EXHIBIT 9-A

SUMMARY OF OPERATIONS

MONTEREY PENINSULA
ASR PROJECT

WATER YEAR 2016

Prepared for:

Monterey Peninsula Water Management District

JUNE 2017

DRAFT

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June 30, 2017
Project No. 12-0046

Monterey Peninsula Water Management District
Post Office Box 85
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Attention: Mr. Jonathan Lear, Senior Hydrogeologist

Subject: Monterey Peninsula ASR Project; Draft Water Year 2016 Summary of Operations Report

Dear Jon:

We are transmitting one digital image (PDF) of the subject draft report documenting operations of the Monterey Peninsula ASR Project during Water Year 2016 (WY 2016) for your review and comments. WY 2016 was a Normal Water Year on the on the Monterey Peninsula, and as a result a commensurately modest volume totaling 699 acre-feet (af) of water was able to be diverted from the Carmel River system for recharge in the Seaside Groundwater Basin (SGB) via the ASR-1, -2, -3 and -4 wells. To date, a total volume of approximately 5,090 af of excess Carmel River system water has been successfully injected, stored, and recovered in the SBG since the ASR project was initiated in 2001.

We appreciate the opportunity to provide ongoing assistance to the District on this important community water-supply project. Please contact us with any questions.

Sincerely,

PUEBLO WATER RESOURCES, INC.

Robert C. Marks, P.G., C.Hg.
Principal Hydrogeologist

Stephen P. Tanner, P.E.
Principal Engineer

Copies submitted: 1 digital (PDF)

TABLE OF CONTENTS

TABLES

TABLE OF CONTENTS (Continued)

FIGURES

APPENDICES
(NOT INCLUDED IN DRAFT)

INTRODUCTION

GENERAL STATEMENT

Presented in this report is a summary of operations of the Monterey Peninsula Aquifer Storage and Recovery (ASR) Project during Water Year 2016 (WY 2016)[1]. During WY 2016, approximately 699 acre-feet (af) of excess flows were diverted from the Carmel River system for recharge, storage, and subsequent recovery in the Seaside Groundwater Basin (SGB). This report presents a summary of the project operations during WY 2016, an assessment of ASR well performance, aquifer response and water-quality data, and provides recommendations for ongoing operation of the project.

BACKGROUND

The Monterey Peninsula ASR Project is cooperatively implemented by the Monterey Peninsula Water Management District (MPWMD or District) and California American Water (CAW) and involves the diversion of excess winter and spring time flows from the Carmel River system for recharge and storage in the Seaside Groundwater Basin (SGB). The excess water is captured by CAW wells in the Carmel Valley during periods when flows in the Carmel River exceed fisheries bypass flow requirements, treated to potable drinking water standards, and then conveyed through CAW's distribution system to ASR facilities in the SGB. Recharge is accomplished via injection of these excess flows into specially designed ASR wells drilled in the SGB. The locations of the ASR wells and associated project monitoring wells in the SGB are shown on **Figure 1**. The recharged water is temporarily stored underground utilizing the available storage space within the aquifer system. During periods of high demand, other existing CAW production wells in the SGB and/or the ASR wells can be used to recover the previously recharged water, which in turn allows for reduced extractions from the Carmel River system during seasonal dry periods.

The District and CAW have been cooperatively developing an ASR project on the Monterey Peninsula since 1996. These efforts have evolved over time, from the performance of various technical feasibility investigations, leading to the construction and testing of pilot- and then full-scale ASR test wells to demonstrate the viability and operational parameters for ASR wells in the SGB. Based on the success of the ASR demonstration testing program, MPWMD and CAW are in the process of implementing a full-scale permanent ASR Project.

The Phase 1 ASR Project includes two ASR wells (SM ASR-1 and SM ASR-2) located at the Santa Margarita ASR Facility at 1910 General Jim Moore Blvd. in Seaside. The Phase 1 Project is capable of recharging up to the State Water Resources Control Board (SWRCB) water right[2] maximum annual diversion limit of 2,426 acre-feet per year (afy) at a combined

[1] Water Year 2016 is the period of October 1, 2015 through September 30, 2016.
[2] SWRCB water right 20808A for the Phase 1 ASR Project is held jointly by MPWMD and CAW.

permitted injection rate of approximately 3,000 gallons per minute ([gpm] maximum diversion rate of 6.7 cubic feet per second [cfs]), with an average annual yield of approximately 920 afy. SM ASR-1 is designed for an injection capacity of 1,000 gpm and SM ASR-2 is designed for an injection capacity of 1,500 gpm. As-built schematics of SM ASR-1 and SM ASR-2 are presented on **Figures 2 and 3**, respectively.

The Phase 2 ASR Project includes two ASR wells (SMS ASR-3 and SMS ASR-4) located at the Seaside Middle School (SMS) ASR Facility at 2111 General Jim Moore Blvd. in Seaside. The Phase 2 Project is designed to be capable of recharging up to the SWRCB water right[3] maximum annual diversion limit of 2,900 afy at a combined permitted injection rate of approximately 3,600 gpm (maximum diversion rate of 8.0 cfs), with an average annual yield of approximately 1,020 afy. SMS ASR-3 and SMS ASR-4 are both designed for injection capacities of 1,500 gpm. SMS ASR-3 was constructed in 2010, and WY 2012 was the first time injection occurred at this well. SMS ASR-4 was constructed in 2012, and WY 2015 was the first time injection occurred at this well. As-built schematics of SMS ASR-3 and SMS ASR-4 are presented on **Figures 4 and 5**, respectively.

A graphical summary of historical ASR operations in the SGB is shown on **Figure 6**. Shown are the annual injection and recovery volumes since the inception of injection operations at the Santa Margarita ASR Facility in WY 2001 through the current period of WY 2016. Also presented is a delineation of the various phases of project implementation, starting with the Santa Margarita Test Injection Well (SMTIW) in 2001, which became SM ASR-1 as the project transitioned from a testing program to a permanent project in WY 2008 (Phase 1 ASR Project), through construction and operation of the second well (SM ASR-2) at the facility in 2010. As shown, having the Santa Margarita Facility in full operation with two ASR wells injecting simultaneously since 2010 (combined with above normal rainfall and Carmel River flows during WY 2010 and WY 2011) resulted in significant increases in the volume injected annually. As the two additional Phase 2 Project ASR wells (SMS ASR-3 and ASR-4) come on line in full operation, commensurate increases in annual injection volumes are expected to occur (depending on hydrologic conditions in any given year).

PURPOSE AND SCOPE

The overall purpose of the ongoing ASR program is to recharge the SGB with excess treated Carmel River system water when it is available during wet periods for storage and later extraction (recovery) during dry periods. ASR benefits the resources of both systems by raising water levels in the SGB during the recharge and storage periods and reducing extractions from the Carmel River System during dry periods.

The scope of the ongoing data collection, analysis, and reporting program for the ASR program can be categorized into issues generally associated with:

[3] The SWRCB water right 20808C for the Phase 2 ASR Project is held jointly by MPWMD and CAW.

1) ASR well hydraulics and performance;
2) Aquifer response to injection, and;
3) Water-quality issues associated with geochemical interaction and mixing of injected and native groundwaters.

The ongoing data collection and reporting program is intended to monitor and track ASR well performance and aquifer response to injection (both hydraulic and water quality) and to comply with the requirements of the Central Coast Regional Water Quality Control Board (RWQCB) for submitting annual technical reports for the project pursuant to Section 13267 of the California Water Code[4] and the existing General Waiver for Specific Types of Discharges (Resolution R3-2008-0010).

FINDINGS

WY 2016 ASR OPERATIONS

General Recharge Procedures

Recharge of the SGB occurs via injection of diverted flows from the CAW distribution system into ASR wells during periods of available excess Carmel River system flows. The ASR recharge source water is potable (treated) water provided from the CAW distribution system. The water is currently diverted by various production well sources in Carmel Valley and (after treatment and disinfection to potable standards) then conveyed through the Segunda-Crest pipeline network to the ASR Pipeline in General Jim Moore Blvd and then to the Santa Margarita and Seaside Middle School ASR facilities.

Injection water is introduced into the ASR wells via the pump columns. Injection rates are controlled primarily by downhole flow control valves (FCV's) installed on the pump columns, and secondarily by modulating the automatic pressure control valves (i.e., Cla-Vals) installed on the ASR wellhead piping. Injection flow rates and total injected volumes are measured with rate and totalizing meters at each of the wellheads. Positive gauge pressures are maintained at the wellheads during injection to prevent cascading of water into the wells (which can lead to air-binding). Continuous water-level data at each of the ASR wells are collected with submersible pressure transducer data loggers.

Injection generally occurs at each of the ASR wells on a continuous basis when flows are available, interrupted only for periodic backflushing, which typically occurs on an approximate weekly basis. Most sources of injection water contain trace amounts of solids that slowly accumulate in the pore spaces in the well's gravel pack and adjacent aquifer materials, and the CAW source water is no exception. Periodic backflushing of the ASR wells is therefore necessary to maintain well performance by removing materials deposited/accumulated around

[4] Letter from Roger W. Briggs, Executive Officer of the Central Coast RWQCB, to Joseph Oliver, Water Resources Manager for MPWMD, dated April 29, 2009.

the well bore during injection. The procedure is similar to backwashing a media filter to remove accumulated material deposited during filtration.

The trigger for backflushing occurs when the amount of water-level drawup during injection equals the available drawdown (as measured from the static water level to the top of the pump bowls) in the well for backflushing, or one week of continuous injection, whichever occurs first. This helps to avoid over-pressurization and compression of plugging materials, thereby maximizing the efficiency of backflushing and limiting the amount of residual plugging. This factor is the basis for the maximum recommended drawup levels referenced in the following section.

The general procedure consists of temporarily stopping injection and then pumping the wells at rates of approximately 2,000 to 3,000 gpm (i.e., at least twice the rate of injection) for 3 cycles of 10 minutes resting between 10 minute pumping cycles, and repeated as necessary to effectively remove particulates from the well screen / gravel pack / aquifer matrix. Backflush water is discharged to the Santa Margarita ASR Facility backflush pit, where it percolates back into the groundwater basin.

Injection Operations Summary

A summary of injection operations at the four ASR wells is presented in **Table 1** below. Field data collected during injection operations are presented in **Appendix A** (not included in draft).

Table 1. WY 2016 Injection Operations Summary

Well	Injection Season		Active	Injection Rate (gpm)			Total Vol
	Start	End	Days	Min	Max	Avg	(af)
ASR-1	1/7/16	4/4/16	37	144	1,615	1,002	163.8
ASR-2	1/7/16	4/4/16	55	1,024	2,156	1,510	367.0
ASR-3	1/19/16	4/1/16	42	703	1,008	884	164.0
ASR-4	1/20/16	3/17/16	5	116	349	197	4.4
						Total	**699.2**

As shown in **Table 1**, recharge operations were performed intermittently in WY 2016 during the period January 7 through April 4, 2016. WY 2016 was classified as a “Normal” Water Year[5] on the Carmel River with up to 55 days of active injection and a total volume of approximately 699 acre-feet (af) of water was available for diversion from the CAW system for recharge in the SGB. The recharge water was injected at all four ASR wells into the Santa Margarita Sandstone aquifer with per-well average injection rates ranging from approximately 115 to 2,150 gpm (approximately 0.5 to 9.53 acre-feet per day [afd]).

[5] Based on 44,923 af of unimpaired Carmel River flow at the Sleepy Hollow Weir in WY 2016.

It is noted that the variability in injection rates at the ASR wells during the injection season is controlled by various factors, including the number of active sources to the CAW system, customer demands on the CAW system, and the ability of CAW's distribution system to maintain piping pressure at the ASR wellheads.

Water-level data collected at SM ASR-1, SM ASR-2, SMS ASR-3 and SMS ASR-4 during WY 2016 are presented in **Figures 7 through 10**, respectively. The water-level data show the response of both SM ASR-1 and ASR-2 to injection, with maximum water-level drawups of approximately 80 and 110 feet, which were below the maximum recommended drawup levels of approximately 100 and 130 feet, respectively. At SMS ASR-3 the maximum water-level drawup was approximately 115 feet, which was also well below its maximum recommended drawup level of approximately 170 feet. At ASR-4, the limited volume and rates of injection resulted in maximum water-level drawup of approximately 75 feet, well below the maximum recommended of 210 feet. In summary, water levels were effectively maintained below the maximum recommended drawup levels at all ASR wells during WY 2016.

Recovery Operations Summary

When the injected water is recovered via delivery through the CAW system, the recovered water is offset by reduced pumping by CAW from the Carmel River system during the low-flow, high demand periods of the year. During WY 2016, SM ASR-1 was utilized for recovery of previously injected water. As shown on **Figure 6**, 493 af of recharged water was recovered by ASR-1 into the CAW system during WY 2016.

It is noted that in this context, ASR recovery is essentially an accounting / allocation of CAW's various water rights and pumping from the SGB, and does not represent a "molecule-for-molecule" recovery of the injected water. Rather, the volume recharged increases the operational yield of the SGB by the same amount and can be "recovered" by any of CAW's wells in the SGB and / or the ASR wells themselves.

WELL PERFORMANCE

Well performance is generally measured by specific capacity (pumping) and / or specific injectivity (injection), which is the ratio of flow rate (pumping or injection) to water-level change in the well (drawdown or drawup) over a specific elapsed time. The value is typically expressed as gallons per minute per foot of water level change (gpm/ft). The value normalizes well performance by taking into account differing static water levels and flow rates. As such, specific capacity / injectivity data are useful for comparing well performance over time and at differing flow rates. Decreases in specific capacity / injectivity are indicative of decreases in the hydraulic efficiency of a well due to the effects of plugging and/or particle rearrangement.

Injection Performance

Injection performance has been tracked at ASR-1 since the inception of the ASR program in WY 2002 by measurement and comparison of 24-hour injection specific injectivities (a.k.a. injection specific capacity).

SM ASR-1. A summary of 24-hour specific injectivity for ASR-1 for WY 2002 through 2016 is presented in **Table 2** below:

Table 2. Injection Performance Summary - ASR-1

Water Year	Injection Rate (gpm)	24-hour DUP (feet)	Specific Injectivity (gpm/ft)	Water Year Change	Comments
WY2002					
Beginning Period	1,570	81.7	**19.2**		FCV not installed yet in WY2002. No recovery pumping performed.
Ending Period	1,164	199.8	**6.4**	**-67%**	
WY2003					
Beginning Period	1,070	70.0	**15.5**		Recovery pumping performed following WY2003 Injection
Ending Period	1,007	49.7	**20.3**	**+31%**	
WY2004					
Beginning Period	1,383	183.4	**7.5**		Recovery pumping performed following WY2004 Injection
Ending Period	1,072	67.4	**15.9**	**+112%**	
WY2005					
Beginning Period	1,045	46.6	**22.4**		Injectate dechlorinated in WY2005. No recovery pumping performed.
Ending Period	976	94.1	**10.4**	**-54%**	
WY2006					
Beginning Period	1,039	71.5	**15.0**		Injection procedures consistent and performance stable in WY2006. No recovery pumping performed.
Ending Period	1,008	62.2	**17.5**	**+17%**	
WY2007					
Beginning Period	1,098	92.4	**11.9**		Only one injection period in WY2007. No recovery pumping performed.
Ending Period	--	--	**--**	**--**	
WY2008					
Beginning Period	979	25.5	**38.4**		Formal rehabilitation performed prior to WY2008 injection
Ending Period	1,063	33.4	**31.8**	**-17%**	
WY 2009					
Beginning Period	1,119	56.1	**19.9**		Beginning period low specific injectivity due to high plugging rate during initial injection period. No recovery pumping performed.
Ending Period	1,069	34.3	**31.1**	**+56%**	
WY 2010					
Beginning Period	1,080	35.6	**30.3**		Observed decline in performance due to residual plugging.
Ending Period	1,326	54.0	**24.6**	**-19%**	

Water Year	Injection Rate (gpm)	24-hour DUP (feet)	Specific Injectivity (gpm/ft)	Water Year Change	Comments
WY 2011					
Beginning Period	1,367	53.0	**25.8**		Observed decline in performance due to residual plugging.
Ending Period	1,454	63.7	**22.8**	**-10%**	
WY 2012					
Beginning Period	NA	NA	NA		No injection at this well this year.
Ending Period	NA	NA	NA	**NA**	
WY 2013					
Beginning Period	NA	NA	NA		No injection at this well this year.
Ending Period	NA	NA	NA	**NA**	
WY 2014					
Beginning Period	NA	NA	NA		No injection at this well this year.
Ending Period	NA	NA	NA	**NA**	
WY 2015					
Beginning Period	NA	NA	NA		No beginning period due to datalogger malfunction.
Ending Period	1,018	40.7	**25.0**	**NA**	
WY 2016					
Beginning Period	NA	NA	NA		**No beginning period due to datalogger malfunction.**
Ending Period	460	14.4	**31.9**	**NA**	

As shown in **Table 2**, the 24-hour specific injectivity the end of WY 2016 was 31.9 gpm/ft; there are no beginning season data to base calculation of residual plugging that occurred at ASR-1 over the course of the WY 2016 injection season.

ASR-2. A summary of the beginning and ending injection performance at ASR-2 for WY 2010 through WY 2016 is presented in **Table 3** below:

Table 3. Injection Performance Summary - ASR-2

Water Year	Injection Rate (gpm)	24-hour DUP (feet)	Specific Injectivity (gpm/ft)	Water Year Change	Comments
WY 2010					
Beginning Period	1,017	156.5	**6.5**		Significant residual plugging.
Ending Period	237	85.0	**2.8**	**-57%**	

Water Year	Injection Rate (gpm)	24-hour DUP (feet)	Specific Injectivity (gpm/ft)	Water Year Change	Comments
WY 2011					
Beginning Period	1,497	39.5	**37.9**	**-0.5%**	Significant improvement as a result of well rehabilitation. No residual plugging during year.
Ending Period	1,292	34.3	**37.7**		
WY 2012					
Beginning Period	1,830	56.1	**32.6**	**-12%**	Observed decline in performance due to residual plugging.
Ending Period	1,817	63.4	**28.7**		
WY 2013					
Beginning Period	1,087	32.7	**33.2**	**+3%**	No residual plugging during year.
Ending Period	1,508	44.2	**34.1**		
WY 2014					
Beginning Period	NA	NA	NA	**NA**	No injection at this well this year.
Ending Period	NA	NA	NA		
WY 2015					
Beginning Period	1,456	38.9	**37.4**	**-14%**	Observed decline in performance due to residual plugging.
Ending Period	1,574	49.1	**32.1**		
WY 2016					
Beginning Period	1,270	34.9	**36.4**	**-30%**	See discussion below.
Ending Period	1,620	63.9	**25.4**		

As shown in **Table 3**, the 24-hour specific injectivity at the beginning of WY 2016 was 36.4 gpm/ft and at the end of WY 2016 it was 25.4 gpm/ft, representing a decrease of approximately 30 percent, indicating that significant residual plugging occurred at ASR-2 over the course of the WY 2016 injection season (discussed further in a following section).

ASR-3. A summary of the beginning and ending injection performance at ASR-3 for WY 2013 through WY 2016 is presented in **Table 4** below:

Table 4. Injection Performance Summary – ASR-3

Water Year	Injection Rate (gpm)	24-hour DUP (feet)	Specific Injectivity (gpm/ft)	Water Year Change	Comments
WY 2013					
Beginning Period	1,044	87.0	**12.0**	**-31%**	See discussion below.
Ending Period	822	99.6	**8.3**		

Water Year	Injection Rate (gpm)	24-hour DUP (feet)	Specific Injectivity (gpm/ft)	Water Year Change	Comments
WY 2014					
Beginning Period	NA	NA	NA	**NA**	No injection at this well this year.
Ending Period	NA	NA	NA		
WY 2015					
Beginning Period	NA	NA	NA	**NA**	No beginning period data.
Ending Period	892	90.3	**9.9**		
WY 2016					
Beginning Period	948	83.6	**11.3**	**+7%**	See discussion below.
Ending Period	897	74.1	**12.1**		

As shown in **Table 4**, the 24-hour specific injectivity at the beginning of WY 2016 was 11.3 gpm/ft and at the end of WY 2016 it was 12.1 gpm/ft, representing a slight increase of approximately 7 percent, indicating that no residual plugging occurred at ASR-3 over the course of the WY 2016 injection season.

ASR-4. There are no 24-hr constant rate injection data for ASR-4 during WY 2016. Rather, injection at ASR-4 during WY 2016 was limited to 5 days of well “conditioning” (4.4 af). This “conditioning” effort consisted of numerous injection and backflushing cycles at relatively low rates and durations, being incrementally increased upon confirmation that well performance was being maintained. The conditioning was performed in an effort to limit the performance decline that has historically been observed at all three previous ASR wells following their initial injection operations (discussed below).

Initial injection was performed at a rate of approximately 260 gpm for 10 minutes, followed by backflushing. The injection rate and duration were incrementally increased over the course of 5 days during WY 2016, up to an injection rate of approximately 1,530 gpm for a maximum duration of 2 hours, followed by backflushing. The specific injectivity during these operations ranged between approximately 54 gpm/ft at the initial low injection rate of approximately 260 gpm to 36 gpm/ft at the ending high rate of 1,530 gpm (the design injection rate is 1,500 gpm). The “conditioning” effort at ASR-4 was considered complete in WY 2016 and formal baseline injection testing is planned for WY 2017.

Injection Performance Summary. The above results indicate a pattern in ASR well performance, with all three ASR wells having experienced comparably significant declines in performance following initial injection, followed by a period of relative stability in performance. It is hypothesized that the observed loss in performance is due to particle rearrangement (mechanical jamming) and/or chemical precipitation, as opposed to the normal and relatively slow plugging caused by particulates. This phenomenon is the reason for the well “conditioning” effort performed at ASR-4 during WY 2015 and WY 2106. It is also noted that while ASR-3 has experienced a significant decline in performance following its initial injection, (which limits its injection capacity to approximately 1,000 gpm,) it is expected that rehabilitation will result in significantly improved performance as has been observed at both ASR-1 and ASR-2.

Pumping Performance and Residual Plugging

Experience at injection well sites around the world shows that all injection wells are subject to some amount of plugging, because no water source is completely free of particulates, bionutrients, or oxidants, all of which can contribute to well plugging; the CAW source water is no exception. During injection, trace amounts of suspended solids are continually being deposited in the gravel pack and aquifer pore spaces, much as a media filter captures particulates in the filter bed. The effect of plugging is to impede the flow of water from the injection well into the aquifer, causing increased injection heads in the well to maintain a given injection rate, or reduced injection rates at a given head level. Well plugging reduces injection and extraction capacity, and can result in decreased useful well life if not mitigated.

Relative measurements of the particulate matter in the injectate have historically been made at the Santa Margarita site through silt density index (SDI) testing during injection. The SDI was originally developed to quantitatively assess particulate concentrations in reverse-osmosis feed waters. The SDI test involves pressure filtration of source water through a 0.45-micron membrane, and observation of the decrease in flow rate through the membrane over time; the resulting (dimensionless) value of SDI is used as a comparative value for tracking relative declines in well plugging rates associated with particulate plugging during an injection season (i.e., plugging rates tend to increase directly with SDI). During WY 2016 injection operations, SDI values at the beginning of the injection season were as high as 5.2 and fell to approximately 1.3 after the first month of injection.

Following routine backflushing operations and periods of water-level recovery, controlled 10-minute specific-capacity tests are typically performed to track well pumping performance, similar to the tracking of injection performance from 24-hour specific injectivity discussed above. Residual plugging is the plugging that remains following backflush pumping. Residual plugging increases drawdown during pumping and drawup during injection, and is manifested as declining specific capacity / injectivity. The presence of residual plugging is indicative of incomplete removal of plugging particulates during backflushing and has the cumulative effect of reducing well performance and capacity over time.

As discussed previously, routine 10-minute specific capacity tests were performed at the ASR wells as part of backflushing events during WY 2016. Presented in **Table 8** below is a summary of the residual plugging calculations for the ASR wells during WY 2016.

Table 5. Pumping Performance and Residual Plugging Summary

Well	Test	Pumping Rate (gpm)	10-min Drawdown (ft)	10-min Q/s[1] (gpm/ft)	Normalization Ratio[2]	Normalized Drawdown[2] (ft)	Residual Plugging (ft)
ASR-1	Pre-Injection	3,300	57.5	57.4	0.91	52.3	--
	Post-Injection	3,300	89.1	37.0	0.91	81.0	28.7
ASR-2	Pre-Injection	2,800	66.5	42.1	1.07	71.3	--
	Post-Injection	2,800	97.7	28.7	1.07	104.7	33.4
ASR-3	Pre-Injection	1,800	106.6	16.9	1.11	118.4	--
	Post-Injection	2,100	156.3	13.4	0.95	148.9	30.4
ASR-4	Pre-Injection	3,200	121.4	26.4	0.94	113.8	--
	Post-Injection	3,300	147.2	22.4	0.91	133.8	20.0

Notes:

1 - Specific Capacity. Ratio of pumping rate to drawdown.

2 - Normalized based on ratio of 3,000 gpm to actual test pumping rate for ASR-1, -2 and -4. Based on 2,000 gpm for ASR-3.

As shown on **Figures 7 through 10**, injection water levels were maintained below the recommended maximum available drawup levels at all four ASR wells during WY 2016; however, as shown in **Table 8**, all four wells experienced residual plugging ranging between approximately 20 and 35 feet and commensurate declines in pumping specific capacity. These results indicate that more intensive backflushing (e.g., multiple backflush cycles as opposed to a single cycle) should be implemented at all four ASR wells during WY 2017 to limit residual plugging and maintain performance.

AQUIFER RESPONSE TO INJECTION

The response of the regional aquifer system to injection has been monitored since the SMTIW project was initiated in WY 2002. Submersible water-level transducer/data logger units have been installed at seven offsite monitoring well locations in the SGB as well as three onsite monitoring wells. The locations of each offsite monitoring well are shown on **Figure 1**, and water-level hydrographs for the monitoring wells during WY 2016 are graphically presented on **Figures 11 through 19**. A summary of the regional water-level observations during the WY 2016 injection season is presented in **Table 9** below.

Table 6. Aquifer Response Summary

Well ID	Distance from Nearest Active ASR Well (feet)	Aquifer Monitored	Fig. No.	Pre-Injection DTW (ft. bgs)	Shallowest Injection DTW (ft. bgs)	Maximum Drawup Response (ft.)
SMS (Shallow)	25 (SMS ASR-3)	QTp	**11**	No Discernable Response		
SMS (Deep)		Tsm		No Data	314.5	**NA**
SM MW-1	190 (SM ASR-2)	Tsm	**12**	345.4	316.8	**28.6**
Paralta Test	650 (SM ASR-2)	QTp & Tsm	**13**	335.8	320.6	**15.2**
Ord Grove Test	1,820 (SM ASR-2)	QTp & Tsm	**14**	No Discernable Response		
Ord Terrace (Shallow)	2,550 (SM ASR-2)	Tsm	**15**	No Discernable Response		
FO-7 (Shallow)	3,700 (SMS ASR-3)	QTp	**16**	No Discernable Response		
FO-7 (Deep)		Tsm		492.4	478.1	**14.3**
FO-9 (Deep)	6,130 (SMS ASR-3)	Tsm	**17**	135.6	123.9	**11.7**
PCA East (Shallow)	6,200 (SMS ASR-3)	QTp	**18**	No Discernable Response		
PCA East (Deep)		Tsm		89.4	77.3	**12.1**
FO-8 (Deep)	6,450 (SMS ASR-3)	Tsm	**19**	399.5	388.1	**11.4**

Notes:
QTp – Quaternary / Tertiary-age Paso Robles Formation aquifer
Tsm – Tertiary-age Santa Margarita Sandstone aquifer
DTW – Depth to Water

As shown on the water-level hydrographs, water levels in the Santa Margarita Sandstone (Tsm) aquifer at the start of the WY 2016 recharge season ranged between approximately 6 to 22 feet below sea level. Positive response to injection during WY 2016 was observed at 7 of the 9 monitoring wells completed in the Santa Margarita Sandstone aquifer, with apparent water-level responses ranging between approximately 11 to 29 feet, with levels decreasing with distance from the ASR wells, which is the typical and expected aquifer response to hydraulic stresses (i.e., injection or pumping). The WY 2016 responses are comparable to those observed in previous water years.

The available water-level data also continue to show that at the Tsm-only monitoring wells, water levels consistently remained below sea level throughout the injection season. Under these water-level conditions, little to no offshore groundwater flow from the Tsm aquifer would be expected to occur and any “losses” associated with ASR project operations from water potentially migrating offshore are highly unlikely.

The limited available data for wells completed in the Paso Robles Formation (QTp) also continue to show no discernible response to injection into the Tsm, and water levels in this aquifer remained above the water levels in the underlying Tsm aquifer during WY 2016. Under these water-level conditions, little to no flow of water from the Tsm to the QTp aquifer would be expected to occur.

It is further noted that the Ord Grove Test and Ord Terrace monitoring wells (refer to **Figures 14 and 15**) continue to show no discernible response to injection operations, as has been observed during previous injection seasons. Most project monitoring wells show no discernible response to the pumping of CAW's Ord Grove production well. These observations suggest that the Ord Terrace Fault or a parallel branch of the fault may represent a hydraulic barrier in the Tsm aquifer.

WATER QUALITY

General

Source water for injection is supplied from the CAW municipal water system, primarily from Carmel River system wells which are treated at the CAW Begonia Iron Removal Plant (BIRP) for iron and manganese removal. The BIRP water is also disinfected and maintains a free chlorine residual. A phosphate-based corrosion inhibitor (Zinc Orthophosphate) is also added to the filtered water before entering the CAW distribution system. The finished product water meets all California Department of Public Health (CADPH) Primary and Secondary water quality standards.

As in previous years, water quality was routinely monitored at the ASR well sites during WY 2016 injection and aquifer storage operations. Far-field water quality was also monitored at the CAW Paralta production well and at the PCE-East Deep monitoring well (PCA-E Deep). Summaries of the collected water-quality data during WY 2016 are presented in **Tables 10 through 18** below. Analytic laboratory reports are presented in **Appendix B** (not included in draft). A discussion of the water-quality data collected during WY 2016 is presented below.

Injection Water Quality

Injection water quality from the CAW system during WY 2016 is presented in **Table 11** below; the data show injection water quality was typical of recent years. Levels of Trihalomethanes (THM) and Haloacetic Acid (HAA) compounds, as well as bionutrients (oxygen, nitrogen, phosphorous, and organic carbon), were all present at levels similar to previous years.

Mixing and Dilution

Injection operations have occurred over the past 15 Water Years (injection began at ASR-1 in WY 2002), an as a result, the proximate groundwater quality in the vicinity of the ASR well field has been altered from the natural subsurface conditions, making a clear distinction between "native" and "non-native" water quality both complex and somewhat subjective. In the past, the most illustrative basis for discussing water-quality changes for the ASR project was to consider groundwater conditions immediately prior to the injection season as a baseline; however, establishing baseline conditions is more complex now that injection is occurring at multiple wells. Because the issue of precisely defining baseline water-quality conditions is increasingly difficult as injection occurs at multiple wells with varying amounts of recovery pumping between injection seasons, the practice has been dropped in this and future reports.

Water Quality During Aquifer Storage

Tables 12 through 15 present summaries of water-quality data collected at the four ASR wells. **Tables 16 and 17** present similar data collected at the on-site monitoring wells SM MW-1 and SMS Deep, respectively; and **Table 18** presents the water-quality data collected at the off-site monitoring wells (PCA-E Deep and Paralta). Data for the ASR wells include baseline water quality taken prior to WY 2016 injection (end of WY 2015 Storage) and stored water quality (WY 2016 Storage) collected periodically from the aquifer after WY 2016 injection operations were terminated.

Review of water-quality parameters gathered at the ASR wells, including major anions and cations, redox potential (ORP), and conductivity all showed similar effects of dilution / intermixing of injected water with native groundwater during aquifer storage. As found in previous ASR operations at the site, the most significant water-quality changes observed during aquifer storage other than simple dilution/mixing were redox-related (and likely biologically mediated) reactions; these were primarily evidenced by the degradation of HAA and THM compounds and absence of hydrogen sulfide[6] even in mixed NGW and injected waters.

Disinfection Byproducts (DBPs) parameters at the on-site wells during WY 2016 are graphically presented on **Figures 20 through 24**. As shown, THMs at the ASR wells showed their typical initial and significant ingrowth during the storage period, which results from the presence of free chlorine and trace levels of organic carbon in the injected water. THM ingrowth generally peaks in concentration approximately 60 to 120 days after the cessation of injection, followed by a gradual decline during the storage period. After approximately 150 to 180 days of storage, THMs typically degraded to below the initial injection levels. The decline in THMs observed at the ASR and on-site monitoring wells followed the characteristic process: rapid degradation of Bromoform and the highly brominated species with much slower decline in Chloroform. It is noted that THMs were below the Maximum Contaminant Level (MCL) of 80 ug/L throughout WY 2016, with the exception of transiently elevated levels during the peak in-growth periods, which dropped to below the MCL by the end of the storage season[7]. HAAs also showed their typical pattern of limited (if any) ingrowth during the initial storage period, followed by rapid degradation by the end of the storage season.

Water Quality at Off-Site Monitor Wells

Water-quality data collected from off-site wells in WY 2016 data are presented in **Table 18**. Samples from PCA-E Deep were collected following the WY 2016 injection season (but were not collected prior for unknown reasons). The absence of DBP's suggest that the influence of recharge operations is negligible to date at this location. Limited data are available from the nearest CAW production well to the ASR wells (i.e., Paralta)[8]; however, the available

[6] Low levels of Hydrogen Sulfide are ubiquitous in the Tsm aquifer under natural conditions.
[7] SMS Deep could not be sampled in the 3rd quarter of 2016 due to a sampling pump malfunction.
[8] Paralta was not sampled by CAW during WY 2016 in accordance with the SAP for unknown reason(s).

THM data show a potential trend of an increasing contribution of injected water quality over the WY 2016 storage season.

Additional Water Quality Observations

As discussed in the WY 2015 Summary of Operations Report (SOR), at the commencement of WY 2013 recovery pumping of ASR-1, a sample collected by CAW[9] had a Mercury (Hg) concentration of 4 µg/L, exceeding the State MCL of 2 µg/L. Although the occurrence of Hg in surface water and groundwater has been documented elsewhere in the Monterey Bay region, the detection of Hg in SGB water was unusual; further investigation of the actual sampling conditions and protocols for that sample were also nonstandard. The results were nonetheless followed up with additional sampling to verify the presence of Hg; the subsequent sampling identified detectable levels of Hg, although below the MCL. The fact that detectable Hg was identified, and at levels above historical NGW and Injectate concentrations led to the development of an in-depth investigation of Hg occurrence at the ASR wells. The origin of the detected Hg above background concentrations could be the result one or more sources, including the following:

- Naturally occurring Hg present in the Santa Margarita Sandstone (Tsm) aquifer mineralogy, which solubilized into the groundwater under natural NGW / Tsm geochemical interaction conditions.
- Hg present in the Carmel River System injection source water that accumulated in the well bore area, similar to the accumulation of other particulate matter present in the Carmel River injectate and CAW conveyance system.
- Solubilization of naturally occurring Hg present in the Tsm minerals, which is the result of geochemical interactions between the injection source water, NGW and aquifer minerals. Recent mineralogy analyses have identified the presence of trace levels of four different sulfide minerals in Tsm cuttings and ASR well backflush residue; the speciation of these four minerals are potentially capable of harboring elemental Hg within their matrix. Further analysis of these samples is in progress.
- Other anthropogenic sources of Hg in well components or other off-site sources.

Prior to WY 2016, a Supplemental Sampling and Analysis Plan[10] (SSAP) was developed for additional investigation of the Hg occurrence. In addition to the collection of Hg samples utilizing a variety of EPA-approved laboratory methods and detections limits, the suite of analytes included a variety of constituents that are known to affect (or directly react with) Hg and/or Hg compounds. As of this writing, the investigation is ongoing; however, the results of SSAP during WY 2016 provided several initial findings, discussed below:

[9] Collected on October 24, 2013.
[10] Dated September 4, 2015

WY 2016 Sampling and Analysis Discussion. Additional sampling was performed during the WY 2016 injection season to further assess the correlation between Hg detections and high Turbidity levels, resulting in these additional findings:

- All sample results showed Hg levels below MCL's, with positive correlation between declining turbidity and decreasing Hg levels.
- Additional sampling of CAW source waters from the Begonia Iron Removal Plant (BIRP) indicated detectable Hg in the raw well water plant influent, and in the BIRP plant finished product water. These Hg levels were all far below MCL's, and even below the detection limits of conventional EPA 200.8 analysis methods; the influent Hg detections were in sub-parts-per-trillion levels.

Figure 25 presents a plot of Hg and Turbidity versus time for a series of samples collected on February 11, 2016 at ASR-1 during a backflush event after one week of injection operations at approximately 1,100 gpm. The new triple-surge backflushing procedure was implemented at this time. Samples were collected at 1, 6, 20, and 30 minutes after well startup; the characteristic occurrence of elevated Hg and elevated Turbidity are present, but decline rapidly as the well is flushed. Similar results are presented in **Figure 26,** which presents the results of a similar well backflushing event at ASR-1 on March 23, 2016; again after approximately one week of injection. The same decline in Hg content and Turbidity is observed.

Figure 27 is a summary plot of all Hg and Turbidity data collected to date from the ASR-1 Hg study, showing the correlation between Hg and Turbidity versus time from start of well pumping. The data thus far are strongly suggestive that there is a meaningful correlation between Hg content, Turbidity, and pumping time in the produced water from ASR-1. The possible explanation for this phenomenon is that the trace-level Hg present in the Carmel River System injection source waters is accumulating in the near-well-bore area during injection operations, and is then released when reverse flows associated with backflushing or recovery production occur.

Initial Recommendations for Facility and Operational Improvements. The results of the investigation thus far have identified important issues associated with the occurrence – and mitigation of Hg in the ASR-1 well. The following conclusions and recommendations provided below are based on the results of the investigation thus far:

- Because the occurrence of elevated Hg levels in ASR-1 appears to be directly correlated to elevated turbidity levels in initial well flush waters, the formal adoption of the enhanced well flushing procedure should be made a part of regular well operations both in Injection mode backflushing operations, and in regular production service whenever the well is placed back into service after any idle period. This procedure should consist of performing a series of 3 consecutive short flush episodes instead of a single longer flush period; thusly increasing well bore velocity changes and inducement of reverse flows in the well. This process resulted in lower final turbidities and lower Hg levels overall after well flushing operations were completed.

- As an additional conservative measure, we recommend continuation of periodic (monthly) well backflushing and associated water quality monitoring with the ASR wells during the WY 2017 storage periods to further assess and confirm the data collected thus far regarding the correlation of Hg occurrence with turbidity on initial well flush discharges.
- To ensure compliant water quality once the ASR-1 well is in recovery mode and is delivering water directly into the Cal-Am distribution system, the use of Turbidity as a surrogate parameter for possible elevated Hg would allow continuous on-line monitoring of water quality vis-à-vis the installation of an online Turbidity analyzer on the well discharge line that is interlocked to a well shutdown and alarm algorithm in the facility PLC/SCADA controls.
- To verify the absence of Hg in produced waters from the well, special sampling is recommended prior to bringing the well back online for production, or whenever the well has been offline for more than one month. The special testing program consists of a series of Hg samples collected at 1, 6, 30 and 60 minutes after initial well startup; these samples will be analyzed by an outside laboratory and results received before the well is placed back into production service.

A revised protocol reflecting the new triple-surge well flushing procedure has been developed and is planned to be adopted for all regular and special operations in WY 2017. The addition of an on-line Turbidity analyzer as discussed above, along with the associated modification of PLC and SCADA system algorithms, are also planned to be implemented to serve as a safeguard against the possible conveyance of turbid (and potentially Hg-noncompliant) waters into the distribution system.

Next Steps. The investigation thus far has established a strong correlation between turbidity in initial flush waters and Hg occurrence at ASR-1, with both parameters declining in the early period of well purging operations. There are currently several additional technical issues that are planned for further investigation in WY 2017, including the following:

- Collection of high-frequency (daily) samples of injectate during the Injection Season to monitor for the presence / absence of Hg in the injected water.
- “Breakthrough” sampling of arrival of injection front from ASR-3 at ASR-4.
- Determination of the precise identification of Hg-bearing particulates (i.e., molecular composition and structure) will be pursued via specialty analytical laboratory methods. This will aid in the understanding of which chemical compounds might be associated with Hg-occurrence. Residue samples collected during the course of the WY 2017 Injection Season are planned for evaluation by the specialty lab to establish if the samples have sufficient quantities of Hg-bearing particulates for this determination.
- Assuming there are suitable quantities of Hg-bearing compounds available that can be identified analytically, this will then be utilized to facilitate refined geochemical

modeling to provide an improved understanding of the geochemical mechanism(s) responsible for Hg-occurrence in the initial flush water samples.

- These recommended steps are intended to facilitate long-term operational improvement considerations for the Aquifer Storage and Recovery program.

As the Hg investigation continues, additional findings, conclusions, and recommendations will be documented in the WY 2017 SOR to facilitate ongoing operation of the ASR project.

Water Quality Summary

Overall, water-quality data from WY 2016 showed no significant deviations from previous years. The only deviation from the norm for the ASR program was the intermittent and transient occurrence of Hg detections as described for the ASR-1 well; however, as discussed above, additional investigation in WY 2017 will be implemented to further investigate the origin of the detected Hg. The most important factors regarding ASR operations to date are that:

1. No evidence of adverse geochemical reactions has been observed during aquifer storage (with the exception of near-bore Hg accumulation possibly related to Hg dissolution), and;
2. Injection has shown direct and measurable benefit to the basin water quality vis-à-vis reductions in salinity, dissolved solids, hardness, and aesthetic parameters such as manganese and sulfide ion, which impart color and odor to the consumers' drinking water.

These improvements are likely to prevail as ASR operations continue and expand in the future.

Table 7. Summary of WY 2016 Water Quality Data – Injectate

Parameter	Unit	PQL	MCL	Results		
				CAW Injectate		
				1/11/16	2/19/16	3/16/16
		Sample Description		Injectate		
Major Cations						
Calcium	mg/L	*0.5*		47		
Magnesium	mg/L	*0.5*		15		
Potasium	mg/L	*0.5*		3.2		
Sodium	mg/L	*0.5*		52		
Major Anions						
Alkalinity, Total (as CaCO3)	mg/L	*2*		153		
Chloride	mg/L	*1*	*250*	34		
Sulfate	mg/L	*1*	*250*	91		
Nitrate (as NO3)	mg/L	*1*	*45*	1		
Nitrite (as Nitrogen)	mg/L	*1*	*1*	0.3		
General Physical						
pH	Std Units			7.6		
Specific Conductance (EC)	uS	*1*	*900*	603		
Total Dissolved Solids	mg/L	*10*	*500*	380		
Metals						
Arsenic (Total)	ug/L	*1*	*10*	1		
Barium (Total)	ug/L	*10*	*1000*	70		
Iron (Dissolved)	ug/L	*10*		ND		
Iron (Total)	ug/L	*10*	*300*	ND		
Lithium	ug/L	*1*		7		
Manganese (Dissolved)	ug/L	*10*		ND		
Manganese (Total)	ug/L	*10*	*50*	ND		
Molybdenum	ug/L	*1*	*1000*	3		
Nickel	ug/L	*10*	*100*	ND		
Selenium	ug/L	*2*	*50*	4		
Strontium (Total)	ug/L	*5*		263		
Uranium (by ICP/MS)	ug/L	*1*	*30*	1		
Vanadium (Total)	ug/L	*1*	*1000*	ND		
Zinc (Total)	ug/L	*10*	*5000*	318		
Miscellaneous						
Ammonia-N	mg/L	*0.05*		ND		
Boron	mg/L	*0.05*		ND		
Chloramines	mg/L	*0.05*		0.19	0.11	0.11
Gross Alpha	pCi/L		*15*	1.72 +/- 1.65		
Kjehldahl Nitrogen (Total)	mg/L	*0.5*		ND		
Methane	ug/L	*0.1*		0.59		
Nitrogen (Total)	mg/L	*0.5*		0.5		
o-Phosphate-P	mg/L	*0.05*		0.3		
Phosphorous (Total)	mg/L	*0.03*		0.47		
Radium 226	pCi/L		*3*	0.036 +/- 0.159		
Organic Analyses						
Haloacetic Acids (Total)	ug/L	*1.0*	*60.0*	11.5	13.9	12.7
Dibromoacetic Acid	*ug/L*	*1.0*		*3.1*	*2.6*	*1.9*
Dichloroacetic Acid	*ug/L*	*1.0*		*5.2*	*6.8*	*6.1*
Monobromoacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*ND*
Monochloroacetic Acid	*ug/L*	*2.0*		*ND*	*ND*	*ND*
Trichloroacetic Acid	*ug/L*	*1.0*		*3.2*	*4.5*	*4.7*
Organic Carbon (Dissolved)	mg/L	*0.2*		1.4		
Organic Carbon (Total)	mg/L	*0.2*		1.4		
Trihalomethanes (Total)	ug/L	*1.0*	*80.0*	25.8	30.4	27.2
Bromodichloromethane	*ug/L*	*0.5*		*8.8*	*11.0*	*9.5*
Bromoform	*ug/L*	*0.5*		*1.7*	*0.99*	*0.73*
Chloroform	*ug/L*	*0.5*		*6.9*	*11.0*	*11.0*
Dibromochloromethane	*ug/L*	*0.5*		*8.4*	*7.4*	*6.0*
Field Parameters						
Temperature	^{0} C	*0.1*			14.6	16.1
Specific Conductance (EC)	uS	*1.0*	*900*		476	450
pH	Std Units	*0.1*	*6.5 - 8.5*		7.5	6.9
ORP	mV	*1.0*			589	372
Free Chlorine Residual	mg/L	*0.1*	*2 - 5*		0.2	1.5
Dissolved Oxygen	mg/L	*0.01*				2.7
Silt Density Index	Std Units	*0.1*				
Gas Volume	mL	*2.0*				
H_2S	mg/L	*0.1*				

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

Table 8. Summary of WY 2016 Water-Quality Data – ASR-1

Parameter	Unit	PQL	MCL	Results SM ASR-1 3/21/01	9/22/15	7/12/16	9/21/16
		Sample Description		NGW	WY 2015 Storage	WY 2016 Storage	
Elapsed Storage Time	Days			--	217	99	170
Volume Purged at Sampling	1,000 gals			--			
Major Cations							
Calcium	mg/L	0.5		85	96	41	68
Magnesium	mg/L	0.5		19	23	13	17
Potasium	mg/L	0.5		5.3	5.7	2.9	4.0
Sodium	mg/L	0.5		88	101	43	71
Major Anions							
Alkalinity, Total (as CaCO3)	mg/L	2		224	237	135	180
Chloride	mg/L	1	250	120	141	28	72
Sulfate	mg/L	1	250	95	118	70	96
Nitrate (as NO3)	mg/L	1	45	ND	ND	ND	1.0
Nitrite (as Nitrogen)	mg/L	1	1		0.3	ND	0.3
General Physical							
pH	Std Units			7.1	7.1	7.4	7.4
Specific Conductance (EC)	uS	1	900	**1015**	**1141**	496	763
Total Dissolved Solids	mg/L	10	500	**618**	**677**	317	471
Metals							
Arsenic (Total)	ug/L	1	10	ND	1	1	1
Barium (Total)	ug/L	10	1000	52	84	56	55
Iron (Dissolved)	ug/L	10			10	ND	ND
Iron (Total)	ug/L	10	300	120	59	120	ND
Lithium	ug/L	1			41	6	19
Manganese (Dissolved)	ug/L	10			20	ND	ND
Manganese (Total)	ug/L	10	50	40	23	ND	ND
Molybdenum	ug/L	1	1000		10	3	6
Nickel	ug/L	10	100		ND	ND	ND
Selenium	ug/L	2	50	ND	2	4	2
Strontium (Total)	ug/L	5			472	222	308
Uranium (by ICP/MS)	ug/L	1	30		1	ND	1
Vanadium (Total)	ug/L	1	1000		ND	ND	ND
Zinc (Total)	ug/L	10	5000	10	118	219	87
Miscellaneous							
Ammonia-N	mg/L	0.05		0.33	0.19	ND	ND
Boron	mg/L	0.05		0.14	0.13	ND	0.08
Chloramines	mg/L	0.05			ND	ND	ND
Gross Alpha	pCi/L		15		4.70 +/- 2.00	1.76 +/- 1.57	2.52 +/- 1.55
Kjehldahl Nitrogen (Total)	mg/L	0.5			ND	ND	ND
Methane	ug/L	0.1			0.4	0.59	2.2
Nitrogen (Total)	mg/L	0.5			ND	ND	0.5
o-Phosphate-P	mg/L	0.05		0.46	0.2	ND	0.1
Phosphorous (Total)	mg/L	0.03			0.17	0.26	0.13
Radium 226	pCi/L		3		1.28 +/- 0.34	0.264 +/- 0.245	0.758 +/- 0.437
Organic Analyses							
Haloacetic Acids (Total)	ug/L	1.0	60.0		0.0	6.0	0.0
Dibromoacetic Acid	*ug/L*	1.0			*ND*	*1*	*ND*
Dichloroacetic Acid	*ug/L*	1.0			*ND*	*1*	*ND*
Monobromoacetic Acid	*ug/L*	1.0			*ND*	*ND*	*ND*
Monochloroacetic Acid	*ug/L*	2.0			*ND*	*ND*	*ND*
Trichloroacetic Acid	*ug/L*	1.0			*ND*	*4*	*ND*
Organic Carbon (Dissolved)	mg/L	0.2			1.5		1.0
Organic Carbon (Total)	mg/L	0.2		6.3	1.3		1.0
Trihalomethanes (Total)	ug/L	1.0	80.0		0.6	**93.0**	28.9
Bromodichloromethane	*ug/L*	0.5			*ND*	*20.7*	*7.6*
Bromoform	*ug/L*	0.5			*ND*	*0.9*	*0.5*
Chloroform	*ug/L*	0.5			*0.6*	*62.1*	*18.8*
Dibromochloromethane	*ug/L*	0.5			*ND*	*9.3*	*2.0*
Field Parameters							
Temperature	^{0} C	0.1			20.4	16.4	19.4
Specific Conductance (EC)	uS	1.0	900	1015	1211	455	667
pH	Std Units	0.1	6.5 - 8.5	7.1	7.3	7.8	7.0
ORP	mV	1.0			-147	-98	-243
Free Chlorine Residual	mg/L	0.1	2 - 5		ND	0.51	ND
Dissolved Oxygen	mg/L	0.01			ND	1.93	1.17
Silt Density Index	Std Units	0.1					
Gas Volume	mL	2.0					
H_2S	mg/L	0.1		1.5	0.07		ND

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

Table 9. Summary of WY 2016 Water Quality Data – ASR-2

Parameter	Unit	PQL	MCL	Results SM ASR-2 12/15/15	6/21/16	9/27/16
		Sample Description		WY 2015 Storage	WY 2016 Storage	
Elapsed Storage Time	Days			**301**	**78**	**176**
Volume Purged at Sampling	1,000 gals					
Major Cations						
Calcium	mg/L	*0.5*			40	60
Magnesium	mg/L	*0.5*			13	19
Potasium	mg/L	*0.5*			3.0	3.8
Sodium	mg/L	*0.5*			42	64
Major Anions						
Alkalinity, Total (as CaCO3)	mg/L	*2*			129	180
Chloride	mg/L	*1*	*250*	126	29	64
Sulfate	mg/L	*1*	*250*		72	81
Nitrate (as NO3)	mg/L	*1*	*45*		1	1
Nitrite (as Nitrogen)	mg/L	*1*	*1*		ND	0.3
General Physical						
pH	Std Units				7.7	7.5
Specific Conductance (EC)	uS	*1*	*900*		487	707
Total Dissolved Solids	mg/L	*10*	*500*		326	431
Metals						
Arsenic (Total)	ug/L	*1*	*10*		1	1
Barium (Total)	ug/L	*10*	*1000*		54	83
Iron (Dissolved)	ug/L	*10*			ND	ND
Iron (Total)	ug/L	*10*	*300*		70	66
Lithium	ug/L	*1*			6	14
Manganese (Dissolved)	ug/L	*10*			ND	10
Manganese (Total)	ug/L	*10*	*50*		ND	11
Molybdenum	ug/L	*1*	*1000*		5	6
Nickel	ug/L	*10*	*100*		ND	ND
Selenium	ug/L	*2*	*50*		6	2
Strontium (Total)	ug/L	*5*			206	300
Uranium (by ICP/MS)	ug/L	*1*	*30*		ND	1
Vanadium (Total)	ug/L	*1*	*1000*		ND	ND
Zinc (Total)	ug/L	*10*	*5000*		228	317
Miscellaneous						
Ammonia-N	mg/L	*0.05*			ND	ND
Boron	mg/L	*0.05*			ND	0.06
Chloramines	mg/L	*0.05*		ND	0.05	ND
Gross Alpha	pCi/L		*15*		0.550 +/- 1.08	2.59 +/- 2.16
Kjehldahl Nitrogen (Total)	mg/L	*0.5*			ND	1
Methane	ug/L	*0.1*			0.43	1.7
Nitrogen (Total)	mg/L	*0.5*			ND	1.5
o-Phosphate-P	mg/L	*0.05*			0.3	0.3
Phosphorous (Total)	mg/L	*0.03*			0.31	0.25
Radium 226	pCi/L		*3*		0.000 +/- 0.105	0.000 +/- 0.246
Organic Analyses						
Haloacetic Acids (Total)	ug/L	*1.0*	*60.0*	0.0	12.0	0.0
Dibromoacetic Acid	*ug/L*	*1.0*		*ND*	*1.0*	*ND*
Dichloroacetic Acid	*ug/L*	*1.0*		*ND*	*2.0*	*ND*
Monobromoacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*ND*
Monochloroacetic Acid	*ug/L*	*2.0*		*ND*	*ND*	*ND*
Trichloroacetic Acid	*ug/L*	*1.0*		*ND*	9.0	*ND*
Organic Carbon (Dissolved)	mg/L	*0.2*			1.4	
Organic Carbon (Total)	mg/L	*0.2*			1.4	1.10
Trihalomethanes (Total)	ug/L	*1.0*	*80.0*	0.0	**101.8**	47.9
Bromodichloromethane	*ug/L*	*0.5*		*ND*	23.7	*12.0*
Bromoform	*ug/L*	*0.5*		*ND*	1.0	0.60
Chloroform	*ug/L*	*0.5*		*ND*	66.5	29.8
Dibromochloromethane	*ug/L*	*0.5*		*ND*	10.6	5.5
Field Parameters						
Temperature	^{0}C	*0.1*		18.5	16.3	18.0
Specific Conductance (EC)	uS	*1.0*	*900*	**1048**	540	610.0
pH	Std Units	*0.1*	*6.5 - 8.5*	7.4	7.6	6.5
ORP	mV	*1.0*		-188	-189	-202.5
Free Chlorine Residual	mg/L	*0.1*	*2 - 5*	ND	0.2	0.24
Dissolved Oxygen	mg/L	*0.01*		ND	1.98	1.01
Silt Density Index	Std Units	*0.1*				
Gas Volume	mL	*2.0*				
H_2S	mg/L	*0.1*		0.05		0.02

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

Table 10. Summary of WY 2016 Water Quality Data – ASR-3

Parameter	Unit	PQL	MCL	Results			
				SMS ASR-3			
				10/22/10	12/16/15	6/22/16	9/21/16
		Sample Description		NGW	WY 2015 Storage	WY 2016 Storage	
Elapsed Storage Time	Days				302	79	170
Volume Purged at Sampling	1,000 gals						
Major Cations							
Calcium	mg/L	*0.5*		76		38	53
Magnesium	mg/L	*0.5*		18		13	17
Potasium	mg/L	*0.5*		5		2.8	3.6
Sodium	mg/L	*0.5*		102		41	59
Major Anions							
Alkalinity, Total (as CaCO3)	mg/L	*2*		304		129	171
Chloride	mg/L	*1*	*250*	107	95	30	58
Sulfate	mg/L	*1*	*250*	56		72	72
Nitrate (as NO3)	mg/L	*1*	*45*	1		1.0	1.0
Nitrite (as Nitrogen)	mg/L	*1*	*1*	ND		ND	0.3
General Physical							
pH	Std Units			7.7		7.6	7.5
Specific Conductance (EC)	uS	*1*	*900*	**954**		501	657
Total Dissolved Solids	mg/L	*10*	*500*	**575**		306	426
Metals							
Arsenic (Total)	ug/L	*1*	*10*	4		16	6
Barium (Total)	ug/L	*10*	*1000*	50		52	78
Iron (Dissolved)	ug/L	*10*		21		ND	ND
Iron (Total)	ug/L	*10*	*300*	21		53	56
Lithium	ug/L	*1*		36		6	14
Manganese (Dissolved)	ug/L	*10*		27		ND	12
Manganese (Total)	ug/L	*10*	*50*	27		ND	13
Molybdenum	ug/L	*1*	*1000*	--		76	21
Nickel	ug/L	*10*	*100*	ND		ND	ND
Selenium	ug/L	*2*	*50*	ND		9	3
Strontium (Total)	ug/L	*5*		403		207	281
Uranium (by ICP/MS)	ug/L	*1*	*30*	--		1	3
Vanadium (Total)	ug/L	*1*	*1000*	--		ND	ND
Zinc (Total)	ug/L	*10*	*5000*	--		231	266
Miscellaneous							
Ammonia-N	mg/L	*0.05*		249		ND	ND
Boron	mg/L	*0.05*		ND		ND	0.05
Chloramines	mg/L	*0.05*		0.08	ND	ND	ND
Gross Alpha	pCi/L		*15*	--		1.16 +/- 1.41	4.28 +/- 1.73
Kjehldahl Nitrogen (Total)	mg/L	*0.5*		ND		ND	1
Methane	ug/L	*0.1*		ND		0.52	1.40
Nitrogen (Total)	mg/L	*0.5*		ND		ND	1.5
o-Phosphate-P	mg/L	*0.05*		ND		0.3	0.2
Phosphorous (Total)	mg/L	*0.03*		0.03		0.28	0.27
Radium 226	pCi/L		*3*	--		0.835 +/- 0.370	0.178 +/- 0.302
Organic Analyses							
Haloacetic Acids (Total)	ug/L	*1.0*	*60.0*	ND	0.0	16.0	3.0
Dibromoacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*1.0*	*1.0*
Dichloroacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*4.0*	*2.0*
Monobromoacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*ND*	*ND*
Monochloroacetic Acid	*ug/L*	*2.0*		*ND*	*ND*	*ND*	*ND*
Trichloroacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*11*	*ND*
Organic Carbon (Dissolved)	mg/L	*0.2*		0.71		1.5	0.9
Organic Carbon (Total)	mg/L	*0.2*		0.70		1.4	1.0
Trihalomethanes (Total)	ug/L	*1.0*	*80.0*	ND	20.9	**99.7**	61.4
Bromodichloromethane	*ug/L*	*0.5*		*ND*	*6.2*	*22.5*	*15.9*
Bromoform	*ug/L*	*0.5*		*ND*	*ND*	*1.1*	*0.8*
Chloroform	*ug/L*	*0.5*		*ND*	*11.0*	*65.8*	*36.7*
Dibromochloromethane	*ug/L*	*0.5*		*ND*	*3.7*	*10.3*	*8.0*
Field Parameters							
Temperature	^{0} C	*0.1*		26.2	20.8	16.3	17.3
Specific Conductance (EC)	uS	*1.0*	*900*	991	788	486	588
pH	Std Units	*0.1*	*6.5 - 8.5*	7.0	7.4	7.6	7.07
ORP	mV	*1.0*		-82	-136	-164	-171
Free Chlorine Residual	mg/L	*0.1*	*2 - 5*	ND	ND	0.2	ND
Dissolved Oxygen	mg/L	*0.01*		--	ND	2.72	4.67
Silt Density Index	Std Units	*0.1*		--			
Gas Volume	mL	*2.0*		--			
H_2S	mg/L	*0.1*		0.60	0.03		ND

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

Table 11. Summary of WY 2016 Water Quality Data – ASR-4

Parameter	Unit	PQL	MCL	7/13/2016	9/21/16
		Sample Description		WY 2016 Storage	
Elapsed Storage Time	Days			**100**	**170**
Volume Purged at Sampling	1,000 gals				
Major Cations					
Calcium	mg/L	*0.5*		65	76
Magnesium	mg/L	*0.5*		14	16
Potasium	mg/L	*0.5*		3.7	4.6
Sodium	mg/L	*0.5*		88	103
Major Anions					
Alkalinity, Total (as CaCO3)	mg/L	*2*		215	234
Chloride	mg/L	*1*	*250*	109	121
Sulfate	mg/L	*1*	*250*	51	55
Nitrate (as NO3)	mg/L	*1*	*45*	ND	1.0
Nitrite (as Nitrogen)	mg/L	*1*	*1*	ND	0.3
General Physical					
pH	Std Units			7.4	7.5
Specific Conductance (EC)	uS	*1*	*900*	850	**924**
Total Dissolved Solids	mg/L	*10*	*500*	**529**	**563**
Metals					
Arsenic (Total)	ug/L	*1*	*10*	6	5
Barium (Total)	ug/L	*10*	*1000*	52	54
Iron (Dissolved)	ug/L	*10*		41	ND
Iron (Total)	ug/L	*10*	*300*	108	144
Lithium	ug/L	*1*		28	32
Manganese (Dissolved)	ug/L	*10*		14	21
Manganese (Total)	ug/L	*10*	*50*	16	21
Molybdenum	ug/L	*1*	*1000*	7	6
Nickel	ug/L	*10*	*100*	61	58
Selenium	ug/L	*2*	*50*	3	2
Strontium (Total)	ug/L	*5*		457	444
Uranium (by ICP/MS)	ug/L	*1*	*30*	2	1
Vanadium (Total)	ug/L	*1*	*1000*	5	ND
Zinc (Total)	ug/L	*10*	*5000*	28	ND
Miscellaneous					
Ammonia-N	mg/L	*0.05*		ND	ND
Boron	mg/L	*0.05*		0.08	0.11
Chloramines	mg/L	*0.05*		ND	ND
Gross Alpha	pCi/L		*15*	2.76 +/- 1.40	3.01 +/- 2.64
Kjehldahl Nitrogen (Total)	mg/L	*0.5*		ND	0.5
Methane	ug/L	*0.1*		1.2	1.7
Nitrogen (Total)	mg/L	*0.5*		ND	1.0
o-Phosphate-P	mg/L	*0.05*		ND	ND
Phosphorous (Total)	mg/L	*0.03*		0.04	ND
Radium 226	pCi/L		*3*	0.596 +/- 0.326	0.760 +/- 0.438
Organic Analyses					
Haloacetic Acids (Total)	ug/L	*1.0*	*60.0*	1.0	0.0
Dibromoacetic Acid	*ug/L*	*1.0*		*1.0*	*ND*
Dichloroacetic Acid	*ug/L*	*1.0*		*ND*	*ND*
Monobromoacetic Acid	*ug/L*	*1.0*		*ND*	*ND*
Monochloroacetic Acid	*ug/L*	*2.0*		*ND*	*ND*
Trichloroacetic Acid	*ug/L*	*1.0*		*ND*	*ND*
Organic Carbon (Dissolved)	mg/L	*0.2*		0.8	
Organic Carbon (Total)	mg/L	*0.2*		0.7	0.6
Trihalomethanes (Total)	ug/L	*1.0*	*80.0*	4.5	0.0
Bromodichloromethane	*ug/L*	*0.5*		*1.2*	*ND*
Bromoform	*ug/L*	*0.5*		*ND*	*ND*
Chloroform	*ug/L*	*0.5*		*2.6*	*ND*
Dibromochloromethane	*ug/L*	*0.5*		*0.7*	*ND*
Field Parameters					
Temperature	^{0}C	*0.1*		21.4	25.1
Specific Conductance (EC)	uS	*1.0*	*900*	926	564
pH	Std Units	*0.1*	*6.5 - 8.5*	8.1	7.1
ORP	mV	*1.0*		-218	-262
Free Chlorine Residual	mg/L	*0.1*	*2 - 5*	ND	ND
Dissolved Oxygen	mg/L	*0.01*		1.75	0.97
Silt Density Index	Std Units	*0.1*			
Gas Volume	mL	*2.0*			
H_2S	mg/L	*0.1*		ND	0.01

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

Table 12. Summary of WY 2016 Water Quality Data – SM MW-1

Parameter	Unit	PQL	MCL	Results			
				SM MW-1			
				12/15/15	1/12/16	6/16/16	9/27/16
		Sample Description		WY 2015 Storage	WY 2016 Injection	WY 2016 Storage	
Elapsed Storage Time	Days			**301**	**0**	**73**	**176**
Volume Purged at Sampling	1,000 gals						
Major Cations							
Calcium	mg/L	*0.5*			61	45	
Magnesium	mg/L	*0.5*			14	11	
Potasium	mg/L	*0.5*			3.5	2.9	
Sodium	mg/L	*0.5*			57	45	
Major Anions							
Alkalinity, Total (as CaCO3)	mg/L	*2*			175	138	
Chloride	mg/L	*1*	*250*	161	63	32	47
Sulfate	mg/L	*1*	*250*		83	73	
Nitrate (as NO3)	mg/L	*1*	*45*		1.0	ND	
Nitrite (as Nitrogen)	mg/L	*1*	*1*		0.3	ND	
General Physical							
pH	Std Units				7.5	7.6	
Specific Conductance (EC)	uS	*1*	*900*		715	520	
Total Dissolved Solids	mg/L	*10*	*500*		446	323	
Metals							
Arsenic (Total)	ug/L	*1*	*10*		2	2	
Barium (Total)	ug/L	*10*	*1000*		37	19	
Iron (Dissolved)	ug/L	*10*			ND	ND	
Iron (Total)	ug/L	*10*	*300*		ND	ND	
Lithium	ug/L	*1*			19	8	
Manganese (Dissolved)	ug/L	*10*			ND	ND	
Manganese (Total)	ug/L	*10*	*50*		ND	ND	
Molybdenum	ug/L	*1*	*1000*		6	3	
Nickel	ug/L	*10*	*100*		ND	ND	
Selenium	ug/L	*2*	*50*		2	4	
Strontium (Total)	ug/L	*5*			226	242	
Uranium (by ICP/MS)	ug/L	*1*	*30*		2	1	
Vanadium (Total)	ug/L	*1*	*1000*		ND	ND	
Zinc (Total)	ug/L	*10*	*5000*		23	ND	
Miscellaneous							
Ammonia-N	mg/L	*0.05*			ND	ND	
Boron	mg/L	*0.05*			0.06	ND	
Chloramines	mg/L	*0.05*		ND	ND	ND	ND
Gross Alpha	pCi/L		*15*		2.53 +/- 1.27	0.924 +/- 1.32	
Kjehldahl Nitrogen (Total)	mg/L	*0.5*			ND	ND	
Methane	ug/L	*0.1*			1.0	0.57	
Nitrogen (Total)	mg/L	*0.5*			0.5	ND	
o-Phosphate-P	mg/L	*0.05*			ND	ND	
Phosphorous (Total)	mg/L	*0.03*			0.05	0.04	
Radium 226	pCi/L		*3*		0.000 +/- 0.393	0.000 +/- 0.389	
Organic Analyses							
Haloacetic Acids (Total)	ug/L	*1.0*	*60.0*	0.0	0.0	0.0	0.0
Dibromoacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*ND*	*ND*
Dichloroacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*ND*	*ND*
Monobromoacetic Acid	*ug/L*	*1.0*		*ND*	*ND*	*ND*	*ND*
Monochloroacetic Acid	*ug/L*	*2.0*		*ND*	*ND*	*ND*	*ND*
Trichloroacetic Acid	*ug/L*	*1.0*		ND	ND	ND	ND
Organic Carbon (Dissolved)	mg/L	*0.2*			1.0	1.3	
Organic Carbon (Total)	mg/L	*0.2*			0.9	1.1	
Trihalomethanes (Total)	ug/L	*1.0*	*80.0*	0.0	58.8	**82.1**	1.9
Bromodichloromethane	*ug/L*	*0.5*		*ND*	*15*	*15.9*	***0.7***
Bromoform	*ug/L*	*0.5*		*ND*	*ND*	*0.7*	*ND*
Chloroform	*ug/L*	*0.5*		*ND*	*41*	*58.8*	*1.2*
Dibromochloromethane	*ug/L*	*0.5*		*ND*	*2.8*	*6.7*	*ND*
Field Parameters							
Temperature	^{0}C	*0.1*		17.4	18.1	19.6	18.9
Specific Conductance (EC)	uS	*1.0*	*900*	975	967	473	519
pH	Std Units	*0.1*	*6.5 - 8.5*	7.3	7.3	7.8	6.45
ORP	mV	*1.0*		-212	-210	-151	-243
Free Chlorine Residual	mg/L	*0.1*	*2 - 5*	ND	ND	0.15	ND
Dissolved Oxygen	mg/L	*0.01*		ND	ND	2.72	0.38
Silt Density Index	Std Units	*0.1*					
Gas Volume	mL	*2.0*					
H_2S	mg/L	*0.1*		0.07	0.04		0.01

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

Table 13. Summary of WY 2016 Water Quality Data – SMS Deep

Parameter	Unit	PQL	MCL	Results		
				SMS Deep		
				12/16/15	2/19/16	6/16/16
		Sample Description		WY 2015 Storage	WY 2016 Injection	WY 2016 Storage
Elapsed Storage Time	Days			**302**	**0**	**73**
Volume Purged at Sampling	1,000 gals					
Major Cations						
Calcium	mg/L	0.5			46	43
Magnesium	mg/L	0.5			11	11
Potasium	mg/L	0.5			2.8	2.8
Sodium	mg/L	0.5			45	41
Major Anions						
Alkalinity, Total (as CaCO3)	mg/L	2			142	134
Chloride	mg/L	1	250	123	31	29
Sulfate	mg/L	1	250		81	70
Nitrate (as NO3)	mg/L	1	45		1.0	ND
Nitrite (as Nitrogen)	mg/L	1	1		0.3	ND
General Physical						
pH	Std Units				7.6	7.6
Specific Conductance (EC)	uS	1	900		554	501
Total Dissolved Solids	mg/L	10	500		366	328
Metals						
Arsenic (Total)	ug/L	1	10		16	12
Barium (Total)	ug/L	10	1000		31	35
Iron (Dissolved)	ug/L	10			ND	ND
Iron (Total)	ug/L	10	300		ND	ND
Lithium	ug/L	1			6	7
Manganese (Dissolved)	ug/L	10			ND	ND
Manganese (Total)	ug/L	10	50		ND	ND
Molybdenum	ug/L	1	1000		39	43
Nickel	ug/L	10	100		ND	ND
Selenium	ug/L	2	50		12	13
Strontium (Total)	ug/L	5			287	267
Uranium (by ICP/MS)	ug/L	1	30		2	2
Vanadium (Total)	ug/L	1	1000		ND	ND
Zinc (Total)	ug/L	10	5000		ND	ND
Miscellaneous						
Ammonia-N	mg/L	0.05			ND	ND
Boron	mg/L	0.05			ND	ND
Chloramines	mg/L	0.05		ND	ND	ND
Gross Alpha	pCi/L		15		1.97 +/- 1.64	1.20 +/- 1.32
Kjehldahl Nitrogen (Total)	mg/L	0.5			ND	ND
Methane	ug/L	0.1			0.52	0.55
Nitrogen (Total)	mg/L	0.5			0.5	ND
o-Phosphate-P	mg/L	0.05			ND	0.2
Phosphorous (Total)	mg/L	0.03			0.12	0.2
Radium 226	pCi/L		3		0.067 +/- 0.228	0.000 +/- 0.316
Organic Analyses						
Haloacetic Acids (Total)	ug/L	1.0	60.0	0.0	17.4	9.0
Dibromoacetic Acid	ug/L	1.0		*ND*	*1.1*	*1*
Dichloroacetic Acid	ug/L	1.0		*ND*	*4.3*	*2*
Monobromoacetic Acid	ug/L	1.0		*ND*	*ND*	*ND*
Monochloroacetic Acid	ug/L	2.0		*ND*	*ND*	*ND*
Trichloroacetic Acid	ug/L	1.0		*ND*	12	6
Organic Carbon (Dissolved)	mg/L	0.2			1.1	1.4
Organic Carbon (Total)	mg/L	0.2			1.4	1.4
Trihalomethanes (Total)	ug/L	1.0	80.0	0.0	**104.5**	**84.2**
Bromodichloromethane	ug/L	0.5		*ND*	*31*	*19.6*
Bromoform	ug/L	0.5		*ND*	*1.5*	*1.0*
Chloroform	ug/L	0.5		*ND*	*57*	*54.4*
Dibromochloromethane	ug/L	0.5		*ND*	*15*	*9.2*
Field Parameters						
Temperature	^{0} C	0.1		19.7	18.5	19.7
Specific Conductance (EC)	uS	1.0	900	775	511	470
pH	Std Units	0.1	6.5 - 8.5	7.4	7.1	7.7
ORP	mV	1.0		-142	+2.4	-149
Free Chlorine Residual	mg/L	0.1	2 - 5	ND	0.04	0.09
Dissolved Oxygen	mg/L	0.01		ND		2.76
Silt Density Index	Std Units	0.1				
Gas Volume	mL	2.0				
H_2S	mg/L	0.1		0.04	ND	

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

Table 14. Summary of WY 2016 Water Quality Data – Off-Site Monitoring Wells

Parameter	Unit	PQL	MCL	PCA-E Deep	Paralta	
				7/26/16	11/12/15	4/26/16
			Sample Description	WY 2016 Storage	WY 2015 Storage	WY 2016 Storage
Volume Pumped at Sampling	1,000 gals					
Major Cations						
Calcium	mg/L	0.5		38		32
Magnesium	mg/L	0.5		8		10
Potasium	mg/L	0.5		3.4		5
Sodium	mg/L	0.5		72		55
Major Anions						
Alkalinity, Total (as CaCO3)	mg/L	2		148		95
Chloride	mg/L	1	250	82		68
Sulfate	mg/L	1	250	22		41
Nitrate (as NO3)	mg/L	1	45	ND		0.8
Nitrite (as Nitrogen)	mg/L	1	1	ND		0.1
General Physical						
pH	Std Units			7.4		7.8
Specific Conductance (EC)	uS	1	900	587		551
Total Dissolved Solids	mg/L	10	500	358		
Metals						
Arsenic (Total)	ug/L	1	10	6		3
Barium (Total)	ug/L	10	1000	59		100
Iron (Dissolved)	ug/L	10		ND		
Iron (Total)	ug/L	10	300	17		100
Lithium	ug/L	1		22		
Manganese (Dissolved)	ug/L	10		ND		
Manganese (Total)	ug/L	10	50	ND		20
Molybdenum	ug/L	1	1000	10		
Nickel	ug/L	10	100	36		10
Selenium	ug/L	2	50	ND		5
Strontium (Total)	ug/L	5		200		
Uranium (by ICP/MS)	ug/L	1	30	ND		
Vanadium (Total)	ug/L	1	1000	ND		
Zinc (Total)	ug/L	10	5000	24		50
Miscellaneous						
Ammonia-N	mg/L	0.05		ND		
Boron	mg/L	0.05		0.06		100
Chloramines	mg/L	0.05		ND		
Gross Alpha	pCi/L		15	1.27 +/- 1.54		
Kjehldahl Nitrogen (Total)	mg/L	0.5		ND		
Methane	ug/L	0.1		0.19		
Nitrogen (Total)	mg/L	0.5		ND		
o-Phosphate-P	mg/L	0.05		ND		
Phosphorous (Total)	mg/L	0.03		0.05		
Radium 226	pCi/L		3	0.035 +/- 0.470		
Organic Analyses						
Haloacetic Acids (Total)	ug/L	1.0	60.0	1.0		
Dibromoacetic Acid	*ug/L*	1.0		*1*		
Dichloroacetic Acid	*ug/L*	1.0		*ND*		
Monobromoacetic Acid	*ug/L*	1.0		*ND*		
Monochloroacetic Acid	*ug/L*	2.0		*ND*		
Trichloroacetic Acid	*ug/L*	1.0		*ND*		
Organic Carbon (Dissolved)	mg/L	0.2		0.5		
Organic Carbon (Total)	mg/L	0.2		0.4		
Trihalomethanes (Total)	ug/L	1.0	80.0	0.0	4.7	8.0
Bromodichloromethane	*ug/L*	0.5		*ND*	*1.0*	*1.6*
Bromoform	*ug/L*	0.5		*ND*	*1.0*	*1.0*
Chloroform	*ug/L*	0.5		*ND*	*1.7*	*4.4*
Dibromochloromethane	*ug/L*	0.5		*ND*	*1.0*	*1.0*
Field Parameters						
Temperature	^{0} C	0.1				
Specific Conductance (EC)	uS	1.0	900			
pH	Std Units	0.1	6.5 - 8.5			
ORP	mV	1.0				
Free Chlorine Residual	mg/L	0.1	2 - 5			
Dissolved Oxygen	mg/L	0.01				
Silt Density Index	Std Units	0.1				
Gas Volume	mL	2.0				
H_2S	mg/L	0.1				

Notes:
Constituents exceeding MCLs denoted in **BOLD** type

CONCLUSIONS

Based on the findings developed from operation of Monterey Peninsula ASR Project during WY 2016, we conclude the following:

WY 2016 Recharge Operations

WY 2016 was classified as a Normal Water Year on the Monterey Peninsula and a total volume of 699 af of water was recharged into the Seaside Groundwater Basin at the Santa Margarita and Seaside Middle Schools ASR Facilities during the WY 2016 injection season.

ASR Well Performance

ASR-1. Pertinent well performance conclusions for ASR-1 during WY 2016 are summarized below:

- Injection Rates: Ranged between approximately 145 to 1,615 gpm, averaging approximately 1,000 gpm.

- Water Levels: Generally maintained greater than 270 ft. bgs with 15 ft. of available "freeboard" remaining below the maximum recommended drawup level.

- Specific Injectivity: Although there are no initial specific injectivity data for WY 2016, the ending specific injectivity was approximately 32 gpm/ft, which is slightly great than the ending value in WY 2015 of approximately 25 gpm/ft.

- Residual Plugging: Approximately 29 feet of residual plugging occurred.

- General Conclusions: ASR-1 performed well during WY 2016; however, the well did experience a moderate level residual plugging. The negative trend in performance at injection rates ranging up to 1,600 gpm suggests the injection rate at this well should be maintained at or below the design rate of 1,500 gpm in WY 2017 and the triple-backflush procedure should be implemented to limit residual plugging.

ASR-2. Pertinent well performance conclusions for ASR-2 during WY 2016 are summarized below:

- Injection Rates: Ranged between approximately 1,025 to 2,160 gpm, averaging approximately 1,510 gpm.

- Water Levels: Generally maintained greater than 270 ft. bgs with 20 ft. of available "freeboard" remaining below the maximum recommended drawup level.

- Specific Injectivity: Ranged between approximately 25 to 36 gpm/ft with an overall negative trend in 24-hr specific injectivity.

- Residual Plugging: Approximately 33 feet of residual plugging occurred.

- General Conclusions: ASR-2 performed well during WY 2016; however, the well did experience a moderate level residual plugging. The negative trend in performance at injection rates ranging up to 2,160 gpm suggests the injection rate at this well should be maintained at or below the design rate of 1,500 gpm in WY 2017 and the triple-backflush procedure should be implemented to limit residual plugging.

ASR-3. Pertinent well performance conclusions for ASR-3 during WY 2016 are summarized below:

- Injection Rates: Ranged between approximately 700 to 1,010 gpm, averaging approximately 885 gpm.

- Water Levels: Generally maintained greater than 240 ft bgs with 60 ft of available “freeboard” remaining below the maximum recommended drawup level.

- Specific Injectivity: Ranged between approximately 11 to 12 gpm/ft and overall stable trend in 24-hr specific injectivity.

- Residual Plugging: Approximately 30 feet of residual plugging occurred.

- General Conclusions: ASR-3 performance appeared to be relatively stable compared to the significant declines observed in WY 2012. The pattern of relative performance stabilization followed by the initial significant decline in well performance observed at ASR-3 is very similar to the pattern observed at both ASR-1 and ASR-2 when they were initially brought on-line. The stable performance at injection rates ranging between 700 to 1,010 gpm suggests the injection rate should be maintained at or below 1,000 gpm to maintain performance.

ASR-4. Injection at ASR-4 during WY 2016 was limited to five days of well “conditioning”. This conditioning was a continuation of similar efforts performed over the course of three days in WY 2015, and consisted of initial injection at relatively low rates and durations, being incrementally increased following thorough backflushing and upon confirmation that well performance was being maintained. The conditioning was performed in an effort to limit the amount of residual plugging that has historically been observed at all three previous ASR wells following their initial injection operations. Injection rates ranging between approximately 250 gpm up to the design rate of 1,500 gpm for durations up to 2 hours were achieved during WY

2016 without a measurable loss in performance. Based on these results, a baseline injection testing program should be implemented in WY 2017.

Water Quality

Significant conclusions regarding the water-quality investigation during WY 2016 include the following:

- Consistent with previous observations, no significant ion exchange, acid-base, or precipitation reactions were observed at the ASR sites.
- THMs at the ASR sites showed characteristic and significant initial "ingrowth" that peaked at approximately 60 to 120 days after the cessation of injection, followed by a gradual decline over the remainder of the WY 2016 Storage Period.
- HAAs showed little "ingrowth" following the cessation of injection and degraded completely during aquifer storage.
- Although there appears to be a correlative relationship between Hg and Turbidity at ASR-1, the exact nature and source of observed Hg exceedances are still unknown. Developing a more complete understanding of the geochemical mechanism(s) responsible for Hg-occurrence will be subject to additional investigation in WY 2017.

RECOMMENDATIONS

Based on the WY 2016 ASR program results and our experience with similar ASR projects, we offer the following recommendations for continued and future operations of the Monterey Peninsula ASR Project wells:

ASR-1 Well Operational Parameters

- Injection Rate: Based on the amount of residual plugging that occurred during WY 2016 with the well injecting up to 1,615 gpm, we recommend the injection rate be limited to approximately **1,500 gpm** in order to limit residual plugging and maintain long-term performance.
- Water-Level Drawup: Under the present local water-level conditions, the amount of water-level drawup should be limited to approximately 100 feet. This amount of water-level drawup during injection equals the typical available drawdown in the well for backflushing. This helps to avoid over-pressurization and compression of plugging materials, thereby maximizing the efficiency of backflushing and limiting the amount of residual plugging.
- Backflushing Frequency: During the recharge season, routine backflushing should continue to be performed on an approximate weekly basis, or when the amount of water-level drawup in the casing reaches approximately 100 feet, whichever occurs first. Backflushing should consist of the triple-flush procedure discussed above.

ASR-2 Well Operational Parameters

- Injection Rate: Based on the amount of residual plugging that occurred during WY 2016 with the well injecting up to 2,160 gpm, we recommend the injection rate be limited to the design rate of approximately **1,500 gpm** in order to limit residual plugging and maintain long-term performance.
- Water-Level Drawup: Under the present local water-level conditions, the amount of water-level drawup should be limited to approximately 130 feet, which is equal to the typical amount of available drawdown in the well for backflushing. Again, this helps to avoid over-pressurization and compression of plugging materials and limiting the amount of residual plugging.
- Backflushing Frequency: During the recharge season, routine backflushing should continue to be performed on an approximate weekly basis, or when the amount of water-level drawup in the casing reaches approximately 130 feet, whichever occurs first. Backflushing should consist of the triple-flush procedure discussed above.

ASR-3 Well Operational Parameters

- Injection Rate: Based on the amount of residual plugging that occurred during WY 2016 with the well injecting up to 1,010 gpm, we recommend the injection rate continue to be limited to **1,000 gpm** in order to limit residual plugging and maintain long-term performance.
- Water-Level Drawup: Under the present local water-level conditions, the amount of water-level drawup should be limited to approximately 170 feet, which is equal to the typical amount of available drawdown in the well for backflushing. Again, this helps to avoid over-pressurization and compression of plugging materials and limiting the amount of residual plugging.
- Backflushing Frequency: During the recharge season, routine backflushing should continue to be performed on an approximate weekly basis, or when the amount of water-level drawup in the casing reaches approximately 170 feet, whichever occurs first. Backflushing should consist of the triple-flush procedure discussed above.

ASR-3 should undergo formal rehabilitation to improve well performance and injection capacity, similar to that performed at SM ASR-1 and SM ASR-2. It is believed that following rehabilitation, the well will be able to operate at its design injection rate of 1,500 gpm (i.e., 50 percent greater than the current capacity of 1,000 gpm).

SMS ASR-4 Well Startup Conditioning and Baseline Injection Testing

"Conditioning" of ASR-4 was completed in WY 2016. A baseline injection testing program should be implemented in WY 2017 that includes the following tests:

1. 8-hr variable rate injection test;
2. 24-hr constant rate injection test;
3. 7-day constant rate injection test;
4. Backflushing between each of the above injection tests, and;
5. Post-injection production performance testing.

At the conclusion of the baseline injection testing program, recommendations for the long-term injection operations of ASR-4 can then be provided.

CLOSURE

This report has been prepared exclusively for the Monterey Peninsula Water Management District for the specific application to the ASR Project on the Monterey Peninsula. The findings and conclusions presented herein were prepared in accordance with generally accepted hydrogeologic and engineering practices. No other warranty, express or implied, is made.

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FIGURES

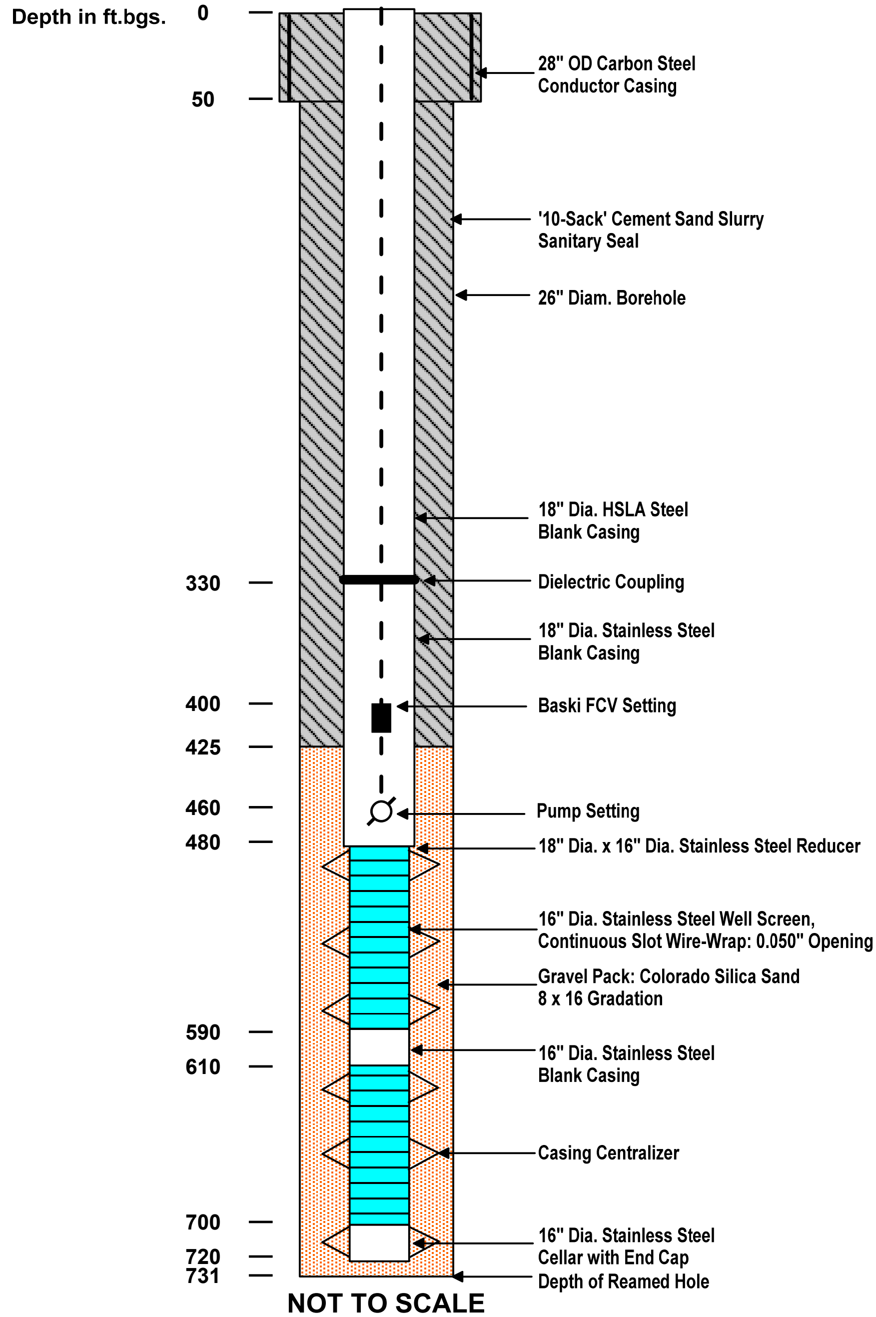
June 2017
Project No. 12-0046

PUEBLO water resources

N
W E
S

Feet
0 1,000 2,000

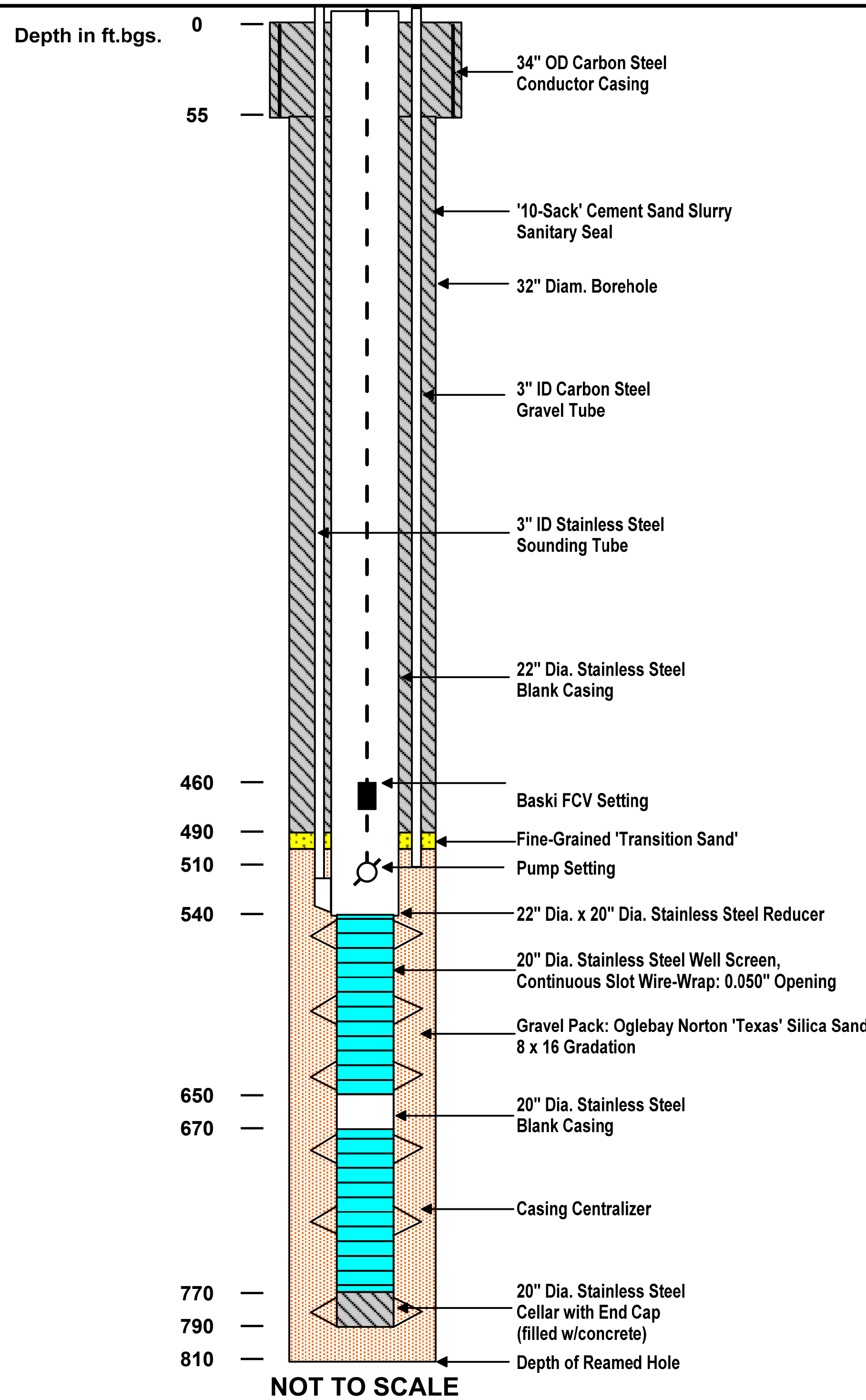
FIGURE 1. SITE LOCATION MAP
WY 2016 ASR Program
Monterey Peninsula Water Management District



Pump Assembly Notes:
Hp: 600
Bowls: 16ENL, 7 stage
Col. Pipe Dia: 12"
Col. Pipe Length: 20'
Assy. Type: Water Lube/Open Shaft
Baski FCV Setting: 400' - 410'
Top of Bowls: 460'
Bowl Length: 10.5'
Suction Length: 10'
Intake: 480.5'

PUEBLO water resources

FIGURE 2. ASR-1 AS-BUILT SCHEMATIC
WY 2016 ASR Program
Monterey Peninsula Water Management District

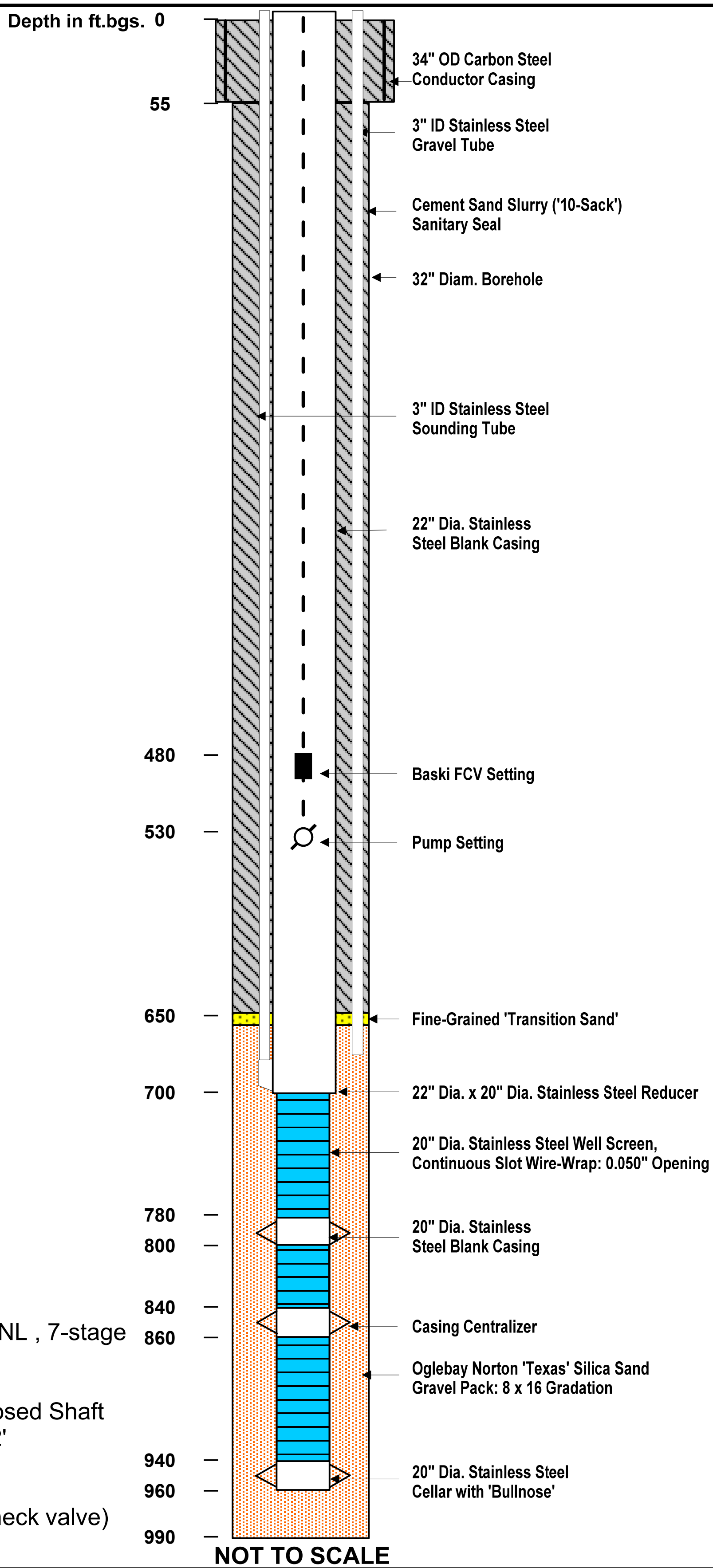


<u>Pump Assembly Notes:</u>
Hp: 600
Bowls: 16ENL, 7 stage
Col. Pipe Dia: 12"
Col. Pipe Length: 20'
Assy. Type: Water Flush/Enclosed Shaft
Baski FCV Setting: 460' - 470'
Top of Bowls: 510'
Bowl Length: 10.5'
Suction Length: 10'
Intake: 530.5'

PUEBLO water resources

FIGURE 3. ASR-2 AS-BUILT SCHEMATIC
WY 2016 ASR Program
Monterey Peninsula Water Management District

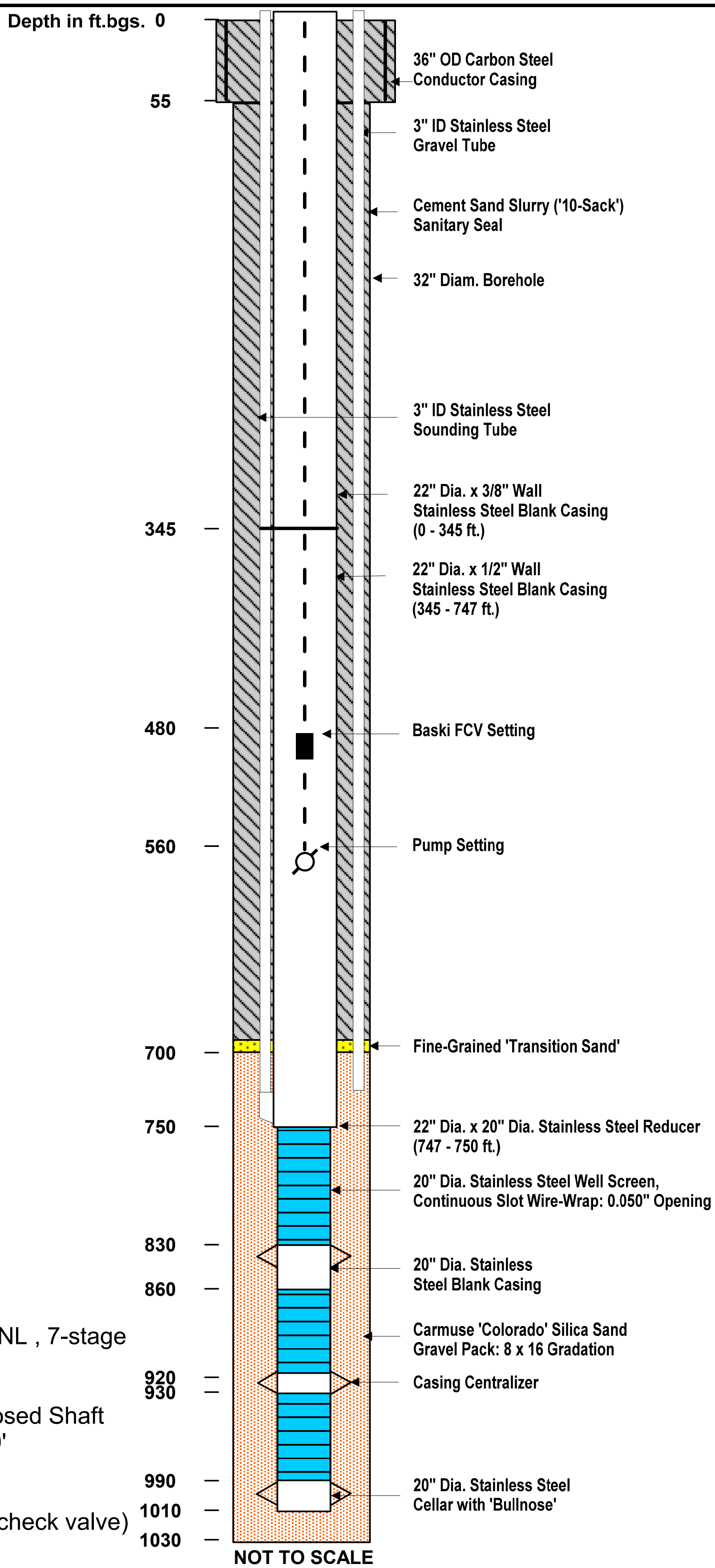
June 2017
Project No. 12-0046



Pump Assembly Notes:
Hp: 600
Bowls: Flowserve Model 16 ENL , 7-stage
Col. Pipe Dia: 12"
Col. Pipe Length: 20'
Assy. Type: Water Flush/Enclosed Shaft
Baski FCV Setting: 482' to 492'
Top of Bowls: 532'
Bowl Length: 10.5'
Suction Length: 8'(including check valve)
Intake: 550.5'

PUEBLO water resources

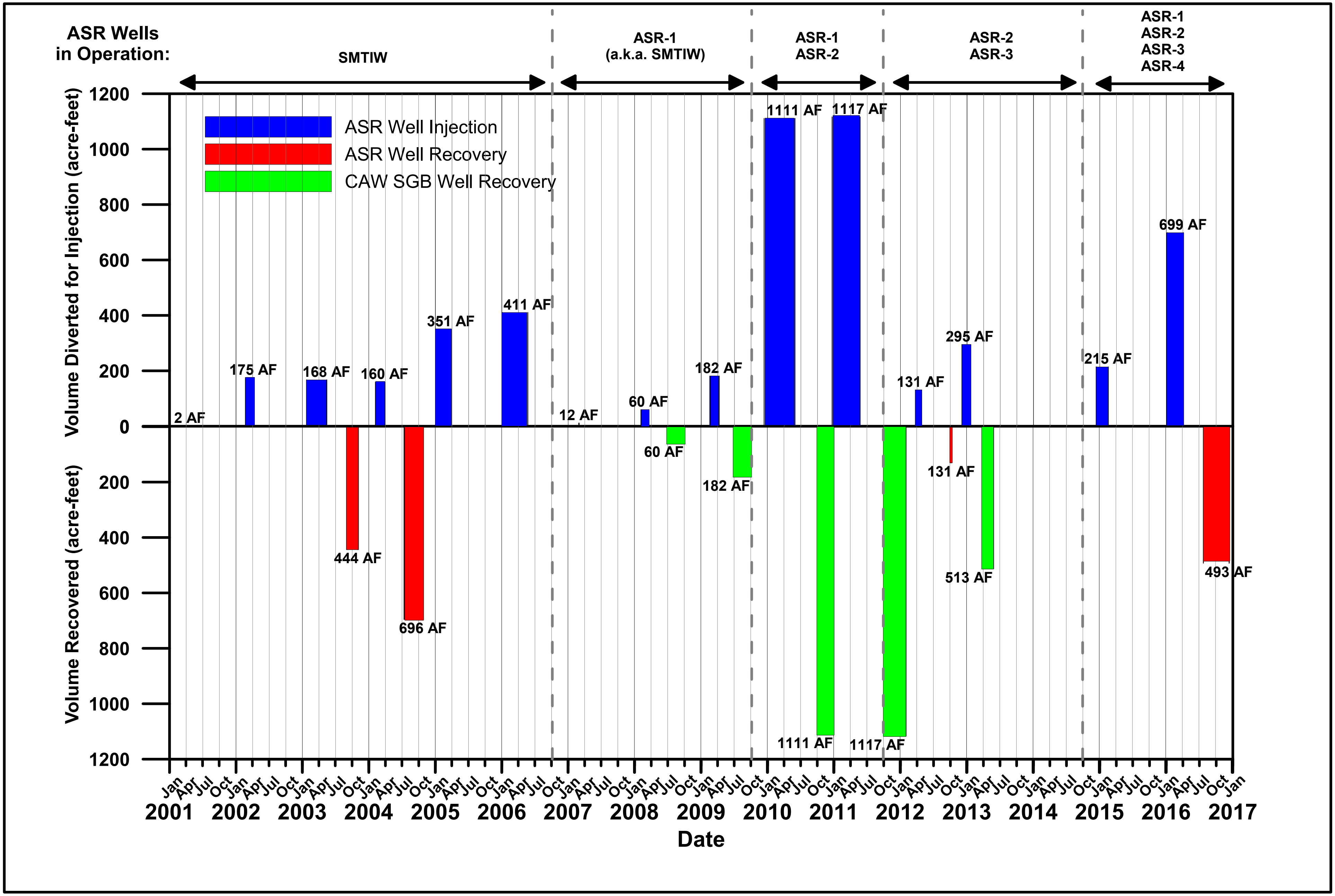
FIGURE 4. ASR-3 AS-BUILT SCHEMATIC
WY 2016 ASR Program
Monterey Peninsula Water Management District



Pump Assembly Notes:
Hp: 600
Bowls: Flowserve Model 16 ENL , 7-stage
Col. Pipe Dia: 12"
Col. Pipe Length: 20'
Assy. Type: Water Flush/Enclosed Shaft
Baski FCV Setting: 480' to 490'
Top of Bowls: 562'
Bowl Length: 10.4'
Suction Length: 10' (including check valve)
Intake: 582.4'

FIGURE 5. ASR-4 AS-BUILT SCHEMATIC
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046



PUEBLO water resources

FIGURE 6. SUMMARY OF ASR OPERATIONS (WY 2001 - WY 2016)
WY 2016 ASR Program
Monterey Peninsula Water Management District

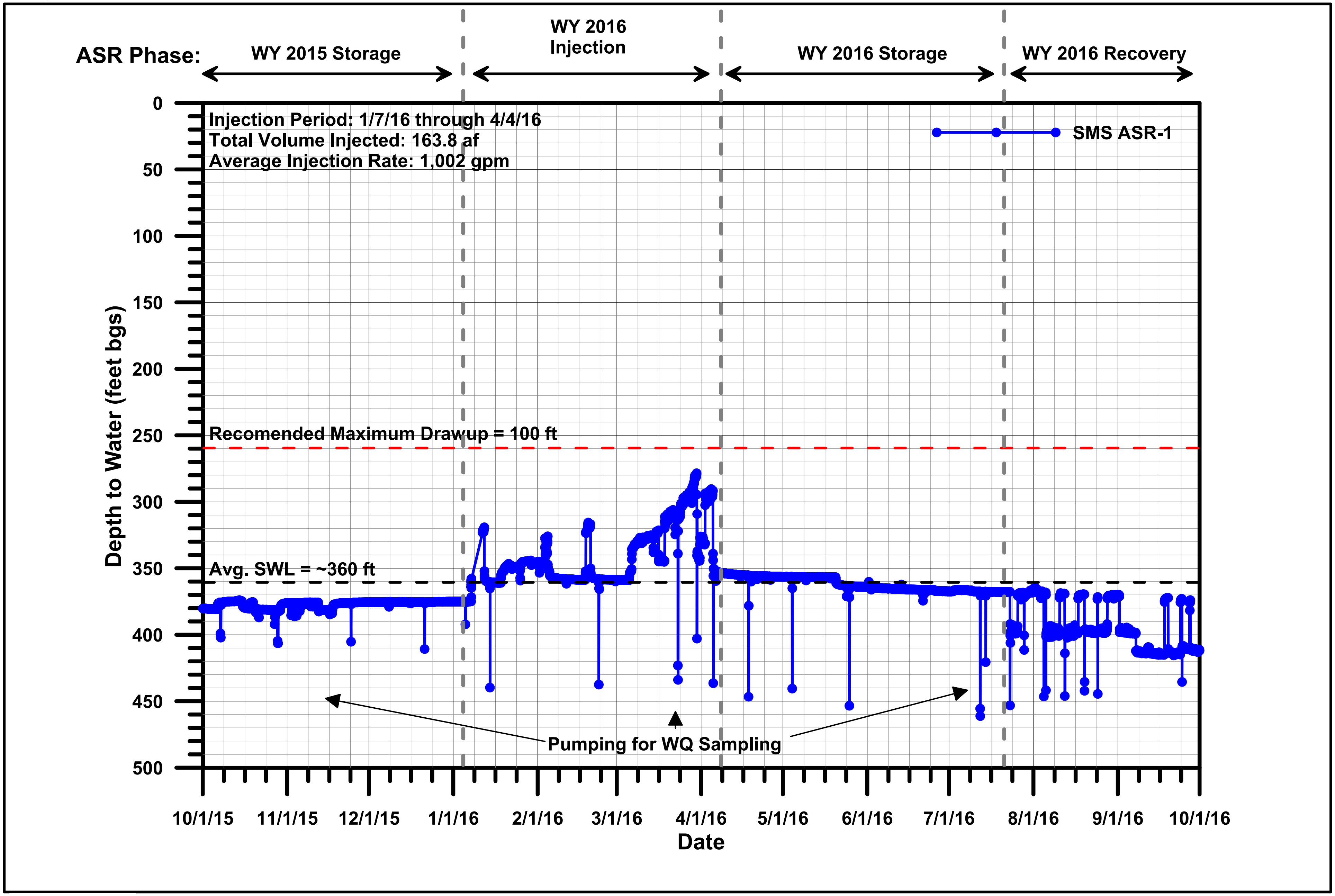


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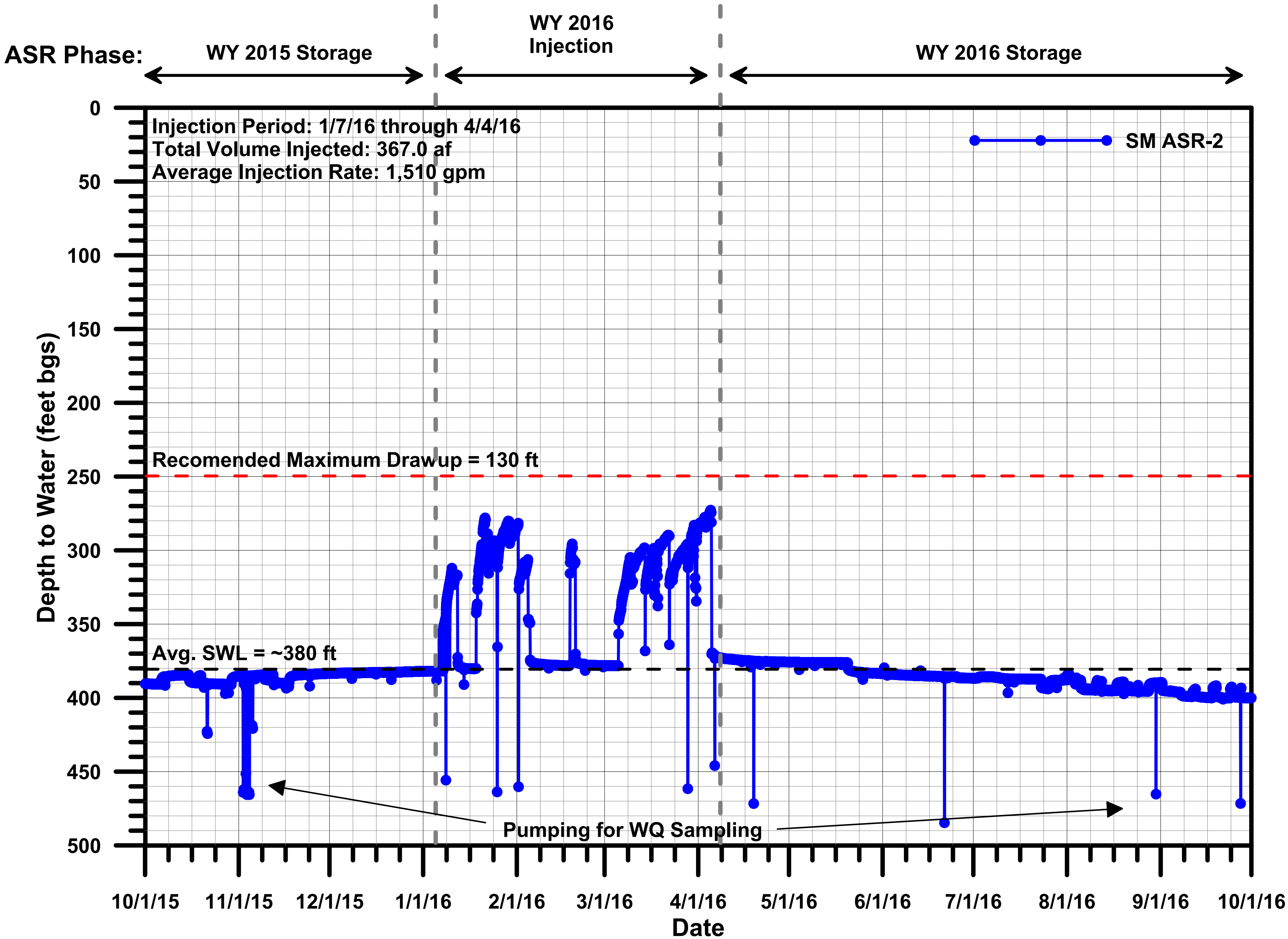
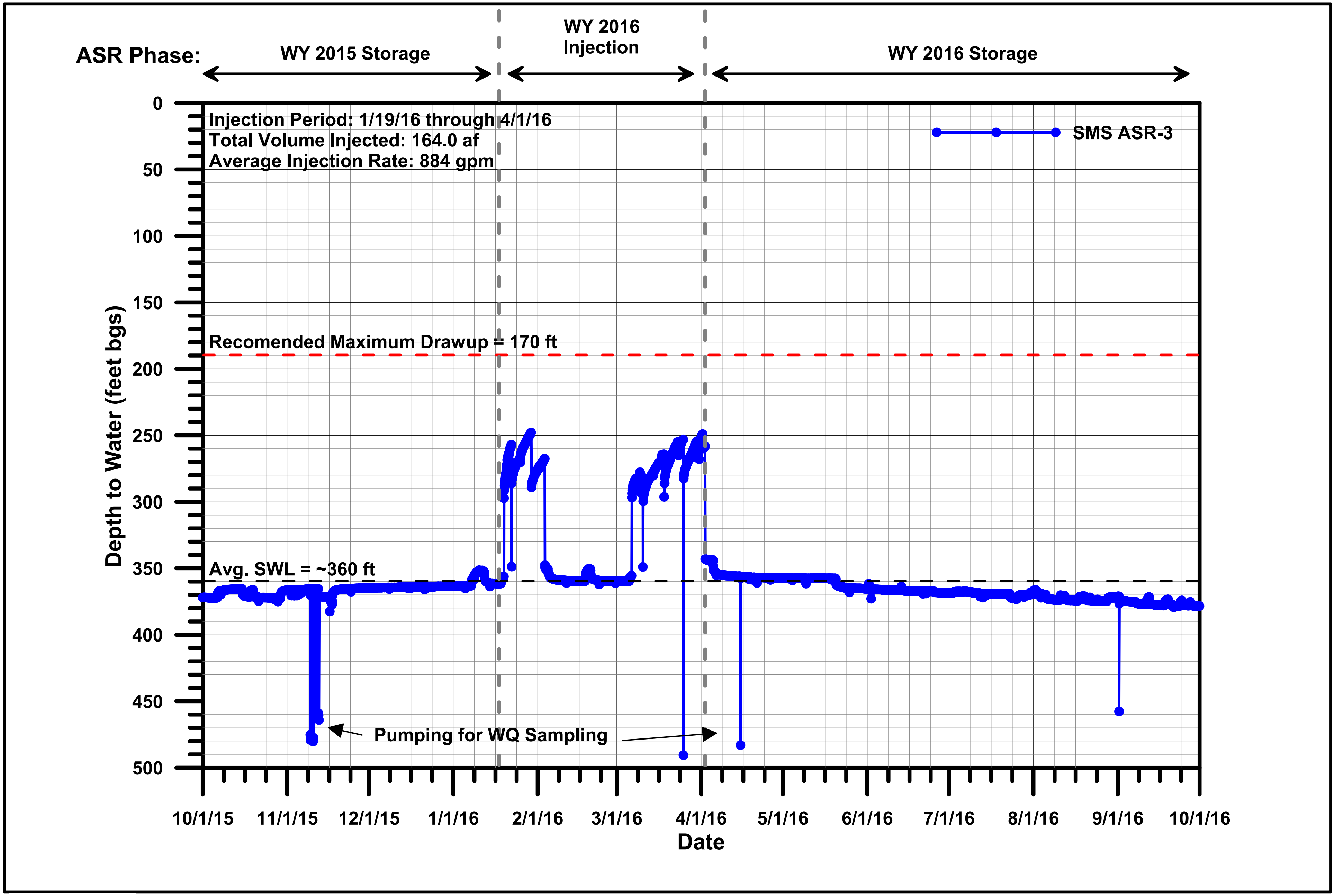
FIGURE 7. ASR-1 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046



PUEBLO water resources

FIGURE 8. ASR-2 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District



PUEBLO water resources

FIGURE 9. ASR-3 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046

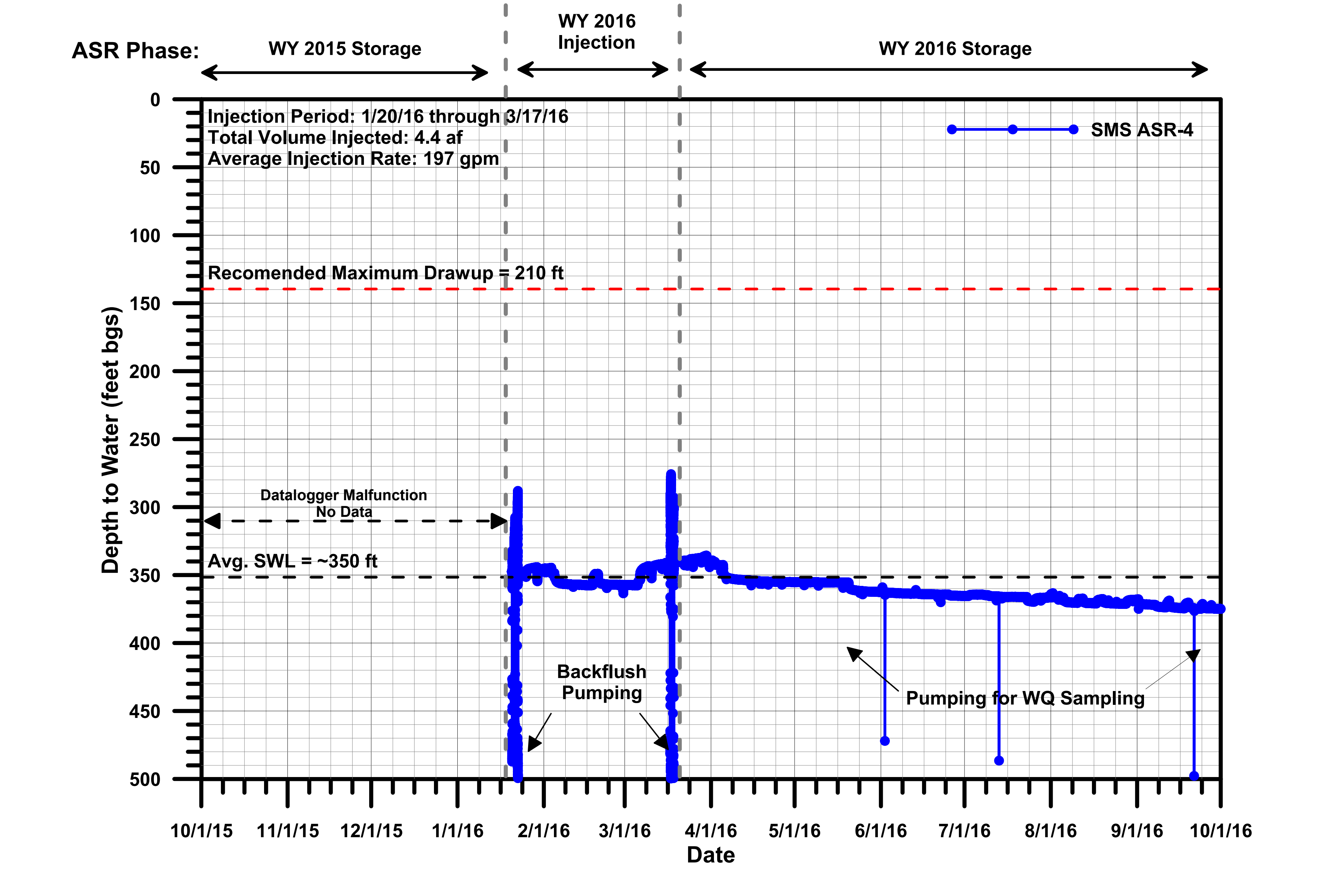


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FIGURE 10. ASR-4 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046

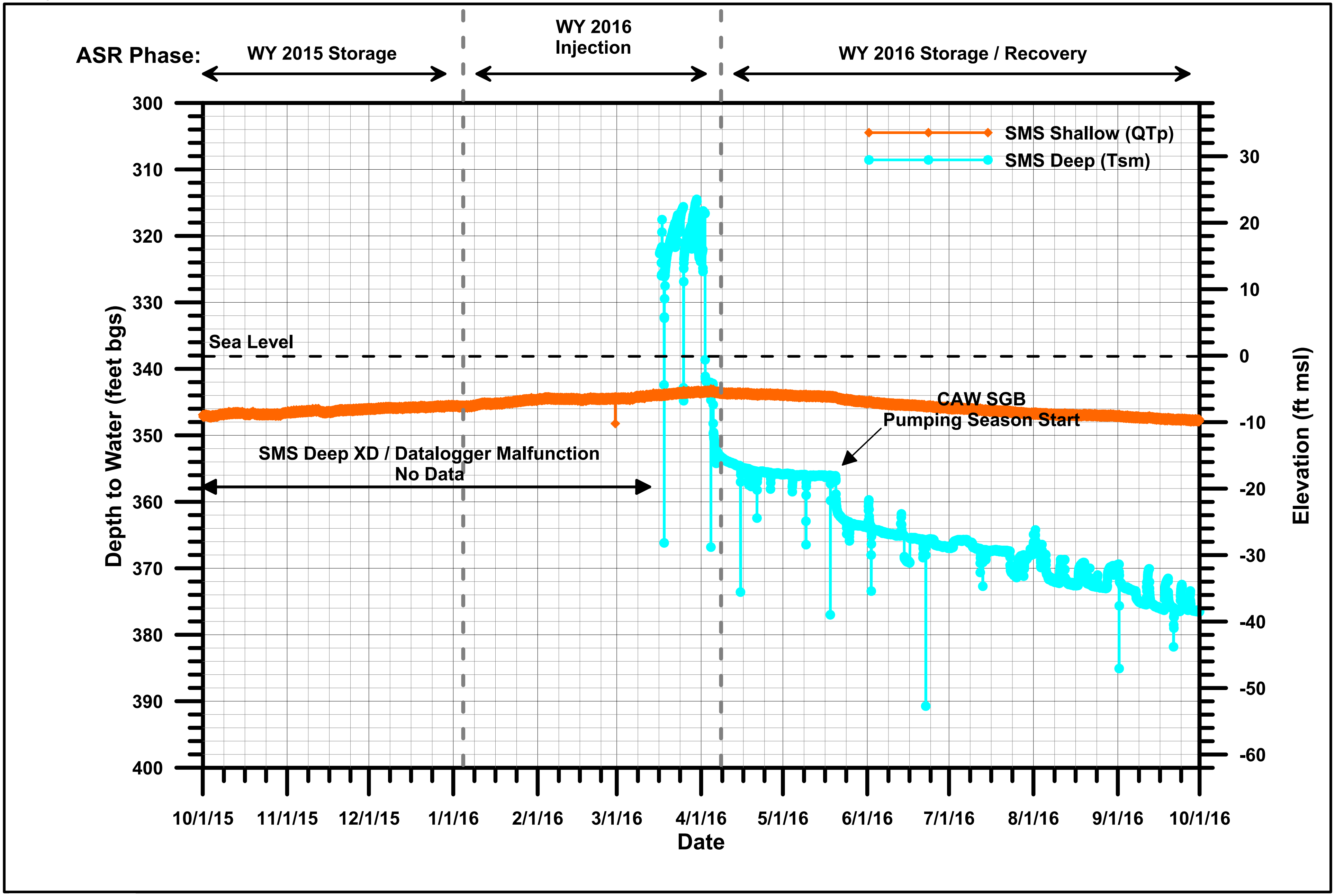

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FIGURE 11. SMS MW WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046

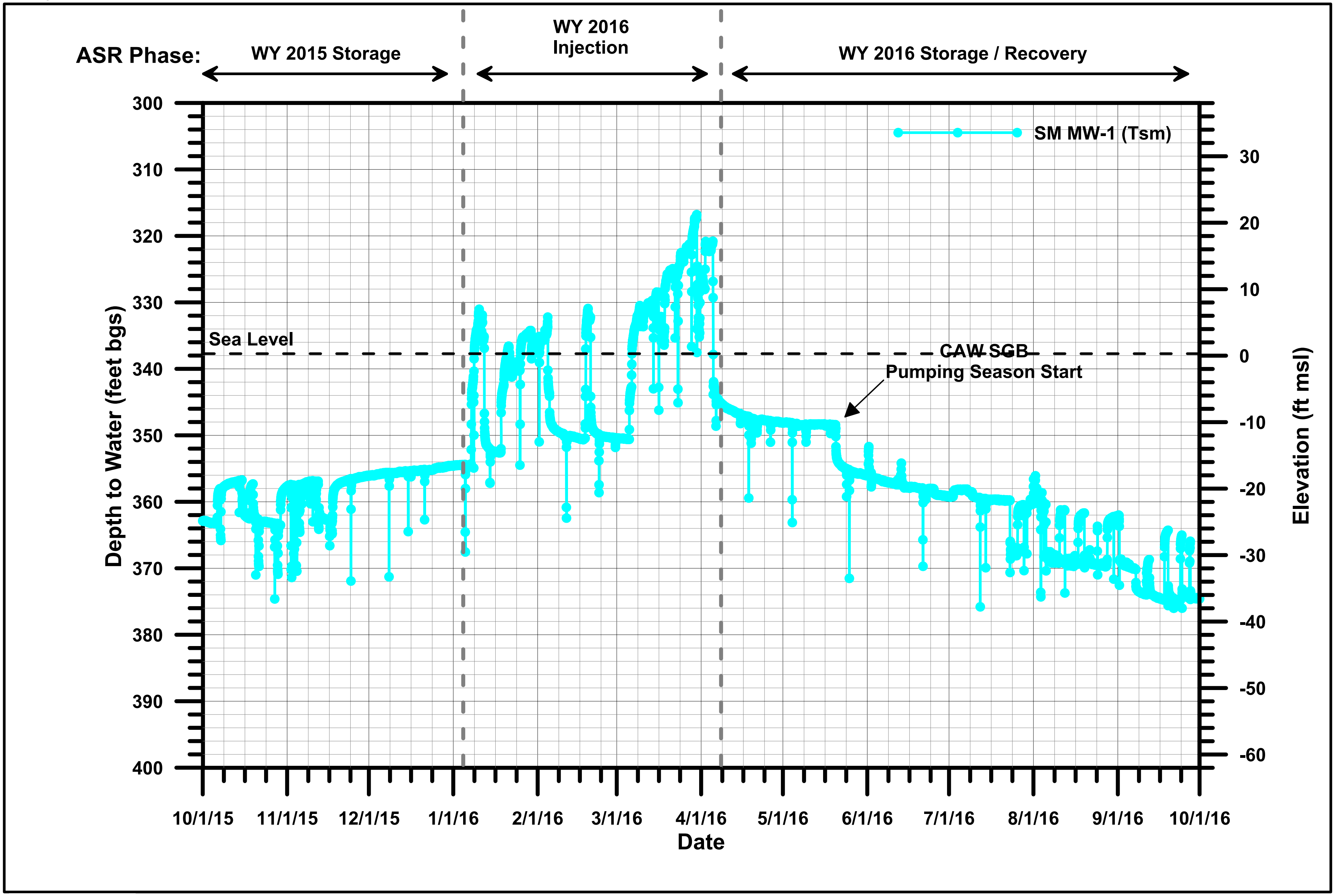

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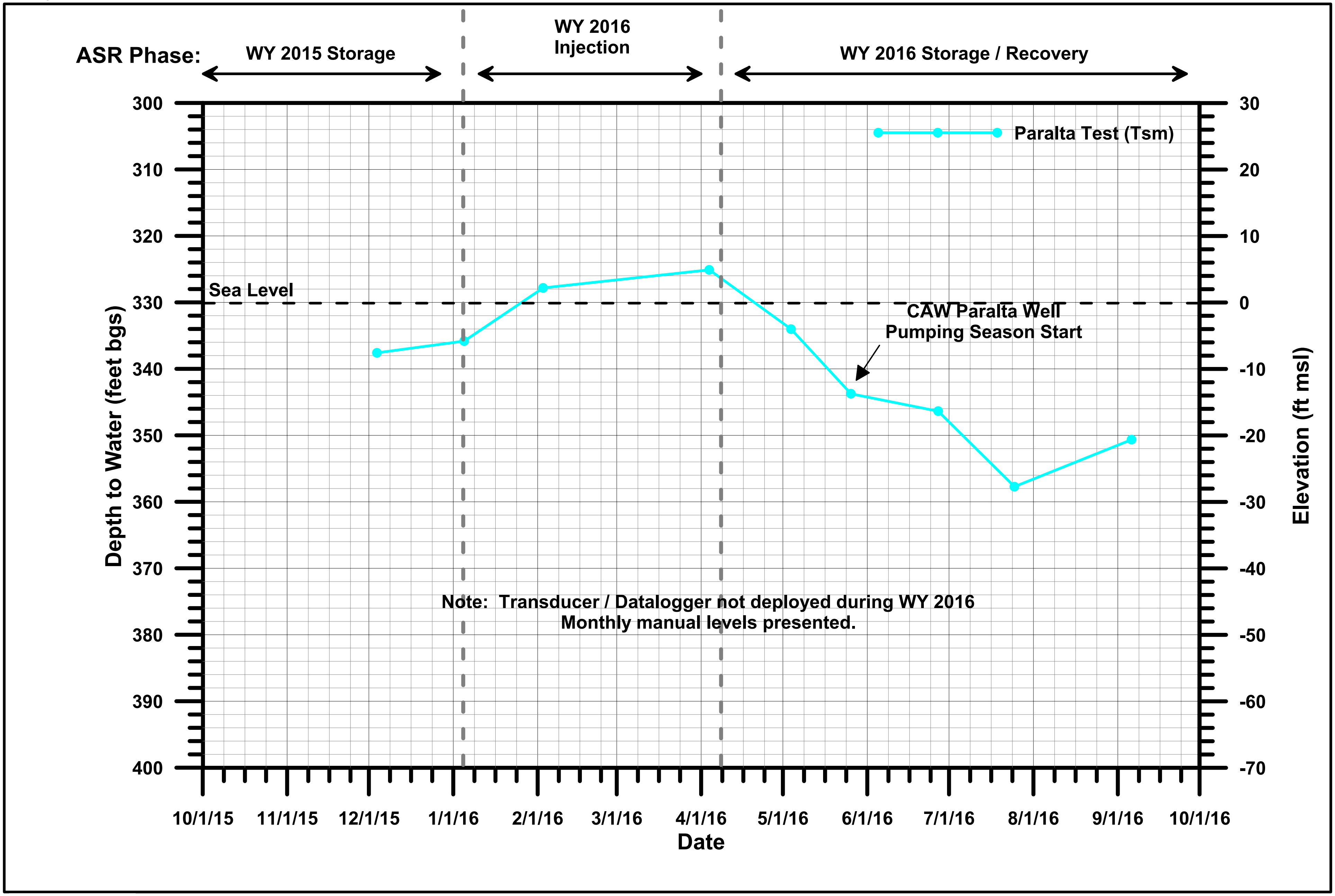
FIGURE 12. SM MW-1 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District



PUEBLO water resources

FIGURE 13. PARALTA TEST WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046

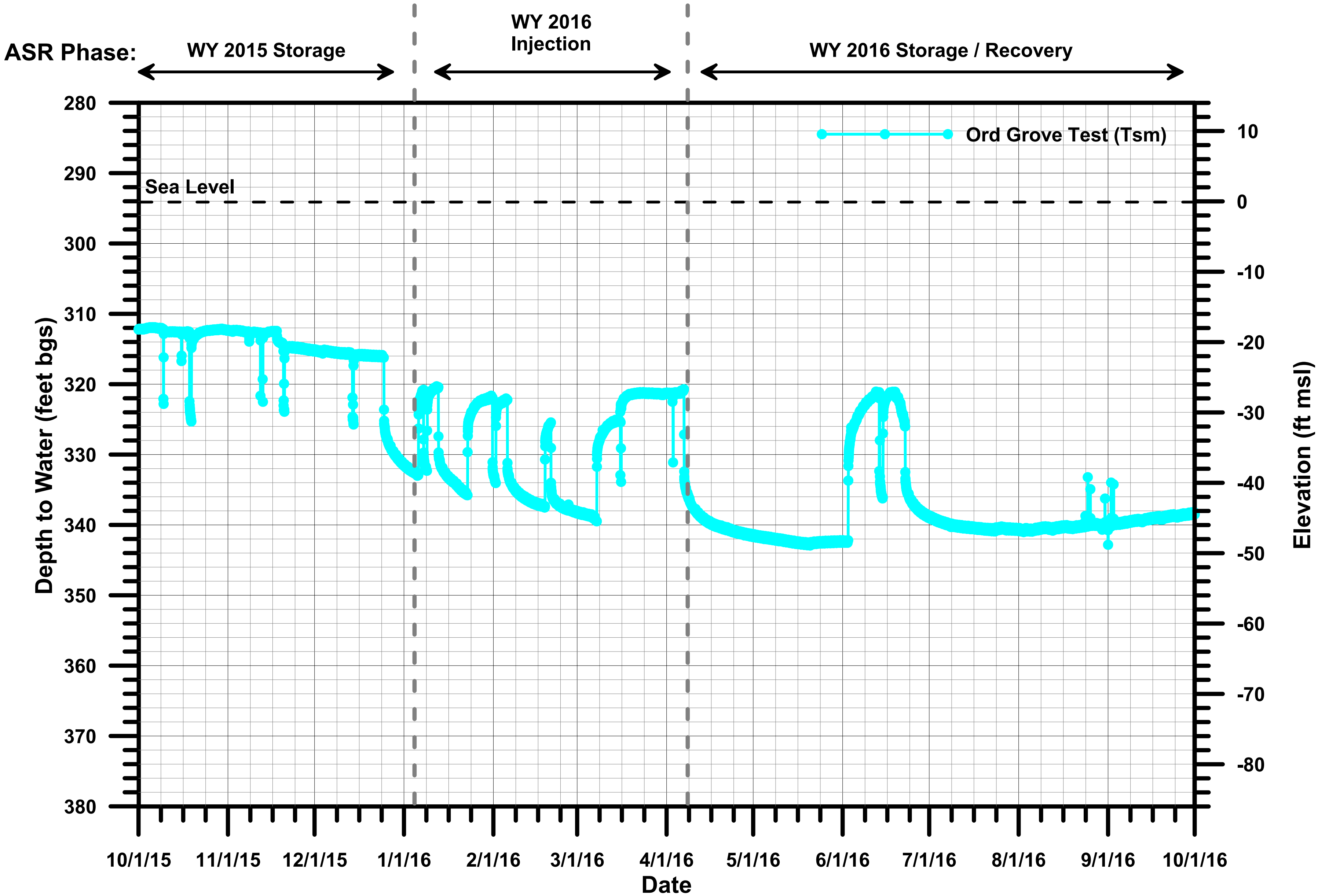


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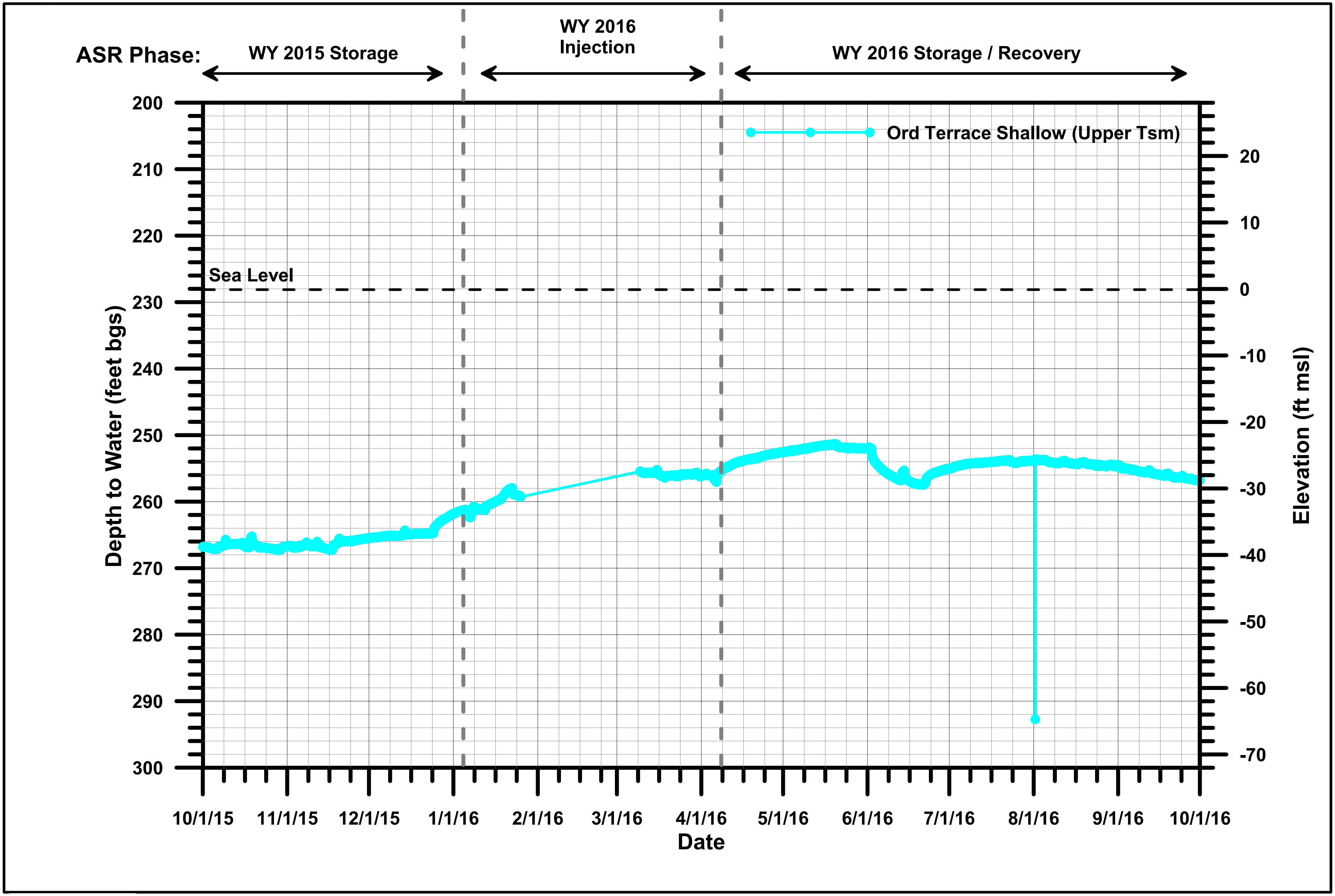
FIGURE 14. ORD GROVE TEST WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046



PUEBLO water resources

FIGURE 15. ORD TERRACE WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046

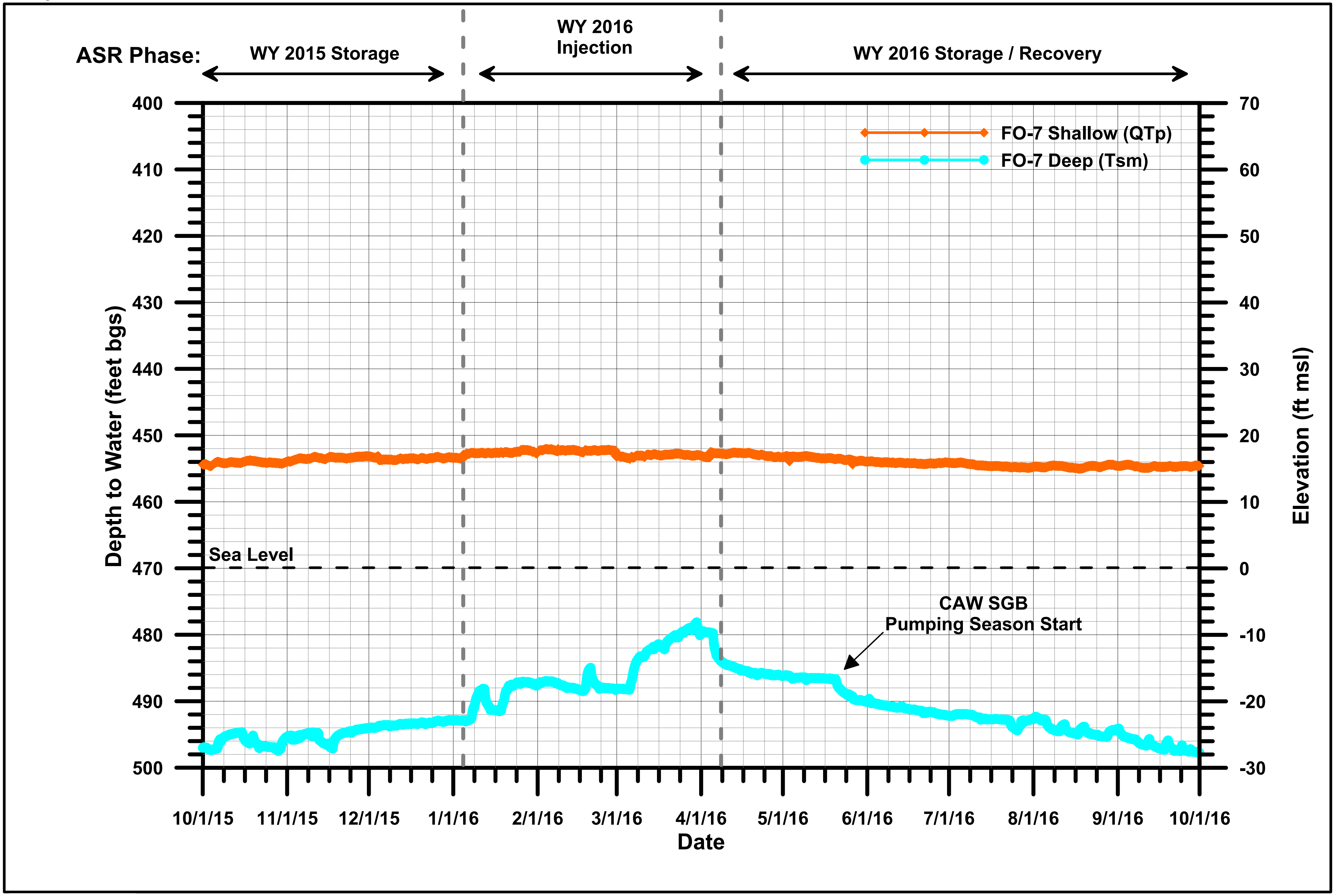


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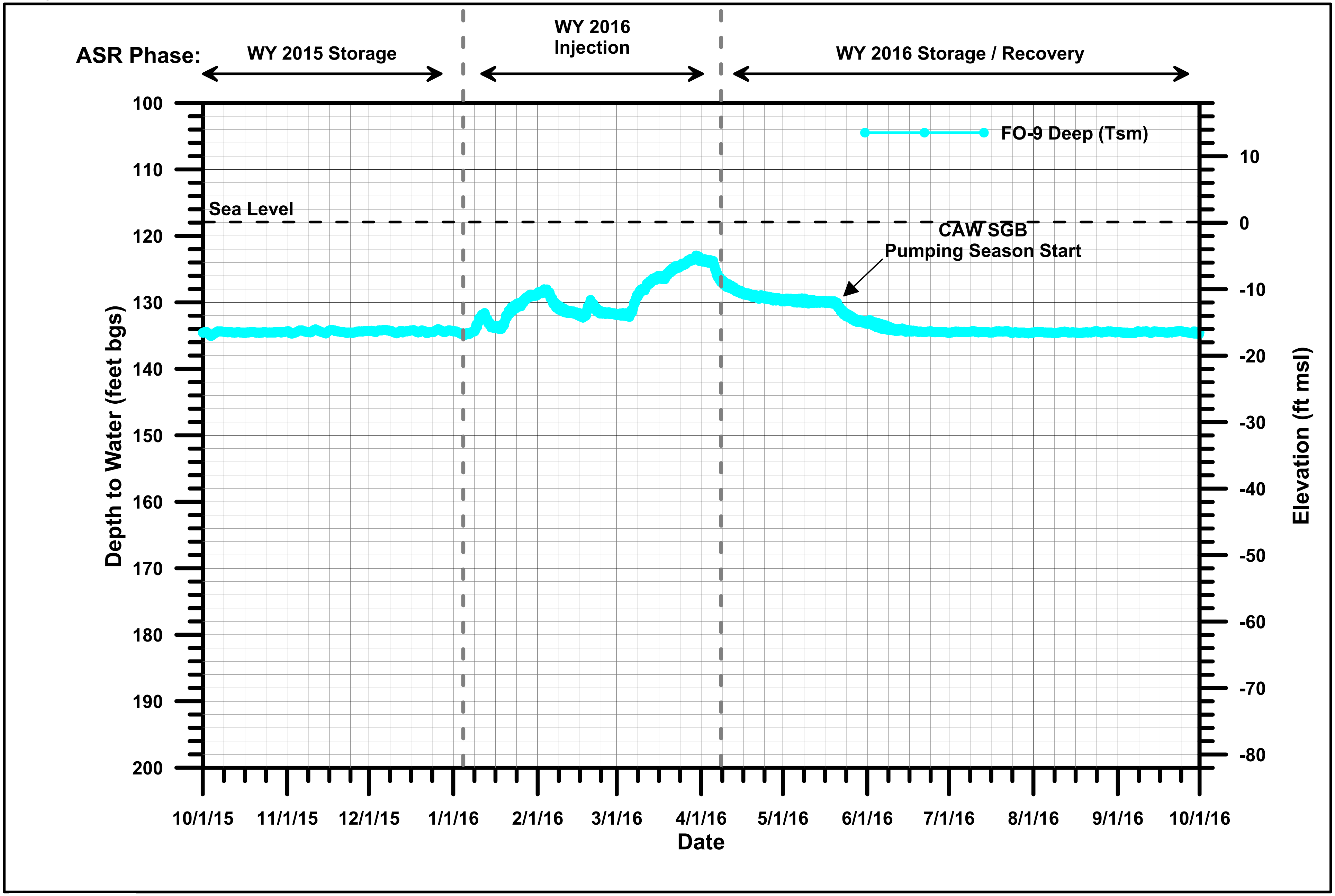
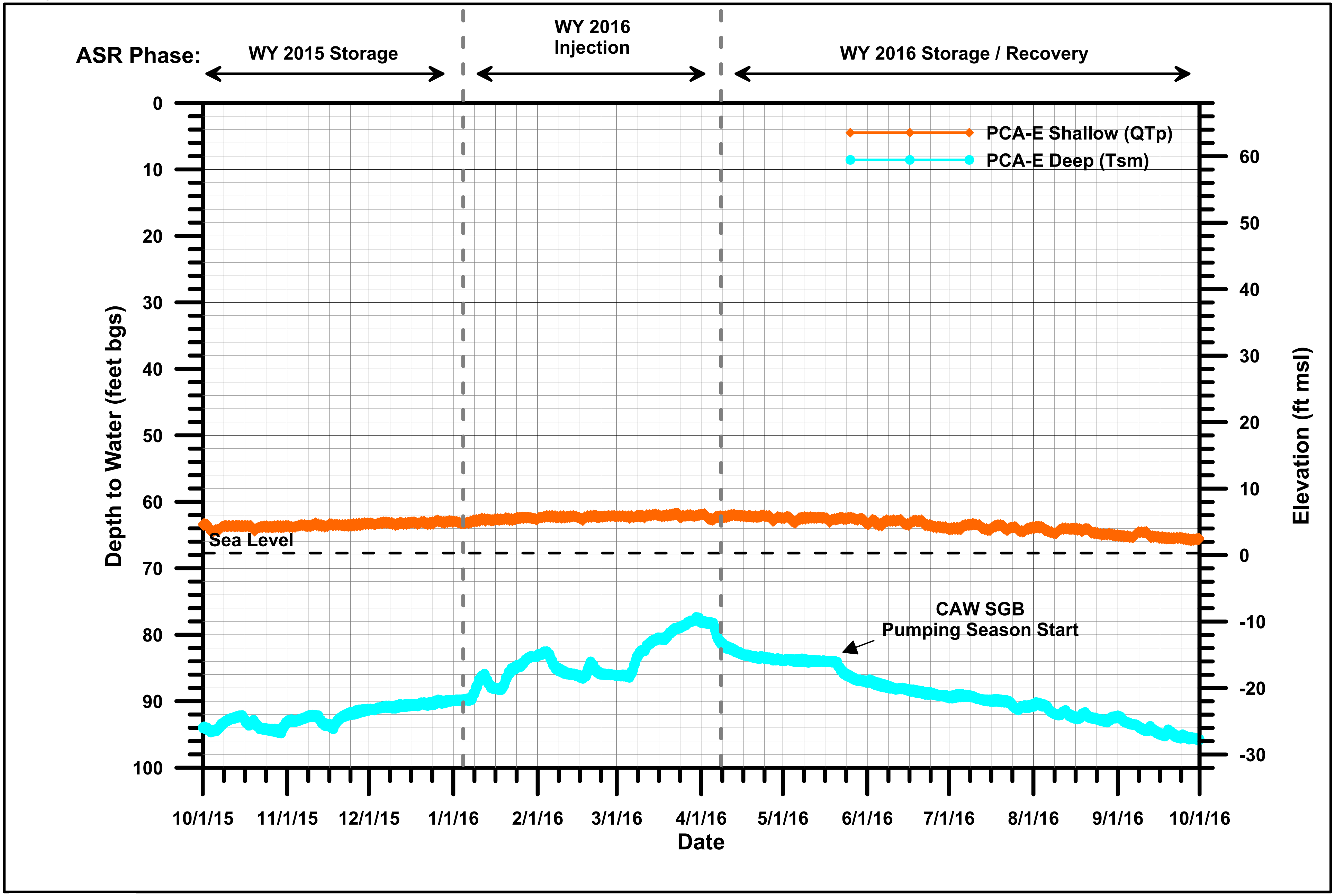
FIGURE 16. FO-7 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District



PUEBLO water resources

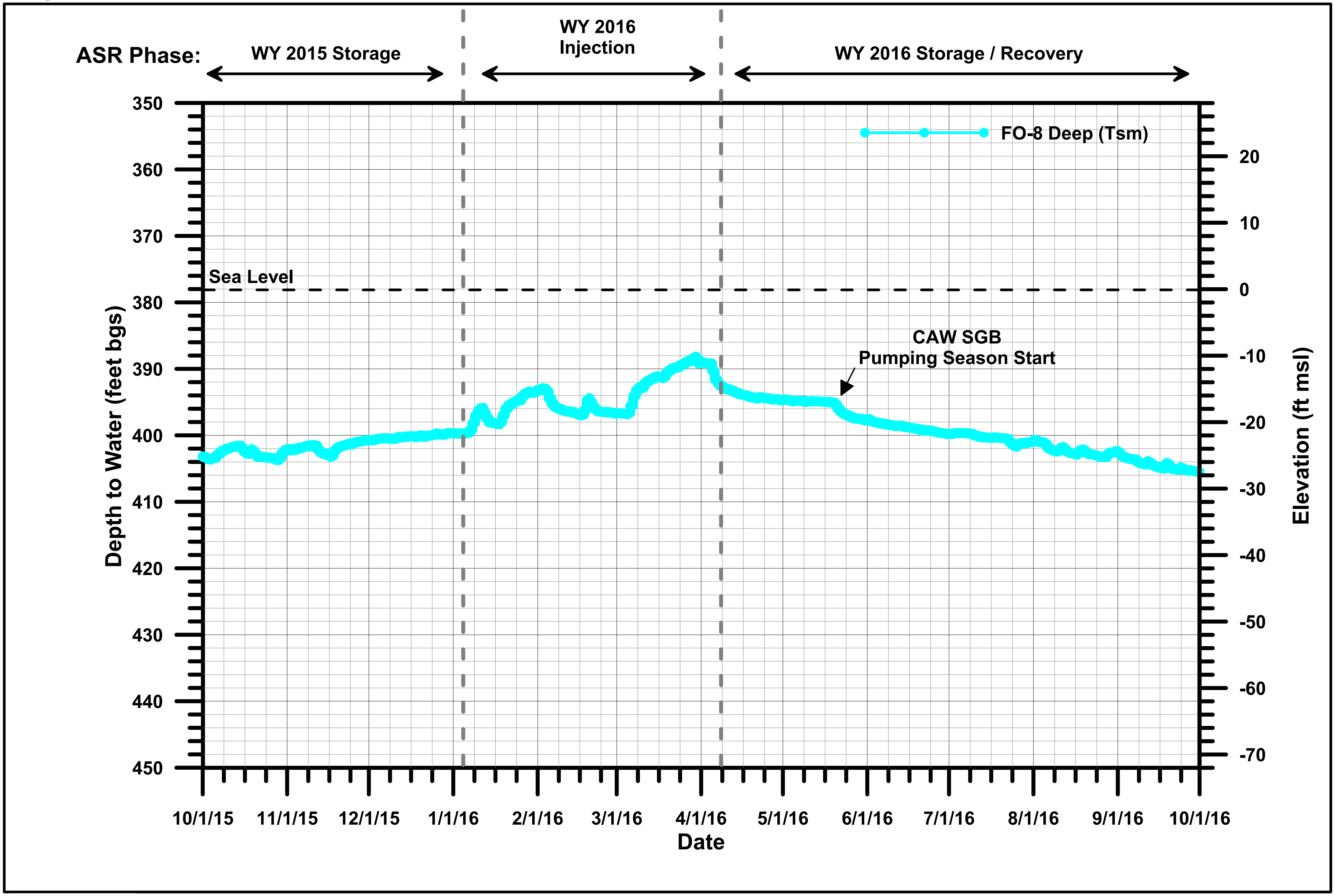
FIGURE 17. FO-9 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District



PUEBLO water resources

FIGURE 18. PCA-EAST WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

June 2017
Project No. 12-0046



PUEBLO water resources

FIGURE 19. FO-8 WATER-LEVEL DATA
WY 2016 ASR Program
Monterey Peninsula Water Management District

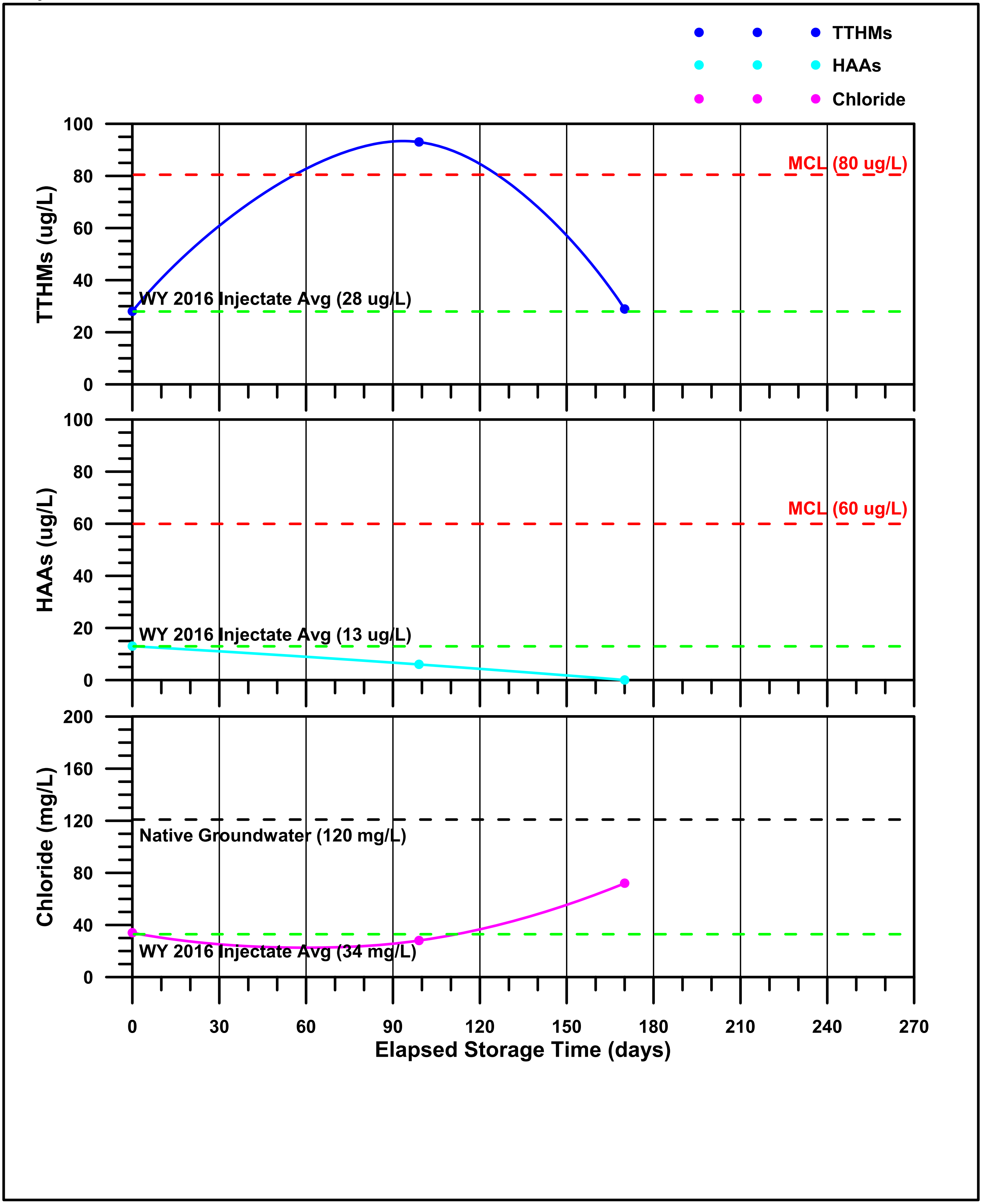
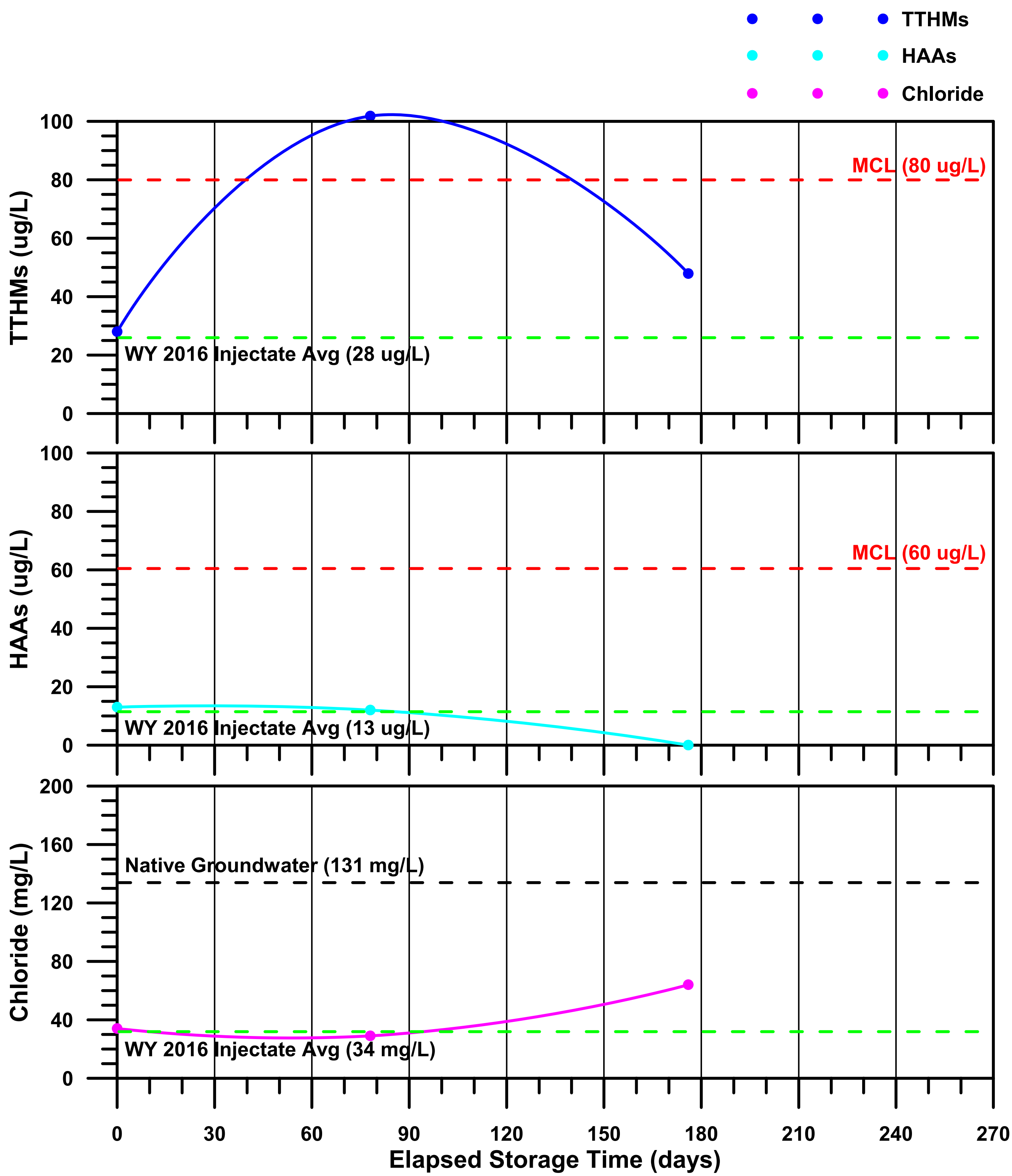


FIGURE 20. ASR-1 DISINFECTION BYPRODUCTS PARAMETERS
WY 2016 ASR Program
Monterey Peninsula Water Management District

PUEBLO water resources



PUEBLO water resources

FIGURE 21. ASR-2 DISINFECTION BYPRODUCTS PARAMETERS
WY 2016 ASR Program
Monterey Peninsula Water Management District

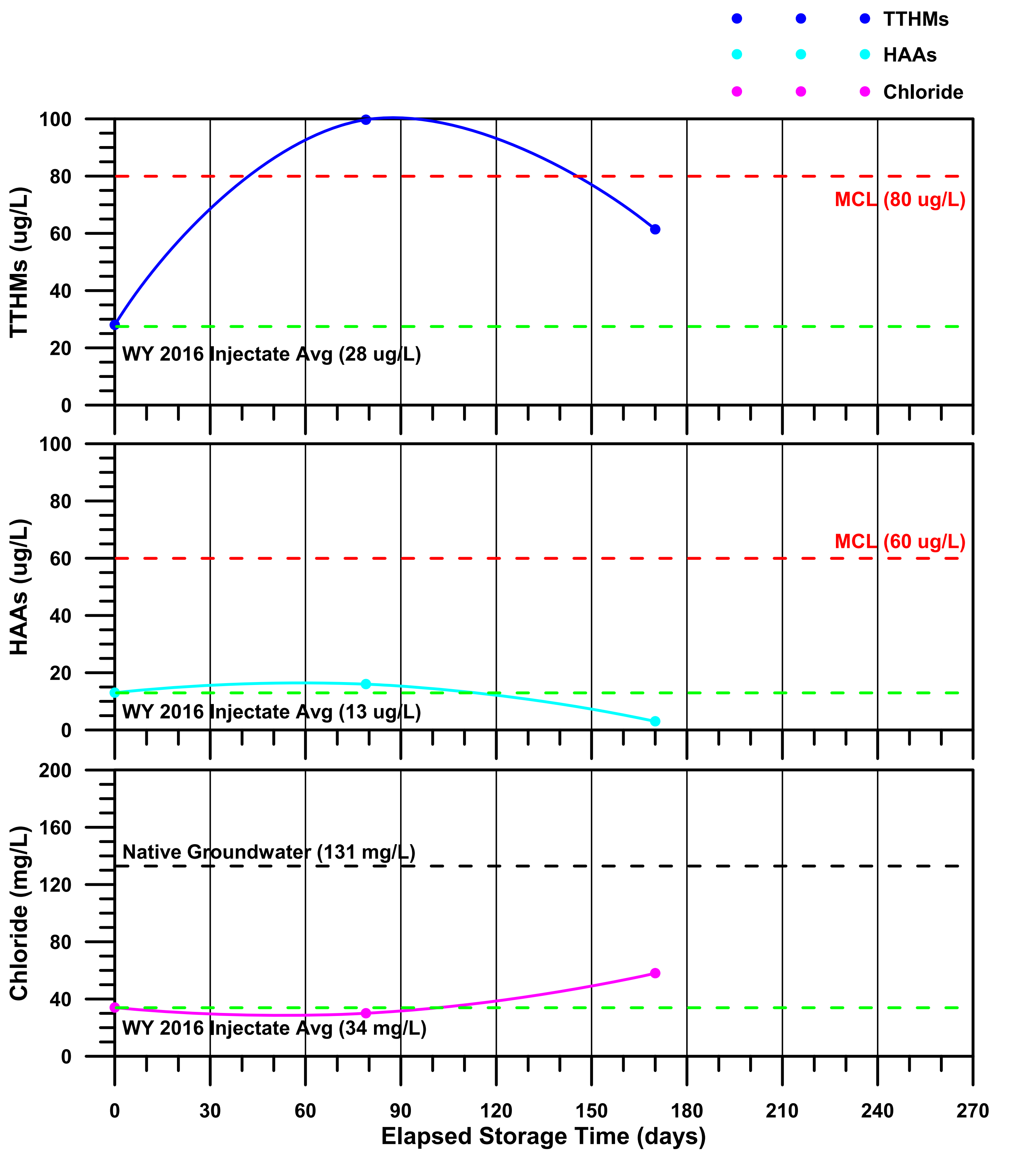
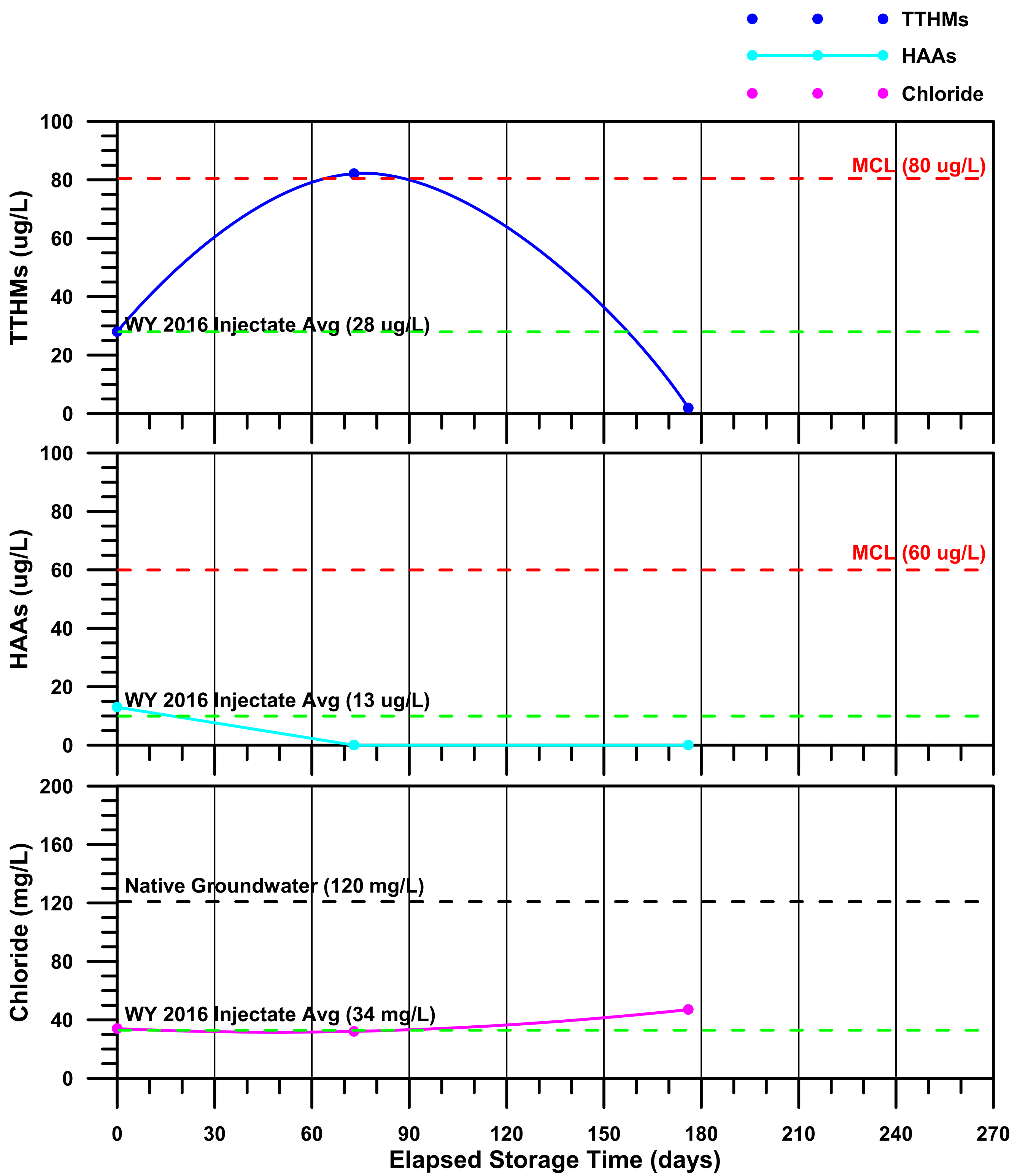


FIGURE 22. ASR-3 DISINFECTION BYPRODUCTS PARAMETERS
WY 2016 ASR Program
Monterey Peninsula Water Management District



PUEBLO water resources

FIGURE 23. SM MW-1 DISINFECTION BYPRODUCTS PARAMETERS
WY 2016 ASR Program
Monterey Peninsula Water Management District

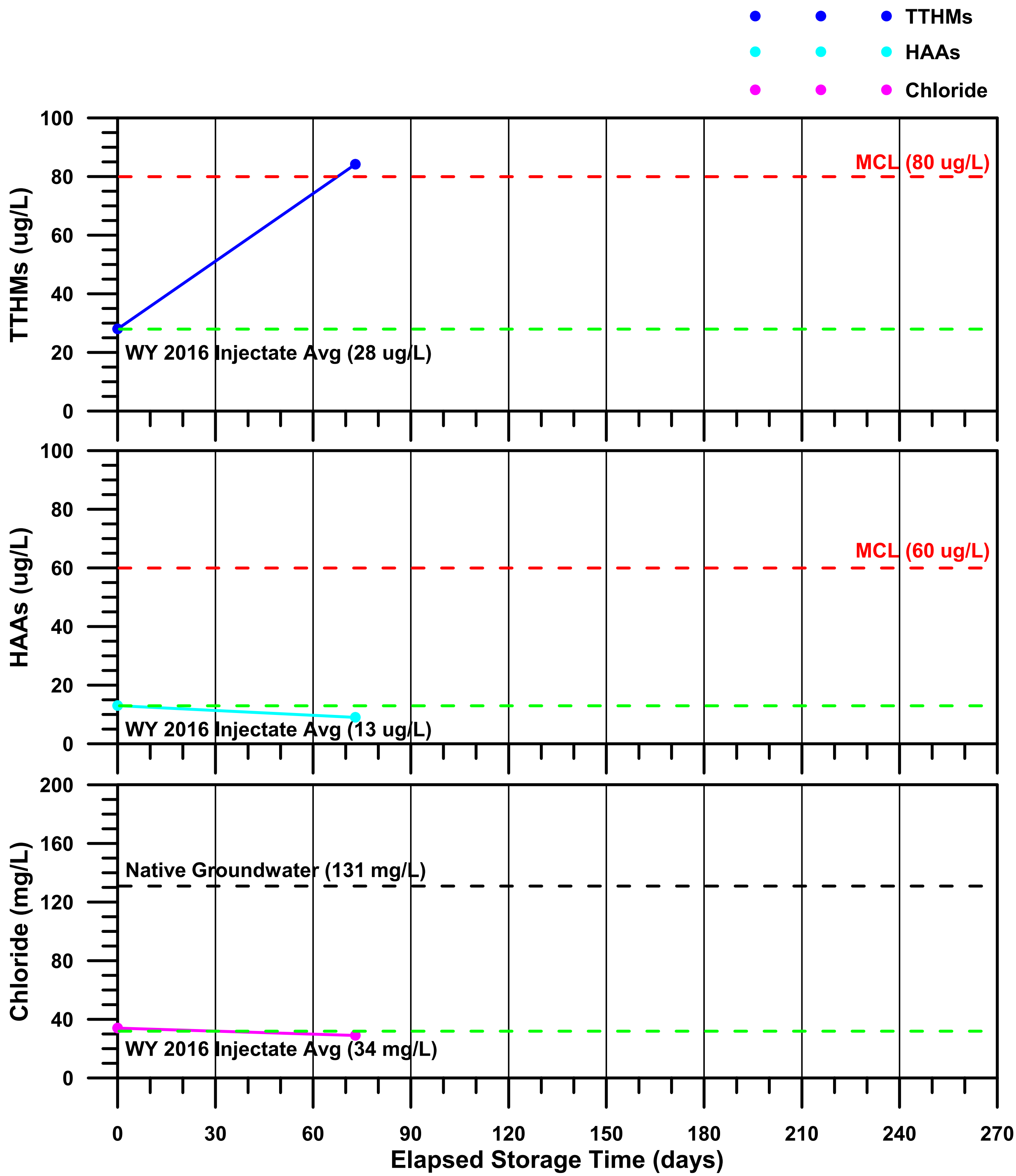
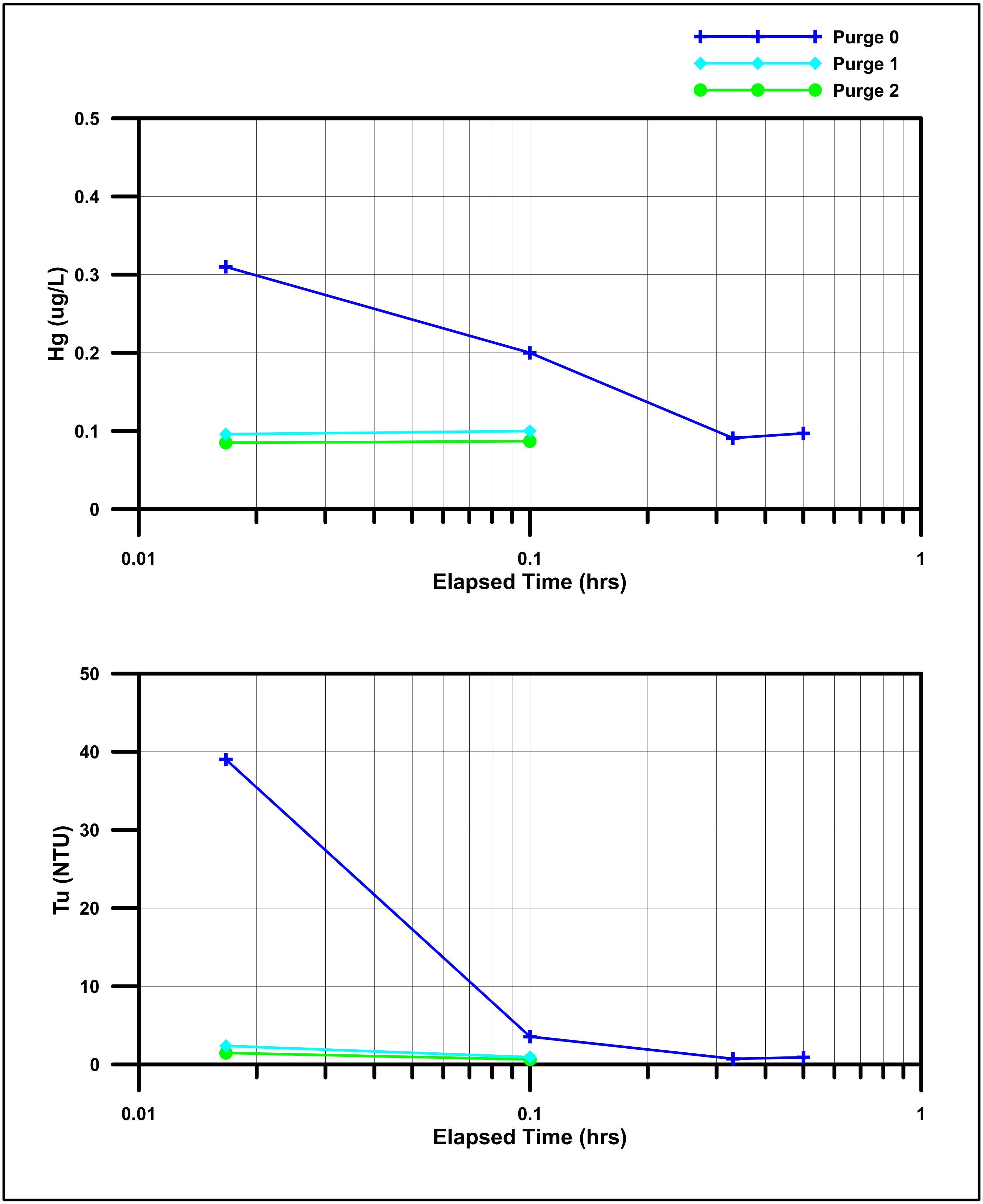


FIGURE 24. SMS DEEP DISINFECTION BYPRODUCTS PARAMETERS
WY 2016 ASR Program
Monterey Peninsula Water Management District



PUEBLO water resources

FIGURE 25. SM ASR-1 (2/11/16 SAMPLE EVENT)
WY 2016 ASR Program
Monterey Peninsula Water Management District

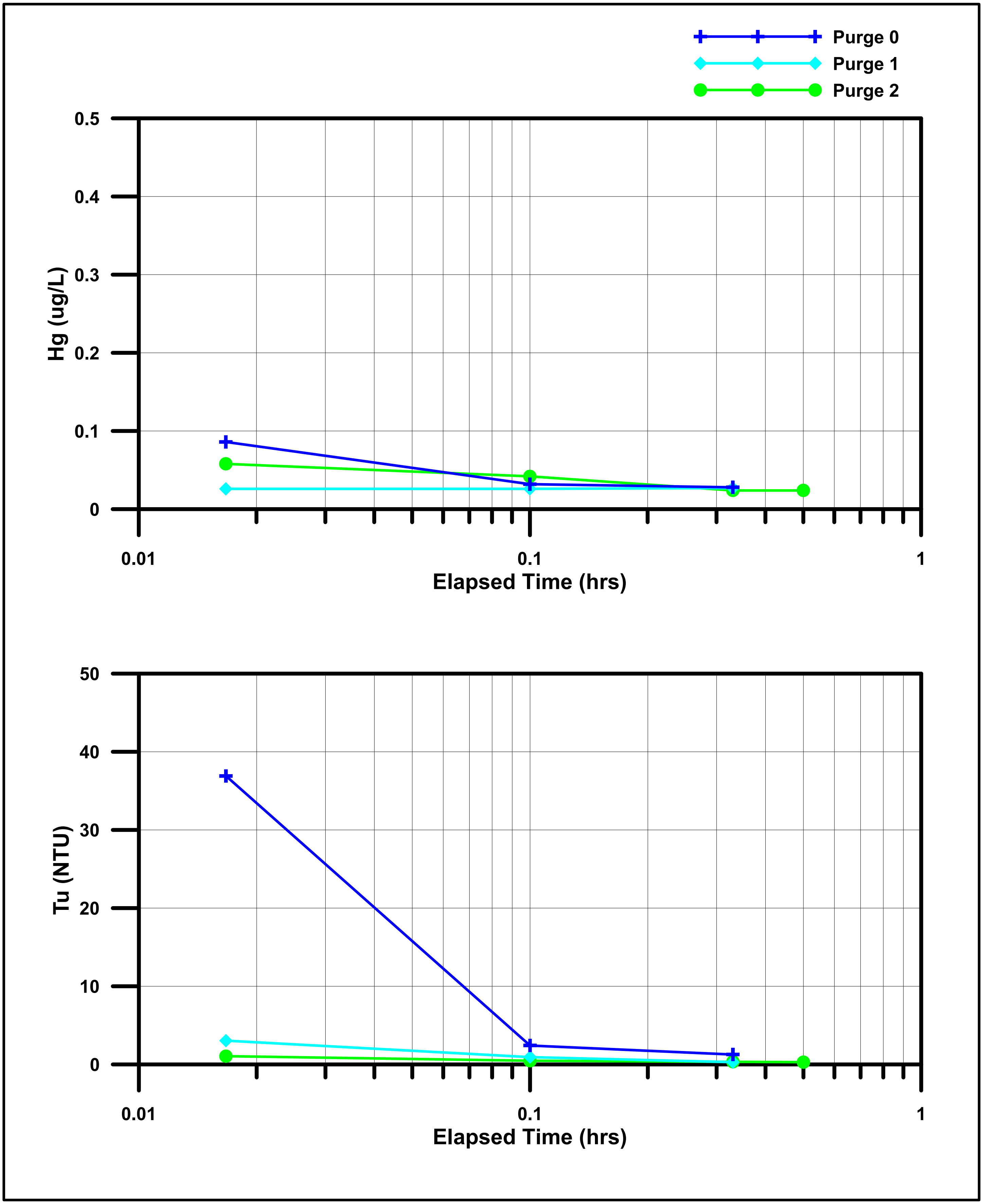


FIGURE 26. SM ASR-1 (3/23/16 SAMPLE EVENT)
WY 2016 ASR Program
Monterey Peninsula Water Management District

PUEBLO water resources

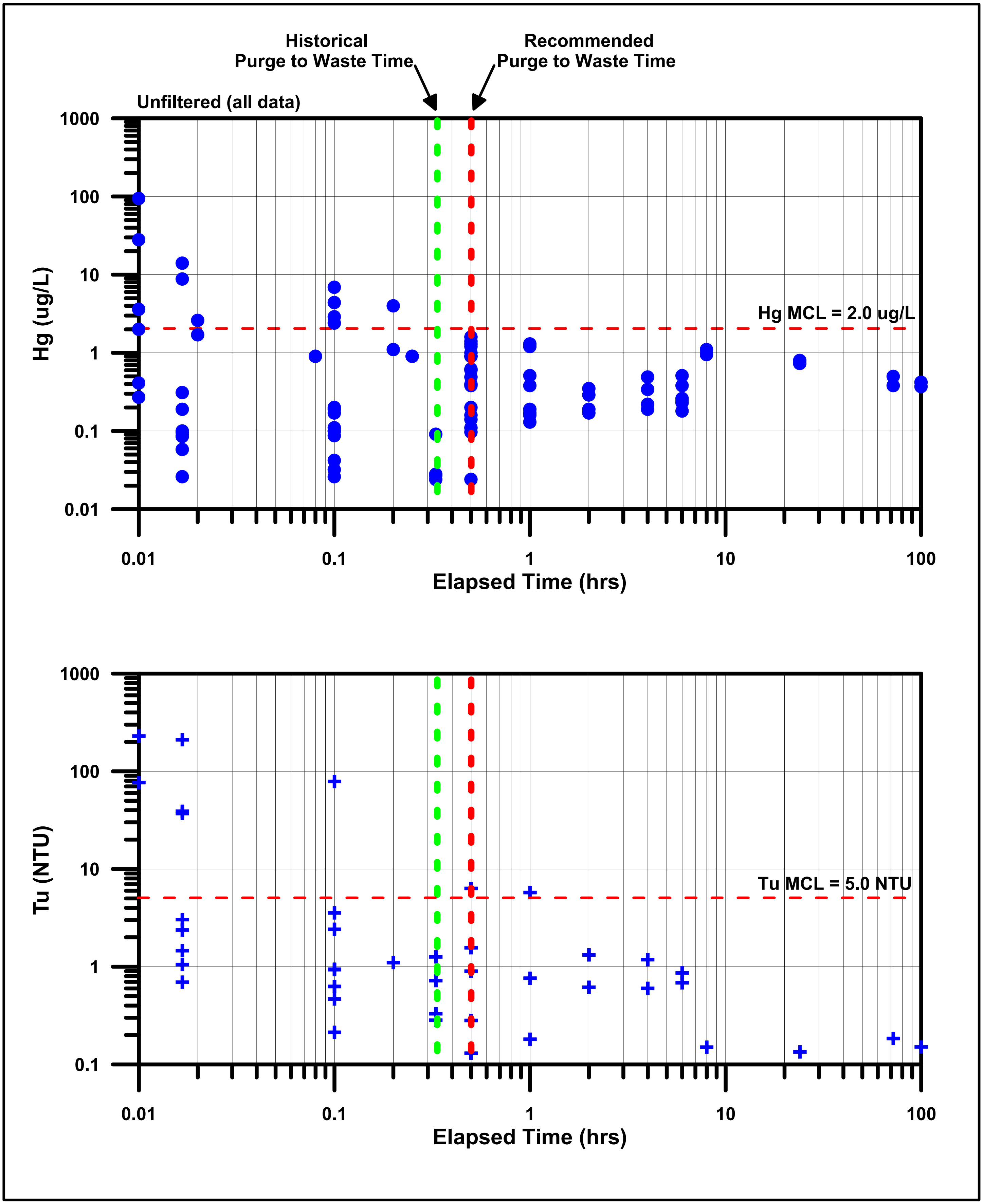


FIGURE 27. SM ASR-1 (Unfiltered Hg vs. Tu)
WY 2016 ASR Program
Monterey Peninsula Water Management District

APPENDIX A - FIELD DATA
(not included in draft)

APPENDIX B – WATER-QUALITY LABORATORY REPORTS
(not included in draft)