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Water Use Table and Water Availability Analysis (2015)

P21-00281

WATER USE ESTIMATE CALCULATIONS - PROPOSED UP MOD CONDITIONS

Updated July 2022

	Water Use ac-ft/yr	Notes
Residential Domestic Water Use		
Existing Residence	0.75	Based on Napa County Phase 1 Water Availability Analysis Guidelines (Primary Residence)
Total Residential Domestic Water Use	0.75	
Winery Domestic & Process Water Use		
Winery - Daily Visitors	0.20	Based on 21,840 visitors per year @ 3 gallons per visitor [1]
Winery - Events with Meals Prepared Onsite (Small and Medium)	0.20	Based on 4,392 guests per year @ 15 gallons per guest [2]
Winery - Events with Catered Meals (Large)	0.02	Based on 1,250 guests per year @ 5 gallons per guest [3]
Winery - Employees	0.16	Based on 16 employees @ 0.01 ac-ft/yr per employee per Napa County Phase 1 Water Availability Analysis Guidelines
Winery - Process	1.72	Based on 7 gallons of water per gallon of wine [4] @ 80,000 gallons max production
Total Winery Water Use	2.30	
Existing Office Water Use		
Office Employees	0.04	Based on 4 employees @ 0.01 ac-ft/yr per employee per Napa County Phase 1 Water Availability Analysis Guidelines
Irrigation Water Use		
Landscape	4.00	Estimated for 1 acre of existing and 1 acre of new moderate water use landscaping at 2 ac-ft/ac/yr
Other Agriculture	4.00	1 acre of garden & orchard @ 4 ac-ft/ac/yr
Total Irrigation Water Use	8.00	
Total Combined Water Use	11.09	

[1] 3 gallons of water per visitor is based on project wastewater disposal feasibility report by Applied Civil Engineering.

[2] 15 gallons of water per guest is based on project wastewater disposal feasibility report by Applied Civil Engineering.

[3] 5 gallons of water per guest is based on project wastewater disposal feasibility report by Applied Civil Engineering.

[4] Napa County Phase 1 Water Availability Analysis Guidelines estimate 7 gallons of water per gallon of wine produced.

WATER USE ESTIMATE CALCULATIONS - EXISTING PERMIT CONDITIONS

	Water Use ac-ft/yr	Notes
Residential Domestic Water Use		
Existing Residence	0.75	Based on Napa County Phase 1 Water Availability Analysis Guidelines (Primary Residence)
Total Residential Domestic Water Use	0.75	
Winery Domestic & Process Water Use		
Winery - Daily Visitors	0.23	Based on 24,960 visitors / year @ 3 gallons per visitor [1]
Winery - Events with Meals Prepared Onsite (Small and Medium)	0.10	Based on 2,078 guests per year @ 15 gallons per guest [2]
Winery - Events with Catered Meals (Large)	0.01	Based on 450 guests per year @ 5 gallons per guest [3]
Winery - Employees	0.16	Based on 16 employees @ 0.01 ac-ft/yr per employee per Napa County Phase 1 Water Availability Analysis Guidelines
Winery - Process	1.72	Based on 7 gallons of water per gallon of wine [4] @ 80,000 gallons max production
Total Winery Water Use	2.21	
Existing Office Water Use		
Office Employees	0.04	Based on 4 employees @ 0.01 ac-ft/yr per employee per Napa County Phase 1 Water Availability Analysis Guidelines
Irrigation Water Use		
Landscape	4.00	Estimated for 1 acre of existing and 1 acre of new moderate water use landscaping at 2 ac-ft/ac/yr
Other Agriculture	4.00	1 acre of garden & orchard @ 4 ac-ft/ac/yr
Total Irrigation Water Use	8.00	
Total Combined Water Use	11.00	

[1] 3 gallons of water per visitor is based on project wastewater disposal feasibility report by Applied Civil Engineering.

[2] 15 gallons of water per guest is based on project wastewater disposal feasibility report by Applied Civil Engineering.

[3] 5 gallons of water per guest is based on project wastewater disposal feasibility report by Applied Civil Engineering.

[4] Napa County Phase 1 Water Availability Analysis Guidelines estimate 7 gallons of water per gallon of wine produced.

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CONSULTING ENGINEERS

GROUNDWATER RESOURCES
HYDROLOGY · DEVELOPMENT · MANAGEMENT

Memorandum

DATE: March 19, 2015 PROJECT: 15-1-011

TO: Lee Hudson, Hudsonia, LLC

CC: George Monteverdi, Monteverdi Consulting, LLC

FROM: Vicki Kretsinger Grabert, Reid Bryson, Nick Watterson, P.G.

SUBJECT: **HUDSON VINEYARDS TIER 1 WATER AVAILABILITY ANALYSIS ESTIMATED AVERAGE ANNUAL GROUNDWATER RECHARGE**

INTRODUCTION

This memorandum presents the results of an analysis of estimated average annual groundwater recharge at the Hudson Vineyards parcel, APN 047-070-016, as related to the pending Napa County Use Permit application for winery facilities on this parcel. The project parcel is located in the Carneros groundwater subarea at 5398 Sonoma Highway, Napa, California 94559. The parcel covers approximately 166.8 acres, as reported on the related Water Availability Analysis – Phase One Study dated May 30, 2014.

At the direction of Napa County, the applicant is conducting additional analyses of potential project impacts according to the criteria included in the revised draft Water Availability Analysis Guidance Document (Napa County, 2015). Among the applicable criteria are the Tier 1 Water Usage Criteria requiring a comparison of projected annual water demands with estimated average annual groundwater recharge on the project parcel.

The groundwater recharge analysis presented in this memorandum has been conducted to meet the requirement for providing an estimate of average annual groundwater recharge for project parcels located in certain areas of the county where a water use criterion has not been established by Napa County. Projected annual water demands for the proposed project are being developed by others and are not addressed by this memorandum.

METHODS

Infiltration of precipitation is believed to represent the primary source of groundwater recharge in Napa County (Kunkel and Upson, 1960). MBK Engineers (MBK) previously conducted a water budget analysis to estimate groundwater recharge in the Napa River Watershed, including eight subwatersheds and tributary watersheds (LSCE and MBK, 2013). The MBK water budget analysis incorporated precipitation, streamflow, and land use data from each gauged watershed, along with evapotranspiration data from Napa Valley, to calculate groundwater recharge on a watershed scale. The period of analysis spanned at least 8 years in each watershed and included a range of wet, dry, and normal precipitation year types. The Huichica Creek Watershed, which

includes the Hudson Vineyards parcel, was not included in that analysis due primarily to the lack of continuous streamflow records (LSCE and MBK, 2013). **Figure 1** depicts the location of the Hudson Vineyards parcel and Huichica Creek Watershed as delineated for this memorandum.

In the absence of any prior water budget analysis for the Huichica Creek Watershed, average annual groundwater recharge at the Hudson Vineyards parcel was estimated in two stages. For the first stage, physical characteristics, including land cover and surficial geology, in the Huichica Creek Watershed[1] were compared with individual tributary watersheds included in the analysis by MBK to determine a representative estimate of average annual groundwater recharge as a percent of average annual precipitation. For the second stage, the watershed scale estimate of groundwater recharge was refined using an evaluation of parcel-specific characteristics, including land surface slope and soils characteristics, based on an approach used previously to evaluate recharge potential in a portion of neighboring Sonoma County (Winzler & Kelly Consulting Engineers and LSCE, 2005).

Land cover data for the Huichica Creek Watershed were compiled from the California Department of Water Resources 1999 survey of land use in Napa County (DWR, 1999) along with the Natural Resources Conservation Service 2011 National Land Cover Dataset (NRCS, 2011). Spatial data on surficial geologic units were obtained from the U.S. Geological Survey (Graymer et al., 2007).

Land surface slope data for the Hudson parcel analysis were obtained from high resolution LiDAR[2] digital elevation datasets publically available through the County of Napa Geographic Information System (GIS) Data Catalog. The elevation data were originally mapped at a scale of 1 inch = 200 feet using LiDAR data acquired in 2003. Soils data were obtained from the Natural Resources Conservation Service (NRCS) soil survey for Napa County (NRCS, 2007). The parcel-specific groundwater recharge estimate was calculated using a spatially-continuous average annual precipitation dataset that includes the Hudson Vineyards parcel.

Average annual precipitation data were obtained from the Oregon State University PRISM Climate Group. PRISM precipitation data incorporate a digital elevation model, point measurements of precipitation, and other climatic factors to produce continuous spatially distributed datasets of precipitation. The most recent PRISM long-term average precipitation dataset, spanning the period from 1981 to 2010, was used for this analysis. The data are produced at a grid cell size of 800 meters (2,624 feet) (PRISM Climate Group, 2012).

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[1] For this analysis the Huichica Creek Watershed was delineated as the catchment area upstream of a point on Huichica Creek below the confluence with the unnamed tributary flowing through the Hudson Vineyards parcel.
[2] Light Detection and Ranging (LiDAR) is a remote sensing method for high resolution elevation mapping where data are collected by an airborne light-emitting sensor paired with a Global Positioning System (GPS) sensor.

ANALYSIS

Average annual groundwater recharge for the Hudson Vineyards parcel was calculated as a percentage of average annual precipitation on the parcel. **Figure 2** depicts the distribution of average annual precipitation at the parcel. The area-weighted mean annual precipitation for the period from 1981 to 2010 for the Hudson Vineyards parcel is 29.54 inches, with an area-weighted average annual volume of 410.5 acre-feet per year (AF/yr).

Land cover data for the Huichica Creek Watershed and other Napa River tributary watershed are summarized in **Table 1**. DWR land use survey data were referenced for determination of the agricultural land uses in the Huichica Creek Watershed, while NRCS land cover data were referenced for determining acreages for developed land and different types of native vegetation. This approach is consistent with the approach used for land use determinations presented in LSCE and MBK (2013). As with the other tributary watersheds, native vegetation and comprises the majority of the watershed area in the Huichica Creek Watershed. The percentages of native vegetation and agricultural acreages in the Huichica Creek Watershed, 76 percent and 20 percent respectively, are most similar to those of the Redwood Creek Watershed, 84 percent and 13 percent respectively.

Previous research has found that geology can also affect recharge potential in coastal California groundwater systems (Muir and Johnson, 1979). Surficial geologic units with the greatest groundwater recharge potential were previously identified by LSCE (2011). **Table 2** summarizes the occurrence of these formations within the Huichica Creek Watershed and other Napa River tributary watersheds. The Huichica Creek Watershed contains a percentage of geologic units with greatest recharge potential, 32 percent, similar to those of the Napa Creek and Milliken Creek Watersheds, 28 percent and 27 percent respectively. Comparing the distribution of geologic units listed for the latter two watersheds, and assuming that similar geologic units present similar recharge potential across different watersheds, the Huichica Creek Watershed is most similar to the Napa Creek watershed, with a more even proportion of Quaternary units to Sonoma Volcanics units.

Based on similarities in land cover and geologic formations, the Redwood Creek and Napa Creek watersheds were determined to be most comparable to the Huichica Creek Watershed. The water balance calculations presented in LSCE and MBK (2013) found average annual groundwater recharge to be 10 percent and 11 percent of average annual precipitation for the Redwood Creek and Napa Creek watersheds, respectively. For this analysis, the value for the Redwood Creek Watershed, 10 percent, was chosen based on the similarities in land cover, which was an explicit component of the water budget analysis performed by MBK (LSCE and MBK, 2013).

Surface slopes on the Hudson Vineyards parcel were reviewed for their potential to affect groundwater recharge. Three slope classes were considered based on previous work for a characterization of groundwater recharge potential in Sonoma County (Winzler & Kelly Consulting Engineers and LSCE, 2005). Surface slopes on the Hudson Vineyards parcel are generally low to moderate, favoring infiltration of precipitation, with only 3 percent of the parcel having slopes greater than 25 percent (**Table 3 and Figure 3**). Mean surface slopes were also

calculated for comparison between the Hudson Vineyards parcel and the watersheds of Huichica Creek, Redwood Creek, and Napa Creek. Mean surface slope for the Hudson Vineyards parcel is 9.78 percent, while the mean slope for the Huichica Creek Watershed is 21.88 percent. The Redwood Creek and Napa Creek Watersheds have mean slopes of 34.96 percent and 30.90 percent, respectively. The lower mean slope for the Hudson Vineyards parcel indicates that surface slopes do not limit infiltration potential on the parcel. However, in order to reduce the likelihood of over estimating groundwater recharge for this analysis, the parcel acreage with slopes greater than 25 percent are not included in the calculation of estimated recharge.

Soils on the parcel have relatively moderate to high vertical hydraulic conductivities that allow infiltration of precipitation (**Table 3 and Figure 3**). The representative vertical soil hydraulic conductivity values on the Hudson Vineyards parcel range from 0.48 cm/hr to 9.1 cm/hr (NRCS, 2007). These values are greater than the 0.33 cm/hr peak rate of precipitation reported in the Napa County Baseline Data Report for the period from 1993 to 2005 at the California Information Management System's Carneros meteorological station (Station 109), located 3 miles southeast of the Hudson Vineyards parcel (Jones and Stokes Associates & EDAW, 2005). Thus, the saturated hydraulic conductivity of soils located on the parcel are not considered to be a limiting factor for the purposes of estimating average annual groundwater recharge on the parcel.

After excluding portions of the parcel with slopes greater than 25 percent, the average annual groundwater recharge on the parcel is estimated to be 39.6 AF/yr (**Table 4**). This amount is equivalent to 10 percent of the area-weighted average annual precipitation for the 97 percent of the parcel with low to moderate surface slopes.

RESULTS AND CONCLUSIONS

Limited available data, in particular continuous streamflow data, for the Huichica Creek Watershed precluded prior development of a water balance analysis of average annual groundwater recharge. However, geologic formations and land cover in the Huichica Creek Watershed are comparable to the Redwood Creek Watershed where prior analysis has calculated that 10 percent of annual precipitation becomes groundwater recharge on an average annual basis.

Area-weighted average annual precipitation on the Hudson Vineyards parcel was 29.54 inches, or 410.5 AF/yr, from 1981 – 2010. After accounting for vertical saturated hydraulic conductivity of soils on the parcel and excluding portions of the parcel where slopes may limit infiltration of precipitation, average annual groundwater recharge on the Hudson Vineyards parcel is estimated to be 2.95 inches, or 39.6 AF/yr.

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Table 1: Land Cover as Percent of Total Watershed Acreage

Land Cover Class[1]	Huichica Creek	Redwood Creek	Napa Creek	Dry Creek	Milliken Creek	Tulucay Creek
Evergreen Forest (NV)	2.4%	36.6%	25.3%	57.1%	3.8%	6.1%
Shrub/Scrub (NV)	21.7%	16.4%	13.3%	21.0%	62.4%	19.8%
Mixed Forest (NV)	12.0%	17.3%	16.3%	9.5%	8.5%	22.0%
Grassland/ Herbaceous (NV)	35.7%	7.6%	13.1%	3.7%	9.6%	17.5%
Woody Wetlands (NV)	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%
Emergent Herbaceous Wetlands (NV)	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Deciduous Forest (NV)	3.5%	5.7%	5.3%	2.4%	1.5%	1.4%
Developed, Open Space	2.2%	2.6%	3.8%	2.8%	3.9%	9.7%
Developed (Low and Med. Intensity)	1.2%	0.8%	11.5%	0.6%	5.8%	12.9%
Idle (Barren Land)	0.1%	0.1%	0.1%	0.2%	0.1%	2.6%
Vineyard (Ag)	19.9%	12.8%	11.2%	2.7%	3.0%	5.6%
Deciduous Fruit (Ag)	0.0%	0.1%	0.1%	0.1%	0.0%	0.2%
Pasture (Ag)	0.0%	0.0%	0.0%	0.0%	0.2%	0.5%
Grain and Hay Crops (Ag)	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Almonds (Ag)	0.0%	0.0%	0.0%	0.0%	0.3%	1.0%
Citrus and Subtropical (Ag)	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Fallow/Idle	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%
Open Water	0.6%	0.0%	0.0%	0.0%	0.5%	0.1%
Total Watershed Acreage	3,141	6,429	9,883	11,152	11,112	8,050
Native Vegetation Land Cover as a Percent of Total Watershed	**76%**	**84%**	73%	94%	86%	67%
Agriculture Land Cover as a Percent of Total Watershed	**20%**	**13%**	11%	3%	4%	7%
Sum of Native Vegetation and Agricultural Percentages	**96%**	**97%**	85%	96%	90%	74%

1 Land cover acreages are a synthesis of data from DWR (1999) and NRCS (2011) as described in the text and in LSCE and MBK (2013).

(NV) denotes Native Vegetation classes.

(Ag) denotes Agricultural classes.

Table 2: Geologic Units of Greatest Recharge Potential, by Acreage

Geologic Formation	Huichica Creek	Redwood Creek	Napa Creek	Dry Creek	Milliken Creek	Tulucay Creek
Quaternary Alluvium	404	0	7	112	105	771
Quaternary Alluvium (Holocene)	0	69	302	0	216	125
Quaternary Channel Deposits	10	25	110	78	23	44
Quaternary Alluvial Fan Deposits	0	0	622	0	170	0
Quaternary Napa Valley Alluvium (Undiff.)	0	75	571	7	46	2507
Sonoma Volcanics Sediment	0	0	0	0	640	0
Sonoma Volcanics Tuff	600	1056	1190	91	1747	438
Total Acreage of Geologic Units of Greatest Recharge Potential	1015	1225	2802	288	2947	3885
Total Watershed Acreage	3,141	6,429	9,883	11,152	11,112	8,050
Geologic Units of Greatest Recharge Potential as a Percent of Total Watershed	**32%**	19%	**28%**	3%	**27%**	48%
Quaternary Units as a Percent of Potential Recharge Units	**41%**	14%	**58%**	68%	19%	89%
Sonoma Volcanics Units as a Percent of Potential Recharge Units	**59%**	86%	**42%**	32%	81%	11%

Table 3: Hudson Vineyards Parcel Acreage by Soil and Slope Characteristics

Representative Saturated Vertical Hydraulic Conductivity, Ksat (cm/hr)[1]	Slope class (percent)			Total Acres
	< 15%	15% - 25%	> 25%	
< 1.0	132.1	10.4	1.1	143.6
1.0 - 5.0	1.4	0.1	0.0	1.5
> 5.0	6.6	10.5	4.6	21.7
Total Acres	140.1	21.0	5.7	166.8

1 Representative saturated vertical hydraulic conductivity values for the dominant soil component in each map unit were calculated for this analysis by the NRCS Soil Data Viewer GIS utility.

Table 4: Hudson Vineyards Parcel Average Annual Precipitation (1981 - 2010) and Estimated Average Annual Groundwater Recharge (AF/yr)

	Slope class (percent)			Total AF/yr
	< 15%	15% - 25%	> 25%	
Average Annual Precipitation	343.2	52.9	14.4	**410.5**
Estimated Average Annual Groundwater Recharge	34.3	5.3	-	**39.6**

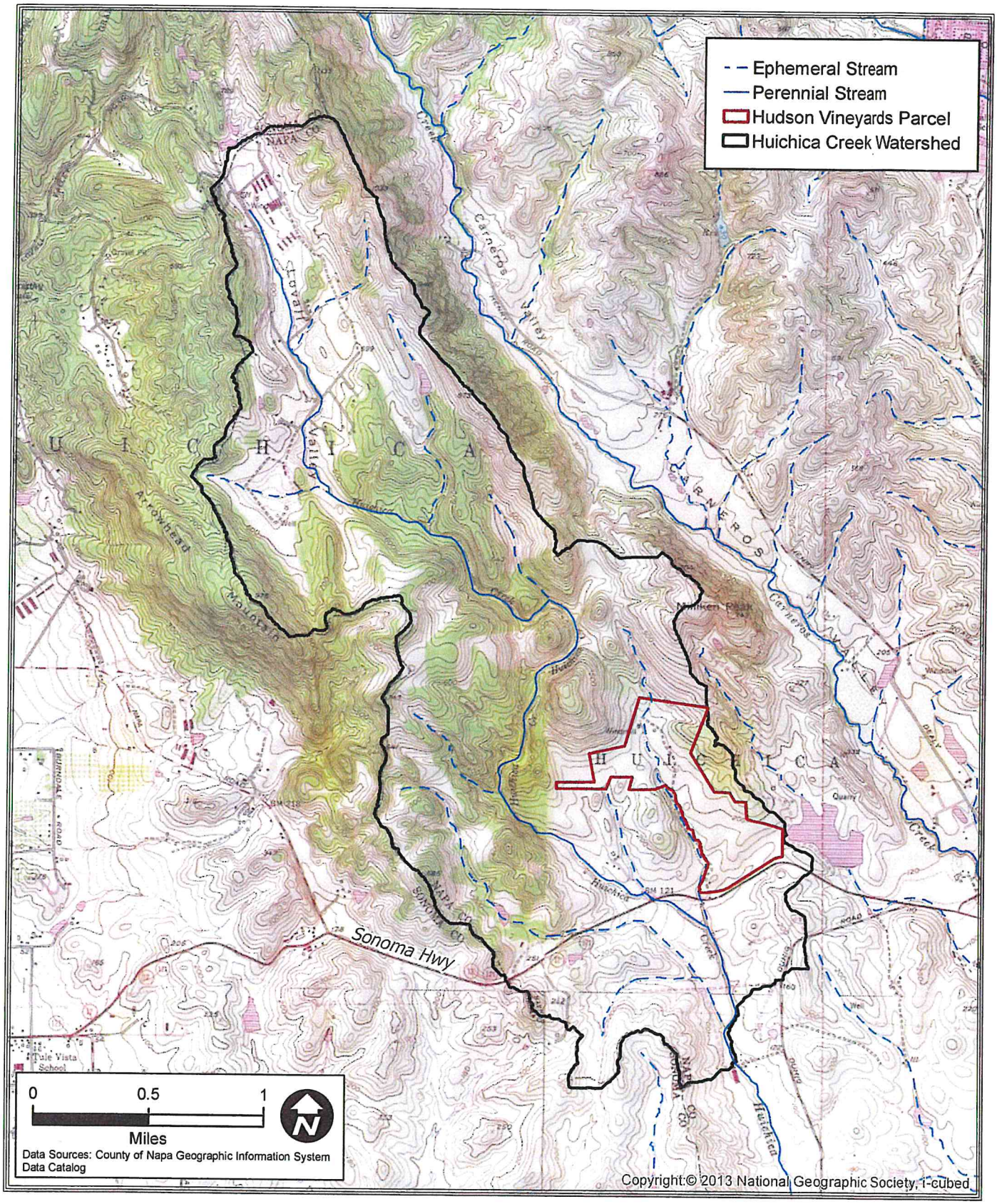

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Figure 1
Hudson Vineyards Parcel and Vicinity

Hudson Vineyards Tier 1 Water Availability Analysis

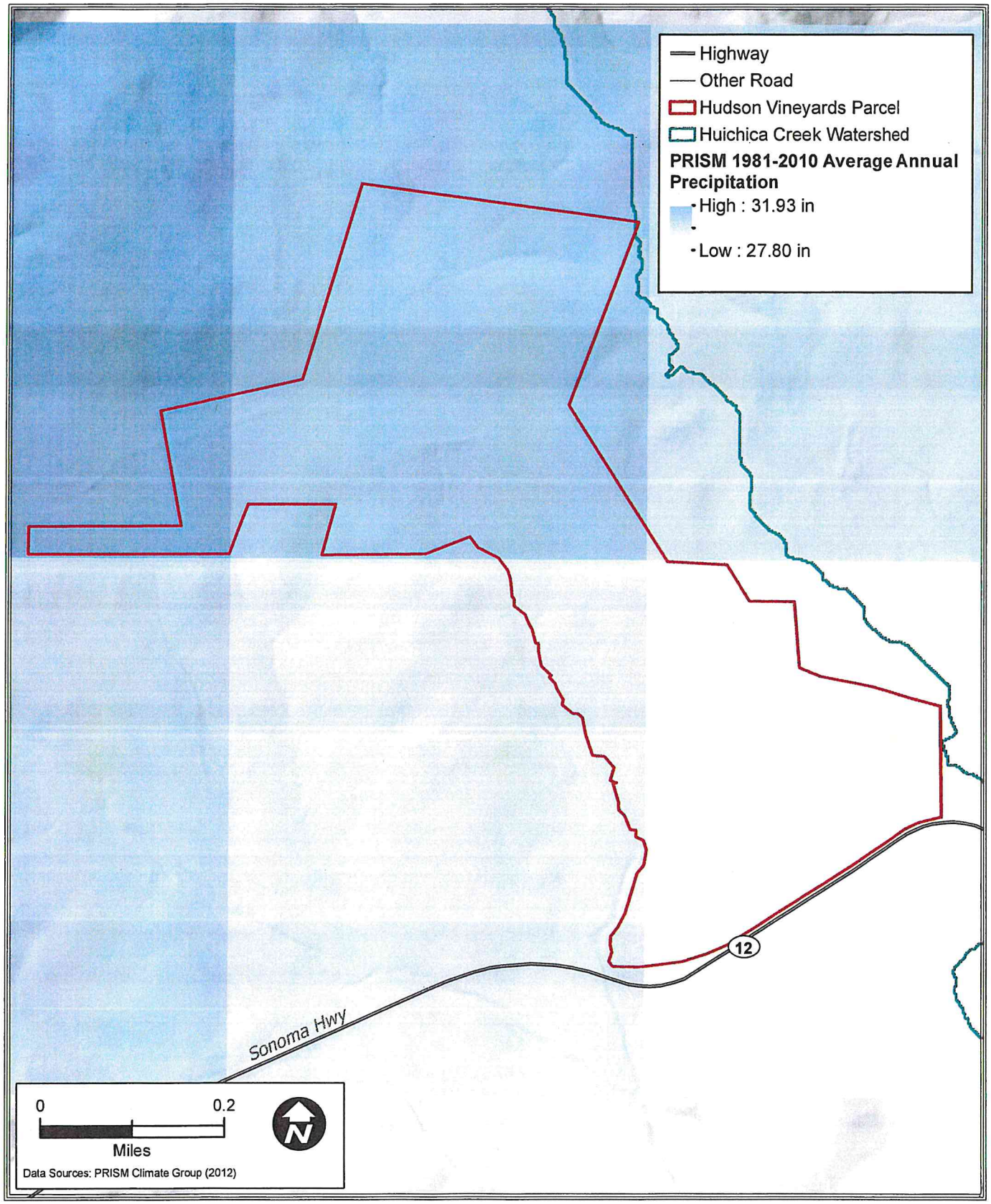

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Figure 2
PRISM Average Annual Precipitation (1981 - 2010)
Hudson Vineyards Tier 1 Water Availability Analysis

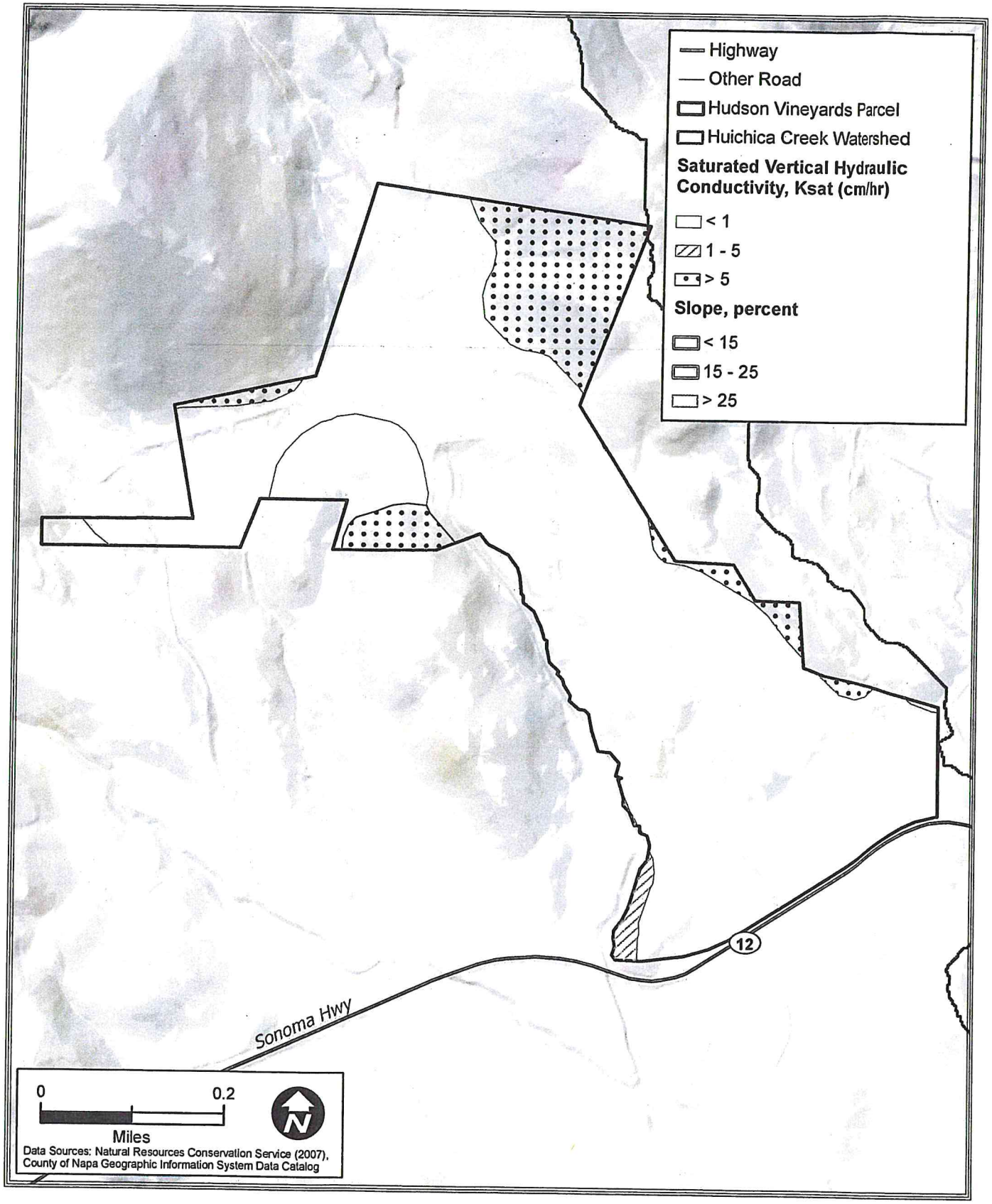

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Figure 3
Soil Hydraulic Conductivity and Surface Slope
Hudson Vineyards Tier 1 Water Availability Analysis