KJS AND SORRENTO VINEYARD CONVERSION EROSION CONTROL PLAN APPLICATION #P17-00432-ECPA

Final Environmental Impact Report Appendices
State Clearinghouse #2018092042

Lead Agency
Napa County Department of Planning, Building and Environmental Services
1195 Third Street, Suite 210
Napa, CA 94559

March 2023

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171261

Appendix A

KJS and Sorrento Emergency Action Plan

SOMERSTON
ESTATE
NAPA VALLEY

1.01.2022

Re: Updated Emergency Action Protocols for Somerston Estate

To all Somerston Estate and Somerston Wine Company employees.

In the event of an emergency at Somerston Estate, the following protocols are to be followed:

In the event of a medical emergency:

- Communicate the type of emergency over the radio or if you have cell coverage call 911
- Notify your supervisor and management of the incident, they will call 911
- Employees will be directed to both the west and east gate to direct EMS to the exact location of the incident
- If evacuation is required due to employee and or resident's safety, leave the estate as soon as possible in the opposite of potential danger
- Please ask your supervisor if you have any questions on what action to take

By signing, I acknowledge that I have read the Company's Policy's and that I understand and agree to comply with them.

__________________________________ ______________
Employee Date

Appendix B

Water Use (2015-2021) for Existing Vineyard

Summary of Hyperion Investments (KJS and Sorrento) Water Use
2015 - 2021

Year	Water Use in Acre-Feet (AF)
2015	23.4 AF
2016	23.9 AF
2017	N/A*
2018	29.7 AF
2019	23.2 AF
2020	10.4 AF
2021	0 AF

*Records for 2017 do not exist

2015 - 2021 Hyperion Investments (KJS and Sorrento) Water Use by Block

BLOCK	ZONE ACRES	2015 Total AF used for Irrigation	2016 Total AF used for Irrigation	2018 Total AF used for Irrigation	2019 Total AF used for Irrigation	2020 Total AF used for Irrigation	2021 Total AF used for Irrigation
1	1.14	0.13					-
2	0.92	0.13	0.02	0.04			-
3	8.50	1.87		1.90	1.53	0.28	-
4	8.55	1.40	0.28	0.22	0.45		-
5	1.88	0.29	0.06	0.11	0.03		-
6	2.03	0.26	0.03	0.03			-
7	2.69	0.33	0.04	0.14			-
8	0.95	0.16	0.62	0.51	0.49	0.24	-
8a	0.99	0.17	0.65	0.57	0.46	0.31	-
8b	1.16	0.20	0.76	0.62	0.54	0.37	-
9	0.71	0.10	0.48	0.42	0.36	0.22	-
10	1.01	0.11	0.60	0.50	0.43	0.26	-
11	0.55	0.08	0.37	0.34	0.28	0.17	-
11a	0.56	0.08	0.38	0.34	0.21	0.18	-
11b	0.73	0.14	0.49	0.45	0.28	0.21	
12	0.93		0.26	0.46	0.38	0.22	-
12a	0.92	0.15	0.52	0.46	0.39	0.20	-
13	0.80	0.08	0.45	0.40	0.33	0.16	-
13a	1.01	0.16	0.57	0.50	0.44	0.22	-
14	1.12	0.11	0.59	0.56	0.46	0.22	-
14a	0.78	0.13	0.43	0.39	0.33	0.17	-
20	2.23	0.82	0.35	0.48	0.28	0.20	-
20A	0.83	0.34	1.15	0.72	0.84	0.36	-
21	0.50	0.14	0.46	0.17	0.34	0.06	-
22	0.21	0.05	0.08	0.05	0.11	0.05	-
23	1.43	0.35	0.03	0.02	0.02	0.02	-
24	4.22		0.23	0.15	0.17	0.14	-
25	1.99		0.33	0.99	0.48	0.26	-
26	1.40		0.88	2.81	1.36	0.93	-
30	1.04	0.48	0.27	0.87	0.41	0.29	-
31	0.33	0.15	0.47	0.32	0.50	0.20	-
32	0.88	0.46	0.15	0.12	0.15	0.08	-
33	0.89	0.46	0.39	0.30	0.39	0.17	-
34	0.88	0.46	0.41	0.33	0.40	0.22	-
35	0.99	0.51	0.39	0.30	0.39	0.17	-
36	0.93	0.45	0.45	0.36	0.44	0.24	-
37	1.52	0.73	0.41	0.49	0.41	0.18	-
38	2.07	1.19	0.67	0.81	0.68	0.37	-
39	1.10	0.61	0.56	0.49	0.51	0.25	-
40	0.74	0.20	0.56	0.44	0.55	0.28	-
41	0.67	0.14	0.28	1.00	0.47	0.49	-
42	1.52	0.09	0.35	0.93	0.50	0.45	-

2015 - 2021 Hyperion Investments (KJS and Sorrento) Water Use by Block

BLOCK	ZONE ACRES	2015 Total AF used for Irrigation	2016 Total AF used for Irrigation	2018 Total AF used for Irrigation	2019 Total AF used for Irrigation	2020 Total AF used for Irrigation	2021 Total AF used for Irrigation
50	1.05	0.30	0.13	0.48	0.22	0.14	-
51	3.49	0.51	0.29		0.20		-
51		0.18	0.24	0.21	0.07		-
52	2.50	0.42	0.38	1.32	0.51	0.10	-
53	0.50	0.12	0.28	1.14	0.43	0.04	-
53A	1.07	0.11	0.21	0.07	0.20	0.11	-
54	0.51	0.09	0.05	0.04	0.14	0.07	-
54		0.06	0.34	0.16	0.31	0.18	-
55	1.27	0.20	0.08	0.06	0.22	0.11	-
55		0.12	0.09	0.08	0.12	0.09	-
56	1.99	0.19	0.04	0.03	0.12	0.06	-
56		0.11	0.11	0.32	0.45	0.36	-
57	1.07	0.11	0.17	0.12	0.46	0.23	-
57		0.04	-	-	-	-	-
58		0.38	-	-	-	-	-
58	4.22	0.56	-	-	-	-	-
	Irrigation	**17.2**	**18.9**	**25.2**	**20.2**	**10.4**	-
	Frost	**6.2**	**5.0**	**4.5**	**3.0**		-
Total Water Usage		**23.4**	**23.9**	**29.7**	**23.2**	**10.4**	**Zero***

*Due to drought conditions, no water available in 2021

2015 - 2021 Hyperion Investments (KJS and Sorrento) Frost Protection

Frost Report 2015 * Based on 50 gpm per acre for overhead frost protection

DATE:	Acres	DURATION OF SPINKLERS:	Acre feet used*	Source
4/1/2015	25.5	3.75	0.9	Matheson
4/3/2015	30.85	2.5	0.7	Matheson
4/4/2015	20.46	3.5	0.7	Matheson
4/6/2015	50	5	2.3	Matheson
4/8/2015	50	3.5	1.6	Matheson
	Total AF used for Frost Protection		**6.163**	

Frost Report 2016

DATE:	Acres	DURATION OF SPINKLERS:	Acre feet used*	Source
3/28/2016	37.5	1.5	0.5	Matheson
3/29/2016	37.5	7	2.4	Matheson
3/30/2016	37.5	6	2.1	Matheson
	Total AF used for Frost Protection		**5.006**	

Frost Report 2018

DATE:	Acres	DURATION OF SPINKLERS:	Acre feet used*	Source
4/1/2017	37.5	2	0.7	Matheson
4/2/2017	37.5	5	1.7	Matheson
4/3/2017	37.5	6	2.1	Matheson
	Total AF used for Frost Protection		**4.488**	

Frost Report 2019

DATE:	Acres	DURATION OF SPINKLERS (hrs.):	Acre feet used*	Source
4/17/2018	51	4	1.878	Matheson
4/19/2018	51	2.3	1.080	Matheson
	Total AF used for Frost Protection		**2.958**	

Frost Report 2020

DATE:	Acres	DURATION OF SPINKLERS (hrs.):	Acre feet used*	Source
	Total AF used for Frost Protection		**No Use**	

Frost Report 2021

DATE:	Acres	DURATION OF SPINKLERS (hrs.):	Acre feet used*	Source
	Total AF used for Frost Protection		**No Use**	

Appendix C
Water Availability

Buchalter

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415.227.0900 Phone
415.227.0770 Fax

File Number: T5162-0021
415.227.3508 Direct
aguerra@buchalter.com

November 2, 2022

VIA E-MAIL

Chris Apallas
Deputy County Counsel
Napa County
1195 Third Street, Room 210
Napa, CA 94559

Re: KJS & Sorrento Erosion Control Plan (ECP) #P17-00432-ECPA

Dear Chris,

Napa County staff requested that we confirm that the KJS &Sorrento ECP Project is designed to avoid a significant impact to water availability in order to assist the County in addressing specific comments on the KJS & Sorrento Draft Environmental Impact Report (Draft EIR). We sent you and Don Barrella information on October 14, 2022 explaining the proposed vineyard planting and phasing plan addressed in the Draft EIR, as further clarified in the information the KJS team previously provided for the County's consideration ("October 14 Letter"). As we previously explained, KJS uses surface water based on the rights it holds to the surface water granted by the State Water Resources Control Board ("Water Board")[1]. KJS does not use groundwater. KJS has no other alternative water source because the surface water supply satisfies the ECP's long-term demand.

You also asked me to explain whether KJS water is "paper water" as discussed in the *Vineyard Area Citizens v. City of Rancho Cordova* (2007) case. Staff has requested confirmation that the actual water granted under the water licenses/permits is "reasonably likely to prove available." You asked that Wagner & Bonsignore explain whether the water needed to get the additional vineyard blocks up and running will be available, and reasonably likely to be available for the next 10 to15 years. The Water Board made a finding of water availability when it issued the original Permit 18459 in accordance with California Water Code section 1375[2].

---

[1] KJS has a license and two permits granted by the Water Board (License 9125 (A013943), Permit 18459 (A026165), and Permit 18282 (A026179)) as further discussed in the Draft EIR.
[2] Before the Water Board issues a permit, it must make certain findings including: (d) There must be unappropriated water available to supply the applicant.'

The purpose of this letter is to forward information from Wagner and Bonsignore explaining that the water supply represents an actual water supply based on KJS & Somerston's water rights permits (see **Exhibit 1**). KJS has been farming based on diversions under its approved surface water rights since it planted its first vineyard blocks as described in the October 14 Letter. The Draft EIR, as further clarified in Exhibit 1 discusses how much water the new KJS-Somerston vineyards will use; where that water will come from; and what the impacts will be using that supply.

With respect to the question you raised regarding how KJS-Somerston's proposed planting plan differs from the circumstances in the *Vineyard Area Citizens* v. City of Rancho Cordova (2007) case, the most important distinction is that KJS is proposing to use an actual water supply it has, and always has had, under its water rights. The proposed strategy for vineyard planting in KJS-Somerston's ECP project differs from the issue evaluated in the *Vineyard Area Citizens* case, and that case does not apply here. In that 2007 case, the court found that the defective EIR did not adequately evaluate future sources of water for a master planned community when no water would be available for *future* phases of the residential project that the City approved. (40 Cal.4th 412, 419.) Here, the Project need not make such an evaluation because the vineyard expansion project in this case simply will not require water when no water is available. In other words, KJS-Somerston will not water its vines in the absence of the available surface water it has the permitted right to use. Nevertheless, when water *is* available, KJS retains the right under its water rights to divert the surface water to which it is entitled. We demonstrated this strategy based on records of actual historical water use for the existing vineyards as shown in the clarifying information we submitted to the County in March 2022 and again in October 2022.

Another important distinction between the project in the *Vineyard Area Citizens* case and KJS-Somerston's proposed Project is that CEQA treats these projects differently. Senate Bill (SB) 610 requires that a public agency evaluate whether a residential project of a certain size provide an adequate water supply during normal rainfall and drought year conditions for the project and a 25 year condition. SB 610 does not apply to agricultural crops and farming.

Moreover, several cases establish a permittee's right to divert surface water, at least when water is available. For example, in *Environmental Defense Fund v. East Bay Municipal Utility District* (1980), the court there explained that a permit provides a "right to take and use water" to the extent and for the purposes granted as specified in the permit. (26 Cal.3d 183, 197.) The "granting of the permit" gives the permittee the right to take and use the amount of water specified in the permit." (*California Trout, Inc. v. State Water Resources Control Board* (1989) 207 Cal.App.3d 585, 612.) A permittee has the "vested rights to the reasonable use of water." (*Imperial Irrigation District v. State Water Resources Control Board* (1990) 225 Cal.App.3d 548, 563-64.)

These cases clearly demonstrate that a water right vests a permittee's right to appropriate that water, subject to constitutional and statutory public interest and reasonable use limitations. Here, because KJS possesses a right to utilize 85 acre feet per year of water under its License 9125, and because they have applied the use of water consistent with the terms of the license, that right has vested. When this licensed surface water is not available, as in an exceptionally dry year, KJS has not planted vines in the existing vineyard blocks. Similarly, KJS will not plant new vines in the new vineyard blocks when water is not available. If that happens and the vines are planted, KJS will dry farm the vineyards so that they will not need to use any water to sustain the vines. Thus, no alternative long-term analysis of water availability is required because KJS-Somerston's water rights provide an adequate water supply that properly managed, would be available for the existing vineyard and the expansion.

KJS-Somerston does not rely, nor does it propose to rely in the future on a groundwater supply for vineyard planting. KJS-Somerston's water for vineyard activities is diverted under KJS-Somerston's water rights permits as explained in the application materials we submitted to the County. Moreover, Permit 18459 would be limited to the quantity that could be beneficially used and would not exceed 48 acre-feet per year by storage collected from December 15 of each year to March 31 of the succeeding year as discussed in the EIR. All of the State Water Board permit provisions are included in the proposed project evaluated in the Draft EIR.

Based on the analysis contained in the EIR, as further clarified in the Wagner & Bonsignore letter, KJS-Somerston has incorporated measures into the project design and phasing of the ECP to assure that planting of the additional vineyard blocks included in the proposed ECP would occur only when water is available for planting the additional vineyard blocks. In this way, the proposed Project is self-mitigating and would avoid any water supply related impacts associated with existing drought conditions. KJS-Somerston has designed the Project to ensure that an adequate water supply is available for its vineyard expansion. This approach differs from the approach in the *Vineyard Area Citizens v. City of Rancho Cordova* case as explained above in accordance with CEQA.

Please let us know if you have any questions or need further assistance. We appreciate your consideration of KJS commitment to sustainable farming practices.

Regards,

BUCHALTER
A Professional Corporation

Alicia Guerra
Shareholder

AG:vs

cc: Don Barrella
Craig Becker
Nick Bonsignore
Jim Bushey
Annalee Sanborn

Appendix D
Water Supply Reliability

Wagner&Bonsignore
Consulting Civil Engineers, A Corporation

Nicholas F. Bonsignore, P.E.
Robert C. Wagner, P.E.
Paula J. Whealen

Martin Berber, P.E.
Patrick W. Ervin, P.E.
David P. Lounsbury, P.E.
Vincent Maples, P.E.
Leah Orloff, Ph.D, P.E.
David H. Peterson, C.E.G., C.H.G.
Ryan E. Stolfus

November 2, 2022
(via email)

Mr. Don Barrella
Napa County Department of Planning, Building & Environmental Services
Engineering and Conservation Division
1195 Third St. #210
Napa CA 94559

Re: Final Environmental Impact Report (EIR) for KJS & Sorrento Erosion Control Plan (ECP) #P17-00432-ECPA

Dear Mr. Barrella:

This responds to your email of October 19, 2022 to Alicia Guerra regarding the reliability of the source of water to support development of new vineyard for the project described in the subject Draft Environmental Impact Report (Draft EIR).

The source of water and an analysis of water availability for the project was described in Wagner & Bonsignore's memorandum to you dated February 19, 2020 (2020 WAA). To summarize the information we provided the County to include in the Draft EIR, the applicant (KJS) proposes to construct a 48-acre-foot offstream reservoir on the property (the KJS Reservoir). The KJS Reservoir would be filled by gravity diversions from Elder Creek upstream of the applicant's licensed Lake Matheson reservoir. Diversions would be authorized under the applicant's existing water right Permit 18459 (Application 26165). Permit 18459 presently allows for the diversion of water to a proposed onstream reservoir on Elder Creek. The applicant filed a Petition for Change with the State Water Resources Control Board, Division of Water Rights (SWRCB) to allow for the diversion to offstream storage at the proposed KJS Reservoir. The Permit allows a diversion season of November 1 of each year to April 30 of the succeeding year.

As described in the 2020 WAA, we prepared a daily operational analysis for a substantial portion of the Sage Creek watershed above Lake Hennessey. The purpose of the daily operational analysis was to compare estimated natural water supply with estimated water demand to assess the availability of water for the project. The estimated natural supply was based on historical daily flow data for a gaging station on Conn Creek over 16-year hydrologic period (Water Years 1930 to 1945) that predated the construction of Conn Dam and Lake Hennessey. Reliance on hydrologic data for a historical period is a commonly used approach to assessing future water availability.

Based on regional precipitation records, average annual precipitation during this 16-year study period was similar to the long term average (over 100 years) and captured a range of hydrologic year-types including drought years. In addition to the absence of Conn Dam, the level of development during this period was likely less, if not much less, than today, and thus this dataset provides a reasonable estimate of natural (unimpaired) flow. The daily gaged data was adjusted to model unimpaired flow at the project points of diversion (POD) as well as at the PODs for all senior water rights of record within the subject watershed.

On the demand side, the analysis assumed that all senior water right holders would divert the full face value of their rights (if water were available at their PODs), including diversions under the applicant's own senior rights. For senior storage rights the analysis assumed that all reservoirs were empty at the start of their diversion season and would divert to the full amount allowed by the right if water were available. This is a conservative assumption because most storage right holders do not empty their reservoirs every year and hence do not divert the full face value of their right every year. In addition, the analysis imposed operational limitations on diversions under Permit 18459 that were requested by the California Department of Fish & Wildlife for environmental protection, including a minimum bypass flow at the PODs equal to the February median flow, and a maximum rate of diversion to offstream storage.

The 2020 WAA concluded that over the 16-year hydrologic study period the full face value of Permit 18459 (48 acre-feet) would be available in five of the 16 years. The average annual diversion amount over the 16-year study period was computed to be 28.4 acre-feet. With reference to PPI Engineering's memorandum to you of November 12, 2021 (PPI memo), the computed average annual availability is similar to the estimated annual demand associated with establishment of a new planting phase (28.2 acre-feet).

With regard to reliability, the analysis evaluates wet season water supply available for diversion on a year to year basis. It assumes that the KJS Reservoir is empty at the start of each diversion season and collects water to storage to the extent that water is available and there is storage space in the reservoir. In reality, there will be years when stored water is carried over after irrigation ceases and the full amount of Permit 18459 will not be required to be diverted in the ensuing diversion season to achieve a full reservoir. For example, in Year 2 of the proposed phased development, water demand is estimated to be 28.2 acre-feet (PPI memo). If the KJS Reservoir were full going into the irrigation season, it would not be empty at the end of the irrigation season, and less than 48 acre-feet would be required to completely replenish the reservoir in the ensuing diversion season.

Per the PPI memo, annual water use over the course of the 6-year development plan varies. In Years 3 through 5, annual water use is estimated to be 56 acre-feet, which is more than the full capacity of the KJS Reservoir. However, the applicant's Lake Matheson reservoir is available to make up the balance of supply needed. Lake Matheson impounds 90 acre-feet and is licensed for 85 acre-feet of annual withdrawal; per the PPI memo, the average annual water demand for the existing vineyard presently supported by Lake Matheson is only 22.1 acre-feet. In Year 7, the estimated annual water demand for the new vineyard levels out at about 8.8 acre-feet; this is only 18 percent of the face value of Permit 18459 and about 31 percent of the estimated average annual supply. Collectively, starting in Year 7, the combined demand for the existing and new vineyard will be about 31 acre-feet (22.1 + 8.8). This will be supported by 138 acre-feet of stored water capacity (90 acre-feet in Lake Matheson and 48 acre-feet in the KJS reservoir).

Lastly, the term "water supply reliability" is a relative term and depends on the situation. For municipal supply, a very conservative approach should be used to ensure a minimum supply is available for human health and safety during drought periods. For agricultural projects there can be more flexibility. In the case of annual crops, a farmer can plant crops with a lower water demand or avoid planting a crop altogether. For permanent crops, such as vineyards, new planting can be delayed, just as KJS does with its existing vineyard operations, and crop management measures can be employed for existing vineyards to minimize water use.

Ultimately, and notwithstanding the discussion above, the implementation of development of the new vineyard will be a management decision. It would be contrary to the applicant's financial interest to plant new vineyard if there is uncertainty about the forecasted sufficiency of water supply to support it over the development timeline.

Very truly yours,

WAGNER & BONSIGNORE
CONSULTING CIVIL ENGINEERS

Nicholas F. Bonsignore, P.E.

Encl.

cc (via email): Craig Becker
Alicia Guerra
Jim Bushey
Annalee Sanborn

Via: email

Wagner&Bonsignore
Consulting Civil Engineers, A Corporation

Nicholas F. Bonsignore, P.E.
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David H. Peterson, C.E.G., C.H.G.
Ryan E. Stolfus

MEMORANDUM
(via email)

To: Don Barrella, County of Napa

From: Nicholas F. Bonsignore, P.E.

Date: January 14, 2023

Re: **KJS & Sorrento Erosion Control Plan (ECP) #P17-00432-ECPA**

This memorandum follows up on the discussion during our conference call of January 11, 2023, regarding the hydrologic analysis for the subject project. The analysis was presented in my memo dated February 19, 2020 (2020 Analysis). My letter of November 2, 2022 (2022 Letter) addressed County staff's questions about water supply reliability for the project.

To recap, the 2020 Analysis relied on adjustment of historical streamflow gage data for a gaging station on Conn Creek below Conn Dam. A 16-year period of gage data for Water Years 1930 to 1945 was selected for the analysis because it predated the existence of Conn Dam and therefore was representative of natural, unimpaired flow for a range of water year types. This unimpaired flow data set was then used as the basis to evaluate water availability for the project, i.e., yield, after considering the effects of all senior diverters of record within the portion of the Sage Creek watershed analyzed. The State Water Resources Control Board, Division of Water Rights (SWRCB) reviewed the 2020 Analysis. SWRCB staff acknowledged that the analysis evaluated certain metrics of concern to CDFW and did not have any objections or request any revisions to the analysis.

During our January 11 conference call County staff requested information supporting my comment in the 2022 Letter that hydrologic conditions over the 16-year study period were representative of long-term conditions. County staff also expressed concern as to whether recent hydrologic conditions have changed relative to those existing during the 16-year study period. My response to the County's concerns are discussed immediately below. Following our conference call, you sent an email requesting consideration of PRISM data for use in the weighted mean annual precipitation calculation in our 2020 Analysis. Our evaluation of the PRISM data is discussed later herein.

Historical vs. Recent Hydrologic Conditions

In my 2022 Letter, I stated that average annual precipitation during the 16-year study period used for the 2020 Analysis was similar to the long term average. The basis for this statement is the monthly precipitation record for the Napa State Hospital (NSH) station, which I believe is representative of the *pattern* of regional rainfall occurrence for Napa County.

Attachment 1 shows the historical monthly precipitation record for the NSH station as acquired from the Western Regional Climate Center (WRCC).[1] The record provides monthly precipitation data dating from 1893 to January 2023 in calendar year format. The columns adjacent to some of the monthly data entries show an alphabetic letter. As noted in the header, the letter "a" indicates one day was missing from that month's data; the letter "b" means two days are missing from the data, and so on. As also noted, for the Period of Record Statistics shown below the data table, individual months are not used for annual or monthly statistics if more than 5 days are missing (i.e., letter "f" months and higher). Individual years are not used for annual statistics if any month in that year has more than 5 days missing. The Period of Record Statistics table indicates that based on 97 years of data, mean annual precipitation (MAP) at NSH is 24.57 inches.

As shown in Attachment 1, there are many months with more than 5 days of missing data, especially in the early years, that the WRCC omitted from the statistical analysis. As part of an internal effort to develop a more robust hydrologic data set, we previously evaluated correlation of the NSH record and other precipitation stations in the region, including St. Helena, Calistoga, and Petaluma. In some instances we were able to estimate missing NSH monthly data based on these relationships, and months for which we made this estimation are color-coded in the modified historical monthly summary shown in **Attachment 2**. Based on this approach, the number of years in the data set increased to 114 years, and the MAP was computed to be 24.60 inches, very close to the 97-year data set.

For wet-season hydrologic analyses, it is more realistic to use a "water year" reckoning rather than calendar year.[2] **Attachment 3** shows the NSH data converted to a water year format. Based on 115 years of data, water year MAP was determined to be 24.75 inches, very close to the calendar year results. For the period of WY 1930 to 1945, annual precipitation averaged 24.21 inches, slightly less than the long-term average.[3]

[1] https://wrcc.dri.edu/Climate/west_coop_summaries.php

[2] A "water year" is defined as October 1 of each year through September 30 of the following year.

[3] With reference to Attachment 1, for the 16-year period there were only two months when the number of days with missing data exceeded five days, March 1933 and December 1944. Because data is *missing*, we assumed that precipitation for these months would have been no less than the values shown and included them in the analyses; if the actual amounts were greater, the analysis is conservative.

The table below compares recent conditions with historical conditions by showing the MAP at NSH for various recent time periods as a percentage of MAP for the 16-year study period:

Water Year Period	No. of Years	NSH Mean Annual Precipitation* (in)	Percent of 16-year Study Period Average (24.21 in) (%)
2018-2022	5	19.23	79
2017-2022	6	23.52	97
2013-2022	10	22.50	93
2008-2022	15	23.57	97
2007-2022	16	23.04	95
2003-2022	20	24.89	103

* With reference to Attachment 1, WY 2018 contains missing data for the month of November. Because data is *missing*, we assumed that precipitation for this month would have been no less than the value shown and included 2018 in the MAP calculation; if the actual amount was greater, the calculation is conservative.

The above table shows variability ranging from 79 to 103 percent. The table also shows that one year can have a pronounced effect on the percentage in the short term. For example, the percentage of 16-year study period MAP is 79 percent over the last 5 years, but jumps to 97 percent for the last 6 years.

Year-to-year variability is also demonstrated by recent rainfall occurrence. After 3 years of drought conditions, WY 2023 is shaping up to be a wet year. Based on preliminary data posted on CDEC, precipitation at the NSH station for December 2022 was 9.5 inches, which is double the long term average December precipitation shown in Attachment 1. Per the California Nevada River Forecast Center, for the period of January 1 through 12, 2023, precipitation at Napa (ASOS, near the airport) stands at 7.17 inches which is 1.4 times the long-term January average for the nearby NSH station (5.12 inches).[4] January month-to-date precipitation at the Atlas Peak station stands at 13.04 inches, about 465 percent of average for this date, with more rain predicted in the next few days. If wet conditions continue for the remainder of the water year, it would tend to increase the percentages in the table above.

Comparison of Weighted MAP Methodologies

In your email of January 11, 2023, you requested consideration of PRISM data for use in the weighted mean annual precipitation calculation. The 2020 Analysis uses the following equation ("*Equation 1*") to adjust gaged streamflow data to various points of interest (POI):

[4] https://cnrfc.noaa.gov/?product=PNM&zoom=9&lat=38.481&lng=-122.365, accessed January 12, 2023.

$$Q_2 = Q_1 \text{ x } (A_2/A_1) \text{ x } (MAP_2/MAP_1) \qquad \textit{(Equation 1)}$$

Where:

Q_2 = Flow at POI or POD;
Q_1 = Estimated unimpaired flow at gage;
A_2 = Watershed area above POI or POD;
A_1 = Watershed area above gage;
MAP_2 = Weighted mean annual precipitation for watershed above POI;
MAP_1 = Weighted mean annual precipitation for watershed above gage.

In *Equation 1*, the *MAP* factor accounts for differing precipitation conditions among regional subwatersheds. Based on the assumption that MAP is directly related to runoff, together with the drainage area factor (*A*), flow at a particular location can be estimated from known (gaged) data at another location. It is noted that use of *Equation 1* is one of two methods set forth in the SWRCB's *Policy for Maintaining Instream Flows in Northern California Coastal Streams, Effective February 4, 2014*, for estimating unimpaired flow in water availability studies used to support issuance of water right permits.

In the 2020 Analysis we computed weighted MAP for the various watersheds based on an isohyetal map published in 1969 and reprinted in 1972 entitled *Mean Annual Precipitation in the California Region, Compiled by S.E. Rantz* (Rantz Map).[5] The isohyetals are shown on Plate I in the 2020 Analysis. Per Attachment A in the 2020 Analysis, MAP for three watersheds of interest is summarized in the table below. The table also shows the ratio of MAP for POI 1 and POI 2 to the MAP for the Conn Creek gage, expressed as percentages.

Watershed of Interest	Watershed MAP based on Rantz Map (in)	Percent of Gage Watershed MAP (%)
Conn Creek Gage	34.84	-
POI 1, A026165 POD #1	31.56	91
POI 2, A026165 POD #2	31.56	91

The PRISM reference you provided is for MAP over the 10-year period from 2012 to 2021. **Attachment 4** shows the watersheds for the Conn Creek Gage, POI 1, and POI 2 overlayed on the PRISM map, and the results of our analysis. We determined the MAP, and the percentage of MAPs for POIs 1 and 2 to the MAP for the Conn Creek gage, to be as follows:

[5] While the Rantz Map is dated, we have referenced it for many water availability analyses that have been approved by the SWRCB in support of issuing new water right permits.

Watershed of Interest	Watershed MAP based on PRISM (in)	Percent of Gage Watershed MAP (%)
Conn Creek Gage	30.28	-
POI 1, A026165 POD #1	29.27	97
POI 2, A026165 POD #2	28.95	96

For the Conn Creek gage, the MAP based on PRISM is about 87 percent of that based on the Rantz Map; for POI 1, PRISM is about 93 percent of the Rantz Map; and for POI 2, PRISM is about 92 percent of the Rantz Map. These values are consistent with the prior discussion for the NSH data, albeit for a slightly different 10-year period.

It should be noted that in *Equation 1*, it is the *ratio* of MAP for the two locations that is determinative. Applied to the same gaged flow data set, a higher MAP ratio (percentage) means that the computed flow at the POI would be higher than if a lower MAP percentage is used. Per the above tables, the MAP percentage for the PRISM data is higher than the MAP percentage for the Rantz Map. Use of the PRISM percentages instead of the Rantz Map percentages would result in higher flows at POIs 1 and 2 than what was computed in our 2020 Analysis, which means computed yield would likely be higher. Because the PRISM MAPs are lower than the Rantz Map MAPs, this result is somewhat counterintuitive.

Conclusion

It appears the County staff's questions regarding the reliability of water supply and the conclusions of the 2020 Analysis are prompted by the recent drought periods that California has experienced. Multiple consecutive years of low precipitation are nothing new. With reference to **Attachment 3**, for the 6-year period from 1929 to 1934, MAP at NSH was 17.52 inches. For the 6-year period of 1987 to 1992, MAP at NSH was 18.48 inches. Conversely, within the last six years there have been two very wet years (WY 2017 and WY 2019). This is the nature of hydrology in California and points to one of the primary purposes for building a storage reservoir, which is to provide carry-over storage for years when available supplies are reduced.

Based on the foregoing, in my view the evidence demonstrates that recent hydrologic conditions are reasonably consistent with historical conditions and do not provide a basis for altering the conclusions of our 2020 Analysis.

cc (via email): Chris Apallas
Craig Becker
Alicia Guerra
Jim Bushey
Annalee Sanborn

ATTACHMENT 1

NAPA STATE HOSPITAL, CA
Monthly Sum of Precipitation (Inches)
(046074)
File last updated on Janaury 12, 2023
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5
Individual Months not used for annual or monthly statistics if more than 5 days are missing.
Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1893	4.27	2.19	4.28 n	1.05	0.49	0	0	0	0.19	0.17	4.03	1.86	14.25 a
1894	8.17	2.97	1.15	----- z	1.49 y	0.85	----- z	0.04	----- z	----- z	1.34	9.37	23.89 e
1895	9.35	2.92	2.21	1.11	----- z	----- z	----- z	----- z	1.16	0.03	1.72 w	1.47 v	16.78 f
1896	9.28	0.25	3.59 r	6.28	1.1	----- z	0	----- z	----- z	1.2	5.03	3.41	26.55 d
1897	----- z	5.68	5.37 r	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	5.68 k
1898	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	0 l
1899	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	0 l
1900	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	0 l
1901	----- z	----- z	----- z	----- z	1.11	0	0	0	0.89	1.32	3.88	2.15	9.35 d
1902	1.58	12.16	3.66	2.55	1.23	0	0	0.02	0	4.84 y	4.13	2.94 y	25.33 b
1903	3.22 w	2.11	5.15 s	----- z	0	0	0	0	0	----- z	4.25	----- z	6.36 e
1904	0.92	8.23 m	7.93	1.7 t	0.04	0	0	0.08	4.79	2.63	2.01	2.4	20.8 b
1905	4.4	2.77	3.44 s	----- z	----- z	0	0	0	0	----- z	1	1.17	9.34 d
1906	6.36 u	4.28	6.77 p	0.43	3.23 y	0.45 y	0	0	0.14	0	----- z	5.87 t	4.85 f
1907	6.5	4.44 s	8.37	0.42	0.26	0.85	0	0	0.01	0.62	----- z	4.37 q	17.03 c
1908	4.15 s	3.96 v	0.8	0.14	0.75	----- z	0	0	0	----- z	2.25	2.43 v	3.94 e
1909	15.04 g	7.22 k	3.02 w	0	0	0.02	0	0	----- z	1.62 w	2.45	6.61 s	2.47 f
1910	3.19	2.01	3.59 s	0.54	0	----- z	0	0	0.13	0.84	0.39	1.35	8.45 b
1911	13.5	2.22	5.17 v	1.32	0.21	0.03	0	0	0	0.53	0.75	2.05	20.61 a
1912	3.16	0.58	3.37	1.47	2.12	----- z	0	----- z	2.52	0.54	3.94	1.35	19.05 b
1913	4.53	0.3	2.08	0.94	0.55	0.2	0.01	0	0	0.51	5.22	7.45	21.79
1914	12.81	6.01	0.99	0.88	0.48	0.15	0	0	0	1.11	0.61	----- z	23.04 a
1915	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	----- z	0.8	6.65 v	0.8 k
1916	15.12	3.23	----- z	----- z	0.23	----- z	----- z	----- z	----- z	----- z	----- z	----- z	18.58 i
1917	----- z	6.19	1.28	0.92	0.51	0	0	0	0.09	0	0.47	1.3	10.76 a
1918	1.04	6.48	2.91	0.75	0.06	0	0	0	2.65	0.43	3.61	1.82	19.75
1919	3.75	11.46	2.98 a	0.14	0.02	0	0	0	0.44	0.37	0.3	4.62	24.08
1920	0.39	1.03	3.53	1.54	0	0.18	0	0	0.15	1.91	4.56	6.19	19.48
1921	6.44	1.28	1.55	0.64	1.19	0	0	0	0.04 a	0.62	1.55	----- z	13.31 a
1922	2.16	5.87	2.46	0.68	0.38	0.21	0	0	0	3.86	4.45	9.21	29.28
1923	3.09	0.54	0.02	4.92	0	0	0	0.26	0.64	0.26	0.35	0.84	10.92
1924	2.58	3.53	1.35	0.35	0.1	0	0 d	0.16	0	3.2	2.5	6.27	20.04
1925	1.37	10.39	2.64	2.49	2.83	0.02	0	0	0.45	0.56	2.91	1.14	24.8
1926	5.15	8.27	0.12	4.98	0.5	0	0	0.07	0	2.31	10.35	1.21	32.96
1927	3.56	10.83	2.96	2.5	0.56	0.51	0	0	0	2.21 a	4.04	5.77	32.94
1928	3.19	2.21	6.54	0.63	0.32	0	0	0	0.01	0.07	0.75	4.96	18.68
1929	1.08	1.18	1.8	1.87	0.08	1.95	0	0	0	0.04	0	5.1	13.1
1930	5.3	2.47	3.9	1.36	0.54	0	0	0	0.96	1.6	1.88	0.56	18.57
1931	6.2	0.95	2.01	0.62	1.46	0.52	0	0	0	0.66	2.88	11.58	26.88
1932	3.81	1.45	0.96	1.01	0.95	0.12	0 a	0	0	0	0.83	3.16	12.29
1933	5.59	1.07	2.02 j	1.87 a	0.08	1.95	0	0	0	2.19	0	4.91	17.66 a
1934	1.52	3.96	0.42	0.68	0.78	0.04	0	0.05	0.03	1.52	5.07	3.34	17.41
1935	5.54	1.85	4.42	3.52	0.02	0	0	0.21	0.02	2.1	0.88	2.45	21.01
1936	5.98	8.69	1.85	1.62	0.26	0.7	0.03	0.04	0	0.3	0	2.94	22.41
1937	4.14	6.27	6.4	0.91	0.03	0.65	0.2	0	0	1.23	3.75	5.17	28.75
1938	4.29	11.38	6.31	1.88	0	0	0	0	0.11	1.49	1.14	1.12	27.72
1939	2.58	1.87	2.38	0.36	1.22	0	0	0	0.03	0.49 c	0.12	1.32	10.37
1940	10.11	9.47	6.31	0.76	1.32	0	0	0	0.2	1.26	1.61	10.9	41.94
1941	8.84	7.27	5.26	5.2	1.45	0.07	0	0	0	2.6	2.88	9.52	43.09
1942	5.32	6.35	4.07	4.51	1.36	0	0	0	0.01	1.15	4.81	4.29	31.87
1943	8.17	1.68	3.47	1.6	0	0.06	0	0	0	0.66	1.54	2.29	19.47
1944	4.93	6.9	1.47	1.94	1.25	0.99	0	0	0	1.58	4.67	2.01 g	23.73 a
1945	1.1	4.87	3.88	0.26	0.95	0	0	0	0	3.4	3.21	9.69	27.36
1946	1.26	1.96	2.03	0.25	0.62	0 b	0.01	0 a	0.03	0.34	----- z	3.24	9.74 a
1947	0.8	2.87	4.63	0.78	0.43	1.16	0	0	0	4.65	0.96	0.58	16.86
1948	1.7	1.21	4.08	4.61	1.35	0.09	0	0	0.21	0.9	1.24	3.98	19.37
1949	1.87	2.75	6.33	0	0.2	0	0	0.2 a	0	0	2.44	2.16	15.95
1950	7.71	3.75	2.41	1.07	0.28	0	0	0	0	3.17	6.81	8.18	33.38
1951	5.59	2.11	2.09	0.84	1.52	0	0	0	0.06	1.24	3.83	8.64	25.92
1952	10.05	2.32	4.46	0.77	0.37	0.59	0	0	0.02	0	2.39	11.7	32.67
1953	5.03	0	3.37	3.17	0.63	0.58	0	0.1	0	0.44	3.35	0.88	17.55
1954	3.6	2.91	4.34	2.25	0.41	0.16	0	0.44	0	0.15	3.13	5.26	22.65
1955	3.04	1.96	0.53	1.93	0.2	0	0	0	0.58	0.07	2.32	16.13	26.76
1956	8.16	4.14	0.24	2.46	0.76	0.03	0	0 a	0.22	1.77	0.06	0.42	18.26
1957	2.95	5.18	2.06	1.57	3.6	0.25	0	0	1.31	2.88	0.75	3.67	24.22
1958	5.83	10.78	5.38	5.93	1.14	0.37	0	0	0	0.15	0.12	1.4	31.1
1959	5.48	7.6	1.09	0.19	0	0	0	0	2.37	0	0	1.92	18.65
1960	4.52	4.61	3.37	1.22	1.7	0	0	0	0	0.23	4.23	3.05	22.93
1961	4.1	1.63	3.92	1.21	0.21	0.03	0	0.08	0.23	0.14	3.01	3.02	17.58

1962	1.23	8.02	3.28	0.37	0	0	0	0.11	0.2	10.37	0.97	3.93	28.48
1963	4.71	3.79	4.91	5.66	0.44	0	0	0	0.29	2.83	5.71	0.73	29.07
1964	3.46	0.19	2.09	0.1	0.15	0.65	0.1	0.06	0	1.48	3.37	7.93	19.58
1965	5.18	0.8	1.68	3.29	0	0	0.04	0.85	0	0.03	5.11	3.78	20.76
1966	5.69	3.14	0.33	0.75	0.19	0.19	0.04	0.18	0.06	0	6.61	4.55	21.73
1967	11.65	0.46	6.08	5.42	0.12	1.95	0	0	0.09	0.8	1.49	2.07	30.13
1968	6.5	2.99	2.41	0.45	0.36	0	0	0.25	0	1.62	2.9	4.87	22.35
1969	8.3	7.58	1.03	1.59	0	0.03	0	0	0	3.14	1.3	7.22	30.19
1970	13.77	1.92	1.97	0.08	0	0.46	0	0	0	1.55	7.28	8.4	35.43
1971	1.68	0.28	3.57	0.49	0.21	0	0	0	0.24	0.09	2.3	4.81	13.67
1972	0.93	1.5	0.15	1.62	0.12	0.25	0	0	1.23	3.34	6.95	3.39	19.48
1973	11.37	5.61	3.1	0.11	0.02	0	0	0	0.41	1.64	10.51	4.4	37.17
1974	4.96	1.84	5.71	1.97	0.02	0	1.05	0	0	1.04	0.99	2.92	20.5
1975	2.39	6.79	7.17	1.3	0.03	0	0.14	0	0	3.64	0.79	0.46	22.71
1976	0.34	1.97	1.62	1.4	0	0	0	1.3	0.84	0.46	1.26	1.27	10.46
1977	1.75	1.5	2.58	0.48	1.21	0	0	0	0.72	0.49	7.9	5.91	22.54
1978	10.17	4.64	5.62	3.77	0.02	0	0	0	0.83	0	2.53	1.11	28.69
1979	10.34	5.35	1.98	1.79	----- z	0	0	0	0	3.59	3.22	7.29	33.56 a
1980	7.45	10.01	1.84	1.48	0.55	0.07	0.13	0	0	0.24	0.19	3.32	25.28
1981	5.92	1.58	4.03	0.32	0.44	0	0	0	0.17	2.64	7.44	7.66	30.2
1982	10.55	4.42	7.53	3.97	0	0	0 a	0	1.58	3.63	7.74	3.41	42.83
1983	7.7	10.62	11.07	3.94	0.49	0	0	0.73	0.86	0.77	7.98	7.08	51.24
1984	0.37	2.4	2.07	1.09	0.14	0.47	0.04	0.34	0.09	2.03	7.77	1.48	18.29
1985	1.75	2.79	4.42	0.08	0.03	0.05	0	0	0.79	0.78	3.88	2.97	17.54
1986	4.5	15.29	7.08	0.82	0.19	0.01	0	0	1.52	0.26	0.15	1.98	31.8
1987	4.11	4.63	4.28	0.16	0	0	0	0	0	1.52	2.2	7.65	24.55
1988	5.06	0.48	0.13	2.29 a	1.04	0.19	0	0 a	0	0.11	4.41	3.39	17.1
1989	1.37	1.37	6.79	0.9	0.08	0.09	0	0	2.31	1.48	1.68	0	16.07
1990	4.05	3.5	1.18	0.34	3.27	0	0	0	0.36	0.23	0.54 d	0.99	14.46
1991	0.46	3.05	10.64	0.33	0.15	0.4	0	0.16	0.01	2.47	0.84	2.18	20.69
1992	2.28	7.34	4.28	0.63	0	1.09	0	0	0	3.09	0.27	8.28	27.26
1993	8.9	5.87	2.08	1.54	1.39	0.71	0	0	0	1.15	3.49	3.5	28.63
1994	2.56	3.62	0.19	1.27	1.57	0.04	0	0	0	1.31	6.17	3.84	20.57
1995	13.66	0.54	11.97	1.26	3.1	0.9	0	0	0	0	0.18	8.9	40.51
1996	8.21	9.6 b	2.35 f	3.81	3.72	0	0	0	0.03	1.94	3.18	12.92	43.41 a
1997	10.5	0.46	0.86	0.57	0.79	0.23	0	0.82	0.03	1.26	7.95	2.56	26.03
1998	8.73	14.15	2.68	1.55	2.99	0.15	0	0	0.15	0.76	4.76	1.02	36.94
1999	3.15	9.83	2.7	2.88	0.13	0	0	0	0.04	0.75	2.84	0.91	23.23
2000	5.36	9.88	2.92	1.69	1.54	0.12	0	0	0.11	2.29	1.34	1.22	26.47
2001	4.34	7.26	1.08	0.46	0	0.26	0	0	0.5	0.51	6.17	9.45	30.03
2002	3.5	1.93	2.63	0.3	1.25	0	0	0	0	0	3.38	13.21	26.2
2003	2.68	3.99	4.98	3.97	1.85	0	0	0.62	0.03	0.25	3.14	7.7	29.21
2004	3.6	6.52	0.86	0.34	0.1	0	0	0	0.14	2.48	2.51	7.93	24.48
2005	4.31 a	3.88	3.42	1.57	2.37	0.9	0	0	0.01	0.67	2.25	15.49	34.87
2006	4.69	3.71	8.41	5.75	1.19	0.11	0	0	0	0.66	3.3	3.71	31.53
2007	0.36	5.12	0.35	1.29	0.35	0	0	0	0.05	2.01	1.05	4.1	14.68
2008	10.06	3.44	0.35	0.19	0.08	0	0	0	0	0.59	3	2.57	20.28
2009	0.97	9.2	1.01	0.95	1.47	0.05	0	0	0.15	5.06	0.83	2.14	21.83
2010	9.19	3.98	2.63	3.86	1.16	0	0	0	0	3.71	3.05	8.64	36.22
2011	1.28 w	4.02 t	8.94 l	0.59 w	1.89 v	2.61 w	0	0	0	1.33 x	1.55 s	0.18	0.18 h
2012	4.89	1.5	9.04	2.48 b	0	0.04	0 a	0	0	1.51	4.8 c	7.87 b	32.13
2013	0.74	0.35	0.93	1.19 a	0.34	0.68	0	0	0.67	0	1.13 a	0.71 b	6.74
2014	0.11 b	10.91	3.38	2.88 a	0.00 a	0.00	0.00	0.05	0.49	0.98	2.42	11.97	33.19
2015	0.02 a	2.72 a	0.10	2.12 c	0.02 a	0.17 a	0.01 a	0.00	0.19 a	0.02 a	1.82	4.53 b	11.72
2016	7.47	0.92	8.36	1.00 a	0.30	0.00 c	0.00	0.00 c	0.00	3.60 c	2.39 b	5.64 a	29.68
2017	13.28 a	11.42	4.22	3.54 b	0.00 a	0.83 a	0.00	0.00 a	0.08 a	0.20 d	4.62 f	0.03 a	33.60 a
2018	4.66 c	0.12 b	6.58 d	3.01 d	0.00 b	0.00 a	0.00 e	0.00 a	0.00 b	0.22	4.36 a	2.78 b	21.73
2019	7.22 a	9.87 c	5.40 a	0.45 b	2.99	0.00 a	0.00 b	0.00	0.00 b	0.00 a	0.96	5.21	32.10
2020	2.09 b	0.00	1.28	1.11 a	1.50	0.00 a	0.00	0.01 b	0.00 a	0.00 b	1.46 b	1.83 c	9.28
2021	3.26	1.81 c	1.64 b	0.24	0.00 b	0.00	0.00 b	0.00 b	0.00	8.56 b	1.63 b	7.24 a	24.38
2022	0.63	0.00 a	0.56	1.46 a	0.00	0.00	0.00 c	0.27 c	0.87	0.00	1.02 f	9.51 b	13.30 a
2023	5.82 t												

Period of Record Statistics													
MEAN	5.04	4.33	3.35	1.66	0.67	0.21	0.01	0.06	0.3	1.36	2.91	4.53	24.57
S.D.	3.54	3.54	2.56	1.51	0.85	0.4	0.1	0.19	0.67	1.61	2.32	3.54	8.22
SKEW	0.78	0.94	1.07	1.31	1.73	2.65	9.79	4.21	3.76	2.57	1.01	1.05	0.43
MAX	15.12	15.29	11.97	6.28	3.72	1.95	1.05	1.3	4.79	10.37	10.51	16.13	51.24
MIN	0.02	0	0.02	0	0	0	0	0	0	0	0	0	6.74
YRS	118	120	112	118	119	117	122	121	121	117	118	113	97

ATTACHMENT 2

NAPA STATE HOSPITAL, CA
Monthly Sum of Precipitation (Inches)
(046074)
File last updated on Oct 02, 2022
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5
Individual Months not used for annual or monthly statistics if more than 5 days are missing.
Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1893	4.27	2.19	6.73	1.05	0.49	0.00	0.00	0.00	0.19	0.17	4.03	1.86	20.98
1894	8.17	2.97	1.15	0.68	0.81	0.85	z	0.04	2.04	1.97	1.34	9.37	29.39 a
1895	9.35	2.92	2.21	1.11	0.96	z	0.08	z	1.16	0.03	w	v	17.82 d
1896	9.28	0.25	r	6.28	1.10	z	0.00	z	z	1.20	5.03	3.41	26.55 d
1897	z	5.68	r	z	z	z	z	z	z	z	z	z	5.68 k
1898	z	z	z	z	z	z	z	z	z	z	z	z	0.00 l
1899	z	z	z	z	z	z	z	z	z	z	z	z	0.00 l
1900	z	z	z	z	z	z	z	z	z	z	z	z	0.00 l
1901	z	z	z	z	1.11	0.00	0.00	0.00	0.89	1.32	3.88	2.15	9.35 d
1902	1.58	12.16	3.66	2.55	1.23	0.00	0.00	0.02	0.00	y	4.13	y	25.33 b
1903	w	2.11	s	z	0.00	0.00	0.00	0.00	0.00	z	4.25	z	6.36 e
1904	0.92	m	7.93	t	0.04	0.00	0.00	0.08	4.79	2.63	2.01	2.40	20.80 b
1905	4.40	2.77	s	z	z	0.00	0.00	0.00	0.00	z	1.00	1.17	9.34 d
1906	u	4.28	6.33	0.43	2.79	0.78	0.00	0.00	0.14	0.00	1.75	7.30	23.80 d
1907	6.50	5.13	8.37	0.42	0.26	0.85	0.00	0.00	0.01	0.62	0.28	5.73	28.17
1908	3.87	4.06	0.80	0.14	0.75	0.00	0.00	0.00	0.00	0.40	2.25	2.54	14.81
1909	19.32	8.08	2.57	0.00	0.00	0.02	0.00	0.00	1.00	1.29	2.45	5.68	40.40
1910	3.19	2.01	3.35	0.54	0.00	0.00	0.00	0.00	0.13	0.84	0.39	1.35	11.80
1911	13.50	2.22	6.83	1.32	0.21	0.03	0.00	0.00	0.00	0.53	0.75	2.05	27.44
1912	3.16	0.58	3.37	1.47	2.12	1.54	0.00	0.00	2.52	0.54	3.94	1.35	20.59
1913	4.53	0.30	2.08	0.94	0.55	0.20	0.01	0.00	0.00	0.51	5.22	7.45	21.79
1914	12.81	6.01	0.99	0.88	0.48	0.15	0.00	0.00	0.00	1.11	0.61	4.23	27.27
1915	9.29	12.47	3.36	0.14	4.72	z	z	z	0.00	0.09	0.80	6.82	37.69 c
1916	15.12	3.23	2.03	0.00	0.23	0.06	0.13	0.35	0.92	0.37	1.04	6.20	29.68
1917	1.27	6.19	1.28	0.92	0.51	0.00	0.00	0.00	0.09	0.00	0.47	1.30	12.03
1918	1.04	6.48	2.91	0.75	0.06	0.00	0.00	0.00	2.65	0.43	3.61	1.82	19.75
1919	3.75	11.46	2.98 a	0.14	0.02	0.00	0.00	0.00	0.44	0.37	0.30	4.62	24.08
1920	0.39	1.03	3.53	1.54	0.00	0.18	0.00	0.00	0.15	1.91	4.56	6.19	19.48
1921	6.44	1.28	1.55	0.64	1.19	0.00	0.00	0.00	0.04 a	0.62	1.55	6.73	20.04
1922	2.16	5.87	2.46	0.68	0.38	0.21	0.00	0.00	0.00	3.86	4.45	9.21	29.28
1923	3.09	0.54	0.02	4.92	0.00	0.00	0.00	0.26	0.64	0.26	0.35	0.84	10.92
1924	2.58	3.53	1.35	0.35	0.10	0.00	0.00 d	0.16	0.00	3.20	2.50	6.27	20.04
1925	1.37	10.39	2.64	2.49	2.83	0.02	0.00	0.00	0.45	0.56	2.91	1.14	24.80
1926	5.15	8.27	0.12	4.98	0.50	0.00	0.00	0.07	0.00	2.31	10.35	1.21	32.96
1927	3.56	10.83	2.96	2.50	0.56	0.51	0.00	0.00	0.00	2.21 a	4.04	5.77	32.94
1928	3.19	2.21	6.54	0.63	0.32	0.00	0.00	0.00	0.01	0.07	0.75	4.96	18.68
1929	1.08	1.18	1.80	1.87	0.08	1.95	0.00	0.00	0.00	0.04	0.00	5.10	13.10
1930	5.30	2.47	3.90	1.36	0.54	0.00	0.00	0.00	0.96	1.60	1.88	0.56	18.57
1931	6.20	0.95	2.01	0.62	1.46	0.52	0.00	0.00	0.00	0.66	2.88	11.58	26.88
1932	3.81	1.45	0.96	1.01	0.95	0.12	0.00 a	0.00	0.00	0.00	0.83	3.16	12.29
1933	5.59	1.07	3.33	1.87 a	0.08	1.95	0.00	0.00	0.00	2.19	0.00	4.91	20.99
1934	1.52	3.96	0.42	0.68	0.78	0.04	0.00	0.05	0.03	1.52	5.07	3.34	17.41
1935	5.54	1.85	4.42	3.52	0.02	0.00	0.00	0.21	0.02	2.10	0.88	2.45	21.01
1936	5.98	8.69	1.85	1.62	0.26	0.70	0.03	0.04	0.00	0.30	0.00	2.94	22.41
1937	4.14	6.27	6.40	0.91	0.03	0.65	0.20	0.00	0.00	1.23	3.75	5.17	28.75
1938	4.29	11.38	6.31	1.88	0.00	0.00	0.00	0.00	0.11	1.49	1.14	1.12	27.72
1939	2.58	1.87	2.38	0.36	1.22	0.00	0.00	0.00	0.03	0.49 c	0.12	1.32	10.37
1940	10.11	9.47	6.31	0.76	1.32	0.00	0.00	0.00	0.20	1.26	1.61	10.90	41.94
1941	8.84	7.27	5.26	5.20	1.45	0.07	0.00	0.00	0.00	2.60	2.88	9.52	43.09
1942	5.32	6.35	4.07	4.51	1.36	0.00	0.00	0.00	0.01	1.15	4.81	4.29	31.87
1943	8.17	1.68	3.47	1.60	0.00	0.06	0.00	0.00	0.00	0.66	1.54	2.29	19.47
1944	4.93	6.90	1.47	1.94	1.25	0.99	0.00	0.00	0.00	1.58	4.67	4.71	28.44
1945	1.10	4.87	3.88	0.26	0.95	0.00	0.00	0.00	0.00	3.40	3.21	9.69	27.36
1946	1.26	1.96	2.03	0.25	0.62	0.00 b	0.01	0.00 a	0.03	0.34	3.63	3.24	13.37
1947	0.80	2.87	4.63	0.78	0.43	1.16	0.00	0.00	0.00	4.65	0.96	0.58	16.86
1948	1.70	1.21	4.08	4.61	1.35	0.09	0.00	0.00	0.21	0.90	1.24	3.98	19.37
1949	1.87	2.75	6.33	0.00	0.20	0.00	0.00	0.20 a	0.00	0.00	2.44	2.16	15.95
1950	7.71	3.75	2.41	1.07	0.28	0.00	0.00	0.00	0.00	3.17	6.81	8.18	33.38
1951	5.59	2.11	2.09	0.84	1.52	0.00	0.00	0.00	0.06	1.24	3.83	8.64	25.92
1952	10.05	2.32	4.46	0.77	0.37	0.59	0.00	0.00	0.02	0.00	2.39	11.70	32.67
1953	5.03	0.00	3.37	3.17	0.63	0.58	0.00	0.10	0.00	0.44	3.35	0.88	17.55
1954	3.60	2.91	4.34	2.25	0.41	0.16	0.00	0.44	0.00	0.15	3.13	5.26	22.65
1955	3.04	1.96	0.53	1.93	0.20	0.00	0.00	0.00	0.58	0.07	2.32	16.13	26.76
1956	8.16	4.14	0.24	2.46	0.76	0.03	0.00	0.00 a	0.22	1.77	0.06	0.42	18.26
1957	2.95	5.18	2.06	1.57	3.60	0.25	0.00	0.00	1.31	2.88	0.75	3.67	24.22
1958	5.83	10.78	5.38	5.93	1.14	0.37	0.00	0.00	0.00	0.15	0.12	1.40	31.10
1959	5.48	7.60	1.09	0.19	0.00	0.00	0.00	0.00	2.37	0.00	0.00	1.92	18.65
1960	4.52	4.61	3.37	1.22	1.70	0.00	0.00	0.00	0.00	0.23	4.23	3.05	22.93
1961	4.10	1.63	3.92	1.21	0.21	0.03	0.00	0.08	0.23	0.14	3.01	3.02	17.58
1962	1.23	8.02	3.28	0.37	0.00	0.00	0.00	0.11	0.20	10.37	0.97	3.93	28.48
1963	4.71	3.79	4.91	5.66	0.44	0.00	0.00	0.00	0.29	2.83	5.71	0.73	29.07
1964	3.46	0.19	2.09	0.10	0.15	0.65	0.10	0.06	0.00	1.48	3.37	7.93	19.58
1965	5.18	0.80	1.68	3.29	0.00	0.00	0.04	0.85	0.00	0.03	5.11	3.78	20.76
1966	5.69	3.14	0.33	0.75	0.19	0.19	0.04	0.18	0.06	0.00	6.61	4.55	21.73
1967	11.65	0.46	6.08	5.42	0.12	1.95	0.00	0.00	0.09	0.80	1.49	2.07	30.13
1968	6.50	2.99	2.41	0.45	0.36	0.00	0.00	0.25	0.00	1.62	2.90	4.87	22.35
1969	8.30	7.58	1.03	1.59	0.00	0.03	0.00	0.00	0.00	3.14	1.30	7.22	30.19
1970	13.77	1.92	1.97	0.08	0.00	0.46	0.00	0.00	0.00	1.55	7.28	8.40	35.43
1971	1.68	0.28	3.57	0.49	0.21	0.00	0.00	0.00	0.24	0.09	2.30	4.81	13.67
1972	0.93	1.50	0.15	1.62	0.12	0.25	0.00	0.00	1.23	3.34	6.95	3.39	19.48
1973	11.37	5.61	3.10	0.11	0.02	0.00	0.00	0.00	0.41	1.64	10.51	4.40	37.17
1974	4.96	1.84	5.71	1.97	0.02	0.00	1.05	0.00	0.00	1.04	0.99	2.92	20.50
1975	2.39	6.79	7.17	1.30	0.03	0.00	0.14	0.00	0.00	3.64	0.79	0.46	22.71
1976	0.34	1.97	1.62	1.40	0.00	0.00	0.00	1.30	0.84	0.46	1.26	1.27	10.46
1977	1.75	1.50	2.58	0.48	1.21	0.00	0.00	0.00	0.72	0.49	7.90	5.91	22.54
1978	10.17	4.64	5.62	3.77	0.02	0.00	0.00	0.00	0.83	0.00	2.53	1.11	28.69
1979	10.34	5.35	1.98	1.79	0.43	0.00	0.00	0.00	0.00	3.59	3.22	7.29	33.99
1980	7.45	10.01	1.84	1.48	0.55	0.07	0.13	0.00	0.00	0.24	0.19	3.32	25.28

KEY:
- No Data
- Relation between NAPA and
- Relation between NAPA and
- Relation between NAPA and

1981	5.92	1.58	4.03	0.32	0.44	0.00	0.00	0.00	0.17	2.64	7.44	7.66	30.20
1982	10.55	4.42	7.53	3.97	0.00	0.00	0.00 a	0.00	1.58	3.63	7.74	3.41	42.83
1983	7.70	10.62	11.07	3.94	0.49	0.00	0.00	0.73	0.86	0.77	7.98	7.08	51.24
1984	0.37	2.40	2.07	1.09	0.14	0.47	0.04	0.34	0.09	2.03	7.77	1.48	18.29
1985	1.75	2.79	4.42	0.08	0.03	0.05	0.00	0.00	0.79	0.78	3.88	2.97	17.54
1986	4.50	15.29	7.08	0.82	0.19	0.01	0.00	0.00	1.52	0.26	0.15	1.98	31.80
1987	4.11	4.63	4.28	0.16	0.00	0.00	0.00	0.00	0.00	1.52	2.20	7.65	24.55
1988	5.06	0.48	0.13	2.29 a	1.04	0.19	0.00	0.00 a	0.00	0.11	4.41	3.39	17.10
1989	1.37	1.37	6.79	0.90	0.08	0.09	0.00	0.00	2.31	1.48	1.68	0.00	16.07
1990	4.05	3.50	1.18	0.34	3.27	0.00	0.00	0.00	0.36	0.23	0.54 d	0.99	14.46
1991	0.46	3.05	10.64	0.33	0.15	0.40	0.00	0.16	0.01	2.47	0.84	2.18	20.69
1992	2.28	7.34	4.28	0.63	0.00	1.09	0.00	0.00	0.00	3.09	0.27	8.28	27.26
1993	8.90	5.87	2.08	1.54	1.39	0.71	0.00	0.00	0.00	1.15	3.49	3.50	28.63
1994	2.56	3.62	0.19	1.27	1.57	0.04	0.00	0.00	0.00	1.31	6.17	3.84	20.57
1995	13.66	0.54	11.97	1.26	3.10	0.90	0.00	0.00	0.00	0.00	0.18	8.90	40.51
1996	8.21	9.60 b	2.68	3.81	3.72	0.00	0.00	0.00	0.03	1.94	3.18	12.92	46.09
1997	10.50	0.46	0.86	0.57	0.79	0.23	0.00	0.82	0.03	1.26	7.95	2.56	26.03
1998	8.73	14.15	2.68	1.55	2.99	0.15	0.00	0.00	0.15	0.76	4.76	1.02	36.94
1999	3.15	9.83	2.70	2.88	0.13	0.00	0.00	0.00	0.04	0.75	2.84	0.91	23.23
2000	5.36	9.88	2.92	1.69	1.54	0.12	0.00	0.00	0.11	2.29	1.34	1.22	26.47
2001	4.34	7.26	1.08	0.46	0.00	0.26	0.00	0.00	0.50	0.51	6.17	9.45	30.03
2002	3.50	1.93	2.63	0.30	1.25	0.00	0.00	0.00	0.00	0.00	3.38	13.21	26.20
2003	2.68	3.99	4.98	3.97	1.85	0.00	0.00	0.62	0.03	0.25	3.14	7.70	29.21
2004	3.60	6.52	0.86	0.34	0.10	0.00	0.00	0.00	0.14	2.48	2.51	7.93	24.48
2005	4.31 a	3.88	3.42	1.57	2.37	0.90	0.00	0.00	0.01	0.67	2.25	15.49	34.87
2006	4.69	3.71	8.41	5.75	1.19	0.11	0.00	0.00	0.00	0.66	3.30	3.71	31.53
2007	0.36	5.12	0.35	1.29	0.35	0.00	0.00	0.00	0.05	2.01	1.05	4.10	14.68
2008	10.06	3.44	0.35	0.19	0.08	0.00	0.00	0.00	0.00	0.59	3.00	2.57	20.28
2009	0.97	9.20	1.01	0.95	1.47	0.05	0.00	0.00	0.15	5.06	0.83	2.14	21.83
2010	9.19	3.98	2.63	3.86	1.16	0.00	0.00	0.00	0.00	3.71	3.05	8.64	36.22
2011	0.77	3.83	10.36	0.53	1.93	3.49	0.00	0.00	0.00	2.41	1.56	0.18	25.06
2012	4.89	1.50	9.04	2.48 b	0.00	0.04	0.00 a	0.00	0.00	1.51	4.80 c	7.87 b	32.13
2013	0.74	0.35	0.93	1.19 a	0.34	0.68	0.00	0.00	0.67	0.00	1.13 a	0.71 b	6.74
2014	0.11 b	10.91	3.38	2.88 a	0.00 a	0.00	0.00	0.05	0.49	0.98	2.42	11.97	33.19
2015	0.02 a	2.72 a	0.10	2.12 c	0.02 a	0.17 a	0.01 a	0.00	0.19 a	0.02 a	1.82	4.53 b	11.72
2016	7.47	0.92	8.36	1.00 a	0.30	0.00 c	0.00	0.00 c	0.00	3.60 c	2.39 b	5.64 a	29.68
2017	13.28 a	11.42	4.22	3.54 b	0.00 a	0.83 a	0.00	0.00 a	0.08 a	0.20 d	4.62 f	0.03 a	38.22 a
2018	4.66 c	0.12 b	6.58 d	3.01 d	0.00 b	0.00 a	0.00 e	0.00 a	0.00 b	0.22	4.36 a	2.78 b	21.73
2019	7.22 a	9.87 c	5.40 a	0.45 b	2.99	0.00 a	0.00 b	0.00	0.00 b	0.00 a	0.96	5.21	32.10
2020	2.09 b	0.00	1.28	1.11 a	1.50	0.00 a	0.00	0.01 b	0.00 a	0.00 b	1.46 b	1.83 c	9.28
2021	3.26	1.81 c	1.64 b	0.24	0.00 b	0.00	0.00 b	0.00 b	0.00	8.56 b	1.63 b	7.24 a	24.38
2022	0.63	0.00 a	0.56	1.46 a	0.00	0.00	0.00 c	0.27 c	0.87	0.00	1.02 f	9.51 b	14.32 b
2023	5.82 t												

Period of Record Statistics													
MEAN	5.12	4.43	3.47	1.61	0.73	0.25	0.02	0.06	0.33	1.35	2.86	4.64	24.60
MAX	19.32	15.29	11.97	6.28	4.72	3.49	1.05	1.30	4.79	10.37	10.51	16.13	51.24
MIN	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.74
YRS	123	125	122	122	125	123	124	123	125	123	125	123	114
S.D.	3.76	3.56	2.59	1.50	0.93	0.51	0.10	0.19	0.68	1.58	2.29	3.46	8.39
SKEW	1.02	0.92	1.05	1.36	1.86	3.45	9.75	4.17	3.54	2.62	1.06	0.99	0.47

ATTACHMENT 3

NAPA STATE HOSPITAL, CA
Monthly Sum of Precipitation (Inches)
(046074)
File last updated on Oct 02, 2022
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5
Individual Months not used for annual or monthly statistics if more than 5 days are missing.
Individual Years not used for annual statistics if any month in that year has more than 5 days missing. **Note: Some months estimated by correlation with other regional precipitation stations. See Calendar Year reckoning for details.**

YEAR(S)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1893	z	z	z	4.27	2.19	6.73	1.05	0.49	0.00	0.00	0.00	0.19	**14.92 c**
1894	0.17	4.03	1.86	8.17	2.97	1.15	0.68	0.81	0.85	z	0.04	2.04	**22.77 a**
1895	1.97	1.34	9.37	9.35	2.92	2.21	1.11	0.96	z	0.08	z	1.16	**30.47 b**
1896	0.03	w	v	9.28	0.25	r	6.28	1.10	z	0.00	z	z	**16.94 f**
1897	1.20	5.03	3.41	z	5.68	r	z	z	z	z	z	z	**15.32 h**
1898	z	z	z	z	z	z	z	z	z	z	z	z	**0.00 l**
1899	z	z	z	z	z	z	z	z	z	z	z	z	**0.00 l**
1900	z	z	z	z	z	z	z	z	z	z	z	z	**0.00 l**
1901	z	z	z	z	z	z	z	1.11	0.00	0.00	0.00	0.89	**2.00 g**
1902	1.32	3.88	2.15	1.58	12.16	3.66	2.55	1.23	0.00	0.00	0.02	0.00	**28.55**
1903	y	4.13	y	w	2.11	s	z	0.00	0.00	0.00	0.00	0.00	**6.24 e**
1904	z	4.25	z	0.92	m	7.93	t	0.04	0.00	0.00	0.08	4.79	**18.01 d**
1905	2.63	2.01	2.40	4.40	2.77	s	z	z	0.00	0.00	0.00	0.00	**14.21 c**
1906	z	1.00	1.17	u	4.28	6.33	0.43	2.79	0.78	0.00	0.00	0.14	**16.91 b**
1907	0.00	1.75	7.30	6.50	5.13	8.37	0.42	0.26	0.85	0.00	0.00	0.01	**30.59**
1908	0.62	0.28	5.73	3.87	4.06	0.80	0.14	0.75	0.00	0.00	0.00	0.00	**16.25**
1909	0.40	2.25	2.54	19.32	8.08	2.57	0.00	0.00	0.02	0.00	0.00	1.00	**36.17**
1910	1.29	2.45	5.68	3.19	2.01	3.35	0.54	0.00	0.00	0.00	0.00	0.13	**18.64**
1911	0.84	0.39	1.35	13.50	2.22	6.83	1.32	0.21	0.03	0.00	0.00	0.00	**26.69**
1912	0.53	0.75	2.05	3.16	0.58	3.37	1.47	2.12	1.54	0.00	0.00	2.52	**18.09**
1913	0.54	3.94	1.35	4.53	0.30	2.08	0.94	0.55	0.20	0.01	0.00	0.00	**14.44**
1914	0.51	5.22	7.45	12.81	6.01	0.99	0.88	0.48	0.15	0.00	0.00	0.00	**34.50**
1915	1.11	0.61	4.23	9.29	12.47	3.36	0.14	4.72	z	z	z	0.00	**35.93 c**
1916	0.09	0.80	6.82	15.12	3.23	2.03	0.00	0.23	0.06	0.13	0.35	0.92	**29.78**
1917	0.37	1.04	6.20	1.27	6.19	1.28	0.92	0.51	0.00	0.00	0.00	0.09	**17.87**
1918	0.00	0.47	1.30	1.04	6.48	2.91	0.75	0.06	0.00	0.00	0.00	2.65	**15.66**
1919	0.43	3.61	1.82	3.75	11.46	2.98	0.14	0.02	0.00	0.00	0.00	0.44	**24.65**
1920	0.37	0.30	4.62	0.39	1.03	3.53	1.54	0.00	0.18	0.00	0.00	0.15	**12.11**
1921	1.91	4.56	6.19	6.44	1.28	1.55	0.64	1.19	0.00	0.00	0.00	0.04	**23.80**
1922	0.62	1.55	6.73	2.16	5.87	2.46	0.68	0.38	0.21	0.00	0.00	0.00	**20.66**
1923	3.86	4.45	9.21	3.09	0.54	0.02	4.92	0.00	0.00	0.00	0.26	0.64	**26.99**
1924	0.26	0.35	0.84	2.58	3.53	1.35	0.35	0.10	0.00	0.00	0.16	0.00	**9.52**
1925	3.20	2.50	6.27	1.37	10.39	2.64	2.49	2.83	0.02	0.00	0.00	0.45	**32.16**
1926	0.56	2.91	1.14	5.15	8.27	0.12	4.98	0.50	0.00	0.00	0.07	0.00	**23.70**
1927	2.31	10.35	1.21	3.56	10.83	2.96	2.50	0.56	0.51	0.00	0.00	0.00	**34.79**
1928	2.21	4.04	5.77	3.19	2.21	6.54	0.63	0.32	0.00	0.00	0.00	0.01	**24.92**
1929	0.07	0.75	4.96	1.08	1.18	1.80	1.87	0.08	1.95	0.00	0.00	0.00	**13.74**
1930	0.04	0.00	5.10	5.30	2.47	3.90	1.36	0.54	0.00	0.00	0.00	0.96	**19.67**
1931	1.60	1.88	0.56	6.20	0.95	2.01	0.62	1.46	0.52	0.00	0.00	0.00	**15.80**
1932	0.66	2.88	11.58	3.81	1.45	0.96	1.01	0.95	0.12	0.00	0.00	0.00	**23.42**
1933	0.00	0.83	3.16	5.59	1.07	3.33	1.87	0.08	1.95	0.00	0.00	0.00	**17.88**
1934	2.19	0.00	4.91	1.52	3.96	0.42	0.68	0.78	0.04	0.00	0.05	0.03	**14.58**
1935	1.52	5.07	3.34	5.54	1.85	4.42	3.52	0.02	0.00	0.00	0.21	0.02	**25.51**
1936	2.10	0.88	2.45	5.98	8.69	1.85	1.62	0.26	0.70	0.03	0.04	0.00	**24.60**
1937	0.30	0.00	2.94	4.14	6.27	6.40	0.91	0.03	0.65	0.20	0.00	0.00	**21.84**
1938	1.23	3.75	5.17	4.29	11.38	6.31	1.88	0.00	0.00	0.00	0.00	0.11	**34.12**
1939	1.49	1.14	1.12	2.58	1.87	2.38	0.36	1.22	0.00	0.00	0.00	0.03	**12.19**
1940	0.49	0.12	1.32	10.11	9.47	6.31	0.76	1.32	0.00	0.00	0.00	0.20	**30.10**
1941	1.26	1.61	10.90	8.84	7.27	5.26	5.20	1.45	0.07	0.00	0.00	0.00	**41.86**
1942	2.60	2.88	9.52	5.32	6.35	4.07	4.51	1.36	0.00	0.00	0.00	0.01	**36.62**
1943	1.15	4.81	4.29	8.17	1.68	3.47	1.60	0.00	0.06	0.00	0.00	0.00	**25.23**
1944	0.66	1.54	2.29	4.93	6.90	1.47	1.94	1.25	0.99	0.00	0.00	0.00	**21.97**
1945	1.58	4.67	4.71	1.10	4.87	3.88	0.26	0.95	0.00	0.00	0.00	0.00	**22.02**
1946	3.40	3.21	9.69	1.26	1.96	2.03	0.25	0.62	0.00	0.01	0.00	0.03	**22.46**
1947	0.34	3.63	3.24	0.80	2.87	4.63	0.78	0.43	1.16	0.00	0.00	0.00	**17.88**
1948	4.65	0.96	0.58	1.70	1.21	4.08	4.61	1.35	0.09	0.00	0.00	0.21	**19.44**
1949	0.90	1.24	3.98	1.87	2.75	6.33	0.00	0.20	0.00	0.00	0.20	0.00	**17.47**
1950	0.00	2.44	2.16	7.71	3.75	2.41	1.07	0.28	0.00	0.00	0.00	0.00	**19.82**
1951	3.17	6.81	8.18	5.59	2.11	2.09	0.84	1.52	0.00	0.00	0.00	0.06	**30.37**
1952	1.24	3.83	8.64	10.05	2.32	4.46	0.77	0.37	0.59	0.00	0.00	0.02	**32.29**
1953	0.00	2.39	11.70	5.03	0.00	3.37	3.17	0.63	0.58	0.00	0.10	0.00	**26.97**
1954	0.44	3.35	0.88	3.60	2.91	4.34	2.25	0.41	0.16	0.00	0.44	0.00	**18.78**
1955	0.15	3.13	5.26	3.04	1.96	0.53	1.93	0.20	0.00	0.00	0.00	0.58	**16.78**
1956	0.07	2.32	16.13	8.16	4.14	0.24	2.46	0.76	0.03	0.00	0.00	0.22	**34.53**
1957	1.77	0.06	0.42	2.95	5.18	2.06	1.57	3.60	0.25	0.00	0.00	1.31	**19.17**
1958	2.88	0.75	3.67	5.83	10.78	5.38	5.93	1.14	0.37	0.00	0.00	0.00	**36.73**
1959	0.15	0.12	1.40	5.48	7.60	1.09	0.19	0.00	0.00	0.00	0.00	2.37	**18.40**
1960	0.00	0.00	1.92	4.52	4.61	3.37	1.22	1.70	0.00	0.00	0.00	0.00	**17.34**
1961	0.23	4.23	3.05	4.10	1.63	3.92	1.21	0.21	0.03	0.00	0.08	0.23	**18.92**
1962	0.14	3.01	3.02	1.23	8.02	3.28	0.37	0.00	0.00	0.00	0.11	0.20	**19.38**
1963	10.37	0.97	3.93	4.71	3.79	4.91	5.66	0.44	0.00	0.00	0.00	0.29	**35.07**
1964	2.83	5.71	0.73	3.46	0.19	2.09	0.10	0.15	0.65	0.10	0.06	0.00	**16.07**
1965	1.48	3.37	7.93	5.18	0.80	1.68	3.29	0.00	0.00	0.04	0.85	0.00	**24.62**
1966	0.03	5.11	3.78	5.69	3.14	0.33	0.75	0.19	0.19	0.04	0.18	0.06	**19.49**
1967	0.00	6.61	4.55	11.65	0.46	6.08	5.42	0.12	1.95	0.00	0.00	0.09	**36.93**
1968	0.80	1.49	2.07	6.50	2.99	2.41	0.45	0.36	0.00	0.00	0.25	0.00	**17.32**
1969	1.62	2.90	4.87	8.30	7.58	1.03	1.59	0.00	0.03	0.00	0.00	0.00	**27.92**

NAPA STATE HOSPITAL, CA
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(046074)
File last updated on Oct 02, 2022
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YEAR(S)	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
1970	3.14	1.30	7.22	13.77	1.92	1.97	0.08	0.00	0.46	0.00	0.00	0.00	**29.86**
1971	1.55	7.28	8.40	1.68	0.28	3.57	0.49	0.21	0.00	0.00	0.00	0.24	**23.70**
1972	0.09	2.30	4.81	0.93	1.50	0.15	1.62	0.12	0.25	0.00	0.00	1.23	**13.00**
1973	3.34	6.95	3.39	11.37	5.61	3.10	0.11	0.02	0.00	0.00	0.00	0.41	**34.30**
1974	1.64	10.51	4.40	4.96	1.84	5.71	1.97	0.02	0.00	1.05	0.00	0.00	**32.10**
1975	1.04	0.99	2.92	2.39	6.79	7.17	1.30	0.03	0.00	0.14	0.00	0.00	**22.77**
1976	3.64	0.79	0.46	0.34	1.97	1.62	1.40	0.00	0.00	0.00	1.30	0.84	**12.36**
1977	0.46	1.26	1.27	1.75	1.50	2.58	0.48	1.21	0.00	0.00	0.00	0.72	**11.23**
1978	0.49	7.90	5.91	10.17	4.64	5.62	3.77	0.02	0.00	0.00	0.00	0.83	**39.35**
1979	0.00	2.53	1.11	10.34	5.35	1.98	1.79	0.43	0.00	0.00	0.00	0.00	**23.53**
1980	3.59	3.22	7.29	7.45	10.01	1.84	1.48	0.55	0.07	0.13	0.00	0.00	**35.63**
1981	0.24	0.19	3.32	5.92	1.58	4.03	0.32	0.44	0.00	0.00	0.00	0.17	**16.21**
1982	2.64	7.44	7.66	10.55	4.42	7.53	3.97	0.00	0.00	0.00	0.00	1.58	**45.79**
1983	3.63	7.74	3.41	7.70	10.62	11.07	3.94	0.49	0.00	0.00	0.73	0.86	**50.19**
1984	0.77	7.98	7.08	0.37	2.40	2.07	1.09	0.14	0.47	0.04	0.34	0.09	**22.84**
1985	2.03	7.77	1.48	1.75	2.79	4.42	0.08	0.03	0.05	0.00	0.00	0.79	**21.19**
1986	0.78	3.88	2.97	4.50	15.29	7.08	0.82	0.19	0.01	0.00	0.00	1.52	**37.04**
1987	0.26	0.15	1.98	4.11	4.63	4.28	0.16	0.00	0.00	0.00	0.00	0.00	**15.57**
1988	1.52	2.20	7.65	5.06	0.48	0.13	2.29	1.04	0.19	0.00	0.00	0.00	**20.56**
1989	0.11	4.41	3.39	1.37	1.37	6.79	0.90	0.08	0.09	0.00	0.00	2.31	**20.82**
1990	1.48	1.68	0.00	4.05	3.50	1.18	0.34	3.27	0.00	0.00	0.00	0.36	**15.86**
1991	0.23	0.54	0.99	0.46	3.05	10.64	0.33	0.15	0.40	0.00	0.16	0.01	**16.96**
1992	2.47	0.84	2.18	2.28	7.34	4.28	0.63	0.00	1.09	0.00	0.00	0.00	**21.11**
1993	3.09	0.27	8.28	8.90	5.87	2.08	1.54	1.39	0.71	0.00	0.00	0.00	**32.13**
1994	1.15	3.49	3.50	2.56	3.62	0.19	1.27	1.57	0.04	0.00	0.00	0.00	**17.39**
1995	1.31	6.17	3.84	13.66	0.54	11.97	1.26	3.10	0.90	0.00	0.00	0.00	**42.75**
1996	0.00	0.18	8.90	8.21	9.60	2.68	3.81	3.72	0.00	0.00	0.00	0.03	**37.13**
1997	1.94	3.18	12.92	10.50	0.46	0.86	0.57	0.79	0.23	0.00	0.82	0.03	**32.30**
1998	1.26	7.95	2.56	8.73	14.15	2.68	1.55	2.99	0.15	0.00	0.00	0.15	**42.17**
1999	0.76	4.76	1.02	3.15	9.83	2.70	2.88	0.13	0.00	0.00	0.00	0.04	**25.27**
2000	0.75	2.84	0.91	5.36	9.88	2.92	1.69	1.54	0.12	0.00	0.00	0.11	**26.12**
2001	2.29	1.34	1.22	4.34	7.26	1.08	0.46	0.00	0.26	0.00	0.00	0.50	**18.75**
2002	0.51	6.17	9.45	3.50	1.93	2.63	0.30	1.25	0.00	0.00	0.00	0.00	**25.74**
2003	0.00	3.38	13.21	2.68	3.99	4.98	3.97	1.85	0.00	0.00	0.62	0.03	**34.71**
2004	0.25	3.14	7.70	3.60	6.52	0.86	0.34	0.10	0.00	0.00	0.00	0.14	**22.65**
2005	2.48	2.51	7.93	4.31	3.88	3.42	1.57	2.37	0.90	0.00	0.00	0.01	**29.38**
2006	0.67	2.25	15.49	4.69	3.71	8.41	5.75	1.19	0.11	0.00	0.00	0.00	**42.27**
2007	0.66	3.30	3.71	0.36	5.12	0.35	1.29	0.35	0.00	0.00	0.00	0.05	**15.19**
2008	2.01	1.05	4.10	10.06	3.44	0.35	0.19	0.08	0.00	0.00	0.00	0.00	**21.28**
2009	0.59	3.00	2.57	0.97	9.20	1.01	0.95	1.47	0.05	0.00	0.00	0.15	**19.96**
2010	5.06	0.83	2.14	9.19	3.98	2.63	3.86	1.16	0.00	0.00	0.00	0.00	**28.85**
2011	3.71	3.05	8.64	0.77	3.83	10.36	0.53	1.93	3.49	0.00	0.00	0.00	**36.31**
2012	2.41	1.56	0.18	4.89	1.50	9.04	2.48	0.00	0.04	0.00	0.00	0.00	**22.10**
2013	1.51	4.80	7.87	0.74	0.35	0.93	1.19	0.34	0.68	0.00	0.00	0.67	**19.08**
2014	0.00	1.13	0.71	0.11	10.91	3.38	2.88	0.00	0.00	0.00	0.05	0.49	**19.66**
2015	0.98	2.42	11.97	0.02	2.72	0.10	2.12	0.02	0.17	0.01	0.00	0.19	**20.72**
2016	0.02	1.82	4.53	7.47	0.92	8.36	1.00	0.30	0.00	0.00	0.00	0.00	**24.42**
2017	3.60	2.39	5.64	13.28	11.42	4.22	3.54	0.00	0.83	0.00	0.00	0.08	**45.00**
2018	0.20	4.62 f	0.03	4.66	0.12	6.58	3.01	0.00	0.00	0.00	0.00	0.00	**19.22 a**
2019	0.22	4.36	2.78	7.22	9.87	5.40	0.45	2.99	0.00	0.00	0.00	0.00	**33.29**
2020	0.00	0.96	5.21	2.09	0.00	1.28	1.11	1.50	0.00	0.00	0.01	0.00	**12.16**
2021	0.00	1.46	1.83	3.26	1.81	1.64	0.24	0.00	0.00	0.00	0.00	0.00	**10.24**
2022	8.56	1.63	7.24	0.63	0.00	0.56	1.46	0.00	0.00	0.00	0.27	0.87	**21.22**

Period of Record Statistics

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANN
MEAN	1.36	2.86	4.60	5.12	4.43	3.47	1.61	0.73	0.25	0.02	0.06	0.33	**24.75**
MAX	10.37	10.51	16.13	19.32	15.29	11.97	6.28	4.72	3.49	1.05	1.30	4.79	**50.19**
MIN	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	**9.52**
NO YRS	122	124	122	123	125	122	122	125	123	124	123	125	**115**
SKEW	2.62	1.04	1.02	1.02	0.92	1.05	1.36	1.86	3.45	9.75	4.17	3.54	**0.63**
S.D.	1.58	2.30	3.44	3.76	3.56	2.59	1.50	0.93	0.51	0.10	0.19	0.68	**8.79**

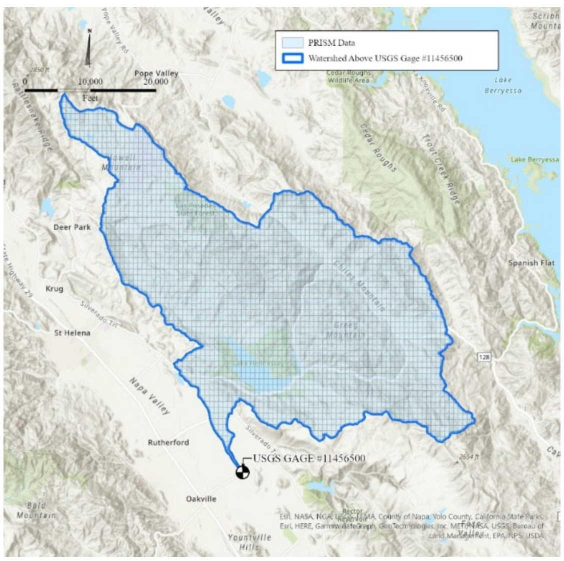
ATTACHMENT 4

Notes:

1. Raw data area units are in square feet
2. Average rain is in inches
3. Watersheds above gage 11456500, POI1, and POI2 acquired from AutoCAD files used for map in 2020 WAA. Q:\Drawings\Somerston Vineyards\CAD\Hydrologic Analysis Map (Jan 2020).dwg
4. PRISM per Napa County. Downloaded from Napa County REST backend using a REST downloader tool https://gis.countyofnapa.org/arcgis/rest/services/Hosted/MeanPrecip_WY_2012_2021_PRISM/FeatureServer/ https://cartong.github.io/arcgis-rest-service-export/
5. PRISM geospatial data clipped to watershed using ArcGIS Pro clip tool
6. Clipped PRISM .dbf files exported to excel using ArcGIS Pro table to excel tool
7. Data average calculated in excel
8. Mean annual precipitation for the three watersheds calculated taking into account differing sizes of polygons in the PRISM layer

Sum of all ((Shape_Area ÷ Sum of all Areas in Shape_Area Field) x Average Rain)

Average Yearly Precipitation For Watershed Above USGS #11456500 (in)	**30.28**
Average Yearly Precipitation For Watershed Above POI #1 (in)	**29.27**
Average Yearly Precipitation For Watershed Above POI #2 (in)	**28.95**



Appendix E

Hydrology and Water Quality Monitoring Plan

Lake Hennessey and Milliken Reservoir Watershed Study

Hydrology and Water Quality Monitoring Plan

A Deliverable

to

Napa County and the City of Napa

Prepared by

Scott Sheeder and Joel Herr

Systech Water Resources, Inc.

Walnut Creek, CA 94596

Revised May 2019

Introduction

The recently developed WARMF models for the Lake Hennessey and Milliken Reservoir watersheds will provide a useful tool for understanding and protecting the critical drinking water supply watersheds by informing management decisions. Development of the model is described in the Model Documentation Report for the Lake Hennessey and Milliken Reservoir Watershed Study, Systech Water Resources Inc., February 2019. There is still uncertainty associated with the WARMF simulation results for the Lake Hennessey and Milliken Reservoir models. The cumulative uncertainty is comprised of many individual components but is generally a combination of uncertainty in the water quality input data and uncertainty associated with the model calculations. Model uncertainty can be reduced significantly through calibration of simulation results to measured water quality and quantity data. In the case of the Lake Hennessey and Milliken Reservoir WARMF models, the limited measured data for key water quality parameters in tributaries limits the ability to accurately and precisely calibrate the models to the range of hydrologic conditions that may be present in these watersheds. This document describes a monitoring and analysis plan to gather data to inform and calibrate the WARMF models.

While the focus of this document is on water quality sampling design to facilitate watershed model calibration, there are many additional benefits of monitoring a water resource. Consistent and comparable water-quality monitoring data are needed for describing the status and trends of a water resource, preventing harm to a water resource through early change detection, determining compliance with health standards, predicting the effects of proposed projects or other changes, and documenting regulatory compliance. Regardless of the parameters included in a monitoring plan, it is essential that the plan is executed in a fashion that enables interested parties to use the data to support each of these initiatives. The USGS and USEPA, through the National Water Quality Monitoring Council, are working to identify and document a suite of acceptable, standardized field and laboratory methods. This effort has led to the creation of the National Environmental Methods Index (NEMI), available at: www.nemi.gov. NEMI provides a thorough review of acceptable methodologies that should be consulted throughout the process of sampling design in accordance with EPA requirements for projects involving surface and groundwater monitoring and collection and analysis of water samples using ELAP-certified laboratories.

Recommendations for implementation of a water quality sampling strategy are divided into separate sections below: spatial considerations, temporal considerations, chemical parameters, and additional considerations. The recommendations are designed to provide sufficient information to inform management decisions, identify areas that may impact water quality with respect to drinking water treatment processes, address aesthetic impacts to customers and enforce state and federal drinking water regulations. The recommendations provided are also intended to acquire the data necessary to calibrate the WARMF models so that they can simulate nutrient dynamics with both accuracy and precision, thereby enabling watershed managers to use the models to monitor the state of the watersheds and determine how activities in the watershed will affect the quality of water in the reservoirs. Should there be additional reasons to collect water quality data other than those already stated in the above objective, then changes to the proposed strategy may be required. It is also important to note that the proposed strategy is intended to supplement, not replace, existing water quality monitoring within the watersheds. Data collected as part of this sampling plan should be stored in a publicly available database, along with other sources of water quality and hydrology information. Future efforts to calibrate the WARMF models will rely on all available data, including data collected in conjunction with development or other activities which require monitoring of aquatic resources.

Spatial Considerations

Lake Hennessey Watershed

The majority of locations where tributaries enter each of the lakes, referred to as lake loading sites, are established monitoring locations. In the Lake Hennessey watershed, five locations have been monitored previously (see Figure 1). These sites are labeled H4, H11, H16, H17, and H18 on Figure 1, and are well positioned to accurately account for the majority of flow and chemical constituent load to Lake Hennessey. Two additional lake loading sites are suggested: H5 and H6. If these two sites are added to the sampling network, they will complete the accounting of loading to the Lake. While these sites are important for calibrating the WARMF model, they do not provide information on loading sources within the watersheds.

Water quality in the tributaries upstream of the lake loading sites is currently not monitored. A number of monitoring locations are proposed so that watershed managers and modelers can begin to understand the effects of land use, soils, and other watershed characteristics on hydrology and water quality within the Lake Hennessey watershed. Land use distribution is illustrated in Figure 1 and tabulated in Table 1, and soil map units are displayed in Figure 2. Land use and soil characteristics are typically the dominant drivers of stream hydrology and water quality, so both are used to inform the location of sampling sites. An attempt is made to select sampling locations that delineate areas of uniform land use and/or soil characteristics so that the influence of these characteristics on hydrology and water quality can be directly evaluated. It is important to note that many of the suggested sampling sites are located on private property and permission to access the sites will need to be arranged prior to finalizing the monitoring plan. The plan includes some redundancy in site selection (e.g. multiple sites with similar characteristics) so that if it is not possible to access a site or two, data collected at the remaining sites will be sufficient to define the relationships between watershed characteristics and hydrology/water quality. Once defined, these relationships can be used to improve the accuracy of, and confidence in the calibration of the WARMF models.

Three additional sites are proposed for the Conn Creek watershed: H1, H2, and H3. It is recommended to establish a water quality monitoring site, H1, on Conn Creek at Howell Mountain Road downstream of the town of Angwin. The contributing area upstream of this site (Figure 1) contains the only developed/commercial property in the watershed. Obtaining information on the water quality downstream of these land uses would aid in calibration of simulated hydrologic and chemical processes associated with septic systems, the land discharge from the Pacific Union College wastewater treatment plant, and the developed land use class in general (Table 1 provides a breakdown of land use upstream of each of the proposed sampling locations). H2 is proposed because the contributing area contains many vineyards, and H3 would provide useful information on the response of native vegetation to precipitation.

Four new sites are proposed within the Chiles Creek watershed. One sampling site (H9) should be added on Moore Creek upstream of the confluence with Chiles Creek, and one added on Chiles Creek, just upstream of the confluence with Moore Creek (H10). Adding these two locations would provide additional information for model calibration since Moore Creek is a relatively large watershed comprised predominantly of forest and scrub, while Chiles Creek drains an area with vineyards in the headwaters. Two sites, H7 and H8, are proposed to characterize hydrology and water quality originating from the vineyards located in the Chiles Creek headwaters. These sites are also characterized by different soils than downstream sites, so sampling at these locations will provide additional information on the influence of these soils on hydrology and water quality.

Four new sites are proposed within the Sage Creek watershed. Information on watershed response to different land use classes and soil type could be generated by establishing water quality sampling locations on Sage Creek upstream of the unnamed tributary which drains Fir Canyon ("Fir Canyon Creek"), and on Fir Canyon Creek upstream of the confluence with Sage Creek (sites H14 and H15). These two drainage areas also have very different land use composition, and monitoring both would enable modelers to refine the coefficients associated with the different land use classes. The Sage Creek watershed is somewhat similar in structure to the Chiles Creek watershed, in that intensive vineyard development has occurred in the headwaters. Sites H12 and H13 are proposed to monitor the effects of vineyard development on hydrology and water quality. Similar to sites H7 and H8, sites H12 and H13 drain a soil type that is different from the surrounding catchments.

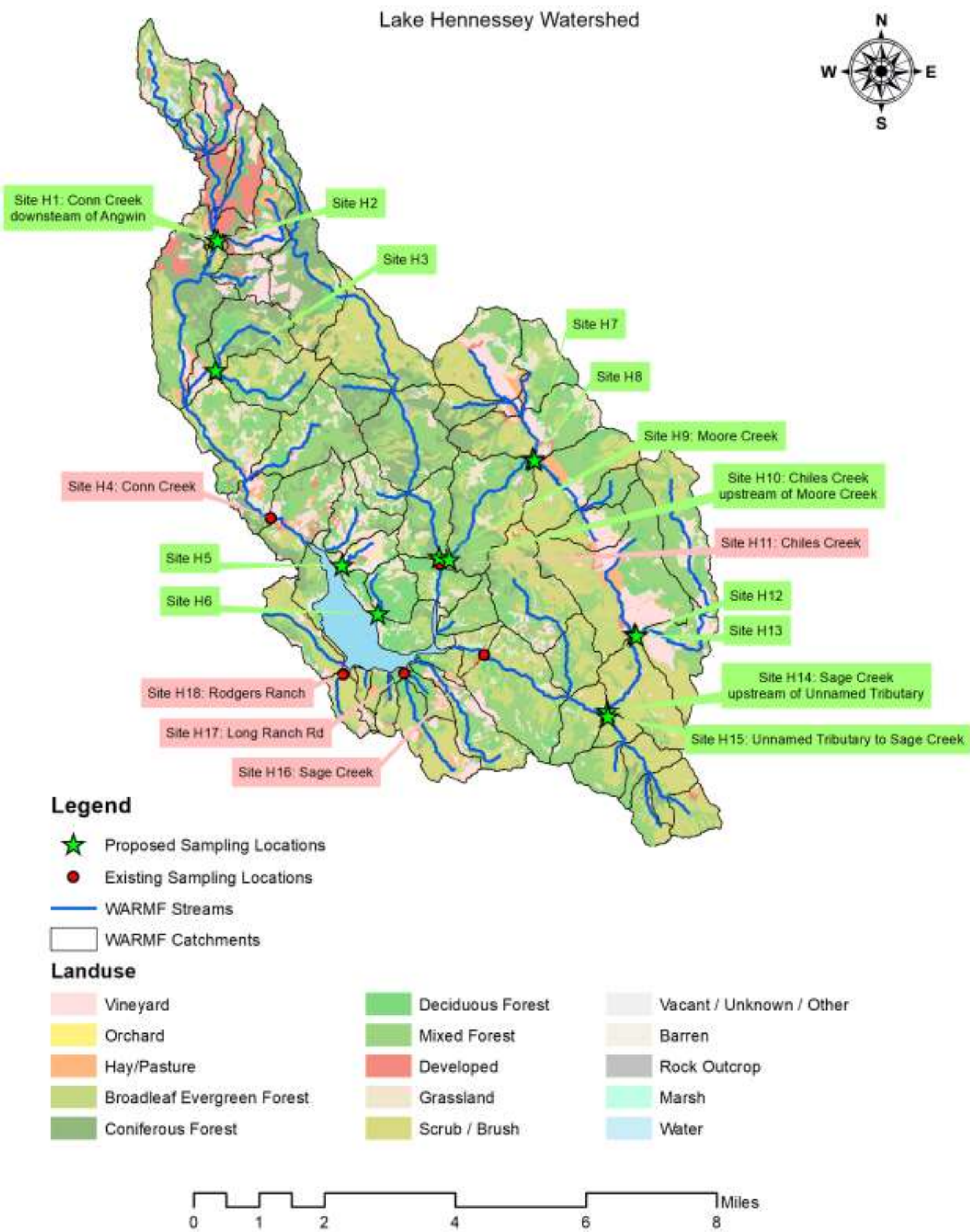


Figure 1 Existing and proposed water quality sampling locations within the Lake Hennessey watershed

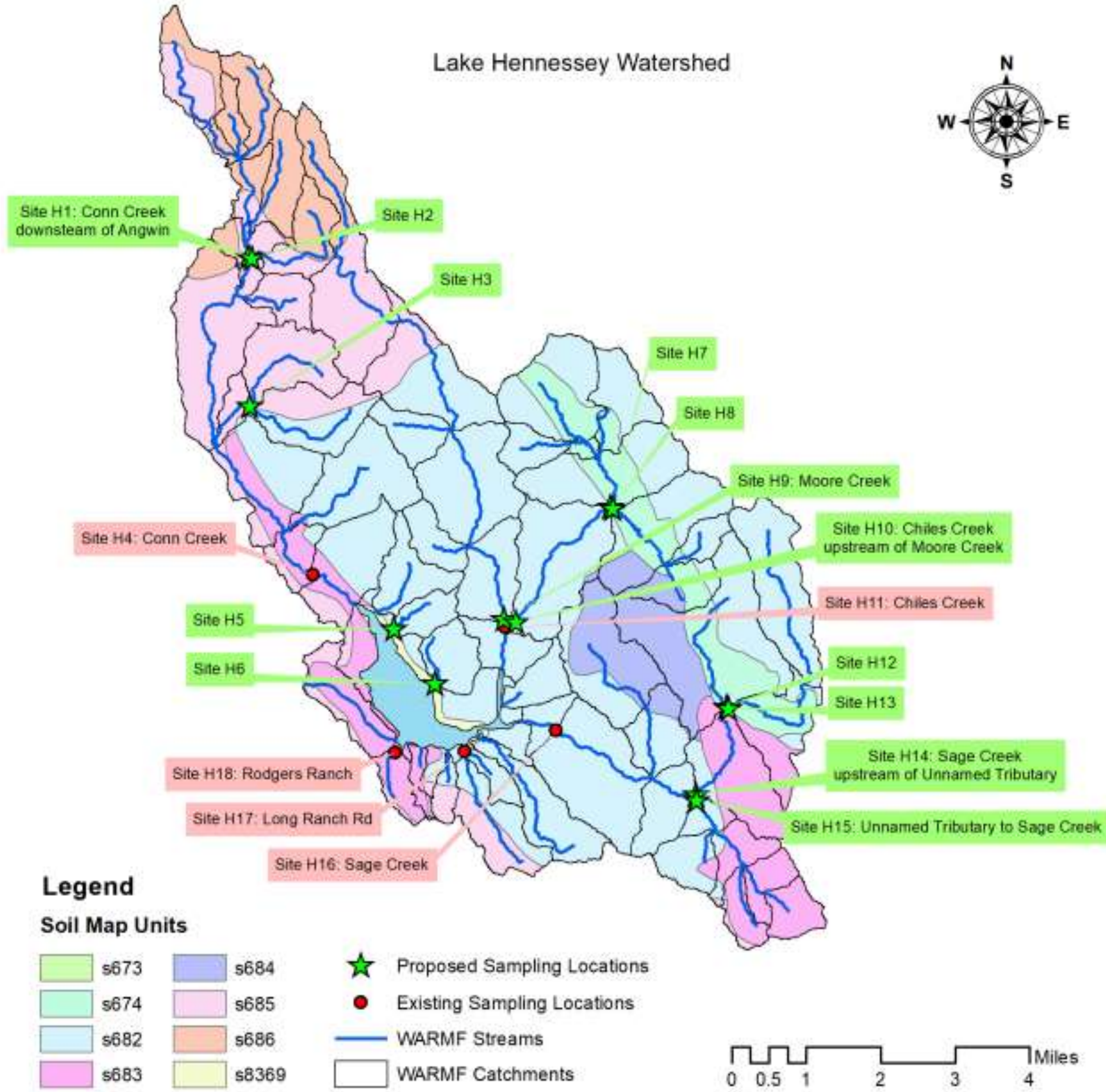


Figure 2 Soil map units located within the Lake Hennessey watershed

Table 1 Drainage area and land use characteristics for Lake Hennessey watersheds upstream of proposed water quality sampling locations

	Watershed Area (Acres)	Forest	Developed	Grassland /Hay /Pasture	Orchard	Scrub/Brush	Vineyard	Water/Marsh	Vacant /Unknown /Other
H1	2,089	39%	26%	8%	0%	8%	15%	4%	0%
H2	476	43%	6%	20%	0%	1%	27%	4%	0%
H3	675	79%	1%	3%	0%	14%	3%	0%	0%
H4	7,872	59%	9%	11%	0%	9%	10%	2%	0%
H5	225	31%	2%	29%	11%	0%	25%	2%	8%
H6	369	76%	0%	23%	0%	1%	0%	0%	0%
H7	2,715	55%	1%	16%	0%	18%	10%	1%	0%
H8	1,521	55%	1%	8%	0%	24%	11%	0%	0%
H9	4,496	68%	0%	8%	0%	21%	3%	0%	1%
H10	5,403	60%	1%	12%	0%	19%	9%	0%	0%
H11	9,929	63%	1%	10%	0%	20%	6%	0%	0%
H12	1,867	55%	2%	7%	0%	20%	15%	1%	0%
H13	1,635	47%	0%	8%	0%	27%	16%	1%	0%
H14	4,338	46%	1%	7%	0%	32%	13%	1%	0%
H15	1,562	53%	1%	1%	0%	45%	0%	0%	0%
H16	8,988	54%	1%	5%	0%	32%	8%	0%	0%
H17	626	41%	2%	3%	0%	39%	14%	0%	0%
H18	234	18%	1%	0%	0%	65%	16%	0%	0%

Milliken Reservoir Watershed

There is very little water quality information available to aid in WARMF model calibration in the Milliken Creek watershed. The two sites that have been established (Site M2: Walt Ranch upstream and Site M3: Walt Ranch downstream) were established to evaluate the effects of a specific contributing area on water quality, but do not provide enough data to accurately calibrate a watershed model. The establishment of additional sites would provide useful information. The location of proposed sites is provided in Figure 3. A site located approximately one quarter mile upstream of where Atlas Peak Road crosses Milliken Creek (site M1) would be useful because the site characterizes a drainage area with extensive longstanding and established vineyard development. The Walt Ranch Upstream site (site M2) is useful coupled with M1 because it will show water quality upstream and downstream of a project prior to and after land use changes are implemented. There is a tributary entering Milliken Creek from the north that drains a forested/grasslands region which has different characteristics than the agricultural portion of the Milliken Creek watershed that is located upstream from this tributary (satellite imagery shows this tributary as an intermittent stream channel, entering Milliken Creek approximately one quarter mile upstream of Atlas Peak Road).

There are four additional sites proposed. Similar to the process employed to select sites in the Lake Hennessey watershed, sites in the Milliken Reservoir watershed were selected to characterize the variability found in both land use (Figure 3) and soils characteristics (Figure 4). These sites are all located downstream of Walt Ranch (site M3), and include:

- Site M4: unnamed tributary to Milliken Creek, selected because the contributing area is representative of natural ground cover (Figure 3, Table 2). Also selected because the soils in the watershed are different from other sampling locations (Figure 4).
- Site M5: unnamed tributary to Milliken Creek, proposed because the creek drains a subbasin that is small but has a high percentage of developed land immediately adjacent to the stream channel (Table 2)
- Site M6: Milliken Creek immediately upstream of the reservoir, proposed because it characterizes the contribution of Milliken Creek discharge and water chemistry to Milliken Reservoir
- Site M7 – Unnamed tributary to Milliken Reservoir, proposed because this is the second largest watershed draining into Milliken Reservoir and is a potentially significant source of discharge and chemical load to the reservoir.

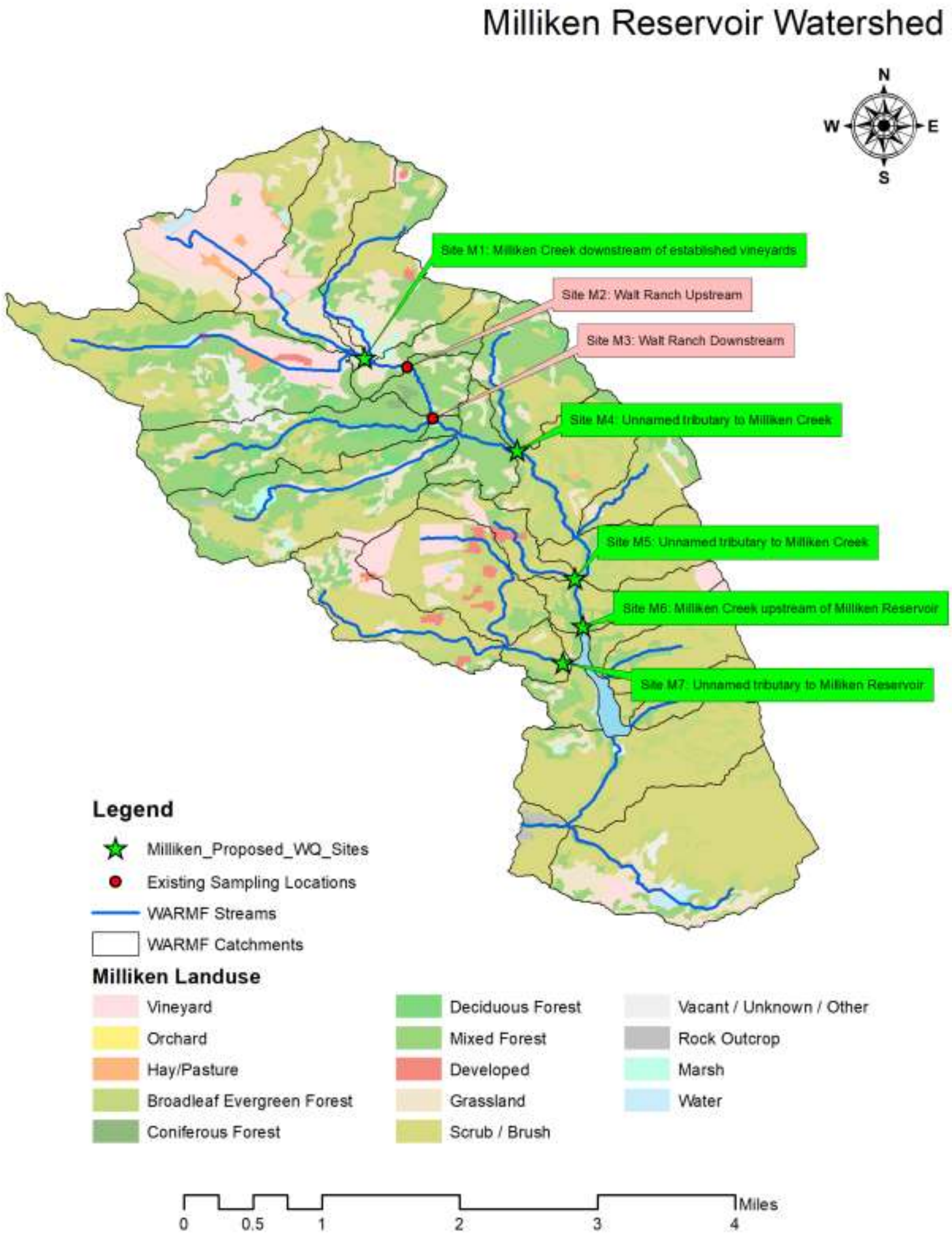


Figure 3 Existing and proposed water quality sampling locations within the Milliken Reservoir watershed

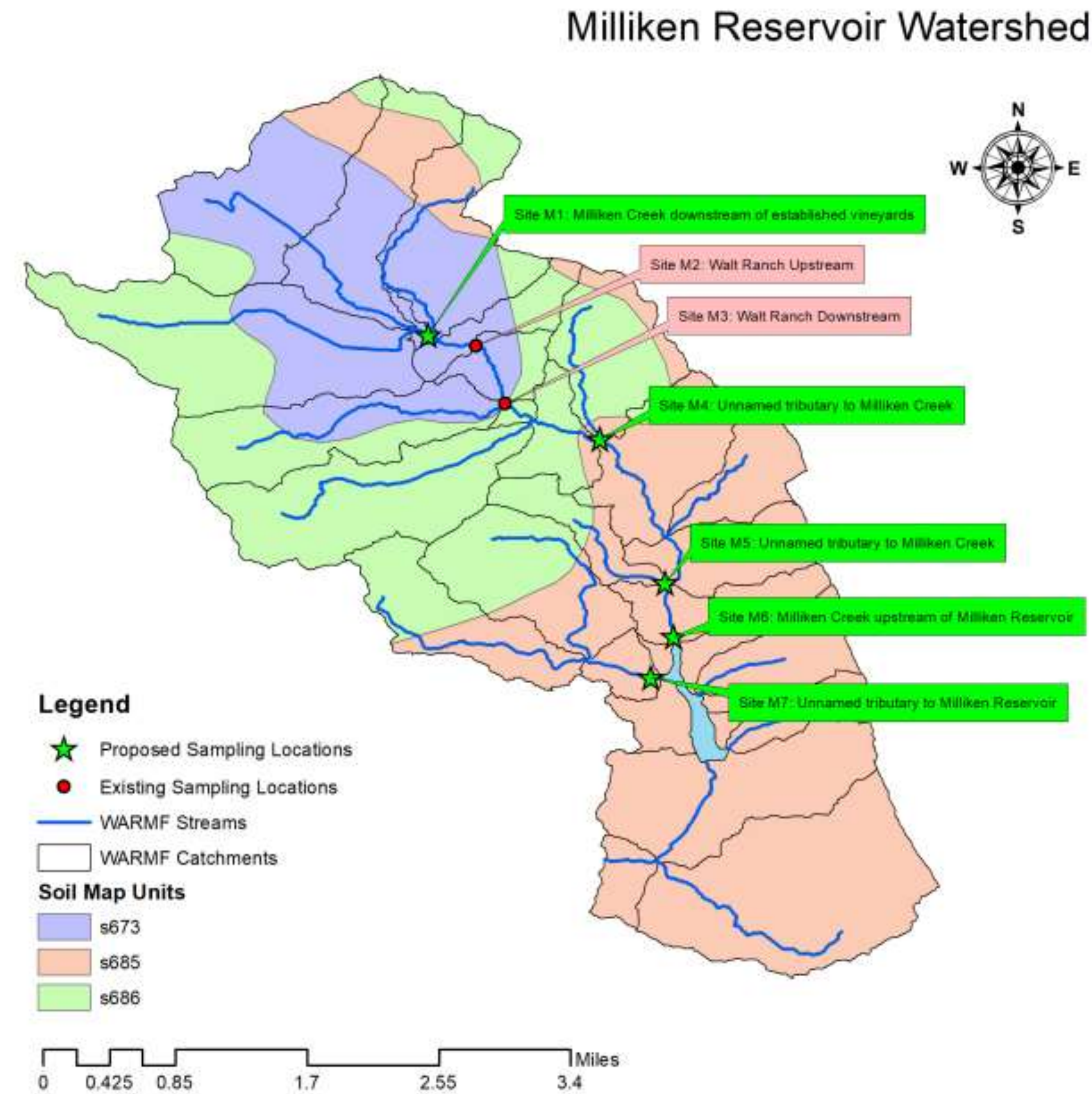


Figure 4 Soil map units located within the Milliken Reservoir watershed

Table 2 Drainage area and land use characteristics for Milliken Reservoir watersheds upstream of proposed water quality sampling locations

	Watershed Area (Acres)	Forest	Developed	Grassland /Hay /Pasture	Scrub/Brush	Vineyard	Water/Marsh	Vacant /Unknown /Other
M1	1,630	30%	1%	16%	26%	23%	2%	3%
M2	2,160	33%	1%	19%	26%	18%	2%	2%
M3	2,271	35%	1%	19%	24%	17%	2%	2%
M4	304	67%	0%	9%	23%	1%	0%	0%
M5	137	36%	7%	3%	45%	9%	0%	0%
M6	4,712	45%	0%	13%	30%	9%	1%	2%
M7	758	28%	4%	5%	47%	15%	1%	0%

Temporal Considerations

A review of existing water quality and hydrology data indicates that the water quality samples that have been collected only represent a relatively narrow segment of the hydrologic conditions that occur in these watersheds. A water quality sampling strategy should be designed to determine the quality of surface waters across the entire range of river discharge experienced in the Lake Hennessey and Milliken Reservoir watersheds. Higher flow conditions are particularly important to monitor since that is when the vast majority of storage water enters Lake Hennessey and Milliken Reservoir. Water quality sampling plans are also designed to address specific questions, and Napa County personnel have indicated that the following are important considerations for sampling design:

- Is the water of acceptable quality for drinking after existing treatment processes (conventional treatment for Lake Hennessey and direct filtration for Milliken Reservoir?)
- Is water quality getting better or worse?
- What is causing the pollution or deterioration of a given lake or stream?

Answers to each of these questions are influenced by the timing of and trends in water quality.

To adequately characterize the quality of water flowing into Lake Hennessey and Milliken Reservoir, samples should be collected at regular intervals throughout the year at each of the locations illustrated in Figure 1 and Figure 3. Ideally, samples would be collected every two weeks during the winter months and through early summer when the creeks are contributing flow to the reservoirs for the first several years (exact length of time is dependent upon data variability) to determine the extent to which concentration of the selected parameters varies with discharge and with season. Additionally, more frequent sampling is likely warranted to capture effects of episodic events such as agricultural fertilizer, pesticide or herbicide application, wildfires, illegal spills or dumping, floods, timber removal, pond draining and agricultural crop harvest. It also provides a better indication of ongoing sources of potential contamination, such as livestock, recreational users, wildlife, and wastewater leach fields.

Storm event sampling should be incorporated into the sampling strategy to characterize the transport of chemical constituents during precipitation events. Collecting samples at regular intervals as streams rise then recede from precipitation events is useful for WARMF model calibration because the chemical signature of water during precipitation events can be used to calibrate overland flow, soil erosion, soil hydrology, and soil pore water chemistry parameters. Storm event sampling could be conducted during a small number of storms (1-3) to start, then expanded if there is significant variability in the data obtained. At a minimum, the proposed sampling locations should include those shown on Figure 2 upstream of Milliken Reservoir and Figure 1 for tributaries that feed Lake Hennessey. The plan includes areas that are already under the influence of land use changes as well as areas, to the extent possible, that are in a natural state. Storm event sampling will be expanded to progress upstream in a sub-basin if results identify water quality concerns.

The most expedient and accurate way to populate and facilitate calibration of the model's water quality predictive capabilities is to sample and analyze sites that represent land use changes. Proposed sample sites recommended based on tributary flow in sub-basins may be physically challenging to access, therefore proposed project sites may be the best to facilitate access to waterways. The City, County and private landowners should work together to facilitate access to sample points, sampling and analyses of water quality data, and use the results to ensure the accuracy and value of the WARMF model.

Chemical Parameters

Table 3 includes a recommended list of core hydrology and water quality parameters that are commonly measured to evaluate waters facing potential degradation. The collection of data for the various forms of nitrogen, phosphorus, organic matter, turbidity, and dissolved oxygen are important for calibrating the WARMF model to accurately simulate the watershed transport and transformation processes which affect the loading of nutrients to the reservoirs. This directly addresses the key concern of potential eutrophication of the reservoirs. Measurements of conservative ions and total dissolved solids are valuable for protecting water supply but are also useful for WARMF model calibration to discern how atmospheric, geologic, and anthropogenic sources of chemical constituents are transported through the watershed. Collection of these data over a period of several years will facilitate improved calibration of the WARMF models for the Lake Hennessey and Milliken Reservoir watersheds.

Table 3 Recommended water quality sampling constituents for the Lake Hennessey and Milliken Reservoir watersheds

Field Measurements	Laboratory Analyses
Stream discharge	Total Kjeldahl nitrogen (organic N + ammonia + ammonium)
Water temperature	Soluble Kjeldahl nitrogen
Air temperature	Nitrate + nitrite
Specific conductance	Ammonia, Ammonium
Dissolved Oxygen	Total phosphorus
pH	Total soluble phosphorus
Turbidity	
	Orthophosphate
	Total organic carbon
	Dissolved organic carbon
	Chlorophyll a
	Total suspended solids
	Total dissolved solids
	Total volatile suspended solids
	Carbonaceous biochemical oxygen demand (CBOD5)
	Sulfate
	Chloride
	Total hardness
	Alkalinity
	Fecal coliform/*E.coli*
	Calcium
	Pesticides and Herbicides (i.e. simazine, di(2-ethylhexylphthalate) (DEHP)

The estimated costs associated with analyzing water quality samples for the constituents listed in Table 3 are provided in Table 5. The estimated cost accounts for laboratory analysis only. The labor costs associated with collection and delivery of samples are not included in this estimate, and can be a significant portion of the overall sampling budget.

Monitoring Priority

This document provides guidance on how to monitor the inflows to Lake Hennessey and Milliken Reservoir to provide a robust set of data for watershed modeling and to provide documentation of degradation of reservoir water quality over time. Given that resources are limited, below in Table 4 are suggested priorities for sampling locations to provide the greatest possible benefit.

Table 4 Prioritized Recommended Water Quality Sampling Sites

	Lake Hennessey Watershed	Milliken Reservoir Watershed
First Priority	• Lake loading sites: H4, H5, H6, H11, H16, H17, H18 • H1 • H2 • H3 • H7 & H8, *or H12 & H13* • H9 & H10, *or H14 & H15*	• M1 • M2 R • M3 R • M4 R • M5 R • M6 • M7 R
Second Priority	• *H7 & H8, or* H12 & H13 • *H9 & H10,* or H14 & H15	

R = Reduced frequency of sampling. Early season, peak storm & late season only.

There is some redundancy built into the proposed sampling strategy. Sampling all locations will provide a very complete dataset, which would be ideal for model calibration. If budget constraints and/or landowner access permission prevent the full implementation of the plan, sites listed as second priority can be omitted as necessary. In the lake Hennessey watershed, lake loading sites should be considered the top priority, followed by site H1, which characterizes hydrology and water quality downstream of Angwin. Sites H2 is valuable because it will represent data gathered before and after proposed land use changes. Site H3 represents soil type similar to that found in the Angwin region however the land is relatively undeveloped. Sites H7 and H8 will provide similar information as sites H12 and H13, so one of these pairs could be omitted if necessary. Sites H9 and H10 are very similar to sites H14 and H15, so again, one of these pairs could be omitted.

In the Milliken Reservoir watershed, site M1 characterizes hydrology and water quality characteristics originating from an area of intense vineyard development. Sites M4, M5, and M7 provide useful information on other land use configurations, and site M6 quantifies hydrology and chemical loading to the lake. These sites are the top priority for sampling. Sites M2 and M3 are valuable because they will represent data gathered before and after proposed land use changes. The sites are being evaluated by the Walt Ranch Project although the list of constituents being analyzed is less extensive than the list defined in this report.

It is recommended that all the constituents listed in Table 3 be sampled together to get a complete analysis of pollutant loading. While stream sampling every two weeks is recommended, more frequent sampling is recommended during the wet season, November – May. This will provide higher resolution data when flow is highly variable and most of the loading is entering the reservoirs. Stream sampling may be done monthly during the dry season or skipped if there is no flow at the sampling sites. Storm event sampling should be done at regular intervals during at least three precipitation events to calibrate the WARMF model simulation of pollutant loading under high flow conditions. ISCO samplers or similar equipment can be used to automatically collect and preserve the samples, which can then be sent off for analysis. Ideally, the storms that are sampled will be at different times of the year, and the program will be expanded to acquire additional data if there is substantial water quality variability between storm events. Reservoir sampling should be conducted throughout the year, as different processes dominate during high flow and low flow regimes (e.g. algae blooms are more likely during low flow, while nutrient concentrations may be higher following precipitation events). As a cost savings measure, the higher cost analyses for pesticides and herbicides could be reduced to monthly instead of every two weeks at the beginning of the program. The analyses can be refined to correspond with data reported to the Agricultural Commissioner such that seasonal application of the fertilizers, pesticides and herbicides take into consideration runoff and the potential for transport whether that is first flush after the dry season, midwinter storms, or spring flows. The monitoring plan should include an adaptive process to evaluate the value of the data collected and refine the locations and frequency of sampling.

Cost of Analyses

Table 5 Estimated Cost of Laboratory Analysis

Laboratory Analyses	Cost (USD/Sample)
Dissolved oxygen	Field measurement
pH	Field measurement
Turbidity	$28.00
Specific conductance	$32.00
Total Kjeldahl nitrogen (organic N + ammonia + ammonium)	$ 50.00
Soluble Kjeldahl nitrogen	$ 50.00
Nitrate + nitrite	$ 50.00
Ammonia, Ammonium	$ 42.00
Total phosphorus	$ 50.00
Total soluble phosphorus	$ 50.00
Orthophosphate	$ 50.00
Total organic carbon	$ 50.00
Dissolved organic carbon	$ 50.00
Total suspended solids	$ 42.00
Total dissolved solids	$ 42.00
Total volatile suspended solids	$ 45.00
Carbonaceous biochemical oxygen demand (CBOD5)	$ 75.00
Sulfate	$ 42.00
Chloride	$ 42.00
Total hardness	$ 35.00
Alkalinity	$ 35.00
Fecal coliform/*E.coli*	$ 60.00
Calcium	$ 42.00
Pesticides and Herbicides	$ 525.00
Total:	$1,487.00

The total expense associated with analysis of one water sample for all parameters listed in Table 5 is $1,487. If all of the proposed water quality sampling locations are sampled (25 sites, 18 in the Lake Hennessey watershed and 7 in the Milliken Reservoir watershed), total analysis cost per sampling event is $37,175. If each site is sampled bimonthly or every two weeks, as originally recommended to quickly populate the model and capture variances in water quality throughout the season, annual expenses for laboratory analysis will be $527,885. Annual costs will be higher when the expenses associated with sample collection and transport are incorporated. This estimate is shown in Table 6, Option A.

In an effort to contain costs and in recognition that the monitoring and analyses program will be adapted (increased or decreased) over time based on the results, a subset for the initial monitoring plan is described in Table 6: Option B. Option B includes monthly monitoring during the winter months at representative 14 sites including H7 & H8 as well as H9 & H10 on Chiles Creek. The representative sites H12 & H13 as well as H14 & H15 have similar variables to the aforementioned sites but are located on Sage Creek so they will be added in the future if warranted based on data-centric plan revisions. The total analysis cost per sampling event is $31,227. Due to the reduced number of sites and frequency (monthly instead of the recommended bimonthly) the total annual cost for Option B is $260,225.

In Milliken watershed, both options allow for reduced monitoring of sites that are between the highest and lowest points in Milliken Creek. Sites M2, M3, M4, M5 and M7 are proposed to start as reduced frequency of monitoring. These samples are located downstream and upstream of full sampling sites, therefore they could be sampled early in the rainy season, within 48 hours of a peak storm and at the end of the rainy season. Depending on the first few years of data, the frequency of these sites may be increased to match the other sampling sites.

Table 6 Estimated Cost of Analyses for a Monitoring Event

Option A: Bi-monthly Analyses during the winter months.

	No. of Sites	Cost of Analysis per Site	Cost per Sampling Event	Frequency of Analyses per Year Bi-Monthly Nov-May	Frequency of Analyses During Storms	Total
Hennessey	18	$1487	$26,766	14	3	$455,022
Milliken	2	$1487	$2,974	14	3	$50,558
Milliken *Reduced*	5	$1487	$7,435	2	1	$22,305
					Subtotal:	**$527,885**

Option B:

	No. of Sites	Cost of Analysis per Site	Cost per Sampling Event	Frequency of Analyses per Year Monthly Nov-May	Frequency of Analyses During Storms	Total
Hennessey	14	$1487	$20,818	7	3	$208,180
Milliken	2	$1487	$2,974	7	3	$29,740
Milliken *Reduced*	5	$1487	$7,435	2	1	$22,305
					Subtotal:	**$260,225**

Due to the expense associated with water quality analysis, the proposed sampling plan should be evaluated under an adaptive management framework. Location and frequency of sampling can and should be adjusted based on review of initial sampling results. For example, if an analyte shows very little variability over a range of hydrologic conditions, the frequency with which that analyte is measured can be decreased. It is also reasonable to consider that not all chemical constituents need to be analyzed at all locations. For example, if there is no potential source of pesticides or herbicides in the watershed upstream of a sampling location, that analyte may be removed from the list of analyses to conduct for that location, or the frequency with which the analyte is measured can be reduced. The analyte can be reincorporated back into the sampling design if conditions in the watershed change.

Additional Considerations

The WARMF watershed models of the Lake Hennessey and Milliken Reservoir watersheds were constructed so that resource managers would have tools at their disposal to evaluate the effects of land management decisions on local water resources. The models are capable of simulating water quality and hydrology in the watersheds upstream of Lake Hennessey and Milliken reservoir. The calibration of these models could be extended in the future to provide the capability to investigate how watershed condition affects water quality in the reservoirs. If resource managers are interested in simulating reservoir processes, the water quality sampling should be expanded to include sampling within the lakes for the same parameters. Lake sampling is time consuming and expensive, so samples can be collected less frequently than river samples. Monthly sampling over several years would yield valuable information. Reservoir simulation would require water quality data collected both at the surface and at depth. Vertical profiles of temperature and dissolved oxygen, which the City has actively collected for over two decades within Lake Hennessey, are key needs to calibrate a model which simulates the stratification of the reservoirs. Because of seasonal taste and/or odor events within Lake Hennessey, the City analyzes surface water samples for algae identification to assist with water treatment operations. To confirm taste and/or odor events in the source water, Geosmin and 2-MIB methyl isoborneol (MIB) sampling is performed monthly. It is also important to consider that reservoirs may be threatened by eutrophication as existing data trends indicate. Source water management is critical for the City to ensure high drinking water quality, manage the aesthetics of the water and to maintain public trust. If the reservoirs become eutrophic in the future, having historical water quality data that illustrates the relationship between the watershed nutrient load and reservoir chlorophyll-a concentrations would be valuable from both a modeling and a regulatory perspective.

Reservoir water quality is largely dependent upon the load of pollutants that enters the reservoir from upstream. The water quality sampling recommendations provide only a portion of the information needed to estimate loading; continuous flow monitoring is also required. Stream gages are operational in the Lake Hennessey watershed, and these gages facilitated hydrology calibration of the WARMF model. However, these gages are designed for measuring base flow and are not accurate at high flow. This situation deserves attention and resources since, from a loading perspective, it is possible for the majority of pollutant load to enter Lake Hennessey during only a handful of extreme events. If improvements to the discharge monitoring are not made it will be more difficult to accurately assess the extent of pollutant loading to the reservoir during these peak events.

In the Milliken Reservoir watershed, accurate flow gages are challenging due to the inconsistent formations and steep channels. There is a gage on Milliken Creek at the reservoir for which data was reported in real-time to napa.onerain.com. This gage only measures depth though – a rating curve, which relates depth to stream discharge, would make the gage much more useful for modeling. The available operations data for Milliken Reservoir includes inflow, reservoir elevation, dam spill, and diversion flow. The data was often inaccurate or incomplete at very high flows and very low flows. To address this issue synthesized total outflow was generated as an input to the WARMF model. Establishing a reliable stream discharge gage on Milliken creek upstream of the reservoir and complete records of discharge from the dam would be extremely helpful for both WARMF hydrology calibration and the quantification of pollutant loads entering and leaving the reservoir.

Recommendations

The goals set out in this effort are to create the WARMF model to understand the status and trends of water quality associated with Lake Hennessey and Milliken Reservoir watersheds, define and predict the spatial and temporal effects of land use changes, and inform land use decisions in the municipal watersheds. To meet these goals and ensure short and long-term protection of water quality in the municipal watersheds, it is recommended that at minimum, the sampling and analyses within the Lake Hennessey and Milliken Watersheds be implemented as defined in Option B. The proposed sample sites must be field-verified to ensure safe and consistent accessibility. City and County staff shall work with adjacent landowners, where applicable to ensure accessibility. Field monitoring instruments that log data real-time shall be considered to gather data for parameters for which the instrumentation is available and feasible. This needs to be considered on a site by site basis since securing and maintaining instruments can be a challenge under high flow conditions. If feasible, the initial costs will be higher, but instrumentation can be less costly in the long term. Currently instruments that log conductivity, turbidity, temperature, pH, nitrate, ammonia and dissolved oxygen are available for purchase. Annual data shall be assessed to determine the effectiveness of the monitoring and analysis program. As data trends are developed, adjustments shall be made to increase or decrease the number of sample sites as well as modify the location and/or frequency of sampling. Over time, the data and calibrated WARMF model will simulate nutrient dynamics with both accuracy and precision, thereby enabling watershed managers to monitor the state of the watersheds and determine how existing and proposed activities in the watershed might affect the quality of water in the reservoirs. This information will inform decisions for land use and associated requirements for land use to ensure drinking water quality protection.

Appendix F

KJS and Sorrento
#P17-00432-ECPA
Conditions of Approval

CONDITIONS OF APPROVAL

KJS AND SORRENTO VINEYARD CONVERSION EROSION CONTROL PLAN APPLICATION #P17-00432-ECPA

Open Burning—Condition of Approval:

The owner/permittee shall conduct open burning of cleared vegetation in accordance with BAAQMD Regulation 5, which allows open burning only during specified burn periods. Prior notification shall be submitted to BAAQMD and documentation of compliance shall be submitted to Napa County.

Hazardous Materials—Conditions of Approval:

The owner/permittee shall implement the following best management practices:

- The owner/permittee shall implement the Hazardous Materials Business Plan (DHD Permit #2920) with the Napa County Division of Environmental Health documenting all proposed hazardous materials to be used on-site during construction and operation. If storage amounts or the use of hazardous materials change during project operation, the owner/permittee shall update the Hazardous Materials Business Plan, as necessary. The Napa County Division of Environmental Health will review the plan and may conduct inspections to ensure that the Hazardous Materials Business Plan is being followed during project operations. Updates to the Hazardous Materials Business Plan, if warranted, will be made through the California Environmental Reporting System.
- The owner/permittee shall refrain from disposing of debris, storing materials, or constructing and operating the vineyard (including vineyard avenues) outside the boundaries of the approved plan, or within required setbacks pursuant to Napa County Code Section 18.108.025 (General Provisions–Intermittent/Perennial Streams). Furthermore, consistent with best management practices for hazardous materials, and to avoid the risk of contaminating surface water or groundwater, all operational activities that include the use or handling of hazardous materials (e.g., storing and washing agricultural chemicals; using portable restrooms; refueling, maintaining, and storing vehicles and equipment; and storing soil amendments) shall occur at least 100 feet from groundwater wells, watercourses, streams, and any other water resources. This requirement shall apply whether or not such activities occurred in these areas before this ECPA.
- During construction and operation, best management practices consistent with recommendations from the Napa County Division of Environmental Health shall be used

to reduce contamination of surface water and groundwater by hazardous materials. Best management practices may include but are not limited to:

- Workers shall follow manufacturers' recommendations on the use, storage, and disposal of chemical products.
- Workers shall avoid overtopping fuel gas tanks and shall use automatic shutoff nozzles where available.
- During routine maintenance of equipment, grease and oils shall be properly contained and removed.
- Discarded containers of fuel and other chemicals shall be disposed of properly.
- Spill containment features shall be installed at the project site wherever chemicals are stored overnight.
- All refueling, maintenance of vehicles and other equipment, handling of hazardous materials, and project staging areas shall occur at least 100 feet from watercourses, the existing groundwater well, and any other water resource to avoid the risk of surface water or groundwater contamination.
- To prevent the accidental discharge of fuel or other fluids from vehicles and other equipment, all workers shall be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.

Water Quality Monitoring—Condition of Approval

The owner/permittee shall grant access to the City to defined access points to the waterways upstream and downstream of the development area to conduct water quality monitoring in accordance with the City and County's 2019 Memorandum of Understanding and 2022 Amendment No. 1 (and any subsequent amendments or extensions thereto) and its associated Hydrology and Water Quality Monitoring Plan. Sample analyses shall be conducted after rain events when the creeks are flowing. Should runoff water exhibit the presence of increased nutrients or any synthetic/manufactured man-made constituents, the City will work with the owner/permittee to ensure that BMPs are adjusted to protect water quality.

Vineyard Irrigation—Conditions of Approval:

- Before the start of any vegetation removal or earthmoving activities associated with development areas located outside of the current authorized place of use, or any portions thereof, the owner/permittee shall provide documentation to Napa County showing or otherwise demonstrating that all portions of this development area are located within the place of use prescribed in Water Right License 9125 and Permit 18459. Development of those areas located outside of the prescribed place of use shall not begin or occur until evidence has been provided to Napa County that the place of use has been changed with the State Water Resources Control Board, Division of Water Rights, to cover said development areas, or until a modification of #P17-00432-ECPA has been processed to evaluate an alternate water supply pursuant to the California Environmental Quality Act and County policies.

- Before development of the offstream reservoir, the owner/permittee shall also provide documentation to the County showing or otherwise demonstrating that: i) the offstream location under Permit 18459 has been changed with the State Water Resources Control Board, Division of Water Rights, from an onstream location to the offstream location; ii) that Permit 18459 has been modified to not exceed 48 acre-feet per year by storage collected from December 15 of each year to March 31 of the succeeding year; iii) that Diversions under Permit 18459 would not occur unless the February median bypass flows of 0.6 cfs at Point of Diversion 1 on Elder Creek and 0.9 cfs at Point of Diversion 2 at Matheson Reservoir were met; and iv) that the maximum rate of diversion to offstream storage would not exceed 0.29 cfs at Point of Diversion 1 or 0.41 cfs at Point of Diversion.
- No new or existing on-site or off-site water sources, other than the surface water evaluated as part of the proposed project (i.e., existing water right License 9125 and Permit 18459) shall be used for irrigation of the proposed vineyard. Any other proposed irrigation source, including but not limited to wells, imported water, new or existing ponds/reservoir(s) or other surface water impoundments, to serve the vineyard, shall not be allowed without additional environmental review, if necessary, and may be subject to modification to this ECPA. Before the start of vegetation clearing and earth-disturbing activities for Phase 1 of ECPA development, the owner/permittee shall demonstrate that a minimum of 28 acre-feet of surface water is in storage on the project site. Before the start of vegetation clearing and earth-disturbing activities for Phase 2 of ECPA development, the owner/permittee shall demonstrate that a minimum of 28 acre-feet of surface water is in storage in addition to the amount necessary to irrigate Phase 1 plantings.

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