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Water Availability Analysis

Black Sears Winery, Major Modification P15-00201 and RSS Exception
Planning Commission Hearing, February 22, 2017

DRAFT

Water Availability Analysis

Black Sears Winery
2610 Summit Lake Drive
Angwin, California 94508
APN 018-060-066

Jerre Sears, Owner

Prepared by:

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& Environmental Services

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Introduction

Black Sears Winery is seeking to modify its Use Permit to allow for tasting room and event visitation. No increases in wine production or vineyard acreage are proposed. Black Sears Winery is located at 2610 Summit Lake Drive (APN 018-060-066) which is located about 2.7 miles northwest of Angwin. The scope of this Water Availability Analysis (WAA) is consistent with 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 Well Completion Reports (drillers' logs) from the area and characterization of local hydrogeologic conditions, and application of Tier 1 and Tier 2 screening criteria requiring respectively estimates of groundwater recharge relative to proposed uses (Tier 1) and the potential for well interference at neighboring wells located within 500-ft of the project 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 limited available data and relies significantly on interpretation of data from disparate sources of disparate quality.

Given the relatively great depth to water in the project well (580-ft), the relationship between groundwater recharge generated within the project parcel area and groundwater availability from the project wells is not expected to be very strong. It is likely that water flowing to the project well is primarily supplied by groundwater inflows from a larger surrounding area rather than from recharge occurring only on the overlying landscape. Analysis of the age and sources of the deep groundwater occurring beneath the project parcel is beyond the scope of this study.

Hydrogeologic Conditions

The project parcel is located in the headwaters of Burton Creek (a tributary to Maxwell Creek and then to Pope Creek) northwest of Angwin in a region where rocks of the Sonoma Volcanics are the dominant type. The Sonoma Volcanics consist of a thick and highly variable series of volcanic rocks including basalt, andesite, and rhyolite lava flows, tuff, tuff breccia, agglomerate, scoria, and their sedimentary derivatives (Kunkel and Upson, 1960). The tuffaceous, scoriaceous, and sedimentary units are the principle water-bearing units whereas the lava flows generally yield little to no water (Kunkel and Upson, 1960; Faye, 1973).

The upper (southwestern) portion of the parcel is underlain by pumiceous ash-flow tuff interlayered with basalt or andesite flows (map unit Tsft, Figure 1) and the lower (northeastern) portion of the parcel is underlain by rhyolite lava flows (map unit Tsr). About 300-ft northeast of the northeast corner of the project parcel the Tsr is in contact with sandstones and shales of the Great Valley Sequence (map unit KJgvl). Rocks of the Great Valley Sequence are typically considered poor aquifer material with low primary porosity and groundwater occurring primarily in fractures.

Driller's logs (from Well Completion Reports) for wells on and around the project parcel were obtained from the California Department of Water Resources (Table 1). A subset of these logs was compiled and georeferenced based on parcel and location sketch information (Figure 1). The project well (PW) is located near the western edge of the parcel, was completed in 1991 to a depth of 870 ft, and had a static water level of 580-ft at the time of completion. The total drawdown was not recorded on the driller's log prohibiting calculation of the specific capacity.

Two wells completed in the Tsft were located in the surrounding area. These wells have depths ranging from 627 to 775-ft and static water levels ranging from 391 to 415-ft. Two wells completed in the Tsa were also located and have similar large depths (729 to 938-ft) and deep static water levels (226 to 700-ft) to the Tsft wells. Three wells completed in the Tst were also located. These wells are shallower (108 to 510-ft) and have significantly shallower static water levels (6 to 150-ft). These comparisons suggest that the hydrogeologic properties of the Tsft unit in the vicinity of the project parcel may be more similar to the lava flows (Tsa) than to the tuff (Tst).

The driller's reports include a wide variety of rock descriptions, but the most common are brown tuff, white ash, gray rock, and brown rock. The rocks described as tuff and ash are likely the tuffaceous rocks of the Sonoma Volcanics and the other rocks are likely lava flows of the Sonoma Volcanics. The driller's log for Well #1, located about 500-ft northwest of the project parcel, shows a clear contact at 840-ft with rocks described as serpentine. This contact most likely represents the base of the Sonoma Volcanics and occurs at approximately the same elevation as the surface contact with the KJgvl located ~2,000-ft east. The PW also appears to show a contact at 590-ft, however the descriptions are not sufficiently detailed to warrant a definitive conclusion regarding the presence of this contact.

A geologic cross section through wells #1, the PW, and #2 show the water table occurring at similar elevations (Figure 2), lowest at PW (1716-ft) and highest at #1 (1758-ft). The PW and well #1 appear to be screened in the lowest section of the Sonoma Volcanics and the upper-most section of the underlying Great Valley Sequence. At well #1, the groundwater elevation is 140-ft above the contact and possibly less at the PW suggesting that the upper portions of the Great Valley Sequence may be partially supplying these wells. The position of the groundwater elevations relative to the contact may also suggest that the Great Valley Sequence is serving as an aquitard causing groundwater from the overlying volcanic rocks to accumulate at the contact between the Sonoma Volcanics and the Great Valley Sequence.

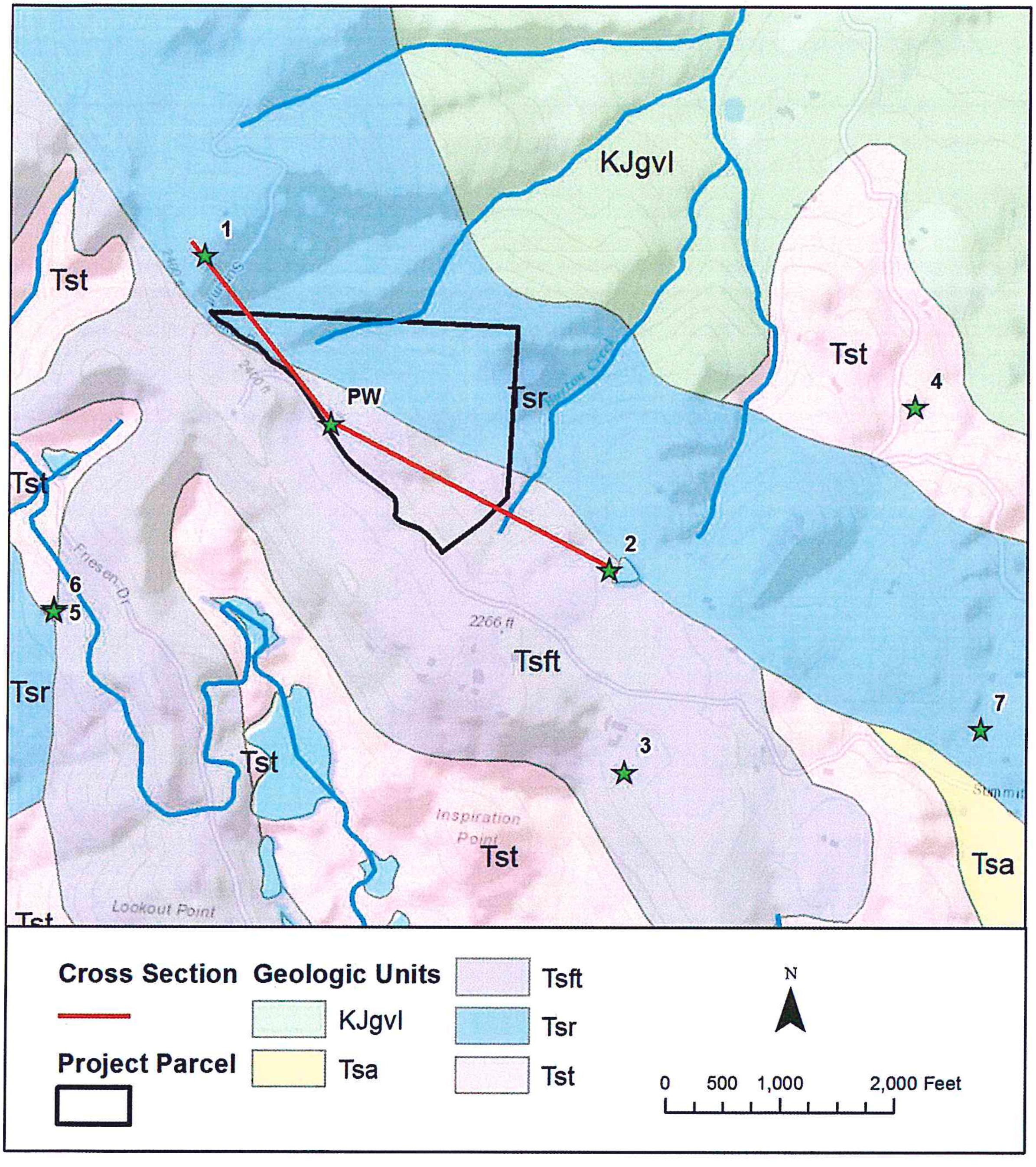

Figure 1: Surficial geology and locations of wells (green stars) in the vicinity of the project parcel (Graymer et al., 2007). Units are as follows:

KJgvl - Great Valley Complex - sandstone, shale, and conglomerate
Tsa - Sonoma Volcanics - andesite flows
Tsft - Sonoma Volcanics - pumiceous ash-flow tuff interlayered with basalt and andesite flows
Tsr - Sonoma Volcanics - rhyolite flows
Tst - Sonoma Volcanics - pumiceous ash-flow tuff

Table 1: Well completion details for the project well and wells on nearby parcels.

Well ID	PW	1	2	3	4	5	6	7
Year Completed	1991	2009	1999	1998	1997	2008	2007	2002
Map Unit	Tsft	Tsr	Tsft	Tsft	Tst	Tst	Tst	Tsr
Depth (ft)	870	938	627	775	108	510	270	719
Static Water Level (ft)	580	700	415	391	6	150	100	226
Top of Screen (ft)	568	720	248	355	50	240	160	279
Bottom of Screen (ft)	866	938	628	775	108	510	270	699
Pumping Rate (gpm)	100	26	90	100	50	100	100	55
Drawdown (ft)	na	na	na	na	100	na	na	na
Test Length (hrs)	6	5	2	2	2	2	1.5	2
Specifc Capacity (gpm/ft)	na	na	na	na	0.50	na	na	na

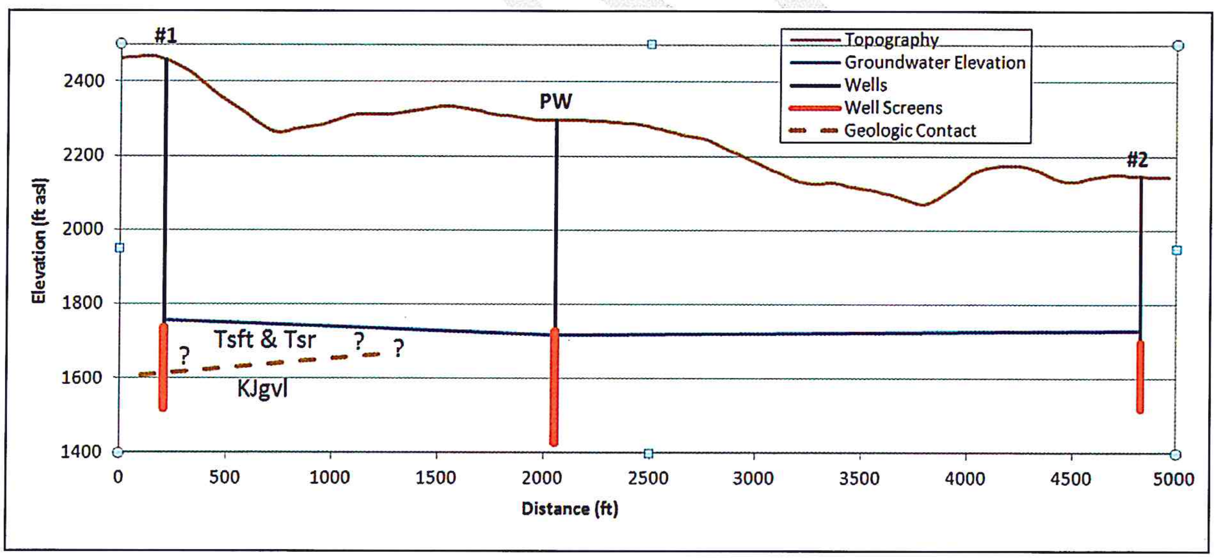

Figure 2: Hydrogeologic cross section through wells #1, PW, and #2. See Figure 1 for location.

Water Demand

Existing groundwater uses within the hypothesized project recharge area (described below in the Groundwater Recharge Analysis section) consist of Residential Use for two primary residences (one of which is on the Black Sears Winery parcel), Winery Use for the 20,000 gallon per year Black Sears Winery, and Irrigation Use for 52.4 acres of vineyard, of which 24.72 acres (48%) is owned by Black Sears Winery on the subject parcel and an adjacent parcel to the southwest.

The existing Residential Use is estimated to total 1.5 ac-ft/yr. The existing Winery Use is estimated to total 0.58 ac-ft/yr, and the existing Irrigation Use is estimated to total 26.2 ac-ft/yr for a Total Existing Use of 28.28 ac-ft/yr. Only about 4.48 ac-ft/yr or 16% of the existing use is associated with the project parcel with the remainder associated with neighboring parcels located within the project recharge area.

Proposed uses consist of existing uses plus an additional 0.07 ac-ft/yr for event and tasting room visitor use associated with the proposed marketing plan for a Total Proposed Use of 28.35 ac-ft/yr. The assumptions behind the various water use estimates are presented in Tables 2 through 7.

Table 2: Existing and proposed groundwater uses within the project recharge area.

Visitor Category	# of Vistors	Use per Visitor (gal/day)	Annual Water Use (ac-ft/yr)
Tours and Tasting Room	5840	3	0.054
Events	400	15	0.018
Event Employees	36	15	0.002
TOTAL			**0.074**

Table 3: Calculation of Residential Use within the project recharge area.

Use Category	# of Units	Use per Unit (ac-ft/yr)	Annual Water Use (ac-ft/yr)
Primary Residences	2	0.75	1.50
TOTAL			**1.50**

Table 4: Calculation of Winery Process and Winery Domestic Use for the existing Black Sears 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	20,000	2.15	0.43
Winery Domestic Use	20,000	0.50	0.10
TOTAL			**0.53**

Table 5: Calculation of Employee Use for the existing Black Sears Winery.

Work Category	# of Employees	# Work Days per Year	Use per Employee (gal/day)	Annual Water Use (ac-ft/yr)
Full-time	4	260	15	0.048
TOTAL				**0.048**

Table 6: Calculation of Irrigation Use within the project recharge area.

Use Category	Number of Acres	Use per Acre (ac-ft/yr)	Annual Water Use (ac-ft/yr)
Irrigation	52.4	0.50	26.20

Table 7: Calculation of proposed new Visitor Use for the Black Sears Winery.

Visitor Category	# of Vistors	Use per Visitor (gal/day)	Annual Water Use (ac-ft/yr)
Tours and Tasting Room	5840	3	0.054
Events	400	15	0.018
Event Employees	36	15	0.002
TOTAL			**0.074**

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).

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 under Limitations, groundwater occurring at significant depths may not be directly related to the recharge generated on the overlying landscape. Significant additional recharge may 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.

Model Development

The eastern boundary of the project aquifer recharge area was defined by the contact between the Sonoma Volcanics and the Great Valley Sequence, the western boundary was defined by the drainage divide between the Conn Creek and Pope Creek watersheds, and the northern and southern boundaries were defined by local drainage divides (Figures 3 & 4). The recharge area covers 258.4 acres. The upper 40% is underlain by the Tsft unit of the Sonoma Volcanics and the lower 60% is underlain by the Tsr unit.

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 developed from the National Land Cover Dataset and modified based on the Napa County shapefile of agricultural areas and interpretation of 2016 aerial photography (Figure 3), 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 4).

A series of model parameters were assigned for each land cover type/soil group combination including a curve number, 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 9) along with default soil-moisture-retention relationships based on Thornthwaite and Mather (1957) (Figure 5).

Daily precipitation and daily minimum and maximum air temperature data were compiled for the Angwin gauging station which is located ~2.9 miles northwest of the project parcel (Figure 6). This station was selected because it represents the best available climate station in proximity to the project site with a long and continuous period 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 Angwin gauging station location and within the project recharge area was 42.5 (PRISM, 2010). 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 (44.6 inches at the Angwin station). The model was also evaluated for water year 2014 to represent drought conditions. Water year 2014 precipitation was 25.0 inches or approximately 59% of long-term average conditions.

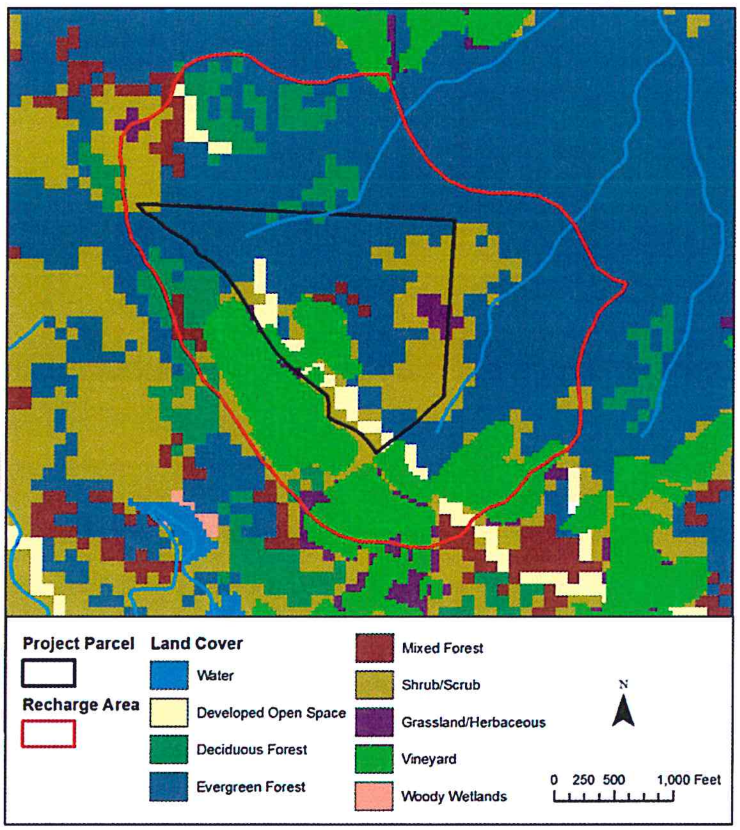

Figure 3: Land cover map used in the SWB model.

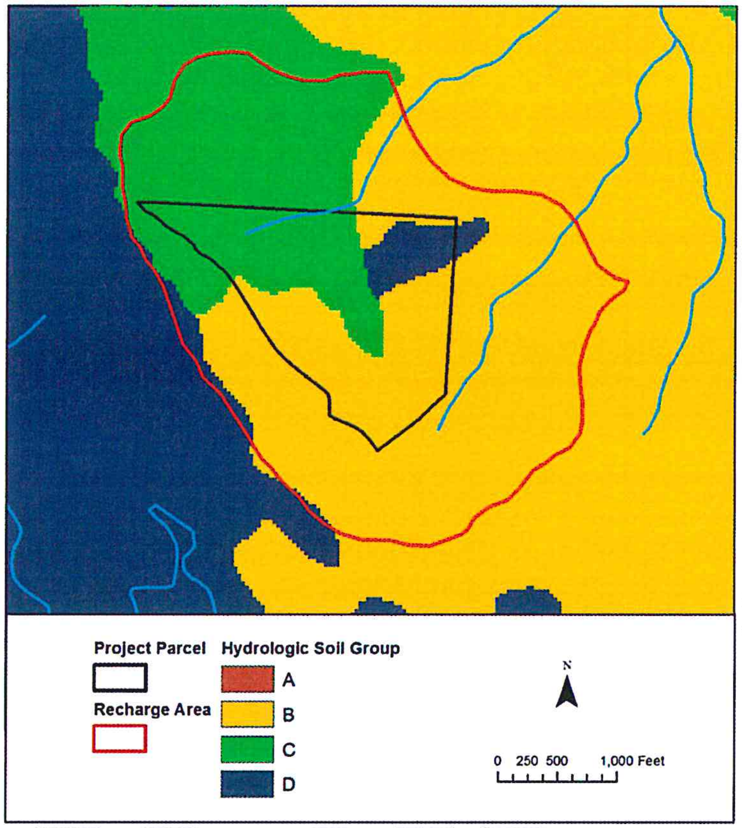

Figure 4: Soil map used in the SWB model.

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

Land Cover	Curve Number			Interception Storage Values		Rooting Depths (ft)		
	B Soils	C Soils	D Soils	Growing Season	Dormant Season	B Soils	C Soils	D Soils
water	100	100	100	0.000	0.000	0.00	0.00	0.00
developed open space	74	82	86	0.010	0.005	2.10	2.00	1.80
deciduous forest	55	70	77	0.050	0.020	5.10	4.90	4.70
evergreen forest	55	70	77	0.050	0.050	4.20	4.00	3.90
mixed forest	55	70	77	0.050	0.035	4.70	4.50	4.30
shrub/scrub	48	65	73	0.080	0.015	2.80	2.70	2.60
grassland/herbaceous	58	71	78	0.005	0.004	1.10	1.00	1.00
vineyard	61	75	81	0.080	0.015	2.10	2.00	1.90
woody wetlands	89	90	91	0.050	0.035	4.70	4.50	4.30

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

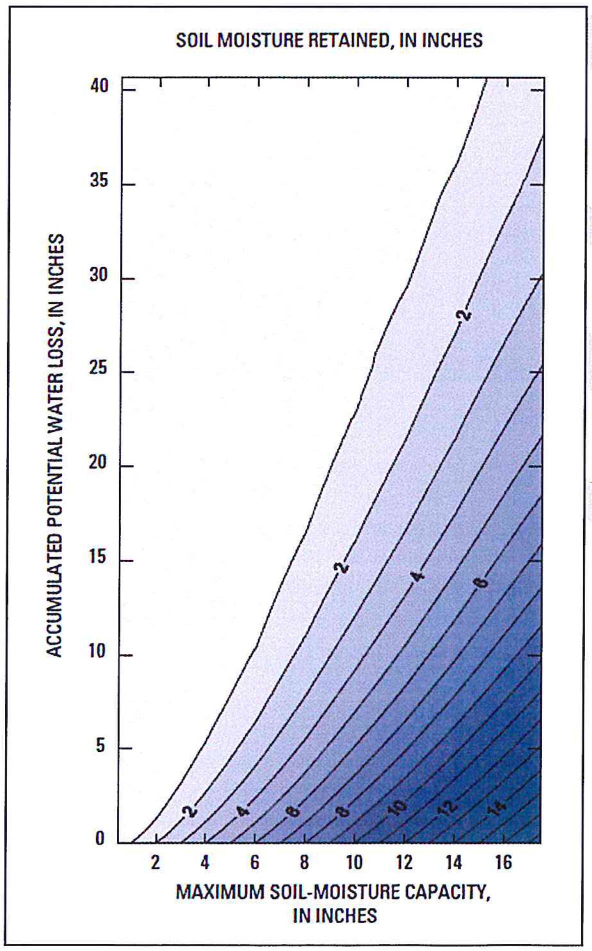

Figure 5: Soil-moisture-retention table (Thornthwaite and Mather, 1957).

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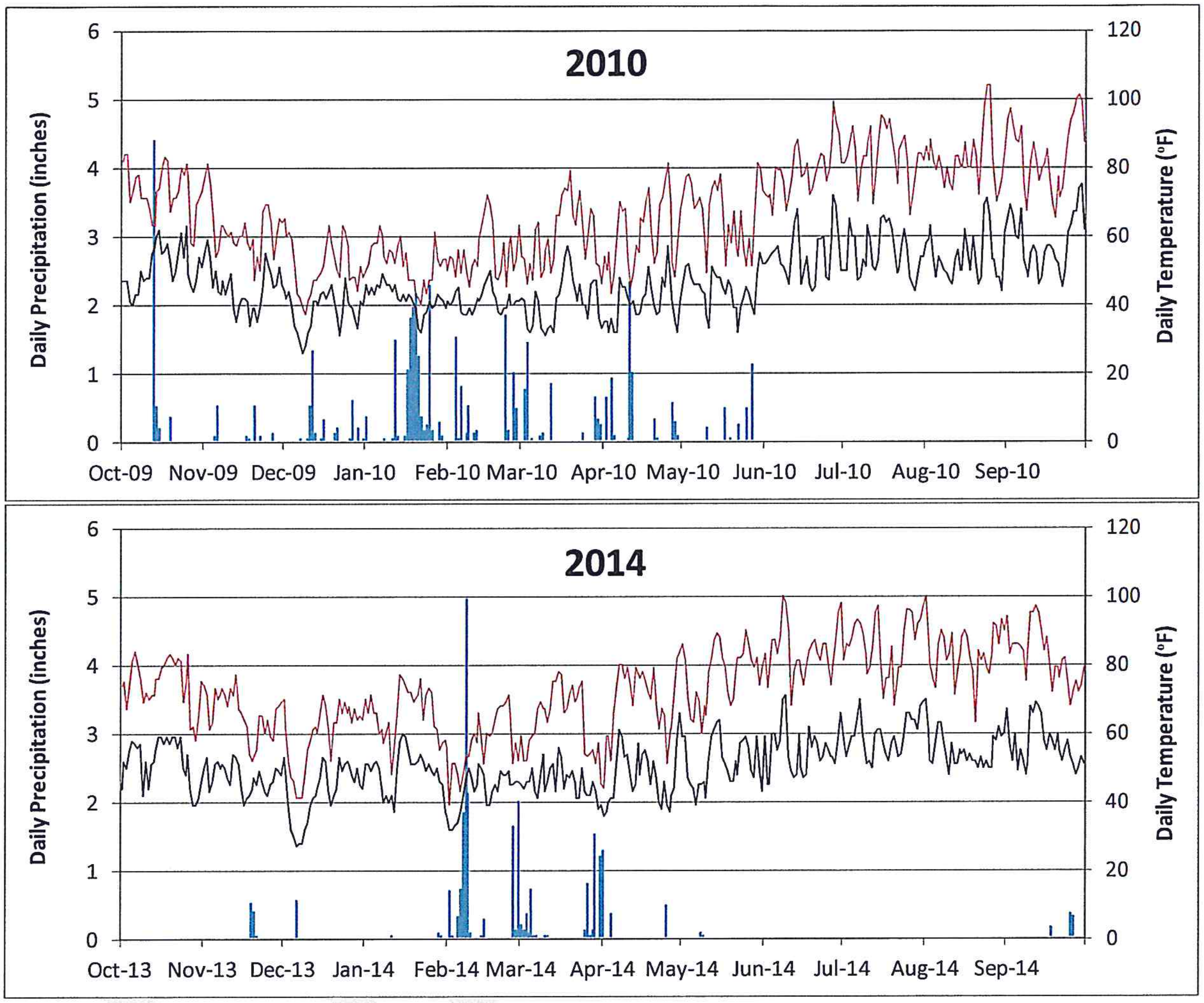

Figure 6: Daily precipitation and minimum and maximum air temperature used in the SWB model.

Results

The simulated Water Year 2010 (average water year) recharge results indicate that recharge varied across the project recharge area from less than 5 inches on ridge tops and in areas underlain by Type D soils to 16 inches in valley bottom areas underlain by Type B and C soils. (Figure 7 and Table 10). Spatially averaged over the project recharge area, the 44.6 inches of precipitation was partitioned as follows: Actual Evapotranspiration (AET) = 22.8 inches, Runoff = 13.0 inches, and Recharge = 8.8 inches (Table 9). The simulated water year 2014 (dry water year) recharge results indicate that recharge varied across the project recharge area from less than 2 inches to more than 7 inches (Figure 8 and Table 10). Spatially averaged over the project recharge area, only 3.9 of the 25.0 inches of precipitation was recharged (Table 9). Recharge as a percentage of annual precipitation ranged from 20% in the average water year to 16% in the dry water year. Runoff as a percentage of annual precipitation was similar (27 - 29%) between dry and average water years

Groundwater recharge estimates can also be expressed as a total volume by multiplying the calculated recharge by the project aquifer recharge area of 258.4 acres. This calculation yields an estimate of total recharge of 83.1 ac-ft during the drought conditions of water year 2014 and of 190.4 ac-ft for the average water year of 2010.

A water budget estimate is available for the Conn Creek watershed which has its headwaters immediately west of the project recharge area (LSCE, 2013). The simulated Water Year 2010 average AET, runoff, and recharge for the project area represents 51%, 29%, and 20% of the precipitation respectively. These proportions are very similar to the Conn Creek results where the AET, runoff, and recharge were estimated to be 53%, 25%, and 21% of the precipitation respectively.

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

	WY 2010		WY 2014	
	inches	% of precip	inches	% of precip
Precip	44.6		25.0	
AET	22.8	51%	14.4	57%
Runoff	13.0	29%	6.7	27%
Recharge	8.8	20%	3.9	16%

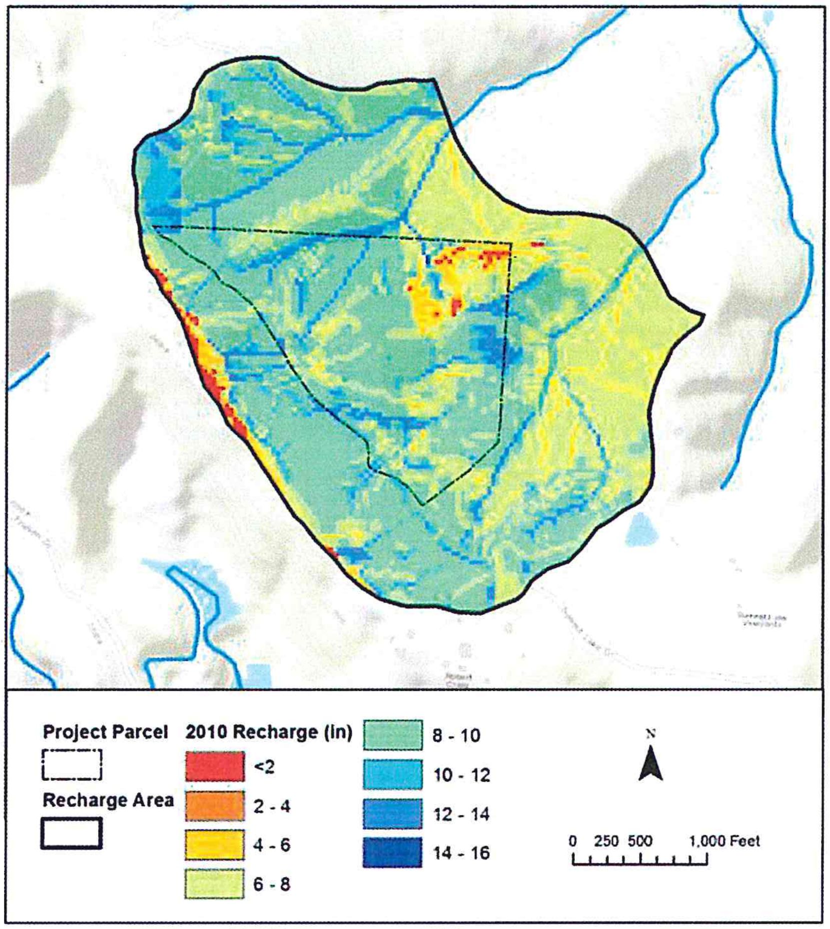

Figure 7: WY 2010 recharge simulated with the SWB model.

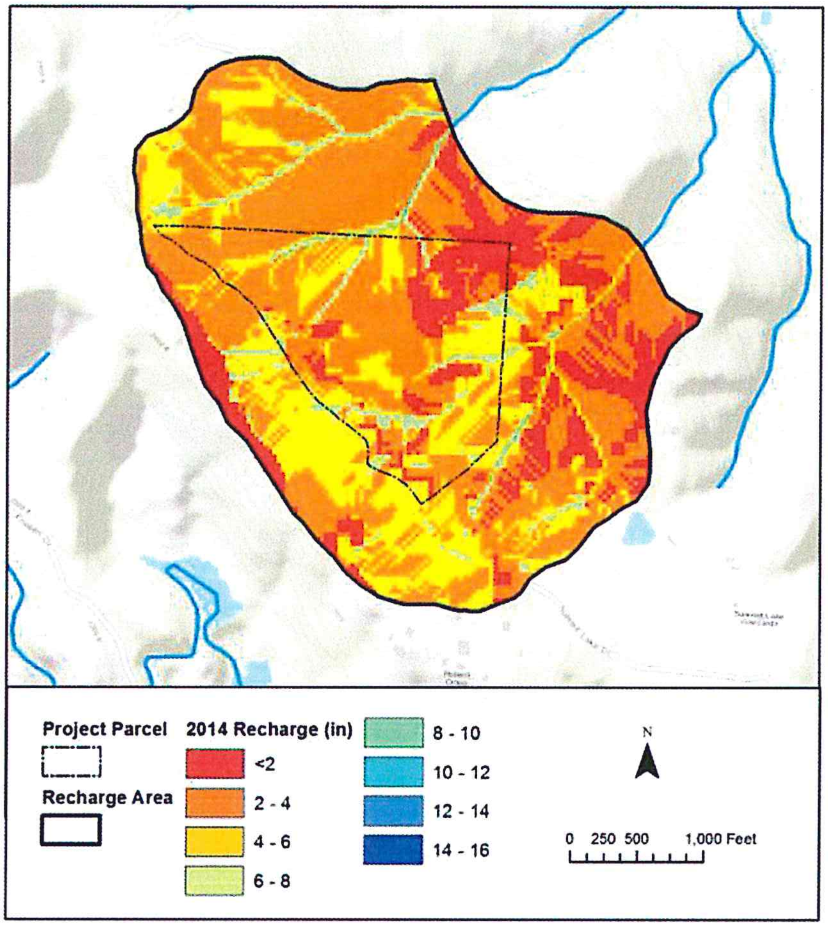

Figure 8: WY 2014 recharge simulated with the SWB model.

Comparison of Water Demand and Groundwater Recharge

The total proposed water use for the project recharge area is estimated to be 28.4 ac-ft/yr. This represents 15% of the estimated mean annual groundwater recharge of 190.4 ac-ft/yr and 34% of the estimated dry water year recharge of 83.1 ac-ft/yr (Table 11). This comparison indicates that there is a substantial surplus of groundwater resources in terms of estimated annual groundwater recharge even during drought conditions such as water year 2014. Given the magnitude of this surplus, the small increase (0.07 ac-ft/yr) in water use associated with the proposed marketing plan for the Black Sears Winery is highly unlikely to result in reductions in groundwater levels or depletion of groundwater resources over time.

Table 10: Comparison of total annual Water Use for the project recharge area and average and dry year 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 Surplus (a c-ft/yr)	Demand as % of Recharge
28.4	190.4	162.0	15%	83.1	83.0	34%

Well Interference Analysis

Only the parcel immediately west of the project parcel is within 500-ft of the project well and there are no active wells on the parcel. The WAA guidance document regarding well interference states that "...the Tier 2 well interference criterion is presumptively met if there are no non-project wells located within 500 feet of the existing or proposed project well(s) ..."; thus no further evaluation of potential well interference is required.

Summary

Application of the Soil Water Balance (SWB) model to the project recharge area revealed that average water year recharge was ~8.8 inches/yr or 190.4 ac-ft/yr. During drought conditions, recharge was significantly lower at ~3.9 inches/yr or 83.1 ac-ft/yr. The total proposed Water Use for the project recharge area is estimated to be 28.4 ac-ft/yr. Only 4.48 ac-ft/yr of this total use is associated with the project parcel, and the increase in use for the proposed winery marketing plan is 0.07 ac-ft/yr. The total use represents only 15% of the mean annual recharge indicating that the project is unlikely to result in declines in groundwater elevations or depletion of the groundwater resources over time. No wells are located within 500-ft of the project well and given the significant distances separating the project well from neighboring wells, well interference associated with water use for the proposed project is highly unlikely.

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