.019	0.023	(manual entry)
					Time of Concentration		.221	

Kenzo
Post-Project, Tc extended for 100-yr storm
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	Paved; open ditches (w/right-of-way)		C	.37	92
	Paved; open ditches (w/right-of-way)		D	.2	93
	User defined urban (Click button or		C	12.23	79
	User defined urban (Click button or		D	.87	84
	Newly graded area (pervious only)		C	2.61	91
	Pasture, grassland or range	(good)	C	3.66	74
	Pasture, grassland or range	(good)	D	.44	80
	Woods - grass combination	(fair)	C	.93	76
	Woods - grass combination	(fair)	D	.2	82
	Woods	(poor)	C	11.23	77
	Woods	(fair)	C	4.46	73
	Woods	(good)	C	18.32	70
	Woods	(good)	D	.35	77
	Total Area / Weighted Curve Number			55.87	76

Kenzo NOAA 14
38.330, -122.192
2/6 = 1.94; R = 69

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	**0.141** (0.125-0.159)	**0.177** (0.158-0.201)	**0.225** (0.200-0.257)	**0.265** (0.233-0.305)	**0.320** (0.270-0.382)	**0.363** (0.299-0.444)	**0.407** (0.327-0.513)	**0.454** (0.353-0.590)	**0.520** (0.385-0.708)	**0.573** (0.408-0.812)
10-min	**0.201** (0.179-0.228)	**0.254** (0.226-0.288)	**0.323** (0.286-0.368)	**0.380** (0.334-0.437)	**0.459** (0.388-0.548)	**0.520** (0.429-0.637)	**0.584** (0.468-0.735)	**0.651** (0.506-0.846)	**0.745** (0.552-1.01)	**0.821** (0.585-1.16)
15-min	**0.244** (0.217-0.276)	**0.307** (0.273-0.348)	**0.390** (0.346-0.445)	**0.460** (0.404-0.529)	**0.555** (0.469-0.663)	**0.629** (0.519-0.770)	**0.706** (0.566-0.889)	**0.787** (0.611-1.02)	**0.901** (0.667-1.23)	**0.993** (0.707-1.41)
30-min	**0.353** (0.314-0.400)	**0.444** (0.395-0.504)	**0.565** (0.501-0.644)	**0.665** (0.584-0.765)	**0.803** (0.678-0.959)	**0.910** (0.751-1.12)	**1.02** (0.819-1.29)	**1.14** (0.885-1.48)	**1.30** (0.966-1.78)	**1.44** (1.02-2.04)
60-min	**0.519** (0.462-0.588)	**0.653** (0.581-0.742)	**0.831** (0.737-0.947)	**0.979** (0.860-1.13)	**1.18** (0.998-1.41)	**1.34** (1.11-1.64)	**1.50** (1.21-1.89)	**1.68** (1.30-2.18)	**1.92** (1.42-2.61)	**2.11** (1.51-3.00)
2-hr	**0.794** (0.707-0.900)	**0.993** (0.883-1.13)	**1.25** (1.11-1.43)	**1.47** (1.29-1.69)	**1.76** (1.48-2.10)	**1.98** (1.63-2.42)	**2.21** (1.77-2.78)	**2.45** (1.90-3.19)	**2.79** (2.07-3.80)	**3.05** (2.18-4.33)
3-hr	**1.02** (0.910-1.16)	**1.27** (1.13-1.45)	**1.61** (1.43-1.83)	**1.88** (1.65-2.16)	**2.24** (1.90-2.68)	**2.52** (2.08-3.09)	**2.81** (2.26-3.54)	**3.11** (2.42-4.04)	**3.52** (2.61-4.80)	**3.86** (2.75-5.46)
6-hr	**1.54** (1.38-1.75)	**1.94** (1.72-2.20)	**2.45** (2.17-2.79)	**2.86** (2.51-3.29)	**3.42** (2.89-4.08)	**3.84** (3.17-4.70)	**4.27** (3.43-5.38)	**4.71** (3.66-6.13)	**5.32** (3.94-7.25)	**5.79** (4.13-8.21)
12-hr	**2.17** (1.94-2.47)	**2.80** (2.49-3.18)	**3.61** (3.20-4.11)	**4.25** (3.73-4.89)	**5.10** (4.31-6.10)	**5.75** (4.75-7.04)	**6.40** (5.13-8.06)	**7.07** (5.49-9.19)	**7.96** (5.90-10.9)	**8.66** (6.17-12.3)
24-hr	**3.04** (2.74-3.45)	**4.03** (3.63-4.58)	**5.29** (4.75-6.01)	**6.29** (5.61-7.20)	**7.61** (6.60-8.96)	**8.61** (7.34-10.3)	**9.60** (8.02-11.7)	**10.6** (8.66-13.3)	**11.9** (9.42-15.5)	**13.0** (9.94-17.3)

Free Online Manning Pipe Flow Calculator

>> Nationalism not welcome here. <<

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Can you help me translate, program, or host these calculators? (../contact.php) [Hide this request]

Check out our newest spreadsheet update: Download Spreadsheet (spreadsheet/Manning-Pipe-Flow.xlsx) Open Google Sheets version (spreadsheet/Manning-Pipe-Flow.php) View All Spreadsheets (http://www.hawsedc.com/engcalcs/SpreadsheetLibrary.php)

--CAUTION: If you have downloaded the spreadsheet prior to September 24, you may have received incorrect results!--

Kenzo

Existing CMP below field

Set units: m | mm | ft | in

Pipe diameter, d_0	24 in
Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)	.018
Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), S_0	.02 rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	50 %

Results

Flow, Q	11.5519	cfs
Velocity, v	7.3544	ft/sec
Velocity head, h_v	0.8406	ft
Flow area	1.5708	ft^2
Wetted perimeter	3.1416	ft
Hydraulic radius	0.5000	ft
Top width, T	2.0000	ft
Froude number, F	1.46	
Shear stress (tractive force), tau	1.2488	psf

Search

Properties and Qualities Ratings

Open All | Close All

Soil Chemical Properties

Soil Erosion Factors

K Factor, Rock Free

K Factor, Whole Soil

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

Layer Options (Horizon Aggregation Method): ◉ Surface Layer (Not applicable) ○ Depth Range (Weighted Average)

Top Depth:

Bottom Depth:

○ Inches ◉ Centimeters

○ All Layers (Weighted Average)

View Description | View Rating

T Factor

Wind Erodibility Group

Wind Erodibility Index

Soil Health Properties

Soil Physical Properties

Soil Qualities and Features

Water Features

Map — K Factor, Whole Soil

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 pa
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 lin
have been shown at a more detailed scale.

Tables — K Factor, Whole Soil — 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
152	Hambright rock-Outcrop complex, 30 to 75 percent slopes	.10	37.7	30.6%
169	Perkins gravelly loam, 5 to 9 percent slopes	.15	14.9	12.1%
179	Sobrante loam, 30 to 50 percent slopes	.32	70.5	57.2%
Totals for Area of Interest			**123.1**	**100.0%**

Map — Hydrologic Soil Group

Scale (not to scale)

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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
152	Hambright rock-Outcrop complex, 30 to 75 percent slopes	D	37.7	30.6%
169	Perkins gravelly loam, 5 to 9 percent slopes	C	14.9	12.1%
179	Sobrante loam, 30 to 50 percent slopes	C	70.5	57.2%
Totals for Area of Interest			**123.1**	**100.0%**

Map — T Factor

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 pa
The design of map units and the level of detail shown in the resulting soil map are dependent on that map scale.

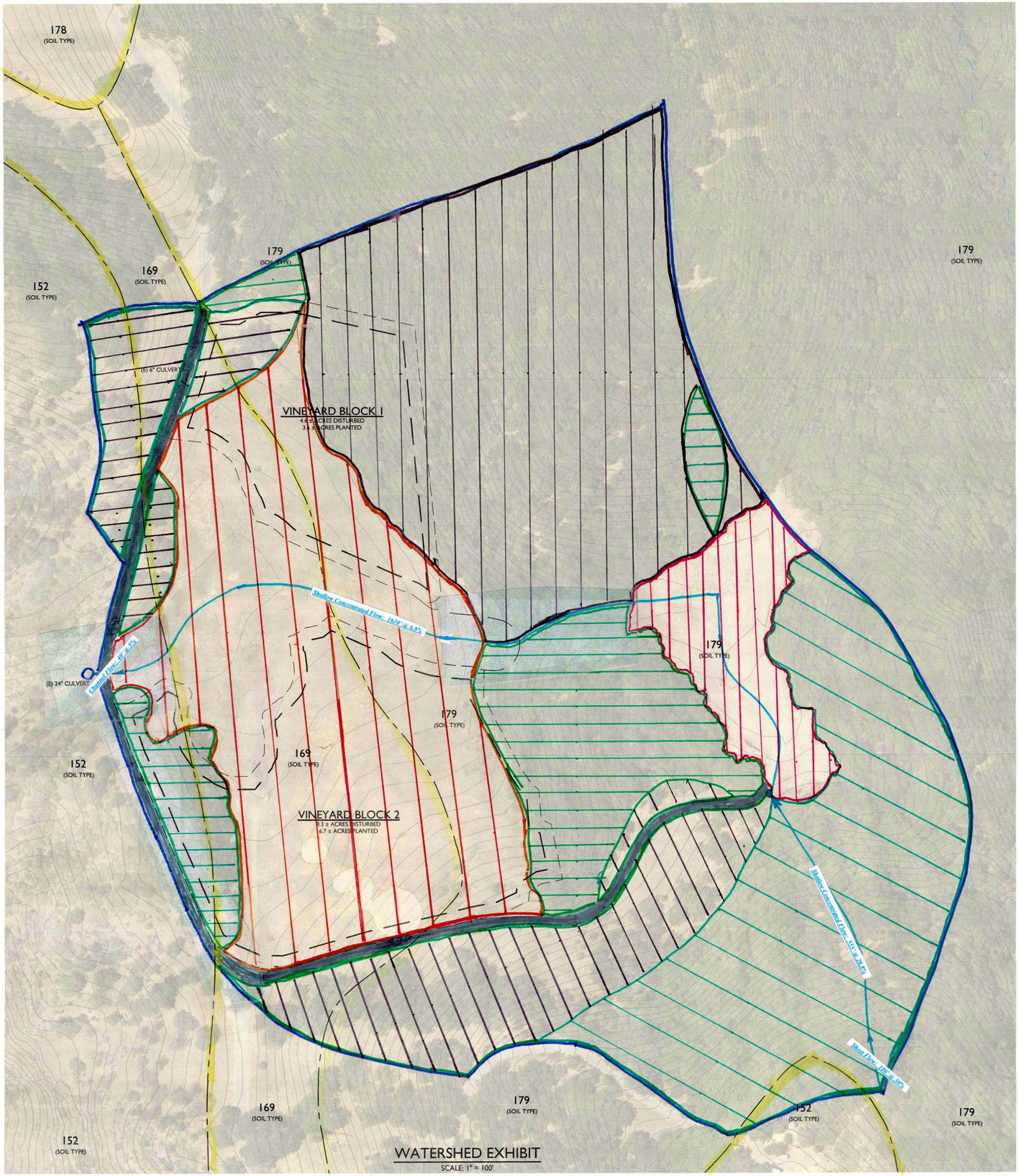
Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil li
have been shown at a more detailed scale.

Tables — T Factor — Summary By Map Unit

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

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

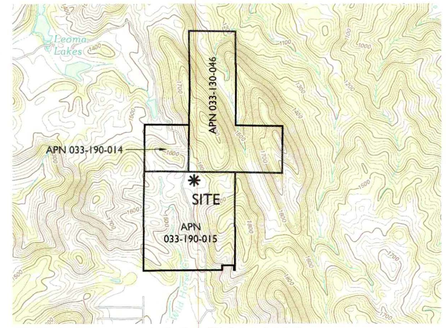
Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
152	Hambright rock-Outcrop complex, 30 to 75 percent slopes	1	37.7	30.6%
169	Perkins gravelly loam, 5 to 9 percent slopes	5	14.9	12.1%
179	Sobrante loam, 30 to 50 percent slopes	2	70.5	57.2%
Totals for Area of Interest			**123.1**	**100.0%**



WATERSHED EXHIBIT
SCALE: 1" = 100'

SCALE: 1" = 100'
0 100' 200'

SCALE: 1" = 2,000'



LOCATION MAP
SCALE: 1" = 2,000'

PROJECT INFORMATION:

PROPERTY OWNER & APPLICANT:
KENZO ESTATE INC
3200 MONTICELLO ROAD
NAPA, CA 94558

SITE ADDRESS:
8999 WILD HORSE VALLEY ROAD
NAPA, CA 94558

ASSESSOR'S PARCEL NUMBERS:
033-190-014, -015 & 033-130-046

PARCEL SIZES:
40± ACRES, 159± ACRES & 160± ACRES

Kenzo Vineyards
Hydrologic Analysis
Runoff Curve Numbers
Pre-Project Conditions

Woods, Good Condition, HSG C, CN 70

Woods, Fair Condition, HSG C, CN 73
HSG D, CN 79

Woods, Poor Condition, HSG C, CN 77

Woods-Grass, Good Condition, HSG C, CN

Woods-Grass, Fair Condition, HSG C, CN 76
HSG D, CN 82

Pasture, Good Condition, HSG C, CN 74
HSG D, CN 80

Outlet (Point of Interest)

Watershed Boundary

Mapping Unit (Soil Type) Boundary

Time of Concentration Flowpath

Fallow, Bare Soil, HSG C, CN 91

APPLIED CIVIL ENGINEERING
2074 West Lincoln Avenue, INCORPORATED
Napa, CA 94558
(707) 320-4968 (707) 320-2395 Fax
www.appliedcivil.com

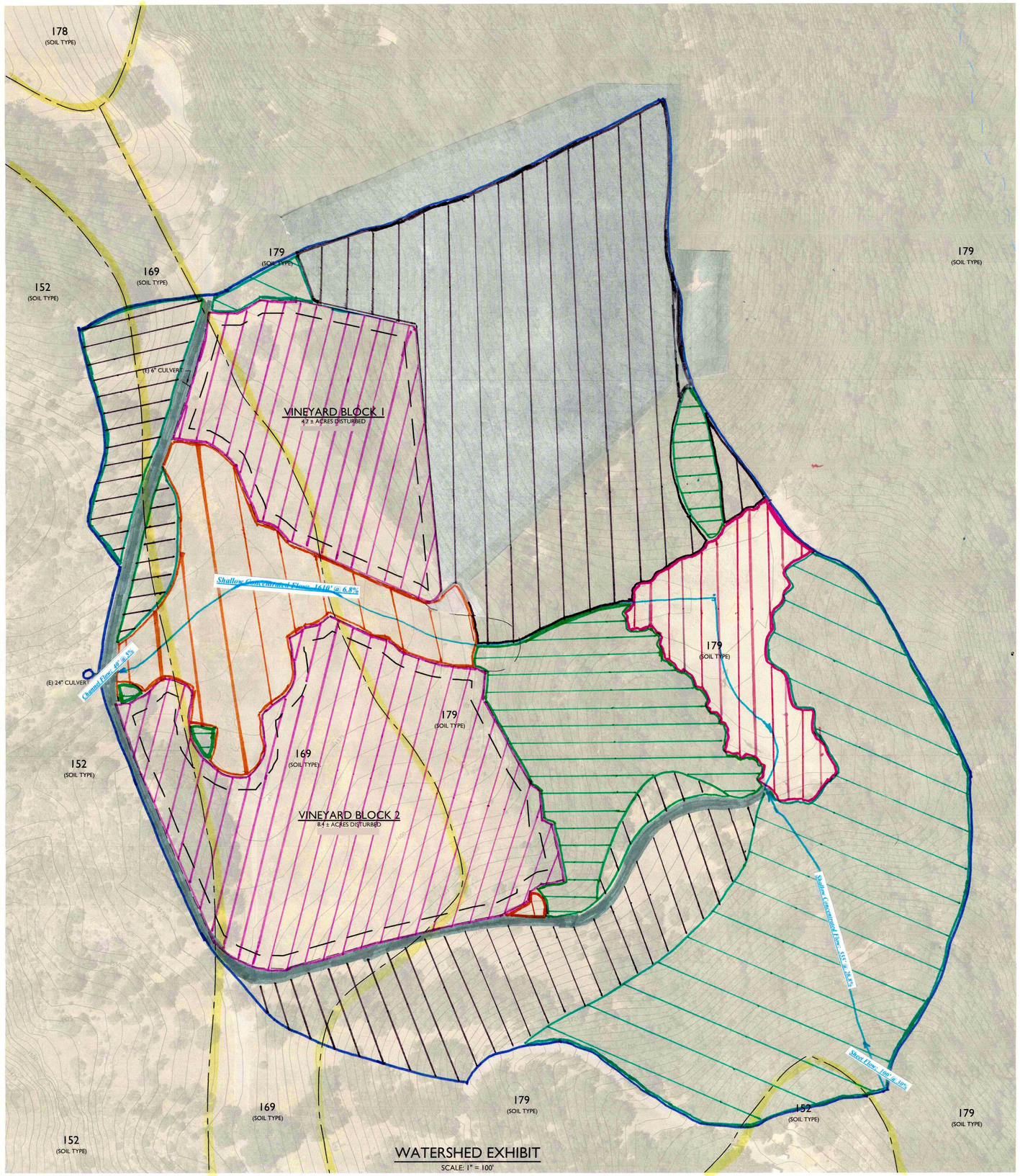
KENZO ESTATE

PHASE 9 VINEYARD WATERSHED EXHIBIT
WATERSHED EXHIBIT

PREPARED UNDER THE DIRECTION OF:

REGISTERED PROFESSIONAL ENGINEER
MICHAEL R. MURRAY
NO. 67435
Exp. 12/31/2018
CIVIL
STATE OF CALIFORNIA
PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY: BT DRAFTING
CHECKED BY: MRM
DATE: FEBRUARY 2018
REVISIONS: BY:
JOB NUMBER: 17-147
FILE: 17-147EXH_OSP.DWG
ORIGINAL SIZE: 24" X 36"
SHEET NUMBER: 1 OF 1



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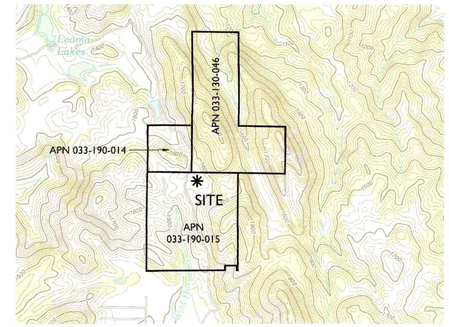

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Woods, Poor Condition, HSG C, CN 77

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PHASE 9 VINEYARD WATERSHED EXHIBIT
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