Soil Loss Analysis – Maxville Winery

Includes: USLE Calculations
April 12, 2023

The subject site is located along Chiles-Pope Valley Rd, St Helena, CA, APNs 025-020-023, 027, and 028. The eastern portion of the site is located within the "Chiles Valley" USGS quadrangle and the western portion is within the "Saint Helena" USGS quadrangle. The property is also situated on a watershed divide with the far eastern portion draining into the Main Fork Lake Hennessy watershed and the majority draining west into the Upper Reach of Maxwell Creek Watershed. Elevations within the proposed vineyard blocks range from about 900 ft to 1375 ft asl. Mapped bedrock units in the area include include Lower Cretaceous marine rocks (Kl) comprised of siltstone-mudstone, with a minor component of sandstone [3].

Most vineyard blocks are within the Bress-Dibble complex (113-114) with some lowland areas in Haire Loam (146) [1]; see Site Plan – Aerial Map for soil boundaries. The Napa County Soil Survey [4] describes site soils as follows:

- Bressa-Dibble complex (113-114) as moderately steep to steep soils on uplands and narrow ridgetops. The soils formed from weathered sandstone and shale. Bressa is the dominant soil type (65%-70%), then Dibble soils (20%), with minor components of other soils intermingled (10%-15% Contra-Costa, Lodo, Los Gatos, Maymen, Millsholm, Montara, and/or Sobrante). Areas with these soils are predominantly used for grazing, which is the case at the Maxville site. Plant cover is typically grassland and scattered oaks.
- The Haire series (146) consists of moderately well drained soils on old terraces and alluvial fans. These soils formed from alluvium derived from the upland soils. Vegetation is typically grasses and forbs.

Soil data were obtained from the NRCS web soil survey, which notes that map data may not be valid the map scale for this project. The soils map was created at a scale of 1:24,000 or 1 in = 2,000 ft. Enlarged maps can cause misunderstandings of the accuracy of soil line placement. The NRCS Web Soil Survey lists the following soil properties:

Soil Type	Soils description	K	T	HSG
113	Bressa-Dibble complex, 15 to 30 percent slopes	0.43	3	C
114	Bressa-Dibble complex, 30 - 50 percent slopes	0.43	3	C
146	Haire loam, 2 to 9 percent slopes	0.32	4	D

Average slope across vineyard blocks ranges from 5-37% with an average of about 20%.

The energy of precipitation (R) value was determined by getting the Point Precipitation Frequency Estimate for the subject site from the NOAA PFDS site (the 6-hr duration with 2-year recurrence interval with 90% confidence interval). The value of 2 was converted to an R value of 75 from Table A-1 [5].

Current groundcover is predominantly Wild Oat Grassland, with intermixed Blue Oak woodland and Coast Live Oak woodland. Existing cover conditions were evaluated in the field on

February 24, 2021. Please refer to Application Section 7: Photos for visual documentation of existing cover crop in each block, which varies by location. Lower quality of ground cover primarily correlated to grazing areas on the lower slopes of the hills and sometimes follows existing fence lines that control movement of cattle

Post-cover conditions will establish an 80% cover crop throughout with the addition of diversion ditches in select locations to break up the slope length across certain vineyard blocks (Table 2 and Table 3).

An up/down-hill row direction for a P factor of 1 was assumed for soil loss calculations. An up-downhill row direction represents the "worst-case" scenario and any row direction that deviates from up/down-hill and approaches parallel to contours would *improve* (i.e. reduce) soil loss.

Erosion Calculation Results

Soil Loss in tons/acre were computed using the following formula [2]:

$$A = (R) \times (K) \times (LS) \times (C) \times (P) \qquad \text{with } A < T+2$$

Where:

A = Predicted Soil Loss (tons/acre)
R = Rainfall & Runoff Factor (energy of precipitation)
K = Soil Erosiveness (NRCS whole soil, surface layer, dominant condition)
LS = Erosion Energy (function of line length and steepness)
C = Factor for cover crop, surface residue, roughness, and canopy
P = Factor for contouring or cross-slope farming (1.0 if contouring is not applicable)
T = Soil Loss Tolerance

Flow line locations are shown on Site Plan: Topo and ECP Detail.

As presented, there will be no net increase in soil loss from the site. Erosion calculations for the Pre- and Post- project site are summarized in TABLE 1.

References

1. Attachments B&C, *Biological Resource Assessment with Botanical Survey and Delineation of Waters of the U.S. for the Maxville Winery & Vineyard Project, APNs 025-020-002, 008, & 0.23 Napa, CA*, prepared by Northwest Biosurvey, December 30, 2022
2. *Custom Soil Reource Report for Napa County, California*, from USDA NRCS Web Soil Survey, January 2023
3. *Guides for Erosion & Sediment Control*, USDA Soil Conservation Service, Davis, CA, 1991
4. Jennings, C.W., et al., *Geologic map of California*, California Geological Survey, 2010, https://ngmdb.usgs.gov/Prodesc/proddesc_96750.htm
5. Lambert, G., Kashiwagi, J. et al., *Soil Survey of Napa County, California*, USDA in cooperation with UC Agricultural Experiment Station, August 1978
6. *USLE Special Applications for Napa County*, USDA, NRCS, May 2014
7. Wischmeier, W.H., and Smith, D.D. *Predicting rainfall erosion losses – a guide to conservation planning.* USDA, Agriculture Handbook No. 537. 1978

	ESTABLISHED VEGETATION																						
	A=(R)(K)(LS)(C)(P)																						
	Vineyard Block	A	B	B	B	B	B	C1	C1	C1	C2	C2	C3	D1	D1	D1	D1	D2	D2	D3	E	E	
	USLE ID#	1	2	2a	2b	2c	3	5a	5b	4	6	7	8	9a	9b	10	11	12	13	14	15	16	
	Soil Type	114	114	114	114	114	114	113	113	113	113	113	114	114	113	113	113	113	113	113	113	114	
Var	DESCRIPTION																						
R	Rainfall & Runoff Factor	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	
K	Soil Erosiveness	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	
	Slope length (ft)	170	268	95	85	87	186	118	88	495	311	388	91	154	119	117	194	105	91	155	184	179	
	Δelevation (ft)								-82%						-79%		-83%						
S	Gradient (%)	14	35	37	35	34	25	34	6	12	19	14	20	29	6	30	5	30	22	29	15	18	
LS^2	Calculated LS (Napa Equ.)	2.804	11.591	7.369	6.527	6.378	6.352	7.428	0.630	3.875	5.728	4.236	3.317	6.979	0.733	6.346	0.745	6.012	3.762	7.002	3.205	4.043	
C	Cover PRE	Table Lookup																					
	Drop Fall Height (ft)	13.0	13.0				13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	
	% Canopy Cover	25%	50%				25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	
	% Ground Cover	75%	75%				70%	70%	70%	70%	60%	70%	60%	75%	70%	70%	75%	75%	70%	70%	75%	70%	
	% W	40%	40%				40%			40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	
	% G	60%	60%				60%	-	-	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
C	Cover PRE	0.034	0.033				0.042	0.028	0.028	0.043	0.062	0.043	0.062	0.034	0.043	0.043	0.034	0.034	0.043	0.043	0.034	0.042	
C	Cover POST	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	
C	Cover POST	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	
P	Cover PRE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
P	Cover POST	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
A	Soil loss, tons/acre PRE	3	12				9	7	0.6	5	11	6	7	8	1	9	1	6.6	5	10	4	6	
A	Soil loss, tons/acre POST	2	8	5	5	5	5	5	0.4	3	4	3	2	5	1	5	1	4.3	3	5	2	3	
	T =	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	T + 2 =	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
LS^2	Guides for Erosion & Sediment Control, USDA Soil Conservation Service, Davis, CA, 1991																						
	A slope reduction of at least 65% qualifies as a deposition zone	(Page 20 of pdf Erosion Guides)																					

	ESTABLISHED VEGETATION														
	A=(R)(K)(LS)(C)(P)														
	Vineyard Block	F	G	G	G	H	H	I	I	I	J	K	L	M	N
	USLE ID#	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	Soil Type	114	114	114	114	146	146	114	114	114	146	113	113	113	114
Var	DESCRIPTION														
R	Rainfall & Runoff Factor	75	75	75	75	75	75	75	75	75	75	75	75	75	75
K	Soil Erosiveness	0.43	0.43	0.43	0.43	0.32	0.32	0.43	0.43	0.43	0.32	0.43	0.43	0.43	0.43
	Slope length (ft)	215	290	380	432	227	162	210	581	867	250	419	557	434	480
	Δelevation (ft)														
S	Gradient (%)	16	10	13	22	16	20	31	16	12	16	26	14	18	15
LS^2	Calculated LS (Napa Equ.)	3.781	2.307	3.789	8.197	3.885	4.426	8.855	6.215	5.128	4.077	10.025	5.076	6.295	5.176
C	Cover PRE														
	Drop Fall Height (ft)	13.0	0.0	13.0	13.0	13.0	13.0	0.0	0.0	0.0	0.0	13.0	0.0	13.0	0.0
	% Canopy Cover	25%	0%	25%	50%	25%	25%	0%	0%	0%	0%	75%	0%	25%	0%
	% Ground Cover	70%	60%	75%	60%	60%	60%	60%	60%	60%	70%	80%	80%	80%	80%
	% W	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	60%	50%	50%	40%
	% G	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	40%	50%	50%	60%
C	Cover PRE	0.042	0.062	0.034	0.059	0.060	0.060	0.062	0.062	0.062	0.043	0.029	0.028	0.028	0.025
C	Cover POST	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
C	Cover POST	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
P	Cover PRE	1	1	1	1	1	1	1	1	1	1	1	1	1	1
P	Cover POST	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A	Soil loss, tons/acre PRE	5	5	4	16	6	6	18	12	10	4	10	5	6	4
A	Soil loss, tons/acre POST	3	2	3	6	2	2	6	4	4	2	7	4	4	4
	T =	3	3	3	3	4	4	3	3	3	4	3	3	3	3
	T + 2 =	5	5	5	5	6	6	5	5	5	6	5	5	5	5
LS^2	Guides for Erosion & Sediment Control, USDA S														
	A slope reduction of at least 65% qualifi														

TABLE 1 Calculation table and results

TABLE 10.—*Factor* **C** *for permanent pasture, range, and idle land*[1]

Vegetative canopy		Cover that contacts the soil surface						
Type and height[2]	Percent cover[3]		Percent ground cover					
		Type[4]	0	20	40	60	80	95+
No appreciable canopy		G	0.45	0.20	0.10	0.042	0.013	0.003
		W	.45	.24	.15	.091	.043	.011
Tall weeds or short brush with average drop fall height of 20 in	25	G	.36	.17	.09	.038	.013	.003
		W	.36	.20	.13	.083	.041	.011
	50	G	.26	.13	.07	.035	.012	.003
		W	.26	.16	.11	.076	.039	.011
	75	G	.17	.10	.06	.032	.011	.003
		W	.17	.12	.09	.068	.038	.011
Appreciable brush or bushes, with average drop fall height of 6½ ft	25	G	.40	.18	.09	.040	.013	.003
		W	.40	.22	.14	.087	.042	.011
	50	G	.34	.16	.08	.038	.012	.003
		W	.34	.19	.13	.082	.041	.011
	75	G	.28	.14	.08	.036	.012	.003
		W	.28	.17	.12	.078	.040	.011
Trees, but no appreciable low brush. Average drop fall height of 13 ft	25	G	.42	.19	.10	.041	.013	.003
		W	.42	.23	.14	.089	.042	.011
	50	G	.39	.18	.09	.040	.013	.003
		W	.39	.21	.14	.087	.042	.011
	75	G	.36	.17	.09	.039	.012	.003
		W	.36	.20	.13	.084	.041	.011

[1] The listed **C** values assume that the vegetation and mulch are randomly distributed over the entire area.

[2] Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 33 ft.

[3] Portion of total-area surface that would be hidden from view by canopy in a vertical projection (a bird's-eye view).

[4] G: cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 in deep.

W: cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface) or undecayed residues or both.

Table 2 C values for non-farmed, natural vegetation [6]

TABLE 9.—*Mulch factors and length limits for construction slopes*[1]

Type of mulch	Mulch Rate	Land Slope	Factor C	Length limit[2]
	Tons per acre	*Percent*		*Feet*
None	0	all	1.0	—
Straw or hay,	1.0	1-5	0.20	200
tied down by	1.0	6-10	.20	100
anchoring and				
tacking	1.5	1-5	.12	300
equipment[3]	1.5	6-10	.12	150
Do.	2.0	1-5	.06	400
	2.0	6-10	.06	200
	2.0	11-15	.07	150
	2.0	16-20	.11	100
	2.0	21-25	.14	75
	2.0	26-33	.17	50
	2.0	34-50	.20	35
Crushed stone,	135	<16	.05	200
¼ to 1½ in	135	16-20	.05	150
	135	21-33	.05	100
	135	34-50	.05	75
Do.	240	<21	.02	300
	240	21-33	.02	200
	240	34-50	.02	150
Wood chips	7	<16	.08	75
	7	16-20	.08	50
Do.	12	<16	.05	150
	12	16-20	.05	100
	12	21-33	.05	75
Do.	25	<16	.02	200
	25	16-20	.02	150
	25	21-33	.02	100
	25	34-50	.02	75

[1] From Meyer and Ports (24). Developed by an interagency workshop group on the basis of field experience and limited research data.

[2] Maximum slope length for which the specified mulch rate is considered effective. When this limit is exceeded, either a higher application rate or mechanical shortening of the effective slope length is required.

[3] When the straw or hay mulch is not anchored to the soil, C values on moderate or steep slopes of soils having K values greater than 0.30 should be taken at double the values given in this table.

Table 3 C values for mulch cover [6]