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Water Availability Analysis

Vine Cliff Winery Modification #P17-00129-MOD
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Water Availability Analysis

Vine Cliff Winery, Napa County APN 032-030-027

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Vine Cliff Winery
7400 Silverado Trail
Napa, California

Prepared by:

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February 27, 2017

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Introduction

Vine Cliff Winery is seeking to modify its Use Permit to allow for increased visitation and employees at its existing winery located at 7400 Silverado Trail (APN 032-030-027) which is located about 2.8 miles east of Oakville in the hills just east of the Napa Valley floor. The subject parcel is adjacent to the valley floor groundwater zone. This Water Availability Analysis (WAA) was developed based on guidance provided in the Napa County Department of Planning, Building, & Environmental Services' Water Availability Analysis Guidance Document formally adopted by the Napa County Board of Supervisors in May 2015.

The WAA includes the following elements: estimates of existing and proposed water uses within the project recharge area, compilation of drillers' logs from the area and characterization of local hydrogeologic conditions, and execution of Tier 1 and Tier 2 screening criteria including estimates of groundwater recharge relative to proposed uses (Tier 1) and the potential for well interference at neighboring wells (Tier 2).

Limitations

Groundwater systems of Napa County and the Coast Range are typically complex, and available data rarely allows for more than general assessment of groundwater conditions and delineation of aquifers. Hydrogeologic interpretations are based on the drillers' reports made available to us through the California Department of Water Resources, available geologic maps and hydrogeologic studies and professional judgment. This analysis is based on available data and relies significantly on interpretation of data from disparate sources of disparate quality.

Given the significant depths to water in wells near the project parcel (160 to 626-ft), the relationship between groundwater recharge generated on the project parcel and groundwater availability at the project wells is uncertain. It is likely that water flowing to the project wells is supplied by groundwater inflows from surrounding areas as well as from recharge occurring on the overlying landscape comprised by the subject parcel. Analysis of the age and sources of the deeper groundwater occurring beneath the project parcel is beyond the scope of this study.

The water balance approach used to estimate groundwater recharge for this study simulates potential recharge from infiltration of precipitation and does not include verifiable estimates of the capacity of the project aquifer materials to accept recharge. Where bedrock of low permeability and/or fractured bedrock underlies the subject parcel and study area, a significant proportion of the potential recharge may exit the project area as shallow subsurface flow rather than percolating and recharging the local aquifer. Quantifying the proportion of the potential recharge that percolates to underlying bedrock aquifers is beyond the scope of this analysis; we have attempted to characterize aquifer hydraulic parameters from available data. Data describing subsurface conditions of soil and bedrock, local aquifer hydraulic characteristics, and local processes and pathways of groundwater percolation are rarely available and difficult to obtains in the absence of focused and well-funded hydrogeologic investigations.

Hydrogeologic Conditions

The project parcel is located in the foothills east of the Napa Valley in the northwest portion of a relatively large (~32 square miles) block of andesitic and basaltic lava flows of the Tertiary-aged Sonoma Volcanics. These volcanic rocks comprise much of the mountains east of the Napa Valley from the northern portion of the Milliken-Sarco-Tullocay (MST) basin north to Lake Hennessey (Figure 1). At the east edge of Napa Valley within the lowest-lying portions of the project parcel and immediately west of the parcel, alluvial fan deposits (map units Qf and Qhf) overlie the Sonoma Volcanics, mapped locally to be andesite and basalt flows (map unit Tsa, Figure 1). Geologic cross sections in the vicinity of the project parcel indicate that the Tsa unit extends to the west beneath portions of the alluvium of the Napa Valley and that wells in the area completed to depths as high as 600-ft do not fully penetrate the Tsa unit (see geologic Sections B and C, LSCE, 2013).

The Tsa unit is part of the lower member of the Sonoma Volcanics which was described by Weaver (1949) as comprised of individual lava flows displaying great variability in thickness and texture over short distances. Given this heterogeneity it can be expected that hydrogeologic conditions exhibit similar spatial variability and yields from wells completed anywhere in the Tsa unit, ranging from minimal yield to several hundred gpm (LSCE, 2013).

Driller's logs (Well Completion Reports) for wells around the project parcel were obtained from the California Department of Water Resources. A subset of these logs was compiled and georeferenced based on parcel and location sketch information available for some wells (Figure 1). The project parcel has two wells. The upper well (UW) is in the central-east portion of the parcel and was completed in 1996 to a depth of 385-ft. The lower well (LW) is in the south-east portion of the parcel and was completed to a depth of 280-ft (Table 1 & Figure 1). Driller's logs could not be located for these wells, thus static water levels and well completion details are unknown. The well depths were reported by the driller of the upper well, Doshier Gregson, as communicated by the property owner and Gregson.

Alluvial fan deposits in the southwest corner of the subject parcel are expected to be highly permeable relative to the underlying volcanic bedrock that comprises the project aquifer. Groundwater recharge processes are likely to be enhanced by the alluvial fan deposits because water may more readily percolate into and saturate the fan deposits and establish a perched water table overlying the bedrock aquifer that could provide for more effective percolation to the bedrock. This phenomena affects only a small portion of the parcel, but could have a disproportionate effect on overall recharge occurring on the subject parcel.

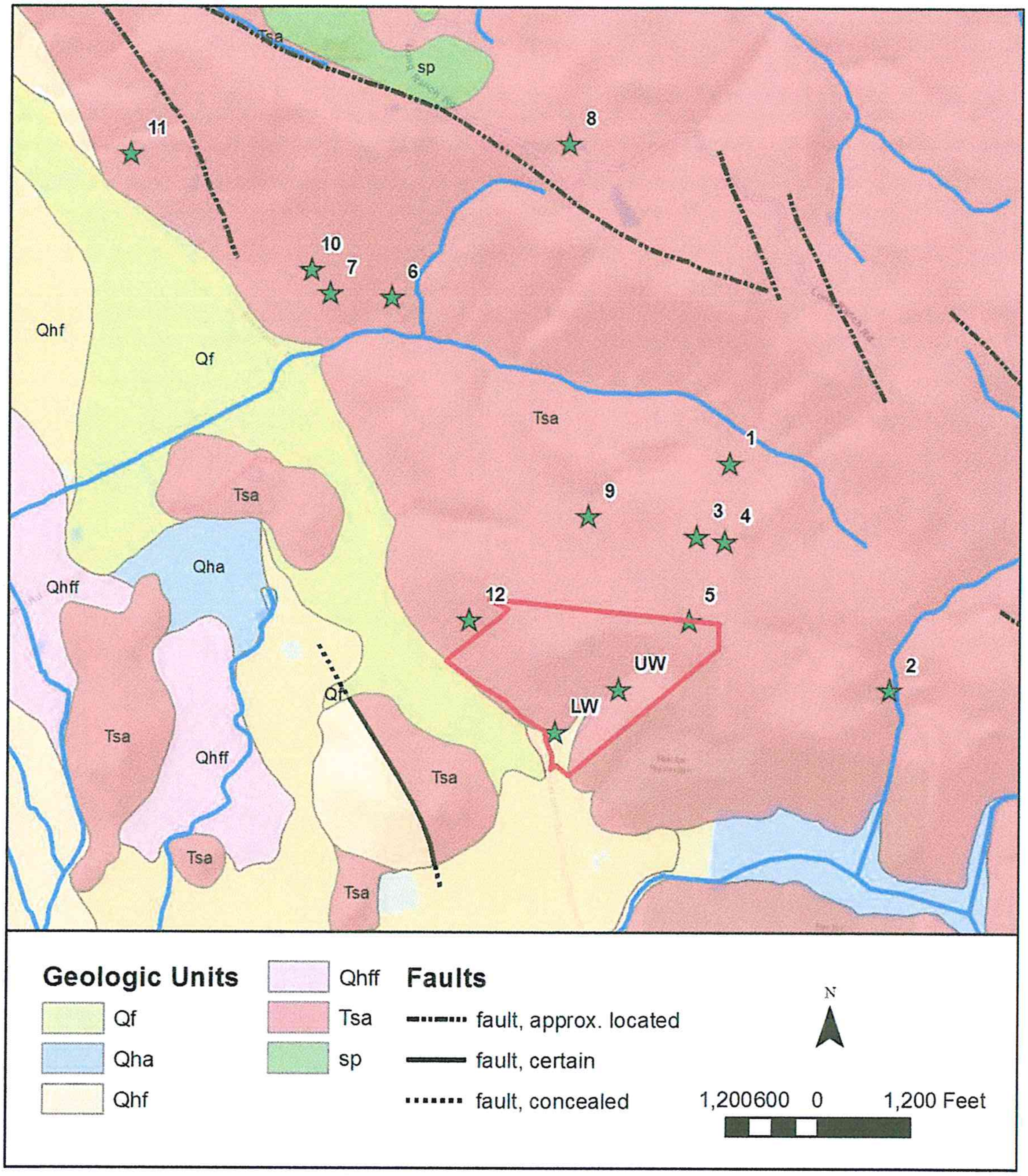

Figure 1: Surficial geology and locations of wells in the vicinity of the project parcel (Graymer et al., 2007). Units are as follows:

Qf - Alluvial fan deposits
Qha - Holocene alluvium
Qhf - Holocene alluvial fan deposits
Qhff - Fine-grained Holocene alluvial fan deposits
Tsa - Andesite to basalt lava flows
sp – Serpentinite

Table 1: Well completion details for the upper well (UW), lower well (LW), and wells on nearby parcels.

Well ID	UW	LW	1	2	3	4	5	6	7	8	9	10	11	12
Year Completed	1996	na	2001	2013	2000	2015	2007	1998	1978	2003	2009	1992	2000	1974
Depth (ft)	385	280	760	1125	590	1173	690	307	350	850	750	398	595	375
Static Water Level (ft)	na	na	393	271	260	626	480	na	220	570	320	249	400	160
Top of Screen (ft)	na	na	433	385	130	493	360	23	150	572	520	258	340	120
Bottom of Screen (ft)	na	na	753	1105	590	1153	690	307	350	762	750	398	595	370
Pumping Rate (gpm)	na	na	150	300	60	250	90	25	20	65	80	40	45	20
Drawdown (ft)	na	na	na	na	580	na	na	na	130	190	na	380	200	160
Test Length (hrs)	na	na	3	2	3	4	3	2	na	4	2	2	4	6
Specifc Capacity (gpm/ft)	na	na	na	na	0.10	na	na	na	0.15	0.34	na	0.11	0.23	0.13

Water Demand

Existing groundwater uses within the project recharge area (described below in the Groundwater Recharge Analysis section) consist of Residential Use for seven residences, Winery Use for the 48,000 gallon per year Vine Cliff Winery, and Irrigation Use for 113 acres of vineyard.

The existing Residential Use is estimated to total 6.70 ac-ft/yr. The existing Winery Use is estimated to total 2.22 ac-ft/yr, and the existing Irrigation Use is estimated to total 56.5 ac-ft/yr for a Total Existing Use of 65.42 ac-ft/yr. About 17.8 ac-ft/yr or 27% of the existing use is associated with the project parcel with the remainder associated with neighboring parcels.

Proposed uses consist of existing uses plus an additional 0.21 ac-ft/yr for the proposed increases in visitation and employee use for a Total Proposed Use of 65.63 ac-ft/yr. The incremental increase in water use associated with the proposed Use Permit modifications represents a 0.3% increase in Total Water Use within the project recharge area. The assumptions behind the various water use estimates are presented in Tables 2 through 7.

The two existing wells on the parcel (UW and LW in Table 1 & Figure 1) are currently supplying all of the Residential, Winery, and Irrigation Use on the parcel and will continue to do so under the proposed use conditions.

Table 2: Existing and proposed annual groundwater uses (ac-ft/yr) within the project recharge area. Existing use on the project parcel is 17.8 ac-ft/yr.

	Irrigation Use	Residential Use	Winery Use	Total Use
Existing Use	56.50	6.70	2.22	**65.42**
Proposed Use	56.50	6.70	2.43	**65.63**

Table 3: Existing and proposed Residential Use within the project recharge area.

Use Category	Count	Annual Water Use (ac-ft/yr)
Oversized Residence	2	2.00
Main Residence	4	3.00
Secondary Residences	1	0.35
Pools	3	0.30
Landscaping		1.05
TOTAL		**6.70**

Table 4: Existing and proposed Winery Process and Winery Landscaping Use for the Vine Cliff Winery.

Use Category	Annual Production (gal/yr)	Use per 100,000 gal of production (ac-ft/yr)	Annual Water Use (ac-ft/yr)
Winery Process Use	48,000	2.15	1.03
Winery Landscaping Use			1.00
TOTAL			**2.03**

Table 5: Existing and proposed Employee Use for the Vine Cliff Winery.

Existing

Work Category	# of Employees	# Work Days per Year	Use per Employee (gal/day)	Annual Water Use (ac-ft/yr)
Full-time	8	260	15	0.096
Part-time	2	130	15	0.012
TOTAL				**0.108**

Proposed

Work Category	# of Employees	# Work Days per Year	Use per Employee (gal/day)	Annual Water Use (ac-ft/yr)
Full-time	12	260	15	0.144
Part-time	4	130	15	0.024
TOTAL				**0.168**

Table 6: Existing and proposed Visitor Use for the Vine Cliff Winery.

Existing

Visitor Category	# of Vistors	Use per Visitor (gal/day)	Annual Water Use (ac-ft/yr)
Tasting Room	1,095	3	0.010
Events	1,500	15	0.069
TOTAL			**0.079**

Proposed

Visitor Category	# of Vistors	Use per Visitor (gal/day)	Annual Water Use (ac-ft/yr)
Tasting Room	14,600	3	0.134
Events	2,100	15	0.097
TOTAL			**0.231**

Table 7: Existing and proposed Irrigation Use within the project recharge area.

Use Category	Number of Acres	Use per Acre (ac-ft/yr)	Annual Water Use (ac-ft/yr)
Existing and Proposed Irrigation	113	0.50	56.50
TOTAL			**56.50**

Groundwater Recharge Analysis

The Soil Water Balance (SWB) model developed by the U.S. Geological Survey (Westenbroek et al., 2010) was used to produce a spatially distributed estimate of annual recharge in the vicinity of the project parcel. This model operates on a daily time step and calculates runoff based on the Natural Resources Conservation Service (NRCS) curve number approach and Actual Evapotranspiration (AET) and recharge based on a modified Thornthwaite-Mather soil-water-balance approach (Westenbroek et al., 2010). The northern boundary of the project aquifer recharge area was defined by an unnamed tributary to Conn Creek, the eastern and southern boundaries were defined by local drainage divides, and the western boundary was defined by the surface contact between the Sonoma Volcanics and the overlying terrace deposits. This entire area is underlain by the Tsa unit of the Sonoma Volcanics and is approximately 308.3 acres in size.

This approach simulates potential recharge from infiltration of precipitation and does not account for the capacity of the project aquifer materials to accept recharge. As discussed above (see Limitations), groundwater found at great depths may not be directly related to the recharge generated on the overlying landscape. Significant additional recharge may also occur through streambed infiltration, and/or groundwater inflows from outside the defined project recharge area, however quantifying these recharge components is beyond the scope of this analysis defined in the Napa PBES guidance document.

Model Development

The model was developed using a 10-meter resolution rectangular grid and water budget calculations were made on a daily time step. Key spatial inputs included a flow direction map developed from the USGS 10-meter resolution Digital Elevation Model, a land cover dataset based on the National Land Cover Dataset (Figure 2), a distribution of Hydrologic Soil Groups (A through D classification from lowest to highest runoff potential), and Available Water Capacity (AWC) developed from the NRCS Soil Survey Geographic Database (SSURGO) (Figure 3).

A series of model parameters were assigned for each land cover type/soil group combination including a curve number, a maximum infiltration rate which represents the maximum daily groundwater recharge, dormant and growing season interception storage values, and a rooting depth (Table 8). Curve numbers were assigned based on standard NRCS methods. Interception storage values and rooting depths were assigned based on literature values and previous modeling experience. Infiltration rates for hydrologic soil groups A through D were applied based on Cronshey et al. (1986) (Table 8) along with default soil-moisture-retention relationships based on Thornthwaite and Mather (1957) (Figure 4).

Daily precipitation data was compiled for the Napa River at Yountville Cross Road gauging station which is located ~2 miles south of the project parcel. Daily minimum and maximum air temperature data were compiled for the Napa State Hospital climate station which is located ~26 miles south of the project parcel. These stations were selected because they represent the best available climate stations in proximity to the project site with long and continuous periods of record. Based on the PRISM dataset which describes the spatial variations in long-term precipitation for the continental U.S., the 1980 to 2010 mean annual precipitation at the Napa River at Yountville Cross Road gauging station location was 31.6 inches versus 33.5 inches for the project recharge area (PRISM, 2010). The precipitation data was scaled up by a factor of 1.06 to account for the difference in precipitation between the station location and the project recharge area. Water Year 2010 was selected to represent average water year conditions for the analysis because it represents a recent year with near long-term average precipitation conditions (35.5 inches at the scaled Napa River at Yountville Cross Road station). The model was also evaluated for water year 2014 to represent drought conditions. Water year 2014 precipitation was 15.4 inches or approximately 46% of long-term average conditions.

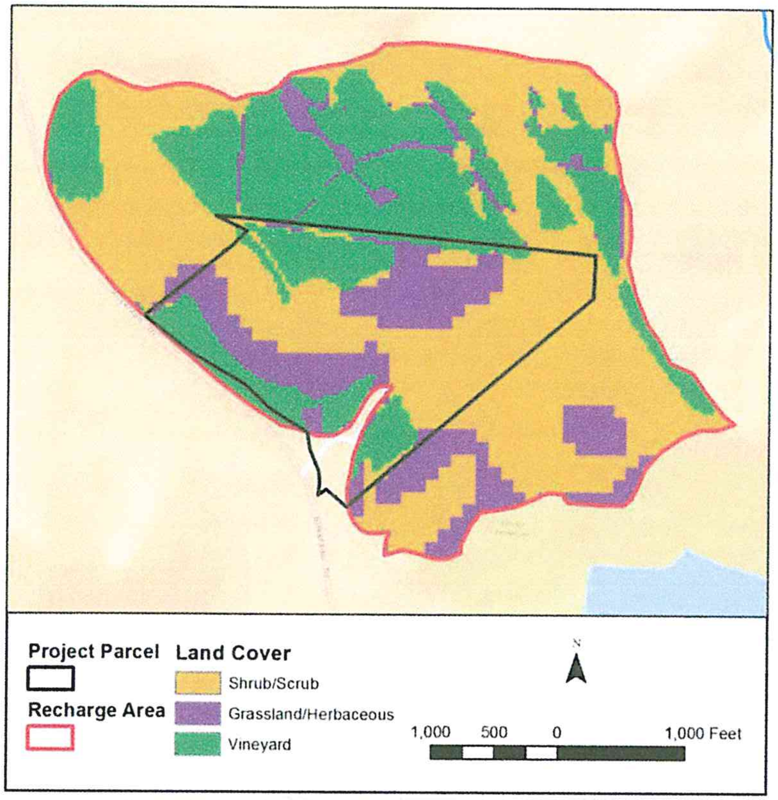

Figure 2: Land cover map used in the SWB model.

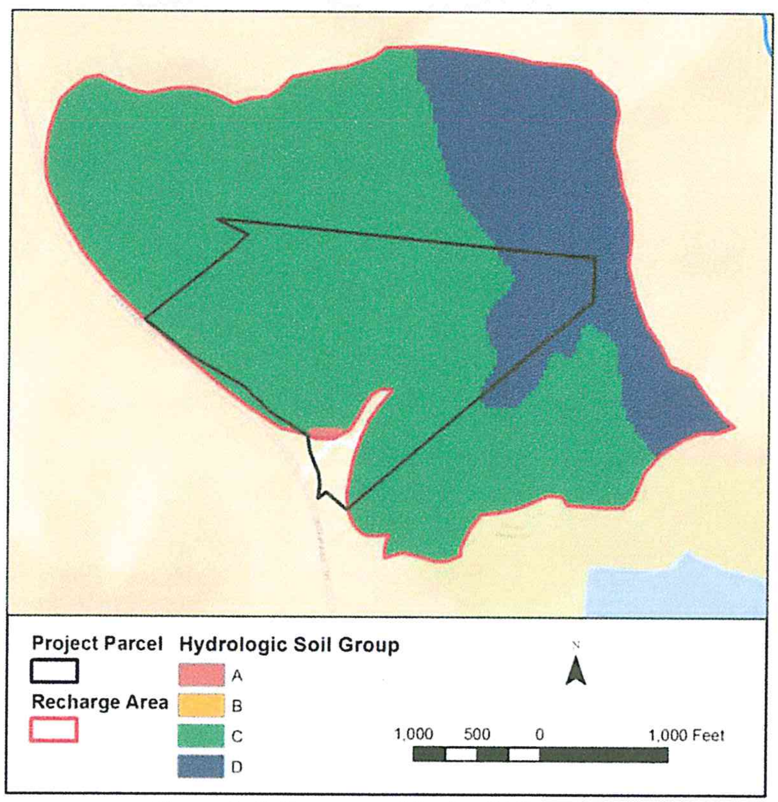

Figure 3: Soil map used in the SWB model.

Table 8: Soil and land cover properties used in the SWB model.

Land Cover	Curve Number			Interception Storage Values		Rooting Depths (ft)		
	A Soils	C Soils	D Soils	Growing Season	Dormant Season	A Soils	C Soils	D Soils
shrub/scrub	30	65	73	0.080	0.015	3.20	2.70	2.60
grassland/herbaceous	30	71	78	0.005	0.004	1.30	1.00	1.00
vineyard	38	75	81	0.080	0.015	2.20	2.00	1.90

Table 9: Infiltration rates for NRCS hydrologic soil groups (Cronshey et al., 1986).

Soil Group	Infiltration Rate (in/hr)
A	> 0.3
B	0.15 - 0.3
C	0.05 - 0.15
D	<0.05

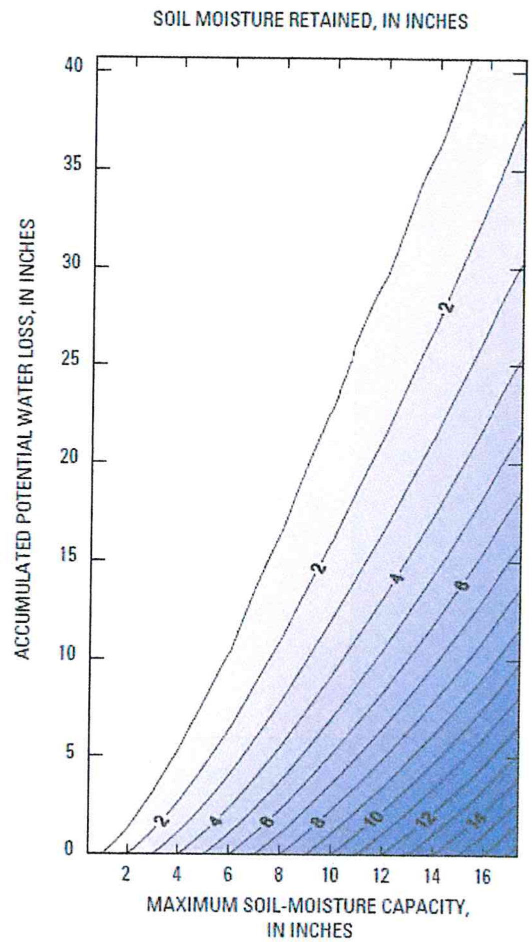

Figure 4: Soil-moisture-retention table (Thornthwaite and Mather, 1957).

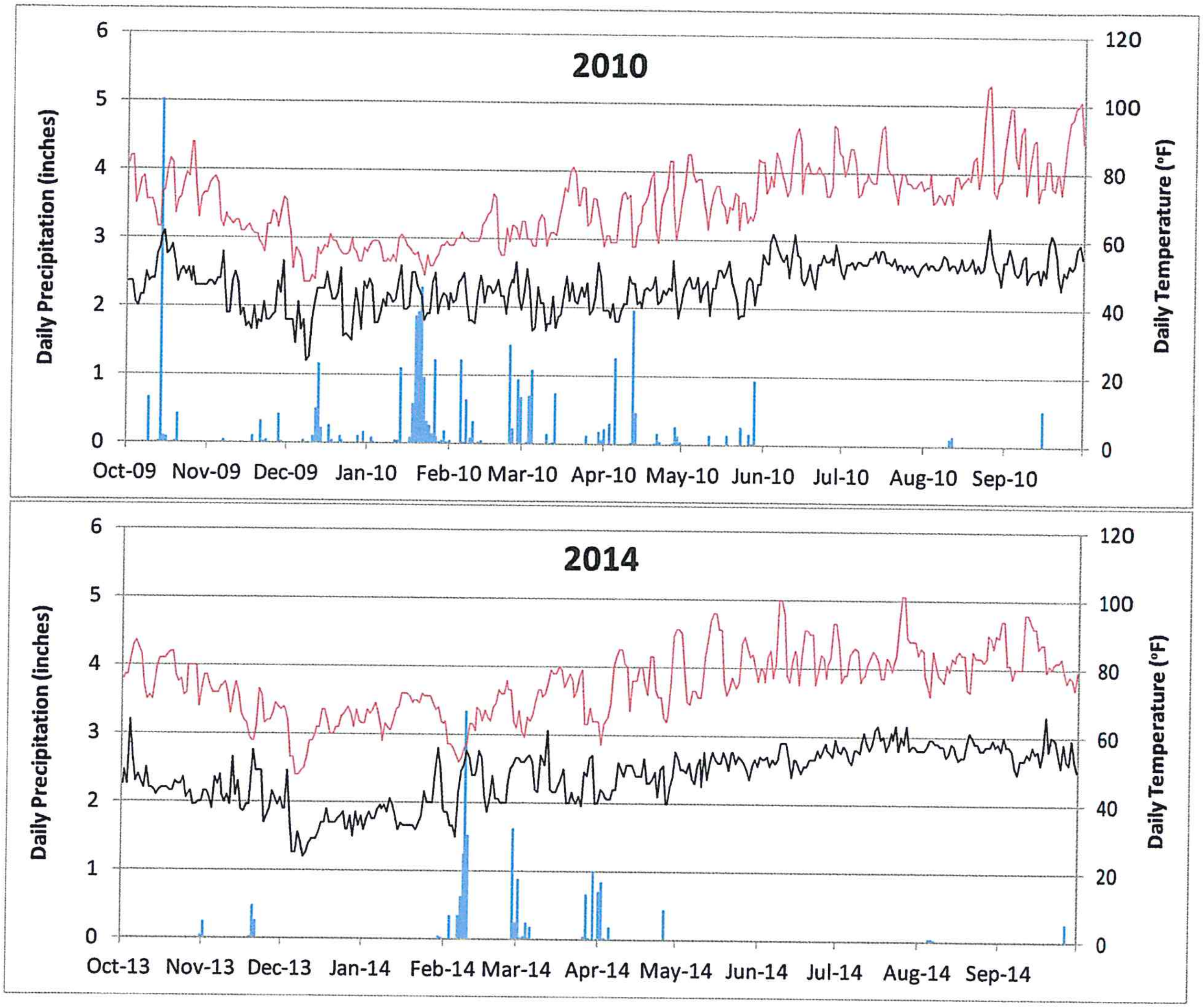

Figure 5: Daily precipitation and minimum and maximum air temperature used in the SWB model.

Results

The simulated water year 2010 (average water year) recharge results indicate that recharge varied across the project recharge area from 2.2 to 6.6 inches (Figure 6 and Table 10). Spatially averaged over the project recharge area, the 35.5 inches of precipitation was partitioned as follows: Actual Evapotranspiration (AET) = 20.0 inches, Runoff = 11.5 inches, and Recharge = 4.0 inches (Table 10). The simulated water year 2014 (dry water year) recharge results indicate that recharge varied across the project recharge area from zero to 2.9 inches (Figure 7 and Table 10). Spatially averaged over the project recharge area, only 1.1 of the 15.4 inches of precipitation was recharged (Table 10). Recharge as a percentage of annual precipitation ranged from 11% in the average water year to 7% in the dry water year. Runoff as a percentage of annual precipitation was substantially lower in the dry water year (13%) compared to the average water year (32%).

Groundwater recharge estimates (in terms of water available for recharge) can also be expressed as a total volume by multiplying the calculated recharge by the project aquifer recharge area of 308.3 acres. This calculation yields an estimate of total recharge of 33.6 ac-ft during the drought conditions of water year 2014 and of 103.3 ac-ft for the average water year of 2010.

A water budget estimate is available for the Conn Creek watershed, the southern boundary of which is located about one miles north of the project recharge area (LSCE, 2013). Similar to the project aquifer area, the Conn Creek watershed drains a portion of the mountains east of the Napa Valley and recharge conditions in this watershed may be expected to be broadly similar to those of the project recharge area although it is underlain by both sedimentary and volcanic rocks whereas the project recharge area is underlain by volcanic rocks only.

The simulated Water Year 2010 average AET for the project recharge area represents ~56% of the precipitation, similar to the results for the Conn Creek watershed (53%). The simulated Water Year 2010 runoff for the project recharge area represents ~32% of the precipitation, somewhat higher than the results for the Conn Creek watershed (25%). The simulated Water Year 2010 groundwater recharge for the watershed represents ~11% of the precipitation which is significantly less than results for the Conn Creek watershed (21%). The higher runoff and lower recharge for the project recharge area relative to the Conn Creek watershed can be attributed to the higher percentage of Type C and D soils in the project recharge area relative to the Conn Creek watershed. Another important difference is the presence of significant exposures of the tuffaceous unit of the Sonoma Volcanics (map unit Tst) in the Conn Creek watershed, which are more permeable than the andesitic rocks within the recharge area.

Table 10: Summary of water balance results from the SWB model.

	WY 2010		WY 2014	
	inches	% of precip	inches	% of precip
Precip	35.5		15.4	
AET	20.0	56%	12.3	80%
Runoff	11.5	32%	2.0	13%
Recharge	4.0	11%	1.1	7%

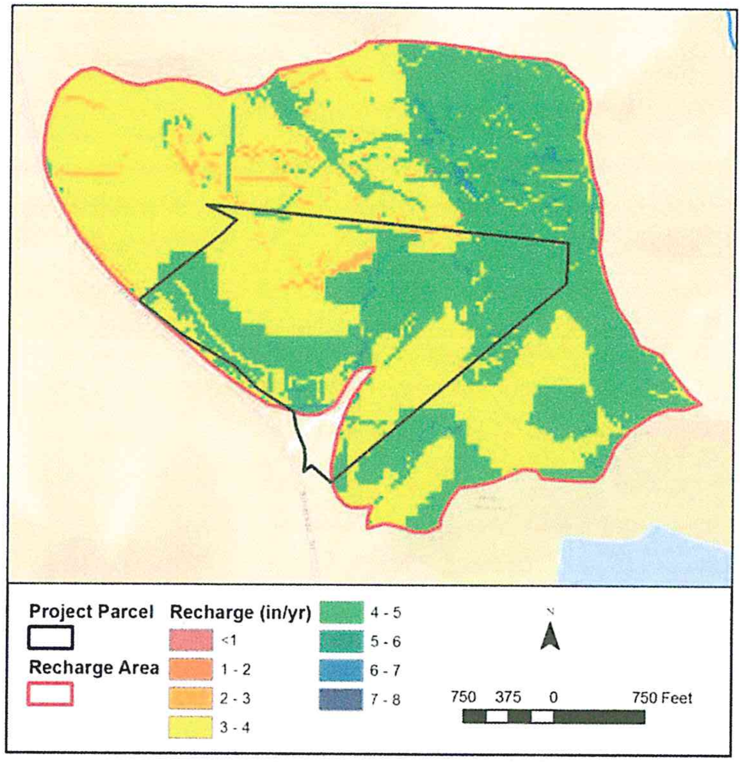

Figure 6: WY 2010 recharge simulated with the SWB model.

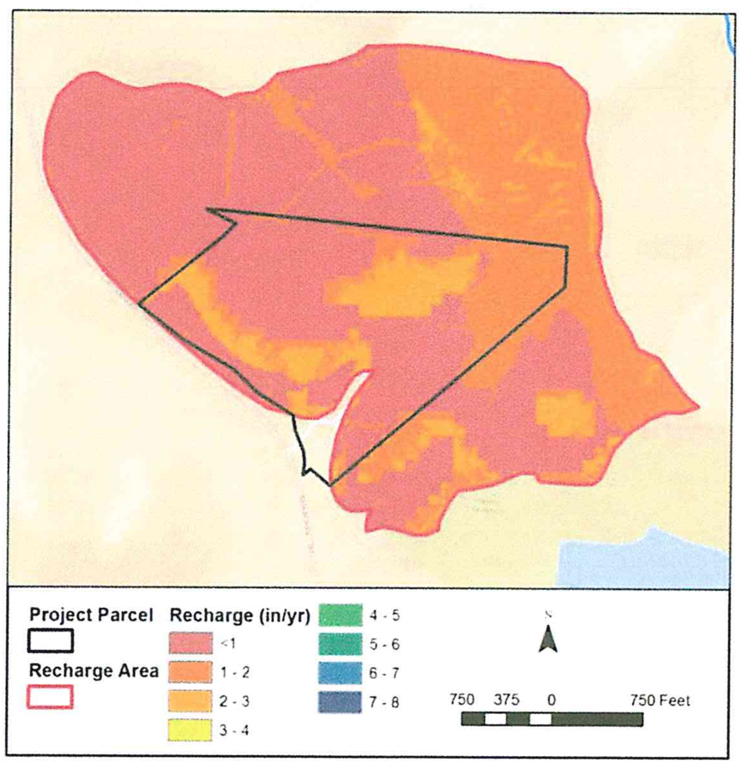

Figure 7: WY 2014 recharge simulated with the SWB model.

Groundwater Storage

Groundwater storage is estimated as the product of the aquifer surface area (assumed to be equivalent to the project recharge area), the depth of the saturated zone of the aquifer intersected by wells, and the porosity of the fractured bedrock. The surface area is about 308.3 acres. The depth of the saturated zone was defined as the average difference between the static water level and the bottom of the screened interval in the two wells closest to the project wells (Wells 5, & 12 in Table 1 & Figure 1). The estimated depth of the saturated zone is therefore about 210-ft. Note that the depth of the aquifer is defined by well depth, and that the saturated zone of the aquifer probably extends to substantially greater depths. The potential aquifer storage capacity is therefore likely to be underestimated.

The porosity of the fractured bedrock is expected to lie between <1 and 10% (Freeze and Cherry, 1979; Weight and Sonderegger, 2000). Given the relatively low specific capacities (for fractured bedrock) of wells (Table 1) in the project aquifer, we assume a low-end (conservative) porosity of 1%. The estimated groundwater storage in the bedrock aquifer is calculated as 647 ac-ft.

Comparison of Water Demand and Groundwater Recharge/Storage

The total proposed water use for the project recharge area is estimated to be 65.6 ac-ft/yr. This represents 64% of the estimated mean annual water available for recharge of 103.3 ac-ft/yr (Table 11). This comparison indicates that the project aquifer has a modest surplus of water in terms of annual use compared to annual recharge, and that the aquifer storage is more than six times the annual recharge. When the comparison is restricted to the footprint of the project parcel, the total proposed water use is a smaller percentage (52%) of the mean annual groundwater recharge (Table 6).

The significant volume of groundwater in storage is expected to moderate the impacts of climatic variations on aquifer conditions. The effects of dry years and wet years are likely balanced out over the period of years or decades required for water to move through the aquifer, such that short-term reductions in groundwater storage associated with periods of reduced groundwater recharge during dry years would be compensated by increases in storage during wetter years.

Given the surplus of groundwater resources in terms of estimated annual groundwater recharge during average water years and the significant volume of groundwater in storage, the increase in water use associated with the proposed Use Permit modifications for the Vine Cliff Winery are unlikely to result in reductions in groundwater levels or depletion of groundwater resources over time.

Table 11: Comparison of total annual Water Use and groundwater recharge.

		Average Water Year (2010)			Dry Water Year (2014)		
	Total Proposed Demand (ac-ft/yr)	Recharge (ac-ft/yr)	Recharge Surplus (ac-ft/yr)	Demand as % of Recharge	Recharge (ac-ft/yr)	Recharge Deficit (ac-ft/yr)	Demand as % of Recharge
Recharge Area	65.6	103.3	37.7	64%	29.3	-36.3	224%
Project Parcel	17.6	33.6	16.0	52%	9.9	-7.7	178%

Well Interference Analysis

The closest neighboring well to the two existing wells on the project parcel appears to be located about 1,275 feet northeast of the Upper Well on the adjacent parcel to the north (Well 5 in Table 1 & Figure 1). Based on the WAA guidance document, a Tier 2 well interference analysis is not required given that non-project wells are located greater than 500-feet from the project wells.

Summary

Application of the Soil Water Balance (SWB) model to estimate water available for aquifer recharge in the project area revealed that average year recharge was ~4.0 inches/yr or 103.3 ac-ft/yr. During drought conditions, recharge was significantly lower at ~1.1 inches/yr or 33.6 ac-ft/yr. The total Water Use for the project recharge area is estimated to be 65.6 ac-ft/yr which represents 64% of the mean annual recharge indicating that the project is unlikely to result in declines in groundwater elevations or depletion of groundwater resources over time.

The closest neighboring well to the project wells is located more than 500 feet from the project wells, hence it is presumed that significant well interference is unlikely to occur per County guidance.

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From: Matt O"Connor
To: Balcher, Wyntress
Cc: "George Monteverdi"
Subject: RE: Vine Cliff Winery WAA
Date: Friday, December 29, 2017 10:00:02 AM
Attachments: image004.png
image002.png

Wyntress

I have reviewed USGS topographic map and GoogleEarth imagery in an effort to identify any springs that might be in use for domestic or agricultural purposes within 1500 feet of the subject parcel. Considering the evident parcel use, steep topography to north, east and south, and the character of aquifer rocks, it appears that there are not any such springs on adjacent parcels.
There is an ornamental/landscape pond feature on the parcel in a topographic position that could be consistent with a spring source. The owners of Vine Cliff Winery use groundwater have described their water sources as two wells on the parcel, indicating the potential spring on the subject parcel is not in use for domestic or agricultural purposes.

I called Mr. Monteverdi's office this morning to inquire whether he has any information on this topic; I did not reach him, but he is cc'd on this email.

Matt O'Connor, PhD, Certified Engineering Geologist
Principal Hydrologist/Geomorphologist
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O E I

From: Balcher, Wyntress [mailto:Wyntress.Balcher@countyofnapa.org]
Sent: Friday, December 29, 2017 9:10 AM
To: 'Matt O'Connor' <matto@oe-i.com>
Cc: George Monteverdi (george@MonteverdiConsulting.com) <george@MonteverdiConsulting.com>
Subject: RE: Vine Cliff Winery WAA

Hi Matt,
The WAA Tier 2 analysis includes a spring interference criteria component. A statement that there are no natural springs in use for domestic or agricultural purposes within 1500 feet from the project well is necessary for the environmental determination and findings of approval that the project would not result in a significant impact on groundwater.
Can I add this statement to my initial study?

Thanks