COUNTY OF SAN MATEO
FOUNDED 1856

PESCADERO (CSA-11) WATER SUPPLY YIELD AND SUSTAINABILITY STUDY

FINAL

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TODD
GROUNDWATER

2490 Mariner Square Loop, Suite 215
Alameda, CA 94501
510.747.6920
www.toddgroundwater.com

SIGNATURE PAGE

CERTIFIED HYDROGEOLOGIST
Eugene
B.
Yates
No. 740
Exp. 1/31/22
STATE OF CALIFORNIA

Gene Yates

Eugene Gates, PG, CHG

Senior Hydrogeologist

CERTIFIED HYDROGEOLOGIST
DANIEL
J.
CRAIG
No. 66
5/19/2021
STATE OF CALIFORNIA

Daniel J. Craig

Daniel Craig, PG, CHG

Senior Hydrogeologist

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1. INTRODUCTION

San Mateo County Service Area No. 11 (CSA-11) provides municipal water service to the community of Pescadero and has had concerns of declining water supply for many years. Pescadero is a small town (population 643 in 2010) on the San Mateo County (County) coast, approximately 14 miles south of Half Moon Bay (**Figure 1**). Since 1992, the municipal water supply has been from wells located on Butano Ridge, a fault-bounded hill between the town and the Pacific Ocean. Water levels in the two original supply wells (Well No. 1 and Well No. 2) steadily declined from 1992 to the present. In 2018, a third well screened at greater depth (Well No. 3) was constructed. Todd Groundwater (herein Todd) subsequently conducted a Source Water Capacity Assessment based on the characteristics of Well No. 3, which found that Well No. 3 will extend the useful life of the well field but not change the local water balance of the groundwater system.

The County is considering several changes in water demand served by the CSA-11 system. One is connecting a new fire station that will be built on land adjacent to the existing Pescadero Middle/High School to replace the existing station located at the intersection of Pescadero Creek Road and Bean Hollow Road (Figure 1). After the new station is built, the existing station would be used only during fire emergencies. A second potential new demand on the system would be the addition of the Pescadero Middle/High School to CSA-11 service area through the annexation and sphere amendment process by the Local Agency Formation Commission (LAFCo). An extension of the water distribution system would need to be built to serve the school, which is located approximately 1 mile east of town (Figure 1). Finally, the County's Local Coastal Program (LCP) updated in 2013 included projected water demands for future development in Pescadero that would effectively double existing demand. Under an LCP buildout scenario, current water supply system may be unsustainable and additional water sources would need to be developed.

The purpose of this study is to: 1) audit existing water use to identify potential unauthorized uses or leaks in the distribution system, and 2) evaluate the adequacy of the current CSA-11 water system under existing and potential additional water demand conditions. A third objective of this study is to evaluate potential alternative water sources in the Pescadero area; the scope and results of this third task will be documented in a separate technical memorandum submitted to the County later this year.

1.1. Water System Characteristics

Previous studies of the local hydrogeology, well and water supply system characteristics, and sustainability of the CSA-11 water system were performed in 2002 and 2018 by Todd. CSA-11 Well Nos. 1, 2 and 3 are located near the top of Butano Ridge at an approximate ground surface elevation of 280 feet above mean sea level (ft msl) and are located a few tens of feet apart from each other. Wells Nos. 1 and 2 are 260 and 247 feet deep, respectively, with screened intervals of 210 to 250 and 207 to 247 feet below ground surface (ft bgs), respectively. Static depth to groundwater in Well No. 1 during 2020 was approximately 200 ft bgs, or near the top of the well screen. From 1992 to 2020, Well No. 1

was the primary supply well, with a pumping rate of 60-70 gallons per minute (gpm). Well No. 2 has always served as a standby well for use in case Well No. 1 is out of service.

New Well No. 3 was installed during summer 2018 and is completed to a total depth of 360 ft bgs, with a screened interval of 250 to 350 ft bgs. During test pumping, Well No. 3 appeared capable of pumping at a rate of 100 gpm or more on a sustained basis (Todd Groundwater, 2019). It was put into service as the primary supply well in fall 2020.

The wells pump into two storage tanks located partway down the ridge. The two tanks have a combined storage capacity of approximately 298,000 gallons. The tanks are filled through separate intake pipes connected to a pipe fed by all three wells. The top of the overflow funnels in both tanks are set at the same elevation, so that the maximum level of stored water is the same in both tanks. A float switch in one of the tanks maintains water levels within a 2-foot range, activating the well to replenish storage whenever the water level drops to 2 feet below its normal high level. The normal high level corresponds to approximately 191,000 gallons (Todd Groundwater, 2019). Additional storage (up to the 298,000 gallon maximum capacity) could be accessed by disconnecting the two tanks from each other, allowing the newer, taller tank to be filled all the way up.

Pumped water is metered at the wells and inside the building that houses the electrical controls for the wells, but outflow from the tanks into the water distribution system is not metered. Water flows through a pipeline that runs from the tanks down to Pescadero Creek Road and continues east with branches to serve customers on several streets. There currently are 101 active customer connections, and water use at each customer turnout (water service lateral) is metered. Metered customer water use during 2015-2019 averaged 19,442 gallons per day.

Groundwater levels in Well Nos. 1 and 2 have declined continuously since 1992. During 2015-2019 the rate of decline was steady at about 0.5 foot per year. The long-term decline indicates that groundwater pumping consistently exceeds the sustainable yield of the groundwater system beneath Butano Ridge.

1.2. Scope of Study

This study evaluates current water usage patterns and options for achieving a sustainable water supply under three demand conditions:

- Current water demand served by the CSA-11 distribution system,
- Current demand plus demand from the new fire station and middle/high school if those facilities are connected to the distribution system, and
- Future demand if growth projected in the Local Coastal Plan occurs.

This report is organized around eight specific tasks defined by the County in the original scope of work, as follows:

Task 1. Audit existing water connections to CSA-11 to identify non-allowable current uses and system water leaks.

Task 2. Analyze the short-term yield (based on last 5 years of available information, 2015-2019) of the CSA-11 wells with the addition of the fire station and school to the system and partial demolition of existing fire station: how does short-term yield compare to both average and peak daily demand on the system? Analysis will incorporate water usage by the "average daily water use during the two months of the highest water use in the year" as a metric.

Task 3. Analyze the long-term impact (including drought and non-drought years) to CSA-11 groundwater supply with the addition of fire station and school: What is the estimated longevity of the wells with the addition of the two new facilities? How much would the two new facilities accelerate aquifer drawdown compared to findings of June 2019 Todd Groundwater report?

Task 4. Identify any potential water quality impacts associated with CSA-11 extension to the fire station and school.

Task 5. Evaluate potential effects of Local Coastal Program (LCP) residential and commercial buildout and increased water demand as shown in LCP Table 2.16 Estimate of Water Consumption Demand at Land Use Plan Buildout for the Town of Pescadero.

Task 6. Account for anticipated water usage associated with retention of the apparatus bay and any other facilities at the existing fire station site.

Task 7. Update any climate change modeling/assumptions and any known increases in private groundwater uses that would impact CSA-11's supply longevity.

Task 8. Identify existing and anticipated non-revenue water as the lines age over the approximate 1-mile CSA-11 extension to ensure that loss would not be a significant factor. (Non-revenue water is water that is "lost" from source before it reaches the customer, e.g. leaks.) Identify existing technology that could be implemented with the CSA-11 extension to mitigate impact of non-revenue water to current customers (e.g. automatic shutoff feature to the main extension to prevent leaks from depressurizing the larger system).

Additional Task 9. Evaluate potential additional sources of supply. This task is currently in-progress, and will be documented in a separate memorandum prepared later this year.

2. ANALYSIS AND RESULTS BY TASK

2.1. Task 1. Audit Existing Water Connections

The objective of this task is to determine whether various conservation strategies might be capable of decreasing water demand to below the sustainable yield of the groundwater source. This involved estimating irrigation use, quantifying unmetered uses, and measuring leakage from the distribution system.

2.1.1. Non-Allowable Uses – Metering Uncertainty

Water production and delivery are both metered in CSA-11. Production is metered at each well for Well Nos. 1 through 3. Water use is also metered at the turnout to each customer. Meters are currently read on a bimonthly schedule. **Figure 2** shows A), "Annual CSA-11 Water Use (Customer Meters)" metered water use for 2004-2019 and B), "Semiannual CSA-11 Water Use" illustrates well production and metered customer consumption for 2012-2020. As shown in the lower graph (B), well production was consistently less than the sum of the customer meter readings until 2016, when the meter on Well No. 1 was replaced. Since then, the two data sets have matched more closely, although the sum of the customer meters has generally been about 20 percent lower than the metered well production since 2018. Water meters tend to under-record as they age, which could be causing some of the recent discrepancy. One study of residential water meter accuracy found that the meters under-recorded by only about 1 percent for the first 20 years of service, increasing to 19 percent at 30 years of service (Allender, 2000). Leaks or unmetered uses in the distribution system could also contribute to the discrepancy. In any case, the obvious effect of changing the well meter in 2016 underscores the fact that even metered water use data are subject to uncertainty.

Review of the upper graph (A) indicates that total system-wide water use during calendar years 2015-2019 averaged 19,442 gallons per day (gpd)[1], as measured by customer meters at the 101 active connections. This five-year period is representative of current water use under non-drought conditions.

2.1.2. Non-Allowable Uses

Customer water use records were examined for indications of irrigation use, some of which might not be allowed. The current water supply and distribution system was authorized by Coastal Development Permit 90-62. One of the conditions of approval was that delivered water be used only for specified uses including "limited landscape irrigation". Irrigation use can often be detected by regular seasonal variations in water use, as illustrated in the sample customer account usage record shown in **Figure 3**. Water use by this customer is highest in summer, corresponding with seasonal irrigation demand. Tourism also peaks in summer, and customer accounts of tourist-serving businesses were not counted as irrigated where they could be identified.

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[1] To facilitate comparison, flow rates in this report are mostly expressed as gallons per day. To convert to other units, divide by 1,440 to obtain gallons per minute, multiply by 30.4 to obtain gallons per month, multiply by 365.25 to obtain gallons per year, and multiply by 0.00112 to obtain acre-feet per year. Conversions from daily or annual data to monthly data assume 30.4 days per month.

Of the 101 active customer accounts, 36 had average usage exceeding 180 gallons per day (gpd). Usage at those accounts was reviewed individually, and 11 of them were found to have an irrigation pattern. The presence of irrigated landscaping was confirmed at most of those accounts during a site visit on September 18, 2020. The amount of irrigation use was estimated using the curve separation technique, which assumes that water use during the minimum-use month of the year is all indoor use and that additional use in other months is for irrigation. By interpolating between these seasonal low points over the entire hydrograph period, indoor use (below the green line in **Figure 3**) was separated from irrigation use (above the line). By this method, average annual irrigation use during 2015-2019 by the eleven accounts with an irrigation pattern amounted to 1,516 gpd cumulatively, or 8 percent of total system water use.

These results indicate that a strict prohibition on landscape irrigation probably would not be sufficient by itself to eliminate the long-term water-level declines, as discussed below. Accounts with smaller amounts of usage might also include some irrigation use, but that usage is probably small relative to the amounts detected in the high-use accounts.

2.1.3. Leaks from the Distribution System

Customer meters and inflow from the storage tanks to the distribution system were both investigated for signs of leakage from the water distribution system. Each customer meter is equipped with a highly sensitive spinner dial capable of detecting small flows, typically down to approximately 0.1 gallon per minute (Pietrosanto and others, 2020). Slow rotation of the spinner dial indicates a possible leak. During the September 18, 2020 site visit, thirty meters were read around the middle of the day. The spinner dial on all of them came to a complete stop while being observed, even ones that initially had some movement. Therefore, none of those accounts appeared to have a plumbing leak downstream of the meter.

The contractor that reads the meters (Bracewell Engineering) looks for spinner dial movement, high water usage or a sudden increase in water usage during each bimonthly meter reading event and notifies the landowner of the possibility of a leak. This is a standard water conservation best management practice and provides additional assurance that leaks on the customer sides of meters are not large or common.

Leaks below the detection level of the spinner dials can be cumulatively large. For example, if all the 101 customers had leaks at 0.05 gpm (half of the flow meter detection limit), the leaks would amount to 7,272 gpd, or about 37 percent of average daily system-wide water use.

Total leakage from the distribution system—including leaks from water mains and from pipes beyond the customer meters—was investigated by measuring overnight flow out of the storage tanks. This was accomplished by placing a Hobo brand pressure transducer/data logger with 0.005 ft accuracy and barometric correction into one of the two storage tanks for a week (November 24-December 2, 2020). Steady water-level declines late at night are an indication of possible leaks from the distribution system because other water uses are low at that time.

The tank levels, recorded at 10-minute intervals, are shown in the upper plot (A. Water Level in Storage Tanks) in **Figure 4**. Float switches control the operation of the well pump. When water levels drop about 2 ft below the high level, the pump is activated and runs until the water level is returned to the high level. Refilling events happened three times during the week, or about every two days. The red circles indicate the late-night periods (1:00 a.m. to 4:00 a.m.) that were used in the leak analysis.

The lower plot (B. Storage Tank Late-Night Water-Level Decline) in **Figure 4** shows an expanded view of water-level declines during 1:00-4:00 a.m. on seven days during the monitoring period, normalized to a level of zero at 1:00 a.m. The lines are not perfectly straight, which may be due to accuracy limitations of the pressure transducer and/or potential non-uniform late night water use. The slopes are also not identical for the seven days. Pipe leaks are a function of pressure in the pipe and are normally constant. There might be variable leakage due to faucets left dripping, toilet flap valves that occasionally do not seat properly, or daily differences in other late-night water uses such as toilet flushing and irrigation. The minimum decline over the 3-hour period was about 0.010 foot (upper three curves), and the average was 0.021 foot (all curves). The water-level decline was converted to a volume by multiplying by the area of the storage tanks. The tanks are refilled at the same time from the well intake pipe and have the same level. The tank diameters are 38 and 41 ft, corresponding to a combined area of 2,454 square feet. The minimum and average 3-hour volume declines were 184 and 386 gallons, respectively.

The late-night storage decline might not all be due to leakage. Possible non-leakage water uses include toilet flushing and drip irrigation systems operated by a timer. An approximate but plausible estimate of systemwide toilet flushing volume between 1:00 and 4:00 a.m. is 258 gallons, which assumes one 2.5-gallon flush during that period for each of the 101 active connections. Drip irrigation use is more speculative. If on any given night five customers have drip systems with thirty 1-gph emitters that operate throughout the 1:00-4:00 a.m. period, the 3-hour irrigation volume would be 450 gallons. Thus, potentially all of the late-night water use indicated by the storage tank levels might be attributable to toilet flushing and/or irrigation.

Extrapolating to 24 hours, the minimum and average late-night water use corresponds to flow rates of 1,470 and 3,080 gpd. These flows equal 8 percent and 16 percent of average daily systemwide water use. This represents a high range of estimated leakage. To the extent that some or all of the late-night water use is for toilet flushing or irrigation, the leakage flow is correspondingly lower. Unfortunately, available data do not support a breakdown of total late-night water use into its component parts, and there is no straightforward way to obtain that information.

A leakage rate equal to 7 percent of total water use is not unusual for municipal water supply systems (Lahlou, 2005). In a supply-constrained system such as this one, however, loss of 8-16 percent of the supply to leaks is significant. The locations of leaks in water mains (upstream of the customer meters) can usually be found by acoustical methods. Specialty contractors that provide leak detection services are available in the Bay Area. Leaks on the customer side of the meters are most commonly from plumbing fixtures and are typically addressed through customer awareness programs.

2.1.4. Water Main and Fire Hydrant Flushing

In many municipal water supply systems, unmetered water uses include exercising of fire hydrants and flushing of water mains. According to fire station staff, hydrants are not currently tested to ensure functionality (“exercised”), primarily due to community sensitivity to apparent water waste. Five dead-end water mains in the water distribution system are flushed of accumulated sediment by opening a valve at the end of the stub line for about 30 seconds. The flow rate is on the order of 200 gpm. This was formerly done quarterly, but the frequency has been reduced to annual due to community concerns over water waste (Brennan, 2020). The amount of water used for this purpose is approximately 500 gallons per year. Averaged over a year, it is equivalent to a flow of 1.4 gpd or 0.007 percent of average annual system-wide water use.

2.2. Task 2. Analyze the Short-Term Effects on CSA-11 Yield with the Addition of the Fire Station and Middle/High School to the System

Two community facilities are proposed for connection to the CSA-11 water distribution system: Pescadero Middle/High School and a new fire station that would largely replace the existing fire station at the intersection of Pescadero Road and Bean Hollow Road (**Figure 1**). The impact of these new demands on system supplies was investigated by comparing the new uses with total existing use and well pumping capacity on an average annual, maximum-month and maximum-day basis.

2.2.1. Water Use at Pescadero Middle/High School

Non-potable water use at Pescadero Middle/High School is presently supplied by an on-site well, and its production is metered. During 2014-2016, the amount of water produced averaged 736 gpd, as shown in **Figure 5**. This is the period of record readily available from the California Division of Drinking Water (DDW) on-line database. School staff tabulated meter readings from the school well for 2012-2015, during which time water use averaged 728 gpd, consistent with the DDW database amounts (Lagow, 2017). Staff estimated that in 2019 water use was “about 25,000 gallons per month”, or 822 gpd (Lagow, 2020). This rate is within 12 percent of the 2014-2016 average. The maximum monthly use during 2014-2016 was 35,500 gal/mo (1,168 gpd), or 1.42 times greater than average use during 2014-2016. This reflects recent but pre-Covid-19 use, which is the appropriate basis for long-term planning.

Groundwater produced by the school well reportedly has elevated nitrate concentrations that exceed State Maximum Contaminant Limits (MCLs) for drinking water. About three years ago, the school began purchasing bottled water for drinking. Detailed records for a 6-month period in 2017-2018 indicated a steady consumption averaging 13.1 gpd (over all days of the month during the school year) (Lagow, 2020). This represents less than 0.07 percent of total water use by existing CSA-11 customers.

Non-potable uses at the school could continue to be supplied by the school's well after potable uses have been switched to the CSA-11 system. These non-potable uses include infrequent water use for storage tank cleaning, pressure tank maintenance, bus washing, initial irrigation for establishing turf, and filling fire trucks. During 2012-2016 those uses corresponded to an average daily use of 123 gpd (Lagow, 2017). Landscaping on the front side of the school is not irrigated. The playing field behind the school building is flood irrigated once in spring by pumping out of Pescadero Creek. The baseball infield was formerly irrigated but is no longer (Lagow, 2020). Although toilet flushing is a non-potable use, it could be expensive to separate the toilet supply from the rest of the building supply. That use is conservatively included in the demand that would be switched to the CSA-11 supply. In 2019 there were about 165 students and 33 staff. Men's bathroom urinals are flushless (waterless).

The total new demand placed on the CSA-11 system by connecting the school would average about 835 gpd, which corresponds to an increase of 4.3 percent. This estimate is conservatively high because it uses the higher of the two estimates of average monthly use and includes some infrequent non-potable uses that in the future likely could continue to be supplied by the well (historically on the order of 120 gpd).

2.2.2. Water Use at Current and New Fire Stations

The current fire station is served by a well and by the CSA-11 distribution system. The well supplies the "apparatus bay" building, which houses an office, toilet, sink, clothes washer and three fire trucks. Water use for the toilet, sink, and clothes washer is 20-25 gallons per day according to the station captain (Cunningham, 2020). The barracks building is already connected to the CSA-11 distribution system (since at least 2012), and water use is metered. This use includes washing of fire trucks. During non-emergency periods, fire trucks are filled with water from the CSA-11 system, but typically from an off-site hydrant. That use is not metered but is estimated to be less than 5,000 gallons per year (equivalent to less than 14 gpd). However, a single major fire event can use more than 10,000 gallons (Gregg, 2020). Average annual use of CSA-11 water at the fire station has been fairly steady at 326 gpd since 2012. The maximum bimonthly use recorded during that period was 836 gpd, or 2.56 times greater than the station's average bimonthly usage.

One of the leading sites under consideration for the new station is next to Pescadero Middle/High School. Potable uses would be served by the CSA-11 distribution system extension to the school (same as potable uses at the existing station). The number of staff at the new facility is expected to be the same as at the existing fire station. Some non-potable water uses such as filling of fire trucks and truck washing could be supplied by the existing fire station well. Those uses are supplied by the CSA-11 system at present. Thus, CSA-11 water use at the new station is expected to be the same or slightly less than current CSA-11 water use at the existing station.

After the move, the existing fire station would be staffed only during emergencies, or an estimated 5-8 days per year (Mintier, 2020). A conservatively high estimate of average monthly use in the future would be the current daily use at the barracks (326 gpd) multiplied by 8 days per year and divided by 365 days, which is 8.0 gpd. This assumes future emergency staffing would have as many people on-site as current routine staffing. If the emergency staff are in addition to the normal staff at the new fire station, this use would be an increase of 0.04 percent in total annual system demand.

2.2.3. Peak Demand and Yield of Water System

The maximum measured water use over a bimonthly measurement period for the entire system during 2015-2019 was 24,164 gpd during June-July 2016. This is 1.24 times the average use during 2015-2019 (19,442 gpd). The average and maximum water use amounts are equivalent to flows of 13.5 gallons per minute (gpm) and 16.8 gpm, respectively. Well No. 1 pumps at a rate of 60-70 gpm. To keep up with average demand, Well No. 1 pumps approximately 5.0 hours/day into the storage tanks. During the maximum month, it needed to pump approximately 6.2 hours/day. To supply the additional maximum-month demands from the Middle/High School (1,168 gpd), the well would need to operate an additional 17 minutes per day. To supply the future water demand at the existing fire station when it is staffed during an emergency (326 gpd), the well would need to operate an additional 5 minutes per day. New CSA-11 Well No. 3 has a sustainable pumping rate greater than 100 gpm. Therefore, the daily operating times required to meet the aforementioned demands will be less than the operating times for Well No. 1.

Well No. 1 or Well No. 3 could easily supply the average and maximum demands associated with the Middle/High School and fire station simply by operating a few additional minutes per day. Total well operating time for either well would remain less than 7 hours per day (even less for Well No. 3), which is comfortably sustainable. Under peak demand periods, wells can operate up to 24 hours per day without adverse effect, although 12 hours per day is often used as a target long-term duty cycle.

The storage tanks provide sufficient buffer to accommodate maximum day and peak hour demands. The storage tanks are presently connected, and the normal high-water level (controlled by a float switch) corresponds to a storage of 191,000 gallons. Maximum day demand for municipal water systems in California is commonly on the order of 2.0 times average day demand (West Yost & Associates, 2014; Black & Veatch, 2018). The maximum day demand factor is probably smaller in Pescadero because the factor correlates with the amount of irrigation, which is a small percentage of total use in Pescadero. Conservatively assuming a maximum day demand factor of 2.0, the total water demand on the maximum day would be approximately 38,884 gallons. Tank storage alone could supply that level of demand for five days, but more realistically it would be supplied by running Well No. 3 for an additional 3-4 hours per day. Peak hour demands involve smaller volumes of water that are easily absorbed by tank storage. Thus, between the storage capacity of the tanks and the additional operating time available for the wells, the system can easily supply maximum day and peak hour demands.

2.2.4. Current Condition of Existing Fire Station Well

The fire station well is located on the hillside behind the station, about halfway between the station and the CSA-11 storage tanks. The output of the well has reportedly been declining in recent years (Cunningham, 2020). A well completion report (driller's log) is not available for the well. A field inspection of the well was made on November 24, 2020. According to labeling on the pump control box, the well is 160 feet deep and the pump is set at a depth of 150 feet. The pump is a Franklin Electric FPS4400 Tri-Seal series pump, Model No. 7FA05S4-PE that was installed on August 11, 2018. The power supply/pump controller was installed in 2013 and delivers 230V single-phase AC current. According to the pump performance curve on the manufacturer's website the pump should be capable of pumping 10.5 gpm against a total head of 100 feet, decreasing to 7 gpm at 200 feet. The static depth to water was 91.1 ft. The well pumps into a covered, concrete above-ground cistern about 25 ft away. The cistern is approximately 10 feet in diameter and 6 feet high (above-ground height). A float switch in the tank turns the well pump on when the water level is about 3 ft below the top of the cistern and turns it off when the water level is about 2 ft below the top.

A short-duration pumping test of the well was performed during the site visit, and the pumping rate, water level, and specific capacity were measured over a 30-minute period. Flow was measured by bucket and stopwatch from a ball-valve spigot on a 1-inch tee at the well head. Water levels were measured by a steel tape through a small opening in the well top plate. The discharge decreased from 4.58 gpm at the start of the test to 4.46 gpm after 10 minutes, then declined to 1.67 gpm after 30 minutes. Meanwhile, the water level dropped to 106.3 ft after 10 minutes and to 117.7 ft after 30 minutes. Specific capacity is obtained by dividing the pumping rate by the amount of drawdown. It decreased during the test, from 0.29 gpm/ft after 10 minutes of pumping to 0.06 gpm/ft after 30 minutes.

The notable results from this test are that the pump was not producing flow at anywhere near the pump performance curve and that the specific capacity of the well is small. The well has a 6-inch diameter steel casing, and approximately 37 percent of the cumulative discharge during the 30-minute test was from storage in the casing. This probably explains some of the decrease in flow rate during the test. Even without pumping at its full rated capacity, the pump is powerful relative to the yield of the well. If pumping had continued another hour, the water level might have dropped to near the level of the pump intake. The relative capacities of the pump and well explain why the pump is set near the bottom of the well and why the discharge pipe into the cistern has a cap with a small orifice about 0.5 inch in diameter. The small orifice produces back pressure on the pump and lowers its flow rate.

The average discharge rate during the test was about 3.53 gpm. However, water level recovery was not measured and might have taken much longer than 30 minutes. If recovery takes three times longer than drawdown, then the effective time-averaged pumping rate would be about 0.88 gpm. This would mean the well could produce about 1,270 gallons over a 24-hour period. This is roughly 50 times more than the current water use for the sink, toilet and clothes washer in the apparatus bay. If the "full" water depth in the cistern is 4 feet, the corresponding storage is 2,350 gallons, and the amount of storage fluctuation between the high and low positions of the float switch is roughly 590 gallons. Thus, the well capacity and storage tank volume are both much larger than current daily demand.

In summary, the fire station well appears to be in good working order. The limitation on yield appears to be the well itself. The storage tank provides sufficient capacity to supply one-time demands of up to 2,350 gallons, but the well might need to operate for two days to replenish that volume. It is not known whether the pump has a low-level cut-off switch, which would turn the pump off for 30 minutes or more if the water level in the well dropped to the level of the pump. Allowing the water level to reach the pump intake would damage the pump. A low-level cut-off switch would protect the pump from damage under conditions of sustained pumping to replenish high water use events.

2.3. Task 3. Evaluate Long-Term Demand and Supply Effects of Connecting Middle/High School and Fire Station to CSA-11 System

The effect of connecting Pescadero Middle/High School and the proposed replacement fire station to the CSA-11 water distribution system depends on how much they would increase existing overdraft. The steady long-term decline in water levels at the CSA-11 wells since 1992 shows that pumping has consistently exceeded recharge. Some of the pumping is supplied by recharge, and the remainder is overdraft. There are no nearby head-dependent boundaries to the Butano Ridge groundwater system, so any increase in pumping would cause an equal increase in overdraft. The first step in evaluating the effect of the new connections is to separate existing pumping into sustainable yield and overdraft.

2.3.1. Current Sustainable Yield

Water levels at CSA-11 Well No. 1 continue to decline, as they have since 1992 when the first CSA-11 well began operating. Measured water levels since 2002 are shown in **Figure 6**. The hydrograph includes three intervals of relatively steady rates of decline: -0.74 feet per year (ft/yr) during 2002-2011, -0.10 ft/yr during 2012-2014, and -0.5 ft/yr during 2015-2019. The smaller rate of decline during the 2012-2014 drought could have been caused by drought-related water conservation efforts and decreased pumping.

It is less likely that the change in rate of decline was caused by changes in recharge. Recharge on Butano Ridge is from rainfall and irrigation return flow. The latter does not vary much from year to year, whereas rainfall recharge is highly variable. The cumulative departure of annual precipitation in Half Moon Bay during 1940-2020—which is shown in **Figure 7**—indicates that 2015-2019 was slightly drier overall than 2002-2011: 94 percent versus 105 percent of the long-term average. The 2012-2014 period was much drier than the other two periods (58 percent of long-term average precipitation). Based on rainfall, recharge was probably lowest during 2012-2014 and greatest during 2002-2011. If water levels reflected current recharge, one would expect the rate of water-level decline to be greatest during 2012-2014 and lowest during 2002-2011, but that was opposite of the observed pattern. The reason is probably that water levels do not respond rapidly to variations in recharge at the ground surface. Annual variations in recharge are attenuated by flow through the thick unsaturated zone (approximately 200 feet in the area of the CSA-

11 wells) and through fractures between the water table and the well screen depth. As a result, recharge arrives at the screened interval at a relatively steady rate, consistent with the steady rate of decline in measured water levels.

The relationship between annual pumping and annual change in water level can theoretically be used to estimate the sustainable yield, which is the amount of pumping associated with zero change in water level. Three methods were tested to apply this concept, none with accurate results. The first method was to create a scatterplot of annual net water-level change versus annual pumping. When tested with the Pescadero data set, the points were too scattered to infer a linear relationship between the variables and thereby calculate the sustainable yield. A variation of this approach was tried in which the data were averaged over longer time periods. This reduced the data to two points: average water use and water-level decline during 2004-2011 and average water use and water-level decline during 2015-2019. These represent the initial and final slopes of the hydrograph for Well No. 1 (Figure 6). The results are shown in **Figure 8**. Extrapolating the line connecting the two data points up to where it crosses the X axis (zero annual water-level change) produces an estimate of sustainable yield. By this method, the estimated sustainable yield is 7,457 gpd, or only 38 percent of average annual pumping. This method is not very accurate because of the long projection distance from the data points to the X axis. A small change in the plotting position of either of the two data points results in a large change in the estimate of sustainable yield. If this yield estimate is correct, then two-thirds of current pumping (about 12,000 gpd) is supplied by storage depletion, which is not indefinitely sustainable. It is also implausible with respect to specific yield and the area over which water levels might be declining, as described below.

The second method of estimating sustainable yield involved applying a well drawdown function to see how much storage depletion would match the observed water-level decline. Using the average 2015-2019 storage depletion rate from the first yield estimating method (9 gpm), it was not possible to obtain the observed drawdown of 2 feet after 4 years using the range of hydraulic conductivity calculated from tests of Well No. 3 in 2018. A smaller conductivity was required. Also, the drawdown equation results in drawdown that occurs almost entirely during the first year, whereas the observed decline in water level was steady over the four years. This method failed to produce a reliable estimate of sustainable yield and casts doubt on the large amount of storage depletion estimated by the first method.

The third method of estimating sustainable yield assumed that the observed water-level declines resulted from steady dewatering of a finite block of aquifer. It is unlikely that the dewatered region would extend more than 1,500 feet to the east (the eastern escarpment of Butano Ridge) although a larger distance is plausible to the west. Assuming the dewatered area extends an average radial distance of 2,000 feet from Well No. 1 and that the specific yield of the aquifer is 0.02 (dimensionless)—which is reasonable for a productive fractured-rock aquifer—a water-level decline of 0.5 ft/yr would produce 2.9 acre-feet per year of water, equivalent to a constant rate of 2,569 gpd, as shown in **Figure 9**. This equals 13 percent of total pumping. The remaining 87 percent of the pumped water was therefore sustainably derived from recharge, or 16,872 gpd. Although this estimate of sustainable yield also involves uncertain assumptions, it is probably the best of the three attempted yield estimates.

Based on the steady decline of water levels observed in the CSA-11 wells it is apparent that current pumping exceeds the current sustainable yield of the Butano Ridge aquifer system tapped by the three CSA-11 supply wells. Based on the first and third estimates of yield described above, 13-67 percent of current groundwater production is supplied by overdraft. However, Well No. 3 will be able to continue supplying current demand for several more decades, as described in the next section.

2.3.2. Projected Effects of Connecting School and Fire Station

Linear extrapolations of the recent Well No. 1 water level trend and increased decline rates for increased pumping scenarios were developed to estimate potential future water levels and dates associated with reaching critical depths such as depths to the well pump intakes. **Figure 10** shows static (non-pumping) water levels in Well No. 1 projected to 2100 under various scenarios. If the existing 2015-2019 trend of 0.5 ft/yr of water level decline continues (solid teal line), the water level will drop below the top of the Well No. 1 well screen around 2039 and would reach the pump intake at around 2115. It would not reach the top of the well screen and pump intake in Well No. 3 until approximately 2115 and 2120, respectively. Adding the demand from the school and fire station would shorten those time frames for Well No. 3 to about 2094 and 2099, respectively (dashed orange line).

These results are sensitive to the estimate of sustainable yield because a small percent change in the yield estimate creates a much larger percent change in the overdraft estimate. For example, if the current estimate of yield is increased or decreased by 10 percent, the projected water-level trends for current demand (without the school and fire station) are shown as the blue dot-dashed line and dashed magenta line, respectively. This range of uncertainty is larger than the effect of adding the school and fire station.

The above analysis is for static water levels. Based on the measured specific capacity and likely pumping rate (100 gpm) of Well No. 3, pumping water levels are 24 feet lower than static water levels. This means that the pump in Well No. 3 could break suction 35 years sooner than shown on the figure, or in approximately 2064 for the scenario with the school and fire station. Breaking suction occurs when the water level in the falls to the depth of the pump intake, at which point air becomes entrained in the pumped water, and water production rates decrease. The pump in Well No. 1 would start to break suction around 2057. It would no longer be serviceable as a backup well after that date because the pump was already lowered to near the bottom of the well and cannot be lowered farther.

If the pump in Well No. 3 started to break suction, it could be lowered, as was done in Well No. 1. It is presently four feet below the top of the screen, and the screen extends for another 96 feet. With some modification to the pump to ensure adequate cooling of the pump motor, the pump can be set within the screened interval. If that option is pursued, the limiting factor for water level decline could be the risk of sea water intrusion or depletion of flow in Butano Creek if water levels declined 70 feet from their current elevation. At that point, however, static and pumping levels would be below the top of the screen, which could decrease well output and cause air entrainment in the well water that would potentially damage the pump.

Note this analysis assumes that aquifer specific yield and hydraulic conductivity do not vary with depth in the aquifer. In addition, the analysis is based on historical and recent trends in Well No. 1. The hydraulic impacts of pumping from new Well No. 3 and future water level trends are currently unknown, and should be closely monitored as Well No. 3 is operated. It is possible that future rates of water level decline could decrease, if deeper Well No. 3 draws water from a thicker and more transmissive portion of the aquifer, and/or if the rates of groundwater inflow to the CSA-11 well field area from surrounding recharge sources increase as a result of a larger and deeper cone of depression around the production wells. Conversely, the rates of water level decline could increase as the upper portions of the aquifer are de-watered and the effective aquifer transmissivity decrease, or if deep fractures prove to be less numerous or productive over the long run than the shallow ones.

The CSA-11 water supply system has sufficient capacity to supply existing demand plus the demands associated with Pescadero Middle/High School and the relocated fire station for at least the next 30-40 years. Many public water systems in California expect to need additional water supplies 30-40 years in the future, and that is a reasonable time frame for bringing new supplies on-line. Gradual groundwater overdraft will continue—with or without the added demands—but would not create a critical supply problem until about 2057, when Well No. 1 will no longer be able to serve as the standby (its pump would start breaking suction and cannot be lowered any farther).

2.4. Task 4. Identify any Potential Water Quality Impacts Associated with CSA-11 Extension to the Fire Station and School

There has been no historical correlation between groundwater levels and water quality at the CSA-11 well field. Todd Engineers (2002) found no relationship between water levels and water quality in Wells 1 and 2. Water quality data for the CSA-11 wells since 2004 were obtained from the California State Water Resources Control Board Division of Drinking Water and plotted as time series to look for trends correlated with the declining trend in groundwater levels. Plots for 23 physical parameters and chemical constituents are shown in **Figure 11**. Although a few of the variables such as turbidity and barium have occasional high values, none of the parameters exhibit an increasing or decreasing trend over time. Nitrate might be an exception, with a possible decreasing trend since 2004. Overall, water quality does not appear to be dependent on groundwater levels. Therefore, connecting the middle/high school and fire station to the CSA-11 system is not expected to affect the quality of water delivered to customers.

The water quality of Well No. 1 meets all drinking water standards. Of the constituents shown in the figure, sixteen are regulated under primary (health-based) drinking water standards and three under secondary (aesthetic) drinking water standards. All but one of the measured concentrations were less than half of the primary or secondary maximum contaminant level (MCL), including nitrate at 5-26 percent of the primary MCL. Total dissolved solids was the exception at 63-72 percent of the long-term secondary MCL (500 mg/L).

2.5. Task 5. Incorporate Anticipated Local Coastal Program (LCP) Residential and Commercial Growth as Shown in LCP Table 2.16 Estimate of Water Consumption Demand at Land Use Plan Buildout for the Town of Pescadero

Table 2.16 of the 2013 Local Coastal Program (LCP) lists estimated annual water demands for existing and proposed land development categories in Pescadero. Those estimates are listed in the left half of **Table 1**. Buildout demand equals the sum of the existing and proposed water demands. The right side of the table shows revisions made for this study based on actual water use during 2015-2019. The LCP estimates for existing conditions were high in terms of number of connections and water use per connection. For example, the LCP estimated that there are 125 residential connections each with 3.5 residents using 70-110 gallons per capita per day (gpcd). The actual number of residential connections is 90. If there are 3.5 residents per household, per-capita use is 48 gpcd. Commercial use is similarly smaller than the LCP estimate with respect to number of connections and water use per connection. For the third category, the LCP recognized that there is one fire station, but metered use of CSA-11 water at the station has been only one-third the LCP estimate. Overall actual water use during 2015-2019 has averaged 19,442 gpd, or only 34-53 percent of the LCP estimate.

In the lower-right part of **Table 1**, actual water usage per connection during 2015-2019 is applied to the LCP estimate of the number of additional future connections to obtain a revised estimate of future total water use. Estimated total water use with the additional connections plus the middle/high school (a demand that was not anticipated in the LCP) is 48,544 gpd, or 43-68 percent of the LCP estimate. It is 29,102 gpd greater than existing total water demand.

If the additional future water demand were supplied by the existing CSA-11 wells, water level declines would accelerate rapidly, as indicated by the downward-curving dashed green line in **Figure 10**. That curve reflects an assumption of a linear increase from existing demand to buildout demand over a 50-year period. Water levels would decline to the top of the Well No. 3 screen by 2044 and to the Well No. 3 pump intake by 2047. Clearly, new water supplies would be needed to support the growth envisioned in the LCP.

2.6. Task 6. Account for anticipated water usage associated with retention of the apparatus bay and any other facilities at the existing fire station site

This topic was addressed in Section 2.2 “Water Use at Current and New Fire Stations”. To reiterate, the existing fire station well could supply all non-potable uses at the apparatus bay, which are currently negligible but could include equipment washing during future emergency periods. The existing fire station would be staffed only during emergencies, or an estimated 5-8 days per year (Mintier, 2020), which corresponds to a conservatively high estimate of average daily use over the year of 8 gpd. This assumes future emergency staffing would have as many people on-site as current routine staffing and that those workers would be in addition to the staff at the new fire station.

2.7. Task 7. Update any climate change modeling/assumptions and any known increases in private groundwater uses that would impact CSA-11's supply longevity

The California Department of Water Resources has developed statewide grids of climate change factors representing anticipated precipitation and reference evapotranspiration (ETo) conditions in 2030 and 2070. The factors are sets of 1,164 monthly multipliers to be applied to historical rainfall and ETo data for 1915-2011 to estimate the amounts that would have occurred under 2030 or 2070 global climatic conditions. Pescadero is located at the boundary between grid cells 5658 and 5746. The monthly multipliers for 2070 conditions were obtained for both cells, and average values for each month of the year were calculated. The results are shown in **Figure12**. The ETo multipliers are greater than 1.0 in all months of the year, which means that plant ET and irrigation demand would both be greater under 2070 climate conditions. Precipitation multipliers have two seasonal peaks, one of which is in summer. However, precipitation is negligible in that season, so that peak has negligible effects on recharge and demand. Of primary importance are the multipliers for the peak in the wet season months of December-March, all of which are greater than 1.0. This means that rainfall and hence groundwater recharge are expected to be greater under 2070 climate conditions, which at least partly offsets the effect of increased ET on water supply. Thus, the warmer but wetter climate expected by 2070 would not likely cause a large net increase or decrease in net water consumption.

Land use on Butano Ridge has been stable over the past 28 years, based on Google Earth aerial imagery. There are approximately 520 acres of cropland, and the most common crop at present is flowers. Of critical importance to CSA-11 sustainable yield is that the agricultural fields are not irrigated by local groundwater but rather by surface water pumped from Lucerne Lake and Bean Hollow Lakes on Arroyo de los Frijoles, south of Butano Ridge (see **Figure 1**). The use of imported water for irrigation was deduced from the small specific capacities of other wells on Butano Ridge (Todd Groundwater, 2019) and confirmed by local growers (Cevasco, 2020). The median specific capacity of 20 wells on Butano Ridge (other than CSA-11 wells) is 0.10 gpm/ft. Even if 100 ft of drawdown is tolerated, a well of that specific capacity would produce only 10 gpm, which could apply 1 inch of water in 24 hours to only 0.53 acres. Clearly, such a well is too small to be of practical use for commercial irrigated agriculture. Lucerne Lake and Bean Hollow Lakes are supplied in part by diversions from Little Butano Creek located east of the coastal ridge, and they are used to irrigate all agricultural lands on Butano Ridge and along Highway 1 for about 5 miles south of Pescadero Creek (Cevasco, 2020). Residences along Bean Hollow Road are supplied by domestic wells, but the total use is small and there is no sign of new development. The greatest risk to CSA-11 yield would be if cropland on Butano Ridge went out of production, because that would eliminate groundwater recharge from deep percolation of irrigation water, which is probably a significant source of recharge. However, land use on Butano Ridge has been stable for many years, and there are no indications of any imminent change.

2.8. Task 8. Identify existing and anticipated non-revenue water loss over the 1-mile CSA-11 extension. Identify existing technology to mitigate impact of non-revenue water loss

Nationwide research has found that water main leaks are a function of pipeline material and age (Folkman, 2018). Based on data for 198,000 miles of water mains operated by 308 water utilities in North America, PVC pipes experience 2.3 detectable breaks per 100-mile-years of pipe, compared to 10.4 for asbestos cement and 34.8 for cast iron. If the 1.3-mile water main extension to the middle/high school will be constructed with PVC pipe, the above factor indicates that the probability of a break occurring in any year would be less than 3 percent, or on average once in more than 33 years. It is more likely that future breaks would be in existing water mains, which are older. San Mateo County normally uses PVC pipe for water mains except where they are exposed at the land surface, such as when they are attached to bridges.

The most economical approach to detecting large, new water main leaks would probably be to monitor nighttime water-level trends in the CSA-11 storage tanks with pressure transducers connected to the existing system monitoring equipment housed at the tank site. Additional water level sensors or flow meters may need to be added if this information is desired on a continuous rather than periodic basis. Because the distribution system is pressurized, water main leaks occur at a continuous steady rate. A persistent increase in nighttime water use would indicate that a leak has probably developed.

An additional measure to detect leaks and other types of non-revenue water use along the pipeline extension would be to install a meter where the extension departs from the existing distribution system. This would allow water use along the extension to be monitored independently. Bimonthly meter reads could be reviewed to detect possible leaks or unauthorized uses—as is presently done with customer meters—but detection would not be immediate. Connecting the meter to a SCADA system would enable rapid detection.

3. CONCLUSIONS AND RECOMMENDATIONS

- The CSA-11 water supply system has sufficient capacity to supply existing demand and additional demands associated with Pescadero Middle/High School and the relocated fire station for the next 30-40 years. For more distant planning horizons, it is appropriate to begin evaluating options for additional water supplies now.
- Average annual water use during 2015-2019 was 19,442 gpd.
- Irrigation use was estimated based on seasonality of water use exhibited in individual customer account records. Average annual irrigation use estimated for 11 customer accounts with suspected irrigation was 8 percent of total use by all accounts.

- Overall leakage from the CSA-11 distribution system may be as much as 8-16 percent of annual production, based on measured system-wide water usage during late-night hours. To the extent that some late-night use is for toilet flushing or drip irrigation systems, leakage losses are less than 8-16 percent.
- Customer water meters are capable of detecting leaks as small as about 0.1 gpm. Leaks less than that rate are individually small but collectively can be much larger.
- Water levels in CSA-11 Well No. 1 declined an average of 0.50 feet per year during 2015-2019. This is slightly less than the trend prior to 2012, which was 0.74 feet per year.
- Water levels in Well No. 3 should be monitored to determine whether water levels continue declining at the historical rate observed in Well No. 1.
- The chronic water-level declines indicate that the aquifer is in overdraft and that CSA-11 pumping exceeds the sustainable yield. The sustainable yield is difficult to estimate from available data. Two estimation methods failed to produce reliable results. A third method—based on assumptions about the aquifer area and specific yield where water levels are declining—produced an estimate of 16,872 gpd, or 87 percent of current pumping. The declining water levels are caused by the remaining 13 percent of pumping (2,570 gpd).
- Connecting Pescadero Middle/High School to the CSA-11 water system would increase annual water use by an estimated 835 gpd (4.3 percent of existing use). Almost all water use at the existing fire station is already supplied by CSA-11. Connecting the new fire station to the CSA-11 system would only increase water use by the amount used for staffing the old station during emergencies, which is estimated to an average of 8 gpd over the course of a year (0.04 percent of existing use).
- If existing water-level declines continue, static (non-pumping) water levels would drop below the top of the Well No. 1 screen around 2039 and would reach the pump intake around 2115. Water levels below the top of the well screen promote corrosion and air entrainment that can damage the well and pump, but the well would continue to produce water. Static water levels would not reach the top of the Well No. 3 screen and pump intake until around 2115 and 2120, respectively.
- Adding the demands from the middle/high school and fire station would slightly accelerate the rate of water level decline and would advance the above dates by about 21 years. However, static water levels would still remain above the pump intakes of Wells No. 1 and No. 3 for another 70 years.
- Pumping water levels are lower than static water levels (by an estimated 24 feet) and would reach the pump intakes about 35 years sooner than the static water levels would. This would cause the pump to break suction, and the well would not produce water. The pump in Well No. 3 could be lowered to extend the functional life of the well by many decades, but the pump in Well No. 1 is already near the bottom of the well.
- The practical limitation on the longevity of the current CSA-11 well supply is the date at which pumping water levels reach the pump intake elevation in Well No. 1, which is estimated to be in 2057. At that point, the well would no longer be able to function as a backup well.

- The existing school well could continue to supply non-potable uses at the facility. Ones that are easily separable from a plumbing standpoint (outdoor uses) have historically amounted to around 120 gpd.
- The fire station well is in reasonable condition and could probably supply uses of up to 1,270 gallons over a 24-hour period, or about fifty times the amount of water presently used from that well. If use of the well were increased substantially, a low-level cutoff switch could be installed that would insert intermittent breaks in a prolonged pumping cycle to prevent drawdown in the well from reaching the pump intake and damaging the pump. It is not known whether the well is already equipped with such a switch.
- Water use estimates for the current CSA-11 service area in the 2013 Local Coastal Program are higher than recent actual use in terms of both number of connections and water use per connection. Updating Table 2.16 in the LCP to reflect actual numbers of connections and per-connection water use, and applying the per-connection use factors to the LCP-projected future number of connections produces an estimate of total future "buildout" water use that is 43-68 percent of the LCP estimate.
- Water demand for future growth would accelerate the rate of water-level declines at the CSA-11 wells. Assuming the LCP-projected growth is implemented gradually over the next 50 years, water levels during pumping would reach the Well No. 3 well screen around 2044 and the top of the Well No. 3 pump intake three years later. At that point the pump in Well No. 3 would need to be lowered.
- Future climate is expected to be warmer and wetter, with increased rainfall recharge at least partially offsetting increased evapotranspiration and irrigation demand. Irrigation of cropland on Butano Ridge near the CSA-11 wells is supplied by off-site surface water reservoirs. Therefore, an increase in irrigation demand would not adversely affect the sustainable groundwater yield available to CSA-11. Conversely, a decrease in irrigation on Butano Ridge would reduce the sustainable yield due to a decrease in irrigation return flow.
- The water main extension to the middle/high school is not as likely to be a source of system leakage as the existing water mains, because the pipes will be newer and made of PVC. Installation of a meter at the branch-off point would enable detection of leaks or unauthorized uses along the extension.

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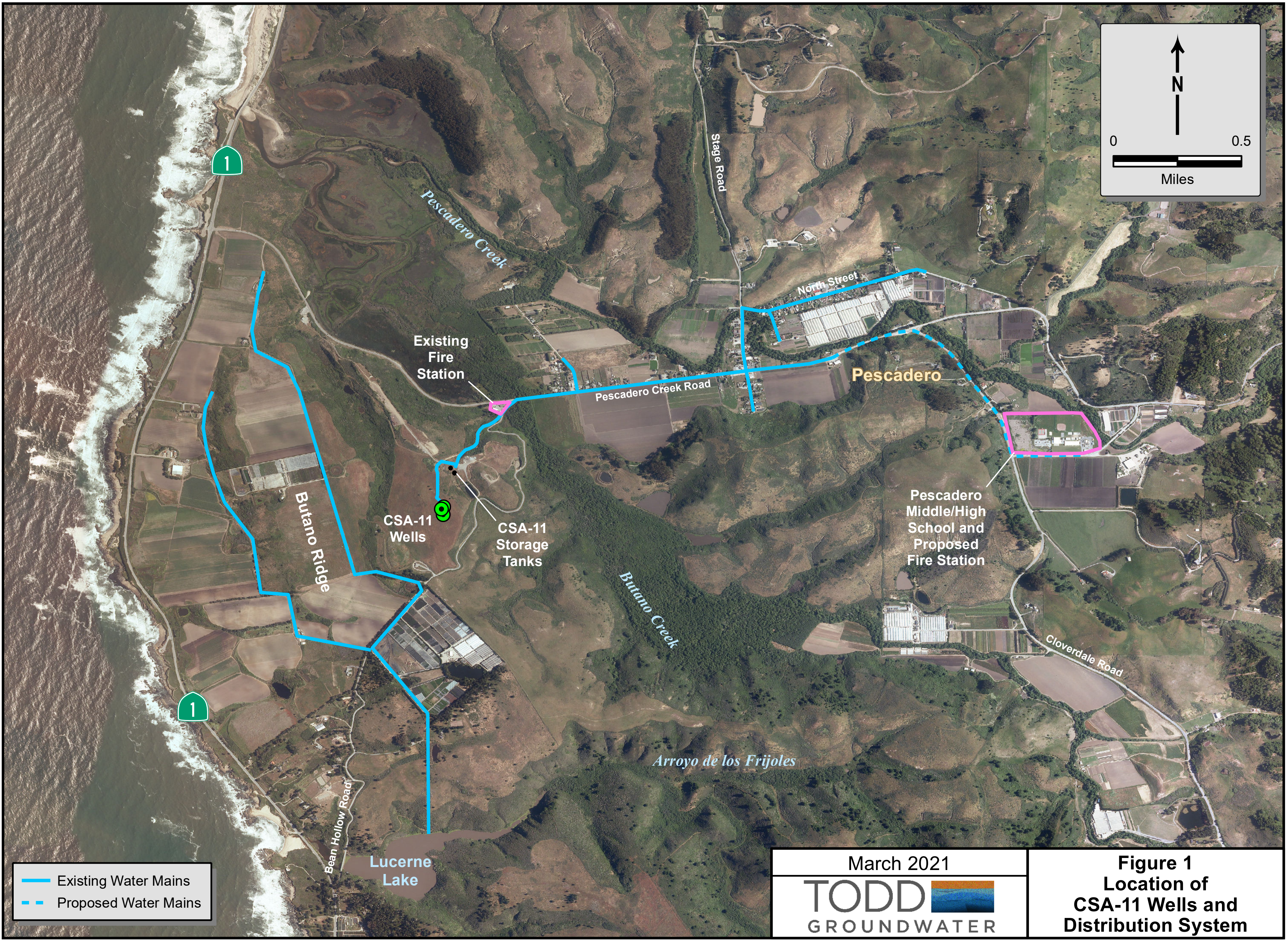
Table 1. Estimates of Existing and Future CSA-11 Water Demand

Water Use Category	Local Coastal Plan (2013) Table 2.16 Number of Connections	Local Coastal Plan (2013) Table 2.16 Gallons/Day	Revised Based on Actual 2015-2019 Number of Connections	Revised Based on Actual 2015-2019 Gallons/Day
Existing Uses				
Dwelling units	125	30,625-48,500	90	15,128
Commercial outlets	20	4,600-7,760	11	3,988
Pescadero fire station	1	1,000	1	326
Subtotal	146	36,500-57,260	102	19,442
Additional Proposed Uses at Buildout				
Dwelling units	125	30,625-48,500	125	21,011
Commercial outlets	20	4,600-7,760	20	7,251
Pescadero fire station[1]	1	1,000	1	8
Middle/high school	n.a.	n.a.	1	832
Subtotal	146	36,500-57,260	147	29,102
Total Buildout Use		**72,050-113,520**		**48,544**

Notes:

[1] The existing fire station use is expected to transfer to a new station that will also be connected to the CSA-11 system. The existing station will generate new use when occupied by additional firefighters during emergency operations.



March 2021

TODD GROUNDWATER

Figure 1
Location of CSA-11 Wells and Distribution System

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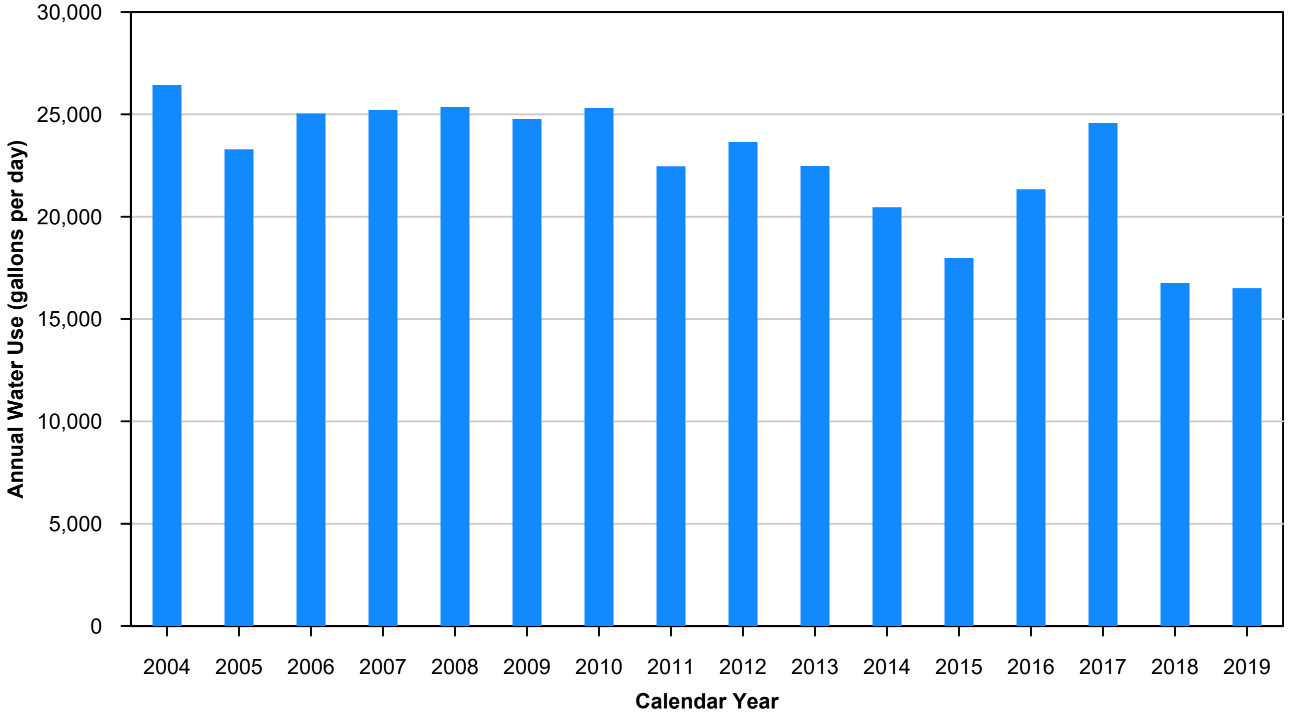
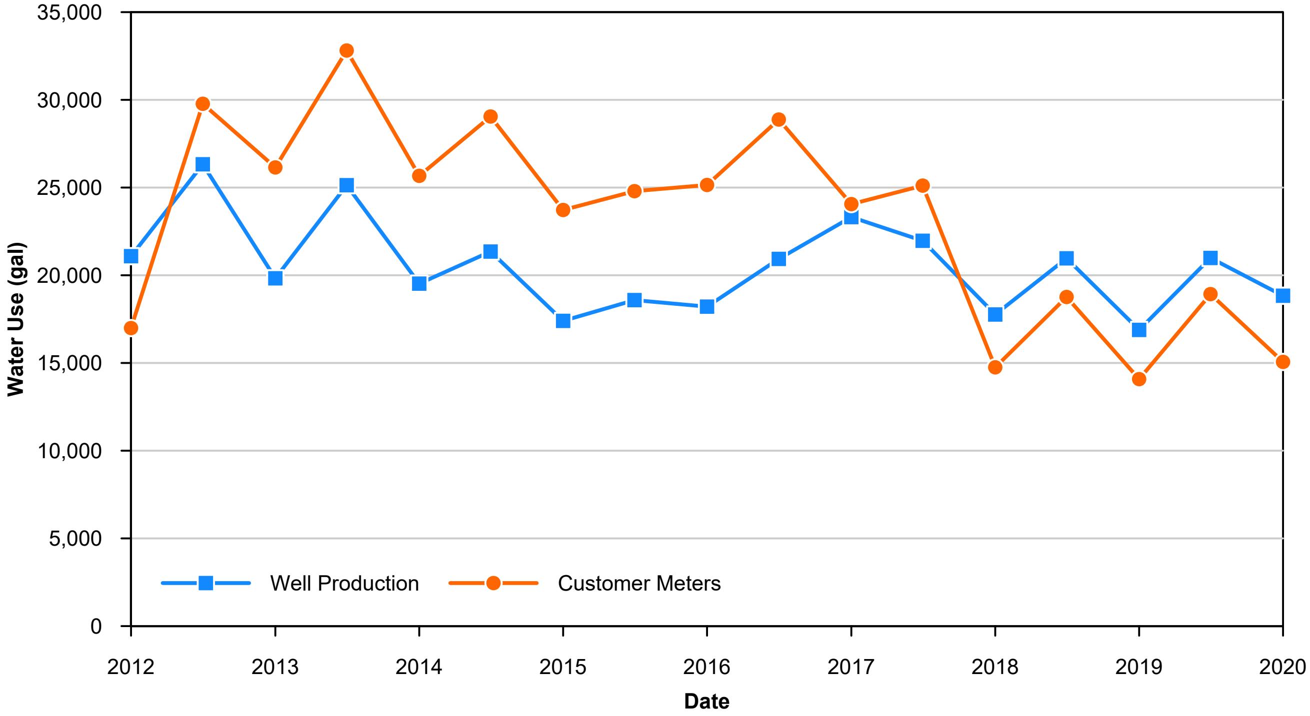
A. Annual CSA-11 Water Use (Customer Meters)



B. Semiannual CSA-11 Water Use



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Data:
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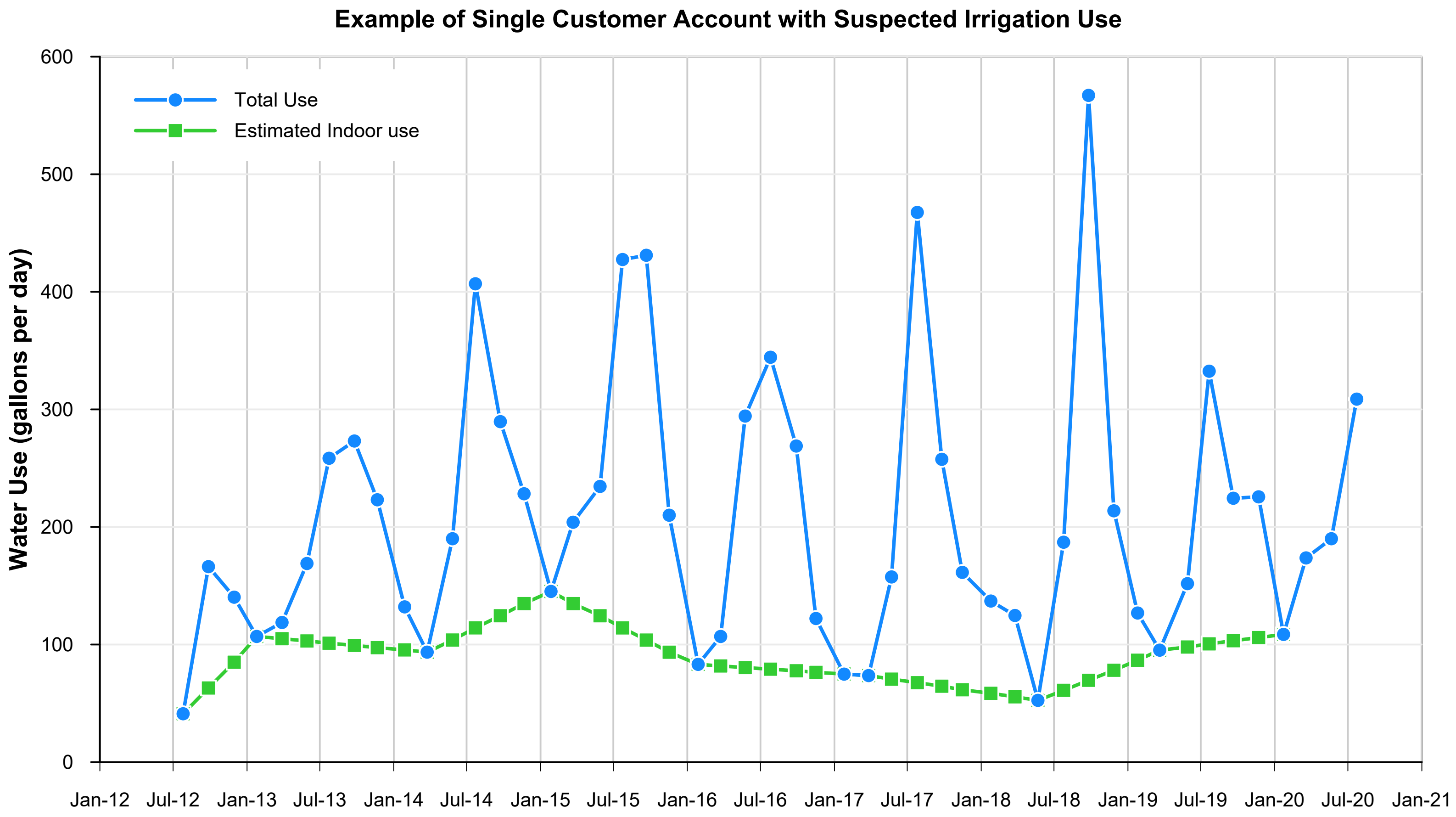
Monthly Reports and CCRs 2017-2020\WaterUse2012-2020.xlsx

March 2021

TODD
GROUNDWATER

Figure 2
Well Production and
Metered Customer Use



Data:
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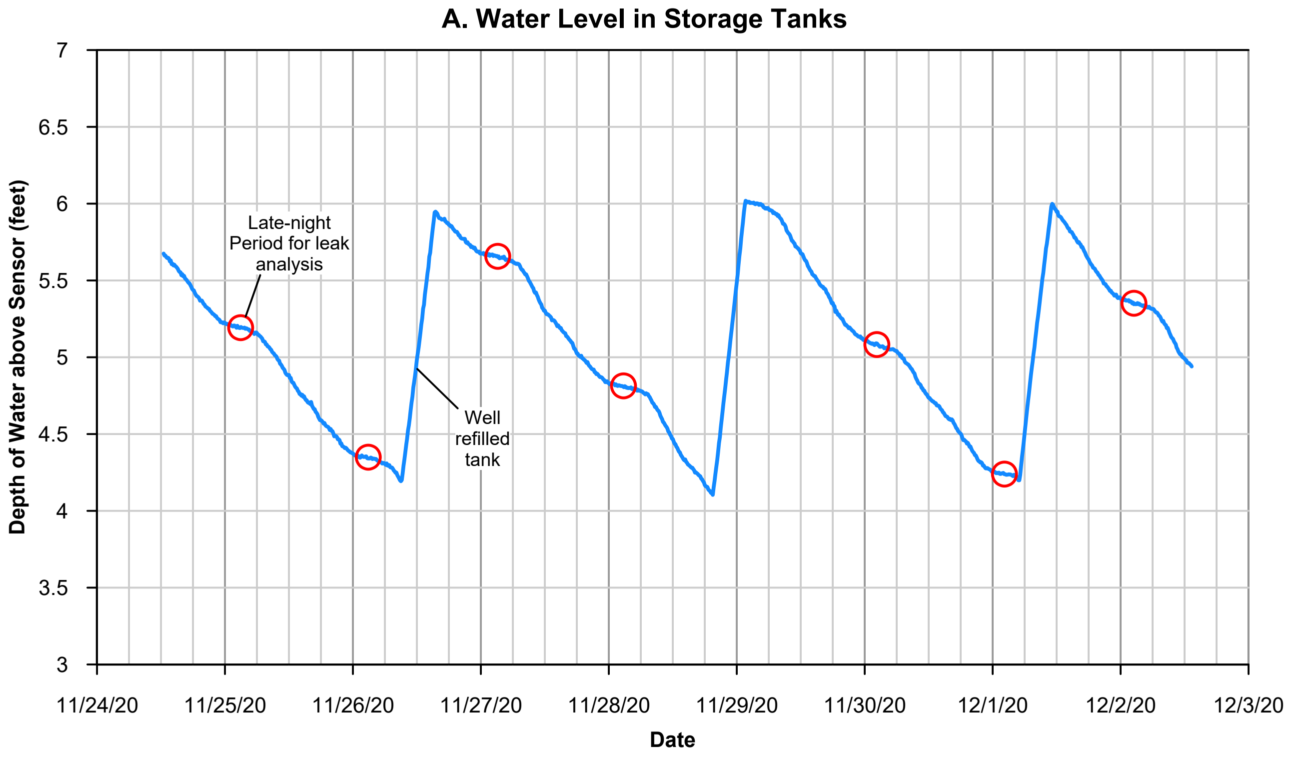
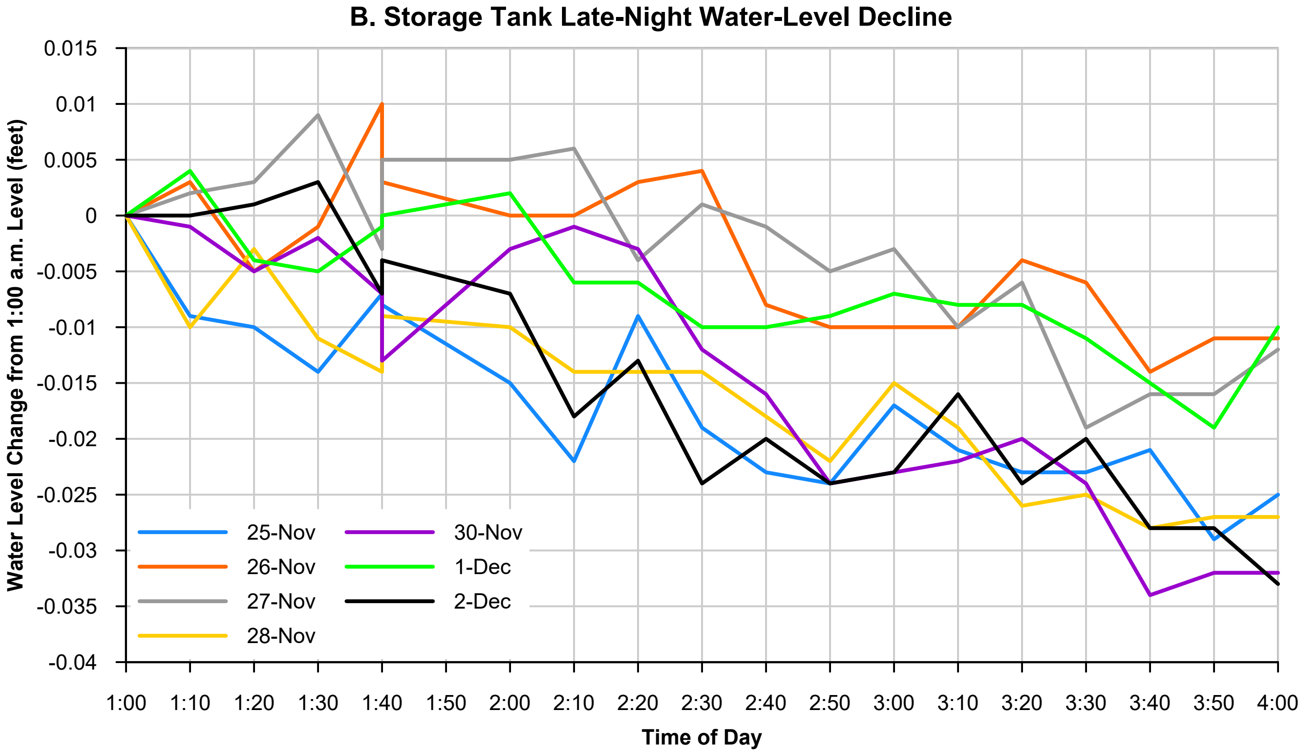
Path: T:\Projects\San Mateo Pescadero Water Budget 80102\GRAPHICS\Figure 3 Customer Account with Suspected Irrigation Use.grj

March 2021

TODD GROUNDWATER

Figure 3
Customer Account with Suspected Irrigation Use


A. Water Level in Storage Tanks


B. Storage Tank Late-Night Water-Level Decline

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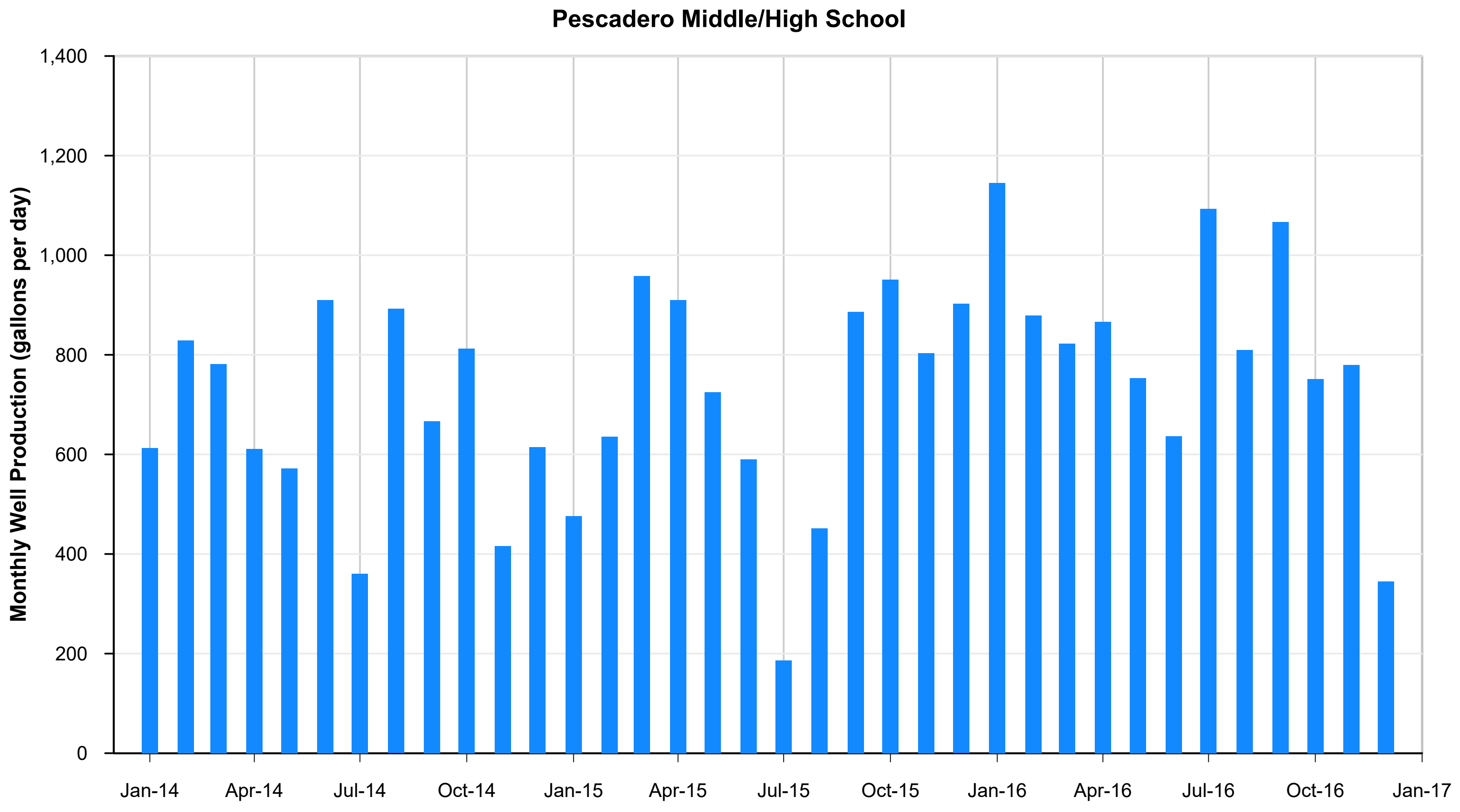
Storage Tank Water Levels\WL-1_North_Tank.xlsx

March 2021

TODD GROUNDWATER

Figure 4
Change in Storage Tank Water Levels During Low Usage



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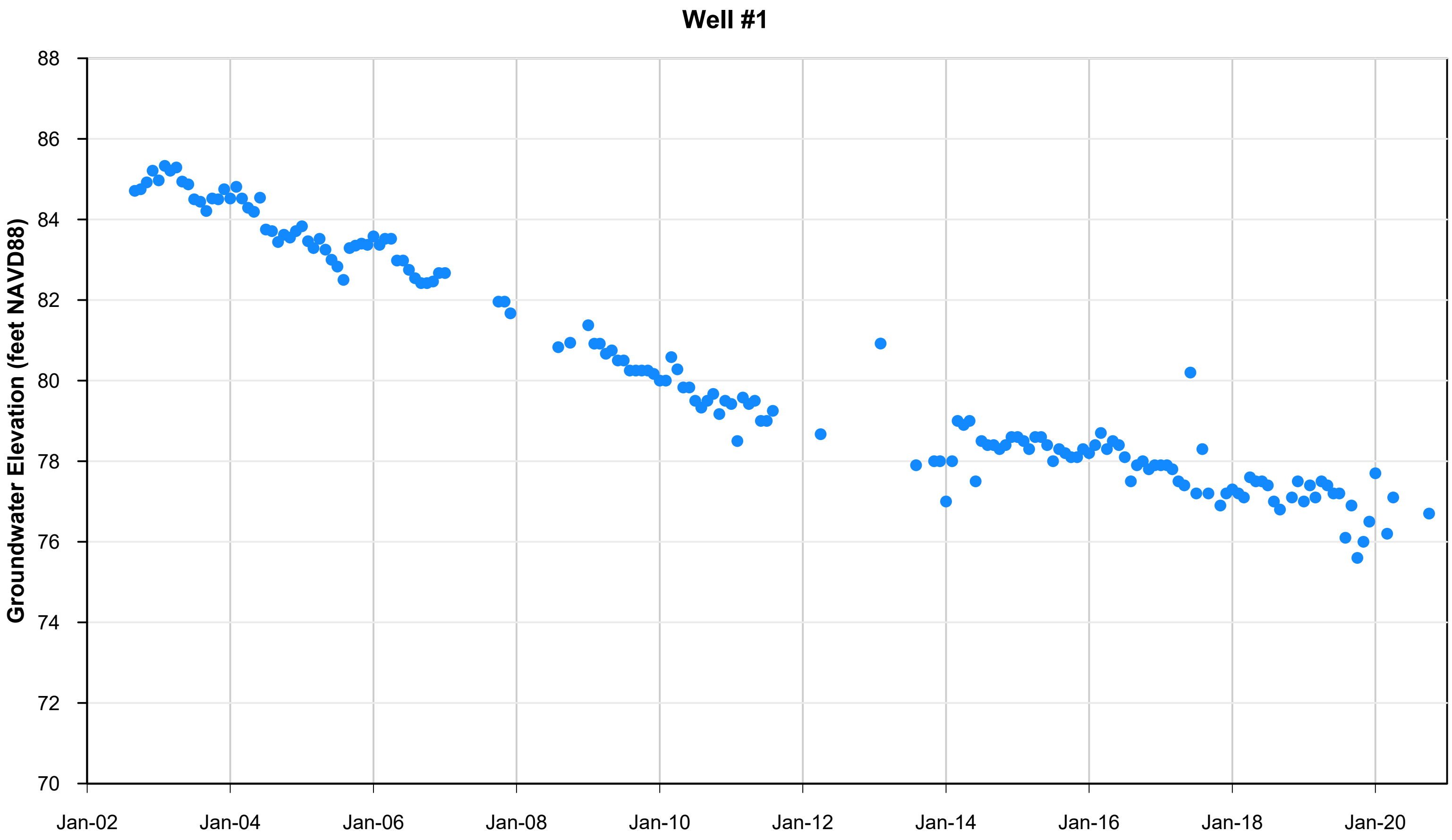
Path: T:\Projects\San Mateo Pescadero Water Budget 80102\GRAPHICS\Figure 5 Monthly Water Use at Pescadero Middle High School.gpj

March 2021

TODD GROUNDWATER

Figure 5
Monthly Water Use
at Pescadero
Middle/High School



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Data:
T:\Projects\San Mateo Pescadero Water Budget 80102\Data\Monthly Reports and CCRs 2017-2020\WaterUse2012-2020.xlsx

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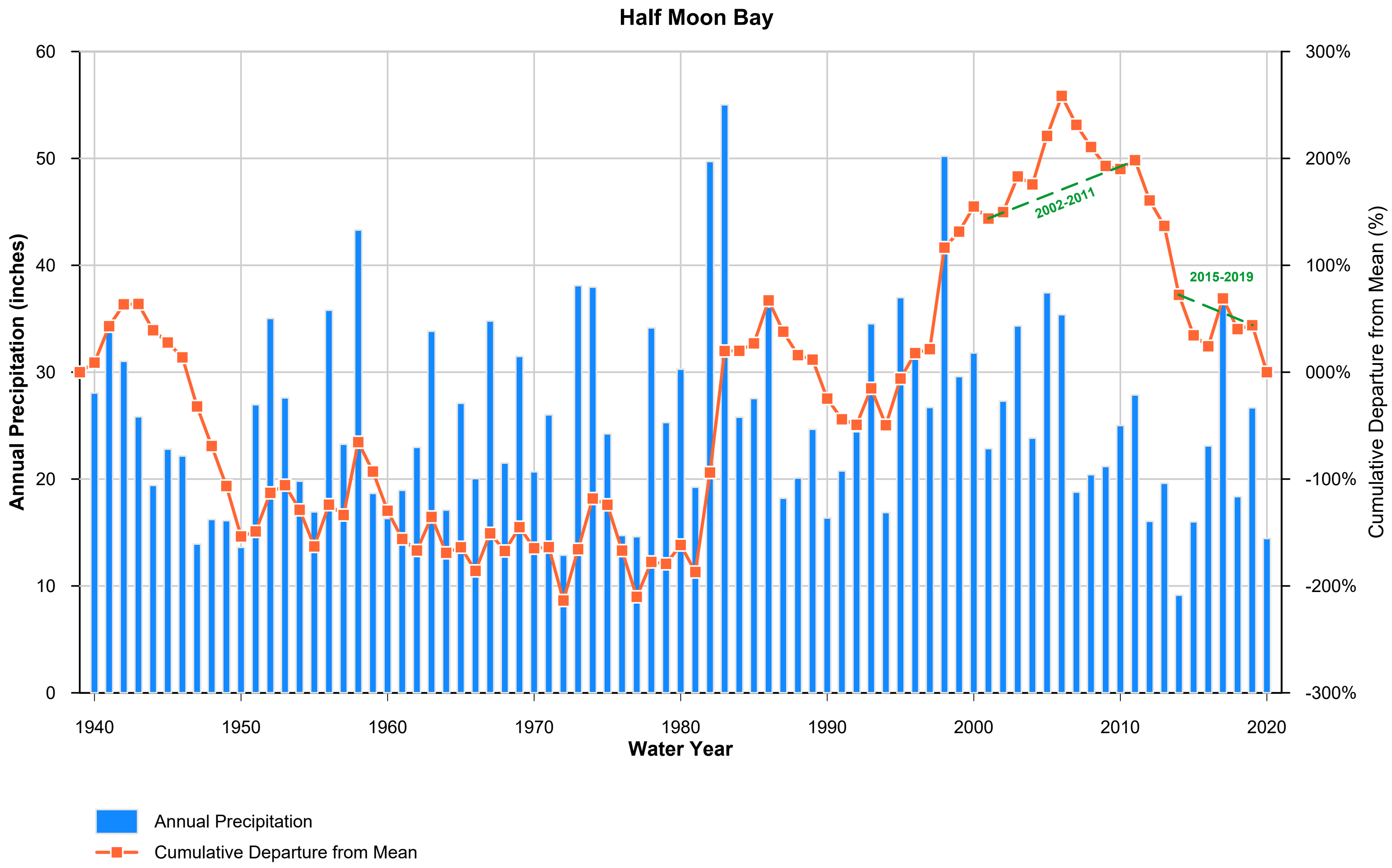
Figure 6
Well No.1
Water Levels
2002-2020



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Data:
T:\Projects\San Mateo Pescadero Water Budget 80102\Data\Climate Change\CumDep_Half_Moon_Bay.xlsx

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Figure 7
Cumulative Departure of Annual Precipitation

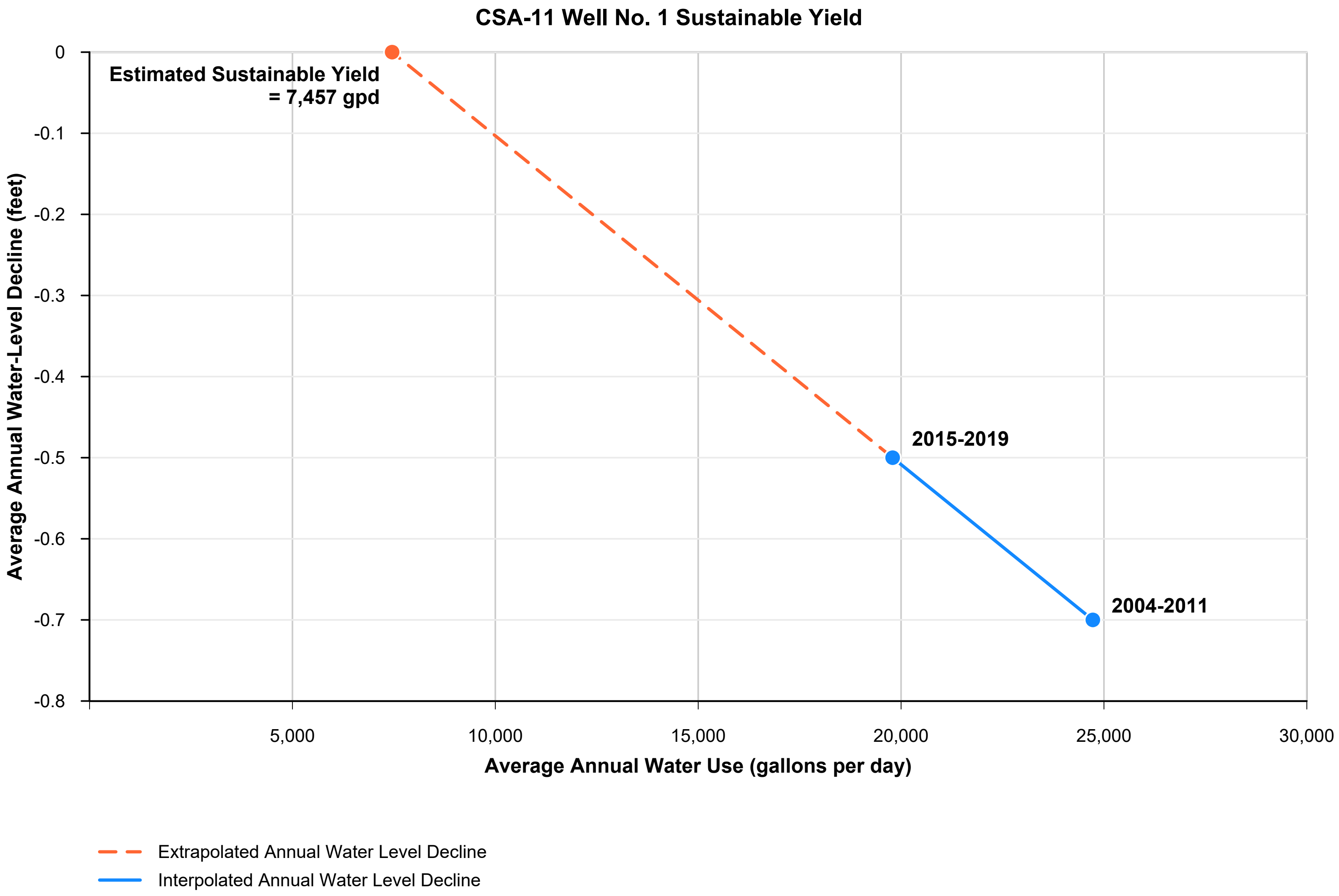

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Figure 8
Water Use and
Water Level Change
in Well No. 1

Data:
T:\Projects\San Mateo Pescadero Water Budget 80102\Data\Monthly Reports and CCRs 2017-2020\WaterUse2012-2020.xlsx

Path: T:\Projects\San Mateo Pescadero Water Budget 80102\GRAPHICS\Figure 8 First Estimate of Sustainable Yield.gpj

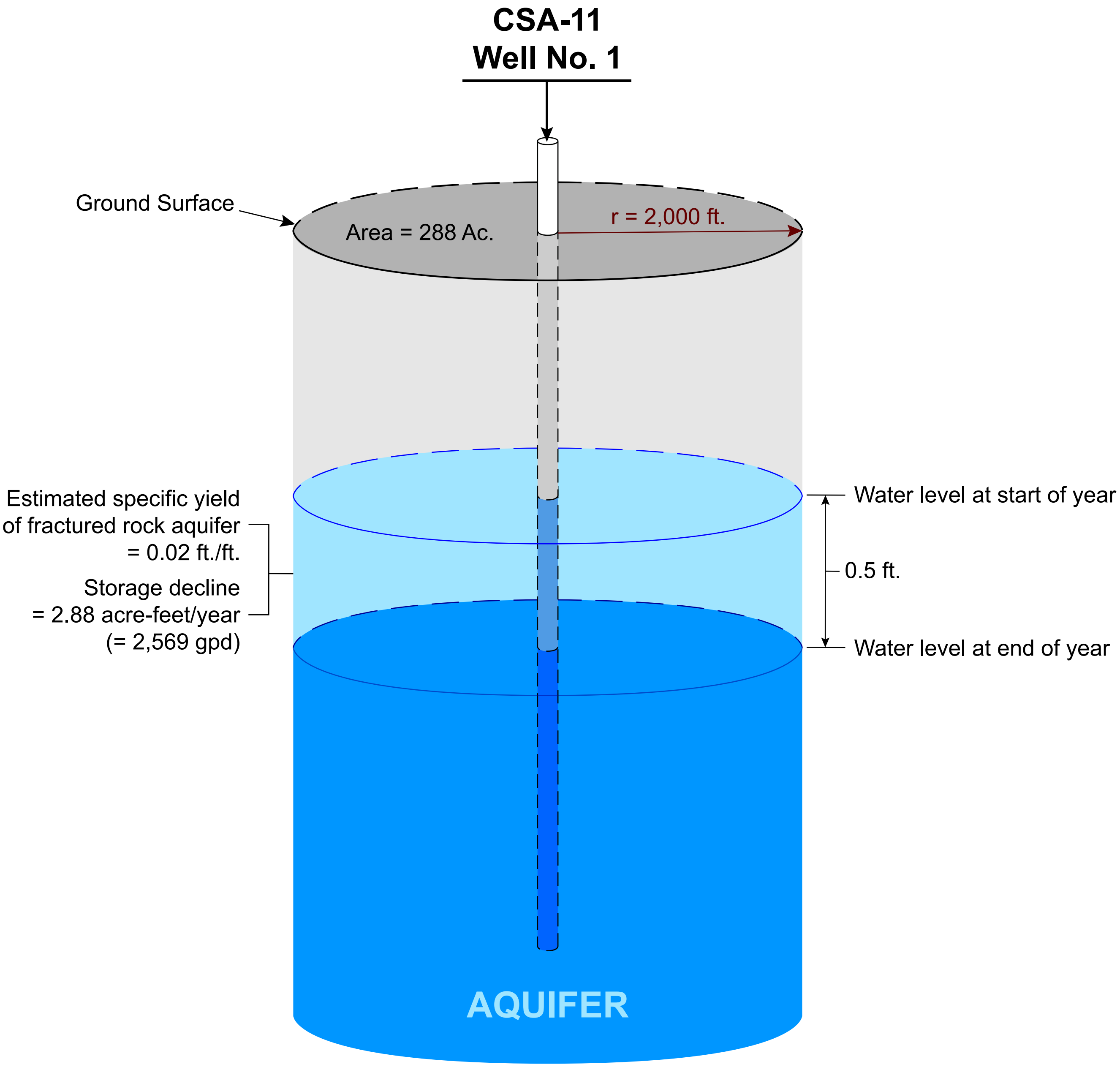

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Figure 9
Storage Depletion
Around Well No. 1

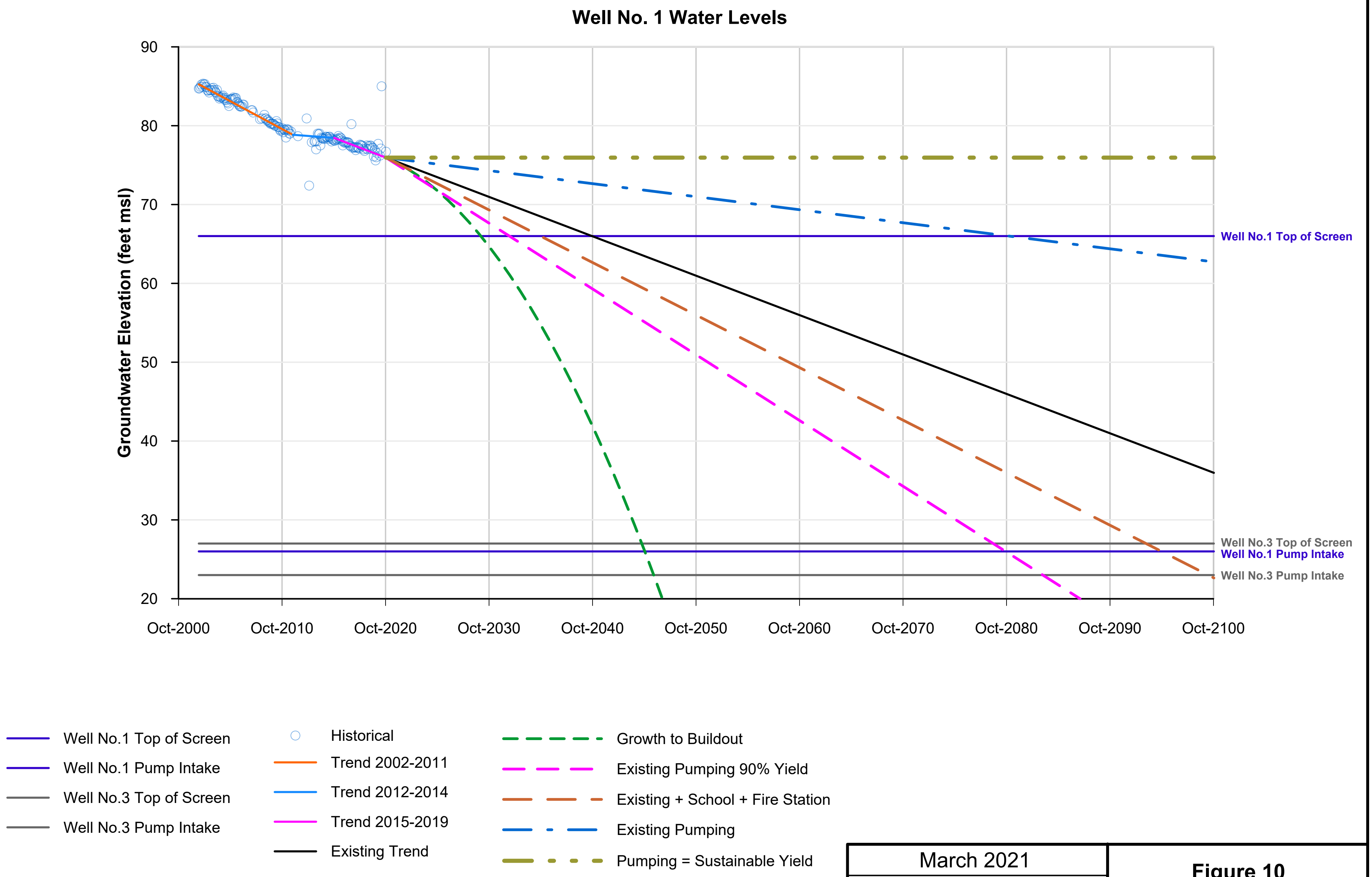

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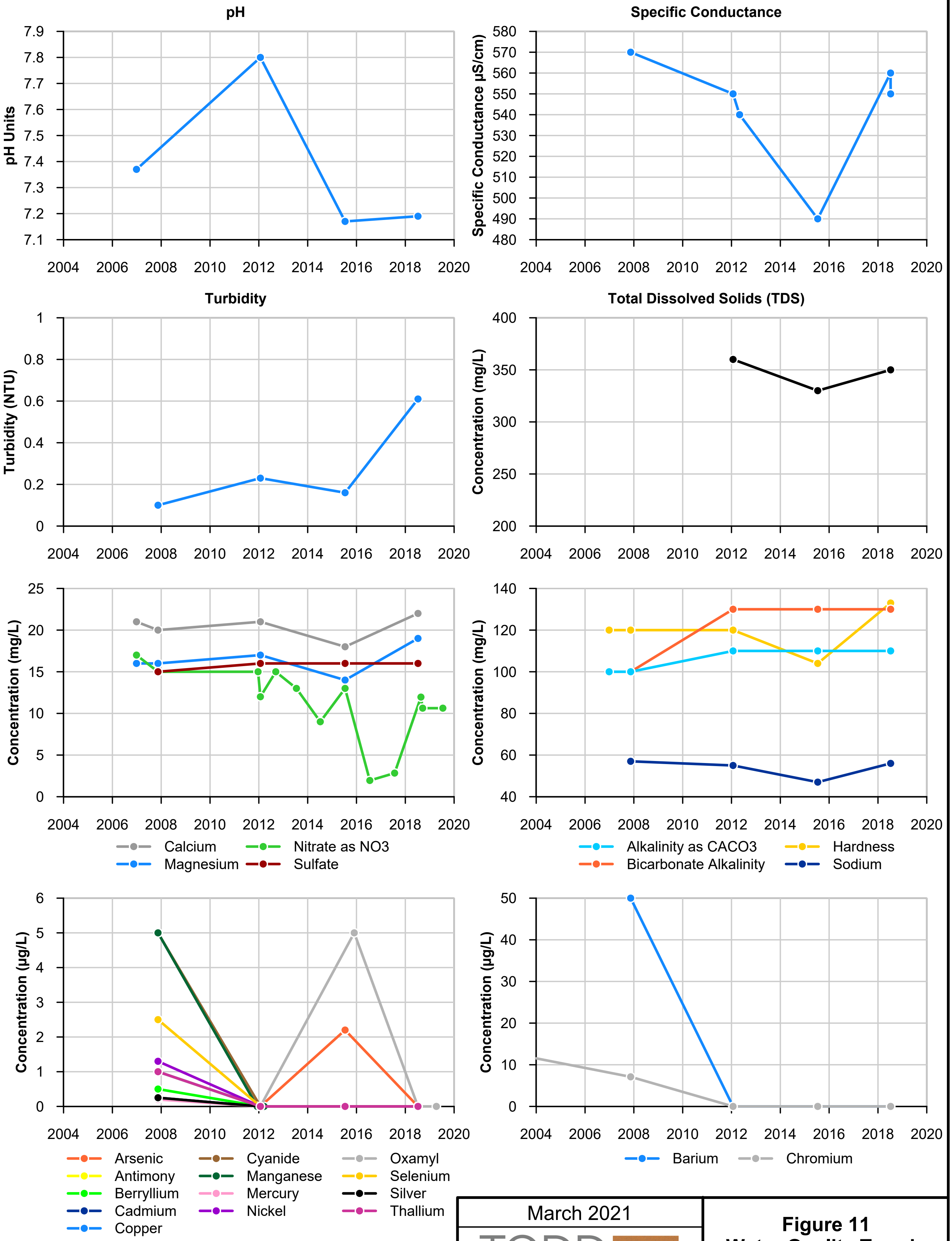
Figure 10
Projected Future Water Levels

Data:
T:\Projects\San Mateo Pescadero Water Budget 80102\Data\Water Levels\Well Water Elevation.xlsx

Path: T:\Projects\San Mateo Pescadero Water Budget 80102\GRAPHICS\Figure 10 Projected Future Water Levels.gpj



Data:
T:\Projects\San Mateo Pescadero Water Budget 80102\Data\
Water Quality\WQ_from_DDW_2000-2020.xlsx

Path: T:\Projects\San Mateo Pescadero Water Budget 80102\GRAPHICS\Figure 11 Water Quality Trends in CSA-11 Well No1.gpj

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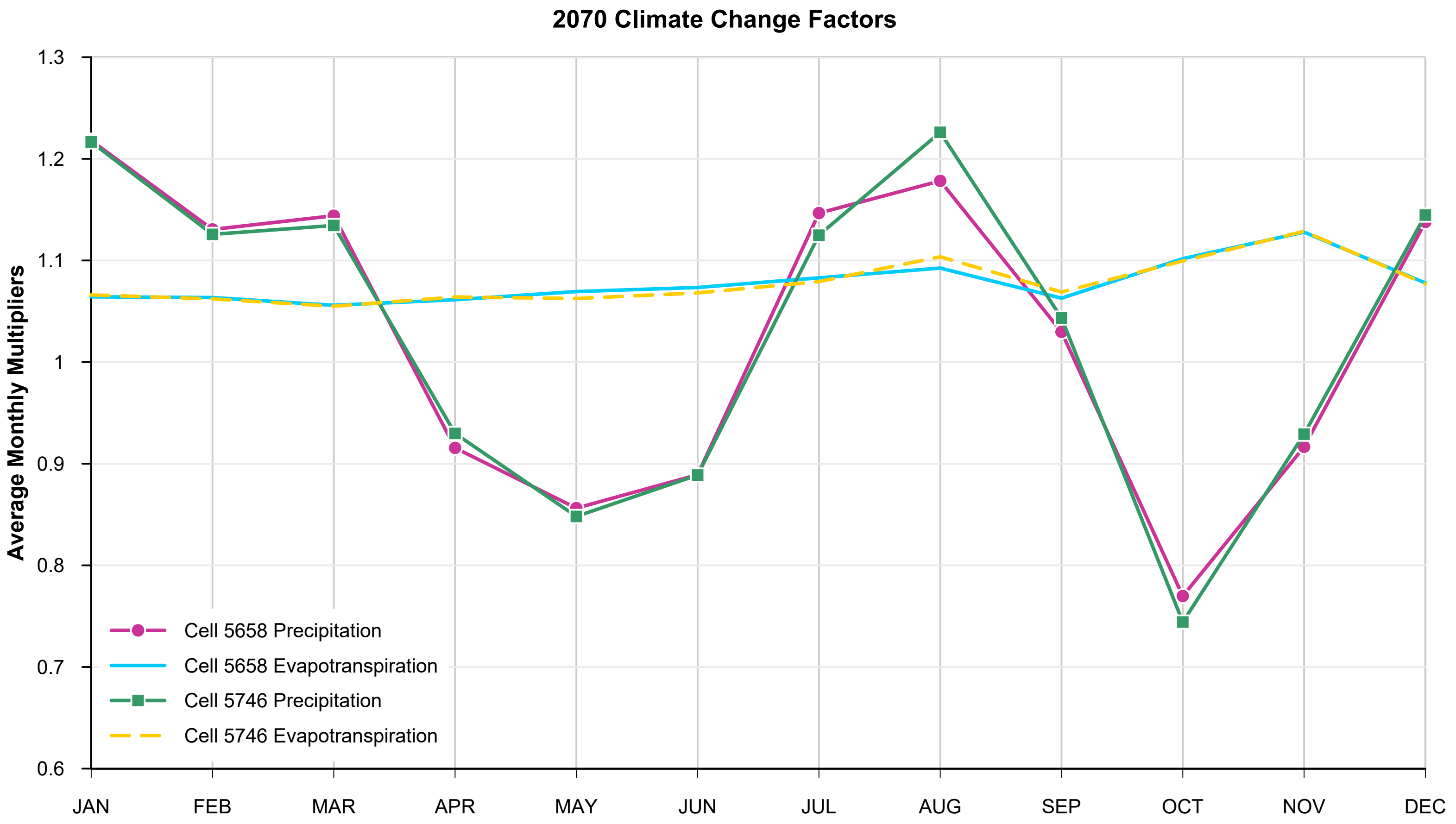
Figure 11
Water Quality Trends
in CSA-11 Well No.1



Note:
Cells refer to statewide grid of 4 km2 cells with climate
change multipliers for precipitation and evapotranspiration
(https://data.ca.gov/dataset/sgma-climate-change-resources)

Data:
T:\Projects\San Mateo Pescadero Water Budget 80102\Data\Climate Change\VIC_grid_factor_comparison.xlsx

Path: T:\Projects\San Mateo Pescadero Water Budget 80102\GRAPHICS\Figure 11 Precipitation and ETo Multipliers for 2070 Climate Conditions.gpj

March 2021

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GROUNDWATER

Figure 12
Precipitation and
ETo Multipliers for
2070 Climate Conditions