



# Water Availability Analysis

for

**Ladera Vineyards**  
3942 Silverado Trail N  
Calistoga, Napa County, CA

LADERA  
*Napa Valley*



Winery Use Permit Minor Modification

Revised September 2022



## TABLE OF CONTENTS

TABLE OF CONTENTS	1
ATTACHMENTS	2
1.0 PROJECT SUMMARY	3
1.1 SITE DESCRIPTION	3
1.1.1 Land Use	3
1.1.2 Water Use	3
1.1.3 Water Quality	3
2.0 WATER DEMAND	4
2.1 EXISTING WATER DEMAND	4
2.1.1 Existing Residential Water Demand	4
2.1.2 Existing Wine Production	4
2.1.3 Existing Winery Domestic Water Demand	5
2.1.4 Existing Landscape Irrigation Demand	5
2.2 TOTAL EXISTING WATER DEMAND	5
2.3 PROPOSED DEMANDS	5
2.3.1 Residential Demand	5
2.3.2 Winery Domestic Water Demand	6
2.3.3 Winery Process Demand	6
2.3.4 Vineyard Irrigation Demand	6
2.3.5 Landscape Irrigation Demand	7
2.4 TOTAL PROPOSED WATER DEMAND	7
3.0 TIER 1 ANALYSIS: WATER USE CRITERIA	7
3.1 WATER AVAILABILITY CRITERIA	7
Parcel Specific Groundwater Recharge	8
4.0 TIER 2 ANALYSIS	10
Neighboring Well APN 021-030-002	11
Neighboring Well APN 021-030-005	11
Neighboring Well APN 021-030-046	11
5.0 TIER 3 ANALYSIS	11
6.0 CONCLUSION	13

## ATTACHMENTS

- 1: Existing & Proposed Water Demand Calculations, MWELO Calculations
- 2: Vicinity Map, Existing Conditions Exhibit, Water Availability Site Plan, Slope Analysis
- 3: Well Interference Calculations & Exhibit, Neighboring Well Research
- 4: Well Log

## 1.0 PROJECT SUMMARY

The project is proposing a minor modification to an existing winery Use Permit under the Napa County Streamlining Ordinance (Ordinance No. 1455). The existing winery is located at 3942 Silverado Trail N in Calistoga, CA. The project is proposing a moderate staff and event increase and is maintaining the existing wine production limit of 20,000 gallons annually. The Water Availability Analysis (WAA) guidance document prepared by Napa County (May 2015) is intended to guide review of projects which increase groundwater use. Projects are evaluated at Tiers of different analysis intensity based on the likelihood of groundwater/surface water impacts due to their geological location. This analysis provides a Tier 1, 2, and 3 analyses per the WAA guidance document as requested by Napa County Planning, Building, & Environmental Services (PBES) Department.

### 1.1 SITE DESCRIPTION

The 7.44-acre subject parcel is located off Silverado Trail between Calistoga and St. Helena in the unincorporated area of Napa County. The south westerly portion of the subject parcel that borders the Silverado Trail is relatively flat with slopes less than five percent. The parcel then slopes upward away from Silverado Trail and consists primarily of dense woodland cover.

#### 1.1.1 *Land Use*

The property sits at the border of the Napa Valley region which is predominantly Agricultural Preserve and Watershed (AP and AW) zoned parcels. These parcels consist of existing vineyards, wineries, and residences. The subject parcel is currently developed with an existing main residence, studio, winery building, tasting room, and green house. Existing landscaped areas and driveway are also located within the flatter portion of the subject parcel. The current land use of the subject parcel is consistent with the proposed improvements that includes a new cave, remodeled tasting room, new vineyard, and new driveway.

#### 1.1.2 *Water Use*

The site includes two existing wells. One of the wells, which is located within the existing shed, has a well log on file. The other well that is located outside and near the shed does not have a well log (that could be found) and is therefore not proposed to be part of this project. The existing wells are located within the Napa Valley Floor-Calistoga groundwater zone. The subject parcel is primarily located within the Napa Valley Floor however is located outside the Napa County Groundwater Sustainability Agency (GSA) boundary per discussion with Planning Department staff. Therefore, water use allotment calculations for the subject parcel will be parcel specific.

#### 1.1.3 *Water Quality*

As discussed in the *Water Feasibility Report* for the proposed project, water quality for the project well will be tested following Use Permit approval and in conjunction with the yield test required for the public water system. Water quality in the well is anticipated to be consistent with the surrounding aquifer which may include elevated levels of iron, manganese, and potentially arsenic. Currently the winery does not have water quality issues. However, should water treatment be

needed water treatment devices will be selected that do not require additional water to be used as part of the treatment process. For example, if elevated arsenic levels are discovered in the well, an adsorptive media filtration system will be installed that does not require the use of any additional water to remove the arsenic from the water stream.

## 2.0 WATER DEMAND

### 2.1 EXISTING WATER DEMAND

Existing water usage records were not available for the subject parcel. The existing water demand is estimated based on the Use Permit Status Determination issued by the Napa County Planning, Building, & Environmental Services (PBES) department for the subject parcel on July 15, 2019 and existing conditions. Water demand estimates are documented in acre-feet to match the WAA water use criteria (1 acre-foot equals 325,850 US gallons). Per the Status Determination, the existing uses on the site are as follows:

- 20,000 gallon wine production limit
- 30 public visitors / wine tasting guests per day maximum; 100 per week anticipated
- 2 full time employees
- No marketing events

#### 2.1.1 *Existing Residential Water Demand*

The subject parcel includes a three-bedroom residence and a one-bedroom studio. Water usage for the residences is based on wastewater generation rates per Napa County PBES requirements. The existing residence and studio do not include low flow fixtures. Water use estimates are based on 150 gallon per day (gpd) per bedroom. The main residence water demand is calculated below assuming year-round occupancy:

$$3 \text{ bedrooms} \times 150 \text{ gpd/bedroom} \times 365 \text{ days/year} \times 1 \text{ acre-ft/325,851 gallons} = 0.5 \text{ acre-ft/year}$$

The studio water demand is calculated below assuming year-round occupancy:

$$1 \text{ bedrooms} \times 150 \text{ gpd/bedroom} \times 365 \text{ days/year} \times 1 \text{ acre-ft/325,851 gallons} = 0.17 \text{ acre-ft/year}$$

The total existing water demand for residential uses is calculated to be 0.67 acre-ft/yr.

#### 2.1.2 *Existing Wine Production*

The existing wine production limit of 20,000 gallons per year is utilized to calculate the annual water usage based on wastewater generation rates for typical wineries (refer to the project Wastewater Feasibility Study for additional information). Winery process wastewater is calculated based on the Regional Water Quality Control Board (RWQCB) General Waste Discharge Requirements for Winery Process Water. This study assumes a winemaking generation rate of six gallons of water used per gallon of wine produced. At a peak production level of 20,000 gallons per year (gpy), the total annual flow is calculated below:

$$20,000 \text{ gallons of wine/year} \times 6 \text{ gallons of WW/wine} \times 1 \text{ acre-ft/325,851 gallons} = 0.37 \text{ acre-feet/year}$$

#### 2.1.3 *Existing Winery Domestic Water Demand*

The existing domestic water usage is calculated based on the existing staffing and visitation plan. Water demand rates for existing water usage are the same as the proposed water usage that includes three gallons per guest per day. The existing weekly visitation of 100 tasting visitors per week over 52 weeks per year at the tasting room equates to an annual visitation count of 5,200 guests per year. Applying the three gallons per day per person to the annual visitation amount, the annual water usage is estimated to be 15,600 gallons per year or 0.05 acre-ft/year.

The two employees working 365 days per year and assumed water usage of 15 gallons per day per staff member (per Napa County PBES requirements; refer to the Wastewater Feasibility Study for additional information), the employees are estimated to use 0.03 acre-ft/year.

#### 2.1.4 *Existing Landscape Irrigation Demand*

The subject parcel currently includes a green house, ornamentals, and landscaped areas. With little information known about the existing landscaped areas on the site, the existing landscape irrigation demand is calculated as the difference between the estimated main residence calculated water usage per the number of bedrooms and the allocation in the WAA guidance document for a residence that includes minor to moderate landscaping (0.75 acre-ft/year). The existing green house is proposed to be removed as part of the proposed project. The domestic water usage generated from the residence alone was calculated to be 0.50 acre-ft/year. Subtracting this from the 0.75 acre-ft/year allotment, the resulting landscape irrigation water usage is estimated to be 0.25 acre-ft/year.

### **2.2 TOTAL EXISTING WATER DEMAND**

The total demand for groundwater on the site is estimated to be:

- Residential Demand = 0.67 acre-feet/year
- Winery Domestic Water Demand = 0.08 acre-feet/year
- Winery Process Water = 0.37 acre-feet/year
- Landscape Irrigation = 0.25 acre-feet/year
- ***Total Water Usage = 1.37 acre-feet/year***

### **2.3 PROPOSED DEMANDS**

The proposed water demands for the proposed project are based on the WAA sizing criteria and wastewater generation rates included in the Wastewater Feasibility Study for the proposed project.

#### 2.3.1 *Residential Demand*

The existing residence is predominantly un-occupied and will remain available for use by ownership as a residence. The existing residence will be retrofitted with low flow fixtures to reduce the annual water demand. Per Napa County PBES requirements, a residence with low flow fixtures generates 120 gpd per bedroom.

The main residence water demand is calculated below assuming year-round occupancy:

$$3 \text{ bedrooms} \times 120 \text{ gpd/bedroom} \times 365 \text{ days/year} \times 1 \text{ acre-ft/325,851 gallons} = 0.40 \text{ acre-ft/year}$$

The project proposes to re-purpose the studio into a garden storage shed and will no longer include a bedroom. The garden shed is not anticipated to generate water as it will be used for storage.

The total proposed water demand for residential uses is calculated to be 0.40 acre-ft/yr.

#### 2.3.2 *Winery Domestic Water Demand*

The water demand for the proposed winery marketing and staffing plan are based on wastewater generation rates. This is consistent with how the existing water demands were calculated. The project proposes catering during events and does not propose a commercial kitchen. During days where events are held, the winery tasting room will be closed. Therefore, water demand from event guests and tasting room guests will not occur on the same day.

The project proposes 210 tasting visitors per week. Assuming the tasting room is open 52 weeks per year, the peak annual visitation is calculated to be 10,920 guests per year. Winery events are held twice a year with 50 guests per year (100 guests total). Accounting for two events per year where the tasting room is closed, a decrease in 30 tastings guests per event day (60 total) will occur. The resulting net annual visitation is estimated to be 10,860 tasting guests per year.

$$(10,860 \text{ tasting guests/year} + 100 \text{ event guests/yr}) \times 3 \text{ gpd/guest} \times 1 \text{ acre-ft/325,851 gallons} = 0.10 \text{ acre-feet/yr}$$

The project proposes three full time and two part time staff members. WAA guidelines do not distinguish between full and part time employees. Therefore, all employees have a water consumption rate of 15 gallons per person per day. Assuming five employees work 365 days per year (conservatively) the proposed employee water usage is estimated below:

$$5 \text{ employees} \times 365 \text{ days/year} \times 15 \text{ gpd/employee} \times 1 \text{ acre-ft/325,851 gallons} = 0.08 \text{ acre-feet/yr}$$

#### 2.3.3 *Winery Process Demand*

Winery process wastewater is calculated based on the Regional Water Quality Control Board (RWQCB) General Waste Discharge Requirements for Winery Process Water and is not anticipated to change since the production limits is not changing. This study assumes a winemaking generation rate of six gallons of water used per gallon of wine produced. This generation rate is within the industry standard for sizing winery wastewater (WW) treatment systems. At a peak production level of 20,000 gallons per year (gpy), the total annual flow is calculated below:

$$20,000 \text{ gallons of wine per year} \times 6 \text{ gallons of WW/wine} = 120,000 \text{ gpy} = 0.37 \text{ acre-feet/year}$$

#### 2.3.4 *Vineyard Irrigation Demand*

Treated process wastewater is proposed to be used for vineyard irrigation and therefore the demand on the project is estimated to be zero (0) acre-ft/year. No frost or heat control water use is planned. Refer to the project Wastewater Feasibility Study for additional information on the winery process wastewater system.

### 2.3.5 *Landscape Irrigation Demand*

The landscape irrigation demand is estimated based on the proposed landscape plan and the Model Water Efficient Landscape Ordinance (MWELO) for estimating water usage. The project proposes low to moderate water consumptive plants. Using the MWELO criteria for estimating the total landscape water budget for the site (Maximum Allowed Water Allotment (MAWA)) and then checking that against the proposed landscape plan, the Estimated Total Water Usage (ETWU) for the proposed project is calculated to be 193,650 gallons per year or 0.59 acre-feet/year. Refer to the landscape irrigation calculations in Attachment 1 for additional information. Refer to the Landscape Design plan included with the UPMM Drawings for additional information on proposed landscaping.

## **2.4 TOTAL PROPOSED WATER DEMAND**

The total demand for groundwater on the site is estimated to be:

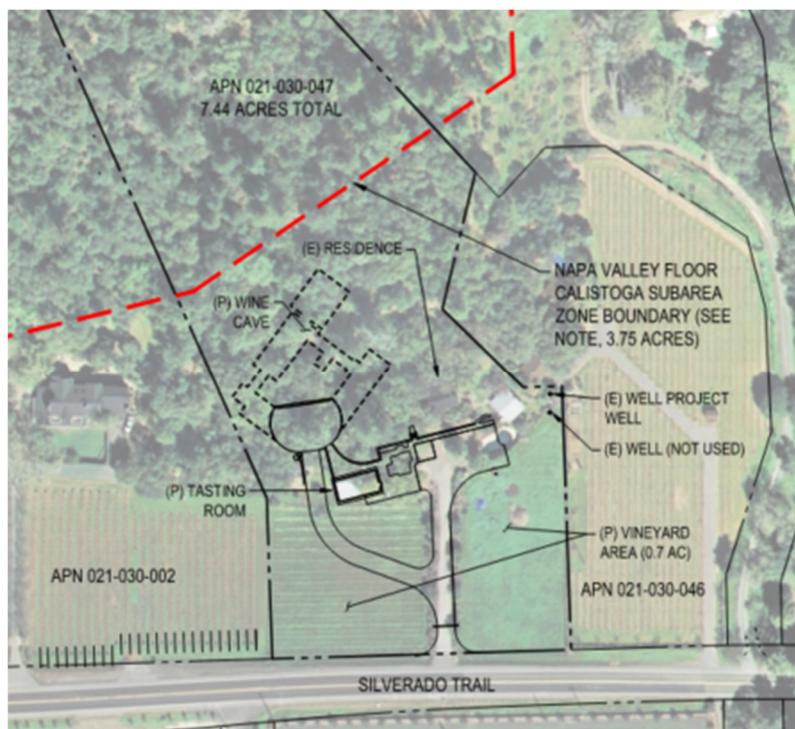
- Residential Demand = 0.40 acre-feet/year
- Winery Domestic Demand = 0.18 acre-feet/year
- Winery Process Water = 0.37 acre-feet/year
- Vineyard Irrigation = 0 acre-feet/year
- Landscape Irrigation = 0.59 acre-feet/year
- ***Total Water Usage = 1.54 acre-feet/year***

## **3.0 TIER 1 ANALYSIS: WATER USE CRITERIA**

### **3.1 WATER AVAILABILITY CRITERIA**

The property spans two groundwater zones. The lower portion of the subject parcel near Silverado Trail and shown in the image below is located within the Napa Valley Floor Calistoga Area groundwater zone. The proposed improvements and existing wells are also located within this area.

*Figure 1 Subject Parcel Groundwater Zone*



The red line shown on Figure 1 represents the boundary of the Napa Valley Floor Calistoga and St. Helena Subareas. This line is sourced from the kmz file provided by the napawatershed.org. The location of this line is also consistent with the Napa County arcgis.org website for the same groundwater delineation. Refer to Attachment 2 for the full Water Availability Site Plan.

The lower/flatter portion of the subject parcel is located within the Napa Valley Floor however the subject parcel is not located within the Napa County Groundwater Sustainability Agency (GSA) boundary per discussion with Planning Department staff. Therefore, water use allotment calculations for the subject parcel will be parcel specific for the entire 7.44 acres.

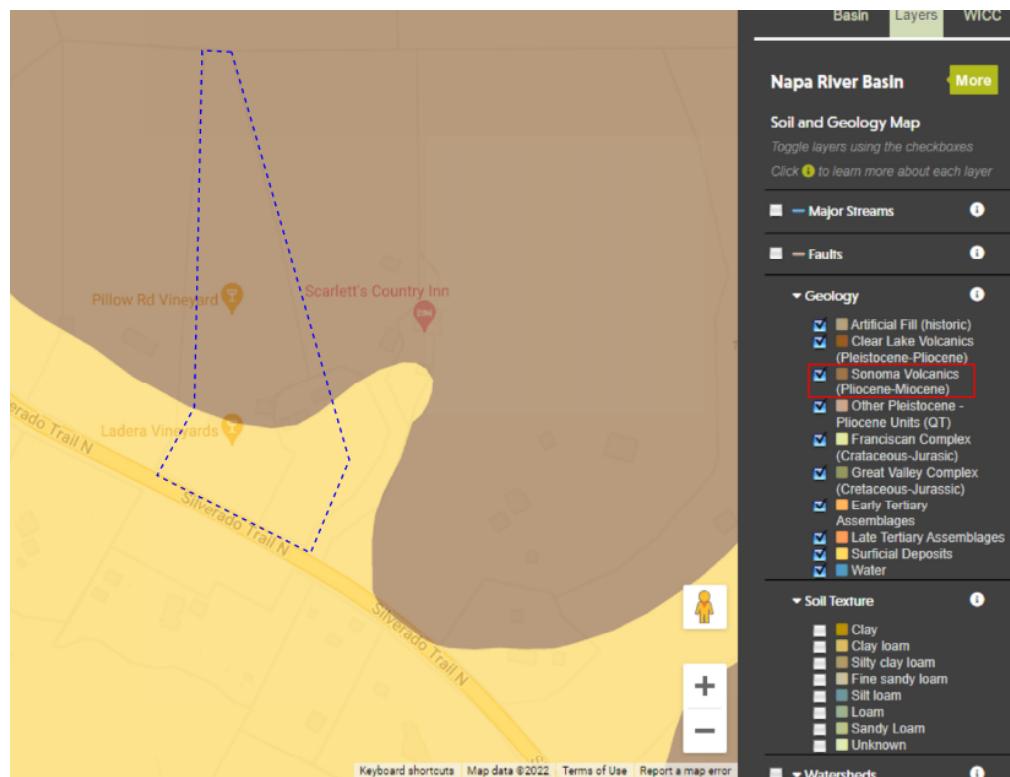
#### *Parcel Specific Groundwater Recharge*

Water availability is determined by evaluating rainfall contributions to groundwater recharge. In areas where slopes exceed 30%, rainfall predominately runs off the natural grade and is not able to percolate into the groundwater aquifer. Portions of the subject parcel that is includes less than 30% ground slopes is approximately 5.49 acres. This will be used as the recharge area.

Groundwater recharge can be estimated by understanding the soil properties and geological materials present and their ability to percolate groundwater to the saturated zone of the aquifer. Sonoma Volcanics are the primary water-bearing geological formation according to the WICC website and description of the groundwater basin. Below is an image from the WICC website<sup>1</sup> for the location of the subject parcel and the underlain soil and geological properties.

*Figure 2 Parcel Soil & Geological Exhibit*

<sup>1</sup> Available at <https://www.napawatersheds.org/>



Per similar groundwater publications, a percent of precipitation is assumed to be available for groundwater recharge within this area. The "Santa Rosa Plan Watershed Groundwater Management Plan 2014" prepared by the Santa Rosa Plan Basin Advisor Panel includes a specified yield of 0 to 15 percent for Sonoma Volcanics. Specified yield refers to the amount of water contained in the saturated zone that flows by gravity and is available to wells<sup>2</sup>. The "Napa-Sonoma Valley Groundwater Basin, Sonoma Valley Subbasin" from the California Groundwater Bulletin 118 describes Sonoma Volcanics as having specific yields varying from 0 to 15 percent<sup>3</sup>.

Groundwater recharge for the recharge area, which includes predominantly includes Sonoma Volcanics that has a reported recharge value of 15% of the annual precipitation. Using the PRISM Climate Group at Oregon State University, that has available rainfall datasets for the property location, the following table includes the monthly rainfall amount in inches per year, total rainfall for that year, average monthly rainfall, and then total average rainfall for the entire dataset.

<sup>2</sup> Per: Johnson, A. 1967. Specific Yield - Completion of Specific Yields for Various Materials. California Department of Water Resources. Geological Survey Water Supply Paper 1662-D.

<sup>3</sup> Per: Napa-Sonoma Valley Groundwater Basin, Sonoma Valley Subbasin. 6/30/14. California's Groundwater Bulletin 118

Table 1 Average Rainfall (in) 2011-2021

Year	January	February	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
2011	1.93	6.95	12.88	0.64	2.61	2.46	0	0	0.02	1.91	2.24	0.22	31.86
2012	7.35	2.33	11.3	3.68	0.26	0.07	0	0	0	1.4	10.24	14.08	50.71
2013	1.15	0.58	1.65	1.52	0.17	1.2	0	0	0.81	0.03	1	0.54	8.65
2014	0.16	12.69	4.49	2.94	0.06	0	0	0.01	0.67	1.01	3.97	16.56	42.56
2015	0.1	5.7	0.22	1.93	0.02	0.08	0.07	0	0.61	0.15	1.79	8.12	18.79
2016	11.64	1.64	12.46	1.7	0.46	0.02	0	0	0	7.88	4.3	7.89	47.99
2017	21.08	16.42	3.85	4.62	0.01	0.38	0	0	0.05	0.33	5.7	0.14	52.58
2018	6.68	0.27	9.36	3.54	0.19	0	0	0	0.04	1.23	5.58	3.85	30.74
2019	10.73	20.68	8.18	1.48	4.2	0	0	0	0.11	0	1.13	11.15	57.66
2020	3.62	0	1.67	1.36	2.15	0	0	0.1	0	0	1.92	2.89	13.71
2021	4.86	2.42	2.91	0.15	0.01	0	0	0	0.15	13.03	2.41	10.23	36.17
Average	6.3	6.33	6.27	2.14	0.92	0.38	0	0	0.22	2.45	3.66	6.88	<b>35.58</b>

The average rainfall collected over this time period is reported to be 35.58 inches. The volume of rainwater that is estimated to be available for groundwater recharge is calculated below based on the recharge area, average rainfall, and the 15% recharge rate:

$$\begin{aligned}
 \text{Annual recharge (acre-ft/yr)} &= \text{Recharge area (acres)} \times \text{Precipitation (ft)} \times \text{Recharge rate} \\
 &= 5.49 \text{ acres} \times (35.58 \text{ in} \times 1 \text{ ft}/12 \text{ in}) \times 15\% \\
 &= 2.44 \text{ acre-ft/yr}
 \end{aligned}$$

The total parcel water availability is estimated to be 2.44 acre-ft/year which is less than the proposed water usage of 1.55 acre-ft/year.

#### 4.0 TIER 2 ANALYSIS

A Tier 2 analysis was performed to analyze neighboring well interference within 500 feet of the project well per the WAA Guidance Document. The distance of the project well from the neighboring well is shown below as well as on the Well Interference Exhibit included in Appendix 3.

- 400 feet from a neighboring well located on APN 021-030-002
- 336 feet from a neighboring well located on APN 021-030-005
- 168 feet from a neighboring well located on APN 021-030-046

The project and neighboring wells are located within the Napa Valley Floor Groundwater Basin. Using *Figure F-3 Estimated Alluvial Aquifer Hydraulic Conductivity Ranges, Napa Valley Floor* (included in the WAA guidance document) and the project location relative to this map, the estimated aquifer hydraulic conductivity is "low" and between 30- 50 feet per day (ft/day). For this analysis the hydraulic conductivity of the aquifer is estimated to be 30 ft/day.

The project well is located within the North Napa Valley Basin (NNVB). According to the Napa County Baseline Data Report (2005), the basin extends north of the city of Napa up to the valley floor to the northwestern end of the valley just north of the City of Calistoga. The majority of NNVB is an unconfined aquifer. The project well is assumed to be located in an unconfined aquifer. The well log further indicates that it was drilled within soil strata as opposed to bedrock. Per the WAA Guidance Document, the specific yield for an unconfined aquifer is typically between 0.1 to 0.3. The lower of these two values (0.1) is used in this drawdown analysis. The well drawdown calculations were performed using the Utah Division of Water Rights which has a built-in calculator that utilizes the Theis Equation to quantify well drawdown. The results for each well are included in Attachment 3.

#### **Neighboring Well APN 021-030-002**

The following is summary of the neighboring well properties per the existing well log:

- 335 feet total well depth
- 50 gpm well yield (estimated)
- 6 inch well casing
- 235 ft of total screenings (represents aquifer thickness)
- Calculated well drawdown is 0.01 feet after one day of continuous pumping

#### **Neighboring Well APN 021-030-005**

The following is summary of the neighboring well properties per the existing well log:

- 120 feet total well depth
- 10 gpm well yield (estimated)
- 5 inch well casing
- 70 ft of total screenings (represents aquifer thickness)
- Calculated well drawdown is 0.01 feet after one day of continuous pumping

#### **Neighboring Well APN 021-030-046**

The following is summary of the neighboring well properties per the existing well log:

- 260 feet total well depth
- 30 gpm well yield (estimated)
- 6 inch well casing
- 40 ft of total screenings (represents aquifer thickness)
- Calculated well drawdown is 0.04 feet

Information from the neighboring Well's Completion Reports are used to estimate the well drawdowns. The project well is proposed to utilize a constant pumping rate of 9 gallons per minute (gpm). This pumping rate is based on the max per Tier 3 Analysis (see below). All wells are assumed to be located within an unconfined aquifer. Refer to the attached Well Interference Exhibit for the neighboring Well locations, Well Completion Reports, and Well Drawdown Calculations for each neighboring well.

## **5.0 TIER 3 ANALYSIS**

As noted above, using *Figure F-3 Estimated Alluvial Aquifer Hydraulic Conductivity Ranges, Napa Valley Floor* (included in the WAA guidance document) and the project location relative to this map, the estimated aquifer hydraulic

conductivity is "low" and between 30- 50 feet per day. The project well is located within the North Napa Valley Basin (NNVB). According to the Napa County Baseline Data Report (2005), the basin extends north of the city of Napa up to the valley floor to the northwestern end of the valley just north of the City of Calistoga. The majority of NNVB is an unconfined aquifer. The project well is assumed to be located in an unconfined aquifer. The well log further indicates that it was drilled within soil strata as opposed to bedrock.

The existing project well appears to be located approximately 730 feet from Dutch Henry Creek. Per the WAA guidance document, a Tier 3 analysis to evaluate groundwater to surface water interaction is included with this analysis. The project well includes a 52 foot cement seal and a total constructed depth of 350 feet. The well diameter is 5 feet and well perforations start at 90 feet from the surface. The project well log is included in Attachment 4 for your reference

The project well has an estimated yield of 50 gallons per minute (gpm) per the well log. Water storage tanks are proposed to provide upstream storage prior to the water connection points of use. This provides flexibility in reducing the pumping rate from the well to the storage tank to limit the instantaneous demand on the project well. A new well pump will be installed within the project well to keep the production classified as a very low-capacity pumping. Per Table 3 from the WAA guidance document (see below) for an unconfined aquifer and a very low pumping well that is located 500 feet from a surface water that meets these conditions will not significantly impact the surface water source. The project well meets all the conditions presented in this table with the exception of the "depth of uppermost perforations (feet)". This table includes a value of 100 feet below the ground surface for the start of perforations. Per the well log, perforations for the project well start at 90 feet below the ground surface. Keeping the other parameters the same, the acceptable distance from the surface channel is interpolated and estimated to be 550 feet to account for the well perforation location. The interpolated value is estimated to be 550 feet assuming a linear relationship between these values and that a 10% reduction in perforation depth results in a 10% increase in separation distance. If a modeling equation for the table can be provided, this number can be more accurately estimated.

*Table 2 WAA Distance Table for Water Wells to Surface Water*

**Table 3. Well Distance Standards and Construction Assumptions; Very low capacity pumping rates (i.e., less than 10 gpm), constructed in unconsolidated deposits in the upper part of the aquifer system (unconfined aquifer conditions). Assume 9 gpm (worst case)**

Aquifer Hydraulic Conductivity (ft/day)	Acceptable Distance from Surface Water Channel			Minimum Surface Seal Depth (feet)	Depth of Uppermost Perforations (feet)
	500 feet	1000 feet	1500 feet		
80	✓			50	100
50	✓			50	100
30	✓			50	100
0.5	✓			50	100
PROJECT WELL	30	550		50	90

The project well is located approximately 730 feet from Dutch Henry creek which is greater than the estimated value of 550 feet. The proposed project well will include a well pump rate of 9 gallons per minute (gpm) or less to the

storage tanks to reduce the impact on Dutch Henry creek and be within the acceptable conditions for a Tier 3 analysis per the WAA guidance document.

This proposed pumping rate of 9 gpm (maximum) is more than sufficient to satisfy the project water demands. Refer to the Water System Feasibility Report submitted with the application materials for a discussion on the project water demands and proposed water system.

## 6.0 CONCLUSION

The project is estimated to slightly increase water usage by approximately 12% (from 1.37 acre-ft/year to 1.54 acre-ft/year). The proposed water usage of 1.54 acre-ft/year is less than the estimated water allotment for the parcel which is calculated to be 2.44 acre-ft/year. The proposed increase in water usage associated with the Minor Modification Permit Application are within the Tier 1, Tier 2, and Tier 3 criteria set forward by the WAA guidance document. The project is unlikely to substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level.

**Attachment 1:**

Existing & Proposed Water Demand Calculations, MWELO Calculations

## EXISTING WATER DEMAND - LADERA VINEYARDS

RESIDENTIAL USES	DESCRIPTION	WATER DEMAND	NOTES
Main Residence	3 bedroom residence	0.50 acre-feet/year	Based on wastewater generation rates; 150 gallons/bedroom/day, 365 days per year
Studio Cottage	1 bedroom studio	0.17 acre-feet/year	Based on wastewater generation rates; 120 gallons/bedroom/day, 365 days per year
<b>WINERY USES</b>			
Wine Production	20,000 gallons wine/year	0.37 acre-feet/year	Based on wastewater generation rates (see WWFS)
Employees	2 full time employees	0.03 acre-feet/year	Assumes 15 gallons per employee per day (see WWFS); winery open 365 days/year
Visitors	5,200 annual visitors	0.05 acre-feet/year	Assumes 3 gallons per guest per day (see WWFS); winery open 365 days/year
<b>VINEYARD/LANDSCAPE</b>			
Landscape Irrigation	0.12 acres	0.25 acre-feet/year	Existing water usage unavailable, WAA guidance document referenced
Total		1.37 acre-feet/year	

## PROPOSED WATER DEMAND - LADERA VINEYARDS

RESIDENTIAL USES	Proposed Change	DESCRIPTION	WATER DEMAND	NOTES
Main Residence	Fixtures retrofitted to be low flow (decrease)	3 bedroom residence	0.40 acre-feet/year	Based on wastewater generation rates; 120 gallons/bedroom/day, 365 days per year
Studio-Cottage	Repurposed as a garden storage shed (decrease)	4 bedroom studio	0.00 acre-feet/year	
<b>WINERY USES</b>				
Wine Production	No change	20,000 gallons wine/year	0.37 acre-feet/year	Based on wastewater generation rates (see WWFS)
Employees	Increase	5 full time employees	0.08 acre-feet/year	Assumes 15 gallons per employee per day (see WWFS); winery open 365 days/year
Visitors	Increase	10,860 annual visitors	0.10 acre-feet/year	Assumes 3 gallons per guest per day (see WWFS); winery open 365 days/year
<b>VINEYARD/LANDSCAPE</b>				
Vineyard Irrigation	Irrigated with treated process wastewater (decrease)	0.75 acres	0.00 acre-feet/year	Irrigated with treated process wastewater
Landscape Irrigation	Increase	0.04 acres	0.59 acre-feet/year	Calculated based on MIWELO requirements
Total			1.54 acre-feet/year	

Model Water Efficient Landscape Ordinance (MWELO)

Landscape Irrigation Calculations

MAWA = Maximum Applied Water Allowance (gallons per year)  
 ETo = Reference Evapotranspiration from Appendix A (inches per year)  
 0.7 = ET Adjustment Factor (ETAF)  
 LA = Landscaped Area includes Special Landscape Area (square feet)  
 0.62 = Conversion factor (to gallons per square foot)  
 SLA = Portion of the landscape area identified as Special Landscape Area (square feet)  
 0.3 = the additional ET Adjustment Factor for Special Landscape Area (1.0 - 0.7 = 0.3)

Project Specific Climate Data

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ETo <sup>1</sup> (in)	1.2	1.5	2.8	3.9	5.1	6.1	7	6.2	4.8	3.1	1.4	0.9	44.00 in/year
Rainfall (in) <sup>2</sup>	6.3	6.33	6.27	2.14	0.92	0.38	0	0	0.22	2.45	3.66	6.88	35.55 in/year
Eppt (in)	1.575	1.5825	1.5675	0.535	0.23	0.095	0	0	0.055	0.6125	0.915	1.72	8.89 in/year

Landscape Design Information

Planter Areas <sup>3</sup>	Area (sf)	PF	CF	SLA	IE
A	4,035	0.4	0.62	0	0.71
B	3,000	0.4	0.62	0	0.71
C	5,420	0.4	0.62	0	0.71
D	145	0.4	0.62	0	0.71
Total	12,600	sf			
	0.04	acres			

MAWA w/ Eppt

If considering Effective Precipitation, use 25% of annual precipitation. Use the following equation to calculate Maximum Applied Water Allowance:

$$MAWA = (ETo - Eppt) (0.62) [(0.7 \times LA) + (0.3 \times SLA)]$$

Planter Areas <sup>3</sup>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
A	0	0	2,158	5,893	8,528	10,516	12,258	10,857	8,309	4,356	849	0	63,726 gal/year
B	0	0	1,605	4,381	6,341	7,819	9,114	8,072	6,178	3,239	631	0	47,380 gal/year
C	0	0	2,899	7,915	11,456	14,125	16,466	14,584	11,162	5,851	1,141	0	85,599 gal/year
D	0	0	78	212	306	378	441	390	299	157	31	0	2,290 gal/year
Total	0	0	6,740	18,401	26,631	32,838	38,279	33,904	25,948	13,603	2,652	0	198,995 gal/year
													0.61 acre-feet/year

ETWU

$$ETWU = (ETo)(0.62) \left( \frac{PF \times HA}{IE} + SLA \right)$$

where:

ETWU = Estimated total water use per year (gallons per year)  
 ETo = Reference Evapotranspiration (inches per year)  
 PF = Plant Factor from WUCOLS (see Definitions)  
 HA = Hydrozone Area [high, medium, and low water use areas] (square feet)  
 SLA = Special Landscape Area (square feet)  
 0.62 = Conversion Factor (to gallons per square foot)  
 IE = Irrigation Efficiency (minimum 0.71)

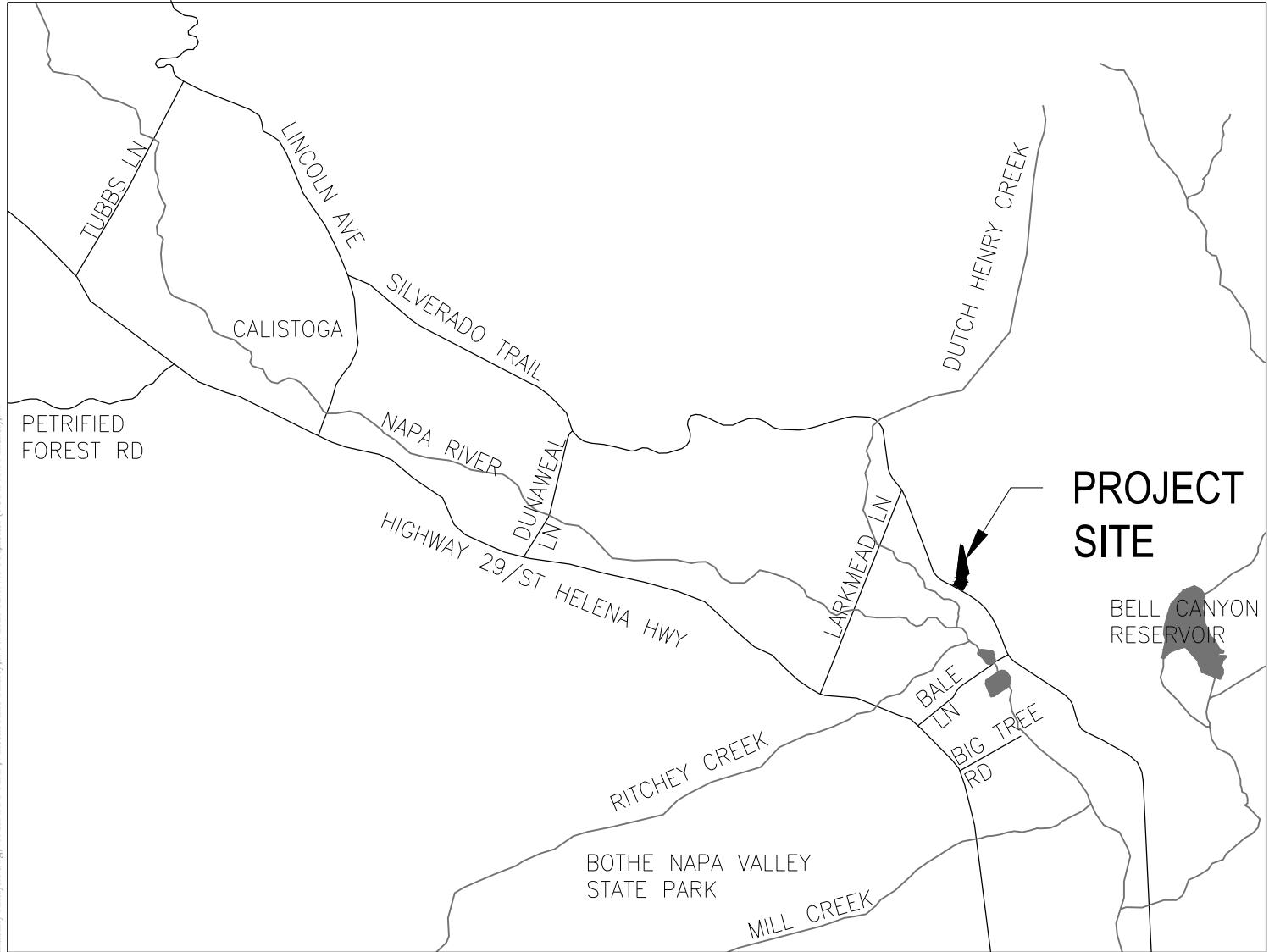
Planter Areas <sup>3</sup>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
A	1,691	2,114	3,946	5,497	7,188	8,597	9,866	8,738	6,765	4,369	1,973	1,268	62,014 gal/year
B	1,257	1,572	2,934	4,087	5,344	6,392	7,335	6,497	5,030	3,248	1,467	943	46,107 gal/year
C	2,272	2,840	5,301	7,383	9,655	11,548	13,252	11,738	9,087	5,869	2,650	1,704	83,300 gal/year
D	61	76	142	198	258	309	355	314	243	157	71	46	2,229 gal/year
Total	5,281	6,602	12,323	17,164	22,446	26,847	30,808	27,287	21,125	13,643	6,162	3,961	193,650 gal/year
													0.59 acre-feet/year

Notes/References

1. ETO values are referenced from Appendix A - Reference Evapotranspiration (ETo) Table from the Model Efficient Landscape Ordinance (WELO) for St. Helena
2. Monthly average rainfall amounts are taken from PRISM <https://prism.oregonstate.edu/> for the project site (4km cell) and averaged monthly from Jan 2012 to Jan 2022
3. Refer to the Planter Area Exhibit for the location and description of plant types; the subsurface drip dispersal field area has been removed from area C since that area will be irrigated with treated wastewater.

**Attachment 2:**

Vicinity Map, Existing Conditions Exhibit, Water Availability Site Plan, Slope Analysis



卷之三



2548 Mission Street  
San Francisco, CA 94110  
[www.sherwoodengineers.com](http://www.sherwoodengineers.com)

## WATER AVAILABILITY ANALYSIS

LADERA WINERY  
CALISTOGA, CALIFORNIA

# Ladera Vineyards

Legend

Existing Conditions

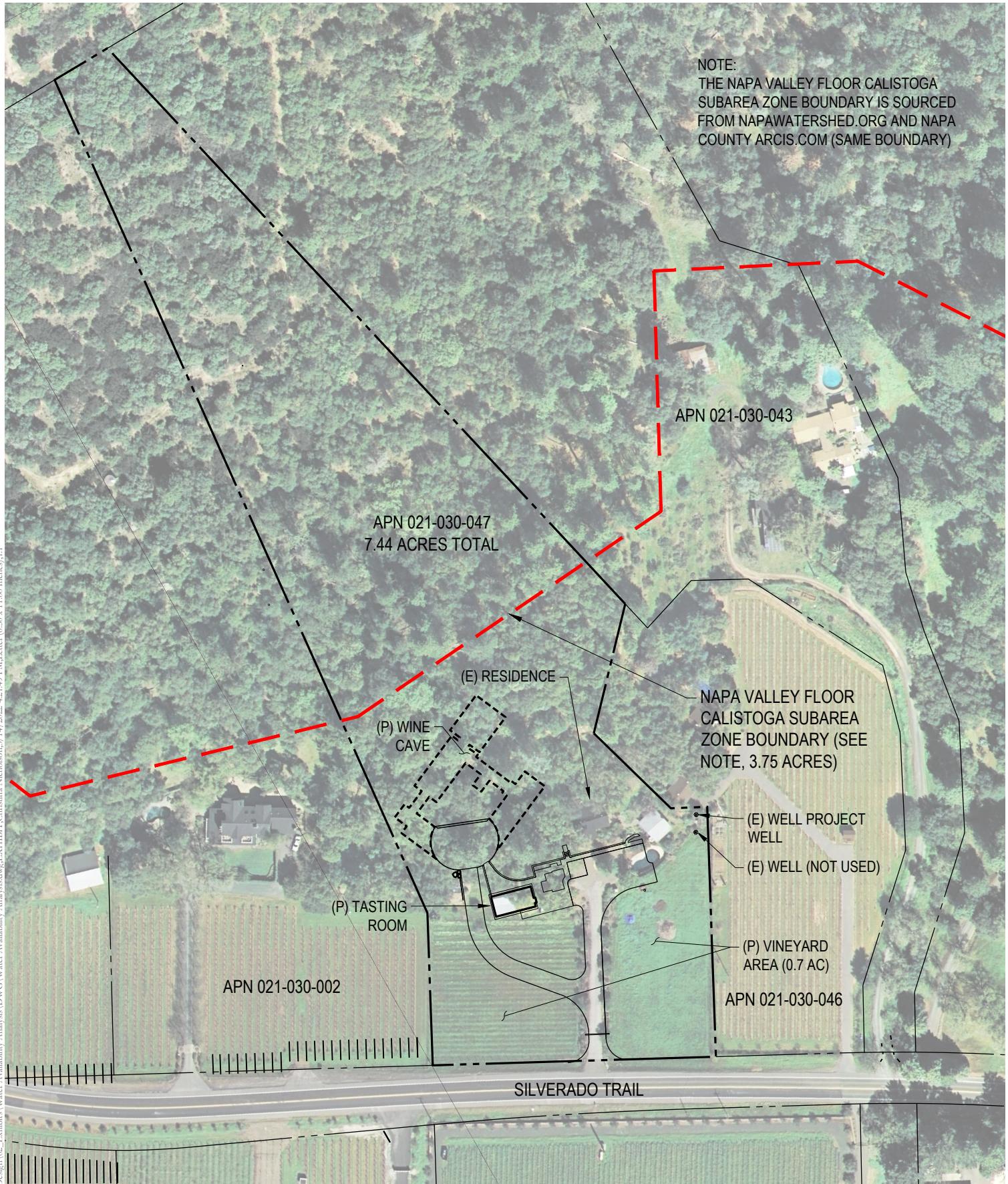


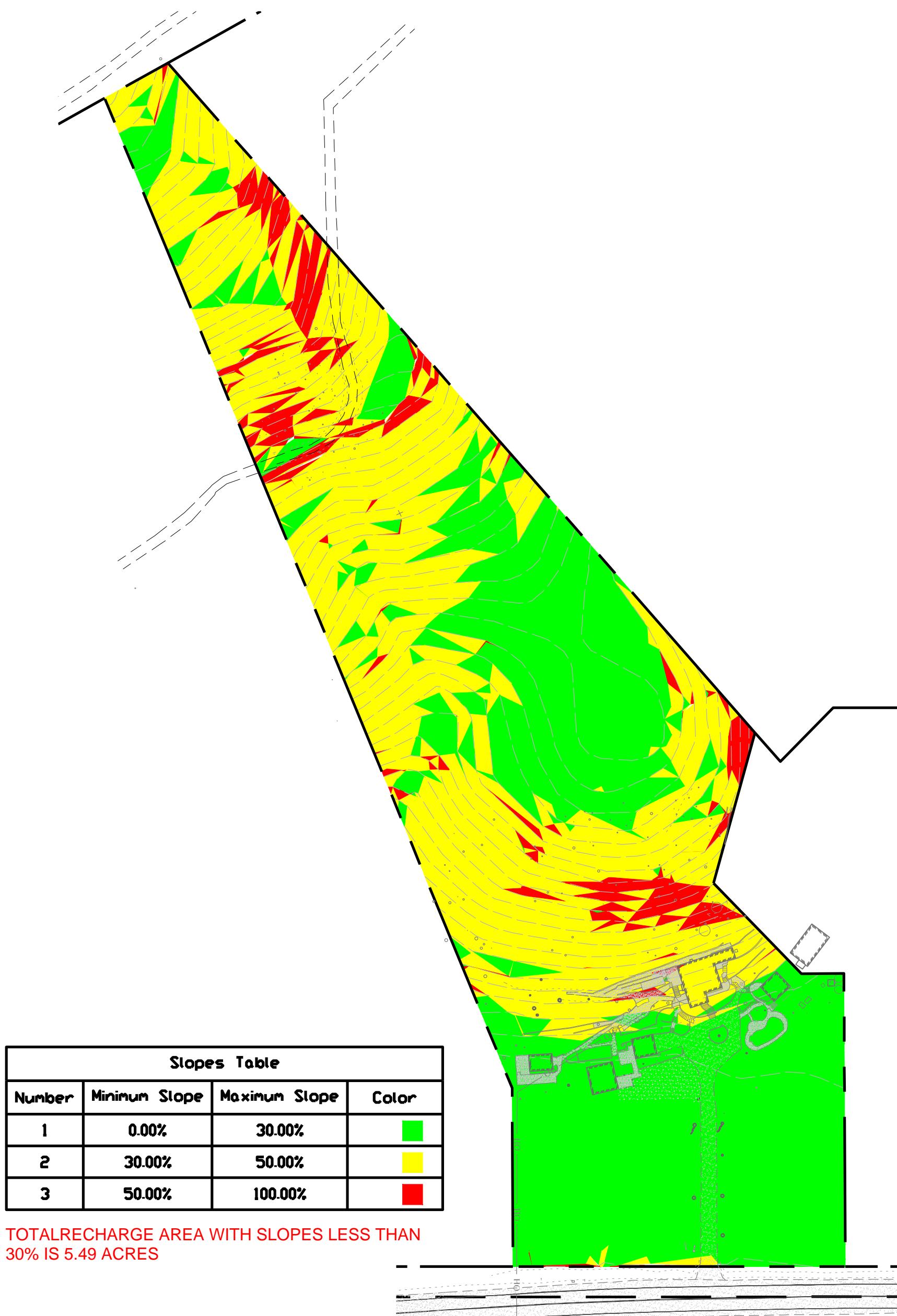
Google Earth

Image Landsat / Copernicus

N

700 ft





**TOTAL RECHARGE AREA WITH SLOPES LESS THAN 30% IS 5.49 ACRES**

## SLOPE ANALYSIS

**LADERA VINEYARDS  
NAPA COUNTY, CALIFORNIA**

---

May 12, 2022

**Attachment 3:**

Well Interference Calculations & Exhibit, Neighboring Well Research

Ladera Vineyards  
Water Availability Analysis

**Tier 2 Analysis Neighboring Well APN 021-030-002**

**Project Well**

**per well completion report 1073647**

Constant pumping rate	Q =	9 gpm	<i>max per Tier 3 Analysis</i>
Well diameter	$\emptyset$ =	5 inch	<i>per well log</i>
Total depth of well	=	350 feet	<i>completed well</i>
Screened interval	=	260 feet	<i>starts at 90 ft bgs</i>

**Neighboring Well<sup>1</sup>**

Constant pumping rate	Q =	50 gpm	<i>estimated yield</i>
Well diameter	$\emptyset$ =	6 inch	
Total depth of well	=	335 feet	
Screened interval	=	235 feet	

**Calculated Drawdown in Neighboring Well**

Aquifer Thickness	D =	235 ft
Hydraulic Conductivity	$Kh$ =	30 ft/day
Aquifer Transmissivity	T =	7,050 ft <sup>2</sup> /day
Pumping Rate	Q =	9 gpm
	=	1,733 ft <sup>3</sup> /day
Radial distance from well	r =	400 feet
Time since pumping began	t =	1 day
Storage coefficient	S =	0.1
Resulting well drawdown	=	0.1 ft

Notes:

<sup>1</sup> Neighboring well data is taken from the well completion report under permit E18-00145



# Utah Division of Water Rights

**CALCULATED THEIS:**

Given input:

Constant pumping rate (Q): 0.020052 cfs

Aquifer transmissivity (T): 7050 ft<sup>2</sup>/day or 0.081597 ft<sup>2</sup>/second

Time since pumping began (t): 1 days

Radial distance from well (r): 400.00 feet

Aquifer storativity (S): .1

$$h_o - h = \frac{Q}{4\pi T} W(u) \quad u = \frac{r^2 S}{4Tt}$$

$$h_o - h = \frac{Q}{4\pi T} \left[ -0.5772 - \ln u + u - \frac{u^2}{2 \cdot 2!} + \frac{u^3}{3 \cdot 3!} - \frac{u^4}{4 \cdot 4!} + \dots \right]$$

Q is the constant pumping rate (L3/T; ft3/day or m3/day)

h is hydraulic head (L; ft or m)

ho is hydraulic head before pumping started (L; ft or m)

ho-h is the drawdown (L; ft or m)

T is aquifer transmissivity (L2/T; ft2/day or m2/day)

t is time since pumping began (T; days)

r is radial distance from the pumping well (L; ft or m)

S is aquifer storativity (dimensionless)

b is aquifer thickness (L; ft or m)

u: 0.567376

W(u) series: 0.48558814891425

Drawdown (ho-h) at day 1: 0.01 ft using series calculation of W(u) to u<sup>6</sup>**Drawdown over the course of a year from initial well drilling:**

Day 1: 0.01 ft

Day 4: 0.03 ft

Day 7: 0.04 ft

Day 10: 0.05 ft

Day 13: 0.05 ft

Day 16: 0.05 ft

Day 19: 0.06 ft

Day 22: 0.06 ft

Day 25: 0.06 ft

Day 28: 0.07 ft

Month 1: 0.07 ft

Month 2: 0.08 ft

Month 3: 0.09 ft

Month 4: 0.09 ft

Month 5: 0.10 ft

Month 6: 0.10 ft

Month 7: 0.10 ft

Month 8: 0.11 ft

Month 9: 0.11 ft

Month 10: 0.11 ft

Month 11: 0.11 ft

Month 12: 0.12 ft

**Drawdown over multiple years from initial well drilling:**

Year 1: 0.12 ft

Year 2: 0.13 ft

Year 3: 0.14 ft

Year 4: 0.14 ft

Year 5: 0.15 ft

Year 6: 0.15 ft

Year 7: 0.15 ft

Year 8: 0.16 ft

Year 9: 0.16 ft

Year 10: 0.16 ft

Year 11: 0.16 ft

Year 12: 0.16 ft

Year 13: 0.17 ft

Year 14: 0.17 ft

**NEIGHBORING WELL -002**

Year 15: 0.17 ft  
Year 16: 0.17 ft  
Year 17: 0.17 ft  
Year 18: 0.17 ft  
Year 19: 0.17 ft  
Year 20: 0.17 ft  
Year 21: 0.17 ft  
Year 22: 0.18 ft  
Year 23: 0.18 ft  
Year 24: 0.18 ft  
Year 25: 0.18 ft  
Year 26: 0.18 ft  
Year 27: 0.18 ft  
Year 28: 0.18 ft  
Year 29: 0.18 ft  
Year 30: 0.18 ft

State of California  
**Well Completion Report**  
Form DWR 188 Submitted 7/17/2018  
WCR2018-005573

Owner's Well Number	Date Work Began	04/13/2018	Date Work Ended	04/23/2018		
Local Permit Agency	Napa County Planning Building and Environmental Services					
Secondary Permit Agency	Permit Number	E18-00145		Permit Date	03/20/2018	
<b>Well Owner (must remain confidential pursuant to Water Code 13752)</b>					<b>Planned Use and Activity</b>	
Name	ALPHA OMEGA, ROBIN BAGGETT				Activity	New Well
Mailing Address	PO BOX 814				Planned Use	Water Supply Domestic
City	RUTHERFORD		State	CA	Zip	94573

<b>Well Location</b>											
Address			3950 SILVERADO TR			APN			021-030-002-000		
City		CALISTOGA		Zip	94515	County	Napa		Township		08 N
Latitude				N	Longitude		W		Range		06 W
Deg.	Min.	Sec.				Deg.	Min.	Sec.		Section	10
Dec. Lat.			38.5630970			Dec. Long.			-122.5110846		
Vertical Datum						Horizontal Datum			WGS84		
Location Accuracy						Location Determination Method					
Ground Surface Elevation						Elevation Accuracy					
Elevation Determination Method											

<b>Borehole Information</b>						<b>Water Level and Yield of Completed Well</b>									
Orientation	Vertical		Specify			Depth to first water	7	(Feet below surface)							
Drilling Method	Direct Rotary		Drilling Fluid			Depth to Static									
Total Depth of Boring	335		Feet			Water Level	12	(Feet)	Date Measured	04/23/2018					
Total Depth of Completed Well	335		Feet			Estimated Yield*	50	(GPM)	Test Type	Air Lift					
Test Length											14	(Hours)	Total Drawdown	67	(feet)
*May not be representative of a well's long term yield.															

<b>Geologic Log - Free Form</b>											
Depth from Surface Feet to Feet		Description									
0	10	Topsoil									
10	40	40% GRAVEL, 30% SAND, 30% CLAY									
40	80	40% LARGE GRAVEL, 40% SAND, 20% CLAY									
80	120	50% GRAVEL, 40% SAND, 10% CLAY									
120	260	80% SMALL & LARGE GRAVEL, 20% SAND									
260	310	50% SHALE, 30% SAND, 20% SMALL GRAVEL									
310	315	50% WHITE ROCK, 50% RED ROCK									
315	335	60% SHALE, 25% SAND, 15% SMALL GRAVEL									

## Casings

Casing #	Depth from Surface Feet to Feet	Casing Type	Material	Casings Specifacations	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if any (inches)	Description
1	0	60	Blank	PVC OD: 6.625 in.   SDR: 21   Thickness: 0.316 in.	0.316	6.625			
1	60	180	Screen	PVC OD: 6.625 in.   SDR: 21   Thickness: 0.316 in.	0.316	6.625	Milled Slots	0	
1	180	200	Blank	PVC OD: 6.625 in.   SDR: 21   Thickness: 0.316 in.	0.316	6.625			
1	200	300	Screen	PVC OD: 6.625 in.   SDR: 21   Thickness: 0.316 in.	0.316	6.625	Milled Slots	0	
1	300	320	Blank	PVC OD: 6.625 in.   SDR: 21   Thickness: 0.316 in.	0.316	6.625			
1	320	335	Screen	PVC OD: 6.625 in.   SDR: 21   Thickness: 0.316 in.	0.316	6.625	Milled Slots	0	

## Annular Material

Depth from Surface Feet to Feet	Fill	Fill Type Details	Filter Pack Size	Description
0	51	Cement	Other Cement	6 SACK CEMENT
51	335	Filter Pack	Other Gravel Pack	3/8" Pea Gravel

## Other Observations:

## Borehole Specifications

Depth from Surface Feet to Feet	Borehole Diameter (inches)	
0	51	14
51	335	11

## Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name MC LEAN & WILLIAMS INC  
 Person, Firm or Corporation  
878 EL CENTRO AVENUE NAPA CA 94558  
 Address City State Zip  
 Signed electronic signature received 07/17/2018 396352  
 C-57 Licensed Water Well Contractor Date Signed C-57 License Number

## Attachments

3950 Silverado Trail Well Location Map.pdf - Location Map

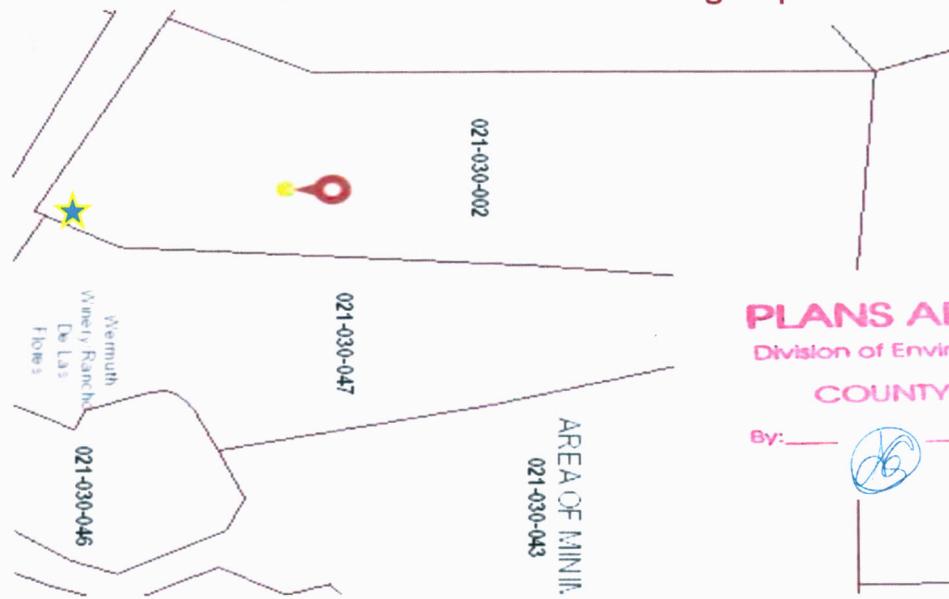
## DWR Use Only

CSG #	State Well Number				Site Code	Local Well Number			
					N				
Latitude Deg/Min/Sec									
Longitude Deg/Min/Sec									
TRS:									
APN:									



**Well Drilling & Pump Service**  
 878 El Centro Ave. Napa Ca, 94558  
 Office 707-255-6450  
 Fax 707-255-6489  
 Lic. #396352

**3950 Silverado Trail Calistoga Ap # 021-030-002**



**PLANS APPROVED**

Division of Environmental Health

**COUNTY OF NAPA**

By: \_\_\_\_\_ Date: 03/20/18



# PLANS APPROVED

Division of Environmental Health

E18-00145

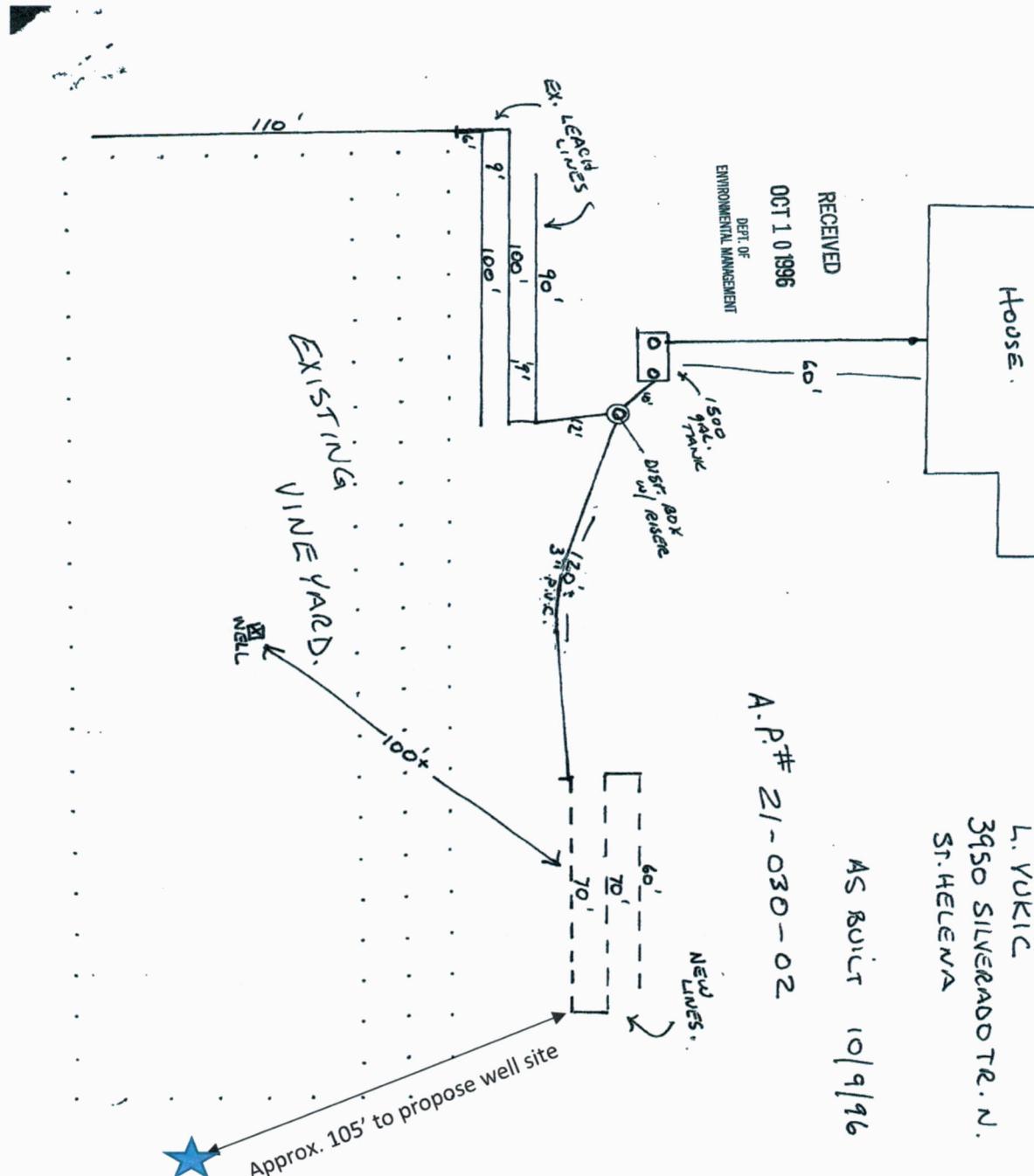


## COUNTY OF NAPA

By:  Date: 03/20/18

3950 Silverado Trail Calistoga Ap # 021-030-002

page 2 of 2



Ladera Vineyards  
Water Availability Analysis

**Tier 2 Analysis Neighboring Well APN 021-030-005**

**Project Well**

**per well completion report 1073647**

Constant pumping rate	Q =	9 gpm	<i>max per Tier 3 Analysis</i>
Well diameter	$\emptyset$ =	5 inch	<i>per well log</i>
Total depth of well	=	350 feet	<i>completed well</i>
Screened interval	=	260 feet	<i>starts at 90 ft bgs</i>

**Neighboring Well**

**per well log from 1971**

Constant pumping rate	Q =	10 gpm	<i>estimated yield</i>
Well diameter	$\emptyset$ =	8 inch	
Total depth of well	=	120 feet	
Screened interval	=	70 feet	

**Calculated Drawdown in Neighboring Well**

Aquifer Thickness	D =	70 ft
Hydraulic Conductivity	$K_h$ =	30 ft/day
Aquifer Transmissivity	T =	2,100 ft <sup>2</sup> /day
Pumping Rate	Q =	9 gpm
	=	1,733 ft <sup>3</sup> /day
Radial distance from well	r =	336 feet
Time since pumping began	t =	1 day
Storage coefficient	S =	0.1
Resulting well drawdown	=	0.1 ft



# Utah Division of Water Rights

**CALCULATED THEIS:****NEIGHBORIN WELL  
APN -005**

Given input:

Constant pumping rate (Q): 0.020052 cfs

Aquifer transmissivity (T): 2100 ft<sup>2</sup>/day or 0.024306 ft<sup>2</sup>/second

Time since pumping began (t): 1 days

Radial distance from well (r): 336.00 feet

Aquifer storativity (S): .1

$$h_o - h = \frac{Q}{4\pi T} W(u) \quad u = \frac{r^2 S}{4 T t}$$

$$h_o - h = \frac{Q}{4\pi T} \left[ -0.5772 - \ln u + u - \frac{u^2}{2 \cdot 2!} + \frac{u^3}{3 \cdot 3!} - \frac{u^4}{4 \cdot 4!} + \dots \right]$$

Q is the constant pumping rate (L<sup>3</sup>/T; ft<sup>3</sup>/day or m<sup>3</sup>/day)

h is hydraulic head (L; ft or m)

h<sub>o</sub> is hydraulic head before pumping started (L; ft or m)h<sub>o</sub>-h is the drawdown (L; ft or m)T is aquifer transmissivity (L<sup>2</sup>/T; ft<sup>2</sup>/day or m<sup>2</sup>/day)

t is time since pumping began (T; days)

r is radial distance from the pumping well (L; ft or m)

S is aquifer storativity (dimensionless)

b is aquifer thickness (L; ft or m)

u: 1.344000

W(u) series: 0.12639530491161

**Drawdown (h<sub>o</sub>-h) at day 1: 0.01 ft using series calculation of W(u) to u<sup>6</sup>****Drawdown over the course of a year from initial well drilling:**

Day 1: 0.01 ft

Day 4: 0.05 ft

Day 7: 0.08 ft

Day 10: 0.10 ft

Day 13: 0.12 ft

Day 16: 0.13 ft

Day 19: 0.14 ft

Day 22: 0.15 ft

Day 25: 0.16 ft

Day 28: 0.16 ft

Month 1: 0.17 ft

Month 2: 0.21 ft

Month 3: 0.24 ft

Month 4: 0.26 ft

Month 5: 0.27 ft

Month 6: 0.29 ft

Month 7: 0.30 ft

Month 8: 0.30 ft

Month 9: 0.31 ft

Month 10: 0.32 ft

Month 11: 0.32 ft

Month 12: 0.33 ft

**Drawdown over multiple years from initial well drilling:**

Year 1: 0.33 ft

Year 2: 0.38 ft

Year 3: 0.40 ft

Year 4: 0.42 ft

Year 5: 0.44 ft

Year 6: 0.45 ft

Year 7: 0.46 ft

Year 8: 0.47 ft

Year 9: 0.47 ft

Year 10: 0.48 ft

Year 11: 0.49 ft

Year 12: 0.49 ft

Year 13: 0.50 ft

Year 14: 0.50 ft

Year 15: 0.51 ft  
Year 16: 0.51 ft  
Year 17: 0.52 ft  
Year 18: 0.52 ft  
Year 19: 0.52 ft  
Year 20: 0.53 ft  
Year 21: 0.53 ft  
Year 22: 0.53 ft  
Year 23: 0.54 ft  
Year 24: 0.54 ft  
Year 25: 0.54 ft  
Year 26: 0.54 ft  
Year 27: 0.55 ft  
Year 28: 0.55 ft  
Year 29: 0.55 ft  
Year 30: 0.55 ft



Ladera Vineyards  
Water Availability Analysis

**Tier 2 Analysis Neighboring Well APN 021-030-046**

**Project Well**

**per well completion report 1073647**

Constant pumping rate	Q	=	9 gpm	<i>max per Tier 3 Analysis</i>
Well diameter	$\emptyset$	=	5 inch	<i>per well log</i>
Total depth of well		=	350 feet	<i>completed well</i>
Screened interval		=	260 feet	<i>starts at 90 ft bgs</i>

**Neighboring Well**

**per well log**

Constant pumping rate	Q	=	30 gpm	<i>estimated yield</i>
Well diameter	$\emptyset$	=	6 inch	
Total depth of well		=	260 feet	
Screened interval		=	40 feet	

**Calculated Drawdown in Neighboring Well**

Aquifer Thickness	D	=	40 ft
Hydraulic Conductivity	$K_h$	=	30 ft/day
Aquifer Transmissivity	T	=	1,200 $ft^2/day$
Pumping Rate	Q	=	9 gpm
		=	1,733 $ft^3/day$
Radial distance from well	r	=	168 feet
Time since pumping began	t	=	1 day
Storage coefficient	S	=	0.1
Resulting well drawdown		=	0.05 ft



# Utah Division of Water Rights

**CALCULATED THEIS:**

Given input:

Constant pumping rate (Q): 0.020052 cfs

Aquifer transmissivity (T): 1200 ft<sup>2</sup>/day or 0.013889 ft<sup>2</sup>/second

Time since pumping began (t): 1 days

Radial distance from well (r): 168.00 feet

Aquifer storativity (S): .1

$$h_o - h = \frac{Q}{4\pi T} W(u) \quad u = \frac{r^2 S}{4Tt}$$

$$h_o - h = \frac{Q}{4\pi T} \left[ -0.5772 - \ln u + u - \frac{u^2}{2 \cdot 2!} + \frac{u^3}{3 \cdot 3!} - \frac{u^4}{4 \cdot 4!} + \dots \right]$$

Q is the constant pumping rate (L3/T; ft3/day or m3/day)

h is hydraulic head (L; ft or m)

ho is hydraulic head before pumping started (L; ft or m)

ho-h is the drawdown (L; ft or m)

T is aquifer transmissivity (L2/T; ft2/day or m2/day)

t is time since pumping began (T; days)

r is radial distance from the pumping well (L; ft or m)

S is aquifer storativity (dimensionless)

b is aquifer thickness (L; ft or m)

u: 0.588000

W(u) series: 0.465549019105062

Drawdown (ho-h) at day 1: 0.05 ft using series calculation of W(u) to u<sup>6</sup>**Drawdown over the course of a year from initial well drilling:**

Day 1: 0.05 ft

Day 4: 0.17 ft

Day 7: 0.23 ft

Day 10: 0.27 ft

Day 13: 0.29 ft

Day 16: 0.32 ft

Day 19: 0.34 ft

Day 22: 0.35 ft

Day 25: 0.37 ft

Day 28: 0.38 ft

Month 1: 0.39 ft

Month 2: 0.47 ft

Month 3: 0.51 ft

Month 4: 0.55 ft

Month 5: 0.57 ft

Month 6: 0.59 ft

Month 7: 0.61 ft

Month 8: 0.63 ft

Month 9: 0.64 ft

Month 10: 0.65 ft

Month 11: 0.66 ft

Month 12: 0.67 ft

**Drawdown over multiple years from initial well drilling:**

Year 1: 0.67 ft

Year 2: 0.75 ft

Year 3: 0.80 ft

Year 4: 0.83 ft

Year 5: 0.86 ft

Year 6: 0.88 ft

Year 7: 0.90 ft

Year 8: 0.91 ft

Year 9: 0.93 ft

Year 10: 0.94 ft

Year 11: 0.95 ft

Year 12: 0.96 ft

Year 13: 0.97 ft

Year 14: 0.98 ft

**NEIGHBORING WELL  
APN -046**

Year 15: 0.98 ft  
Year 16: 0.99 ft  
Year 17: 1.00 ft  
Year 18: 1.00 ft  
Year 19: 1.01 ft  
Year 20: 1.02 ft  
Year 21: 1.02 ft  
Year 22: 1.03 ft  
Year 23: 1.03 ft  
Year 24: 1.04 ft  
Year 25: 1.04 ft  
Year 26: 1.05 ft  
Year 27: 1.05 ft  
Year 28: 1.06 ft  
Year 29: 1.06 ft  
Year 30: 1.06 ft

QUADRUPLE

For Local Requirements

STATE OF CALIFORNIA  
WELL COMPLETION REPORT  
Refer to Instruction Pamphlet

No. 0949216

Page 1 of 1  
Owner's Well No. 100-00785  
Date Work Began 1/03/13, Ended 1/24/13  
Local Permit Agency Napa  
Permit No. E12-00785 Permit Date 1/3/13

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE

LONGITUDE

APN/TRS/OTHER

WELL OWNER

Name [REDACTED]  
Mailing Address [REDACTED]

CITY [REDACTED]

STATE [REDACTED] ZIP [REDACTED]

WELL LOCATION

Address 3940 Silverado Trail  
City Calistoga  
County Napa

APN Book 021 Page 030 Parcel 045

Township  Range  Section

Lat. DEG. MIN. SEC. N Long DEG. MIN. SEC.

LOCATION SKETCH

NORTH

Y NEW WELL

MODIFICATION/REPAIR  
— Deepen  
— Other (Specify)

DESTROY (Describe  
Procedures and Materials  
Under "GEOLOGIC LOG")

USES (✓)  
WATER SUPPLY  
— Domestic ✓ Public  
— Irrigation  Industrial  
MONITORING  
TEST WELL  
CATHODIC PROTECTION  
HEAT EXCHANGE  
DIRECT PUSH  
INJECTION  
VAPOR EXTRACTION  
SPARGING  
REMEDIATION  
OTHER (SPECIFY)

WEST Silverado Trail EAST  
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings,  
Fences, Rivers, etc. and attach a map. Use additional paper if  
necessary. PLEASE BE ACCURATE & COMPLETE.

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER  (ft.) BELOW SURFACE

DEPTH OF STATIC

WATER LEVEL 53 (ft.) & DATE MEASURED 1/24/13

ESTIMATED YIELD 30 (GPM) & TEST TYPE air

TEST LENGTH 17 (Hrs.) TOTAL DRAWDOWN 240 (ft.)

\* May not be representative of a well's long-term yield.

ORIENTATION (✓)		VERTICAL	HORIZONTAL	ANGLE	(SPECIFY)
DEPTH FROM SURFACE		DRILLING METHOD	FLUID	DESCRIPTION	
Ft.	to	FL		Describe material, grain size, color, etc.	
0	20		super gel	topsoil brown clay	
20	60			multicolor rock brown clay	
60	80			white brown gray black rock	
80	100			white ash gray rock	
100	140			brown white red lt green rock	
140	160			gray hard rock	
160	180			frac gray green red rock	
180	200			green gray black white rock	
200	260			gray black frac rock	
CASING CONTINUED					
120	220	9 7/8	Perf	F480	6" 200 factory
220	240	9 7/8	Blank	F480	6" 200
240	260	9 7/8	Perf	F480	6" 200 factory
TOTAL DEPTH OF BORING <u>260</u> (Feet)					
TOTAL DEPTH OF COMPLETED WELL <u>250</u> (Feet)					

DEPTH FROM SURFACE	BORE-HOLE DIA. (Inches)	CASING (S)				
		TYPE (✓)	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
ft.	to ft.	BLANK	SCREEN	CONDUIT	FILL PIPE	
0	33	12 3/4	X	F480	6	200
33	40	9 7/8	X	F480	6	200
40	60	9 7/8	X	F480	6	200 factory
60	80	9 7/8	X	F480	6	200
80	100	9 7/8	X	F480	6	200 factory
100	120	9 7/8	X	F480	6	200

ATTACHMENTS (✓)

Geologic Log  
Well Construction Diagram  
Geophysical Log(s)  
Soil/Water Chemical Analyses  
Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME McLean & Williams, Inc.  
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 878 El Centro Ave., Napa, CA 94558

CITY [REDACTED] STATE [REDACTED] ZIP [REDACTED]

3/22/13

DATE SIGNED

396352

C-57 LICENSE NUMBER

C-57 LICENSED WATER WELL CONTRACTOR

**Attachment 4:**

Well Log

