Water Supply Assessment Addendum

Prepared for:
Bay Area Vipassana Center
9201 El Matador Drive, Gilroy, California
December 16, 2021

Prepared by:
Thomas K.G. Mohr, P.G., H.G., E.G.
Mohr HydroGeoScience, LLC
Salinas, California

Executive Summary

This addendum to the May 2021 BAVC Water Supply Assessment provides new data and insights into water supply for the planned Bay Area Vipassana Center at 9201 El Matador Drive, Gilroy. The data collected from August through mid-October 2021 and presented herein demonstrates that the alluvial aquifer underlying the eastern portion of the BAVC property is continuously recharged by flow in Uvas Creek. The aquifer properties include high storativity and high transmissivity, as demonstrated by very quick recovery following minimal drawdown in response to ongoing pumping. This report demonstrates that BAVC could use the alluvial aquifer without adversely impacting the operation of HAMWC Well #1, located 95 feet away from the BAVC well. Data collection using a continuous water level recorder enabled detailed observation of the interaction of the BAVC well, HAMWC Well #1, and multiple agricultural pumping wells irrigating row crops in the fields east of Watsonville Road.

The water level data show that there is only a small amount of drawdown in the BAVC well from pumping in the nearby HAMWC well, which recovers within 3 hours when the HAMWC well stops pumping, and slightly larger and longer term effects from the agricultural wells pumping east of Watsonville Road. Mohr HydroGeoScience' (MHGS) interpretation of this data is that the alluvial aquifer can easily sustain both BAVC and HAMWC operations in all years since the severe 1977 drought, and particularly since 1996, when reservoir release patterns shifted to favor continuous flow in Uvas Creek.

The 1977 drought dried out Uvas Reservoir and Uvas Creek, which likely caused very low levels in the HAMWC well. During multiple consecutive years of extreme drought, HAMWC's well is likely to go dry, which would occur regardless of whether the BAVC plan is built. Because BAVC's planned pumping is on the order of 2% of the agricultural pumping from the alluvial aquifer, BAVC's operations will have a negligible impact on HAMWC's well performance, even though BAVC's well is located closer than the agricultural wells east of Watsonville Road..

Water level measurement in the BAVC well has shown that the alluvial aquifer is not only well-supplied and resilient, but water levels have *increased* 12+ feet from the beginning of August through mid-December 2021, during the peak of the 2020/21 drought, including 6 feet of rise before the first rainfall on October 24^{th}. The stable and increasing trend in groundwater level speaks to the ample supply sustained by recharge from Uvas

Creek, which has been consistently flowing at or above 10 acre-feet per day, and was flowing at about 18 acre-feet per day on October 20th.[1]

Concerns have been raised regarding potential well interference to wells supplying homes and vineyards on Redwood Retreat Road (RRR). If well interference was an issue for the RRR wells, the larger pumpers in the alluvial aquifer (HAMWC wells, growers irrigating row crops east of Watsonville Road) would play a substantially larger role in causing that interference than the comparatively small amount of pumping planned for BAVC. MHGS finds that pumping in a future BAVC well is extremely unlikely to produce a measurable response in the residential and vineyard wells on Redwood Retreat Road (RRR), upstream of the confluence of Little Arthur Creek with Uvas Creek. The wells on Redwood Retreat Road are located a minimum of 1,400 feet distant from the BAVC alluvial well, and the RRR wells are generally screened in the bedrock; hence the interaction between BAVC pumping and water levels in the RRR bedrock wells is not expected to be measurable. Nevertheless, BAVC remains willing to collaborate with neighboring well owners to measure interactivity between their wells and the existing BAVC alluvial well, and the HAMWC alluvial well.

In summary, observation of water levels in BAVC's alluvial well has shown that BAVC's initial inclination to avoid using the alluvium for a water supply well, in order not to risk adversely impacting the operation of HAMWC Well #1, is unwarranted, as the aquifer is highly transmissive and continuously recharged. The impact of HAMWC's much larger pumping on BAVC's well is minimal, which indicates that the impact of BAVC's pumping on HAMWC's Well #1 will be very small and not cause adverse drawdown of water levels in HAMWC's well.

The Santa Clara Valley Water District's operational objectives for Uvas Reservoir releases to Uvas Creek, which recharges the alluvial aquifer from which both BAVC and HAMWC pump, favor a robust water supply from the alluvial aquifer. SCVWD is bound by a legal agreement with the California Department of Fish and Wildlife to manage releases to sustain populations of anadromous fish that migrate in Uvas Creek. The planned annual demand for water supply for BAVC operations is negligible in comparison to the large magnitude pumping by irrigation wells for row crops and commercial nurseries along Uvas Creek. My recommendation is for BAVC to pursue permitting a water system based on a new well in the alluvium, with backup well(s) in the bedrock in the uplands section of the BAVC property.

[1] 10 acre-feet per day is about 5 cubic feet per second.

1. Introduction

This addendum to the Water Supply Assessment for the Bay Area Vipassana Center (BAVC), 9201 El Matador Drive, Gilroy, provides additional data and perspective that was not available at the time that the May 2021 Water Supply Assessment (WSA) was prepared. MHGS had been directed to prepare the WSA with the assumption that BAVC's old agricultural well in the alluvium, located 95 feet away from the Happy Acres Mutual Water Company (HAMWC) Well #1, or the alluvium in general, could not be used, due to the high potential for interference with HAMWC's well, and BAVC's strong desire to avoid any impacts to the HAWMC water system, which supplies 79 homes. MHGS has since collected data from August through mid-October 2021 that provides compelling evidence that the groundwater supply in the alluvium is sufficient to sustain both BAVC and HAMWC operations, provided that rainfall runoff to Uvas Reservoir is sufficient to allow that Santa Clara Valley Water District (SCVWD) to continue releases to Uvas Creek, which it has done successfully with very limited exceptions since the 1977 drought, i.e. for the past 43 years.

2. Alluvial Aquifer Description

The alluvial aquifer[2] in which the old agricultural well on BAVC's property, and the HAMWC well are completed is a relatively shallow feature, deposited by Uvas Creek and Little Arthur Creek (LAC), and ostensibly by high stands of Pleistocene Lake San Benito[3].

2.1. Alluvial Aquifer Dimensions

The relatively flat ground comprising the floodplains of Little Arthur Creek and Uvas Creek are generally underlain by alluvial deposits. The dimensions of the alluvium are approximately one-half mile wide at confluence with LAC; 2,000 feet wide below Chictactac Adams County Park; and about 2,100 feet wide from Pharmer Rd to Burchell Rd, perpendicular to the stream. The depth of the alluvium is generally less than 100 feet, but is not well defined because relatively few wells have been drilled in the alluvium near the BAVC property. At the southeast corner of the BAVC property, sandstone bedrock is found at about 85 feet below ground.

Figure 1 presents a geologic map that delineates the limits of alluvium in the vicinity of the BAVC property (alluvium mapped in yellows and green).

---

[2] An alluvial aquifer is made of interlayered sands, gravels, silts and clays, which are unconsolidated, i.e. not compressed into rock. Alluvial aquifers store ~100 times more water than local bedrock aquifers made of sandstone and shale.

[3] Jenkins, O., 1973. Pleistocene Lake San Benito. California Geology.

Inspection of available well logs shows that the elevation of bedrock beneath the alluvium varies, but is generally less than 100 feet, and as shallow as 50 feet. The bedrock surface is uneven: a few wells closer to Uvas Creek have higher bedrock elevations (thinner alluvium depth) than found near the BAVC well.

For the purpose of estimating available supply in the alluvial aquifer, an area of alluvium large enough to account for influence of Uvas Creek and nearby pumping was selected. This area extends one-half mile upstream of BAVC, and one mile downstream of BAVC. The area of the alluvium within a half mile upstream of the BAVC property (in both Uvas Creek and Little Arthur Creek, and 1 mile downstream, is about 625 acres – slightly less than one square mile. Assuming an average alluvium depth of 65 feet, the volume of alluvium is 40,625 acre feet. Assuming porosity is 27%, and using the current depth to groundwater in the BAVC well, 35 feet (depth measured in mid-October 2021),[4] the volume of groundwater stored and flowing through the alluvium is potentially 5,000 acre-feet.

2.2. Lithology

The unconsolidated alluvium comprising the alluvial aquifer is recorded on drillers' logs as a mixture of gravel and sands. Gravels and cobbles occur in a sandy matrix, creating zones of high transmissivity and storage. In many wells, clay layers are encountered, which may impede the downward movement of groundwater from Uvas Creek. Clay units have been logged up to 20 feet thick, while gravel units are up to 47 feet thick. In most of the alluvium well logs inspected, the predominant texture is gravel.

2.3. Recharge Sources

The sources of groundwater recharge replenishing groundwater extracted from wells pumping in the alluvium include:

- Little Arthur Creek recharge
- Uvas Creek recharge
- Rainfall recharge
- Deep percolation of irrigation water
- Springs and Flow from Bedrock into Alluvium

[4] Average of October 19 and October 15, 2021 depth to water measurements.

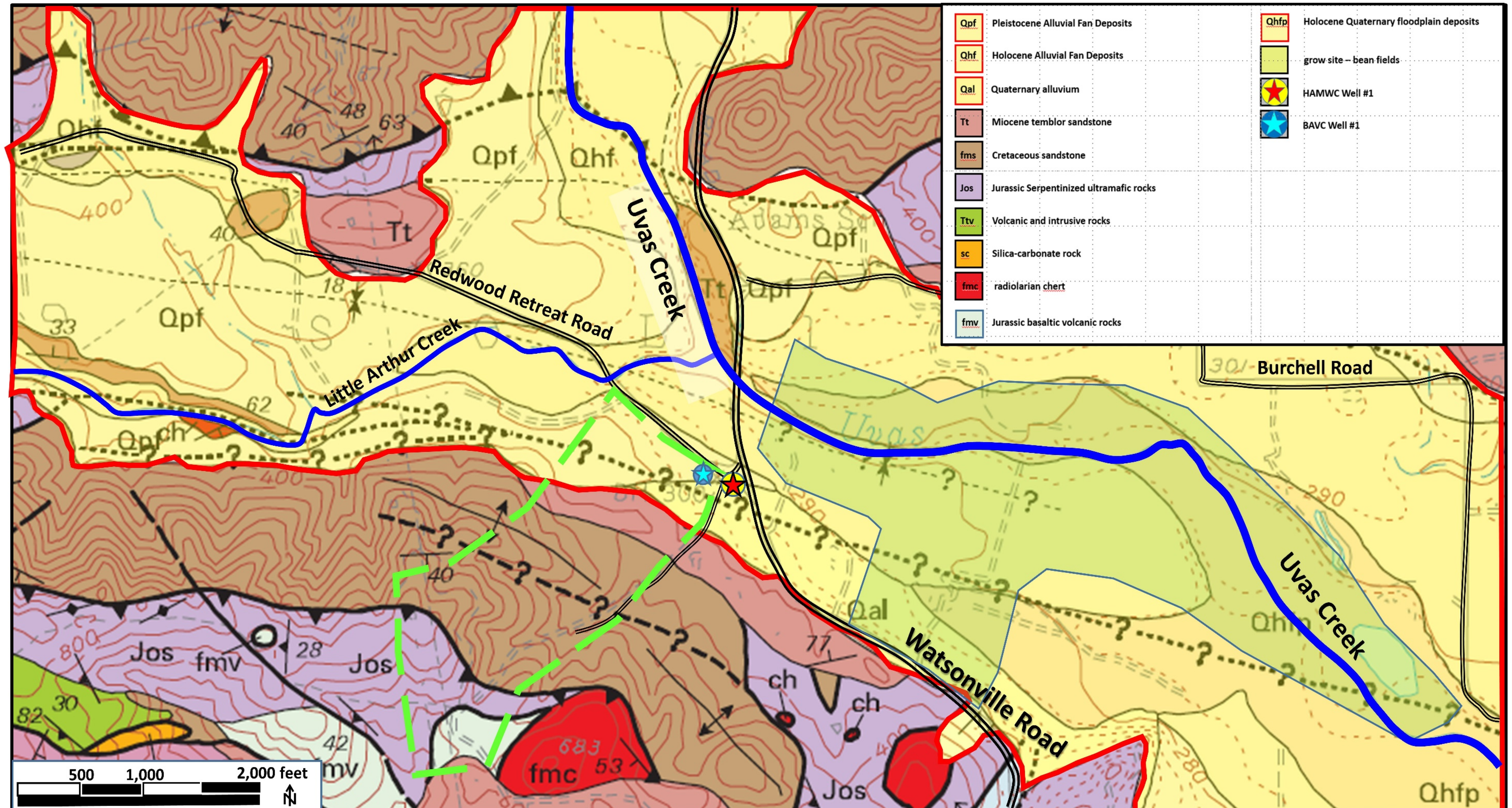
There are no built facilities for managed aquifer recharge near the confluence of Little Arthur Creek and Uvas Creek. However, SCVWD leverages Uvas Creek itself as a means to manage groundwater supply in aquifers replenished by creek recharge by operating Uvas Reservoir for continuous low flows in Uvas Creek.

Recharge from Little Arthur Creek

Recharge from Little Arthur Creek is limited to a shorter flow season, as there is not a major dam on the creek to retain flows for long-term releases. The 9 square mile catchment area of Little Arthur Creek, which includes areas where rainfall is among the highest in Santa Clara County, discharges substantial flows of rainfall runoff through the Redwood Retreat Valley. As described in the initial WSA submittal, flows are substantial but of short duration, and taper off by May or June, and less often, July. Dry-back occurs in early summer, and in 2021, in early May. Once dry-back occurs, base flow is fairly limited, and recharge to the narrow and often shallow alluvium along Little Arthur Creek is greatly diminished. Because recharge from Little Arthur Creek is of limited duration, some residents and vintners in the Redwood Retreat Valley, particularly those on bedrock wells, employ a wet season pumping strategy to fill tanks to carry over through the dry summer and fall.

Recharge from Uvas Creek

Recharge from Uvas Creek is of primary importance to the BAVC and HAMWC alluvial wells, as it generally flows year-round. Accordingly, this addendum provides a detailed analysis of Uvas Creek flows as regards their impact upon BAVC and HAMWC alluvial well operations. Groundwater in the BAVC well is derived from both Little Arthur Creek recharge and Uvas Creek recharge, based on isotopic "finger-printing" of water samples from the BAVC well, Uvas Creek, and a spring in the bedrock uplands of the BAVC property (see **Appendix A**).



Qpf Pleistocene Alluvial Fan Deposits
Qhf Holocene Alluvial Fan Deposits
Qal Quaternary alluvium
Tt Miocene temblor sandstone
fms Cretaceous sandstone
Jos Jurassic Serpentinized ultramafic rocks
Ttv Volcanic and intrusive rocks
sc Silica-carbonate rock
fmc radiolarian chert
fmv Jurassic basaltic volcanic rocks
Qhfp Holocene Quaternary floodplain deposits
grow site – bean fields
HAMWC Well #1
BAVC Well #1
Uvas Creek
Redwood Retreat Road
Little Arthur Creek
Burchell Road
Watsonville Road
500 1,000 2,000 feet
N

SCVWD manages Uvas Reservoir with the objective of extending flows as late as possible into the year before the next rainy season. SCVWD is bound by a legal agreement with the California Department of Fish and Wildlife, the Lake or Streambed Alteration Agreement (LSAA or "permit") issued by the California Department of Fish and Wildlife in 2012, to operate Uvas Reservoir in a manner that sustains anadromous fish habitat in Uvas Creek[5] during critical phases of their life cycle. The permit requires reservoir releases and minimal habitat flows to ensure that rare and endangered species such as the South-Central California Coast Steelhead are supported, consistent with the federal Endangered Species Act (ESA) Recovery Plan. This plan calls for additional water releases to improve access to spawning and rearing habitats, and instream habitat conditions as the principal recovery actions needed to increase local steelhead populations. During the summer, the District operates the reservoirs controlling releases to recharge the aquifers underlying Uvas Creek. SCVWD's goal is to continue minimal releases from Uvas Dam as long as possible until significant rainfall returns. This requires anticipating the timing of the return of significant rainfall that will fill the reservoir.[6]

Uvas Reservoir was built in 1957 and stores 9,835 acre-feet at full capacity, which is used for flood control, downstream groundwater recharge and to sustain steelhead populations. The catchment area for Uvas Reservoir is 47 square miles, and includes the portions of Santa Clara County that consistently receive the heaviest recorded rainfall in the county. The highest elevation in the Uvas Watershed is 3,790 feet. The lowest recorded mean annual precipitation (MAP) for Uvas Reservoir is 9.4 inches (in the 2020/21 water year, October 1 to September 30), while the highest recorded MAP is 51 inches (Balance Hydrologics, 2018).

Superimposing an isohyetal map[7] of mean annual precipitation over the Uvas Reservoir Catchment Area yields a rough estimate of total rainfall during a normal rainfall season. **Figure 2** illustrates the isohyetal map of the Uvas Reservoir catchment area, which receives approximately 94,000 acre-feet of rainfall during normal rainfall years, a substantial portion of which runs off to the reservoir. Because the reservoir capacity is on the order of 1/10th the volume of rain falling in normal years, during heavy rainfall events, there is spillover into Uvas Creek, producing flood flows. **Table 1** lists recent spill events at Uvas Reservoir.

---

[5] The Uvas Reservoir LSAA was first executed in May 2012, amended in 2013 and extended in 2016; an additional renewal is under consideration.

[6] For the current year, which is shaping up to be a La Niña year, some meteorologists forecast the earliest heavy rains in January 2022; the heavy rains on October 24th are considered anomalous by NWS meteorologists, and added only 375 acre-feet to Uvas Reservoir. The second atmospheric river event of 2021 on December 12th dropped 8.2 inches in the upper reaches of the Uvas Creek Watershed (at Uvas Canyon County Park), and tripled the storage in Uvas Reservoir within 72 hours (from 10% to 30%)

[7] An isohyetal map depicts lines of equal average rainfall, in the same manner that a topographic map depicts lines of equal elevation.

Table 1 – Recent Uvas Reservoir Spill Volumes (SCVWD, 2018)

Year	Volume (Acre-Feet)		Year	Volume (Acre-Feet)
2004	3,564		2011	30,584
2005	11,264		2012	2,387
2006	21,547		2013	3,236
2007	0		2014	0
2008	0		2015	0
2009	0		2016	11,130
2010	3,109		2017	103,068

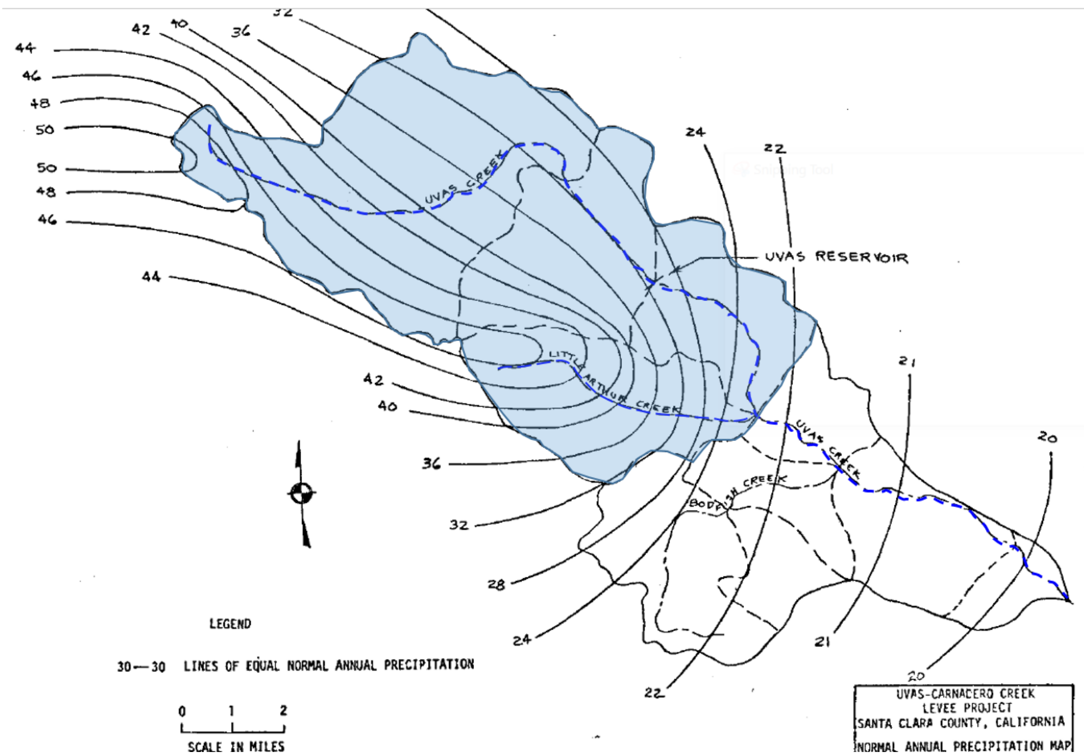


Figure 2 – Isohyetal Map of Mean Annual Rainfall over the Upper Uvas Creek Watershed

In the five years in which there was no spill from Uvas Reservoir (see Table 1), controlled releases from Uvas Dam maintained flows in Uvas Creek throughout the year, i.e. recharge to the BAVC and HAMWC wells was continuous even when the reservoir did not spill. A review of data from the Uvas Creek Gaging Station #5084 below Uvas Dam reveals the frequency of flow interruption in Uvas Creek over the last 31 years. Table 2 lists low-flow events in Uvas Creek below Uvas Dam.

Table 2 – Periods of Low Flow (<1 cubic feet per second) on Uvas Creek – 10/1/1990 to 8/31/2021

Low Flow Interval Start Date	Low-Flow Interval duration, days	Duration of Flows > 1 cfs Preceding Low-Flow Interval, days	Average continuous flow preceding low-flow interval, cubic feet per second [Acre-feet/day]	Low-Flow Interval
12/3/1990	6	63*	1.8 [3.6]	1 week
12/3/1990	9	12	5.9 [11.7]	1 week
1/24/1991	96	20	3.4 [6.7]	3 months
3/17/1992	39	322	7.5 [14.9]	1 months
12/29/1992	121	252	7.9 [15.7]	4 months
2/28/1995	27	670	7.3 [14.5]	1 month
12/2/1998	6	1,044	21.2 [42.0]	1 week

*63 days to the start of records.

Nearly all of the low flow events occurred before 1996, which seems to demarcate a change in SCVWD's operation of Uvas Reservoir Releases.[8] Flow dropped below 1 cfs, i.e. 2 acre-feet per day, for longer than 10 days on only 4 occasions in the 31 years for which stream gaging records are available. The numbers of consecutive days with flow below 450 gpm were 27, 39, 96, and 121 days. In 2021, flows of just 5 cfs have sustained steady groundwater levels measured in the BAVC alluvial well from early August through mid-October 2021, one of the driest years on record**.**[9] **Figure 3** displays stream gaging data on Uvas Creek below Uvas Dam. The threshold flow necessary to supply all of the pumpers between Uvas Dam and BAVC has not been determined for this addendum, but current flows in the 2021 drought year appear sufficient to sustain all of the vineyards, nurseries, orchards, trailer parks, and mutual water companies, based on rising groundwater levels in the BAVC well.

[8] In 1996, SCVWD faced litigation from the Guadalupe-Coyote Resource Conservation District (GCRCD), Trout Unlimited, Pacific Coast Federation of Fishermen's Associations, and numerous other groups concerned with the protection of fish habitat. The litigation alleged that SCVWD's operations impaired fish habitat and migration. The Fish and Aquatic Habitat Collaborative Effort (FAHCE) Settlement Agreement was negotiated, providing many improvements to the compatibility of District operations with fish preservation. Currently, the Fish Habitat Restoration Plan (FHRP) is being implemented. Although neither FAHCE nor FHRP directly limit District operations on Uvas Creek, the 1996 litigation most likely played a key role in the shift toward continuous releases from Uvas Reservoir.

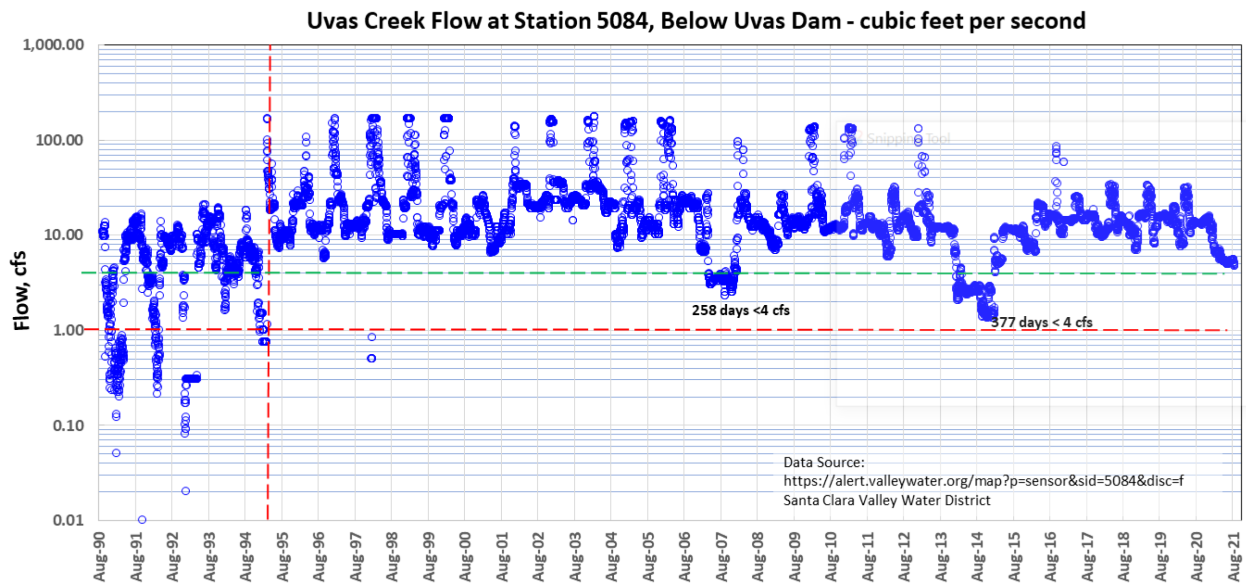


Figure 3 – Stream Gaging Data at SCVWD Station 5084 below Uvas Dam, 10/1/90 to 8/31/21

The driest periods since Uvas Dam was constructed occurred in the 1977 and 1988 droughts. **Figure 4** illustrates the impact of the driest periods on record on Uvas Dam storage and level. As noted above, SCVWD's strategy for managing Uvas Reservoir releases may have been serving different objectives before 1996. For example, a pipeline allows transfer of Uvas releases to the Llagas Watershed for in-stream and off-channel groundwater recharge. In 1977, Uvas Reservoir was dry, a consequence of severe drought. Currently, ministerial considerations[10] and logistical constraints limit transfers from the Uvas Creek to Llagas Creek watershed.

The amount of recharge to the local alluvial aquifer from flows in Uvas Creek is not known with precision, but can be estimated. SCVWD has determined from stream gaging measurements that the estimated recharge capacity of Uvas Creek below Uvas Dam is 8,100 acre-feet per year, or roughly 460 acre-feet per mile of creek along the ~17.6 miles of Uvas Creek below Uvas Dam before it joins the Pajaro River.[11] It is therefore reasonable to expect that, within a half mile upstream and 1 mile downstream of the BAVC property, there may be up to 920 AF of groundwater recharge to the local alluvial aquifer from Uvas Creek per year, with substantial additional recharge from Little Arthur Creek.

[10] For example, the LSAA and the circumstances that led to the 1996 litigation against the District regarding the Coyote, Guadalupe, and Stevens Creek watersheds

[11] https://www.valleywater.org/sites/default/files/2018-03/031618NA_Redacted.pdf

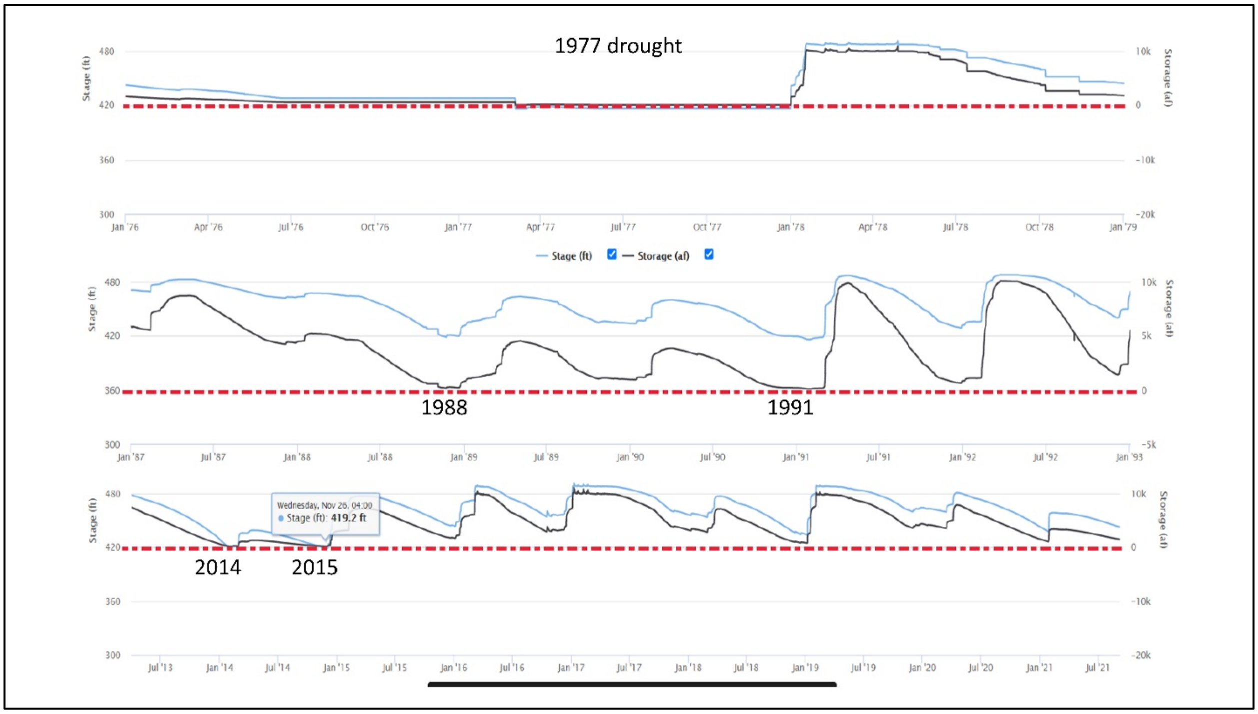


Figure 4 – Periods of Low Water in Uvas Reservoir in the Last 46 Years

Rainfall Recharge

Direct rainfall recharge in a normal year can add up to 156 acre feet of water over the 625 acre area described above, assuming that 1) 15% of rainfall manifests as deep aquifer recharge in the alluvium, and 2) there is 20 inches rainfall in a normal year.

Deep Percolation of Irrigation Water

Crops on the 90 acre row crop fields east of Watsonville Road are irrigated with several shallow irrigation wells completed in the alluvium. The crops grown vary from year to year. In 2021, crops observed included cucumbers and beans. The total irrigation demand will depend upon crop type, number of crop cycles, and evapotranspiration, which can be exacerbated by heat waves and winds. For the purposes of a screening level estimate, the assumption is made that the crop is cucumbers and beans, and that the percent of irrigated water that manifests as deep percolation is 15%[12]. The crops grown in 2021 did not employ drip irrigation, which would substantially reduce the amount of water irrigated and the amount of recharge from crop irrigation. Using total irrigation of 30 inches for cucumbers and beans combined across the 90 acres under cultivation east of Watsonville Road, the recharge from irrigation returns is estimated as 34 acre-feet.

[12] For the Santa Clara Valley Water District model of the Llagas groundwater subbasin, a 20% irrigation deep percolation factor is used. 15% is assumed to account for the growers' experience and knowledge with local conditions and the specific crops grown, and their desire to optimize irrigation such that electrical costs and groundwater charges for pumping are minimized.

Springs and Flow from Bedrock into Alluvium

In very wet years, recharge to the fractured rock aquifers outside the alluvium may be sufficient to supply springs or cause bedrock aquifers to discharge groundwater into the alluvial aquifer below ground. However, as the quantity of water stored in a cubic foot of fractured rock aquifer is about one hundredth of the groundwater storage in an equivalent volume of alluvium, recharge from bedrock to the alluvium is likely negligible, and not considered in this analysis. Similarly, springs are likely to be seasonal, and in most years, insignificant in contrast to the voluminous recharge from Uvas Creek.

There is a spring in the 74-acre sub-watershed above El Matador Drive that was found discharging water at about a pint a minute in late August 2021. Groundwater discharge during the late summer of an extremely dry year is an unexpected condition, with two possible causes. The spring location seems to align with the trace of the Berrocal Fault mapped by McLaughlin et al., 2005. Faults may serve as a barrier to groundwater flow in bedrock aquifers, which could create a viable supply for a backup well on the BAVC property. A second possible cause for a flowing spring late in the summer is septic tank effluent from the homes located uphill. This latter explanation proved to be the case, as demonstrated by a spring sample analysis for wastewater marker chemicals (caffeine, sucralose) and explained in **Appendix B.** The finding that in late summer, this spring is primarily discharging septic effluent, does not diminish the importance of the spring. During the wet season months and springtime, this and other springs may be discharging a higher proportion of groundwater derived from rainfall, and serve as a longer-term but low volume source of recharge to the alluvial aquifer pumped by HAMWC, and currently by BAVC for landscape irrigation.

Summary of Alluvial Aquifer Recharge

The sum of the recharge sources described above for the 625 acre area of alluvial aquifer within a half mile upstream and a mile downstream of the BAVC property is shown in **Figure 5**:

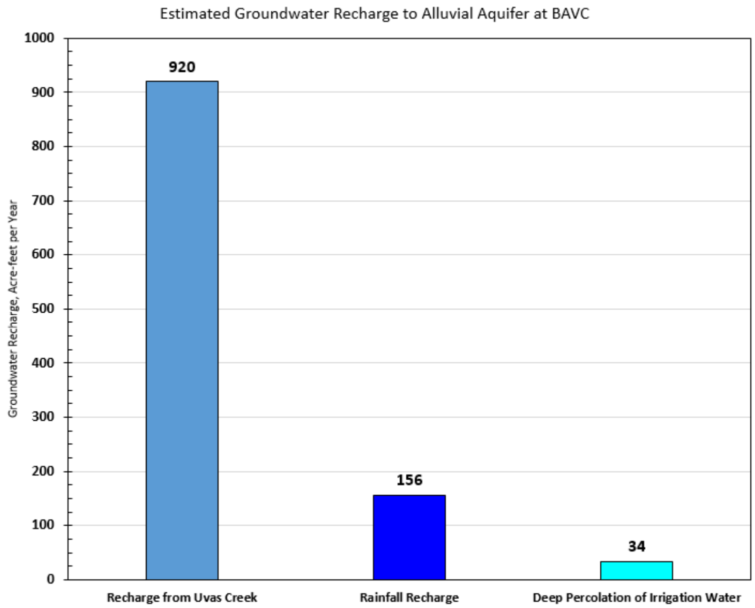


Figure 5 – Estimated Groundwater Recharge to Alluvial Aquifer in Vicinity of BAVC

Recharge in dry years will include less rainfall recharge, but not less recharge from Uvas Creek than is seen in currently during a severe drought year, unless releases from Uvas Dam are suspended. Conversely, wet years will produce significantly more recharge, causing water levels to rise dramatically. However, more recharge in one year may not necessarily carry over to sustain groundwater supplies in the following year. Groundwater will continue to drain away, due to a moderate topographic gradient (0.33%, from Uvas Creek at Burchell Rd to the Hecker Pass Highway bridge).

2.4 Pumping in the Alluvial Aquifer

Releases from Uvas Reservoir serve to recharge the alluvial aquifer, which is actively pumped in the vicinity of BAVC. In the immediate proximity of the BAVC property, the most relevant pumping of the alluvial aquifer is by the irrigation wells for row crops east of Watsonville Road and the large commercial nursery on Hecker Pass Highway, as well as by HAMWC. The approximate locations of these wells and the estimated pumping associated are with these wells are shown in **Figures 6 and 7.**

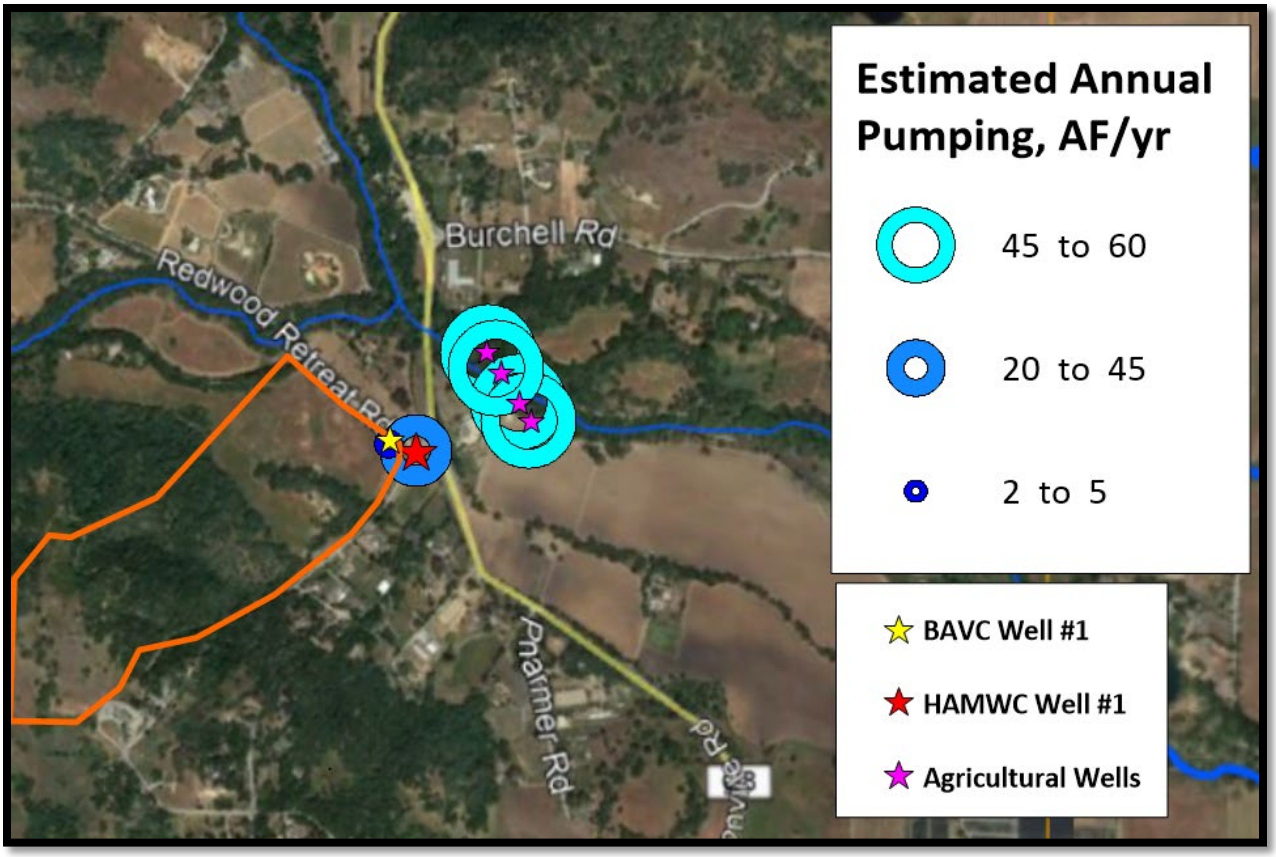


Figure 6 - Relative Positions of Nearest Wells Pumping from the Alluvial Aquifer (locations approximate)

Figures 7 and 8 compare annual average pumping among BAVC, HAMWC, and pumping in the agricultural wells east of Watsonville Road used to irrigate 90 acres of row crops. A large nursery operation occupies 60 acres about ¾ mile east of the BAVC property. The estimated water demand for the nursery operation is greater than 500 acre-feet per year.[13] The locations of the wells serving the nursery are not precisely known but are assumed to be in the alluvium. Nearly a mile east of BAVC, the Burchell Road Water System is another water system whose wells most likely draw from the alluvial aquifer. Burchell Road Water System serves 27 connections (132 residents). Using HAMWC's annual water consumption as a benchmark, the approximate pumping by the Burchell Road Water System's two wells is estimated as 17 acre-feet per year.

[13] A nursery may use from 14,000 to 19,000 gallons per day per acre during peak growing season (https://maeap.org/wp-content/uploads/2019/03/W278.pdf)

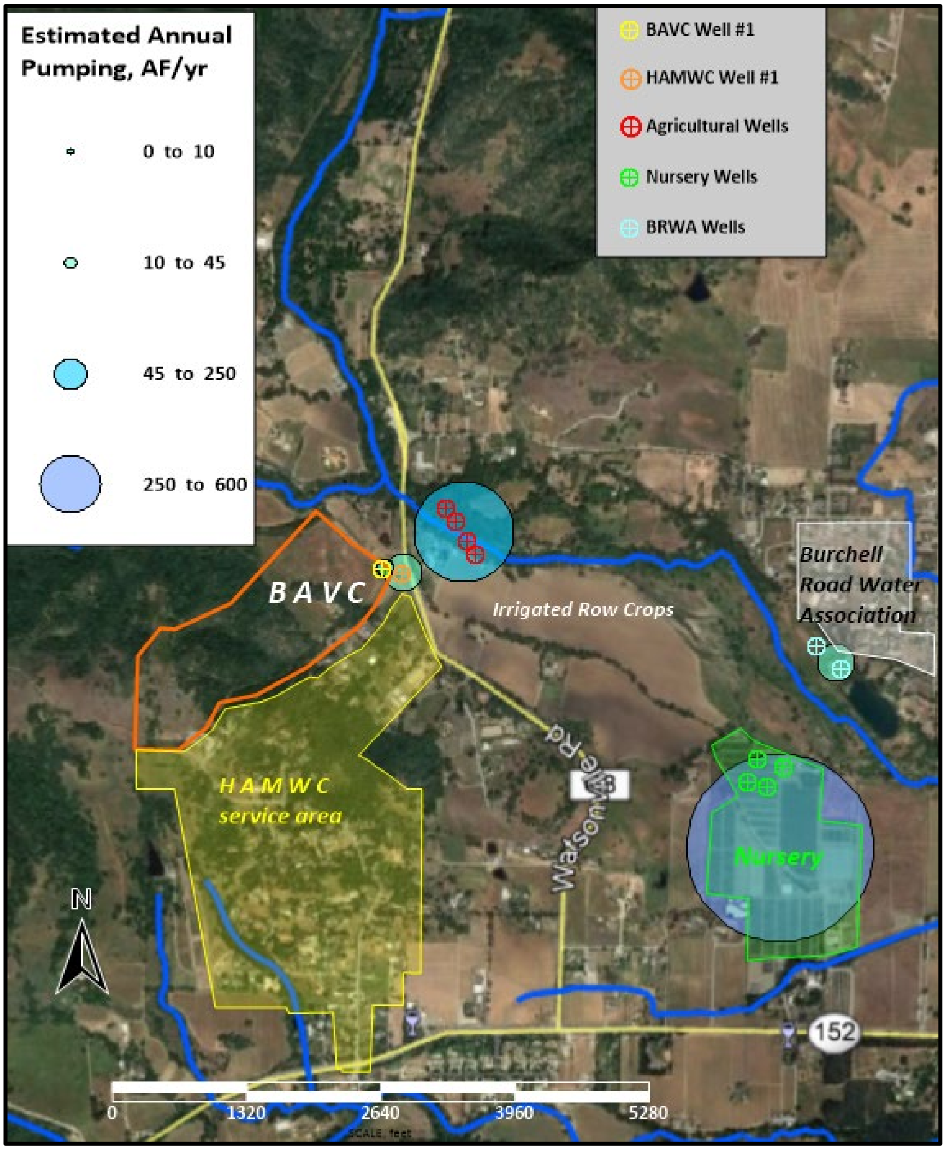


Figure 7 – Estimated Annual Pumping in Uvas Creek Alluvium within a Mile of BAVC

Compared to existing, ongoing pumping, BAVC's planned pumping (5 acre feet per year) is so small that it falls within the "background noise" of regional pumping; i.e. the agricultural pumping may vary by more than 5 acre feet per year more or less depending on cropping choices, heat waves, etc. Accordingly, the magnitude of pumping proposed for BAVC is of comparatively little consequence to the operation of HAMWC Well #1. Average pumping in HAMWC Well #1 (~28 AF/yr) is 5.6 times the planned 5 AF/yr for the BAVC well. Estimated agricultural pumping (~240 AF/yr) is 8.6 times the annual pumping in the HAWMC well, and 48 times the projected annual water demand for BAVC operations. Finally, the wells serving the large nursery operation(s) and adjacent vineyards stretching from Hecker Pass Highway to Uvas Creek pump an estimated 500 AF/yr, which is nearly 18 times the annual pumping in the HAMWC well, and 100 times the pumping in the BAVC well. While the location of the nursery pumping, ¾ miles downstream of the BAVC property, is presumably too far away to cause measurable well interference, it nevertheless competes for recharge from Uvas Creek. Regardless of which water use factors are assumed to estimate annual pumping, the other wells pumping in the alluvium are invariably pumping many times more than the planned BAVC pumping.

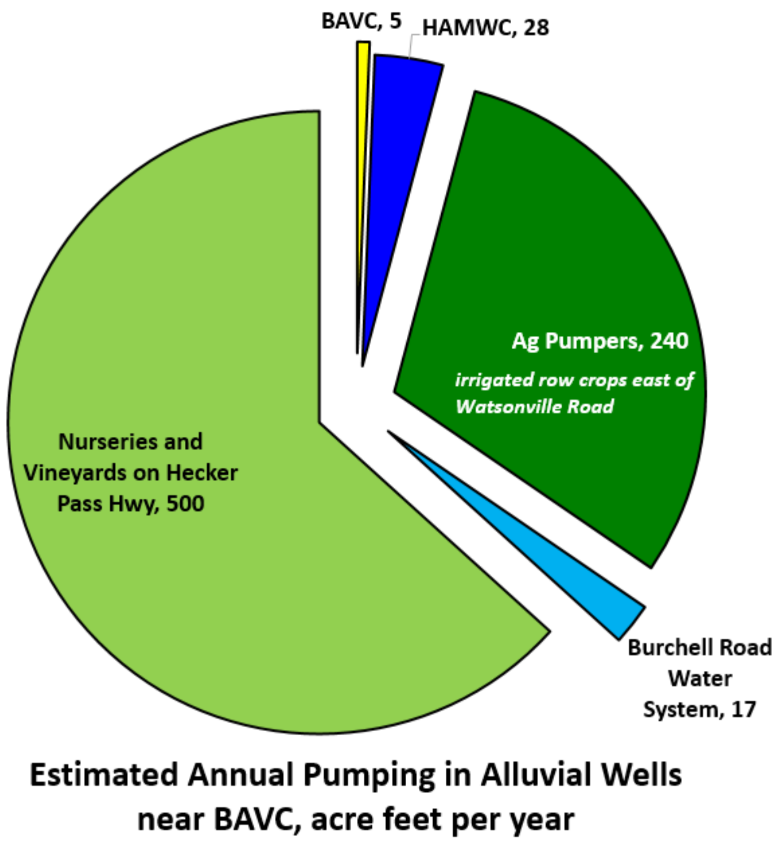


Figure 8 – Comparison of Annual Estimated Pumping from Major Alluvial Wells near BAVC.

3. Potential for Well Interference

The Water Supply Assessment submitted in May 2021 included a review of the potential for pumping from a bedrock well on the BAVC property to cause drawdown in neighboring bedrock wells and the HAWMC well. That review was based on calculations using hydrogeologic factors estimated from available well logs. To estimate well interference from pumping in a BAVC well completed in the alluvium, the same approach can be used; however, direct measurement of the impact of HAMWC pumping on water levels in the BAVC well is more informative. This section presents and interprets data collected from the BAVC well.

3.1. Periodic Water Level Measurements

The old agricultural well on the BAVC property is completed in the alluvium, and is located 95 feet north of the HAMWC well. Depth to water measurements have been made weekly since August 6, 2021. **Figure 8** illustrates the measured groundwater levels in the BAVC well.

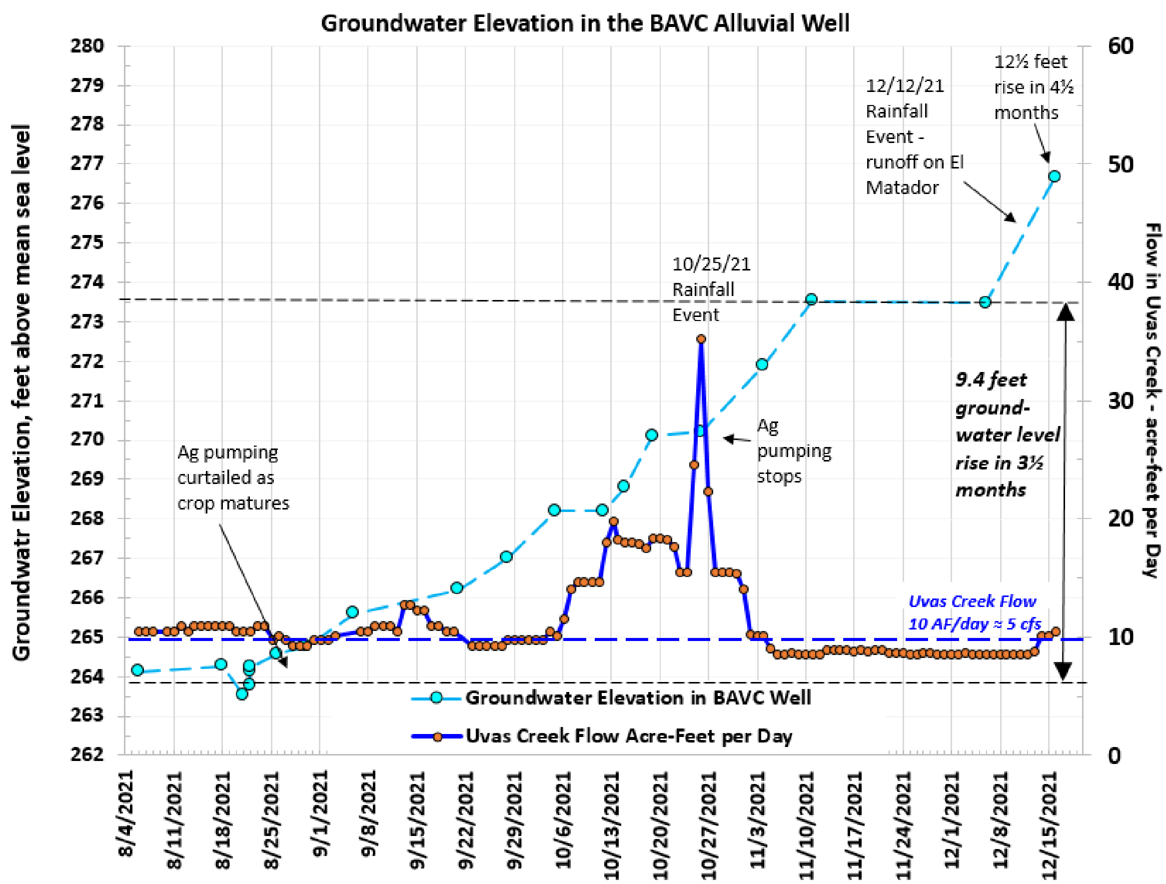


Figure 9 – Groundwater Elevation Measurements in BAVC Alluvial Well

Groundwater elevation in the BAVC alluvial well varies in response to pumping; however the overall trend is currently increasing. Groundwater has risen 6 feet in the BAVC well since measurements began on August 6, 2021. This may seem counterintuitive, considering that these measurements are taken in the late summer and fall of one of the driest years on record. The explanation lies with the continuous groundwater recharge from sustained flows in Uvas Creek, and the cessation of high volume agricultural irrigation of row crops east of Watsonville Road at the end of September and beginning of October. Overall, groundwater levels in the BAVC well are very stable and rising, in spite of pumping about 3,500 gallons per week for landscape irrigation, at a rate of 110 gallons per minute for a few minutes per day. Moreover, concurrent with agricultural pumping, water levels in the BAVC well have been very stable, indicating a highly transmissive aquifer with ample storage. A more limited aquifer would show declining groundwater elevations in response to sub-regional agricultural pumping.

3.2. Water Level Measurements – Continuous

MHGS installed a pressure transducer in the BAVC well in late August to record continuous water level measurements, in order to discern the effect of pumping in HAMWC Well #1 on water levels in the BAVC well, as well as the effect of pumping agricultural wells on BAVC Well water levels. A Solinst Levellogger 5 was used in tandem with a Solinst Barologger to record barometric pressure for use in calculating barometric compensation of measured water levels. The Levellogger was set to record water levels every 20 seconds, producing ~18,500 measurements between the morning of August 22nd and the evening of August 26th. **Figure 9** displays a hydrograph of collected data, adjusted to compensate for barometric pressure, and annotated to add MHGS' interpretation of the causes of water level variations.

A few features of the continuous water level hydrograph stand out. The predominant influence on water levels is pumping from the multiple agricultural wells – as many as 8 – located in the 90-acre row crop fields east of Watsonville Road. Pumping in the nearby HAMWC well produces only a temporary and minor decrease in water level, which rebounds to the original level within 2½ to 3 hours. Pumping the BAVC well at 110 gpm for a few minutes produces a drawdown of more than a foot, which rebounds within 3½ minutes or less. The rapid recovery of water levels upon cessation of pumping in HAMWC's wells is consistent with a highly transmissive gravel aquifer that has ample storage.

The continuous water level measurements demonstrate that HAMWC's pumping has minimal effect on the BAVC well, particularly in view of the 12½ foot rise in water levels since measurements began on August 6th. This also means that BAVC's plans to pump 5 acre-feet per year could proceed using the existing agricultural well, or another alluvial well constructed to meet the well standard for drinking water supply wells, with no significant impact to HAMWC's operations. Drawdown in the HAMWC well from pumping the existing or new BAVC alluvial well will be minor and temporary.

A further interpretation of the hydrograph is that pumping in the BAVC or HAMWC wells will not affect the water levels in wells on the north side of Little Arthur Creek. Inspection of the logs associated with these wells reveals that the alluvium at these locations is thin, and these wells are predominately bedrock wells with low yields, which are slowly recharged by Little Arthur Creek, and to a lesser extent by Uvas Creek. Pumping in the BAVC and HAMWC wells, located a minimum of 1,400 feet distant from these wells, is extremely unlikely to produce a measurable response in the wells on Redwood Retreat Road upstream of the confluence.[14]

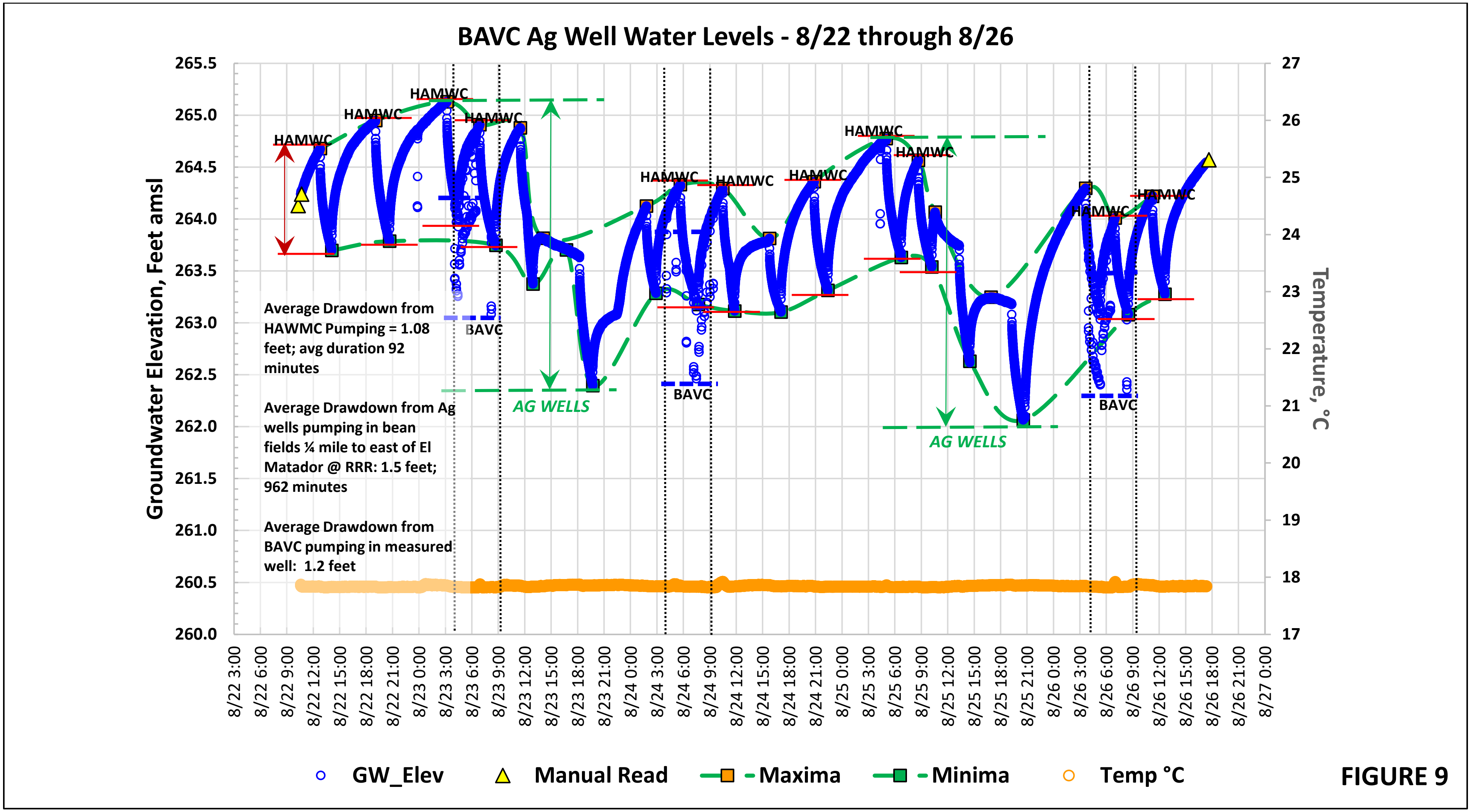
3.3 Future Droughts – 50 Year Outlook

It is not possible to reliably predict future hydrologic conditions; however, it is nonetheless valuable to speculate on possible future hydrologic scenarios. The consensus among climate scientists is that human-caused climate change is occurring now, and is likely to produce drier and hotter summers, and less reliable winter rains. Even without anthropogenic climate change, past mega-droughts in the southwest, recorded in tree-ring data, have persisted for decades[15]. In the event that Uvas Creek goes dry following multiple years of protracted drought, alluvial and bedrock wells operated by both BAVC and HAMWC are likely to go dry.

The scenario for which a BAVC contingency plan may make a difference to HAMWC is during the second year of severe drought, should SCVWD be unable to sustain flow in Uvas Creek. In a condition of declining water levels, it may be possible for BAVC to switch over to backup bedrock supply wells, so that the arrival of dry well conditions to HAMWC's well is avoided or delayed.

[14] Several of the subject wellowners were invited to participate in the water level monitoring exercise, i.e. to have a transducer (water level sensor) installed in their well for concurrent measurements, but they declined to respond or participate.

[15] Conversely, we should also remember that Governor Leland Stanford in 1862 had to row to his inauguration, due to massive flooding of the entire Sacramento Valley following 40 days of nearly continuous rain.



BAVC Ag Well Water Levels - 8/22 through 8/26
Groundwater Elevation, Feet amsl
Temperature, °C
HAMWC
BAVC
AG WELLS
Average Drawdown from HAWMC Pumping = 1.08 feet; avg duration 92 minutes
Average Drawdown from Ag wells pumping in bean fields ¼ mile to east of El Matador @ RRR: 1.5 feet; 962 minutes
Average Drawdown from BAVC pumping in measured well: 1.2 feet
GW_Elev
Manual Read
Maxima
Minima
Temp °C

FIGURE 9

The conditions that would make temporary suspension of BAVC pumping in the alluvial aquifer beneficial to HAMWC have apparently manifested only once in the past 43 years, in 1977, when Uvas Creek was dry.[16] In view of changing climate, it is likely that Uvas Reservoir may go dry more often in the future. For this reason, contingencies should be developed for multiple years of severe drought. BAVC is open to drafting a Contingency Plan to shift water supply operations from the alluvial well to bedrock well(s). BAVC may develop redundant supply to allow switching to backup wells completed in the bedrock on the west side of their property. The BAVC Contingency Plan would address the water level threshold at which the next meditation session would be supplied by bedrock wells, until water levels rise above a threshold for resumption of alluvial well operations. As the operative water level would be measured in HAMWC's well, the BAVC contingency plan should be developed in coordination with HAMWC. Such an arrangement would require close communication to share operations and water level data.

4. Opportunities to Improve Water Supply Reliability in the Alluvial Aquifer

There are no available options that could prevent the effects of multiple years of extreme drought from causing the BAVC and HAMWC wells to go dry. This would be the case regardless of whether BAVC is built. For scenarios short of a disastrous drought, some measures may be helpful to extend the available supply. These include the following:

4.1. BAVC Rainwater Capture

BAVC plans to capture rainfall from building roofs for percolation into the alluvial aquifer. In a normal rainfall year, assuming 20 inches of rain, this could return up to 2¼ acre feet to groundwater.

4.2 BAVC Graywater Reuse

BAVC is evaluating the benefit of using gray water capture for landscape irrigation, which would decrease the total pumping by a corresponding amount.

4.3 BAVC Runoff Infiltration Trenches

The 54 acre BAVC property produces substantial rainfall runoff, which locally recharges the alluvial aquifer, but also flows into Uvas Creek and out to Monterey Bay. BAVC is developing plans to assess the feasibility and benefit to diverting some of this runoff into an infiltration trench on BAVC's property parallel to El

[16] HAWMC has declined to share historic water level data with BAVC to assist with water supply planning and analysis. Interpretation of conditions that could cause HAMWC's well to go dry is inferred from Uvas Creek flows and observation of water levels in BAVC's well.

Matador Drive, with the objective of enhanced aquifer recharge that would add as much rainfall runoff to the aquifer as BAVC pumps in a given year. Preliminary analysis[17] indicates that the sub-watershed generating runoff to the drainage to the east along El Matador Drive is 74 acres. In a normal rainfall year (~20 inches rainfall), this area will generate up to 6½ acre-feet of runoff, and during a dry year, 2¼ acre-feet of runoff may drain to the El Matador ditch.

4.4 HAMWC Conservation Efforts

During the 2014 drought, HAMWC customers rallied to achieve impressive water conservation results, and are likely doing so again during the current drought. In addition to changes to water use patterns, homes in the HAMWC service area may be amenable to gray water system installation for permanent use of gray water on less sensitive landscaping. SCVWD operates a comprehensive water conservation program that can assist homeowners, often at no charge, with identifying opportunities to further conserve water. SCVWD also provides incentives to install graywater systems, including rebates of $200 to $400 per home.[18]

4.5 Growers' Micro-irrigation

The largest user of groundwater pumped from the alluvial aquifer near the BAVC property by far is the row crop fields east of Watsonville Road, for which at least 200 acre feet per year is pumped, and possibly much more. If the growers were to change their practices and employ drip irrigation or other micro-irrigation techniques, a substantial and meaningful reduction in groundwater pumping could be achieved. Moreover, if the growers could be persuaded to grow crops with lower water demand, further reduction in pumping might be achievable, which could allow continuing use of the BAVC and HAMWC wells for longer duration during periods of severe drought.

5 Conclusion

The alluvial aquifer can supply both the BAVC and HAMWC wells without significant threat of well interference or mutual competition for groundwater supply because it is actively and continuously recharged by Uvas Creek during most years. The aquifer is abundantly supplied and resilient, such that temporary depression of water levels in response to even heavy agricultural pumping recovers to original levels fairly quickly. The largest user of groundwater is pumping about 8 wells to irrigate the 90-acres of row crop fields east of Watsonville Road, which pumps 6 times as much as HAMWC's maximum pumping, and 48 times

[17] Estimates were derived using the Soil Conservation Service *Curve Number Method* using soils data from Soil Survey of Eastern Santa Clara County (1974). The calculation will be fully enumerated in a future addendum, pending further assessment of water supply priorities.
[18] https://www.valleywater.org/saving-water/rebates-surveys/graywater-rebate

BAVC's planned annual pumping, yet even the agricultural pumping produces only a temporary and fully recoverable effect on water levels in the BAVC well, and presumably in the HAMWC well too.

The conditions under which recharge to the alluvial aquifer may be limited and threaten water supply reliability for BAVC and HAMWC have been rather infrequent: one interruption in the past 45 years, and three other episodes of very dry conditions in the same timeframe. Climate change scientists tell us we should expect extreme drought more often. For this reason, BAVC will consider developing contingency plans so that HAMWC's alluvial well supply to homeowners continues uninterrupted for as long as possible, and BAVC may shift to bedrock well supply until groundwater conditions favor resumption of alluvial well operations. BAVC is planning water conservation measures that will minimize its demand on the alluvial aquifer, while returning rainwater capture and rainfall runoff to recharge the alluvial aquifer.

A P P E N D I X   A

Stable Isotope Analysis of BAVC Well Groundwater Sample to Assess Recharge Sources

All water contains natural variations in composition including the most abundant isotopes of its constituent atoms (^{16}O, oxygen with sixteen neutrons – 99.76%), and ^{1}H, hydrogen with one neutron), and in a small fraction of water molecules, ^{18}O, i.e., oxygen with two extra neutrons – 0.2%, and ^{2}H (deuterium), hydrogen with one extra neutron - 0.0115%. The slight variation in water molecule mass can be detected using a highly sensitive mass spectrometer, to distinguish water sources, akin to "finger-printing" the water.

Water released to Uvas Creek from Uvas Reservoir is likely to have been subjected to substantial evaporation during the weeks to months it resided in the reservoir. When water evaporates, the lighter water molecules, i.e. those without the heavy isotopes of oxygen and hydrogen (^{18}O and ^{2}H), will be preferentially evaporated. The water released from Uvas Reservoir is likely to be enriched with respect to the heavier water molecules, such that water in Uvas Creek may bear a unique and distinguishable stable isotope ratio.

In contrast, rainfall falling onto the BAVC property and surrounding bedrock hills, a portion of which infiltrates the soil and underlying bedrock to recharge the groundwater residing in the bedrock fractures, is not subjected to the same degree of evaporation. Groundwater in the bedrock, accessible in the springs, is likely to have an isotopic signature that is more similar to the isotopic composition of rainfall. The isotopic character of water recharged by runoff from the Little Arthur Creek watershed is also likely to be closer to the meteoric water line, i.e. more similar to rainfall.

Measurements of stable isotopes of water are expressed relative to an international standard, and plotted relative to the *meteoric water line*, using the following conventions:

$$\delta D\ ‰ = \frac{(D/H)_{sample} - (D/H)_{SMOW}}{(D/H)_{SMOW}} \times 1000$$

$$\delta^{18}O\ ‰ = \frac{(^{18}O/^{16}O)_{sample} - (^{18}O/^{16}O)_{SMOW}}{(^{18}O/^{16}O)_{SMOW}} \times 1000$$

where ‰ means per mille, i.e. thousandths, and SMOW is the Vienna Standard Mean Ocean Water. By convention, δD and $\delta^{18}O$ (read as "delta-D" or "delta-deuterium" and "delta 18 O" or "delta oxygen-18") are expressed as negative numbers. A sensitive mass spectrometer is used to identify the fraction of the heavier isotope to the lighter one.

MHGS collected samples from the spring, the BAVC well, and Uvas Creek at Chictactac-Adams County Park on August 19th, 2021 for submittal to the University of California at Davis Stable Isotope Facility. MHGS recommended this approach to understand the recharge origins of groundwater in the BAVC well, and because this method is robust, reliable, and relatively inexpensive. Graphical and tabular results from these samples are presented below.

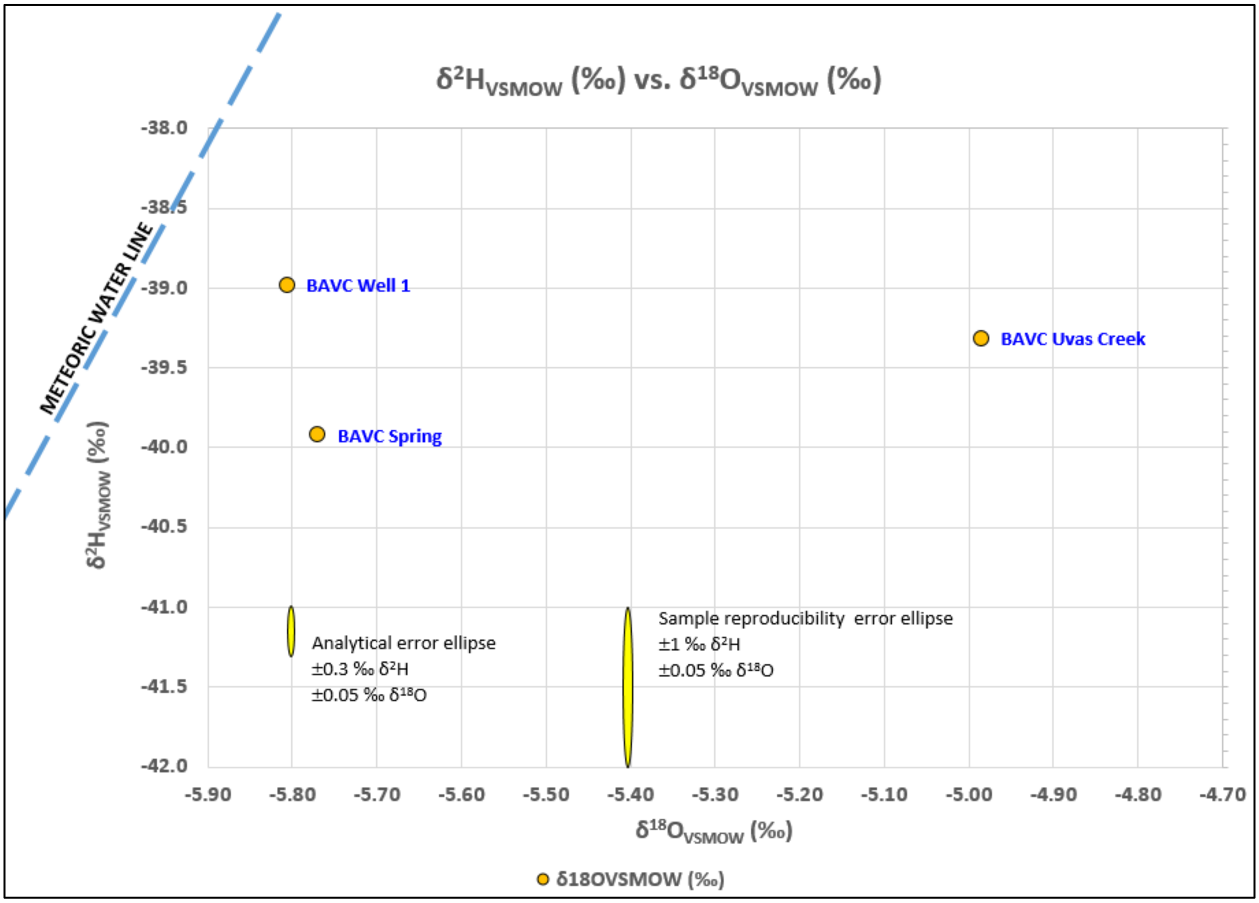


Figure A-1 – Stable Isotope Ratios of Water Samples from BAVC Well, Spring, and Uvas Creek. Points plotting furthest from the Meteoric Water Line are most evaporated.

Interpretation: There is little variation in the oxygen-18 content of the water samples, but more differentiation in the deuterium ratios. The most evaporated sample is the creek sample, which is consistent with its origin from Uvas Reservoir, where summertime evaporation concentrates the remaining water relative to the heavier isotopes of water. The similarity between the spring sample and the BAVC well sample implies that the spring sample represents water discharged from septic effluent on properties supplied with the same alluvial aquifer groundwater as the BAVC well sample, i.e. the HAMWC well. The homes at the top of the 74 acre sub watershed are in the HAMWC service area and served by HAMWC's well. Because the HAMWC well is only 95 feet away from the BAVC well, the isotopic signature in the HAMWC well is likely to be nearly identical to the sample obtained from the BAVC well.

While the BAVC well is recharged by Uvas Creek, it is also recharged by Little Arthur Creek, and by rainfall runoff from the uplands on the BAVC property. This is suggested by the fact that the BAVC well groundwater sample did not plot immediately adjacent to the Uvas Creek sample, indicating that the substantial recharge contribution from Little Arthur Creek is present in the groundwater, which is a mixture of both Uvas Creek and Little Arthur Creek recharge.

One should bear in mind that the aquifer is a dynamic system, and the groundwater flowing through it may vary in origin over different times of year. This means that analysis of stable isotopes from samples obtained in the springtime may be more rainfall dominated and less evaporated than the samples collected in August. In addition, the stable isotope ratios in rainfall itself vary based on the latitude from which the storm event originated (e.g. a pineapple express vs. a storm coming down from the northwestern Pacific/Alaska area). Even with natural variation in rainfall isotopic ratios, the fact that the BAVC Well sample is shifted toward the Uvas Creek sample indicates that it includes a portion of groundwater recharged by Uvas Creek.

UNIVERSITY OF CALIFORNIA, DAVIS

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBA

STABLE ISOTOPE FACILITY
DEPARTMENT OF PLANT SCIENCES
ONE SHIELDS AVE
DAVIS, CALIFORNIA 95616
530-752-8100

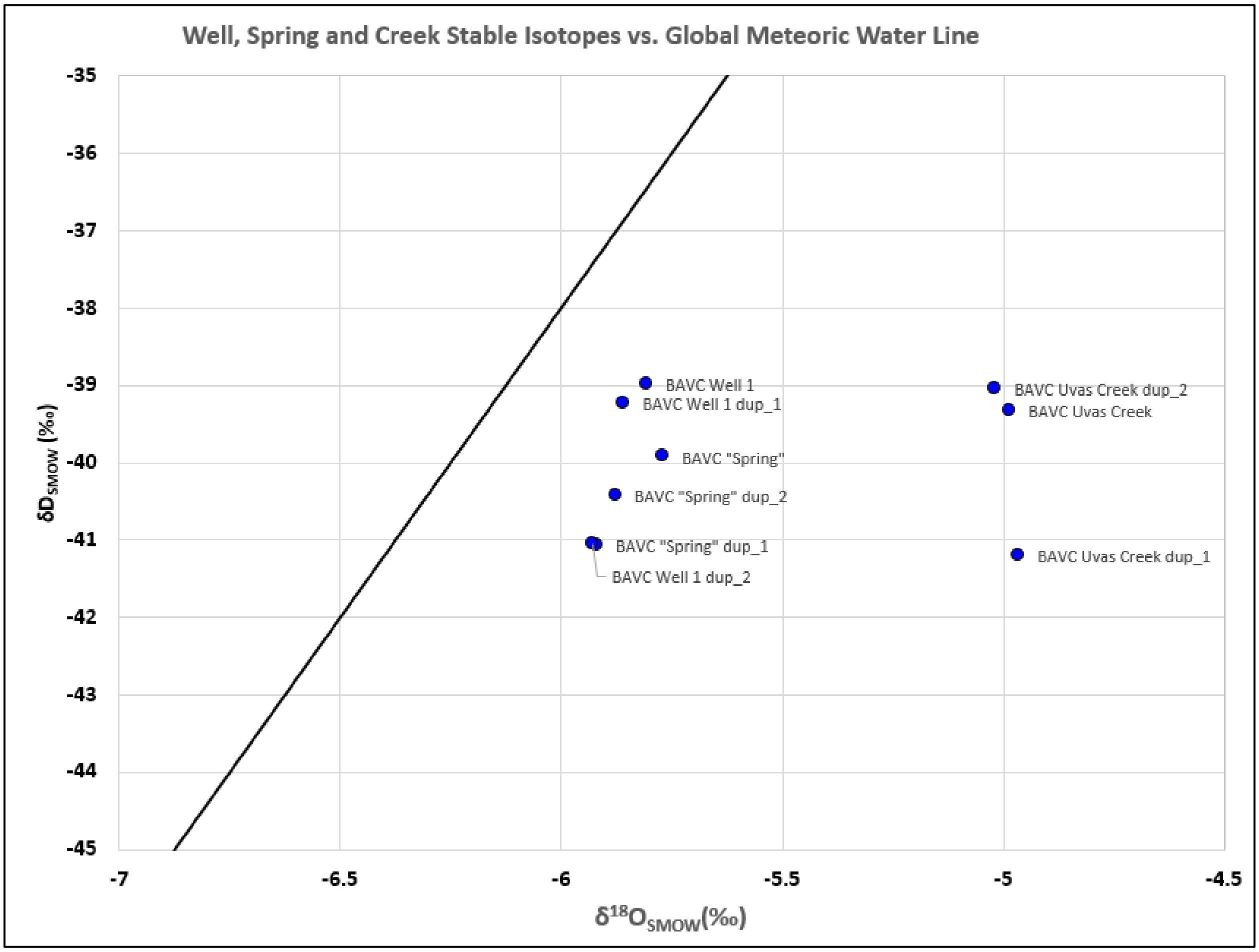
UNIVERSIT
COLLEGE OF AGR
ENVIRONM

Stable Isotope Facility Data Report

Principal Investigator:	Thomas Mohr	Email:	tkgmohr@gmail.com
Researcher	same	Email:	same
Institution:	Mohr HydroGeoScience LLC		
Project:	BAVC Groundwater Recharge Source End-members		
Submission Date:	August 19, 2021		
Completion Date:	September 9, 2021		
Report Date:			
Analysis:	^{2}H of Water by Headspace Equilibration using Gas Bench-IRMS		
		δ^{2}H	**δ^{18}O**
Mean SD for sample material replicates in this project:		±1.0 ‰	±0.05 ‰
Mean SD for reference material replicates in this project:		±1.2 ‰	±0.04 ‰
Mean absolute accuracy for calibrated reference materials within:		±0.3 ‰	±0.05 ‰
Notes:			
Sample count to be charged:	6		
Additional charges:	None		
Reported by:	Richard R. Doucett rrdoucett@ucdavis.edu		

Please review your data in a timely fashion, so that we may fully address any questions or concerns.

^{2}H Analysis #	^{18}O Analysis #	Sample ID	$\delta^{18}O_{VSMOW}$ (‰)	$\delta^{2}H_{VSMOW}$ (‰)	Comments
PD-79261	ICE-36322	BAVC Spring	-5.77	-39.9	BAVC "Spring"
PD-79262	ICE-36323	BAVC Spring dup_1	-5.92	-41.1	BAVC "Spring" dup_1
PD-79263	ICE-36324	BAVC Spring dup_2	-5.88	-40.4	BAVC "Spring" dup_2
PD-79264	ICE-36325	BAVC Well 1	-5.81	-39.0	BAVC Well 1
PD-79265	ICE-36326	BAVC Well 1 dup_1	-5.86	-39.2	BAVC Well 1 dup_1
PD-79266	ICE-36327	BAVC Well 1 dup_2	-5.93	-41.0	BAVC Well 1 dup_2
PD-79267	ICE-36328	BAVC Uvas Creek	-4.98	-39.3	BAVC Uvas Creek
PD-79268	ICE-36329	BAVC Uvas Creek dup_1	-4.97	-41.2	BAVC Uvas Creek dup_1
PD-79269	ICE-36330	BAVC Uvas Creek dup_2	-5.02	-39.0	BAVC Uvas Creek dup_2



APPENDIX B

Wastewater Marker Chemical Analysis of Spring Sample to Determine Spring Origin

Identification of common wastewater marker chemicals such as caffeine, sucralose, DEET, and others can serve as a means of identifying groundwater under the influence of wastewater, commonly due to septic effluent or leaking sewer lines. MHGS collected a sample from the spring flowing in the sub-watershed draining to El Matador Drive for analysis by EPA 1694M-ESI+PPCPs - Pharmaceuticals by LC/MSMS-ESI+, with standards run for caffeine and sucralose.

Analytical results are attached. The analysis showed that sucralose, caffeine, and one pharmaceutical compound were detected in the sample. This indicates that the spring origin is septic effluent. The identity of the pharmaceutical compound has been omitted from the report in order to protect the privacy of the residents whose septic systems may be contributing to flow in the spring.

APPENDIX A

Stable Isotope Analysis of BAVC Well Groundwater Sample to Assess Recharge Sources

All water contains natural variations in composition including the most abundant isotopes of its constituent atoms (^{16}O, oxygen with sixteen neutrons – 99.76%), and ^{1}H, hydrogen with one neutron), and in a small fraction of water molecules, ^{18}O, i.e., oxygen with two extra neutrons – 0.2%, and ^{2}H (deuterium), hydrogen with one extra neutron - 0.0115%. The slight variation in water molecule mass can be detected using a highly sensitive mass spectrometer, to distinguish water sources, akin to "finger-printing" the water.

Water released to Uvas Creek from Uvas Reservoir is likely to have been subjected to substantial evaporation during the weeks to months it resided in the reservoir. When water evaporates, the lighter water molecules, i.e. those without the heavy isotopes of oxygen and hydrogen (^{18}O and ^{2}H), will be preferentially evaporated. The water released from Uvas Reservoir is likely to be enriched with respect to the heavier water molecules, such that water in Uvas Creek may bear a unique and distinguishable stable isotope ratio.

In contrast, rainfall falling onto the BAVC property and surrounding bedrock hills, a portion of which infiltrates the soil and underlying bedrock to recharge the groundwater residing in the bedrock fractures, is not subjected to the same degree of evaporation. Groundwater in the bedrock, accessible in the springs, is likely to have an isotopic signature that is more similar to the isotopic composition of rainfall. The isotopic character of water recharged by runoff from the Little Arthur Creek watershed is also likely to be closer to the meteoric water line, i.e. more similar to rainfall.

Measurements of stable isotopes of water are expressed relative to an international standard, and plotted relative to the *meteoric water line*, using the following conventions:

$$\delta D \text{‰} = \frac{(D/H)_{sample} - (D/H)_{SMOW}}{(D/H)_{SMOW}} \times 1000$$

$$\delta^{18}O \text{‰} = \frac{(^{18}O/^{16}O)_{sample} - (^{18}O/^{16}O)_{SMOW}}{(^{18}O/^{16}O)_{SMOW}} \times 1000$$

where ‰ means per mille, i.e. thousandths, and SMOW is the Vienna Standard Mean Ocean Water. By convention, δD and $\delta^{18}O$ (read as "delta-D" or "delta-deuterium" and "delta 18 O" or "delta oxygen-18") are expressed as negative numbers. A sensitive mass spectrometer is used to identify the fraction of the heavier isotope to the lighter one.

MHGS collected samples from the spring, the BAVC well, and Uvas Creek at Chictactac-Adams County Park on August 19th, 2021 for submittal to the University of California at Davis Stable Isotope Facility. MHGS recommended this approach to understand the recharge origins of groundwater in the BAVC well, and because this method is robust, reliable, and relatively inexpensive. Graphical and tabular results from these samples are presented below.

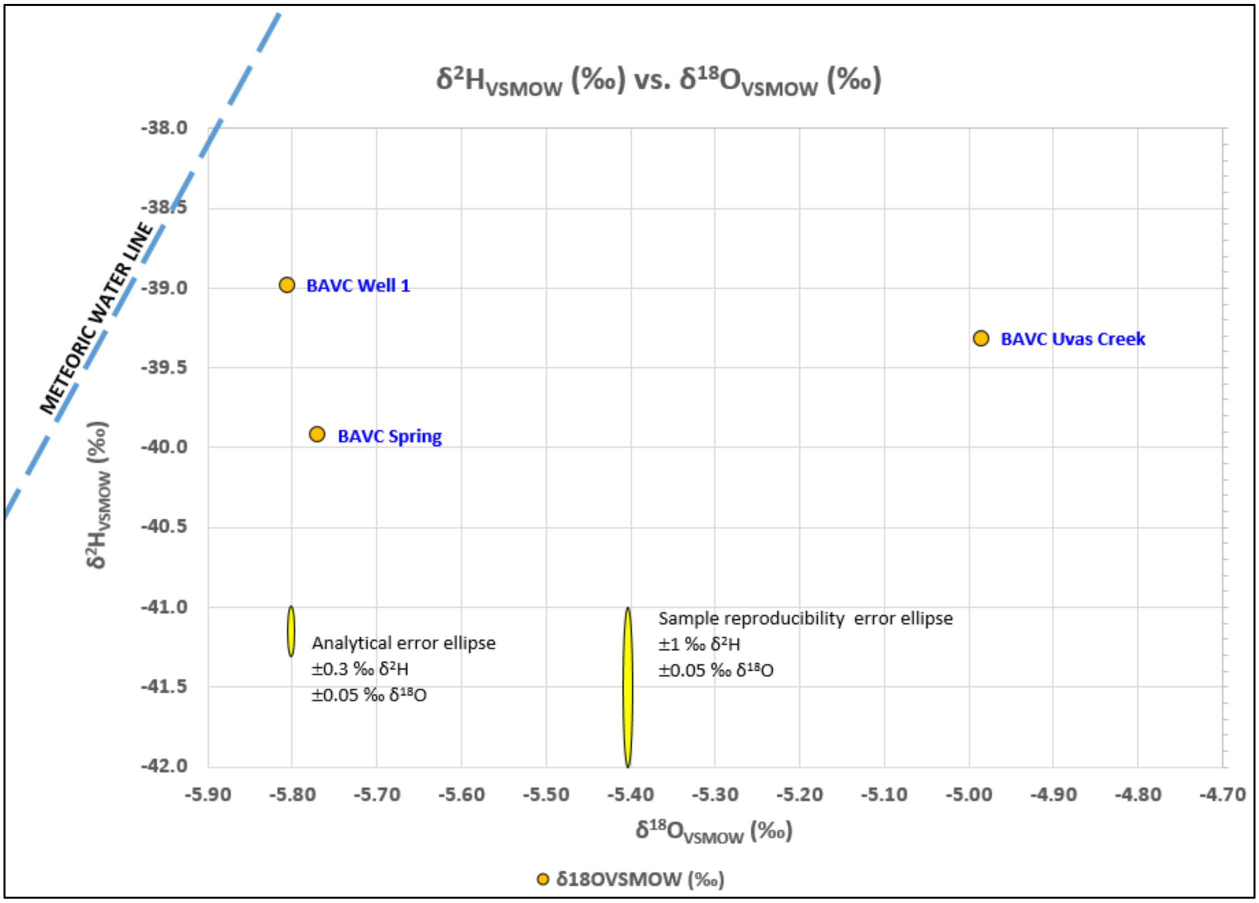


Figure A-1 – Stable Isotope Ratios of Water Samples from BAVC Well, Spring, and Uvas Creek. Points plotting furthest from the Meteoric Water Line are most evaporated.

While the BAVC well is recharged by Uvas Creek, it is also recharged by Little Arthur Creek, and by rainfall runoff from the uplands on the BAVC property. This is suggested by the fact that the BAVC well groundwater sample did not plot immediately adjacent to the Uvas Creek sample, indicating that the substantial recharge contribution from Little Arthur Creek is present in the groundwater, which is a mixture of both Uvas Creek and Little Arthur Creek recharge.

One should bear in mind that the aquifer is a dynamic system, and the groundwater flowing through it may vary in origin over different times of year. This means that analysis of stable isotopes from samples obtained in the springtime may be more rainfall dominated and less evaporated than the samples collected in August. In addition, the stable isotope ratios in rainfall itself vary based on the latitude from which the storm event originated (e.g. a pineapple express vs. a storm coming down from the northwestern Pacific/Alaska area). Even with natural variation in rainfall isotopic ratios, the fact that the BAVC Well sample is shifted toward the Uvas Creek sample indicates that it includes a portion of groundwater recharged by Uvas Creek.

UNIVERSITY OF CALIFORNIA, DAVIS

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBA

STABLE ISOTOPE FACILITY
DEPARTMENT OF PLANT SCIENCES
ONE SHIELDS AVE
DAVIS, CALIFORNIA 95616
530-752-8100

UNIVERSIT
COLLEGE OF AGR
ENVIRONM

Stable Isotope Facility Data Report

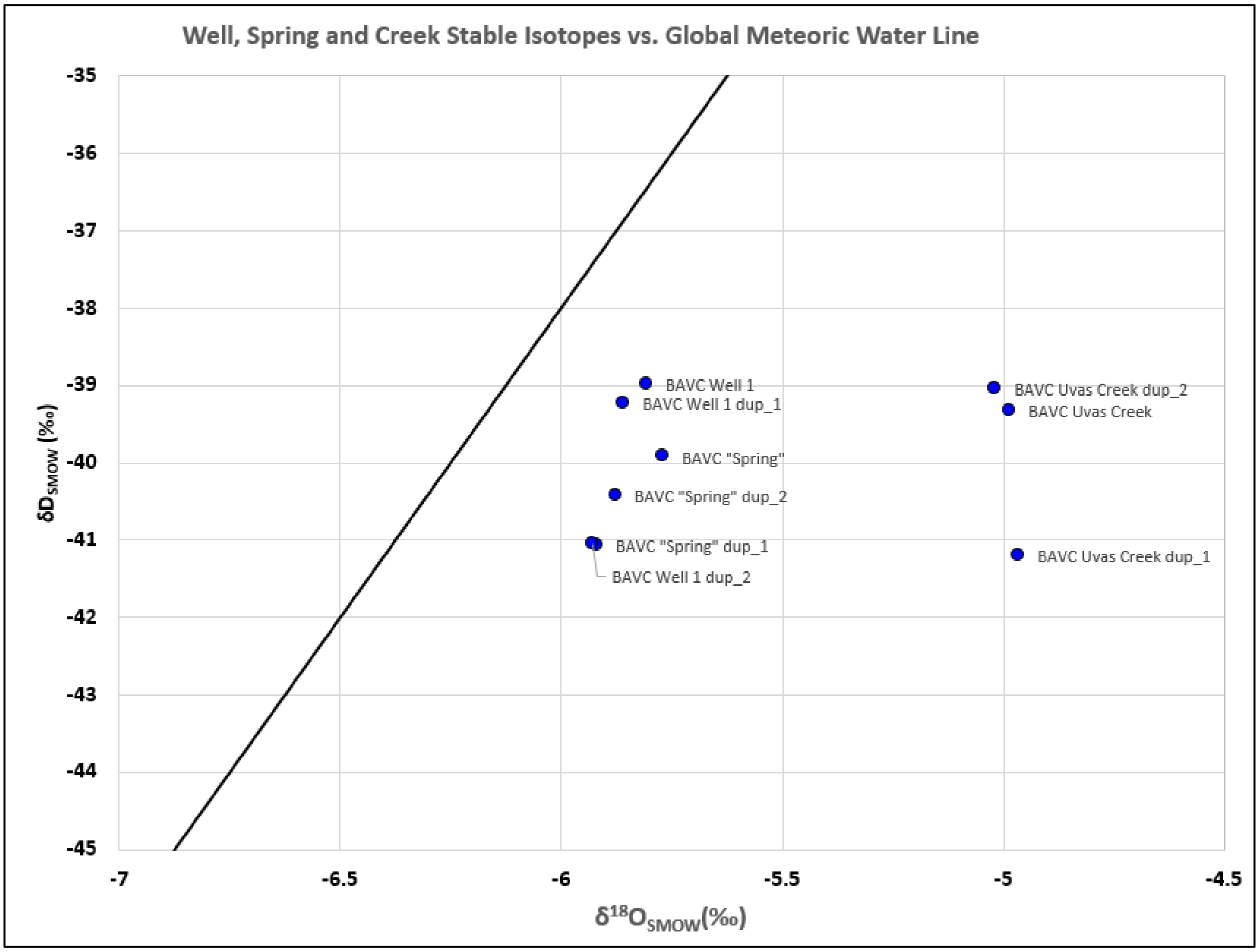
Principal Investigator:	Thomas Mohr	Email:	tkgmohr@gmail.com
Researcher	same	Email:	same
Institution:	Mohr HydroGeoScience LLC		
Project:	BAVC Groundwater Recharge Source End-members		
Submission Date:	August 19, 2021		
Completion Date:	September 9, 2021		
Report Date:			
Analysis:	^{2}H of Water by Headspace Equilibration using Gas Bench-IRMS		

	δ^{2}H	**δ^{18}O**
Mean SD for sample material replicates in this project:	±1.0 ‰	±0.05 ‰
Mean SD for reference material replicates in this project:	±1.2 ‰	±0.04 ‰
Mean absolute accuracy for calibrated reference materials within:	±0.3 ‰	±0.05 ‰

Notes:	
Sample count to be charged:	6
Additional charges:	None
Reported by:	Richard R. Doucett rrdoucett@ucdavis.edu

Please review your data in a timely fashion, so that we may fully address any questions or concerns.

^{2}H Analysis #	^{18}O Analysis #	Sample ID	$\delta^{18}O_{VSMOW}$ (‰)	$\delta^{2}H_{VSMOW}$ (‰)	Comments
PD-79261	ICE-36322	BAVC Spring	-5.77	-39.9	BAVC "Spring"
PD-79262	ICE-36323	BAVC Spring dup_1	-5.92	-41.1	BAVC "Spring" dup_1
PD-79263	ICE-36324	BAVC Spring dup_2	-5.88	-40.4	BAVC "Spring" dup_2
PD-79264	ICE-36325	BAVC Well 1	-5.81	-39.0	BAVC Well 1
PD-79265	ICE-36326	BAVC Well 1 dup_1	-5.86	-39.2	BAVC Well 1 dup_1
PD-79266	ICE-36327	BAVC Well 1 dup_2	-5.93	-41.0	BAVC Well 1 dup_2
PD-79267	ICE-36328	BAVC Uvas Creek	-4.98	-39.3	BAVC Uvas Creek
PD-79268	ICE-36329	BAVC Uvas Creek dup_1	-4.97	-41.2	BAVC Uvas Creek dup_1
PD-79269	ICE-36330	BAVC Uvas Creek dup_2	-5.02	-39.0	BAVC Uvas Creek dup_2



A P P E N D I X B

Wastewater Marker Chemical Analysis of Spring Sample to Determine Spring Origin

Identification of common wastewater marker chemicals such as caffeine, sucralose, DEET, and others can serve as a means of identifying groundwater under the influence of wastewater, commonly due to septic effluent or leaking sewer lines. MHGS collected a sample from the spring flowing in the sub-watershed draining to El Matador Drive for analysis by EPA 1694M-ESI+PPCPs - Pharmaceuticals by LC/MSMS-ESI+, with standards run for caffeine and sucralose.

Analytical results are attached. The analysis showed that sucralose, caffeine, and one pharmaceutical compound were detected in the sample. This indicates that the spring origin is septic effluent. The identity of the pharmaceutical compound has been omitted from the report in order to protect the privacy of the residents whose septic systems may be contributing to flow in the spring.

MBAS

Monterey Bay Analytical Services

4 Justin Court Suite D
Monterey, CA 93940
Phone: (831) 375-MBAS (6227)
www.MBASinc.com

ELAP Certification Number: 2385

Certificate of Analysis

October 11, 2021

Thomas Mohr
Mohr HydroGeoScience
Salinas,CA 93907

Thank you for using Monterey Bay Analytical Services for your analytical testing needs.
In the following pages please find the test results for the samples submitted August 27, 2021 for order ID #: 210913_02

Sample results are on the Sample Results page and are related only to the samples analyzed.

The samples were analyzed in accordance with the attached Chain of Custody document.
Sample receipt conditions were noted on the chain of custody forms and are reported at the end of this report. Any deviations from the quality requirements are specified in the Quality Control report attached (if applicable) to the analytical report.

This certificate of analysis shall not be reproduced except in full, without written approval of the laboratory.

Authorized by

David Holland
Laboratory Director
Monterey Bay Analytical Services

CALIFORNIA SMALL BUSINESS 23348

Thank you again for using MBAS. We value your business and appreciate your loyalty.

Mohr HydroGeoScience
Thomas Mohr
Salinas, CA 93907

Monterey Bay Analytical Services
4 Justin Court Suite D, Monterey, CA 93940
831.375.MBAS (6227)
www.MBASinc.com
ELAP Certification Number: 2385

Monday, October 11, 2021

Sample Results

Lab Number: 210913_02-01 Sample Description: BAVC Spring/Septic, Spring water collected in a natural drainage

Collection Date/Time: 8/26/2021 16:30 Sample Collector: Mohr, T Client Sample #: Spring 1
Received Date/Time: 8/27/2021 10:20 System ID:

Analyte	Method	Unit	Result	Dilution	Qualifier	PQL	MCL	Analysis Date / Time	Analyst
PPCP - Pharmaceuticals *EPA 1694M-ESI+: Caffeine, Sucralose*	External	External	Attached	1	E			9/13/2021 12:00	E

Monterey Bay Analytical Services
4 Justin Court Suite D, Monterey, CA 93940
831.375.MBAS (6227)
www.MBASinc.com
ELAP Certification Number: 2385

Mohr HydroGeoScience
Thomas Mohr
Salinas, CA 93907

Monday, October 11, 2021

Sample Condition Upon Receipt

Order ID: 210913_02

Is there evidence of chilling? *NOTE: Systems are encouraged but not required to hold samples <10°C (Microbiology) or <6°C (Chemistry) during transit.	N/A
Did bottle arrive intact?	N/A
Did bottle labels agree with COC?	N/A
Adequate sample volume?	N/A
Additional Comments	Client shipped FedEx direct to Weck;
Additional Comments	Sample not received by MBAS.

WeckLab c/o MBAS

1H27054

MBAS Order ID: 210913-02

MBAS
Monterey Bay Analytical Services

Chain of Custody / Analysis Request

4 Justin Court, Suite D, Monterey, CA 93940
(831) 375-MBAS (6227) * Fax: (831) 641-0734
info@mbasinc.com www.MBASinc.com

Client / Company Name:	Attention:	Email Address(es) to Send Report/Invoice:	Phone Number:
Mohr HydroGeoScience	Thomas Mohr	tkgmohr@gmail.com	408-832-1978
Project/System Info:	**System ID: *Required for EDT***	**Billing Address:**	**Contract/ P.O. #:**
BAVC Spring/Septic		8646 Dyer Rd, Salinas, CA 93907	Please invoice MBAS

Mark if YES: For Regulatory Reporting? ☐ Requires EDT? ☐

LAB USE ONLY
1. ☐ DW ☐ WW ☐ Soil ☐ Other ______
2. Is there evidence of chilling? (Y) / N N/A < 2hrs
3. Adequate sample volume? (Y) / N
4. Was the sample filtered? Y / (N)
5. Did bottles agree with the COC? Y / N
IR Used:

Requested Analysis

MBAS Lab #	Source Code for Client Sample ID *Required for EDT*	Sample Description	Sample Collection Date	Sample Collection Time	Receiving Temp (°C)	Coliform Analysis: CL2 Residual (mg/L)	Routine	Other	Repeat	Special	Container: # Cont.	Type*	Size	EPA 1694M w/stds for sucralose, caffeine			Preservative (include pH) Initials: HNO3	H2SO4	NaOH	HCl	Na2S2O3
-01	Spring 1	Spring water collected in a natural drainage	08/26/21	16:30							2	G	250mL	✓							
		not a drinking water source																			
		not a regulatory compliance sample																			
		One analysis. DUP sample provided only in case of breakage.																			

	Printed Name	Signature	Date	Time	Comments
Sampled and Relinquished by:	Thomas Mohr	[signature]	8/26/21		High turbidity, TSS please decant, filter, or centrifuge as appropriate.
Received by:					
Relinquished by:	FedEx				
Received by:	J. Alvarado	[signature] 11.2°C TO830	8/27/21	10:20	

☐ Payment Received Check #: Amount: Date:

*Container Type: P=Plastic, G=Glass, V=Various

*Samples received warm. OK to proceed with analysis per Sara Sugarman via email on 8/27/21 -ess 8/27/21

MBAS_COC_Rev. 3/20

WECK LABORATORIES, INC.

Certificate of Analysis

FINAL REPORT

Work Orders:	1H27054	**Report Date:**	10/11/2021
		Received Date:	8/27/2021
Project:	BAVC Spring/Septic	**Turnaround Time:**	Normal
		Phones:	(831) 375-6227
		Fax:	(831) 641-0734
Attn:	David Holland	**P.O. #:**	
Client:	Monterey Bay Analytical Services 4 Justin Court, Suite D Monterey, CA 93940	**Billing Code:**	

ELAP-CA #1132 • EPA-UCMR #CA00211 • Guam-EPA #17-008R • HW-DOH #4047 • LACSD #10143 • NELAP-OR #4047 • NJ-DEP #CA015 • SCAQMD #93LA1006

This is a complete final report. The information in this report applies to the samples analyzed in accordance with the chain-of-custody document. Weck Laboratories certifies that the test results meet all requirements of TNI unless noted by qualifiers or written in the Case Narrative. This analytical report must be reproduced in its entirety.

Dear David Holland,

Enclosed are the results of analyses for samples received 8/27/21 with the Chain-of-Custody document. The samples were received in good condition, at 11.2 °C and on ice. All analyses met the method criteria except as noted in the case narrative or in the report with data qualifiers.

Reviewed by:

Brandon Gee
Operations Manager/Senior PM

Certificate of Analysis

FINAL REPORT

WECK LABORATORIES, INC.

Monterey Bay Analytical Services
4 Justin Court, Suite D
Monterey, CA 93940

Project Number: BAVC Spring/Septic

Project Manager: David Holland

Reported:
10/11/2021 11:32

Sample Summary

Sample Name	Sampled By	Lab ID	Matrix	Sampled	Qualifiers
Spring 1	Thomas Mohr	1H27054-01	Water	08/26/21 16:30	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634

www.wecklabs.com

Sample Results

Sample: Spring 1 — 1H27054-01 (Water)

Sampled: 08/26/21 16:30 by Thomas Mohr

Analyte	Result	MDL	MRL	Units	Dil	Analyzed	Qualifier
PPCPs - Pharmaceuticals by LC/MSMS-ESI+							
Method: EPA 1694M-ESI+ — **Instr:** LCMS03							
Batch ID: W1I0504 — **Preparation:** EPA 3535/SPE — **Prepared:** 09/09/21 08:32 — **Analyst:** jna							
Caffeine	**61**	4.0	4.0	ng/l	1	09/10/21	

Sample Results

Sample: Spring 1 — 1H27054-01RE1 (Water)

Sampled: 08/26/21 16:30 by Thomas Mohr

Analyte	Result	MDL	MRL	Units	Dil	Analyzed	Qualifier
PPCPs - Pharmaceuticals by LC/MSMS-ESI+							
Method: EPA 1694M-ESI+ — **Instr:** LCMS03							
Batch ID: W1I0504 — **Preparation:** EPA 3535/SPE — **Prepared:** 09/09/21 08:32 — **Analyst:** jna							
Sucralose	**140**	20	20	ng/l	1	09/13/21	

The balance of the report includes analysis for pharmaceutical compounds as wastewater marker chemicals. These results will not be reported in order to protect the privacy of the residents whose septic leach fields are likely contributing to flow in the spring. In addition to pharmaceutical results, the balance of the report includes QA/QC lab data. MHGS has not provided the lab report to BAVC or any other party. The data has been used only to verify or refute whether wastewater contributes to the spring found flowing in mid-August in an extremely dry year.