

## Appendix 6-C

**Technical Memorandum: Monterey Subbasin Modeling, dated April 2, 2021**

## TECHNICAL MEMORANDUM

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DATE: April 2, 2021 PROJECT #: 9100

TO: SVBGSA Advisory Committee

CC: Donna Meyers

FROM: Abby Ostovar, Greg Nelson, Staffan Schorr, and Derrik Williams

SUBJECT: Monterey Subbasin Modeling

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### INTRODUCTION

Two groundwater models have been developed that encompass the Monterey Subbasin, and which could potentially be used to prepare the Monterey Subbasin Groundwater Sustainability Plan (GSP). These models include:

- The **Salinas Valley Integrated Hydrologic Model (SVIHM)** developed by the U.S. Geological Survey (USGS)), including its future version, the Salinas Valley Operational Model, or SVOM, which encompass the entire Salinas Valley Groundwater Basin; and
- The **Monterey Subbasin Model** developed by Marina Coast Water District Groundwater Sustainability Agency's (MCWD GSA) consultant EKI Environment & Water, Inc. (EKI), which encompasses the Monterey Subbasin and incorporates observed boundary conditions with the adjoining Seaside Subbasin and the 180/400 Foot Aquifer Subbasin.

SVBGSA recently obtained the SVIHM, and Montgomery & Associates (M&A) has been reviewing the SVIHM and developing water budgets based on model results. M&A's review suggests that the SVIHM does not accurately reflect hydrologic conditions in the Monterey Subbasin. SVIHM calibration efforts primarily focus on other portions of the Salinas Valley Groundwater Basin where there is significant agricultural groundwater use. The SVIHM was not calibrated to any groundwater level data from the Seaside Subbasin and included only one calibration location in the Monterey Subbasin. M&A believes the SVIHM is not detailed or accurate in the Monterey Subbasin.

The Monterey Subbasin Model focuses on conditions within the Monterey Subbasin and has incorporated over 30,000 water level measurements from the Monterey Subbasin in its calibration. It also incorporates water level data from the 180/400-Foot Aquifer Subbasin and Seaside Subbasin to establish transient boundary conditions and account for conditions in these



adjoining subbasins. EKI has worked closely with M&A to incorporate feedback regarding conditions in the Corral de Tierra area and the 180/400-Foot Aquifer Subbasin.

Due to the limitations of the SVHIM in its representation of the Monterey Subbasin and the more robust calibration of the Monterey Subbasin Model for this subbasin, SVBGSA and MCWD GSA plan to use the Monterey Subbasin Model for developing the Monterey Subbasin GSP. The Monterey Subbasin Model will also form the basis for the seawater intrusion model that SVBGSA has received grant funding to develop for the Monterey Subbasin.

## MODELING COLLABORATION

EKI and M&A began collaborating on modeling while developing the SGMA Round 3 Planning Grant application for the Monterey Subbasin. Based on this application, MCWD received grant funds to develop the Monterey Subbasin Model, and SVBGSA received grant funds to develop a seawater intrusion model for the Monterey Subbasin.

EKI engaged M&A during the Monterey Subbasin Model development process to review the model's layering and structure, connectivity of the aquifers, input data such as historical groundwater elevations and extractions, boundary conditions with adjacent subbasins, and calibration. EKI and M&A will continue to collaborate in the interpretation of model results.

M&A will use the Monterey Subbasin Model as the basis for the seawater intrusion model for the Monterey Subbasin. Aquifer layers in the Monterey Subbasin Model will be extended north into the 180/400 Aquifer Subbasin in a manner that is consistent with SVIHM layering and incorporate boundary conditions and flows from the SVIHM. Development of the seawater intrusion model will begin upon completion and calibration of the Monterey Subbasin Model.

Since these are grant funded, no additional funding is needed for the modeling other than consultant staff time, and both agencies will have access to both models. SVBGSA and MCWD have a collaborative working relationship.

## MODEL COMPARISON

M&A has been reviewing and interrogating the SVIHM model. The SVIHM was provided in a provisional and preliminary status, meaning that the USGS can, and likely will, update and change the model prior to its release to the public. The Monterey Subbasin and Seaside Subbasin are included in the SVIHM; however, model development and calibration in these subbasins appears not to have been performed to the same degree as other areas of the Model. For example, the SVIHM did not include any water level calibration points in the Seaside Subbasin and only one calibration location in the Monterey Subbasin.

Model calibration is an assessment of how a model simulates observed historical conditions. Generally, a model's calibration is evaluated through calibration statistics – comparing simulated groundwater elevations to measured groundwater elevation data. One commonly used statistic is known as the scaled root mean squared residual of the error between simulated water levels and

observed water levels. A general rule of thumb in assessing model calibration is that the model is considered adequately calibrated when the scaled root mean squared error is less than 10%. The basin-wide statistics of the SVIHM meet these criteria (see Attachment A).

In the Monterey Subbasin, the SVIHM includes only one location containing calibration data; and an assessment of the Subbasin calibration cannot be adequately performed using the limited measurements from only this one data location. To check the accuracy of the SVIHM in the Subbasin, M&A compared simulated groundwater elevations from the SVIHM to an additional 4,555 observed water levels from 55 locations in the Monterey Subbasin. With the additional data. The root mean squared error of the residuals is over 7%, which indicates reasonable calibration (see Attachment B).

However, comparing simulated and observed hydrographs across the Subbasin shows that the model results do not match measured data in many areas: particularly in the Corral De Tierra. Some hydrographs have opposite trends, indicating the model is not adequately calibrated in this area. Attachment C includes some example hydrographs that illustrate certain wells with inadequate calibration. Measured data on these hydrographs are shown with black dots, and simulated data are shown with blue lines. The clear difference between measured and simulated trends on these plots results in poor confidence in the model's ability to simulate at least parts of the Monterey Subbasin. This poor confidence only applies to the Monterey Subbasin; much of the rest of the model is well calibrated.

In the Corral de Tierra area, only the bottom three layers of the SVIHM are active. These three layers represent the bedrock (bottom layer) and part of the El Toro Primary Aquifer System (other two active layers). This model configuration raises concerns over the adequacy of hydrogeologic representation of the Corral de Tierra area.

In contrast to the SVIHM, the Monterey Subbasin Model being developed by EKI currently has a root mean squared error residual of less than 2% (Attachment D). Calibration of the Monterey Subbasin model is ongoing, and all results are still preliminary. The Monterey Subbasin Model also has more detailed and more accurate representation of the hydrogeology in the Corral de Tierra area, which was developed incorporating input from M&A. EKI has also included additional groundwater level data for calibration throughout the Monterey Subbasin, totaling 30,555 observations from 608 wells. Thus, because of the more accurate calibration and hydrogeologic representation of the Monterey Subbasin within the Monterey Subbasin Model, SVBGSA plans to use the Monterey Subbasin Model for the development of the Monterey Subbasin GSP.

## MODEL COMPATIBILITY

To assess model compatibility, EKI and M&A have been collaborating on modeling and most recently have compared information from the Monterey Subbasin Model and the SVIHM. This includes analyzing conditions along the boundary of the 180/400-Foot Aquifer Subbasin and beneath the Salinas River. Groundwater levels along this boundary are being compared to ensure the two models are compatible and simulate this boundary comparably. Model layering and

hydrogeologic representation have also been reviewed and appear to reasonably match. In some areas, the Monterey Subbasin Model has greater vertical resolution with more refined aquifer layers. In general, however, the Monterey Subbasin Model layer is compatible with the SVIHM layering.

In the future, when the SVIHM becomes public, the information from the Monterey Subbasin Model could be incorporated into the SVIHM. Additionally, SVBGSA could expand the seawater intrusion model into the 180/400-Foot Aquifer Subbasin by incorporating SVIHM parameters so that it can model the impacts of valley-wide projects on seawater intrusion.

## CONCLUSION

A detailed description of the Monterey Subbasin Model will be included as an appendix to the Monterey Subbasin GSP, which will be made available for public review and comment. In addition, the Monterey Subbasin Model will be submitted to the California Department of Water Resources as part of the GSP. It will be available for future use by the USGS and others as part of basin-wide modeling efforts.

All groundwater models are tools to help understand groundwater conditions and how factors may change groundwater conditions. Given the complexity of groundwater interactions, models provide the best tool for understanding of these interactions and their effects. Exact numbers will change as the Model is refined and updated; however, it will not likely change the direction and approach of groundwater management.

### Attachments:

Attachment A: SVIHM Calibration Statistics for entire Salinas Valley Groundwater Basin

Attachment B: SVIHM Calibration Statistics for Monterey Subbasin (with added water level observations)

Attachment C: Measured and SVIHM Simulated Hydrographs for Monterey Subbasin

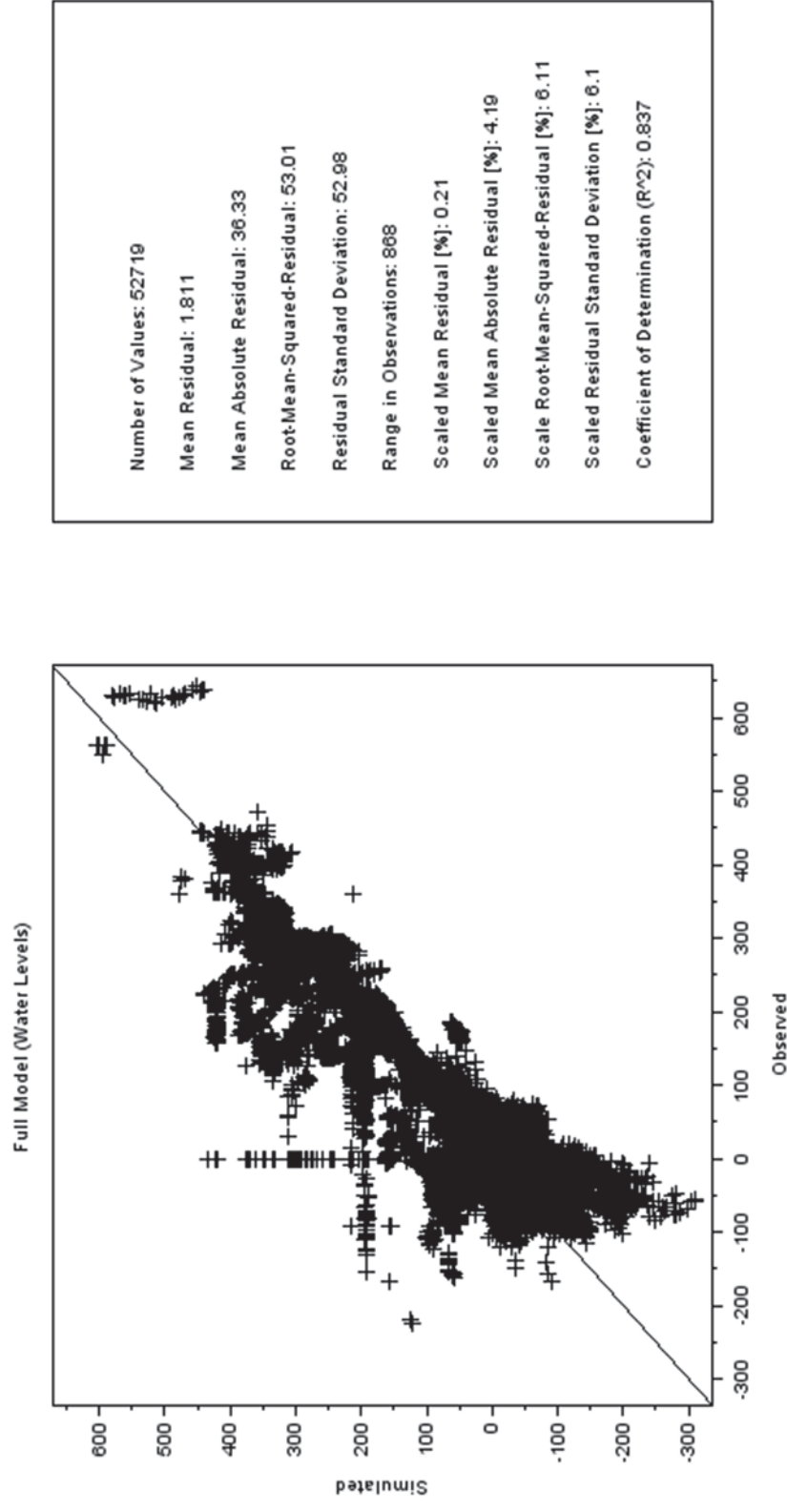
Attachment D: Monterey Subbasin Model Preliminary Calibration Statistics (as of 3/29/2021)

### SVIHM Note:

This data (model and/or model results) are preliminary or provisional and are subject to revision. This model and model results are being provided to meet the need for timely best science. The model has not received final approval by the U.S. Geological Survey (USGS). No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the model and related material nor shall the fact of release constitute any such warranty. The model is provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the model.

ATTACHMENT A

SVIHM CALIBRATION STATISTICS FOR ENTIRE SALINAS VALLEY GROUNDWATER BASIN

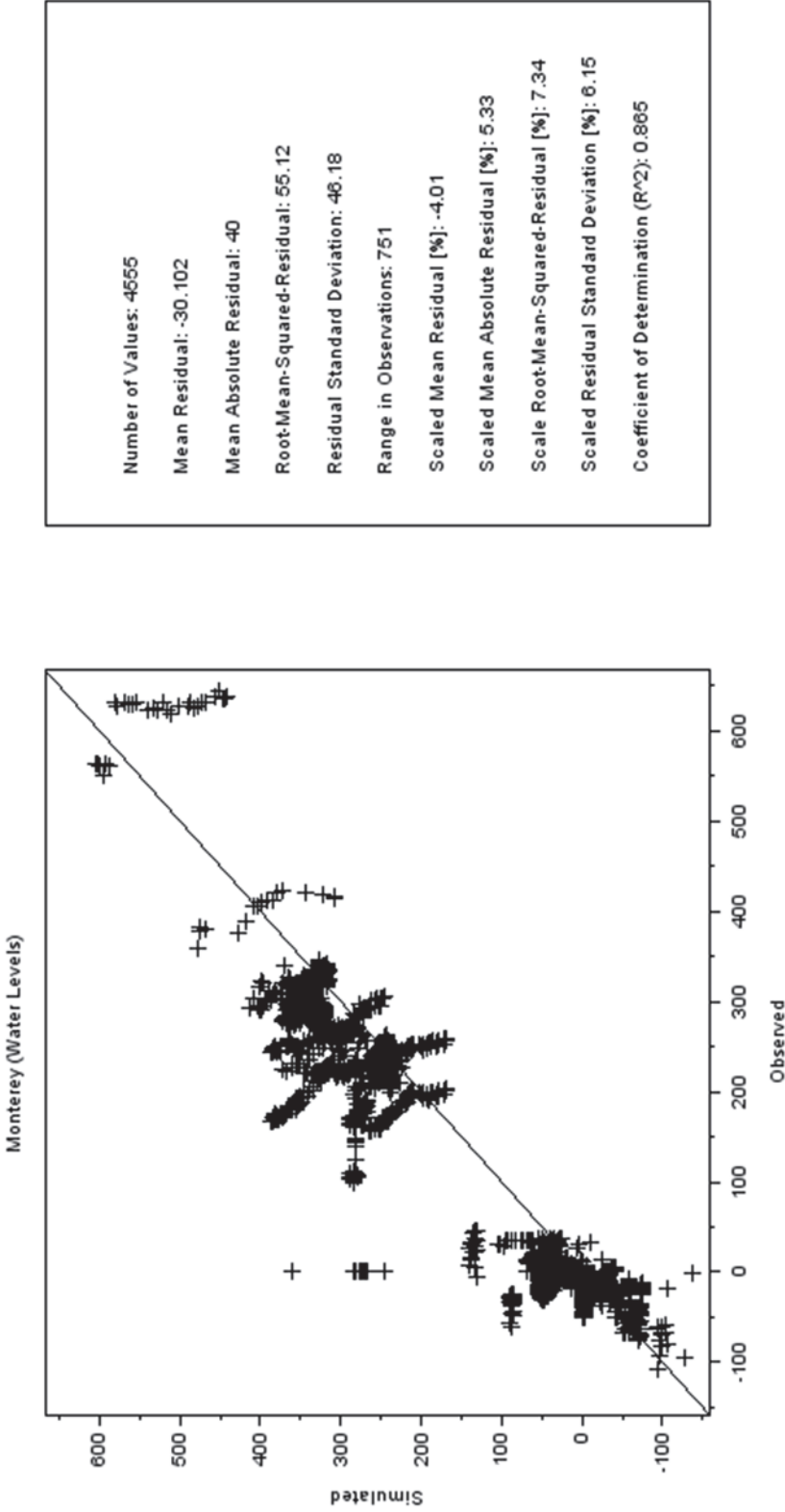


Note: All reported statistics are in feet unless otherwise noted.

All model results are provisional and subject to revision.

ATTACHMENT B

SVIHM CALIBRATION STATISTICS FOR MONTEREY SUBBASIN (WITH ADDED WATER LEVEL OBSERVATIONS)

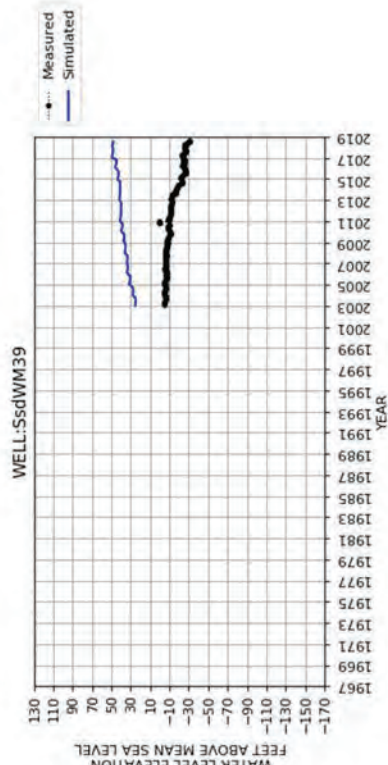
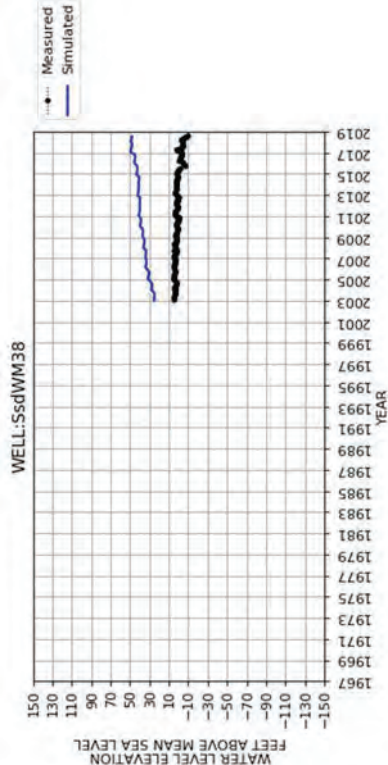
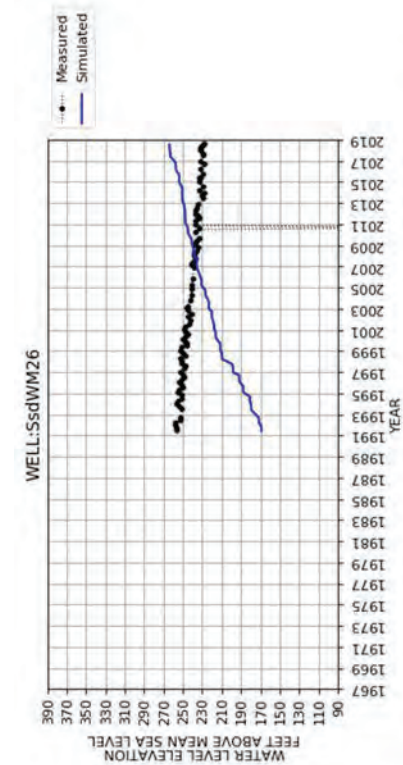
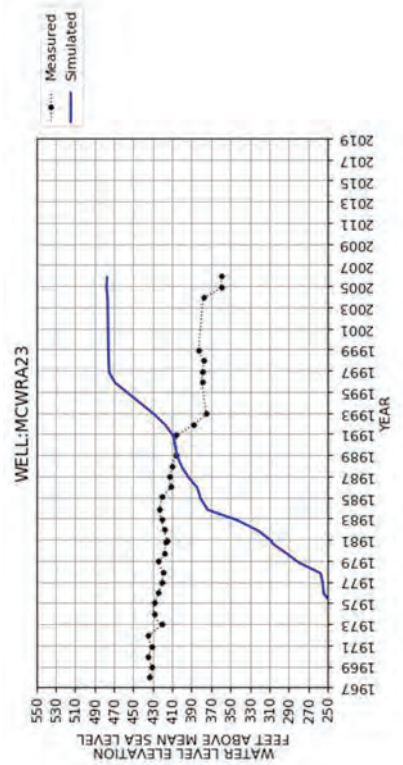


**Note:** All reported statistics are in feet unless otherwise noted.

All model results are provisional and subject to revision



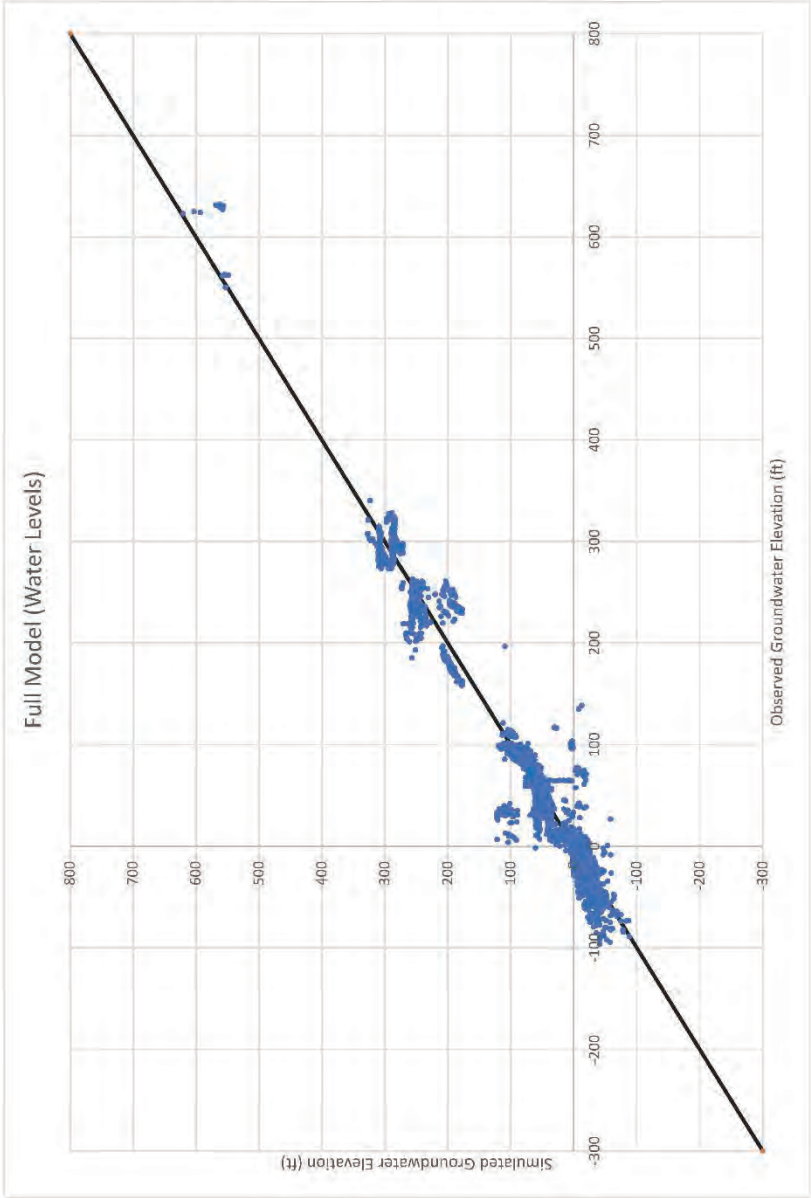
ATTACHMENT C  
MEASURED AND SVIHM SIMULATED HYDROGRAPHS  
FOR MONTEREY SUBBASIN



Note: All reported statistics are in feet unless otherwise noted.  
All model results are provisional and subject to revision

ATTACHMENT D

MONTEREY SUBBASIN MODEL PRELIMINARY CALIBRATION STATISTICS (AS OF 3/29/2021)



Number of Wells:	608
Number of Observations:	30555
Mean Residual (ft):	-1.93
Mean Absolute Residual (ft):	8.38
Root-Mean-Squared Residual (ft):	12.77
Residual Standard Deviation (ft):	12.62
Range in Observations (ft):	728.44
Scaled Mean Residual [%]:	-0.26%
Scaled Mean Absolute Residual [%]:	1.15%
Scaled Root-Mean-Squared Residual [%]:	1.75%
Scaled Residual Standard Deviation [%]:	1.73%
Coefficient of Determination (R^2):	0.94

Note: All results are preliminary and subject to revision.

## Appendix 7-A

### MCWRA CASGEM Monitoring Plan



# **CASGEM Monitoring Plan for High and Medium Priority Basins in the Salinas Valley Groundwater Basin**

March 10, 2015



Monterey County Water Resources Agency  
893 Blanco Circle  
Salinas, CA 93901

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Appendix B – Report on Salinas Valley Water Conditions for the fourth Quarter of Water Year 2013-2014
Appendix C – CASGEM Network Well Data Summary
Appendix D – Transducer Specifications

## List of Acronyms and Abbreviations

CASGEM	California Statewide Groundwater Elevation Monitoring
DWR	California Department of Water Resources
MCWRA	Monterey County Water Resources Agency
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WY	Water Year

## 1.0 Introduction

This monitoring plan has been developed by the Monterey County Water Resources Agency (MCWRA) to meet requirements of the California Department of Water Resources (DWR) California Statewide Groundwater Elevation Monitoring (CASGEM) program. The plan covers monitoring of groundwater elevations within high and medium priority alluvial subbasins identified in DWR Bulletin 118 that are located in Monterey County, and for which a Monitoring Entity has not yet been designated. This monitoring plan provides information on the groundwater basins, the wells to be sampled, and the monitoring schedule and methods.

### 1.1 Scope and Purpose

The monitoring plan presents descriptions of the groundwater subbasins; monitoring schedule and well network distribution; procedures for collecting and reporting the groundwater elevation data; and a description of the monitoring plan rationale.

This groundwater monitoring plan can be revised as necessary when refinements are made to the monitoring network to address program needs and data gaps. Revisions will be submitted to DWR when additions or removal of wells from the monitoring network occur.

## 2.0 Groundwater Basin Descriptions and Hydrogeology

Monterey County is located in the Central Coast Hydrologic Region. Thirteen basins and subbasins are identified in DWR Bulletin 118 as being partially or fully located within Monterey County (Figure 1).

This monitoring plan addresses seven of the subbasins in the Salinas Valley Groundwater Basin, specifically those which DWR has prioritized as “high” or “medium” (Table 1). Three of the basins - Cholame Valley (3.5), Lockwood Valley (3-6), and Peach Tree Valley (3-32) - have been prioritized as “low” or “very low” and will be covered by a subsequent monitoring plan.

<b>Table 1 - DWR Basin Nomenclature, Numbering, and Prioritization</b>		
<b>Subbasin Name</b>	<b>Basin/Subbasin Number</b>	<b>Basin Prioritization</b>
180/400 Foot Aquifer	3-4.01	High
East Side Aquifer	3-4.02	High
Forebay Aquifer	3-4.04	Medium
Upper Valley Aquifer	3-4.05	Medium
Paso Robles Area	3-4.06	High
Langley Area	3-4.09	Medium
Corral de Tierra Area	3-4.10	Medium

The remaining three basins in Monterey County - Carmel Valley (3-7), Pajaro Valley (3-2), and the Seaside Area (3-4.08) - have a designated Monitoring Entity. The Monterey Peninsula Water Management District (MPWMD) is the Monitoring Entity for the Carmel Valley and Seaside basins; Santa Cruz County Environmental Health Services is the Monitoring Entity for the Pajaro Valley basin. The Paso Robles Area will be monitored both by MCWRA and the San Luis Obispo County Flood Control & Water Conservation District, with monitoring split along the county lines.

## **2.1 Overall Setting**

The Salinas Valley is an intermontane alluvial basin extending 120 miles southeast from the Monterey Bay to Paso Robles. Although the valley fill is as thick as 15,000 feet, all of the principal water-bearing sediments lie within 2,000 feet of the ground surface (Showalter et al, 1983). These water-bearing sediments consist of Tertiary and Quaternary marine and terrestrial sediments, including the Pliocene Purisima Formation, the Plio-Pleistocene Paso Robles Formation, the Pleistocene Aromas Formation, and the Pleistocene to Holocene Valley Fill.

## **2.2 180/400 Foot Aquifer**

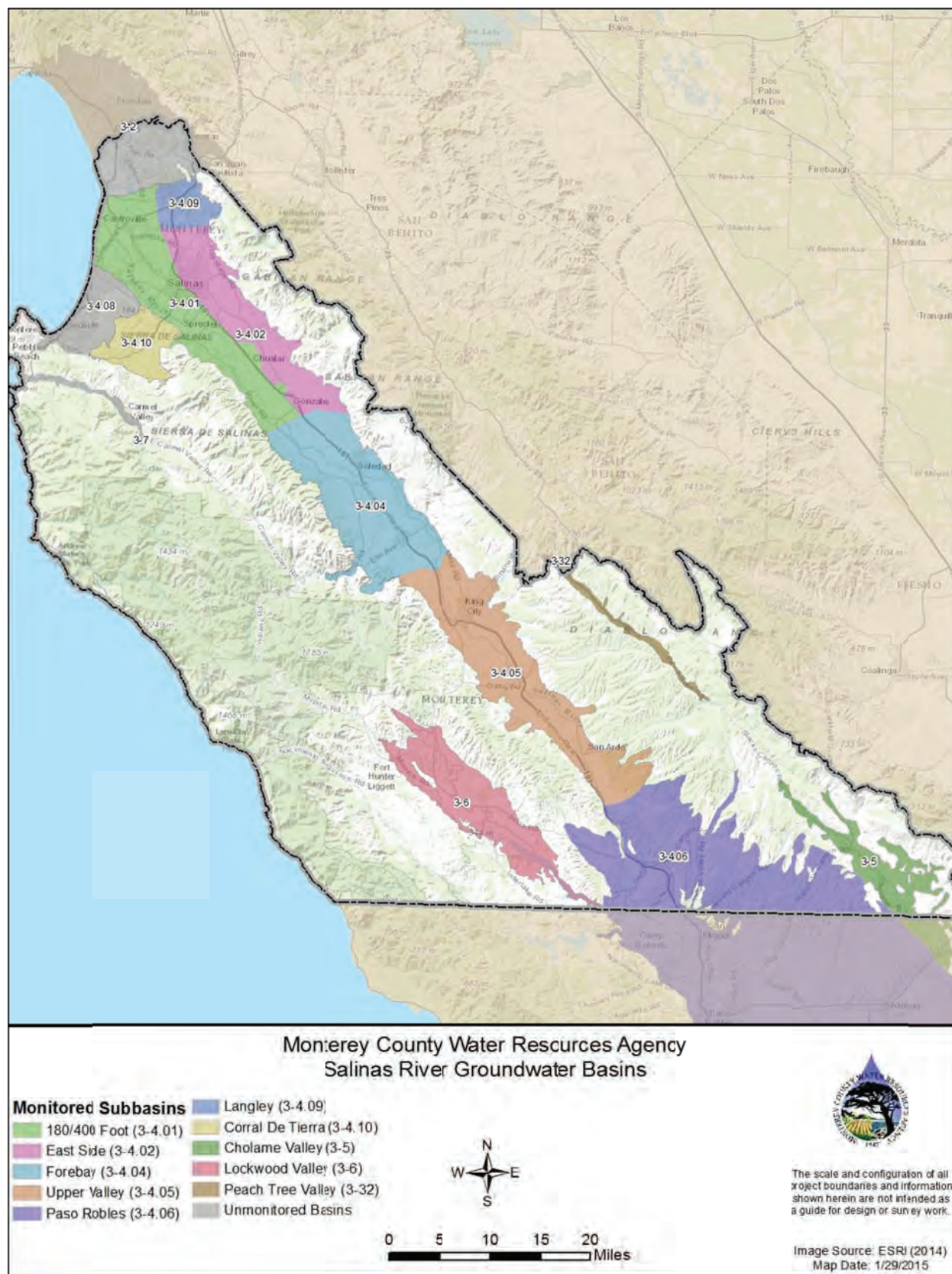
The 180/400 Foot Aquifer subbasin is located in the northwestern part of the Salinas Valley basin. The northeastern boundary of the 180/400 Foot Aquifer subbasin is shared with the East Side Aquifer subbasin; the Forebay Aquifer subbasin lies on southeastern boundary, near the City of Gonzales. Monterey Bay abuts the northwestern boundary of the 180/400 Foot Aquifer subbasin.

The 180-Foot Aquifer ranges from 50 to 150 feet in thickness and is confined by an overlying blue clay layer, known as the Salinas Aquitard, which ranges from 25 to 100 feet thick. The Salinas Aquitard thins to the east and south of the subbasin and is present only in this subbasin. The 180-Foot Aquifer consists of interconnected layers of sand, gravel, and clay that are separated from the 400-Foot Aquifer by blue marine clay and other discontinuous aquifers and aquitards ranging from 10 to 70 feet in thickness. The 400-Foot Aquifer has an average thickness of 200 feet and consists of sands, gravels, and clay lenses (DWR, 2003). The blue marine clay aquitard has been reported to be absent in some areas of the 180/400 Foot Aquifer subbasin (Kennedy/Jenks, 2004).

There is a third water-bearing unit underlying the 180/400 Foot Aquifer subbasin, often referred to as the Deep Aquifer, which is separated from the overlying 400-Foot Aquifer by a blue marine clay aquitard (DWR, 2003). The Deep Aquifer is a confined unit that has been less developed than the 180-Foot and 400-Foot Aquifers, but wells are increasingly being drilled into this unit, so it will be included in the monitoring plan for this subbasin.



**Figure 1 – Groundwater Basins and Subbasins in Monterey County**



### **2.3 East Side Aquifer**

The East Side Aquifer subbasin is located in the northeastern portion of the Salinas Valley basin, bounded by the foothills of the Gabilan Range to the northeast and Highway 101 to the southwest (Kennedy/Jenks 2004).

The East Side Aquifer subbasin is dominated by poorly bedded sequences of gravel, silt, sand, gravelly/sandy clay, and clay. In portions of the East Side Aquifer subbasin, decomposed granite is a prominent component of the sediments (Kennedy/Jenks, 2004). The primary water-bearing units of the East Side Aquifer subbasin are the same units that are present in the 180/400 Foot Aquifer subbasin. However, the near-surface Salinas Aquitard is not present in the East Side Aquifer subbasin, and the aquitard that separates the 180-foot and 400-Foot Aquifers is less continuous in the East Side Aquifer subbasin, leading to semi-confined to unconfined conditions for much of the groundwater (DWR, 2003).

### **2.4 Forebay Aquifer**

The Forebay Aquifer subbasin is located in the central portion of the Salinas Valley basin, bounded by the Sierra de Salinas and Gabilan Range to the west and east, respectively. The Forebay subbasin is bounded to the north by the 180/400 Foot Aquifer and East Side Aquifer subbasins. The southern boundary of the Forebay Aquifer subbasin is shared with the Upper Valley Aquifer subbasin (DWR, 2003).

Many of the same hydrostratigraphic units that comprise the 180/400 Foot Aquifer subbasin are present in the Forebay Aquifer subbasin, though the aquitard separating the two water bearing units in the northern subbasin is absent in the Forebay Aquifer subbasin. Groundwater in the Forebay Aquifer subbasin is unconfined and occurs in lenses of sand and gravel that are interbedded with massive units of finer grained material (DWR, 2003).

### **2.5 Upper Valley Aquifer**

The Upper Valley Aquifer subbasin occupies a stretch of the Salinas Valley groundwater basin from just south of Greenfield, CA to San Ardo, CA. The northern border of the Upper Valley Aquifer subbasin is shared with the Forebay Aquifer subbasin, while the southern border is shared with the Paso Robles Area subbasin.

Groundwater in the Upper Valley Aquifer subbasin is unconfined and is derived primarily from an aquifer of unconsolidated to semi-consolidated and interbedded gravel, silt, sand, and alluvial fan and river deposits (DWR, 2003).

### **2.6 Paso Robles Area**

The Paso Robles Area subbasin is partially located in Monterey County, though the majority of the subbasin is located in San Luis Obispo County. The Upper Valley Aquifer subbasin forms the northern boundary of the Paso Robles Area subbasin.



Groundwater in the Paso Robles Area subbasin is found in two formations: Holocene age alluvium and the Pleistocene age Paso Robles Formation. Groundwater in the fine- to coarse-grained sand, pebbles, and boulders of the alluvium is unconfined while groundwater in the Paso Robles Formation is generally confined (DWR, 2003).

The Paso Robles Groundwater Basin Computer Model (Model) has characterized flow in the basin using four vertical groundwater zones: one in the alluvium and three within the Paso Robles formation (SLOFCWD, 2014).

## **2.7 Langley Area**

The Langley Area subbasin is located in the northeastern part of the Salinas Valley groundwater basin. Portions of the Langley Area subbasin are underlain by granitic bedrock that is not considered to be a viable water-bearing unit. In the remaining areas of the Langley Area subbasin, the groundwater supply is derived from shallow, well-sorted sands separated by confining layers of interbedded clays and silty clays (DWR, 2003).

A study of hydrogeology in northern Monterey County was conducted by Fugro West, Inc. (Fugro) and included most of the Langley Area subbasin. The Fugro study further divided the subbasin, as it is defined by DWR, into hydrogeologic subareas using factors such as well yields, depth to bedrock, volume of groundwater storage, and sources of recharge (Fugro, 1995). Two of the hydrogeologic subareas defined by the Fugro study are coincident with approximately 75% of the Langley Area subbasin: Highlands South and Granite Ridge (Figure 2).

The Highlands South subarea consists of saturated Aromas Sands (interbedded sands, clay, and gravel) overlying the Purisima Formation (semi-consolidated units of fine sand, clay, and silt), which has not proved a viable aquifer (Fugro, 1995). The Highlands South hydrogeologic subarea, as defined by the Fugro report, covers approximately 46% of the Langley Area subbasin.

The Granite Ridge subarea is characterized by a thin layer of Aromas Sands overlying granitic bedrock or weathered granite. Wells in the Granite Ridge subarea are typically completed in either granular materials (Aromas Sands and weathered granite; fresh granite; or other consolidated formations (Fugro, 1995). Approximately 29% of the Langley Area is coextensive with the Granite Ridge subarea.

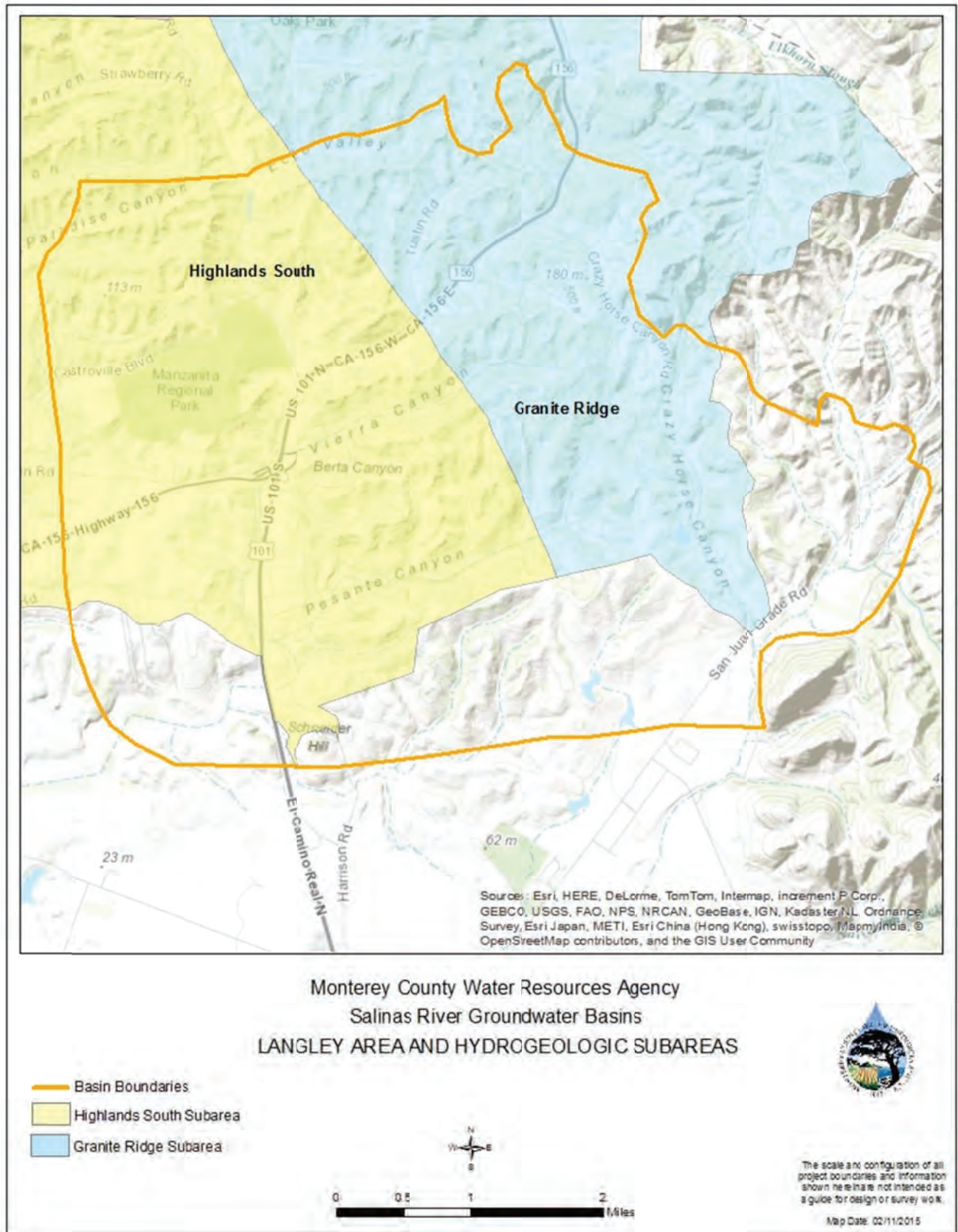
The transition between hydrogeologic conditions of the Highlands South and Granite Ridge subareas is gradual and occurs slightly east of the center of the Langley Area. The transition is characterized by the thinning of saturated sediments to the east, eventually thinning to the extent that the granitic bedrock is above regional saturation (Fugro, 1995).

## **2.8 Corral de Tierra Area**

The Corral de Tierra Area subbasin is located to the west of the 180/400 Foot Aquifer subbasin and contains portions of the former Fort Ord and other unincorporated areas. It is bounded to the northwest by the Seaside Area subbasin.

Groundwater in the Corral de Tierra Area subbasin comes primarily from the Paso Robles Formation, which consists of sand, gravel, and clay interbedded with minor calcareous beds. The poorly consolidated marine sandstone of the Santa Margarita Formation also yields water in the Corral de Tierra Area subbasin (DWR, 2003). A previous study which included the Corral de Tierra Area found that although there are thick sequences of low permeability material in some areas of the subbasin that may limit vertical hydraulic communication between aquifer units, a comparison of water level data shows general consistency between wells screened in different units (Geosyntec, 2007).

**Figure 2 – Langley Area Subbasin and Hydrogeologic Subareas**



## **3.0 Groundwater Level Monitoring**

The following sections discuss the history of groundwater level monitoring in the Salinas Valley groundwater basin; current monitoring activities in the basin; and the proposed network of CASGEM monitoring wells. Data gaps in the monitoring network are also identified and discussed.

### **3.1 Monitoring History**

Groundwater level measurements in the Salinas Valley groundwater basin have been ongoing, in some form, since the 1940s. Presently, MCWRA conducts monthly and annual surveys of groundwater levels to monitor fluctuations in water level and determine relative changes in storage over time. Data collected through the MCWRA groundwater level monitoring program also contributes to analysis of seawater intrusion in coastal groundwater zones.

MCWRA maintains a small network of dedicated monitoring wells where groundwater level data is recorded by a pressure transducer on an hourly basis. However, the distribution of the dedicated monitoring wells is limited; much of the groundwater level data is collected from privately-owned agricultural production wells where owners have granted permission to MCWRA. MCWRA collects groundwater level measurements from over four hundred wells on an annual basis; on a monthly basis, groundwater levels are measured in about one quarter of these wells.

### **3.2 Monitoring Network Rationale**

The CASGEM network is of a combination of dedicated monitoring wells that are owned by MCWRA and wells that are owned by private individuals who elected to participate in the CASGEM program.

The MCWRA-owned monitoring wells were selected for inclusion in the program due to their distribution throughout Monterey County, the availability of detailed and reliable well construction data, and relative ease of data collection.

In the selection of privately owned wells, preference was given to wells that are in the MCWRA monthly groundwater level monitoring program, since the minimum number of data points for CASGEM reporting are already being gathered. MCWRA also considered wells that are in the annual groundwater level monitoring program. Wells in the annual program are currently measured only once per year, so additional staff effort will be required to schedule a second visit in order to satisfy the biannual measurement criteria for CASGEM reporting.

Additional privately owned wells were sought in areas where dedicated monitoring wells are not available. MCWRA filled as many data gaps as possible with privately owned wells, working toward a target minimum density of 10 wells per 100 square miles of groundwater basin.

Approximately one third of the land in the Corral de Tierra Area is federal property. MCWRA has reached out to the United States Army Corps of Engineers (USACE), which owns the property, seeking participation in the CASGEM program (Appendix A). As of the date of this monitoring plan, USACE has not responded to MCWRA's letter. As such, the land owned by USACE is considered a

data gap in the Corral de Tierra Area. The following subbasin-specific discussions address data gaps in the MCWRA CASGEM network in more detail.

MCWRA considered the availability of reliable well construction data choosing CASGEM wells. Where appropriate, wells were also selected to provide coverage of vertically distinct aquifers.

<b>Table 2 - Recommended Monitoring Well Network Density by Subbasin</b>			
<b>Subbasin Name</b>	<b>Subbasin Area in Monterey County mi<sup>2</sup></b>	<b>Federal Land Area of Subbasin (mi<sup>2</sup>)</b>	<b>Wells Needed for Target Minimum Density</b>
<b>High and Medium Priority (10 wells per 100 mi<sup>2</sup>)</b>			
180/400 Foot Aquifer	132	0	13
East Side Aquifer	90	0	9
Forebay Aquifer	147	0	15
Upper Valley Aquifer	153	0	15
Paso Robles Area	221	0	22
Langley Area	24	0	2
Corral de Tierra Area	35	12	4
<b>Total wells in High and Medium Priority Subbasins</b>			<b>80</b>

### 3.3 CASGEM Monitoring Network and Data Gaps

This section describes the number and distribution of wells in the CASGEM monitoring network of each subbasin, identifies data gaps in some of the monitored subbasins, and outlines the approach for addressing data gaps where applicable.

As shown in Table 3, the CAS EM network meets the target minimum density in some subbasins, while additional wells are required in other subbasins in order to meet the target.

<b>Table 3 - CASGEM Network Compared to Target Minimum Density Numbers</b>				
<b>Subbasin Name</b>	<b>Target Minimum Density</b>	<b>CASGEM Wells</b>	<b>Voluntary Wells</b>	<b>Wells Remaining to Meet Target Minimum Density</b>
180/400 Foot Aquifer	13	22	1	0 <sup>a</sup>
East Side Aquifer	9	8	0	1
Forebay Aquifer	15	9	2	11 <sup>b</sup>
Upper Valley Aquifer	15	3	0	12
Paso Robles Area	22	1	0	21
Langley Area	2	3	0	0 <sup>c</sup>
Corral de Tierra Area	4	2	0	2
<b>TOTAL</b>	<b>80</b>	<b>48</b>	<b>3</b>	<b>47</b>
<b>Notes</b> (a) Additional wells will be sought to address a data gap in the vertical distribution of the well network as funding is available. (b) Forebay Aquifer CASGEM wells include multiple well clusters, so only four geographic locations are covered by the nine wells. (c) Additional wells will be sought to address data gaps in horizontal distribution of the well network as funding is available.				



### 3.3.1 180/400 Foot Aquifer

The CASGEM well network for the 180/400 Foot Aquifer subbasin is shown on Figure 3. MCWRA has fifteen (15) dedicated monitoring wells in the 180/400 Foot Aquifer subbasin, all of which will be included in the CASGEM network. Some of the monitoring wells consist of clusters of multiple nested wells at a single location, with each well in the cluster monitoring a different aquifer. The CASGEM well network includes seven (7) privately owned wells; where the well owner has granted permission for MCWRA to include his/her well in the CASGEM program. There is also one (1) voluntary well in the 180/400 Foot Aquifer subbasin.

#### *Data Gaps – Horizontal Distribution of Wells*

The 180/400 Foot Aquifer subbasin is 132 square miles. Based on the target minimum density of ten (10) wells per 100 square miles, this subbasin should have 13 monitoring wells to meet the needs of the CASGEM program. MCWRA has met the target minimum density in the 180/400 Foot Aquifer subbasin with a network distributed throughout the basin, as shown in Figure 3.

#### *Data Gaps – Vertical Distribution of Wells*

As discussed in Section 2.2, the 180/400 Foot Aquifer subbasin has three distinct water-bearing zones, each separated by a blue marine clay aquitard. All three aquifers will be monitored by the wells in the CASGEM network, as shown in Table 4.

<b>Table 4 - Vertical Distribution of Wells in 180/400 Foot Aquifer</b>			
<b>Aquifer Zone</b>	<b>Dedicated Monitoring Wells</b>	<b>Privately Owned CASGEM Wells</b>	<b>Total Wells</b>
180-Foot Aquifer	8	1	9
400-Foot Aquifer	3	5	8
180/400 Foot Aquifers	4	0	4
Deep Aquifer	0	1	1
<b>TOTAL</b>	<b>15</b>	<b>7</b>	<b>22</b>

As shown in Table 4, eight (8) of the MCWRA dedicated monitoring wells are constructed with screens in the 180-Foot Aquifer, as is one (1) of the privately owned wells. Three (3) of the MCWRA monitoring wells are constructed with screens in the 400-Foot Aquifer, as are five (5) of the privately owned wells. Groundwater elevations in the Deep Aquifer will be monitored at one (1) well location where permission has been granted by the well owner.

Two sets of the MCWRA dedicated monitoring wells (four total wells) are constructed in areas recognized as hydrogeologic transition zones between the 180/400 Foot Aquifer and the East Side Aquifer, and between the 180/400 Foot Aquifer and the Forebay Aquifer. The transition zone between the 180/400 Foot Aquifer and the East Side Aquifer is distinguished by a shift from predominantly fluvial facies, common to the 180/400 Foot Aquifer, to predominately alluvial fan facies (Kennedy/Jenks, 2004). The transition from the 180/400 Foot Aquifer to the Forebay Aquifer

is characterized by thinning and/or pinching out of the near surface confining unit, the Salinas Aquitard (DWR, 2003).

Although the site-specific geology at these monitoring wells suggests that the wells are more representative of the East Side Aquifer or Corebay Aquifer, MCWRA has assigned these four wells to the 180/400 foot Aquifer subbasin because they are geographically located in this basin, as directed by DWR (staff communication, 2015). If an opportunity arises in the future to adjust the groundwater basin/subbasin boundaries, wells like these will be useful for defining transitional zones and aligning basin boundaries with known hydrogeology.

Though MCWRA has met the target minimum density in the 180/400 foot Aquifer, there is only one well monitoring the Deep Aquifer Zone, which suggests a data gap in the CAS-EM network. MCWRA will address this data gap by evaluating the possibility of including new privately owned wells in the CASGEM program, and will reach out to well owners seeking participation when an appropriate well is found. Additionally, while there are no funds accessible at present to drill new monitoring wells, MCWRA will consider this option if funding becomes available.

### **3.3.2 East Side Aquifer**

The CAS-EM network for the East Side Aquifer subbasin is shown on Figure 4. MCWRA has two (2) dedicated monitoring wells in the East Side Aquifer subbasin, both of which will be included in the CASGEM network. The CASGEM well network also includes six (6) privately owned wells in the East Side Aquifer subbasin.

#### *Data Gaps – Horizontal Distribution of Wells*

The East Side Aquifer subbasin has an approximate area of 90 square miles, suggesting that the subbasin should have nine (9) monitoring wells to meet the CASGEM program target minimum density. The CASGEM network in this monitoring plan, which consists of eight (8) wells, is one well short of this target minimum density.

There remains an area in the central portion of the subbasin of approximately 26 square miles (29% of the subbasin area) where there are no monitoring wells. MCWRA continues to seek suitable privately owned wells in this area for inclusion in the CASGEM program. Additionally, as funding opportunities become available, MCWRA will consider the installation of new monitoring wells in this area of the East Side Aquifer subbasin.

#### *Data Gaps – Vertical Distribution of Wells*

Groundwater in the East Side Aquifer is semi-confined to unconfined, as discussed in Section 2.3 of this document. For purposes of monitoring in this subbasin, MCWRA distinguishes the unconfined (shallow) portion of the aquifer from the semi-confined (deeper) portion, though there is not a continuous confining layer present at all locations within the subbasin.

Recognizing this distinction, the East Side Aquifer CASGEM network includes wells that are screened in both unconfined and semi-confined water-bearing zones: two (2) of the wells are screened in the shallow zone and one (1) is screened in the deeper zone.

Five (5) of the wells in the CASGEM network have screens in both zones. These wells have been included in the CASGEM network because there are few MCWRA program wells (i.e. potential CASGEM wells) in this subbasin that are screened in a discrete aquifer zone. Despite having screened intervals in both the shallow and deep zones, viable groundwater elevation data can be gleaned from these wells. Trends in the groundwater elevation data from these dual-screened wells is compared to that from wells that are screened in a discrete zone, and professional judgment is used to determine which zone is best represented by the dual-screened well and how the data fits with overall data trends seen in other wells across the basin.

MCWRA will evaluate the possibility of including additional privately owned wells, including ones that may not currently be in a monitoring program, to resolve data gaps in the East Side Aquifer. Preference will be given to wells that are screened in a single water-bearing zone. As funding becomes available, the option to install new monitoring wells will also be considered.

### **3.3.3 Forebay Aquifer**

The CASGEM network for the Forebay Aquifer subbasin is shown on Figure 5. MCWRA has nine (9) dedicated monitoring wells in the Forebay Aquifer subbasin, all of which will be included in the CASGEM network. The nine (9) monitoring wells cover four (4) geographic locations within the basin, divided as follows: three (3) clusters of two (2) nested wells each and one (1) cluster of three (3) nested wells. The Forebay Aquifer subbasin also includes two (2) voluntary wells.

#### *Data Gaps – Horizontal Distribution of Wells*

The Forebay Aquifer subbasin is approximately 147 square miles, indicating a need for 15 monitoring wells in order to achieve the target minimum density. For the purposes of horizontal distribution, the CASGEM network in the Forebay Aquifer subbasin will cover four (4) locations due to the nested construction at some of the monitoring well pairs. An additional 11 wells are required to meet the target minimum density for this subbasin.

MCWRA does not currently have funding to support installation of an additional 11 monitoring wells in the Forebay Aquifer subbasin. However, as funding opportunities become available, MCWRA will review the possibility of installing additional wells to address data gaps in the CASGEM network. In the meantime, MCWRA will continue to evaluate existing privately owned wells and, as deemed appropriate, entreat the permission of the well owners for inclusion of more wells into the CASGEM network.



#### *Data Gaps – Vertical Distribution of Wells*

The Forebay Aquifer is considered to be an unconfined aquifer. As such, there are no data gaps in the vertical distribution of the CASGEM network. The current wells, and any additional wells that may be incorporated in the future, will be monitoring the same vertical water-bearing zone.

#### **3.3.4 Upper Valley Aquifer**

The CASGEM network for the Upper Valley Aquifer subbasin is shown on Figure 6. The CASGEM network will include the three 3) wells: one 1) dedicated monitoring well owned by MCWRA in the Upper Valley Aquifer subbasin and two (2) privately owned wells.

#### *Data Gaps – Horizontal Distribution of Wells*

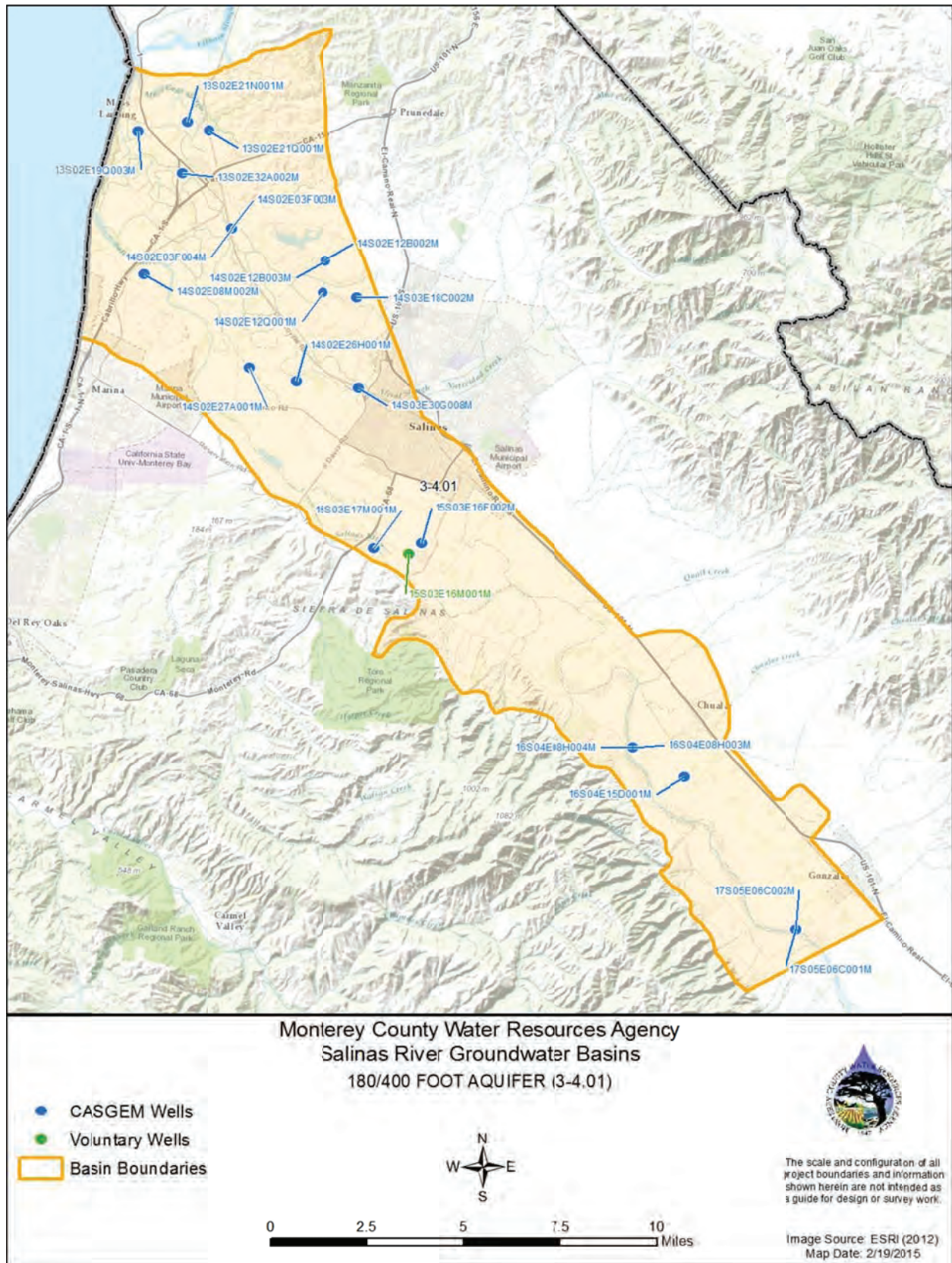
The Upper Valley Aquifer subbasin is 153 square miles; therefore, 15 monitoring wells are required to meet the target minimum density for the subarea. To meet this target, the Upper Valley Aquifer subbasin will require an additional 12 wells.

MCWRA does not currently have plans or funding to install any additional monitoring wells in the Upper Valley Aquifer subbasin to alleviate the data gap in this subbasin. However, should funding become available, MCWRA will explore the installation of dedicated monitoring wells where data gaps exist in the CAS EM network. Until such funding becomes available, MCWRA will seek additional participation from private well owners whose wells are deemed suitable to achieve the needs of the CASGEM program.

#### *Data Gaps – Vertical Distribution of Wells*

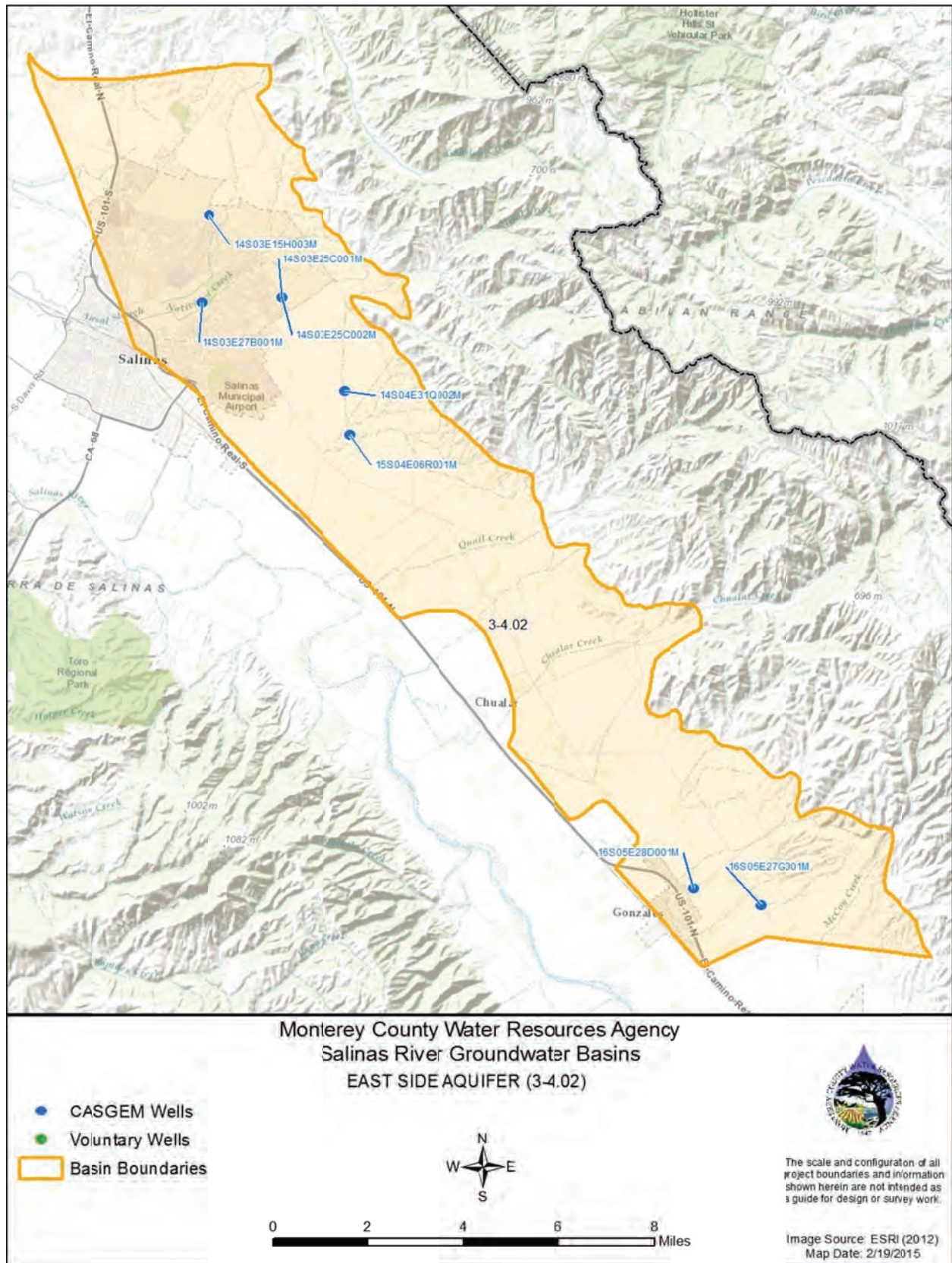
The Upper Valley Aquifer is considered to be an unconfined aquifer. As such, there are no data gaps in the vertical distribution of the CAS EM network. The current wells, and any additional wells that may be incorporated in the future, will be monitoring the same vertical water-bearing zone.

Figure 3 - 180/400 Foot Aquifer Subbasin





**Figure 4 – East Side Aquifer Subbasin**





**Figure 5 – Forebay Aquifer Subbasin**

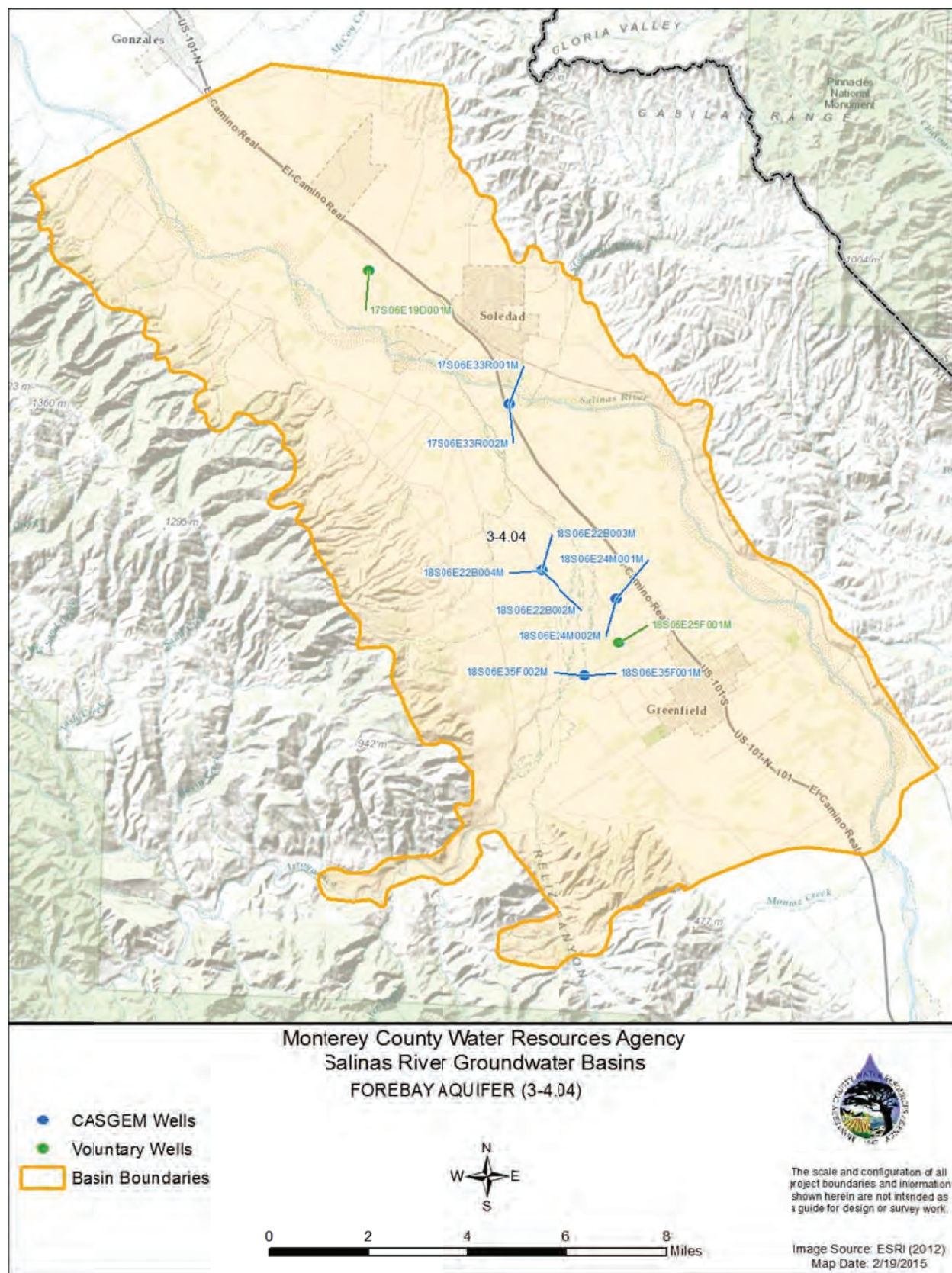
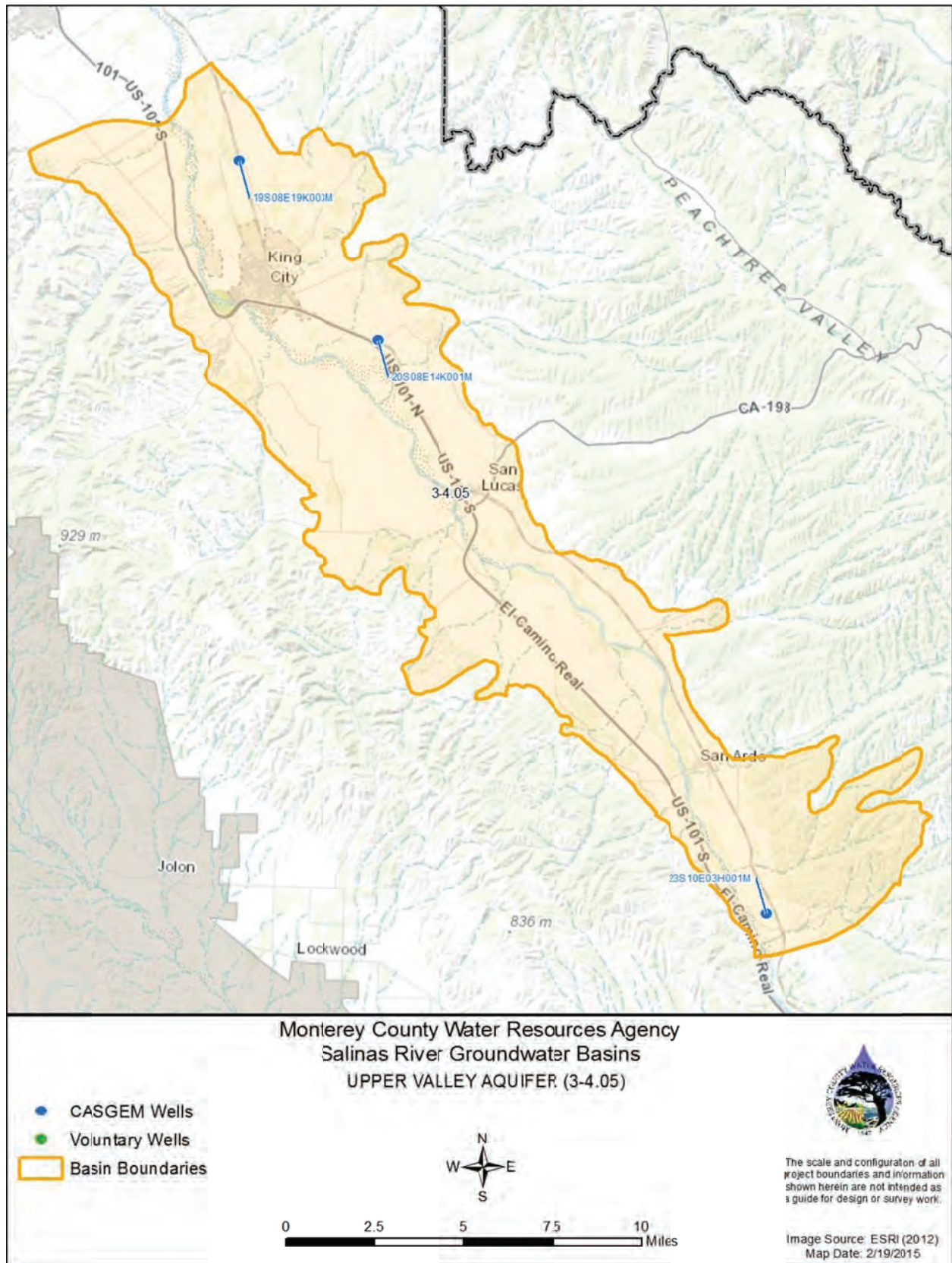




Figure 6 – Upper Valley Aquifer Subbasin



### 3.3.5 Paso Robles Area

The Paso Robles Area subbasin is located in both Monterey and San Luis Obispo counties, as shown on Figure 7. The subbasin is split by the county lines, with approximately 221 square miles of the Paso Robles Area located in Monterey County. Based on the area within Monterey County, 22 monitoring wells would be required to meet the target minimum density for the subarea. The remainder of the Paso Robles Area subbasin will be monitored by the San Luis Obispo County Flood Control & Water Conservation District.

MCWRA has one (1) dedicated monitoring well in the Paso Robles Area subbasin, which will be included in the CASGEM network (Figure 7). The San Luis Obispo County portion of the Paso Robles Area is currently monitored by fourteen (14) wells, as shown on Figure 7 (SLOCFCWD, 2014); one of these wells is very close to the Monterey County/San Luis Obispo County line.

MCWRA does not currently have plans or funding to install any additional monitoring wells in the Paso Robles Area Subbasin, though if funding becomes available, the construction of new monitoring wells will be explored as a mechanism for addressing this data gap in the CASGEM network. Consideration will be given to the San Luis Obispo County CASGEM network when evaluating installation of new wells or incorporation of privately owned wells from the subbasin in the CASGEM network, as it is monitoring of the basin as a whole that is the priority.

#### *Data Gaps – Horizontal Distribution of Wells*

With only one well located in the Paso Robles Area, there is a data gap to address in this subbasin; 21 additional wells are required to meet the target minimum density. MCWRA will continue to investigate the possibility of locating privately owned wells for the CASGEM program, while also considering the installation of additional monitoring wells should a funding mechanism become available. As discussed above, the existing CASGEM network in the San Luis Obispo County portion of the subbasin will be considered when evaluating augmentation of the monitoring network in the Monterey County portion of the subbasin.

#### *Data Gaps – Vertical Distribution of Wells*

As discussed in Section 2.6 of this Monitoring Plan, the Paso Robles Groundwater Basin Computer Model (Model) has characterized flow in the basin using four vertical groundwater zones: one in the alluvium and three within the Paso Robles Formation (SLOCFCWD, 2014).

The one monitoring well that currently comprises the CASGEM network in this subbasin is monitoring the unconfined alluvial unit. Any future wells that are brought into the CASGEM program will be evaluated and selected with consideration given to the zone that is monitored by the well. Similarly, any new monitoring wells that may be installed in this area will be designed such that all of the zones defined by the Model are monitored.

### **3.3.6 Langley Area**

The Langley Area subbasin is approximately 24 square miles in area. Based on the target minimum density, the CASGEM network for this subbasin should include two (2) wells. MCWRA does not have any dedicated monitoring wells in the Langley Area subbasin, but three (3) CASGEM wells have been located for this subbasin (Figure 8).

#### *Data Gaps – Horizontal Distribution of Wells*

The three (3) CASGEM wells in the Langley Area are located in the eastern half of the subbasin, leaving a data gap in the western portion of the subbasin, near the boundary with the 180/400 foot Aquifer subbasin. MCWRA has identified possible privately owned wells that are located in the data gap area and continues to work with the well owners toward inclusion of these wells in the CAS EM program. In addition, should funding become available, MCWRA will consider this area as a candidate for installation of new monitoring wells.

#### *Data Gaps – Vertical Distribution of Wells*

The dominant water-bearing unit in the Langley Area is the Aromas Red Sands. Based on the depth of the CASGEM wells, the Aromas Red Sands are being monitored, so there are no apparent vertical data gaps to address. Other geologic units present in the Langley Area are neither alluvial nor considered to be water-bearing.

### **3.3.7 Corral de Tierra Area**

The Corral de Tierra subbasin is approximately 35 square miles in area, so four (4) monitoring wells are required to meet the target minimum density for the subarea. MCWRA does not have any dedicated monitoring wells in the Corral de Tierra subbasin; however, MCWRA has identified two (2) CASGEM wells in this subbasin (Figure 9).

#### *Data Gaps – Horizontal Distribution of Wells*

Land that is part of the former Fort Ord, now owned by the United States Army Corps of Engineers (USACE), occupies the northwestern, and part of the northeastern, areas in the Corral de Tierra Area subbasin. MCWRA has contacted USACE seeking their participation in the CAS EM program, but has yet to receive a response (Appendix A). MCWRA cannot access the USACE land, therefore, the CASGEM network will be limited to the eastern/southeastern areas of the subbasin. The two (2) CAS EM wells are located in the south-central part of the Corral de Tierra Area, leaving a data gap in the eastern part of the subbasin.

Though MCWRA does not currently have funding to install any additional monitoring wells in the Corral de Tierra Area subbasin, this will be explored as a possibility if funding becomes available. MCWRA has been unable to secure approval for participation from the well owners contacted in this portion of the subbasin, but staff continues to look for privately owned wells and will assess the feasibility of incorporating such wells into the CASGEM network as a means of addressing data

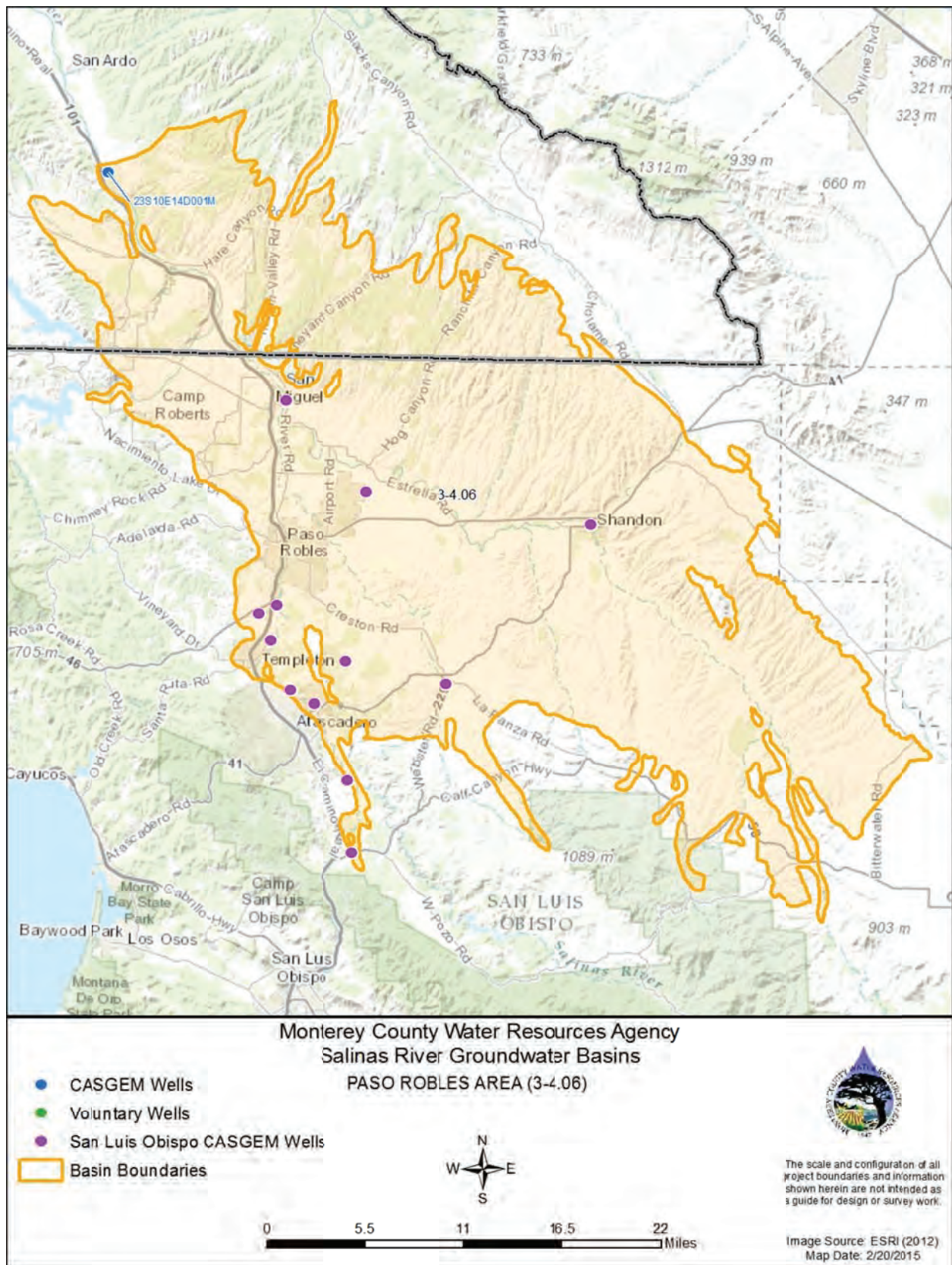
gaps. In addition, MCWRA will coordinate with USACE if that agency becomes willing to allow access to wells on the federal land at some point in the future.

#### *Data Gaps – Vertical Distribution of Wells*

Previous studies indicate that there is no significant limitation on vertical communication between the two water-bearing units in this subbasin and that wells screened in both units exhibit similar water levels (Geosyntec, 2007). Any additional wells added to the network to address horizontal data gaps will simply enhance monitoring of the same units.

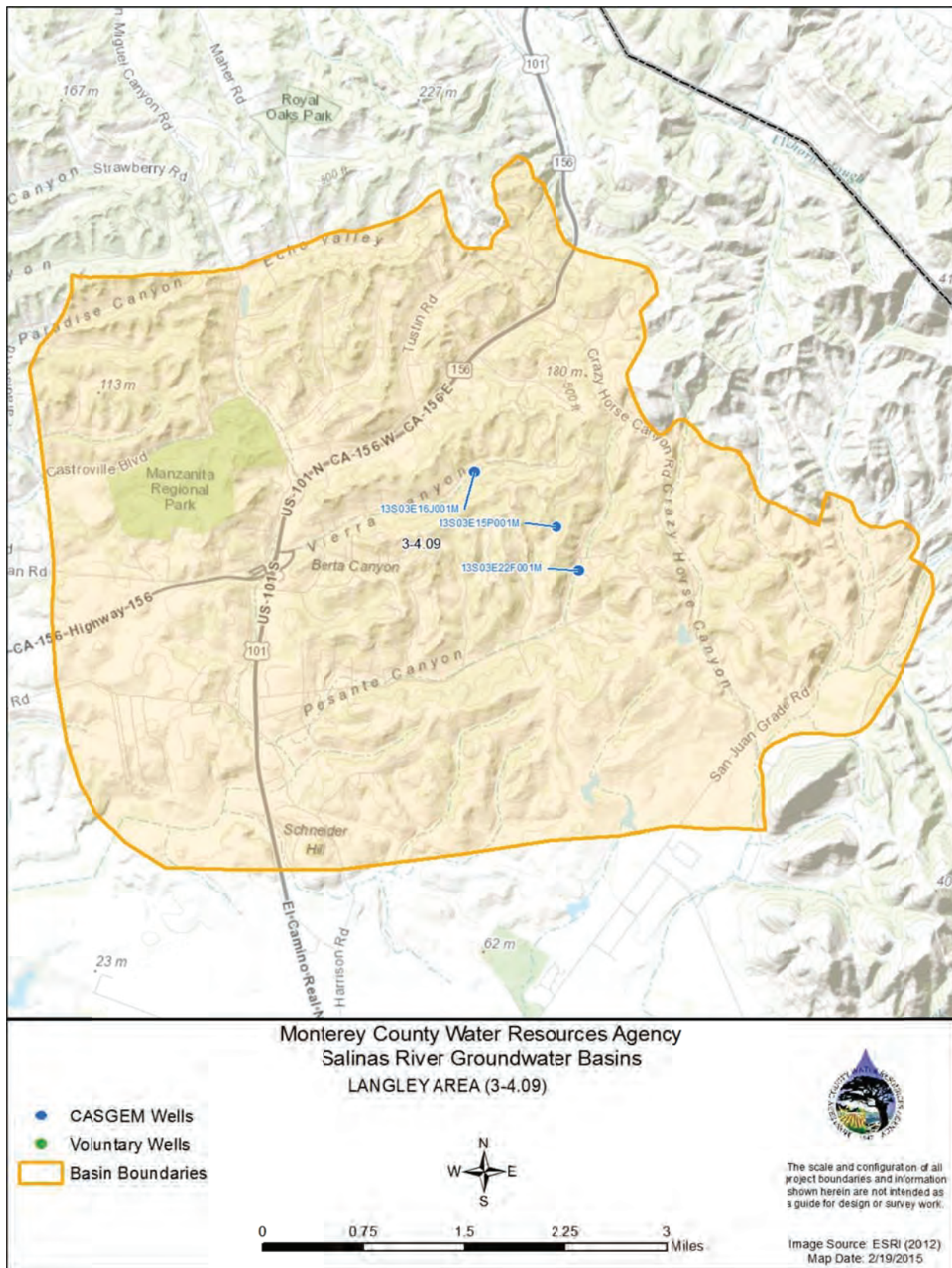


**Figure 7 – Paso Robles Area Subbasin**



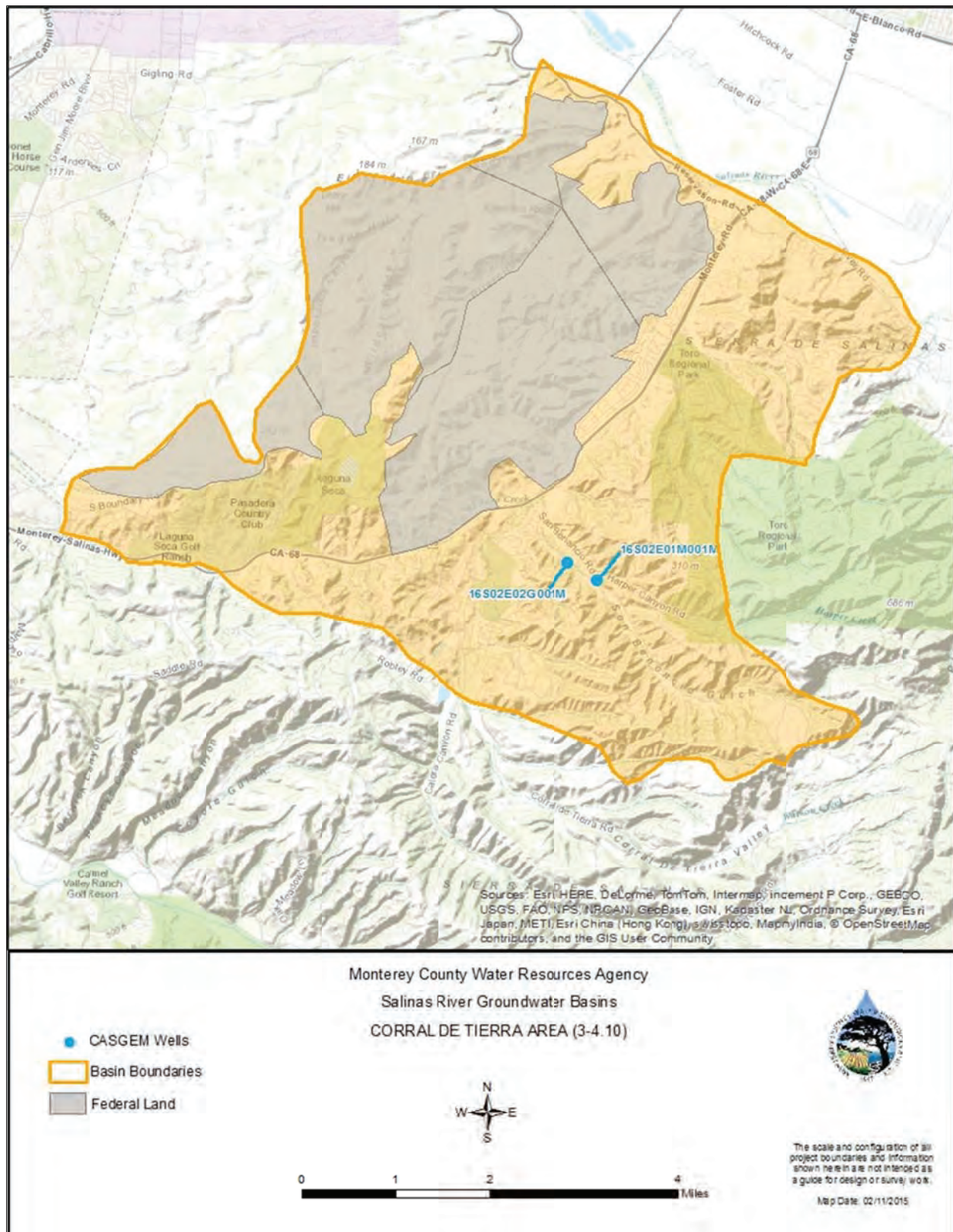


**Figure 8 - Langley Area Subbasin**





**Figure 9 - Corral de Tierra Area Subbasin**



## 4.0 Monitoring Procedures

This section addresses the various procedures and protocols involved in collecting, processing, and reporting data from wells in the CASGEM network.

### 4.1 Monitoring Frequency and Timing

Nineteen (19) of the CAS EM wells are currently, and will continue to be, measured on a monthly basis. The three (3) voluntary wells are also measured monthly. MCWRA will use the monthly measurements from August and either January, February, or March to satisfy the biannual CAS EM reporting criteria.

To determine the monthly distribution of seasonal high and low groundwater elevations, MCWRA analyzed measurements from approximately 50 wells throughout the Salinas Valley Groundwater Basin. This included wells in the 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer. The measurements were collected during eight (8) different Water Years (WY): WY 1985, representative of near normal conditions; WY 1991, representative of dry conditions; and the six most recent Water Years, WY 2009 through WY 2014. MCWRA reports this data on a quarterly basis; a sample report is included in Appendix B.

Based on this analysis of historical data, August is typically representative of seasonal low conditions (Figure 10). A relaxation of groundwater levels, or seasonal high conditions, is evident during the period from January to March (Figure 11). Data from these three months will be evaluated and the highest groundwater elevation from that series will be submitted to the CAS EM online submittal system. The month chosen to be representative of the seasonal high groundwater conditions will be consistent across all data groups.

Nineteen (19) of the CASGEM wells are equipped with pressure transducers which collect depth to water data on an hourly basis. This data will be synthesized so that biannual measurements representing seasonal high and low conditions are available for CASGEM reporting. The groundwater level measurement collected at noon on the fifteenth day of the month will be selected and compared to other monthly data to ensure that it is a representative value. Data from the month of August will be used to represent the seasonal low and a fall/winter measurement from either January, February, or March will be used to represent the seasonal high; the same month will be used as was selected based on monthly well measurements, as discussed above.

Four (4) of the wells in the CAS EM network are currently measured once per year, during the period from November to January. Based on the recent analysis of seasonal groundwater highs, this period will be shifted to cover the months from January through March. An additional measurement event will be added during the month of August for these wells in order to also capture the seasonal groundwater low.

Appendix C contains a summary of the frequency and timing of measurement of wells in the CASGEM network. Any new wells that are brought into the CASGEM program will be monitored on a

biannual basis, with data collection occurring on the same schedule as the other wells that are measured twice a year.

## **4.2 Well Locations**

The latitude and longitude of each well was collected using a handheld GPS unit, which has accuracy to within one (1) meter. Coordinates for wells in the CASGEM network are shown in Appendix A. Any wells incorporated into the CAS EM network in the future will be geographically located using a similar method.

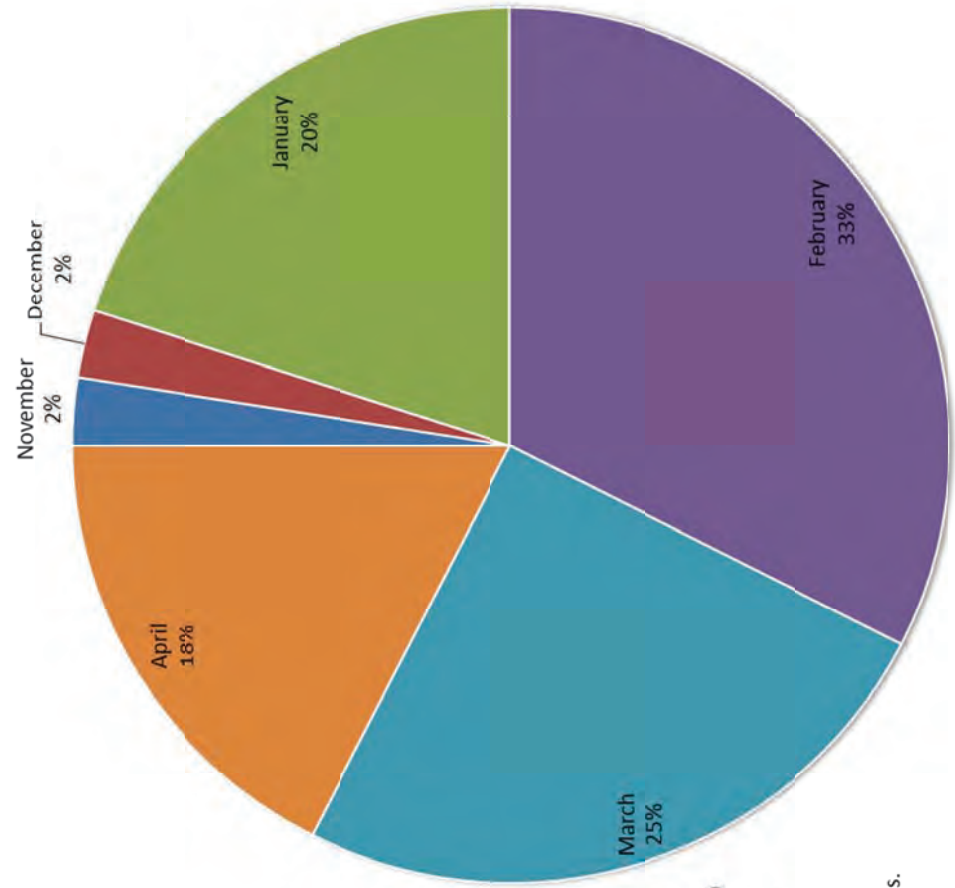
## **4.3 Reference Points**

All of the wells that comprise the CASGEM network described herein are currently part of a groundwater level monitoring program conducted by MCWRA. As part of the existing monitoring programs, reference points (RP) have been established for all of the wells. To ensure consistency in measuring depth to water, a description of each well's RP is recorded in a field data collection notebook. In many cases, photographs have also been taken of the RP. Reference point elevations have been determined for all wells that are currently in a monitoring program; this data is listed in Appendix A.

A reference point will be determined for any new wells that are brought into the CASGEM network. Reference point elevations are determined using a digital elevation model from the United States Geological Survey (USGS) with a cell size of 32 feet by 32 feet.

**Figure 10 – Distribution of Seasonal High Groundwater Elevations by Month**

### Distribution of Seasonal High Groundwater Elevations by Month

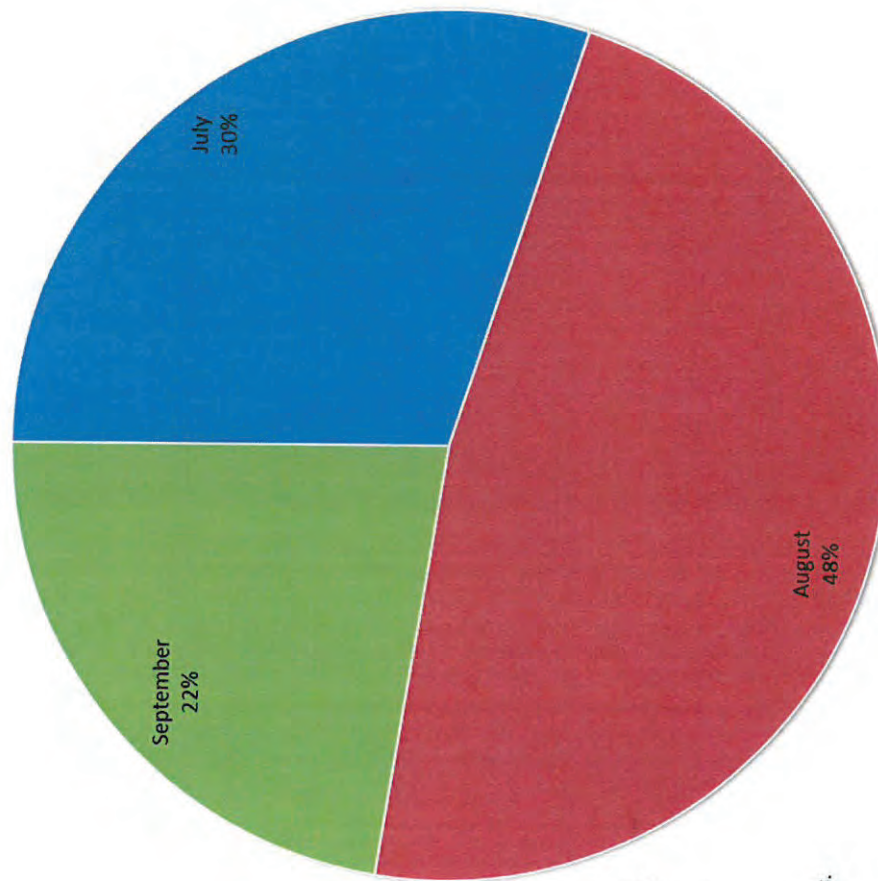


**Notes**  
 (1) Chart reflects data from the following subbasins of the Salinas Valley Groundwater Basin: 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer.  
 (2) Water Years 1985, 1991, and 2009-2014 were used in this analysis. These years represent near normal conditions (WY85), dry conditions (WY91), and the six most recent water years.



**Figure 11 – Distribution of Seasonal Low Groundwater Elevations by Month**

### Distribution of Seasonal Low Groundwater Elevations by Month



#### Notes

(1) Chart reflects data from the following subbasins of the Salinas Valley Groundwater Basin: 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer.

(2) Water Years 1985, 1991, and 2009-2014 were used in this analysis. These years represent near normal conditions (WY85), dry conditions (WY91), and the six most recent water years.

## 4.4 Field Methods

Groundwater elevation data collected from wells in the CASGEM network is intended to reflect static conditions. Best efforts will be made to ensure that wells have not recently been pumped prior to collecting a data point. Depth to water measurements will be made using one or more of the methods discussed in the following sections. Measurement methods described in the following sections are based on the Department of Water Resources document *Groundwater Elevation Monitoring Guidelines* (December 2010) with some alterations specific to wells in the monitored basins/subbasins described in this Monitoring Plan.

### 4.4.1 Graduated steel tape

Prior to measurement:

- Ensure that the reference point on the well can be clearly determined. Check notes in the field data collection notebook.
- Review the notes and comments for previous measurements in the field data collection notebook to determine if there are any unique circumstances at this well.
- Take note of whether oil has previously been present at this well; this will be recorded in the comments section of the data form.

Making a measurement:

- Use the previous depth to water measurement to estimate a length of tape that will be needed.
- Lower the tape into the well, feeling for a change in the weight of the tape, which typically indicates that either (a) the tape has reached the water surface or (b) the tape is sticking to the side of the well casing.
- Continue lowering the tape into the well until the next whole foot mark is at the reference point. This value on the tape should be recorded in the field data collection notebook.
- Bring the tape to the surface and record the number of the wetted interval to the nearest foot.
- If an oil layer is present, read the tape at the top of the oil mark to the nearest foot. Note in the comments section of the data form that oil was present.
- Repeat this procedure a second time and note any differences in measurement in the field data collection notebook.

### 4.4.2 Electric water level meter

This method of measurement employs a battery-powered water level meter and a small probe attached to a ruled length of cable. Depth to water measurements collected using this equipment are recorded to the nearest tenth of an inch. This instrument is sometimes referred to as a “sounder”.

Prior to measurement:

- Review the field data sheet for the well and note whether oil has been present at this well in the past. The electric water level meter should not be used in wells where oil is present.
- Ensure that the reference point on the well can be clearly determined. Check notes in the field data collection notebook.
- Confirm that the water level meter is functioning and is turned on so that the beeping indicator will operate properly.

Making a measurement:

- Review previous depth to water measurements for the well to estimate the length of tape that will be needed.
- Lower the electrode into the well until the indicator sounds, showing the probe is in contact with the water surface.
- Place the tape against the reference point and read the depth to water to the nearest 0.1 foot. Record this value on the field data sheet.
- Make a second measurement and note any differences in measurement in the field data collection notebook.

#### **4.4.3 Sonic water level meter**

This meter uses sound waves to measure the depth to water in a well. The meter must be adjusted to the air temperature outside the well; there is a card with reference temperatures in the case with the sonic meter.

Making a measurement:

- Insert the meter probe into the access port and push the power-on switch. Record the depth from the readout.
- Record the depth to water measurement in the field data collection notebook.

#### **4.4.4 Pressure transducer**

Automated water-level measurements are made with a pressure transducer attached to a data logger. Pressure transducers are lowered to a depth below the water level in the well and fastened to the well head at a reference point. Data points are logged on an hourly basis. MCWRA uses factory-calibrated, vented pressure transducers (Appendix D). MCWRA staff collects the pressure transducer data once per quarter. During the data collection process, data loggers are stopped, and the data is downloaded onto a laptop, and then the data logger is reactivated and scheduled to begin collecting data again on the next hour. Upon return from the field, data is processed and reviewed for errors.

#### 4.5 Data Collection, Processing, and Reporting

Following completion of all fieldwork, data is transcribed from field data sheets and checked for errors before being loaded into MCWRA's Oracle platform database. All data will be stored in the MCWRA database before being uploaded to the CASGEM website. Submittal of data to the CASGEM website will occur at a minimum of twice per year, no later than January 1 and July 1, per DWR CASGEM program guidelines.

Bi-annual submittal of data to the CAS EM website will include the following for each well in the CASGEM network, as described in the DWR document *CASGEM Procedures for Monitoring Entity Reporting*:

- Well identification number
- Measurement date
- Reference point and land surface elevation, in feet, using NAVD88 vertical datum
- Depth to water, in feet
- Method of measuring water depth
- Measurement quality codes
- Measuring agency identification
- Comments about measurement, if applicable

The following information will also be submitted to the CAS EM online system, as it is required by DWR unless otherwise noted:

- Monitoring Entity name, address, telephone number, contact person name and email address, and any other relevant contact information
- Groundwater basins being monitored (both entire and partial basins)
- State Well Identification number (recommended)
- Decimal latitude/longitude coordinates of well (NAD83)
- Groundwater basin or subbasin
- Reference point elevation of the well, in feet, using NAVD88 vertical datum
- Elevation of land surface datum at the well, in feet, using NAVD88 vertical datum
- Use of well
- Well completion type (e.g. single well, nested well, or multi-completion well)
- Depth of screened interval(s) and total depth of well, in feet, if available
- Well Completion Report number (DWR Form 188), if available

## 5.0 References

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# Appendix A

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# MONTEREY COUNTY

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Fort Ord BRAC Office  
PO Box 5008  
Monterey, CA 93944-504

February 13, 2015

Dear Mr. Eisen:

On behalf of the Monterey County Water Resources Agency (MCWRA) I am writing to request the U.S. Army Corps of Engineers' voluntary participation in the California Statewide Groundwater Elevation Monitoring (CASGEM) program.

On November 4, 2009, the State Legislature amended the California Water Code with Senate Bill SBx7-6, which resulted in development of the CASGEM program by the California Department of Water Resources (DWR). As part of the CASGEM program, MCWRA is the designated Monitoring Entity for certain groundwater basins in Monterey County, including the Salinas Valley Groundwater Basin.

The U.S. Army Corps of Engineers (USACE) owns multiple parcels of land, specifically portions of the former Fort Ord, which are located in the Salinas Valley Groundwater Basin. MCWRA is seeking USACE's voluntary participation in the CASGEM program because the existing monitoring well network does not extend to this area of the groundwater basin.

MCWRA has no specific knowledge as to the location of monitoring wells on USACE property, so consent to participate in the CASGEM program would require disclosure of well information and either permission for MCWRA to access these wells or an arrangement wherein USACE would provide data to MCWRA. If USACE is considering participation, MCWRA can discuss this in more detail as needed.

As part of the CASGEM program, MCWRA would submit certain data about USACE wells to DWR for inclusion in a statewide database. The database will be available to the public for local and state entities to evaluate and monitor groundwater conditions. MCWRA will report the following to DWR for any well included in the CASGEM program:

- Depth to static (non-pumping) groundwater level, reported two times per year, beginning in 2015
- Approximate well location, within 1,000 feet of the actual well location
- Screened interval(s) and depth of the well as provided on the well log
- General category of well use (i.e. monitoring, public supply, domestic)

MCWRA sincerely appreciates your consideration of voluntary participation in the CASGEM program. Please feel free to contact MCWRA at 831-755-4860 if you have any questions. Additional information about the CASGEM program is also available from DWR at [www.water.ca.gov/groundwater/casgem](http://www.water.ca.gov/groundwater/casgem).

Regards,

A handwritten signature in blue ink that reads "David E. Chardavoyne". The signature is fluid and cursive, with the first name "David" being the most prominent.

David E. Chardavoyne  
General Manager

*Cc: California Department of Water Resources - C. Michael McKenzie, PG*

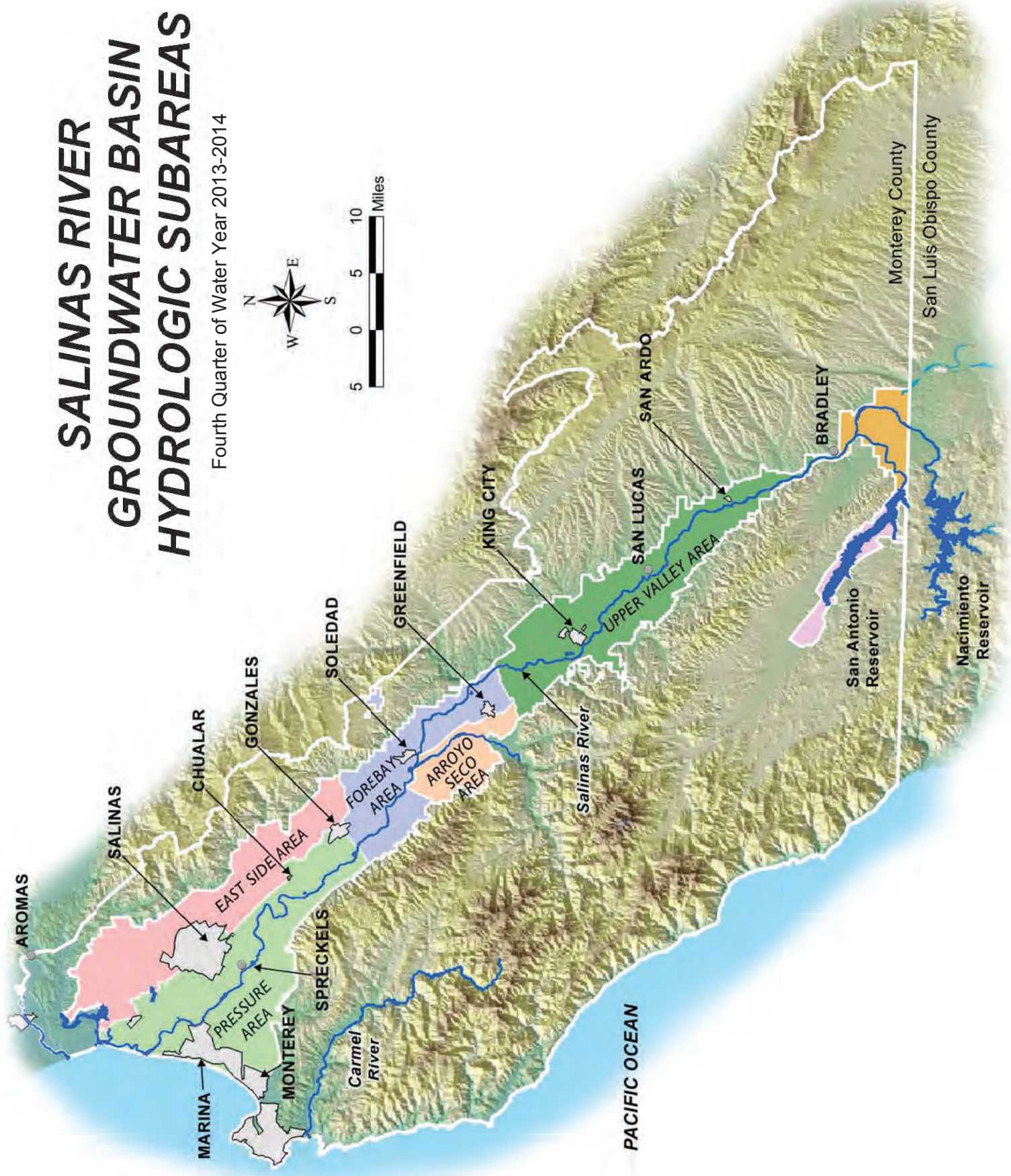
## Appendix B

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# SALINAS RIVER GROUNDWATER BASIN HYDROLOGIC SUBAREAS

Fourth Quarter of Water Year 2013-2014



**MONTEREY COUNTY WATER RESOURCES AGENCY  
BOARD OF DIRECTORS**

<b>MEETING DATE:</b>	October 27, 2014	<b>AGENDA ITEM:</b>	
<b>AGENDA TITLE:</b>	RECEIVE REPORT ON SALINAS VALLEY WATER CONDITIONS FOR THE FOURTH QUARTER OF WATER YEAR 2013-2014		
<div>Consent ( X )                      Action (   )                      Information (   )</div>			
<b>SUBMITTED BY:</b>	Robert Johnson	<b>PREPARED BY:</b>	Peter Kwiek, Jess Barreras
<b>PHONE:</b>	755-4860	<b>PHONE:</b>	755-4860
<b>DEADLINE FOR BOARD ACTION:</b>		October 27, 2014	

**RECOMMENDED BOARD ACTION:**

Receive report on Salinas Valley water conditions for the fourth quarter of Water Year 2013-2014.

**PRIOR RELEVANT BOARD ACTION:**

A report was last presented to the Board on September 22, 2014, covering the third quarter of Water Year 2013-2014.

**DISCUSSION/ANALYSIS:**

This report covers the fourth quarter of Water Year 2013-2014 (WY14), July through September, 2014. It provides a brief overview of water conditions in the Salinas Valley with discussion of precipitation, reservoir storage, and ground water level trends. Data for each of these components are included as graphs and tables in Attachments A through I.

**Precipitation** – The fourth quarter of WY14 brought less than normal rainfall to Salinas and King City. Cumulative totals for the quarter were 0.11 inches (55% of normal rainfall for the quarter) at the Salinas Airport, while no measurable rainfall was logged in King City, which, on average, receives a total of 0.17 inches during the months of July through September.

Attachment A contains graphs for both stations showing monthly and cumulative precipitation data for the current and a normal water year. Tables with precipitation values shown on the graphs and percent of normal precipitation are also presented in Attachment A.

Rainfall data for Salinas and King City should be considered preliminary until verified by National Weather Service data at a later date.

**Reservoirs** - The following table compares fourth quarter storage at Nacimiento and San Antonio reservoirs for the past two years. Storage in Nacimiento Reservoir is 46,763 acre-feet lower than in September 2013, while storage in San Antonio Reservoir is 8,547 acre-feet lower.

<b>Reservoir</b>	<b>September 30, 2014 (WY14) Storage in acre-feet</b>	<b>September 30, 2013 (WY13) Storage in acre-feet</b>	<b>Difference in acre-feet</b>
Nacimiento	63,850	110,613	-46,763
San Antonio	12,266	20,813	-8,547

Graphs for both reservoirs showing daily storage for the last five water years and average daily storage are included as Attachments B and C.

**Ground Water Levels** – More than 80 wells are measured monthly throughout the Salinas Valley to monitor seasonal ground water level fluctuations. Data from approximately 50 of these wells is used in the preparation of this report. The measurements are categorized by hydrologic subarea, averaged, and graphed to compare current water levels with selected past conditions. Graphs for individual subareas, showing the current year's water level conditions, last year's conditions (WY13), dry conditions (WY91), and near-normal conditions (WY85), are found in Attachments D through H. Attachment I is a summary of water level changes for all subareas.

Ground water level measurements indicate that, by the end of the fourth quarter of WY14, water levels were recovering in the Pressure and East Side Subareas, but not in the Forebay or Upper Valley Subareas. Over the past month, average ground water levels rose by four feet in the Pressure 180-Foot Aquifer, two feet in the Pressure 400-Foot Aquifer, and one foot in the East Side Subarea while declining by two feet in the Forebay Subarea and one foot in the Upper Valley Subareas.

Compared to September 2013, average ground water levels in September 2014 were eight to twelve feet lower in all subareas, as shown in Attachment I.

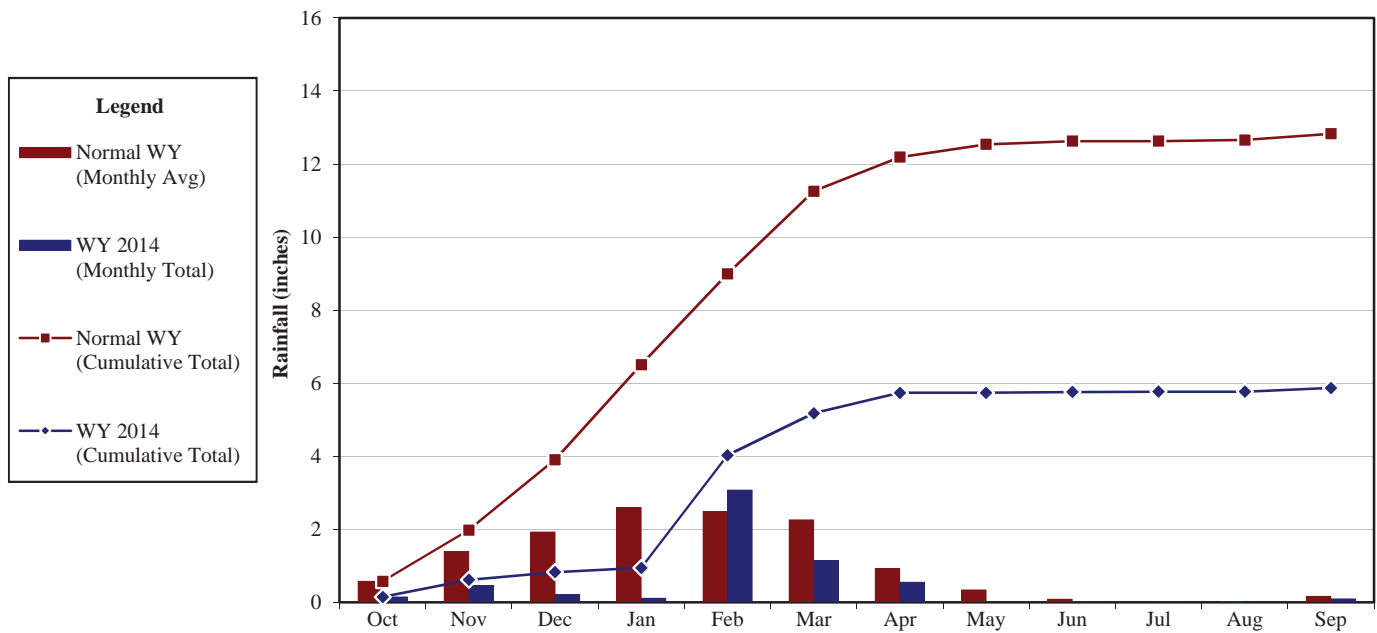
When compared to WY85, which is considered to be a year of near normal ground water conditions, current water levels are 25 feet lower in the East Side Subarea, 10 feet lower in the Pressure 180-Foot Aquifer, eight feet lower in the Forebay Subarea and six feet lower in the Upper Valley Subarea. Water levels in the Pressure 400-Foot Aquifer are two feet higher than in WY85.

Average ground water levels for the fourth quarter of WY14 have fallen to WY91 levels in the Forebay Subarea, while falling below WY91 levels in both the East Side and Upper Valley Subareas. In the Pressure 180-Foot Aquifer, water levels equaled WY91 levels in August 2014 before recovering by two feet by the end of the quarter. By contrast, throughout the fourth quarter, water levels in the Pressure 400-Foot Aquifer remained eight to 10 feet higher than in WY91.

<b>FINANCIAL IMPACT:</b>	<b>YES (   )</b> <b>NO ( X )</b>
<b>FUNDING SOURCE:</b>	
<b>COMMITTEE REVIEW AND RECOMMENDATION:</b>	None
<b>ATTACHMENTS:</b>	1. Salinas Valley Hydrologic Subareas Map 2. Salinas and King City Precipitation Graphs, Attachment A 3. Nacimiento and San Antonio Reservoir Graphs, Attachments B and C 4. Salinas Valley Monthly Water Level Graphs for Each Subarea, Attachments D through H 5. Generalized Ground Water Trends, Attachment I.
<b>APPROVED:</b>	<div style="border-top: 1px solid black; display: flex; justify-content: space-between; margin-top: 10px;"> <span><b>General Manager</b></span> <span><b>Date</b></span> </div>

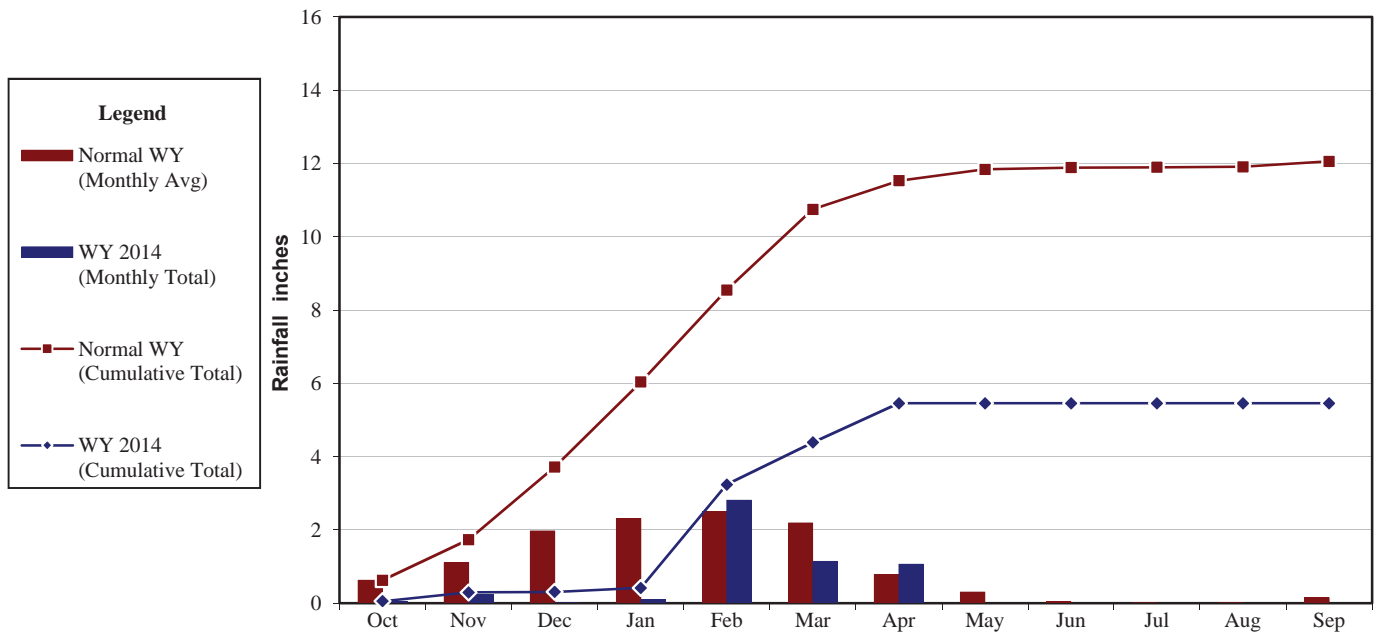


## SALINAS AIRPORT RAINFALL WATER YEAR 2014



Monthly Rainfall (WY 2014)	0.15	0.47	0.21	0.12	3.08	1.15	0.56	0.00	0.02	0.01	0.00	0.10
Monthly Rainfall (Normal WY*)	0.58	1.40	1.93	2.60	2.49	2.26	0.93	0.35	0.09	0.00	0.03	0.17
Percent of Normal for Month	26%	34%	11%	5%	124%	51%	60%	0%	22%	N/A	0%	59%
Cumulative Rainfall (WY 2014)	0.15	0.62	0.83	0.95	4.03	5.18	5.74	5.74	5.76	5.77	5.77	5.87
Cumulative Rainfall (Normal WY*)	0.58	1.98	3.91	6.51	9.00	11.26	12.19	12.54	12.63	12.63	12.66	12.83
Percent of Cumulative Normal	26%	31%	21%	15%	45%	46%	47%	46%	46%	46%	46%	46%

## KING CITY RAINFALL WATER YEAR 2014

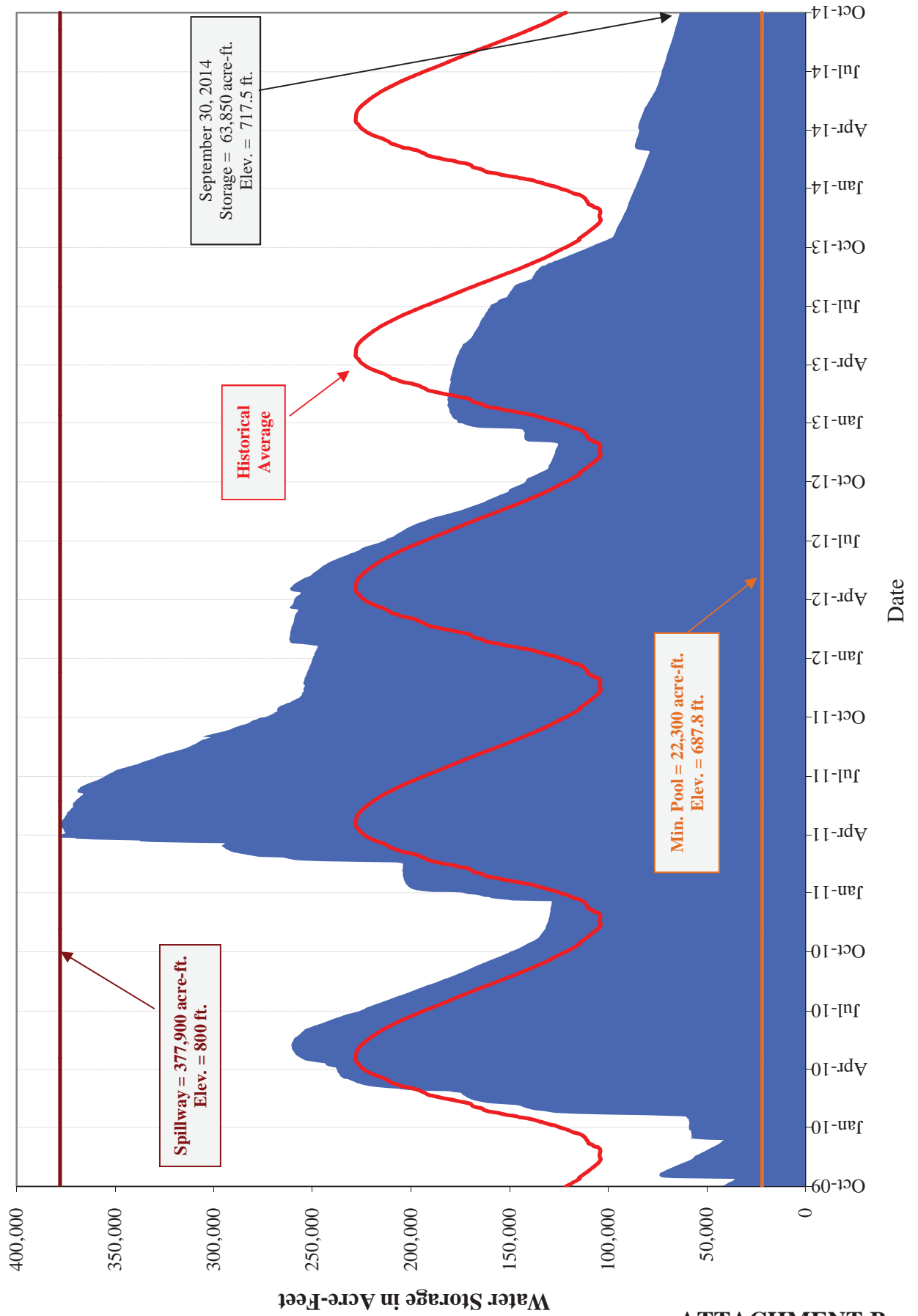


Monthly Rainfall (WY 2014)	0.06	0.24	0.01	0.11	2.82	1.15	1.07	0.00	0.00	0.00	0.00	0.00
Monthly Rainfall (Normal WY*)	0.63	1.11	1.98	2.32	2.51	2.20	0.78	0.31	0.05	0.01	0.01	0.15
Percent of Normal for Month	10%	22%	1%	5%	112%	52%	137%	0%	0%	0%	0%	0%
Cumulative Rainfall (WY 2014)	0.06	0.30	0.31	0.42	3.24	4.39	5.46	5.46	5.46	5.46	5.46	5.46
Cumulative Rainfall (Normal WY*)	0.63	1.74	3.72	6.04	8.55	10.75	11.53	11.84	11.89	11.90	11.91	12.06
Percent of Cumulative Normal	10%	17%	8%	7%	38%	41%	47%	46%	46%	46%	46%	45%

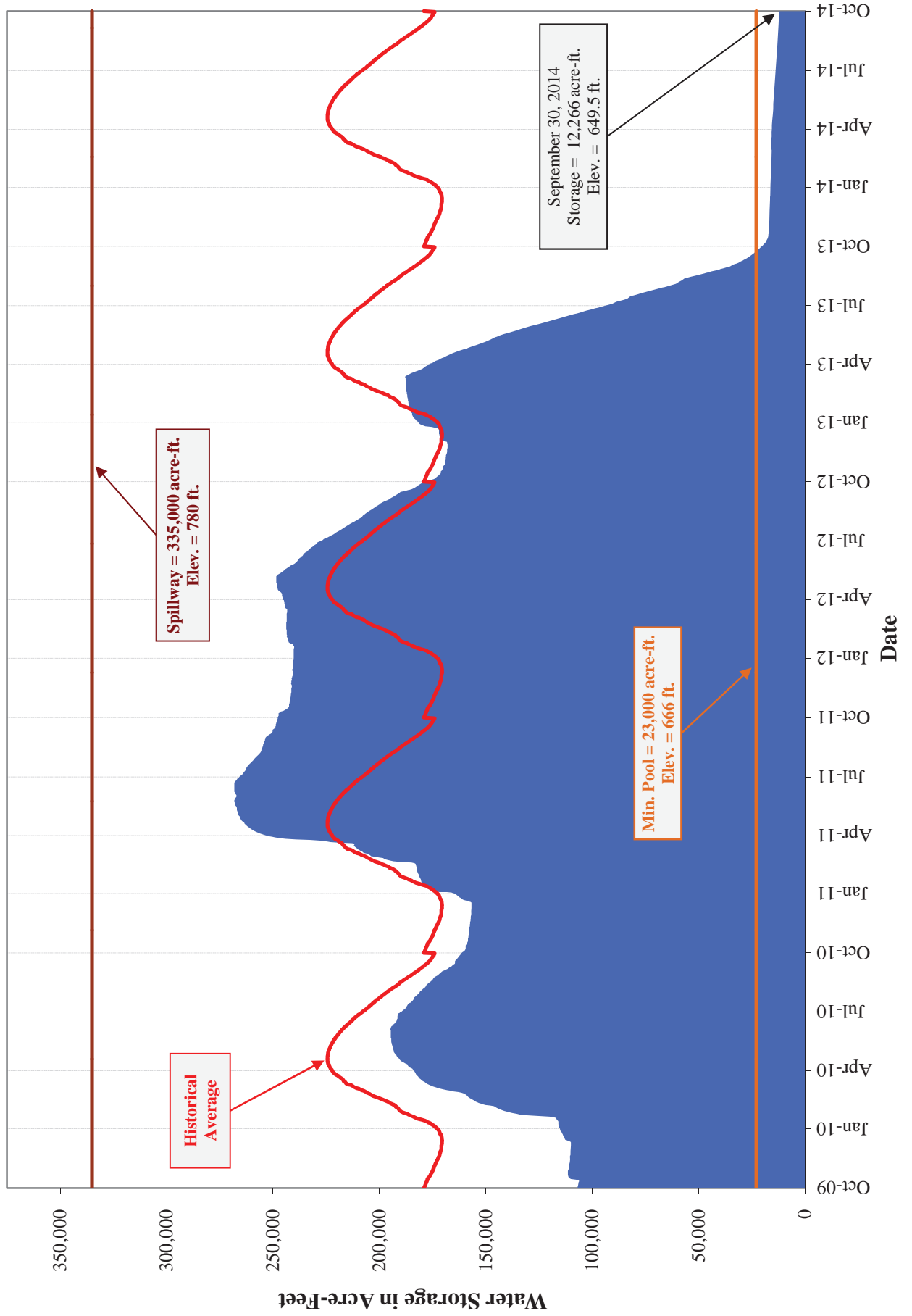
\*Average precipitation over the most recent 30-year period ending in a decade (1981-2010)

**ATTACHMENT A**

# NACIMIENTO RESERVOIR DAILY STORAGE



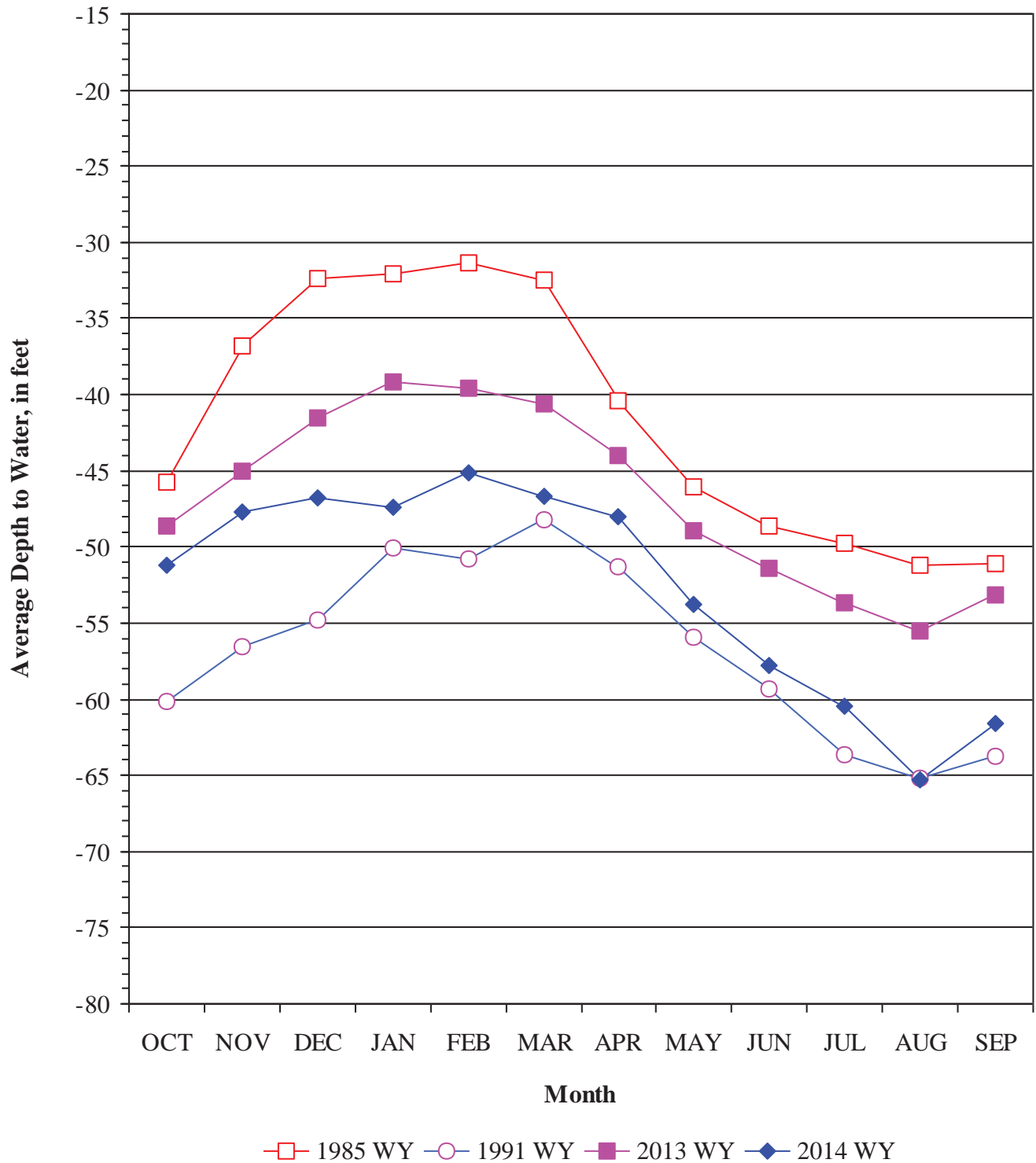
# SAN ANTONIO RESERVOIR DAILY STORAGE



# HISTORIC GROUND WATER TRENDS

## PRESSURE 180-FOOT AQUIFER

5 Wells

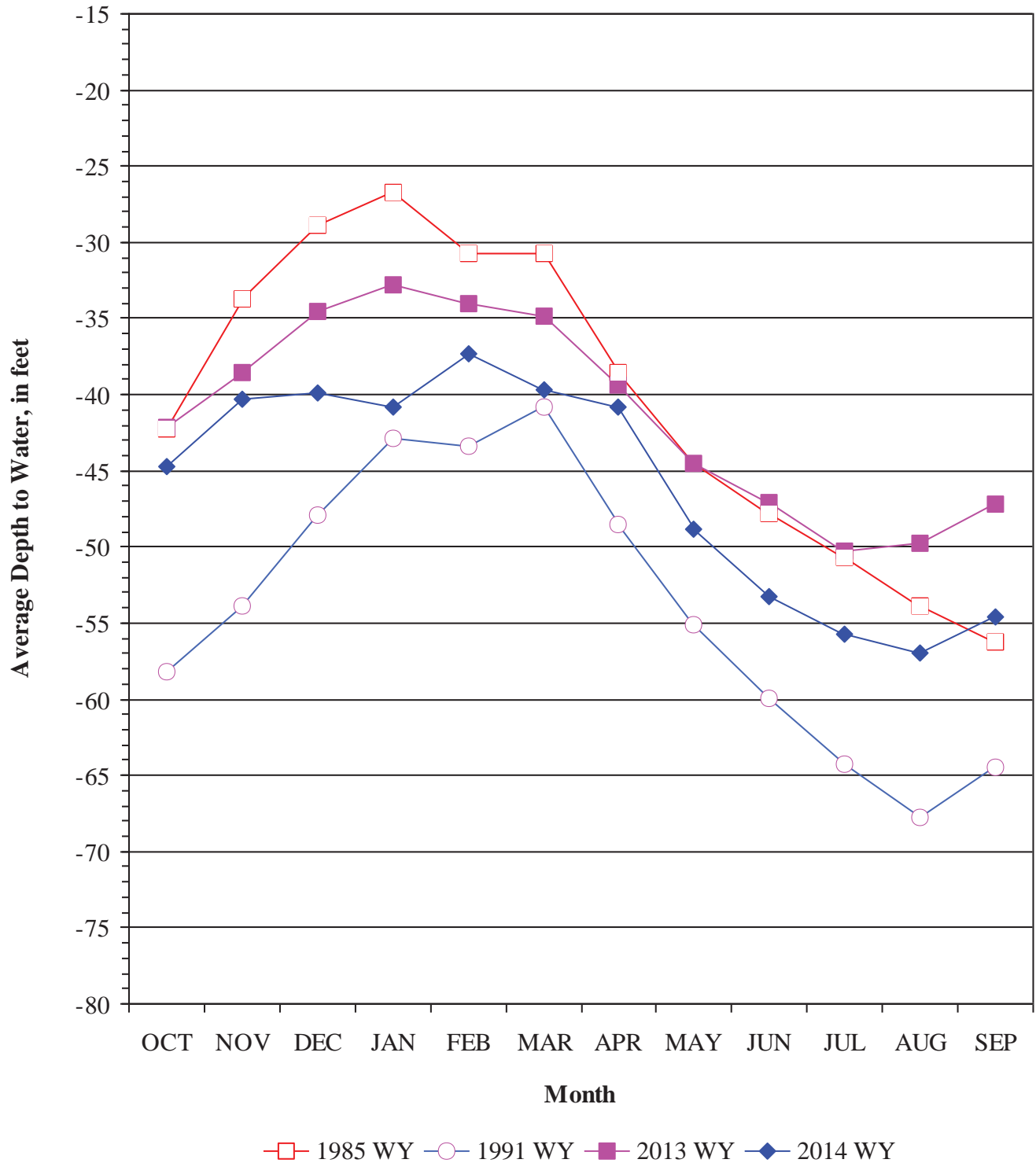




# HISTORIC GROUND WATER TRENDS

## PRESSURE 400-FOOT AQUIFER

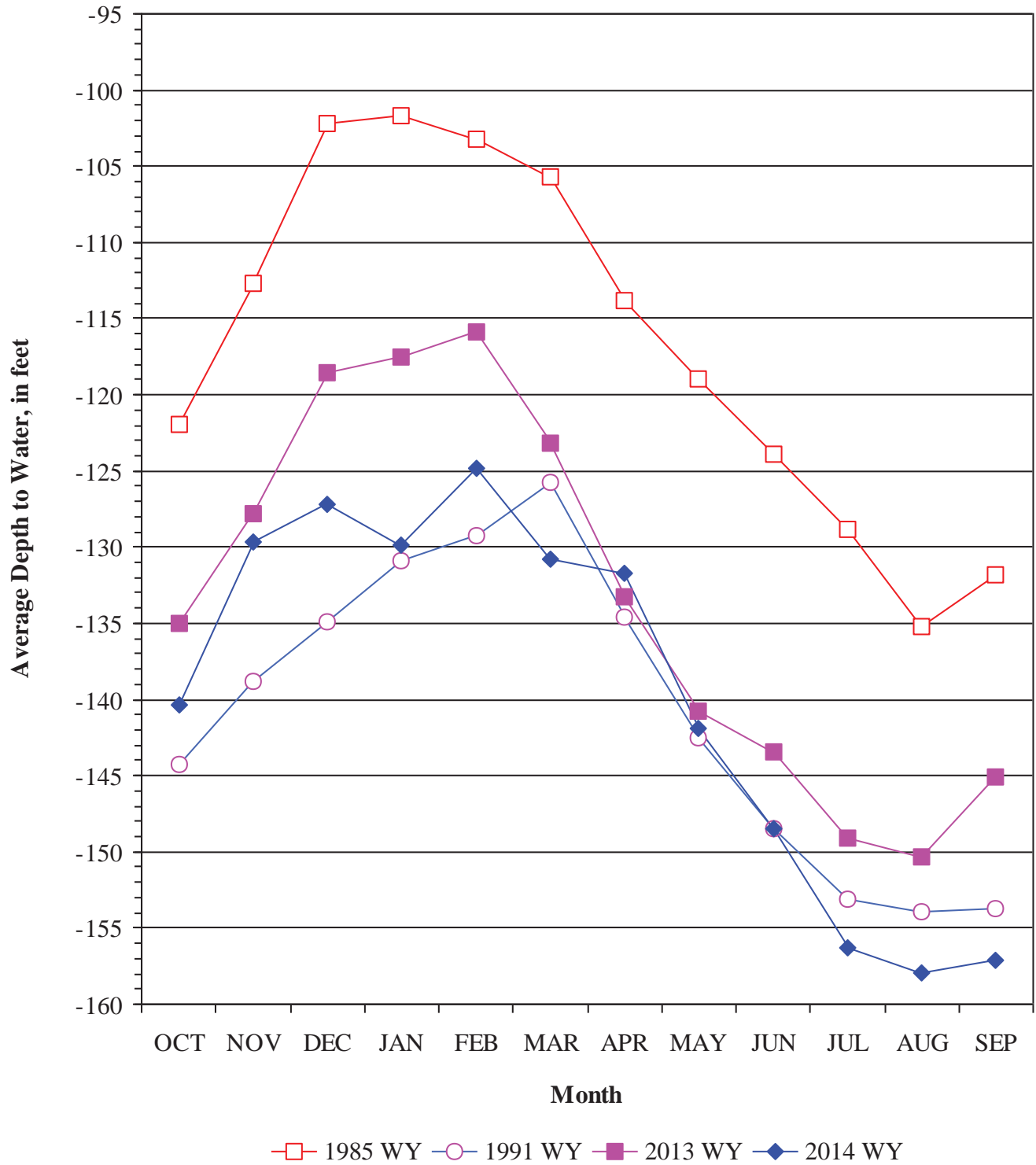
11 Wells



# HISTORIC GROUND WATER TRENDS

## EAST SIDE SUBAREA

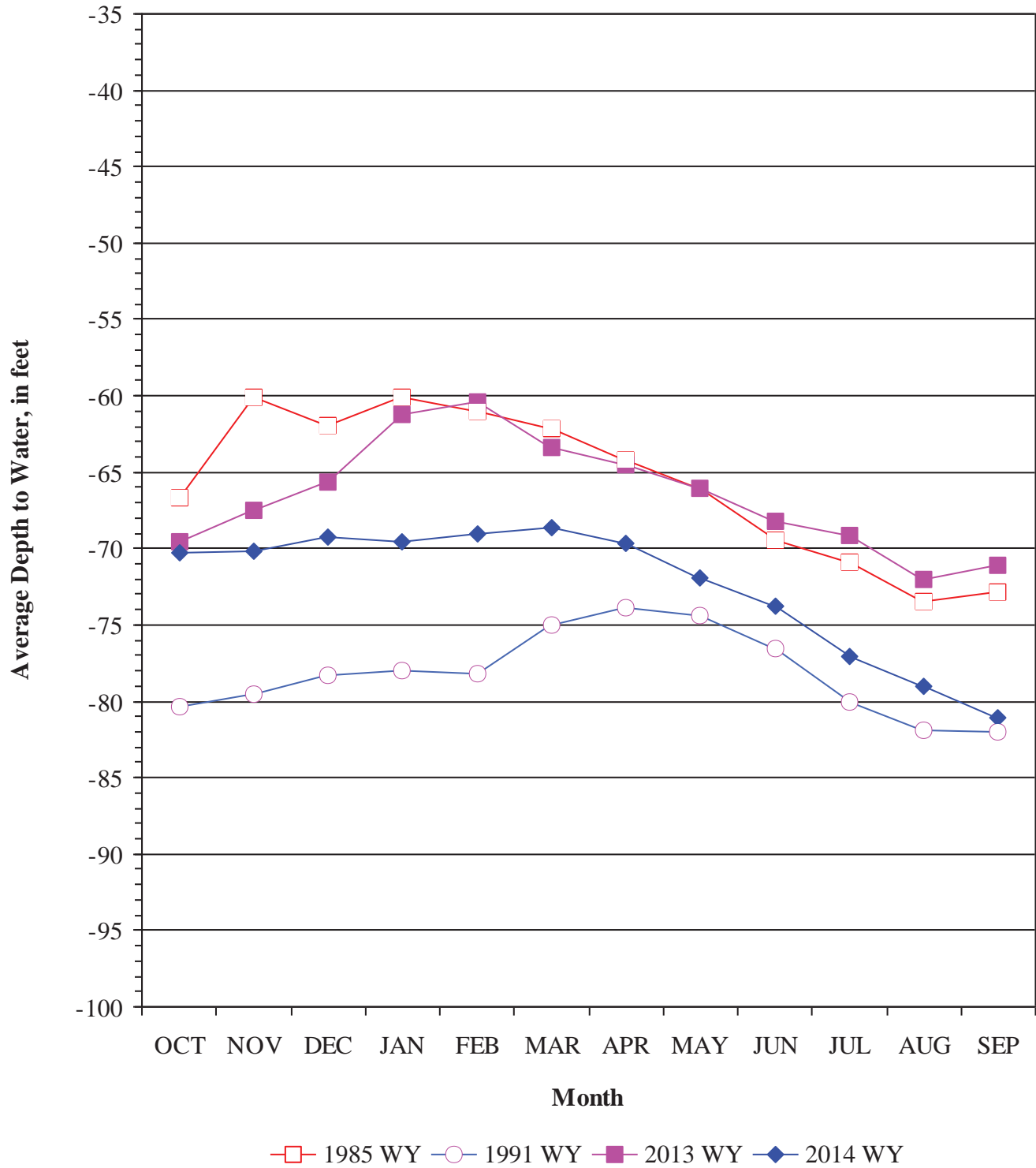
11 Wells



# HISTORIC GROUND WATER TRENDS

## FOREBAY SUBAREA

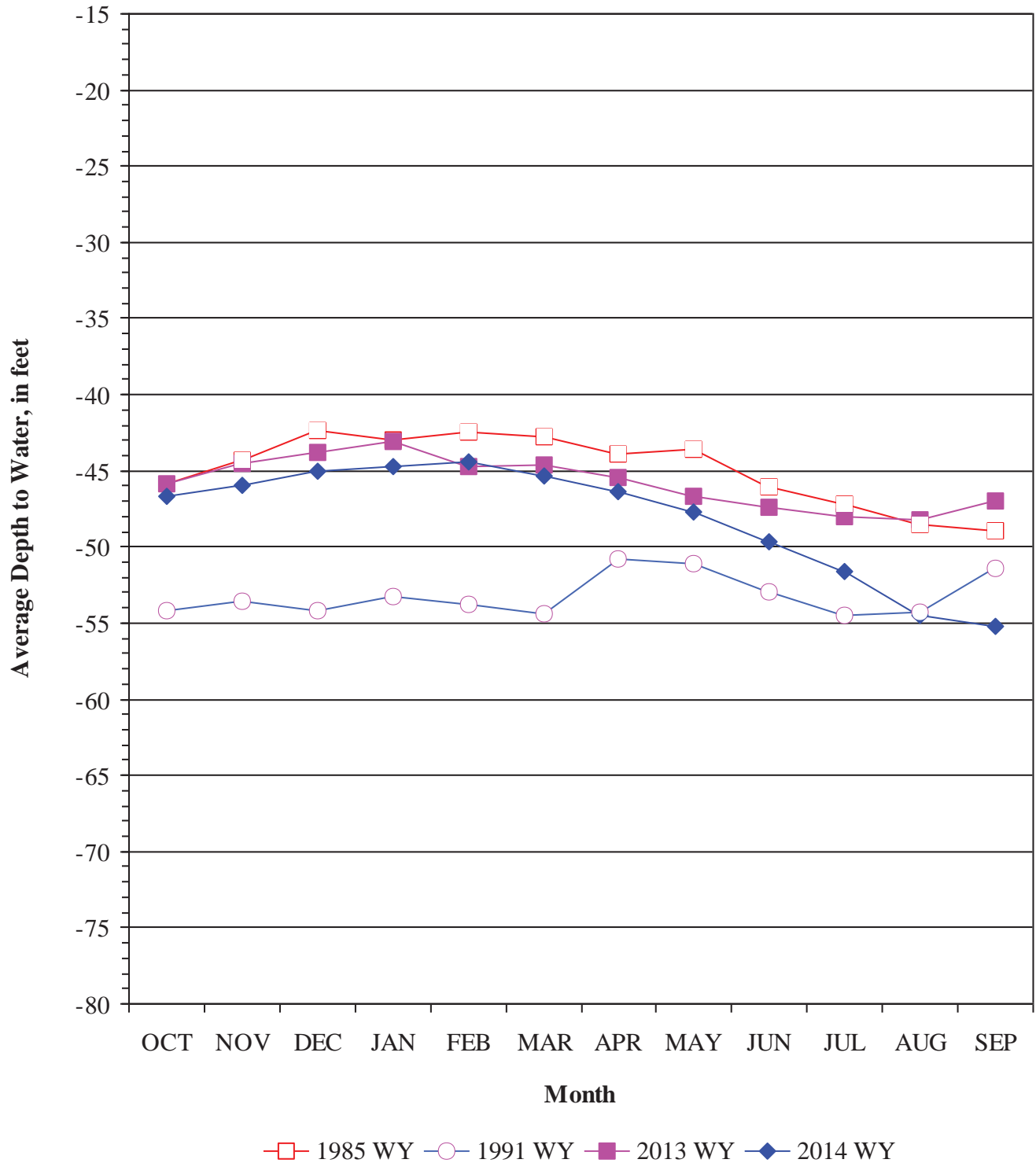
10 Wells



# HISTORIC GROUND WATER TRENDS

## UPPER VALLEY SUBAREA

9 Wells





# Generalized Ground Water Trends

## September 2014

<b>Area</b>	<b>September 2014 Depth to Water</b>	<b>1 Year Change</b>	<b>Change From WY 1985</b>	<b>1 Month Change</b>
<b>Pressure 180-Foot Aquifer</b>	<b>62'</b>	<b>down 8'</b>	<b>down 10'</b>	<b>up 4'</b>
<b>Pressure 400-Foot Aquifer</b>	<b>55'</b>	<b>down 7'</b>	<b>up 2'</b>	<b>up 2'</b>
<b>East Side Subarea</b>	<b>157'</b>	<b>down 12'</b>	<b>down 25'</b>	<b>up 1'</b>
<b>Forebay Subarea</b>	<b>81'</b>	<b>down 10'</b>	<b>down 8'</b>	<b>down 2'</b>
<b>Upper Valley Subarea</b>	<b>55'</b>	<b>down 8'</b>	<b>down 6'</b>	<b>down 1'</b>

September water levels, compared to last year, range from 12' lower to 7' lower.

September water levels, compared to WY 1985, range from 25' lower to 2' higher.

September changes in water levels over the last month range from 2' lower to 4' higher.

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# Appendix C

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Table C.1 - CASGEM Network Well Data Summary

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation NAVD88-ft	Ground Surface Elevation NAVD88-ft	Well Use	Well Completion Type	Depth of Screened Interval ft-bgs	Total Depth ft-bgs	Well Completion Report Number DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4-01 180/400 Foot Aquifer	13S02E19Q003M	75	36.780798	-121.784687	18	not available	irrigation	single	1220-1550	1562	071658	monthly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	13S02E21N001M	2432	36.784731	-121.761804	17.3	16.7	irrigation	single	369-550	550	not available	monthly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	13S02E21Q001M	SELA22633	36.781644	-121.751387	12.4	12.8	dedicated monitoring	single	105-155	157	E011401	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	13S02E32A002M	10161	36.765339	-121.765589	10.6	not available	irrigation	single	300-600	600	not available	monthly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E03F003M	ESP822635	36.745480	-121.739493	28.2	28.7	dedicated monitoring	single	420-450	455	E011400	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E03F004M	ESPA22636	36.745391	-121.739314	24.2	24.7	dedicated monitoring	single	154-204	205	E011399	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E08M002M	239	36.727523	-121.780250	14.6	13.5	irrigation	single	314-325, 367-399, 426-456	500	71883	monthly	1) August 2) Jan. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E12B002M	RODA14455	36.734316	-121.695850	55.5	56.1	dedicated monitoring	single	210-260	265	338411	hourly	1) August 2) Jan. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E12B003M	RODB14456	36.734282	-121.695864	55.9	56.1	dedicated monitoring	single	350-380	390	338410	hourly	1) August 2) Jan. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E12Q001M	1707	36.722108	-121.696473	64	62	domestic	single	273-280, 288-292	619	not available	monthly	1) August 2) Jan. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E26H001M	AMST22651	36.688875	-121.707934	37.7	38.1	dedicated monitoring	single	287-337	339	E011403	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	14S02E27A001M	MCFD22632	36.693296	-121.729435	24.7	25.1	dedicated monitoring	single	240-290	293	E011398	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	14S03E18C001M	BORA15009	36.720722	-121.680556	54.8	55.1	dedicated monitoring	single	165-215	225	201242	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	14S03E18C002M	BORB15010	36.720736	-121.680531	54.9	55.1	dedicated monitoring	single	270-320, 365-385	395	201241	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	14S03E30C008M	MKTC22650	36.686880	-121.678517	44.3	44.8	dedicated monitoring	single	240-290	293	E011402	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	15S03E16F002M	1862	36.629202	-121.647449	59.5	58.5	irrigation	single	427-445, 485-570	592	81037	monthly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	15S03E16M001M*	1359	36.624978	-121.653213	59.5	58.2	irrigation	single	not available	not available	not available	monthly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	15S03E17M001M	1480	36.626540	-121.669184	49.2	47.6	irrigation	single	128-160, 165-180	271	25902	monthly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	16S04E08H003M	CHEB21205	36.555033	-121.546546	91.5	88.9	dedicated monitoring	nested	240-290	295	491023	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	16S04E08H004M	CHEA21208	36.555022	-121.546558	90.6	88.8	dedicated monitoring	nested	85-135	140	491023	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	16S04E15D001M	BRME10389	36.544407	-121.522009	102	103.3	dedicated monitoring	single	170-189, 314-358	384	100604	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	17S05E06C001M	ZWB21201	36.488323	-121.468404	119.7	120.1	dedicated monitoring	nested	250-290	300	491020	hourly	1) August 2 an. to Mar.
3-4-01 180/400 Foot Aquifer	17S05E06C002M	ZWA21202	36.488324	-121.468395	119.7	120.105	dedicated monitoring	nested	60-110	115	491020	hourly	1) August 2 an. to Mar.

## Notes

ft = feet

ft-bgs = feet below ground surface

\* = voluntary well

Table C.1 - CASGEM Network Well Data Summary

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation NAVD88, ft	Ground Surface Elevation NAVD88, ft	Well Use	Well Completion Type	Depth of Screened Interval ft-bgs	Total Depth ft-bgs	Well Completion Report Number DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.02 East Side Aquifer	14S03E15H003M	752	36.717412	-121.622173	126	not available	irrigation	single	200-775	784	38491	monthly	1) August 2 an. to Mar.
3-4.02 East Side Aquifer	14S03E25C001M	ALB2618	36.692754	-121.594058	143.8	144.2	dedicated monitoring	single	570-670	680	773476	hourly	1) August 2 an. to Mar.
3-4.02 East Side Aquifer	14S03E25C002M	ALA2619	36.692725	-121.594032	143.8	144.2	dedicated monitoring	single	175-195, 240-260, 300-360	370	768985	hourly	1) August 2) Jan. to Mar.
3-4.02 East Side Aquifer	14S03E27B001M	15126	36.690611	-121.624200	42	42	rrigation	single	60-335	348	not available	monthly	1) August 2 an. to Mar.
3-4.02 East Side Aquifer	14S04E31Q002M	806	36.666105	-121.569391	104	103	irrigation	single	250-390, 400-550, 580-640, 690-710	710	552493	monthly	1) August 2) Jan. to Mar.
3-4.02 East Side Aquifer	15S04E06R001M	1726	36.651722	-121.566933	93.7	92.5	irrigation	single	190-270, 345-390, 430-776	786	not available	monthly	1) August 2) Jan. to Mar.
3-4.02 East Side Aquifer	16S05E27G001M	2519	36.512244	-121.407957	272	271.5	irrigation	single	281-322, 368-410, 512-543, 565-631, 694-757, 793-930, 966-1,091	1,122	50822	monthly	1) August 2) Jan. to Mar.
3-4.02 East Side Aquifer	16S05E28D001M	871	36.516669	-121.432772	169	168	irrigation	single	200-215, 242-368, 408-425, 448-460, 480-508, 639-695, 754-762, 798-808	832	not available	monthly	1) August 2) Jan. to Mar.
3-4.04 Forebay Aquifer	17S06E19D001M*	1485	36.442444	-121.368184	170	170	irrigation	single	not available	170	not available	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	17S06E33R001M	VidaDeep21209	36.404756	-121.316169	197.4	198.0	dedicated monitoring	nested	200-250	260	491019	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	17S06E33R002M	VidaShallow21210	36.404723	-121.316163	197.6	198.0	dedicated monitoring	nested	50-115	120	491019	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E22B002M	LosCochesC18449	36.356198	-121.303324	227.4	227.9	dedicated monitoring	nested	510-580	590	490996	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E22B003M	LosCochesB21066	36.356178	-121.303292	228.5	229.0	dedicated monitoring	nested	220-270	280	490996	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E22B004M	LosCochesA21314	36.356206	-121.303260	227.8	228.3	dedicated monitoring	nested	40-90	95	490996	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E24M001M	UD B18467	36.348507	-121.275550	232.5	233.0	dedicated monitoring	nested	193-243	253	490994	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E24M002M	UD A21067	36.348475	-121.275639	232.5	233.0	dedicated monitoring	nested	70-120	130	490994	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E25F001M*	1495	36.335895	-121.274486	254.5	not available	irrigation	single	not available	120	not available	monthly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E35F001M	THNB18502	36.325857	-121.286318	265.6	266.1	dedicated monitoring	nested	198-248	258	490995	hourly	1) August 2 an. to Mar.
3-4.04 Forebay Aquifer	18S06E35F002M	THNA21068	36.325833	-121.286378	265.7	266.1	dedicated monitoring	nested	60-110	120	490995	hourly	1) August 2 an. to Mar.

Notes

ft = feet

ft-bgs = feet below ground surface

\* = voluntary well

**Table C.1 - CASGEM Network Well Data Summary**

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation NAVD88, ft	Ground Surface Elevation NAVD88, ft	Well Use	Well Completion Type	Depth of Screened Interval ft-bgs	Total Depth ft-bgs	Well Completion Report Number DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.05 Upper Valley Aquifer	19S08E19K003M	1379	36.261416	-121.143185	282	not available	irrigation	single	130-178	212	114600	monthly	1) August 2 an. to Mar.
3-4.05 Upper Valley Aquifer	20S08E14K001M	1735	36.190341	-121.071326	347.2	not available	irrigation	single	115-145, 148-205	236	43828	monthly	1) August 2 an. to Mar.
3-4.05 Upper Valley Aquifer	23S10E03H001M	SArdoN19447	35.959280	-120.871501	463.6	461	dedicated monitoring	single	72-132	142	490983	monthly	1) August 2 an. to Mar.
3-4.06 Paso Robles Area	23S10E14D001M	SArdoS19450	35.936241	-120.866068	465.8	463.1	dedicated monitoring	single	72-132	142	490086	monthly	1) August 2 an. to Mar.
3-4.09 Langley Area	13S03E15P001M	13572	36.795258	-121.63002	365.1	364	domestic	single	300-430	430	199702	biannual	1) August 2 an. to Mar.
3-4.09 Langley Area	13S03E16J001M	13625	36.801055	-121.641165	270	270	domestic	single	104-244	252	38447	biannual	1) August 2 an. to Mar.
3-4.09 Langley Area	13S03E22F001M	13950	36.790570	-121.626689	236.2	235	domestic	single	260-270, 280-290, 310-320	334	22780	biannual	1) August 2) Jan. to Mar.
3-4.10 Corral de Tierra Area	16S02E01M001M	16797	36.568031	-121.707315	406	405	domestic	single	80-120, 160-180	294	43634	biannual	1) August 2 an. to Mar.
3-4.10 Corral de Tierra Area	16S02E02G001M	16820	36.570536	-121.713413	371	370	domestic	single	320-340, 360-440	448	38099	monthly	1) August 2 an. to Mar.

**Notes**

ft = feet

ft-bgs = feet below ground surface

\* = voluntary well

# Appendix D

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## Level **TROLL**® 400, 500 & 700 Data Loggers

### **Be Reliable**

### **Be Effective**

Sensors undergo NIST®-traceable factory calibration across the full pressure and temperature range. For applications requiring the highest levels of accuracy, use a vented (gauged) system.

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# Level TROLL® 400, 500 & 700 Data Loggers

**Every Application  
& Budget**

General	Level TROLL 400	Level TROLL 500	Level TROLL 700	BaroTROLL
<b>Temperature ranges<sup>1</sup></b>	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) <b>Calibrated: -5-50° C (23-122° F)</b>	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)
<b>Diameter</b>	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)
<b>Length</b>	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)
<b>Weight</b>	197 g (0.43 lb)	197 g (0.43 lb)	197 g (0.43 lb)	197 g (0.43 lb)
<b>Materials</b>	Titanium body; Delrin® nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone
<b>Output options</b>	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA
<b>Battery type &amp; life<sup>2</sup></b>	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings
<b>External power</b>	8-36 VDC	8-36 VDC	8-36 VDC	8-36 VDC
<b>Memory</b>	2.0 MB	2.0 MB	4.0 MB	1.0 MB
<b>Data records<sup>3</sup></b>	130,000	130,000	260,000	65,000
<b>Data logs</b>	50	50	50	2
<b>Log types</b>	Linear, Fast Linear, and Event	Linear, Fast Linear, and Event	Linear, Fast Linear, Linear Average, Event, Step Linear, True Logarithmic	Linear
<b>Fastest logging rate</b>	2 per second	2 per second	4 per second	1 per minute
<b>Fastest output rate</b>	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second
<b>Real-time clock</b>	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period
<b>Sensor Type/ Material</b>	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium
<b>Range</b>	<i>Absolute (non-vented)</i> 30 psia: 11 m (35 ft) 100 psia: 60 m (197 ft) 300 psia: 200 m (658 ft) 500 psia: 341 m (1120 ft)	<i>Gauged (vented)</i> 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	<i>Absolute (non-vented)</i> 30 psia: 11 m (35 ft) 100 psia: 60 m (197 ft) 300 psia: 200 m (658 ft) 500 psia: 341 m (1120 ft) 1000 psia: 693 m (2273 ft) <i>Gauged (vented)</i> 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	30 psia (usable up to 16.5 psi; 1.14 bar)
<b>Burst pressure</b>	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Vacuum/over-pressure above 16.5 psi damages sensor
<b>Accuracy @ 15° C<sup>4</sup></b>	±0.05% full scale (FS)	±0.05% FS	±0.05% FS	±0.05% FS
<b>Accuracy (FS)<sup>5</sup></b>	±0.1% FS	±0.1% FS	±0.1% FS	±0.1% FS
<b>Resolution</b>	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better
<b>Units of measure</b>	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH <sub>2</sub> O, inH <sub>2</sub> O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH <sub>2</sub> O, inH <sub>2</sub> O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH <sub>2</sub> O, inH <sub>2</sub> O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH <sub>2</sub> O, inH <sub>2</sub> O
<b>Temperature Sensor</b>	Silicon	Silicon	Silicon	Silicon
<b>Accuracy &amp; resolution</b>	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better
<b>Units of measure</b>	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit
<b>Warranty<sup>6</sup></b>	3 years	3 years	3 years	3 years
<b>Notes</b>	<sup>1</sup> Temperature range for non-freezing liquids. <sup>2</sup> Typical battery life when used within the factory calibrated temperature range. <sup>3</sup> 1 data record = date/time plus 2 parameters logged (no wrapping) from device within the factory calibrated temperature range. <sup>4</sup> Across factory calibrated pressure range. <sup>5</sup> Across factory calibrated pressure and temperature ranges. <sup>6</sup> Up to 5-year (total) extended warranties are available for all sensors—call for details. Delrin is a registered trademark of E.I. du Pont de Nemours and Company.			

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## Appendix 7-B

### MPWMD CASGEM Monitoring Plan



CASGEM Monitoring Plan

April 18, 2012

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## **Introduction**

The Monterey Peninsula Water Management District (MPWMD or District) is participating in the California Statewide Groundwater Elevation Monitoring Program (CASGEM) which is administered by the Department of Water Resources (DWR). This groundwater monitoring plan lays the foundation for this monitoring effort and provides information on the wells to be sampled, monitoring schedule, and the characteristics of the groundwater basins. This plan contains two parts because MPWMD will be providing monitor well data from the Seaside Groundwater Basin as well as the Carmel Valley Alluvial Aquifer under the CASGEM.

## **Regional Geologic Setting for the Seaside Groundwater Basin**

### **Water Bearing Formations**

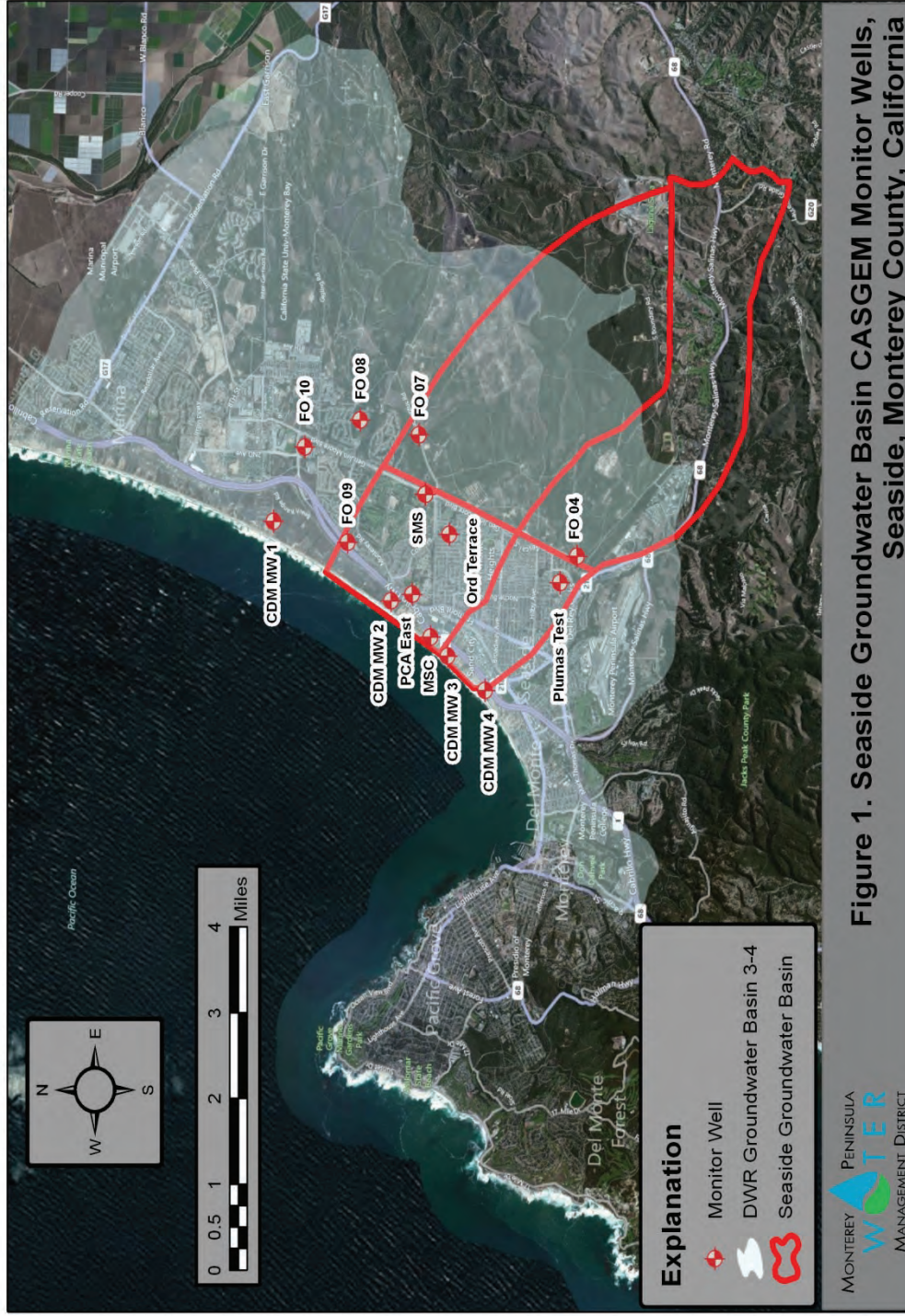
The Seaside Groundwater Basin consists of a sedimentary sequence of water-bearing materials that overlie the relatively impermeable Monterey Formation of Miocene age and older crystalline rocks. From oldest to youngest, the water-bearing units of the Seaside Basin are the Miocene Santa Margarita Sandstone (Tsm), the Tertiary and Quaternary “continental deposits” (QTc), and the Pleistocene and Holocene Aromas Sand and Older Dunes (Qe and Qt) (Yates and others 2005 and GTC 1986).

The Santa Margarita Sandstone corresponds to the “Santa Margarita Aquifer” and is a loose to weakly-cemented, marine sandstone with stratigraphic thickness up to approximately 300 feet. The upper portion of this deposit is medium-grained clean sand. With increasing depth and proximity to the underlying Monterey Formation, the clay content of the unit increases (Yates and others 2005).

The continental deposits correspond to the “Paso Robles Aquifer” and consist of a complex sequence of interbedded sand, gravel, and clay deposits. These deposits are more than 600 feet thick in some portions of the basin. The water-bearing portions of the continental deposits are thick lenses of sand and gravel of limited areal extent (Yates and others 2005).

The Aromas Sand and Older Dunes are surficial deposits that are of minor importance in the basin. The deposits are unconfined, in direct hydraulic communication with the ocean, and are only saturated in the extreme coastal portion of the basin (Yates and others 2005).

Surface outcrops within the area are limited primarily to alluvial sands and terrace deposits. Small areas of the Paso Robles and Santa Margarita Aquifers outcrop in the eastern portion of the Seaside Basin.



## **Restrictive Structures**

Structural deformation of the basin has resulted in varying thickness and depths of all of the geologic units across the basin (Yates and others 2005, GTC 1986, and DWR 1974). Basin structure is relatively well understood in the Laguna Seca and coastal subareas where production wells are numerous. Subsurface information in those areas reveals a complex arrangement of faults, anticlines, and synclines. Prominent among them is the Laguna Seca Anticline that uplifts the Monterey Formation and forms the boundary between the northern and southern subbasins. The Paso Robles and the Santa Margarita Aquifers thicken toward the eastern end of the southern subbasin as a result of a syncline. The Seaside and Ord Terrace faults create abrupt increases in basin thickness within the coastal parts of the southern and northern subbasins.

In the Seaside Basin, faults are associated with abrupt changes in basin thickness but appear to have little effect on groundwater flow where permeable units are present on both sides of the fault. All of the faults are steep normal or reverse faults, and most of them exhibit a combination of horizontal displacement (right-lateral) and vertical displacement (downthrown block on the north). All of them trend southeast-northwest. The Chupines fault forms the southern boundary of the basin where it juxtaposes relatively impermeable units of the Monterey Formation against the Santa Margarita Sandstone and continental deposits. The next fault to the north – the Seaside fault – passes obliquely through the southern subbasin. It is associated with as much as 500 feet of vertical displacement of the top of the Monterey Formation and it truncates the southern extent of the Santa Margarita Sandstone and continental deposits. Groundwater appears to flow freely across the Seaside fault in shallow aquifer horizons. Farther north, the Ord Terrace fault is similar to the Seaside fault, with as much as 450 feet of displacement of the top of the Monterey Formation. Neither the Seaside nor Ord Terrace faults are a significant barrier to groundwater flow.

The Seaside Basin does not appear to have a regional confining layer equivalent to the Salinas Valley Aquiclude that overlies the 180-Foot Aquifer throughout most of the coastal part of the Salinas Valley. The first clay layers encountered in the boreholes for four monitoring wells installed by MPWMD between Seaside and the Main Garrison area on the former Fort Ord are thin (less than 20 feet) and of inconsistent elevation.

Based on calibration of a groundwater flow model of the Laguna Seca area (the eastern part of the southern subbasin), the hydraulic conductivities for the Paso Robles and Santa Margarita Aquifers were estimated to be 2 ft/day and 3-5 ft/day, respectively. Similarly, calibrated storativity values were estimated to be 0.08 in unconfined aquifers and 0.0006 in confined aquifers.

## **Recharge Areas**

The largest native sources of recharge to the basin are deep percolation of rainfall, irrigation water, and pipe leaks (Yates and others 2005, GTC 1986, and Muir 1982). This recharge occurs throughout the basin and is facilitated by the generally sandy soils. Septic system leach fields also contribute small amounts of groundwater recharge. The



largest non-native source of recharge to the basin is by groundwater recharge via injection wells. Since 1998, MPWMD has injected over 4,300 acre-feet into specialized Aquifer Storage and Recovery (ASR) wells the northern subbasin.

A significant percentage of groundwater yield near the coast consists of groundwater inflow from inland areas. In addition, groundwater can flow to or from offshore areas depending on the elevation of groundwater levels near the coast. If coastal water levels are below sea level, groundwater flows onshore (landward). Initially, this onshore flow may not be salty if offshore parts of the aquifer still contain residual freshwater from previous decades when groundwater flow was greater or past periods when sea levels were lower. It is estimated that approximately 1,100 acre-feet of onshore flow from the offshore part of the Santa Margarita Aquifer occurred in 2002 (Yates and others 2005).

### **Groundwater Level Trends**

Groundwater level monitoring in production and monitoring wells within the basin has generally shown declines in the period from the 1960's to the present. Most groundwater extraction in the Seaside Basin is from the coastal part of the northern subbasin. Hydrographs for that area show a significant decline in water levels in almost all wells in the Santa Margarita Aquifer since 1995. In many of these wells, water levels were consistently above sea level prior to 1995 and are now consistently below sea level. The net decline in spring water levels between 1995 and 2002 was 10-15 feet in many wells, and the amount of seasonal drawdown from spring to fall each year has also increased from less than 5 feet to 15 feet (Yates and others 2005). The hydrographs for some wells in the Paso Robles Aquifer have also been declining, while others have been rising. These patterns are more strongly related to groundwater extraction than to climatic conditions.

### **Groundwater Storage**

The storage capacity of the Seaside Groundwater Basin was estimated to be 564,700 acre-feet in 1990 (SGD 1990). This estimate included a component for offshore storage and assumed a weighted average specific yield value of 12%. Of this total, the estimated storage for the onshore parts of the coastal subareas was 162,300 acre-feet, with 9,000 acre-feet estimated to be above sea level. More recent storage capacity estimates based on a specific yield value of 8% suggest that the amount of usable groundwater storage capacity in the coastal area of the basin is 6,200 acre-feet (Yates and others 2005).

### **Monitoring Plan Rationale**

Monitor wells selected for CASGEM monitoring are distributed to give a good representation of groundwater conditions of the Seaside Groundwater Basin. However, it should be noted that large areas of the basin do not have adequate monitor well coverage due to the lack of historical development and land-use restrictions (i.e., inland firing ranges of the former Fort Ord).



## **Well Network**

The well network consists of 22 wells located primarily in and near the coastal subareas of the Seaside Groundwater Basin. Many of these wells are paired and labeled deep and shallow to represent where they are screened in the aquifer. The list of monitoring wells for the Seaside Ground Water Basin is provided in Table 1. It is our understanding that Monterey County Water Resources Agency will be reporting on monitor wells that are located in and near the inland portions of the basin.

## **Monitoring Schedule**

Wells for the CASGEM program will be monitored twice a year, once at the end of September and once at the end of March.

## **Description of Field Methods**

Depth to the water table is measured directly with electric measuring tape to the nearest hundredth of a foot.

Table 1.

Well Name	State Well No.	Well Owner's Name	Date Drilled	DWR Well Drillers Report	MCHD Permit	Data Type	Hole Depth (feet)	Well Depth (feet)	Screened Interval (feet)	Strata Seal (feet)	Casing Type	Geologic Unit	Elevation feet AMSL pre-2008)	Reference Point Elevation feet AMSL)	Ground Level Elevation feet AMSL
Northern Coastal Subarea (and vicinity)															
M SC-Shallow	5S/E-6N3	MPWMD	5/25/1990	3384 G		wl, wq	720	695	490 - 680	95 - 275	2" pvc	QTc	80.58 s1	80.10	77.23
M SC-Deep	5S/E-6N2	MPWMD	5/25/1990	3384 Z5		wl, wq	920	865	810 - 850	725 - 775	2" pvc	Tsm	80.78 s1	80.29	77.25
PCA-E (Multiple) Shallow	5S/E-6K5	MPWMD	4/16/1990	3384 D2	W5748	wl, wq	863	410	350 - 400	10 - 50	2" pvc	QTc	69.31 s1	68.51	68.8
	PCA-E (Multiple) Deep	MPWMD	4/16/1990	3384 D2	W5748	wl, wq	863	710	650 - 700	580 - 620	2" pvc	Tsm	69.31 s1	68.54	68.8
Ord Terrace-Shallow	5S/E-23Ca	MPWMD	8/5/1999	--		wl, wq	530	340	280 - 330	--	2" pvc	Tsm upper	230 e1	228.65	228.74
MPWMD #FO-09-Shallow	5S/E-1P a	MPWMD	8/16/1994	--		wl, wq	1110	660	610 - 650	500 - 540	2" pvc	QTc/ Tp	19.11(s3	18.89	18.61
MPWMD #FO-09-Deep	5S/E-1P b	MPWMD	8/16/1994	--		wl, wq	1110	840	790 - 830	700 - 765	2" pvc	Tsm	19.15(s3	18.85	18.61
MPWMD #FO-0- Shallow	5S/E-2Fa	MPWMD	9/3/1996	442738	WSAL 96-18	wl, wq	1500	650	620 - 640	480 - 500	2" pvc	QTc	201.9 s3	200.85	200.45
MPWMD #FO-0- Deep	5S/E-2Fc	MPWMD	9/3/1996	442738	WSAL 96-18	wl, wq	1500	1420	1380 - 1410	1280 - 1300	2" pvc	Tp	201.10 s3	201.03	200.45
Seaside Middle School-Shallow		MPWMD		EO 00046		wl		670	570-650		2" pvc	QTc		333.35	333.35
Seaside Middle School-Deep		MPWMD		EO 00047		wl		1080	730-950		4" pvc	Tsm		332.62	332.62
CDM MW-1 Beach Range B)	5S/E-02Pa	MPWMD	11/12/2003			wl		140	50-140		2" pvc	Ood/Qar		93.16	93.81
CDM MW-2 Ord Village Lift Sta.	5S/E-5Ga	MPWMD	11/17/2003			wl		91	81-91		2" pvc	Ood/Qar		63.51	63.82
Northern Inland Subarea and vicinity															
MPWMD #FO-07-Shallow	5S/E-8La	MPWMD	7/12/1994	--		wl	940	650	600 - 640	520 - 540	2" pvc	QTc	473.94 s3	470.19	473.95
MPWMD #FO-07-Deep	5S/E-8Lb	MPWMD	7/12/1994	--		wl	940	850	800 - 840	700 - 750	2" pvc	Tsm	473.97 s3)	470.15	473.95
MPWMD #FO-08-Shallow	5S/E-2Qa	MPWMD	7/25/1994	--		wl	1110	790	740 - 780	640 - 680	2" pvc	QTc	378.53(s3	378.04	379.13
MPWMD #FO-08-Deep	5S/E-2Qb	MPWMD	7/25/1994	--		wl	1110	950	900 - 940	830 - 850	2" pvc	Tsm	378.54(s3	378.10	379.13
Southern Coastal Subarea (and vicinity)															
Plumas 90 Test	5S/E-27J6	MPWMD	4/25/1990	3384 H		wl	550	485	430 - 470	--	2" pvc	Tsm	58.41(s2	57.83	57.83
CDM MW-3 End Tioga Rd.	5S/E-22De	MPWMD				wl		59	49-59			Ood/Qar		33.81	34.44
CDM MW-4 Seaside Beach lot	5S/E-21Ka	MPWMD				wl		53	43-53			Ood/Qar		8.69	19.24
Laguna Seca Subarea (and vicinity)															
MPWMD #FO-04-Shallow E)	5S/E-26Na	MPWMD	10/26/1988	192669		wl	320	320	260 - 300	--	2" pvc	QTc	58.95(s4	58.23	58.43
MPWMD #FO-04-Deep W	5S/E-26Nb	MPWMD	10/24/1988	192670		wl	640	580	500 - 560	340 - 345	2" pvc	Tsm	58.27(s4	57.44	57.79
NOTES:															
1. Well Numbers are unofficial designations; not verified with DWR-assigned well numbers.															
2. Geologic Unit refers to the unit adjacent to the screened interval: Qod/Qar Quaternary "Older Dunes and Aromas Sand" (Dune aquifer); QTc Tertiary and Quaternary "continental deposits" Paso Robles aquifer ; Tsm Tertiary "Santa Margarita Sandstone" (Santa Margarita aquifer); Tp "Purisima Formation"; and Tm "Monterey Formation".															
3. Elevation, reference point elevation at the wellhead: (e1) estimated with Paulin altimeter; e2) estimated from topo map; (s1) surveyed by Land Data Services (LDS) (Jul20, 1990 ; s2) surveyed by LDS (Aug 27, 1992); (63) surveyed by Sandis Hunter Jones (1995 and 1997); (s4) surveyed, source uncertain; (65) surveyed by MPWMD Jun 6, 1997).															
4. "--" in a blank cell means not applicable or not available. "--" in a Screened Interval cell indicates multiple screen intervals.															
5. Data type refers to MPWMD data collected: wl = water level; wq = water quality.															
6. Well completion data at sites MPWMD #FO-01, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424															
7. Well completion data at site MPWMD #FO-04, 5, 6 and 8 are documented in "Laguna Seca Ranch, Supplemental Hydrogeologic Assessment", SGD, Jul 12, 1991.															
8. Well completion data at site MPWMD #FO-05 and 9 are documented in "Laguna Seca Ranch, Supplemental Hydrogeologic Assessment", SGD, Nov 1988.															
9. Well completion data for MSC, PCA-W, PCA-E, Plumas 90 Test and Paralta Test sites are documented in individual reports for each of these sites. SGD, Jul 1990.															
10. Well completion data for Justin Court site are documented in "Additional Investigations of Ryan Ranch a Water Supply", John Logan, Jun 27, 1981.															
11. Well completion data for LS Plots Range, York Rd-West, Seca Place, and Robley Rd sites are documented in "Phase II Hydrogeologic Investigation, Laguna Seca Subarea", SGD, Sep 1988.															
12. Well completion data for LS Driving Range (SCS Deep) and LS No. 1 Subdivision sites are listed in Appendix B of "Phase II Hydrogeologic Investigation, Laguna Seca Subarea", SGD, Sep 1988.															
13. Well completion data for LS Driving Range (SCS Deep) and LS No. 1 Subdivision sites are listed in Appendix B of "Phase II Hydrogeologic Investigation, Laguna Seca Subarea", SGD, Sep 1988.															
14. Geologic unit picks for MPWMD FO-09 and FO-10 sites from Feeney and Rosenberg, Mar 31, 2003 (Figure 4).															
15. The well at the location of "Blue Larkspur-East End" has been described in LSS Phase II and III reports as "LSR 59 Pond Test". However, based on information and notes from DWR Log #43668, it appears that "LSR 59 Pond Test" well has been misinterpreted to be located at the east end of Blue Larkspur Lane. Accordingly, well completion data for "Blue Larkspur-East End" are not known.															
16. In addition to the wells shown in this table, the MPWMD utilizes water level data from selected CAW production wells as part of its monthly groundwater storage tracking program in the coastal subareas of the basin.															
17. It should be noted that the Seaside Basin Watermaster conducted a wellhead elevation survey of monitor and production wells in 2008. Please see MPWMD Seaside Basin Watermaster Memorandum 2008-05 for updated wellhead reference elevation data.															

## **Regional Geologic Setting for the Carmel Valley Alluvial Aquifer**

The 36-mile-long Carmel River drains 255 square miles of the central coast of California (Figure 2). The watershed includes the Santa Lucia Mountains to the south and the Sierra del Salinas to the north. Bedrock in the basin is mainly Sur Series crystalline rock (granite, gneiss, schist) or Monterey Shale with significant outcrops of sandstone and volcanics (Page and Mathews, 1984). Mean annual rainfall varies from about 14 inches along the northeast perimeter of the basin to over 40 inches in the high peaks (up to approximately 5,000 feet in elevation) of the southern portion (James, 1999). Upper reaches on the Carmel River flow through steep-sided canyons, while the lower 16 miles is a relatively flat alluvial valley to the ocean that ranges in width from 300 to 4,500 feet. The average annual runoff at the San Clemente Dam site is 69,200 acre-feet (James, 1999). Bankfull flow is 2,200 cubic feet per second (cfs) near the mouth. On March 10, 1995, the river peaked at 16,000 cfs, which is the largest recorded (gaged) event on the Carmel River.

The unconsolidated sediments of the younger alluvium is the most significant water bearing unit in the Carmel Valley Alluvial Aquifer (Figure 2). The valley floor is composed of Holocene age poorly consolidated boulders, gravel, sand, and silt deposited by the Carmel River. Clay layers are thin and uncommon. However, silt becomes more common in the lower part of the valley. Aquifer thickness ranges from 30 feet at the drainage basin narrows to about 180 feet 1 mile upstream from the Carmel River lagoon (Kapple, 1984).

Recharge to the aquifer comes primarily through river infiltration which is about 85 percent of the net recharge. During normal to above normal rainfall years the water table recovers completely from the dry seasonal lows.

## **Historical Water Levels for the Carmel Valley Alluvial Aquifer**

In general, the water table of the Carmel Valley Alluvial Aquifer recovers fairly rapidly with the onset of the rainy season and an increase in stream flow. For example, after the two year drought of 1976-1977, precipitation that began in January of 1978 caused water levels to recover by February 1978 (Kapple, 1984).

## **Monitoring Plan Rationale**

Monitor wells selected for CASGEM monitoring are distributed to give a good representation of groundwater conditions of Carmel Valley Alluvial Aquifer.



## **Well Network**

The well network in the Carmel Valley Alluvial Aquifer consists of 16 wells. These wells are spread throughout the alluvial aquifer to establish groundwater elevation trends. Monitor well information for the Carmel Valley Alluvial Aquifer is provided in Table 2.

## **Monitoring Schedule**

Wells for the CASGEM program will be monitored twice a year, once at the end of September and once at the end of March.

## **Description of Field Methods**

Depth to the water table is measured directly with electric measuring tape to the nearest hundredth of a foot.



Table 2. Attribute Data for Carmel Valley Alluvial Aquifer Monitor Wells

River <sub>1</sub> Mile	Distance from River (feet)	Well Common Name	State Well No. <sup>2</sup>	Well Owner's Name	Aquifer <sub>3</sub> Subunit	Date Drilled	DWR Drillers Log	Well Type	Data Collection <sup>5</sup>	Well Depth (feet)	Screened Interval (feet)	Reference Point Elevation feet AMSL	Ground Level Elevation (feet AMSL)	Other Name Designations or Notes
0.72	250	Odello West - near CAWD W	T 6S/RW-73Lc	MPWMD	4	3/10/1989	Y	DMW	WL, WQ	130	120-129	15.10 e	15.74	MW3 D, CSD_Deep_CSD_TURN_WEST
1.65	790	CAWD-Rio North D	T 6S/R/E-8Mc	MPWMD	4	8/27/1993	492664	DMW	WL	159	54-54	25.88 s	25.88	
2.16	1350	RC West Monitor	T 6S/R/E-18Ka	MPWMD	4	9/10/1993	492668	DMW	WL	100	40-90	38.00 a)	38.00	3th Hile West Course
3.25	280	Via Mallorca	T 6S/R/E-17Lc	MPWMD	4	7/7/84	N	DMW	WL	115	5-16	47.38 s	47.75	see DMA Phase III, 195 report
3.56	80	Rubin	T 6S/R/E-17Jd	MPWMD	3	7/7/84	N	DMW	WL	95	5-95	48.59 s	50.14	see DMA Phase III (1/85), Suppl Data, Vol. 1
3.85	350	Brookdale Drive	T 6S/R/E-17J4	MPWMD	3	5/27/1981	Y	DMW	WL, WQ	39	29-34	57.58 s	57.96	
3.86	900	Valley Greens Drive	T 6S/R/E-17R2	MPWMD	3	5/22/1981	Y	DMW	WL, WQ	50	40-45	68.18 s	68.44	VG SC
5.44	2400	Williams North Monitor	T 6S/R/E-22Da	MPWMD	3	9/15/1993	492670	DMW	WL	77	32-72	100.00 e	99.43	east side of Williams Ranch Road right-of-way
5.57	50	Williams South Monitor	T 6S/R/E-22Fc	MPWMD	3	7/19/87	N	DMW	WL	100	5-100	87.08 s	87.33	see DMA Phase III (1/85), Suppl Data, Vol. 1
6.53	2300	Schulte Road	T 6S/R/E-23E4	MPWMD	3	5/28/1981	Y	DMW	WL, WQ	58	43-53	10.31 s	10.56	
6.70	1300	Carmel Valley High School #1	T 6S/R/E-23Fb	MPWMD	3	11/16/1988	Y	DMW	WL, WQ	180	60-160	112.42 (s)	112.94	16S/E-23F CVH
6.72	150	Reimers #1	T 6S/R/E-23La	MPWMD	3	11/9/1988	Y	DMW	WL, WQ	122	50-122	102.10 (s)	102.25	16S/E-23L R-1
8.02	1390	Center Street	T 6S/R/E-24N5	MPWMD	3	5/29/1981	Y	DMW	WL, WQ	57	47-52	135.04 s	135.54	
12.52	260	Boronda Road	T 6S/R2E-33Q1	MPWMD	2	5/31/1981	137408	DMW	WL, WQ	32	22-27	220.42 s	218.07	
13.65	380	Little League #1	T 7S/R2E-03La	MPWMD	2	9/24/1988	192663	DMW	WL, WQ	50	30-50	251.00 s	251.60	LL#1
14.28	250	De Los Helechos	T 7S/R2E-10B1	MPWMD	2	5/15/1981	137402	DMW	WL, WQ	28	18-23	272.62 s	273.00	Via Helechos

NOTES:

1. River Mile designations are referenced to the mouth of the Carmel River at Carmel Bay (i.e. RM 0.0). Distances are based on the June 1986 aerial photo enlargements (1" = 100'.
2. Official State Well Number ends with a numeral, unofficial MPWMD Well Number ends with a small case letter.
3. Aquifer Subunit designations are as follows: AS1 - San Clemente Dam to Esquiline Bridge, AS2 - Esquiline Bridge to the Narrows, AS3 - Narrows to Via Mallorca Bridge, AS4 - Via Mallorca Bridge to Carmel Bay, CVU - Carmel Valley Upland.
4. DMW - Dedicated Monitor Well, PPW - Private Production Well.
5. WL - Water Level data, WQ - Water Quality data.
6. (s) - surveyed elevation, (h) - hand-leveled elevation, (e) - estimated elevation from topo map.
7. It should be noted that not all wells shown in this table are currently being monitored by the MPWMD.

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## Appendix 7-C

**Quality Assurance Project Plan for the former Fort Ord, Appendix A**

# Quality Assurance Project Plan Former Fort Ord, California Volume I, Appendix A

## Final Revision 7 Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume



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Task No. 14



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Report Date: **August 7, 2019**  
Report Version: **Final**

## Report Use and Limitations

Report Title: **Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A  
Final Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2  
and 12, and Operable Unit Carbon Tetrachloride Plume**

Prime Contractor: Ahtna Environmental, Inc.

USACE Contract No. W91238-14-C-0048

Task No. 14

Ahtna Environmental, Inc. (Ahtna) prepared this report at the direction of the U.S. Army Corps of Engineers (USACE) for the sole use of the U.S. Department of the Army (Army), the intended beneficiary. No other party should rely on the information contained herein without the prior written consent of the Army. This report and its interpretations, conclusions, and recommendations use the information presented in other documents, as cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.



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## Acronyms and Abbreviations

%	percent
%D	percent difference/percent drift
°C	degrees Celsius
µg/L	micrograms per liter
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCA	1,2-dichloroethane
1,2-DCE (total)	total 1,2-dichloroethene
1,2-DCPA	1,2-dichloropropane
1,3-DCPE (total)	total 1,3-dichloropropane
2/12	Sites 2 and 12
ACL	Aquifer Cleanup Level
ADR	Automated Data Review
AES	Ahtna Engineering Services
Ahtna	Ahtna Environmental, Inc.
Army	U.S. Department of the Army
BCT	BRAC Cleanup Team
BEC	BRAC Environmental Coordinator
BFB	4-bromofluorobenzene
BRAC	Base Realignment and Closure
CCB	continuing calibration blanks
CCRWQCB	California Regional Water Quality Control Board, Central Coast Region
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
COC	chemical of concern
COD	coefficient of determination
CQCR	Contractor Quality Control Report
CRF	Cooler Receipt Form
CT	carbon tetrachloride
DL	detection limit
DO	dissolved oxygen
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
DTW	depth to water
EDD	electronic data deliverable
EISB	enhanced <i>in situ</i> bioremediation

## Acronyms and Abbreviations (continued)

ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
EW	Extraction Well
FADL	Field Activity Daily Logbook
FODIS	Fort Ord Data Integration System
FO-SVA	Fort Ord-Salinas Valley Aquitard
GAC	granular activated carbon
GC/MS	gas chromatography-mass spectrometry
GIS	geographic information system
GWMP	groundwater monitoring program
GWTP	groundwater treatment plant
GWTS	groundwater treatment system
HCl	hydrochloric acid
HLA	Harding Lawson Associates
HNO <sub>3</sub>	nitric acid
IC	ion chromatography
ICAL	initial calibration
ICP	inductively coupled plasma
ICS	interference check sample
ICV	initial calibration verification
ID	identification
IDQTF	Intergovernmental Data Quality Task Force
LCS	laboratory control samples
LCSD	LCS duplicate
LOD	limit of detection
LOQ	limit of quantitation
MACTEC	MACTEC Engineering and Consulting, Inc.
MC	methylene chloride
MCL	maximum contaminant level
MCWD	Marina Coast Water District
mg/L	milligrams per liter
mL	milliliter
MNA	monitored natural attenuation
MPC	measurement performance criteria
MS/MSD	matrix spike/matrix spike duplicate
MSL	mean sea level
N/A	not applicable
ND	non-detect
NPL	National Priorities List



## Acronyms and Abbreviations (continued)

O&M	operations and maintenance
ORP	oxidation-reduction potential
OU	operable unit
OU2	Operable Unit 2
OUCTP	Operable Unit Carbon Tetrachloride Plume
PARCCS	precision, accuracy, representativeness, comparability, completeness, sensitivity
PCE	tetrachloroethene
PDB	passive diffusion bag
PDS	post-digestion spike
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
RF	response factor
ROD	Record of Decision
RPD	relative percent difference
RSD	relative standard deviation
SIM	selected ion monitoring
Sites 2/12	Sites 2 and 12
SM	Standard Methods
SOP	standard operating procedure
SRF	Sample Receipt Forms
SSHO	Site Safety and Health Officer
TAT	turnaround time
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
TS	treatment system
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
VC	vinyl chloride
VOA	volatile organic analysis
VOC	volatile organic compound
Wood	Wood Environment & Infrastructure Solutions, Inc. (formerly Amec Foster Wheeler)

## 1.0 Introduction

On behalf of the U.S. Army Corps of Engineers (USACE), Sacramento District, Ahtna Environmental, Inc. (Ahtna) updated this Quality Assurance Project Plan (QAPP)<sup>1</sup> under Contract Number W91238-14-C-0048 for response actions to be performed at the former Fort Ord (Figure 1) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or “Superfund”) to address historical releases of chemicals of concern (COCs) at the former Fort Ord. The QAPP was updated and revised to:

- Update the number of wells monitored on an annual basis (Table 1), the list of wells sampled (Worksheet #17c) and the sampling location maps (Figures 2, 5A, 8A, 8B, 8C, and 9 through 13) based on newly installed wells,<sup>2</sup> recently decommissioned wells,<sup>3</sup> and recent progress in remedial actions for groundwater.<sup>4</sup>
- Update laboratory company name from SGS North America, Inc. to SGS.
- Update subcontractor company name from Amec Foster Wheeler to Wood Environment & Infrastructure Solutions, Inc. (Wood).
- Reference Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.1.
- Update metals analysis from 6010C to 6010D.
- Reflect recent changes in project personnel.
- Update Operable Unit 2 (OU2) groundwater treatment system (GWTS) changes based on the new groundwater treatment plant (GWTP) and new extraction wells (Figure 7 and Worksheets #17b1 and #17b2).
- Include a description of how COC concentration contours and groundwater elevation contours are drawn in the quarterly reports.

This QAPP is the governing guidance document for groundwater and treatment system sampling associated with Sites 2/12, OU2, and Operable Unit Carbon Tetrachloride Plume (OUCTP) at the former Fort Ord. This QAPP details quality assurance (QA) and quality control (QC) procedures for sampling and analytical activities performed for the GWTS and the groundwater monitoring program (GWMP). The QAPP ensures the data generated are accurate, precise, complete, and representative of field conditions, and of sufficient quality to support project decisions.

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<sup>1</sup> This document is Appendix A to the *Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I*. Volume I is also the governing document for sampling and analysis of soil (Appendix B), soil gas (Appendix C), and landfill gas (Appendix D). Volume II of the QAPP pertains to the former Fort Ord military munitions response program.

<sup>2</sup> Based on the *Monitoring Well Installation Completion Report, Former Fort Ord, California* (Well Install Completion Report; Ahtna, 2019f).

<sup>3</sup> Based on the *2019 Monitoring Well and Soil Gas Probe Decommissioning Completion Report, Former Fort Ord, California* (Ahtna, 2019g).

<sup>4</sup> The United States Environmental Protection Agency (EPA), California Department of Toxic Substances Control (DTSC) and California Regional Water Quality Control Board, Central Coast Region (CCRWWCB) agreed to these changes.

## 2.0 Project Management

### 2.1 Worksheets #1 and #2: Title and Approval Page

**Site Name/Project Name:** Former Fort Ord/Superfund Response Actions



**Site Location:** Former Fort Ord, California

**Document Title:** Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A Final Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume

**Lead Organization:** U.S. Army Corps of Engineers

**Preparer's Name, Organization, and Contact Info:** Holly Dillon, Ahtna  
296 12<sup>th</sup> St, Marina, CA 93933  
(831) 384-3735  
hdillon@ahntna.net

**Preparation Date:** August 2, 2019

Project Role	Name Organization	Signature	Date
Investigative Organization's Project Manager	Derek Lieberman Ahtna		7/24/2019
Investigative Organization's Program Chemist	Christopher Ohland Ahtna		7/24/2019
Lead Organization's Technical Lead	Alex Kan USACE	KAN.ALEXANDER .1297094749	Digitally signed by KAN.ALEXANDER.1297094749 Date: 2019.08.06 14:16:59 -07'00'
Lead Organization's Project Chemist	Jonathan Whipple USACE	WHIPPLE.JONATHAN N.PAUL.1283504758	Digitally signed by WHIPPLE.JONATHAN.PAUL.12835 04758 Date: 2019.08.06 14:35:12 -07'00'

**Plans and reports from previous investigations relevant to this project:**

**Site Name/Project Name:** Former Fort Ord/Superfund Response Actions

**Site Location:** Monterey County, California

**Site Number/Code:** Not Applicable (N/A)

**Operable Units:** OU2, OUCTP, and Sites 2/12

**Contractor Name:** Ahtna Environmental, Inc.

**Contract Number:** W91238-14-C-0048

**Contract Title:** Former Fort Ord Basewide Groundwater and Soil Vapor Treatment and Monitoring, Former Fort Ord, California

**Work Assignment Number:** N/A

**Guidance used to prepare QAPP:** Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets, March 2012, Revision 1. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1, 2017

**Regulatory Program:** Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as amended by Superfund Amendment and Reauthorization Act (SARA)

**Approval Entities:** U.S. Environmental Protection Agency (EPA), California Department of Toxic Substance Control (DTSC), and Regional Water Quality Control Board, Central Coast Region (CCRWQCB)

**Data Users:** U.S. Department of the Army (Army), USACE, EPA (and its consultant TechLaw, Inc.), DTSC, CCRWQCB, Army/USACE contractors, citizen groups, and members of the public

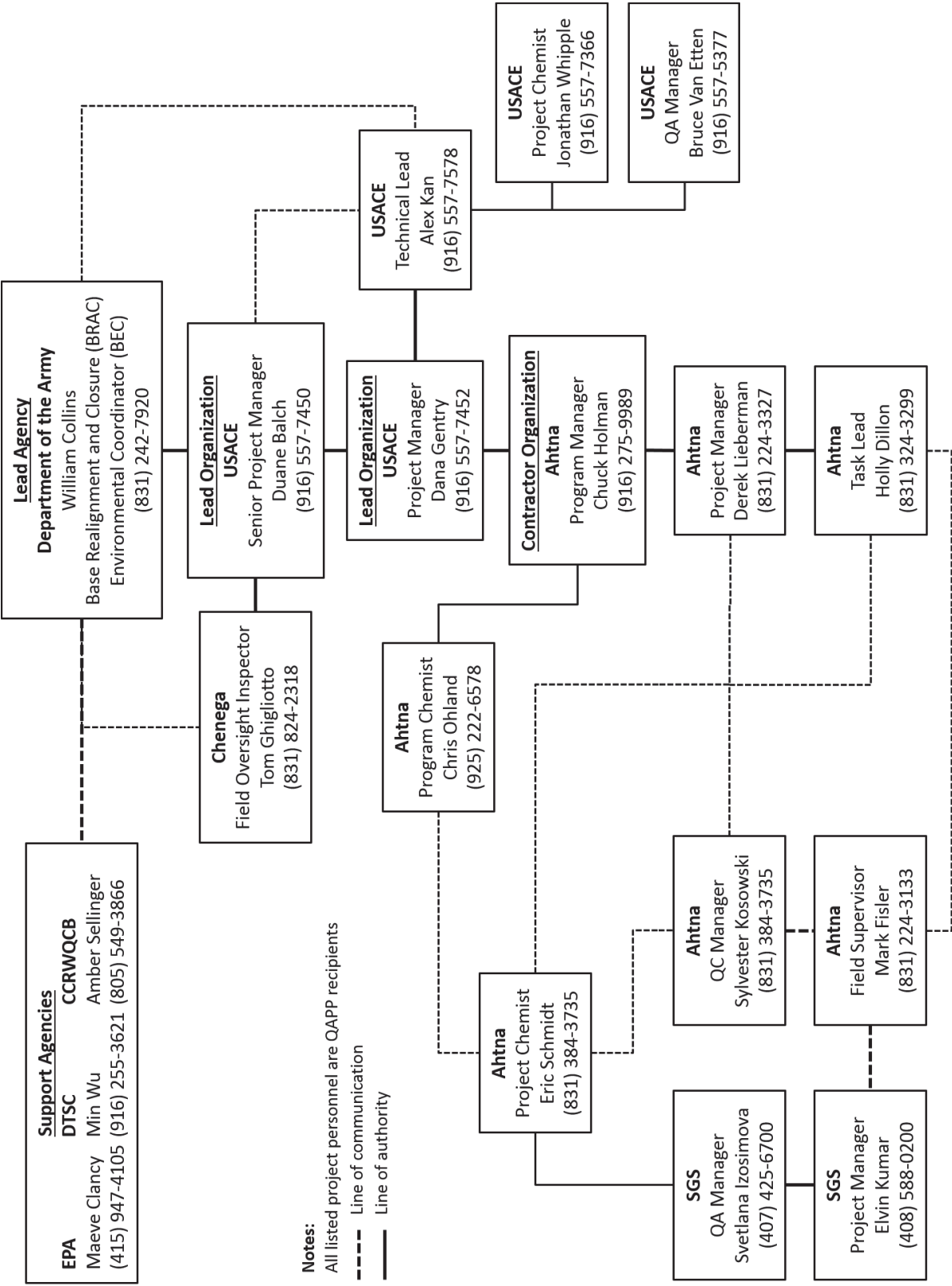
**Organizational partners (stakeholders) and connection with lead organization:** USACE, Army (lead agency/owner), EPA (lead oversight agency), DTSC (support agency), and CCRWQCB (support agency)

**The QAPP is (select one):** Generic: \_\_\_\_\_ Project Specific:  X

**Dates and titles of QAPP documents written for previous site work:**

<b>Title</b>	<b>Approval Date</b>
<i>Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 6</i>	March 2018
<i>Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 5</i>	June 2017
<i>Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 4</i>	March 2016
<i>Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 3</i>	June 2015
<i>Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 2</i>	February 2014
<i>Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 1</i>	December 21, 2012
<i>Draft Final Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Groundwater Extraction and Treatment Systems at Operable Unit 2 and Sites 2 and 12; Groundwater Monitoring Program at Sites 2 and 12, Operable Unit 1, Operable Unit 2, and Operable Unit Carbon Tetrachloride Plume</i>	May 31, 2011
<i>Draft Final, QAPP/CDQMP Groundwater Monitoring Program, Sites 2 and 12, OU2 and OUCTP</i>	January 20, 2010
<i>Final Sampling and Analysis Plan, Operable Unit 2 and Sites 2 and 12 Groundwater Treatment Systems, Former Fort Ord</i>	August 20, 2009


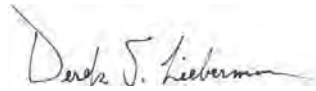


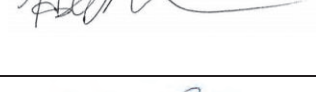


2.2 Worksheets #3 and #5: Project Organization and QAPP Distribution





## 2.3 Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet

Organization: Ahtna

Name	Project Title/Role	Education/ Experience <sup>1</sup>	Specialized Training/ Certifications <sup>2</sup>	Signature <sup>3</sup>	Date
Chuck Holman	Program Manager	Resume on file	HAZWOPER		7/24/2019
Derek Lieberman	Project Manager	Resume on file	First aid, CPR, MEC, PE, H&S, HAZWOPER, CQM		7/24/2019
Christopher Ohland	Program Chemist	Resume on file	H&S, HAZWOPER		7/24/2019
Eric Schmidt	Project Chemist	Resume on file	HAZWOPER, CQM		7/24/2019
Holly Dillon	Task Lead	Resume on file	First aid, CPR, MEC, H&S, HAZWOPER, CQM		7/24/2019
Mark Fisler	Field Supervisor	Resume on file	First aid, CPR, MEC, HAZWOPER, CQM		7/24/2019
Sylvester Kosowski	QC Manager	Resume on file	HAZWOPER, CQM		7/24/2019

### Notes:

<sup>1</sup> Resumes available in Attachment B.

<sup>2</sup> Specialized Training/Certifications Key:

CPR: cardiopulmonary resuscitation

CQM: Construction Quality Management.

H&S: health and safety training, including, but not limited to: hazard communication, fire extinguisher use, defensive driving, behavior-based safety, confined spaces.

HAZWOPER: 40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response

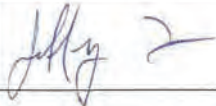

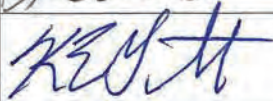
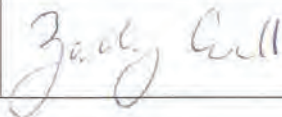
MEC: munitions and explosives of concern recognition and safety training

PE: registered Professional Engineer

<sup>3</sup> Signatures indicate personnel has read and agree to implement this QAPP as written.

## Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet (Continued)

Organization: Wood Environment & Infrastructure Solutions, Inc. (Wood)

Name	Project Title/Role	Education/Experience <sup>1</sup>	Specialized Training/Certifications <sup>2</sup>	Signature <sup>3</sup>	Date
Jeff Fenton	Project Manager	Resume on file	HAZWOPER		7/29/19
Scott Graham	Field Task Manager	Resume on file	HAZWOPER, first aid, CPR, MEC, CQM		7/24/19
Kevin Garrett	Project Chemist	Resume on file	Not applicable		7/24/19
Zachary Carroll	Data Validation Specialist	Resume on file	Not applicable		7/24/19

### Notes:

<sup>1</sup> Resumes available in Attachment B.

<sup>2</sup> Specialized Training/Certifications Key:

CPR: cardiopulmonary resuscitation

CQM: Construction Quality Management.

HAZWOPER: 40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response


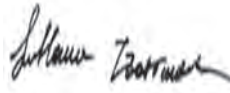


MEC: munitions and explosives of concern recognition and safety training

PE: registered Professional Engineer

<sup>3</sup> Signatures indicate personnel has read and agree to implement this QAPP as written.

## Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet (Continued)

Organization: SGS

Name	Project Title/Role, Location	Education/Experience <sup>1</sup>	Specialized Training/Certifications	Signature <sup>2</sup>	Date
Elvin Kumar	Project Manager, Florida	Resume on file	Not applicable		07/25/19
Svetlana Izosimova	Quality Assurance Officer, Florida	Resume on file	Not applicable		7/25/19
Caitlin Brice	General Manager, Florida	Resume on file	Not applicable		7/25/19
Norman Farmer	Corporate Technical Director, Florida	Resume on file	Not applicable		7/25/19

**Notes:**

<sup>1</sup> Resumes available in Attachment B.

<sup>2</sup> Signatures indicate personnel has read and agree to implement this QAPP as written.

## 2.4 Worksheet #6: Communication Pathways

Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
Point of Contact with lead support agency (EPA)	Lead Agency – Army BEC	William Collins	(831) 242-7920	Project materials and information will be submitted to the EPA, DTSC, and CCRWQCB as appropriate by William Collins (or designee) via e-mail or hardcopy.
Point of contact with Army Base Realignment and Closure (BRAC) Office	USACE	Alex Kan	(916) 557-7578	Materials and information regarding the project will be forwarded to Army BRAC Office through USACE Technical Lead.
Point of Contact with lead organization (USACE)	Ahtna Program Manager	Chuck Holman	(916) 275-9989	Project materials and information will be submitted to Alex Kan via e-mail or hardcopy.
Manage Project – contractor organization	Ahtna Project Manager	Derek Lieberman	(831) 384-3735	Manage project schedule and budget. Communicate project information to project team and Alex Kan. Ahtna Team liaison to Ahtna Program Manager.
Manage Project – contractor organization	Ahtna Task Lead	Holly Dillon	(831) 384-3735	Manage project fieldwork, data management, and document preparation. Communicate information to Project Manager.
Manage Project – subcontractor	Wood Project Manager	Jeff Fenton	(707) 793-3832	Manage project schedule and budget. Communicate project information to project team and Derek Lieberman.
Status Reports	Ahtna	Derek Lieberman	(831) 384-3735	Derek Lieberman will provide updates to USACE during weekly status meetings.
Stop work due to safety issues	Ahtna	Any person	(831) 384-3735	Any individual has the ability to stop work based on an unsafe work condition, or a potential for an unsafe work condition.
QAPP deviation in field	Wood Field Task Manager / Ahtna O&M Manager	Scott Graham/ Mark Fisler	(707) 364-3620/ (831) 224-3133	Notify Eric Schmidt by telephone or e-mail of variances to QAPP made in the field and the reasons within 24 hours. Eric Schmidt will notify Jonathan Whipple.

Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
QAPP changes in field (modification to QAPP)	Wood Field Task Manager	Scott Graham	(707) 364-3620	Scott Graham will propose modifications to Kevin Garrett, Jeff Fenton, and Holly Dillon prior to implementation. Holly Dillon will propose an appropriate modification to Eric Schmidt and Derek Lieberman for approval. Derek Lieberman will propose a modification to Jonathan Whipple for approval. Communication regarding modification will be in writing (e-mail or hardcopy).
	Wood Project Chemist	Kevin Garrett	(303) 293-6082	
	Ahtna Program Chemist	Christopher Ohland	(925) 222-6593	
	Ahtna Project Chemist	Eric Schmidt	(831) 384-3735	
	USACE Project Chemist	Jonathan Whipple	(916) 557-7366	
QC and contract compliance	Ahtna QC Manager	Sylvester Kosowski	(831) 384-3735	Reviews project plans; assures Ahtna compliance with contract requirements.
Daily Field Progress Reports/Field QA/QC Issues	Wood Field Task Manager	Scott Graham	(707) 364-3620	Scott Graham will report field progress and field QA/QC issues daily by fax or e-mail to Jeff Fenton, Kevin Garrett, and Holly Dillon.
Laboratory Issues	SGS Project Manager	Elvin Kumar	(408) 588-0200	Elvin Kumar to notify Kevin Garrett of any problems with the laboratory (i.e. receipt of samples, instrument problems, detection limits (DLs), or any other issues that will affect the data or turnaround time (TAT) of reported results) within 24 hours of the occurrence, by phone and follow-up written communication (e-mail or hardcopy).
Field and Laboratory Data Quality Issues	Wood Project Chemist	Kevin Garrett	(303) 293-6082	Kevin Garrett will notify Jeff Fenton and Holly Dillon by phone or e-mail of field or lab QA/QC issues within one business day. Holly Dillon will notify Derek Lieberman and Eric Schmidt. Derek Lieberman will notify Jonathan Whipple.

Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
Field and Analytical Corrective Actions <sup>1</sup>	Wood Project Chemist	Kevin Garrett	(303) 293-6082	The need for field or laboratory corrective action will be determined by Kevin Garrett and/or Holly Dillon, which will be communicated in writing to Jeff Fenton, Derek Lieberman, and laboratory contact (when appropriate) within two business days. Derek Lieberman will notify Jonathan Whipple.
Release of Analytical Data	Wood Project Chemist	Kevin Garrett	(303) 293-6082	Analytical data will not be released for use until review or validation is completed, as appropriate. Following Eric Schmidt's approval of validation findings, Kevin Garrett will release the data via e-mail to the project team.
Data import and export	Wood Data Validator	Zack Carroll	(707) 793-3873	Uploads field/fixed lab and data recorder data into the Fort Ord Data Integration System.
Hazardous or unsafe conditions that raise question of stopping work	Wood Field Task Manager / Ahtna O&M Manager	Scott Graham/ Mark Fisler	(707) 364-3620/ (831) 224-3133	Confer with Derek Lieberman and/or the Ahtna Site Safety and Health Officer (SSHO) to determine whether work needs to be stopped; the Ahtna SSHO will report stop-work decision to the Ahtna PM.
Perform field QC checks to ensure proper sampling methods, custody procedures, and packaging, and shipment are performed	Ahtna QC Manager	Sylvester Kosowski	(831) 384-3735	Report result of field checks to Derek Lieberman and Eric Schmidt.
Prepare initial write-up of field generated data to be included in final reports	Ahtna Task Lead	Holly Dillon	(831) 384-3735	Confer with Derek Lieberman on questions and resolutions.



Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
Database setup and data management planning	Ahtna Task Lead	Holly Dillon	(831) 384-3735	Provides information on sample and analytical reporting groups, and types of report tables required for the project.
Data verification/data validation	Wood Data Validator	Zack Carroll	(707) 793-3873	Report result of analytical QC checks to Chris Ohland.
Data review issues and corrective actions	Ahtna	Eric Schmidt	(831) 384-3735	Report result of analytical QC corrective action to Christopher Ohland and Derek Lieberman.

**Notes:**

<sup>1</sup> In the event significant corrective action is required for field or laboratory activities, information concerning the corrective action will be provided to the EPA, DTSC, and CCRWQCB by the Army within 30 days of the event, typically at the next scheduled monthly meeting of the BRAC Cleanup Team (BCT).

## 2.5 Worksheet #9: Project Planning Session Summary

<b>Project Name:</b> Former Fort Ord Basewide Groundwater and Soil Vapor Treatment and Monitoring <b>Projected Start Date:</b> Ongoing <b>Project Manager:</b> Derek Lieberman, Ahtna			<b>Site Name:</b> Former Fort Ord <b>Site Location:</b> Former Fort Ord, CA	
<b>Date of Session:</b> October 2, 2018 <b>Scoping Session Purpose:</b> Define scope of work to be included in the QAPP				
Name	Title	Affiliation	Telephone #	E-mail Address
Derek Lieberman	Project Manager	Ahtna	(831) 384-3735	dlieberman@ahtna.net
Eric Schmidt	Project Chemist	Ahtna	(831) 384-3735	eschmidt@ahtna.net
Holly Dillon	Task Lead	Ahtna	(831) 384-3735	hdillon@ahtna.net
Andrew Mauck	Field Technician	Ahtna	(831) 384-3735	amauck@ahtna.net

### Planning Session Summary:

Reviewed contract to determine QAPP requirements and reviewed QAPP Revision 6 for potential updates needed.

### Action Items:

Based on this review, Ahtna will:

- Initiate QAPP Revision 7 update.
- After review of the previous four quarters of data (Fourth Quarter 2017 through Third Quarter 2018) and comparison to decision rules in the QAPP, update the list of monitoring and extraction wells to be sampled quarterly and annually. Remove wells from sampling program as allowed by decision rules. Updates to be proposed for approval by the BCT at the meeting on November 14, 2018 and to be applied to the Fourth Quarter 2018 GWMP event to be conducted in December 2018.
- Update subcontractor from Amec Foster Wheeler to Wood.
- Review SGS changes to QAPP including QSM Version 5.1 changes.

### **3.0 Project Quality Objectives**

#### **3.1 Worksheet #10: Conceptual Site Model**

##### **3.1.1 Background and History**

The former Fort Ord is located along the Pacific Ocean in northwest Monterey County, approximately 80 miles south of San Francisco, California (Figure 1). The former military installation covered about 28,000 acres, is bounded by Monterey Bay to the west and the Santa Lucia Range to the south, and is surrounded by the cities of Del Rey Oaks, Marina, Sand City, and Seaside. State Highway 1 and the Union Pacific Railroad right-of-way traverse through the western portion of the former Fort Ord, separating the Monterey Bay beach front from the rest of the installation. The former Fort Ord served as a training and staging facility for infantry troops from 1917 until its closure in 1994. In 1990, the former Fort Ord was placed on the EPA's National Priorities List (NPL),<sup>5</sup> primarily due to volatile organic compounds (VOCs) found in groundwater beneath the Fort Ord Landfills. The former Fort Ord was closed in 1994 under the Base Realignment and Closure Act (BRAC).<sup>6</sup> Environmental remediation at the former Fort Ord is being completed pursuant to the CERCLA §121 and the National Oil and Hazardous Substances Contingency Plan.

##### **3.1.2 Sources of Known or Suspected Hazardous Waste**

###### Sites 2/12

When the former Fort Ord was an active military facility, Site 2 consisted of the primary sewage treatment facility for Fort Ord and Site 12 included numerous industrial activities, including vehicle maintenance and repair, furniture repair, storage of motor oils, hazardous material storage, vehicle cleaning and degreasing, and disposal of waste and oil.

###### OU2

The source of the OU2 groundwater contamination was from the Fort Ord Landfills. No detailed records were kept on the amount or types of wastes disposed of at the Fort Ord Landfills; however, household and commercial refuse, ash from incinerated infectious wastes, dried sewage sludge, demolition material, and small amounts of chemical waste (such as paint, waste oil, pesticides, electrical equipment, ink and epoxy adhesives) are believed to have been disposed of in the Fort Ord Landfills (Dames & Moore, 1993).

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<sup>5</sup> The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

<sup>6</sup> BRAC is the process the Department of Defense (DoD) has used to reorganize its installation infrastructure to more efficiently and effectively support its forces and increase operational readiness.

### OUCTP

The apparent source of the OUCTP groundwater plume is located on what is now Lexington Court, a residential area in the northern portion of the former Fort Ord. Historical practices at this site included cleaning electronic equipment and radios.

#### **3.1.3 Known Contaminants**

Known contaminants, or COCs, were identified during Remedial Investigations at the sites and documented in the decision documents for each site. The COCs are listed in Worksheet #15a and are summarized below.

#### Sites 2/12

There are eight COCs for groundwater at Sites 2/12, with the primary COCs (those detected at the highest concentrations over the greatest area) identified as tetrachloroethene (PCE) and trichloroethene (TCE). Additionally, PCE and TCE are the two COCs for soil gas at Sites 2/12, which is described in the QAPP Volume I Appendix C for Soil Gas Monitoring (Ahtna, 2019c).

#### OU2

There are eleven COCs for groundwater at OU2, with the primary COC identified as TCE. Operations and maintenance (O&M) of the Fort Ord Landfills and the landfill gas extraction and treatment system is described separately in the QAPP Volume I, Appendix D, OU2 Landfills (Ahtna, 2019d).

### OUCTP

The primary COC in groundwater at OUCTP is carbon tetrachloride (CT); however, there are eight COCs for the A-Aquifer, one COC for the Upper 180-Foot Aquifer, and two COCs in the Lower 180-Foot Aquifer.

#### **3.1.4 Fate and Transport Considerations**

#### Sites 2/12

There are or have been four potential migration pathways specific to Sites 2/12:

- Leaching of chemicals into underlying unsaturated zone soil.
- Diffusion of vapor phase chemicals in soil gas.
- Partitioning of chemicals between soil gas and groundwater.
- Migration of dissolved phase chemicals in groundwater.

Based on environmental conditions, historical data at Sites 2/12, and chemical-specific properties, PCE and TCE are considered to have medium to high persistence and moderate mobility. Soil types present at the site have a low retardation factor and there is insignificant adsorption of these chemicals. Additionally, PCE and TCE water solubilities and partition coefficients indicate moderate mobility. Persistence of PCE and TCE over time and the relative absence of breakdown products indicate little or no reductive dechlorination of these compounds, particularly in soil gas. Concentration-driven diffusion is likely a continuing process at Site 12 given the variation of concentration gradients in the unsaturated zone over time. Additionally, groundwater and soil gas analytical data and modeling during the Remedial

Investigation/Feasibility Study Addendum at Sites 2/12 indicated the areas of highest concentrations of PCE and TCE in soil gas were associated with concentrations of PCE and TCE in groundwater that exceed Aquifer Cleanup Levels (ACLs; AES, 2015). Groundwater contamination at Sites 2/12 affected the unconfined Upper 180-Foot Aquifer.

## OU2

VOCs remaining in waste disposed of at the Fort Ord Landfills and VOCs detected in landfill gas have the potential to travel through soil pore space to exposure points via a number of mechanisms:

- Advection: mass transport due to bulk flow of water in which contaminants are dissolved;
- Dispersion: transport due to the groundwater flow whether or not a compound is dissolved;
- Diffusion: spreading of contaminants due to molecular diffusion in response to concentration gradients; and
- Volatilization: loss of chemical vapor to the atmosphere.

VOCs naturally undergo biological degradation processes in soil, soil gas, and groundwater; however, the rate of such degradation is limited by oxygen and nutrient sources depending upon the type of degradation that is occurring (aerobic vs. anaerobic). Further, degradation of compounds is dependent on the biological pathway available.

Groundwater contamination at OU2 affected the upper three groundwater aquifers: the A-Aquifer, the Upper 180-Foot Aquifer, and the Lower 180-Foot Aquifer (HLA, 1995). In the vicinity of OU2, the tops of each of these aquifers typically are first encountered at depths of about 60 feet bgs, 150 feet bgs, and 250 feet bgs, respectively. In monitoring well MW-OU2-73-A, located at the Fort Ord Landfills Area F source area, PCE and TCE are below their ACLs or not detected, but vinyl chloride is detected at the highest concentrations for the OU2 A-Aquifer. Vinyl chloride is a breakdown product in the natural reductive dechlorination process and may indicate this process is occurring locally at Fort Ord Landfills Area F.

With implementation of the remedy as prescribed in the OU2 Fort Ord Landfills Record of Decision (OU2 ROD; Army, 1994; engineered landfill cover system, and groundwater extraction and treatment system) in addition to operation of the landfill gas extraction and treatment system, impacts to the underlying groundwater from the Fort Ord Landfills have been greatly mitigated.

## OUCTP

There are or have been four potential migration pathways specific to OUCTP:

- Leaching of chemicals into underlying unsaturated zone soil.
- Diffusion of vapor phase chemicals in soil gas.
- Partitioning of chemicals between soil gas and groundwater.
- Migration of dissolved phase chemicals in groundwater.

The CT plume appears to have originated from a training facility referred to in 1958 as “ST-11”, near what is now Lexington Court (Figure 8A), and migrated through the vadose zone beneath the vicinity of

this facility and into groundwater of the A-Aquifer, the Upper 180-Foot Aquifer, and the Lower 180-Foot Aquifer; CT has not been detected in the 400-Foot Aquifer.

Hydraulic communication between the A-Aquifer and the underlying aquifers is limited to those areas west of OUCTP where the Fort Ord-Salinas Valley Aquitard (FO-SVA) clay unit pinches out, or where it was penetrated by wells without adequate sanitary seals. Two such vertical conduits were identified that resulted in the migration of CT from the A-Aquifer to the underlying Upper and Lower 180-Foot Aquifers. All identified vertical conduits have been destroyed (grouted and sealed) eliminating hydraulic communication between the A-Aquifer and the underlying aquifers. Groundwater in the Upper 180-Foot Aquifer flows to the southeast toward the apparent discontinuity in the underlying Intermediate 180-Foot Aquitard where it then recharges the Lower 180-Foot Aquifer. Groundwater in the Lower 180-Foot Aquifer primarily migrates to the east (Army, 2008).

In addition to CT, chloroform, TCE, and PCE were also present both within the vadose zone (vapor phase) and in the A-Aquifer near the source (dissolved phase). Chloroform is a biodegradation product of CT whose presence in OUCTP suggests there are native microbial bacteria acting within the subsurface to biodegrade CT. The presence of PCE and TCE in soil gas near the source area suggests these compounds were also disposed of in this area, presumably during the use of the same training facility.

In addition to CT, TCE is also present in the Lower 180-Foot Aquifer, which suggests groundwater originating from OU2 in the Upper 180-Foot Aquifer may be flowing from the southwest toward the apparent discontinuity in the Intermediate 180-Foot Aquitard (Ahtna, 2019b).

### **3.1.5 Potential Receptors and Exposure Pathways**

Groundwater at Sites 2/12, OU2 and OUCTP currently is not used by residents within the Fort Ord area for domestic household purposes. Drinking water in the Fort Ord area is provided by the Marina Coast Water District (MCWD) and is pumped from wells that are located east of the Sites 2/12, OU2 and OUCTP areas. These supply wells are screened in the Lower 180-Foot Aquifer or deeper aquifers. Groundwater within the Sites 2/12, OU2 and OUCTP areas is located in the Prohibition Zone of the Special Groundwater Protection Zone at the former Fort Ord, within which the installation of new supply wells is restricted by Monterey County. According to Monterey County Code Title 15 Section 15.08.140, a prohibition zone is an area overlying or adjacent to a contaminant plume where water well construction is prohibited and applications for water wells will not be accepted; therefore, direct contact groundwater exposure pathways for residents potentially exposed to groundwater from the Sites 2/12, OU2 and OUCTP areas are currently incomplete and are expected to remain so in the future.

### **3.1.6 Land Use Considerations**

#### Sites 2/12

In March 2004, the Army transferred the property at Site 12 and the land was redeveloped into a commercial retail area, which included construction of several big-box stores, a movie theater complex, food services, and a large parking area which is identified as The Dunes on Monterey Bay. The Army transferred the property at Site 2 in September 2006 and this land remains undeveloped and open to



the general public as part of Fort Ord Dunes State Park. The Site 2 area was proposed for reuse as an aquaculture and oceanographic research facility, and later as a desalination plant (Fort Ord Reuse Authority [FORA], 1997); however, the site remains unused with the derelict sewage treatment plant facilities still onsite.

## OU2

The OU2 area consists of the Fort Ord Landfills, which encompass approximately 120 acres of undeveloped land, as well as mixed-use residential, commercial, and undeveloped areas.

## OUCTP

The apparent source of the OUCTP is located on what is now Lexington Court, part of the Abrams Housing Development, in the northern portion of the former Fort Ord. A groundwater contaminant plume emanating from this area ultimately extends across an area bounded by Del Monte Boulevard, Abrams Drive, Neeson Road, and Blanco Road. The OUCTP area consists of mixed-use residential, commercial, light industrial, and undeveloped areas including habitat reserve areas.

### **3.1.7 Physiography and Topography**

The predominant topography of the area reflects a morphology typical of the dune sand deposits that underlie the western and northern portions of the former Fort Ord. In these areas, the ground surface slopes gently to the west and northwest, draining toward Monterey Bay. Runoff is minimal because of the high rate of surface-water infiltration into the permeable dune sand. Consequently, well-developed natural drainages are absent throughout much of this area. Closed drainage depressions typical of dune topography are common. Elevations at the former Fort Ord range from approximately 50 feet above mean sea level (MSL) at Site 2 to 250 feet above MSL at the Fort Ord Landfills.

### **3.1.8 Geology and Hydrology**

The predominant lithology is a loose, well-sorted (poorly graded) fine to medium sand. The sands represent active and recently active dunes and Pleistocene-age older dune sands. The active dune sands parallel the beach and extend several hundred feet inland. The older dune sands cover most of the northern and western portions of the former Fort Ord. Paleosols, representing former ground surfaces (silty sands) exist within these sands. These paleosols indicate that one or more cycles of dune deposition have occurred with intervening periods of soil development. The paleosols in the dunes bordering the beach indicate that older dune sand is locally present beneath the recent dune sand.

Three groundwater aquifers are in the remediation phase of cleanup activities at the former Fort Ord: the unconfined A-Aquifer, the unconfined and confined Upper 180-Foot Aquifer, and the confined Lower 180-Foot Aquifer. The aquifers consist predominantly of fine to coarse-grained sands which are separated by silty clay or clayey fine-grained sand aquitards. The A-Aquifer is located within the recent dune sands and is perched above the regional FO-SVA. To the west where the FO-SVA pinches out, the unconfined A-Aquifer and confined Upper 180-Foot Aquifer combine to form a continuous, unconfined hydrostratigraphic unit (identified as the unconfined Upper 180-Foot Aquifer). A north-trending groundwater divide in the unconfined Upper 180-Foot Aquifer exists midway between the FO-SVA and

Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer west of the divide flows west and discharges to the Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer east of the divide flows under the FO-SVA (becoming confined) toward the Salinas Valley. The Upper and Lower 180-Foot Aquifers, and portions of the 400-Foot Aquifer (locally) are contained within valley fill deposits. The Upper 180-Foot Aquifer is separated from the Lower 180-Foot Aquifer by the Intermediate 180-Foot Aquitard, which appears to be laterally discontinuous in the eastern portion of the former Fort Ord near the OU2 and OUCTP areas creating a natural conduit between the aquifers (Army, 2008).

### 3.2 Worksheet #11: Project/Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that outline the decision-making process and specify the data required to support corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from data. The DQO process used for developing data quality criteria and performance specifications for decision-making is consistent with the *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 2006). The DQO process consists of the following seven steps:

- Step 1: State the problem
- Step 2: Identify the goals of the study
- Step 3: Identify information inputs
- Step 4: Define the boundaries of the study
- Step 5: Develop the analytical approach
- Step 6: Specify performance or acceptance criteria
- Step 7: Develop the plan for obtaining data

The DQOs steps are presented below for the five operable units (OUs):

- Sites 2/12
- OU2
- OUCTP A-Aquifer
- OUCTP Upper 180-Foot Aquifer
- OUCTP Lower 180-Foot Aquifer

#### 3.2.1 Step 1: State the Problem

Concentrations of VOCs (primarily PCE, TCE and related breakdown products, and CT) are present in groundwater at the former Fort Ord at concentrations above the ACLs prescribed in the relevant RODs or Explanations of Significant Differences (ESDs), thereby requiring periodic monitoring and reporting of groundwater conditions and VOC concentrations to the CCRWQCB, DTSC, EPA, and USACE. Groundwater contamination is present in three aquifers within and adjacent to the former Fort Ord footprint: A-Aquifer, Upper 180-Foot Aquifer, and the Lower 180-Foot. Three main study areas have been identified, and comprise the majority of the GWMP: Sites 2/12 (one aquifer: Upper 180-Foot Aquifer), OU2 (two aquifers: A-Aquifer and Upper 180-Foot Aquifer) and OUCTP (three aquifers: A-Aquifer, Upper 180-Foot Aquifer, and Lower 180-Foot).

##### Sites 2/12

Groundwater in the Upper 180-Foot Aquifer beneath Sites 2/12 has been adversely impacted by eight VOCs (Worksheet #15a) that are identified in the Basewide Remedial Investigation Sites Record of Decision (RI Sites ROD; Army, 1997). These compounds are identified as COCs because they are present in groundwater at levels that pose an unacceptable risk to human health or the environment. As a result, the RI Sites ROD and the RI Sites ESD (Army, 2016) require remediation of the Upper 180-Foot Aquifer beneath and downgradient of Sites 2/12 using groundwater extraction with liquid-phase

granular activated carbon (GAC) treatment and soil gas extraction with vapor-phase GAC treatment (Ahtna, 2019c). Figure 2 shows the Sites 2/12 monitoring and extraction well locations by sampling schedule, Figure 3 shows the Sites 2/12 GWTS configuration with current extraction well status, and Figure 4 shows the Sites 2/12 GWTP schematic and sampling locations. A detailed discussion of the soil vapor extraction and treatment system can be found in the Soil Gas QAPP (Ahtna, 2019c).

Improper disposal of solvents from former activities in this area led to contamination of the groundwater by COCs at concentrations above ACLs. The extent of the plume is defined by the detectable presence of PCE in groundwater, as it is the most common and widespread chemical constituent in this area. Active remedial action at Sites 2/12 consists of groundwater extraction and treatment by liquid-phase GAC since 1999, and soil gas extraction and treatment by vapor-phase GAC since 2015. Additionally, monitoring wells at Sites 2/12 are subject to seawater intrusion due to their proximity to Monterey Bay; as a result, chloride concentrations are monitored annually at select wells.

## OU2

Groundwater in the A-Aquifer and Upper 180-Foot Aquifer beneath and downgradient from the Fort Ord Landfills has been adversely impacted by 11 VOCs. These compounds were identified as COCs (Worksheet #15a) in the OU2 ROD (Army, 1994) because they are present in groundwater at levels that pose an unacceptable risk to human health or the environment. As a result, the OU2 ROD and the OU2 ESD (Army, 1995) require remediation of the A-Aquifer and Upper 180-Foot Aquifer beneath and downgradient of OU2 using groundwater extraction with GAC treatment and treated water recharged to the aquifer or reused at the surface. Figures 5A and 5B show the OU2 monitoring and extraction well locations by sampling schedule, Figure 6 shows the OU2 GWTS configuration with current extraction well status, and Figure 7 shows the OU2 GWTP schematic and sampling locations.

COC migration from landfills covering 150 acres in the area has led to contamination of the groundwater by COCs at concentrations above ACLs. Three water supply wells (FO-29, FO-30, and FO-31), which MCWD owns and operates as part of the drinking water supply system for the former Fort Ord and the City of Marina, are also located near the OU2 area. The extent of the plume is defined by the detectable presence of TCE in groundwater, as it is the most common and widespread chemical constituent in this area. Active and ongoing (since 1995) remediation at OU2 consists of extraction and GAC treatment of groundwater.

Disposal of spent small arms ammunition in the Fort Ord Landfills was also identified as a possible source for metals (antimony, copper, and lead) contamination of the groundwater. Metals are not identified as COCs for groundwater in the OU2 ROD and therefore do not have ACLs. However, metals (antimony, copper, and lead) concentrations are monitored at select wells around the Fort Ord Landfills annually to validate that groundwater is not impacted by soil and spent small arms ammunition disposed of in the Fort Ord Landfills during remediation of small arms firing ranges at Fort Ord.

## OUCTP A-Aquifer

Improper disposal of CT, used as a cleaning solvent for activities conducted in this area, led to contamination of the groundwater (Army, 2008). The extent of the OUCTP in the A-Aquifer is defined by the detectable presence of CT in groundwater, as it is the most common and widespread chemical

constituent in this area. Remedial action at OUCTP includes a combination of enhanced *in situ* bioremediation (EISB) and monitored natural attenuation (MNA). EISB treatment began with the pilot study starting in 2008 and completed in 2012 at Deployment Areas 1 and 2. Post-treatment and long-term groundwater monitoring have been conducted since 2012 (AES, 2014).

Additional monitoring wells were installed in 2011 and 2015 to close data gaps for the MNA remedy. The wells installed in 2015 indicated the CT groundwater plume was migrating northeast of the A-Aquifer groundwater divide (Figure 11) and construction of EISB Treatment Area #3 was recommended as shown in Figure 14. EISB Deployment Area 3A construction was completed and remedial operations began on December 1, 2016. Operations were completed on August 4, 2017 and post-treatment long-term performance monitoring is continuing according to the *Final Operable Unit Carbon Tetrachloride Plume Remedial Action Work Plan Addendum, Former Fort Ord, California* (Ahtna, 2016).

The effectiveness of EISB treatment is determined through periodic monitoring and reporting of groundwater quality parameters (dissolved oxygen [DO] and oxidation-reduction potential [ORP] in specific wells listed in Worksheet #17c3) and VOC concentrations (Worksheet #15a) to the CCRWQCB, DTSC, EPA, and USACE. Figure 8A shows the OUCTP A-Aquifer monitoring well locations by sampling schedule.

#### OUCTP Upper 180-Foot Aquifer

Groundwater in the Upper 180-Foot Aquifer at OUCTP has been adversely impacted by CT (Worksheet #15a) as identified in the OUCTP ROD (Army, 2008). This compound is identified as a COC because it is present in groundwater at levels that pose an unacceptable risk to human health or the environment. As a result, the OUCTP ROD requires remediation of OUCTP in the Upper 180-Foot Aquifer using groundwater extraction and treatment via the existing OU2 GWTS. Figure 8B shows the OUCTP Upper 180-Foot Aquifer monitoring well locations by sampling schedule. Figure 6 shows the location of the OUCTP Upper 180-Foot Aquifer extraction well, EW-OU2-09-180.

#### OUCTP Lower 180-Foot Aquifer

Groundwater in the Lower 180-Foot Aquifer at OUCTP has been adversely impacted by CT (Worksheet #15a) as identified in the OUCTP ROD (Army, 2008). The remediation of the Lower 180-Foot Aquifer includes MNA and contingency wellhead treatment of the nearby MCWD supply wells. Figure 8C shows the OUCTP Lower 180-Foot Aquifer monitoring well locations by sampling schedule. Groundwater in the Lower 180-Foot Aquifer has been adversely impacted by TCE at concentrations exceeding the maximum contaminant level (MCL) for drinking water, which suggests groundwater originating from OU2 in the Upper 180-Foot Aquifer may be flowing from the southwest toward the apparent discontinuity in the Intermediate 180-Foot Aquitard (Army, 2008 and Ahtna, 2019b).

### **3.2.2 Step 2: Identify the Goals of the Study**

The primary goals associated with the Sites 2/12, OU2, and OUCTP remediation projects are to monitor the programs and verify they reflect current site conditions and whether the sites are in continued compliance with the RI Sites ROD (Army, 1997) and ESD (Army, 2016), OU2 ROD (Army, 1994) and ESD (Army, 1995), and the OUCTP ROD (Army, 2008), respectively.

### OU2 and Sites 2/12 GWTSs

Data collected from the Sites 2/12 and OU2 GWTS will be used to perform the following assessments:

- Evaluate whether the GWTS are effectively and efficiently reducing concentrations of COCs in the aquifers of concern.
- Assess whether GWTS effluent meets discharge requirements before it is used for groundwater recharge or onsite for non-potable construction purposes (dust control, soil compaction, etc.).
- Evaluate when the GWTS GAC requires change-out.
- Evaluate whether the GWTS provides adequate hydraulic containment of the COC plume and prevents its migration.
- Assess whether ACLs have been achieved for COCs within project boundaries and whether closure of the site or OU is warranted.
- Assess whether the current extraction well sampling frequency is adequate to meet project objectives.

### OU2, Sites 2/12, and OUCTP GWMP

The data collected from the Fort Ord GWMP are used to evaluate the following decisions:

- Are concentrations of COCs in groundwater above the relevant ROD- or ESD-prescribed ACLs?
- What is the vertical and lateral extent of relevant ROD-specified COCs in groundwater?
- Are concentrations of TCE in the Lower 180-Foot Aquifer above the MCL?
- What is the vertical and lateral extent of TCE in the Lower 180-Foot Aquifer?
- What is the source of TCE in the Lower 180-Foot Aquifer?
- What are the groundwater and aquifer conditions relative to the stability of the contaminant plumes, and what trends and temporal changes in groundwater levels and COC concentrations are taking place?
- Does the conceptual site model need to be updated or verified?
- Is closure of the site or OU, or a hydraulic zone within the site or OU, warranted if concentrations of COCs in groundwater are less than or equal to the relevant ROD- or ESD-prescribed ACLs?
- Are concentrations of chloride in monitoring wells at Sites 2/12 above the Monterey County Water Resources Agency threshold of 500 mg/L for classification as “seawater intruded”?
- Are concentrations of dissolved antimony, copper, and lead above MCLs for drinking water in wells associated with the Fort Ord Landfills?<sup>7</sup>

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<sup>7</sup> Antimony, copper, and lead are the primary metals found in spent ammunition deposited in the Fort Ord Landfills, but are not identified as COCs for groundwater in the OU2 ROD and do not have ACLs; therefore, detected concentrations are compared to MCLs for drinking water. The Federal and California MCLs for antimony, copper and lead are the same numerical value (see Worksheet #15c). The MCL is the maximum concentration of a chemical that is allowed in public drinking water systems, though the groundwater being monitored is within the Prohibition Zone and is not intended for use as drinking water (see Section 3.1.5).



- Do post-treatment DO and ORP measurements in the OUCTP A-Aquifer monitoring wells indicate biodegradation is still occurring in the EISB Deployment Areas?

### **3.2.3 Step 3: Identify Information Inputs**

#### OU2 and Sites 2/12 GWTSs

Inputs to decisions for the Sites 2/12 and OU2 GWTS are as follows:

- COC concentration data from extraction well samples collected to assess relative concentrations in the aquifer and whether ACLs have been met for COCs.
- COC concentration data from locations within the GWTS collected to assess whether the GWTS is operating effectively and efficiently.
- COC concentration data from TS-212-INJ and TS-OU2-INJ to confirm whether site-specific discharge requirements (Worksheet #15a) are met.
- COC concentration data from GAC treatment effluent collected to determine whether a GAC change-out is required.
- GWTS flow rate data collected to evaluate and document system operation.
- Groundwater monitoring data and/or groundwater flow modeling results to determine whether the plume is hydraulically contained.

#### OU2, Sites 2/12, and OUCTP GWMP

Decision inputs for the Fort Ord GWMP are as follows:

- Historical groundwater monitoring results and archived information.
- Historical knowledge of geologic and hydrologic conditions at Fort Ord.
- Groundwater modeling data from recent trend analysis.
- Statistical analysis of COC concentration trends on a well-by-well basis.
- ROD- or ESD-prescribed ACLs.
- State of California MCLs for drinking water.
- Fort Ord GWTS operational data and monitoring results.
- Drinking water production well data from local districts and municipalities.

### **3.2.4 Step 4: Define the Boundaries of the Study**

The physical study boundaries for the Sites 2/12, OU2, and OUCTP groundwater remedies are described below and shown in Figure 1. Study boundaries are further divided into hydraulic zones based on the zone of groundwater with COC concentrations above ACLs and influenced by the groundwater remedy; therefore, hydraulic zones and study boundaries may be revised depending on changes in the extent of groundwater with COC concentrations above ACLs and modifications to the groundwater remedies. The long-term temporal boundaries for the remedies are indefinite; however, groundwater monitoring should continue at the sites in accordance with the decision rules presented in Step 5 of Worksheet #11 until the project objectives are met.

The overall geographic boundary for the site is the Main Garrison at the former Fort Ord including the Fritzsche Army Airfield area,<sup>8</sup> and the adjacent portion of the City of Marina. The lateral boundary is defined by the zone of groundwater impacted or potentially impacted by VOCs. The vertical boundary is defined by the zone of contaminated groundwater in the following aquifers or hydrogeologic units.

- A-Aquifer
- Upper 180-Foot Aquifer
- Lower 180-Foot Aquifer

The extent of groundwater with COC concentrations above ACLs is represented by the COC concentration contours shown on figures presented in quarterly and annual reports. COC analytical data are grouped by site for COC concentrations above ACLs and ArcGIS Desktop 10.4 (ESRI, 2017) is used to generate shapefiles depicting the COC concentration contours. Adjustments are made to the contours based on comparative evaluation of current COC concentrations and contours from previous quarters. If more than one sample is collected from a well in a quarterly monitoring event, the sample with the highest detected COC concentration will be used for generating the contour. The COC concentration contours can be compared to historical contours and used to optimize hydraulic zones and study boundaries, and interpret progress toward achieving remedial action objectives.

Groundwater elevations in each aquifer are represented by groundwater elevation contours shown on figures presented in quarterly and annual reports. Groundwater levels are measured each quarter at the wells listed in Worksheet #17 and compared to the wells' known top of casing elevation to determine the groundwater elevation at each well. For multi-port wells that have multiple ports in one aquifer, the groundwater level data from all the ports is averaged to determine the groundwater elevation at that location. Groundwater elevation data sets are imported into the Surfer 15 (Golden Software, LLC) software application. Within Surfer® 15, the geostatistical gridding method (i.e., kriging) is used to interpolate a gridded surface from the groundwater elevation data. Point kriging, with a circular search ellipse and without a drift type (i.e., ordinary kriging), is used to estimate grid node values based on the known data points near the node with the data points weighted by their distance from the node. The size of the grid cells is set to approximately 30 feet by 30 feet. Once the grid is constructed, Surfer® 15 uses linear interpolation to generate contour lines of equal elevation based on the grid node values. Contour lines for each aquifer are exported from Surfer® 15 as shapefiles and imported into ArcGIS Desktop 10.4 (ESRI, 2017) for final manual adjustments, such as trimming the extents of the contours and smoothing curves. Finally, extraction well operation data are compared to measured groundwater levels at those wells and cones of depression are added manually around operating extraction wells. Groundwater elevation contours can then be used to interpret the flow characteristics of groundwater in each of the aquifers.

The time frame for decision-making relates to the quarterly monitoring and reporting schedule and periodic (e.g., annual) reporting and review cycles. With the exception of certain times of the year when

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<sup>8</sup> Now the Marina Municipal Airport.

the presence of sensitive biological resources requires modification to the site or well access procedures, practical constraints on data collection are not applicable to this project.

#### Sites 2/12

Study boundaries at Sites 2/12 are as follows:

- The overall geographic boundary for the site is within the western Main Garrison area at the former Fort Ord.
- The lateral boundary is defined by the zone of groundwater impacted by COCs. The vertical boundary is defined by the zone of contaminated groundwater in the Upper 180-Foot Aquifer.
- Because the zone of contaminated groundwater is relatively small, limited to a single aquifer, and within the capture area of the existing extraction well network, there is currently only one hydraulic zone at Sites 2/12.

#### OU2

Study boundaries at OU2 are as follows:

- The overall geographic boundary for the site is the Main Garrison area and the Fort Ord Landfills at the former Fort Ord.
- The lateral boundary is defined by the zone of groundwater impacted by COCs. The vertical boundary is defined by the zone of contaminated groundwater in the A-Aquifer and Upper 180-Foot Aquifer.
- The study boundaries for OU2 are further divided into eight hydraulic zones based on the extent of the COC plumes in the A-Aquifer and Upper 180-Foot Aquifer, and groundwater extraction well network capture areas (Figures 9 and 10).

#### OUCTP

Study boundaries at OUCTP are as follows:

- The overall geographic boundary for the site is the Main Garrison area north of the Fort Ord Landfills at the former Fort Ord.
- The lateral and vertical boundaries are defined by the zone of groundwater impacted by COCs in the A-Aquifer, Upper 180-Foot Aquifer, and Lower 180-Foot Aquifer.
- The study boundaries for OUCTP are further divided into seven hydraulic zones based on the extent of the COC plumes in the A-Aquifer, Upper 180-Foot Aquifer and Lower 180-Foot Aquifer, and the areas of groundwater remedy influence for each aquifer (Figures 11, 12 and 13).

### **3.2.5 Step 5: Develop the Analytical Approach**

The analytical approach has been developed by using decision rules on information inputs to support the goals of the project for the GWTs and GWMP.

### OU2 and Sites 2/12 GWTSs

Decision rules for the Sites 2/12 and OU2 GWTS have been developed to address the five major components of treatment system operation: discharge limit compliance; GAC change-out; hydraulic containment; sampling frequency; and plume remediation. Each of these components is described below.

#### *Discharge Limit Compliance*

- If analytical results indicate COC discharge limits (Worksheet #15a) are being met, then the system will continue to operate and GWTS effluent will be recharged to the aquifer.
- If analytical results indicate the discharge limit for any COC other than methylene chloride<sup>9</sup> is not met, then a confirmation sample will be collected and analyzed with a 24-hour TAT.
- If analytical results indicate the discharge limit for methylene chloride is not met, then the analytical results will be evaluated against QC sample analytical results associated with the same sampling event.
  - If the evaluation indicates the presence of methylene chloride above the discharge limit is not representative of groundwater conditions due to associated QC sample detections, then the OU2 GWTS will continue to operate and effluent will be recharged to the aquifer.
  - If the evaluation indicates the concentration of methylene chloride above the discharge limit is representative of groundwater conditions, then a confirmation sample will be collected from the OU2 GWTS discharge point of compliance and analyzed with a 24-hour TAT.
- If confirmation sample analytical results indicate the discharge limit for any COC is not met, then the affected GWTS will be shut down, operating conditions and GAC loading evaluated, extraction well flow rates adjusted as necessary and a variance report issued for any out-of-limits operation. Following operational changes, which may include GAC change-out, the GWTS will be restarted and re-sampled to verify compliance.
- If verification sample analytical results indicate discharge limits for COCs are being met, then the system will continue to operate and system effluent will be recharged to the aquifer.
- If verification sample analytical results indicate the discharge limit for any COC is not met, then the affected GWTS will be shut down, and operating conditions and GAC loading re-evaluated. Following operational changes, the GWTS will be restarted and re-sampled to verify compliance.

#### *GAC Change-out*

The decision rules for determining when a GAC change-out is needed at the Sites 2/12 GWTP are:

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<sup>9</sup> Methylene chloride is a COC for OU2 and OUCTP in the A-Aquifer. EPA Method 8260-SIM, Analysis of Volatile Organics by GC/MS, Select Ion Monitoring (SIM) (Attachment A, SGS SOP# MS010) identifies methylene chloride as a common laboratory contaminant detected in the analysis for volatile organics.

- If analytical results for TCE and PCE from a process sample collected immediately downstream of the GAC vessel (upstream of the air stripper) are less than or equal to 90 percent (%) of ACLs, then a GAC change-out is not necessary. The Sites 2/12 system will continue to operate and the final effluent stream will continue to be recharged to the aquifer.
- If the analytical result for TCE or PCE from a process sample collected immediately downstream of the GAC vessel (upstream of the air stripper) is greater than 90% of ACLs, then a GAC change-out will be scheduled.

The *Operations and Maintenance Manual, Operable Unit 2 (OU 2) Groundwater Treatment Plant, Former Fort Ord* (OU2 GWTP O&M Manual; JV, 2018) provides procedures for O&M of the OU2 GWTS. The OU2 GWTP O&M Manual describes the conditions required for GAC change-out, but those instructions are superseded by the following based on Ahtna's experience operating GWTS using liquid-phase GAC as the primary treatment technology. At the OU2 GWTP, the average concentration of each COC in the lead GAC vessel effluent will be calculated based on analytical results from process samples collected immediately downstream of the lead GAC vessel (upstream of the second GAC vessel) during each process sampling event (where such samples are collected). Decision rules for determining when a GAC change-out at OU2 is necessary are:

- If the average concentration of each COC is less than 90% of its respective ACL (Worksheet #15a), then a GAC change-out is not necessary. The OU2 system will continue to operate and the final effluent stream will continue to be recharged to the aquifer.
- If the average concentration of any COC other than methylene chloride is equal to or greater than 90% of its ACL, a GAC change-out will be scheduled.
- If the average concentration of methylene chloride is equal to or greater than 90% of its ACL, then the analytical results for lead GAC vessel effluent sample will be evaluated against the analytical results for QC samples associated with the same sampling event.
  - If the evaluation indicates an average concentration of methylene chloride greater than 90% of its ACL is not representative of groundwater conditions due to associated QC sample detections, then a GAC change-out is not necessary. The system will continue to operate and OU2 GWTS effluent will be recharged to the aquifer.
  - If the evaluation indicates the concentration of methylene chloride above the discharge limit is representative of groundwater conditions and the average concentration of methylene chloride is equal to or greater than 90% of its ACL, a GAC change-out will be scheduled.

#### *Hydraulic Containment*

During remediation system operation, specific decision rules must be followed to demonstrate COC plume capture. The decision rules are:

- If groundwater monitoring and/or groundwater flow modeling demonstrate plume capture is occurring, then system operation will continue as currently configured. During operation,

extraction well flow rates may be optimized to reduce O&M costs while maintaining plume capture.

- If the system flow rate data, in conjunction with the groundwater flow model, indicate the plume is being hydraulically contained, then the system will continue to operate.
- If groundwater monitoring and/or groundwater flow modeling indicate plume capture is not occurring, additional groundwater flow modeling will be conducted to determine whether adjustment of either extraction or recharge flow rates will improve capture or whether additional extraction wells or recharge points are required. Based on this evaluation, system reconfiguration may be recommended.

### *Plume Remediation*

Assessment of aquifer cleanup resulting from the Sites 2/12 and OU2 GWTS is conducted through a GWMP that evaluates plume migration and COC concentrations. Extraction well monitoring data will be used for evaluating the operational status of individual extraction wells and for statistical evaluations of remediation progress. The decision rules for determining the operational status of groundwater extraction wells with respect to plume remediation are:

- An extraction well will continue to operate if any COC detected is greater than the corresponding ACL (Worksheet #15a).
- An extraction well will continue to operate if the extraction well flow rate data and analytical data from nearby wells, in conjunction with groundwater flow modeling, indicate operation of the extraction well is necessary for hydraulic containment of the plume.
- An extraction well will be shut off if COCs detected are less than the ACL for two consecutive quarterly monitoring events, and if the extraction well flow rate data and analytical data from nearby wells, in conjunction with groundwater flow modeling, indicate operation of the extraction well is no longer necessary for hydraulic containment of the plume.
- Following termination of pumping at an extraction well, the well will be incorporated into the GWMP.

### *Sampling Frequency*

Extraction wells will be sampled quarterly when operating as part of the GWTS. The decision rules for determining the sampling frequency and monitoring status for groundwater extraction wells following termination of operation are:

- If four consecutive quarters of monitoring data show concentrations of COCs are below their respective limits of quantitation (LOQs) (Worksheet #15a) or below 10% of their respective ACLs (Worksheet #15a), whichever is greater, an annual monitoring schedule may be proposed.
- If two annual monitoring results show concentrations of COCs are below their respective LOQs or below 10% of their respective ACLs, whichever is greater, then the well may be proposed for removal from the sampling program.



- If wells adjacent to a well sampled annually, or no longer sampled, show detections of any COCs equal to or greater than their ACLs, then the well monitoring frequency may be increased to quarterly.
- If an annual well monitoring result shows a detection of any COC equal to or greater than its ACL, then the well monitoring frequency may be increased to quarterly.
- If a well is no longer needed for the program, it will be proposed for decommissioning.

Implementation of agency-approved exit strategies for Sites 2/12, OU2 and OUCTP, or portions thereof, may result in modification of these decision rules.

The statistical parameter of interest is the maximum value detected in the well or monitoring point compared to the ACLs or historical trend for that well or monitoring point. For perimeter control, the minimum value detected in the monitoring point (e.g., non-detect [ND] at the limit of detection [LOD]) is the statistical parameter of interest.

#### OU2, Sites 2/12, and OUCTP GWMP

The decision rules for groundwater monitoring are:

- If four consecutive quarters of monitoring data show concentrations of COCs below their respective LOQs, or below 10% of their respective ACLs (Worksheet #15a), whichever is greater, then an annual sampling schedule may be proposed.
- If two consecutive annual monitoring results show concentrations of COCs below their respective LOQs or below 10% of their respective ACLs, whichever is greater, then the well may be proposed for removal from the sampling program.<sup>10</sup>
- If wells adjacent to a well sampled annually, or no longer sampled, show detections of any COCs equal to or greater than their ACLs, then the well monitoring frequency may be increased to quarterly.
- If an annual well monitoring result shows a detection of any COC equal to or greater than its ACL, then the well monitoring frequency may be increased to quarterly.
- If monitoring or modeling input indicates the groundwater monitoring network no longer provides vertical or lateral control of COCs, then additional groundwater wells may be proposed to be added to the program.
- If a groundwater monitoring well is no longer needed for the program, it will be proposed for decommissioning.
- If a monitoring well in Sites 2/12 is determined to be intruded by seawater based on chloride data, the GWTS operator and Project Manager will be notified to implement possible GWTS changes.
- If concentrations of dissolved copper, lead, and antimony in select A-Aquifer wells (Worksheet #17c) exceed MCLs, the BCT will be notified.

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<sup>10</sup> The well will continue to be monitored for depth to water until it is decommissioned or determined to be redundant or unnecessary water elevation data.

Decisions regarding application of passive diffusion bags (PDBs) are described in the *Technical Memorandum Passive Diffusion Bag Pilot Study Results and Recommendations* (Harding ESE, 2001).

#### *OUCTP A-Aquifer EISB Post-Treatment Water Quality Parameter Monitoring*

The parameters of interest for the OUCTP A-Aquifer are DO and ORP levels compared to the baseline values or historical trend for that well or monitoring point to evaluate the effectiveness of EISB. The decision rules for determining the monitoring frequency for post-treatment groundwater quality parameters are:

- Continue quarterly monitoring of post-treatment groundwater quality parameters if measurements indicate continued aquifer conditions are affected by the associated EISB treatment at the well; or measurements at one or more adjacent wells indicate aquifer conditions are affected by the associated EISB treatment; or measurements at one or more wells in an immediately upgradient Deployment Area indicates aquifer conditions are affected by the associated EISB treatment;
- If two consecutive quarters of post-treatment water quality parameter monitoring data show both DO and ORP measurements have returned to the approximate levels of recorded baseline conditions,<sup>11</sup> then water quality parameter monitoring may be reduced to an annual frequency at the well; or,
- If four consecutive quarters of post-treatment water quality parameter monitoring data show there has been no effect on the well by EISB treatment (i.e., there has been no significant deviation from recorded baseline conditions),<sup>12</sup> then water quality parameter monitoring may be reduced to an annual frequency at the well.
- If two consecutive annual monitoring periods of post-treatment water quality monitoring at an OUCTP A-Aquifer well show both DO and ORP have returned to the approximate levels of recorded baseline conditions,<sup>13</sup> then water quality parameter monitoring may be discontinued.
- If sampling a well for VOC analyses has been discontinued in accordance with the decision rules for the GWMP, then discontinuing post-treatment water quality parameter monitoring may be considered on a case-by-case basis in consultation with the BCT.

Measurement of post-treatment groundwater quality parameters in an OUCTP A-Aquifer well may be reinstated or increased in frequency should conditions change in an adjacent well or immediately upgradient Deployment Area, including additional EISB treatment.

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<sup>11</sup> As presented in the *Final OUCTP Remedial Action Work Plan, Former Fort Ord, California; Appendix A OUCTP A-Aquifer Remedial Design Addendum* (OUCTP RAWP RD Addendum; AES, 2014)

<sup>12</sup> As presented in the OUCTP RAWP RD Addendum (AES, 2014).

<sup>13</sup> As presented in the OUCTP RAWP RD Addendum (AES, 2014).

### *Completion of Groundwater Restoration Remedial Actions<sup>14</sup>*

The decision rules for determining when groundwater remedial actions are complete in a particular site or OU, or a hydraulic zone within the site or OU, are:

- If data collected during the GWMP indicate potential uncertainties regarding the remedy's effectiveness and/or current site conditions, or potential key data gaps, then the conceptual site model will be re-evaluated and updated.
- If COC concentrations in a well are above ACLs, then the well and its respective hydraulic zone will remain in the remediation monitoring phase.<sup>15</sup>
- If four consecutive quarters of monitoring data show concentrations of COCs in a well are less than or equal to their respective ACLs, the well may be evaluated for completion of the remediation monitoring phase.
  - If non-statistical data review shows all COCs in the well are ND, all detected COC concentrations are less than or equal to the ACLs, or a combination of the two, then the remediation monitoring phase is complete in the well.
  - If groundwater monitoring data do not lend themselves to a non-statistical review, then statistical analysis of the data set may be used (e.g., mean test or trend test).
  - If the selected statistical method demonstrates the 95% upper confidence limit (UCL) value is equal to or less than the ACL for the COCs where a statistical analysis was used, then the remediation monitoring phase is complete in the well.
- If a well has completed the remediation monitoring phase, then the well will enter the attainment monitoring phase.<sup>16</sup>
- If monitoring data show concentrations of COCs in a well are less than or equal to their respective ACLs, and it can be demonstrated COC concentrations will continue to be less than or equal to ACLs in the future, then the attainment monitoring phase is complete under any of the following conditions.
  - If all COCs in the well are ND, the LOQ is below the ACL, or a combination of ND sampling results and all detected COC concentrations are below the ACLs for eight consecutive sampling events, then a non-statistical or visual review of the COC data will be sufficient to conclude the attainment monitoring phase is complete in the well.

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<sup>14</sup> Adapted from EPA, 2014a and EPA, 2014b.

<sup>15</sup> The remediation monitoring phase refers to the phase of the remedy where remedial activities are being implemented to reach groundwater cleanup levels selected in a remedy decision document. During this phase, groundwater sampling and monitoring data are collected to evaluate COC migration and changes in COC concentrations over time. The completion of this phase at a monitoring well typically occurs when the data collected and evaluated demonstrate that the groundwater has reached the cleanup levels for all COCs, as they are stated in the remedy decision document (EPA, 2013).

<sup>16</sup> The attainment monitoring phase typically occurs after it is determined the remediation monitoring phase is complete. When the attainment phase begins, data are collected to evaluate if the well has reached post remediation conditions (i.e., steady state conditions) where remediation activities, if employed, are no longer influencing the groundwater in the well (EPA, 2013).

- If all COCs in the well are less than or equal to their respective ACLs for eight consecutive sampling events, and a statistical analysis (i.e., trend analysis) demonstrates COCs will remain less than or equal to ACLs in the future (the trend line has a statistically significant zero [steady state] or negative [decreasing] slope, and the 95% UCL value is less than or equal to the ACL), then the attainment monitoring phase is complete in the well.
- If the well is removed from the sampling program in accordance with the decision rules applicable to GWMP decision rules presented above, then the attainment monitoring phase is complete in the well.
- If a well has completed the attainment monitoring phase and it is not needed for groundwater elevation data, then it will be proposed for decommissioning.
- If all the wells at particular site or OU, or a hydraulic zone within the site or OU have completed the attainment monitoring phase, then the attainment monitoring phase is complete for the particular site or OU, or hydraulic zone within the site or OU and the decision rules for GWMP no longer apply (i.e., sampling for COC analysis may be discontinued and the wells may be proposed for decommissioning unless needed for groundwater elevation data).
- If the attainment monitoring phase is complete at all the hydraulic zones within a site or OU, then the site or OU will be proposed for closure in a remedial action completion report.

The decision rules for the GWMP and for Completion of Groundwater Restoration Remedial Actions will be implemented concurrently; however, decision rules for determining when groundwater remedial actions are complete take precedence over the decision rules applicable to groundwater monitoring (e.g., if the attainment monitoring phase is complete at all wells in a hydraulic zone, then sampling for COC analysis is no longer necessary).

Exit strategy decision logic related to remedial process optimization and contingency measures should the remedies not progress as expected are presented in the *Final Technical Memorandum, Groundwater Remediation Exit Strategy, Sites 2/12 and OU2, Former Fort Ord, California* (MACTEC, 2009).

### **3.2.6 Step 6: Specify Performance or Acceptance Criteria**

#### OU2 and Sites 2/12 GWTSs

The null hypotheses for the Sites 2/12 and OU2 GWTS are:

- 1) Concentrations of VOCs in groundwater entering the GWTS exist above the action levels
- 2) Concentrations of VOCs at the discharge points of compliance for the GWTS effluents are below discharge limits

The two types of decision errors that could result are a false acceptance decision error and a false rejection decision error. A false acceptance decision error for each null hypothesis would be to:

- 1) Assume a measured concentration is above the action level when in fact it is not.
- 2) Assume a measured concentration at a discharge point of compliance is below discharge limits when in fact it is not.

Consequences of the first false acceptance error might include unnecessarily treating groundwater that is not above action levels or continuation of remediation system operation after applicable ACLs have been met.

Consequences of the second false acceptance error might include delay of timely GAC change-out, resulting in discharge of water from the GWTS above discharge limits, or discontinuation of remediation system operation when applicable ACLs have not been met.

A false rejection error for each null hypothesis would be to:

- 1) Assume a measured concentration is not above the action level when in fact it is.
- 2) Assume a measured concentration at a discharge point of compliance is above the discharge limit when in fact it is not.

Consequences of the first false rejection error might include premature removal of extraction wells from the remediation system program before ACLs have been met.

Consequences of the second false rejection error might include unnecessarily performing or initiating confirmation sampling of GWTS effluent that actually met discharge limits during normal operation or remediation system shutdown, GAC change-out, and variance report issuance for effluent that met discharge limits after GAC vessel backwashing activities.

Decision errors are most likely to occur when the measured concentration is near the action level, or in the case of NDs, when the LOQ is near the action level. To control decision errors when the LOQ is near the action level, the laboratory is required to report any detections below the LOQ (but above the DL), thereby giving the data user additional information regarding trace level contamination. To control decision errors when the measured concentration is near the action level, the program is very conservative about making recommendations or changes based on individual sampling events and will require data from additional sampling or subsequent sampling events before modifying the treatment system network.

#### OU2, Sites 2/12, and OUCTP GWMP

VOCs in groundwater at the former Fort Ord range in concentration from ND to 12.3 micrograms per liter ( $\mu\text{g/L}$ ) PCE (at Sites 2/12), 16.5  $\mu\text{g/L}$  TCE (at site OU2), and 7.4  $\mu\text{g/L}$  CT (at OUCTP), the primary COCs at these sites (as measured in the Third Quarter 2018 GWMP).

The null hypothesis for this project is that concentrations of VOCs in groundwater exist above the action levels. A false acceptance decision (i.e., false positive decision error) would be to assume a measured concentration is above the action level, when in fact, it is not. The consequences of this decision error would be to incur unnecessary expense to study and potentially modify the monitoring network to address an extent of contamination that does not exist.

A false rejection decision error (i.e., false negative decision error) would be to assume a measured concentration is not above the action level when in fact it is. The consequences of this decision error would be to not study or potentially modify the monitoring network, thereby resulting in an incomplete understanding of the extent of contamination and potential threat to groundwater quality.

Decision errors are most likely to occur when the measured concentration is near the action level, or in the case of NDs, when the LOQ is near the action level. To control decision errors when the LOQ is near the action level, the laboratory is required to report any detections below the LOQ (but above the DL), thereby giving the data user additional information regarding trace level contamination. To control decision error when the measured concentration is near the action level, the program is very conservative about making recommendations or changes based on individual monitoring events and will require data from additional sampling or subsequent sampling events before modifying the monitoring network.

In addition, trend analysis provides a valuable tool for assessing reliability of reporting concentrations. Furthermore, data are subjected to automated data review using an electronic system of QC checks, under the direction of a qualified chemist, using USACE and industry standards of analytical QC.

The null hypothesis is that EISB is not occurring in the Deployment Areas. A false acceptance decision (i.e., false positive decision error) would be to assume measured DO and ORP indicates there are no reducing conditions in the aquifer, when in fact there are. The consequences of this decision error would be to incur unnecessary expense to potentially perform additional EISB to establish reducing conditions in areas where they already exist.

A false rejection decision error (i.e., false negative decision error) would be to assume measured DO and ORP indicates there are reducing conditions in the aquifer, when in fact there are not. The consequences of this decision error would be to not perform additional EISB, thereby resulting in a longer period to achieve remedial action objectives.

Decision errors are most likely to occur when measured DO and ORP are near zero. To control such decision errors, the program is very conservative about making recommendations or changes based on individual monitoring events and will require data from additional sampling or subsequent sampling events before modifying the monitoring network. In addition, trend analysis provides a valuable tool for assessing reliability of reporting groundwater quality parameters.

### **3.2.7 Step 7: Develop the Plan for Obtaining Data**

As a result of the DQO process, the optimum sampling design is derived for the Sites 2/12, OU2, and OUCTP remedies. Sample collection locations, rationales, and frequencies were established to achieve discharge compliance and provide a cost-effective means to evaluate the treatment of the impacted groundwater, and can be found in Worksheets #17a1 and #17a2 for Sites 2/12, and Worksheets #17b1 and #17b2 for OU2 and OUCTP. The EPA Method 8260-SIM (selected ion monitoring) analytical procedure for this project was selected to accurately quantify the chemicals of interest at the levels of concern. Method performance criteria for EPA Method 8260-SIM are presented in Worksheets #24 and #28a.

The overall sampling network design is described in Worksheet #17c1 through #17c5.

Sampling design considerations regarding application of PDBs are described in the *Technical Memorandum Passive Diffusion Bag Pilot Study Results and Recommendations* (Harding ESE, 2001).



### 3.3 Worksheet #12: Measurement Performance Criteria

The measurement performance criteria (MPC) for chemical analyses being performed for each matrix and analytical parameter are summarized in the tables below in Worksheet #12. The MPCs follow those defined in the referenced EPA method or laboratory standard operating procedures (SOPs). The quality of the data to be collected for this project will be verified through appropriate MPCs established for both sampling procedures and analytical methods. The criteria relate to data quality indicators (DQIs) consisting of precision, accuracy, representativeness, comparability, completeness, and sensitivity, commonly referred to as PARCCS parameters. The DQIs are defined as follows:

- Precision refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms.
- Accuracy refers to the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits.
- Representativeness describes the extent to which a sampling design adequately reflects the environmental conditions of a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.
- Comparability addresses the degree to which different methods or data agree or can be represented as similar. Comparability is achieved by using standard methods (SM) for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.
- Completeness is a measure of the amount of valid data collected using a measurement system. Completeness is expressed as a percentage of the number of measurements that are specified in this QAPP.
- Sensitivity is the ability of a method or instrument to detect the target analytes at the level of interest. Sensitivity can be measured by calculating the percent recovery of the analytes at the LOQ, which is the minimum concentration of an analyte that can be routinely identified and quantified above the method LOQ by a laboratory.

The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall PARCCS, in accordance with procedures described in Worksheet #37 (Data Usability Assessment). The results will be summarized in an overall data usability report.

### 3.3.1 Worksheet #12a: VOCs - Sites 2/12 and OU2 GWTS and Sites 2/12, OU2, and OUCTP GWMP

**Analytical Group/Method:** VOCs by EPA Method 8260-SIM

**Matrix:** Groundwater (µg/L)

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)																														
S: SOPs #1-5	Precision	RPD ≤ 30%	Field Duplicate	S																														
A: SGS SOP#MS010.7		<table><tr><td>Analyte</td><td>RPD</td></tr><tr><td>1,1-DCA</td><td>≤ 15%</td></tr><tr><td>1,1-DCE</td><td>≤ 18%</td></tr><tr><td>1,2-DCA</td><td>≤ 14%</td></tr><tr><td>1,2-DCE (total)</td><td>≤ 17%</td></tr><tr><td>1,2-DCPA</td><td>≤ 14%</td></tr><tr><td>1,3-DCPE (total)</td><td>≤ 23%</td></tr><tr><td>Benzene</td><td>≤ 14%</td></tr><tr><td>CT</td><td>≤ 23%</td></tr><tr><td>Chloroform</td><td>≤ 15%</td></tr><tr><td>cis-1,2-DCE</td><td>≤ 15%</td></tr><tr><td>MC</td><td>≤ 16%</td></tr><tr><td>PCE</td><td>≤ 16%</td></tr><tr><td>TCE</td><td>≤ 15%</td></tr><tr><td>VC</td><td>≤ 18%</td></tr></table>	Analyte	RPD	1,1-DCA	≤ 15%	1,1-DCE	≤ 18%	1,2-DCA	≤ 14%	1,2-DCE (total)	≤ 17%	1,2-DCPA	≤ 14%	1,3-DCPE (total)	≤ 23%	Benzene	≤ 14%	CT	≤ 23%	Chloroform	≤ 15%	cis-1,2-DCE	≤ 15%	MC	≤ 16%	PCE	≤ 16%	TCE	≤ 15%	VC	≤ 18%	8260-SIM: LCS/LCSD and MS/MSD	A
Analyte	RPD																																	
1,1-DCA	≤ 15%																																	
1,1-DCE	≤ 18%																																	
1,2-DCA	≤ 14%																																	
1,2-DCE (total)	≤ 17%																																	
1,2-DCPA	≤ 14%																																	
1,3-DCPE (total)	≤ 23%																																	
Benzene	≤ 14%																																	
CT	≤ 23%																																	
Chloroform	≤ 15%																																	
cis-1,2-DCE	≤ 15%																																	
MC	≤ 16%																																	
PCE	≤ 16%																																	
TCE	≤ 15%																																	
VC	≤ 18%																																	
A: SGS SOP#MS010.7	Accuracy / Precision	<table><tr><td>Analyte</td><td>Recovery</td></tr><tr><td>1,1-DCA</td><td>81-122%</td></tr><tr><td>1,1-DCE</td><td>78-137%</td></tr><tr><td>1,2-DCA</td><td>75-125%</td></tr><tr><td>1,2-DCE (total)</td><td>76-127%</td></tr><tr><td>1,2,-DCPA</td><td>76-124%</td></tr><tr><td>1,3-DCPE (total)</td><td>75-120%</td></tr><tr><td>Benzene</td><td>81-122%</td></tr><tr><td>CT</td><td>76-136%</td></tr><tr><td>Chloroform</td><td>80-124%</td></tr><tr><td>cis-1,2-DCE</td><td>78-120%</td></tr><tr><td>MC</td><td>69-135%</td></tr><tr><td>PCE</td><td>76-135%</td></tr><tr><td>TCE</td><td>81-126%</td></tr><tr><td>VC</td><td>69-159%</td></tr></table>	Analyte	Recovery	1,1-DCA	81-122%	1,1-DCE	78-137%	1,2-DCA	75-125%	1,2-DCE (total)	76-127%	1,2,-DCPA	76-124%	1,3-DCPE (total)	75-120%	Benzene	81-122%	CT	76-136%	Chloroform	80-124%	cis-1,2-DCE	78-120%	MC	69-135%	PCE	76-135%	TCE	81-126%	VC	69-159%	8260-SIM: LCS and MS	A
Analyte	Recovery																																	
1,1-DCA	81-122%																																	
1,1-DCE	78-137%																																	
1,2-DCA	75-125%																																	
1,2-DCE (total)	76-127%																																	
1,2,-DCPA	76-124%																																	
1,3-DCPE (total)	75-120%																																	
Benzene	81-122%																																	
CT	76-136%																																	
Chloroform	80-124%																																	
cis-1,2-DCE	78-120%																																	
MC	69-135%																																	
PCE	76-135%																																	
TCE	81-126%																																	
VC	69-159%																																	
A: SGS SOP#MS010.7	Bias	<u>Analyte: Recovery</u> 1,2-Dichloroethane-d <sub>4</sub> : 74-125% Toluene-d <sub>8</sub> : 88-111%	8260-SIM: Surrogates	A																														

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
S: SOPs #1-5 A: SGS SOP#MS010.7	Bias / Contamination	No analytes detected > ½ LOQ or > ⅒ the amount measured in any sample or > ⅒ the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Method blank, field blank, trip blank	S&A
S: SOPs #1-5	Representativeness	> 0°C ≤ 6°C	Cooler Temperature Blank	S
		Samples preserved to pH < 2.0	Measure pH of samples after analysis	
S: SOPs #1-5 A: SGS SOP#MS010.7	Comparability	Reasonableness	Historical data	S&A
		Qualitative measure for field sampling procedures	LCS/LCSD and MS/MSD	A
S: SOPs #1-5	Completeness	≥ 95% field completeness	Number of samples collected out of total samples planned	S
A: SGS SOP#MS010.7		≥ 90% analytical completeness	Evaluation of number of unqualified <sup>17</sup> results out of the total results reported	A
A: SGS SOP#MS010.7	Sensitivity	Evidence of shift in instrument response or zero setting	LCS, ICAL, CCAL	A
		Limit of quantitation	LOQ studies	

Notes on next page.

<sup>17</sup> Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

**Notes:**

<: less than  
≤: less than or equal to  
>: greater than  
≥: greater than or equal to  
%: percent  
°C: degrees Celsius  
CCAL: continuing calibration  
1,1-DCA: 1,1-dichloroethane  
1,1-DCE: 1,1-dichloroethene  
1,2-DCA: 1,2-dichloroethane  
1,2-DCE (total): total 1,2-dichloroethene  
1,2-DCPA: 1,2-dichloropropane  
1,3-DCPE: 1,3-dichloropropene  
A: analytical  
cis-1,2-DCE: cis-1,2-dichloroethene  
CT: carbon tetrachloride  
DL: detection limit  
DQI: data quality indicator  
ICAL: initial calibration  
LCS: laboratory control samples  
LCSD: laboratory control sample duplicate  
LOQ: limit of quantitation  
MC: methylene chloride  
MPC: measurement performance criteria  
MS: matrix spike  
MSD: matrix spike duplicate  
PCE: tetrachloroethene  
QC: quality control  
RPD: relative percent difference  
S: sampling  
S&A: sampling and analytical  
SIM: selected ion monitoring  
SOP: standard operating procedure  
TCE: trichloroethene  
trans-1,2-DCE: trans-1,2-dichloroethene  
VOC: volatile organic compound  
VC: vinyl chloride

### 3.3.2 Worksheet #12b: Metals - OU2 GWMP

**Analytical Group:** Metals by EPA Method 6010D

**Matrix:** Groundwater (µg/L)

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
S: SOP #3	Precision	RPD $\leq$ 30%	Field Duplicate	S
A: SGS SOP#MET 108.03		RPD $\pm$ 20%	LCS/LCSD and MS/MSD	A
A: SGS SOP#MET 108.03	Accuracy / Bias	MS and LCS: Antimony 80-120% Copper 80-120% Lead 80-120%	LCS and MS	A
S: SOP #3 A: SGS SOP#MET 108.03		The absolute values of all analytes must be $< \frac{1}{2}$ LOQ or $< \frac{1}{10}$ the amount measured in any sample or $\frac{1}{10}$ the regulatory limit, whichever is greater.	Method blank and field blank	S&A
S: SOP #3	Representativeness	Samples preserved to pH $< 2.0$	Measure pH of samples upon receipt	S
		$> 0^{\circ}\text{C} \leq 6^{\circ}\text{C}$	Cooler Temperature Blank	
S: SOP #3	Comparability	Reasonableness	Historical data	S
A: SGS SOP#MET 108.03		Qualitative measure for field sampling procedures	LCS/LCSD and MS/MSD	A
S: SOP #3	Completeness	$\geq 95\%$ field completeness	Number of samples collected out of total samples planned	S
A: SGS SOP#MET 108.03		$\geq 90\%$ analytical completeness	Evaluation of number of unqualified results out of the total results reported <sup>18</sup>	A

<sup>18</sup> Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
A: SGS SOP#MET 108.03	Sensitivity	Evidence of shift in instrument response or zero setting	LCS, ICAL, CCAL	A
		Limit of quantitation	LOQ studies	

**Notes:**

≤: less than or equal to

≥: greater than or equal to

A: analytical

°C: degrees Celsius

CCAL: continuing calibration

DL: detection limit

ICAL: initial calibration

LCS/LCSD: laboratory control sample/laboratory control sample duplicate

LOQ: limit of quantitation

MS/MSD: matrix spike/matrix spike duplicate

RPD: relative percent difference

S: sampling

S&A: sampling and analytical

SOP: standard operating procedure



### 3.3.3 Worksheet #12c: Wet Chemistry - Sites 2/12 GWTS and Sites 2/12 GWMP

**Analytical Group:** Chloride by EPA Method 9056A

**Matrix:** Groundwater (mg/L)

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
S: SOPs #3&5	Precision	RPD $\leq$ 30%	Field Duplicate	S
A: SGS SOP#GN22 8.9		<u>Analyte</u> RPD Chloride $\leq$ 20%	Laboratory duplicates and MS/MSD (chloride only)	A
A: SGS SOP#GN22 8.9	Accuracy / Bias	<u>Analyte</u> <u>Recovery</u> Chloride 90-110%	LCS and MS	A
S: SOPs #3&5 A: SGS SOP#GN22 8.9		No analytes detected $> \frac{1}{2}$ LOQ or $> \frac{1}{10}$ the amount measured in any sample or $> \frac{1}{10}$ the regulatory limit, whichever is greater. Common contaminants must not be detected $>$ LOQ.	Method blank and field blank	S&A
S: SOPs #3&5	Representativeness	$> 0^{\circ}\text{C} \leq 6^{\circ}\text{C}$	Cooler Temperature Blank	S
S: SOPs #3&5	Comparability	Reasonableness	Historical data	S
A: SGS SOP#GN22 8.9		Qualitative measure for field sampling procedures	LCS/LCSD and MS/MSD	A
S: SOPs #3&5	Completeness	$\geq 95\%$ field completeness	Number of samples collected out of total samples planned	S
A: SGS SOP#GN22 8.9		$\geq 90\%$ analytical completeness	Evaluation of number of unqualified results out of the total results reported <sup>19</sup>	A
	Sensitivity	Evidence of shift in instrument response or zero setting	LCS, ICAL, CCAL	A

<sup>19</sup> Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
A: SGS SOP#GN22 8.9		Limit of quantitation	LOQ studies	

**Notes:**

≤: less than or equal to

≥: greater than or equal to

A: analytical

°C: degrees Celsius

CCAL: continuing calibration

ICAL: initial calibration

DL: detection limit

LCS/LCSD: laboratory control sample/laboratory control sample duplicate

LOQ: limit of quantitation

MS/MSD: matrix spike/matrix spike duplicate

RPD: relative percent difference

S: sampling

S&A: sampling and analytical

SOP: standard operating procedure

### 3.4 Worksheet #13: Secondary Data Uses and Limitations

Since the groundwater sampling activities for the Sites 2/12 and OU2 GWTS and the Sites 2/12, OU2, and OUCTP GWMP are both long-term remedial action and monitoring programs and not active investigative programs, the secondary data that will be used to evaluate performance and concentration trends for both programs consist of the most recent annual monitoring reports as listed below. Secondary data and information that will be used, including originating sources, are identified below. How the secondary data will be used and the limitations on their uses are specified. Data from these documents will be utilized as appropriate.

Data Source	Data Generator	How Data Will be Used	Limitations on Data Use
<i>Final Sites 2 and 12 Fourth Quarter 2017 through Third Quarter 2018 Groundwater and Soil Gas Monitoring and Treatment System Report, Former Fort Ord, California (Ahtna, 2019a)</i>	Ahtna/Amec	Historical data used to evaluate GWTS performance over time	None
<i>Final Operable Unit 2 Fourth Quarter 2017 through Third Quarter 2018 Groundwater Monitoring and Treatment System Report, Former Fort Ord, California (Ahtna, 2019e)</i>	Ahtna/Amec	Historical data used to evaluate GWTS performance over time	None
<i>Final Operable Unit Carbon Tetrachloride Plume Fourth Quarter 2017 through Third Quarter 2018 Groundwater Monitoring Report, Former Fort Ord, California (Ahtna, 2019b)</i>	Ahtna/Amec	Historical data used to evaluate concentration trends	None

**Note:**

Amec: Amec Foster Wheeler

### **3.5 Worksheets #14 and #16: Project Tasks & Schedule**

#### **3.5.1 Project Tasks**

Applicable SOP(s) for the project tasks outlined in this worksheet are listed in Worksheet #21 and provided in detail in Attachment A. The sampling tasks are described in Worksheets #17 and #18.

#### **3.5.2 Waste and Equipment Decontamination**

Wastewater generated during decontamination will be disposed of at the OU2 or Sites 2/12 GWTS and treated with the influent groundwater. Personal protective equipment and miscellaneous waste will be placed in large garbage bags, sealed, and disposed of in facility trash receptacles.

#### **3.5.3 Quality Control Tasks**

Implement field SOPs. Field QC samples will be collected at the frequency indicated in Worksheet #20. Samples will be analyzed by the laboratory in accordance with the stated method and the DoD QSM and this QAPP. For items related to QC, see Worksheets #11, #12, #15, #22, #24, #25, #27, and #28.

#### **3.5.4 Secondary Data**

See Worksheet #13.

#### **3.5.5 Data Management Tasks**

The following are the team members and their responsibilities for the data management process:

**Program Chemist.** Responsible for reviewing chain of custody forms and establishing the sample tracking system. Oversees proper use of Ahtna's sample management system and accuracy of the information entered. Reviews laboratory data for accuracy and quality and compares electronic outputs for accuracy to laboratory electronic copies. Conducts tracking of samples, forwards tracking information and received data to the database manager, and identifies the data inputs (for example, sample numbers) to use in generating tables and figures.

**Database Manager.** Responsible for setting up the data management system in consultation with the program chemist at the beginning of the data evaluation task. Also oversees the data management process, including data conversion/manual entry into the data management system, QC of the entered data, and preparation of the required tables and plots of the data. Coordinates with the person responsible for reviewing the entered data for QC purposes. Forwards all deliverables to the Project Manager.

**Geographic Information System (GIS) Manager.** Responsible for coordinating with the Project Manager to set up the geodatabase prior to sampling. Maintains spatial layers and overall geodatabase integrity and accuracy. Provides all GIS-related outputs for reports.

#### **3.5.6 Sample Tracking**

The program chemist is responsible for tracking samples in the sample tracking database to ensure that the analytical results for all samples sent for analysis are received. Copies of chains of custody from the field team are used to enter in sample identifications (IDs), collect data, and for analyses. Upon receipt

of a sample receipt notice from the laboratory, the date received by the laboratory, and a date the electronic copy is due will be entered. Likewise, upon receipt of the electronic copy and electronic data deliverable (EDD), the date they are received will also be entered. The EDDs will be uploaded when received from the laboratory and will be tracked in the sample tracking table. Validation qualifiers will be added to the database and results qualified accordingly.

### 3.5.7 Data Types

The data will be added to the project database as they become available. The data will include new data collected in the laboratory and validated by Ahtna. The data source will be noted in the database.

### 3.5.8 Data Tracking and Management

Every data set received from analytical laboratories will be tracked individually. Analytical laboratory reports of chemical analysis results will be tracked in a consistent fashion. Every data set will be assigned a unique identifier. The date of receipt, status of data validation, and status of database entry for each data set will all be tracked and recorded in the project database.

**Hard/Electronic Copy.** Measurements made during field data collection activities will be recorded in field logbooks and sample processing logs. Field data will be reduced and summarized, tabulated, and stored along with the field logbooks and sample processing logs. All raw analytical laboratory data are stored electronically.

**Data Input Procedures.** Sampling information, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development. The analytical data will be loaded into the database using EDD files received from the analytical laboratory. Validation qualifiers will be entered manually. Other available field-related data collected will be manually entered onto standard EDD templates for loading into the database. Historical data, either in hard copy or electronic form, will be manually entered on or formatted to standard EDD templates for database loading.

### 3.5.9 Computer Database

The technical data, field observations, laboratory analytical results, and analytical data validation will be managed using Ahtna's and Wood's database to store and analyze project data submissions.

The database must be protected from unauthorized access, tampering, accidental deletions or additions, and data or program loss that can result from power outages or hardware failure. The following procedures will be adopted to ensure protection:

- The master database will be stored on a network file server local to the installation of the Ahtna and Wood data management system. Members of the data management team involved in loading, modifying, or querying the database will be given access through user accounts and passwords, as well as the appropriate network server permissions.
- Copies of the master database will be stored on the local area network for access by project staff through reporting tools developed to minimize possible database corruption by users. Whenever the master database is updated or modified, it will be recopied to the local area

network to ensure that the current copy is available to users.

- Backups of the master database and its copies will be made to ensure that the data will not be lost due to problems with the network.

In addition to the internal computer database, EDDs will be uploaded to the BRAC Fort Ord Data Integration System (FODIS) database and the CCRWQCB GeoTracker database.

### **3.5.10 Geographic Information System Description**

A project geodatabase will be set up prior to sampling by the Project Manager, database technician, and GIS technician. Ahtna will adhere to all applicable federal, DoD, and Army geospatial data standards for tasks and deliverables in this QAPP and will meet the minimum requirements for spatial data in accordance with Spatial Data Standards for Facilities, Infrastructure and Environment, current version whenever possible. Ahtna will submit the native GIS files that will include map data (.mxd) and geodatabase (.dbf) format. Ahtna will provide validated geospatial data to USACE for submission by BRAC to the FODIS database.

Each geospatial data set shall be accompanied by metadata conforming to the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata and the Army Installation Geospatial Information & Services Metadata Standard, v1. The horizontal accuracy of any geospatial data created shall be tested and reported in accordance with the National Standard for Spatial Data Accuracy and the results shall be recorded in the metadata. All data will have a datum of GCS\_North American\_1983 and a projection of North American Datum 1983 State Plane California Zone 4. The sea level datum used will be the National Geodetic Vertical Datum 1929 to conform with historical former Fort Ord data.

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

### **3.5.11 Documentation**

Documentation of data management activities is critical because it provides the following:

- An electronic copy record of project data management activities
- Reference information critical for database users
- Evidence that the activities have been properly planned, executed, and verified
- Continuity of data management operations when personnel changes occur

The data management plan will serve as the initial general documentation of the project data management efforts. Additional documentation will be maintained to document specific issues such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.



### 3.5.12 Presentation of Data

Depending on data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures showing concentration isopleths or location-specific concentrations
- Tables providing statistical evaluation or calculation results
- Presentation tools, such as ArcMap or similar analysis/presentation aids

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

### 3.5.13 Assessment and Audit Tasks

See Worksheets #31, #32, and #33.

### 3.5.14 Data Review Tasks

The laboratory will make sure that the data are complete for all samples received. Laboratory data will be validated by Ahtna or Wood. Validated data and field logs will be reviewed to assess total measurement error and determine the overall usability of the data for project purposes. Final data are placed in the database with qualifiers. See Worksheets #34 through #37 for the tasks.

### 3.5.15 Documentation and Records

Records and field measurements of all samples will be collected in notebooks. Chains of custody and sample logs will be prepared and retained for each sample. A copy of the final QAPP will be kept at the Ahtna Marina office. Field forms are shown in Attachment C.

### 3.5.16 Project Schedule

A general project schedule for long-term monitoring is presented below.

Activity	Responsible Party	Frequency	Deliverable(s)	Deliverable Due Date
OU2 GWTS O&M	Ahtna	Ongoing	Quarterly and Annual Reports	Quarterly Report (Final only) due 60 days after sampling event concludes* Annual Report (Pre-Draft) due 75 days after sampling event concludes*
Sites 2/12 GWTS O&M				
OU2 GWMP		Quarterly		
Sites 2/12 GWMP				
OUCTP GWMP				

**Notes:**

\* The conclusion of the sampling event is defined as the last day samples are collected for the event.

### 3.6 Worksheet #15: Laboratory-Specific Detection/Quantitation Limits

#### 3.6.1 Worksheet #15a: VOCs by EPA Method 8260-SIM

Matrix: Groundwater (µg/L)

Analyte	CAS #	Project Action Limits <sup>1</sup> (µg/L)										Project LOQ (µg/L)	Analytical Method Limits <sup>2</sup> (µg/L)		Achievable Laboratory Limits <sup>3</sup> (µg/L)	
		Sites 2/12			OU2			OUCTP					DL	LOD and LOQ	DL	LOQ
		ACL	DCL <sup>4</sup>	ACL	DCL	ACL	A-Aquifer	Upper 180-Foot Aquifer	Lower 180-Foot Aquifer	ACL						
1,1-Dichloroethane	75-34-3	-	-	5	5 <sup>5</sup>	-	-	-	-	0.03	0.50	0.10	0.25	0.50		
1,1-Dichloroethene	75-35-4	6	6	-	-	6	-	-	-	0.12	0.50	0.10	0.25	0.50		
1,2-Dichloroethane	107-06-2	0.5	0.5	0.5	0.5	-	-	-	-	0.02	0.50	0.10	0.25	0.50		
1,2-Dichloroethene (total) <sup>6</sup>	540-59-0	-	-	-	-	6	-	-	-	0.49	1.0	0.10	0.25	0.50		
1,2-Dichloropropane	78-87-5	-	-	1	0.5	-	-	-	-	0.02	0.50	0.10	0.25	0.50		
1,3-Dichloropropene (total) <sup>6</sup>	542-75-6	0.5	0.5	-	-	-	-	-	-	0.27	0.50	0.10	0.25	0.50		
Benzene	71-43-2	-	-	1	0.5	-	-	-	-	0.03	0.50	0.10	0.25	0.50		
Carbon Tetrachloride	56-23-5	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.02	0.50	0.10	0.25	0.50		
Chloroform	67-66-3	2	2	2	2 <sup>5</sup>	2	-	-	-	0.04	0.50	0.10	0.25	0.50		
cis-1,2-Dichloroethene	156-59-2	6	6	6	6 <sup>5</sup>	-	-	-	-	0.06	0.50	0.10	0.25	0.50		
Methylene chloride	75-09-2	-	-	5	0.5	5	-	-	-	0.62	2.0	0.50	0.50	2.0		
Tetrachloroethene	127-18-4	5	5	3	0.5	5	-	-	-	0.05	0.50	0.10	0.25	0.50		
Trichloroethene	79-01-6	5	5	5	0.5	5	-	-	-	0.02	0.50	0.10	0.25	0.50		
Vinyl Chloride	75-01-4	0.1	0.1	0.1	0.1	0.1	-	-	-	0.04	0.10	0.050	0.050	0.10		

Notes on next page.

**Notes:**

µg/L: micrograms per liter

ACL: Aquifer Cleanup Level

CAS #: Chemical Abstracts Service Number

DCL: discharge limit

DL: detection limit

LOD: limit of detection

LOQ: limit of quantitation

NP: not provided in method

OU: Operable Unit

OUCTP: Operable Unit Carbon Tetrachloride Plume

-: not applicable

<sup>1</sup>ACLs and discharge limits are site-specific and identified in the relevant decision documents (Army, 1994; Army, 1995, Army, 1997; Army, 2008; and Army, 2016).

<sup>2</sup>Analytical method DLs, LODs and LOQs are those documented in published methods.

<sup>3</sup>Achievable DLs, LODs, and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. An analyte is ND at the LOD, and a measurable detection above the DL and less than the LOQ is estimated (“J-qualified”).

<sup>4</sup>Discharge limit for the applicable groundwater treatment system using groundwater plume need only meet ACLs (HLA, 1999).  
2/12 GWTS, discharge to areas overlying the contaminated groundwater plume need only meet ACLs (HLA, 1999).

<sup>5</sup>Discharge limit revised to ACL for this COC to optimize GAC usage (HLA, 1999).

<sup>6</sup>Total of cis- and trans- isomers.

### 3.6.2 Worksheet #15b: Ion Chromatography by EPA Method 9056A

**Matrix:** Groundwater (mg/L)

Analyte	CAS Number	Project Action Limits <sup>1</sup> (mg/L) Sites 2/12	Project LOQ (mg/L)	Analytical Method Limits <sup>2</sup> (mg/L)		Achievable Laboratory Limits <sup>3</sup> (mg/L)		
				DL	LOD and LOQ	DL	LOD	LOQ
Chloride	16887-00-6	250	250	0.02	Not Provided in Method	0.80	1.0	2.0

**Notes:**

CAS: Chemical Abstracts Service

DL: detection limit

LOD: limit of detection

LOQ: limit of quantitation  
mg/L: milligrams per liter

<sup>1</sup>Project Action Limits are National Secondary MCLs for Drinking Water Quality.

<sup>2</sup>Analytical method DLs, LODs and LOQs are those documented in published methods.

<sup>3</sup>Achievable DLs, LODs, and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. An analyte is ND at the LOD, and a measurable detection above the DL and less than the LOQ is estimated (“J-qualified”).

### 3.6.3 Worksheet #15c: Dissolved Metals by ICP by EPA Method 6010D

**Matrix:** Groundwater (µg/L)

Analyte	CAS Number	Project Action Limits <sup>1</sup> (µg/L) OU2	Project LOQs (µg/L)	Analytical Method Limits <sup>2</sup> (µg/L)			Achievable Laboratory Limits <sup>3</sup> (µg/L)		
				DL	LOD	LOQ	DL	LOD	LOQ
Antimony	7440-36-0	6.0	6.0	21	Not Provided in Method	Not Provided in Method	1.0	5.0	6.0
Copper	7440-50-8	1,000	25	3.6			1.0	2.0	25
Lead	7439-92-1	15	10	28			1.1	2.0	5.0

**Notes:**

CAS: Chemical Abstracts Service

DL: detection limit

LOD: limit of detection

LOQ: limit of quantitation

µg/L: micrograms per liter

<sup>1</sup>Project Action Limits are state or federal MCLs (whichever is lower) for drinking water in OU2 wells associated with the Fort Ord Landfills. Antimony, copper, and lead are the primary metals found in spent ammunition deposited in the Fort Ord Landfills. MCLs are used to evaluate concentrations of these dissolved metals in groundwater near the Fort Ord Landfills; however, the groundwater being monitored is not intended for use as drinking water.

<sup>2</sup>Analytical method DLs, LODs and LOQs are those documented in published methods.

<sup>3</sup>Achievable DLs, LODs, and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. An analyte is ND at the LOD, and a measurable detection above the DL and less than the LOQ is estimated ("J-qualified").

## 4.0 Sample Design

### 4.1 Worksheet #17: Sampling Design and Rationale

A summary of existing monitoring locations is listed in the worksheets below separated by site and aquifer accordingly.

#### 4.1.1 Worksheet #17a1: Sites 2/12 GWTS Part I

Sampling Location	Activity	EPA Method	Comments/Rationale <sup>4</sup>	SOP Reference
TS-212-INF	GWTS monitoring <sup>1</sup>	8260-SIM	To measure influent COC concentrations and evaluate GWTS efficiency.	SOP #5
TS-212-GAC A			To measure COC concentrations downstream from the GAC vessel and evaluate GAC efficiency.	
TS-212-EFF			To measure COC concentrations downstream from the air stripper unit and evaluate air stripper efficiency.	
TS-212-INJ			To comply with discharge limits.	
EW-12-03-180U <sup>6</sup>	Groundwater Monitoring <sup>2</sup>	8260-SIM  EPA Method 9056A SM 9056A	To measure changes in groundwater COC concentrations. To evaluate general inorganic constituents.	
EW-12-03-180M <sup>5</sup>				
EW-12-04-180U <sup>6</sup>				
EW-12-04-180M <sup>6</sup>				
EW-12-05-180M <sup>3</sup>				
EW-12-06-180M <sup>3</sup>				
EW-12-07-180M <sup>3</sup>				
EW-12-08-180U <sup>3</sup>				

#### Notes:

COC: chemical of concern

EFF: effluent

EW: extraction well

GAC: granular activated carbon

INF: influent

INJ: injection

TS: treatment system sampling port

SOP: standard operating procedure

<sup>1</sup> The sampling frequency is variable based on historical GAC breakthrough rates, as shown on Worksheet #17a2.

<sup>2</sup> Samples and water level measurements are collected quarterly or annually from the extraction wells based on the decision rules identified in Worksheet #10a.

<sup>3</sup> During the 3<sup>rd</sup> Quarter (Annual) sampling event, chloride is analyzed.

<sup>4</sup> The rationale for sampling locations and frequency is based on the RI Sites ROD and RI Sites ESD, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

<sup>5</sup> Pump removed from the inoperable extraction well, groundwater sampling conducted with PDBs as identified in Worksheet #17c.

<sup>6</sup> Well no longer sampled per decision rules (Worksheet #10a).



#### 4.1.2 Worksheet #17a2: Sites 2/12 GWTS Part II

The *Final Operations and Maintenance Manual Volume II, Sites 2 and 12 Groundwater Remedy, Former Fort Ord, California* (Sites 2/12 GWTS O&M Manual; AES, 2009) provides procedures for O&M of the Sites 2/12 GWTS. The Sites 2/12 GWTS O&M Manual also describes the conditions required for GAC change-out in Section 4.2.3, but those instructions are superseded by Worksheet #17a2.

Sites 2/12 GWTS Sampling Frequencies <sup>3</sup>									
Sample Point	Weeks after GAC change-out <sup>4</sup>								
	0	12	21	30	36	42	44	46	48 <sup>4</sup>
TS-212-INF			xx		x	xx	x	xx	x
TS-212-GAC-A <sup>1</sup>	x <sup>2</sup>		x	x	x	x	x	x	x
TS-212-EFF						x	x	x	x
TS-212-INJ		x	x	x	x	x	x	x	x

**Notes:**

≥: greater than or equal to

?: percent

x: sample collected

xx: sample and duplicate collected

<sup>1</sup> Sample point immediately downstream of the GAC vessel.

<sup>2</sup> Sample collected no less than 2 hours after bringing a newly repacked GAC vessel online.

<sup>3</sup> The sampling frequency is determined based on historical COC breakthrough rates; however, the sampling frequency may be altered if there are significant operational changes.

<sup>4</sup> If GAC change-out is not indicated by Week 48, further sampling will be performed weekly, or at a frequency determined by the Project Manager, until GAC effluent PCE or TCE concentration is ≥ 90% of the discharge limit.

#### 4.1.3 Worksheet #17b1: OU2 GWTS Part I

Sampling Location	Activity	Test Methods	Comments/Rationale <sup>3</sup>	SOP Reference
TS-OU2-INF-01*	GWTS Monitoring <sup>1</sup>	EPA Method 8260-SIM	To measure influent COC concentrations and evaluate GWTS efficiency.	SOP #5
TS-OU2-INF-02*				
TS-OU2-EFF-1A*				
TS-OU2-EFF-1B*				
TS-OU2-EFF-1C*				
TS-OU2-EFF-2A*				
TS-OU2-EFF-2B*				
TS-OU2-EFF-2C*				
TS-OU2-INJ-01*				
EW-OU2-01-A <sup>5</sup>	Groundwater Monitoring <sup>2</sup>	EPA Method 8260-SIM	To evaluate changes in groundwater COC concentrations.	SOP #5
EW-OU2-02-A				
EW-OU2-03-A <sup>5</sup>				
EW-OU2-04-A				
EW-OU2-05-A				
EW-OU2-06-A				
EW-OU2-07-A <sup>5</sup>				
EW-OU2-09-A				
EW-OU2-10-A				
EW-OU2-11-AR				
EW-OU2-12-A				
EW-OU2-13-A				
EW-OU2-14-A				
EW-OU2-16-A				
EW-OU2-17-A				
EW-OU2-18-A				
EW-OU2-19-A				
EW-OU2-20-A				
EW-OU2-01-180 <sup>4</sup>				
EW-OU2-02-180R				
EW-OU2-03-180				
EW-OU2-04-180 <sup>5</sup>				
EW-OU2-05-180				
EW-OU2-06-180				
EW-OU2-07-180 <sup>4</sup>				
EW-OU2-08-180				
EW-OU2-09-180 <sup>6</sup>				

Sampling Location	Activity	Test Methods	Comments/Rationale <sup>3</sup>	SOP Reference
EW-OU2-10-180	Groundwater Monitoring <sup>2</sup>	EPA Method 8260-SIM	To evaluate changes in groundwater COC concentrations.	
EW-OU2-11-180				
EW-OU2-12-180				

**Notes:**

COC: chemical of concern

EFF: effluent

EW: extraction well

GAC: granular activated carbon

INF: influent

INJ: injection

TS: treatment system sampling port

<sup>1</sup> The sampling frequency is variable based on historical GAC breakthrough rates, as shown in Worksheet #17b2.

<sup>2</sup> Groundwater samples and water level measurements are collected quarterly or annually from the extraction wells based on the decision rules identified in Worksheet #10a.

<sup>3</sup> The rationale for sampling locations and frequency is based on the OU2 ROD, OU2 ESD, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

<sup>4</sup> Pump removed from the inoperable extraction well, groundwater sampling conducted with PDBs as identified in Worksheet #17c5.

<sup>5</sup> Well no longer sampled per decision rules (Worksheet #10).

<sup>6</sup> Well operated to remediate the OUCTP Upper 180-Foot Aquifer as listed in Worksheet #17c4.

\* The OU2 GWTP sampling locations were renamed as listed below.

<u>New Name</u>	<u>Former Name</u>
TS-OU2-INF-01	SP-IN-01
TS-OU2-INF-02	SP-IN-02
TS-OU2-EFF-1A	SP-1A-EF
TS-OU2-EFF-1B	SP-1B-EF
TS-OU2-EFF-1C	SP-1C-EF
TS-OU2-EFF-2A	SP-2A-EF
TS-OU2-EFF-2B	SP-2B-EF
TS-OU2-EFF-2C	SP-2C-EF
TS-OU2-INJ-01	SP-EF-01

#### 4.1.4 Worksheet #17b2: OU2 GWTS Part II

The OU2 GWTP O&M Manual (JV, 2018) provides procedures for sampling of the OU2 GWTP and describes the conditions required for GAC change-out, but those instructions are superseded by Worksheet #17b2.

		OU2 GWTS Sampling Frequencies <sup>3,4</sup> Median GAC Cycle to be determined <sup>5</sup>												
Sampling Point	GAC change-out	Weeks after GAC change-out <sup>6</sup>												
		0	1	2	3	4	5	9	13	16	19	22	24	26
TS-OU2-INF-01		X	X	XX	X	X	X	XX		X		XX		X
TS-OU2-INF-02		XX	X	X	X	XX	X			XX		X		XX
TS-OU2-EFF-1A <sup>1</sup>		X	X	X	X	X	X			X	X	X	X	X
TS-OU2-EFF-1B <sup>1</sup>		X								X		X		X
TS-OU2-EFF-1C <sup>1</sup>		X								X		X		X
TS-OU2-EFF-2A <sup>1</sup>		X	X	X	X	X	X			X	X	X	X	X
TS-OU2-EFF-2B <sup>1</sup>		X								X		X		X
TS-OU2-EFF-2C <sup>1</sup>		X								X		X		X
TS-OU2-INJ-01		X <sup>2</sup>	X	X	X	X	X	X	X	X	X	X	X	X

#### Notes:

TS-OU2-INF-01 (formerly SP-IN-01) = Eastern Main influent

TS-OU2-INF-02 (formerly SP-IN-02) = Western Main influent

TS-OU2-EFF-1A (formerly SP-1A-EF) = GAC 1A effluent

TS-OU2-EFF-1B (formerly SP-1B-EF) = GAC 1B effluent

TS-OU2-EFF-1C (formerly SP-1C-EF) = GAC 1C effluent

TS-OU2-EFF-2A (formerly SP-2A-EF) = GAC 2A effluent

TS-OU2-EFF-2B (formerly SP-2B-EF) = GAC 2B effluent

TS-OU2-EFF-2C (formerly SP-2C-EF) = GAC 2C effluent

TS-OU2-INJ-01 (formerly SP-EF-01) = discharge point of compliance

x: sample collected

xx: sample and duplicate collected

<sup>1</sup> Sample point to be immediately downstream of the lead GAC vessel.

<sup>2</sup> Sample collected no less than 2 hours after bringing a newly repacked GAC vessel on-line.

<sup>3</sup> The sampling frequency is determined based on historical COC breakthrough rates at the old OU2 GWTP; however, the sampling frequency may be altered at the discretion of the Project Manager if there are significant differences in operational conditions at the new OU2 GWTP.

<sup>4</sup> The sampling schedule assumes vessels GAC 1A and GAC 2A are in the lead position.

<sup>5</sup> The median GAC cycle for the new OU2 GWTP based on analytical results for process samples collected during the first year of operation.

<sup>6</sup> If GAC change-out is not indicated by Week 26, further sampling will be performed weekly or at a frequency determined by the direction of the Project Manager.

**4.1.5 Worksheet #17c1: Sites 2/12 GWMP**

Well Name	CI	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
EW-12-03-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-02-05-180	A	A	Q	HydraSleeve™, PDB/ SOP #3,2	RI Sites ROD/ESD
MW-02-13-180M	A	Q	Q	HydraSleeve™, PDB/ SOP #3,2	RI Sites ROD/ESD
EW-12-05-180M	A	Q	Q	Pump Spigot/SOP #5	RI Sites ROD/ESD
EW-12-06-180M	A	Q	Q	Pump Spigot/SOP #5	RI Sites ROD/ESD
EW-12-07-180M	A	Q	Q	Pump Spigot/SOP #5	RI Sites ROD/ESD
EW-12-08-180U	A	Q	Q	Pump Spigot/SOP #5	RI Sites RI/FS Addendum
MW-12-01-180		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-05-180	A		Q	HydraSleeve™ / SOP #3	RI Sites ROD/ESD
MW-12-09R-180		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-14-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-15-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-16-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-18-180U		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-20-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-21-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-22-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-24-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-25-180U		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-26-180U		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-28-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-29-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-30-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-31-180M		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-32-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
<b>The Following Wells Are Measured for Groundwater Elevation Data Only:</b>					
EW-12-03-180U			Q	SOP #5	Groundwater elevation trend analysis
EW-12-04-180M			Q	SOP #5	Groundwater elevation trend analysis



Well Name	CI	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
EW-12-04-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-02-06-180			Q	SOP #5	Groundwater elevation trend analysis
MW-02-10-180			Q	SOP #5	Groundwater elevation trend analysis
MW-02-13-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-07-180			Q	SOP #5	Groundwater elevation trend analysis
MW-12-08-180			Q	SOP #5	Groundwater elevation trend analysis
MW-12-12-180L			Q	SOP #5	Groundwater elevation trend analysis
MW-12-17-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-19-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-19-180M			Q	SOP #5	Groundwater elevation trend analysis
MW-12-23-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-27-180U			Q	SOP #5	Groundwater elevation trend analysis

**Notes:**

A: sampled on an annual basis

Cl: chloride

ESD: Explanation of Significant Differences

PDB: passive diffusion bag

Q: sampled on a quarterly basis

RI: Remedial Investigation

ROD: Record of Decision

SIM: selected ion monitoring

SOP: standard operating procedures

VOCs: volatile organic compounds

<sup>1</sup>The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

**4.1.6 Worksheet #17c2: OU2 GWMP**

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
EW-OU2-01-180		Q	Q	PDB/SOP #2	OU2 ESD
EW-OU2-02-180R <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-02-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-03-180		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-04-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-05-180		Q	Q	PDB/SOP #2	OU2 ROD
EW-OU2-05-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-06-180		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-06-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-08-180		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-09-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-10-180 <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-10-A		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-11-180 <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-11-AR <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-12-180 <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-12-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-13-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-14-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-15-A		Q	Q	PDB/SOP #2	OU2 ESD
EW-OU2-16-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-17-A <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-18-A <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-19-A <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-20-A <sup>2</sup>		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
MW-BW-02-180		Q	Q	PDB/SOP #2	OU2 ESD/OUCTP ROD
MW-BW-13-A		Q	Q	PDB/SOP #2	OU2 ROD

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MW-BW-14-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-BW-50-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-01-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-02-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-04-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-06-180R2		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-06-AR		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-07-180R		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-07-A		A	Q	PDB/SOP #2	OU2 ROD
MW-OU2-08-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-12-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-20-180		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-23-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-24-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-25-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-27-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-28-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-28-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-30-180		A	Q	PDB/SOP #2	OU2 ESD
MW-OU2-34-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-39-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-40-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-43-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-44-A		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-44-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-45-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-46-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-46-180		Q	Q	PDB/SOP #2	OU2 ESD

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MW-OU2-47-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-50-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-51-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-53-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-56-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-61-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-62-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-63-180		A	Q	PDB/SOP #2	OU2 ESD
MW-OU2-73-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-74-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-75-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-79-A		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-80-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-81-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-81-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-83-A		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
<b>The Following Wells Are Measured for Groundwater Elevation Data Only:</b>					
EW-OU2-01-A			Q	SOP #5	Groundwater elevation trend analysis
EW-OU2-03-A			Q	SOP #5	Groundwater elevation trend analysis
EW-OU2-04-180			Q	SOP #5	Groundwater elevation trend analysis
EW-OU2-07-A			Q	SOP #5	Groundwater elevation trend analysis
MW-14-03-180			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-01-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-11-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-12-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-03-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-05-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-05-180			Q	SOP #5	Groundwater elevation trend analysis

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MW-OU2-09-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-09-180R			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-13-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-20-180X			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-21-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-23-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-29-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-29-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-30-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-31-180R			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-32-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-35-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-36-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-49-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-52-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-54-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-55-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-57-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-58-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-76-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-77-A			Q	SOP #5	Groundwater elevation trend analysis
PZ-OU2-06-180			Q	SOP #5	Groundwater elevation trend analysis

**Notes:**

A: sampled on an annual basis

Cu: copper

ESD: Explanation of Significant Differences

PB: lead

PDB: passive diffusion bag

Q: sampled on a quarterly basis

ROD: Record of Decision

Sb: antimony

SIM: selected ion monitoring

SOP: standard operating procedures

VOCs: volatile organic compounds

<sup>1</sup>The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

<sup>2</sup> New wells installed in 2016 to be operated and sampled once the new OU2 GWTP is online in 2018.

**4.1.7 Worksheet #17c3: OUCTP A-Aquifer GWMP**

Well Name	DO ORP	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
EISB-EW-01		Q	Q	PDB/SOP #2	OUCTP ROD
EISB-EW-02		A	Q	PDB/SOP #2	OUCTP ROD
EISB-EW-09		Q	Q	PDB/SOP #2	OUCTP ROD
EISB-EW-12	Q		Q	PTM/SOP #6/7	OUCTP ROD
EISB-EW-15	Q		Q	PTM/SOP #6/7	OUCTP ROD
EISB-MW-01		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-109-A		Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-112-A	Q	A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-119-A	Q	A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-124-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-132-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-135-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-144-A	Q		Q	PTM/SOP #6/7	OUCTP ROD
EW-BW-149-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-150-A	Q	A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-155-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-159-A	Q		Q	PTM/SOP #6/7	OUCTP ROD
EW-BW-160-A	Q	Q	Q	PDB/SOP #2	OUCTP ROD
EW-BW-161-A	Q		Q	SOP #5	OUCTP ROD
EW-BW-164-A	Q		Q	SOP #5	OUCTP ROD
EW-BW-165-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-166-A	Q	Q	Q	PDB/SOP #2	OUCTP ROD
EW-BW-167-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-168-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-169-A		A	Q	PDB/SOP #2	OUCTP ROD
MP-BW-46-095		A	Q	Westbay Port/SOP #1	OUCTP ROD
MW-B-12-A		Q	Q	PDB/SOP #2	OUCTP ROD



Well Name	DO ORP	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MW-B-14-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-15-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-17-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-24-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-26-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-27-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-28-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-30-A		A	Q	SOP #5	Groundwater elevation trend analysis
MW-BW-31-A		Q	Q	PDB/SOP #2	
MW-BW-32-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-35-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-36-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-39-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-42-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-43-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-44-A		A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
MW-BW-48-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-49-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-56-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-58-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-60-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-65-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-66-A		Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
MW-BW-74-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-75-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-77-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-78-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-79-A		Q	Q	PDB/SOP #2	OUCTP ROD

Well Name	DO ORP	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MW-BW-80-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-83-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-85-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-86-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-87-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-88-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-89-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-90-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-91-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-92-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-93-A		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-BW-94-AR		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-BW-95-A		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
<b>The Following Wells Are Measured for Groundwater Elevation Data Only:</b>					
EISB-EW-03			Q	SOP #5	Groundwater elevation trend analysis
EISB-MW-04			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-92-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-93-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-100-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-104-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-126-A			Q	SOP #5	Groundwater elevation trend analysis
MP-BW-46-080			Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-48-113			Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-48-133			Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MW-40-01-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-16-A			Q	SOP #5	OUCTP ROD
MW-BW-18-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-25-A			Q	SOP #5	Groundwater elevation trend analysis

Well Name	DO ORP	VOCs (8260- SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MW-BW-34-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-38-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-41-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-45-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-46-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-51-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-53-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-54-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-57-A			Q	SOP #5	OUCTP ROD
MW-BW-59-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-63-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-67-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-71-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-81-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-82-A			Q	SOP #5	Groundwater elevation trend analysis

**Notes:**

A: sampled on an annual basis

DO: dissolved oxygen

ORP: oxidation-reduction potential

PDB: passive diffusion bag

PTM: post-treatment monitoring

Q: sampled on a quarterly basis

ROD: Record of Decision

SIM: selected ion monitoring

SOP: standard operating procedures

<sup>1</sup> The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

**4.1.8 Worksheet #17c4: OUCTP Upper 180-Foot Aquifer GWMP**

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
EW-OU2-09-180	Q	Q	Pump Spigot/SOP #5	OUCTP ROD
MP-BW-41-231	A	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-46-170	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MW-BW-52-180	Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-57-180	Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-BW-58-180	Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-OU2-64-180	Q	Q	PDB/SOP #2	OUCTP ROD
MW-OU2-67-180	Q	Q	PDB/SOP #2	OUCTP ROD
MW-OU2-70-180	A	Q	PDB/SOP #2	OUCTP ROD
<b>The Following Wells Are Measured for Groundwater Elevation Data Only:</b>				
MP-BW-30-282		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-287		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-272		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-242		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-178		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-193		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-202		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-256		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-195		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-215		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-235		Q	Westbay Port/SOP #1	Groundwater elevation trend analysis
MP-BW-46-185		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-46-200		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-46-215		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MW-B-05-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-21-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-26-180		Q	SOP #5	Groundwater elevation trend analysis

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MW-BW-43-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-44-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-45-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-47-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-49-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-50-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-51-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-53-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-54-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-55-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-56-180		Q	SOP #5	Groundwater elevation trend analysis

**Notes:**

A: sampled on an annual basis

PDB: passive diffusion bag

PTM: post-treatment monitoring

Q: sampled on a quarterly basis

ROD: Record of Decision

SIM: selected ion monitoring

SOP: standard operating procedures

<sup>1</sup> The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

#### 4.1.9 Worksheet #17c5: OUCTP Lower 180-Foot Aquifer GWMP

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
Airfield	Q	Q	PDB/SOP #2	OUCTP ROD
EW-OU2-07-180	Q	Q	PDB/SOP #2	OUCTP ROD
FO-29	Q		Sampling Port/SOP #4	OUCTP ROD
FO-30	Q		Sampling Port/SOP #4	OUCTP ROD
FO-31	Q		Sampling Port/SOP #4	OUCTP ROD
Mini-storage	A		Sampling Port/SOP #4	OUCTP ROD
MP-BW-31-292	A	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-41-318	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-41-353	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-42-345	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-287	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-316	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-368	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-400	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MP-BW-50-339	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MP-BW-50-384	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MP-BW-51-405	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MW-BW-04-180	A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-59-180	Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-OU2-66-180	Q	Q	PDB/SOP #2	
MW-OU2-69-180	Q	Q	PDB/SOP #2	
MW-OU2-72-180	Q	Q	PDB/SOP #2	
MW-OU2-78-180	Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-82-180	Q	Q	PDB/SOP #2	OU2 ESD
<b>The Following Wells Are Measured for Groundwater Elevation Data Only:</b>				
MCWD-08A		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-317		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MP-BW-30-342		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-397		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-467		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-537		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-332		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-362		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-407		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-457		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-522		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-332		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-366		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-412		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-472		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-522		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-317		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-352		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-397		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-292		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-357		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-422		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-492		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-537		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-312		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-366		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-402		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-467		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-527		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-562		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis



Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MP-BW-37-328		Q	Westbay Port/SOP #1	Groundwater elevation trend analysis
MP-BW-37-303		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-368		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-398		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-460		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-327		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-341		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-353		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-368		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-418		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-310		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-330		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-350		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-395		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-333		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-353		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-375		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-400		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-286		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-396		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-295		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-314		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-400		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-49-336		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-50-289		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-50-309		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-50-359		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-51-315		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale <sup>1</sup>
MP-BW-51-340		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-51-370		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-323		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-338		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-363		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-388		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-408		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MW-BW-03-400		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-07-400		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-28-400		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-68-180		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-71-180		Q	SOP #7	Groundwater elevation trend analysis
Test 2		Q	SOP #7	Groundwater elevation trend analysis

**Notes:**

A: sampled on an annual basis

PDB: passive diffusion bag

PTM: post-treatment monitoring

Q: sampled on a quarterly basis

ROD: Record of Decision

SIM: selected ion monitoring

SOP: standard operating procedures

<sup>1</sup>The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

## **4.2 Worksheet #18: Sampling Locations and Methods**

This Worksheet was not used. Information that would be included in this worksheet is incorporated into Worksheets #17a through #17c.

## 5.0 Sampling Requirements

### 5.1 Worksheets #19 and #30: Sample Container, Preservation, and Hold Times

Laboratory: SGS

Florida:

4405 Vineland Rd, Suite C-15

Orlando, FL 32811

Telephone: 407-425-6700

Point of Contact: Svetlana Izosimova

E-mail: Svetlana.Izosimova@sgs.com

Sample Delivery Method: Courier to San Jose, CA distribution center or FedEx overnight shipment to Florida

Matrix	Analytical Group	Preparation/Analytical Method	Sample Volume	Containers	Preservation	Holding Time <sup>1</sup>	SGS Laboratory
Water	VOCs	EPA 5030/8260-SIM	120 mL	Three 40-mL Teflon-lined VOA Vials	HCl to pH < 2 Sample temp > 0°C ≤ 6°C	14 days	Florida
	Dissolved Metals	EPA 3010A/6010D	500 mL	Two 250-mL HDPE bottles	HNO <sub>3</sub> to pH < 2 after field filtering Sample temp > 0°C ≤ 6°C	6 months	
	Chloride	EPA 9056A	100 mL	One 100-mL HDPE bottle	Sample temp > 0°C ≤ 6°C	28 days	

#### Notes:

°C: degrees Celsius

HCl: hydrochloric acid

HDPE: high-density polyethylene

HNO<sub>3</sub>: nitric acid

mL: milliliter

VOA: volatile organic analysis

VOCs: volatile organic compounds

<sup>1</sup> Data package TAT is 15 business days

## 5.2 Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group (Method)	Frequency of Field Duplicate Samples	Frequency of Trip Blanks	Frequency of Field Blanks	Frequency of Equip Blanks	Frequency of MS/MSD
Water	VOCs (8260-SIM)	10% of field samples collected	1 set per cooler /day	1 per sampling day	1 per sampling event (Westbay sampling only <sup>1</sup> )	5% of field samples collected
	Metals (6010D)	10% of field samples collected	N/A	N/A	N/A	5% of field samples collected
	Cl (9056A)	10% of field samples collected	N/A	N/A	N/A	5% of field samples collected

**Notes:**

Cl: chloride

MS/MSD: matrix spike/matrix spike duplicate

N/A: not applicable

VOCs: volatile organic compounds

<sup>1</sup>Sampling at Westbay wells requires reuse and decontamination of sampling equipment. Sampling with PDBs, HydraSleeves and from sampling ports is performed with non-reusable sampling equipment, and no decontamination of field equipment is required. Westbay sample locations are identified as "Westbay Port" in the "Sampling Method" column of Worksheet #17c.

### 5.3 Worksheet #21: Field SOPs/Methods

SOP Reference Number	Title	Organization	Revision Date	Equipment Type	Modified for Project Work?	Comments
SOP #1	Westbay MOSDAX Sampler Probe – Model 2531 Operations Manual	Schlumberger	Oct. 20, 2006	Westbay Multi-port Wells	No	
SOP #2	PDB Sampling Protocol	Wood/U.S. Geological Survey (USGS)	2001	PDBs	Yes	Project-specific procedures are appended to USGS User's Guide
SOP #3	HydraSleeve Field Manual	GeolInsight	2006	HydraSleeve	No	
SOP #4	Supply and Irrigation Well Sampling Protocol	Wood/Ahtna	2016	Sampling Ports	Yes	GWMP project-specific procedures
SOP #5	OU2 and Sites 2/12 GWTs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements	Ahtna	2016	Sampling Ports	Yes	GWTs project-specific procedures
SOP #6	Low Flow Groundwater Quality Parameter Collection	Ahtna	2016	Horiba Multi-Meter and Low Flow Pump	Yes	OUCTP GWMP project-specific procedures
SOP #7	Downhole Meter Groundwater Quality Parameter Collection	Ahtna	2016	YSI Sonde Downhole Meter	Yes	OUCTP GWMP project-specific procedures

**Note:** SOPs are provided in Attachment A.

## 5.4 Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Electric Water Level Sounder	Calibrated against steel tape	Maintain in proper working order, store in a secure location, decon after each use	Check battery and sensitivity daily prior to use	Inspect tape for damage prior to use	Quarterly prior to use	Calibrates with steel tape to within 0.05 ft/100 feet depth to water	Send into factory for repair	Field Supervisor	SOPs #2 & #5
YSI Sonde Downhole Meter	Calibrated with solutions	Decon after each use, store according to manufacturer directions	Check battery prior to use	Inspect for damage prior to use	Quarterly prior to use	According to manufacturer instructions	Check manual or send into factory for repair	Field Supervisor	SOP #7
Digital Thermometer	Factory calibrated, ice-point method per HACCP-based SOP	Store in a secure location, avoid excessive heat	Check battery prior to use	Inspect for damage prior to use	Annually	Factory calibration, temperature reading = $0^{\circ}\text{C} \pm 1^{\circ}\text{C}$	Replace with new unit	Field Supervisor	SOPs #2 & #5

### Notes:

°C: degrees Celsius

HACCP: Hazard Analysis & Critical Control Points (Title 9 Code of Federal Regulations Part 417)

N/A: not applicable

SOP: standard operating procedures



## 6.0 Analytical Requirements

### 6.1 Worksheet #23: Analytical SOPs

The SOPs referenced below are the laboratory-specific procedures for the tests for which the laboratory is certified under DoD Environmental Laboratory Accreditation Program (ELAP). Laboratories with the DoD ELAP certificate undergo annual audits by the independent accrediting bodies responsible for the DoD ELAP certification. Copies certifications including the specifically referenced methods are included in Attachment F.

Data will be evaluated based on the guidance provided in the DoD QSM Version 5.1, the published methods, and the laboratory Quality Assurance Manual.

SOP Reference Number	Title	Organization	Revision Date	Equipment Type	Modified for Project Work?	Comments
SGS SOP# MS010.7	Analysis of Volatile Organics by GC/MS Select Ion Monitoring (SIM) (VOCs by 8260 SIM)	SGS	Aug 30, 2017	Analytical Instruments	No	
SGS SOP# MET108.03	Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) (Metals by 6010D)	SGS	Feb 22, 2018	Analytical Instruments	No	
SGS SOP# GN228.9	Determination of Inorganic Anions by Ion Chromatography (Chloride by 9056A)	SGS	April 4, 2018	Analytical Instruments	No	
SGS SOP# SAM101.19	Sample Receipt and Storage	SGS	Oct 29, 2018	None	No	
SGS SOP# SAM108.10	Sample and Laboratory Waste Disposal	SGS	Jan 21, 2016	None	No	

## 6.2 Worksheet #24: Analytical Instrument Calibration

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
GC/MS – VOCs by EPA Method 8260-SIM	Check of instrument tuning using BFB	Prior to ICAL and every 12 hours	Refer to method for specific ion criteria	Re-tune instrument Re-analyze affected	GC/MS Analyst
	Multipoint calibration (minimum of five points), lowest point at or below LOQ	Initially and as required	Minimum RF per method. Each analyte must meet one of the three options below: Option 1: RSD for each analyte $\leq 15\%$ Option 2: linear least squares regression $r^2 \geq 0.99$ Option 3: non-linear regression – coefficient of determination (COD) $r^2 \geq 0.99$ (six points shall be used for second order, seven for third order)	Correct problem, then repeat ICAL	GC/MS Analyst
	Second Source - ICV Standard	Once after each ICAL	Analytes within $\pm 20\%$ of true value	Correct problem and verify second source standard. Re-run second source verification. If that fails, correct the problem and repeat ICAL.	GC/MS Analyst
	Instrument blanks and method blanks	After initial calibration and daily, prior to sample analysis (instrument blank) and with each	No analytes detected $> \frac{1}{2}$ LOQ or $> \frac{1}{10}$ the amount measured in any sample or $\frac{1}{10}$ the regulatory limit, whichever is greater.	Re-analyze blank Clean system Re-analyze affected samples	GC/MS Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
GC/MS – VOCs by EPA Method 8260-SIM (continued)	Continuing calibration verification (CCV) standard	batch of samples (method blank)  Daily before sample analysis and every 12 hours of analysis time, and at the end of the analytical run	Common contaminants must not be detected > LOQ.  RF criteria per method. All reported analytes and surrogates within $\pm 20\%$ of true value All reported analytes and surrogates within $\pm 50\%$ for end of analytical batch CCV	Correct problem, then re- run the CCV. If that fails, repeat ICAL. Re-analyze samples run since last successful CCV.	GC/MS Analyst
ICP Metals by EPA Method 6010D	ICAL: Single or multipoint calibration. Minimum one high standard and a calibration blank	Daily ICAL prior to sample analysis	If more than one calibration standard is used, $r^2 \geq 0.99$	Correct problem, then repeat ICAL	ICP Analyst
	Second Source (ICV) Standard	Once after each ICAL, prior to sample analysis	Value of second standard source for target analytes within $\pm 10\%$ of true value	Correct the problem and verify second source standard. Re-run ICV. If that fails, correct problem and repeat ICAL.	ICP Analyst
	CCV	After analysis of every 10 samples and at the end of the analytical sequence	Within $\pm 10\%$ of true value	Correct problem, then re- run the CCV. If that fails, repeat ICAL. Re-analyze samples run since last successful CCV.	ICP Analyst
	Low-level calibration check standard (LOQ low point standard from calibration)	Daily, following one point ICAL	Within $\pm 20\%$ of true value	Correct problem, then re- analyze.	ICP Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
	ICS (Interference check sample)	After ICAL and prior to sample analysis	ICS-A: Absolute value of concentration for all non- spiked project analytes < ½ LOQ (unless they are a verified trace impurity from one of the spiked analytes)	Terminate analysis. Locate and correct problem. Re-analyze ICS and samples.	ICP Analyst
ICP Metals by EPA Method 6010D  (continued)	Calibration blanks	Immediately after the ICV and Immediately after every CCV.	The absolute values of all analytes must be < ½ LOQ or < ⅓ the amount measured in any sample.	Calibration blanks: Correct the problem. Re- prep and re-analyze calibration blank. Samples following the last acceptable calibration blank must be re-analyzed.	ICP Analyst
Ion Chromatography – Chloride by EPA Method 9056A	Initial Calibration (minimum three standards and one calibration blank)	ICAL prior to sample analysis	$r^2 \geq 0.99$	Correct problem, then repeat ICAL.	IC Analyst
	ICV	After each ICAL and prior to sample analysis	Analytes within ± 10% of true values and retention times within appropriate windows	Correct problem and verify second source standard. Re-run ICV. If that fails, correct the problem and repeat ICAL.	IC Analyst
	Retention time window position establishment	Once per multipoint calibration	Retention time width is set using the midpoint standard of the ICAL for each analyte when ICAL is performed. On days when ICAL is not performed, the initial CCV is used	If the retention time shifts by more than 10%, a new ICAL is performed.	IC Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
Ion Chromatography – Chloride by EPA Method 9056A (continued)	CCV	After ICAL, after every ten samples, and at end of run	Analytes within established retention time windows and within $\pm 10\%$ of true value	Correct problem, then re- run the CCV. If that fails, repeat ICAL. Re-analyze samples run since last successful CCV.	Wet Chemistry Analyst

**Notes:**

%D: percent difference / percent drift  
 BFB: 4-bromofluorobenzene  
 CCC: continuing calibration check compounds  
 CCV: continuing calibration verification  
 COD: coefficient of determination  
 GC/MS: gas chromatography / mass spectrometry  
 ICAL: initial calibration  
 ICP: inductively coupled plasma atomic emission spectroscopy  
 ICS: interference check sample  
 ICS-A: interference check standard A  
 ICS-AB: interference check standard AB  
 ICV: initial calibration verification  
 LOD: limit of detection  
 LOQ: limit of quantitation  
 N/A: not applicable  
 RF: response factor  
 RSD: relative standard deviation  
 SIM: selected ion monitoring  
 VOCs: volatile organic compounds  
<sup>1</sup> Normal balance and thermometer calibration applies (Worksheet #25).

### 6.3 Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing and Inspection

Analytical instruments used for this project will be maintained in accordance with the requirements presented in the SGS QA Manual and the individual analytical method SOPs. The SGS QA Manual also presents the documentation requirements for maintenance activities.

Instrument/Equipment	Maintenance/Inspection Activity	Frequency	Person Responsible for Corrective Action
GC/MS	Inspect/replace column Clean ion source Inspect, clean concentrator trap Change electron multiplier Backflush purge and trap Change rough oil pump	As required. Refer to Analytical Method and instrument manufacturer.	GC/MS Analyst
ICP	Inspect/replace tubing and pump Inspect/replace windings Inspect/replace torch and injector	As required. Refer to Analytical Method and instrument manufacturer.	ICP Analyst
IC	Inspect/perform column cleanup	As required. Refer to Analytical Method and instrument manufacturer.	IC Analyst

**Notes:**

GC/MS: gas chromatography/mass spectrometry

IC: ion chromatography

ICP: inductively coupled plasma

#### 6.4 Worksheets #26 and #27: Sample Handling, Custody, and Disposal

Groundwater samples will be collected in laboratory-provided bottles using methods described in Worksheets #17a through #17c and #19, and SOPs #1 through #5. Samples will be received and logged into the laboratory information management system for analysis as described in the DoD QSM Version 5.1. Chain of custody procedures will be performed in accordance with Worksheet #29.

Sample organization: Ahtna/ Wood

Laboratory: SGS

Method of sample delivery (shipper/carrier): SGS courier or FedEx overnight shipping

Number of days from reporting until sample disposal: No less than 30 days after final report sent to the client

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Labeling	Ahtna/ Wood Field Technicians	SOP #5
Chain of custody form completion	Ahtna/ Wood Field Technicians	SOP #5
Packaging	Ahtna/ Wood Field Technicians	SOP #5
Shipping coordination	Ahtna/ Wood Field Technicians	SOP #5
Sample receipt, inspection, & log-in	SGS Sample Management Supervisor	SOP #SAM101.19
Sample custody and storage	SGS Sample Management Supervisor	SOP #SAM101.19
Sample disposal	SGS Sample Management Supervisor	SOP #SAM108.10

**Notes:**

N/A: not applicable

O&M: operation and maintenance



## 6.5 Worksheet #28: Analytical Quality Control and Corrective Action

### 6.5.1 Worksheet #28a: VOCs

Matrix: Groundwater (µg/L)

Analytical Group/Test Method: VOCs by EPA Method 8260-SIM

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator																																													
Method Blank	1 per analytical batch	No analytes detected > ½ LOQ or > ⅓ the amount measured in any sample or ⅓ the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	DoD QSM 5.1 App B Table 4	Re-analyze method blank. If fails, clean system and re-analyze blank and affected samples.	GC/MS Analyst	Accuracy/ Bias Contamination																																													
Laboratory Control Sample (LCS)/ LCSD	1 set per analytical batch. Spike target compounds. VC to be spiked at DL of 0.1 µg/L.	<table><thead><tr><th>Analyte</th><th>Recovery</th><th>RPD</th></tr></thead><tbody><tr><td>1,1-DCA</td><td>81-122%</td><td>≤ 15%</td></tr><tr><td>1,1-DCE</td><td>78-137%</td><td>≤ 18%</td></tr><tr><td>1,2-DCA</td><td>75-125%</td><td>≤ 14%</td></tr><tr><td>1,2-DCE (total)</td><td>76-127%</td><td>≤ 17%</td></tr><tr><td>1,2-DCPA</td><td>76-124%</td><td>≤ 14%</td></tr><tr><td>1,3-DCPE (total)</td><td>75-120%</td><td>≤ 23%</td></tr><tr><td>Benzene</td><td>81-122%</td><td>≤ 14%</td></tr><tr><td>CT</td><td>76-136%</td><td>≤ 23%</td></tr><tr><td>Chloroform</td><td>80-124%</td><td>≤ 15%</td></tr><tr><td>cis-1,2-DCE</td><td>78-120%</td><td>≤ 15%</td></tr><tr><td>MC</td><td>69-135%</td><td>≤ 16%</td></tr><tr><td>PCE</td><td>76-135%</td><td>≤ 16%</td></tr><tr><td>TCE</td><td>81-126%</td><td>≤ 15%</td></tr><tr><td>VC</td><td>69-159%</td><td>≤ 18%</td></tr></tbody></table>	Analyte	Recovery	RPD	1,1-DCA	81-122%	≤ 15%	1,1-DCE	78-137%	≤ 18%	1,2-DCA	75-125%	≤ 14%	1,2-DCE (total)	76-127%	≤ 17%	1,2-DCPA	76-124%	≤ 14%	1,3-DCPE (total)	75-120%	≤ 23%	Benzene	81-122%	≤ 14%	CT	76-136%	≤ 23%	Chloroform	80-124%	≤ 15%	cis-1,2-DCE	78-120%	≤ 15%	MC	69-135%	≤ 16%	PCE	76-135%	≤ 16%	TCE	81-126%	≤ 15%	VC	69-159%	≤ 18%	Lab-derived	Re-prepare and re-analyze LCS/LCSD and associated batch samples	GC/MS Analyst	Bias Accuracy/ Precision
Analyte	Recovery	RPD																																																	
1,1-DCA	81-122%	≤ 15%																																																	
1,1-DCE	78-137%	≤ 18%																																																	
1,2-DCA	75-125%	≤ 14%																																																	
1,2-DCE (total)	76-127%	≤ 17%																																																	
1,2-DCPA	76-124%	≤ 14%																																																	
1,3-DCPE (total)	75-120%	≤ 23%																																																	
Benzene	81-122%	≤ 14%																																																	
CT	76-136%	≤ 23%																																																	
Chloroform	80-124%	≤ 15%																																																	
cis-1,2-DCE	78-120%	≤ 15%																																																	
MC	69-135%	≤ 16%																																																	
PCE	76-135%	≤ 16%																																																	
TCE	81-126%	≤ 15%																																																	
VC	69-159%	≤ 18%																																																	

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
MS/MSD	1 per analytical batch spike target compounds. VC to be spiked at DL of 0.1 µg/L.	Same as LS/LCSD acceptance limits for 8260-SIM.	Lab-derived	If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.  If the concentration in parent sample is > 4x the spiked amount, include in case narrative. No CA required.	GC/MS Analyst	Bias/Precision
Surrogates	Field samples and laboratory QC	1,2-Dichloroethane-d <sub>4</sub> 74-125% Toluene-d <sub>8</sub> 88-111%	Lab-derived	Re-prepare and re-analyze affected samples unless matrix interference is present.	GC/MS Analyst	Bias
Internal Standards	Field samples, standards, and laboratory QC	Retention time ±10 seconds from retention time of the midpoint standard in the ICAL; extracted ion current profile area within -50% to +100% of ICAL midpoint standard.  On days when ICAL is not performed, the daily initial CCV can be used.	DoD QSM 5.1 App B Table 4	Inspect mass spectrometer and GC for malfunction. Re-analysis of samples analyzed while system was malfunctioning is mandatory.	GC/MS Analyst	Bias/Precision

**Notes on next page.**

**Notes:**

?: percent

µg/L: micrograms per liter

cis-1,2-DCE: cis-1,2-dichloroethene

CT: carbon tetrachloride

1,1-DCA: 1,1-dichloroethane

1,1-DCE: 1,1-dichloroethene

1,2-DCA: 1,2-dichloroethane

1,2-DCE (total): total 1,2-dichloroethene

1,2-DCPA: 1,2-dichloropropane

1,3-DCPE (total): total 1,3-dichloropropene

DL: detection limit

DoD: Department of Defense

GC/MS: gas chromatography/mass spectrometry

ICAL: initial calibration

LCS: laboratory control sample

LCSD: laboratory control sample duplicate

LOQ: limit of quantitation

MC: methylene chloride

MS: matrix spike

MSD: matrix spike duplicate

N/A: not applicable

PCE: tetrachloroethene

QC: quality control

QSM: Quality Systems Manual

RPD: relative percent difference

TCE: trichloroethene

VC: vinyl chloride

## 6.5.2 Worksheet #28b: Metals

**Matrix:** Groundwater (µg/L)

**Analytical Group/Test Method:** Metals by EPA Method 6010D

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator												
Method Blank	1 per analytical batch	Absolute values of analytes detected < ½ LOQ or < ⅒ the amount measured in any sample or ⅒ the regulatory limit, whichever is greater.	DoD QSM 5.1 App B Table 8	Correct problem. Re-prepare and re-analyze method blank and affected samples.	ICP Analyst	Accuracy/Bias Contamination												
Laboratory Control Sample (LCS)	1 per analytical batch. Spike target compounds.	<table><tr><th>Analyte</th><th>Recovery</th></tr><tr><td>Antimony</td><td>80-120%</td></tr><tr><td>Copper</td><td>80-120%</td></tr><tr><td>Lead</td><td>80-120%</td></tr></table>	Analyte	Recovery	Antimony	80-120%	Copper	80-120%	Lead	80-120%	DoD QSM 5.1 App B Table 8 and App C Table 4	Re-prepare and re-analyze LCS and associated batch samples	ICP Analyst	Bias Accuracy/Precision				
Analyte	Recovery																	
Antimony	80-120%																	
Copper	80-120%																	
Lead	80-120%																	
Laboratory Duplicate Sample	1 per analytical batch	≤ 20%	DoD QSM 5.1 App B Table 8	Narrate outliers in case narrative. No CA	ICP Analyst	Precision												
MS/MSD	1 per analytical batch	<table><tr><th>Analyte</th><th>Recovery</th><th>RPD</th></tr><tr><td>Antimony</td><td>80-120% ≤20%</td><td></td></tr><tr><td>Copper</td><td>80-120% ≤20%</td><td></td></tr><tr><td>Lead</td><td>80-120% ≤20%</td><td></td></tr></table>	Analyte	Recovery	RPD	Antimony	80-120% ≤20%		Copper	80-120% ≤20%		Lead	80-120% ≤20%		DoD QSM 5.1 App C Table 4	Perform additional QC test (dilution test and/or post-digestion spike [PDS]) unless concentrations in parent sample are > 4x the spiked amount (no corrective action required). Perform PDS.	ICP Analyst	Bias/Precision
Analyte	Recovery	RPD																
Antimony	80-120% ≤20%																	
Copper	80-120% ≤20%																	
Lead	80-120% ≤20%																	
Dilution Test	1 per prep batch	5-fold dilution must agree within ± 10% of the original measurement	DoD QSM 5.1 App B Table 8	Perform post-digestion spike	ICP Analyst	Bias/Precision												

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
Post-Digestion Spike (PDS)	Perform if MS/MSD fails, 1 per analytical batch	Recovery within 80-120%	DoD QSM 5.1 App B Table 8	Run associated samples by method of standard addition or flag data	ICP Analyst	Bias/Precision

**Notes:**  
 µg/L: micrograms per liter  
 ICP: inductively coupled plasma  
 LOQ: limit of quantitation  
 PDS: post-digestion spike  
 RPD: relative percent difference

### 6.5.3 Worksheet #28c: Wet Chemistry

**Matrix:** Groundwater (mg/L)

**Analytical Group/Test Method:** Chloride by EPA Method 9056A

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Method Blank	1 per analytical batch	No analytes detected > $\frac{1}{2}$ the LOQ or > $\frac{1}{10}$ the amount measured in any sample or $\frac{1}{10}$ the regulatory limit	Laboratory limits	Correct problem. Re-prepare and re-analyze method blank and affected samples.	Wet Chemistry Analyst	Accuracy/Bias Contamination
Laboratory Control Sample (LCS)	1 per analytical batch.	EPA 9056A: 90-110%	Laboratory performance-based limits	Re-prepare and re-analyze LCS and associated batch samples.	Wet Chemistry Analyst	Bias Accuracy/Precision
MS/MSD	1 set per analytical batch.	90-110% and RPD $\pm 20\%$	Lab performance-based limit	Re-prepare and re-analyze MS/MSD samples and report both sets of data.  If concentration in parent sample is > 4x the spiked amount, include in case narrative. No CA required.	Wet Chemistry Analyst	Bias/Precision

**Notes:**

‰: percent

LCS: laboratory control sample

mg/L: milligrams per liter

MS/MSD: matrix spike/ matrix spike duplicate

N/A: not applicable

RPD: relative percent difference

## 7.0 Data Management and Data Review

### 7.1 Worksheet #29: Project Documentation and Records

Project data and information will be documented, tracked, and managed in a manner to ensure data integrity, defensibility, and retrievability. Project records will be generated from various aspects of the project, including 1) Sample Collection and Field Measurement Records, 2) Analytical Records, and 3) Data Assessment Records. Project data and information are stored in the Fort Ord Administrative Record located at Building 4463, Room 101, Gigling Road, Seaside, California. The Administrative Record is managed by the Army and will be maintained until site closure, at which time disposition of site records will be determined by the Army.

#### 7.1.1 Sample Collection and Field Measurement Records

At a minimum, the following documentation will be used for sample collection and field measurement activities. Examples of field forms are presented in Attachment C.

- Field Activity Daily Logbook – A bound, Field Activity Daily Logbook (FADL), with sequentially numbered pages will be used for field documentation of key sampling and analytical activities associated with the Sites 2/12 and OU2 GWTS and the Sites 2/12, OU2, and OUCTP GWMP. The FADL will contain information to include:
  - Name and company of sampling technician
  - Date, time, and location of sample collection
  - Site observations and remarks related to sampling activities
  - Field equipment calibration documentation
- Groundwater Level Field Data Sheets – are used to record depth to groundwater measurements, and include the following information:
  - Sampling station name, date, and time of measurement
  - Depth to water (DTW) sounder serial number and documented calibration differential from steel tape
  - Samplers initials
  - Measured depth to water
  - Historical average DTW and total depth of well which are used to verify the measured reading in the field
- Groundwater Sampling Forms – are used to record collection of groundwater samples. Groundwater samples from the Sites 2/12, OU2 and OUCTP GWMP are collected via PDBs, Westbay multi-port wells, and sampling ports, while samples from the Sites 2/12 and OU2 GWTS are primarily collected via sampling ports. Each of these sampling systems has a designated groundwater sampling form, specific to the data needed for each sampling method; however, each groundwater sampling form will contain the same essential information:



- Name of sampling technician
  - Date and time of sample collection
  - Depth to water (where applicable)
  - Depth of sample collection (or port number, or bag number)
  - Method of sample collection
  - Volume of sample collected
  - Preservation of samples (if any)
  - Analysis requested
  - QC samples collected at the sampling station
- Sample Labels – Sample labels will be affixed to each sample container upon collection and prior to transfer to the laboratory. Each sample will be assigned a unique sample identification number. The sample label will include the following information:
  - Project name, number, and location
  - Site name
  - Name of collector
  - Date and time of collection
  - Sample identification number
  - Sample preservation
- Chain of Custody Forms - A chain of custody form will be completed for every sample collected and submitted to the analytical laboratory to document custody of the sample from the time of collection to receipt at the laboratory. Chain of custody forms will be completed in triplicate (at a minimum) so one copy is kept at the field site, one copy is sent to the Project Manager or designee, and one copy accompanies the samples submitted to the analytical laboratory. The laboratory will send the project chemist, or designee, a copy of the completed chain of custody along with a completed Cooler Receipt Form (CRF) and completed log-in information within 24 hours of sample receipt and log-in. The chain of custody will include the following information:
  - Name, number, and location of project
  - Project Manager or “Report to” contact
  - Name and signature of sample collector, sampler, or recorder
  - Date and time of sample collection
  - Sample type/matrix
  - Number of containers submitted and preservative used (if any)
  - Analyses requested and TAT requirements
  - Signature trail of persons relinquishing and receiving samples
  - Receiving laboratory address and contact information
  - Date and time of sample receipt

### **7.1.2 Analytical Records**

The analytical laboratory will maintain and submit the following records as part of the data deliverable for each sample. These records together make up the Comprehensive Certificate of Analysis, which is a required deliverable to report results and is used in the data validation process.

- Chain of custody records
- Sample/Cooler Receipt Forms (SRFs/CRFs) documenting the general condition of the samples upon receipt including temperature, sample preservation, and number of containers received as well as any discrepancies or issues
- Sample tracking forms
- Sample preparation and analysis forms/logbooks
- Tabulated data summary forms and raw data for field samples, QC samples, and standards. If manual integration is performed on project samples, raw data to include chromatographs from before and after manual integration is applied. The case narrative will also address the reason manual integration was performed on each affected sample
- Case narrative
- Date and times of sample receipt, extraction, and analysis
- QC sample results
- Communication logs
- Corrective action reports
- Definitions of laboratory qualifiers
- Instrument calibration data and summary reports
- Signatures for laboratory sign-off

### **7.1.3 Project Data Assessment Records**

Project data assessment records will be generated and submitted as part of the quarterly or annual reporting requirements for the Sites 2/12, OU2, OUCTP GWMP and the Sites 2/12 and OU2 GWTS as necessary. Project Data Assessment reports may be created at any time throughout the project, and typically consist of the following:

- Field Sampling Audit Report (if applicable)
- Laboratory Audit Report (if applicable)
- Data Validation Summary Report

## **7.2 Worksheets #31, #32, and #33: Assessments and Corrective Action**

Planned project assessments will be completed for the Sites 2/12 and OU2 GWTS and Sites 2/12, OU2, and OUCTP GWMP through the Three Phase Quality Control Process, as follows:

- Preparatory Phase: Activities and assessments conducted during the preparatory phase are conducted prior to the start of a feature of work to ensure technical requirements and work prerequisites have been completed. Discrepancies will be resolved and corrective actions implemented and verified prior to the start of work.
- Initial Phase: Activities and assessments conducted during the initial phase are performed during the first day of the feature of work to verify compliance with the specifications and requirements described in this QAPP and approved project plans and procedures. Discrepancies will be resolved and corrective actions implemented and verified prior to work proceeding.
- Follow-Up and Reporting Phase: Activities and assessments performed during the follow-up and reporting phase are conducted to verify continued compliance with project requirements and to verify project reports meet client and regulatory requirements.

An overview of the Three Phase Quality Control Process and related forms used to document the process are provided in Attachment D. The activities and assessments conducted during each phase of the Three Phase Quality Control Process are described below.

### 7.2.1 Assessments and Corrective Action

Phase I - Preparatory Phase						
Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Planning Document review	Internal Memo	Document Author	Prior to the start of field activities	Response to comments documentation and USACE approval of document as applicable	Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	One week
Planning document (QAPP) sign-off by field and laboratory	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM, SGS	Prior to the start of field activities	Obtain sign-off that document has been read and understood by field and lab personnel	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	One week
Review of lab and field personnel readiness	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM, SGS	Prior to the start of field activities	Provide kickoff meeting notes from field and lab meetings	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	One week
Review of field equipment	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna	Prior to the start of field activities	Provide checklist documenting field equipment is available and in good working order	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	Prior to the start of field activities

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
<b>Phase II – Initial Phase</b>						
Field and laboratory audit	Field and lab audit report	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM, SGS Eric Schmidt, Project Chemist, Ahtna Jeff Fenton, PM, Wood Derek Lieberman, PM, Ahtna	Within 48 hours of audits	Field and laboratory to issue formal response to audit findings requiring corrective action	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	One week
Review of Contractor QC Reports	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Sylvester Kosowski, QC Manager, Ahtna	Within 48 hours of review	Revision of Contractor Quality Control Reports (CQCRs) as needed	Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	One week

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Review of project plans to reflect current site or lab activities	Memo	Holly Dillon, Task Lead, Ahtna Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM SGS	Within 10 days of observations	Update project plans to reflect current conditions (may be addendum to existing document) or documentation of changes to field or lab protocol to be in accordance with project plans	Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	Prior to next scheduled sampling event
<b>Phase III – Follow-Up and Reporting Phase</b>						
Review of Data Reports	Internal comments from staff and external comments from client and regulatory agencies	Document Author Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	Internal = prior to issuance of report  External = within 30 days of receipt of report	Provide response to comments and revise report as needed	Commenting client and/or agencies Alex Kan, Technical Lead, USACE	30 days

## 7.2.2 QA Management

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Sites 2/12 GWMP and GWTS O&M Reports	Quarterly	Final 60 days after end of quarterly sampling event	Derek Lieberman, PM, Ahtna Holly Dillon, Task Lead, Ahtna	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan – Technical Lead Fort Ord BRAC: William Collins – BEC Chenega: Tom Ghigliotto – Field Oversight Inspector Fort Ord Administrative Record EPA: Maeve Clancy – PM TechLaw: Robert Young CCRWQCB: Amber Sellinger – PM DTSC: Min Wu – PM
	Annually	Preliminary Draft 75 days after end of annual sampling event		
OU2 GWMP and GWTS O&M Reports	Quarterly	Final 60 days after end of quarterly sampling event	Derek Lieberman, PM, Ahtna Holly Dillon, Task Lead, Ahtna	
	Annually	Preliminary Draft 75 days after end of annual sampling event		
OUCTP GWMP Reports	Quarterly	Final 60 days after end of quarterly sampling event	Derek Lieberman, PM, Ahtna Holly Dillon, Task Lead, Ahtna	
	Annually	Preliminary Draft 75 days after end of annual sampling event		
CQCR	Quarterly, following each sampling event	Within 60 days of completion of field sampling event	Jeff Fenton, Project Manager, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan – Technical Lead Chenega: Tom Ghigliotto – Field Oversight Inspector Ahtna: Derek Lieberman, Project Manager



Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Non-Routine Occurrences Report	As needed	Within 48 hours of a Non-Routine Occurrence in the field or laboratory. A copy of this report will also be included in the CQCR	Kevin Garrett, Project Chemist, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan– Technical Lead Chenega: Tom Ghigliotto – Field Oversight Inspector Ahtna: Christopher Ohland, Program Chemist Wood: Jeff Fenton, PM
Field Work Variance Report	As needed	Prior to implementation of proposed change or immediately following a variance implemented in the field. A copy of the Field Work Variance will also be included in the CQCR	Scott Graham, Field Task Manager, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan– Technical Lead Ahtna: Derek Lieberman - PM, Christopher Ohland - Program Chemist Wood: Jeff Fenton - PM, Kevin Garrett - Project Chemist Chenega: Tom Ghigliotto – Field Oversight Inspector
Validation Summary Report	Quarterly, following each sampling event	Produced as part of the Quarterly Monitoring Report	Kevin Garrett, Project Chemist, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan– Technical Lead Fort Ord BRAC: William Collins – BEC Fort Ord Administrative Record EPA: Maeve Clancy – PM TechLaw: Robert Young CCRWQCB: Amber Sellinger – PM DTSC: Min Wu – PM

### 7.3 Worksheet #34: Data Verification and Validation Inputs

Verification Input	Description	Internal / External	Responsible for Verification (Name, Organization)
Chain of custody and shipping forms	Chain of custody forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. When everything is verified, the shipper's signature on the chain of custody form will be initialed by the reviewer. A copy of the form will be retained in the site file, and the original and remaining copies will be taped inside the cooler for shipment. Refer to Attachment A for SOPs #4 and #7 for further detail.	I	Sites 2/12 and OU2 GWTS: Mark Fisler, O&M Manager, Ahtna
	Receiving laboratory will verify chain of custody forms with contents of coolers. Wood project chemist will be notified of any discrepancies or issues within 24 hours of sample receipt. Resolution will be documented in writing and submitted with final data package.	E	Sites 2/12, OU2, OUCTP GWMP: Scott Graham, Field Task Manager, Wood
	Laboratory receipt/log-in report will be reviewed against chain of custody internally.	I	Sites 2/12 and OU2 GWTS: Holly Dillon, Data Manager, Ahtna Sites 2/12, OU2, OUCTP GWMP Zack Carroll, Data Validator, Wood
Field Notes	Field notes will be reviewed internally by the field supervisor for consistency with the chain of custody forms and SOPs. One copy of the field notes will be retained in the onsite project file, and originals will be forwarded to the Project Manager for review.	I	Sites 2/12, OU2 GWTS: Mark Fisler, O&M Manager, Ahtna Sites 2/12, OU2, OUCTP GWMP: Scott Graham, Field Task Manager, Wood

Verification Input	Description	Internal / External	Responsible for Verification (Name, Organization)
Laboratory Data	Analytical data packages will be verified by the laboratory performing the work for completeness prior to submittal.	I	Svetlana Izosimova, Quality Assurance Officer, SGS
	Received data packages will be verified according to the data validation procedures specified in Worksheet #35. Laboratory electronic deliverables will be verified against the data package hard copy reports.	I	Sites 2/12, OU2 GWTS: Christopher Ohland, Program Chemist, Ahtna Sites 2/12, OU2, OUCTP GWMP: Zack Carroll, Project Database Analyst, Wood

## 7.4 Worksheet #35: Data Verification Procedures

Stage 2A/2B	Validation Input	Description	Responsible for Verification – GWTS	Responsible for Verification – GWMP
2A	Methods used for sample collection	Field data notes will be reviewed for compliance with published methods and SOPs. Deviations from SOPs and methods described in this QAPP will be summarized and provided to the Project Manager in writing.	Mark Fisler, O&M Manager, Ahtna	Scott Graham, Field Task Manager, Wood
2A	Methods used for analysis	Laboratory data packages will be reviewed to verify the methods specified in this QAPP were followed. Deviations shall be documented in writing.	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Sampling SOPs and Analytical Compliance	Review field notes for compliance with SOPs. Review laboratory data deliverables for compliance with QAPP and published methods.	Mark Fisler, O&M Manager, Ahtna  Eric Schmidt, Project Chemist, Ahtna	Scott Graham, Field Task Manager, Wood  Zack Carroll, Project Database Analyst, Wood
2A	Documentation of method QC results	Review laboratory data packages to determine if QC parameters required by the referenced methods were performed and reported. The QC forms will be reviewed to determine if method acceptance criteria were met. Method QC outliers will be identified by the laboratory in the case narrative. Reviewer will determine if data will require qualification due to outliers.	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Documentation of QAPP QC sample results	Verify QC samples specified in this QAPP were analyzed and reported. Reviewer will identify QAPP QC sample results in the data validation report.	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood

Stage 2A/2B	Validation Input	Description	Responsible for Verification – GWTS	Responsible for Verification – GWMP
2B	Laboratory data package documentation	Laboratory data packages will be reviewed to ensure documentation requirements specified in the QAPP have been met. If deficiencies are found, the Data Reviewer will document the issue in a memorandum to the laboratory. The laboratory will address deficiencies in writing or submit a revised data package correcting the deficiencies.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Target analyte list	Laboratory report summary forms will be reviewed to verify the target compounds and parameters specified in the QAPP were reported.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	LOQs	Determine quantitation limits were achieved, as outlined in the QAPP. Verify the laboratory analyzed a low standard at the quantitation limit in the initial calibration.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Raw data and laboratory transcription errors	Ten percent (10%) of raw data will be reviewed to confirm laboratory calculations and that there are no transcription errors. Chromatographs containing manual integrations, if any, will be evaluated as part of the raw data review.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A and 2B	Data Validation Report	Summarize deviations from the referenced methods, SOPS, and QAPP-specific requirements. Include qualified data and explanations of all data qualifiers.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Wood
2A and 2B	Data Validation Report Review	Review validation reports and Validation Summary Report.	Christopher Ohland, Program Chemist, Ahtna	Kevin Garrett Project Chemist, Wood

## 7.5 Worksheet #36: Data Validation Procedures

Stage 2A/2B	Matrix	Analytical Group	Validation Criteria	GWTS Validator	GWMP Validator
2A	Aqueous	VOCs	EM-200-1-10. <i>Guidance for Evaluating Performance-based Chemical Data</i> (USACE, June 2005) and SW-846 Method 8260-SIM	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Aqueous	VOCs	QAPP Worksheets and ADR Library	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Aqueous	Dissolved metals	EM-200-1-10 and SW-846 Method 6010D	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Aqueous	Dissolved Metals	QAPP Worksheets and ADR Library	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Aqueous	Wet Chemistry	EM-200-1-10, EPA Method 9056A (chloride)	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Aqueous	Wet Chemistry	QAPP Worksheets and ADR Library	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood

**Notes:**

ADR: Automated Data Review program

### **7.5.1 Stage 1 Validation**

Stage 1 validation of the laboratory analytical data package consists of verification and validation checks for the compliance of sample receipt conditions, sample characteristics (e.g., percent moisture), and analytical results (with associated information). The following minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 1 validation:

- 1) Documentation identifies the laboratory receiving and conducting analyses and includes documentation for all samples submitted by the project or requester for analyses.
- 2) Requested analytical methods were performed and the analysis dates are present.
- 3) Requested target analyte results are reported along with the original laboratory data qualifiers and data qualifier definitions for each reported result.
- 4) Requested target analyte result units are reported.
- 5) Requested LOQs for all samples are present and results at and below the requested (required) LOQs are clearly identified (including sample DLs if required).
- 6) Sampling dates (including times if needed), date and time of laboratory receipt of samples, and sample conditions upon receipt at the laboratory (including preservation, pH, and temperature) are documented.
- 7) Sample results are evaluated by comparing sample conditions upon receipt at the laboratory (e.g., preservation checks) and sample characteristics (e.g., percent moisture) to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

### **7.5.2 Stage 2A Validation**

Stage 2A validation builds on the validation conducted in Stage 1. Stage 2A validation of the laboratory analytical data package consists of the Stage 1 validation plus the verification and validation checks for the compliance of sample-related QC. The following additional minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 2A validation:

- 1) Requested methods (handling, preparation, cleanup, and analytical) are performed.
- 2) Method dates (including dates, times and duration of analysis for radiation counting measurements and other methods, if needed) for handling (e.g., Toxicity Characteristic Leaching Procedure), preparation, cleanup, and analysis are present, as appropriate.
- 3) Sample-related QC data and QC acceptance criteria (e.g., method blanks, surrogate recoveries, laboratory control sample (LCS) recoveries, duplicate analyses, matrix spike and matrix spike duplicate recoveries, serial dilutions, post-digestion spikes, standard reference materials) are provided and linked to the reported field samples (including the field QC samples such as trip and equipment blanks).
- 4) Requested spike analytes or compounds (e.g., surrogate, LCS spikes, post-digestion spikes) have been added, as appropriate.
- 5) Sample holding times (from sampling date to preparation and preparation to analysis) are evaluated.



- 6) The frequency of QC samples is checked for appropriateness (e.g., one LCS per 20 samples in a preparation batch).
- 7) Sample results are evaluated by comparing holding times and sample-related QC data to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

### 7.5.3 Stage 2B Validation

Stage 2B validation builds on the validation conducted in Stage 2A. Stage 2B validation of the laboratory analytical data package consists of the Stage 2A validation plus the verification and validation checks for the compliance of instrument-related QC. The following additional minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 2B validation:

- 1) Initial calibration data (e.g., initial calibration standards, initial calibration verification [ICV] standards, initial calibration blanks [ICBs]) are provided for all requested analytes and linked to field samples reported. For each initial calibration, the calibration type used is present along with the initial calibration equation used including any weighting factor(s) applied and the associated correlation coefficients, as appropriate. Recalculations of the standard concentrations using the initial calibration curve are present, along with their associated percent recoveries, as appropriate (e.g., if required by the project, method, or contract). For the ICV standard, the associated percent recovery (or percent difference, as appropriate) is present.
- 2) Appropriate number and concentration of initial calibration standards are present.
- 3) Continuing calibration data (e.g., continuing calibration verification [CCV] standards and continuing calibration blanks [CCBs]) are provided for all requested analytes and linked to field samples reported, as appropriate. For the CCV standard(s), the associated percent recoveries (or percent differences, as appropriate) are present.
- 4) Reported samples are bracketed by CCV standards and CCBs standards as appropriate.
- 5) Method specific instrument performance checks are present as appropriate (e.g., tunes for mass spectrometry methods, instrument blanks and interference checks for ICP methods).
- 6) The frequency of instrument QC samples is checked for appropriateness (e.g., gas chromatography-mass spectroscopy [GC-MS] tunes have been run every 12 hours).
- 7) Sample results are evaluated by comparing instrument-related QC data to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

Metals and Wet Chemistry analyses are also reviewed under Stage 2B validation using a combination of criteria from the DoD QSM (where provided) and laboratory performance-based in-house acceptance criteria.

VOC data are used to evaluate compliance with the relevant ROD and ACLs for each of the GWTS. As a result, the VOC data are subject to a rigorous 100% EPA Stage 2B data review (EPA, 2009) to verify data are of a known quality in compliance with this QAPP, the *Department of Defense Quality Systems*

*Manual for Environmental Laboratories, Final Version 5.1*, the published analytical methods, and are capable of supporting project decisions.

Stage 2B review is performed using the automated data review software program ADR.NET. Flagging conventions for the test methods included in the QAPP are incorporated with the ADR program's reference library (Attachment E) to assess compliance with project requirements. The ADR program is used as an electronic validation tool for the following Stage 2B elements:

- Holding Times
- Instrument Performance Checks
- Method Blank Contamination
- Surrogates
- Laboratory Duplicates
- Laboratory Control Samples
- Matrix Spike Samples
- Field Blank Contamination
- Field Duplicates
- Initial and Continuing Calibration Data

Initial and continuing calibration files for each test method may need to be validated manually if the contract library is unable to provide electronic validation files.

The Data Reviewer checks the ADR-generated Non-Conformance Report, identifying items that do not conform to the ADR Project Library requirements, and the results are incorporated into the assessment of the data.

The Data Reviewer proceeds with the review of the ADR files in the ADR Data Review module. The ADR Data Review module identifies outliers and applies validation qualifiers to the data based on the ADR Project Library data review requirements. The ADR Library qualification scheme files are provided as Attachment E.

The Data Reviewer then reviews the ADR output, comparing the ADR findings with the lab reports to ensure the automated validation process is working accurately. The Data Reviewer may manually edit the validation qualifiers based on his or her professional judgment, which will be described in the Validation Summary Report. Flagging conventions used for data qualification are presented in Attachment E.

#### **7.5.4 Stage 3 Validation**

Stage 3 validation builds on the validation conducted in Stage 2B. Stage 3 validation of the laboratory analytical data package consists of the Stage 2B validation plus the recalculation of instrument and sample results from the laboratory instrument responses, and comparison of recalculated results to laboratory reported results. The following additional minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 3 validation:

- 1) Instrument response data (e.g., GC peak areas, ICP corrected intensities) are reported for requested analytes, surrogates, internal standards, and deuterated monitoring compounds for all requested field samples, matrix spikes, matrix spike duplicates, LCS, and method blanks as well as calibration data and instrument QC checks (e.g., tunes, DDT/Endrin breakdowns, interelement correction factors, and Florisil cartridge checks).
- 2) Reported target analyte instrument responses are associated with appropriate internal standard analyte(s) for each (or selected) analyte(s) (for methods using internal standard for calibration).
- 3) Fit and appropriateness of the initial calibration curve used or required (e.g., mean calibration factor, regression analysis [linear or non-linear, with or without weighting factors, with or without forcing]) is checked with recalculation of the initial calibration curve for each (or selected) analyte(s) from the instrument response.
- 4) Comparison of instrument response to the minimum response requirements for each (or selected) analyte(s).
- 5) Recalculation of each (or selected) opening and closing CCV (and CCB) response from the peak data reported for each (or selected) analyte(s) from the instrument response, as appropriate.
- 6) A compliance check of recalculated opening and/or closing CCV (and CCB) response to recalculated initial calibration response for each (or selected) analyte(s).
- 7) Recalculation of percent ratios for each (or selected) tune from the instrument response, as appropriate.
- 8) A compliance check of recalculated percent ratio for each (or selected) tune from the instrument response.
- 9) Recalculation of each (or selected) instrument performance check (e.g., DDT/Endrin breakdown for pesticide analysis, instrument blanks, interference checks) from the instrument response.
- 10) Recalculation and compliance check of retention time windows (for chromatographic methods) for each (or selected) analyte(s) from the laboratory reported retention times.
- 11) Recalculation of reported results for each reported (or selected) target analyte(s) from the instrument response.
- 12) Recalculation of each (or selected) reported spike recovery (surrogate recoveries, deuterated monitoring compound recoveries, LCS recoveries, duplicate analyses, MS/MSD recoveries, serial dilutions, post-digestion spikes, standard reference materials etc.) from the instrument response.
- 13) Each (or selected) sample result(s) and spike recovery(ies) are evaluated by comparing the recalculated numbers to the laboratory reported numbers according to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

Selection of analytes, spikes, and performance evaluation checks for the Stage 3 validation checks for a laboratory analytical data package being verified and validated generally will depend on many factors including (but not limited to) the type of verification and validation being performed (manual or electronic), requirements and guidelines present in national or regional data validation documents,

analytical method(s) or contract, the number of laboratories reporting the data, the number and type of analytical methods reported, the number of analytes reported in each method, and the number of detected analytes.

#### **7.5.5 Stage 4 Validation**

10% of the data are subject to Stage 4 data review, which builds on the validation conducted in Stage 3. Stage 4 validation of the laboratory analytical data package consists of the Stage 3 validation plus the evaluation of instrument outputs. It is recommended that the following additional minimum baseline checks (as relevant) be performed on the laboratory analytical data package received for a Stage 4 validation:

- 1) All required instrument outputs (e.g., chromatograms, mass spectra, atomic emission spectra, instrument background corrections, and interference corrections) for evaluating sample and instrument performance are present.
- 2) Sample results are evaluated by checking each (or selected) instrument output (e.g., chromatograms, mass spectra, atomic emission spectra data, instrument background corrections, interference corrections) for correct identification and quantitation of analytes (e.g., peak integrations, use of appropriate internal standards for quantitation, elution order of analytes, and interferences).
- 3) Each (or selected) instrument's output(s) is evaluated for confirmation of non-detected or tentatively identified analytes.

In the event the findings of the Stage 4 validation indicate the potential for other reported results to be impacted by quality related issues, the Stage 4 validation may be expanded to include additional samples.

## 7.6 Worksheet #37: Data Usability Assessment

The suitability of the environmental data collected from both the Sites 2/12 and OU2 GWTS and the Sites 2/12, OU2, and OUCTP GWMP will be assessed by the Ahtna Project Chemist and the Wood Project Chemist, respectively. Data usability will comprise an evaluation of the quantity, type, and overall quality of the generated data against the project DQOs as presented in Worksheet #11 and the MPC presented in Worksheet #12. The usability of data associated with QC results outside of the established acceptance criteria is dependent on the degree of the exceedance, whether the potential bias is high or low, and whether the uncertainty implied by the exceedance is significant relative to project decisions and DQOs. Data usability will be assessed in accordance with the guidance provided in the DoD QSM Version 5.1 and additional applicable USACE and EPA guidance as well as the professional experience of the decision maker during data validation. The following items will be assessed and conclusions are drawn based on their results:

- **Precision** – Duplicate field and laboratory samples will be evaluated for precision based on relative percent difference (RPD). RPD will be calculated for each detectable result between the two samples. RPDs exceeding MPC in Worksheet #12 will be identified in the Validation Summary Report and any limitations on the use of the data will be noted. RPDs within the MPC will demonstrate the data have acceptable precision and the data are usable.
- **Accuracy** – Laboratory Control Samples (LCS), Laboratory Control Sample Duplicate (LCSD), MS/MSD sample results will be evaluated by comparing spike recovery results with MPC in Worksheet #12.
- **Sensitivity** – Data sensitivity will be verified by comparing method blank results with MPC in Worksheet #12 and cross checking analyte data with limits of quantitation (LOQs) and ACLs presented in Worksheet #15a.
- **Bias** – Laboratory surrogate compound recovery will be evaluated for bias by comparing results with MPC in Worksheet #12.
- **Contamination** – Field blank, trip blank and method blank data will be used to determine whether there are contamination issues based upon MPC in Worksheet #12.
- **Representativeness** – Sampling procedures will be implemented in accordance with SOPs to eliminate or minimize sources of error. Compliance with SOPs will be confirmed through QC field audits. Analytical procedures will be implemented in accordance with laboratory SOPs, QC acceptance limits, and the laboratory Quality Assurance Manual. Laboratories used for sample analysis will maintain DoD ELAP certification and undergo annual audits by the independent accrediting bodies responsible for the DoD ELAP certification.
- **Completeness** – The completeness of the sample event will be determined based upon the number of field samples collected compared to the number of samples planned and the number of unqualified laboratory results compared to the total number of results.<sup>20</sup> This information will be compared to MPC in Worksheet #12.

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<sup>20</sup> Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

- **Comparability** – The data from each sampling event are comparable to past and future events as long as the same or similar sampling and analytical SOPs located in Attachment A are utilized.
- **Reconciliation** – Each of the DQOs presented in Worksheet #11 will be examined to determine whether the objectives were met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will be first evaluated separately in terms of the major impacts observed from the data validation, DQIs, and MPC assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality, data usability for each analysis will be determined. Based on the combined data usability from all analyses for an objective, it will be determined whether the DQO was met and whether action limits were exceeded.

In the event the data quantity or quality prove to be inadequate to meet project objectives, re-analysis or re-sampling may be required. Replacement samples may be collected when existing data are insufficient or inadequate to support project objectives. The decision to take replacement samples will be made in coordination with the project team and may include USACE, Ahtna or Wood Project Managers, and the Ahtna Program Chemist or Wood Project Chemist.

Usability of the data will be presented in the Validation Summary Report, included with each Quarterly Monitoring Report. Copies of the associated data validation reports will be presented as an attachment to the Validation Summary Report. The Validation Summary Report will contain the following information:

- Basic summary of validation results, including a summary of data qualified with validation flags as listed in Attachment E
- Summary of deviations from the QAPP
- Summary of rejected data that resulted in a data gap
- Summary of points that went into the reconciliation of each objective
- Comments on recovery issues with the MS/MSDs
- Comments on limitations on the data usability
- Comments on corrective action needed and/or taken
- Conclusions and recommendations

## 8.0 References<sup>21</sup>

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<sup>21</sup> At the end of references included in the Fort Ord Administrative Record are the Administrative Record Numbers (AR#s) (e.g. BW-1234). To find the referenced document, this number may be typed into the online search tool at: <http://www.fortordcleanup.com/documents/search/>. Please note the referenced documents were available in the Fort Ord Administrative Record at the time this document was issued; however, some may have been superseded by more current versions and were subsequently withdrawn. TBD: to be determined.



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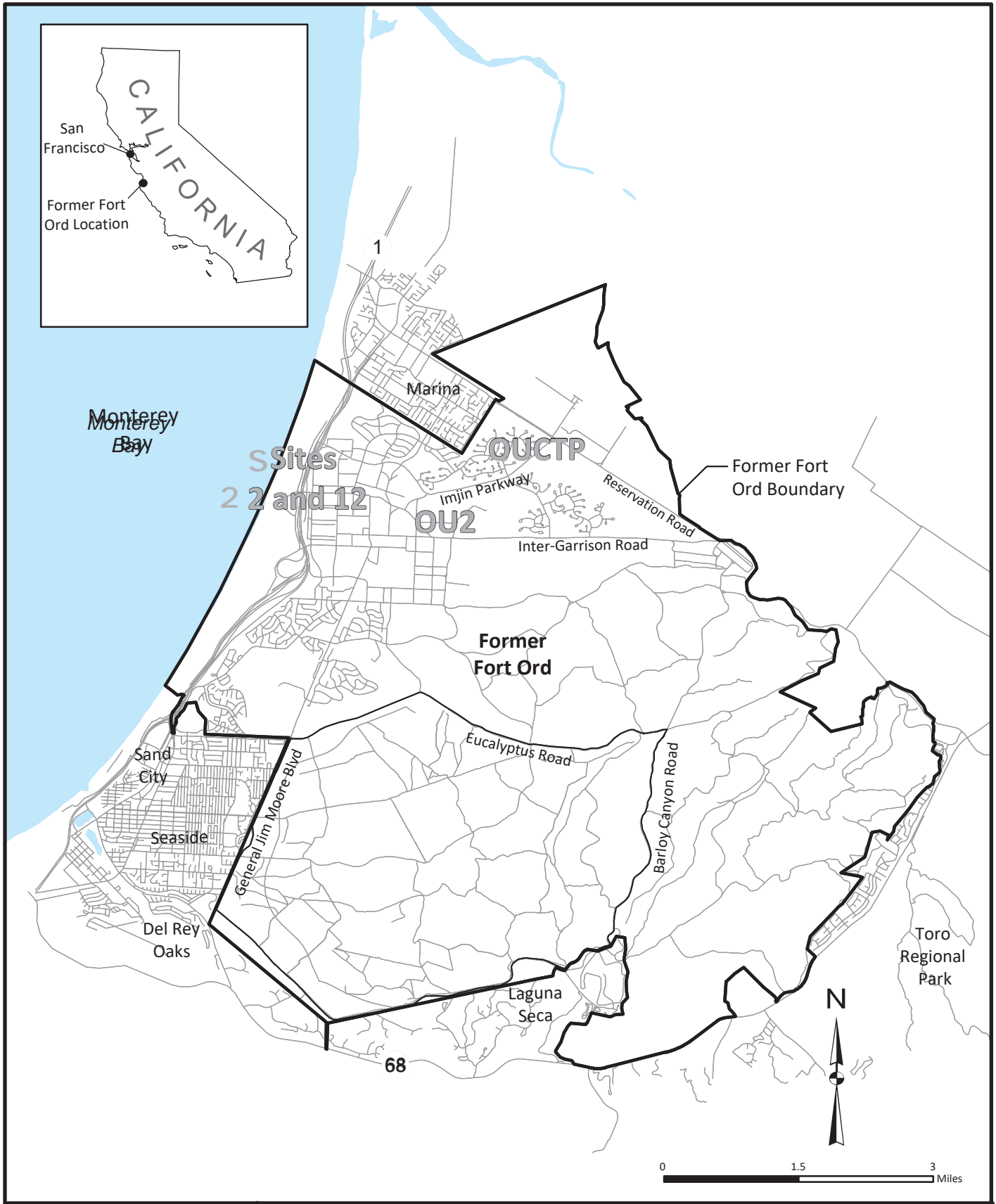
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## **FIGURES**



Ahtna

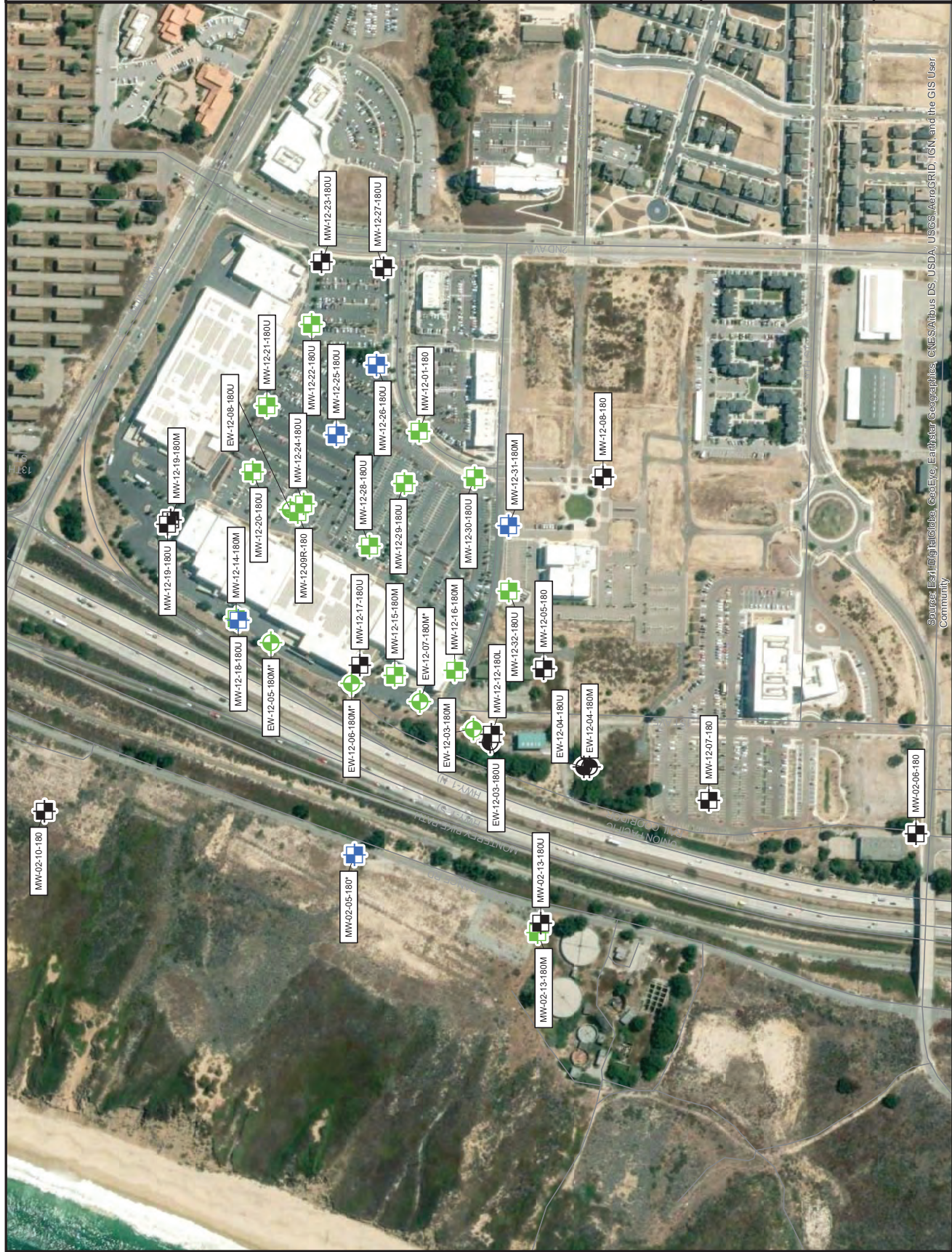
## Former Fort Ord Location Map

Quality Assurance Project Plan, Former Fort Ord, California, Volume 1, Appendix A  
Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2,  
Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume

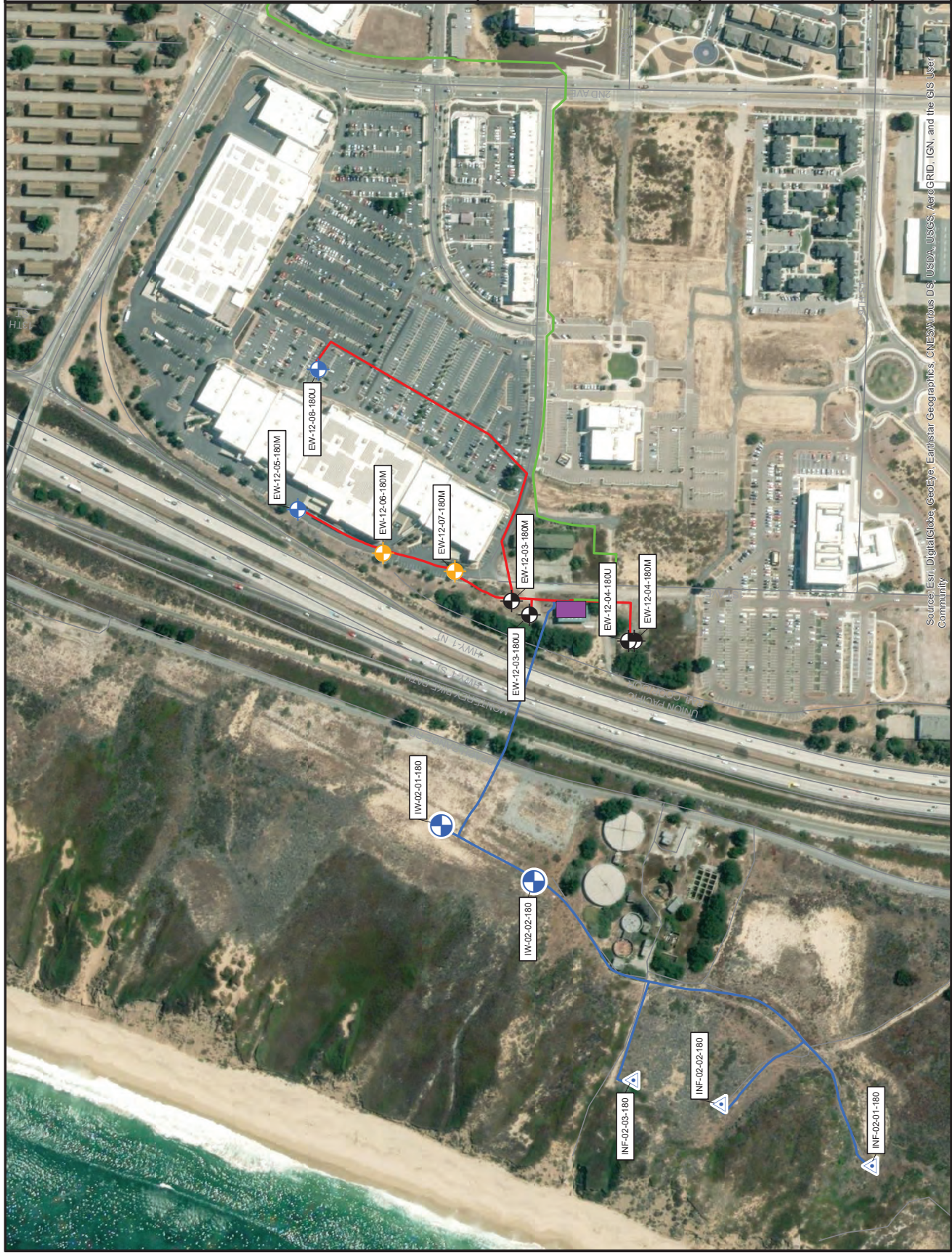
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**1**









Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

#### Legend

— Roads

#### Extraction Well Operations

Extraction Well - Operated

Extraction Well - Not Operated

Extraction Well - No Pump

Sites 2/12 GWTP

#### Groundwater Remedy

Sites 2/12 Groundwater Extraction

Combined Treated Water Discharge

OU2 Treated Water Discharge

#### Discharge Structures

Infiltration Gallery

Injection Well

Injection Well

Injection Well

Injection Well

Injection Well

Injection Well

Injection Well

Injection Well

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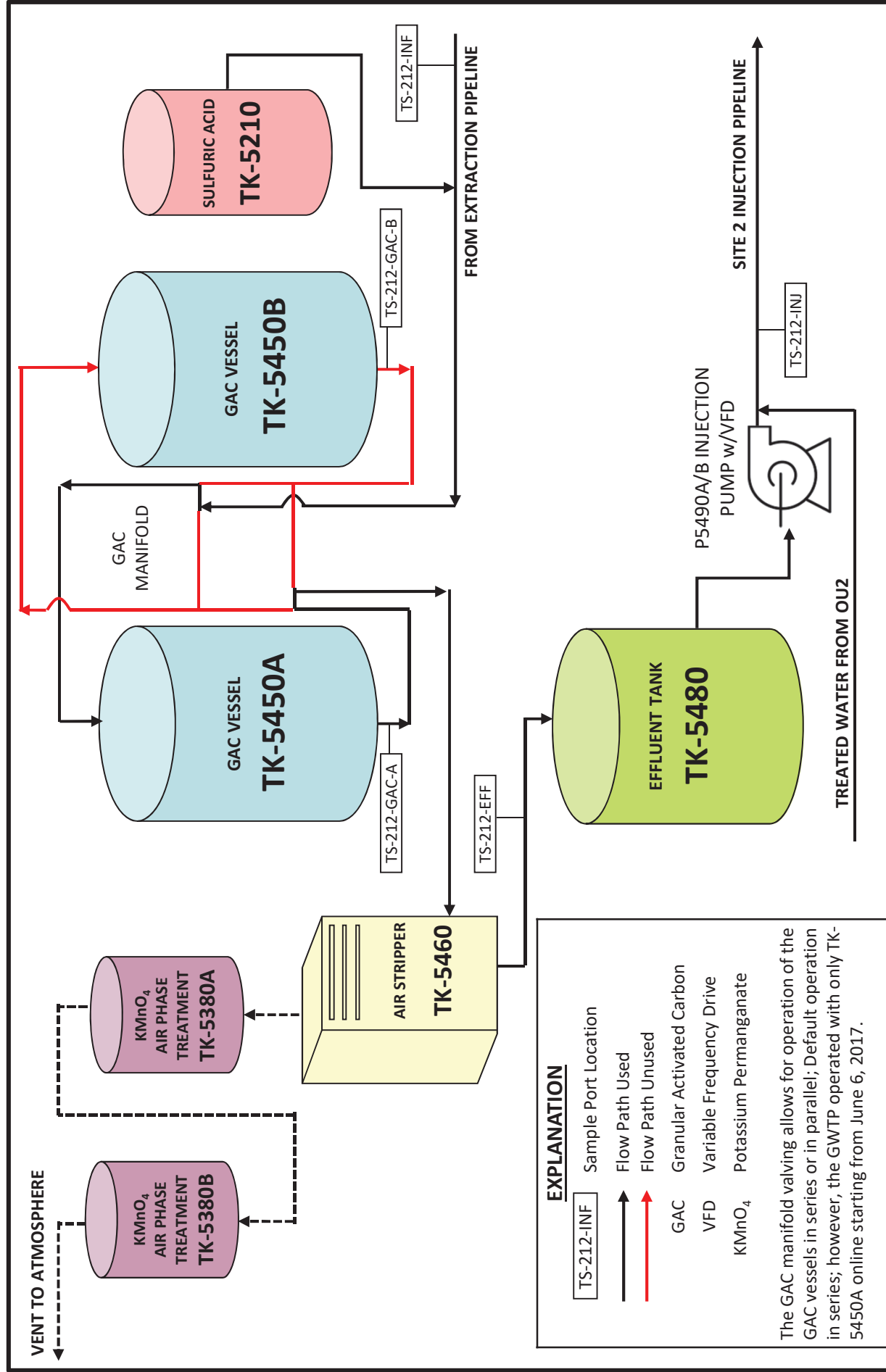
#### Sites 2/12 Groundwater Remedy Map

Quality Assurance Project Plan  
Former Fort Ord, California  
Volume 1, Appendix A, Revision 7  
Groundwater Remedies and Monitoring  
at Operable Unit 2, Sites 2 and 12,  
and Operable Unit Carbon Tetrachloride Plume

Figure:

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*Ahtna*

## Sites 2/12 Groundwater Treatment Plant Schematic

Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A, Revision 7  
Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and  
Operable Unit Carbon Tetrachloride Plume

Figure:

4





**OU2 A-Aquifer  
Groundwater Monitoring Program  
Sampling Locations**

Quality Assurance Project Plan  
Former Fort Ord, California  
Volume 1, Appendix A, Revision 7  
Groundwater Remedies and Monitoring  
at Operable Unit 2, Sites 2 and 12,  
and Operable Unit Carbon Tetrachloride Plume

Figure:

# Ahtna



 Monitoring Well - Water Levels

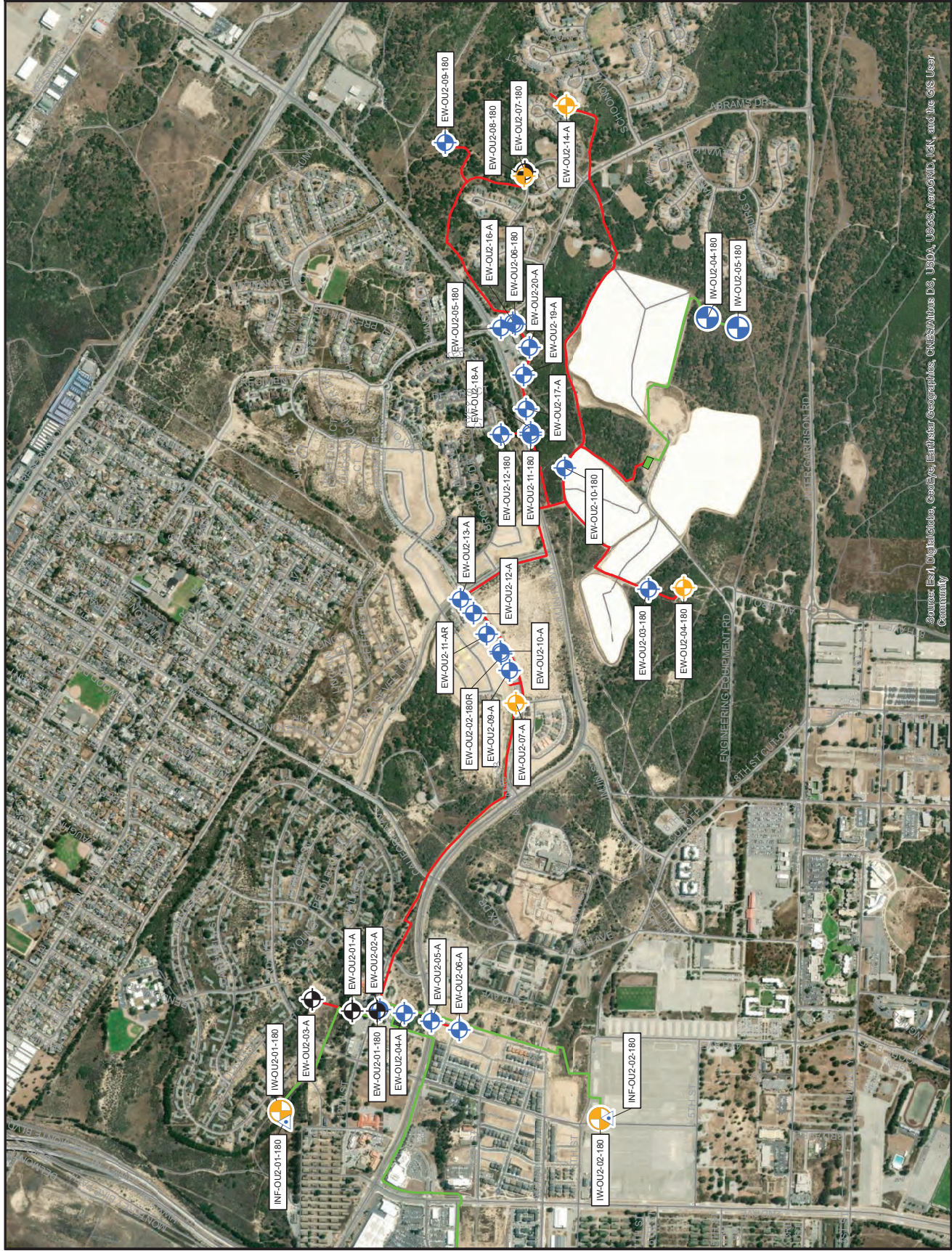
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Figure:

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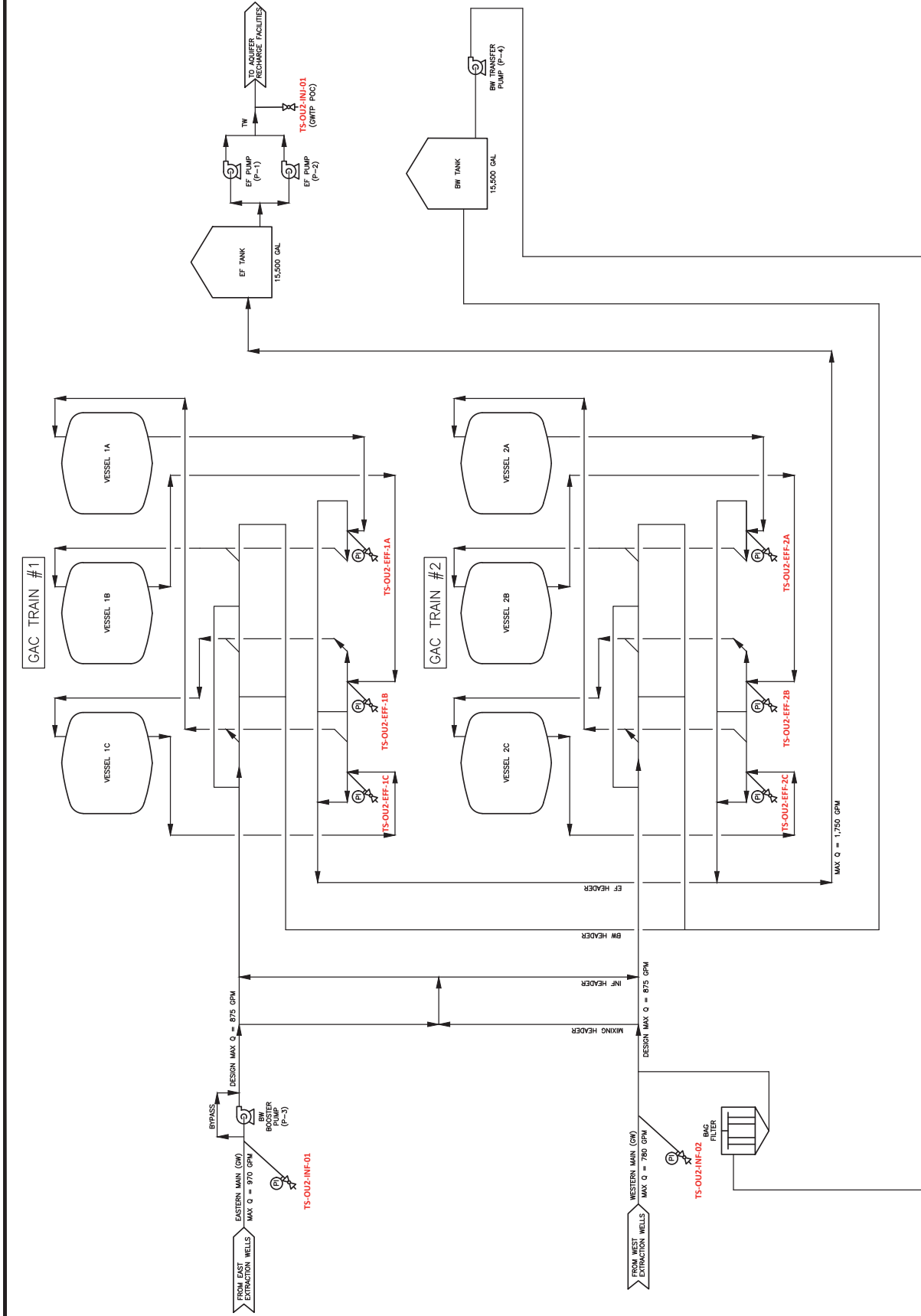
- Legend**
- Roads
  - Fort Ord Landfills
  - OU2 GWTP
  - Extraction Well Status**
    - Extraction Well - Operated
    - Extraction Well - Not Operated
    - Extraction Well - No Pump
  - Groundwater Pipeline**
    - Groundwater Extraction
    - OU2 Treated Water Discharge
    - Injection Well - Not Used
    - Injection Well - Operated
    - Infiltration Gallery - Operated

**OU2 and OUCTP  
Upper 180-Foot Aquifer  
Groundwater Remedies Map**

Quality Assurance Project Plan  
Former Fort Ord, California  
Volume 1, Appendix A, Revision 7  
Groundwater Remedies and Monitoring  
at Operable Unit 2, Sites 2 and 12,  
and Operable Unit Carbon Tetrachloride Plume

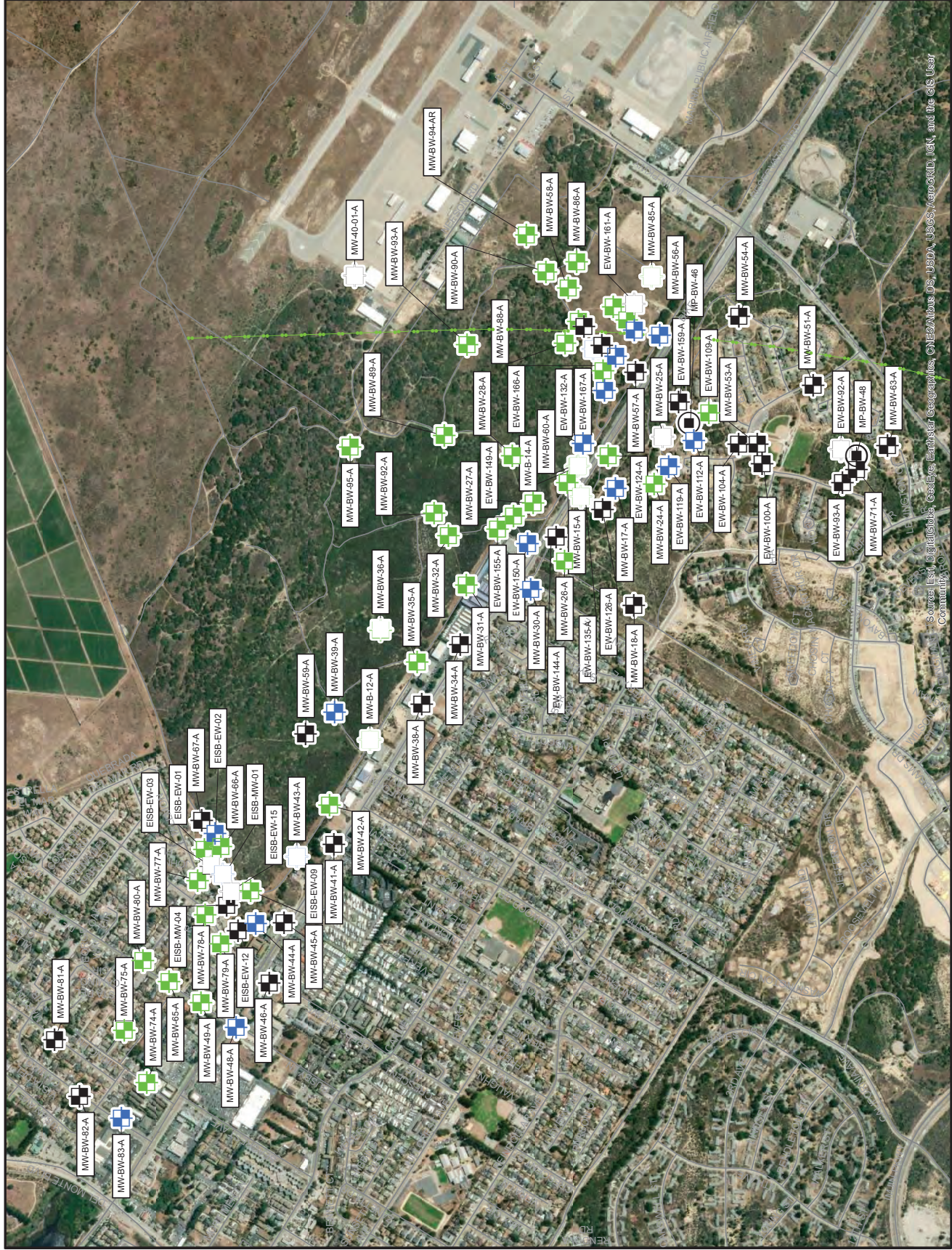
Source: Esri, DeLorme, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





# **OU2** **Groundwater** **Treatment Plant** **Schematic** Quality Assurance Project Plan Former Fort Ord, California Volume I, Appendix A Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume





**Legend**

— Roads

— Groundwater Divide

**OUCTP-A Wells 2019-2Q**

**Well Type and Sample Schedule**

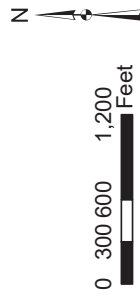
Monitoring Well - Quarterly VOCs

Multi-Port Well - Quarterly VOCs

Monitoring Well - Annual VOCs

Monitoring Well - Water Levels

Multi-Port Well - Water Levels



**OUCTP A-Aquifer  
Groundwater Monitoring Program  
Sampling Locations**

Quality Assurance Project Plan  
Former Fort Ord, California  
Volume 1, Appendix A, Revision 7  
Groundwater Remedies and Monitoring  
at Operable Unit 2, Sites 2 and 12,  
and Operable Unit Carbon Tetrachloride Plume

Figure:

*Ahtna* **8A**

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community





# Legend

— Roads

Fort Ord Landfills

## OUCTP-Upper Wells 2018-3Q

### Well Type and Sample Schedule

Extraction Well - Quarterly VOCs

Monitoring Well - Quarterly VOCs

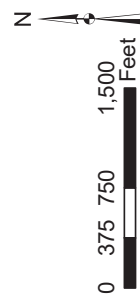
Multi-Port Wells - Quarterly VOCs

Monitoring Well - Annual VOCs

Multi-Port Well - Annual VOCs

Monitoring Well - Water Levels

Multi-Port Well - Water Levels



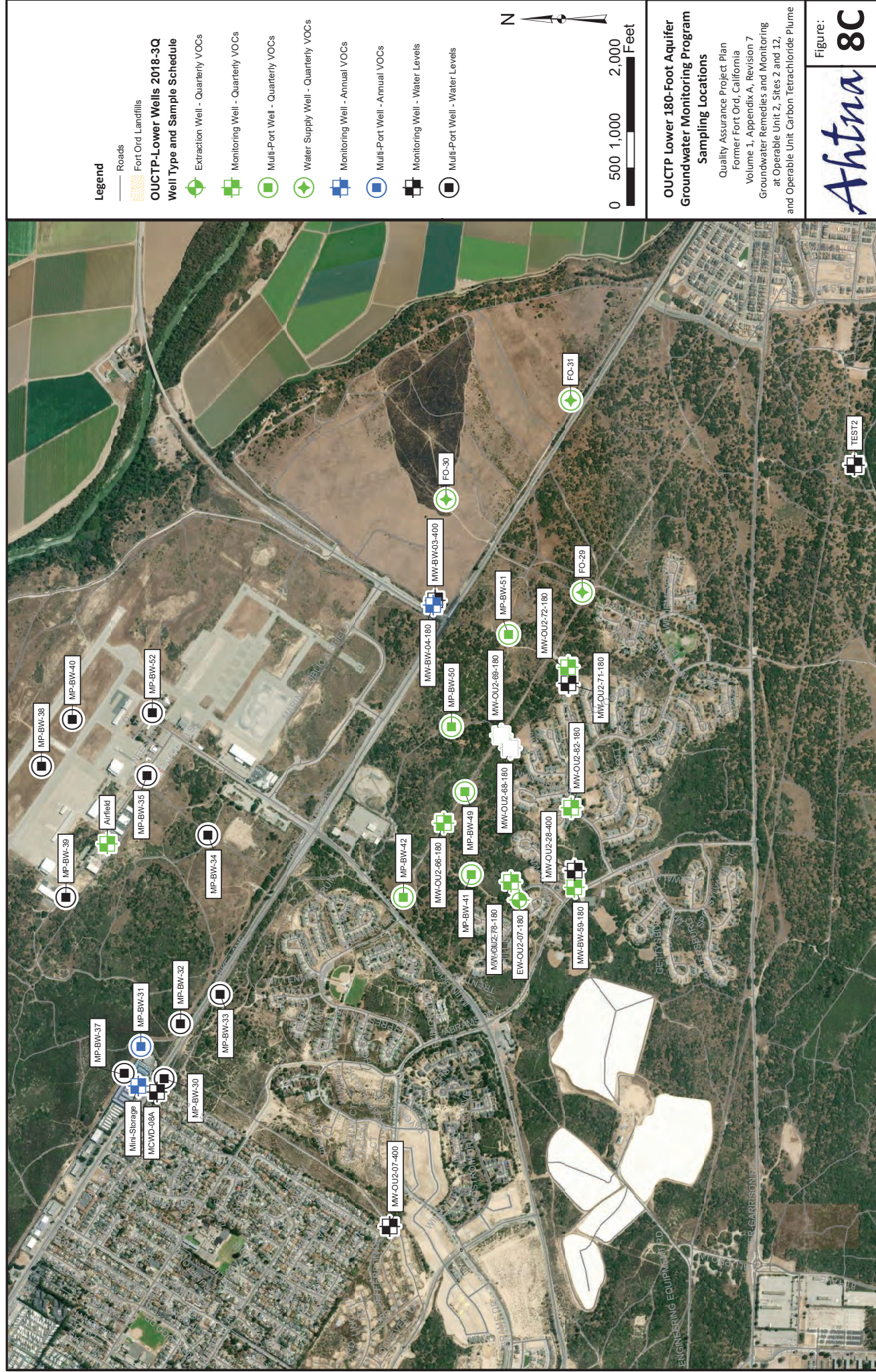
## OUCTP Upper 180-Foot Aquifer Groundwater Monitoring Program Sampling Locations

Quality Assurance Project Plan  
Former Fort Ord, California  
Volume 1, Appendix A, Revision 7  
Groundwater Remedies and Monitoring  
at Operable Unit 2, Sites 2 and 12,  
and Operable Unit Carbon Tetrachloride Plume

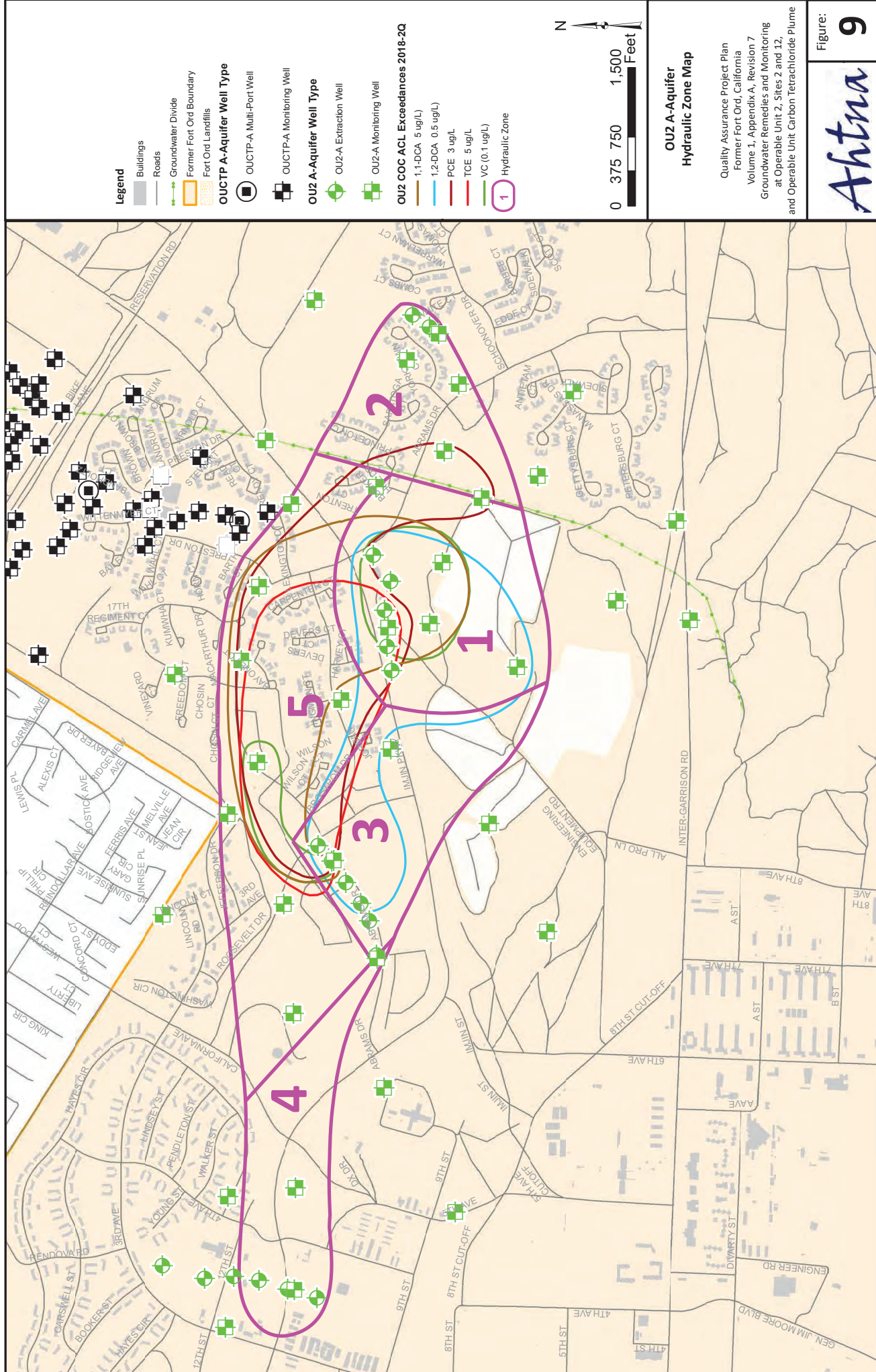
Figure:  
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**8B**

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

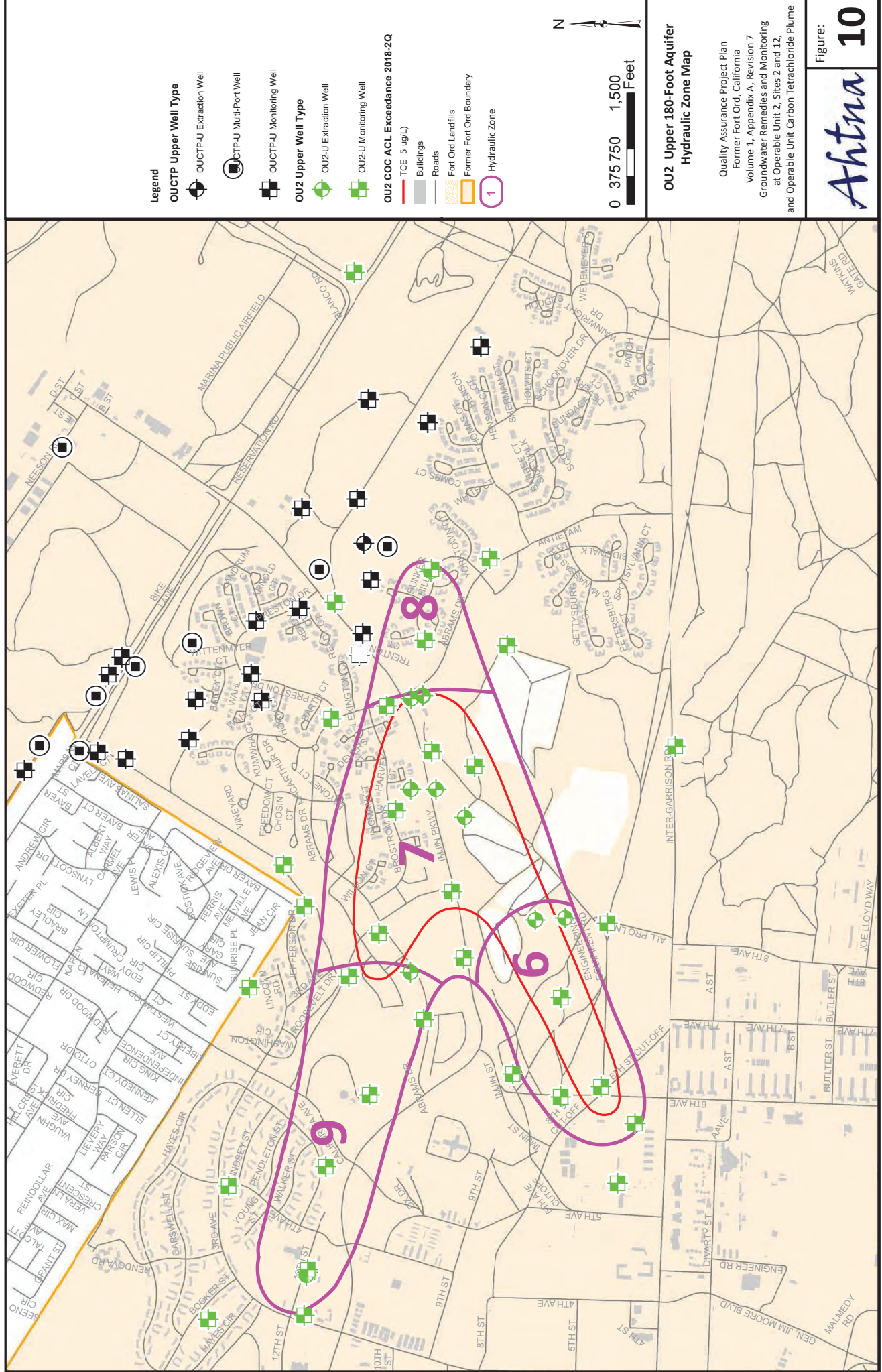






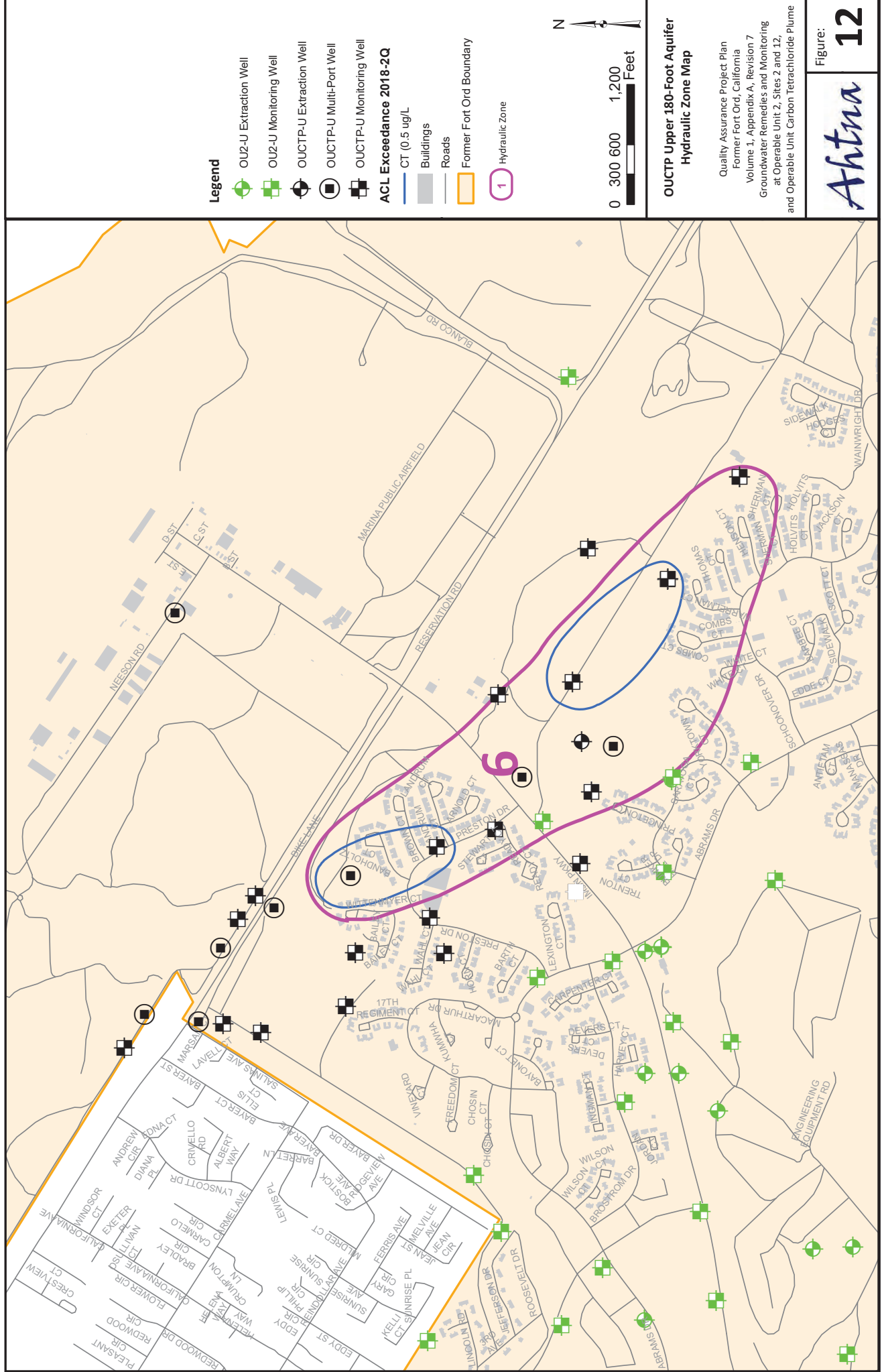


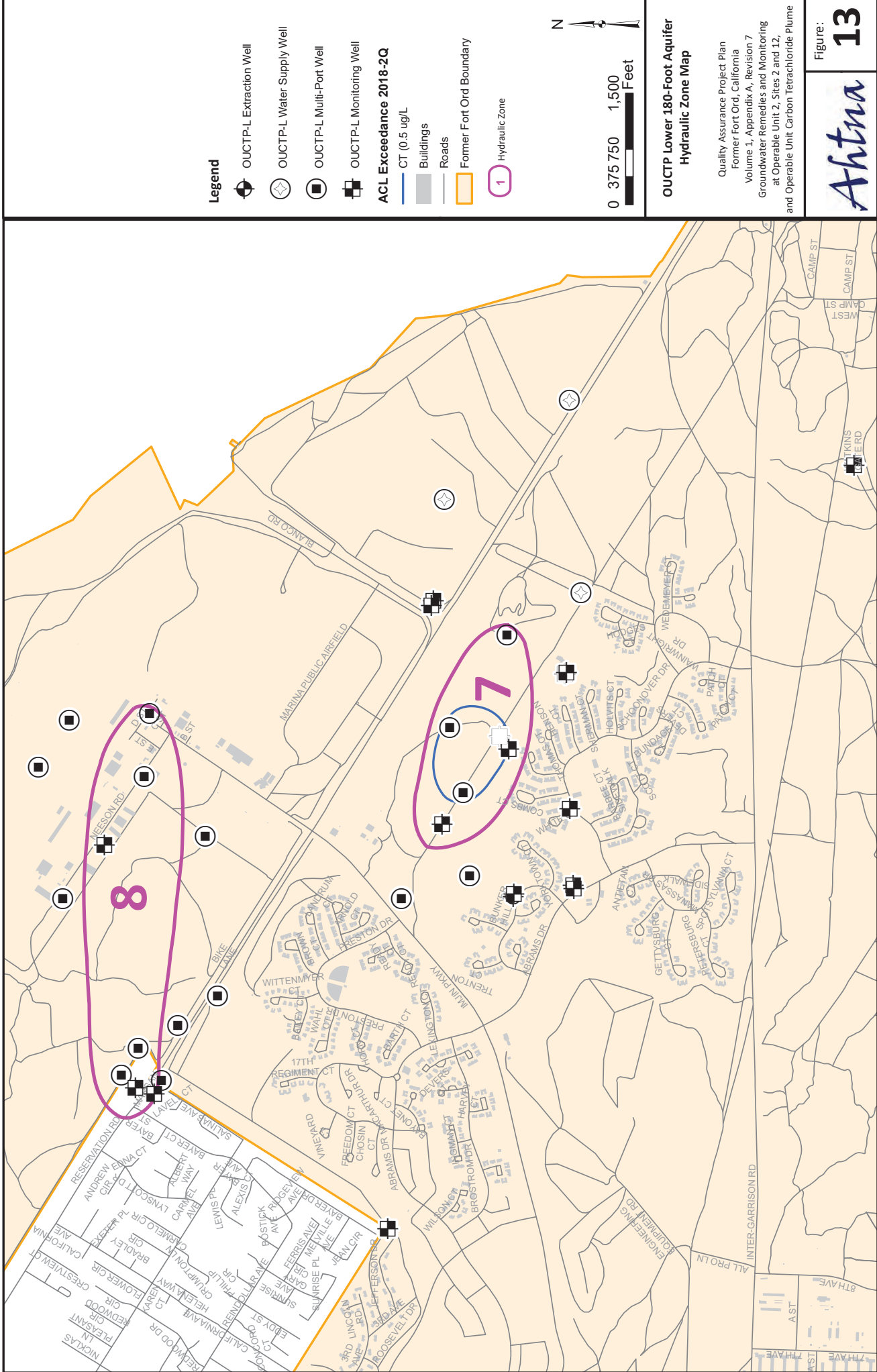




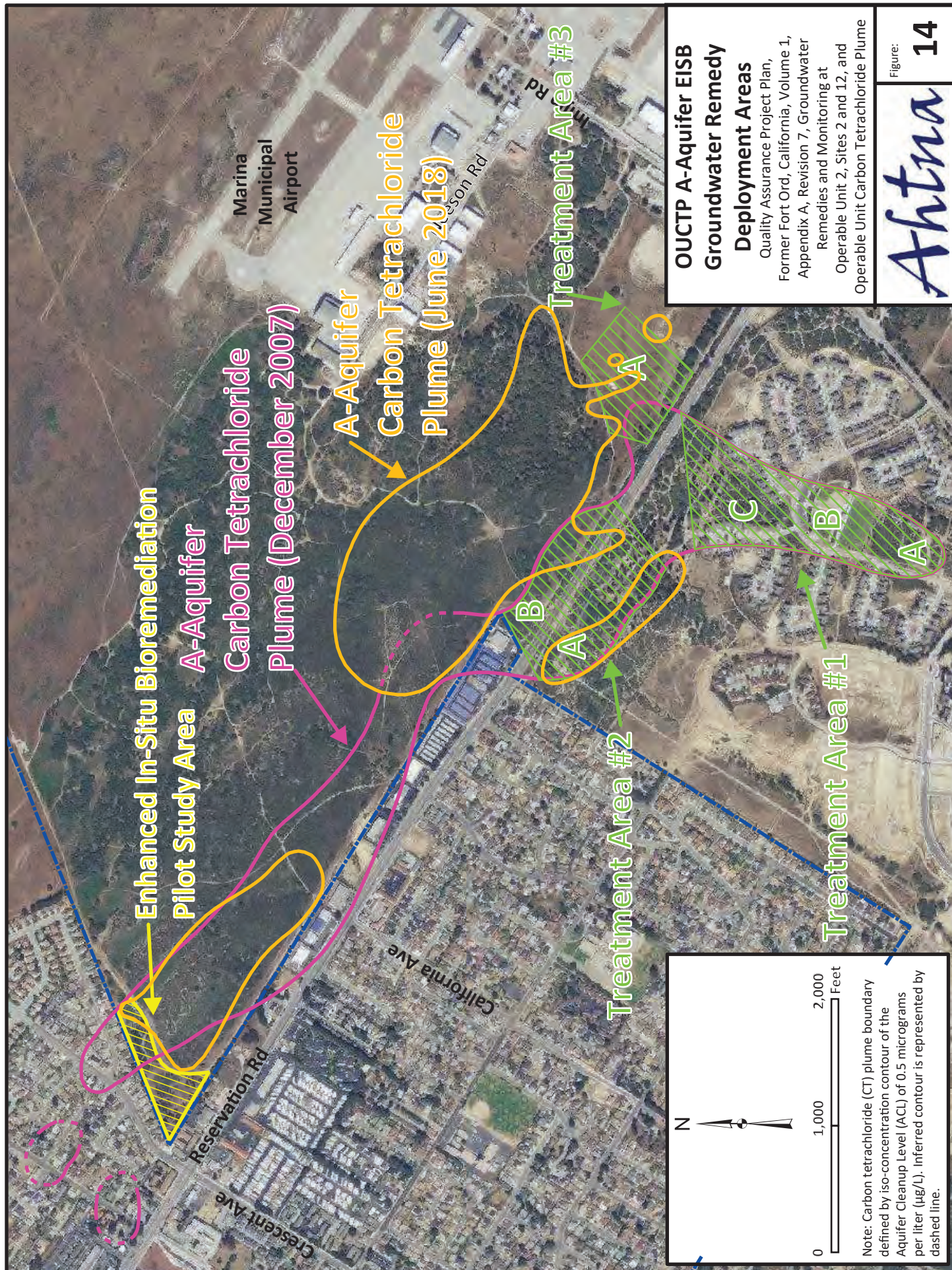














## TABLE



**Table 1: Summary of Existing Monitoring Wells and Samples Collected Annually**

Site	Aquifer	Total Number <sup>1</sup> of Wells Per Aquifer	Number of Army-Owned Wells	Total Number of Sample Ports Currently Sampled	Number of Well/Ports Sampled Quarterly	Number of Wells/Ports Sampled Annually	Number of Wells Not Sampled (water level only)	Number of Samples Collected Annually <sup>2</sup>
Sites 2 and 12	A	0	0	0	0	0	0	0
	Upper 180	38	38	24	19	5	14	89
	Lower 180	1	1	0	0	0	1	0
	<b>Subtotal</b>	<b>39</b>	<b>39</b>	<b>24</b>	<b>19</b>	<b>5</b>	<b>15</b>	<b>89</b>
Operable Unit 2	A	59	59	40	39	1	19	173
	Upper 180	45	45	31	29	2	14	130
	Lower 180	0	0	0	0	0	0	0
	<b>Subtotal</b>	<b>104</b>	<b>104</b>	<b>71</b>	<b>68</b>	<b>3</b>	<b>33</b>	<b>303</b>
Operable Unit Carbon Tetrachloride Plume	A	95	95	62	43	19	33	210
	Upper 180	37	37	9	7	2	28	33
	Lower 180	95	89	24	21	3	71	96
	<b>Subtotal</b>	<b>227</b>	<b>221</b>	<b>95</b>	<b>71</b>	<b>24</b>	<b>132</b>	<b>339</b>
<b>Total Number of Samples Collected Annually</b>								<b>730</b>

**Notes:**

<sup>1</sup> Number of wells in the groundwater monitoring program (not including wells not measured for depth to water and to be decommissioned at a later date).

<sup>2</sup> Includes duplicate samples collected during groundwater monitoring at a frequency of 10 percent (%) per quarterly event.

## **ATTACHMENTS**

## **ATTACHMENT A**

### **Standard Operating Procedures (SOPs)**

## **Sampling SOPs**

1. Westbay MOSDAX Sampler Probe – Model 2531 Operations Manual
2. Passive Diffusion Bag (PDB) Sampling Protocol
3. HydraSleeve Field Manual
4. Supply and Irrigation Well Sampling Protocol
5. OU2 and Sites 2/12 GWTs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements
6. Low Flow Groundwater Quality Parameter Collection
7. Downhole Meter Groundwater Quality Parameter Collection

# OPERATIONS MANUAL

## Westbay MOSDAX Sampler Probe - Model 2531





## NOTICE

Operation of Westbay System equipment should only be undertaken by qualified instrument technicians who have been trained by Westbay authorized personnel.

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## DO NOT OPEN THE SAMPLER

All warranties expressed or implied will be void if, after examination by Westbay Instruments Inc. personnel, it is established that any of the instrument housings have been opened without prior authorization from Westbay Instruments Inc.

## DO NOT LET THE SAMPLER FREEZE

Extreme care should be taken to avoid freezing the MOSDAX Sampler probe. Permanent transducer damage may result from freezing.

Manual Revision: 1.13 20 October 2006

Issued for Serial No.: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

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## **1. DESCRIPTION**

### **1.1 MOSDAX Sampler Probe, Model 2531**

The MOSDAX Sampler is a downhole probe designed to collect fluid pressure information and fluid samples from Westbay System monitoring wells. Each MOSDAX pressure sensor is calibrated over its full pressure range for nonlinearity and temperature variation. MOSDAX Sampler probes are available in a variety of pressure ranges to permit operation to various depths. The shoe and valve motors can be operated from the surface. The power for the shoe and valve motors is supplied from the surface.

### **1.2 MOSDAX Automated Groundwater Interface (MAGI), Model 2536**

The MOSDAX Sampler can be operated directly by the keypad on the MOSDAX Automated Groundwater Interface (MAGI), or by a Hand Held Controller (HHC) connected to the MAGI, or with a computer running Microsoft Windows (2000 or higher) and Westbay software connected to the MAGI. The MAGI translates the signals between the computer or HHC and the MOSDAX Sampler. The MAGI requires 12 volt DC power to operate.

Older versions of MOSDAX sampling equipment may incorporate a Model 2522 MOSDAX PC Interface (MPCI) and HHC rather than a MAGI. For such systems, reference to the MAGI in this document can be considered as reference to the MPCI and HHC.

### **1.3 Cable Reels**

The manual cable reel can operate all Westbay probes and tools to a depth of 300m (1,000 ft) on a single-conductor cable. The manual reel is hand operated with an internal brake to control the speed of descent of the probe in the well. The two-pin cable connects the MAGI to the reel and the signals pass through a slipring located in the hub of the reel into the control cable. For maintenance information, see the appropriate cable reel manual.

Motorized cable reels are available for deeper applications.

### **1.4 Sample Containers**

Sample containers can be used with the MOSDAX Sampler. The nonvented stainless steel sample containers maintain samples under formation pressure while the sampler and container are brought to the surface.

## 2. PRESSURE PROFILING

### 2.1 Items Required

- MOSDAX Sampler Probe, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sheave with counter and tripod
- 12 VDC, 2 Amp power source (Battery pack, car/truck battery, or transformer)
- Water level measuring tape
- MProfile User's Guide for computer or the Handheld Controller Operations Manual
- Westbay Casing Log showing depths to ports and couplings in hole to be tested.

### 2.2 Surface Checks

1. Remove the MOSDAX Sampler from its storage case. Inspect the probe housing and body for any damage. Please contact Westbay for advice on any cover tube damage.
2. Assemble the tripod and counter over the well. Run the cable over the counter.
3. Connect the probe to the cable. Before attaching, inspect the O-ring at the top of the probe and lubricate with silicon. The O-ring should be clean and intact. Tighten the nut hand tight only.
4. Connect the two-pin cable from the MPC1 to the cable reel. With the MPC1 OFF connect the three-pin cable from the MPC1 to the 12 v power supply.
5. Connect the 9 pin cable from computer or HHC to the MPC1 and turn the MPC1 ON.
6. Perform the following surface checks to ensure that the location arm and the shoe mechanisms are operating normally: Release the location arm. The location arm should extend smoothly. The number of revolutions used to release the location arm is displayed and should be 15 to 16 revolutions. If a smaller number of revolutions is reported, retract the arm and repeat. Place the probe in a piece of Westbay casing or coupling. Activate the shoe. The shoe should extend and hold the probe firmly in the coupling or casing. The display should indicate 16 to 19 revolutions. A reading of 23 revolutions indicates the probe is activated in open air. Retract the backing shoe.

7. Check that the face plate for sampling and the plastic plunger are installed on the sampler.
8. The probe is now ready to be lowered down the well.

## 2.3 Pressure Measurement Procedures

1. Obtain the completed Westbay Casing Log.
2. With the location arm retracted, lower the probe into the Westbay casing to immediately below the lowest measurement port coupling to be monitored. If magnetic collars have been installed on the well, the Collar Detect Command can be used to detect the collars. The Collar Detect Command is cancelled by pressing any key.
3. Release the location arm. The display should update and beep after the arm is released.
4. Raise the probe about 0.5 m (1.5 ft) above this measurement port. If the probe is accidentally lifted above the next higher coupling, it will be necessary to retract the location arm and lower the probe to below the measurement port and release the arm.
5. Lower the probe gently until the location arm rests in the measurement port.
6. Record the pressure and temperature inside the Westbay casing.
7. Optional: If a water level tape is available, measure and record the depth to water in the Westbay casing.
8. Activate the shoe. The pressure on the display should change to the formation pressure.
9. When the reading has stabilized, record the formation pressure.
10. Once the pressure has been recorded, retract the shoe.
11. Record the pressure of the fluid in the Westbay casing. This reading should be similar to that recorded in Step 6. If a large difference is noted between the readings, record the water level inside the Westbay casing again using the water level tape.
12. The three pressure readings plus the time and water level constitute a complete set of readings at a measurement port coupling.
13. Continue up the Westbay casing to obtain the pressure data from other measurement ports.
14. Take one last set of pressure and temperature readings at the surface. These readings should be similar to those recorded in Step 2.

**CAUTION:** If a water level tape was used, remove the water level tape from the Westbay casing before removing the sampler probe from the well to prevent them from becoming jammed.

### 3. FLUID SAMPLING

#### 3.1 Items Required

- MOSDAX Sampler, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sample containers and connecting tubes
- Westbay Casing Log
- Groundwater Sampling Field Data Sheet
- 12 VDC, 2 amp power source (battery pack, car/truck, or transformer)
- Counter and tripod
- Westbay Sampling Kit including vacuum pump

#### 3.2 Surface Checks and Preparation

1. Set up the MOSDAX Sampler probe following Steps 1 through 8 of Section 2.2.
2. Attach the sample containers.
3. Release the location arm. Locate the probe in the vacuum coupling.
4. Activate the shoe in the vacuum coupling.
5. Close the sampler valve. The motor should run about 5 seconds. The display should indicate one revolution.
6. Use the vacuum pump to apply a vacuum through the vacuum coupling. The vacuum should remain constant. If the vacuum is not maintained, inspect for leaks at the face seal of the probe, the connection to the pump and at the probe sampling valve.
7. Once a vacuum has been maintained, open the sampler valve. Apply a vacuum again to check that all connections are sealed.
8. Close the sampler valve. A vacuum has now been applied to the sample bottles.
9. Retract the shoe.



### 3.3 Drillhole Sampling

1. Check recent pressure logs of the hole and ensure that the head inside the Westbay casing is lower than the head outside the measurement port to be sampled.
2. After completing the surface checks, follow Steps 1 to 5 of Section 2.3 to locate the sampler at the measurement port in the monitoring zone to be sampled.
3. Record the pressure reading.
4. Activate the probe and record the formation pressure.
5. Open the sampler valve. The pressure should drop and then slowly increase as the bottles fill. When the pressure in the bottle equals the zone pressure from Step 4, the bottle is full. Wait a maximum of two minutes per sample bottle even if the pressures are not equal.
6. Close the sampler valve and retract the shoe.
7. Record the pressure reading. A reading the same as in Step 3 indicates that the sample is OK.
8. Reel the sampler to the surface and remove it from the Westbay casing.
9. **Do not open the sampler valve as damage to the probe or injury to the operator could occur.**
10. Remove the cap from the bottom sample bottle and open the valve on the bottle to release the pressure and to transfer the sample.
11. Open the sampler valve to allow the sample to flow from the bottles. Once the pressure in the sampler and bottles has decreased to atmospheric, the bottles may be disconnected to speed the process.
12. Take particular care in handling pressurized samples.

### 3.4 Rinsing Instructions

Rinse the sampler around the face seal and the bottom connector. With the sampler valve open, flush the interior of the sampler from the bottom connector. Rinse the sample bottles and connectors.

**Note:** Project specific procedures for decontaminating the sampler and sample bottles are the responsibility of the project manager and are not covered in this manual.

## 4. Care and Maintenance

The MOSDAX Sampler System must be routinely maintained for optimum performance. The procedures outlined here are required to keep the instrument operating properly. For any additional information or advice, please contact Westbay Instruments Inc.

### 4.1 MAGI

The MAGI should be cleaned to remove dirt and dust and inspected for damage or wear. If any part requires replacement, contact Westbay for information.

### 4.2 Cable Reels and Control Cable

The cable reels should be kept clean and protected from damage. The cable and cable head should be inspected for kinks and corrosion. Rehead the cable if necessary. For more information concerning cable reels and the control cable, refer to the appropriate reel manual.

### 4.3 MOSDAX Sampler Probe

1. Never allow the probe to freeze or the pressure transducer may be damaged.
2. Clean and inspect the probe for dents and scratches on the cover tube. Clean the threads with a nylon brush, such as a toothbrush. DO NOT use a wire brush. Protect the O-rings from damage and dirt.

#### 4.3.1 Face Seal

Inspect the face seal and replace if damaged or worn.

1. Remove the two screws holding the face plate to the probe body and lift the face plate off.
2. Remove the face seal and plunger. Set the location arm assembly aside. Clean the plunger and probe body.
3. When reinstalling the face plate hold the face seal, plunger and location arm assembly in place. Replace the two screws the hold the face plate on the probe.

#### 4.3.2 Location Arm

Release the location arm. Check that the arm moves smoothly and freely and check for damage and sharp edges due to wear. Replace the location arm if necessary.

1. Release the location arm. Remove the two screws and face plate (Section 4.3.1).
2. Remove the location arm with its spring and pivot pin. Clean and inspect all parts and replace if needed.
3. Insert the spring and pivot in the location arm and place the assembly in the probe body. Place the face plate over the face seal and location arm and tighten the two screws.

## SECTION 4.3.2 SUPPLEMENT

### WESTBAY Probe Location Arm replacement

- a) It is easier when the arm is first extended to the "out" position (Fig. A). Do this before powering down and disconnecting the probe.
- b) Remove the face seal slowly and stabilize the arm as it is under tension from the spring (Section 4.3.2.2) and may suddenly pop out. Observe the position and orientation of the parts as they are removed (Fig. B).
- c) Insert the hook of bent leg of the spring into the tiny hole on the neck of the new arm and align the spring coil opening alongside the larger hole in the arm with the spring leg positioned directly against the arm and over the pivot facing out (Fig. C-1). The metal pivot pin goes through the hole in the arm and through the spring coil (Fig. C-2). The straight leg of the spring leads under the pivot into the smaller side slot on the side of the main arm aperture, parallel with the probe. Place the assembly into its space in the probe body (Fig. C-3). The arm assembly has to be held in place while replacing the face seal to counter the force of the slightly compacted spring (Fig.C-4).
- d) Replace the face seal by sliding it toward the top of the probe and sliding the top edge into the slot while at the same time allowing the arm to protrude through the face seal. The arm should remain in the extended position while screwing down the face seal.
- e) Check to see that the arm can be freely, manually pushed in and that it pops back out when released. Attach the probe to the cable and mechanically retract the arm using the MAGI commands.

Figure A - Arm is extended out at start of replacement operation.



Figure **B** - Disassembled face seal and location arm.



Figure C-1 - Orientation of spring relative to arm.

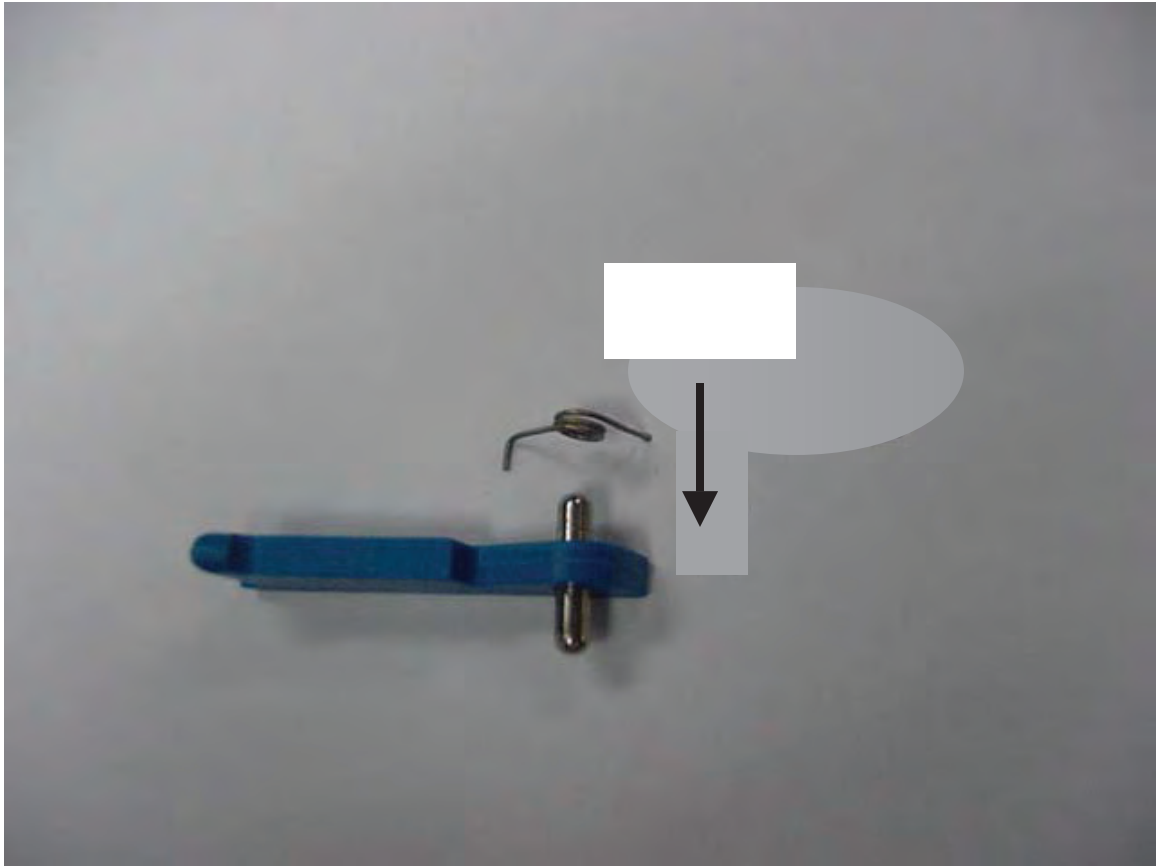




Figure C-2 - Position of spring and pivot in the arm.



Figure C-3 - Placement of arm assembly.

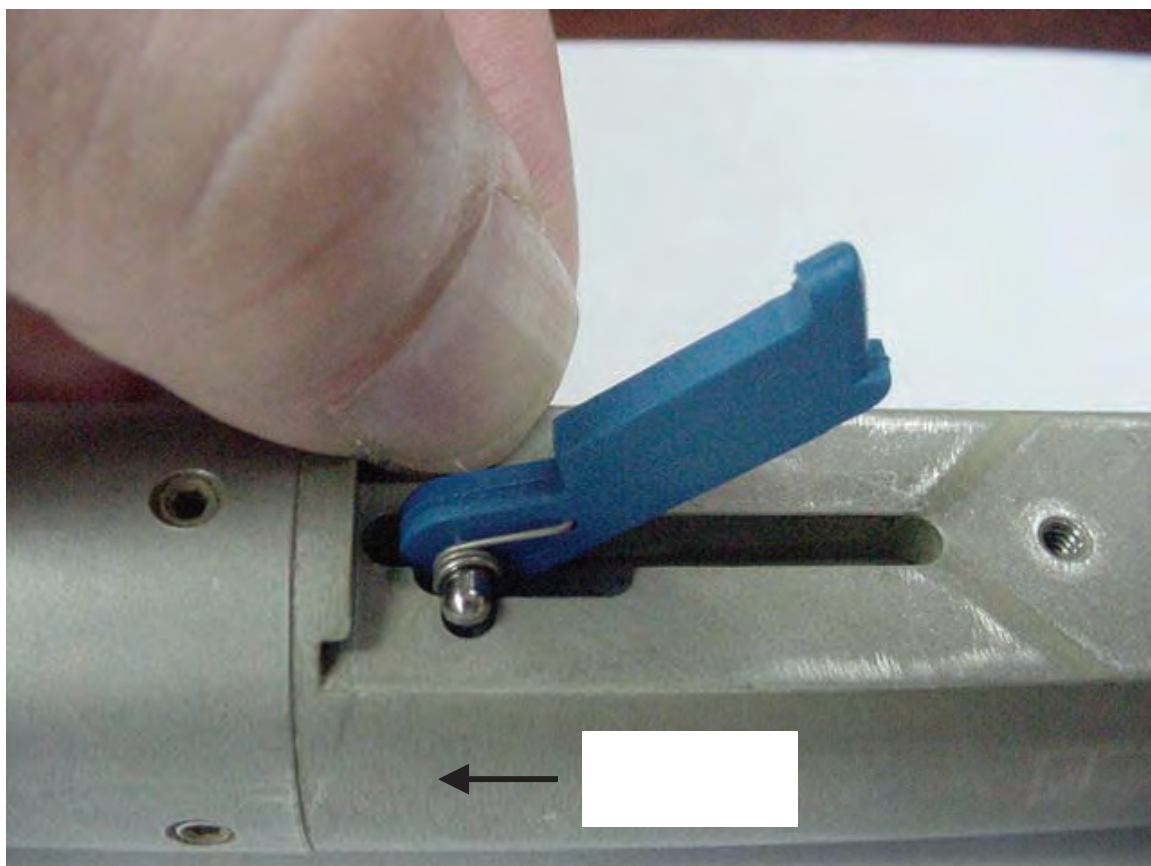
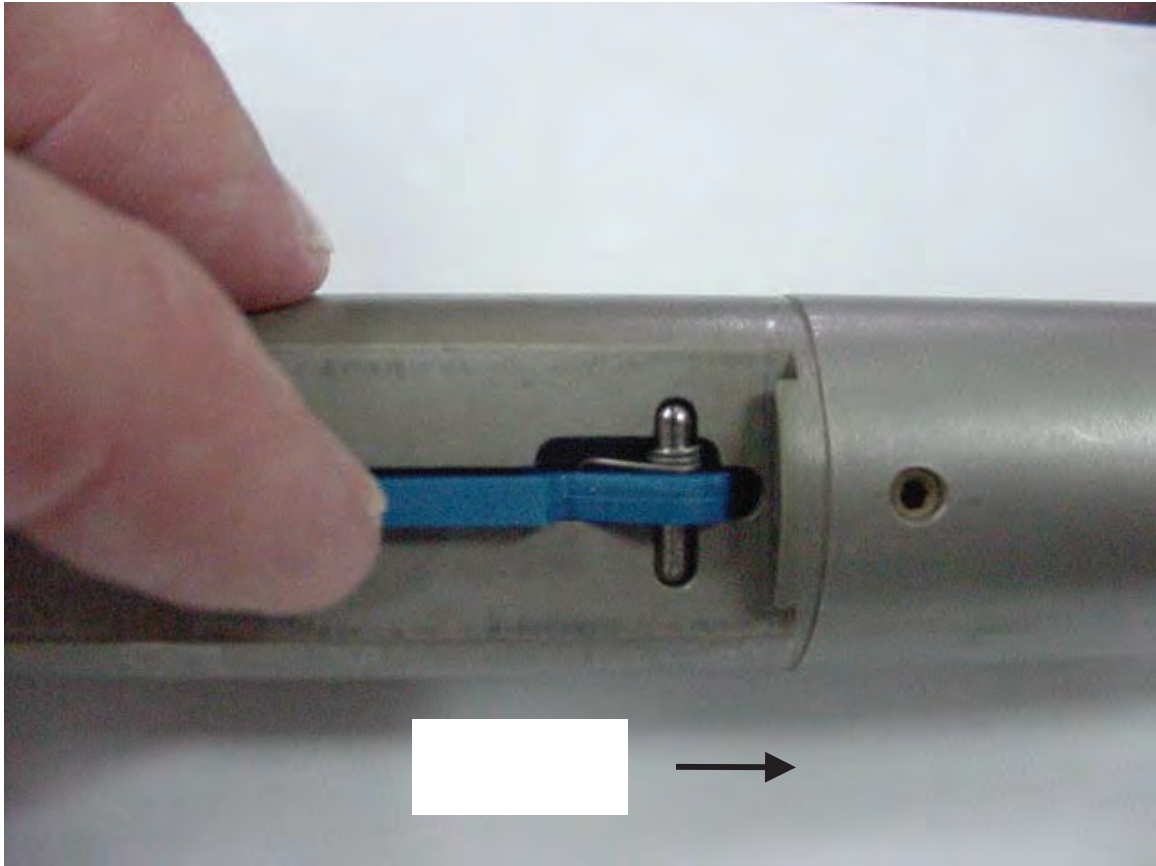


Figure C-4 - Top view of arm and spring placement.



Check that the arm is moving freely and the face seal insert and plunger are held securely in place.

#### 4.3.3 Shoe Replacement

Activate the shoe and inspect for damage or wear. The shoe should rotate freely about the pivot pin. When the shoe is retracted it should retract quickly and smoothly back into the probe. The shoe may be replaced in the following manner:

1. Release the location arm and extend the shoe to expose the pivot pin.
2. Unscrew the shoe pivot pin from the lever arm and remove the shoe.
3. Place a new shoe in the lever arm and install the shoe pivot pin.

#### 4.3.4 Actuator Nut

The actuator nut needs to be routinely cleaned to remove particles of grit which can interfere with its movement. Remove the actuator nut in the following manner:

1. Remove the two set screws that hold in the lever arm pivot pin. Using the Allen key, push the lever pivot pin out of the probe body.
2. Remove the set screws on the side of the probe body that holds the plastic support block.
3. Remove the screw closest to the top of the probe.
4. Lift out the lever arm, guide plate, shoe, spring and plastic support block as one unit.
5. Use the Clean Nut Command to remove the actuator nut from the actuator screw. Turn off the MPC1 and remove the nut from the probe.
6. Clean the actuator nut with the cleaning tap. Use the Clean Nut Command and clean the actuator screw with a nylon brush. DO NOT use a wire brush.
7. Apply a thin coating of silicone lubricant to the actuator screw. Place the actuator nut in the probe body against the actuator screw and retract the arm to thread the nut onto the actuator screw. Allow the nut to travel along the full length of the screw. YOU MAY HAVE TO REPEAT THIS OPERATION.
8. Install the single unit from Step 4 in the probe body. Install the lever arm pin through the probe body, lever arm, and spring. Lock the pin in position with two set screws.
9. Install the top screw into the guide plate and install the set screws to secure the support block.

## 5. CALIBRATION

The Westbay System permits frequent or periodic calibration of the transducers used for pressure measurement. Contact Westbay for details.

## 6. SPARE PARTS LIST

Item	Part No. or Size	Qty
Face Seal Insert	200302	5
Plunger	see Note 1)	5
Location Arm	252112	5
Shoe	252313	5
Pin 3 (Location Arm)	252320	2
Spring 2 (Location Arm)	252319	2
Pin 1 (Shoe)	252316	2
Spring 1 (Shoe Lever)	252318	2
Pan Head Screw	# 4-40 x 1/4 - inch	2
Pan Head Screw	# 6-32 x 3/16 - inch	2
Pan Head Screw	# 6-32 x 1/2 - inch	2
Hex Socket Head Screw	# 8-32 x 1/8 - inch	4
Hex Socket Head Screw	# 10-32 x 3/16 - inch	4
Hex Socket Set Screw	# 8-32 x 5/16 - inch	2
Allen Key	5/64 - inch	1
Allen Key	3/32 - inch	1
Actuator Nut Tap	208001	1
Cablehead Parts:		
O-ring	# 111 B	2
Termination Sleeve	251805	1
Termination Insert	251806	1
Feedthru Connector	251814	1
Bushing 1	251812	1
Bushing 2	251813	1
O-Ring	# 108 V	1
O-Ring	# 010 V	1
O-Ring	# 004 V	1
Boot	JF0602CF	1
Contact	JF0603CF	1
Cable Heading Tool	208100	1

1. Plunger appropriate to type of measurement port to be accessed.



Date:

Start Time:                      Atm. Rdg:

End Time: \_\_\_\_\_ Atm. Rdg: \_\_\_\_\_

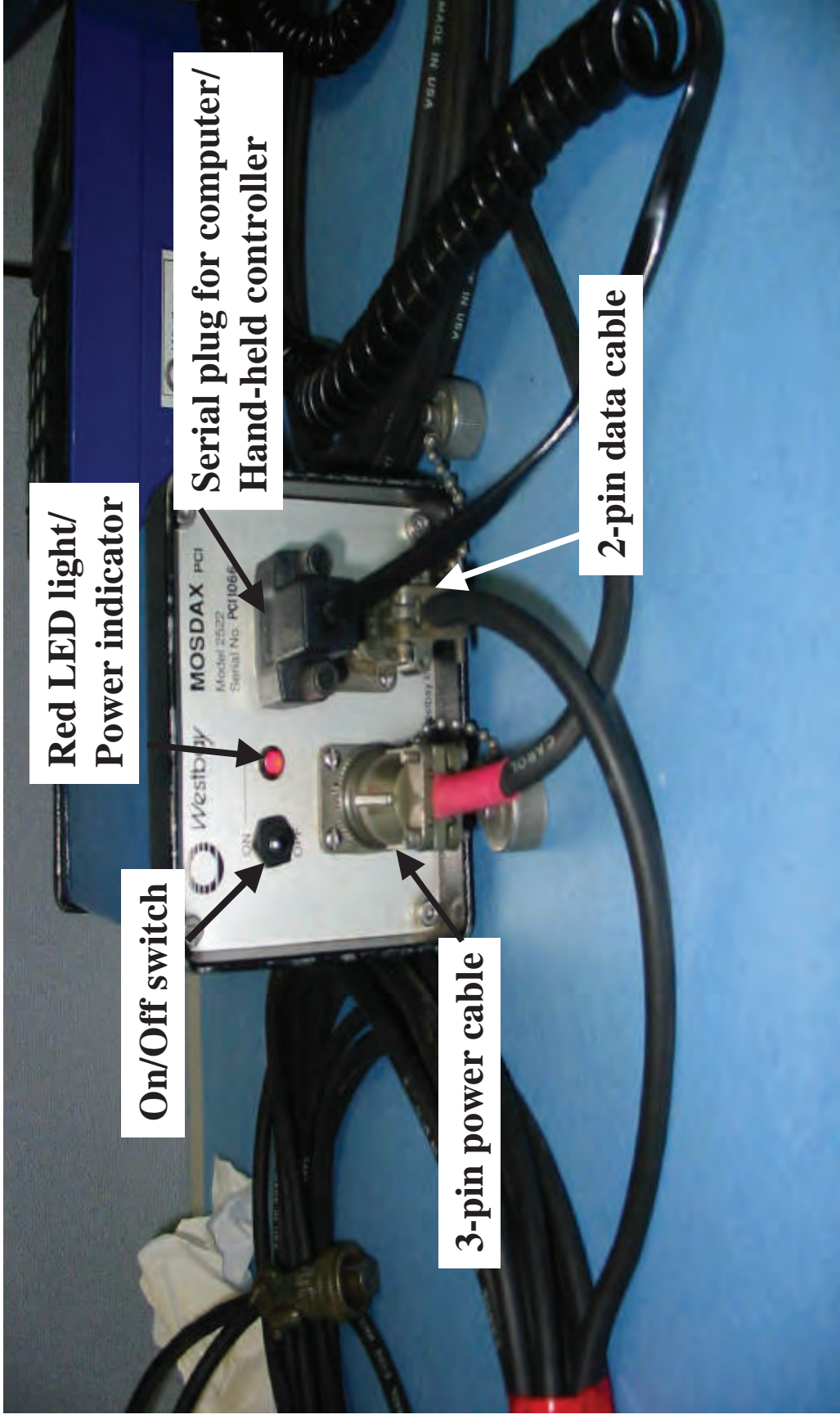
Operators:

Additional Comments: (pH, turbidity, S.C., etc.)

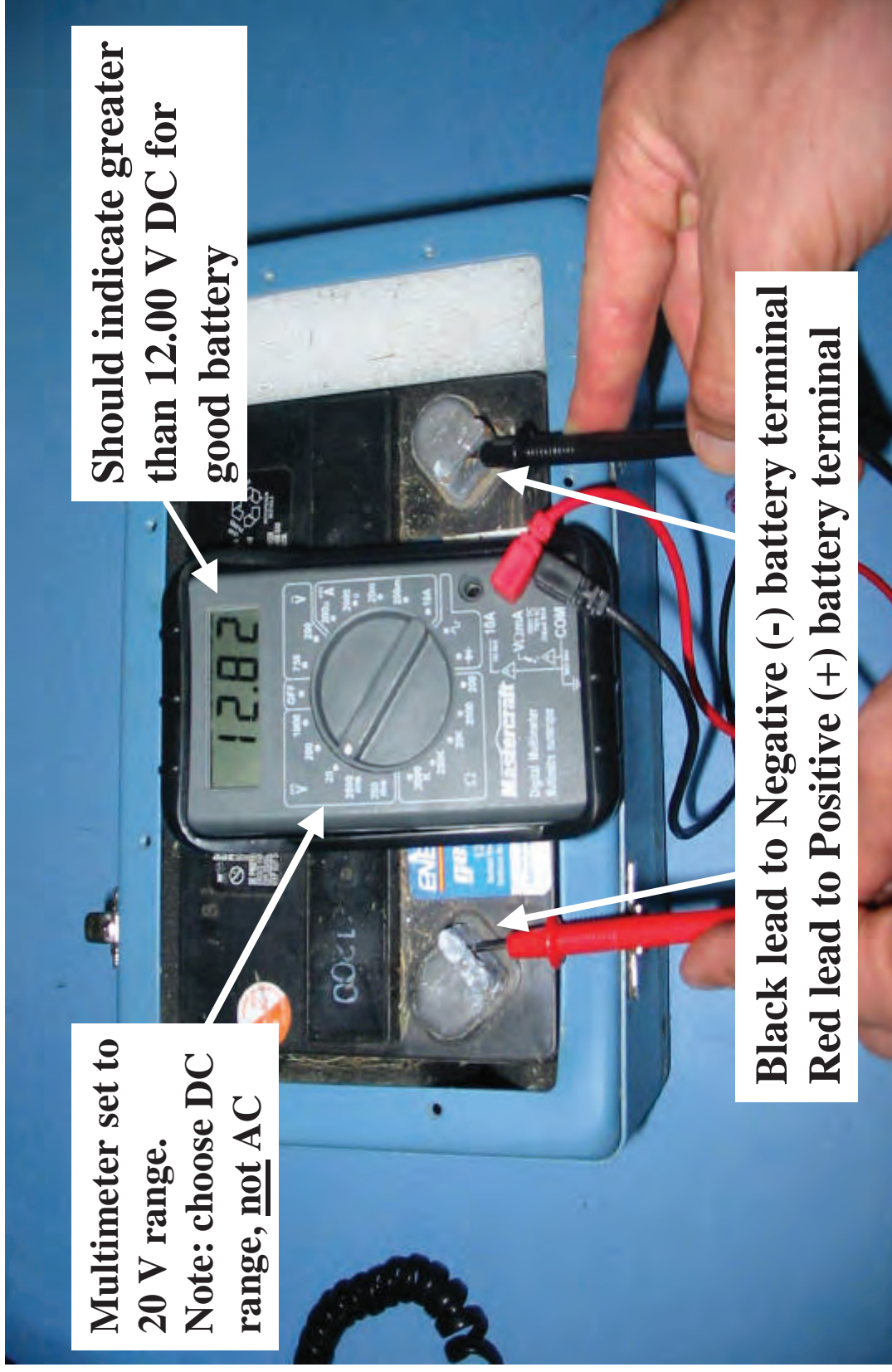




**Pic.1 Computer Interface Units, old and new:  
MPCI model 2522 (left) and MAGI model 2536 (right)**

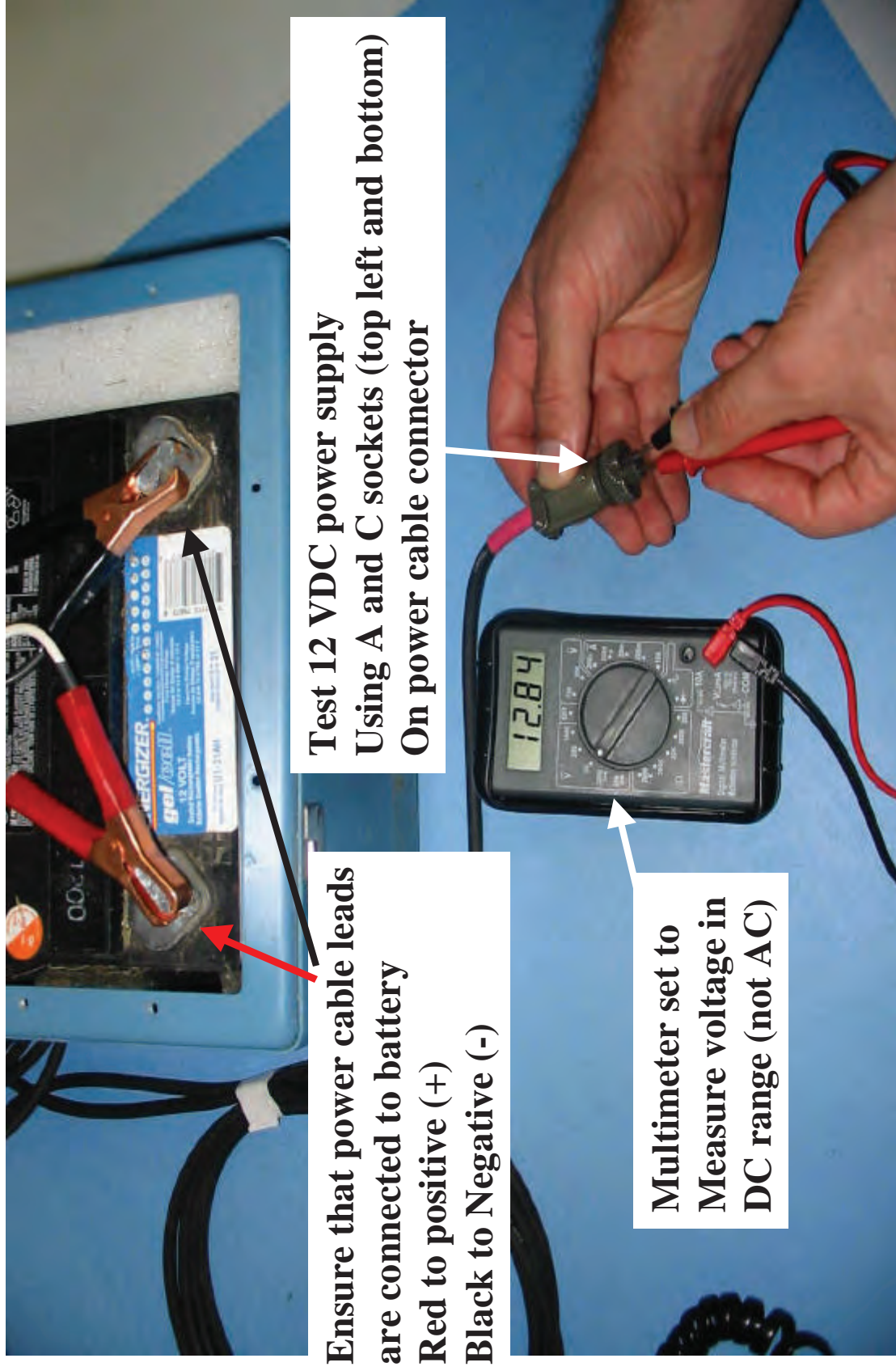


**Pic.2 MPCPI unit showing typical set-up configuration**

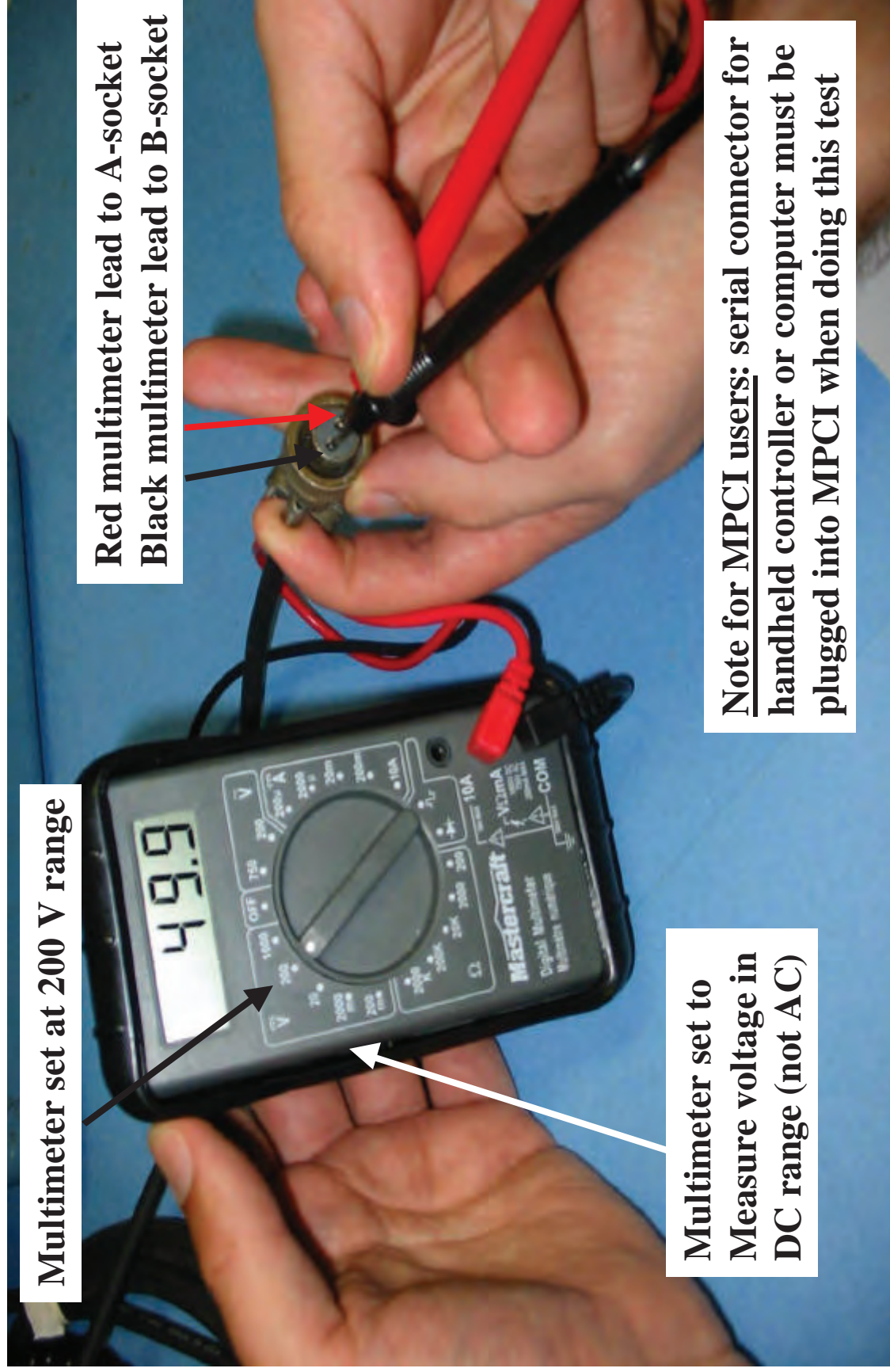


**Pic.3 Testing 12 VDC Power Supply using Multimeter**



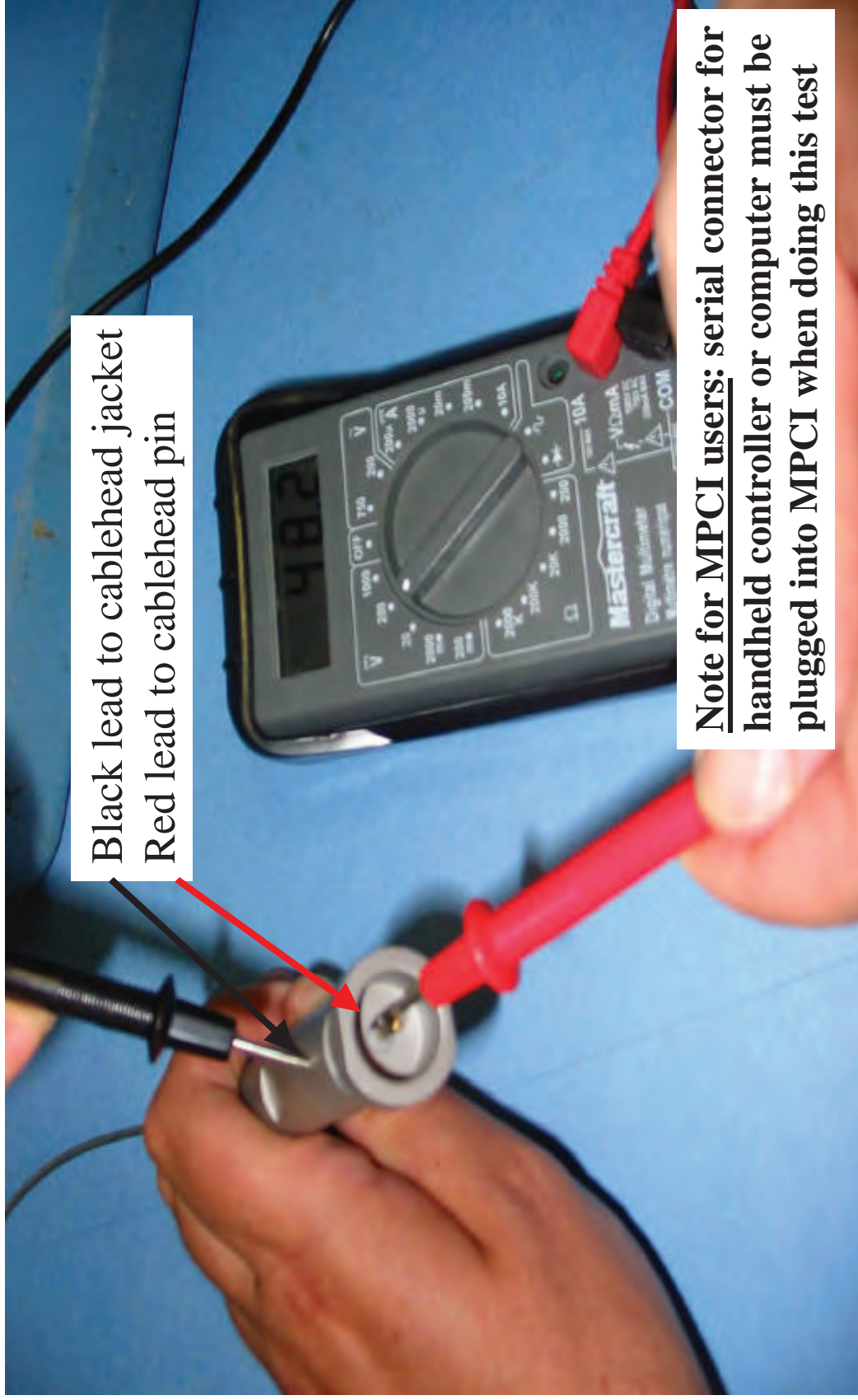


**Pic.4 Testing Power Cable Voltage**  
(should indicate greater than 12.00 V DC for good battery and cable)



**Pic.5**    **Testing Power output from MPCl or MAGI using data cable**  
**(should be greater than 48 V) Note: MPCl/MAGI must have**  
**power ‘on’ and be connected to power supply.**



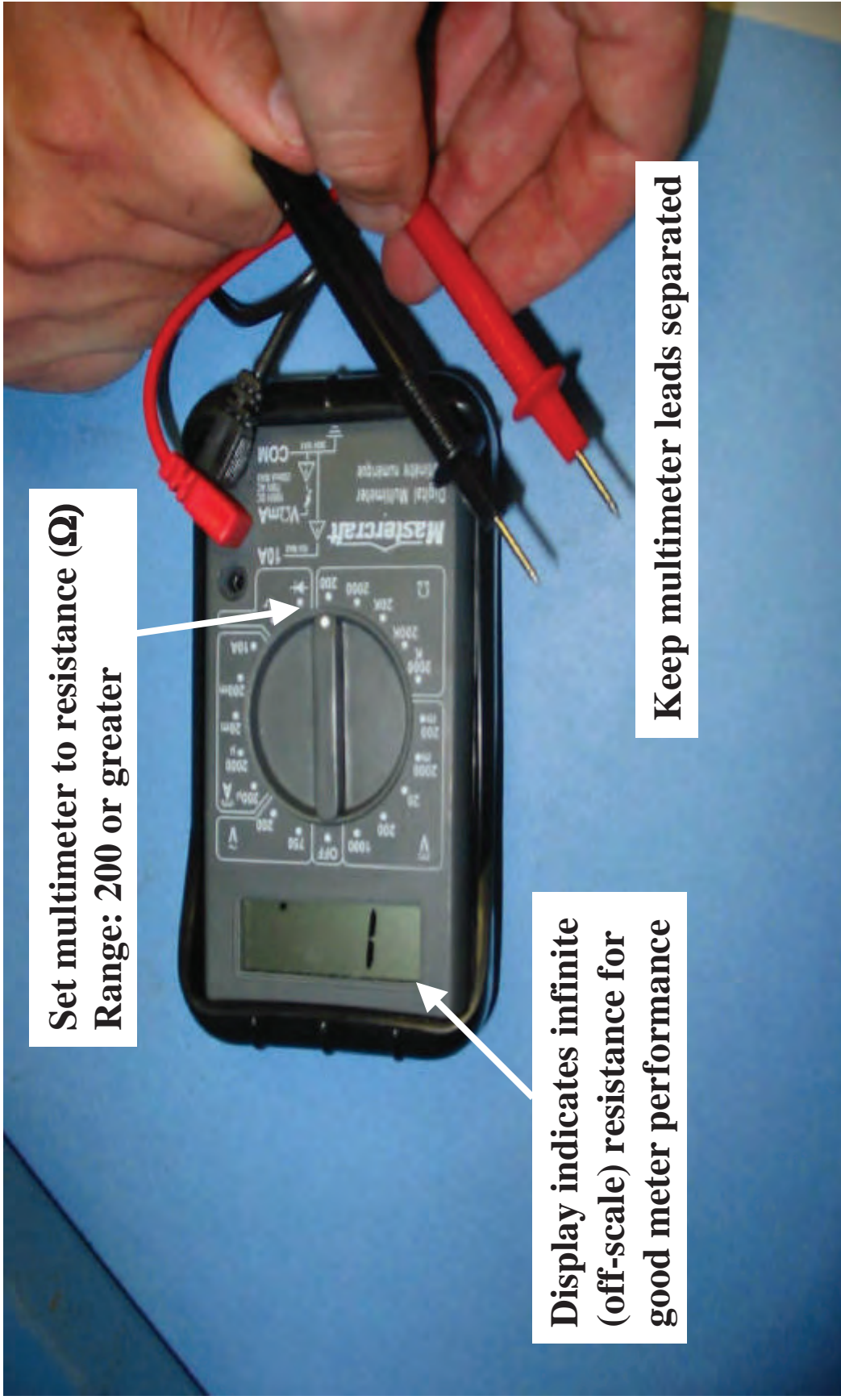


**Pic.6**

**Checking power output at cablehead (should be greater than 48 V)**

***Note: MPCl/MAGI must have power 'on' and be connected to power supply.***



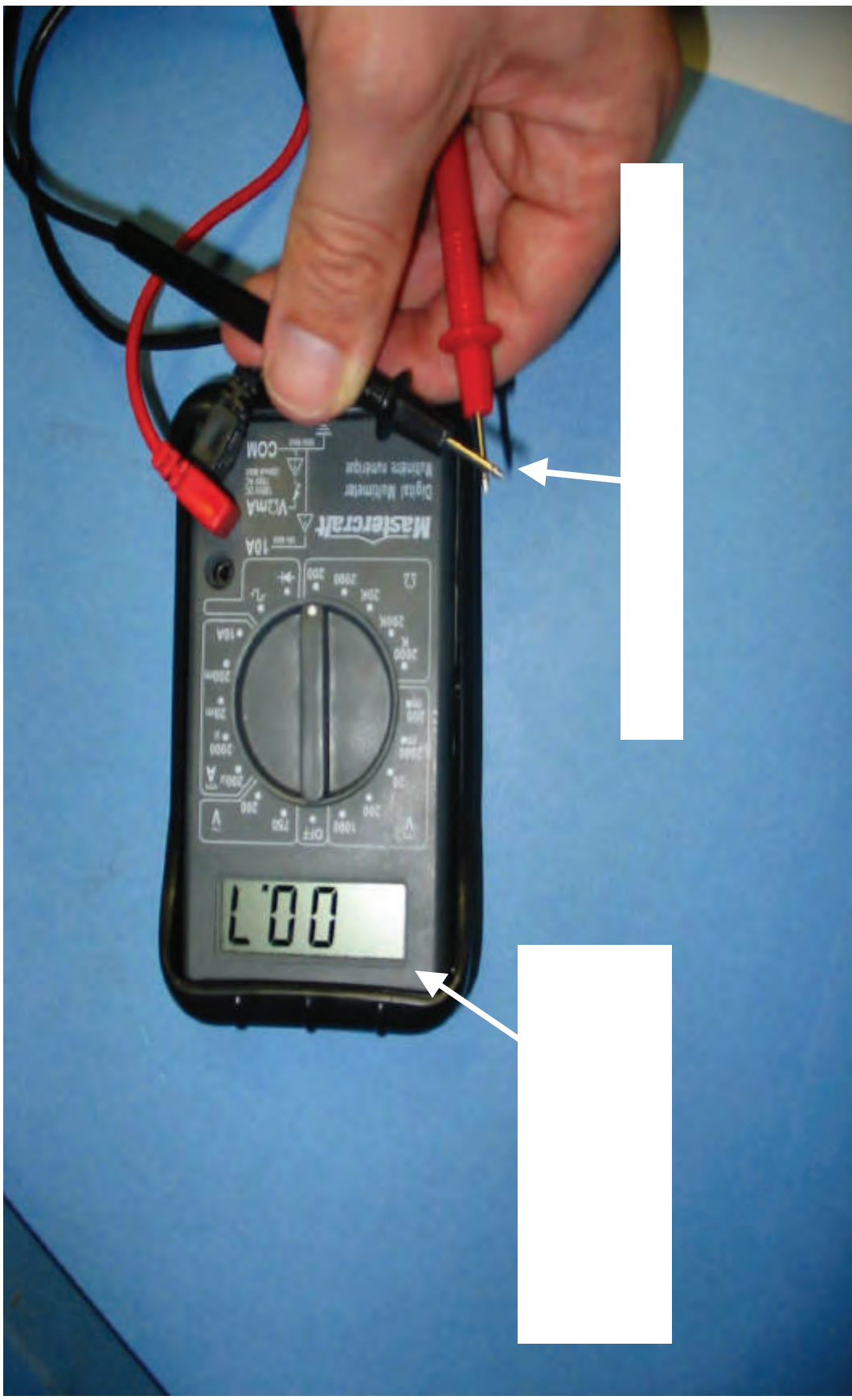


**Set multimeter to resistance ( $\Omega$ )  
Range: 200 or greater**

**Display indicates infinite  
(off-scale) resistance for  
good meter performance**

**Keep multimeter leads separated**

**Pic.7 Test multimeter “open” resistance**

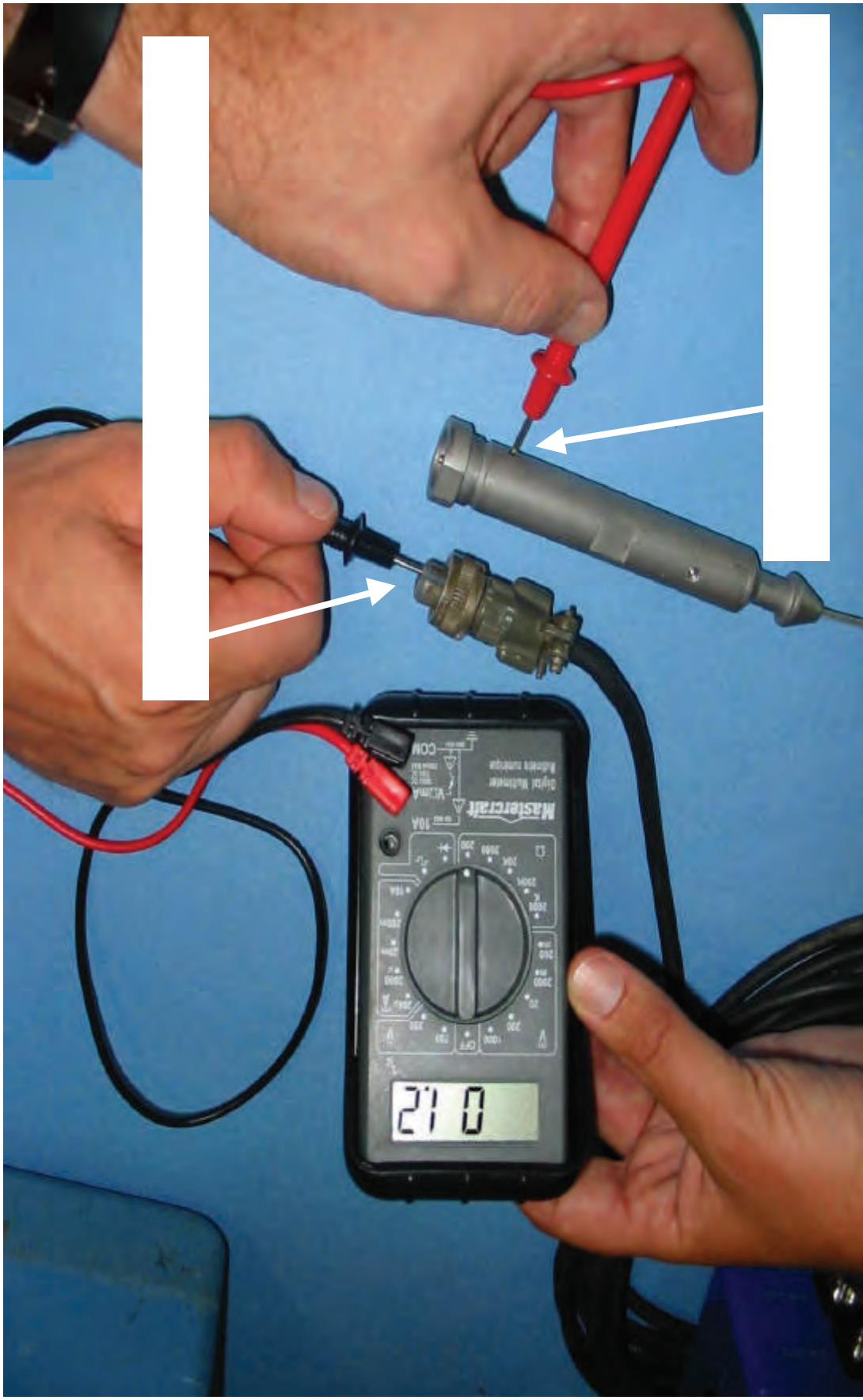


**Pic.8 Test multimeter “closed” resistance**



**Pic.9 Test wireline 'A-A' resistance (approx. 27  $\Omega$ /1000 ft)**





**Pic.10 Test wireline 'B-B' resistance (should be less than 'A-A')**

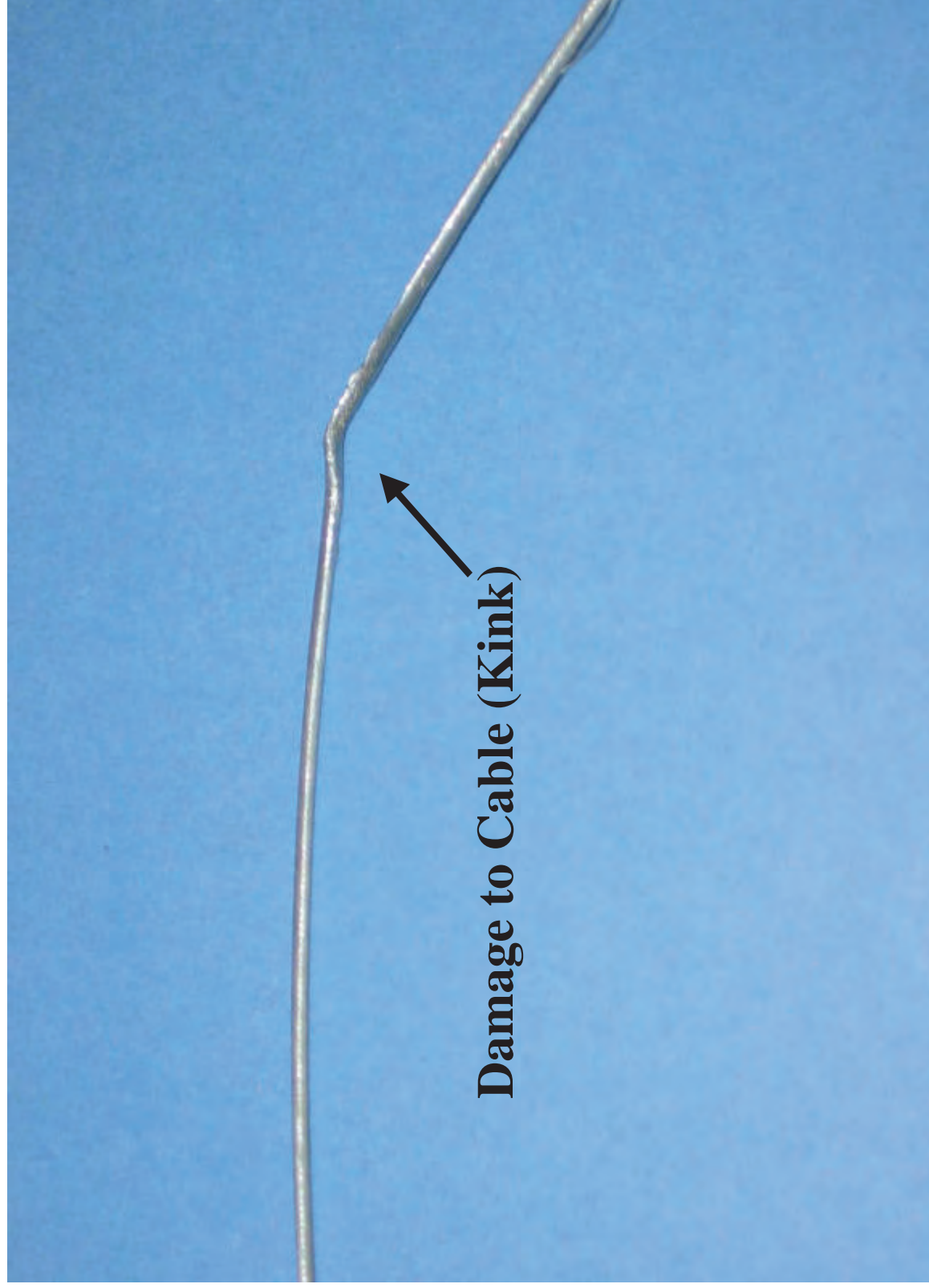


**Pic.11 Test wireline ‘A-B’ resistance at cablehead  
(should be off-scale)**



**Pic.11 Test wireline 'A-B' resistance at data cable (should be off-scale)**

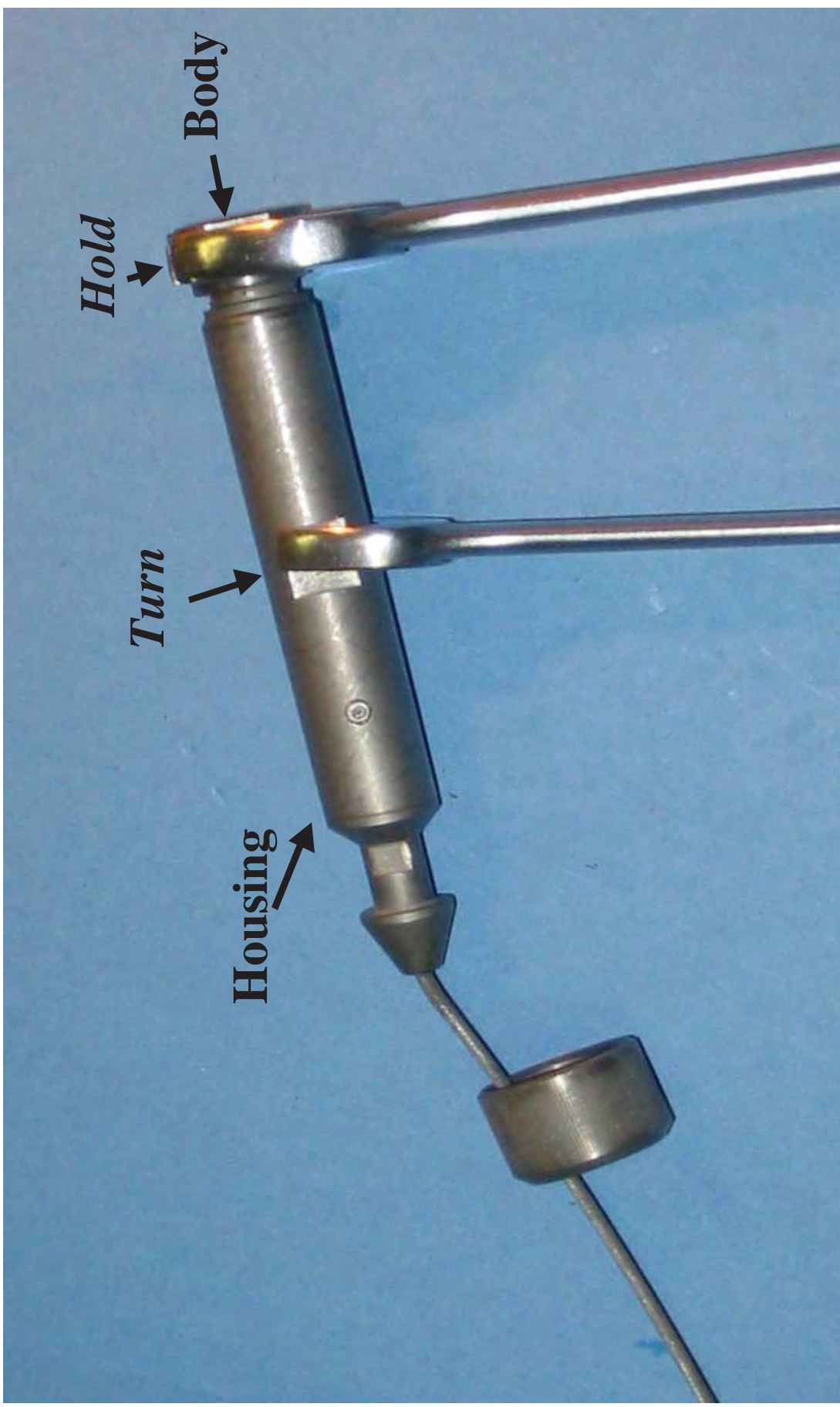




**Pic.1 Identification of Cable Damage**

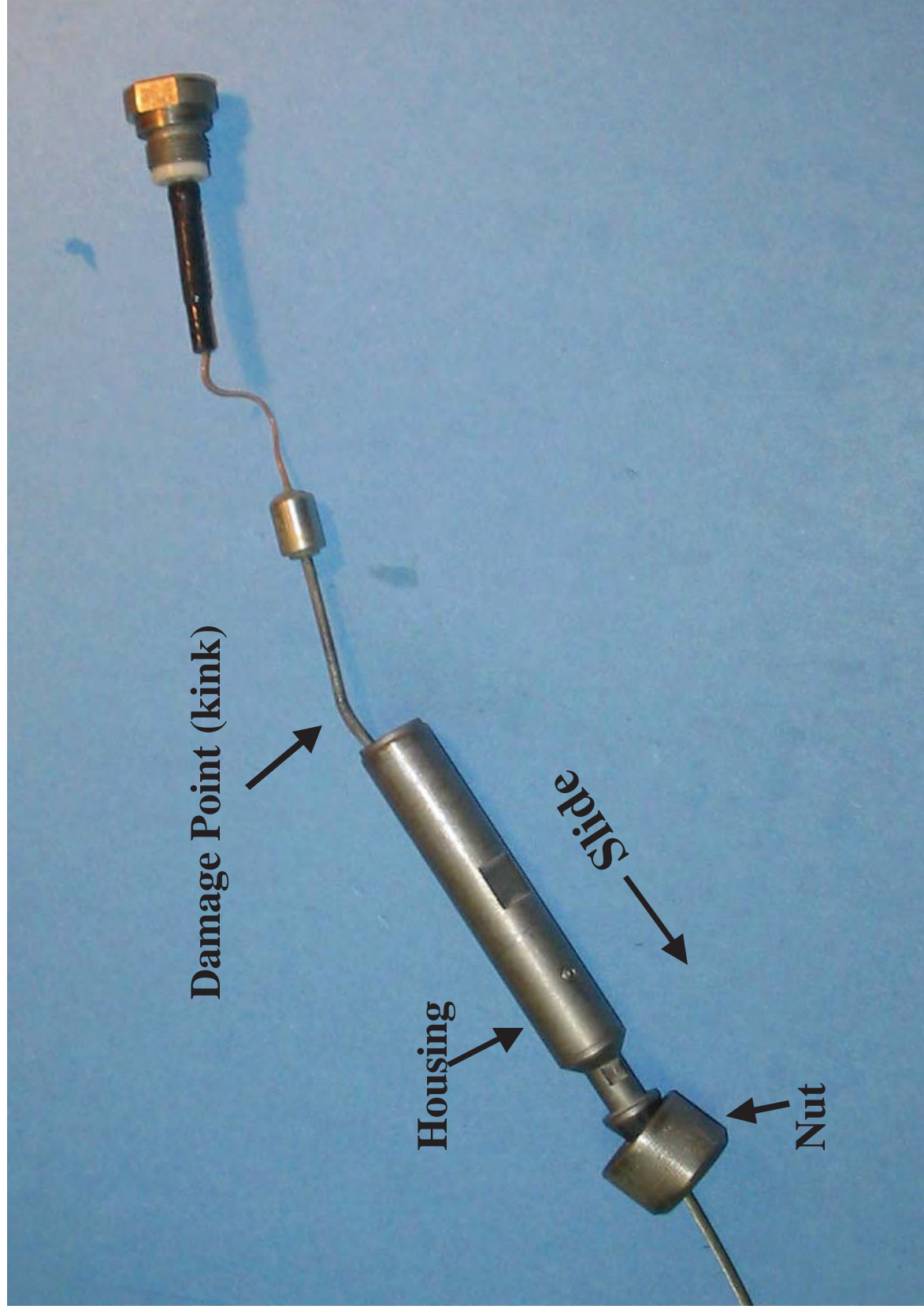


**Pic.2    Cablehead Disassembly (1): Loosen set Screws**

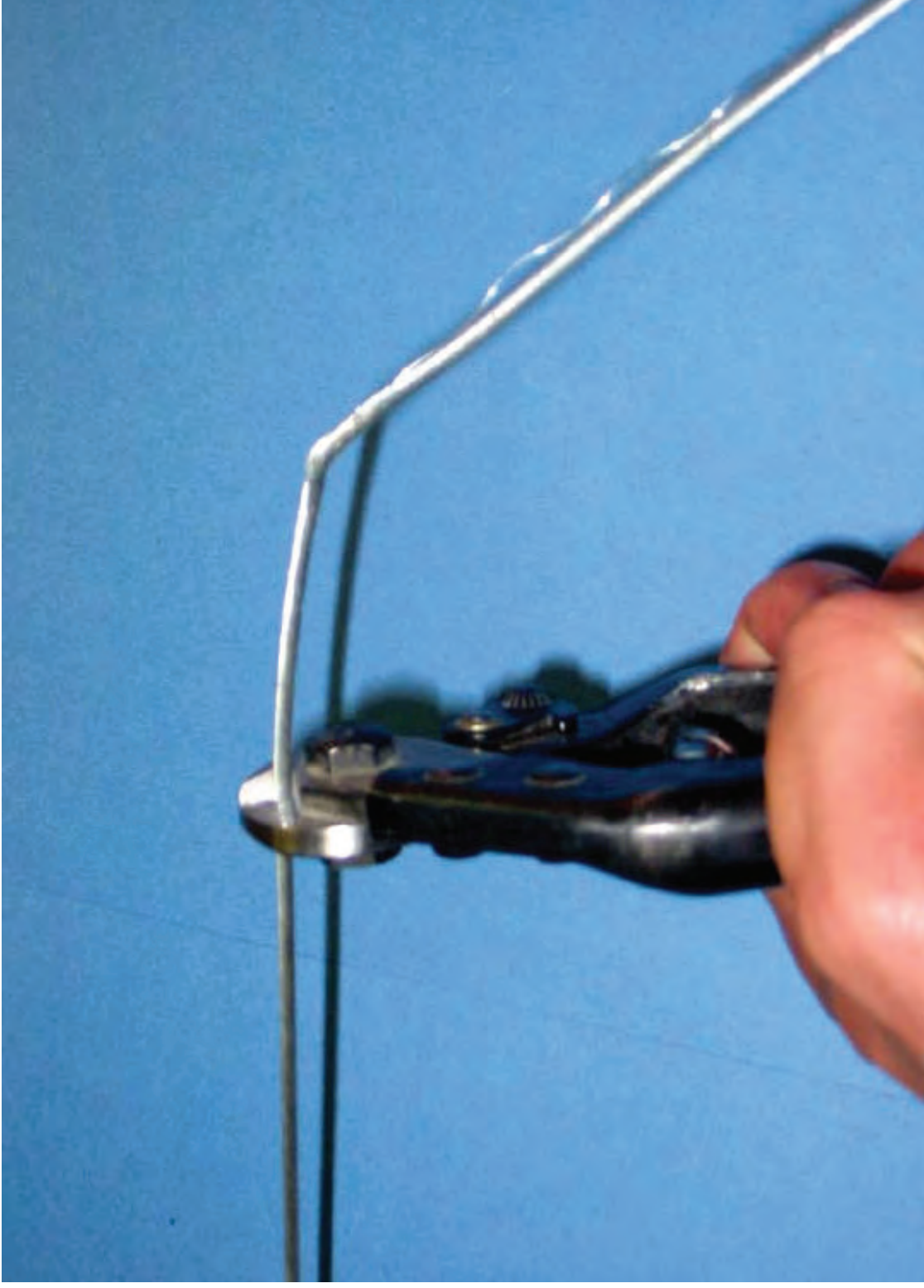


**Pic.3 Cablehead Disassembly(2): Unscrew Housing From Body**



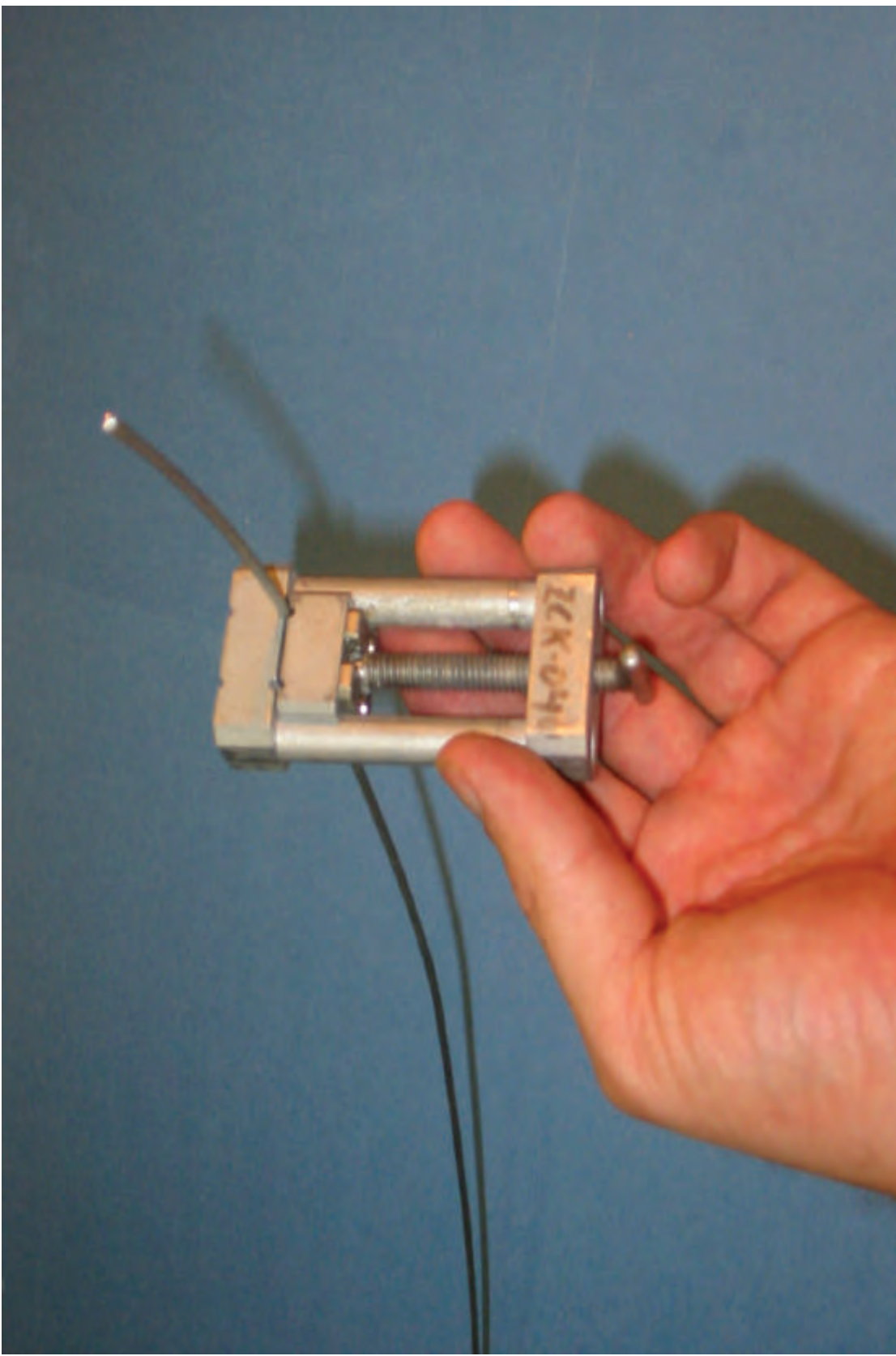


**Pic.4 Cablehead Disassembly(3):  
Slide Housing and Cablehead Nut Past Damage Point**

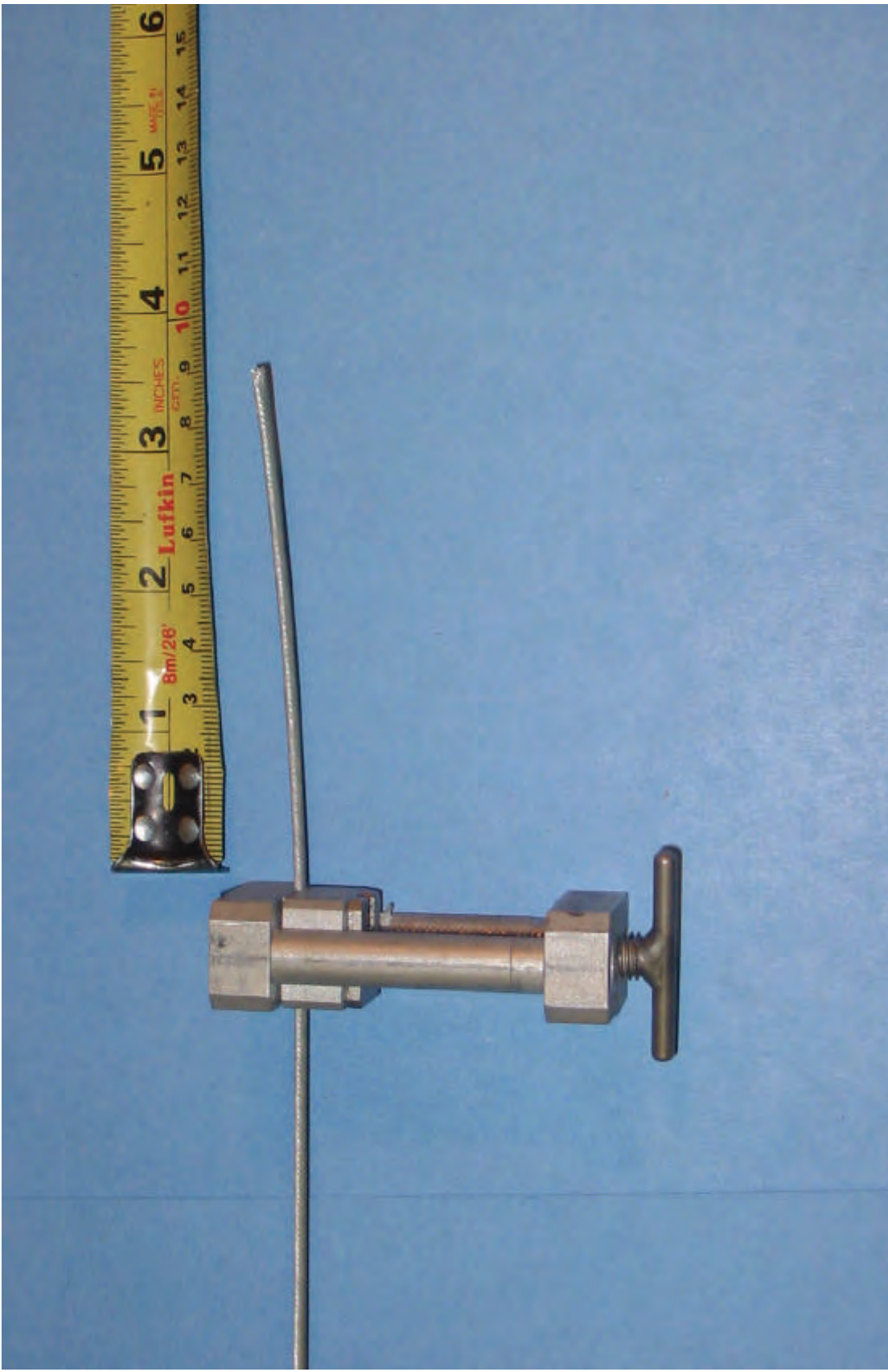


**Pic.5    Cut Cable above Damage Point**

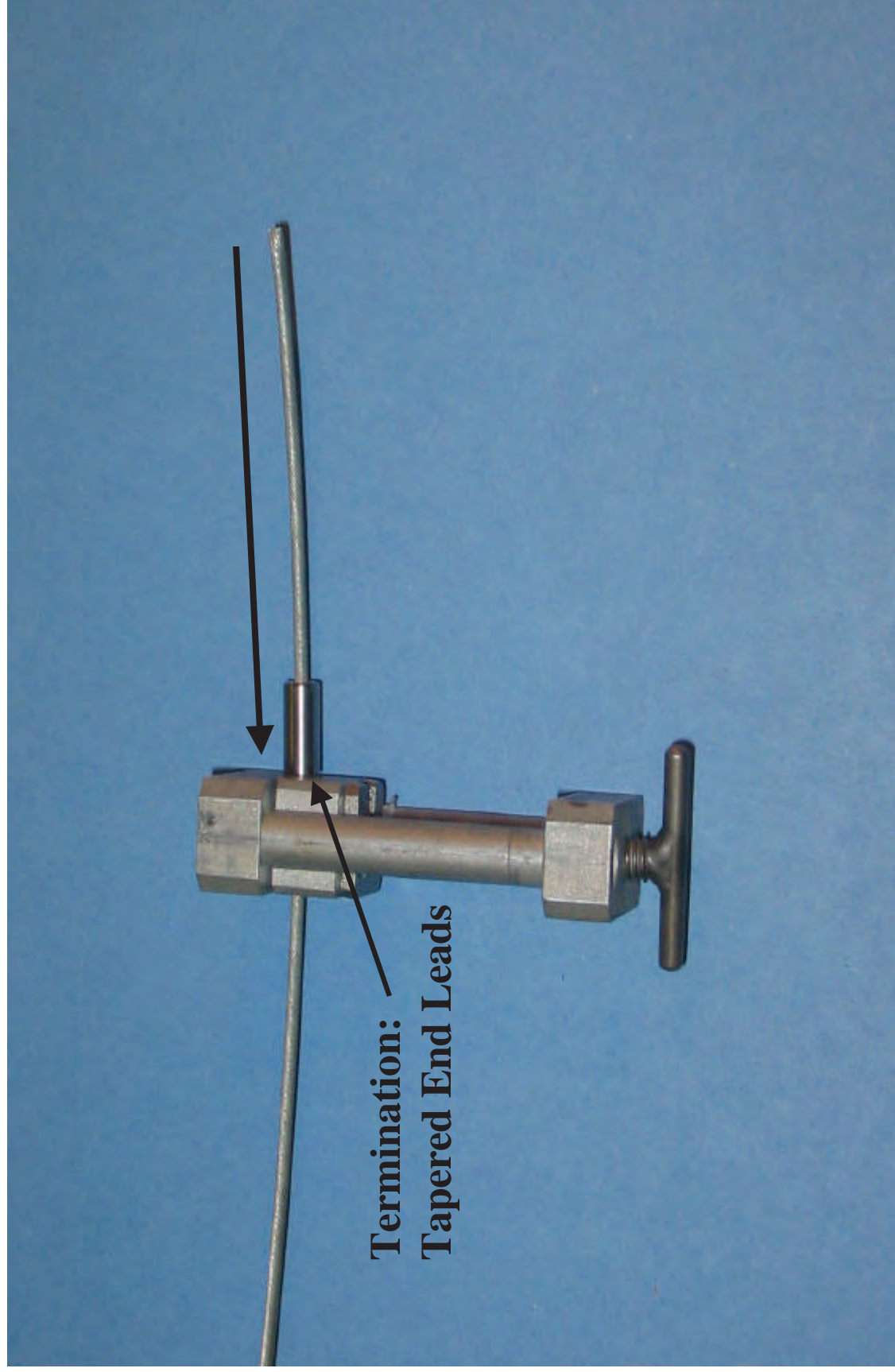




**Pic.6a    Clamp Cable in Termination Jig**

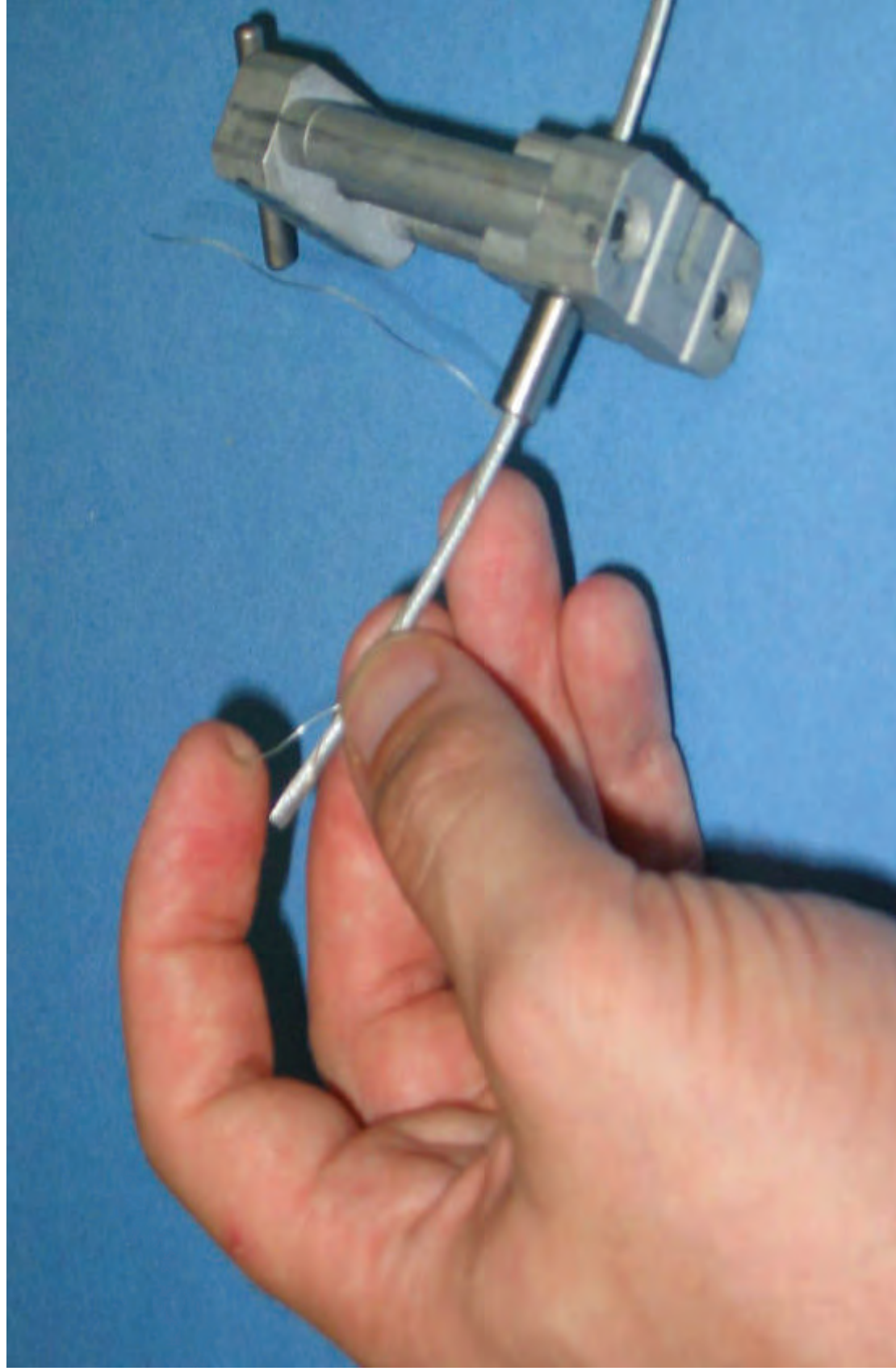


**Pic.6b   Leave 3.5 inches Cable Exposed**

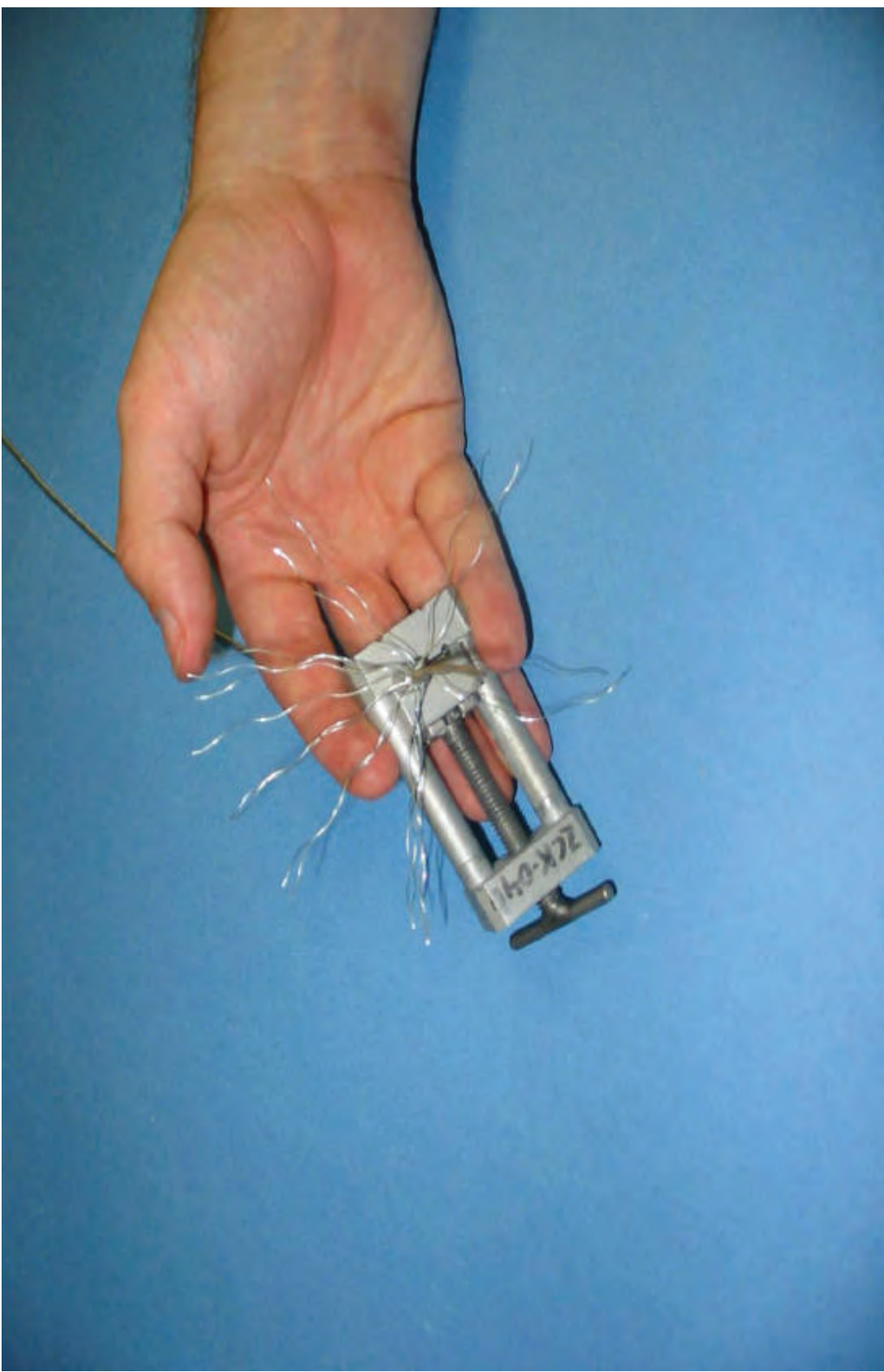


**Pic.6c Slide Termination Insert Over Cable**



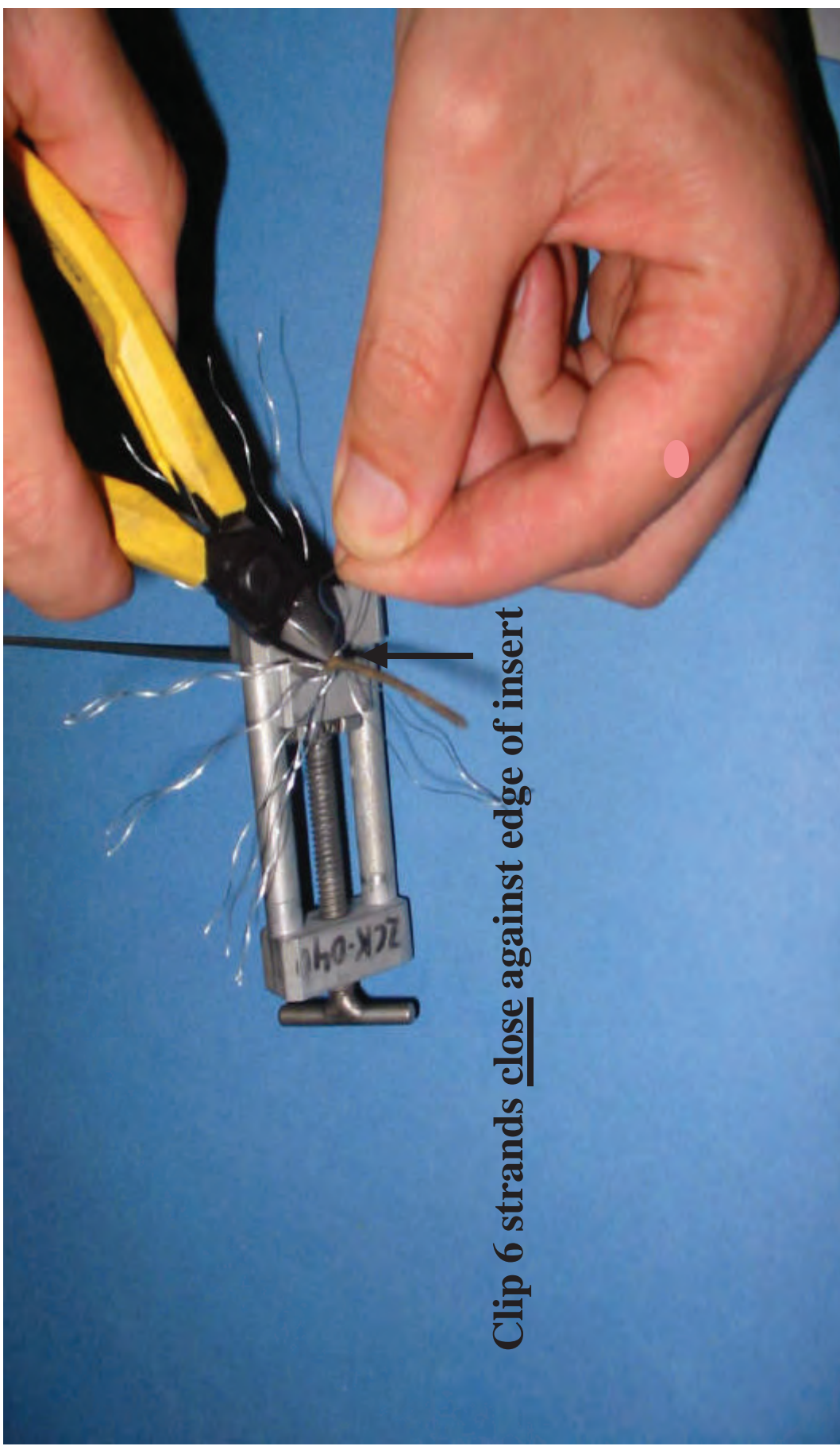


**Pic.7a    Unwind Outer-layer Strands (start)**

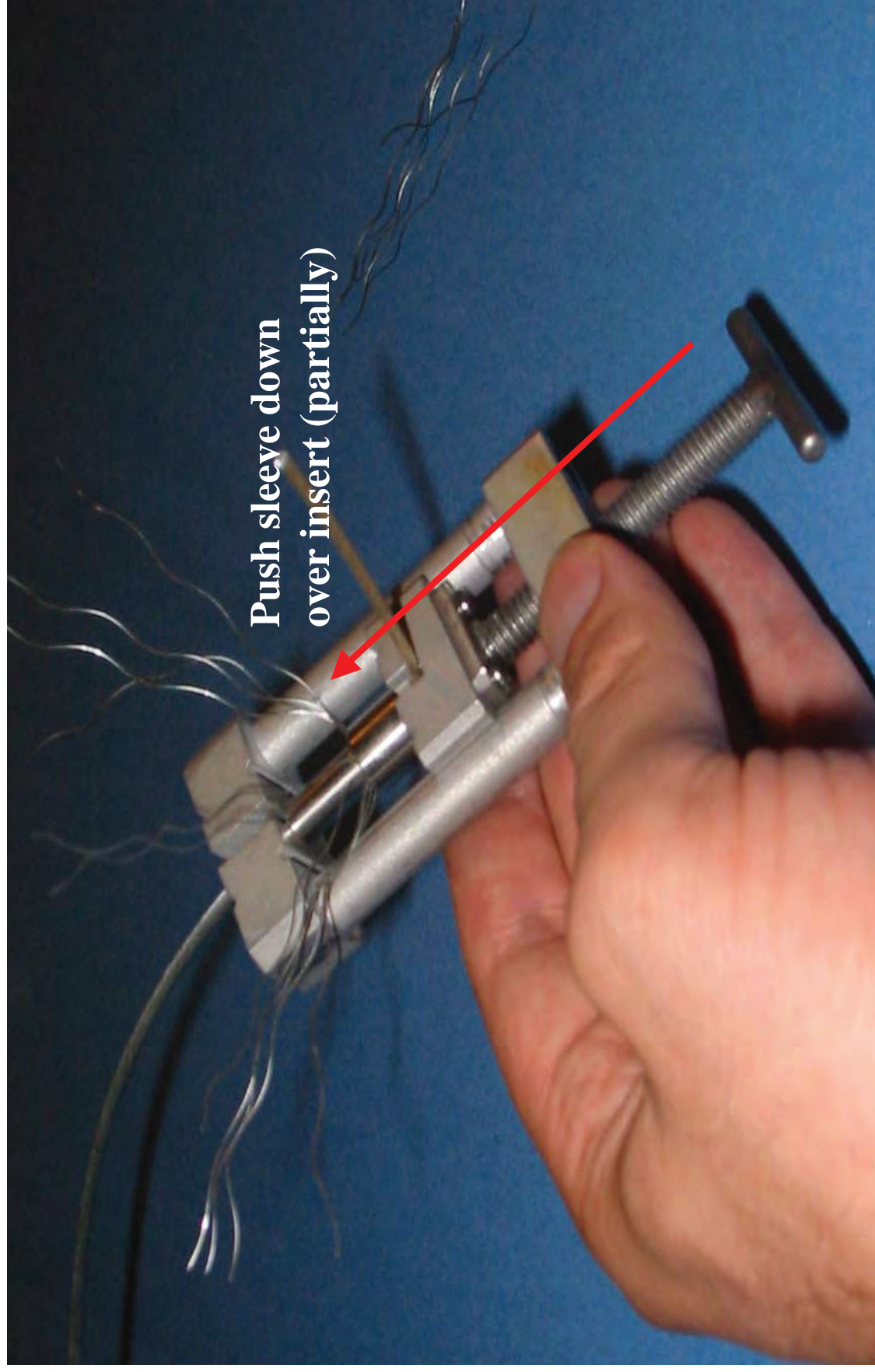


**Pic.7b Unwind Outer Layer Strands (finish)**





**Pic.8    Clipping Outer Wire Strands (6 strands out of 18)**

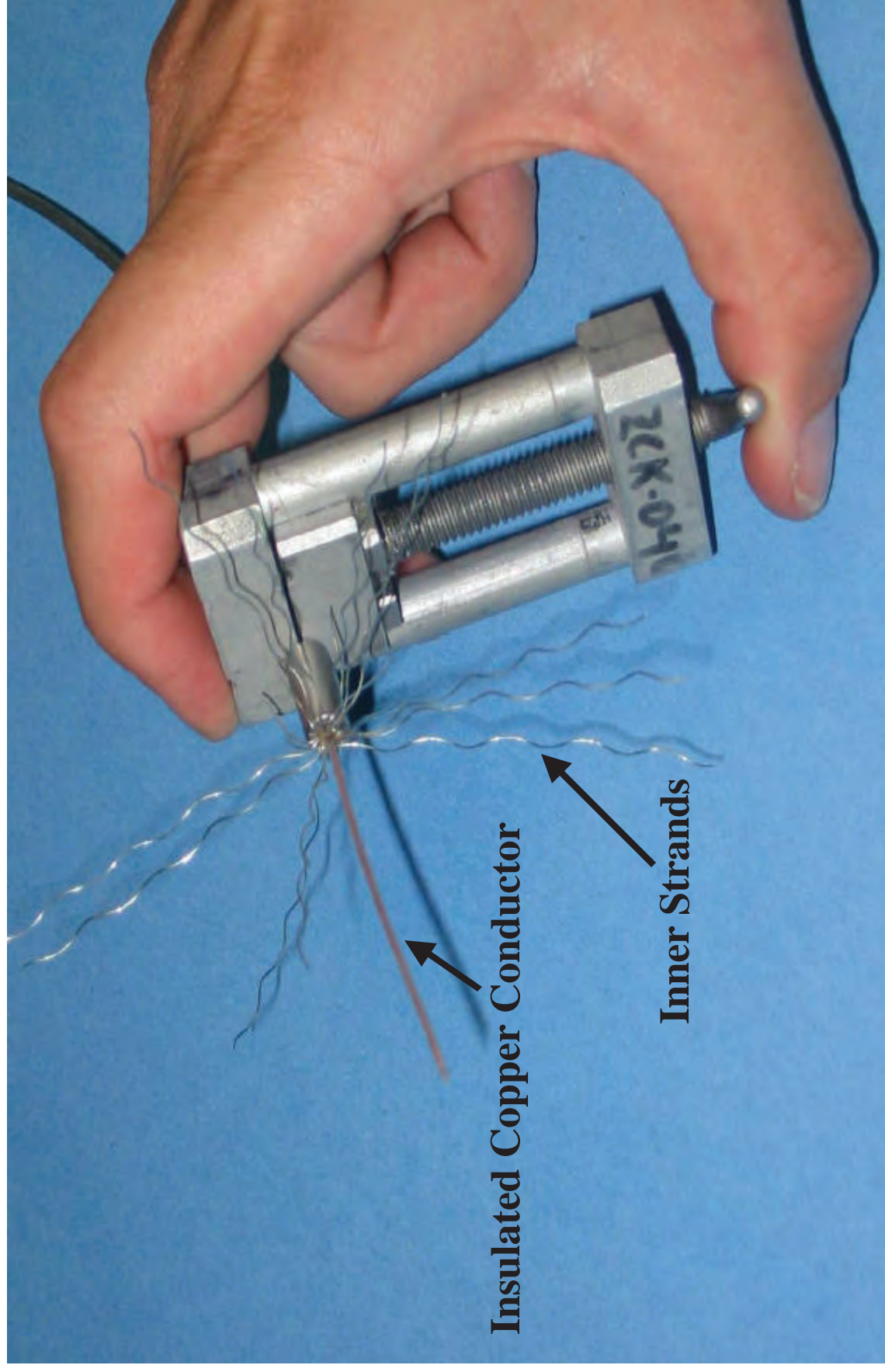


**Pic.9    Partially Push Sleeve Down on Insert Using Jig  
(enough to bend strands down along insert)**

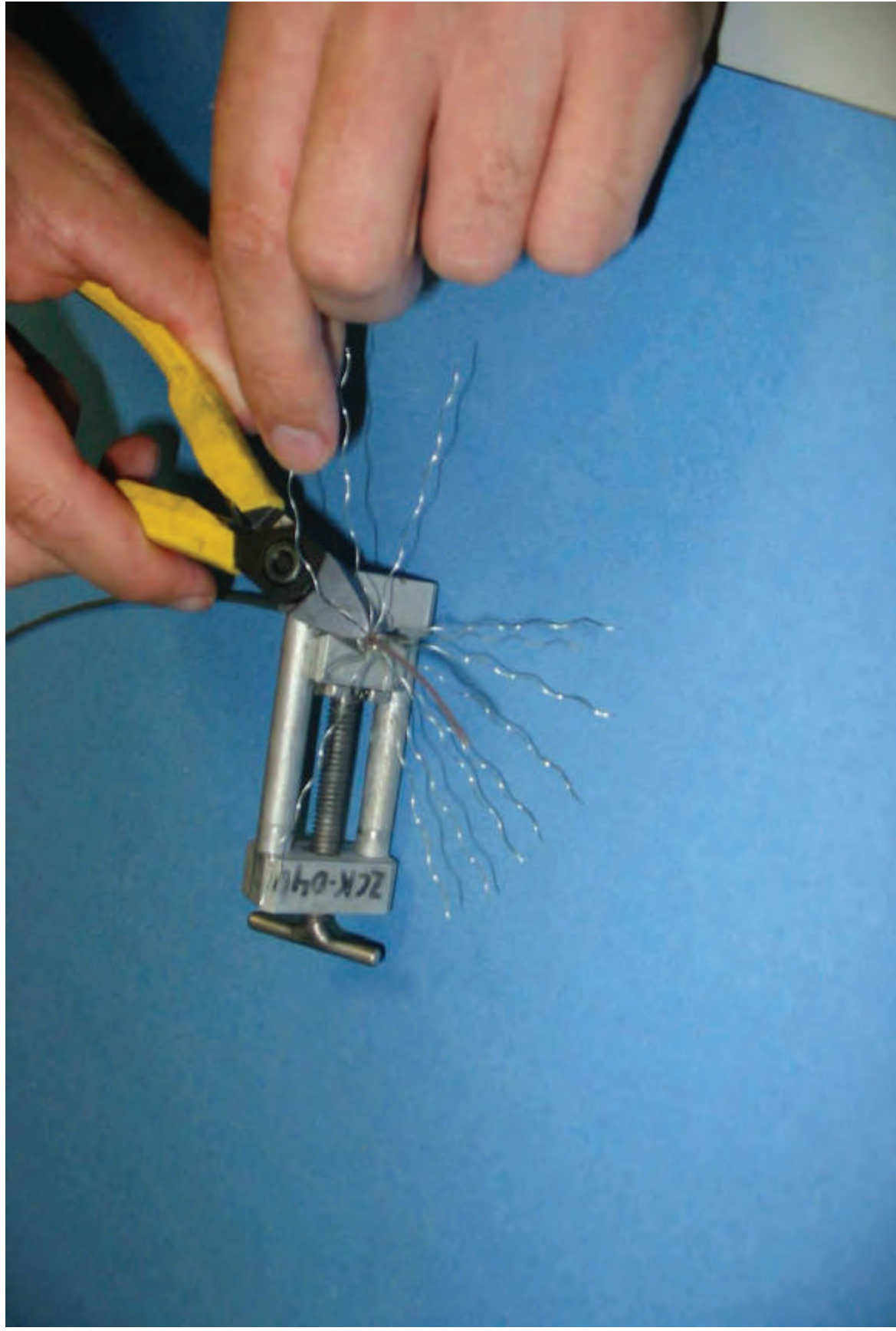


**Pic.10 Trim Outer Wire Strands to Base of Insert.**



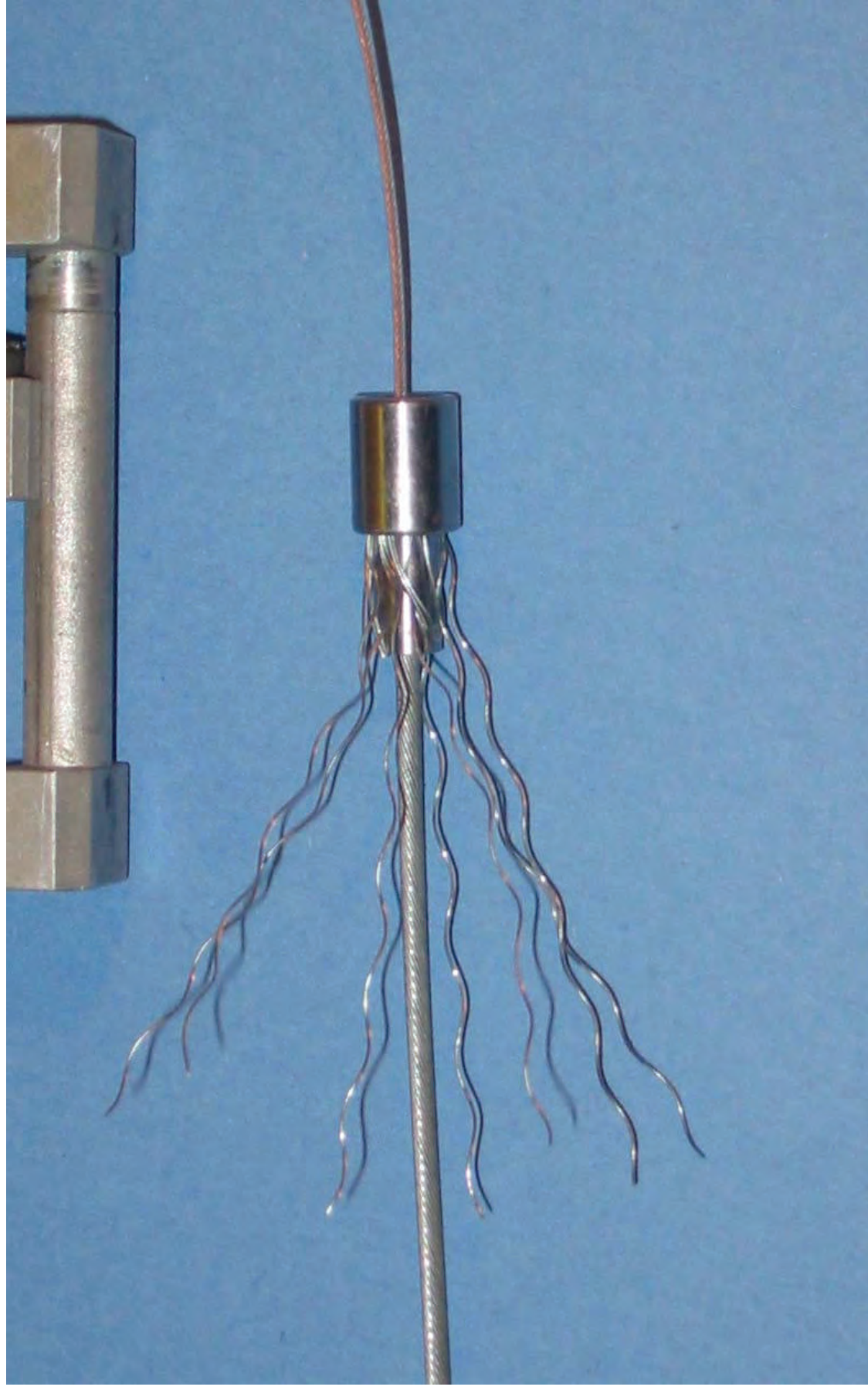


**Pic.11 Unwind inner-layer strands of armor  
(exposing the insulated conductor wire)**

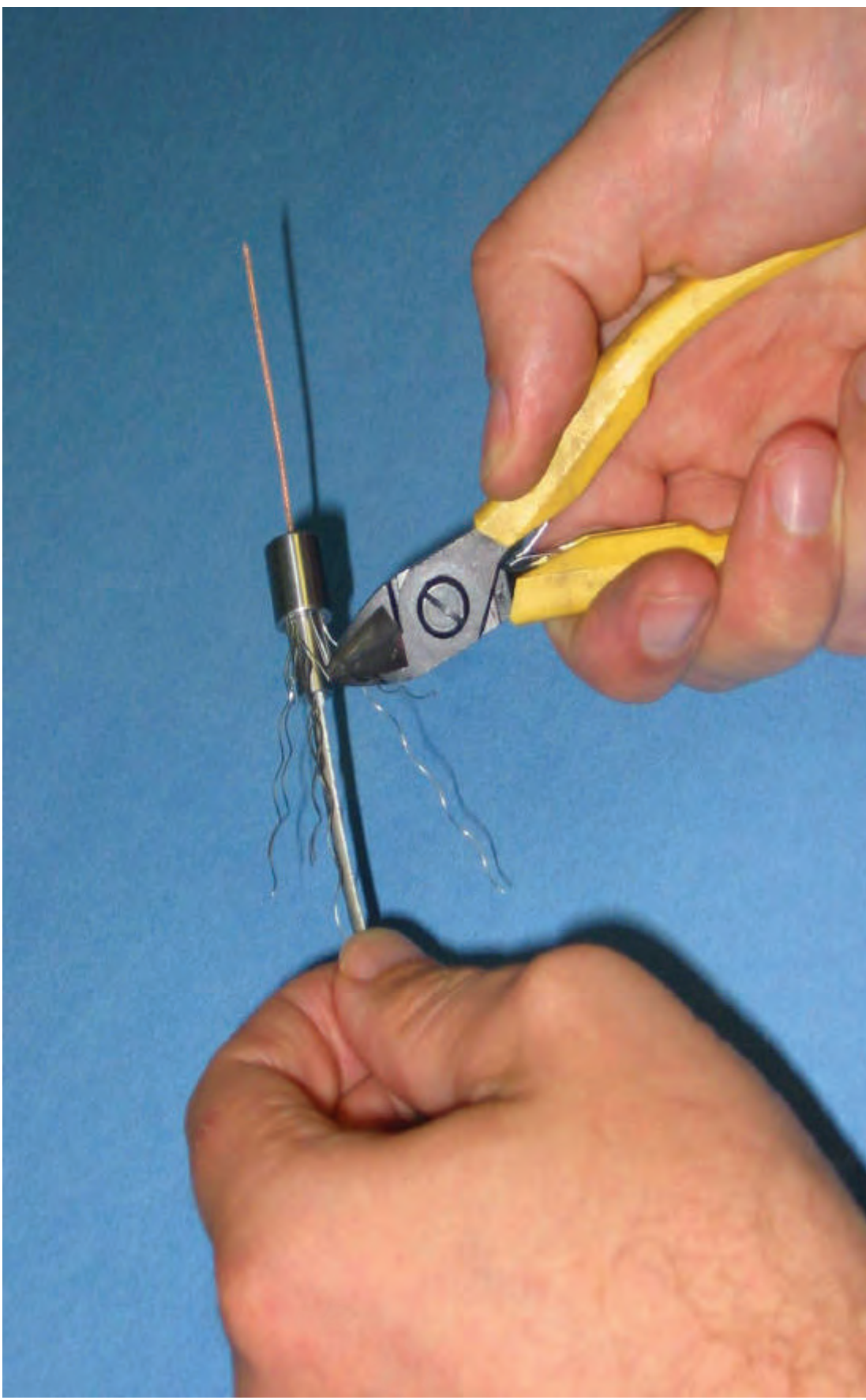


**Pic.12   Clip 5 of the 12 inner armor strands close to the top of the insert**





**Pic.13 Bend down Remaining Inner Wire Strands  
(Use jig and termination sleeve)**

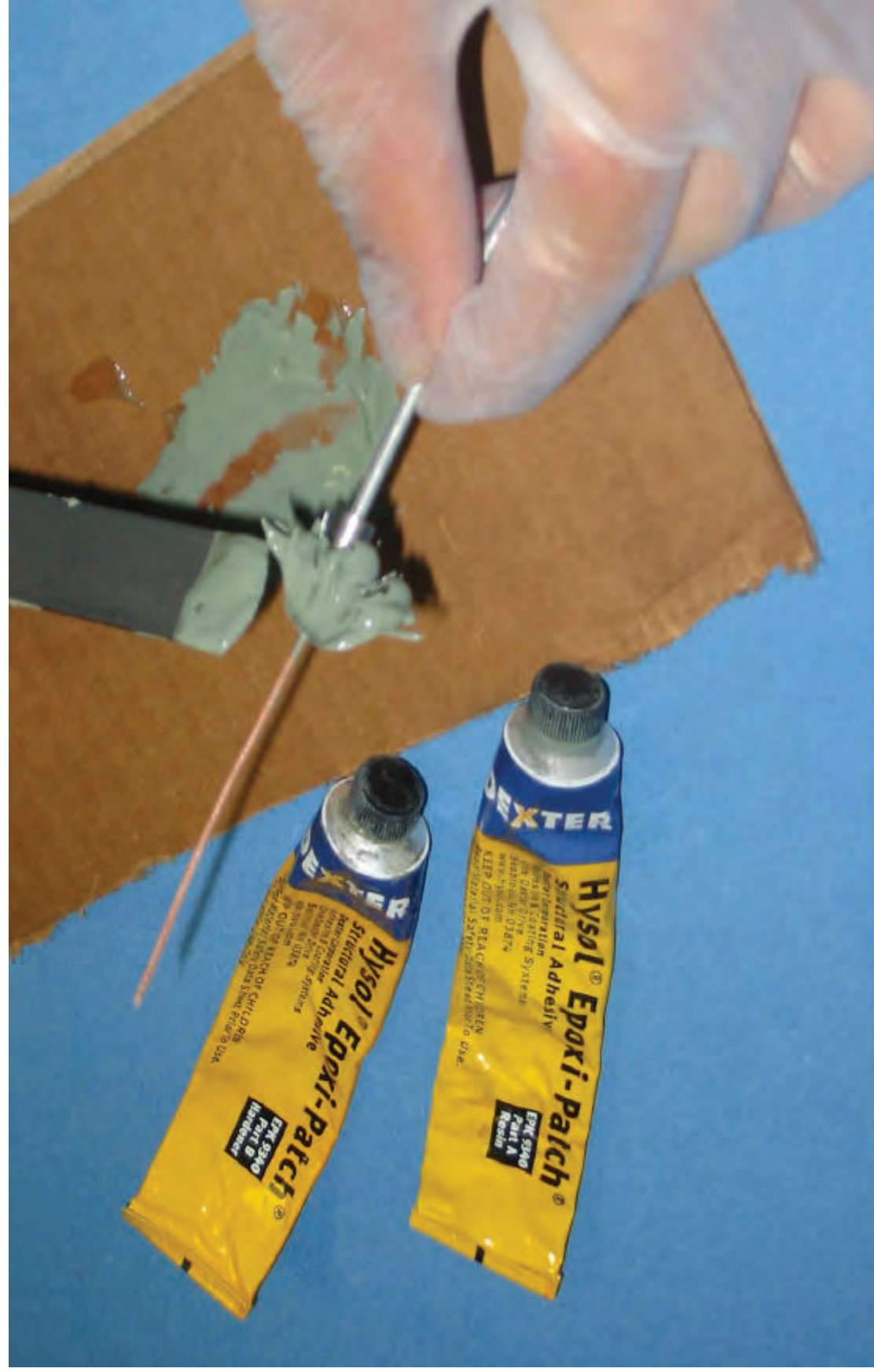


**Pic.13 Trim Inner Wire Strands to Base of Insert**

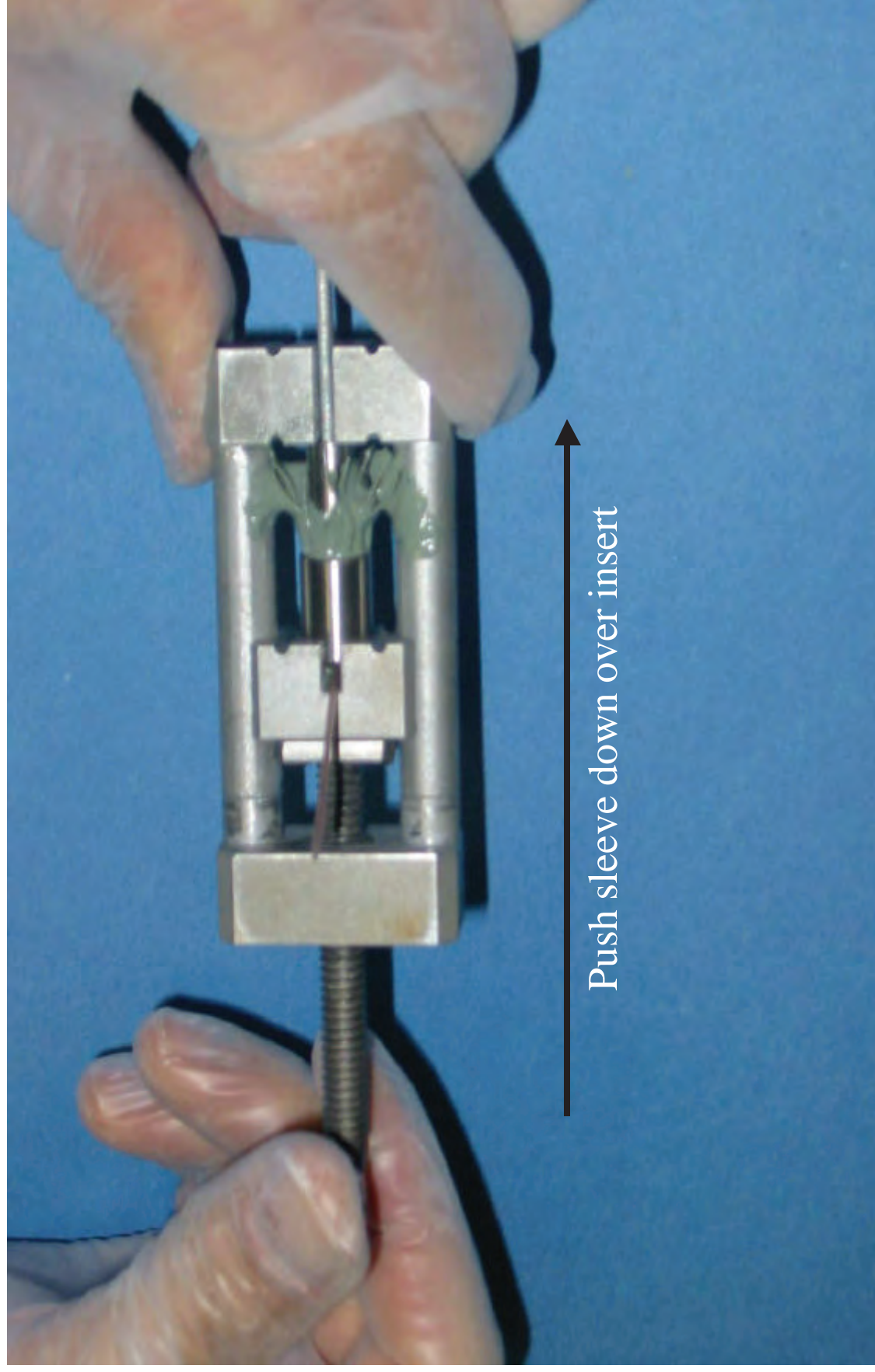




**Pic.14 Mix epoxy**



**Pic.15    Apply epoxy.    Cover the trimmed armor strands with epoxy**



**Pic.16 Using the termination jig, push the termination sleeve completely down over the insert**



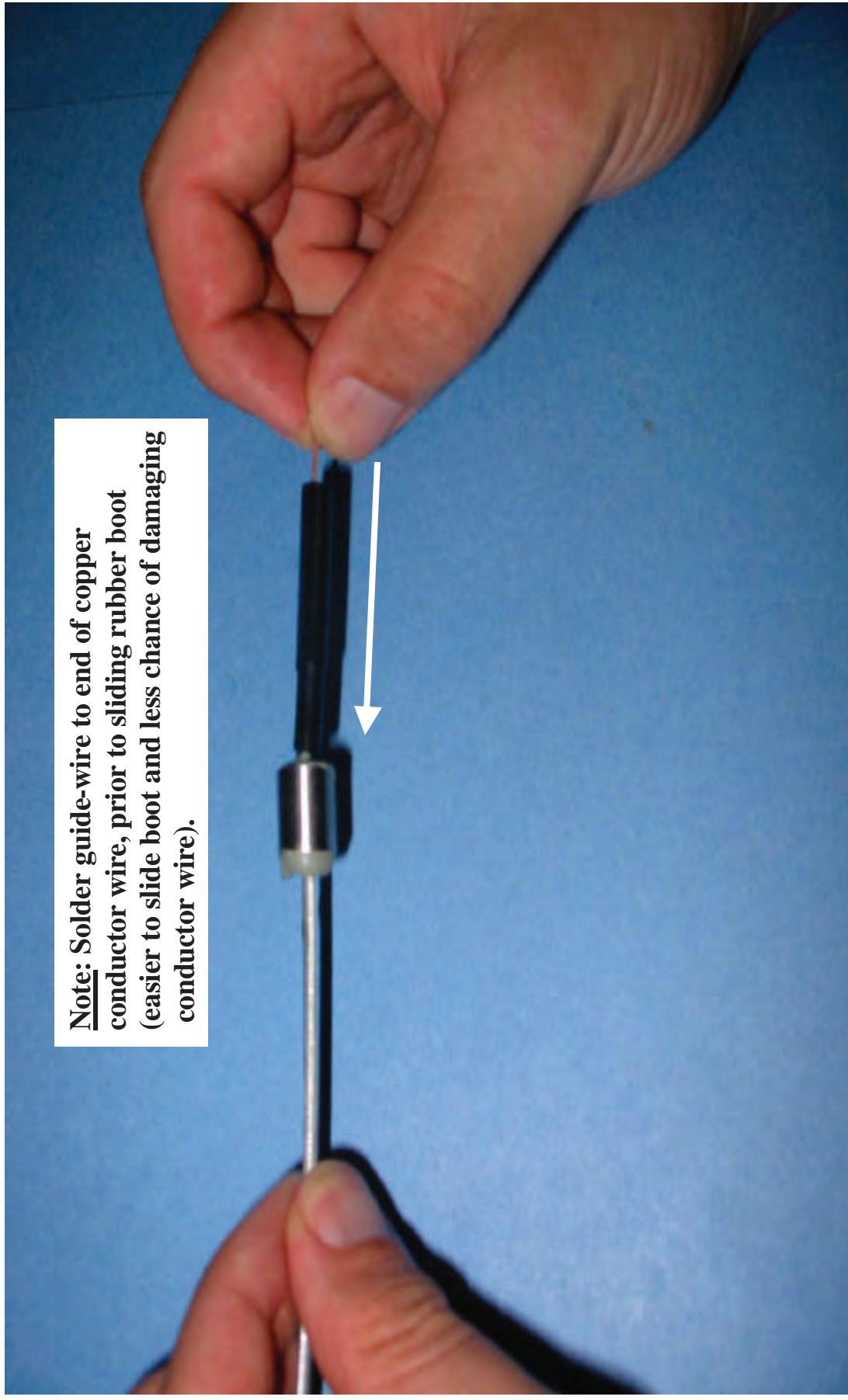


Remove From Jig, Wipe Off Excess Epoxy  
(making sure that both top and bottom of insert  
are well-sealed) and let cure (typically 24 hours).

**Pic.17 Termination Sleeve completely pushed down over insert**

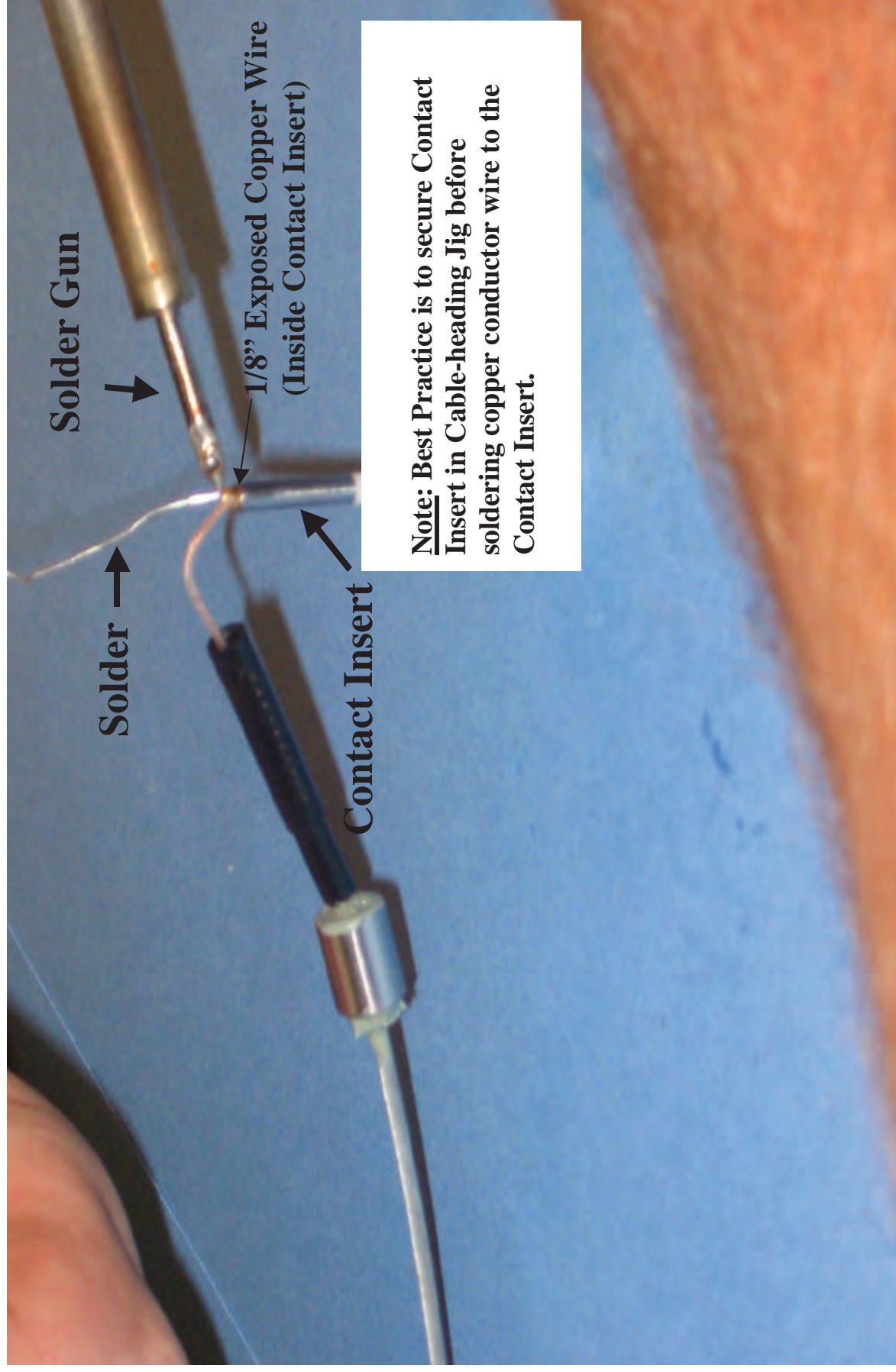


**Pic.18    Apply silicon lubricant to the insulated conductor wire**

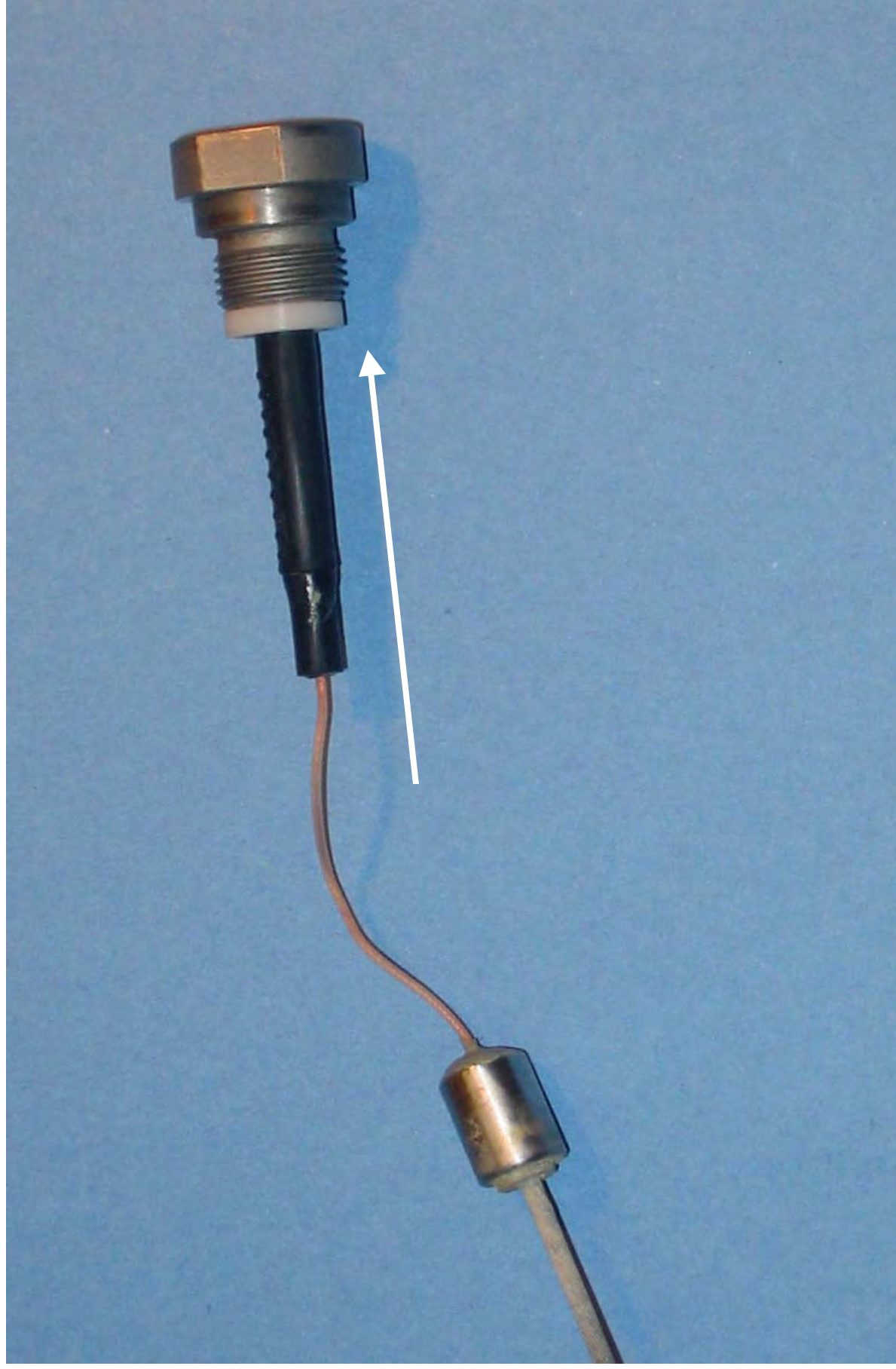


**Pic.20** Slide the rubber boot towards the cablehead termination (final position)



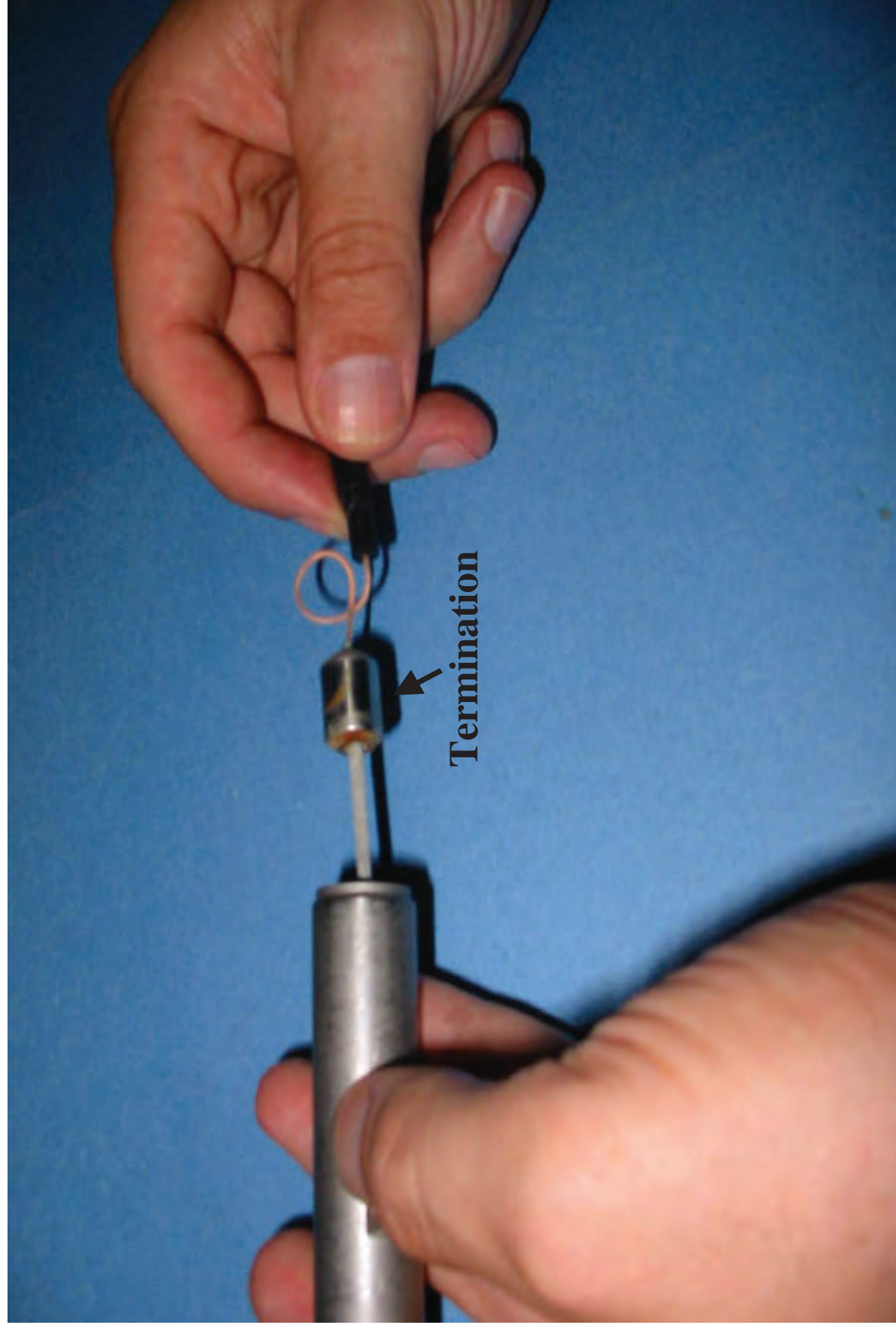


**Pic.21 Solder 1/8 inch exposed copper wire (use wire strippers) into contact insert**



**Pic.22** Slide the rubber boot down over the contact insert  
(when the solder has cooled)



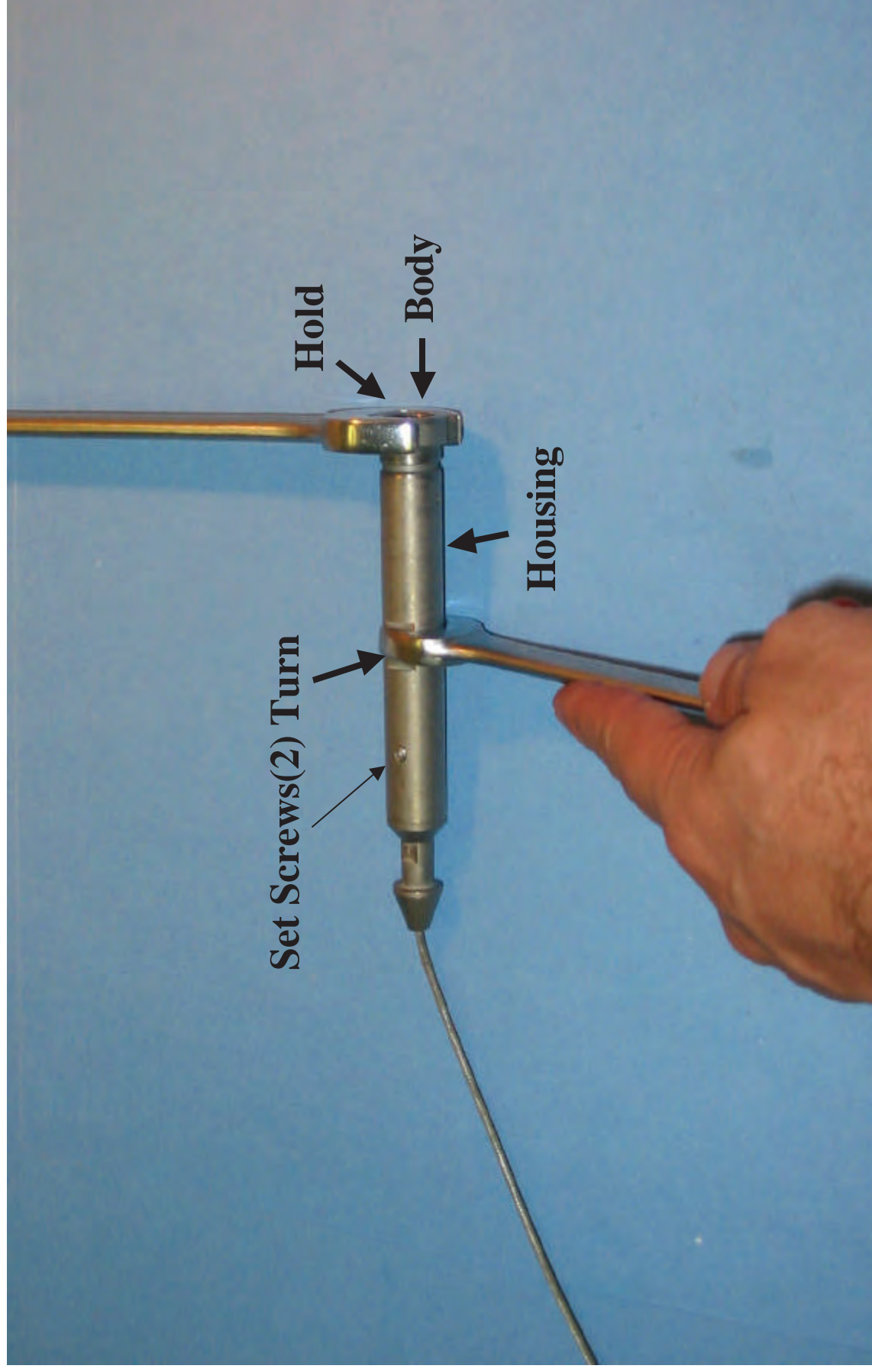


**Pic.23** Create a loop in the conductor wire before sliding the cablehead housing down over the termination

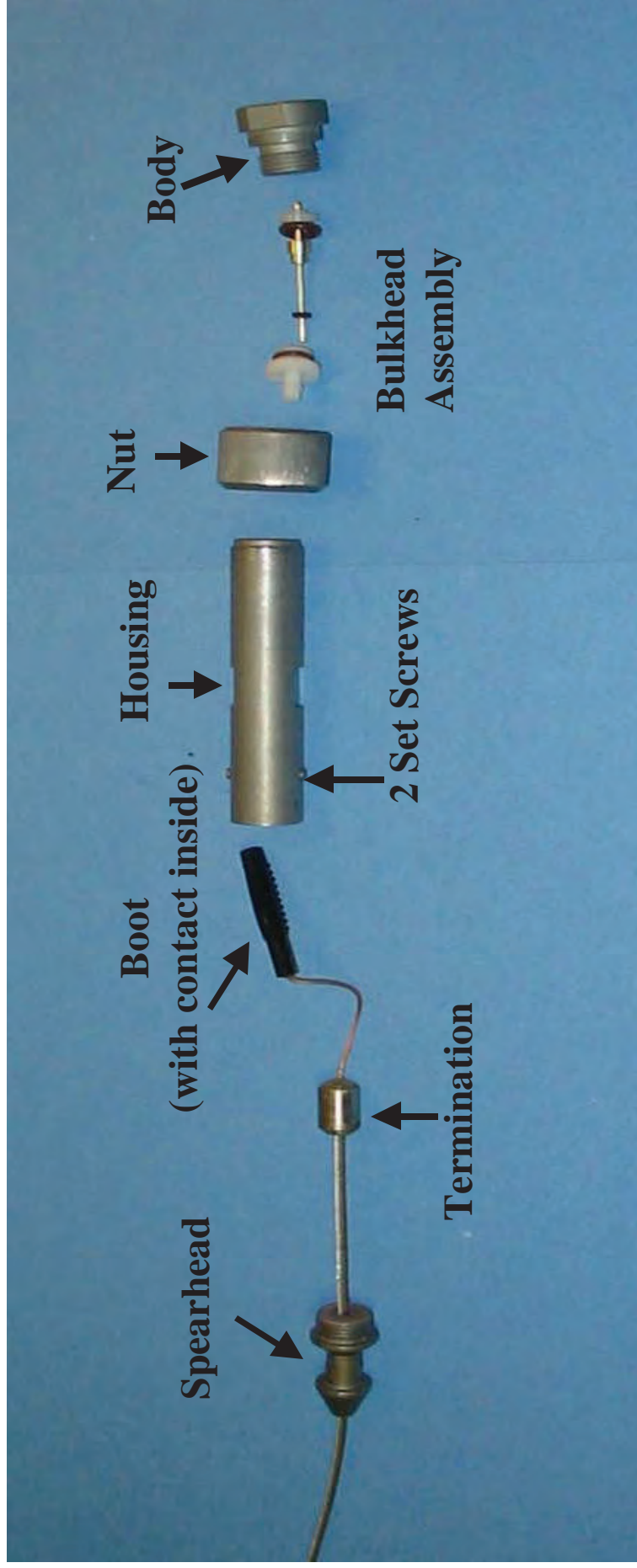


**Pic.24 Thread the cablehead housing onto the body  
(Do not twist the body! –this can damage the conductor wire)**

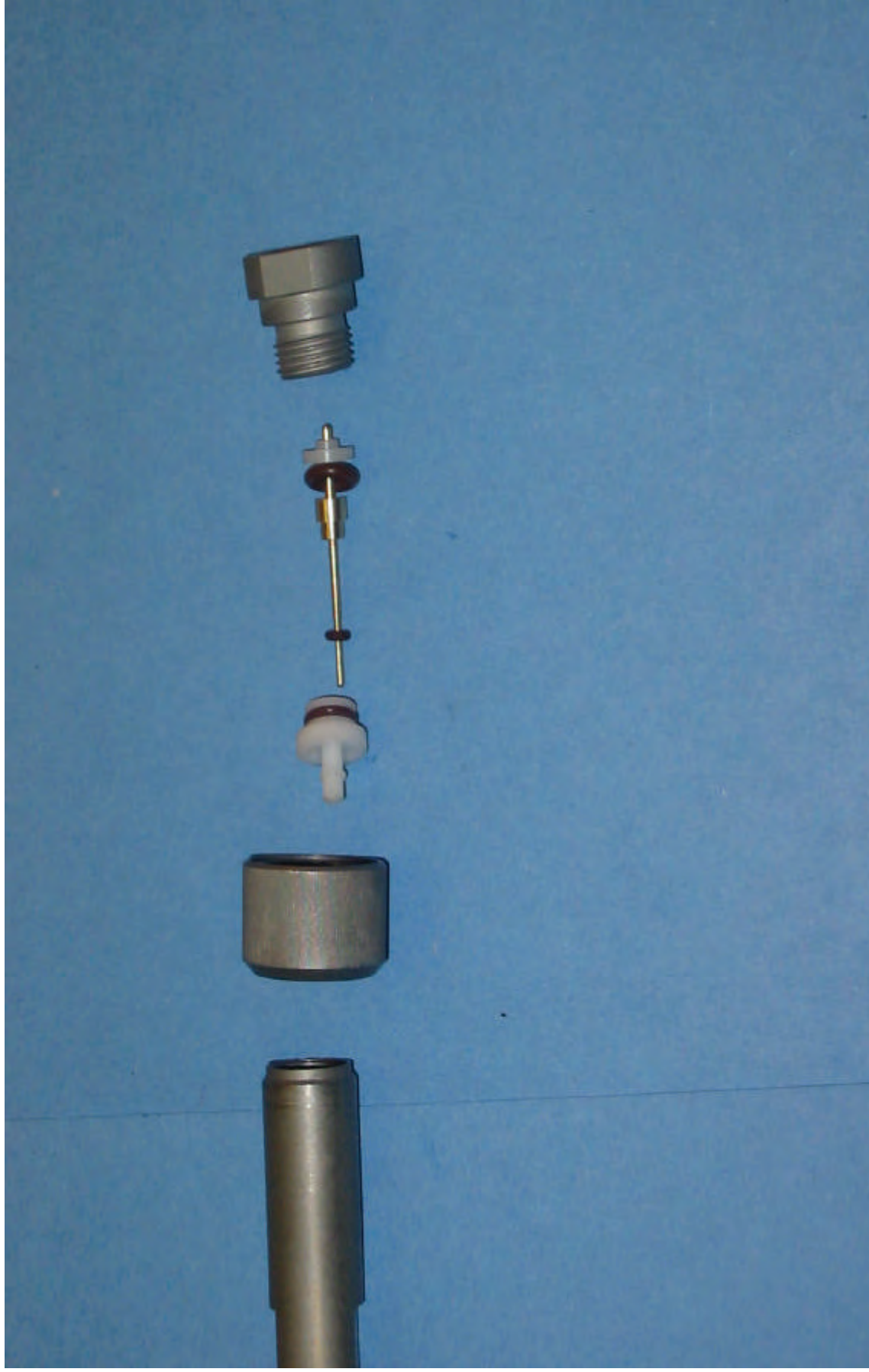




**Pic.25** Tighten the housing to the body  
Tighten the set screws to complete re-assembly of the cablehead



**Pic.26 Exploded view of cablehead assembly**



**Pic.27 Exploded view of bulkhead assembly**



## **Attachment A: Standard Operating Procedure (SOP) #2**

### **Passive Diffusion Bag (PDB) Sampling Protocol**

#### **1.0 Obtain PDB Sampler Hardware**

- The hardware for each well in the sampling program will be custom-made by the PDB manufacturer (EON Products, Inc.) or by field sampling personnel, prior to the initiation of the field program.
- Each hardware kit is labeled for each well, and should closely match the dimensions submitted to the kit manufacturer.
- Open the hardware kit bag and carefully unwind the first few feet of cable or rope, to expose the first PDB station (colored zip ties or metal clips) from which the PDB samplers will hang.

#### **2.0 Install PDB Sampler Hardware (Page 6, USGS, 2001)**

- Unseal the appropriate PDB sampler hardware kit (match label to well name) and carefully retrieve hardware.
- Clip the first (bottom) PDB sampler onto the top and bottom PDB station using the available zip ties.
- Record time and bag position in the well.
- If this well is to be profiled, continue attaching PDB samplers to remaining PDB stations for this monitoring well.
- Otherwise, if this well is not scheduled to be profiled and has not yet been profiled, continue unwinding the hardware kit until the uppermost set of plastic disks is exposed and then attach the second PDB sampler.
- Once a well has been profiled and a specific depth has been selected from which to monitor groundwater quality, only one PDB sampler will be installed on the hardware kit – the depth interval will be noted on the field instruction form.
- Once the necessary PDB samplers have been installed, carefully lower the hardware kit until the stainless steel weight touches the well bottom.
- Confirm that the top clip (marker) roughly equals the top of casing and adjust as necessary to ensure a snug fit (slightly taught line) when the well cap is closed.
- Attach the end of the hardware line to the well head hanging device – make sure that the PDB sampler kit does not sag when well cap is closed.
- Secure the well.

#### **3.0 Sample Naming/Recording**

- Sample numbers will be generated as specified in the QAPP.
- Field personnel must include a depth for each sampler on the chain-of-custody.

- Record the relative position of each bag – they will be numbered in the order they will be retrieved (i.e., top → #1... #2... #n... → bottom) – in other words, the first PDB sampler to be installed will have the highest number and the last PDB sampler will have the lowest number.

#### **4.0 PDB Sampler Retrieval (Page 9, USGS, 2001)**

- Collect the appropriate number of VOA vials for the required number of VOC samples.
- Measure and record the corrected depth to water from the top of casing to ensure PDB are completely submerged below the water level.
- Note the time and begin reeling the PDB sampler hardware line.
- Field personnel must include a depth for each sampler on the chain-of-custody in the form of station number as recorded during bag placement.
- Important - the contents of each bag must be transferred to the VOA vials immediately after PDBs are removed from the well and before addressing any other sampling-related issues to avoid losing volatile compounds to atmosphere. Once the first bag leaves the water, the time limit starts at the same time for all exposed bags. All samples shall be contained in the VOA vials within 15 minutes of the PDB leaving the water.
- Extract the PDB sampler(s) from the well, remove the sampler cap and carefully empty the contents into VOA vials (preferably set up in a bottle holder), taking care not to over agitate the bag or water.
- Apply completed label to each VOA vial to ensure that they are not confused later.
- Repeat until all PDB samplers have been removed and contents transferred.
- QC duplicate samples consist of two separate sets of VOA vials filled from the same diffusion sampler.
- Store all filled VOA vials in Ziploc bags inside a properly cooled container.
- Follow above guidelines to re-install new PDB samplers as scheduled (profile or single-bag scenario).
- Dispose of all used passive diffusion sample bags and components appropriately as either IDW or recyclable material.
- Decontaminate all reusable equipment with clean water and ALCONOX.

#### **5.0 User's Guide for Polyethylene-based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells**

(See following pages)

# **USER'S GUIDE FOR POLYETHYLENE-BASED PASSIVE DIFFUSION BAG SAMPLERS TO OBTAIN VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN WELLS**

## **PART 1: DEPLOYMENT, RECOVERY, DATA INTERPRETATION, AND QUALITY CONTROL AND ASSURANCE**

**Water-Resources Investigations Report 01-4060**

Prepared in cooperation with the

**U.S. AIR FORCE**

**U.S. NAVAL FACILITIES ENGINEERING COMMAND**

**U.S. ENVIRONMENTAL PROTECTION AGENCY**

**FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE**

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**U.S. ARMY CORPS OF ENGINEERS and**

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# User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells

## *Part 1: Deployment, Recovery, Data Interpretation, and Quality Control and Assurance*

*By* Don A. Vroblesky

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U.S. Geological Survey

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Columbia, South Carolina  
2001



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## Conversion Factors, Vertical Datum, Acronyms, and Abbreviations

Multiply	By	To obtain
<i>Length</i>		
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
<i>Area</i>		
square mile (mi <sup>2</sup> )	2.590	square kilometer
<i>Flow</i>		
foot per day (ft/d)	0.3048	meter per day
foot squared per day (ft <sup>2</sup> /d)	0.09294	meter squared per day
gallon per minute (gal/min)	0.06308	liter per second
gallon per day (gal/d)	0.003785	cubic meter per day
inch per year (in/yr)	25.4	millimeter per year
<i>Volume</i>		
gallon (gal)	3.785	liter

**Temperature** is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation: °F = 9/5 (°C) + 32

**Sea level** refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

**Chemical concentration** in water is expressed in metric units as milligrams per liter (mg/L) or micrograms per liter (µg/L).

Additional Abbreviations	
EDB	1,2-Dibromomethane
AFCEE	Air Force Center for Environmental Excellence
cDCE	cis-1,2-Dibromoethene
ft <sup>3</sup> /d	cubic feet per day
ft <sup>3</sup> /mg	cubic feet per milligram
°C	degrees Celsius
g	gram
ITRC	Interstate Technology Regulatory Cooperation
LDPE	low-density polyethylene
L	liter
µg	microgram
µm	micrometer
µL	microliter
mg	milligram
mL	milliliter
mL/min	milliliter per minute
MTBE	Methyl- <i>tert</i> -butyl ether
NAVFAC	Naval Facilities Engineering Command
NAPL	non-aqueous phase liquid
PDB	passive diffusion bag
PCE	Tetrachloroethene
TCE	Trichloroethene
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOA	Volatile organic analysis
VOC	Volatile organic compound

# User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells

## Part 1: Deployment, Recovery, Data Interpretation, and Quality Control and Assurance

By Don A. Vroblesky

### EXECUTIVE SUMMARY

Water-filled passive diffusion bag (PDB) samplers described in this report are suitable for obtaining concentrations of a variety of volatile organic compounds (VOCs) in ground water at monitoring wells. The suggested application of the method is for long-term monitoring of VOCs in ground-water wells at well-characterized sites.

The effectiveness of the use of a single PDB sampler in a well is dependent on the assumption that there is horizontal flow through the well screen and that the quality of the water is representative of the ground water in the aquifer directly adjacent to the screen. If there are vertical components of intra-bore-hole flow, multiple intervals of the formation contributing to flow, or varying concentrations of VOCs vertically within the screened or open interval, then a multiple deployment of PDB samplers within a well may be more appropriate for sampling the well.

A typical PDB sampler consists of a low-density polyethylene (LDPE) lay-flat tube closed at both ends and containing deionized water. The sampler is positioned at the target horizon of the well by attachment to a weighted line or fixed pipe.

The amount of time that the sampler should be left in the well prior to recovery depends on the time required by the PDB sampler to equilibrate with ambient water and the time required for the environmental disturbance caused by sampler deployment to return to ambient conditions. The rate that the water within the PDB sampler equilibrates with ambient water depends on multiple factors, including the type of compound being sampled and the water temperature. The concentrations of benzene, *cis*-1,2-dichloroethene,

tetrachloroethene, trichloroethene, toluene, naphthalene, 1,2-dibromoethane, and total xylenes within the PDB samplers equilibrated with the concentrations in an aqueous mixture of those compounds surrounding the samplers under laboratory conditions within approximately 48 hours at 21 degrees Celsius (°C). A subsequent laboratory study of mixed VOCs at 10 °C showed that tetrachloroethene and trichloroethene were equilibrated by about 52 hours, but other compounds required longer equilibration times. Chloroethane, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, and 1,1-dichloroethene were not equilibrated at 52 hours, but appeared to be equilibrated by the next sampling point at 93 hours. Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane were not equilibrated at 93 hours, but were equilibrated by the next sampling point at 166 hours. Different equilibration times may exist for other compounds. Differences in equilibration times, if any, between single-solute or mixed VOC solutions have not yet been thoroughly examined.

The samplers should be left in place long enough for the well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment. Laboratory and field data suggest that 2 weeks of equilibration probably is adequate for many applications; therefore, a minimum equilibration time of 2 weeks is suggested. In less permeable formations, longer equilibration times may be required. When applying PDB samplers in waters colder than previously tested (10 °C) or for compounds without sufficient corroborating data, a side-by-side comparison with conventional methodology is advisable to justify the field equilibration time.

Following the initial equilibration period, the samplers maintain equilibrium concentrations with the ambient water until recovery. Thus, there is no specified time for sampler recovery after initial equilibration. PDB samplers routinely have been left in ground waters having concentrations of greater than 500 parts per million (ppm) of trichloroethene for 3 months at a time with no loss of bag integrity, and at one site, the PDB samplers have been left in place in VOC-contaminated ground water for 1 year with no reported loss of sampler integrity. The effects of long-term (greater than 1 month) PDB-sampler deployment on sampler and sample integrity have not yet been thoroughly tested for a broad range of compounds and concentrations, however. Moreover, in some environments, development of a biofilm on the polyethylene may be a consequence of long-term deployment. Investigations of semipermeable membrane devices (SPMDs) have shown that the transfer of some compounds across a heavily biofouled polyethylene membrane may be reduced, but not stopped. If a heavy organic coating is observed on a PDB sampler, it is advisable to determine the integrity of the sample by comparison to a conventional sampling method before continuing to use PDB samplers for long-term deployment in that well.

Recovery consists of removing the samplers from the well and immediately transferring the enclosed water to 40-milliliter sampling vials for analysis. The resulting concentrations represent an integration of chemical changes over the most recent portion of the equilibration period (approximately 48 to 166 hours, depending on the water temperature and the type of compound).

The method has both advantages and limitations when compared to other sampling methods. Advantages include the potential for PDB samplers to eliminate or substantially reduce the amount of purge water associated with sampling. The samplers are relatively inexpensive and easy to deploy and recover. Because PDB samplers are disposable, there is no downhole equipment to be decontaminated between wells, and there is a minimum amount of field equipment required. The samplers also have the potential to delineate contaminant stratification in the formation across the open or screened intervals of monitoring wells where vertical hydraulic gradients are not present. In addition, the samplers integrate concentrations over time, which may range between about 48 to 166 hours depending on the compound of interest. Because the pore size of LDPE is only about

10 angstroms or less, sediment does not pass through the membrane into the bag. Thus, PDB samplers are not subject to interferences from turbidity. In addition, none of the data collected suggest that VOCs leach from the LDPE material, or that there is a detrimental effect on the VOC sample from the PDB material.

Water-filled polyethylene PDB samplers are not appropriate for all compounds. The samplers are not suitable for inorganic ions and have a limited applicability for non-VOCs and for some VOCs. For example, although methyl-*tert*-butyl ether and acetone and most semivolatile compounds are transmitted through the polyethylene bag, laboratory tests have shown that the resulting concentrations were lower than in ambient water. A variety of factors influence the ability of compounds to diffuse through the polyethylene. These factors include the molecular size and shape and the hydrophobic nature of the compound. Unpublished laboratory test data of semivolatile compounds in contact with PDB samplers showed a higher concentration of phthalates inside the PDB sampler than outside the PDB sampler, suggesting that the polyethylene may contribute phthalates to the enclosed water. Thus, the samplers should not be used to sample for phthalates.

VOC concentrations in PDB samplers represent concentrations in the vicinity of the sampler within the well screen or open interval. This may be a limitation for PDB samplers and some other types of sampling, such as low-flow sampling, if the ground-water contamination is above or below the screen or not in the sample intervals providing water movement to the PDB samplers. If there is a vertical hydraulic gradient in the well, then the concentrations in the sampler may represent the concentrations in the water flowing vertically past the sampler rather than in the formation directly adjacent to the sampler. Vertically spaced multiple PDB samplers may be needed in chemically stratified wells or where flow patterns through the screen change as a result of ground-water pumping or seasonal water-level fluctuations.

The purposes of this document are to present methods for PDB sampler deployment, and recovery; to discuss approaches to determine the applicability of passive diffusion samplers; and to discuss various factors influencing interpretation of the data. The intended audience for the methodology sections of this report is managers and field personnel involved in using PDB samplers. The discussion of passive diffusion sampler applicability and interpretation of the data is



suited for project managers, technical personnel, and the regulatory community. Part 2 of this report presents case studies of PDB sampler field applications.

## INTRODUCTION

The use of PDB samplers for collecting ground-water samples from wells offers a cost-effective approach to long-term monitoring of VOCs at well-characterized sites (Vroblesky and Hyde, 1997; Gefell and others, 1999). The effectiveness of the use of a single PDB sampler in a well is dependent on the assumption that there is horizontal flow through the well screen and that the quality of the water is representative of the ground water in the aquifer directly adjacent to the screen. If there are vertical components of intra-borehole flow, multiple intervals of the formation contributing to flow, or varying concentrations of VOCs vertically within the screened or open interval, then deployment of multiple PDB samplers within a well may be more appropriate for sampling the well.

The samplers consist of deionized water enclosed in a LDPE sleeve (fig. 1) and are deployed adjacent to a target horizon within a screened or open interval of a well. The suggested application is for long-term monitoring of VOCs in ground-water wells. Where the screened interval is greater than 10 feet (ft), the potential for contaminant stratification and/or intra-borehole flow within the screened interval is greater than in screened intervals shorter than 10 ft. It is important that the vertical distribution of contaminants be determined in wells having 10-ft-long well screens, and that both the vertical distribution of contaminants and the potential for intra-borehole flow be determined in wells having screens longer than 10 ft. For many VOCs of environmental interest (table 1), the VOC concentration in water within the sampler approaches the VOC concentration in water outside of the PDB sampler over an equilibration period. The resulting concentrations represent an integration of chemical changes over the most recent part of the equilibration period (approximately 48 to 166 hours, depending on the water temperature and the type of compound being sampled). The approach is inexpensive and has the potential to eliminate or substantially reduce the amount of purge water removed from the well.

A variety of PDB samplers have been utilized in well applications (fig. 1). Although the samplers vary in specific construction details, a typical PDB sampler consists of a 1- to 2-ft-long LDPE tube closed at both ends and containing laboratory-grade deionized water (fig. 1). The typical diameter for PDB samplers used in a 2-inch-diameter well is approximately 1.2 inches; however, other dimensions may be used to match the well diameter. Equilibration times may be longer for larger diameter PDB samplers. On the outside of the PDB sampler, a low-density polyethylene-mesh sometimes is used for protection against abrasion in open boreholes and as a means of attachment at the prescribed depth. The PDB sampler can be positioned at the target horizon by attachment to a weighted line or by attachment to a fixed pipe.

PDB samplers for use in wells are available commercially. Authorized distributors as of March 2001 are Columbia Analytical Services (800-695-7222; [www.caslab.com](http://www.caslab.com)) and Eon Products (800-474-2490; [www.eonpro.com](http://www.eonpro.com)). A current list of vendors and PDB-sampler construction details can be obtained from the U.S. Geological Survey Technology Transfer Enterprise Office, Mail Stop 211, National Center, 12201 Sunrise Valley Drive, Reston, Virginia 20192 (telephone 703-648-4344; fax 703-648-4408). PDB samplers employ patented technology (U.S. patent number 5,804,743), and therefore, require that the user purchase commercially produced samplers from a licensed manufacturer or purchase a nonexclusive license for sampler construction from the U.S. Geological Survey Technology Enterprise Office at the above address.

The purposes of this document are to present methods for PDB sampler deployment, and recovery; to discuss approaches for determining the applicability of passive diffusion samplers; and to discuss various factors influencing interpretation of the data. The intended audience for the methodology sections of this report is managers and field personnel involved in using PDB samplers. The discussion of PDB sampler applicability and interpretation of the data is suited for project managers, technical personnel, and the regulatory community. Part 2 of this report presents case studies of PDB-sampler field applications.



**Figure 1.** Typical water-filled passive diffusion bag samplers used in wells, including (A) diffusion bag with polyethylene mesh, (B) diffusion bag without mesh, and (C) bag and mesh attached to bailer bottom.

Table 1. Compounds tested under laboratory conditions for use with passive diffusion bag samplers [From Vroblecky and Campbell, 2001]

Tested compounds showing good correlation (average differences in concentration of 11 percent or less between diffusion-sampler water and test-vessel water) in laboratory tests			
Benzene	2 Chlorovinyl ether	<i>cis</i> -1,2-Dichloroethene	1,1,1-Trichloroethane
Bromodichloromethane	Dibromochloromethane	<i>trans</i> -1,2-Dichloroethene	1,1,2-Trichloroethane
Bromoform	Dibromomethane	1,2-Dichloropropane	Trichloroethene
Chlorobenzene	1,2-Dichlorobenzene	<i>cis</i> -Dichloropropene	Trichlorofluoromethane
Carbon tetrachloride	1,3-Dichlorobenzene	1,2-Dibromoethane	1,2,3-Trichloropropane
Chloroethane	1,4-Dichlorobenzene	<i>trans</i> -1,3-Dichloropropene	1,1,2,2-Tetrachloroethane
Chloroform	Dichlorodifluoromethane	Ethyl benzene	Tetrachloroethene
Chloromethane	1,2-Dichloroethane	Naphthalene	Vinyl chloride
	1,1-Dichloroethene	Toluene	Total xylenes
Tested compounds showing poor correlation (average differences in concentration greater than 20 percent between diffusion-sampler water and test-vessel water) in laboratory tests			
Acetone*	Methyl- <i>tert</i> -butyl ether	Styrene	

\*T.M Sivavec and S.S. Baghel, General Electric Company, written commun., 2000

## Summary of Passive Diffusion Bag Sampler Advantages and Limitations

### Advantages

1. PDB samplers have the potential to eliminate or substantially reduce the amount of purge water associated with sampling.

2. PDB samplers are inexpensive.

3. The samplers are easy to deploy and recover.

4. Because PDB samplers are disposable, there is no downhole equipment to be decontaminated between wells.

5. A minimal amount of field equipment is required.

6. Sampler recovery is rapid. Because of the small amount of time and equipment required for the sampling event, the method is practical for use where access is a problem or where discretion is desirable (that is, residential communities, business districts, or busy streets where vehicle traffic control is a concern).

7. Multiple PDB samplers, distributed vertically along the screened or open interval, may be used in conjunction with borehole flow meter testing to gain insight on the movement of contaminants into and out of the well screen or open interval or to locate the zone of highest concentration in the well. Analytical costs when using multiple PDB samplers sometimes can be reduced by selecting a limited number of the samplers for laboratory analysis based on screening by using field gas chromatography at the time of sample collection.

8. Because the pore size of LDPE is only about 10 angstroms or less, sediment does not pass through the membrane into the bag. Thus, PDB samplers are not subject to interferences from turbidity. In addition, none of the data collected suggest that VOCs leach from the LDPE material or that there is a detrimental effect from the PDB material on the VOC sample.

### Limitations

1. PDB samplers integrate concentrations over time. This may be a limitation if the goal of sampling is to collect a representative sample at a point in time in an aquifer where VOC-concentrations substantially change more rapidly than the samplers equilibrate. Laboratory results obtained indicate that a variety of compounds equilibrated within 48 hours at 21 °C (Vroblesky and Campbell, 2001). Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane may require between 93 and 166 hours to equilibrate at 10 °C (T.M. Sivavec and S.S. Baghel, General Electric Company, written commun., 2000). The initial equilibration under field conditions may be longer to allow

well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment.

2. Water-filled polyethylene PDB samplers are not appropriate for all compounds. For example, although methyl-*tert*-butyl ether and acetone (Vroblesky, 2000; Paul Hare, General Electric Company, oral commun., 2000) and most semivolatile compounds are transmitted through the polyethylene bag, laboratory tests have shown that the resulting concentrations were lower than in ambient water. A variety of factors influence the ability of compounds to diffuse through the polyethylene membrane. These factors include the molecular size and shape and the hydrophobic nature of the compound. Compounds having a cross-sectional diameter of about 10 angstroms or larger (such as humic acids) do not pass through the polyethylene because the largest (transient) pores in polyethylene do not exceed about 10 angstroms in diameter (Flynn and Yalkowsky, 1972; Hwang and Kammermeyer, 1975; Comyn, 1985). The samplers are not appropriate for hydrophilic polar molecules, such as inorganic ions. A detailed discussion of the relation between hydrophobicity and compound transport through polyethylene can be found in Gale (1998). Unpublished laboratory test data (D.A. Vroblesky, U.S. Geological Survey, written commun., 1998) of semi-volatile compounds in contact with PDB samplers showed a higher concentration of phthalates inside the PDB sampler than outside the PDB sampler, suggesting that the polyethylene may contribute phthalates to the enclosed water. Thus, the samplers should not be used to sample for phthalates.

3. PDB samplers rely on the free movement of water through the well screen. In situations where ground water flows horizontally through the well screen, the VOC concentrations in the open interval of the well probably are representative of the aquifer water in the adjacent formation (Gillham and others, 1985; Robin and Gillham, 1987; Kearn and others, 1992; Powell and Puls, 1993; Vroblesky and Hyde, 1997). In these situations, the VOC concentration of the water in contact with the PDB samplers, and therefore, the water within the diffusion samplers, probably represents local conditions in the adjacent aquifer. However, if the well screen is less permeable than the aquifer or the sandpack, then under ambient conditions, flowlines may be diverted around the screen. Such a situation may arise from inadequate well development or from iron bacterial fouling of the well screen. In this case, the VOC concentrations in the PDB samplers may not represent concentrations in

the formation water because of inadequate exchange across the well screen. PDB samplers have not yet been adequately tested to determine their response under such conditions.

4. VOC concentrations in PDB samplers represent ground-water concentrations in the vicinity of the screened or open well interval that move to the sampler under ambient flow conditions. This is a limitation if the ground-water contamination lies above or below the well screen or open interval, and requires the operation of a pump to conduct contaminants into the well for sampling.

5. In cases where the well screen or open interval transects zones of differing hydraulic head and variable contaminant concentrations, VOC concentrations obtained using a PDB sampler may not reflect the concentrations in the aquifer directly adjacent to the sampler because of vertical transport in the well. However, a vertical array of PDB samplers, used in conjunction with borehole flow meter testing, can provide insight on the movement of contaminants into or out of the well. This information then can be used to help determine if the use of PDB samplers is appropriate for the well, and to select the optimal vertical location(s) for the sampler deployment.

6. In wells with screens or open intervals with stratified chemical concentrations, the use of a single PDB sampler set at an arbitrary (by convention) depth may not provide accurate concentration values for the most contaminated zone. However, multiple PDB samplers distributed vertically along the screened or open interval, in conjunction with pump sampling (as appropriate), can be used to locate zone(s) of highest concentration in the well. Multiple PDB samplers also may be needed to track the zone of maximum concentration in wells where flow patterns through the screened interval change as a result of ground-water pumping or seasonal water-table fluctuations.

## **PASSIVE DIFFUSION BAG SAMPLER DEPLOYMENT**

A variety of approaches can be used to deploy the PDB samplers in wells. A typical deployment approach, described in this section, is to attach the PDB samplers to a weighted line. It also is acceptable to attach the weights directly to the PDB sampler if the attachment point is of sufficient strength to support the weight. The weights attached to the bottom of the

line are stainless steel and can be reused, but must be thoroughly decontaminated with a detergent before the first use or before using in a different well. Rope, such as 90 pound, 3/16 inch braided polyester, can be used as the line for single-use applications if it is of sufficient strength to support the weight and sampler, is nonbuoyant, and is subject to minimal stretch; however, the rope should not be reused because of the high potential for cross contamination. Stainless-steel or Teflon-coated stainless-steel wire is preferable. The weighted lines should not be reused in different wells to prevent carryover of contaminants. A possible exception is coated stainless-steel wire, which can be reused after sufficient decontamination. An alternative deployment approach, not discussed in this section, is to attach the PDB samplers to a fixed pipe in the well (Vroblesky and Peters, 2000, p. 3; also included in Part 2 of this publication). The PDB samplers should not contact non-aqueous phase liquid (NAPL) during deployment or retrieval to prevent cross contamination. An approach that can be utilized to deploy diffusion samplers through a layer of floating NAPL is described in the field test at Naval Station North Island, California (Vroblesky and Peters, 2000, p. 3-4; also included in Part 2 of this publication).

If the PDB sampler is to be compared with a conventional pumping approach to sampling, then it is suggested that both the pump and the PDB sampler be deployed at the same time, with the sampler attached near (such as directly below) the pump inlet. This approach eliminates potential concentration differences between the two methods that may result from well disturbance during equipment removal and deployment at the time of sampling. An alternative method is to deploy the PDB samplers independently of the pumps and recover the samplers immediately prior to placing the pump down the well.

PDB samplers are available either prefilled (field ready) with laboratory-grade deionized water or unfilled. The unfilled samplers are equipped with a plug and funnel to allow for field filling and sample recovery. To fill these samplers, remove the plug from the sampler bottom, insert the short funnel into the sampler, and pour laboratory-grade deionized water into the sampler. The sampler should be filled until water rises and stands at least half way into the funnel. Remove excess bubbles from the sampler. Remove the funnel and reattach the plug. A small air bubble from the plug is of no concern.



The following steps should be used for deploying PDB samplers in wells:

1. Measure the well depth and compare the measured depth with the reported depth to the bottom of the well screen from well-construction records. This is to check on whether sediment has accumulated in the bottom of the well, whether there is a nonscreened section of pipe (sediment sump) below the well screen, and on the accuracy of well-construction records. If there is an uncertainty regarding length or placement of the well screen, then an independent method, such as video imaging of the well bore, is strongly suggested.

2. Attach a stainless-steel weight to the end of the line. Sufficient weight should be added to counterbalance the buoyancy of the PDB samplers. This is particularly important when multiple PDB samplers are deployed. One approach, discussed in the following paragraphs, is to have the weight resting on the bottom of the well, with the line taut above the weight. Alternatively, the PDB sampler and weight may be suspended above the bottom, but caution should be exercised to ensure that the sampler does not shift location. Such shifting can result from stretching or slipping of the line or, if multiple samplers are attached end-to-end rather than to a weighted line, stretching of the samplers.

3. Calculate the distance from the bottom of the well, or top of the sediment in the well, up to the point where the PDB sampler is to be placed. A variety of approaches can be used to attach the PDB sampler to the weight or weighted line at the target horizon. The field-fillable type of PDB sampler is equipped with a hanger assembly and weight that can be slid over the sampler body until it rests securely near the bottom of the sampler. When this approach is used with multiple PDB samplers down the same borehole, the weight should only be attached to the lowermost sampler. An additional option is to use coated stainless-steel wire as a weighted line, making loops at appropriate points to attach the upper and lower ends of PDB samplers. Where the PDB sampler position varies between sampling events, movable clamps with rings can be used. When using rope as a weighted line, a simple approach is to tie knots or attach clasps at the appropriate depths. Nylon cable ties or stainless-steel clips inserted through the knots can be used to attach the PDB samplers. An approach using rope as a weighted line with knots tied at the appropriate sampler-attachment points is discussed below.

- (a) For 5-ft-long or shorter well screens, the center point of the PDB sampler should be the vertical midpoint of the saturated well-screen length. For example, if the well screen is at a depth of 55 to 60 ft below the top of casing, and the measured depth of the well is 59 ft, then the bottom of the well probably has filled with sediment. In this case, the midpoint of the sampler between the attachment points on the line will be midway between 55 and 59 ft, or at 57 ft. Thus, for a 1.5-ft-long sampler, the attachment points on a weighted line should be tied at distances of 1.25 ft ( $2 \text{ ft} - 0.75 \text{ ft}$ ) and 2.75 ft ( $2 \text{ ft} + 0.75 \text{ ft}$ ) from the top of the sediment in the well, or the bottom of the well, making adjustments for the length of the attached weight. When the PDB sampler is attached to the line and installed in the well, the center of the sampler will be at 57-ft depth. If, however, independent evidence is available showing that the highest concentration of contaminants enters the well from a specific zone within the screened interval, then the PDB sampler should be positioned at that interval.

- (b) For 5- to 10-ft-long well screens, it is advisable to utilize multiple PDB samplers vertically along the length of the well screen for at least the initial sampling (fig. 2). The purposes of the multiple PDB samplers are to determine whether contaminant stratification is present and to locate the zone of highest concentration. The midpoint of each sampler should be positioned at the midpoint of the interval to be sampled. For 1.5-ft-long samplers, at each sampling depth in the screened interval, make two attachment points on the weighted line at a distance of about 1.5 ft apart. The attachment points should be positioned along the weighted line at a distance from the bottom end of the weight such that the midpoint between the knots will be at the desired sampling depth along the well screen. Sampler intervals are variable, but a simple approach is to use the top knot/loop of one sampler interval as the bottom knot/loop for the overlying sampler interval.





**Figure 2.** Example of multiple PDB samplers prepared for deployment.

(c) PDB samplers should not be used in wells having screened or open intervals longer than 10 ft unless used in conjunction with borehole flow meters or other techniques to characterize vertical variability in hydraulic conductivity and contaminant distribution or used strictly for qualitative reconnaissance purposes. This is because of the increased potential for cross contamination of water-bearing zones and hydraulically driven mixing effects that may cause the contaminant stratification in the well to differ from the contaminant stratification in the adjacent aquifer material. If it is necessary to sample such wells, then multiple PDB samplers should be installed vertically across the screened or open interval to determine the zone of highest concentration and whether contaminant stratification is present.

4. The samplers should be attached to the weights or weighted line at the time of deployment. For samplers utilizing the hanger and weight assembly,

the line can be attached directly to the top of the sampler. PDB samplers utilizing an outer protective mesh can be attached to a weighted line by using the following procedure:

(a) Insert cable ties through the attachment points in the weighted line.

(b) At each end of the PDB sampler, weave the ends of the cable ties or clamp through the LPDE mesh surrounding the sampler and tighten the cable ties. Thus, each end of the PDB sampler will be attached to a knot/loop in the weighted line by means of a cable tie or clamp. The cable ties or clamps should be positioned through the polyethylene mesh in a way that prevents the PDB sampler from sliding out of the mesh.

(c) Trim the excess from the cable tie before placing the sampler down the well. Caution should be exercised to prevent sharp edges on the trimmed cable ties that may puncture the LDPE.

5. When using PDB samplers without the protective outer mesh, the holes punched at the ends of the bag, outside the sealed portion, can be used to attach the samplers to the weighted line. Stainless-steel spring clips have been found to be more reliable than cable ties in this instance, but cable ties also work well.

6. Lower the weight and weighted line down the well until the weight rests on the bottom of the well and the line above the weight is taut. The PDB samplers should now be positioned at the expected depth. A check on the depth can be done by placing a knot or mark on the line at the correct distance from the top knot/loop of the PDB sampler to the top of the well casing and checking to make sure that the mark aligns with the lip of the casing after deployment.

7. Secure the assembly in this position. A suggested method is to attach the weighted line to a hook on the inside of the well cap. Reattach the well cap. The well should be sealed in such a way as to prevent surface-water invasion. This is particularly important in flush-mounted well vaults that are prone to flooding.

8. Allow the system to remain undisturbed as the PDB samplers equilibrate.

## **PASSIVE DIFFUSION BAG SAMPLER AND SAMPLE RECOVERY**

The amount of time that the samplers should be left in the well prior to recovery depends on the time required by the PDB sampler to equilibrate with ambient water and the time required for environmental disturbances caused by sampler deployment to return to ambient conditions. The rate that the water within the PDB sampler equilibrates with ambient water depends on multiple factors, including the type of compound being sampled and the water temperature. The concentrations of benzene, *cis*-1,2-dichloroethene (cDCE), tetrachlorethene (PCE), trichloroethene (TCE), toluene, naphthalene, 1,2-dibromoethane (EDB), and total xylenes within the PDB samplers equilibrated with the concentrations in an aqueous mixture of those compounds surrounding the samplers under laboratory conditions within approximately 48 hours at 21 °C (Vroblesky and Campbell, 2001). A subsequent laboratory study of mixed VOCs at 10 °C showed that PCE and TCE were equilibrated by about 52 hours, but other compounds required longer equilibration times (T.M. Sivavec and S.S. Baghel, General Electric Company, written commun., 2000). Chloroethane, cDCE, *trans*-1,2-dichloroethene, and 1,1-dichloroethene were not

equilibrated at 52 hours, but appeared to be equilibrated by the next sampling point at 93 hours. Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane were not equilibrated at 93 hours, but were equilibrated by the next sampling point at 166 hours. Different equilibration times may exist for other compounds. Differences in equilibration times, if any, between single-solute or mixed-VOC solutions have not yet been thoroughly examined.

Under field conditions, the samplers should be left in place long enough for the well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment. The results of borehole dilution studies show that wells can recover to 90 percent of the predisturbance conditions within minutes to several hours for permeable to highly permeable geologic formations, but may require 100 to 1,000 hours (4 to 40 days) in muds, very fine-grained loamy sands, and fractured rock, and may take even longer in fractured shales, recent loams, clays, and slightly fractured solid igneous rocks (Halevy and others, 1967).

In general, where the rate of ground-water movement past a diffusion sampler is high, equilibration times through various membranes commonly range from a few hours to a few days (Mayer, 1976; Harrington and others, 2000). One field investigation showed adequate equilibration of PDB samplers to aquifer trichloroethene (TCE) and carbon tetrachloride (CT) concentrations within 2 days in a highly permeable aquifer (Vroblesky and others, 1999). In other investigations, PDB samplers recovered after 14 days were found to be adequately equilibrated to chlorinated VOCs (Obrien & Gere Engineers, Inc., 1997a, 1997b; Hare, 2000); therefore, the equilibration period was less than or equal to 14 days for those field conditions. Because it appears that 2 weeks of equilibration probably is adequate for many applications, a minimum equilibration time of 2 weeks is suggested. When applying PDB samplers in waters colder than previously tested (10 °C) or for compounds without sufficient corroborating field data, a side-by-side comparison with conventional sampling methodology is advisable to justify the field equilibration time.

In less permeable formations, longer equilibration times may be required. It is probable that water in the well bore eventually will equilibrate with the pore-water chemistry; however, if the rate of chemical change or volatilization loss in the well bore exceeds the rate of exchange between the pore water and the well-bore water, then the PDB samplers may under-

estimate pore-water concentrations. Guidelines for equilibration times and applicability of PDB samplers in low-permeability formations have not yet been established. Therefore, in such situations, a side-by-side comparison of PDB samplers and conventional sampling methodology is advisable to ensure that the PDB samplers do not underestimate concentrations obtained by the conventional method. A detailed discussion of diffusion rates relevant to diffusion sampler equilibrium in slow-moving ground-water systems can be found in Harrington and others (2000).

Following the initial equilibration period, the samplers maintain equilibrium concentrations with the ambient water until recovery. Thus, there is no specified maximum time for sampler recovery. PDB samplers have routinely been left in ground waters having concentrations of greater than 500 ppm of TCE for 3 months at a time with no loss of bag integrity, and at one site, the PDB samplers have been left in place in VOC-contaminated ground water for 1 year with no reported loss of sampler integrity (Paul Hare, General Electric Company, oral commun., 2000). The effects of long-term (greater than 1 month) PDB-sampler deployment on sampler and sample integrity have not yet been thoroughly tested for a broad range of compounds and concentrations. Moreover, in some environments, development of a biofilm on the polyethylene may be a consequence of long-term deployment. Investigations of semipermeable membrane devices (SPMDs) have shown that the transfer of some compounds may be reduced, but not stopped, across a heavily biofouled polyethylene membrane (Ellis and others, 1995; Huckins and others, 1996; Huckins and others, in press). If a heavy organic coating is observed on a PDB sampler, it is advisable to determine the integrity of the sample by comparing contaminant concentrations from the PDB sampler to concentrations from a conventional sampling method before continuing to use PDB samplers for long-term deployment in that well.

Recovery of PDB samplers is accomplished by using the following approach:

1. Remove the PDB samplers from the well by using the attached line. The PDB samplers should not be exposed to heat or agitated.

2. Examine the surface of the PDB sampler for evidence of algae, iron or other coatings, and for tears in the membrane. Note the observations in a sampling field book. If there are tears in the membrane, the

sample should be rejected. If there is evidence that the PDB sampler exhibits a coating, then this should be noted in the validated concentration data.

3. Detach and remove the PDB sampler from the weighted line. Remove the excess liquid from the exterior of the bag to minimize the potential for cross contamination.

4. A variety of approaches may be used to transfer the water from the PDB samplers to 40-mL volatile organic analysis (VOA) vials. One type of commercially available PDB sampler provides a discharge device that can be inserted into the sampler. If discharge devices are used, the diameter of the opening should be kept to less than about 0.15 inches to reduce volatilization loss. Two options are presently available to recover water from the sample using discharge devices. One option involves removing the hanger and weight assembly from the sampler, inverting the sampler so that the fill plug is pointed upward, and removing the plug. The water can be recovered by directly pouring in a manner that minimizes agitation or by pouring through a VOC-discharge accessory inserted in place of the plug. The second approach involves piercing the sampler near the bottom with a small-diameter discharge tube and allowing water to flow through the tube into the VOA vials. In each case, flow rates can be controlled by tilting or manipulating the sampler. Alternatively, the PDB sampler can be cut open at one end using scissors or other cutting devices which have been decontaminated between use for different wells. Water can then be transferred to 40-ml VOA vials by gently pouring in a manner that minimizes water agitation. Acceptable duplication has been obtained using each method. Preserve the samples according to the analytical method. The sampling vials should be stored at approximately 4 °C in accordance with standard sampling protocol. Laboratory testing suggests that there is no substantial change in the VOC concentrations in PDB samplers over the first several minutes after recovery; however, the water should be transferred from the water-filled samplers to the sample bottles immediately upon recovery.

5. A cost-effective alternative when using multiple PDB samplers in a single well is to field screen water from each sampler using gas chromatography. These results can be used to decide which of the multiple PDB samplers should be sent to an EPA-approved laboratory for standard analysis. Typically, at least the sample containing the highest concentration should be analyzed by a laboratory.



6. If a comparison is being made between concentrations obtained using PDB samplers and concentrations obtained using a conventional sampling approach, then the well should be sampled by the conventional approach soon after (preferably on the same day) recovery of the PDB sampler. The water samples obtained using PDB samplers should be sent in the same shipment, as the samples collected by the conventional approach for the respective wells. Utilizing the same laboratory may reduce analytical variability.

7. Any unused water from the PDB sampler and water used to decontaminate cutting devices should be disposed in accordance with local, state, and Federal regulations.

### **DETERMINING APPLICABILITY OF PASSIVE DIFFUSION BAG SAMPLERS AND INTERPRETATION OF DATA**

When attempting to determine whether the use of PDB samplers is appropriate at a particular well, a common approach is to do a side-by-side comparison with a conventional sampling method during the same sampling event. This approach is strongly suggested in wells having temporal concentration variability. In a well having relatively low temporal concentration variability, comparison of the PDB-sampler results to historical concentrations may provide enough information to determine whether the PDB samplers are appropriate for the well. In general, if both PDB and conventional sampling produce concentrations that agree within a range deemed acceptable by local, state, and Federal regulatory agencies and meet the site-specific data-quality objectives, then a PDB sampler may be approved for use in that well to monitor ambient VOC concentrations. If concentrations from the PDB sampler are higher than concentrations from the conventional method, it is probable that concentrations from the PDB sampler adequately represent ambient conditions because there usually is a greater potential for dilution from mixing during sampling using conventional methods than during sampling using PDB samplers.

If, however, the conventional method produces concentrations that are significantly higher than those obtained using the PDB sampler, then it is uncertain whether the PDB-sampler concentrations represent local ambient conditions. In this case, further testing can be done to determine whether contaminant stratification and/or intra-borehole flow is present. Multiple sampling devices can be used to determine the pres-

ence of contaminant stratification, and borehole flow-meters can be used to determine whether intra-borehole flow is present. When using flowmeters to measure vertical flow in screened boreholes, however, the data should be considered qualitative because of the potential for water movement through the sand pack. Borehole dilution tests (Halevy and others, 1967; Drost and others, 1968; Grisak and others, 1977; Palmer, 1993) can be used to determine whether water is freely exchanged between the aquifer and the well screen.

Once the source of the difference between the two methods is determined, a decision can be made regarding the well-specific utility of the PDB samplers. Tests may show that VOC concentrations from the PDB samplers adequately represent local ambient conditions within the screened interval despite the higher VOC concentration obtained from the conventional method. This may be because the pumped samples incorporated water containing higher concentrations either from other water-bearing zones induced along inadequate well seals or through fractured clay (Vroblesky and others, 2000), from other water-bearing zones not directly adjacent to the well screen as a result of well purging prior to sampling (Vroblesky and Petkewich; 2000), or from mixing of chemically stratified zones in the vicinity of the screened interval (Vroblesky and Peters, 2000).

The mixing of waters from chemically stratified zones adjacent to the screened interval during pumping probably is one of the more important sources of apparent differences between the results obtained from PDB sampling and conventional sampling because such stratification probably is common. Vertical stratification of VOCs over distances of a few feet has been observed in aquifer sediments by using multilevel sampling devices (Dean and others, 1999; Pitkin and others, 1999), and considerable variation in hydraulic conductivity and water chemistry has been observed in an aquifer in Cape Cod, Massachusetts, on the scale of centimeters (Wolf and others, 1991; Smith and others 1991; Hess and others, 1992). Multiple PDB samplers have been used to show a change in TCE concentration of 1,130 ( $\mu\text{g/L}$ ) over a 6-ft vertical screened interval in Minnesota (Vroblesky and Petkewich, 2000). Tests using PDB samplers in screened intervals containing VOC stratification showed that the PDB-sampler data appeared to be point-specific, whereas the pumped sample integrated water over a larger interval (Vroblesky and Peters, 2000).

The decision on whether to use PDB samplers in such situations depends on the data-quality objectives for the particular site. If the goal is to determine and monitor higher concentrations or to examine contaminant stratification within the screened interval, then the PDB samplers may meet this objective. If the goal is to determine the average concentrations for the entire screened interval, then a pumped sample or an average from multiple diffusion samplers may be appropriate.

As an aid in the decision-making process, the following section examines the influences that hydraulic and chemical heterogeneity of an aquifer can have on sample quality in long-screened wells. Because VOC concentrations from PDB samplers commonly are compared to VOC concentrations from other sampling methodologies, the second section examines the differences in sample quality between these methodologies in situations of hydraulic and chemical heterogeneity.

### **Influences of Hydraulic and Chemical Heterogeneity on Sample Quality in Long-Screened Wells**

Sampling biases and chemical variability in long-screened wells, which can be loosely defined as wells having significant physical and chemical heterogeneity within the screened interval and in the adjacent aquifer (Reilly and LeBlanc, 1998), have been the subject of numerous investigations. Sources of chemical variability in such wells include non-uniform flow into wells (Robbins and Martin-Hayden, 1991; Reilly and Gibbs, 1993; Chiang and others, 1995; Church and Granato, 1996; Reilly and LeBlanc, 1998), lithologic heterogeneity (Reilly and others, 1989; Robbins, 1989; Martin-Hayden and others, 1991; Gibbs and others, 1993; Reilly and Gibbs, 1993), and in-well mixing. In a well open across a chemically or hydraulically heterogeneous section of the aquifer, differences in the sampling methodology can produce significant differences in the sampling results.

Long-screened wells have the potential to redistribute chemical constituents in the aquifer where there are vertical hydraulic gradients within the screened interval. Water can move into the well from one horizon and exit the well at a different horizon (Church and Granato, 1996; Reilly and LeBlanc 1998). If there is vertical flow in the screened or open interval, and the zone of low hydraulic head (outflow from

the well) is within the contaminated horizon, then the PDB samplers (or any standard sampling methodology) can underestimate or not detect the contamination. The reason is that, in this case, the contaminated horizon does not contribute water to the well under static conditions. Instead, water from other horizons with higher hydraulic head will invade the contaminated horizon by way of the well screen. Under pumped conditions, the majority of the extracted water will be from the most permeable interval, which may not be the contaminated zone. Even when pumping induces inflow from the contaminated interval, much of that inflow will be a reflection of the residual invaded water from other horizons. In this situation, a substantial amount of purging would be required before water representative of the aquifer could be obtained (Jones and Lerner, 1995). Such sampling is not likely to reflect a significant contribution from the contaminated zone, and concentrations in the contaminated zone probably will be underestimated.

Similarly, if VOC-contaminated water is flowing into the well and is exiting the well at a different horizon, then VOCs will be present along the screened interval between the two horizons. In this case, VOC concentrations in the screened interval may be representative of aquifer concentrations at the inflow horizon, but may not be representative of aquifer concentrations near the outflow horizon.

In areas where vertical stratification of VOC concentrations is anticipated, using multiple PDB samplers may more fully characterize the contaminated horizon than using a single PDB sampler. This is particularly true in wells having screens 10 ft or longer; however, significant VOC stratification has been observed over intervals of less than 5 ft (Vroblesky and Peters, 2000). Because of the increased probability of vertical concentration or hydraulic gradients within the open interval of long-screened (greater than 10 ft) wells, it is advisable to determine the zones of inflow and outflow within the screened or open interval of these wells using borehole flowmeter analysis (Hess, 1982; 1984; 1986; 1990; Young and others, 1998).

### **Comparison of Passive Diffusion Bag Sampling Methodology to Conventional Methodologies**

Traditional sampling methodologies, such as the purge-and-sample (or conventional purging method), low-flow or low-volume sampling, and using straddle packers and multilevel samplers, produce VOC



concentrations that may differ from VOC concentrations obtained from PDB samplers because the methodologies sometimes are influenced in different ways by aquifer hydraulic and chemical heterogeneity. This section examines potential sources of concentration differences between traditional methodologies and the PDB methodology.

The purge-and-sample approach to ground-water monitoring differs from the diffusion-sampler approach primarily because the area of the screened or open interval that contributes water to the purged sample typically is greater than for the PDB sampler, and the potential for mixing of stratified layers is higher. When pumping three or more casing volumes of water prior to collecting a sample, chemical concentrations in the discharging water typically change as the well is pumped (Keely and Boateng, 1987; Cohen and Rabold, 1988; Martin-Hayden and others, 1991; Robbins and Martin-Hayden, 1991; Reilly and Gibbs, 1993; Barcelona and others, 1994; Martin-Hayden, 2000), due to mixing during pumping and other factors, such as the removal of stagnant water in the casing and changing patterns of inflow and outflow under ambient and pumping conditions (Church and Granato, 1996). The induction of lateral chemical heterogeneity during pumping also may produce variations in the sampled concentrations. The amount of mixing during purging can be highly variable (Barber and Davis, 1987; Church and Granato, 1996; Reilly and LeBlanc, 1998; Martin-Hayden, 2000), and may result in concentrations that are not locally representative (Reilly and Gibbs, 1993). Substantial vertical hydraulic gradients, even in shallow homogeneous aquifers, have been observed to bias sampling using conventional purging because the majority of the pumped water may come from a particular horizon not related to the contaminated zone and because the intra-well flow that intruded the aquifer may not be adequately removed during purging (Hutchins and Acree, 2000). Thus, differences may be observed between concentrations obtained from a pumped sample and from a PDB sample in a chemically stratified interval if the pumped sample represents an integration of water collected from multiple horizons and the PDB sampler represents water collected from a single horizon.

Low-flow purging and sampling (Barcelona and others, 1994; Shanklin and others, 1995) disturbs the local ground water less than conventional purge-and-

sample methods. Thus, samples obtained by PDB samplers are likely to be more similar to samples obtained by using low-flow purging than to those obtained by using conventional purge-and-sample methods. Even under low-flow conditions, however, purging still can integrate water within the radius of pumping influence, potentially resulting in a deviation from VOC concentrations obtained by PDB sampling. One investigation found that in low hydraulic conductivity formations, low-flow sampling methodology caused excessive drawdown, which dewatered the screened interval, increased local ground-water velocities, and caused unwanted colloid and soil transport into the ground-water samples (Sevee and others, 2000). The authors suggest that in such cases, a more appropriate sampling methodology may be to collect a slug or passive sample from the well screen under the assumption that the water in the well screen is in equilibrium with the surrounding aquifer.

Isolating a particular contributing fracture zone with straddle packers in an uncased borehole allows depth-discrete samples to be collected from the target horizon (Hsieh and others, 1993; Kaminsky and Wylie, 1995). Strategically placed straddle packers often can minimize or eliminate the impact of vertical gradients in the sampled interval. However, even within a packed interval isolating inflowing fracture zones, deviations between VOC concentrations in water from PDB samplers and water sampled by conventional methods still may occur if the conventional method mixes chemically stratified water outside the borehole or if the packed interval straddles chemically heterogeneous zones.

The use of multilevel PDB samplers and other types of multilevel samplers (Ronen and others, 1987; Kaplan and others, 1991; Schirmer and others, 1995; Gefell and others, 1999; Jones and others, 1999) potentially can delineate some of the chemical stratification. Diffusion sampling and other sampling methodologies, however, can be influenced by vertical hydraulic gradients within the well screen or the sand pack. When vertical hydraulic gradients are present within the well, water contacting the PDB sampler may not be from a horizon adjacent to the PDB sampler. Rather, the water may represent a mixing of water from other contributing intervals within the borehole. In a screened well, even multilevel samplers with baffles to limit vertical flow in the well cannot prevent influences from

vertical flow in the gravel pack outside the well screen. Such vertical flow can result from small vertical differences in head with depth. A field test conducted by Church and Granato (1996) found that vertical head differences ranging from undetectable to 0.49 ft were sufficient to cause substantial flows (as much as 0.5 liters/minute) in the well bore.

## QUALITY CONTROL AND ASSURANCE

The sources of variability and bias introduced during sample collection can affect the interpretation of the results. To reduce data variability caused during sampling, a series of quality-control samples should be utilized.

Replicate samples are important for the quality control of diffusion-sampler data. Sample replicates provide information needed to estimate the precision of concentration values determined from the combined sample-processing and analytical method and to evaluate the consistency of quantifying target VOCs. A replicate sample for water-filled diffusion samplers consists of two separate sets of VOC vials filled from the same diffusion sampler. Each set of VOC vials should be analyzed for comparison. Approximately 10 percent of the samplers should be replicated.

The length of the PDB sampler can be adjusted to accommodate the data-quality objectives for the sampling event. The length can be increased if additional volume is required for collection of replicate and matrix spike/matrix spike duplicate samples.

Trip blanks are used to determine whether external VOCs are contaminating the sample due to bottle handling and/or analytical processes not associated with field processing. Trip blanks are water-filled VOA vials prepared offsite, stored and transported with the other bottles used for collecting the environmental sample, and then submitted for analysis with the environmental sample. Consideration also should be given to the collection of a predeployment PDB trip blank to determine if the PDB samplers are exposed to extraneous VOCs prior to deployment. The predeployment trip blank should be a PDB sampler that is stored and transported with the field PDB samplers from the time of sampler construction to the time of deployment in the wells. An aliquot of the predeployment blank water should be collected from the PDB sampler in a VOA vial and submitted for analysis at the time of sampler deployment.

Water used to construct the diffusion samplers should be analyzed to determine the presence of background VOCs. Although many VOCs accidentally introduced into the diffusion-sampler water probably will reequilibrate with surrounding water once the diffusion samplers are deployed, some VOCs may become trapped within the diffusion-sampler water. For example, acetone, which is a common laboratory contaminant, does not easily move through the polyethylene diffusion samplers (Paul Hare, General Electric Company, oral commun., 1999). Thus, acetone inadvertently introduced into the diffusion-sample water during sampler construction may persist in the samplers, resulting in a false positive for acetone after sampler recovery and analysis.

## SUMMARY

Water-filled passive diffusion bag (PDB) samplers described in this report are suitable for obtaining a variety of VOCs in ground water at monitoring wells. The suggested application for PDB samplers is for long-term monitoring of VOCs in ground-water wells at well-characterized sites. Where the screened interval is greater than 10 ft, the potential for contaminant stratification and/or intra-borehole flow within the screened interval is greater than in screened intervals shorter than 10 ft. It is suggested that the vertical distribution of contaminants be determined in wells having 10-ft-long well screens, and that both the vertical distribution of contaminants and the potential for intra-borehole flow be determined in wells having screens longer than 10 ft. A typical PDB sampler consists of a 1- to 2-ft-long low-density polyethylene lay-flat tube closed at both ends and containing deionized water. The sampler is positioned at the target horizon by attachment to a weighted line or fixed pipe.

The amount of time that the samplers should be left in the well prior to recovery depends on the time required by the PDB sampler to equilibrate with ambient water and the time required for environmental disturbances caused by sampler deployment to return to ambient conditions. The rate that water within the PDB sampler equilibrates with ambient water depends on multiple factors, including the type of compound being sampled and the water temperature. Concentrations of benzene, *cis*-1,2-dichloroethene, tetrachloroethene, trichloroethene, toluene, naphthalene, 1,2-dibromoethane, and total xylenes within the PDB samplers equilibrated with the concentrations in an

aqueous mixture of those compounds surrounding the samplers under laboratory conditions within approximately 48 hours at 21 °C. A subsequent laboratory study of mixed VOCs at 10 °C showed that tetrachloroethene and trichloroethene were equilibrated by about 52 hours, but other compounds required longer equilibration times. Chloroethane, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, and 1,1-dichloroethene were not equilibrated at 52 hours, but appeared to be equilibrated by the next sampling point at 93 hours. Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane were not equilibrated at 93 hours but were equilibrated by the next sampling point at 166 hours. Different equilibration times may exist for other compounds. Differences in equilibration times, if any, between single-solute or mixed-VOC solutions have not yet been thoroughly examined.

The samplers should be left in place long enough for the well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment. Laboratory and field data suggest that 2 weeks of equilibration probably is adequate for many applications. Therefore, a minimum equilibration time of 2 weeks is suggested. In less permeable formations, longer equilibration times may be required. When deploying PDB samplers in waters colder than previously tested (10 °C) or for compounds without sufficient corroborating data, a side-by-side comparison with conventional methodology is advisable to justify the field equilibration time.

Following the initial equilibration period, the samplers maintain equilibrium concentrations with the ambient water until recovery. Thus, there is no specified maximum time for sampler recovery after initial equilibration. PDB samplers have routinely been left in ground waters having concentrations of greater than 500 ppm of TCE for 3 months at a time with no loss of bag integrity, and at one site, the PDB samplers were left in place in VOC-contaminated ground water for 1 year with no reported loss of sampler integrity. The effects of long-term (greater than 1 month) PDB-sampler deployment on sampler and sample integrity have not yet been thoroughly tested for a broad range of compounds and concentrations. In some environments, development of a biofilm on the polyethylene may be a consequence of long-term deployment. Investigations of semipermeable membrane devices

(SPMDs) have shown that the transfer of some compounds across a heavily biofouled polyethylene membrane may be reduced, but not stopped. If a heavy organic coating is observed on a PDB sampler, it is advisable to determine the integrity of the sample by comparing sampler results to a conventional sampling method concentrations before continuing to use PDB samplers for long-term deployment in that well.

PDB methodology is suitable for a broad variety of VOCs, including chlorinated aliphatic compounds and petroleum hydrocarbons. The samplers, however, are not suitable for inorganic ions and have a limited applicability for non-VOCs and for some VOCs. For example, although methyl-*tert*-butyl ether and acetone and most semivolatile compounds are transmitted through the polyethylene bag, laboratory tests have shown that the resulting concentrations were lower than in ambient water. The samplers should not be used to sample for phthalates because of the potential for the LDPE to contribute phthalates to the water sample.

When attempting to determine whether the use of PDB samplers is appropriate at a particular well, a common approach is to do a side-by-side comparison with a conventional sampling method. This approach is strongly suggested in wells having temporal concentration variability. In a well having relatively low temporal concentration variability, comparison of the PDB-sampler results to historical concentrations may provide enough information to determine whether the PDB samplers are appropriate for the well. In general, if the two approaches produce concentrations that agree within a range deemed acceptable by the local, state, and Federal regulatory agencies, then use of a PDB sampler in that well will provide VOC concentrations consistent with the historical record. If concentrations from the PDB sampler are higher than concentrations from the conventional method, then it is probable that the concentrations from the PDB sampler are an adequate representation of ambient conditions. If, however, the conventional method produces concentrations that are substantially higher than the concentrations found by using the PDB sampler, then the PDB sampler may or may not adequately represent local ambient conditions. In this case, the difference may be due to a variety of factors, including mixing or translocation due to hydraulic and chemical heterogeneity of the aquifer within the screened or open interval of the well and the relative permeability of the well screen.



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# **HYDRASleeve**

Simple by Design

US Patents No. 6,481,300; No. 6,837,120; others pending

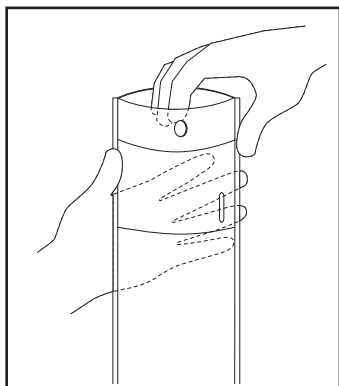
## **Field Manual**

# Introduction

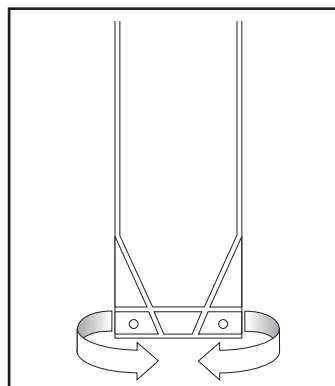
The HydraSleeve groundwater sampler can be used to collect a representative sample for most physical and chemical parameters without purging the well. It collects a whole water sample from a user-defined interval (typically within the well screen), without mixing fluid from other intervals. One or more HydraSleeves are placed within the screened interval of the monitoring well, and a period of time is allocated for the well to re-equilibrate. Hours to months later, the sealed HydraSleeve can be activated for sample collection. When activated, HydraSleeve collects a sample with no drawdown and minimal agitation or displacement of the water column. Once the sampler is full, the one-way reed valve collapses, preventing mixing of extraneous, non-representative fluid during recovery.

## Assembly

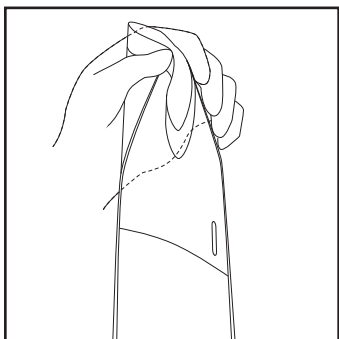
Assembling the HydraSleeve is simple, and can be done by one person in the field, taking only a minute or two.



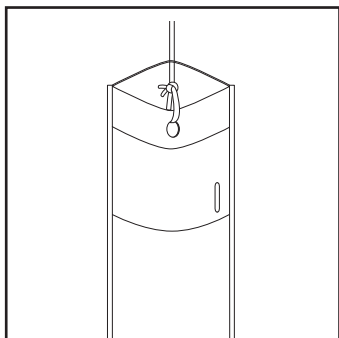
**1** Remove HydraSleeve from package and grasp top to "pop" open.



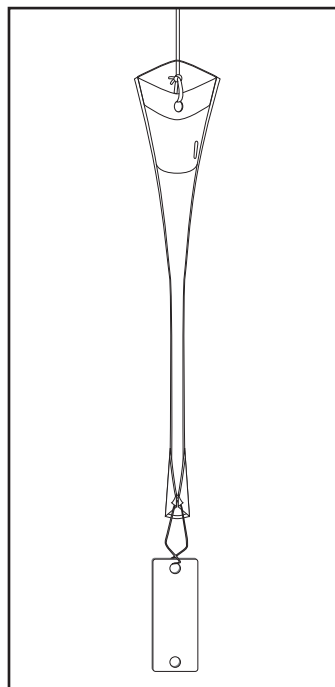
**4** Fold the two holes at bottom of HydraSleeve together and attach weight



**2** Squeeze side fins together at top to bend reinforcing strips outward.



**3** Attach line to hole at top of HydraSleeve.



**5** Sampler is ready to insert into the well.

# Placing the HydraSleeve(s)

To collect a representative groundwater sample without purging, the well must be allowed time to re-equilibrate after placement of the sampler. When any device is lowered into a well, some mixing of the water column occurs. The diameter of the device and its shape greatly affect the degree of mixing. The flat cross-section of the empty HydraSleeve minimizes the disturbance to the water column as the sampler is lowered into position, reducing the time needed for the well to return to equilibrium.

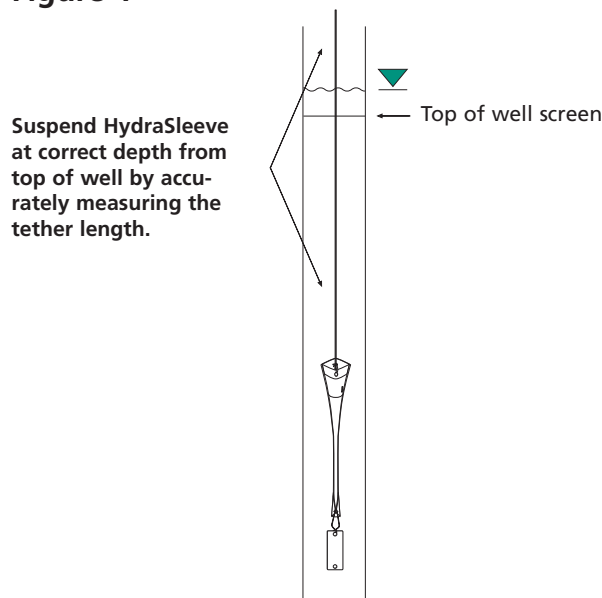
There are three basic methods for holding a HydraSleeve in position as the well equilibrates.

## TOP DOWN DEPLOYMENT (Figure 1)

Measure the correct amount of suspension line needed to "hang" the top of the HydraSleeve(s) at the desired sampling depth (in most cases, this will be at the bottom of the sampling zone). The upper end of the tether can be connected to the well cap to suspend the HydraSleeve at the correct depth until activated for sampling.

Note: For deep settings, it may be difficult to accurately measure long segments of suspension line in the field. Factory prepared, custom suspension line and attachment points can be provided.

Figure 1

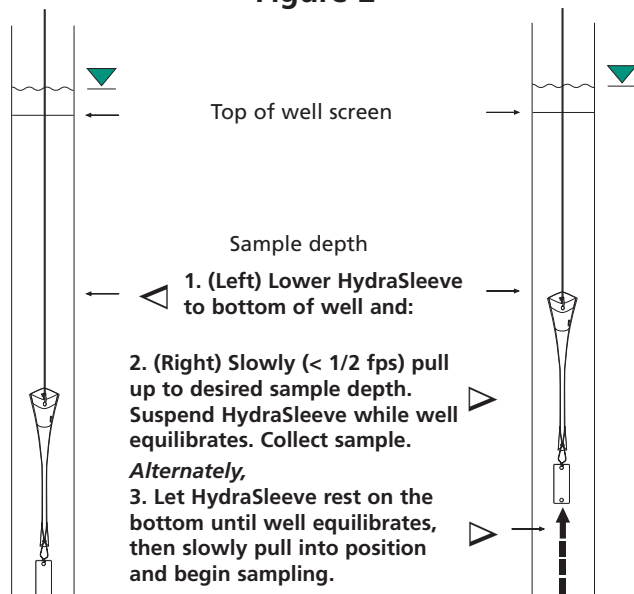


## BOTTOM DEPLOYMENT (Figure 2)

Sound the well to determine the exact depth. Lower the weighted HydraSleeve into the well and let it touch the bottom. Very slowly (less than 1/2 foot per second) raise the sampler to the point where the check valve is at the depth the sample is to be collected. Attach the suspension line to the top of the well to suspend it at this depth. (It is often easier to measure a few feet from the bottom of the well up to the sample point, than it is to measure many feet from the top of the well down.)

Alternately, the sampler can be left on the bottom until the well re-equilibrates. For sampling, it can be very slowly pulled (< 1/2 fps) to sampling depth, then activated (see "Sample Collection," p. 6) to collect the sample, and retrieved to the surface.

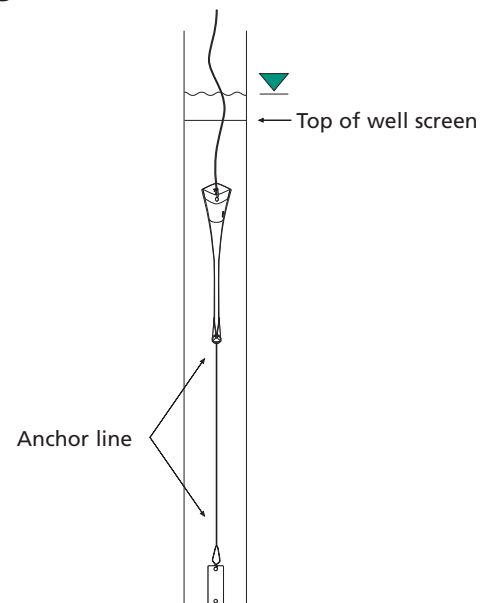
Figure 2



### BOTTOM ANCHOR (Figure 3)

Determine the exact depth of the well.  
Calculate the distance from the bottom of the well to the desired sampling depth.  
Attach an appropriate length anchor line between the weight and the bottom of the sampler and lower the assembly until the weight rests on the bottom of the well, allowing the top of the sampler to float at the correct sampling depth.

Figure 3



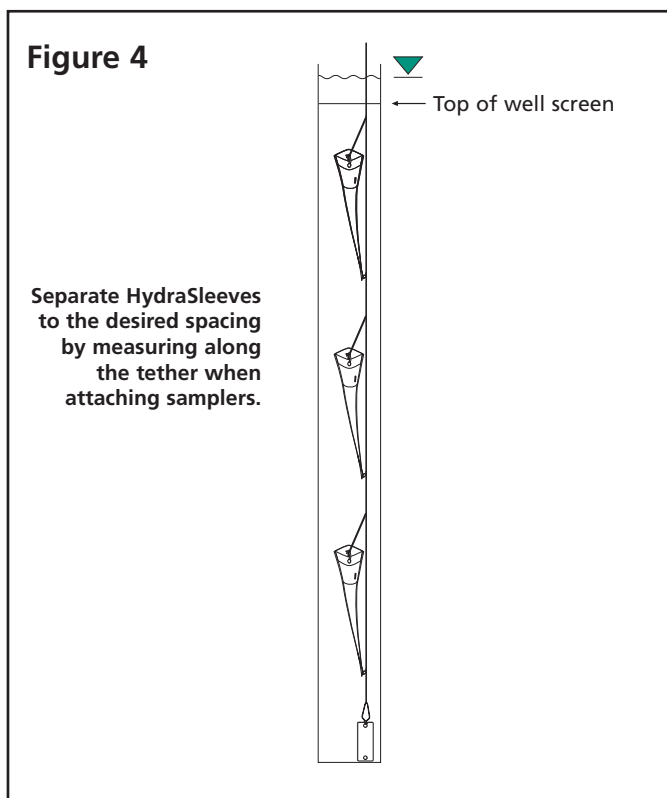


# Multiple Interval Deployment

There are two basic methods for placing multiple HydraSleeves in a well to collect samples from different levels simultaneously.

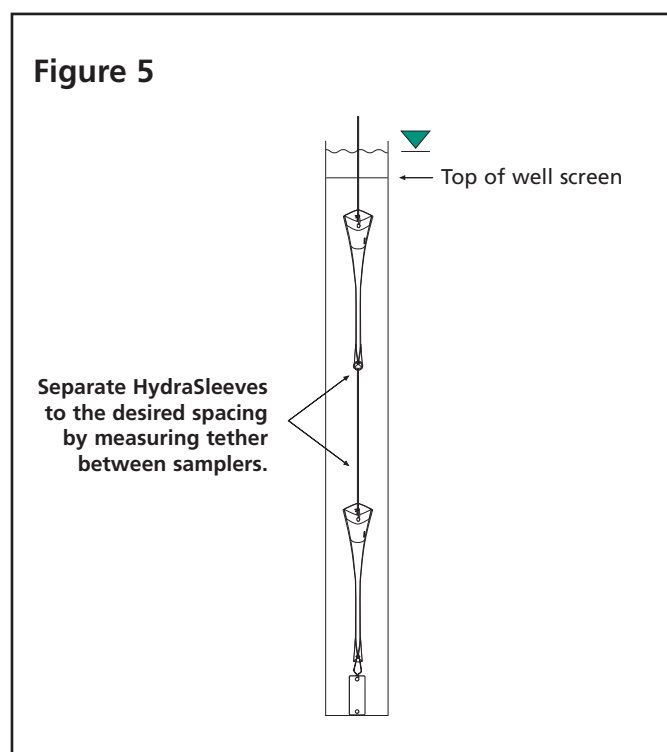
## ATTACHED TO A SINGLE TETHER (Figure 4)

To use 3 or more samplers simultaneously, we recommend attaching them all to a tether for support to prevent the sampling string from pulling apart. The weight is attached to a single length of suspension line and allowed to rest on the bottom of the well. The top and bottom of each HydraSleeve are attached to the tether at the desired sample intervals. Cable tie or stainless steel clips (supplied) work well for attaching the HydraSleeves to the line. Simply push one end of the clip between strands of the rope at the desired point before attaching the clip to the HydraSleeve.



## ATTACHED END TO END (Figure 5)

To place 2 or 3 stacked HydraSleeves for vertical profiling, use one of the methods described above to locate the bottom sampler. Attach the bottom of the top sampler to the top of the following HydraSleeve(s) with a carefully measured length of suspension cable. Connect the weight to the bottom sampler. Note: if many HydraSleeves are attached to a tether, more weight may be required than with a single sampler.



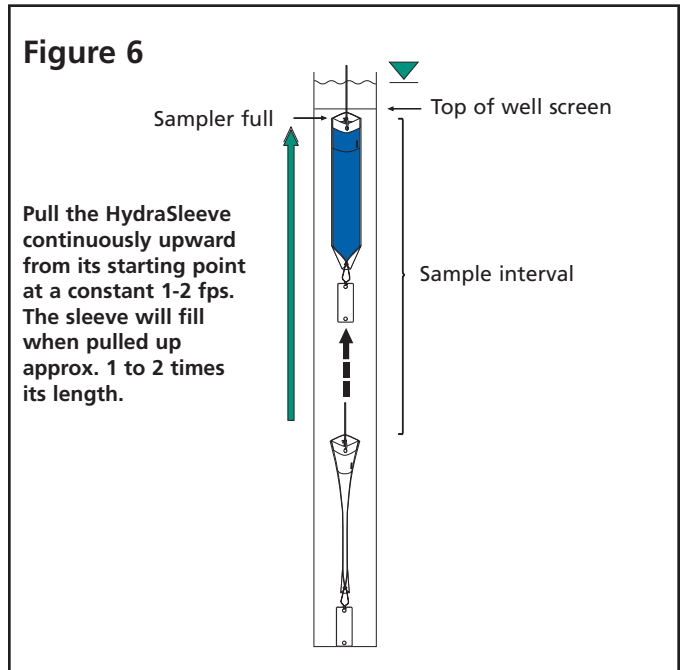
# Sample Collection

The HydraSleeve must move upward at a rate of one foot per second or faster (about the speed a bailer is usually pulled upward) for water to pass through the check valve into the sample sleeve. The total upward distance the check valve must travel to fill the sample sleeve is about 1 to 2 times the length of the sampler. For example, a 24-inch HydraSleeve needs a total upward movement of 24 to no more than 48 inches to fill. The upward motion can be accomplished using one long continuous pull, several short strokes, or any combination that moves the check valve the required distance in the open position. A special technique is used for sampling low-yield wells.

## CONTINUOUS PULL (Figure 6)

Pull the HydraSleeve continuously upward from its starting point at a constant 1 to 2 feet per second until full. This method usually provides the least turbid samples and is analogous to coring the water column from the bottom up.

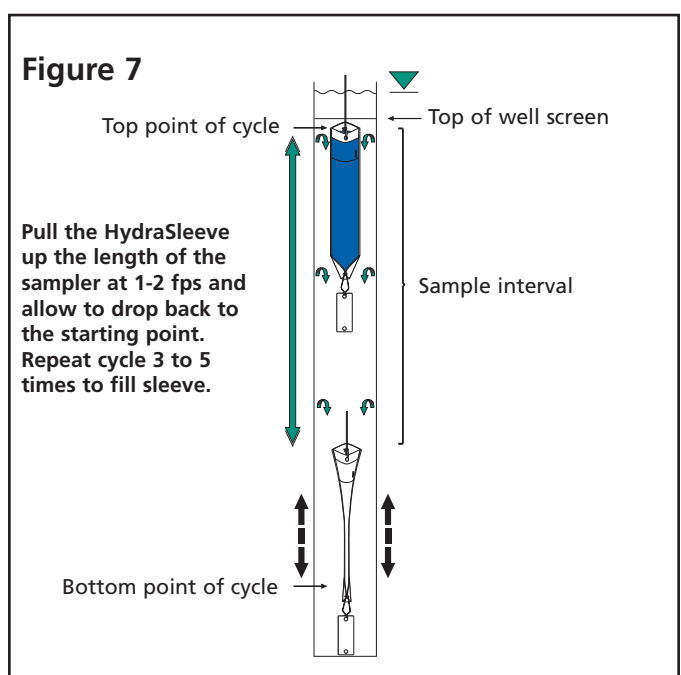
*Note: When using this method, the screen interval should be long enough so the sampler fills before exiting the top of the screen.*



## SHORT STROKES (Figure 7)

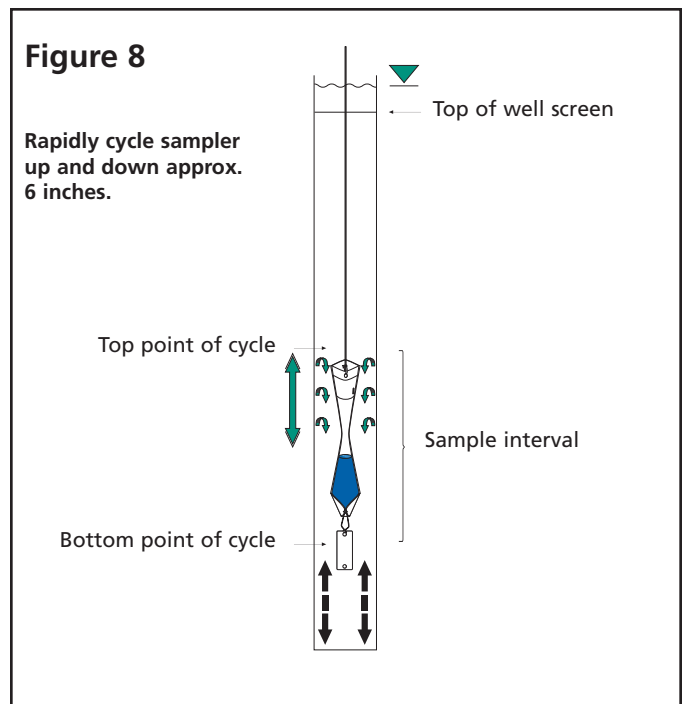
Pull the sampler upward at about 1 to 2 feet per second for the length of the sampler and let it drop back to the starting point. Repeat the cycle 3 to 5 times.

This method provides a shorter sampling interval than the continuous pull method (above), and usually reduces the turbidity levels of the sample below that of numerous rapid, short cycles (below). The sample comes from between the top of the cycle and the bottom of the sampler at its lowest point.



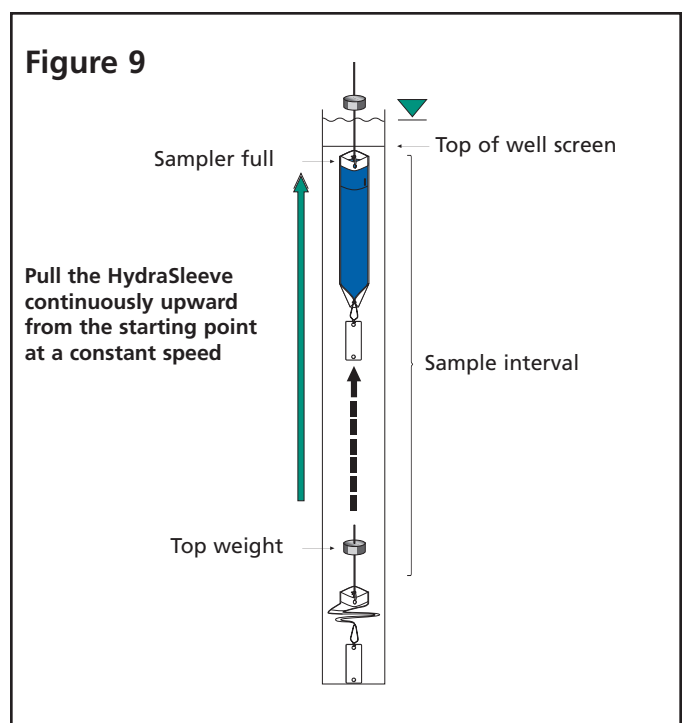
## RAPID, SHORT CYCLES (Figure 8)

Cycle the HydraSleeve up and down using rapid, short strokes (6-inch cycle at a minimum of 1 cycle per second) 5 to 8 times. This method provides the shortest sampling interval. Dye studies have shown that when using this method the sample flows into the check valve from along the length of the sampler and immediately above the check valve. The sample interval is from the bottom the sampler at its lowest point in the cycle to the top of the check valve at the peak of the cycle.



## SAMPLING LOW-YIELD WELLS (Figure 9)

HydraSleeve provides the best available technology for sampling low yield wells. When pulled upward after the well re-equilibrates, the HydraSleeve will collect a water core from the top of the sampler to about its own length above that point. The sample is collected with no drawdown in the well and minimal sample agitation. An optional top weight can be attached to compress the sampler in the bottom of the well if needed for an extremely short water column. With a top weight, the check valve is pushed down to within a foot of the bottom of the well.



# Sample Discharge

The best way to remove a sample from the HydraSleeve with the least amount of aeration and agitation is with the short plastic discharge tube (included).



First, squeeze the full sampler just below the top to expel water resting above the flexible check valve. (Photo 1, top left)



Then, push the pointed discharge tube through the outer polyethylene sleeve about 3-4 inches below the white reinforcing strips. (Photo 2, middle left)



Discharge the sample into the desired container. (Photo 3, bottom left)

Raising and lowering the bottom of the sampler or pinching the sample sleeve just below the discharge tube will control the flow of the sample. The sample sleeve can also be squeezed, forcing fluid up through the discharge tube, similar to squeezing a tube of toothpaste. With a little practice, and using a flat surface to set the sample containers on, HydraSleeve sampling becomes a one-person operation.



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## **Attachment A: Standard Operating Procedure (SOP) #4**

### **Supply and Irrigation Well Sampling Protocol**

#### **1.0 Sample Collection**

Samples are collected from three former Fort Ord supply wells (Well 29(A), 30 (B), and 31 (C)<sup>1</sup>) operated by the Marina Coast Water District (MCWD), and on private off post irrigation well (Mini-Storage). Samples from these wells are analyzed for VOCs by EPA Test Method 8260 SIM (selected ion monitoring) OUCTP A-Aquifer COC list on a quarterly basis<sup>2</sup>. Samples are collected in three 40 milliliter (mL) VOA vials pre-preserved with hydrochloric acid (HCl). The water from these wells is collected prior to treatment or chlorination; therefore, the addition of sodium thiosulfate as a preservative is not needed.

#### **2.0 Sample Techniques**

Upon arriving at the supply well, the MCWD field technician will inform the sampler if the well is on (pumping) or off. If the pump is off, the sampler should remain outside the building until the MCWD field technician has started the pump due to noise associated with the pump's initial start-up. Once the pump is running, the sampler must open the sampling port, a small Teflon or copper tube coming from the main water flow pipe. The MCWD field technician can help locate the sampling port if the sampler is unable to identify it. Let the spigot run approximately one minute at high flow to flush the sampling port tube. A drain located in the floor near the spigot collects the discharge water. Adjust the flow rate downward until you are able to fill the 40mL VOA vials with no splashing or bubbling, letting the water flow down the side of the container. Do not overfill or rinse the container or the preservative will be lost. The 40mL VOA vials should be completely filled to the point where the water's meniscus forms a convex shape above the lip of the container. Replace the container's cap and secure snugly making sure not to over tighten, and check for headspace or bubbles. VOA vials are zero headspace and therefore if a bubble appears inside the bottle after capping, a new sample must be collected. The sample bottles are to be labeled, stored in a Ziploc bag, and placed on ice in a sample cooler immediately. The chain of custody (COC) and daily field logbook shall be filled out completely prior to moving on to the next well.

The Mini-Storage well is located in the Marina Mini-Storage yard on the north side of Reservation Road in Marina. The pump head is located just north of the parking area in the main lot. Two spigots are on the top of the pump head just outside a small garden box container. A hose may be attached to one or both spigots. The spigot where the sample will be collected should be turned on and the water allowed to flow for at least a minute. A pressure gauge is located on the pipe and will indicate when the pump has been activated. After the pump has turned on, allow the water to run for another one to one and a half minutes. Remove any hoses attached to the spigot, adjust the flow as low as reasonable, and collect the sample in the same fashion as described for the Supply Wells. When finished replace any hoses that have been removed from the spigots. The sample bottles are to be labeled, stored in Ziploc bags, and placed on ice in a sample cooler immediately. The COC and daily field logbook shall be filled out completely prior to moving on to the next well.

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<sup>1</sup> These wells are identified as FO-29, FO-30, and FO-31, respectively.

<sup>2</sup> Unless a well is inoperable.



## **Attachment A: Standard Operating Procedure (SOP) #5**

### **OU2 and Sites 2/12 GWTs and OUCTP EISB Extraction Well**

### **Sample Handling and Custody Requirements**

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## **1.0 Sample Types**

Project samples may be extraction well groundwater samples, Groundwater Treatment Plant (GWTP) process water samples, or quality control/quality assurance samples. Standard operating procedures for the collection of these water samples are described in this document.

### **1.1 Extraction Well Samples**

Extraction well samples (standard field samples) will be generated to evaluate the effectiveness of the remedial action in containing the groundwater contamination plume, removing contaminant mass from the groundwater, and achieving remedial action objectives. Data generated will be applied to decision rules identified in the QAPP to determine operational status and sampling frequency for individual extraction wells.

### **1.2 GWTP Process Samples**

GWTP process samples (standard field samples) will be generated to evaluate the effectiveness and efficiency of GWTP components in removing chemicals of concern (COCs) from extracted groundwater, determining the timing for replacing granular activated carbon (GAC) in the GAC vessels, and maintaining discharge limits for COCs in treated water.

### **1.3 Quality Control (QC)**

Field QC samples will be generated to evaluate the precision, accuracy, and integrity of field sampling and laboratory analytical procedures. Quality control samples are introduced into the sample analysis stream along with environmental samples. The frequency of field QC sample generation is based on project Data Quality Objectives (DQOs), as well as the total number of samples submitted and the nature and intensity of the investigative process that is being monitored or evaluated. The following QC samples will be employed during the field program.

#### **1.3.1 Trip Blanks**

Trip blanks are prepared by the laboratory using contaminant-free water (e.g., nitrogen purged deionized water) which is poured into Volatile Organic Analysis (VOA) vials and shipped to Ahtna Environmental Inc. (Ahtna) by the laboratory. The laboratory also provides pre-cleaned and hydrochloric acid (HCl) acid-preserved sample containers for collecting water samples for Volatile Organic Compound (VOC) analysis. Trip blanks will accompany sample containers into the field and will be shipped back to the laboratory with every cooler that contains samples for VOC analyses. Trip blanks will be analyzed for all VOC analytes specified for environmental samples in the corresponding cooler.

#### **1.3.2 Field Duplicate Samples**

Duplicate samples are submitted to the contract laboratory for the purpose of assessing the effect of the sample matrix on analytical measurement precision.

The laboratory will not be informed as to the identity of duplicate samples and no special sample handling protocol will be employed during collection, shipment, or analysis of these samples. These “blind” duplicate samples will be submitted and analyzed on a frequency of one in ten of the total

environmental sampling effort for each matrix sampled. Areas of known contamination or critical sampling points may be preferentially selected for submittal as blind duplicates. Duplicate samples will be analyzed for the same parameters as the corresponding primary sample.

## **2.0 Field Documentation**

Field activities and sample collection will be documented using the following forms and information as appropriate: sample label, chain of custody form, groundwater sampling form, well completion details, well development form, cooler receipt form, waste management label, and hazardous waste label. The purpose of standardized field documentation and sampling procedures is to maintain integrity of field documentation and field samples throughout the remediation process. Each field sample will be labeled and sealed immediately after collection. Sample identification documents will be carefully prepared to maintain control of sample disposition. Field sample custody procedures are described in Section 4.1. Standard procedures for documentation of field activities are presented below.

### **2.1 Field Logbooks**

Field procedures relevant to sample collection and field activities will be recorded daily in permanently bound notebooks. Each individual in the field will maintain a bound field logbook with serially numbered pages. The logbook is signed and dated prior to daily initiation of field work. If logbook duties are transferred, the individuals relinquishing and receiving will both sign and date the logbook and record the transfer time. Logbook corrections are made by a single line strikeout of the incorrect entry and entering the correct information that is initialed by the person making the entry. If the correction is made at a later time or date, the correction date is also entered. Unused partial or whole logbook pages are crossed out and unused pages signed and dated at the end of each workday. All entries must be legible, in ink, and primarily factual in content. Hypothetical information can be entered but should be noted accordingly. Logbook entries may include the following information as necessary:

- Project name and number.
- Site name and location.
- Arrival and departure date/time.
- Name and affiliation of personnel onsite (including site visitors), and personnel contacted.
- Author name and date.
- Field instrument calibration methods and identification number.
- Chronology and location of activities.
- Sampling locations.
- Sample identification numbers, amount collected, sampling method and container (size/type) for each sample collected, including QC samples. Sample processing techniques such as filtration, compositing, and preservation techniques should be noted. Alternatively, this information may be contained on the COC form, groundwater sampling form, or other field form. The logbook will then contain a unique identifier linking the field log book entry to the field form.
- Date and time of sample collection, name of sampler.
- Field observations including weather conditions and applicable comments.

- Number of shipping coolers packaged and sent.
- Name and address of all receiving laboratories.
- Any modifications or deviations from quality assurance project plan.

Written reports of all significant non-routine events for field and laboratory work will be sent to the USACE Contracting Officer within 48 hours of occurrence. These reports will identify the problem, corrective action, and verbal written instructions from the USACE Project Manager (PM) to Ahtna regarding corrective action. Significant non-routine events are occurrences that impact cost of work, work schedule, work quality, and analytical data quality.

## **2.2 Sample Identification and Labels**

### **2.2.1 Sample Identification**

Two sample identifiers, the sample number and the station number, will be used to designate samples and sampling locations. Sample numbers will be used for coding, tracking, and reporting chemical data. Station numbers will encode sample type, site identification, and boring number or monitoring well sequence. Conventions for generating sample and station numbers are presented below.

The sample number is a coded identification designed to satisfy project and database criteria. Each sample number:

- Will contain up to 12 characters.
- Will be unique.
- Will be traceable to a specific sampling event.
- Will be traceable to a specific sampler.
- Will incorporate a specific site designation.
- Will not obviously indicate to the laboratory the sample depth, station number, or type of sample (i.e., original sample and duplicate).

All chemical data produced by the contract laboratory will be reported using the sample number. Samples will be numbered as follows (no spaces in actual sample numbers):

**YR WK X SSS 000 Z**

Where:

YR = Calendar year

WK = Week of the year

X = One-letter ID code assigned to each field sampler

SSS = Three-character site identification code: "OU2" or "212"

000 = Three-digit sequence number for each sample

Z = Assigned QC sample code

Assigned sample QC codes are as follows:

- A = Trip blank

- B = Not used for groundwater treatment system (GWTS) sampling
- C = Not used for GWTS sampling
- D = Field duplicate
- E = Not used for GWTS sampling
- F = Standard field sample

For example, sample number 1704M212015A represents the fifteenth sample collected by sampler "M" and is a trip blank (QC code A) collected at Sites 2/12 during Week 4 of 2017. Each sample collector will start with sequence number 001 and continue consecutively through 999. Field personnel are responsible for keeping track of their own sequence in the field logbook. Field audits will include checks of this sample numbering system to ensure that correct procedures are being followed.

Week numbers are assigned to week-long periods ending on Friday. For example, Week 4 of 2017 is the week ending January 27, 2017. Week numbers below 9 must contain a zero (i.e., 01 through 08). For aqueous samples, multiple sample containers for each discrete sample may be required to fulfill analytical requirements. In these instances, the same sample number will be used on all sample containers.

The station description is a sequence of characters designed to identify site-specific samples. Station descriptions will not be included on the laboratory copy of the chain of custody form. The station description field on the chain of custody form will be used to record the site, sample type, sequence number, and other relevant sample characteristics.

The convention for station description naming is as follows:

**ST-SSS-000-XXX**

Where:

ST = Sample type

SSS = Three-character site identification code (same as for sample numbering scheme)

000 = Station number unique to each station

XXX = Sample depth or aquifer

Station description names will not include spaces. Example sample type codes are as follows:

- EW = Extraction well
- MP = Multi-port well
- MW = Monitoring well
- SG = Soil gas
- SL = Sludge
- PZ = Piezometer
- TS = Treatment system
- WW = Wastewater
- VE = Vapor extraction



Sample depth may indicate the actual depth the sample was collected relative to ground surface or top of well casing (e.g. the pump intake depth), the port the sample was collected from in a multi-port well, or the aquifer the sample was collected from. Example sample depth codes for aquifers at the former Fort Ord are as follows:

- A = A-Aquifer
- 180 = Upper or Lower 180-Foot Aquifer

For example, station name EW-OU2-13-A represents an extraction well station 13 at the OU2 site with a sample depth in the A-Aquifer.

### **2.2.2 Sample Label**

All samples will be properly labeled to prevent misidentification of samples. Preprinted sample labels will be provided. The label will be affixed to the sample container prior to transportation to the laboratory and will contain the following information:

- Project name, number, and location
- Site name
- Name of collector
- Date and time of collection
- Sample identification number
- Preservative, if any
- Requested test methods or analyses

## **2.3 Chain of Custody Record**

A chain of custody (COC) record will be filled out for and will accompany every sample to the analytical laboratory for documentation of sample possession from the time of collection to sample receipt. A carbonless copy of the chain of custody form will be retained in the investigation files according to project number. The primary laboratory will upload copies of the cooler receipt forms and associated chain of custody forms to its LabLink website for review by the Project Chemist within 24 hours of sample receipt. The forms will contain the following information:

- Sample number or identification
- Name and signature of collector, sampler, or recorder
- Name, number, and location of project
- Project manager's name
- Date of collection
- Place of collection (station description)
- Sample type
- Analyses requested
- Dates and times of possession changes

- Signature of persons relinquishing and receiving sample
- Laboratory sample number, where applicable
- Date and time of laboratory sample receipt

## **2.4 Transfer and Review of Field Documentation**

During site-specific field operations, copies of each field logbook page will be telefaxed or hand delivered to the Task Manager on a daily basis. In the absence of a facsimile, field staff will be in contact with the Task Manager, via mobile telephones.

At the end of each week of field operations, all field documentation will be copied, and originals sent to the Task Manager or Project Manager for review and verification. Original field documents will be kept in the project files. Verification and review of field documentation will include at a minimum, the following checks:

- Consistency of dates and times of activities; among the various field records and forms
- Consistency of sample location and identification documentation among the various field records and forms
- Accuracy and correctness of well completion details
- Correctness of sample preservation techniques

Errors or inconsistencies identified during the review process will trigger a nonconformance investigation to be conducted by the Project Chemist or Quality Control System Manager (QCSM). Appropriate corrective action will be implemented and documented if systemic errors are identified.

## **3.0 Groundwater Sampling**

This section describes groundwater sampling procedures to be followed prior to, during, and after groundwater sample collection from monitoring wells. Procedures for collecting grab groundwater samples are described at the end of this section.

### **3.1 Sampling Preparation**

Prior to sampling, the well vault or GWTS process sampling port will be examined for signs of tampering or deterioration and observations noted. After a well vault is opened, the Activity Hazard Analysis (AHA) may call for the air in the wellhead vicinity to be tested for organic vapors with the Photo Ionization Detector (PID) or Flame Ionization Detector (FID) and/or for explosive atmospheres with an oxygen/combustible gas indicator (see Appendix E of the Site Safety and Health Plan). Results will be recorded in the field notebook. (Note: well vault air testing is not required for routine groundwater sampling as long as previous results indicate that organic vapors or explosive atmosphere are not present). All measuring and sampling equipment will be decontaminated prior to use in any well (see Section 3.5).

Extraction wells that are not normally operated will be run to purge a minimum of three well volumes prior to sample collection. Pumped purge volumes will be estimated using the flow meter in the well vault. The volume of water purged and the withdrawal rates will be recorded. Purge rates will be sustainable and executed at a rate that minimizes drawdown to prevent water from cascading into the

well. Prior to sample collection, ports for extraction well and process sampling will be purged with the port valve completely open for a minimum of 1 minute to ensure stagnant water and any foreign matter or debris are discharged so a representative sample may be collected.

If a well is purged dry before three casing volumes have been removed, VOC samples will be collected immediately. Other samples will be taken after the well has recovered to within 80 percent of the static water level prior to purging, or after 4 hours, or when sufficient water volume is available to meet analytical requirements, whichever occurs first.

Pre-cleaned sample containers will be provided by the laboratory. The containers for each sample will be labeled in advance of the sampling event with the date, sample number, project name, sampler's name or initials, parameters for analysis (method numbers where possible), and preservation.

### **3.2 Sampling Procedures**

After purging, samples will be collected using designated sampling ports in extraction well vaults or designated GWTS process sampling ports. Water samples will be collected carefully by discharging directly from the sample port to the appropriate sample containers.

Water samples for VOC analysis will be collected in VOA vials, which will be filled by inserting the sample port spout to the bottom of the VOA vial and keeping the spout beneath the surface of the liquid as it fills the vial until there is a convex meniscus over the neck of the bottle. The Teflon side of the septum (in the cap) will be positioned against the meniscus, and the cap screwed on tightly; the sample will be inverted, and the vial tapped lightly. The absence of an air bubble indicates a successful seal; if a bubble is evident, the sample will be discarded and the process repeated.

All sample bottles and equipment will be kept away from fuels and solvents. Gasoline (used in generators) will be transported in a different vehicle from the vehicle containing sampling equipment, sample bottles, etc. If possible, one person should be designated to handle samples and another person should operate the generators and refuel equipment, if required. Disposable gloves will be worn for each separate activity and then properly disposed. Care will be taken to avoid fuel spillage.

All samples will be packaged and transported appropriately, as described in Section 4.3.

### **3.3 Water-Level Measurement**

The methods presented below are intended to produce water-level measurements that are consistent over multiple measurement events. Calibration and precision requirements for water-level measurements are summarized in Section 3.4.

Groundwater levels may be measured using an electrical sounder, a steel tape, or a pressure transducer. All water-level measurements will be taken from an obvious survey mark at the top edge of the well casing. Water levels will be measured using the following procedures.

#### **Electrical Sounder**

The standard equipment for making individual water-level measurements will be a battery-powered sounder. The sounder must have firmly affixed or permanent marks on the sounder line at regular intervals (minimum interval of 0.01 foot).

Calibration checks on the electrical sounder will be made periodically. The sounder markings will first be checked for the proper spacing by physically comparing the spacing with a graduated steel tape. Accuracy rechecks will be made after any incident that might alter the measuring capability of the instrument, such as cable stretching, entanglement, or sensor tip replacement.

Portions of the cable that are inserted in wells will be decontaminated after use according to the procedure described in Section 3.5. Sounders will be maintained in a clean and functional condition.

### **Steel Tape**

A graduated steel tape (with 0.01-foot graduations) can be used for water-level measurements in conjunction with other methods and, when required, for a quality control check of other methods. The steel tape will be periodically checked for kinks, and if kinked tapes are found, the tape will be labeled as unusable and taken out of service. Portions of the tape that are inserted in wells will be cleaned after use according to the procedure described in Section 3.5. Tapes will be maintained in a clean and functional condition.

## **3.4 Sampling Equipment Calibration Procedures**

Included is a description of the procedure or a reference to an applicable standard operating procedure, the calibration frequency, and the calibration standards used. All instruments and manufacturers' instructions and specifications are maintained in the project files. All instruments are calibrated prior to being sent to the field. Field calibration procedures will be documented in the Field Logbook.

### **Water-Level Measurement Instruments**

Electrical sounder: Checked against steel surveyor's tape prior to initial use. Battery and sensitivity checked daily.

Graduated steel tape: Referred to new steel tape; manufacturer-supplied temperature correction is applied if appropriate for field conditions.

Pressure transducer: Factory calibrated once, in-house calibration checked with water columns prior to aquifer tests, and weekly field checks made against steel tape or electrical sounder.

## **3.5 Decontamination Procedures**

All reusable equipment that may come in contact with potentially contaminated soil, sediment, or water will be decontaminated prior to use to reduce the potential for cross-contamination during field activities. Decontamination will consist of steam cleaning (high pressure, hot water washing); non-phosphate detergent wash; solvent rinse; distilled, deionized (DI), or clean water rinse; pesticide-grade methanol rinse; and final rinse with DI water, as appropriate.

The procedures for decontaminating sampling equipment are described below:

- Wash steel tapes, well sounders, transducers, and water quality probes in a non-phosphate detergent solution, and rinse in distilled or DI water, or wipe clean after each use, depending upon site conditions. Clean the portion of these devices inserted into wells with a mild non-phosphate detergent solution.

## **4.0 Sample Handling Procedures**

Appropriate sample handling techniques are necessary to protect the samples and maintain sample custody protocol requirements following collection. Sample handling includes custody, container/preservative type, transfer, storage, and disposal.

### **4.1 Field Sample Custody**

Standardized sample custody procedures will be followed through sample collection, transfer, storage, analysis, and ultimate disposal. Sample custody begins with shipment of the empty sample container sent to the office or site. All sample containers are shipped from the laboratory in sealed containers or cartons with appropriate seals and custody information. Sample quantities, types, and locations will be specified before the actual field work commences.

A sample is considered under custody if one or more of the following criteria are met:

- The sample is in the sampler's possession
- The sample is in the sampler's view
- The sample is in a designated secure area after being in the sampler's possession

### **4.2 Sample Containers and Preservation**

Samples should be collected and containerized in order of the analyte volatilization sensitivity. A preferred collection order is listed below:

- Volatile organic compounds
- Sulfate and chloride

Methods of sample preservation are intended to retard biological action, retard hydrolysis, and reduce sorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light.

All sample containers will be properly labeled (see Section 2.2) and monitored for temperature control in the field and during laboratory transport and storage. Temperature blanks will be used in all coolers containing samples requiring preservation at reduced temperature (4°C).

### **4.3 Sample Transfer and Shipment**

Samples will always be accompanied by a chain of custody record. When transferring samples, both the individuals relinquishing and receiving the samples will sign, date, and note the transference time on the chain of custody record. Samples will be packaged properly for shipment, including isolation of samples suspected of high chemical concentrations, and dispatched to the appropriate laboratory for analysis. Custody seals will be used when samples are shipped via courier service, and must be placed on the container so that the seals have to be broken before the container can be opened. The seal must be signed and dated by the field personnel. Custody seals are not deemed necessary when the samples will be in the continuous possession of project, field, or laboratory personnel. The chain of custody record(s) will accompany each sample shipment. Samples will be packaged for shipment as follows:

- Print the following information clearly in waterproof ink on the label; the test methods requested, the



preservative(s) used (if any), the sample number, the project number, the initials of the sample collector, and the date and time the sample was collected.

- Fill out field sample log and chain of custody record as described in Sections 1.2.1 and 1.2.3, respectively.
- Place each sample bottle or set of VOA vials in a separate plastic bag and seal the bag. Squeeze air from the bag before sealing.
- If using a plastic cooler as a shipping container, tape shut the drain plug from the inside and outside, and line the cooler with a large plastic bag. If sample containers are glass, place approximately 3 inches of inert packing material, such as asbestos-free vermiculite, perlite, or Styrofoam beads in the bottom of the container or wrap the sample containers in other appropriate protective packing material (e.g., bubble wrap. Other commercial shipping containers (cardboard or fiber boxes complete with separators and preservatives) may be used but should be preapproved by the USACE.
- Place the bottles upright in the lined plastic cooler and position to avoid contact during shipment. Cardboard separators may be placed between the bottles at the discretion of the shipper.
- Transport all samples to the laboratory on ice chilled to  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ .
- Place additional inert packing material in the cooler to partially cover the sample bottles (more than halfway). If samples are required to be shipped to the laboratory with ice, place ice in double bags around, among, and on top of the sample bottles, fill the cooler with inert packing material, and tape the liner shut.
- Place paperwork going to the lab inside a plastic bag. Seal the bag and tape to the inside of the cooler lid. Include the original of the COC form in the paperwork sent to the laboratory. The last block on the COC form should indicate the over-night carrier and air bill number, if applicable. Fill out the air bill before the samples are handed over to the carrier. Notify the laboratory if the shipper suspects that the sample contains any other substance that would require laboratory personnel to take additional safety precautions.
- Close the cooler and tape it securely shut.
- Place at least two signed custody seals on the cooler, one on the front and one on the side. Additional seals may be used if the sampler or shipper deems necessary. Affix "fragile" and "this end up" labels on coolers, as appropriate.
- Samples may be hand delivered to the laboratory, transported by commercial or laboratory couriers, or shipped to the laboratory using an overnight shipper.

#### **4.4 Laboratory Custody**

A designated laboratory sample custodian will accept custody of the samples and verify that the information on the sample label matches that on the chain of custody form(s). Pertinent information as to sample condition, shipment, pickup, and courier will also be checked on the chain of custody form(s). In addition, a Cooler Receipt Form (e.g., cooler receipt form) will also be completed by the custodian and copies will be sent to the project chemist within 24 hours of sample receipt. On receiving samples at the laboratory, the temperature inside the cooler and of the temperature blank will be measured immediately after opening the cooler and the results recorded on the cooler receipt form. Information on

the date and time of receipt, method of shipment, and sample condition also will be recorded on this form. The custodian will then enter the appropriate data into the laboratory sample tracking system. The laboratory custodian will use the sample number on the sample label as well as assign a unique laboratory number to each sample. The custodian will then transfer the sample(s) to the proper analyst(s) or store the sample(s) in the appropriate secure area.

Laboratory personnel are responsible for the care and custody of samples from the time they are received through sample disposal. Data sheets and laboratory records will be retained by the laboratory as part of the permanent documentation for a period of at least 3 years.

## Attachment A: Standard Operating Procedure (SOP) #6

### Low Flow Groundwater Quality Parameter Collection

#### 1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures for calibrating and operating the field equipment necessary for collecting groundwater stabilization parameters by low flow. Groundwater stabilization parameters are obtained by using electronic equipment and are required to meet calibration standards.

#### 2.0 Equipment List

- Decontamination equipment including soap, de-ionized and tap water
- Health and safety equipment including safety glasses and nitrile/latex exam gloves
- Field logbook, indelible ink pens and field forms
- Tools to open wells
- Horiba U-50 Series multi-meter or equivalent
- Electronic water level meter such as the Solinst Model 101 or equivalent
- Rinse water receptacle and disposal area
- Horiba pH4 multi-calibration solution or equivalent
- Horiba oxygen-reduction potential (ORP) standard powder No. 160-22 or No. 160-51 or equivalent.
- Flow-through-cell/chamber for Horiba
- Dedicated or non-dedicated submersible low flow 12 volt Geosquirt pump or equivalent
- Vehicle battery to power pump with pump controller
- Sample tubing (dedicated or non-dedicated) 3/8 inch (") or 1/2" inner diameter (ID) Polyethylene

#### 3.0 Procedures

##### 3.1 Multi-Meter Calibration

Water parameters are primarily recorded with the **Horiba U-50 Series** (Horiba) multi-meter (or equivalent). A wide variety of measurements can be obtained, but for groundwater stabilization parameter purposes only temperature, specific conductivity, dissolved oxygen (DO), pH, ORP, and turbidity are needed. All these parameters require calibration with the exception of temperature. According to the Horiba manual utilize approximately 200 milliliters (mL) of calibration fluid in the calibration cup. While calibrating turbidity, the lower fill line in the calibration cup is used. Remember to remove any protective caps from the sensors prior to calibration and use of the meter.

The Horiba instrument utilizes simultaneous Auto Calibration of **DO, pH, conductivity, and turbidity** with the standard pH 4 calibration solution. At a standard temperature of 25 degrees Celsius (°C); pH is

calibrated to 4.01, conductivity is calibrated to 4.49 milliSiemens per centimeter (mS/cm), DO is calibrated to 8.92 milligrams per liter (mg/L), and turbidity calibrated to 0 nephelometric turbidity units (NTU). Be sure the calibration solution is approximately the same temperature as the ambient air, if this cannot be confirmed, allow a one hour equilibration time. To perform auto calibration of the parameters listed above, follow the steps below:

1. Turn the Horiba unit on and let it warm up for approximately 20 minutes.
2. Remove the sensor guard and wash the sensor probe two to three times with deionized (DI) water.
3. Remove the transparent calibration cup.
4. Fill the transparent calibration cup to the "With TURB" labeled lower line with pH 4 standard solution.
5. Press the Horiba's "CAL" key or navigate to the Calibration menu to set the calibration mode.
6. Select "Auto Calibration".
7. Immerse the sensor probe in the transparent calibration cup.
8. Check that there are no air bubbles and the appropriate sensors are submerged.
9. Place the transparent cup with probe into the black calibration cup.
10. When all the sensor values have stabilized, press the "ENTER" key to start calibration.
11. Calibration is finished when the message "Cal complete. MEAS to measure" appears.
12. Press "MEAS" to begin reading parameters.
13. Finally, remove the calibration cup and rinse sensors and cup with DI water.

**ORP** is calibrated with another set of steps and materials as described below. ORP standard solution is not stable for more than an hour and therefore cannot be stored. For measuring low concentrations measurements may not be repeatable, start the measurement immediately after submersion.

1. Fill a clean beaker with one bag of ORP standard powder No. 160-22 or No. 160-51.
2. Add 250 mL of DI water and agitate the solution thoroughly (there will be some excess quinhydrone [a black powder] that floats on the surface when agitating the solution).
3. Fill the transparent calibration cup to the reference line (the upper line "Without TURB") with this ORP solution.
4. Wash the sensor probe two to three times with DI water then submerge probe into the transparent calibration cup.
5. Press the Horiba's "CAL" key or navigate to the Calibration menu to set the calibration mode.
6. Select "Manual Calibration".
7. Select "ORP".
8. Set the millivolts (mV) value of the ORP standard solution appropriate for specific temperature conditions as specified in the table below.

Temperature (°C)	ORP Powder 160-22	ORP Powder 160-51
5	+274	+112
10	+271	+107
15	+267	+101
20	+263	+95
25	+258	+89
30	+254	+83
35	+249	+76
40	+244	+69

9. Once the value has stabilized, press “ENTER” to start calibration.
10. Calibration is finished when the message “Cal complete. ENT to manual cal menu” appears.
11. Press “ENT” and then “MEAS” to begin reading parameters.
12. Finally, remove the calibration cup and rinse sensors and cup with DI water.

The auto multi-calibration and the ORP calibration of the Horiba should be performed daily. Record the auto multi-calibration and ORP calibrations were performed in the daily field logbook and other paperwork as necessary. Remember to replace any protective caps on the sensors following calibration or use of the meter and decontamination.

### 3.2 Site Control

- Upon arrival at groundwater monitoring well or sample station, position field vehicle in location convenient to access well as necessary for use of pump and field equipment while collecting parameters. Consider using the field vehicle to provide safety from traffic or shade from the sun.
- Establish a work area as needed. Lay out equipment in an orderly manner so as to avoid creating trip hazards. This is an important consideration in regards to cords and tubing. If necessary, use traffic cones or caution tape to define a work area and do not allow the public or subcontractors to enter your work area. Control activities in the sample collection work area so as to preserve the quality and integrity of the parameters being collected.

### 3.3 Water Level Measurement

Water level indicators (sounders) need to be calibrated and checked for accuracy. If more than one instrument is to be used, they should be checked by measuring a single well using both instruments to assure that measurements are consistent. A single water level meter can be checked against another tape (i.e. 100 foot reel measuring tape). Turn on unit and test the audible detector by depressing button on the site of unit before use.



Prior to leaving field office or before beginning water level measurements, decontaminate the probe and cable. Inspect well casing and locking cap for tampering, damage, maintenance needs or rust and make note of the conditions on the appropriate *Well Maintenance Form* and in the field logbook.

Use care when removing the well cap or J-plug and observe if there is a pressure difference between the closed well and atmospheric pressure. If project groundwater wells tend to build pressure attach a lanyard to well cap to eliminate the potential for injury from rapid pressure release. Never place body, face or head directly over a well while opening the well cap. Each well shall be marked with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed. In the event a marking is not visible or well is not yet surveyed, take the water level reading from the north-side top of casing.

Don disposable silicone or nitrile exam gloves before lowering well sounder probe and measuring tape into the well. After decontaminating the sounder following water level measurement, properly dispose of exam gloves. A fresh pair of exam gloves should be used for each well or monitoring station.

Slowly lower probe into the monitoring well until contact with the water surface. An audible alarm on the water level meter will occur when the probe touches the water. Gently lift and lower the probe until an accurate measurement can be determined. Adjust well sounder sensitivity as necessary to get a good reading. Obtain the reading from the established mark on the well casing and measure to the nearest 0.01 foot. Record water level on the appropriate field forms.

After a water level measurement is collected at a groundwater monitoring well, decontaminate the measuring tape and reel. After decontamination is completed, properly secure the sounder in the sampling vehicle before moving on to the next location.

### **3.4 Equipment Setup**

- Lie out and connect electric cords to vehicle battery from the pump. Lie out and connect pump discharge tubing from pump to flow-through-cell and from flow-through-cell to purge water storage tank. Keep tubing and equipment in shade whenever possible.
- Check the specifications for the well and place the pump at the specified depth after collecting a depth to water measurement, collecting any necessary analytical samples, and removing any hardware in the well. Make sure the pump is decontaminated accordingly with deionized water and soap between locations. Discharge tubing should be securely attached to the pump head and decontaminated or replaced between locations. Secure the pump electrical line and discharge tubing to the top of the well in a manner to avoid kinking once the desired depth has been reached. Record depth to water and depth to pump in the field log.
- Attach the end of the discharge tubing to the flow through cell that has been setup with the calibrated Horiba multi-meter. Attach the discharge of the flow through cell to a bucket for collecting purge water.
- Attach the end of the pump's electrical connector to the controller and connect the controller to the battery. The pump should start running once the controller is on and hooked up but it may

take a few minutes for water to come up to the surface. Adjust the flow accordingly if no water is being produced. Allow the flow through cell to fill before taking the first reading.

- Measure and monitor the flow rate with a graduated cylinder and record it as milliliters per minute (mL/min). Also record the cumulative volume purged as liters (L) and the water quality parameters temperature, pH, conductivity, dissolved oxygen, oxidation reduction potential, and turbidity.

Low-flow dedicated pump purging and sampling will consist of low flow 12 volt Geosquirt, or equivalent, low flow type pump to purge wells. This pump type is meant to pull water from approximately 120 feet below ground surface or shallower. If the well is too deep to pump adequately, lift the pump in the water column and record the pump depth on the field log.

The pumping rate will be maintained within the range of 0.25 to 1.0 liters per minute, limited to minimize the drawdown of the water table. Water level measurements will be collected before purging and after purging to ensure that drawdown in the well is not causing the well to go “dry”. Any well that should go “dry” during the course of sampling will be noted in the field notebook as well as on the appropriate field monitoring data sheet. After recharge time is allowed purging may be reattempted at a slower rate.

### 3.5 Groundwater Quality Parameter Collection

Parameters are measured from the wells by low-flow dedicated or non-dedicated pumping with a Horiba multi-meter or equivalent. Begin well documentation by filling out the top half of the water sampling log as needed.

The Horiba will be connected to a flow through cell. Parameter measurements are recorded on the sample log as follows:

- Time of measurement
- Pump intake depth (feet below top of casing)
- Flow rate (mL/min)
- Cumulative volume (L)
- Temperature (°C)
- Conductivity (mS/cm)
- DO (mg/L)
- pH (unitless)
- ORP (mV)
- Turbidity (NTU)
- Additional comments, if any

Each successive measurement will be recorded within 3-5 minutes. At least three measurements will be taken but there must be three successive readings stabilized according to the requirements below:

- pH:  $\pm 0.1$  units
- Electrical conductivity:  $\pm 3\%$  mS/cm

- ORP:  $\pm 10$  mV
- Dissolved oxygen:  $\pm 10$  percent mg/L
- Temperature:  $\pm 1.0$  °C
- Turbidity:  $\pm 10\%$  or less than 10.0 NTU

Well purging will be continued until the field parameters meet the criteria above, or until a maximum of three well volumes have been purged. An additional water level measurement should also be taken after monitoring is completed to assure the drop in water level is not excessive. Complete paperwork as needed.

### **3.6 Demobilization and Equipment Decontamination**

- Stop purging the well, remove pump if non-dedicated and tubing and electrical line from the well. Re-install hardware and deploy passive diffusion bag (PDB) for next sampling event as necessary.
- Install the well cap or J-plug. Store dedicated discharge tubing in well or contain on vehicle as applicable. Decontaminate non-dedicated pump and tubing with water and soap, purging tubing by operating the pump.
- If possible, purge wells in order of lowest to highest contaminant of concern (COC) concentrations to reduce the chance of carryover from non-dedicated equipment.
- For wells located in a busy street, once all sampling equipment is packed, travel to the next scheduled location before decontaminating field equipment.
- Pumps should not be stored in an area where volatile sources (e.g., household cleaning chemicals, fuels, oils) are present; pumps shall not be stored without appropriate decontamination. Prior to use, the outside of the pump and tubing should be thoroughly rinsed with reagent grade water. Decontaminate all other equipment that contacted the well discharge water, including the water level sounder and the field meter flow-through-cell and probes.
- Collect all cords, tubing, tools and equipment and store in field vehicle in an orderly manner. Police site for trash and investigative derived waste and place in a trash bag.
- Collect any traffic control equipment while paying attention to potential traffic hazards. Never turn your back to oncoming traffic while on the street or when de-mobilizing traffic control from your work area.

### **3.7 Waste Management**

Purged groundwater will be collected in temporary storage tanks, buckets or drums and transferred to proper storage tank for disposal at the Sites 2 and 12 groundwater treatment plant (2/12 GWTP). Non-hazardous solid wastes such as latex and nitrile gloves, plastic bags and paper towels will be collected and discarded to an approved municipal solid waste collection container.

## **Attachment A: Standard Operating Procedure (SOP) #7**

### **Downhole Meter Groundwater Quality Parameter Collection**

#### **1.0 Scope and Application**

This Standard Operating Procedure (SOP) describes the procedures for calibrating and operating the field equipment necessary for collecting groundwater quality parameters by downhole meter.

#### **2.0 Equipment List**

- Decontamination equipment including soap, de-ionized and tap water
- Health and safety equipment including safety glasses and nitrile/latex exam gloves
- Field logbook, indelible ink pens and field forms
- Rinse water receptacle and disposal area
- Water level meter
- Tools to open wells
- YSI 6-Series (6920) Multi-parameter Water Quality Sonde or equivalent downhole multi-parameter probe
- Calibration cup
- Probe guard
- Battery if required
- Ruler
- Barometer recommended
- Calibration solutions:
  - Conductivity: 10 milliSiemen per centimeter (mS/cm) YSI 3163 or 1 mS/cm YSI 3165 or equivalent
  - pH: pH 7 and pH 10 buffer solutions or pH 4 and pH 7 buffer solutions
  - Oxygen-reduction potential (ORP): Zobell standard recommended
  - Turbidity: two standards 0 nephelometric turbidity unit (NTU) and 100 NTU of formazin prepared by YSI, Hach, or other approved vendor.
  - Water for dissolved oxygen (DO)
- Ring stand recommended
- YSI 200 foot Sonde cable (for deeper wells)
- YSI 100 foot Sonde cable (for shallower wells)

#### **3.0 Procedures**

##### **3.1 Downhole Meter Calibration**

If the Sonde did not come with the sensors installed, install and activate the appropriate sensors per manufacturer's instructions. Remove protective caps on the sensors before calibration or use of the meter. If the meter is rented, calibration has already been performed by the vendor and field calibration is not

necessary during field events lasting less than 1 month. If the meter is rented, it is assumed that, unless warranted by erroneous field data, the meter will not require any maintenance.

To perform calibration of the Sonde, follow the general procedures below or specific manufacturer directions.

1. If installed, remove the Sonde probe guard.
2. Use the calibration cup supplied with the Sonde for all calibrations.
3. Rinse the Sonde probe and calibration cup with water and shake off excess.
4. Rinse the Sonde probe and calibration cup with a small amount of calibration solution if there is sufficient volume.
5. While calibrating the Sonde can be upright or inverted, but the sensors should be fully submerged.
6. Turn on the YSI meter and select Calibrate on the menu.

The following approximate volumes of calibration solution are to be used (check calibration solution and meter directions).

- Conductivity: 320 milliliters (mL) upright (150 mL inverted)
  - Dissolved Oxygen: 1/8 inch (") water vented to air
  - pH/ORP: 200 mL upright (150 mL inverted)
  - Optical sensors (turbidity): 225 mL upright (do not calibrate inverted)
7. Fill the calibration cup with the appropriate amount and type of calibration standard.
    - a. For conductivity, be sure the probe is dry prior to immersing and no salt deposits. Make sure the sensor is completely immersed past the vent hole. Rotate the Sonde to remove air bubbles from sensor. Allow the temperature to equilibrate for approximately one minute after submersion.
    - b. When calibrating dissolved oxygen, place 3 millimeters (mm) or 1/8" of water in the calibration cup. Engage only one or two threads of the calibration cup to vent to air. Loosen the bottom cap if the probe is inverted. Do not immerse DO or temperature sensors in the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for temperature equilibration.
    - c. For pH, allow approximately one minute for temperature stabilization.
  8. Screw the cup onto the probe. It is recommended to use a ring stand to prevent the probe from falling over.
  9. In the Sonde Menu select "Calibrate".
  10. Input the calibration type you are performing (i.e., conductivity, Dissolved Oxygen, pH, ORP, Turbidity).
    - a. Select Specific Conductivity for Conductivity calibration.
    - b. Calibrating for percent (%) DO will also calibrate for milligrams per liter (mg/L) DO.
    - c. For pH, enter 2-point calibration for two buffer solutions.
    - d. For turbidity, enter 2-point calibration.



11. Once a parameter is selected, some will have a number that appears in parenthesis, which is the default value to be used for calibration.
12. Check the number is correct on the calibration standard being used, and press Enter or change the calibration value accordingly.
  - a. For pH you must enter the calibration value, which is usually temperature dependent.
  - b. For DO, you must enter the current barometric pressure. If you do not have a barometer, check the local weather station and calculate according to actual elevation. Barometric pressure must be entered in mm Hg. If given in in Hg, multiply by 25.4. To calculate for elevation take the barometric pressure at sea level in your area and subtract the following; divide your location's altitude in feet above sea level by 100 and multiply by 2.5.
  - c. For turbidity, the 0 NTU standard must be calibrated first.
13. A real time value will display, with all enabled sensors reading values, not just the sensor currently being calibrated.
  - a. For turbidity activate the wiper function to remove any bubbles if necessary.
14. Observe the stabilization of the sensor value being calibrated. When the reading stabilizes for approximately 30 seconds, press Enter to accept calibration.
15. Press Enter to return to the Calibration menu, and proceed to the next calibration. Repeat steps 3-13 for each calibration standard. For pH and turbidity 2-point calibrations, the Sonde will prompt you for the second calibration solution. Dry the Sonde between readings.
16. Once completed rinse and dry the Sonde.

The Sonde is now ready to be used for readings throughout the day. Recalibrate as necessary if field conditions present erroneous data or the Sonde experiences mechanical issues. Record the calibrations were performed in the daily field logbook and other paperwork as necessary. Remember to replace any protective caps on the sensors following calibration or use of the meter and decontamination.

### **3.2 Site Control**

- Upon arrival at groundwater monitoring well or sample station, position field vehicle in location convenient to access well as necessary for use of pump and field equipment while collecting parameters. Consider using the field vehicle to provide safety from traffic or shade from the sun.
- Establish a work area as needed. Lay out equipment in an orderly manner so as to avoid creating trip hazards. This is an important consideration in regards to cords and tubing. If necessary, use traffic cones or caution tape to define a work area and do not allow the public or subcontractors to enter your work area. Control activities in the sample collection work area so as to preserve the quality and integrity of the parameters being collected.

### **3.3 Water Level Measurement**

Water level indicators (sounders) need to be calibrated and checked for accuracy. If more than one instrument is to be used, they should be checked by measuring a single well using both instruments to assure that measurements are consistent. A single water level meter can be checked against another tape

(i.e. 100 foot reel measuring tape). Turn on unit and test the audible detector by depressing button on the site of unit before use.

Prior to leaving field office or before beginning water level measurements, decontaminate the probe and cable. Inspect well casing and locking cap for tampering, damage, maintenance needs or rust and make note of the conditions on the appropriate *Well Maintenance Form* and in the field logbook.

Use care when removing the well cap or J-plug and observe if there is a pressure difference between the closed well and atmospheric pressure. If project groundwater wells tend to build pressure attach a lanyard to well cap to eliminate the potential for injury from rapid pressure release. Never place body, face or head directly over a well while opening the well cap. Each well shall be marked with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed. In the event a marking is not visible or well is not yet surveyed, take the water level reading from the north-side top of casing.

Don disposable silicone or nitrile exam gloves before lowering well sounder probe and measuring tape into the well. After decontaminating the sounder following water level measurement, properly dispose of exam gloves. A fresh pair of exam gloves should be used for each well or monitoring station.

Slowly lower probe into the monitoring well until contact with the water surface. An audible alarm on the water level meter will occur when the probe touches the water. Gently lift and lower the probe until an accurate measurement can be determined. Adjust well sounder sensitivity as necessary to get a good reading. Obtain the reading from the established mark on the well casing and measure to the nearest 0.01 foot. Record water level on the appropriate field forms.

After a water level measurement is collected at a groundwater monitoring well, decontaminate the measuring tape and reel. After decontamination is completed, properly secure the sounder in the sampling vehicle before moving on to the next location.

### **3.4 Equipment Setup**

Remove any sample or hardware from the well and allow settling time before deployment of the downhole meter, approximately five minutes. Remove hardware and take water level readings in a manner to minimize disturbance of the water column in the monitoring well, lower and remove equipment slowly.

Be sure the Sonde and cables have been decontaminated prior to deployment in the monitoring well. Connect the Sonde to the power source if needed and connect communication cable from the Sonde to the probe.

Remove the probe guard and any protective sensor caps before using the Sonde. After calibration of the meter, confirm the sensors and parameters that are needed (turbidity, temperature, DO, ORP, and conductivity) are all reading on the instrument display. Replace the probe guard and keep in place during deployment. Check the pump intake depth for the current monitoring well and attach the correct length of Sonde cable to the meter (100 foot or 200 foot cable available).

Deploy the meter into the monitoring well and secure at the top of the well once the appropriate depth has been reached as to avoid kinking. Attempt to not disturb the water column too much while deploying by lowering the meter slowly. Allow settling time before collecting parameters, approximately two minutes.

### **3.5 Groundwater Quality Parameter Collection**

On the YSI meter menu, Select Run. Choose Discrete Sampling on the meter's menu. Discrete sampling is used for spot sampling and short term sampling. In the Discrete Sampling Menu, set the appropriate sample interval sample time length. The default sample interval is four seconds and is appropriate for most discrete sampling. Optionally, identify the location by entering a filename and site name. Then select Start Sampling. Once the sample interval time has passed (4 seconds), the data will be displayed and it can be saved by selecting Log Last Sample.

When using the downhole meter, place the meter at the specified pump depth and record one measurement on the field paperwork once stabilized. If no other readings are required, remove the Sonde and cable from the monitoring well. Replace the hardware and deploy a passive diffusion bag (PDB) as necessary for the next sampling event. Replace the well cap and secure well.

### **3.6 Equipment Decontamination and Waste Disposal**

Decontaminate the Sonde, meter cables, and all sensor probes with deionized water and a mild detergent. A small brush may be used on the sensors if necessary. The cable connector port must always be covered to prevent moisture from entering. If the cable is not connected cover the port with the pressure cap.

For short term storage place approximately 0.5 inches of water in the calibration or storage cup and place it on the Sonde. The use of a moist sponge is also acceptable instead of water. Do not immerse the sensors. The purpose is to keep the air in the cup at 100% humidity. Any type of water may be used such as tap water, distilled water, or deionized water. Make sure the cup is on tight to prevent evaporation. Check periodically to make sure there is still water/moisture present. For Sondes with level sensors, keep the tube sealed and dry.

Containerize any decontaminate water and dispose at the Sites 2 and 12 groundwater treatment plant (2/12 GWTP). Bag up any non-hazardous solid wastes, such as disposable gloves and paper towels, for disposal in a garbage receptacle.

## **Analytical SOPs**

MS010.7	Analysis of Volatile Organics by GC/MS Select Ion Monitoring (SIM) (VOCs by 8260 SIM)
MET108.03	Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) (Metals by 6010D)
GN228.9	Determination of Inorganic Anions by Ion Chromatography (Chloride by 9056A)
SAM101.19	Sample Receipt and Storage
SAM108.10	Sample and Laboratory Waste Disposal



ACCUTEST

SGS ACCUTEST  
STANDARD OPERATING PROCEDURE  
FN: MS 010.7  
Rev. Date: 08/2017  
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## ANALYSIS OF VOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)

Prepared by: Norm Farmer Date: 08/28/17

Approved by: Juan Garcia Date: 08/30/17

### Annual Review

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## **TITLE: ANALYSIS OF VOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)**

**REFERENCES: SW846 8260B**

**REVISED SECTIONS: 1.1.8, 4.6, 7.5.2.2-7.5.2.4 and 11.1**

### **1.0 SCOPE AND APPLICATION, SUMMARY**

#### **1.1 Scope and Application**

- 1.1.1 This method is used to determine the concentrations of various volatile organic compounds in water utilizing a gas chromatograph equipped with a mass spectrometer detector. This SOP was written primarily for the analysis of 1,4-dioxane but the analytes listed in Table 1 have also been validated by this method.
- 1.1.2 Unlike conventional full scan 8260, this method utilizes the instrument's selected ion monitoring (SIM) capabilities. By monitoring for a few specific ions the sensitivity can be increased 10 to 20 fold.
- 1.1.3 Utilizing a heated purge greatly improves the purge efficiency of 1,4-dioxane from water.
- 1.1.4 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the sample amount and the lowest calibration standard. LLOQs may vary depending on matrix complications and sample volumes. The LLOQ for 1,4-dioxane by this method are 1.0 ug/l for aqueous samples and 5.0 ug/kg for solid samples. The LLOQs for the additional analytes listed in Table 1 are 0.1 to 0.5ug/l for aqueous samples and 5 to 25ug/kg for methanol soils. Solid matrices are reported on a dry weight basis.
- 1.1.5 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.
- 1.1.6 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

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- 1.1.7 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the LLOQ be reported.
- 1.1.8 For DOD projects refer to QSM 4.2, Table F4; QSM 5.0, Table 4; or QSM 5.1, Table B-4 for additional method requirements and data qualifying guidance.

## 1.2 Summary

- 1.2.1 This method is adapted from SW846 method 8260B.
- 1.2.2 Samples are received, stored, and analyzed within the appropriate holding times.
- 1.2.3 Sample preparation is performed in accordance with SGS Accutest - Orlando SOP OP020 and OP021.
- 1.2.4 The samples are analyzed on a gas chromatograph equipped with mass spectrometer detector.
- 1.2.5 The peaks detected are identified by comparison to characteristic ions and retention times specific to the known target list of compounds.
- 1.2.6 Library searches cannot be performed on data acquired in SIM mode because data was only acquired for selected ions.
- 1.2.7 Manual integrations are performed in accordance with SOP QA029.

## 2.0 PRESERVATION AND HOLDING TIME

### 2.1 Preservation

#### Aqueous Samples:

- 2.1.1 Samples should be preserved to a pH < 2. The pH should be checked and recorded immediately after the sample analysis. If the sample is not preserved to a pH < 2, it must be noted on the report.
- 2.1.2 The samples must be stored in capped vials, with minimum headspace, at  $\leq 6^{\circ}\text{C}$  in an area free of solvent fumes. The size of any bubble caused by degassing upon cooling should not exceed 5-6mm.

#### Solid Samples:

- 2.1.3 Special 40ml vials for purge-and-trap of solid samples, as well as the collection and preservation options are described in OP020.

2.1.4 Low level soil samples are preserved by storing them in sealed VOA vials at temperatures between  $-10^{\circ}\text{C}$  to  $-20^{\circ}\text{C}$ . High level soil samples are preserved by storing them in methanol at a ratio of 1 gram of soil to 1ml of methanol.

## 2.2 Holding Time

2.2.1 Aqueous samples are to be analyzed within 14 days of collection, unless otherwise specified by the contract. Samples that are not preserved should be analyzed within 7 days of collection; however, the preservation deficiency must be noted in the report.

2.2.2 Solid and waste samples must be analyzed within 14 days of collection.

## 3.0 INTERFERENCES

- 3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.
- 3.2 Impurities in the purge gas, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory blanks. The use of non-TFE tubing, non-TFE thread sealants, or flow controllers with rubber components in the purging device should be avoided.
- 3.3 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal into the sample during shipment and storage. A trip blank can serve as a check on such contamination.
- 3.4 Contamination by carry-over can occur whenever high level and low-level samples are sequentially analyzed. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of reagent water to check for carry-over.
- 3.5 SIM may provide a lesser degree of confidence in compound identification unless multiple ions are monitored for each compound. In general, SGS Accutest monitors 3 ions per compound.
- 3.6 Historically 1,4-dioxane was used as a stabilizer for various chlorinated solvents such as trichlorethene and tetrachloroethene. Samples that contain 1,4-dioxane often contain trichloroethene and/or tetrachloroethene at orders of magnitude higher concentrations. Because of this, it is best to analyze samples for 1,4-dioxane on a system dedicated to only the analysis of 1,4-dioxane.

## 4.0 DEFINITIONS

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited

to a maximum of 20 samples or samples loaded on an instrument within the same 12-hour shift, whichever comes first.

- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).
- 4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all MS methods, a CCV must be analyzed at the beginning of each analytical run. For DoD QSM 5 and 5.1 projects, an additional CCV must be analyzed at the end of the run.
- 4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 4.5 Internal Standards: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Internal standards for mass spec methods are often deuterated forms of target analytes. Internal standards are used to compensate for retention time and response shifts during an analytical run.
- 4.6 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the LLOQ.
- 4.7 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.
- 4.8 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.
- 4.9 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.10 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

- 4.12 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.
- 4.13 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the purge efficiency.
- 4.14 Trip Blank: A sample of analyte-free matrix taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organic samples.

## **5.0 REAGENTS**

- 5.1 Reagent water – distilled or deionized water free of interferences
- 5.2 Methanol – purge-and-trap grade or equivalent
- 5.3 Hydrochloric acid (HCl) – ACS reagent grade or equivalent
- 5.4 Inert Gas – UHP Helium or UHP Nitrogen
- 5.5 1,4-Dioxane stock standards – traceable to Certificate of Analysis
- 5.6 4-Bromofluorobenzene (BFB) – instrument tuning mix
- 5.7 Surrogate standards – (varies based on analytes being reported)

Dibromofluoromethane  
1,2-Dichloroethane-d<sub>4</sub>  
Toluene-d<sub>8</sub>

- 5.8 Internal standards – (varies based on analytes being reported)

Fluorobenzene  
Chlorobenzene-d<sub>5</sub>  
1,4-Dioxane-d<sub>8</sub>

## **6.0 APPARATUS**

- 6.1 Gas Chromatograph – Agilent Technologies 6890 or 7890
  - 6.1.1 Gas Chromatograph

The analytical system that is complete with a temperature programmable gas chromatograph and all required accessories, analytical columns, and gases.



- 6.1.2 The injection port is designed for split-splitless injection with capillary columns. The injection port must have an appropriate interface for sample introduction.
- 6.2 Mass Spectrometer– Agilent Technologies 5973 or 5975
- The mass spectrometer must be capable of scanning from 35-300 amu every second or less, utilizing 70-volt (nominal) electron energy in the electron impact ionization mode. It must also be capable of producing a mass spectrum that meets all the criteria in section 7.5.1.1 when injecting 50 ng of bromofluorobenzene (BFB).
- 6.3 Purge and Trap – OI Analytical 4560 or 4660 with OI Analytical 4552 or 4551
- 6.3.1 The following autosampler models are used for purging, trapping and desorbing the sample onto GC column.
- O.I. Model 4560 sample concentrator with 4552 Water/Soil multisampler
  - O.I. Model 4660 sample concentrator with 4552 Water/Soil multisampler
  - O.I. Model 4660 sample concentrator with 4551 Water multisampler
- 6.3.2 The sample purge vessel must be designed to accept 5 ml samples with a water column at least 3 cm deep.
- 6.3.3 The multisampler or concentrator is equipped with a heater capable of maintaining the purge chamber at 60 °C to improve purging efficiency.
- 6.3.4 The desorber should be capable of rapidly heating the trap to the manufacturer recommended desorb temperature.
- 6.4 Data System – Agilent Technologies MS Chemstation rev. DA 02.0x, DA 03.0x or EA 02.0x.
- 6.4.1 A computer system interfaced to the mass spectrometer that allows for the continuous acquisition and storage of all mass spectral data obtained throughout the duration of the chromatographic program.
- 6.4.2 The computer utilizes software that allows searching any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP).
- 6.4.3 The software should allow for integrating the abundances in any EICP between specific time or scan number limits. See Table 2.
- 6.4.4 Data is archived to a backup server for long term storage.
- 6.5 Trap – OI #10 or equivalent: Tenax, Silica Gel, and Carbon Molecular Sieve. The trap should be conditioned according to the manufacturer's recommendations.
- 6.6 Columns – RTX-624 or equivalent: 60m X 0.25mm 1.4um.  
– RTX-VMS or equivalent: 40m X 0.18mm 1.0um

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- 6.7 Gas-tight syringes and class "A" volumetric glassware for dilutions of standards and samples.

## **7.0 PROCEDURE**

### **7.1 Standards Preparation**

Standards are prepared from commercially available certified reference standards. All standards must be logged in the Volatile Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at temperatures between  $-10^{\circ}\text{C}$  and  $-20^{\circ}\text{C}$ , or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, preparation information, and vendor part numbers can be found in the MSVOA STD Summary in the Active SOP directory.

#### **7.1.1 Stock Standard Solutions**

Stock standards are available from several commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to six months (one month for gases) or the vendor's expiration date (whichever is shorter).

#### **7.1.2 Intermediate Standard Solutions**

Intermediate standards are prepared by quantitative dilution of the stock standard with methanol. The hold time for intermediate standards is one month (one week for gases) or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

#### **7.1.3 Calibration Standards**

Calibration standards for the volatile organics are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. The low standard concentration is at or below the LLOQ, and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

### **7.2 Instrument Conditions**

#### **Gas Chromatograph/ Mass Spectrometer**

Carrier gas flow	1.0-1.3 ml/min
Transfer line temperature	220 - 280 $^{\circ}\text{C}$
Analyzer temperature	150 $^{\circ}\text{C}$

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Oven program – 45 °C for 2.5 minutes (RTX-VMS 40m)  
10 °C/min to 80 °C for 0 minutes  
15 °C/min to 185 °C for 0 minutes  
30 °C/min to 240 °C for 2.5 minutes

Oven program – 35 °C for 2.5 minutes (RTX-VMS 40m)  
4 °C/min to 60 °C for 0 minutes  
25 °C/min to 220 °C for 0 minutes  
30 °C/min to 240 °C for 1.2 minutes

Oven program – 45 °C for 2.0 minutes (RTX-624)  
10 °C/min to 80 °C for 0 minutes  
14 °C/min to 210 °C for 0 minutes  
16 °C/min to 240 °C for 4.2 minutes

GC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

MS Descriptors – Monitor 3 characteristic ions for each target analyte, and 2 characteristic ions for each surrogate and internal standard. Each descriptor may have up to 30 ions; however, the more ions in a descriptor, the less the sensitivity. Therefore, it is beneficial to use multiple descriptors for longer analytes lists. Refer to the specific instrument methods for actual descriptors.

### 7.3 Purge and Trap Device conditions

Purge Gas:	Helium or Nitrogen at 30-45 ml/min
Sample Temp:	Aqueous (60°C) Soils (40°C)
Trap Temp:	<25°C
Purge Time:	6 or 11 min
Desorb:	1 min. at 190°C
Bake:	5 min. at 210°C

Purge and Trap conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

**NOTE:** Due to the poor purge efficiency of 1,4-dioxane, purge times of less than 11 minutes should not be used when analyzing for 1,4-dioxane.

### 7.4 Sample Preparation

#### 7.4.1 Water Samples

A 5ml aliquot of sample is loaded onto the purge-and-trap device and purged for 6 or 11 minutes at 60°C. Detailed procedures are described in SOP OP021.

#### 7.4.2 Solid Samples

A 5-gram aliquot of sample is loaded onto the purge-and-trap device. 5mls of reagent water is added along with internal standards and surrogates. The sample is then purged for 6 or 11 minutes while heated to 40°C and mechanically agitated. Detailed procedures are described in SOP OP020.

Alternatively a methanol aliquot from the sample is loaded onto the purge-and-trap device. 5mls of reagent water is added along with internal standards and surrogates. The sample is then purged for 6 or 11 minutes. Detailed procedures are described in SOP OP020 and OP021.

#### 7.5 Gas Chromatographic Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures  
Continuing Calibration Verification

##### 7.5.1 Initial Calibration Procedures

Before samples can be run, the GC/MS system must be tuned, the injection port inertness must be verified, and the instrument must be calibrated.

##### 7.5.1.1 Tune Verification (BFB)

The instrument should be hardware tuned per manufacturer's instructions. Verify the instrument tune by injecting 50ng of BFB solution onto the instrument. The BFB standard may also be purged. The resulting BFB spectra should meet the criteria in the following table.

##### BFB KEY IONS AND ION ABUNDANCE CRITERIA

<b>Mass</b>	<b>Ion Abundance Criteria</b>
50	15-40% of mass 95
75	30-60% of mass 95
95	Base peak, 100% relative abundance
96	5-9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5-9 % of mass 174
176	>95% and <101% of mass 174
177	5-9% of mass 176

Evaluate the tune spectrum using three mass scans from the chromatographic peak and a subtraction of instrument background. This procedure is performed automatically by the MS Chemstation software by running "autofind" on the BFB peak.

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Select the scans at the peak apex and one to each side of the apex. Calculate an average of the mass abundances from the three scans.

Background subtraction is required. Select a single scan in the chromatogram that is absent of any interfering compound peak and no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tuning compound peak.

Alternatively, the average spectra over the entire peak may be used. **All subsequent tune evaluations must use the same procedure that was used for the Initial Calibration.**

If the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are met.

Analysis must not begin until the tuning criteria are met. The injection time of the acceptable tune analysis is considered the start of the 12-hour clock. The same mass spec settings must be used for the calibration standards and samples that were used for the tune evaluation standard. The exception being that the tune evaluation standard must be acquired in full scan mode and all others in SIM mode.

#### 7.5.1.2 Internal Standard Calibration

A minimum 5-point calibration curve is created for the volatile organic compounds and surrogates using an internal standard technique. SGS Accutest Laboratories routinely performs a 6-point calibration to maximize the calibration range.

Historically, many analytical methods have relied on linear models of the calibration relationship, where the instrument response is directly proportional to the amount of a target compound. The linear model has many advantages including simplicity and ease of use. However, given the advent of new detection techniques and because many methods cannot be optimized for all the analytes to which they may be applied, the analyst is increasingly likely to encounter situations where the linear model neither applies nor is appropriate. The option of using non-linear calibration may be necessary to address specific instrumental techniques. However, it is not EPA's intent to allow non-linear calibration to compensate for detector saturation or avoid proper instrument maintenance.

**NOTE:** Because of this concern, select programs including SC DHEC do not support the use of non-linear regressions.



The low point may be omitted from the calibration table for any compound with an LLOQ set at the level two standard. Additionally, the high point may be omitted for any compound that exhibits poor linearity at the upper end of the calibration range.

An entire level may be omitted provided that a minimum of 5 points remain. There must be technical justification to omit an entire level. This should be documented in the run log.

Response factors (RF) for each analyte are determined as follows:

$$RF = (A_{\text{analyte}} \times C_{\text{istd}}) / (A_{\text{istd}} \times C_{\text{analyte}})$$

$A_{\text{analyte}}$	=	area of the analyte
$A_{\text{istd}}$	=	area of the internal standard
$C_{\text{analyte}}$	=	concentration of the analyte
$C_{\text{istd}}$	=	concentration of the internal standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

$$\%RSD = (\text{Standard Deviation of RF} \times 100) / \text{Mean RF}$$

If the  $\%RSD \leq 15\%$ , linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples. Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions. Linear regressions may be unweighted or weighted as  $1/x$  or  $1/x^2$ . If the correlation coefficient ( $r$ ) is  $\geq 0.995$  ( $r^2 \geq 0.990$ ) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Alternatively, either of the two techniques described below may be used to determine whether the calibration function meets acceptable criteria. These involve refitting the calibration data back to the model. Both % Error and Relative Standard Error (RSE) evaluate the difference between the measured and the true amounts or concentrations used to create the model.

Calculation of the % Error

$$\% \text{ ERR} = (x_i - x'_i) / x_i \times 100$$

$x'_i$  = Measured amount of analyte at calibration level  $i$ , in mass or concentration units.

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$x_i$  = True amount of analyte at calibration level  $i$ , in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte should be  $\leq 30\%$  for all standards. For some data uses,  $\leq 50\%$  may be acceptable for the lowest calibration point.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^n \left[ \frac{x'_i - x_i}{x_i} \right]^2 / (n - p)}$$

$x'_i$  = Measured amount of analyte at calibration level  $i$ , in mass or concentration units.

$x_i$  = True amount of analyte at calibration level  $i$ , in mass or concentration units.

$p$  = Number of terms in the fitting equation.  
(average = 1, linear = 2, quadratic = 3)

$n$  = Number of calibration points.

The %RSE acceptance limit criterion is  $\leq 15\%$  for good performing compounds and  $\leq 30\%$  for poor performing (PP) compounds.

#### 7.5.1.3 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be  $\leq 20\%$ . If the %D  $> 20\%$ , the analysis of samples may still proceed if the analyte failed high and the analyte is not expected to be present in the samples. However, if a reportable analyte is detected in a sample and the %D for that analyte was greater than 20% in the ICV, the sample will need to be reanalyzed on a system with a passing ICV for that analyte.

**NOTE:** For any DoD QSM project, the %D for all target compounds should be  $\leq 20\%$ . If samples must be analyzed with an analyte of interest having a %D  $> 20\%$ , then the data must be qualified accordingly.

If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV

prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

#### 7.5.2 Continuing Calibration Verification (CCV)

- 7.5.2.1 Inject 2ul of the tune evaluation mix at the beginning of each 12-hour shift. Evaluate the resultant peaks against the criteria in section 7.5.1.1. The injection time of this standard starts the 12-hour window.

When the analyst is running an unattended second 12-hour window, they may opt to purge the BFB standard. This can be performed by purging an additional blank (which contains BFB) just prior to the second CCV.

- 7.5.2.2 Analyze a continuing calibration check standard. The CCV should be at or below the mid-point of the calibration curve.

The percent difference (%D) for each analyte of interest will be monitored. The  $|\%D|$  should be  $\leq 20\%$  for each analyte.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria then the system is considered in control and results may be reported.

Rationale for second standard such as instrument maintenance, clipped column, remade standard, etc should be documented in the run log or maintenance log. Reanalysis of second standard without valid rationale may require the analysis of a third standard (in which case both the second and third standard would have to pass).

**NOTE:** For any DoD QSM project, if the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria then the system is considered in control and results may be reported.

If the  $|\%D|$  is greater than 20%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported, i.e., the CCV failed high, the associated QC passed, and the samples were ND.

**NOTE:** For any DoD QSM project, if samples must be reported with a target analyte having a  $\%D > 20\%$ , then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

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**NOTE:** Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed or the data must be qualified.

- 7.5.2.3 For DoD QSM 5.0 and 5.1 compliance, an additional CCV must be analyzed at the end of each run. The closing CCV should be within the 12-hour Tune window.

The %D for all target compounds in this CCV should be  $\leq 50\%$ . If the %D  $> 50\%$  for any target compound, then the samples should be reanalyzed at least once at the appropriate dilution. If the %D  $> 50\%$  for the analytes in the reanalysis, the department supervisor shall review the data and determine what further action is necessary. This may include reanalyzing the samples at a higher dilution or qualifying the data.

**NOTE:** If samples are ND and an analyte in the CCV fails high, then the sample does not need to be reanalyzed.

- 7.5.2.4 If any of the internal standard area change by a factor of two (-50% to +100%) or retention time changes by more than 30 seconds (10 seconds for DOD QSM 5.1 compliance) from the midpoint standard of the last initial calibration or from the daily CCV, the mass spectrometer must be inspected for malfunctions and corrections made, as appropriate. Corrective action may include re-calibration (initial Calibration) of the instrument.

### 7.5.3 Sample Analysis

- 7.5.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Tune Evaluation Mix  
Initial Calibration Standards (or CCV)  
QC Samples  
Samples

- 7.5.3.2 One microliter of internal standard/surrogate solution is added to every 5ml of sample in the sparge vessel. Generally, 5ml of sample are transferred to the sparge vessel.

- 7.5.3.3 After purging, the system will automatically reverse flow and rapidly heat the trap to desorb the sample analytes onto the GC column.

- 7.5.3.4 Qualitative identification

The target compounds shall be identified by analysts with competent knowledge in the interpretation of mass spectra by comparison of the

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sample mass spectrum to the mass spectrum of a standard of the suspected compound. The criteria required for a positive identification are:

The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

The sample component must elute at the same relative retention time (RRT) as the daily standard. The RRT of sample component must be within  $\pm 0.06$  RRT units of the standard.

All ions monitored in the standard mass spectra should be present in the sample spectrum.

The relative intensities of these ions must agree within  $\pm 30\%$  between the daily standard and sample spectra, (e.g., for an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 20 and 80%).

Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

If peak identification is prevented by the presence of interferences, the sample must be diluted so that the interference does not mask any analytes.

#### 7.5.3.5 Quantitative analysis

When a target compound has been identified, concentration will be based on the integrated area of the quantitation ion, which is normally the base peak.

The sample matrix may produce an interference with the primary ion. This may be characterized by an excessive background signal of the same ion, which distorts the peak shape beyond a definitive integration. The interference could also, severely inhibit the response of the internal standard ion.

If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that



samples be diluted so that the response falls into the middle of the calibration curve.

## 7.6 Maintenance and Trouble Shooting

7.6.4 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.6.5 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.6.6 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.6.7 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

## 8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

## 9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

### 9.1 Internal Standards

9.1.1 Fluorobenzene, Cchlorobenzene-d<sub>5</sub>, and 1,4-dioxane-d<sub>8</sub> may be used as the internal standards for this method. The response of the internal standard in all subsequent runs should be within a factor of two (-50% to +100%) of the internal standard response in the opening CCV for each sequence. On days that an initial calibration is performed, the internal standard response should be compared to the internal standard response for the mid-point standard.

9.1.2 If the internal standard response is not within limits, the following are required.

- 9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.
- 9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
- 9.1.1.3 If no problem is found, prepare a second aliquot of sample and reanalyze the sample. If there is insufficient sample for reanalysis, footnote this on the report.
- 9.1.1.4 If upon reanalysis, the responses are still not within limits, the problem is considered matrix interference. The sample may need to be diluted or the results qualified.

## 9.2 Surrogates

9.2.1 Dibromofluoromethane, 1,2-dichloroethane-d<sub>4</sub> and toluene-d<sub>8</sub> may be used as the surrogate standards to monitor the efficiency of the purge-and-trap system.

A known amount of surrogate standard is added to each sample including the QC set prior to purging. The percent recovery for each surrogate is calculated as follows:

$$\% \text{ Recovery} = (\text{Sample Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery must fall within the established control limits for all surrogates for the results to be acceptable.

9.2.2 If any surrogate recovery is not within the established control limits, the following are required.

- 9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, surrogate solutions or internal standard solutions. If errors are found, recalculate the data accordingly.
- 9.2.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
- 9.2.2.3 If no problem is found, reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then reanalysis may not be

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necessary. For any DoD QSM projects, the resulting data must be qualified accordingly. If there is insufficient sample for reanalysis, footnote this on the report.

- 9.2.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis should be reported on the final report.

### 9.3 Method Blank

- 9.3.1 The method blank is de-ionized water or de-ionized water with 5 grams of Teflon chips (depending upon sample matrix) to which the surrogate standard has been added. An appropriate aliquot of methanol should also be added. The method blank is then purged along with the other samples to determine any contamination from the system or ambient sources. The method blank must be free of any analytes of interest or interferences at ½ the required LLOQ level to be acceptable. Common laboratory contaminants such as methylene chloride must be below the LLOQ if present. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.
- 9.3.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.
- 9.3.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.
- 9.3.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be reanalyzed for confirmation. If there is insufficient sample to reanalyze, or if the sample is reanalyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

### 9.4 Blank Spike

- 9.4.1 The blank spike is de-ionized water or de-ionized water with 5 grams of Teflon chips (depending upon sample matrix) to which the surrogate standard and spike standard have been added. An appropriate aliquot of methanol should also be added. The blank spike is then processed along with the other samples to monitor the efficiency of the purge-and-trap procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable.

**NOTE:** A secondary check against 70-130% limits should be performed for all analytes reported to SC DHEC.

9.4.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions, or internal standard solutions. If errors are found, recalculate the data accordingly.

9.4.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. For any DoD QSM projects, the resulting data must be qualified accordingly.

9.4.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples or qualifying the results as estimated.

9.4.2.5 If there is insufficient sample to reanalyze, or if the sample is reanalyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

## 9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then processed along with the other samples to monitor the precision and accuracy of the purge-and-trap procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = ([\text{Spike Amount} - \text{Sample Amount}] / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions, or internal standard solutions. If errors are found, recalculate the data accordingly.

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- 9.5.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.
- 9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for reanalysis, but are an indication of the sample matrix effects.

### 9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$\text{RPD} = (| \text{MS Result} - \text{MSD Result} | / \text{Average Result}) \times 100$$

The RPD for each analyte should fall within the established control limits. If the RPDs fall outside of the established control limits, the department supervisor shall review the data and determine if any corrective action is necessary. RPD failures are generally not grounds for batch reanalysis.

## 10.0 CALCULATIONS

The concentration of each target compound in the original sample is calculated as follows:

$$\text{Water (ug/l)} = (\text{CONC}_{\text{inst}}) \times \text{DF}$$

$$\text{Soil (ug/kg)} = [(\text{CONC}_{\text{inst}}) \times (5 / W_I)] / \% \text{solids (low level soils)}$$

$$\text{Soil (ug/kg)} = [(\text{CONC}_{\text{inst}}) \times (V_F / V_A) \times (5 / W_I) \times \text{DF}] / \% \text{solids (high level soils)}$$

CONC <sub>inst</sub>	=	Instrument concentration calculated from the initial calibration using mean RF or curve fit.
DF	=	Dilution Factor
V <sub>F</sub>	=	Volume of methanol extract (ul)
V <sub>A</sub>	=	Volume of methanol aliquot (ul)
W <sub>I</sub>	=	Weight of sample (g)
%solids	=	Dry weight determination in decimal form

For high level soils, V<sub>F</sub> is calculated as follows:

$$V_F = \{\text{ml of solvent} + [(\% \text{moisture} \times W_I) / 100]\} \times 1000 \text{ ul/ml}$$



## **11.0 SAFETY AND POLLUTION PREVENTION**

### **11.1 Safety**

The analyst should follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

### **11.2 Pollution Prevention**

Waste solvents from the sample analysis, methanol extraction, and standards preparation are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Old stock standards are disposed of in the waste vial drum.

Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining aqueous and soil samples are transferred to the appropriate drums for disposal.

## **12.0 REFERENCES**

SW846 Method 8000D Revision 4, July 2014

SW846 Method 8260B Revision 2, December 1996

**TABLE 1**

Routine Target Analytes

Benzene	cis-1,3-Dichloropropene
Carbon Tetrachloride	trans-1,3-Dichloropropene
Chloroform	1,4-Dioxane
1,1-Dichloroethane	Methyl Chloride
1,2-Dichloroethane	Methylene Chloride
1,1-Dichloroethylene	Tetrachloroethylene
cis-1,2-Dichloroethylene	1,1,1-Trichloroethane
trans-1,2-Dichloroethylene	Trichloroethylene
1,2-Dichloropropane	Vinyl Chloride

**TABLE 2**

Characteristic Ions

Analyte	Quant. Ion	Q1	Q2	Q3
Fluorobenzene IS	96	70		
Methyl Chloride	50	52		
Vinyl Chloride	62	64		
1,1-Dichloroethene	61	96	98	63
Methylene Chloride	49	84	86	51
trans-1,2-Dichloroethene	61	96	98	63
1,1-Dichloroethane	63	65		
cis-1,2-Dichloroethene	96	61	98	63
Chloroform	83	85	47	
Dibromofluoromethane Surr	113	111	192	
Carbon Tetrachloride	117	119	121	82
1,1,1-Trichloroethane	97	99	61	
Benzene	78	51		
1,2-Dichloroethane-d4 Surr	65	67	102	
1,2-Dichloroethane	62	49	64	
Trichloroethene	95	130	97	132
1,2-Dichloropropane	63	62	41	76
cis-1,3-Dichloropropene	75	77	39	
Chlorobenzene-d <sub>5</sub> IS	117	82		
Toluene-d <sub>8</sub> Surr	98	100		
trans-1,3-Dichloropropene	75	77	39	49
Tetrachloroethene	166	164	129	131
1,1,2-Trichloroethane	83	97	61	99
1,4-Dioxane-d <sub>8</sub> IS	96	64		
1,4-Dioxane	88	58	43	



## METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

Prepared by: David Metzgar III Date: 02/22/2018

Approved by: Svetlana Izosimova Date: 02/22/2018

### Annual Review

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## **TITLE: METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)**

**REFERENCES:** SW846 6010D, 2014

**INSTRUMENT:** THERMO 6500, SERIAL # 20100903 SSTRACE 1

**INSTRUMENT:** THERMO 6500, SERIAL # 20103825 SSTRACE 2

**AUTOSAMPLER:** CETAC 240 POSITION, SERIAL # 031038A520 SSTRACE 1

**AUTOSAMPLER:** CETAC 240 POSITION, SERIAL # 041048A520 SSTRACE 2

**SUGGESTED WAVELENGTH (S):** TABLE 2

**REVISED SECTIONS:** removed all references to Accutest

### **1.0 SCOPE AND APPLICATION SUMMARY**

SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only, and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

- 1.1 This method is applicable for the determination of metals in water, sludges, sediments, and soils. Elements that can be reported by this method include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Titanium, Thallium, Tin, Vanadium, and Zinc.
- 1.2 Sample matrices are pretreated following SW846 and EPA methods for digestion of soil, sediment, sludge or water samples. Refer to specific metals department digestion SOP's for more information on digestion techniques.
- 1.3 This inductively coupled argon plasma optical emission spectrometer s ICP-OES) uses an Echelle optical design and a Charge Injection Device (CID) solid-state detector to provide elemental analysis. Control of the spectrometer is provided by PC based iTEVA software. In the instrument, digested samples are introduced into the Thermo 6500 ICP, passed through a nebulizer and transported to a plasma torch. The element-specific emission spectra are produced by a radio frequency inductively coupled plasma. The spectra are dispersed by a spectrometer, and the intensities of the emission lines are monitored with the solid state detector.
- 1.4 Reporting limits (RL)(LLOQ) are based on the extraction procedure. Reporting limits may vary depending on matrix complications, volumes and by client needs, but the reporting

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limits must always be verified with a low check which meets the criteria outlined in this SOP. Solid matrices are reported on a dry weight basis. Refer to table 1 of this SOP for SGS - Orlando typical reporting limits. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits.

- 1.5 MDLs must be established for all analytes, using a solution spiked at approximately 3 to 5 times the estimated detection limit. To determine the MDL values, take seven replicate aliquots of the spiked sample and process through the entire analytical method. The MDL is calculated by multiplying the standard deviation of the replicate analyses by 3.14, which is the student's t value for a 99% confidence level. MDLs must be determined approximately once per year for each matrix and instrument. Please refer to SGS - Orlando QA SOP QA020, current version for further information regarding method performance criteria and experimental method detection limits.

MDLs are generated for each matrix on both ICP instruments. The higher of the two statistically calculated MDL's is entered into LIMS as the MDL. The verified MDLs are stored in the LIMS and must be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

- 1.6 LLOQ verification. LLOQ is the lowest point of quantitation. The LLOQ is initially verified by the analysis of 7 replicate samples, spiked at the LLOQ and processed through all preparation and analysis steps of the method. The mean recovery should be within +/- 35 percent of the true value with an RSD  $\leq$  20 percent.
- 1.7 Ongoing Lower limit of quantitation (LLOQ) check sample. The lower limit of quantitation check sample should be analyzed on a quarterly basis to demonstrate the desired detection capability. The LLOQ sample is carried through the entire preparation and analytical procedure. The mean recovery should be within +/- 35 percent of the true value with an RSD  $\leq$  20 percent.
- 1.8 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.
- 1.9 Instrument Detection Limits (IDL). It is suggested that IDL's be completed upon initial instrument installation, whenever instrument conditions have significantly changed, or at a minimum annually. Instrument detection limits can be estimated as the mean of the blank results plus 3 times the standard deviation of 10 replicate analyses of the reagent blank solution. (use zero for the mean if the mean is negative) Each IDL measurement shall be performed as though it were a separate analytical sample. IDLs shall be determined and reported for each wavelength used in the analysis of the samples.

## **2.0 PRESERVATION AND BOTTLEWARE**

All samples should be preserved with nitric acid to a pH of <2 at the time of collection. All sample pH are checked in sample receiving and within the metals department. Samples that are received with a pH >2 must be preserved to pH <2 and held for 24 hours prior to metals digestion to

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dissolve any metals that absorb to the container walls. Refer to SOP SAM101, current revision for further instruction. Final pH of TCLP extracts are checked and recorded in SGS - Orlando Extractions Department. Please refer to TCLP (1311) fluid determination logbook and SPLP (1312) fluid determination logbook for further information. TCLP extracts received from SGS - Orlando Extractions Department are prepared as soon as possible, no longer than 24 hours from time of receipt. If precipitation is observed during the sample preparation process the sample(s) are immediately re-prepped on dilution until no precipitation is observed. Samples received for dissolved metals analysis should be filtered and preserved to pH<2 as soon as possible and held for 24 hours prior to digestion. Refer to SGS - Orlando Sample Filtration Logbook for further information.

All soil samples must be stored in a refrigerator at  $\leq 6^{\circ}\text{C}$  upon receipt. Refer to SOP SAM101, current revision for further instruction.

All bottleware used by SGS - Orlando is tested for cleanliness prior to shipping to clients. Analysis results must be less than one half the reporting limit (LLOQ) to be acceptable. Refer to SOP SAM104, current revision for further instruction.

### **3.0 HOLDING TIME AND BATCH SIZE**

All samples must be prepared and analyzed within 6 months of the date of collection. Refer to appropriate SGS - Orlando digestion SOP, current revision for batch size criteria.

### **4.0 INTERFERENCES**

Several types of interferences can cause inaccuracies in trace metals determinations by ICP. These interferences are discussed below.

- 4.1 Spectral interferences are caused by overlap of a spectral line from another element, unresolved overlap of molecular band spectra, background contribution from continuous or recombination phenomena, and background contribution from stray light from the line emission of high concentration elements. Corrections for these interferences can be made by using interfering element corrections, by choosing an alternate analytical line, and/or by applying background correction points. The locations selected for the measurement of background intensity will be determined by the complexity of the spectrum adjacent to the wavelength peak. The locations used for routine measurement must be free of off-line spectral interference or adequately corrected to reflect the same change in background intensity as occurs at the wavelength peak.

Note: Refer to section 17.0 of this SOP for further instruction regarding interfering element correction factor generation.

- 4.2 Physical interferences can be caused by changes in sample viscosity or surface tension, by high acid content in a sample, or by high dissolved solids in a sample. These interferences can be reduced by making sample dilutions.

- 4.3 Matrix interferences in high solid samples can be overcome by using an internal standard. Yttrium/Indium mix is used for the Thermo 6500 ICP. The concentration must be sufficient for optimum precision but not so high as to alter the salt concentration of the matrix. The element intensity is used by the instrument as an internal standard to ratio the analyte intensity signals for both calibration and quantitation.
- 4.4 Chemical interferences are not pronounced with ICP due to the high temperature of the plasma, however if they are present, they can be reduced by optimizing the analytical conditions (i.e. power level, torch height, etc.).

## **5.0 APPARATUS**

- 5.1 Currently there are two solid state ICPs available for use in the lab. Both are Thermo 6500 ICP units. These units have been optimized to obtain lower detection limits for a wide range of elements. Since they are solid state systems, different lines may be included for elements to obtain the best analytical results. However, the lines which are normally included in the normal analysis program are shown in Table 2.
- 5.2 Instrument auto samplers. For random access during sample analysis.
- 5.3 Class A volumetric glassware and pipettes.
- 5.4 Polypropylene auto sampler tubes.
- 5.5 Eppendorf Pipette (s) - Pipette (s) are checked daily for accuracy and to ensure they are in good working condition prior to use. Volumes are checked at 100% of maximum volume (nominal volume). Pipettes are checked within the metals department and results are stored electronically in the "Pipette Calibration Log". Refer to SOP QA006, current revision for further information regarding pipette calibration. BIAS: mean must be within 2% of nominal volume. Precision: RSD must be  $\leq 1\%$  of nominal volume based on three replicates.
- 5.6 Fisher Brand 0.45 micron (um) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be less than one half the reporting limit(LLOQ) to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.
- 5.7 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be less than one half the reporting limit (LLOQ) to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.
- 5.8 Data System

Microsoft Windows XP Professional Version 2002  
Instrument software SST1 – Thermo iTEVA version 2.8.0.89

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Instrument software SST2 – Thermo iTEVA version 2.7.0.87

- 5.8.1 A computer system interfaced to the Thermo 6500 ICP that allows for the continuous acquisition and storage of all data obtained throughout the duration of the analytical run sequence.
- 5.8.2 Data is archived to a backup server for long term storage.

## **6.0 REAGENTS**

All chemicals listed below are trace metal grade unless otherwise specified. Refer to Acid Certificate of Analysis logbook for Certificates of Analysis and compliance with the specifications of the grade listed. SGS - Orlando produces DI water to the specifications for the ASTM Type II standard designation based on the system manufacturer's performance specifications. The DI water is used exclusively for laboratory purposes. De-ionized DI water should be used whenever water is required. Refer to SOP QA037, current revision for more information regarding testing and monitoring. Refer to the Metals Department Standard Prep Logbook for the make-up and concentrations of standards and stock solutions being used within this SOP. Some of the information included in the logbook is as follows: standard name, elements in mix, manufacturer, lot number, parent expiration date, acid matrix, stock concentration, volume of standard added, total volume, final prepared concentration, prep date, initials, MET number, and prepared standard expiration date. Standards and prepared reagents must be prepared every 6 months or before stock standard expiration date, whichever comes first. Refer to tables 3 through 7 of this SOP for concentration levels of standards used. Unless otherwise approved, the calibration curve must contain 3 points determined by a blank and a series of standards representing the elements of interest.

- 6.1 2.5 ppm Yttrium and 10 ppm Indium internal standard, made from ICP quality standard.
- 6.2 Hydrochloric acid, trace metals grade.
- 6.3 Nitric Acid, trace metals grade.
- 6.4 ICP quality standard stock solutions are available from Inorganic Ventures, Spex, Plasma Pure, Ultra, Environmental Express, or equivalent.
- 6.5 Calibration Standards. These can be made up by diluting the stock solutions to the appropriate concentrations. The calibration standards should be prepared using the same type of acid (s) and at approximately the same concentration as will result in the samples following sample preparation.
  - 6.5.1 For calibration and quantitation an internal standard (Yttrium/Indium) is used to limit nebulization problems. If it is known that the samples contain a significantly different acid matrix, the samples must be diluted so that they are in a similar matrix to the curve. All sample results are referenced to the initial calibration blank (ICB) Internal Standard counts. The criteria is 60-125 percent of the initial calibration blank (ICB) counts. If the internal standard counts fall outside these criteria matrix effects must be

suspected and the sample diluted until it meets the criteria or footnoted in LIMS as suspected matrix interference.

- 6.5.2 Standards must be prepared so that there is minimal spectral interference between analytes.

Note: All Ag stock and intermediate solutions must be stored away from direct sunlight.

## 6.6 Analytical Quality Control Solutions.

All of the solutions below are prepared by adding either mixed or single element metals solutions to a solution prepared using the same type of acid s) and at approximately the same concentration as will result in the samples following sample preparation.

### 6.6.1 Blank (Calibration, ICB, CCB)

This reagent blank contains Nitric Acid at 3 percent and Hydrochloric Acid at 5 percent.

### 6.6.2 Initial Calibration Verification solution.

This standard solution must be made from a different source than the calibration curve. The concentrations for each element must be within the range of the calibration curve and should be approximately at the midpoint of the curve. This solution is used to verify the accuracy of the initial calibration. Levels for the ICV standard are shown in Table 4.

### 6.6.3 Continuing Calibration Verification solution.

The metals concentrations for this standard should be at approximately the mid-point of the calibration curve for each element. This standard should be prepared from the same source that is used for the calibration curve. Levels for the CCV standard are shown in Table 5.

- 6.6.4 Spectral Interference Checks (SIC). Two types of SIC checks are used. Individual element SIC are performed when the instrument is initially set up, and every six months thereafter. The mixed element SIC solution is used daily to check that the instrument is free from interference from elements typically observed in high concentration and to check that interference corrections (IEC) are still valid.

6.6.4.1 Single element interference checks – At a minimum, single element SIC checks should be performed for the following elements: Aluminum 500 mg/l; Barium 4 mg/l; Calcium 500 mg/l; Copper 4 mg/l; Iron 500 mg/l; Magnesium 500 mg/l; Manganese 4 mg/l; Molybdenum 4 mg/l; Sodium 1000 mg/l; Nickel 4 mg/l; Selenium 4 mg/l; Silicon 50 mg/l; Tin 4 mg/l; Vanadium 4 mg/l and Zn 4 mg/l.



Mixed element SIC solution – The mixed element SIC solution is used as an ongoing daily check of freedom from spectral interferences. The mixed element SIC contains the following elements: Aluminum 500 mg/l; Calcium 500 mg/l; Iron 200 mg/l; Magnesium 500 mg/l.

The absolute value of the concentration observed for any unspiked analyte in the single element SIC checks must be less than 2 times the analytes LLOQ. The concentration of the SIC checks are suggested, but become the highest reportable concentration in the sample analysis and cannot be higher than the highest established linear range. Samples with concentrations of elements higher than the SIC check must be diluted until the concentration is less than the SIC check solution. Reanalysis of a diluted sample is required even if the high concentration element is not required to be reported for the specific sample, since the function of the SIC check is to evaluate spectral interferences on other elements. The daily mixed element SIC solution is analyzed daily after calibration. The concentration measured for any target analytes must be less than +/- the LLOQ. For spiked elements, the analyzed results must be within 20 percent of the true value for SIC check and within 10 percent for linear range check. If this criterion cannot be met then sample analysis may not proceed until the problem is corrected, or the LLOQ is raised to twice the concentration observed in the SIC solution. The only exceptions are those elements that have been demonstrated and documented as contaminants in the SIC solutions. Levels for the SIC and mixed SIC can be found on tables 9 and 10.

**6.7 CRIA Standard Solution (Also referred to as LLCCV)**

The CRIA standard contains the elements of interest at levels equal to SGS - Orlando quantitation limits (RL). Please refer to Table 6 for list of elements of interest and concentration levels for the CRIA. If special client reporting limits are requested, then low checks corresponding to those reporting limits must also be analyzed.

**6.8 Matrix Spike, Matrix Spike duplicate, and Spike Blank Solution.**

This solution is prepared by adding either mixed or single element metals solutions to a solution containing 3 percent nitric acid and 5 percent hydrochloric acid and diluting to a fixed final volume with this acid mixture. Spiking solution (s) must be added to the spike blank, matrix spike, and the matrix spike duplicate prior to digestion. Levels for the MS and MSD and Spike Blank standard are shown in Table 7.

**6.9 Liquid Argon or Argon Gas. (99.999% purity)**

## **7.0 ANALYTICAL PROCEDURE**

Note: Please refer to section 8 of this SOP for further detail on quality control standards. Please refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

- 7.1 General procedure on how to operate the Thermo 6500 is described below. Refer to the Thermo 6500 operation manual for further details.
- 7.2 Before starting up the instrument, make sure that the pump tubing is in good condition, the torch assembly, the nebulizer, and the spray chamber are clean, the dehumidifier (if used) is filled with DI water up to the level between Minimum and Maximum, and that there are no leaks in the torch area.
- 7.3 Turn on the recirculating cooler. Verify that the argon is turned on and there is enough for the entire days analytical run.
- 7.4 Tighten the pump platens and engage the peristaltic pump. Make sure sample and internal standard solutions are flowing smoothly.
- 7.5 Put a new solution of acid rinse into the rinse reservoir. The composition of the rinse solution may be periodically changed to minimize sample introduction problems and sample carryover. If internal standard is being used, make sure that sufficient amount of internal standard is prepared for the entire analytical run.
- 7.6 Start up the instrument following the sequence show below.
  - 7.6.1 Double click the **iTEVA Control Center** Icon on the desktop. Type **admin** in User Name field, and then click **OK**.
  - 7.6.2 Once the iTEVA Control Center window is opened, click on **Plasma** Icon at status bar area. Then click on **Instrument Status** to check the interlock indicators (torch compartment, purge gas supply, plasma gas supply, water flow and exhaust should be in green; drain flow and busy should be in gray) and the Optics Temperature. It should be around 38°C.) Click on the Close box.
  - 7.6.3 Click **Plasma On**. When the plasma is on, click close. Let the instrument warm up for 15 to 20 minutes before starting the analysis. New tubing may take an hour to stabilize.
- 7.7 Torch Alignment and Auto Peak
  - 7.7.1 If the torch has been cleaned, then the torch alignment procedure must be performed.
  - 7.7.2 Open the method and then click on **Sequence** tab, then click on **List View** Icon until you reach rack display.
  - 7.7.3 Go to S-6 position (you can assign any position in the rack for torch alignment), then right click to select **Go** to empty sample S:6. Now, the auto sampler tip moves from Rinse to this position).

- 7.7.4 Click on **Analysis** tab, then select **Torch Alignment** from Instrument drop down menu. There will be a pop up dialog box present. Click **Run**. Then there will be another dialog pop up box (This is a reminder for Torch Alignment Solution 2 ppm Zn)), click **Ok**. Now, the instrument is initializing an automated torch alignment. It takes about 7 minutes to complete this step. Progress is indicated in the progress bar.
  - 7.7.5 After torch alignment is complete, click **Close**. Click on **Sequence** tab, then followed by **List View** Icon.
  - 7.7.6 Go to Rinse position at rack display, right click to select Go to rinse and let it rinse for approximately 5 minutes.
  - 7.7.7 Perform Auto Peak
  - 7.7.8 It is recommended that the Auto Peak Adjust procedure be performed daily prior to calibration. A standard that contains all of the lines of interest is used and the system automatically makes the appropriate fine adjustments. High standard solution should be used for this process.)
  - 7.7.9 Click **Sequence** tab, then click on **List View** Icon until the rack is displayed.
  - 7.7.10 Go to S-5 position (you can assign any position in the rack for auto peak adjust), then right click to select **Go** to empty sample S:5. Now, the auto sampler tip moves from the Rinse position to this position. Click on **Analysis** tab. All elements result is shown in the display area. From Instrument drop down menu, select **Perform Auto Peak**. There will be a pop up dialog box present. Highlight "All Elements", and then click **Run**. Then there will another pop up dialog box (This is a reminder for Auto Peak Solution), click **Ok**. Now, the instrument is performing auto peak adjust. It takes about 5 minutes to complete this process. The Auto Peak dialog box will show a green check mark in front of "All Elements", which indicates Auto Peak is complete.
- 7.8 Open the method and start up the run.
- 7.8.1 Click on **Analyst** Icon at the workspace. Go to the method and choose Open from the drop down menu. Select the method with the latest revision number.
  - 7.8.2 Go to **Method** tab at the bottom of left hand corner to click on **Automated Output** at the workspace area. Type a filename in Filename field in the data display area (i.e. : SA101010M1, starts with SA, then followed by MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3 and so on for the second and third runs.) Click on **Apply To All Sample Types**.
  - 7.8.3 Click on **Sequence** tab at the bottom of left hand corner. From Auto Session drop down menu bar, click on **New Auto sampler** to create a sequence. This will pop up a dialog box, then click on **New** and fill in number of samples i.e.: 100) in the Number of Samples field and the sample I.D. (leave this field empty) in Sample Name field. Type a sequence name (i.e. : SEQ101010M1, starts with SEQ, then MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3

and so on for the second and third runs) in the Sequence Name field. Click Ok, then put in "0" as settle time between sequences, and click **Ok**.

- 7.8.4 Right click on **Untitled** Cetac ASX-520 Enviro 5 Named Rack is the rack that is currently used) at the workspace area, click on **Auto-Locate All** to locate all sample positions.
- 7.8.5 Double click on **Untitled** again, then click on the sequence name i.e. : SEQ101010M1), on the data display area, type the sequence in Samplename column, dilution factor (if needed) in CorrFact column, check the box in front of Check column, and select an appropriate check table.
- 7.8.6 Once done with creating sequence, go to **Method** drop down menu and save all changes as **Save As**. There will be a Save a Method dialog box present, go to the save option to check on "Overwrite Method and bump revision number" box, and then click **Ok**.
- 7.8.7 Go to Sequence tab, click on List View Icon from tool bar, then click on Connect Autosampler to PC and Initialize Icon.
- 7.8.8 See table 8 for a typical run sequence.
- 7.9 Calibrate the instrument as outlined below. See table 3 for calibration standards concentrations. This calibration procedure is done a minimum of once every 24 hours. The calibration standards may be included in the auto sampler program or they may be run manually from the **Calibrate Instrument graduated cylinder** icon located on the Analyst tab. The instrument may be calibrated using a single point standard and a calibration blank or a multipoint calibration. If a multipoint calibration is used a minimum of three standards are required. All curves must be determined from a linear calibration prepared in the normal manner using the established analytical procedure for the instrument. Refer to instrument manual for further detail. Three exposures will be used with a percent relative standard deviation of less than 5 percent. The resulting correlation coefficient must be  $\geq 0.995$ . If the calibration curves do not meet these criteria, analysis must be terminated, the problem corrected, and instrument re-calibrated. Correlation coefficients, slopes, and y-intercepts for each wavelength are printed and included in each analytical data package.
- 7.10 Initial Calibration Verification Standard (ICV).

After each calibration, a standard from a different source than the calibration standard shall be analyzed. For the ICV, all elements to be reported must be within 10 percent of the true value for 6010D. If the ICV is outside these criteria then the analysis must be terminated, problem corrected, and the instrument re-calibrated.
- 7.11 After analyzing the ICV, the ICB must be analyzed. The results of the ICB must be less than one half the reporting limit (LLOQ). The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a "B" or "V"

qualifier, or raising the reporting limit (LLOQ) for all samples to greater than two times the background concentration.

- 7.12 Before analyzing any real world samples the CRIA (also referred to as LLCCV) must be analyzed. The CRIA contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

- 7.13 Before analyzing any real world samples, the Mixed element SIC solution must be analyzed. The mixed element SIC solution is used as an ongoing daily check of freedom from spectral interferences. The mixed element SIC contains the following elements: Aluminum 500 mg/l; Calcium 500 mg/l; Iron 500 mg/l; Magnesium 500 mg/l.

The daily mixed element SIC solution is analyzed daily after calibration. The concentration measured for any target analytes must be less than +/- the LLOQ. For spiked elements, the analyzed results must be within 20 percent of the true value for SIC check and within 10 percent for linear range check. If this criterion cannot be met then sample analysis may not proceed until the problem is corrected, or the LLOQ is raised to twice the concentration observed in the SIC solution. The only exceptions are those elements that have been demonstrated and documented as contaminants in the SIC solutions. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

- 7.14 After the initial analytical quality control has been analyzed, the samples and the preparation batch matrix quality control shall be analyzed. Each sample analysis must be a minimum of 3 readings using at least a 5 second integration time. Between each sample, flush the nebulizer and the solution uptake system with a blank rinse solution for at least 60 seconds or for the required period of time to ensure that analyte memory effects are not occurring.
- 7.15 Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010D, the CCV shall be reanalyzed to confirm the initial value. If the CCV is not within criteria after the reanalysis, no samples can be reported in the area bracketed by the failing CCV. Immediately following the analysis of the CCV the CCB shall be analyzed. The results of the CCB must be less than one half the reporting limit (LLOQ) for all elements. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a "B" or "V" qualifier, or raising the reporting limit (LLOQ) for all samples to greater than two times the background concentration.
- 7.16 One sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution (SDL) must be prepared. For the serial dilution, a 1:5

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dilution must be made on the sample. The results of the 1:5 dilution shall agree within 20 percent of the true value as long as the analyte concentration is within the linear range of the instrument and sufficiently high minimally, a factor of 25 times greater than the LLOQ). If the results are outside these criteria then matrix interference should be suspected and the proper footnote entered into LIMS. A post digestion spike (PDS) must be performed if the SDL fails. The PDS must recover within  $\pm 25$  percent for method SW846-6010D. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

- 7.17 The upper limit of quantitation may exceed the highest concentration calibration point and can be defined as the "linear range". Sample results above the linear range shall be diluted under the linear range and reanalyzed. Following calibration, the laboratory may choose to analyze a standard (or mixed standard solution) at a higher concentration than the high standard used in the calibration curve. The standard must recover within 10 percent of the true value, and if successful, establishes the linear range. The linear range standards must be analyzed in the same instrument run as the calibration they are associated with, but may be analyzed anywhere in the run. Samples following a sample with high concentrations of analyte (s) must be examined for possible carryover. Verification may be done by rinsing the lines with an acid solution and then reanalyzing the sample. A limit check table is built into the autosampler file so that samples exceeding the standardization range are flagged on the raw data.
- 7.18 After the instrument is optimized and all initial QC has been run, click on **Run Auto-Session** icon to start the analytical run sequence.
- 7.18.1 If you need to add or delete samples once the run is started, follow the steps shown below.
- 7.18.2 Click on **Sequence** tab, then click on **List View** icon at the tool bar. There is the sequence table shown on the display area.
- 7.18.3 Click on **Add Samples** icon. This will pop up a dialog box, and then fill in number of samples that need to be added. Click **Ok**. By doing this, samples will be added to the end of the current sequence without a rack location.
- 7.18.4 On the Samplename column type in the sample I.D., correction factors, and check tables. **Click on Auto Locate All**.
- 7.18.5 The added samples will be analyzed at the end of the original sequence run order unless they are assigned a different run order.
- 7.18.6 Deleting Samples
- 7.18.7 Click on **Sequence** tab, and then click on **List View** icon under the sequence display area.
- 7.18.8 Highlight all samples that need to be deleted and then click on the **Delete Samples** icon.

- 7.19 When the analysis is completed export the data to LIMS following the procedure outlined below.
- 7.19.1 Double click on **ePrint** Icon on desktop. There will be a **LEADTOOLS ePRINT** pop up box, click on **Finish Jobs** and **OK** boxes.
  - 7.19.2 Double click the **PDF** Icon on the desktop; the PDF file will be present as Document\_#. Right click on that file, select **rename** to change the filename to an assigned analytical run I.D. (i.e.: MA9000). This is the raw data file for MA9000.
  - 7.19.3 Drop the raw data to the **LIMS Data Drop** icon located on the desktop.
  - 7.19.4 By completing the above steps, the raw data i.e.: MA9000 can be viewed and/or printed from the Raw Data Search function.
  - 7.19.5 Go to **Analysis** tab, right click on sample header, and select export all samples. A pop up dialog box will come up, type in the analytical run I.D. i.e.: SA101010M1) and click **Ok**. Go to **Lims Export** folder located on the desktop, right click on analytical run and change extension from .TXT to .ICP. Open the analytical file and make any necessary changes, such as deleting any samples that need to be re-run on dilution. **Save** the file. Drop the data file to the **LIMS Data Drop** icon located on the desktop. This will then send the export file to LIMS for review.
- 7.20 The data can be evaluated by running an automated data evaluation program, which will help to generate quality control summary pages. Each run must be evaluated as quickly as possible to make sure that all required quality control has been analyzed. With each data package include: cover sheet, copies of all prep sheets, autosampler run sequence, dilution sheets, and raw data. Label each folder with MA#, instrument run I.D., instrument used, and date.
- 7.21 At the end of the analysis day the ICP must be shutdown using the following sequence.
- 7.21.1 Place the auto sampler tip in the rinse cup and rinse in a mixed solution of approximately 5 percent nitric acid and 5 percent hydrochloric acid for 10 minutes and then in DI water for 20 minutes.
  - 7.21.2 Turn off the plasma by clicking on the **Plasma** Icon and then by clicking **Plasma Off**.
  - 7.21.3 Close all iTeva programs/windows.
  - 7.21.4 Release the tension on the sample pump platens.
  - 7.21.5 Turn off recirculating chiller.

## 8.0 QUALITY CONTROL

This section outlines the QA/QC operations necessary to satisfy the analytical requirements for method SW846 6010D. Please refer to scheduling sheets and/or project specific QAPP for further

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information regarding client specific QC requirements. Check with the area supervisor or lab manager for any non-compliant quality control for further information.

**8.1 Initial Calibration Verification Standard (ICV).**

After each calibration, a standard from a different source than the calibration standard shall be analyzed. For the ICV, all elements to be reported must be within 10 percent of the true value for 6010D. If the ICV is outside these criteria then the analysis must be terminated, problem corrected, and the instrument re-calibrated.

**8.2 Continuing Calibration Blank/Initial Calibration Blank.**

Analyze the Initial calibration blank solution at the beginning of each run and the continuing calibration blank after every tenth sample and at the end of the sample run. The ICB/CCB must be less than one half the reporting limit (LLOQ) for each element. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a "B" or "V" qualifier, or raising the reporting limit (LLOQ) for all samples to greater than two times the background concentration.

**8.3 Low Standard Check (CRIA or LLCCV).**

Before analyzing any real world samples the CRIA (also referred to as LLCCV) must be analyzed. The CRIA contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

**8.4 ICSA (Mixed SIC Solution)**

Before analyzing any real world samples, the Mixed element SIC solution must be analyzed. The mixed element SIC solution is used as an ongoing daily check of freedom from spectral interferences. The mixed element SIC contains the following elements: Aluminum 500 mg/l; Calcium 500 mg/l; Iron 500 mg/l; Magnesium 500 mg/l.

The daily mixed element SIC solution is analyzed daily after calibration. The concentration measured for any target analytes must be less than +/- the LLOQ. For spiked elements, the analyzed results must be within 20 percent of the true value for SIC check and within 10 percent for linear range check. If this criterion cannot be met then sample analysis may not proceed until the problem is corrected, or the LLOQ is raised to twice the concentration observed in the SIC solution. The only exceptions are those elements that have been

demonstrated and documented as contaminants in the SIC solutions. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

8.5 Continuing Calibration Verification.

Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010D the CCV must be reanalyzed to confirm the initial value. If the CCV is not within criteria after reanalysis no samples can be reported in the area bracketed by the failing CCV.

8.6 Method Blank.

The laboratory must digest and analyze a method blank with each batch of samples. The method blank must contain elements at less than one half the reporting limit (LLOQ) for each element. The exception to this rule is when the samples to be reported contain greater than 10 times the method blank level. In addition, if all the samples are less than a client required limit and the method blank is also less than that limit, then the results can be reported as less than that limit. Samples associated with the contaminated blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-digesting and reanalyzing the samples, qualifying the results with a "B" or "V" qualifier, or raising the reporting limit LLOQ to greater than two times the background concentration,

8.7 Blank Spike Sample.

The laboratory must digest and analyze a spike blank sample with each batch of samples. Blank Spikes must be within 20 percent of the true value for method SW846-6010D. If the lab control is outside of the control limits for a reportable element, all samples must be re-digested and reanalyzed for that element. The exception is if the lab control recovery is high and the results of the samples to be reported are less than the reporting limit (LLOQ). In that case, the sample results may be reported with no flag. For solid standard reference materials (SRMs)  $\pm 20$  percent accuracy may not be achievable and the manufacturer's established acceptance criterion should be used for all soil SRMs.

8.8 Matrix Spike and Matrix Spike Duplicate Recovery.

The laboratory must digest and analyze a matrix spike and matrix spike duplicate with each batch of samples. The matrix spike recovery is calculated as shown below and must be within 20 percent of the true value for method SW846-6010D. If a matrix spike is out of control, then the results must be flagged with the appropriate footnote. If the matrix spike amount is less than one fourth of the sample amount, then the sample cannot be assessed against the control limits and must be footnoted to that effect.

Note: Both the matrix spike amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

$$\frac{(\text{Spiked Sample Result} - \text{Sample Result})}{\text{Amount Spiked}} \times 100 = \text{matrix spike recovery}$$

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8.9 Matrix Duplicate/Matrix Spike Duplicate Relative Percent Difference.

The laboratory must digest a duplicate with each batch of samples. The relative percent difference (RPD) between the duplicate and the sample must be assessed and must be  $\leq$  20 percent for sample results at or above the reporting limit (LLOQ). If the RPD is outside the 20 percent criteria the results must be qualified in LIMS. RPD's are also calculated in LIMS for sample results below the reporting limit (LLOQ). RPD's outside the 20 percent criteria are not considered failing and LIMS automatically footnotes these as "RPD acceptable due to low duplicate and sample concentrations."

Note: Both the duplicate amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

$$\frac{|\text{Sample Result} - \text{Duplicate Result}| \times 100}{\text{Sample Result} + \text{Duplicate Result}/2} = \text{Duplicate RPD}$$

8.10 Serial Dilution Analysis and Post Digestion Spike.

One sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution (SDL) must be prepared. For the serial dilution, a 1:5 dilution must be made on the sample. The results of the 1:5 dilution shall agree within 20 percent of the true value as long as the analyte concentration is within the linear range of the instrument and sufficiently high (minimally, a factor of 25 times greater than the LLOQ). If the results are outside these criteria then matrix interference should be suspected and the proper footnote entered into LIMS. A post digestion spike (PDS) must be performed if the SDL fails. The PDS must recover within  $\pm$  25 percent for method SW846-6010D. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

$$\frac{|\text{Sample Result} - \text{Serial Dil. Result}| \times 100}{\text{Sample Result}} = \text{Serial Dilution RPD}$$

8.11 Linear Calibration ranges.

The upper limit of quantitation may exceed the highest concentration calibration point and can be defined as the "linear range". Sample results above the linear range shall be diluted under the linear range and reanalyzed. Following calibration, the laboratory may choose to analyze a standard (or mixed standard solution) at a higher concentration than the high standard used in the calibration curve. The standard must recover within 10 percent of the true value, and if successful, establishes the linear range. The linear range standards must be analyzed in the same instrument run as the calibration they are associated with, but may be analyzed anywhere in the run. Samples following a sample with high concentrations of analyte(s) must be examined for possible carryover. Verification may be done by rinsing the lines with an acid solution and then reanalyzing the sample. A limit check table is built into the autosampler file so that samples exceeding the standardization range are flagged on the raw data.



#### 8.12 Sample RSD

For samples containing levels of elements greater than five times the reporting limits (LLOQ), the relative standard deviation for the replicates should be less than 5%. If not, reanalyze the sample. If upon reanalysis, the RSD's are acceptable then report the data from the reanalysis. If RSD's are not acceptable upon reanalysis, then the results for that element should be footnoted that there are possible analytical problems and/or matrix interference indicated by a high RSD between replicates.

#### 8.13 Interelement Spectral Interference Correction Validity

For the interelement spectral interference corrections to remain valid during sample analysis, the interferent concentration must not exceed its linear range. If the interferent concentration exceeds its linear range or its correction factor is big enough to affect the element of interest even at lower concentrations, sample dilution with reagent blank and reanalysis is required. In these circumstances, analyte dilution limits are raised by an amount equivalent to the dilution factor.

#### 8.14 Internal Standard (Yttrium/Indium)

For any readings where the internal standard is outside of the range 60-125 percent of the internal standard level in the reference standard (Initial Calibration Blank), then the sample must be diluted until the internal standard is within range and all sample results must be footnoted in LIMS.

#### 8.15 MSA (Method of Standard Additions)

SGS - Orlando uses the internal standard technique as an alternative to the MSA per SW846-6010D section 4.4.2. However, in certain circumstances MSA may be needed by some project specific requirements. SGS - Orlando may perform an MSA when sample matrix interference is confirmed through the post digestion spike process or may qualify the results in LIMS. SGS - Orlando will use a single addition method as described in SW846-7000B.

### 9.0 GLASSWARE CLEANING

All glassware must be washed with soap and tap water and then rinsed with 5 percent nitric acid. It must then be rinsed at least 3 times with DI water. Refer to SOP GN196, current revision for further information regarding glassware cleaning.

### 10.0 DOCUMENTATION REQUIREMENTS

Refer to the Laboratory Quality Assurance Manual for documentation requirements. All raw data is printed to .PDF format and archived to a backup server for long term storage.

### 11.0 SAFETY

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The analyst must follow normal safety procedures as outlined in the SGS - Orlando Safety Manual which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and must be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor. Follow proper safety precautions when working with gas cylinders.

## 12.0 CALCULATIONS

For water samples, the following calculations must be used. Refer to the QC section for the calculations to be used for the QC samples.

Original sample concentration of metal (ug/l) =

$\frac{\text{conc. in the digestate (ug/l)} \times (\text{final digestate volume (ml)})}{(\text{initial sample volume (ml)})}$
--

For soil samples, the following calculations must be used.

Concentration of the metal in the dry sample (mg/kg) =

$\frac{\text{conc. in the digestate (mg/l)} \times \text{final digestate volume(L)}}{(\text{sample wt. (kg)}) \times (\% \text{ solids}/100)}$
--

## 13.0 INSTRUMENT MAINTENANCE

Recommended periodic maintenance includes the items outlined below. All maintenance must be recorded in the instrument maintenance log.

- 13.1 Change the pump tubing as needed.
- 13.2 Clean the filter on the recirculating pump approximately once a month and dust off the power supply vents as needed.
- 13.3 Clean or replace the nebulizer, torch assembly, and injector tube as needed.
- 13.4 Change the sampler tip as needed.
- 13.5 Clean the recirculating pump lines and internal sock filter every 3 months or as needed.
- 13.6 Clean the radial view quartz surface weekly or more often if needed.

## 14.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

#### 14.1 Pollution Prevention

Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids must be followed. All method users must be familiar with the waste management practices described in Section 14.2.

#### 14.2 Waste Management

Individuals performing this method must follow established waste management procedures as described in the Sample and Laboratory Waste Disposal SOP SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

### 15.0 GENERIC DEFINITIONS

- 15.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 24 hours whichever comes first.
- 15.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).
- 15.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. A CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.
- 15.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 15.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the reporting level.
- 15.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.
- 15.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the performance of a method in a given sample matrix.

- 15.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the precision and performance of a method in a given sample matrix.
- 15.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 15.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 15.11 Preservation: Refrigeration and/or reagents added at the time of sample collection or later) to maintain the chemical integrity of the sample.

## **16.0 METHOD PERFORMANCE**

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Statistical control limits are stored in the LIMS for QA purposes only. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

## **17.0 GENERATION OF INTERFERING ELEMENT CORRECTION FACTORS**

- 17.1 It is recommended that all IEC's be verified and updated approximately every 6 months or whenever instrument conditions change significantly. It is also recommended that elements with frequent high concentrations or with large IEC's should be checked more frequently.
- 17.2 Calculate the IEC correction factors and enter them into the method (refer to Thermo 6500 instrument manual). Calculate the correction factor using the equation shown below. This correction factor must be added to the correction factor already in place in the method for a given element.

$$\text{IEC} = \frac{\text{Concentration Result of the element with the interference}}{\text{Concentration result of the interfering element}}$$

- 17.3 Verify the new correction factors by reanalyzing the ICSA/ICSAB solutions and/or the SIC solutions or by reloading and recalculating the previously stored results. If the reanalysis is not within QC limits, make additional changes to the IEC factors and then re-verify both the individual and combined solution values.

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- 17.4 Save and update the method.
- 17.5 Interfering element correction factors are saved as raw data along with the run printouts on a daily basis so that the IEC's for a given run are traceable.



**TABLE 1: REPORTING LIMIT BY ELEMENT**

Analyte	Water Reporting Limit(LLOQ) (ug/L)	Soil Reporting Limit(LLOQ)(mg/kg)	TCLP Reporting Limit(LLOQ) (mg/L)/MCL
Tin	50	5	
Aluminum	200	20	
Antimony	5	1	
Arsenic	10	0.5	0.10 / 5.0
Barium	200	20	10 / 100
Beryllium	4	0.5	
Cadmium	5	0.4	0.05 / 1.0
Calcium	1000	500	
Chromium	10	1	0.10 / 5.0
Cobalt	50	5	
Copper	25	2.5	
Iron	300	10	
Lead	5	1	0.5 / 5.0
Magnesium	5000	500	
Manganese	15	1.5	
Nickel	40	4.0	
Potassium	5000	500	
Selenium	10	1	0.5 / 1.0
Silver	10	1	0.10 / 5.0
Sodium	5000	500	
Thallium	10	1	
Vanadium	50	5	
Zinc	20	2	
Molybdenum	50	2.5	
Strontium	10	0.5	
Titanium	10	0.5	

**TABLE 2. THERMO 6500 ANALYSIS LINES**

Element	Wavelength
Al	396.1
As	189.042
Ca	317.933
Fe	259.9
Mg	279.078
Mn	257.610
Pb	220.353
Se	196.026
Tl	190.864
V	292.402
Ag	328.068
Ba	455.4
Be	313.042
Cd	226.502
Co	228.616
Cr	267.716
Cu	324.753
K	766.491
Na	589.5
Ni	231.604
Sb	206.838
Zn	206.2
Mo	202.030
Sn	189.900
Sr	407.7
Ti	334.9

**TABLE 3: LOW, MID AND HIGH STANDARD LEVELS**  
**Single Point Calibration (blank and high standard) may be used**

Element	Low ug/l	Mid ug/l	High ug/l
Al	10000	40000	80000
As	500	2000	4000
Ca	10000	40000	80000
Fe	10000	40000	80000
Mg	10000	40000	80000
Mn	500	2000	4000
Pb	500	2000	4000
Se	500	2000	4000
Tl	500	2000	4000
V	500	2000	4000
Ag	62.5	250	500
Ba	500	2000	4000
Be	500	2000	4000
Cd	500	2000	4000
Co	500	2000	4000
Cr	500	2000	4000
Cu	500	2000	4000
K	10000	40000	80000
Na	10000	40000	80000
Ni	500	2000	4000
Sb	500	2000	4000
Zn	500	2000	4000
Mo	500	2000	4000
Sn	500	2000	4000
Sr	500	2000	4000
Ti	500	2000	4000

**TABLE 4: ICV STANDARD LEVELS**

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000

**TABLE 5: CCV STANDARD LEVELS**

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000



**TABLE 6: CRIA(LLCCV) STANDARD LEVELS**

Element	CRIA ug/l
Al	200
As	10
Ca	1000
Fe	300
Mg	5000
Mn	15
Pb	5
Se	5
Tl	10
V	50
Ag	10
Ba	200
Be	5
Cd	5
Co	50
Cr	10
Cu	25
K	5000
Na	5000
Ni	40
Sb	5
Zn	20
Mo	50
Sn	50
Sr	10
Ti	10

**TABLE 7: BLANK SPIKE, MATRIX SPIKE AND MATRIX SPIKE DUPLICATE LEVELS**

Element	Concentration
	ug/l
Al	27000
As	2000
Ca	25000
Fe	26000
Mg	25000
Mn	500
Pb	500
Se	2000
Tl	2000
V	500
Ag	50
Ba	2000
Be	50
Cd	50
Co	500
Cr	200
Cu	250
K	25000
Na	25000
Ni	500
Sb	500
Zn	500
Mo	500
Sn	500
Sr	500
Ti	500

**TABLE 8: TYPICAL RUN SEQUENCE**

BLANK
LOW
MID
HIGH
HIGH STD
ICV
ICB
CRIA
ICSA
ICSAB
CCV
CCB
MB
SB
SAMPLE1
DUPLICATE
SERIAL DILUTION
MATRIX SPIKE
MATRIX SPIKE DUPLICATE
POST DIGESTION SPIKE
SAMPLE2
SAMPLE3
CCV
CCB
SAMPLE4
SAMPLE5
SAMPLE6
SAMPLE7
SAMPLE8
SAMPLE9
SAMPLE10
SAMPLE11
SAMPLE12
SAMPLE13
CRIA CLOSING
ICSA CLOSING
ICSAB CLOSING
CCV
CCB

**TABLE 9: ICSA (Mixed SIC) SOLUTION LEVELS**

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	500
Mg	500
Mn	0
Pb	0
Se	0
Tl	0
V	0
Ag	0
Ba	0
Be	0
Cd	0
Co	0
Cr	0
Cu	0
K	0
Na	0
Ni	0
Sb	0
Zn	0
Mo	0
Sn	0
Sr	0
Ti	0

**TABLE 10: SINGLE ELEMENT INTERFERENCE CHECK SOLUTION (SIC) LEVELS**

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	500
Mg	500
Mn	4
Pb	0
Se	4
Tl	0
V	4
Ag	0
Ba	4
Be	0
Cd	0
Co	0
Cr	0
Cu	4
K	0
Na	1000
Ni	4
Sb	0
Zn	4
Mo	4
Sn	4
Si	50
Sr	0
Ti	0





## DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY

Prepared by: Jenna Kravitz Date: 11/28/2017

Approved by: Svetlana Izosimova Date: 04/04/2018

### Annual Review

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## TITLE: DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY

**REFERENCES:** EPA 300.0, Revision 2.1, 1993; SW846 9056A;  
40CFR, part 136, App. B – MDL procedure

**REVISED SECTIONS:** Apparatus and Reagents sections 7 and 8 are revised to accommodate transition to carbonate-bicarbonate eluent; updated references sec. 17.

### 1.0 SCOPE AND APPLICATION

- 1.1 This method is for the measurement of anions such as bromide, chloride, fluoride, nitrate, nitrite and sulfate by ion chromatography. The method is applicable to potable and non-potable water, solids after extractions, and neutral leachates.

### 2.0 SUMMARY OF METHOD

- 2.1 A small volume of sample is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, and analytical column, a suppressor, and a conductivity detector.
- 2.2 Detection limits vary with the instrument conditions and calibration levels used.

### REPORTING LIMIT AND METHOD DETECTION LIMIT

- 3.1 Reporting Limit. The normal reporting limit for this method is normally established at or above the lowest non-zero concentration standard in the calibration curve. Detected concentrations below this concentration are not reported unless MDL reporting is being done. Reporting limits were set as follows:

<u>ANALYTE</u>	<u>REPORTING LIMIT</u>
Bromide	0.50 mg/l
Chloride	2.00 mg/l
Fluoride	0.20 mg/l
Nitrate	0.10 mg/l
Nitrite	0.10 mg/l
Sulfate	2.00 mg/l

- 3.2 Method Detection Limit. Experimentally determine MDLs using the procedure specified in 40 CFR, Part 136, Appendix B. This value represents the lowest reportable concentration of an individual compound that meets the method qualitative identification criteria.

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Experimental MDLs must be determined semiannually for this method, as outlined in EPA 300.0. Refer to SOP QA020, current revision, for further details.

## **4.0 DEFINITIONS**

- 4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or samples loaded on an instrument within the same 12-hour shift, whichever comes first.
- 4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).
- 4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.
- 4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.
- 4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.
- 4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.
- 4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.
- 4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.
- 4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.
- 4.10 Method Detection Limits (MDLs) MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. This definition is qualitative in nature and does not evaluate

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an acceptable quantitative limit for method performance. MDLs should be determined semiannually for every matrix in this method. Refer to SOP QA020, current revision.

- 4.11 Reagent Blank: The reagent blank is a blank that has the same matrix as the samples, i.e., all added reagents, but did not go through sample preparation procedures. The reagent blank is an indicator for contamination introduced during the analytical procedure. For methods requiring no preparation step, the reagent blank is equivalent to the method blank.
- 4.12 Reagent Grade: Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents, which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
- 4.13 Reagent Water: Water that has been generated by any method, which would achieve the performance specifications for ASTM Type II water.
- 4.14 Reference Material: A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.
- 4.15 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.
- 4.16 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

## **5.0 HEALTH & SAFETY**

- 5.1 The analyst should follow normal safety procedures as outlined in the SGS Accutest Health and Safety Program which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.
- 5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets should be made available to all personnel involved in these analyses.

## **6.0 COLLECTION, PRESERVATION, AND HOLDING TIME**

- 6.1 Samples must be cooled to <6°C at the time of collection.
- 6.2 Bromide, chloride, fluoride, and sulfate must all be analyzed within 28 days. Nitrite and nitrate must be analyzed within 48 hours for aqueous samples. For solids, the same hold time applies, after the samples are prepared (see section 10.1.)

**Note:** State of West Virginia requires 48 hours from collection to completion for NO<sub>2</sub>/NO<sub>3</sub>,

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regardless of matrix.

## 7.0 APPARATUS AND MATERIALS

- 7.1 Ion Chromatograph with a guard column, an analytical column, a suppressor column, and a conductivity detector. This SOP is written for the use with the Dionex ICS-2000 or ICS-2100 instrument. The ICS-2000 is run using prepared eluent. The columns used are listed below. Alternate columns may be used if all method requirements can be met.

*Maintenance and troubleshooting* procedures are described in detail in operation manual. Most basic procedures include checking connections for leaks, cleaning and/or replacing tubing, monitoring and recording the pressure. See Sec.12.0.

- 7.1.1 Suppressor, AERS 500 Carbonate 4mm. Dionex part number 085029
- 7.1.2 Guard Column, IONPAC AG22 4 mm. Dionex part number 064139
- 7.1.3 Analytical Column, IONPAC AS22. Dionex part number 064141
- 7.1.4 Data System **Chromeleon 6.80 SR 10, build 2818**. Data system's revisions will be updated during annual SOP revisions. Data system changes prior to the date of revision are to be recorded in Maintenance log.
- 7.2 Top loading balance, capable of weighing to 0.01g. Calibrated and serviced annually by outside vendor and verified daily with Class 1 weights.
- 7.3 Analytical balance capable of accurately weighing to the nearest 0.0001 g.
- 7.4 Centrifuge Centra CL2, or equivalent
- 7.5 Class 1 weights
- 7.6 Volumetric glassware, class A.
- 7.7 IC vials and caps
- 7.8 Volumetric pipettes, class A or autopipetters. Note: If autopipetters are used, make sure that the calibration is checked before use as specified in the autopipetter SOP QA006, current revision.
- 7.9 Helium tank and regulator. On the ICS-2000 and ICS-2100 instruments, helium is used only for head pressure on the water reservoirs. The pressure should be set at approximately 6 psi.
- 7.10 Nylon 0.45µm membrane filters or equivalent.
- 7.11 Disposable syringes, for sample filtering.
- 7.12 Conductivity meter to pre-determine dilutions for possible interferences.

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## 8.0 REAGENTS

All chemicals listed below are reagent grade unless otherwise specified. Deionized water must be used whenever water is required.

- 8.1 Stock Standard Solutions, custom mix standards that contain all target anions with a concentration range from 500mg/L to 10000mg/L: This custom standard can be purchased from various manufacturers such as High Purity Standard cat. # SM-205-001 and Inorganic Ventures cat.# acuttest-19.

Note: Levels shown below are suggested levels and may be changed to meet different reporting limit requirements.

- 8.1.1 The final concentrations of suggested standards are shown in the table below. All units are in mg/L.

Anion	STD A	STD B	STD C	STD D	STD E	STD F	STD G
F	.1	.5	1.5	2.5	5	7.5	10
CHL	2	10	30	50	100	150	200
NO2	.1	.5	1.5	2.5	5	7.5	10
BRO	.5	2.5	7.5	12.5	25	37.5	50
SO4	2	10	30	50	100	150	200
NO3	.1	.5	1.5	2.5	50	7.5	10

- 8.1.2 The volume of stock added to 100mL volumetric flask are shown in the table below. All volume units are in mL.

Anion	STD A	STD B	STD C	STD D	STD E	STD F	STD G
Custom mix	0.02	0.10	0.30	0.50	1.00	1.50	2.00

- 8.2 CCV. Same concentration as standard D.
- 8.3 ICV (External Check Solution.) The ICV can be made in the same manner as the standard D from a separate source than the ICAL standards. It must be within the range of the curve. Alternatively, it can be purchased from an outside supplier.
- 8.4 Stock Eluent (450mM Na<sub>2</sub>CO<sub>3</sub>, 140mM NaHCO<sub>3</sub>): In a 1000mL flask, add approximately 300mL of DI H<sub>2</sub>O. Using oven dried reagent, dried at 105°C, (temperature should not exceed 110 °C) weigh 47.6955g of Na<sub>2</sub>CO<sub>3</sub> and 11.7614g of NaHCO<sub>3</sub>, and add to flask. Bring this solution to volume. This solution is stable for 6 months stored refrigerated.
- 8.5 Eluent Solution (4.5mM Na<sub>2</sub>CO<sub>3</sub>, 1.4mM NaHCO<sub>3</sub>): Dilute Stock Eluent –Sec. 8.4 using 20mL of stock in a 2000mL flask and bring up to volume. This solution is stable for a week stored refrigerated.

- 8.6 0.2N H<sub>2</sub>SO<sub>4</sub> for suppressor regeneration: Pipet 1.0 mL of concentrated H<sub>2</sub>SO<sub>4</sub> into 100 mL DI and dilute to final volume of 200mL with DI.
- 8.7 0.1M Oxalic Acid for metals column clean-up: Dissolve 6.3g of oxalic acid into approx. 300mL of DI water. Bring to final volume of 500mL with DI water.
- 8.8 10X eluent concentrate for hydrophilic ionic contamination clean-up.
- 8.9 Acetonitrile, reagent grade
- 8.10 1M HCl: Add 8.3 mL of concentrated hydrochloric acid to approximately 70 mL of deionized water. Dilute to a final volume of 100 mL and mix well.

## **9.0 INTERFERENCES**

- 9.1 Interferences can be caused by substances with retention times that are similar to and overlap those of the anion of interest. This interference is especially important at low concentrations.
- 9.2 The acetate anion elutes early during the chromatographic run and can cause elution times of other anions to vary when large amounts of acetate are present. High levels of acetate also can cause interference with the fluoride peak. Therefore, this method is not recommended for leachates containing acetic acid.
- 9.3 Large amounts of an anion can interfere with the peak resolution of an adjacent anion. High concentrations of an anion can also cause the peak to be misidentified on the chromatograph due to the large width of the peak. Sample dilution and fortification can be used to correct most interference problems connected with peak resolution.
- 9.4 Samples that contain particles greater than 0.45µm and reagents with particles larger than 0.2µm must be filtered to prevent damage to instrument columns and flow systems.

## **10.0 SAMPLE PREPARATION PROCEDURE**

- 10.1 For soil samples, follow the preparation outlined below.
  - 10.1.1 Mix the sample well and remove any artifacts as discussed in SOP QA034, current revision. Weigh approximately 5g of sample and add 50mL of DI water. Mix or shake the resulting slurry for 10 minutes. Record the weight to the nearest 0.01g on preparation log.
  - 10.1.2 For matrix spikes, make sure to spike the aliquot of the sample directly and then add the volume of DI water needed to make the volume of liquid being added to the soil sample equal to 50 mL including the volume of the spike solutions. In most cases this will be 49.75 mL of DI.
  - 10.1.3 Prepare blank QC (Method Blank and Blank Spike) using a clean solid matrix, using

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approximately 5g aliquot and 50mL of DI water. Record the weight to nearest 0.01g.

10.1.4 Check with the lab supervisor if there is insufficient sample to use a 5g aliquot. Smaller aliquots may be used if a homogeneous portion of the sample can be obtained. The sample must always be extracted with 10 times the sample weight of DI water.

10.1.5 Centrifuge samples and QC for 10 minutes at 2000 RPM, then pre-filter through 0.45µm filters before analysis.

10.2 For aqueous samples, pre-filter water samples through 0.45µm filters only if they contain sediment or appear cloudy before analysis. Matrix spikes must be spiked before filtration. Pre-filter method blanks and blank spikes to act as QC check of the filters, only if there are samples in the batch that have been filtered. Record which samples have been filtered and the lot number of the filters in the run log. An unfiltered Method Blank and unfiltered Blank Spike are required for every batch of samples.

## **11.0 ION CHROMATOGRAPHY ANALYSIS PROCEDURE**

11.1 Check to make sure that the helium tank pressure is > 100 PSI and the pressure gauge by the eluent bottles is set at 6 PSI.

11.2 Fill the eluent generation bottle(s) that are to be used with Eluent Solution- Sec. 8.5, making sure that they are pressurized with helium. On the instrument panel (or in the software) set the water volume at the level in the bottles and adjust the flow rate up to 1.0 mL/min.

11.3 Check the lines coming out of the suppressor for air bubbles. Bubbles should be present. If not, then check to make sure the current is on and the suppressor is working properly.

11.4 Check the pump waste line and see if bubbles are present. If they are present, then prime the pump using the procedure described below.

11.4.1 Verify that the priming valve on the primary pump head (right side) is closed. Hit the prime button on the front panel.

11.4.2 Follow the screen prompts. When prompted, open the waste valve by turning the knob ¼ to ½ turn counter-clockwise.

11.4.3 Check for air bubbles on the pump waste line. Continue priming until no air bubbles are exiting the waste line. Turn the pump off and then close the waste valve.

11.4.4 Allow the instrument conditions to settle and then check the pressure and check for air bubbles. If there is still a problem, the priming procedure may be repeated.

11.5 In the software, go to the browser and go to the correct instrument panel (1 or 2). Then connect the instrument. Monitor the baseline until it is stable.

11.6 Go to the template sequences and edit a sequence for the samples in the run. If a calibration

is being used from an earlier run, make sure to copy the calibration into the front of the sequence. After the sequence is generated, then save it using the file name (instrument, date, run). Refer to the instrument manuals or help screens in the program for help in using the software. A summary of the instrument conditions required for the analysis of anions is shown below. Note: the retention time for each anion must not exceed  $\pm 10\%$  of that anions retention time from the calibration. Refer to section 14.7 for more discussion of the proper application of retention time.

Column: IonPac AG22, AS22  
Eluent: 4.5mM Na<sub>2</sub>CO<sub>3</sub>, 1.4mM NaHCO<sub>3</sub>  
Suppressor setting: approximately 30mAmps. This setting will be autogenerated.  
Flow Rate: 1.0mL/min  
Inj. Volume: 12.5 $\mu$ l  
Pump pressure – should be around 1600 psi  
Detection: Suppressed conductivity, SRS Ultra II, external water mode

- 11.7 Check sample conductivity with a conductivity meter to determine if dilutions are needed. Refer to spreadsheet of possible dilutions stored on LAN in GenChem directory.
- 11.8 Load the autosampler and turn it on. The autosampler should then move to the first sample. A print-out of the autosampler table should be generated showing the order that the samples are loaded into the autosampler.
- 11.9 Start the run. Monitor the results as the run is going to make sure that problems are identified quickly. Note: the initial demonstration of capability, including instrument MDL's and linear calibration ranges, must be completed before samples can be run.
  - 11.9.1 Data files should be saved using the naming scheme of instrument, year (last 2 digits), month, day, run number followed by the extension of .txt. For example, the first IC run on instrument 2 on May 20, 2005 would be named 205052001.txt. This name should always be used in the workgroup description in the LIMS system.
  - 11.9.2 It is recommended that a new calibration be run a minimum of once per month. (It is required that a calibration be run once per quarter.) Calibrations standards may be varied from the one stated in this SOP depending on the levels of each anion that are to be reported. A minimum of 5 standards and a blank are required and a low standard must be at or below the reporting limit for each anion. A correlation coefficient of 0.995 or greater is required. If this correlation coefficient is not met, than the instrument must be recalibrated. Force to Origin (aka Force to Zero) is not permitted.
    - 11.9.2.1 Using weighed regression 1/concentration is also acceptable. Same correlation coefficient of 0.995 or better is required for this calibration model. *For greater details refer to SOP QA042, current revision.*
  - 11.9.3 After the calibration, a low check at the reporting limit must be run. This low check must have the levels in standard A or at the reporting limit for the calibration outlined in this SOP and recoveries must be in the range of 50–150%. On a daily basis, it is recommended that an external check is analyzed and recoveries must be within a

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range of 90-110%. (This check must be analyzed at a minimum with each new calibration.) Continuing calibration checks and continuing calibration blanks must be run every 10 samples. The continuing calibration checks must have recoveries in the range of 90-110%. Refer to the quality control section of this SOP for more detail on these quality control samples.

11.10 After the run is completed, review all of the chromatograms and check for overlapping peaks, dilutions, etc.

11.10.1 If the retention time of any anion in the ICV or CCV check standards has shifted more than 10% from the original calibration curve retention time, then no results can be reported for that anion. The column should be reconditioned, if necessary, and the instrument recalibrated before any more samples are reported for that anion. Affected samples are reanalyzed after the problem has been corrected.

11.10.2 If a sample peak has shifted significantly from the original retention time (and the ICV and CCV check standards are within the 10% retention time window), then verify the reported result using post-digest spike on that sample. Do not report results from peaks where the retention time has shifted more than 10 percent unless the peak can be verified using a post-digest spike.

11.10.3 For large or overlapping peaks, make dilutions. If at all possible, make dilutions and reruns on the same run as the original sample.

11.10.4 Refer to section 14.7 for information on how to determine the appropriate retention time window.

11.11 Review all data and update the appropriate tests in the LIMS system. A write-up including a run log, a calibration summary, batch quality control summary, and copies of all chromatograms should be turned into the area supervisor for each batch.

11.11.1 If edits are needed in the calibration after the data has been calculated, the run can be reprocessed using the batch function in the software. Refer to the instrument manuals or on-screen help for additional information.

## **12.0 INSTRUMENT MAINTENANCE**

12.1 Whenever a new suppressor is put in place or when the baseline is unstable or very high, the suppressor should be regenerated. The procedure below is for the Ultra 4mm suppressor.

12.1.1 Using a disposable plastic syringe, push approximately 3mL of 0.2(200mN) H<sub>2</sub>SO<sub>4</sub> through the ELUENT OUT port and 5mL of 0.2N H<sub>2</sub>SO<sub>4</sub> through the REG IN port respectively.

12.1.2 Allow the suppressor to sit for approximately 20 minutes to fully hydrate the suppressor screens and membranes.

12.1.3 Re-connect the suppressor to the system in the recycle mode.

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12.2 Periodically, due to the matrix of samples, both guard and analytical columns become degraded and cleaning them becomes necessary. This is evidenced in changing retention times, round-shaped peaks, tailing peaks and overall poor integration. The metals cleanup should be done a minimum of once per month, while the others should be done a minimum of once per quarter.

12.2.1 There are 3 recommended cleanup solutions for the AS22 and AG22 columns.

12.2.2 Metal contamination column clean-up: Use 500mL of 0.2M oxalic acid solution.

12.2.3 Low valency hydrophilic ionic contamination column clean-up. Use 500mL of 10X eluent concentrate (300 mM KOH).

12.2.4 High valency hydrophobic ion 200mM HCl in 80% acetonitrile: The acetonitrile solution is stored in a separate eluent bottle because acetonitrile slowly breaks down in acidic aqueous solutions. Prepare 2 bottles (E1 and E2) with the following 500-mL solutions: E1: 100% Acetonitrile and E2: 1M HCl using DI water.

### 12.3 Column Clean-up Procedure.

12.3.1 Prepare 500mL solution of the appropriate cleanup solution from 12.2.1

12.3.2 Disconnect the suppressor from the IonPac AS22 Analytical column. **Make sure to reverse the order of the guard and analytical column in the eluent flow path.** Contaminants that have accumulated on the guard column can be eluted onto the analytical column and irreversibly damage it. Cleaning each column separately is recommended. Double check that the eluent flows in the direction designated on each of the column labels.

12.3.3 Set the pump flow rate to 1.0mL/min for an AS22 4-mm analytical or guard column.

12.3.4 Rinse the column for 15 minutes with DI water before pumping the chosen cleanup solution over the columns.

12.3.5 Pump the cleanup solution through the column for at least 60 minutes.

12.3.6 Rinse the column for 15 minutes with DI water before pumping eluent over the column.

12.3.7 Equilibrate the columns with eluent before resuming normal operation for at least 30 minutes.

12.3.8 Reconnect the suppressor and place the guard column in line between the injection valve and the analytical column.

### 13.0 METHOD PERFORMANCE

Method performance (accuracy and precision) is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

Filtered method blanks and blank spikes to act as QC check of the filters. Unfiltered method blanks and blank spikes are used to monitor overall method performance.

### 14.0 QC REQUIREMENTS

14.1 A method detection limit study must be done semiannually, or when new operator begins work, or whenever there is a significant change in the background or instrument response. The MDL study is done following the procedure outlined in the SGS Accutest - Orlando SOP QA020, current revision. A minimum of seven replicates spiked at 3 to 5 times the MDL must be taken through the procedure for each anion. If instrument conditions (columns, etc.) are modified, then a new MDL must be done.

14.2 A method blank and a spike blank are required to be run with every batch of 20 samples. Additionally a matrix spike and a matrix duplicate are required for every 10 samples. In some cases a matrix spike duplicate may be required in place of a duplicate.

14.2.1 The method blank must contain  $< \frac{1}{2}$  RL of each anion that is reported and this sample must be run with each set of samples in a batch. If the blank contains more than the reporting level, then all samples must be reanalyzed. If no sample volume remains to be reanalyzed, then the data must be flagged. (The exception is if the sample results are less than the reporting limit.)

**Note:** West Virginia state specific requirement for method blank must contain analyte at  $< \text{MDL}$

14.2.1.1 Although the method states that values greater than the MDL should be suspect, this is not appropriate for the concentration levels being applied for this analysis. MDL's are generally up to 10 times lower than reporting limits for all analytes and values over the MDL do not impact data usability.

14.2.2 The recovery of the spike blank must be within the limits of 90-110% recovery for each anion that is reported and this sample must be run with each set of samples in a batch. If the recoveries are outside of this range, then all associated samples must be reanalyzed. If no sample volume remains to be reanalyzed, then the data must be flagged.

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- 14.2.3 The matrix spike is spiked with all anions of interest. Method limits of 90 -110 % recovery must be applied. Control limits must be generated from laboratory data to support method limits. If the recoveries are outside of this range, and all other method quality control is within limits, then matrix interference should be suspected.
- 14.2.4 For matrix duplicates control limits of 10% RPD must be applied for all sample values within the calibration range (up to 10 times the reporting limit). If the RPD values are outside of this range, and all other method quality control is within limits, then sample non-homogeneity should be suspected.
- 14.3 An external source standard (ICV) must be analyzed after every new calibration and its recovery must be within 10% of the true value. If the ICV is not within  $\pm 10\%$ , a second ICV should be prepared and analyzed. If the ICV is still outside of the limits, sample analysis must be discontinued and the cause determined (preparation of ICV from third source, instrument recalibration, etc)
- 14.4 It is recommended that a new calibration be run a minimum of once per month. (It is required that a calibration be run once per quarter.) Calibrations standards may be varied from the one stated in this SOP depending on the levels of each anion that are to be reported. A minimum of 5 standards and a blank are required and a low standard must be at or below the reporting limit for each anion. A correlation coefficient of 0.995 is required.
- 14.4.1 A new calibration is required when standard retention times shift by more than 10% from the original calibration.
- 14.5 A low check at the reporting limit (CCV2) for each anion must be run after each calibration. Acceptance criteria is 50–150%.
- 14.6 Continuing Calibration Verification (CCV) Checks at or near the mid-level of the curve must be run at the beginning and the end of the run and after every 10 samples throughout the run. Every CCV must be followed by a continuing calibration blank (CCB). The CCV must have results within 90-110% of the true value. If the CCV results are outside of the acceptance criteria range, analyst must demonstrate acceptable performance with two CCVs analyzed immediately (started within 1 hour), with no samples between failing CCV and the two additional CCVs. The results for the CCB must be  $< 1/2$  RL for an analyte. If they are not, then all bracketed samples for that analyte must be reanalyzed.
- 14.7 Retention time windows must be established whenever a new column/guard column is installed in an instrument or whenever a major change has been made to an instrument. Retention time shift is checked weekly with a CCV to ensure it does not exceed 10%, and the data is stored on LAN in GenChem directory.

Retention time windows are established by injecting standard mix three times over the course of 24 hours and calculating the standard deviation of the retention times of each analyte. Plus or minus three times the standard deviation of the retention times is defined as the retention time window of that compound.

Peak identification is based on the retention time of an analyte in the standard (initial or continuing) being used as the mid-point of the retention time window. The retention time windows should be used as a guide for identifying compounds; however, the experience of

the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known standard peaks throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than  $\pm 0.10$  minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential "hits". The analyst will then review these "hits" and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

- 14.8 The Linear Calibration Range (LCR) is the concentration range the instrument response is linear and must be initially determined and verified every 6 months or whenever a significant change in the instrument is observed or expected. Initially, enough standards must be used to insure the curve is linear. The linearity verification must use at a minimum, a blank and 3 standards. The verification data must be within  $\pm 10\%$  of the assigned values. If the data falls outside of this range, then the linearity of the instrument must be reestablished. If any portion of the curve is nonlinear, then sufficient standards must be used to clearly delineate the nonlinear portion of the curve.

NOTE: Samples with detections within 10% of highest calibration standard must be diluted.

- 14.9 ***Contingencies for handling out-of-control QC.*** Upon certain circumstances data can be reported from batches with QC non-conformances. Such samples are to be qualified accordingly. Examples include:

- If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results reported with appropriate qualifiers and footnotes. If the MB is contaminated but the samples results are  $> 10$  times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. *This must be approved by the department supervisor.* Samples with hits  $< 10$  times contamination are reprepped and reanalyzed. If there is insufficient sample to reanalyze, or if the sample is re-analyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. *This must be approved by the department supervisor*
- Similarly, if the recovery of LCS or CCV is high and the associated sample is non-detect, the data may be reportable with appropriate qualifiers and footnotes. If the recovery of LCS or CCV is below lower acceptance limit, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, reprepping and/or reanalyzing the samples, or qualifying the results as estimated. *This must be approved by the department supervisor.* If there is insufficient sample to reanalyze, or if the sample is re-analyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. *This must be approved by the department supervisor.*

If the matrix spike recoveries are not within the established control limits, compare the recoveries to those of the LCS to assess method performance in clean QC matrix. Matrix spike recovery failures are not grounds for reanalysis but are an indication of the sample matrix effects

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## **15.0 DOCUMENTATION REQUIREMENTS**

- 15.1 All reagents must be recorded in a reagent logbook with manufacturers, lot numbers, and expiration dates. All reagent information must be cross referenced on the sample worksheet.
- 15.2 All instrument data must be exported to the LIMS system and a copy of the run log must be included in the logbook by the instrument.
- 15.3 A data package consisting of a manual run log, a LIMS run log, a calibration summary, batch quality control summary, and copies of all chromatograms must be turned into the area supervisor for each batch. The analyst should also complete the preliminary review in the LIMS system.
- 15.4 Refer to SOP QA029, current revision, for procedures and documentation that must be followed when peaks are manually integrated.

## **16.0 POLLUTION PREVENTION & WASTE MANAGEMENT**

- 16.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 16.2.
- 16.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

## **17.0 ADDITIONAL REFERENCES**

- 17.1 Dionex Instrument and column manuals
- 17.2 QA020 Method performance SOP, current revision
- 17.3 QA029 Manual Integration SOP, current revision.
- 17.4 QA042, General Chemistry Calculations, current revision
- 17.5 TNI 2009 standards.
- 17.6 DoD QSM, Rev. 5.1, 2017



**Table 1 QC Criteria**

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Initial Calibration: r = coefficient of correlation	At least quarterly	$\geq 0.995$	Rerun calibration standards, and/or prepare new calibration standards and recalibrate the instrument, or document why the data are acceptable. See 11.9.2.
Initial Calibration Verification standard (ICV)	One per calibration	90-110% of the standard's true value	Rerun standard, and/or prepare new standard, and/or recalibrate instrument, or document why the data are acceptable. See 14.3
Continuing Calibration Verification standard (CCV)	Every tenth sample	90-110% of the standard's true value	Rerun standard, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable. See 14.6
Low-level Standard	One per calibration	50-150% of the standard's true value	Rerun standards, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Method blank (MB) and Calibration Blank (CCB)	MB: One per batch CCB: Every tenth sample	$< \frac{1}{2}$ RL <b>Note:</b> West Virginia state specific requirement for method blank must contain analyte at $< \text{MDL}$	Reanalyze, and/or stop the run and determine the source of contamination, or document why the data are acceptable.
Retention time	Checked weekly	90-110% of the standard's true value	Rerun standard, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Blank Spike (BS or LCS)	One per batch	90-110%	Determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.
MS/MSD	10% of matrix	90-110%	Determine and correct the problem, reanalyze samples and MS/MSD, or document why data are acceptable
Linear Calibration Range (LCR)	Bi-annually	$\pm 10\%$ of the standard's true value	Rerun and/or prepare new series of standard, and/or recalibrate instrument



## SAMPLE RECEIPT AND STORAGE

Prepared by: Svetlana Izosimova Date: 10/25/2018

Approved by: Heather Wandrey Date: 10/29/2018

### Annual Review

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## TITLE: SAMPLE RECEIPT AND STORAGE

**REFERENCES:** TNI Standards 2009 and 2016, State of Florida DEP SOPs, 40 CFR Part 136, DoD QSM 5.1 and 5.1.1

**REVISED SECTIONS:** Removed Accutest references throughout the document; Added Access Receipt program throughout the document; added verification of correction factors to 2.2.2; discussed recording temperature to first decimal place in 2.2.3; added section 2.4.8; added green labels to 2.11.2; removed 2.5 as redundant to 2.2.4; edited 2.10;

### 1.0 SCOPE AND APPLICATION

To maintain documentation of custody of all bottle sets, samples (domestic and foreign), digestates, distillates, and extracts that fall under the responsibility of SGS North America, Inc. - Orlando.

### 2.0 EXTERNAL CHAIN-OF-CUSTODY PROCEDURE

2.1 Samples are received via commercial carrier, client delivery, or are picked up by SGS - Orlando employees. Upon receipt, sample management inspects the outside of the container for signs of tampering, such as a torn or missing custody seal. The staff reviews Chain Of Custody (CoC) document for the following information:

2.1.1 Client Information- Name / Address, Phone and Fax contact numbers

2.1.2 Facility Information- Project name, Location, Project Number.

2.1.3 Field ID / Point of Collection- Date- Time- (HOLD TIMES) Samplers Initials- # of containers Shipped, Preservative types.

2.1.4 Matrix of samples: WW- water, GW-ground water, SW-surface water, DW-drinking water, SO-Soil, SOL-other solid, LIQ-other liquid, OI- Oil, AIR-air, WP- Wipe, FB-field blank, TB-trip blank.

2.1.5 Analytical Information- Samples with hold times of 72 hrs or less remaining on analyses upon receipt are considered Short Hold Samples and are listed on Short Hold Notification form in order of hold times, from ASAP to 7 days with less than 3 days left. These samples are processed immediately. Job Numbers are assigned, and the samples are given directly to the appropriate lab. Copy of CoC and completed Short Hold Notification Form are relinquished to the appropriate lab by the sample receiving technician. Laboratory personnel accept the samples, time of transfer is recorded, both parties sign SHNF and a copy of the SHNF is attached to CoC. (See Attachment I, Short Hold Notification Form)

2.1.5.1 VOC soil sample vials must be frozen within 48 hours of collection. Receiving technicians review sample times and deliver samples with a

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SHNF if sufficient hold-time remains to process the samples. If samples are close to expiring the samples are immediately placed in the freezer with a card notating the time they were placed in the freezer.

- 2.1.6 TURN AROUND TIME- Samples with a 6 day or less TAT are processed as soon as possible, depending on samples with short hold status.
- 2.1.7 Sample custody documentation signatures – relinquished/received in Client – Carrier – Laboratory sequence. Per FL DEP SOPs signature shall consist of full signature – no initials allowed – and business affiliation.
- 2.1.8 Special Requirements and or comments - Compositing, filtering or preservation of samples, Extended sample storage etc.
- 2.2 Samples are processed by a two-technician team, The sample custodian(s) accepts sample custody upon receipt of samples and verifies that the custody document is correct. Sample conditions, sample temperature, and other observations, including custody seal condition, are documented in detail on the electronic Sample Receipt Confirmation form p-note).
- 2.2.1 Temperature is measured using IR thermometer against white label on temperature blank, or on the sample container, if temperature blank is absent.  
**NOTE: For jobs originated in West Virginia every sample container must be checked.** This thermometer is calibrated measuring the temperature off of white sample label against NIST-traceable liquid-in-glass thermometer – see SOP QA002, current revision. When recording the cooler temperature with the use of an IR gun the following needs to be documented on Sample Receipt Confirmation Form:
  - 2.2.1.1 IR gun used.
  - 2.2.1.2 Correction factor.
  - 2.2.1.3 Observed cooler temperature.
  - 2.2.1.4 Corrected cooler temperature.
- 2.2.2 Verify IR thermometer correction factor gains Correction factor recorded in Receipt utility to make sure it is correct in both locations. Notify QA/Department Manager if these values are not the same. Apply temperature correction factor for a face value – positive number to be added to direct reading temperature, negative correction factor to be subtracted.
- 2.2.3 **Samples must remain in coolers full of ice until it is time to process the job for login. Coolers received out of temperature range have initial temperature recorded and are then placed into a Walk-In cooler until resolution from client is received.** 40 CFR part 136, TNI Standards 2009, 2016 revision and DoD QSM 5.1 all designate acceptable temperature as “above freezing and below 6°C”. Temperature is measured and recorded to first decimal place due to state-specific and client-specific requirements.

- 2.2.4 Any discrepancies or non-compliant situations are documented on the Sample Receipt Confirmation Form (p-note which is automatically e-mailed to the SGS - Orlando Project Manager (PM) team. PM assigned to the particular client contacts the client for resolution. Major issues require the client to be contacted before the samples can be logged in, such as but not limited to missing COC's, samples being out of hold, insufficient sample volume, bottles received not on COC or out of temperature range. If resolution of the problem is taking time, the samples are labeled as is and placed into refrigerated storage until the problems are resolved. Samples are then removed and processed according to client's instructions. Minor issues identify discrepancies that do not interfere with log-in and/or analysis of the samples, such as 1 of 2 PAH bottles received broken or supplied. The resolution is documented and communicated to sample management for execution.
- 2.2.5 Once the sample custodian(s) is (are) satisfied with the information on the chain of custody document, the job number is generated from Receipt access-based utility with the next available SGS - Orlando sequential job ID in FXXXXXX convention.
- 2.2.6 First technician arranges samples on the counter in the order of CoC. Every different point of collection must have a different fraction number, i.e. -1, -2, etc. The assigned fraction number must be written on the chain of custody, to the left of the line identifying the point of collection (Client ID) unless there is insufficient space. The custodian then assigns a unique sample identifier to each sample container, i.e. FAXXXXX-1.4, where 4 is a unique container designation.
- 2.2.7 The same technician enters samples in the sample location database and prints the labels for the samples. A second technician then attaches the labels to the samples and re-verifies sample client ID and Lab fraction number against CoC. After all the steps in Sec. 3 are completed, first technician closes the Sample Receipt Confirmation Form and second technician reviews it for completeness and accuracy of recorded information.
- 2.2.7.1 Wherever samples are designated to be put on hold by the client, labels on these samples are highlighted in bright pink and additional bright pink **"HOLD – Do Not Dispose"** label is attached to the individual containers
- 2.2.8 **After Hours Delivery Procedure.** Upon return to the lab SGS - Orlando-employed couriers will visually inspect the coolers and add ice if needed. Coolers will then be placed into Refrigerated storage until Sample Receiving Technicians can process the coolers. Sample Receiving technicians will arrive first thing in the morning to verify Short Holds, Rushes etc as per sec. 3.1.5 and 3.1.6.
- 2.3 When assigning a job number, the following information from the chain of custody is entered in the Access Receipt utility:
- 2.3.1 SGS - Orlando Assigned Job #
  - 2.3.2 Client Name
  - 2.3.3 Project Name
  - 2.3.4 Date and Time Samples Received.
  - 2.3.5 # of coolers Received.

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- 2.3.6 Courier Information
  - 2.3.7 Skif # (Sample Kit Information Sheet)
  - 2.3.8 Technician Initials
- 2.4 The sample custodian then checks the samples' preservation, except for the volatile samples, which are checked by the analyst after the sample is analyzed. Should a sample be received preserved incorrectly the following actions are taken:
- 2.4.1 pH and residual chlorine: For samples requiring preservation (HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, NaOH and NaOH/Zn Acetate) each container is tested by applying the sample with disposable capillary to narrow-range pH paper. Residual chlorine presence/absence is measured using potassium iodide/starch paper in samples for all EPA 600 series and samples originated in North Carolina (one bottle per well). 45-ml VOC vials are exempt from this procedure and are being tested in the lab after the requested tests are completed (purge-and-trap GC and GC/MS, TOC/TC and EPA 504/8011).
  - 2.4.2 Organochlorine pesticides and PCBs by EPA 608 - samples that are not extracted within 72 hours of collection need to have pH checked and adjusted, if necessary, to a pH within 5.0-9.0 using H<sub>2</sub>SO<sub>4</sub> or NaOH. Coordinate with Extraction department.
  - 2.4.3 Pesticides/PCB's/Semivolatile Organic aqueous samples with residual chlorine present: Add 1 ml of 8% sodium thiosulfate solution per 1liter (0.008%) to all containers except VOA. Record event on Sample Receipt Confirmation Form and in preservative adjustment log.
  - 2.4.4 Cyanide is preserved to pH  $\geq 12$  using 10N NaOH, prepared by WetChem personnel.
  - 2.4.5 Sulfide is preserved to pH  $\geq 9$  using 10N NaOH and Zn acetate, prepared by WetChem personnel.
  - 2.4.6 Aqueous samples for metals are preserved to pH  $\leq 2$  with nitric acid, prepared by WetChem Personnel. These samples are marked with colored label **"Metals Sample Received Unpreserved. Preserved Date\_\_\_\_Time\_\_\_\_ Analyze after 24 hours"**. For correctly preserved aqueous metals sampling date and time from COC is recorded as date and time of preservation.
  - 2.4.7 Aqueous samples for TRPH and some WetChem parameters are preserved to a pH of  $\leq 2$  with H<sub>2</sub>SO<sub>4</sub>, prepared by WetChem Personnel.
  - 2.4.8 To avoid using expired preservatives, in the beginning of the calendar month obtain no more than 100 ml of currently used preservative reagents from Shipping area, appropriately label the container with reagent identity and expiration date and discontinue its use at the end of the month. Turn unused portion to the Waste room for further disposal.
- 2.5 .

- 2.6 Incorrectly preserved samples have the proper amount of preservative added, upon confirmation from PM or client, volume added is recorded on the Sample Receipt Confirmation form and in preservative adjustment log. The same volume and type of preservative is then added to the Equipment Blank and/or Field Blank, regardless of pH reading. Volume added is recorded on the Sample Receipt Confirmation form and in the preservative adjustment log. Also see Sec. 3.4.5.

Job Number, Sample ID, Bottle Number, Parameter, Preservative Type, Preservative Lot, and Amount of Preservative Added, Date/Time Added and the technician's initials.

- 2.7 All bottles must be labeled. Each bottle will be labeled both on the cap and on the bottle. VOA vials have the label wrapped around the top of the vial, just below the cap. The labels are generated by the electronic sample receipt log. The following information is entered into the electronic log:

- 2.7.1 Job #:
- 2.7.2 Client Name and Project
- 2.7.3 Date and time samples were received.
- 2.7.4 The number of coolers received
- 2.7.5 The temperature of each cooler
- 2.7.6 Initials of custodian logging in the job
- 2.7.7 Number of samples
- 2.7.8 Number of bottles
- 2.7.9 Bottle type
- 2.7.10 Preservative by code. Preservatives codes are:
  - "1" = preservative is checked by analyst
  - "2" = not applicable
  - "3" = correctly preserved for the analysis requested
- 2.7.11 Bottle storage location
- 2.7.12 Department to do the analysis
- 2.7.13 The information is saved and labels can be printed.

- 2.8 The following information must be on the bottle:

- 2.8.1 The sample number and bottle number
- 2.8.2 Storage location
- 2.8.3 The preservative used during sampling as indicated on the chain
- 2.8.4 Any hazard the Sample Custodian may be aware of

- 2.9 The samples must be placed in their assigned locations and kept at above freezing and below 6.0°C until preparation and/or analysis. Water samples preserved with HNO<sub>3</sub> for metals analyses are stored at room temperature. Access to the area is limited.

- 2.10 The original chain of custody and any additional documented information relative to the job is handed to Log-in technician for further processing as described in SOP QA048, current revision, for entry in LIMS.

- 2.11 **Foreign samples** are referred to samples originated outside of continental United States. These samples must be segregated from domestic samples in storage, processing and disposal. Objective of such segregation is to keep agricultural pests and pathogens from entering continental US territory and interfering with animal and plant health.
- 2.11.1 Foreign Samples shall be shipped in securely closed watertight containers and free of debris and macro organisms (insects, mollusks, worms, ticks and mites).
- 2.11.2 Foreign samples are stored in lockable cage in WI#3 to prevent accidental disposal. This cage is clearly marked *for foreign samples only*. Sample labels are colored green to stand out in the lab departments.
- 2.11.3 Keep lids tightly closed while in storage.
- 2.11.4 All unconsumed samples and containers must be separately collected for disposal. SGS - Orlando employs outside contractor to sterilize and dispose of foreign samples – see SOPs SAM108 and SAM109, current revision.

### **3.0 SAMPLE STORAGE TEMPERATURE AND CROSS-CONTAMINATION MONITORING**

- 3.1 While in the laboratory, samples shall be stored in limited-access, temperature –controlled areas. Refrigerators shall be monitored for temperature daily. Acceptance criteria for the temperature of refrigerator is 0.5 to 6.0 °C and is listed in the refrigerator log. Thermometers that have been calibrated with a NIST traceable thermometer monitor all cold storage areas. As indicated by the finding of the calibration, a correction factor is applied to each thermometer for a face value. Records that include acceptance criteria shall be maintained.
- \*According to TNI 2009 and 2016, V1M2, sec. 5.8.9.a.i) temperature should be above freezing point and below 6.0°C, when specified storage temperature is 4°C. Lowest temperature that can be practically read above freezing point is 0.5°C.
- 3.2 Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Acceptance criteria for the temperature of a volatile refrigerator is 0.5 to 6.0 °C and is listed in the refrigerator's log. VOC Soil freezers are maintained between –10.0°C and -20.0°C per SW-846 5035A. For further details refer to SOP QA004, current revision.
- 3.3 Sample storage area for volatile organics shall be monitored for cross contamination using refrigerator blanks. Refrigerator blanks shall be analyzed every other week.
- 3.3.1 If contamination of the refrigerator is confirmed, the samples must be removed from the refrigerator and placed in coolers with ice, or in alternate refrigerated storage.
- 3.3.2 All samples received after the date of the last clean refrigerator blank must be checked for the same contaminants. If present, they must be reported and flagged with a qualifier indicating possible lab contamination.

- 3.3.3 The source of the contamination must be located and removed.
- 3.3.4 A new refrigerator blank is then placed in the refrigerator and analyzed after 24 hours.
- 3.3.5 Samples may be returned to the refrigerator when all contaminants are removed as indicated by the analysis of a refrigerator blank without contamination.

## **4.0 DOCUMENTATION**

All samples received by SGS - Orlando must come with a chain-of-custody COC . Special attention shall be paid to client-specific COCs.

SGS - Orlando personnel MUST record dates and time in **mm/dd/yy 24:00** format, and both observed and corrected temperatures.

Current revisions of forms and label templates used in sample receipt process are maintained as controlled documents in limited access directory on LAN.

### Attachment I

SHORT HOLD NOTIFICATION FORM

JOB # \_\_\_\_\_

<u>HOLD TIME</u>	<u>ANALYTE</u>	<u>CHECK COC</u>	<u>COMMENTS</u>
<b>ASAP</b>	RedOx		
	Bacteria- Total Coliform/Fecal Coliform		
<b>24 hrs</b>	XCr / Hexachrome / Cr +6		
	Dissolved/Filtered Metals		
	Odor		
	Salinity SCON+ Field Temp & Presure		
<b>48 hrs</b>	BOD		
	CBOD		
	MBAS		
	Turbidity		
	Color		
	Nitrate NO3		
	Nitrite NO2		
	TN NO2/NO3		
	OPO4 / Orthophos		
	SS Settleable Solids		
	Chlorophyl A Subcontract		
<b>72 hrs</b>	Acrolein/Acrylonitrile VOA from Alaska		
	Formaldehyde Subcontract		
<b>7 days Only for samples received after 5 days</b>	Unpreserved Voa Vials		
	TDS/TSS/TS		
	Sulfide		
	8141 pesticides in soil		
	All the Water extractables		
<b>Soils</b>			
<b>48 Hours</b>	5035 Field Kit DI vials		
	Encore Sampler VOA/VPH/GRO		
	Soil Jar Bulk Sample VOA/VPH/GRO		
	NO2/NO3 from WV IC analysis		

Relinquished by: \_\_\_\_\_ Date/Time relinquished: \_\_\_\_\_

Received by: \_\_\_\_\_ Date/Time received: \_\_\_\_\_

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## SAMPLE AND LABORATORY WASTE DISPOSAL

Prepared by: Svetlana Izosimova Date: 12/30/2015

Approved by: Randy Shields Date: 01/21/2016

### Annual Review

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

### Document Control

Issued to: QA Department Date: 01/21/2016

Issued to: Sample Management (Shipping) Date: \* 01/21/2016

Issued to: \_\_\_\_\_ Date: \_\_\_\_\_

Issued to: \_\_\_\_\_ Date: \_\_\_\_\_

Issued to: \_\_\_\_\_ Date: \_\_\_\_\_

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Effective 7 days after “ ” date

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## **TITLE: SAMPLE AND LABORATORY WASTE DISPOSAL**

**REFERENCES:** Florida DEP Hazardous Waste; 40 CFR, Part 261

**REVISED SECTIONS:** Segregation of Foreign soils – see 4.2.6; Storage and Disposal of samples in “HOLD” status – sec. 4.7 (new), corrected facility name throughout the document.

### **1.0 SCOPE AND APPLICATION**

The disposal of samples and lab waste adhering to Florida State and Federal Regulations.

### **2.0 SUMMARY**

This SOP describes the procedures used by SGS Accutest - Orlando to properly and safely dispose of samples and laboratory wastes; hazardous and non-hazardous; domestic and foreign.

### **3.0 DEFINITIONS**

- 3.1 Foreign sample: Samples from sites that are outside the continental United States.
- 3.2 Hazardous Sample or Waste: A material is considered hazardous if it is listed in the Code of Federal Regulations, 40 CFR, Part 261 or it demonstrates any of the hazardous characteristics including, ignitability, corrosivity, reactivity, or has demonstrated toxicity.

### **4.0 PROCEDURE**

Sample Disposal: Samples are kept in appropriate storage for a minimum of 30 days after the report is sent to the client unless otherwise specified by client. The samples are divided into three categories: Aqueous, Soil, and Non-aqueous liquid.

#### **4.1 Aqueous Samples**

- 4.1.1 A disposal list is generated by computer, based on either reporting dates or sample number range (see attached).
- 4.1.2 Samples are then removed from the refrigerators and/or cabinets, and are separated as non-hazardous (non-detected or normal) and hazardous (positive result) samples.
- 4.1.3 Non-hazardous samples are emptied into a drum. Once full, the drum is sampled and screened for metals. If screening results are within TCLP limits, the drum is then pumped into a large holding tank. If TCLP limits are exceeded, the drum should be disposed of via the contracted waste disposal company. Once the large

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holding tank is full, the contracted waste disposal is contacted to arrange for an on-site transfer. The contents are profiled annually unless a major change to the waste stream occurs.

- 4.1.4 VOA vials are processed through a glass crusher and into an open-top drum. The solid material (glass, plastic, and septa) is separated from the liquid and is drummed separately. The liquid drum, when full, is then handled in the same way as described in section 4.1.3. The crushed glass drum is handled as described in section 4.2.2.
- 4.1.5 SGS Accutest - Orlando contract Disposal Company segregates hazardous aqueous samples into the appropriate waste drums for disposal.
- 4.1.6 Samples containing PCB in excess of 50 ppm are automatically flagged by LIMS on disposal list. These samples are labeled with distinct PCB label and segregated from the rest of waste samples to be disposed of in LabPak.
- 4.1.7 Some samples, on a case by case basis, are returned to the client for disposal.

#### 4.2 Soil Samples

- 4.2.1 Domestic Soil Samples (DSS) are placed in drums after the storage period, either in a hazardous or non-hazardous drum per the samples' status on the disposal sheets.
- 4.2.2 When the drums are full, they are then sampled and analyzed to determine their hazardous constituents (Full TCLP, RCI, and PCBs).
- 4.2.3 Based on the results of analysis, the drums are then either disposed of as hazardous or non-hazardous by our contract disposal company.
- 4.2.4 Samples containing PCB in excess of 50 ppm are automatically flagged by LIMS on disposal list. These samples are labeled with distinct PCB label and segregated from the rest of waste samples to be disposed of in LabPak.
- 4.2.5 Some samples, on a case by case basis, will be returned to the client for disposal.
- 4.2.6 Foreign soil samples (FSS) come in vials (volatile organic analysis) or jars. These soils are segregated in WI#3 in lockable cage (see also SAM101 and SAM109, current revisions)
- 4.2.7 After minimum 60-day hold period, but not to exceed 6 months, these FSS are disposed of in the following manner.
  - 4.2.7.1 FSS vials: Vial samples are preserved either with methanol or DI water. Vials with water are uncapped and placed into a drum labeled specifically for foreign soils. No more than six months may elapse from the accumulation start date on the drum before the drum must be disposed. The contracted disposal company must be certified to handle and dispose of foreign soils. Vials with methanol must be filtered. The filtrate

(methanol) is disposed of in the non-chlorinated solvent waste drum. The soil is then drummed per the hazard status on the disposal sheets.

- 4.2.7.2 FSS Solids: FSS in jars are emptied into drum labeled specifically for foreign soils. Once full, the drum is disposed of via the contracted disposal company. No more than six months may elapse from the accumulation start date on the drum to disposal.

#### 4.3 Non-aqueous liquid samples

- 4.3.1 Non-aqueous samples are placed in drums after the hold period.
- 4.3.2 When the drums are full, they are then sampled and analyzed to determine their hazardous constituents PCBs . Drums have a 6 month expiration time. If the drum is not full by then it is analyzed and picked up by our contract disposal company.
- 4.3.3 Based on the results of analysis, the drums are then either disposed of as hazardous or non-hazardous by our contract disposal company.
- 4.3.4 Samples, on a case by case basis, will be returned to the client for disposal.

#### 4.4 Sample Containers

- 4.4.1 Containers from samples deemed Non-Hazardous are immediately disposed of into a waste container provided by waste management services specifically for SGS Accutest - Orlando direct use. A lock and key has been installed to keep the containers use limited to Accutest only.
- 4.4.2 Containers from samples deemed hazardous are disposed of into the Hazardous waste solids drum.
- 4.4.3 Waste Management services picks the container up on a weekly basis and brings to the local sort facility where contents are destroyed -recycled.

#### 4.5 Laboratory Waste Disposal:

- 4.5.1 All materials determined to be hazardous are containerized in appropriate vessels (i.e. drums . A waste is considered hazardous if it is listed in the Code of Federal Regulations, 40 CFR, Part 261 or it demonstrates any of the hazardous characteristics including, ignitability, corrosivity, reactivity, or has demonstrated toxicity. Our contract disposal company disposes of the drums.
- 4.5.2 WASTE DRUMS are separated by type:

Chlorinated Waste (Closed Top Steel - Methylene Chloride

Non-Chlorinated Waste (Closed Top Steel) - Hexane, Methanol, and mixed solvents

Sodium Sulfate/Used Charcoal (Open Top Steel) - Charcoal and paper filters used in the filtering of samples.

Non Hazardous Aqueous Vials (Open Top Poly) - Primarily Acid Vials.

Hazardous Flammable Vials (Open Top Poly) - Methylene Chloride, Hexane.

Hazardous Aqueous waste (Closed Top Poly) - High Odor Samples, Lachat Waste.

Non Hazardous Soil (Open Top Steel - Soils.

Hazardous Solid Waste - (Open Top Steel).

Non-Aqueous/Oil Samples- (Closed Top Steel)

*Difference between Open and Closed type of drums is whether it is possible to remove entire lid or just threaded stopper. Drums are closed at all times while in storage.*

4.5.3 Disposal is done as conscientiously as possible following guidelines set forth by both the State of Florida and our contract disposal company. Management and proper handling is necessary to avoid any violation. The guidelines change depending on how much waste is generated on a monthly basis:

4.5.3.1 Less than 220 pounds (100 kilograms or about half a drum) is a "Conditionally Exempt Small Quantity Generator".

4.5.3.2 A "Small Quantity Generator" generates 220-2,200 pounds 100-1,000 kilograms or about half a drum to 5 drums)

4.5.3.3 More than 2,200 pounds (100-1,000 kilograms or more than about 5 drums) is a "Large quantity Generator".

4.5.3.4 SGS Accutest - Orlando is considered a "Small Quantity Generator".

#### 4.6 Waste Containers and Storage

4.6.1 Containers must be maintained in good condition at all times. Care must be taken to prevent leaks, ruptures, and the accumulation of rainwater on tops of the drums.

4.6.2 Waste containers must be kept closed at all times, except when waste is being transferred to drum.

4.6.3 The containers must be compatible with the waste being stored (i.e. acids should not be stored in metal drums). Never store incompatible wastes in the same container (i.e. acids and bases . Containers must be stored in such a way to accommodate inspection for leaks and damage from all sides

4.6.4 Each waste container must be labeled with the following information.



- 4.6.4.1 Type and nature of waste (soil, oil, hazardous, non-hazardous)
- 4.6.4.2 Waste generator's name and address
- 4.6.4.3 Manifest document number
- 4.6.4.4 Proper DOT shipping name and identification number
- 4.6.4.5 Accumulation start date (change to storage date when container is full)
- 4.6.4.6 In addition, a hazardous waste must have the words "HAZARDOUS WASTE. FEDERAL LAW PROHIBITS IMPROPER DISPOSAL. IF FOUND, PLEASE CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY" prominently displayed on the container.

4.6.5 Inspection and Records

- 4.6.5.1 Containers must be inspected weekly. All records must be kept on file for three years. The records, which must be kept on file, include:
  - 4.6.5.1.1 A written log of the inspections
  - 4.6.5.1.2 Manifests and shipping receipts
  - 4.6.5.1.3 Results of laboratory analyses of the wastes
  - 4.6.5.1.4 Land Disposal Restriction form

4.7 Samples in "HOLD" status

- 4.7.1 Wherever samples are designated to be put on hold by the client, labels on these samples are highlighted in bright pink and additional bright pink "**HOLD – Do Not Dispose**" label is attached to the individual containers.
- 4.7.2 Additionally, all Foreign Soils are kept in lockable cage in WI#3 regardless of status (see 4.2.6).
- 4.7.3 When samples are removed from the temperature controlled storage and boxed for extended storage these boxes also receive same bright pink label as individual containers.
- 4.7.4 Samples are segregated into a designated quarantine area with clear signs to the nature of the stored samples.
- 4.7.5 Prior to removal and disposal from this area, written permission should be obtained from the Project Manager, addressed to Sample Management Supervisor and CC'd to the Laboratory Director.
  - 4.7.5.1 Due to 6-months storage restriction on Foreign soils samples see 4.2.7.1) Project Manager's input must be requested by Sample Management department in a timely manner.

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## **5.0 HEALTH AND SAFETY**

- 5.1 All employees who handle waste materials should wear full protective clothing including safety glasses &/or face shield, gloves, boots, lab coat or a Tyvek suit, and air-purifying respirator. Direct skin contact with waste materials should be avoided.
- 5.2 If an employee has accidentally been exposed to a hazardous waste, the individual should rinse the affected areas thoroughly under a safety shower for at least 15 minutes. If the individual begins to exhibit any adverse effects from the exposure, he should be immediately transported to the nearest hospital emergency room. Employees are referred to the Material Safety Data Sheets for specific instructions on exposure to hazardous substances.

## **ATTACHMENT B**

### **Resumes**

#### EDUCATION

MS, Coastal and Watershed Science and Policy (watershed emphasis), 2010, California State University

BA, Environmental Science (Public Policy Minor), 2005, Mills College

#### CERTIFICATIONS, LICENSES, TRAINING

Safety, Health, and Environmental Program (SHEP), 2015

Leading Cultural Change, 2014

Management Conference, 2014

Biennial American Red Cross CPR / First Aid

Confined Spaces for Construction, 2009 / Respiratory Protection, 2009

HAZWOPER 40-Hour, 2005 / Annual 8-Hour Refresher

Hazardous Waste Management, 2004 / Hazard Communication, 2005

OSHA 30-Hour Construction Safety, 2009

HAZWOPER Supervisor, 2009 / Health and Safety Leadership, 2009

DOT Hazmat, 2013

Laboratory, 2008 / Compressed Gas, 2008 / Fire Extinguisher, 2010 / Defensive Driving Safety, 2014

U.S. Army Corps of Engineers Construction Quality Management for Contractors, 2011

US Army AKO READ and ERIS, 2013

Incident Management and Reporting Procedures, 2012

#### EXPERIENCE SUMMARY

- Over 11 years of experience as an Environmental Scientist supporting federal/DoD environmental remediation projects through data management, sampling and analysis, site safety and quality control, and the development of work plans and reports
- Over 6 years of SSHO experience and specialized safety training in field and office workplace environments including USACE environmental remediation projects throughout California; ensure quality health and safety reporting, safety training; develop APPs and AHAs, perform safety inspections, conduct daily toolbox meetings and administer best safety practices; experience at sites where EPA Level C PPE was required
- Over 8 years of quality control (QC) experience including QC inspections and reporting of field and office work performance, equipment, and reports
- 2 years of experience implementing Stormwater Pollution Prevention Plan (SWPPP) Best Management Practices

#### PROJECT EXPERIENCE

##### ***Environmental Scientist and SSHO, Ahtna, 2009-Present***

Maintain safety training records and schedule training. Assist with production of safety plans including Business Response Plans, Site Specific Health and Safety Plans (SSHPs), Activity Hazard Analyses (AHAs), Accident Prevention Plans (APPs), Emergency Action Plan (EAP), and Hazard Communication Program (HCP). Provide training to coworkers and subcontractors for safety related topics and conduct safety meetings. Maintain Safety Data Sheets (SDSs) for all onsite hazardous substances, inventories of materials, and update site plans and maps accordingly. Support the development of quarterly and annual monitoring reports, work plans, construction completion reports, and project-specific reports. Manage environmental data for various projects including tracking sample information, data validation, and data upload to project specific databases. Analyze environmental data by creating and updating site maps, plume and water elevation contours, tracking data trends, creating data tables, and assisting with project decisions based on data analyses. Completed all work to date with zero lost-time safety incidents.

##### ***Environmental Scientist/SSHO, Groundwater Treatment Plant O&M – Former Fort Ord, USACE Sacramento, Marina, CA, 2008-present, \$10M***

Prepare Quarterly and Annual Groundwater Treatment System and Groundwater Monitoring reports, and project APP and AHAs as well as Quality Assurance Project Plans (QAPPs). Provide technical support, handouts, and minutes for client and agency monthly and semi-annual meetings. Perform groundwater treatment plant sampling, data management, data analysis, and data validation in support of O&M of two GWTPs consisting of a network of 28 extraction and 6 injection wells and infiltration galleries. Provide field supervision and support, oversee QC, and health and safety during the quarterly sampling of over 200 groundwater monitoring wells, as well as water level measurements at over 300 wells. Support project optimization

### Environmental Scientist/SSHO

Behavior Based Safety, 2012

Terrorism Awareness, 2013

Annual Medical Clearance and Respirator Fit Test

Globally Harmonized System, 2013

Munitions Response, 2012

Qualified SWPPP Practitioner (QSP) training, 2012 (not licensed)

#### WORK HISTORY

Ahtna Environmental Inc., Environmental Scientist/Site Safety & Health Officer, 2015-present

Ahtna Engineering Services, LLC, Environmental Scientist/Site Safety & Health Officer, 2009-2015

Volt Workforce Inc. (California American Water), Laboratory Technician, 2008-2009

Student Intern, California State University Monterey Bay, 2007-2010

MACTEC Engineering & Consulting, Environmental Scientist, 2005-2007

City of Menlo Park, Engineering Intern, 2004-2005

Yoh Scientific/ICF Consulting (USEPA Contractor), Laboratory Assistant, 2002-2004

PTRL West, Laboratory Assistant, 2001

and expansion strategies for remedial systems at three sites in six groundwater aquifers.

***Environmental Scientist/SSHO, Operable Unit Carbon Tetrachloride Plume (OUCTP) Evaluation, Injection, and Bioremediation, Former Fort Ord, USACE Sacramento, Marina, CA, 2014-present, \$2.5M***

Write APP and AHAs and provide SSHO support for field work involving the evaluation and remediation of the OUCTP A-Aquifer CT groundwater plume, including installation and sampling of eight new groundwater monitoring wells, and installation and operation of an injection and bioremediation system (summer 2016).

***Environmental Scientist/SSHO, Sites 2/12 Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Fort Ord, USACE Sacramento, Marina, CA, 2013-2015, \$1.2M***

Executed fieldwork as part of a four-person team to perform drilling and sampling work to investigate plume delineation of groundwater and soil gas, as well as potential for soil vapor intrusion in commercial buildings. Directed the installation and sampling of 167 soil gas probes and 17 monitoring wells, and provided support for 25 sub-slab soil gas samples and 25 indoor air samples. Provided technical input into the RI/FS Work Plan and Addendum report. Prepared Cinema Work Plan and SSHP. Provided technical support for client, agency, and land owner meetings. Performed data management and analyses. Performed onsite field QC inspections, safety meetings. Oversaw field activities including monitoring well and soil boring drilling, overnight drilling, soil gas probe and monitoring well installation, geologic logging, soil gas sampling, soil sampling, groundwater sampling, laboratory and subcontractor oversight. Completed the installation and operation of a Soil Vapor Extraction Pilot Study. Produced the RI/FS report and additional Indoor Investigation Technical Memorandum. Supported preparation to expand the groundwater remedy to include additional groundwater extraction and a full-scale soil vapor extraction treatment system at Sites 2/12.

***Environmental Scientist/SSHO, Multiple Environmental Government Acquisition (MEGA) ID/IQ Environmental Services, USACE Sacramento, Hawthorne Army Depot, NV, 2014-2015, \$97.7K***

Prepared APP in support of groundwater assessment work at three solid waste management units. Provided safety support during field execution. Implemented corrective actions as needed to maximize safe execution of work.

***Environmental Scientist/SSHO, Greely Hall, East Range Mine Shaft and South Range Landfill, Fort Huachuca, USACE Los Angeles, Fort Huachuca, AZ, 2013-2014, \$1.3M***

Prepared APP for all three sites that involve environmental services to achieve site closure including the installation of groundwater monitoring wells, groundwater monitoring, and development of a Response Complete Decision Document. Provided safety support during field execution. Implemented corrective actions as needed to maximize safe execution of work.

***Environmental Scientist/SSHO, POM/OMC Stormwater Compliance,***



**Environmental Scientist/SSHO*****USACE Sacramento, Former Fort Ord, CA, 2013-2014, \$21K***

Prepared the SWPPP Implementation Plan to guide the Presidio of Monterey/Ord Military Community in ensuring compliance with the new municipal storm water permit by researching new permit requirements, organizing requirements into an annual list of requirements, and researching available resources of nearby storm water organizations.

***Environmental Scientist, Building 258 Source Area Remediation (SAR) Excavation, USACE Los Angeles, Fort Hunter Liggett, CA, 2012-2013, \$5M***

Prepared a SWPPP for the Building 258 Source Area Remediation (SAR) land farm. Implemented and provided staff training for the SWPPP including land farm BMP inspections, daily weather reports, Rain Event Action Plans, reporting on SMARTS including annual reports and the Notice of Termination (site closeout). Created gINT boring logs for the new monitoring wells installed.

***Environmental Scientist/SSHO, O&M - Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2009-present, \$1.2M***

Perform QC document editing of monthly and quarterly progress reports, SDS records, training records, safety oversight of site personnel in support of the O&M of the GWTP.

***Environmental Scientist/SSHO, Building 258 Monitoring Well Installation, UVOST, MIP, HPT profiling, USACE Sacramento, Fort Hunter Liggett, CA, 2011-2012, \$5.8M***

Supported the installation of new monitoring wells at Building 258. Drilled soil borings to perform Ultraviolet Optical Screening Tool (UVOST), Membrane Interface Probe (MIP), and Hydro Punch Tool (HPT) subsurface vertical profiling for site plume and remediation analysis. Performed HPT profiling, monitoring well installation. Prepared Work Plan and Construction Completion reports. Conducted data management and analyses. Created gINT boring logs for the new monitoring wells. Observed MIPS and UVOST field work. Presented HPT results to the Army. Provided safety oversight and QC inspections of field work.

***Environmental Scientist/SSHO, FAA Anchorage, FAA Release Investigation, McGrath, AK, 2011, \$760K***

Provided field support during a UVOST subsurface investigation of 13 former Federal Aviation Administration (FAA) underground storage tank (UST) and aboveground storage tank (AST) and conveyance pipeline sites in remote McGrath, Alaska. Performed Geoprobe direct-push drilling oversight, UVOST data analysis, monitoring well installation oversight, soil sampling, geologic logging, monitoring well development with pump and bailer, groundwater sampling with micro-purge, shipping and receiving samples, created gINT boring logs, and survey monitoring wells. Performed QC and safety oversight of subcontractors.

***Environmental Scientist/SSHO, Fort Hunter Liggett Building 194 Chemical Injections, USACE Sacramento, Fort Hunter Liggett, CA, 2011-2012, \$360K***

**Environmental Scientist/SSHO**

Provided oversight of fieldwork and technical support during in situ chemical injections at the Building 194 area using direct push technology as well as groundwater sampling and analysis to monitor the groundwater post-injection. Ensured all field work was executed in accordance with approved work plans and schedule. Conducted safety vapor monitoring of worker breathing zone. Coordinated sampling and laboratory work. Prepared Chemical Injection Completion Report. Performed safety oversight and QC inspections of field work.

***Environmental Scientist/SSHO, Building 258 Groundwater Monitoring and Reporting, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2013, \$750K***

Provided technical expertise for groundwater monitoring and reporting of the monitoring well network at Building 258. Conducted groundwater sampling, safety oversight and QC inspections of field work. Prepared quarterly and annual progress reports, and data management and analysis.

***Environmental Scientist/SSHO, OUCTP Monitoring Well Installation, USACE Sacramento, Former Fort Ord, CA, 2010-2011, \$1.6M***

Conducted safety meetings and safety oversight of field activities, and QC inspections during the installation of monitoring wells. Prepared Work Plan and Construction Completion report. Monitored well drilling and installation executed by a four-person crew, including geologic logging, well development, well surveying, groundwater sampling, Westbay multi-port well installation, and overnight drilling operations. Created gINT boring logs for the installed wells.

***Environmental Scientist/SSHO, Landfill Post-Closure Monitoring, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2011, \$750K***

Provided technical guidance during the inspection and monitoring of the closed FHL Landfill. The FHL Landfill includes 32 landfill gas vents, 7 landfill gas probes, and 28 wells. Prepared semi-annual reports, and performed data management, safety and QC oversight of field activities, landfill inspections, and micro-purge groundwater sampling.

***Environmental Scientist/SSHO, Building 258 Soil Vapor Extraction System (SVE) Operation and Maintenance, USACE Sacramento, Fort Hunter Liggett, CA, 2009-2011, \$750K***

Provided technical expertise during the construction and operation of an SVE treatment system including five SVE wells. Installed, maintained and sampled the SVE system. Performed micro-purge groundwater sampling and data management. Oversaw safety and QC for field activities. Prepared monthly and quarterly progress reports.

***Environmental Scientist/SSHO, Building 194 Groundwater Monitoring and Reporting, USACE Sacramento, Fort Hunter Liggett, CA, 2009-2011, \$207K***

Supported groundwater monitoring and reporting of the monitoring well network at Building 194. Completed groundwater sampling with a bladder pump and micro-purge, and oversaw safety and QC inspections of field work. Prepared quarterly and annual monitoring reports, and performed data management and analyses.

**Environmental Scientist/SSHO*****Environmental Scientist/SSHO, Del Monte Shopping Center Groundwater Monitoring, USACE Sacramento, Monterey, CA, 2009-2010, \$6.7K***

Performed groundwater monitoring and reporting of the monitoring well network of approximately 15 wells at the Del Monte Shopping Center in Monterey, CA. Recorded groundwater elevation measurements. Completed groundwater sampling of monitoring wells, pump station, and creek surface water sampling. Communicated with shopping center personnel to coordinate sampling. Oversaw safety and QC inspections of field work.

***Environmental Scientist/SSHO, Fort Hunter Liggett Building 194 Well Repair, USACE Sacramento, Fort Hunter Liggett, CA, 2009, \$7.5K***

Conducted safety tailgate meeting and safety oversight of field activities during the relocation of seven monitoring wells in the Building 194 area. Oversaw 2-person field crew.

**Other Relevant Work Experience 2001-2009*****Laboratory Technician, Volt Workforce Inc. (California American Water), CA, 2008-2009***

Performed drinking water sampling at customer homes, businesses, reservoirs, treatment pump stations, and wells. Analyzed drinking water samples and Moss Landing pilot desalination plant samples in a bacteriological laboratory for coliform, total heterotrophic plate count, alkalinity, and general water quality parameters. Operated an autoclave for sterilization of bacteriological waste. Maintained laboratory and prepared biological media. Investigated customer drinking water complaints.

***Student Intern, California State University Monterey Bay, CA, 2007-2010***

Conducted field and laboratory tests and analyzed data with computer modeling simulation software to predict environmental data with various agricultural settings. Developed predictions of greenhouse gas emissions from application of fertilizer on agricultural fields. Performed stream and watershed analyses of steelhead fish population, diurnal invertebrate cataloging, urea contamination distribution, and impacts of wildfire and rain on stream erosion and meandering.

***Environmental Scientist, MACTEC Engineering and Consulting, CA, 2005-2007***

Prepared and implemented several phases of remedial investigation to delineate lateral and vertical extent of perchlorate in soil and groundwater for design of an onsite remediation system at the site of a former flare manufacturing facility. Perchlorate was detected in onsite soil and onsite and offsite groundwater extending 10 miles from the site and to depths in excess of 600 feet below ground surface. Supported the identification and implementation of innovative monitoring well installation techniques, in situ aquifer testing procedures, groundwater sampling methods, as well as several monitoring and evaluation programs to save the client additional future costs. Collected drinking water samples for

perchlorate analysis at customer homes, businesses, agricultural pumps, and municipal wells. Sampled groundwater from monitoring wells with micro-purge, barcade, bailer, airlift, bladder pump, snap sampler, and watterra hydrolift. Measured water elevation with water level meter and transducer. Inspected and sampled ion-exchange (IX) perchlorate groundwater treatment systems. Received HAZWOPER safety training and supervised QC and safety during field activities including monitoring well drilling, sampling, and surveying activities.

***Engineering Intern, City of Menlo Park, CA, 2004-2005***

Sampled drinking water at customer residences, water wells, pumps, and reservoirs. Analyzed drinking water for chemical disinfectant and byproducts with a colorimeter and performed data entry and analyses. Identified system maintenance and upgrades to increase water quality within the distribution system. Performed hazardous waste disposal per applicable regulations utilizing the Uniform Hazardous Waste Manifest. Prepared a Hazard Communication Program and an Emergency Preparedness Plan for the office.

***Laboratory Assistant, Yoh Scientific/ICF Consulting (USEPA), 2002-2004***

Performed laboratory analyses including Total Organic Carbon (TOC), percent moisture, and alkalinity. Performed safety and QC inspections of laboratory equipment, emergency equipment, personnel, and mobile laboratory vehicle. Cleaned laboratory equipment utilizing ovens and acid washers in accordance with SOPs. Maintained SDS records and disposed of and treated hazardous waste IAW laws and regulations. Produced laboratory spiral locked notebooks. Maintained laboratory scales, thermometers, pH meters, refrigerators, and freezers. Prepared an SOP report for calibrating thermometers.

***Laboratory Assistant, PTRL West, 2001***

Performed laboratory analyses, sample preparation, shipping and receiving including radioactive and biological materials, and hazardous waste operations.

### EDUCATION

BS, Biology, George Mason University

### CERTIFICATIONS, LICENSES, TRAINING

40-Hour HAZWOPER and annual 8-Hour refresher

CA. Dept. of Health Services Water Distribution 2 and Water Treatment 2 certifications

USACE Construction Quality Management for Contractors

OSHA Construction and Safety Health

OSHA 30-Hour Construction Safety

First Aid/CPR

### WORK HISTORY

Ahtna Environmental, Inc., Field Supervisor, 2015-present

Ahtna Engineering Services, Field Supervisor, 2002-2006, and 2006-2015

Harding Lawson Associates, Plant Operator, 2001-2002

Advanced Biological Testing, VP and Field Manager, 1993-2001

### EXPERIENCE SUMMARY

- Environmental: 15+ years of experience on Army/DoD environmental restoration projects with expertise in the O&M of groundwater treatment plants; 3+ years of experience in the O&M of soil vapor extraction systems
- Field Supervisor: 8 years of experience directing field teams during the execution of groundwater monitoring, upgrades and repairs to GWTS at three DoD/Army installations in CA

### PROJECT EXPERIENCE

#### ***Senior Plant Operator/Field Supervisor, Groundwater Treatment System Operation and Maintenance, USACE Albuquerque and Sacramento, Former Fort Ord, Marina, CA, 2002-present, \$16M***

Manage daily O&M of OU2 and Sites 2/12 GWTPs consisting of 27 extraction wells, four injection wells, and five infiltration galleries. Perform weekly inspections of mechanical and electrical systems, repairs and preventive maintenance, routine housekeeping, GAC change-outs, GWTS monitoring, flow regulation, and process sampling. Direct the execution of system upgrades in support of optimization. Ensure the effective management of hazardous materials resulting from a 1,000-gal tank of sulphuric acid stored at Sites 2/12. Develop daily reports.

- To-date, maintained a total maximum flow rate of 1,200-gpm for both GWTS, for an average of 95% operability since 2002
- Consistently complete work on schedule and within budget in accordance with contract requirements

#### ***Field Supervisor, Groundwater Monitoring, USACE Albuquerque, Former Fort Ord, Marina, CA, 2010-present, \$10M***

Oversee quarterly groundwater sampling at over 200 wells across 5,000 acres using passive diffusion bag samplers, the Westbay sampling system, and HydraSleeves. Perform routine maintenance on monitoring wells, including replacing broken or worn locks on well covers, repainting and labeling well completions, checking and recording total depth.

#### ***Senior Plant Operator, Groundwater Treatment System Operation and Maintenance, sub to Geosyntec Consultants, Hollister, CA, 2013-present, \$50K***

Perform operations and maintenance of a groundwater extraction system with seven extraction wells at a former explosives facility utilizing a combination of bio-reaction, sand filtration, and granular activated carbon to remove perchlorate, chromium 6+, arsenic, and volatile organic carbons. Perform sampling of all plant constituents to comply with NPDES requirements for discharge. Provide daily reports to the client within 24 hours to confirm work completed in accordance with the task list provided by the prime contractor.

- Recommended and completed four upgrades and optimization strategies within the first three months to increase productivity and reduce long-term O&M costs



- Successfully resolved an unanticipated system shutdown within a few hours of discovery, avoiding significant impact to system functionality

***Field Supervisor, Groundwater Treatment System Operation and Maintenance, Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2004-present, \$8M***

Oversee the operations and maintenance of the GWTP at the former Riverbank Army Ammunition Plant. Perform three phase inspection processes. Review daily field activity reports and monthly O&M reports. Manage hazardous waste streams, including treatment, handling and temporary storage, documentation, transport and disposal. Support the Project Manager in resolving any operation and maintenance issues.

- Successfully completed upgrades to an existing extraction well to increase the extraction capacity to three times the previous rate
- To-date, performed all work with zero safety incidents

***Field Supervisor, Site 12 Remedial Investigation/Feasibility Study Addendum, Former Fort Ord, USACE Sacramento, Marina, CA, 2012-present, \$1.2M***

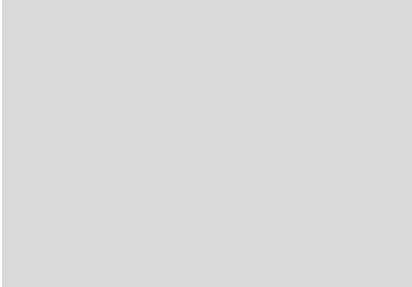
Manage field team performing soil gas sampling at Site 12 on the Former Fort Ord as part of the RI/FS addendum. Perform USACE three phase inspections. Work with chemistry labs to ensure the timely procurement of supplies. Support the field team in completing fieldwork in accordance with budget and schedule. Develop daily reports.

***Senior Plant Operator/Field Supervisor, Soil Vapor Extraction System Operation and Maintenance, USACE Albuquerque and Sacramento, Former Fort Ord, Marina, CA, 2015-present***

Manage daily O&M of Site 12 SVE System consisting of 10 vapor extraction wells. Perform daily and weekly inspections of mechanical and electrical systems, repairs and preventive maintenance, routine housekeeping, vapor extraction monitoring, flow regulation, and process sampling. Direct the execution of system upgrades in support of optimization. Develop daily reports.

- To-date, maintained a total maximum flow rate of approximately 800 cfm, for an average of 99% operability since 2015
- Consistently complete work on schedule and within budget in accordance with contract requirements
- Ensure cost efficiencies and productivity by evaluating the chemistry and identifying which of the 10 wells to run at any given time, and reducing sampling events from weekly to monthly to quarterly as appropriate
- Saved money by eliminating ambient air sampling after demonstrating through historical data collected from years working at the site, that the ambient air samples had been non-detect during the entire sampling period.

***Field Supervisor, Monitoring Well Installation and Development, USACE Sacramento, Former Fort Ord, Marina, CA, 2010-2011, \$1.6M***



Executed fieldwork for the installation of 11 monitoring wells including lithologic logging and soil classification during drilling, and groundwater sampling and analysis. Managed IDW, including disposal of drill cuttings/soil core, in accordance with applicable laws and regulations.

- Successfully completed the work three months ahead of schedule and within budget, despite the challenges of working in and around an active airport and residential areas, and habitat reserve

### EDUCATION

Graduate, Structural Design,  
Heald Institute of Engineering,  
1978

### CERTIFICATIONS, LICENSES, TRAINING

NQA-1 Certified Lead Auditor  
40-Hour HAZWOPER and 8-  
Hour Refresher

USACE Construction Quality  
Management for Contractors  
DOT Certification

### WORK HISTORY

Ahtna Environmental, Inc.,  
Environmental Program  
Manager, 2016-present

Ahtna Engineering Services,  
LLC, Environmental Program  
Manager, 2009-2015

Ahtna Government Services  
Corporation, Environmental  
Program Manager, 2006-2009

TN&A, Inc., Senior Technical  
Manager, 2003-2006

Shaw Environmental IT  
Corporation, Construction and  
QC Management, 1996-2003

Parsons Brinckerhoff, Nuclear  
Quality Services, 1986-1996

Kaiser Engineers, Construction  
Management, 1977-1986

### EXPERIENCE SUMMARY

- 38 years of experience including 28 years working for the DoD and DOE on environmental engineering and construction projects located nationwide
- 15 years of program management experience on DoD/Army environmental contracts; managed multiple contracts valued at over \$100M to-date; successfully procured \$16M in DoD/Army sole source awards in 2013 as a result of outstanding performance and strong client relationships; maintained 100% repeat business with the AEC and USACE SPD, consistently performing quality work at individual sites for over 10 years
- 15 years of project management experience overseeing all technical execution of environmental restoration projects, QA/QC, project controls, and personnel management; managed projects/task orders exceeding \$1B in total value
- Received multiple letters of recognition for outstanding work and client service for work performed at the Former Fort Ord and Riverbank Army Ammunition Plant: "...Without exception, Ahtna has provided the Fort Ord BRAC office with the highest degree of expertise and professionalism."
- More than doubled the growth of SWE operations from one office with five employees to three offices and 30 employees, with cumulative revenues of over \$150 million

### PROJECT EXPERIENCE

#### ***Vice President, Southwest Environmental Operations, Pleasant Hill, CA, 2015-present***

Direct a team of 30 staff in the development and execution of USACE and USAEC programs across the southwest U.S. (CA, NV, NM, AZ) with an annual budget of \$25M. Oversee the development of cost bids for negotiated and sole source contracts. Develop and maintain client relationships within the USACE SPD and USAEC, achieving 100% repeat business rate to-date. Manage staff resources in multiple locations to maintain an average of 89% utilization.

#### ***Program Manager, Two MESA IDIQs, USACE Los Angeles, AZ and CA, 9/2013-present, \$20M***

Direct the planning and execution of 12 environmental and engineering support services task orders (to-date) varying in size and complexity from a \$30K geophysical survey to a \$4.5M major auger excavation and a \$5.8M soil removal at a high profile FUDS. Manage client relations. Review and approve work plans. Identify and allocate resources to meet project requirements. Ensure contractual, safety, and quality requirements and expectations are exceeded on all task orders.

#### ***Program Manager, Environmental Remediation Services IDIQ, USACE Sacramento, Multiple Locations, CA, 2006-present, \$23M***

Oversaw 40 TOs under four consecutive contracts to provide environmental services at multiple Army installations including O&M/optimization of GWTPs, groundwater sampling and analysis/monitoring, and the development of SWMPs. Direct the

### Vice President, Southwest Environmental Operations

development of project estimates. Perform resource allocation and client communications. Oversee project teams for the timely and cost-effective completion of all work including project reports in accordance with plans. Develop and maintain relationships with regulators and ensure compliance with all requirements.

- Commended by Robert Smith, BRAC Environmental Coordinator: "I would like to congratulate and thank you for the exceptional professionalism and customer service I have received from Ahtna for the last three years...[I] look forward to working with [Ahtna] in the future."

#### ***Program Manager, Environmental Services IDIQ – Former Fort Ord, USACE Albuquerque, Marina, CA, 2010-present, \$10M***

Oversee the execution of FFP environmental quality and restoration projects at the Former Fort Ord, including development of hazardous materials management storage plans at the GWTP, O&M, remedial system construction, and document production. Manage government client and stakeholder relations with the USAEC, USACE, and US Army/FFO. Ensure the delivery of all work in accordance with quality, safety, and performance standards and expectations.

- Consistently complete work on schedule and within budget and in accordance with contract requirements
- Performed all work to-date with zero recordable or reportable injuries to-date

#### ***Ahtna Government Services Corporation/Ahtna Engineering Services, LLC (Ahtna), Environmental Program Manager***

As the senior cost center manager for nationwide environmental operations, managed identification of opportunities, evaluated teaming options, developed proposals, and managed program start up through reporting and turnover. Achieved significant departmental growth, development of an employee mentoring plan, and consistent high evaluations from clients. Worked as an integral part of the company senior management team helping to keep this small disadvantaged business on the leading edge of technological and managerial excellence. Projects include the development and implementation of SWPPPs, groundwater treatment systems, construction, operations and maintenance (O&M), demolition, soil removal actions, and groundwater monitoring, reporting, and analysis. Specific Ahtna projects include the following:

#### ***Program/Project Manager, Pacific Gas and Electric Company Storm Water Pollution Prevention Services and Support, Various Locations, CA, 2009-2011, \$2.6M***

Directed multiple T&M, not-to-exceed projects to prepare, install, monitor and inspect a variety of SWPPPs. Managed 14-person team to perform full services from determination of BMPs, SWPPP development/approval, BMP implementation, and preparation and processing of NOTs. Interfaced daily with client. Monitored cost/schedule. Executed 29 projects at sites across California, with an average of 10 projects managed concurrently.

- Completed all work in compliance with 1 and 2 Risk/Type Levels

### Vice President, Southwest Environmental Operations

for General Construction and Linear Underground/Aboveground Projects in accordance with permitting requirements

BMPs have included erosion control, sediment control, tracking control, wind erosion control, non-storm water management, and materials and waste management controls. The SWPPPs also featured appropriate BMP “cut-sheets” identifying installation, inspection, and maintenance requirements. Provided water pollution control drawings showing the recommended temporary BMPs. The SWPPPs included sampling and analysis plans for construction storm water monitoring for non-visible pollutants, sediment, siltation, and/or turbidity pollutants.

***Program/Project Manager, Performance-Based Multiple Award Contract (PERMAC) for Environmental Remediation Services at Naval and Marine Corps Installations in California, Arizona, Nevada, New Mexico, and Utah, NAVFAC Southwest (Sub to AMEC), 2008-2009, \$13M***

- Camp Pendleton, Pesticides Soil Treatment/Removal, 400,000 cy, 370-acre soil removal. Mobilization and startup had to be accomplished in a very short time frame to support federal reconstruction funding requirements. Successfully mobilized including 14 pieces of heavy equipment and all operators and engineers and began operations within 2 weeks of NTP
- Moffett Naval Air Station, Hangar 1 Demolition Engineering Support, PCB contaminated Hangar Demolition
- Alameda Naval Air Station, Sites 1 and 2 Soil Remediation, landfill excavation, waste management and backfill immediately adjacent to the SF Bay

**Nuclear Quality Services Director, Parsons Brinckerhoff, California**

As Quality Services Director for the nuclear services division on DOE Projects, planned, budgeted, staffed, and assessed performance of QA/QC functions for all 4 high-level nuclear waste programs. Performed contract reviews, developed QA and PM procedures, completed audits and surveillance, and kept senior management advised of project performance. Developed and ensured implementation of all NQA-1 based quality programs, companywide.

- Successfully procured \$500M project to perform QA/QC and engineering support for the exploratory tunnel construction at Yucca Mountain including repository design and exploratory studies facilities construction, construction of all radioactive waste conveyance systems and facilities, and ensuring that the disposal facilities met regulatory requirements
- Basalt waste isolation project, exploratory studies facilities (ESF), and repository design, including the assessment of radiological waste migration prevention measures and background surveys for naturally occurring radioactive constituents
- Salt project, ESF design, including designs for all radioactive waste isolation systems
- Waste isolation pilot project, sealing systems design, including performance monitoring of the test sealing and containment systems for radioactive leaks



### **Senior Technical Manager, TN and Associates Inc.,**

***Senior Technical Manager, Hunters Point Shipyard, Tetra Tech ECI, San Francisco, CA, \$4M***

Managed radiological remediation project including the production of high quality planning documents responsive to radiological and environmental regulatory standards, construction of SWPPP and BMPs for the excavation, regrading, and site restoration for \$70M of cleanup activities.

- Successfully obtained approvals for HPS documents involving a complex set of regulations, working collaboratively and proactively with the EPA, DTSC, Water Board, Fish and Wildlife
- Completed all work on time and on budget

### **Shaw (IT) Environmental**

***Site Manager, Environmental Compliance, Alameda Naval Air Station, Alameda, CA***

Manage environmental compliance and restoration work. Developed work plans, including SWPPP, QC, and Health & Safety Plans. Ensured NPDES SWPPP field compliance, and managed field construction, subcontractors, sampling, QC, Health and Safety, T&D of the soil and groundwater. Obtained Navy and regulatory (EPA, DTSC, and Water Board) approval of the plans governing construction and remediation operations for the groundwater analysis, design, and construction of dual-vapor extraction systems for removal of free hydrocarbon products.

- Successfully led the completion of more than \$23M in remedial actions at Alameda and received commendations from the Navy

***Construction Manager, Sulphur Bank Mercury Mine Superfund Site, USEPA, Clear Lake, CA***

Managed the construction of a 36" diameter, mile-long storm water diversion pipeline at an abandoned mercury mine. The construction was completed in hazardous conditions on time and within budget.

### **Senior QC Manager, Fort Ord, Monterey, CA, \$50M**

Managed a support staff of more than 20 people during the execution of a \$50M project. Oversaw SWPPP compliance inspection, chemistry, sampling, and document control. Worked extensively with client, regulators (EPA and DTSC), and responsible parties to facilitate cost-effective land transfer. Completed base-wide SWPPP compliance; installation, testing, and startup of a base-wide groundwater pump and treat system; consolidation of existing US Army landfills into a single facility; completion of a 28-acre landfill cap; removal, transportation, screening, and recycling of more than 285,000 cy of lead soils from the beach ranges.

- Successfully addressed all management and technical concerns of the client and was commended by the USACE Program Manager, Mr. Steve Lightner, for contributions to the successful turnaround of this major environmental undertaking

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**Vice President, Southwest Environmental Operations*****QC Manager, Presidio of San Francisco, San Francisco, CA***

Managed the development and implementation of plans for both field and technical activities, ensuring balance between client needs and regulators (DHS, EPA and DTSC) in a highly charged political atmosphere. Managed the field technical staff, technicians, document control staff, and sampling groups. This project involved planning, field activities, and preparation of closure reports necessary to receive regulatory approval for turnover of multiple properties including the Crissy Field soil remediation, the fuel distribution systems pipeline removal and soil remediation, the Nike Missile Silos lead abatement and water treatment, and the Fill Site 7 soil and groundwater remediation.

- Successfully completed the remedial actions to allow the base to be turned over to the Presidio Trust

***QC Manager, Hamilton Army Airfield, Novato, CA***

Managed the review and approval of site closure documents including Work Plans, Sampling and Analysis Plans, Risk Assessment Reports, and Closure Reports.

***Field Supervisor, Kaiser Engineers, CA***

Supervised mechanical systems design, construction supervision, and QA/QC. Successfully performed the following:

- Basalt nuclear waste isolation project, ESF design/construction, including all natural and engineered high-level radioactive waste barriers
- ICBM basing research, construction
- VALCO aluminum smelter, construction and capital improvements
- Mechanical design, various industrial facilities

## EDUCATION

MS, Civil & Environmental Engineering, University of Wroclaw Poland

MS, Hydrogeology, University of Wroclaw Poland

BS, Geotechnical Engineering, University of Wroclaw Poland

## CERTIFICATIONS, LICENSES, TRAINING

24-Hour Hazardous Waste Generator Training and 8-Hour Annual Refresher Training

40-Hour HAZWOPER & 8-Hour Refresher

OSHA 30-Hr Construction Safety Training

## WORK HISTORY

Ahtna Environmental, Inc.  
 Project Manager/Senior Environmental Scientist, 2016-present

T3W Business Solutions, Inc.,  
 Senior Project Manager, 2011-2016

Jacobs Technology, Inc./Jacobs Engineering, Inc. Senior Project Manager, 2008-2011

General Dynamics Information Technology (GDIT)

Remedial project Manager, 2006-2008

Tybrin Corporation, Senior Remediation Project Manager, 2000-2006

Laidlaw Environmental/Safety-Kleen, (California), Inc.

Project Manager, 1997-2000

Remedial Management Corporation,

Vice President Engineering

## EXPERIENCE SUMMARY

- 30 years in environmental consulting including 16 years in program management with expertise in all phases of the environmental assessment and remediation in the United States within different EPA regions.
- Well-qualified Environmental Program and Project Management Leader with extensive experience in the development and execution of domestic and international remediation and compliance programs and projects that have significantly improved productivity and environmental quality while reducing operating costs for major domestic and international private companies and government agencies.
- Assists in negotiating cleanup and remediation strategies and technical approaches with regulators to secure cost-effective remediation and accelerated, risk based site remediation and closures.
- Oversees field teams including multiple subcontractors conducting soil/groundwater assessments, groundwater monitoring/sampling, SVE O&M, groundwater extraction system O&M, post-closure landfill O&M, in situ chemical injection, demolition, bioremediation, bio augmentation, land farming, and remedial landfill cap installations.
- Manages CERCLA remediation program and project-specific activities and oversees performance of the remediation project and program specific activities including technical document deliverables. Reviews remedy specific operations and monitoring to optimize remedies performances.

## PROJECT EXPERIENCE

***Project Manager/Senior Environmental Scientist, Sharp Army Depot Groundwater and Soil Remediation, USACE Sacramento, Lathrop, CA 5/2016-present, \$ 10 M***

Manages CERCLA remediation program and project-specific activities and oversees performance of the remediation project and program specific activities including technical document deliverables.

- Reviews remedy specific operations and monitoring to optimize remedies performances. Manages and supervises program and project specific staff and contractor personnel.
- Assists in negotiating cleanup and remediation strategies and technical approaches with regulators to secure cost-effective remediation and accelerated,

1993-1997

Canonie Environmental  
Corporation

Project Engineer/Project  
Manager 1989-1993

International Technology  
Corporation (IT)

Staff Engineer/Hydrogeologist  
1986-1989

risk based site remediation and closures.

- Ensures remediation and remedy performance and monitoring activities are performed in accordance with applicable laws, guidelines and regulations. Recommends optimization approaches to remedial process and remedy operations and long term monitoring.
- Performs business development activities and assists in proposal preparations.
- Oversees personnel during field remediation and monitoring activities.

***Senior Project Manager, RCRA Hazardous Waste Facility  
Management and IRP Program Support, NAF El Centro CA, NAVFAC  
SW San Diego, CA, 2011–2016,  
\$ 6.0 M***

Directed program and project-specific activities and oversaw performance of the compliance and restoration program activities. Oversaw and participated in business development activities, including meetings, presentations and proposal preparation and oversight. Managed and supervised program and project staff and contractor personnel. Negotiated cleanup and remediation strategies and technical approaches with regulators to secure cost-effective remediation and accelerated, risk based site closures. Ensured compliance and remediation activities are performed in accordance with applicable laws, guidelines and regulations.

- Prepared and implemented Environmental Assessment, Remediation, Compliance, Solid and Hazardous Waste Management Plans, and Storm Water Pollution Prevention and Spill Prevention, Control and Countermeasure (SPPCC) Plans. Prepared water quality, surface water and treated groundwater discharge monitoring plans. Ensured compliance with all Federal (US EPA), State and Local environmental regulations pertaining to soil, storm water, air emissions and water quality.
- Provided support to project management, field remediation, compliance and construction personnel. Ensured storm water is managed and discharged in accordance with the General Permit to Discharge under the National Pollutant Discharge Elimination System (NPDES), State Pollutant Discharge Elimination System, and County

requirements.

- Ensured compliance and remediation systems at installations are managed with state and county specific air emissions permits and discharge requirements. Interacted with regulatory agencies to negotiate cleanup strategies based on risk based and cost-effective cleanup goals and objectives. Supported the client(s) at the meetings with regulatory agencies negotiations. Advised clients and supporting contractors on changes to compliance and restoration program approaches and strategies in order to optimize programs performance. Provided recommendations on how to implement new approaches, strategies, and technological advances to minimize waste generation activities at the installations.

***Senior Project Manager, Site 25 OU8 and Multiple Sites in OU5, OU 10 and OU 8 RI/FS, PP, ROD, IRAs RD, RA, RAO and LTM, AFCEE/AFCEC San Antonio, TX, Edwards Air Force Base, Edwards, CA, 2008-2011,***

***\$ 10 M***

Maintained client relationships, directed and oversaw environmental remediation program and project work to maintain high technical and high quality control standards. Managed, mentored and supervised program and project specific personnel. Participated in business development activities, including meetings, presentations, proposal preparation, and oversight. Directed and oversaw preparation of budgets, and monthly status reports. Conducted due diligence activities, contaminated site investigation, remediation, regulatory compliance, permitting, and storm water management. Directed, performed and oversaw work in regulatory compliance for landfills and other solid waste projects.

- At Edwards Air Force Base (EAFB) in California, worked with Environmental Restoration operations, including program and project specific components. Performed the Environmental Restoration Program, Planning, Budgeting and Execution. Assisted in developing cleanup strategies and participated in cleanup strategies negotiations with regulatory agencies. Developed engineering cost estimates and scope of works (SOW).
- Provided program and project management, engineering support, and technical assistance for the Operable Units (OUs), on complex, Comprehensive

Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation Recovery Act (RCRA), Military Munitions Response Program (MMRP), Underground Storage Tank (UST) investigation, assessment, and remediation projects. Oversaw and performed technical reviews of Environmental Restoration documents.

- Reviewed new restoration and compliance mitigation technologies, and provided recommendations on how to implement restoration Research and Development (R&D) activities at Edwards AFB. Provided sub-consultants and subcontractors management and oversaw their performance via field surveillance activities. Served as a senior remedial project manager for OUs 5, 10 and OU8.

***Remedial Project Manager, Multiple Sites in Multiple OUs RI/FS, PP, ROD, IRAs RD, RA, IRAs, RAO and LTM, NAVFAC SW and BRAC PMO West San Diego, CA, NWS Seal Beach Detachment Concord, CA, 2006-2008, \$ 10 M***

Served as client manager to direct and oversee environmental services program and project work to maintain high technical and high quality control standards. Participated in business development activities, including meetings, presentations, proposal preparation, and oversight. Managed and supervised program and project-specific staff personnel. Directed and oversaw preparation of budgets, and monthly status reports. Managed and mentored contract and task specific personnel and client(s). Interacted with regulators and clients to negotiate cleanup strategies and associated cleanup goals and objectives. Conducted due diligence assessments, contaminated site investigation, remediation, regulatory compliance, permitting, and storm water management. Directed, performed and oversaw work in regulatory compliance for landfills and other solid waste projects.

- Provided vision and direction as the Remedial Project Manager (RPM) at Naval Weapons Station Seal Beach Detachment Concord (NWSSB) Tidal and Inland Areas, in Concord, California.
- Assisted at Base Realignment and Closure Program Management Office (BRAC PMO West) in San Diego with the Installation Restoration Program/Environmental Restoration Program (IRP/ERP) Division operations by providing program and project management, engineering advisory



support, and technical assistance on complex Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation Recovery Act (RCRA), Military Munitions Response Program (MMRP), and Underground Storage Tank (UST) investigation, assessment and remediation projects.

- Directed, oversaw, and performed technical reviews of IRP/ERP Remedial Investigation (RI), Feasibility Study (FS), Proposed Plan (PP), Record of Decision (ROD), Remedial Design (RD), Remedial Action (RA), Operations and Maintenance (O&M), Remedial Process Optimization (RPO), and Long Term Monitoring/Management (LTM) documents. Managed and provided oversight of the IRP/ERP contractors during the performance of field investigations, treatability and/or feasibility studies, remediation design and system optimization, remedial action, and long term management activities under CERCLA, RCRA, MMRP, and LUFT programs.
- Interacted with the regulatory Remedial Project Managers (RPMs), Restoration Advisory Board (RAB) members and other stakeholders during the program and project management planning and execution meetings and activities. Developed engineering cost estimates and scope of works (SOW).

***Senior Remediation Project Manager, OU4 and OU 9 AFRL RI/FS, PP, ROD, IRAs RD, RA, RAO and LTM, AFCEE/AFCEC San, AFCEC San Antonio, TX, Edwards AFB, Edwards, CA, 2000-2006, \$ 30 M***

Worked with Environmental Restoration Division (ERD) operations by providing program and project management, engineering support, and technical assistance for the Operable Units (OUs 4 & 9), on complex Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation Recovery Act (RCRA), Munitions Response Program (MRP), and Underground Storage Tank (UST) investigation and remediation projects. Reviewed new restoration technologies, and provided recommendations on how to implement restoration Research and Development (R & D) at Edwards AFB. Developed engineering scope of works and cost estimates.

- Advised ERD on changes to technical documents to

avoid receiving similar comments from the regulatory agencies and other reviewers. Provided surveillance of ERP contractors during the performance of field investigations, treatability and/or feasibility studies, remediation systems implementation, maintenance, operation, remedial systems optimization, and long term monitoring activities.

- Assisted ERD team in developing multiple risk based cleanup strategies leading to multi million dollars in remediation cost avoidance. Maintained and assimilated detailed technical information for tracking progress and efficiency of ERP projects. Performed remedial action (RACER) cost estimates. Prepared OU4 and 9 project funding narratives and associated cost estimates.

***Project Manager, Multiple Private and Government Clients, Los Angeles, CA, 1997 – 2000, \$ 12 M***

Responsible for project management, client relations, and interaction with Federal, State, and local regulatory agencies to meet all requirements associated with hazardous waste removal, treatment, and remediation. Assisted with business development activities, proposal preparation, estimates, bids and maintained cost controls, community and client relations. Won multiple bids and contributed to a company gross revenue increase. Served as project manager and task (TO) and/or DO manager on a variety of private and government projects. Met with clients on a regular basis to provide updates regarding status of the projects and discuss scope of work of the projects.

- Directed, oversaw and performed technical review of documents that involved site investigations (RI/FS), remedial design and implementation (RD/RA), and Long Term Operation/Long Term Monitoring (LTO/LTM) associated with soil and groundwater remediation systems. Managed and oversaw development of work plans, remedial investigations, engineering design and remediation to comply with CERCLA, RCRA and LUFT laws, guidelines and regulations. Supervised, trained and mentored staff geologists, engineers and technicians.

***Vice President Engineering, Multiple Private and Government Clients and Projects, Schaumburg IL, and Newport Beach, CA, 1993-1997, \$ 10 M***

Acted in charge of P&L and overall financial performance of the RMC

Schaumburg, Illinois office. Involved in development and implementation of strategic plans to establish and grow the business in Midwest and Europe. Directed and conducted marketing and business development activities to identify new domestic and international opportunities. Oversaw and participated in domestic and international contract, teaming and joint venture partnering activities and negotiations. Established an office for the environmental services consulting company in Midwest.

- Managed, mentored and supervised program and project specific RMC personnel in Schaumburg, Illinois office. Participated in business development activities. Acted as program account manager and client(s) representative/liaison during program and project execution activities, and negotiations with regulatory agencies.
- Managed and prepared business development proposals and cost estimates for the removal and treatment of contaminated soil and groundwater. Managed and oversaw the assessment of contaminant extent and design of soil and groundwater remediation systems. Directed and oversaw preparation of hydrogeological and engineering reports to ensure technical quality and thoroughness.

***Project Engineer/Project Manager, Multiple Private and Government Clients and Projects San Mateo, CA, 1989 – 1993, \$ 5.0 M***

Served as project engineer and project manager and worked on private sector NPL, CERCLA and RCRA investigation and remediation projects such as industrial and landfill facilities. Prepared hydrogeological, design and remediation engineering reports. Reviewed and prepared applications for the NPDES permits. Planned and performed hazardous waste investigations, design and remediation under CERCLA, RCRA and LUFT regulations. Prepared landfill cap and liner design, closure and post closure reports. Participated and assisted in business development activities including meetings, presentations and proposal preparation. Evaluated NPL site investigation and remediation decision documents (RI/FS) to identify data gaps relating to selection, design and implementation of future potential remedies.

- Directed and prepared conceptual remedial and corrective action plans (RAPs and CAPs), engineering

design, and construction plans and specifications. Investigated, selected and implemented RCRA corrective action programs associated with hazardous waste management facilities.

- Investigated and designed Class I surface impoundments and landfills meeting RCRA minimum standards. Developed surface impoundments and landfill cap and liner design and implemented closure and post closure plans.

***Staff Engineer/Hydrogeologist, NPL Site Former Firestone Plant  
Salinas, CA, 1986-1989, \$ 2.0 M***

Worked as staff engineer and hydrogeologist on a National Priority List (NPL) site in Salinas, CA. The site was a former Firestone Site (Superfund Project). The project included additional site assessment, remedial design, remediation construction and site remediation, O&M, and LTO/LTM associated with a large full scale pump and treat system (800 gpm).

- Conducted pump tests for different types of aquifers, data analysis due to pumping tests and evaluation of hydrogeological characteristics for shallow and deep aquifers. Prepared technical hydrogeological and engineering reports.
- Performed data analysis of hydrological, hydrogeological and geotechnical parameters of the aquifers affecting groundwater and well hydraulics, their planning, design and construction. Evaluated groundwater flow directions, shallow and deep aquifers contour maps. Performed soil, treatment plant, surface and groundwater sampling.

#### EDUCATION

MA, Science, Technology, and Public Policy, The George Washington University Elliott School of International Affairs, 2002

Master of Environmental Management, Yale University, School of Forestry and Environmental Studies, 2000

BS, Engineering (Geological Engineering), Purdue University, 1989

#### REGISTRATIONS

Professional Engineer, Civil Engineering, California #C57417

Qualified SWPPP Developer/Practitioner (QSD/QSP) CA#20527

#### CERTIFICATIONS, LICENSES, TRAINING

40-Hour HAZWOPER

8-Hour HAZWOPER Refresher Supervisory Hazardous Substances/Waste Health and Safety, 1994

Health and Safety Training and Field Experience for Hazardous Materials Operations, 1994

U.S. Army CHPPM Advanced Health Risk Communication Training, 2004

Defensive Driving Techniques, 2010

Confined Spaces, 1992

OSHA 30-hour Construction Safety, 2013

DOT Hazmat Employee, 2013

USACE Construction Quality Management for Contractors, 2011

#### WORK HISTORY

Ahtna Environmental Inc., Senior Project Manager, 2015 – present

Ahtna Engineering Services, LLC, Senior Project Manager,

#### EXPERIENCE SUMMARY

- 23 years of engineering experience in environmental remediation services (ERS), including soil, soil gas and groundwater remediation, CERCLA (as amended by SARA)/RCRA/BRAC sites, and geotechnical investigation, design and construction oversight
- 13 years of experience managing the preparation of analytical and descriptive reports and property transfer documentation
- 12 years of experience in Community Relations, delivering presentations on behalf of the U.S. Army regarding the status of the groundwater remediation program at the former Fort Ord at the U.S. Army's Community Involvement Workshops, Technical Review Committee meetings, Open House events
- 10 years of experience managing operations and maintenance (O&M) of full scale groundwater treatment systems (GWTS) and soil vapor extraction and treatment systems (SVETS), including system optimization and QC oversight of construction, documentation and environmental sampling
- In-depth experience with the CERCLA process, including development of Decision Documents and use of EPA's Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents
- Commended by Gail Youngblood, BRAC Environmental Coordinator: "No listing of Ahtna's personnel would be complete without Derek Lieberman, whose breadth of knowledge about remediation systems, Fort Ord history, and the ins-and-outs of transferring property have helped Fort Ord reach the point of having transferred the vast majority of property available for redevelopment."

#### PROJECT EXPERIENCE

***Director, Environmental Services, Former Fort Ord, Multiple Consecutive USACE Sacramento and Albuquerque Districts, Marina, CA, 2008-present, \$10M***

Manage seven environmental technical onsite staff performing FFP ERS, including development of hazardous materials business plans (HMBP), remedial system construction and O&M, reporting, preparation of CERCLA documents and UFP-QAPPs. Provide expertise on CERCLA/RCRA issues. Update the HMBP describing procedures for emergency response for hazardous materials (sulfuric acid and compressed helium) stored at the groundwater treatment plants (GWTP) in accordance with the requirements of the local California Certified Unified Program Agency. Maintain hazmat storage facilities in compliance with laws/regulations and received no notices of violation (NOVs). Participate in regular meetings with the U.S. Army Environmental Command (AEC), USACE, regulatory agencies and the public to provide technical and regulatory expertise on ERS in accordance with CERCLA/RCRA.

***Project Manager, O&M of GWTS and SVETS, Former Fort Ord, Multiple Consecutive USACE Sacramento, Marina, CA, 2007-present, \$20M (multiple consecutive awards)***

### Senior Project Manager/Regulatory Specialist

2007 – 2015

J.M. Waller Associates, Inc.,  
Senior Environmental  
Compliance Specialist, 2003 –  
2007

U.S. Department of Agriculture,  
Economist, 2001 – 2003

The Tahoe-Baikal Institute,  
Environmental Exchange  
Participant, 2000

Harding Lawson Associates  
(now Amec Foster Wheeler),  
Project Engineer, 1991 – 1999

Herzog Associates (now  
defunct), Assistant Engineer,  
1989 – 1991

Direct O&M of two GWTS, which include 32 extraction wells, 4 injection wells and 4 infiltration galleries, and one SVETS, which includes 10 extraction wells. All three systems use granular activated carbon (GAC) as the primary treatment technology for VOCs. Prepare and review programmatic documents, including project management plan, O&M manuals, project schedule, UFP-QAPPs, and site-specific Accident Prevention Plan (APP). Directed construction and commissioning of automated sampling and analytical platforms, including integration w/SCADA system to allow real-time automated decision-making for GWTS operations. Develop all work plans, QC/safety plans. Monitor productivity, cost/schedule and provide progress reports. Oversee implementation of USACE three-phase inspection process for ERS and remedial system construction. Perform data validation, database management, and reporting, which includes quarterly O&M status and monitoring summary reports, and an annual effectiveness evaluation report. Manage accumulation, manifesting and shipment of wastes in the form of spent GAC.

- Successfully operated both GWTS at over 99% cumulative operability since 2007
- As of December 2015, treated over 8.5 billion gallons of contaminated groundwater while maintaining plume capture; discharged treated water per CWA requirements with no NOVs
- Successfully operated the SVETS at over 99% cumulative operability since startup in September 2015
- Discharged treated air per CAA requirements with no NOVs

#### ***Project Manager, O&M of Landfills and Landfill Gas Extraction and Treatment System, Former Fort Ord, USACE Sacramento, Marina, CA, 2015-present***

Direct O&M of five landfill areas and a landfill gas (LFG) extraction and treatment system, which includes 35 extraction wells, LFG collector pipes, and a thermal treatment unit (TTU) as the primary treatment technology for methane and VOCs. Prepare and review programmatic documents, including O&M manual, project schedule, UFP-QAPP, and site-specific APP. Develop all work plans, QC/safety plans. Monitor productivity, cost/schedule and provide progress reports. Oversee implementation of USACE three-phase inspection process for O&M activities. Perform data validation, database management, and reporting, which includes monthly O&M status and LFG monitoring reports, and an annual O&M and regulatory compliance monitoring report.

- Successfully operated the TTU at over 99% cumulative operability since September 2015
- Discharged treated LFG per CAA requirements with no NOVs
- Successfully managed LFG in compliance with California Code of Regulations Title 27

#### ***Senior Environmental Engineer, Optimization of GWTS and SVETS, Former Fort Ord, Multiple Consecutive USACE Sacramento Environmental Services Contracts, Marina, CA, 2007-present***

Provide engineering and regulatory expertise to identify cost-saving measures to be implemented at the GWTS (e.g., waste minimization



### Senior Project Manager/Regulatory Specialist

and waste management). Evaluate quarterly analytical and operational data and modify GWTS and SVETS operational parameters accordingly (e.g., extraction wells were operated based on specific decision rule criteria). Employ groundwater modeling to evaluate GWTS effectiveness and capture analysis to optimize the operation of extraction and injection wells. Evaluate new technologies for potential application to the GWTS and SVETS. Present optimization recommendations to the USACE for implementation with regulatory agency approval.

- Optimized GWTS operations through decision rules that maximize GAC lifecycle, confirm plume capture and remediation progress, and significantly reduce sampling frequency
- When an air stripper was installed as a polishing step after GAC treatment at the Sites 2 and 12 (2/12) GWTP, determined the air stripper effectively treated specific contaminants that were not efficiently treated by GAC. This allows for continuous operation until the GAC capacity is maximized for trichloroethene (TCE), the primary chemical of concern at Sites 2/12, reducing the need for GAC change-outs from once every 8-12 weeks to once every 19-23 months; decision rules were approved by regulatory agencies and subsequently modified and applied by other contractors at the former Fort Ord
- Performed a cost benefit analysis to determine the feasibility of relocating the Operable Unit 2 (OU2) GWTP to an area with the highest concentrations of contaminants in groundwater; determined that moving the GWTP in combination with installing new extraction wells and groundwater recharge structures would reduce the time to achieve remedial action objectives by 10 years, thereby reducing costs by almost 50% over the life of the project; based on these findings, the Army is proceeding with the project

***Project Manager/Environmental Engineer, Installation of Monitoring Wells, Former Fort Ord, USACE Sacramento, Marina, CA, 2010-2011, \$1.6M***

Designed and executed the installation of 11 monitoring wells up to 450 feet deep in support of a monitored natural attenuation groundwater remedy in a deep aquifer. Developed a well installation work plan that included a SAP and an Environmental Protection Plan to address well installation in protected habitat areas that include several federally listed species and species of concern. Implemented a high level of quality control through all phases of well construction, including determining well locations, borehole logging, well design by a registered professional hydrogeologist, well casing and screen installation, well development, and installation of the Westbay sampling system. Coordinated all work with multiple stakeholders including: the Fort Ord BRAC Office Biologist to minimize impact to protected habitat; the Army to avoid impact to residential neighborhoods, and the municipality, airport staff, and the Federal Aviation Administration to avoid impact to airport operations.

- Completed the project three months ahead of schedule, and with no impact to residents, airport operations, or critical habitat

**Senior Project Manager/Regulatory Specialist**

(of the 11 wells, two are located in the habitat area, four in residential areas, and one at an airport)

- Successfully worked with the Army, regulatory agencies and University of California (habitat reserve managers) to complete the work plans and obtain the necessary permits to allow work to start the first week of December, complying with the Army's request to start drilling no later than December to avoid impact to protected plant species (the growing season for sand gilia and Monterey spine flower is approximately December through May)

***Project Manager, Groundwater Monitoring Program, Former Fort Ord, USACE Sacramento, Marina, CA, 2010-present, \$900K***

Manage quarterly groundwater sampling at over 150 wells on the former Fort Ord using passive diffusion bag samplers (PDS), the Westbay sampling system, and HydraSleeves. Analyze groundwater samples for organic and inorganic compounds in accordance with the approved Quality Assurance Project Plan (QAPP). Measure and record water level elevations with respect to established survey control points. Use data to optimize GWTS operations.

***Project Manager, Soil Gas Investigation and Vapor Intrusion Analysis, Former Fort Ord, USACE Sacramento, Marina, CA, 2008-2009, \$30K***

Developed a work plan, SAP, and Activity Hazard Analysis to conduct a soil gas investigation within an area proposed for residential development at the former Fort Ord. Used the investigation data to perform a screening level assessment of the vapor intrusion pathway using DoD guidance documents (Tri-Services Handbook for the Assessment of the Vapor Intrusion Pathway) and the DTSC Human and Ecological Risk Division (HERD) version of the EPA Vapor Intrusion (Johnson and Ettinger [J&E]) Model (HERD Model), which contains the toxicity criteria acceptable to the DTSC. Based on the analytical and HERD Model results, the site passed a site-specific J&E evaluation; therefore, no further consideration for indoor air risk was necessary and the site continues to meet No Action conditions.

***Community Relations Specialist, Former Fort Ord, USACE Sacramento, Marina, CA, 2004-present, \$250K (multiple awards)***

As a recognized subject matter expert with effective communication skills, provide community relations representation on behalf of the U.S. Army for environmental work at former Fort Ord. Deliver presentations regarding the status of the groundwater remediation program at the former Fort Ord to the public at the Army's Community Involvement Workshops (CIW), Technical Review Committee (TRC) meetings, and Open House events.

***Environmental Compliance Manager, Property Transfer, Former Fort Ord, USACE Sacramento, Marina, CA, 2003-present, \$450K (multiple awards)***

Provide technical support to U.S. Army BRAC Fort Ord Office for property transfer documentation including producing reports and documents, and responding to regulatory agency and public comments concerning property transfer and real estate issues as they relate to the environmental remediation program. Draft deeds for

**Senior Project Manager/Regulatory Specialist**

transfer of former Fort Ord property in accordance with the Army's Model Deed and the Department of Defense Instruction Number 4165.72. Provide technical support for USACE legal review of the deeds including preparing or reviewing draft deed revisions and memorandums, coordinating receipt of legal descriptions and other deed exhibits, responding to comments and questions from USACE and property recipients regarding environmental and technical components of the deed, and tracking the progress of deed execution and recordation. With expertise in institutional controls for real estate transactions, prepare and coordinate Covenants to Restrict Use of Property (CRUPs) to be executed by the Army and the State of California for application and enforcement of land use controls on former Fort Ord property. Prepare documentation required to obtain RCRA Corrective Action Complete Determination (CACD) from DTSC for all transferred property where remedial action is complete.

- Completed Findings of Suitability to Transfer (FOST) in accordance with the Army's Model FOST for former Fort Ord property impacted by munitions and explosives of concern (MEC)
- Due to the policy complexities associated with MEC at CERCLA sites, participated in successful negotiations between the Army's Environmental Law Division and Office of General Counsel, EPA and DTSC to resolve issues pertaining to the environmental condition of the property and the appropriate section of CERCLA under which the transfer should occur
- Reviewed and commented on land use control implementation plans (LUCIPs) for munitions response areas (MRAs) at the former Fort Ord, which ensured conformity between the LUCIP and the requirements of the deed under CERCLA
- Established the procedure for issuing the CERCLA Warranty for early transfer property where CERCLA remedial actions are complete

***Environmental Compliance Manager, CERCLA Decision Documents, Former Fort Ord, USACE Sacramento, Marina, CA, 2006-2010***

Completed two Explanations of Significant Differences (ESDs) to the Operable Unit 1 (OU1) ROD and the OU2 ROD at the former Fort Ord. Successfully coordinated with the regulatory agencies and obtained signatures from all the parties on behalf of the Army. The OU2 ESD was particularly complex and addressed several areas of concern, including MEC, mitigation of landfill gas, Corrective Action Management Unit (CAMU) requirements for a landfill, and use of treated groundwater for construction purposes. Participated in the review process for several RODs and ROD Amendments.

***Project Manager, Remedial Investigation/Feasibility Study (RI/FS) Addendum at Sites 2/12, Former Fort Ord, USACE Sacramento, Marina, CA, \$1.2M, 2013-2014***

Manage \$1.2M project to determine the magnitude and extent of PCE and TCE contamination in soil, soil gas, groundwater, and indoor air. Developed and implemented detailed RI/FS work plan to meet the client's aggressive schedule, which included a significant community relations effort to address the concerns of the property owners and 11 retailers located within the project site (Target, Kohl's, Old Navy,

**Senior Project Manager/Regulatory Specialist**

Recreational Equipment, Inc., etc.), and to coordinate field work to ensure minimal impact to daily retail operations. Designed and implemented remedial investigation; designed and constructed a soil vapor extraction (SVE) and air sparge (AS) pilot treatability study, and developed a RI/FS Addendum report.

- Eliminated offsite disposal of waste – solid IDW transferred to onsite OU2 Landfills for reuse as landfill cover, liquid IDW treated at the onsite GWTS
- Scheduled the SVE/AS pilot study as “proveout” study ahead of the RI/FS report, based on 10+ years of experience at the former Fort Ord including previous use of SVE at other former Fort Ord locations, thereby completing the project four months ahead of schedule
- Completed extensive indoor air and sub-slab sampling program without disruption to retail operations; received no complaints from property owners, retail managers or customers
- Based on RI results, determined there was no unacceptable risk to human health due to vapor intrusion, but additional remedial action was appropriate to protect groundwater from contaminants found in soil gas

***Project Manager, Groundwater Remedy Addendum at Sites 2/12, Former Fort Ord, USACE Sacramento, Marina, CA, 2015, \$1.2M***

Based on the results of the RI/FS Addendum, prepared an ESD to the Remedial Investigation Sites ROD to include soil vapor extraction and treatment as part of the Sites 2/12 groundwater remedy to prevent partitioning of contaminants between soil gas and groundwater. Managed \$1.2M project to construct and operate the SVETS and one additional groundwater extraction well. Developed and implemented detailed remedial action work plan to meet the client’s aggressive schedule, which included a significant community relations effort to address the concerns of the property owners and 11 retailers located within the project site (Target, Kohl’s, Old Navy, Recreational Equipment, Inc., etc.), and to coordinate field work to ensure minimal impact to daily retail operations. Developed an O&M manual based on construction and start-up/shakedown activities.

***Qualified SWPPP Developer (QSD), Multiple federal and commercial clients, Marina, CA***

In compliance with CWA requirements, develop storm water pollution prevention plans (SWPPPs) for federal facilities and private utility sites throughout California. QSD of record for over a dozen projects. Select and design Best Management Practices (BMPs). Developed an implementation plan and related cost estimate for the execution of the new storm water management program at the Presidio of Monterey (POM) and Ord Military Community (OMC) in accordance with the Phase II Small Municipal Separate Storm Sewer Systems (MS4) General Permit (California State Water Resources Control Board [SWRCB] Order No. 2013-0001 DWQ) and applicable SWRCB guidance.

***Quality Control Engineer, Fort Hunter Liggett Building 194 Groundwater Monitoring and Reporting, USACE Sacramento, Fort***

**Senior Project Manager/Regulatory Specialist**

***Hunter Liggett, CA, \$285K (multiple task orders)***

Provide senior level quality control review for quarterly groundwater sampling and analysis, data validation, waste management, well maintenance, quarterly groundwater monitoring reports, and annual groundwater monitoring report. Ensure regulatory compliance and technical accuracy.

***Quality Control Engineer, Fort Hunter Liggett Building 258 Soil Vapor Extraction System Operations and Maintenance, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2011, \$478K***

Provide senior level quality control review, ensuring regulatory compliance and technical accuracy of all documents for a project involving vadose zone hydro-carbon remediation at the Building 258 Area using SVE technology. Reviewed Remedial Action Work Plan detailing the SVE system requirements for installation, start-up, and shakedown, and semi-annual treatment system monitoring reports.

***Quality Control Engineer, Operations and Maintenance of Fort Hunter Liggett Landfill, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2012, \$109K***

Provide senior level quality control review, ensuring regulatory compliance and technical accuracy of all documents for a project involving the O&M of Landfill #1, including semiannual groundwater monitoring, landfill gas monitoring, laboratory analysis, data validation, waste management, reporting, well maintenance, and landfill cover inspections.

***Quality Control Engineer, O&M of Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2007-2012, \$4M***

Support the O&M for the RBAAP GWTP and quarterly groundwater monitoring. Provide QC and technical and regulatory compliance oversight for O&M of groundwater treatment facilities, a closed landfill, and associated reporting and documentation.

***Quality Control Engineer and Regulatory Specialist, RCRA Hazardous Waste Facility Permit Closure, Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2011-2013, \$4M***

Provide QC and technical and regulatory compliance oversight during preparation of closure plans, QAPP, and closure certification reports, and decommissioning activities for 13 hazardous waste management units.

***Senior Environmental Compliance Specialist, Fort Ord Office, U.S. Army Base Realignment and Closure, J.M. Waller Associates, Inc., College Park, GA, 2003-2006***

Worked with the BRAC Environmental Coordinator (BEC), USACE, contractors, and regulatory agencies to ensure requirements were met for environmental cleanup actions for contaminated soil and groundwater at the former Fort Ord. Monitored and modified project schedules and ensured specifications of the Federal Facility Agreement, CERCLA, RCRA, and applicable or relevant and appropriate requirements (ARARs) were met. Ensured actions were cost-effective and efficient, as well as protective of human health and the environment. Met with and presented information to community



**Senior Project Manager/Regulatory Specialist**

groups, local government officials, and others as requested by the BEC.

- Successfully completed and obtained regulatory approval of four FOSTs, two Findings of Suitability for Early Transfer (FOSETs), two Findings of Suitability to Lease (FOSLs), and 24 CRUPs leading to the transfer of more than 8,000 acres of property
- Coordinated with USACE to support production of deeds for transfer of property; reviewed and commented on draft deeds and provided technical support
- Initiated request and compiled all documentation for DTSC RCRA corrective action complete determinations
- Provided technical support for completion of a Covenant Deferral Request (CDR) for early transfer of property
- Initiated development of a land use control (LUC) database for LUCs for use in drafting LUC Implementation Plans
- Coordinated with property recipients to resolve post-transfer issues related to the environmental condition of the property
- Achieved regulatory closure of RCRA hazardous waste facility

***Economist, U.S. Department of Agriculture, Foreign Agricultural Service, Commodity and Marketing Programs, Forest and Fishery Products Division, Washington, DC, 2001 - 2003***

Assisted industry associations to develop and maintain export markets for U.S. forest and fishery products via a Unified Export Strategy. Analyzed markets for U.S. forest products in North America, Europe, and Oceania. Assessed impact of trade agreements and environmental reviews on U.S. forest products exports. Assessed causes and consequences of illegal logging and timber trade. Analyzed market trends for exports of U.S. forest and fishery products for development of a Global Marketing Strategy. Wrote briefing papers for each of the top 15 states in seafood industry production for use in presentations and speeches by USDA personnel.

***Environmental Exchange Participant, Lake Baikal, Russia and Lake Tahoe, United States, Tahoe-Baikal Institute, South Lake Tahoe, CA, 2000***

Studied natural and cultural histories and current environmental problems and policies related to the respective limnological systems through contact with government agencies, non-government organizations, and citizens. Performed volunteer work for multiple water quality improvement projects at both lakes:

- Site Restoration in the village of Khuzhir on Olkhon Island in Lake Baikal: Worked on the U.S. Agency for International Development (USAID)-funded restoration of Shaman's Cape, a Buryat sacred site. Work focused on an area once encompassed by a Soviet-era petroleum fueling and storage facility. Provided manual labor and made recommendations to project leaders for site restoration. Utilized engineering experience to plan and implement interim erosion control measures to mitigate shoreline degradation and migration of contaminated silt and storm runoff to the lake.
- Land-use Planning -- Environmental Assessments on Olkhon



### Senior Project Manager/Regulatory Specialist

Island: Worked with researcher from the Institute of Geography of Irkutsk, Siberian Branch of the Russian Academy of Sciences to assess anthropogenic impact on wildlife areas. Proposed policies for future land use, management of wildlife protection, recreational activities, and waste disposal to be incorporated into national park zoning plan.

- Stream Restoration: Worked with California Tahoe Conservancy on stream restoration project for Cold Creek, a tributary to Lake Tahoe. Native vegetation was transplanted into areas degraded by livestock activity along a one-mile section of stream.
- Environmental Policy and Natural Resource Management: Evaluated impact of wild horses and domestic livestock grazing in the South Lake Tahoe watershed and Great Basin by observing wild horses and range areas, interviewing experts, including Bureau of Land Management (BLM) officials and ranchers, and performing research regarding wild horses. Completed a report, including policy recommendations, for the Animal Legal Defense Fund, BLM, U.S. Forest Service, and members of U.S. Congress.

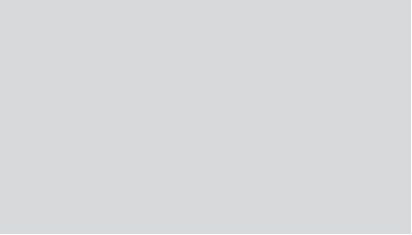
#### ***Project Engineer, Harding Lawson Associates (now AMEC), Petaluma, CA, 1991 - 1999***

Managed field offices, coordinated and supervised trainees, engineering technicians, staff engineers, and scientists in environmental sampling and investigation work. Developed and implemented health & safety and work plans. Conducted QA/QC programs for hazardous materials/waste investigations. Performed feasibility studies and remedial actions on civilian, military and Superfund projects, including: lead abatement in former military small arms ranges in coastal sand dunes; hexavalent chromium abatement in former military pickling and plating facility; decommissioning of sewage treatment plants and tank farms; sampling and analysis of discharge from shoreline storm drain outfalls; monitoring and remediation of contaminated groundwater; sampling and remediation of contaminated dredge material. Performed O&M of remedial systems, including soil vapor extraction, bioremediation, and groundwater treatment facilities utilizing granular activated carbon and ultraviolet light oxidation/reduction. Supervised trainees, engineering technicians, staff engineers, and scientists in the same. Successfully operated systems with minimal down time. Devised and proposed expansion of groundwater treatment system. Supervised general laborers and heavy equipment operators in construction of remedial systems. Consistently completed projects on time and within budget. As site project manager, acted as liaison to clients, regulatory agencies, the public, and the media; interpreted data and wrote project status reports and proposals; and gave presentations to prospective clients. Conducted Phase I and Phase II site assessments; supervised drilling crews for installation of exploratory borings and monitoring and extraction wells; logged and sampled borings; conducted soil gas surveys; developed and sampled wells; and performed construction and remedial action oversight.

#### ***Assistant Engineer, Herzog Associates, Petaluma, CA, 1989 - 1991***

Observed and tested geotechnical related construction, including

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**Senior Project Manager/Regulatory Specialist**

earthwork, grading, paving, and foundation installations for commercial and residential projects to confirm conformance to plans and specifications. Wrote proposals, reports, and plan reviews; drafted site plans and detailed specifications; and designed street and parking lot pavements and building foundations. As Radiation Safety Officer, devised and implemented state compliant program for and oversaw use of nuclear testing equipment.

### EDUCATION

BS, Water Chemistry,  
University of Wisconsin, 1985

### CERTIFICATIONS,

### LICENSES, TRAINING

40-hour HAZWOPER, 1988

8-Hour HAZWOPER Refresher,  
2015

Blood-borne Pathogens, 1998

Confined Spaces, 1996

DOT Hazmat Employee, 2013

RCRA Statistics, 1992

Supervisory Hazardous Sub-  
stances/Waste Health and  
Safety, 1988

USACE Construction Quality  
Management for Contractors,  
2015

### WORK HISTORY

Ahtna Environmental, Inc.  
Senior Program Chemist, 2015  
– Present

E-Data, Inc.

Technical Director, 2009 –  
2015

Sullivan International, Inc.  
Project Manager / Program  
Chemist, 2007 – 2009

OTIE, Inc.  
Project Manager / Program  
Chemist, 1998 – 2007

Katalyst Analytical  
Technologies, Inc.  
Operations Director, 1996 –  
1998

CH2M Hill, Inc.  
Senior Project Scientist, 1988  
– 1996

Hazleton Laboratory America  
Senior Project Scientist, 1985  
– 1988

### EXPERIENCE SUMMARY

- Over 27 years of experience in environmental investigation and remediation programs for government/DoD, state, and commercial clients
- 19 years of experience as Project Manager directing site assessments; remedial investigations; feasibility studies; risk assessments; long-term operations and management; remedial actions; regulatory agency interaction and negotiations; community involvement programs
- Technical expertise in environmental chemistry, data management, meteorological and perimeter air quality, natural attenuation, soil vapor and indoor air monitoring, multi-media sampling methods, quality assurance, and quality control

### WORK EXPERIENCE

#### ***Ahtna Environmental Inc. – Pleasant Hill, CA Senior Program Chemist***

Oversight of corporate laboratory programs, third-party quality assurance/quality control (QA/QC) reviews, and analytical chemistry consulting services to industrial clients and environmental science and engineering firms.

#### ***E-Data Inc. – San Francisco, CA Technical Director***

Oversight of corporate laboratory programs, third-party quality assurance/quality control (QA/QC) reviews, and analytical chemistry consulting services to industrial clients and environmental science and engineering firms.

Typical tasks include: develop chemistry programs, perform laboratory data validation, define data quality objectives, complete QA/QC project plans, write SOPs, train employees in proper field sampling protocol and documentation, and perform ongoing QC audits of sample collection and handling activities and contracted laboratory vendors. Used MS Access to import various electronic data (SEDDs, ERPIMS, EQulS, others), evaluate, report, and export large datasets.

#### ***Sullivan – San Francisco, CA Project Manager / Program Chemist***

Served as USACE and Navy Program Chemist with firm-wide oversight of task-level associates that wrote sampling and analysis plans, quality assurance plans (UFP-QAPP), performed sampling and chemical testing, managed laboratory vendors, reviewed chemical data, and validated data with ADR.net.

Managed 16 ongoing environmental projects valued at \$2.4M that were completed on time and profitable. Projects included: fuel spills investigations, hotspots assessments, sediment/soil/groundwater investigations, skeet debris removal, and soil gas and vapor intrusion studies.

Proposal and deputy program manager for USEPA Region 9 and USACE Sacramento District direct awards. Successful as proposal manager and interim program manager for awards with USEPA

Region 9 (\$1M direct award and \$3.5M small biz award), USACE-Omaha (\$1M MATOC task order); and USEPA Region 2 (\$10M Small Business RAC IDIQ). Developed project scope through carefully written specification statements to limit contract liability and establish a fair price. Developed cost and schedule estimates, managed risk registers, wrote technical specifications, and assigned staff resources for projects.

***OTIE, Inc. – Project Manager / Program Chemist***

Technical lead for environmental chemistry programs and data management using in-house database management tools. Responsible for growing the environmental chemistry practice, maintaining high quality standards and efficient work processes, training and mentoring the team, providing senior technical support, working to create external visibility, while building the client portfolio.

Extensive experience in preparation and peer review of field sampling plans and data quality objectives to ensure effective and appropriate data collection along with other quality-related tasks, including field and laboratory auditing and training, writing technical specifications and standard operating procedures (SOPs), providing QA/QC and health and safety orientation, document preparation, data quality assessments, data validation of analytical laboratory data, data management, technical support, and senior document review. Identified innovative solutions to streamline work flow processes resulting in reduced levels of labor effort, budget and schedule improvements, and increased access to innovative technology.

Project management of more than 30 projects valued between \$25K and \$1M. In this role, collaborated with project stakeholders, developed scope of work, wrote work plans, established budgets and schedule, staffing plans, QA/QC plans, and risk management plans; monitoring progress of project and providing technical direction and resources to project team, and managing project scope.

Brief list of extraordinary personal accomplishments:

- Knowledge of USEPA terminology and requirements for environmental chemistry programs was a key advantage to winning the firm's first USEPA Region 9 contract
- Expert testimony led to two successful subcontractor litigations
- Grew the environmental chemistry team from a single office to a nationwide team of highly qualified chemists and data managers
- Collected, chemically tested, and managed data for 900 multimedia samples for off-site chemical analysis and 3,000 soil samples for onsite analysis during a 3 month remedial action
- Developed a perimeter air monitoring program with real-time data acquisition and reporting that allowed sediment remediation work to proceed without a single fence line non-compliance

- Designed a soil bio-pile treatability study resulting in remediation of fuel contaminated soil and onsite reuse at base landfill; successfully eliminating all offsite transportation and disposal costs
- Performed a PA/SA for 91 listed areas at Dare County Bombing Range and successfully negotiated 86 no action determinations and reducing remediation cost by 85%

***Katalyst Analytical Laboratory, Inc. - Laboratory Operations Director***

Manage the overall financial and technical aspects of the laboratory operations while maintaining corporate profit goals. Responsibilities include all data reported by the laboratory, personnel management, environmental consulting, public relations and financial support and management. Review the operations of each reporting function on a regular basis and support the development and implementation of the quality control program to maintain an excellent reputation in the environmental field.

***CH2M Hill, Inc. - Sr. Project Scientist.***

Skilled in the sampling of multimedia environmental samples (air, water, soil, waste, unknown material), chain-of-custody documentation, packing and shipping hazardous materials, data interpretation and reporting, and regulatory agency notification. Authored various documents and work plans including activities memorandums, field sampling and analysis plans, quality assurance project plans, health and safety plans, spill containment plans, and sections of investigation reports. Setup and operated mobile laboratories for general chemistry, GC, HPLC, and XRF instrumentation.

***Hazleton Laboratory America, Inc. – Project Scientist***

As a project scientist in the Environmental Fate, Metabolism, and Transport department responsible for laboratory procedures used to quantify pesticide degradation using various pathways such as soil metabolism, soil and aqueous photolysis, hydrolysis, column leaching, and volatility. Trained in the safe use of radiological isotopes.

### EDUCATION

M.S., Environmental Science and Engineering, Contaminant Hydrology Focus, Oregon Graduate Institute, 1993

B.S., Biochemistry, University of California, Davis, 1986

### TRAINING

40-Hour HAZWOPER

ERPIMS Training course, 2013

QSP/QSD Training course, 2012

Microsoft elearning SQL Server 2005 coursework, 2010

Geographic Information Systems, San Francisco State University, 2002

Stream Habitat Restoration Course, CDFG, 1995

Database: MS Access, SSMS, Oracle

Programming: VBA, C, FORTRAN, Javascript, HTML

### WORK HISTORY

Ahtna Environmental, Marina, CA, Senior Environmental Project Manager, 2015-Present

Chicago, Bridge, and Iron Federal Services, IMS Analyst III, 2013 – 2015

Shaw Environmental, Scientist III, 2003 – 2013

International Technologies Corporation, Project Chemist, 1997 – 2003

Woodward Clyde Consultants, Project Chemist, 1995 – 1997

Law Crandall Associates, Project Chemist, 1994-1995

Kuparuk Industrial Center Laboratory, Chemist, 1990 – 1992

Chemical and Geological Laboratories of Alaska,

### EXPERIENCE SUMMARY

- 21 years of experience as a Project Chemist for multiple environmental investigation and remediation DoD/Army CERCLA sites
- 20 years of experience performing environmental data management, and programming
- 27 years of field sampling of multiple media including soil, ambient air, indoor air, landfill gas, soil vapor, surface water, vernal pools, groundwater, and landfill leachate.
- Document Development: Primary or co-author in documents that include Quality Control Summary Reports, Work Plans, Technical Memorandums and Reports, Quarterly and Annual Reports, Closure Reports, Uniform Federal Policy Quality Assurance Project Plans (UFP-QAPP), Sampling and Analysis Plans, Chemical Data Quality Management Plans, and Environmental Protection Plans

### PROJECT EXPERIENCE

#### ***Project Chemist/Senior Scientist, Former Fort Ord, Presidio of Monterey, CA, 9/97 - present***

Management of subcontracted laboratories and third party data validation using Automated Data Review (ADR) software; Development of project specific ADR libraries; Gas/Soil/Groundwater/Surface water sampling; Familiar with standard test methods, SW846, and other analytical methods in sample analysis; Incorporation of the latest DoD QSM requirements and EPA data quality objectives process in the development of UFP-QAPPs; Implementation of data validation per EPA guidance; Production of Quality Control Summary Reports, Contractor Quality Assurance Reports, and Data Quality Assessments.

Optimization, monitoring of landfill gas (LFG) thermal treatment unit; field measurement of LFG for compliance, LFG Annual reporting, assistance in annual source testing to determine compliance with regulations; groundwater velocity calculations and plume determinations, creation of Environmental Protection Plan which involved detailed review of Fort Ord Wetlands Restoration Plan, and USFWS Biological Opinions.

#### ***Programmer, Treasure Island, San Francisco, CA, 2013 – 2014***

Performed needs assessment and worked with radiological technicians and program manager in the development of a customized Excel VBA application for radiological field work.

#### ***GIS/Database Manager, Former Fort Ord, Presidio of Monterey, CA, 8/2006 – 8/2009***

Managed [www.fortordcleanup.com](http://www.fortordcleanup.com) and [www.fodis.net](http://www.fodis.net), and associated databases (MS Access and SQL Server); designed web-based chemistry data loading tool, managed subcontractors performing work for Sacramento Total Environmental Restoration Contract (TERC) I and II project site; and provided cost estimates, schedule updates, accruals, and budget information on a monthly basis.



Supervisor/Chemist, 1988 – 1990

Sebastiani Vineyards,  
Laboratory Technician, 1987 - 1988

***Data Management/Programming, 8/2006 – 8/2009***

Creation of customized MS Access databases for data management of chemistry and landfill data; Development of custom MS Excel VBA macros for data conversion, loading, and presentation; Optimization and improvement of existing programming, utilization of data in a multitude of formats (delimited, fixed length); Querying, and updating of SQL and oracle databases; Tortoise SVN SOP development; Development of Migration Plan and QC Test Plan for migration and merger of multiple databases; Google API map development: <http://199.255.250.170/parcelmap/>; and troubleshooting and QC of applications, and training.

***Task Manager, Former Fort Ord, Presidio of Monterey, CA, 2006 – 2007***

Task management for offsite drilling operations, and fence construction; Liaison with local land owners to address their concerns and provide information; installed passive diffusion bags, and profiled aquifer for TCE contamination; provided technical evaluations of data to the client and to the agencies, wrote statements of work and procured subcontractors; and tracked costs/invoices and performed monthly accruals.

***MEC Removal Database Manager, Former Fort Ord, Presidio of Monterey, CA, 8/2005 – 9/2008***

Data management for MEC removal action; imported data into an offsite SQL server database that was collected using handheld PDAs, resolved data issues with field staff, queried SQL server database (using MS Access as a front end) for daily reporting, presented updates at weekly meetings with USACE, made grid assignments working with task management and UXO supervisors, worked with UXO QC, lead Geophysicist;

***Senior Staff Scientist, Hamilton Army Airbase, Novato, CA, 8/1995 – 9/1997***

Applied statistical analysis on analytical data to characterize remediation stockpiled soils; created SAPs, QAPPs, work plans, and Data Quality Assessment reports for the USACE; developed database for analytical data; generated data quality assessment for inclusion in Remedial Investigation report; and directed preparatory phase inspections.

***Supervisor/Chemist, AK, 10/1988 – 8/1992***

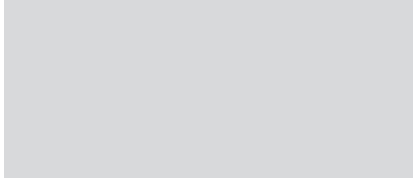
Worked at two laboratories, one of which was on remote camp in the Arctic; Developed and produced Standard Operating Procedures to ensure uniformity in sample analysis; implemented QA/QC procedures for inorganic sample analysis and field work done at Kuparuk Field, Alaska; gathered soil samples at petroleum spill site; Supervised Inorganic Chemical Analysis section; and developed extraction procedure for soil petroleum hydrocarbons analyses.

**Field work:** Kenai, Alaska, screened for petroleum hydrocarbons at oil company cleanup site; Kodiak, Alaska, screened for petroleum hydrocarbons on bore samples, to determine location of leaking

Ahtna

**Eric Schmidt**

**Chemist**



underground fuel tank; and Soldotna, Alaska, samples monitoring wells at Kenai and Soldotna landfills.



**Zachary T. Carroll - Staff Database Analyst II**

13 total years of experience

**EDUCATION**

Bachelor of Art, History (Social Science Program), 1999, California State University, Sonoma

**BIOSKETCH**

Mr. Carroll is a Data Management Specialist and Data Validation Technician who has been maintaining data integrity and production of scheduled reports in a timely manner since 2000. He has reviewed all aspects of program databases for accuracy, advised on future database design needs, performed data validation, wrote and presented reports, and answered questions regarding analysis.

**PROJECT EXPERIENCE**

**Data Validation Technician: Casmalia Resources Superfund Site Maintenance, Remedial Investigation/Feasibility Study (RI/FS), Groundwater Monitoring, Casmalia, California.** Responsible for providing quality assurance (QA) and quality control (QC) review relative to analytical laboratory data. Performed Level III and Level IV data review in accordance with the project work plan, the project field sampling plan, and the principals presented in the *USEPA National Functional Guidelines for Superfund Organics Data Review* and the *USEPA National Functional Guidelines for Laboratory Data Review, Inorganics*. Scope: Work performed in support of site maintenance and management, RI/FS, regulatory compliance and support of investigation at a 252-acre, former Class I Superfund, Hazardous Waste Management Facility comprising five separate landfills and which included approximately 40,000 tons of industrial waste on site (with acids, caustics, solvents, pesticides, and metals). Implemented 24-hour operating leachate collection and contaminated groundwater treatment system, and over 300 monitoring wells.

**Data Validation Technician: Universal Paragon Corporation / BP PLT-1, LLC Former Schlage Lock and Southern Pacific Brisbane Rail Yard Operable Units (OUs) Brownfield Soil and Groundwater Remediation Services, San Francisco, California.** Responsible for providing data review summary reports describing analytical performance expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). Scope: Engineering efforts in development of a strategic roadmap to help close the real estate deal and transfer of environmental liability to BP/MACTEC Team for redevelopment. Brownfield site is scheduled to be redeveloped into a \$450 million mixed-use development, including 1,200 residential homes and public open space. Conducted remedial investigation (RI) and feasibility studies (FSs) to identify final remedies for volatile organic compound- (VOC) impacted soil and groundwater and metal-impacted soils. The selected remedial action will entail in-situ bioremediation of VOC-impacted groundwater using enhanced reductive de-chlorination by injecting soybean oil into the subsurface to enhance natural microbial activities.

**Database Specialist/Data Validation Technician: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Groundwater Sampling, Analysis and Reporting, Fort Ord Site (Seaside), California.** Responsible for providing data review in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans*; generating quarterly output and maintaining the project libraries for the project's Automated Data Review (ADR) software; writing of the Quality Control Summary Report for inclusion in the Quarterly Report; and conducting ongoing data loading in SQL and Access databases. Scope: Continuation of ongoing groundwater sampling, analysis, and reporting program at Fort Ord site. Quarterly sampling and analysis conducted at more than 300 stations along with evaluation of treatment systems operation.

**Database Technician/Data Validation Technician: Former Chemical Manufacturing Facility Perchlorate Investigation, Remediation, Morgan Hill, California.** Responsible for providing Level III and Level IV data review in accordance with the *USEPA National Functional Guidelines for Laboratory Data Review, Inorganics*; troubleshooting data validation issues with laboratory personnel; MAROS Mann-Kendall Analysis for determining

trends in analyte concentration levels; performing quarterly reporting of QA/QC findings; regulatory uploading of data packages and written reports to Geo-Tracker online website; and data loading and QC tracking in SQL and Access databases. Work is being done in support of a Remedial Investigation to delineate lateral and vertical extent of perchlorate in soil and groundwater at the site of a former flare manufacturing facility. Perchlorate has been detected in onsite soil and onsite and offsite groundwater.

**Database Specialist/Data Validation Technician: Confidential Client, Former Manufacturing Facility, Groundwater Investigation and Remediation, Northern California.** Responsible for ongoing uploading of chemistry data to SQL database and providing database support in implementation of SQL database relating both historical and incoming chemistry data in support of regulatory review and environmental support services for a former industrial building products manufacturer; Level II and Level III data validation performed in accordance with the project's Quality Assurance Project Plan and the *USEPA National Functional Guidelines for Superfund Organics Data Review* and writing of quarterly data review summary. Services provided include groundwater testing and sampling pertaining to nearby groundwater plume impacted by solvents (PCE and TCE).

**Database Specialist/Data Validation Technician: Groundwater Monitoring Program, Los Angeles, California.** Responsible for reviewing data for compliance with laboratory control limits and method compliance in accordance with USEPA Level II review; quarterly reporting of validation summary for groundwater data to assist client with making project decisions; MAROS Mann-Kendall analysis to determine trends in chemicals of concern on a quarterly basis. Work is being done in support of O&M of Soil Vapor Extraction (SVE) system and vapor enhanced recovery (VER) system and semi-annual groundwater monitoring program. Site occupies several acres on property converted from manufacturing operation (including buildings) to present day asphalt-covered commercial parking lot.

**Database Specialist/Data Validation Technician: Site A Environmental Site Assessment and Remediation, Torrance, California.** Responsible for quarterly reporting of validation summary for groundwater data to assist client with making project decisions; review of data for compliance with laboratory control limits and method compliance, in accordance with USEPA Level II review. Work being done in support of soil and groundwater contamination remediation at a 3.2 million square feet industrial complex site comprised of numerous manufacturing buildings. Services included indoor air monitoring for VOCs.

**Database Technician: IBM Corporation Phase I Environmental Site Assessments, Groundwater Treatment System O&M and Monitoring, San Jose, California.** Provided database support, including data loading, QC, reporting, and archiving. Created and delivered to the client a data extract from SQL database in EQuIS data format. Scope: Phase I Environmental Site Assessments and other environmental services for leased properties at end of lease, prior to being returned to owner. Sites have included offices and manufacturing facilities. Activities included well installation and abandonment; O&M of groundwater extraction system; management of Self-Monitoring Program; and various on-call services to support client's environmental program. MACTEC services saved IBM an average of \$40,000-\$50,000 a year over a four-year period in monitoring and O&M costs by negotiating closure of over 150 monitoring wells.



**Jeffery J. Fenton - Senior Geologist**

27 total years of experience

**EDUCATION**

Bachelor of Science, Geology, 1981, Oregon State University, Corvallis

**CERTIFICATIONS**

HAZWOPER 40 Hour

HAZWOPER 8 Hour Refresher

HAZWOPER 8 Hour Supervisor

OSHA Confined Space Entry

**BIOSKETCH**

Mr. Fenton is a Senior Geologist and Project Manager with over 27 years of experience. He is responsible for designing and managing programs, developing work plans, performing record searches and evaluation of storage and handling of hazardous wastes, supervising field work and data reduction, and participating in agency and public meetings. He has managed numerous large and small HTRW projects, including the evaluation and characterization of sites with hydrocarbon, solvent, metals, pesticide, PCB, explosive compound, and low-level radioactive wastes. His responsibilities have included preparing RI/FS and site characterization reports, confirmation reports, IA Approval Memos, Environmental Baseline Surveys, FOSTs, FOSLs, FOSETs, environmental compliance reports, BRAC Cleanup Plans, site safety plans, and confirmation reports in compliance with BRAC, DoD, CERCLA, RCRA, USACE, EPA and State and local guidance. He has managed tasks involving industrial facilities, landfills, munitions response sites, service stations, food processing plants, and agricultural facilities for federal DoD agencies (e.g., USACE, Army, and Navy) and private sector clients.

**PROJECT EXPERIENCE**

**Project Manager: Ahtna Engineering Services, Fort Ord Groundwater Monitoring Program, Sites 2 and 12, OU2 and OUCTP.** Responsible for the monitoring and characterization of three groundwater plumes at the former Fort Ord, CERCLA site. Manage the collection of groundwater elevations and the chemical sampling of a network of over 300 monitoring wells on a quarterly basis. Samples are analyzed for a variety of inorganic and organic compounds. Groundwater elevation and chemistry data are compiled for inclusion into quarterly and annual monitoring reports that include groundwater elevation contour maps and iso-concentration plots of the data collected for each plume and for each aquifer affected. Responsible for overall project quality control, validation of analytical data and submittal of the quarterly and annual reports to the client, regulatory agencies and the public.

**Project Manager: Ageiss, Inc., Data Validation Support, Semi-Annual Groundwater Sampling, Dodge Hill Landfill, Fort Sill Oklahoma.** Provide validation and statistical analysis of all groundwater data collected during semi-annual groundwater sampling at the Dodge Hill Landfill, Fort Sill Oklahoma. Validation includes Level III review on 100% of the data and Level IV review on 10% of the data with qualifiers applied to the electronic deliverable file (EDD). Data review is presented in a Data Validation Summary Report. Perform statistical analysis on all groundwater analytical data for each sampling event. The statistical analysis is presented in a report which is appended to the client's semi-annual groundwater report for submittal to the US Army Corps of Engineers (Ageiss client) and the Oklahoma Department of Environmental Quality.

**Project Manager: Hydrogeologic Inc. (HGL), Treatment Plant Decommissioning, Fort Ord, California.**

Provided technical review of the Work Plan and Completion Report prepared by HGL and provided field oversight of well destruction activities to ensure well destruction was completed as per the permit requirements and HGL's Work Plan. Work performed for HL under Huntsville Small Business Worldwide Environmental Services (WERS) contract.



**Project Manager: Innovative Technical Solutions, Inc. (ITSI), A Gilbane Company, Groundwater Modeling and Technical Memorandum Revision, Fort Ord, California.** Provided updates to the fort Ord groundwater model to support the design element of the relocation of the Operable Unit 2 (OU2) groundwater treatment plant. Completed a groundwater model run with existing and proposed extraction and injection wells, including a cost benefit analysis used to support the design basis for the new location of the OU2 groundwater treatment plant. Included revision/finalization of the draft groundwater technical memorandum. The technical memorandum included the proposed locations of new extraction wells to supplement and optimize the existing groundwater extraction well network.

**Task Manager: Lennar / BVHP, LLC Hunters Point Naval Shipyard Parcel A Environmental Consulting Services, San Francisco California.** Environmental consulting services to support client's legal counsel, address special requests for information from project stakeholders, and present information at planning and technical meetings as part of ongoing effort to redevelop Parcel A of area formerly occupied by U.S. Naval shipyard. Provided review of and recommendations on existing documents. ***Lennar achieved compliance with regulatory requirements with MACTEC's assistance.*** Responsible for preparing a Finding of Suitability to Lease document for 8 buildings and 2 open spaces.

**Geologist: The Presidio Trust Site Closure Environmental Services, San Francisco California.** Environmental services associated with site closure, including site investigation, risk assessment, feasibility study (FS), engineering design, data management, ecological risk assessment, remediation, and reporting at historic 1,416-acre former military base at the south end of the Golden Gate Bridge. Responsible for preparing a Supplemental Health and Safety Plan for Munitions and Explosives of Concern.

**Task Manager: U.S. Army Corps of Engineers - Huntsville District, Fort Ord Operable Unit (OU) Habitat Remedial Investigation / Feasibility Study (RI/FS), Monterey California.** Since 2004, MACTEC has been conducting full remediation investigation / feasibility study (RI/FS) to address munitions and explosives of concern (MEC) at the Impact Area Munitions Response Area (MRA) for 6,500 acres of a 8,000-acre former U.S. Army training range complex (small arms to artillery fire). Activities included planning, site characterization, archival (historic) search, risk assessment (human health), feasibility study, and community relations support. Responsible for conducting site characterization efforts.

**Task Manager: U.S. Army Corps of Engineers - Huntsville and Sacramento Districts, Fort Ord Site RI/FS Reports Track 0&1 Approval Memorandum, Parker Flats ROD and Public Meeting, Monterey California.** Under an additional delivery order, completed the development and submittal of additional Track 0 and 1 approval memoranda and ROD for multiple reuse parcels throughout site of former Fort Ord. Activities support remedial investigation efforts as part of Military Munitions Response Program. ***Analysis performed by MACTEC resulted in No Further Action determination for 21 of 24 Track 1 sites.*** Responsible for participating as one of the authors of the Remedial Investigation / Feasibility Studies document.

**Task Manager: U.S. Army Corps of Engineers - Huntsville and Sacramento District, Environmental Baseline Survey for Transfer (EBST) Documentation Services, Monterey California.** Preparation of documents and associated evaluations relating to broad range of environmental issues (e.g., asbestos and lead-based paint) at Fort Ord as part of work for Environmental Baseline Survey for Transfer (EBST). In support of property transfer MACTEC prepared Findings of Suitability to Transfer (FOST), Findings of Suitability to Lease (FOSL), and Findings of Suitability for Early Transfer (FOSET). ***Early transfer was approved saving \$1 million in infrastructure and maintenance cost.*** Responsible for writing the FOST documents for 30 parcels and the FOSET documents for 64 parcels.

**Task Manager: U.S. Army Corps of Engineers - Huntsville and Sacramento Districts, Fort Ord Site Investigation and Documentation for FOST, Monterey California.** Investigative and documentation activities performed as part of development of environmental basewide survey for transfer (EBST) and findings of suitability for transfer (FOST) at former Fort Ord site. In support of property transfer MACTEC prepared Findings of



Suitability to Transfer (FOST), Findings of Suitability to Lease (FOSL), and Findings of Suitability for Early Transfer (FOSET). *Early transfer was approved saving \$1 million in infrastructure and maintenance cost.* Responsible for writing the FOST document for one parcel.

**Project Manager: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Groundwater Sampling, Analysis and Reporting 2008-2009, Fort Ord Site (Seaside) California.** Continuation of ongoing groundwater sampling, analysis and reporting program at Fort Ord site for 2008-2009 (Option Year 3). Quarterly sampling and analysis conducted at more than 300 stations along with evaluation of treatment systems operation. Responsible for data management, data evaluation, and reporting.

**Task Leader: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Site Electronic Data Integration and Management, Monterey California.** Electronic data integration and management of various environmental databases, administrative records, facilities management information and GIS applications developed for site characterization, OE investigation, and remediation activities at former Fort Ord site. Work is continuation of services under ongoing BRAC and IRP programs. The database contains over one million records. Contract Compliance Screening (CCS), Automated Data Review (ADR), and Environmental Management System software programs were developed and resulted in *cost savings of up to 50% in labor reduction (\$250K) and improvements in the data management process for numerous task orders.* Responsible for contributing information regarding property transfer-related documents that needed to be integrated into the overall Fort Ord database.

**Environmental Task Manager: U.S. Army Corps of Engineers, Sacramento District, Fort Ord Complex Site BRAC Related Environmental Services, Monterey California.** Environmental and engineering services under BRAC Program since 1985 for Fort Ord Complex (28,000-acre former Fort Ord, the Presidio of Monterey, and Fort Hunter Liggett, Fritzsche Army Airfield), a National Priorities List (NPL) site. Completed several hundred multidisciplinary, multitask delivery orders, with dozens more in progress. Services have included site investigations, risk assessments, feasibility studies, including ordnance/explosives remedial investigation, remedial designs, remedial actions, environmental compliance, utilities/roads, parcel descriptions, endangered species and habitat assessments, underground storage tank investigations, asbestos assessments, groundwater remediation, planning for base reuse, and community relations. Services have been conducted under CERCLA; RCRA; NEPA/CEQA; California landfill regulations; Monterey County underground storage tank (UST) regulations; air toxics regulations; and other federal, state, and local environmental laws and regulations. *Successful completion of RI/FS documentation as part of 40+ site RI/FS allowed the Army to meet the congressionally mandated 36 month RI/FS schedule.* To track the status of the property transfer and to provide the most up-to-date information to community stakeholders on the environmental cleanup, MACTEC developed a public website ([www.fortordcleanup.com](http://www.fortordcleanup.com)). This allowed interested parties to view information online. *This reduced the time needed for onsite staff to manage the paper administrative record by approximately 50%.* Responsible for serving as the BRAC task manager, preparing appropriate documentation, including Environmental Baseline Surveys (EBSs), Findings of Suitability to Transfer (FOSTs), Findings of Suitability for Early Transfer (FOSETs), Findings of Suitability to Lease (FOSLs), and Notices of Intent (NOIs), under the Comprehensive Environmental Response, Compensation, and Recovery Act (CERCLA) guidance, which accelerated real-property transfers in accordance with the Defense BRAC Act (BRAC Program). Worked closely with the U.S. Department of the Army, U.S. Army Corps of Engineers (USACE), EPA, and State of California to develop approaches that met the requirements of CERCLA 120(h) and satisfied regulatory concern for documenting the environmental condition of the property at the time of transfer. Also responsible for RCRA closure activities.

**Technical Consultant: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Wetlands Habitat Monitoring 2003, Monterey California.** Continuation of habitat monitoring work as part of the BRAC and IRP activities at site of former Fort Ord. Monitoring activities at wetland sites on property include vegetation sampling, wildlife surveys, and collecting and analyzing physical and hydrological data. *Results of the habitat monitoring showed that the habitat had recovered in four years and thus eliminated the fifth year of monitoring saving \$85,000.* Responsible for review of property transfer documents related to habitat monitoring activities.

**Task Manager: U.S. Army Corps of Engineers - Sacramento District, Fort Ord and Fort Hunter Liggett Groundwater Monitoring Program, Forts Ord, Hunter Liggett California.** Groundwater investigations and provided quarterly monitoring; prepared property transfer documents; performed habitat monitoring and groundwater remediation system evaluation; and conducted Small Arms Range remediation pilot study evaluation at site of two former U.S. Army installations under BRAC program. *The project has been completed and consisted of twelve sites requiring remediation that have been closed with regulatory approval resulting in a reduction in long-term O&M for the client.* Responsible for data evaluation and management, preparation of reports and cost proposals, and review of invoices.

**Task Manager: USACE, Sacramento District, Military Munitions Response Program (MMRP), FortOrd, Monterey County, California.** Currently serving as Task Manager responsible for the completion of a RI/FS, Proposed Plan, and Record of Decision at former munitions response sites. Conducted and evaluation of the possible use of military munitions at 24 former military munitions sites. The evaluation included researching the history of each site (PA/SI) and completing a review of the available data to develop conceptual site model(s) for each potential site. Data gaps were identified and the potential risk remaining at each site was also evaluated. Worked directly with federal and state regulatory agencies and community stakeholders throughout the review and approval process. The RI/FS is being conducted following EPA, DoD, and CERLA guidance. Other documentation prepared in support of the Fort Ord MMRP include IA Approval Memorandums, and Notices of Intent (NOI) for Removal Actions and Land disposal Site Plans prepared in support of the Army's Time-Critical Removal Action (TCRA) program. The NOI complies with 40 CFR, Part 300, Section 415 and notifies the regulatory agencies and the public of upcoming removal actions, intended to mitigate or eliminate the threat to public safety presented by the presence of munitions and explosives of concern (MEC).

**Task Manager: USACE, Sacramento District, Closure of RCRA Solid Waste Management Units, Former Fort Ord, Monterey County, California.** Implementing the closure of two solid waste management units under the Fort Ord RCRA program. Closure involves the site investigation and characterization of a former PCB storage facility and a former Open Burning/Open Detonation (OB/OD) munitions disposal unit. Investigation involved conducting a field investigation including the sampling and analysis for chemicals of concern, and completion of a closure certification report following RCRA guidance.

**Task Manager: USACE, Sacramento District, Investigation of Solid Waste Management Units, Former Fort Ord, Monterey County, California.** Task manager for the evaluation of former hazardous waste storage units. Evaluation involves physical inspection of the units including a review of the cleanliness and integrity, waste handling and storage practices, determining whether a release has occurred and making sampling recommendations if necessary. Information including any recommendations made to state and federal regulatory agencies through a status report. Wastes stored and evaluated include waste oil, fuel, solvents and paint, PCBs, pesticides, asbestos, used ethylene glycol, adhesives and polymers. Created a detailed historic account of the solid waste management units which has been instrumental in the regulatory approval of the transfer of property containing the units.

**Project Geologist: Confidential Client, Regulatory Compliance Audits, Processing and Distribution Facilities, Western U.S.** Served on audit teams performing regulatory compliance audits for a major food production, processing and distribution company. The project entailed the completion of audits in a 5-month period at 37 facilities in California, and several other facilities in four states. The audit protocol prepared by HLA addressed facility compliance with regulations for hazardous waste, hazardous materials, air quality, water quality, drinking water and transportation. The protocol further provided for the completion of a preliminary screening evaluation that involves the local facility management in targeting relevant operations and matters of concern for the audit, prior to proceeding with the on-site phase of the program.

**Task Manager: USACE, Site Investigations, Fort Ord, Monterey, California.** Served as task manager for the investigation of several UST sites. Was responsible for determination of MACTEC and subcontractors scope of work, calculation of excavation volumes, oversight of subcontractors, collection of samples, review of analytical data, preparation of clearance and characterization reports, and budget tracking.

**Task Manager: USACE, Remedial Investigation/Feasibility Study, Fort Ord, Monterey, California.** Served as task manager for the remedial investigation/feasibility study (RI/FS) of two IRP sites at Fort Ord. Was responsible for the interpretation of chemical and hydrogeologic data, oversight of chemical and geologic database, coordination with risk assessment and engineering personnel, determination of contaminant fate and transport, coordination and production of final RI/FS report, and budget tracking.

**Task Manager: Alameda County Department of Public Works, Landfill Investigation, Winton Avenue Landfill, Hayward, California.** Served as task manager for landfill investigation under the state Solid Waste Assessment Test (SWAT) program. Was responsible for the preparation of work plan, installation and quarterly sampling of groundwater and leachate monitoring wells, aquifer testing, data evaluation, assessment of impact of leachate on waters of the state, and preparation of SWAT report.

**Task Manager: U.S. Navy/PRC, Utilities Investigation, Hunters Point Naval Shipyard, San Francisco, California.** Was task manager for a cross-base underground utilities investigation. Study involved the review of as-built drawings of sanitary sewer, storm drain, steam pipelines, and fuel lines, and the collection of soil and water samples adjacent to and within utility systems. Was responsible for the review and interpretation of analytical data, recommendations on remediation and mitigation measures, and the presentation of the results at a series of client and agency meetings.

**Task Manager: U.S. Navy/PRC, Remedial Investigation, Hunters Point Naval Shipyard, San Francisco, California.** Served as task manager for RI of five sites for contaminants including petroleum hydrocarbons, PNAs, pesticides, and metals. Completed interim-action evaluation in accordance with the EPA Superfund Accelerated Cleanup Model. Was responsible for budget and schedule tracking, chemical and hydrogeologic data interpretation, report preparation, and client representation at regulatory agency meetings.

**Field Manager: U.S. Navy/PRC, Field Coordination, Hunters Point Naval Shipyard, San Francisco, California.** Managed all aspects of field work, including the development, implementation and tracking of field schedules; coordination with client, subcontractors, and regulatory agencies; scheduling field personnel and reviewing all field documentation; and calculating and ordering all field supplies.

**Task Manager: U.S. Navy/PRC, Aquifer Testing, San Francisco, California.** Developed and implemented site-wide aquifer characterization program. Work included the development of the scope of work assessment of well construction and suitability, performing step-tests, and constant rate discharge tests.

**Project Manager: Confidential Client, Product Removal Investigation, Hunters Point Naval Shipyard, San Francisco, California.** As project manager, supervised the field investigation involving the removal of free-phase floating hydrocarbons from monitoring wells. Calculated and tracked the volume of product removed to determine the feasibility of installing a pumping system.

**Task Manager: Confidential Client, Monitoring Well Network Installation, Longview, Washington.** Installed, developed, and sampled network of groundwater monitoring wells in bedrock to investigate the impacts of a long-term release of mercury.

**Task Manager: Montecito Heights Landfill, Monitoring Well Installation, Napa County, California.** Installed monitoring well in deep aquifer using air rotary drilling method.

**Task Manager: Former Fuel Storage and Dispensing Facility, Contra Costa County, California.** Supervised and directed excavation of hydrocarbon-contaminated soil at former oil tank farm.

**Task Manager: Site Assessment and Remediation, Richmond, California.** Installed and developed monitoring wells and collected soil and groundwater samples. Supervised and directed contractor's removal of lead-, hydrocarbon-, and lime-contaminated soils at former shipyard site.

**Field Manager: Well Installation, Morgan Hill, California.** Installed double-cased well in deep aquifer using mud rotary drilling methods.

**Field Manager: Well Installation, Vorhees, New Jersey.** Installed monitoring well nests in shallow and deep aquifers using mud rotary and hollow stem auger methods.

**Well Site Geologist: Exploration Logging Geothermal Division, Geothermal Exploration, California, Nevada, and Japan.** Experienced in mud rotary, air rotary, and aerated mud drilling systems. Performed geologic logging of deep exploration geothermal boreholes. Responsibilities included descriptive lithologic sample analysis, monitoring of borehole temperature, borehole pressure and borehole gas levels; collection of borehole gas samples for chemical analysis; geothermal well production testing and reservoir analysis. Health and safety monitoring of carbon dioxide, methane and hydrogen sulfide gas levels around the drill site. Field experience in the Geysers California, Steamboat Nevada, Takigami and Fushime Fields, Kyushu Japan.

**Kevin E. Garrett Ph.D., P.E., PMP – Senior Principal**

21 Years Experience

**EDUCATION**

Doctor of Philosophy, The Pennsylvania State University Chemistry, 1990

Bachelor of Science, Colorado State University Chemistry, 1986

**REGISTRATIONS**

Colorado Licensed Professional Engineer (License number 43243)

Project Management Institute Project Management Professional (PMP)

**BIOSKETCH**

Dr. Garrett has a Ph.D. in Chemistry and is a Colorado licensed professional engineer with extensive experience in groundwater and soil remediation, site investigation, and the application of environmental chemistry. Dr. Garrett has managed RCRA facility investigation projects (RFIs) and remediation projects that have included developing innovative regulatory approaches resulting in significant cost savings for associated site remediation. Dr. Garrett has managed projects and applied innovative approaches to remediate groundwater, including monitored natural attenuation (MNA), enhanced reductive dechlorination (ERD), in situ biological remediation, in situ chemical oxidation (ISCO), soil vapor extraction (SVE), and neutralization remediation strategies.

Dr. Garrett has designed a full-scale in situ treatment system to remove chlorinated solvents such as methylene chloride, trichloroethene (TCE), tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), petroleum products, and inorganic constituents such as nitrate and perchlorate from groundwater. The remediation designs utilizes innovative strategies that that has minimized system complexity with reduced set up, operating and maintenance costs and achieve client and regulatory agency remediation goals in the shortest time possible.

Dr. Garrett has managed projects under a variety of regulatory programs including Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and State Voluntary Cleanup Programs. During these projects, Dr. Garrett has aided clients in negotiating site closure, points of compliance, and remediation criteria with regulatory agencies. . These negotiations have aided AMEC clients to close and/or redevelop sites for other uses while meeting the environmental and human health protection goals of the regulatory agency.

In addition, Dr. Garrett has assisted clients with implementation of client's environmental compliance programs including monitoring. Activities include requirements hazardous waste, waste water and storm water compliance, spill prevention plans, and emergency response planning. Dr. Garrett has extensive experience with Phase I and II environmental site assessments (Phase I and Phase II ESA).

As Project Manager and Senior Principal, Dr. Garrett manages technically difficult projects. Dr. Garrett is responsible for all aspects of a project, including compliance with company policies, definition of scope of work, establishment of budgets and schedules, control of project costs, compliance with schedule, timely payment for the work, and assurance of overall client satisfaction. In addition, as project manager, Dr. Garrett ensures project quality control activities are in place and adhered to. Selects and supervises project team members; ensures that team members are assigned appropriate roles. Provides leadership to project team; maintains a positive environment and high morale. As Senior Principal, Dr. Garrett provides senior-level technical expertise for project teams. Acts as primary interface with clients for assigned projects; communicates with clients on an ongoing basis; responds effectively to meets clients' needs.

Dr. Garrett is the Chief Engineer of AMEC's Golden, Colorado office. As Chief Engineer, Dr. Garrett provides leadership role for marketing to major clients, service areas, and technically unusual projects; responsible for



selected key clients. Serves as primary quality assurance officer for assigned office(s); verifies implementation of quality programs and initiatives.

In the area of quality assurance, Dr. Garrett has extensive experience in development of project-specific QA / QC programs and writing of quality assurance project plans (QAPPs). He has developed appropriate analytical and QA/QC criteria, selected appropriate methods, and developed appropriate reporting limits and method detection limits (MDLs). Dr. Garrett has extensively validated and evaluated analytical data.

## **PROJECT EXPERIENCE**

**Project Manager: Molycorp RCRA Facility Investigation (RFI) and Site Closure Remediation Services, Louviers, Colorado.** Dr. Garrett managed design and construction of a full-scale in situ biodegradation system (under RCRA) to treat the groundwater nitrate plume at the facility's 34-acre pond area and 32-acre operations area. He developed an innovative in situ remediation system to remove nitrate from groundwater that minimized system complexity and minimized treatment costs to the client. Negotiated and developed the technical approach and justification to close 6 process water holding ponds two years ahead of the original schedule. Included in the technical approach were negotiations with the state regulatory agency on site-specific soil standards for nitrate that met the state goal of being protective of groundwater. Provided technical oversight of the pond closure contractor to ensure that the closure plan requirements were met. Closure of the ponds allowed for expansion of the groundwater treatment system. The expanded in situ treatment system reduced the time required to meet the compliance schedule with respect to nitrate in groundwater. Developed monitoring and characterization plan for perchlorate and demonstrated that the nitrate treatment was effective in meeting the negotiated site specific remediation goals with CDPHE. Performed radiological dose assessment for groundwater and soil in support of the facilities request to terminate their radioactive materials license. This effort included modeling potential radiation dose to hypothetical future residents from exposure to the sites soil and groundwater.

**Project Manager: GSA - Denver Federal Center (DFC), Site-Wide Long-Term Monitoring, Lakewood, Colorado.** As project manager, Dr. Garrett is leading the site-wide long-term monitoring activities at the Denver Federal Center. These activities include quarterly sampling of up to 250 monitoring wells and surface water locations on and off of the DFC. Quarterly activities include water level measurements, sampling, data validation, data management, and reporting. Additional activities include a 5-Year Review of the performance of the groundwater corrective measures. These corrective measures include, funnel and gate barrier system, source area pump and treat system, and off site plume. At project manager, Dr. Garrett is responsible for ensuring that the activities area completed on time and within budget.

**Project Manager: GSA - Denver Federal Center (DFC), Investigative Area (IA) 13 and 16 Corrective Measures, Lakewood, Colorado.** As project manager, Dr. Garrett lead the IA 13 source area characterization activities. These activities included characterization of 2 geophysical anomalies by trenching and soil sampling. In addition, the extent of the source area groundwater plume was evaluated using a Membrane Interface Probe (MIP). Based on the MIP results 20 additional monitoring wells were installed. After characterization activities, AMEC implemented the corrective measure which included injection of potassium permanganate into the alluvium and upper weathered bedrock (UWB) and injection of sodium permanganate into the lower weathered bedrock (LWB). Of particular interest was injection of permanganate at the LWB/consolidated bedrock interface. Injections were conducted in approximately 157 alluvium/UWB locations and 60 LWB locations. Post injection monitoring is currently being performed to evaluate the remediation effort to date.

**Project Manager: GSA - Denver Federal Center (DFC), Investigative Area (IA) 04D RCRA Facility Investigation (RFI), Lakewood, Colorado.** Dr. Garrett conducted two RCRA Facility Investigations (RFIs) and a survey of asbestos in soil for two parcels for the General Services Administration (GSA) at the DFC. The Interior RFI was completed at Building 41 and 42 and consisted of 68 borings and monitoring wells installed inside the buildings. The drilling was completed in conjunction with the facilities ongoing operations. The work



included extensive coordination with the GSA and building tenants to ensure that the RFI activities did not impact their normal business activities. The Exterior RFI for the investigation area 04D included installing 80 borings and monitoring wells, excavating 11 trenches to characterize soil and potential impacts from historic operations at the DFC. The investigation included jetting/cleaning and video survey of sanitary and storm water sewer lines in IA04D. Responsibilities included general supervision of the work and activities such as development of subcontractor scopes of work, soliciting competitive subcontractor bids, insuring compliance with standard operating procedures, and health and safety plan development/implementation. Dr. Garrett was responsible for maintaining project schedules, monitoring the budget and costs, and preparing invoices for submittal to GSA. Dr. Garrett also provided regular project status updates to the GSA Project Manager.

**Principal-in-Charge: Colorado Department of Transportation (CDOT) Region 6 Headquarters RCRA Facility Investigation (RFI) and Remediation Project, Denver, Colorado.** Dr. Garrett served as a Remediation Specialist and Principal Chemist responsible for evaluating and interpreting groundwater monitoring and treatment data as well as conducting statistical evaluation of the treatment data. He oversees engineering and environmental services implemented to remediate soil and groundwater contaminated with methylene chloride, TCE, PCE, and 1,1-DCE. Dr. Garrett's responsibilities include ensuring that the project meets the technical and quality requirements for the engineering and environmental services implemented to remediate groundwater and soil. He has assisted in (1) site investigations; (2) design and construction of the bioremediation system; and (3) ongoing O&M activities for the groundwater treatment system.

**Remediation Specialist and Principal Chemist: Lowry Assumption Company - Former Lowry Air Force Base Redevelopment Design / Build, Denver, Colorado.** Remediation Specialist responsible as for assisting in development of groundwater and soil analytical programs for Operable Unit 2 (OU2) work, and assisting in development of OU2 Work Plan and final report for OU2 landfill closure. Scope: Design and construction of a 67-acre landfill cap, remediation of major groundwater plume, and privatized contaminant characterization and cleanup including groundwater monitoring at 1,866-acre former air force base in large urban area. Services included engineering design and construction quality assurance. Approach is predicted to save several years of cleanup time and has allowed for more efficient and quicker redevelopment activities into a mixed-use community that has been recognized with the Governor's Award for Smart Growth.

**Project Manager, Petroleum Distribution Center, Denver, Colorado.** Through a comprehensive liability assessment of the site, AMEC identified an alternative approach to obtaining site closure and significantly reducing the cleanup costs and the amount of time needed to obtain closure from the regulators. This approach required the transfer of the site from the EPA Region VIII's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Emergency Response Administrative Order to the Colorado Department of Public Health and Environment's (CDPHE's) Voluntary Cleanup program (VCUP). This strategic transfer from EPA CERCLA oversight to the CDPHE VCUP oversight resulted in an overall project remediation cost savings and has expedited the time necessary to obtain closure from the regulators thereby reducing the time required for remediation activities at the site. Negotiated with CDPHE and developed a strategy to break the site into 5 parcels. Wrote VCUP applications for 4 of the 5 parcels and received no action determinations for 3 of the parcels. Dr. Garrett was responsible for the site-wide operation and maintenance reporting and groundwater monitoring compliance program. The monitored natural attenuation (MNA) approach for groundwater remediation has been implemented. VOC contamination was reduced in soil source areas by applying soil vapor extraction (SVE) remediation strategy. Contracted and provided oversight for the demolition of 3 buildings on the client's property.

**Project Manager: Rocky Mountain Steel Mills South Mills Solid Waste Management Units (SWMUs), RCRA Facility Investigation (RFI), Pueblo, Colorado.** Dr. Garrett was responsible for managing the project that included a RCRA Facility Investigation (RFI) for the South Mills SWMUs that includes the South Mills waste water treatment lagoons. RFI work included sampling of soil borings, waste oil skimmer remediation, including surface soil sampling, soil removal and disposal. Sixteen soil borings were logged and sampled and

soil around 4 oil water separator were removed and backfilled with clean material. In addition, sediment from three lagoons was samples. An RFI report was prepared and submitted to the CDPHE for approval.

**Project Manager: Rocky Mountain Steel Mills Solid Waste Management Unit (SWMU) No. 78 Desulfurizer Baghouse, RCRA Facility Investigation (RFI), Pueblo, Colorado.** Dr. Garrett was responsible for managing the project, writing the RFI report, and performing historic research on the design and historic operation of the desulfurizer baghouse facility. He conducted the RCRA Facility Investigation (RFI) for Solid Waste Management Unit (SWMU) No. 78, a former desulfurizer baghouse that was part of former blast furnace operations at the steel mill facility. Research of historic records conducted to demonstrate to State Regulator that the baghouse facility was not connected to the historic coke oven facility (as historic permits incorrectly indicated). This research enabled the client to limit the SWMU investigation and facilitate closure, thereby saving both time and money. Thirty samples also collected from five boring locations as part of investigation.

**Project Manager: Confidential Client Site Characterization and Remediation Services, Olathe, Kansas.** Responsible for overseeing on-site groundwater monitoring activities, developing budgets, developing site closure and remediation strategy; and providing oversight of remediation activities. The scope includes site characterization and development of final groundwater and soil remediation strategy and plan for final closure of 9,000-SF building site occupying corner of property near source area. Plume extends 1,000 feet to near property boundary.

**Remediation Specialist and Principal Chemist: Hamilton Sundstrand, RCRA Facility Investigation (RFI) Project, Denver, Colorado.** Dr. Garrett has evaluated the analytical data for this project since 1992. He also assisted in design and implementation of soil, groundwater, NAPL and seepage water investigations (RFIs); feasibility and treatability studies; remedial design pilot-scale testing, engineering and construction; regulatory permitting, treatment systems O&M; treatment systems monitoring and reporting; risk assessments; RCRA and CAP designs and implementation. He redesigned the groundwater quality monitoring program incorporating elements of the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (EPA, 1996). He assisted in preparation of an accelerated RCRA Corrective Action Strategy for site. As Principal Chemist, he was responsible for data evaluation, validation, and interpretation as well as site conceptual model development.

**Chemist: University of Nebraska Agricultural Research & Development Center (ARDC) Remedial Investigation / Feasibility Study, Remedial Assessment and Removal Action, Ithaca, Nebraska.** Responsible as principal chemist for writing and reviewing project Quality Assurance Project Plan (QAPP), oversight of the analytical program, and project quality assurance program. The scope includes Remedial Investigation / Feasibility Study (RI/FS) and removal actions involving four different sites from one-half to five acres each, distributed over the 9,600-acre R&D facility and including eight disposal trenches, a former landfill and a pesticide rinsate area. Work included excavation, characterization, packaging, disposal and transportation of 30,000 CY of radioactive and chemical wastes produced as part of University medical research program and buried at site many years earlier, quality control planning and data management.

**Project Manager, Landfill Monitoring Program, Denver, Colorado** Managed groundwater monitoring and reporting for EPA CERCLA groundwater and surface-water monitoring program. Tasks include coordinating the analytical laboratory and field activities for the Landfill Operation and Maintenance (O&M) monitoring program for the semiannual groundwater and surface-water sampling. Prepare laboratory scope of work, oversight of data management activities, and coordination with field and laboratory personnel. Oversaw data validation for the project and reported the analytical and QA/QC results to the client and regulatory agencies. Dr. Garrett prepared a statistical approach to find potentially flawed or inconsistent data. Reported results of site O&M and groundwater monitoring program to the EPA on a semiannual basis.

## **CHEMICAL RESEARCH**

**Research Associate, University of Delaware.** Research Associate in organometallic, inorganic, and catalytic chemistry. Studied the interaction of metal clusters on metal oxide supports. Developed new methodology for the synthesis of mixed metal transition metal clusters on metal oxide supports. Studied these supported metal clusters by a variety of instrumental and analytical techniques.

**Graduate Student Researcher, Pennsylvania State University.** Researcher in organometallic and inorganic chemistry. Studied the interaction of a variety of organic compounds with highly reactive transition metal complexes. Demonstrated the use of tungsten complexes as substrates in the synthesis of organic compounds such as naphthols. Studied the mechanisms by which the organic products are formed. Studied organic, organometallic, and inorganic compounds by a variety of instrumental and analytical techniques.

## **CERTIFICATIONS AND TRAINING**

OSHA 8-Hour Hazardous Materials/Waste Health and Safety Training Refresher Course  
OSHA 40-Hour Hazardous Materials/Waste Health and Safety Training Course  
OSHA 8-Hour Supervisory Hazardous Materials/Waste Health and Safety Training Course  
Project Management Training the AMEC Way, 2012  
Project Controls Level I and Level II Training, 2010  
Capturing and Winning AMEC Business, Shipley 2006  
Optimizing Injection Strategies for Full-Scale In Situ Reactive Zone Remediation, 2005  
Contract Review Seminar, 2005  
Applications of Ground Water Geochemistry, 2004  
Economic Analysis for Ground Water Remediation a Tool for Decision Making, 2003  
The Remediation Course, Princeton Groundwater, Inc., 2003  
Environmental Geochemistry of Metals, 2003  
Principles and Practices of Project Management, 2002  
Groundwater Pollution and Hydrology Course, Princeton Groundwater, Inc., 2001  
Environmental Law Short Course, Environmental Education Enterprises, Inc., 1996

## **PUBLICATIONS AND PRESENTATIONS**

2007. Selecting the Optimal Remediation Strategy. *Presentation at the March 2007 Society of American Military Engineers Frontier Post Meeting, March 22, 2007, Cheyenne Wyoming.*

2005. In situ Bionitrification Groundwater Remediation System. *Proceedings of the Eighth International In Situ and On-Site Bioremediation Symposium, Baltimore, Maryland, June 6-9, 2005*, B.C. Alleman and M.E. Kelley: Battelle Press: Columbus, OH, 2005; Paper O-02 (with Amy L. Hudson).

2005. In situ Bionitrification Groundwater Treatment System. *Presentation to the New Mexico Environment Department, May 9, 2005, Santa Fe, New Mexico.*

2005. Large-Scale Application of In Situ Remediation to Remove Nitrate from Groundwater. *Federal Facilities Environmental Journal*, Wiley Periodicals, Inc., Spring 2005; p 97 (with Amy L. Hudson)

2004. Impacts of Near Mountain Geology on an In Situ Bionitrification System. *Presentation at the 2004 Geological Society of America (GSA) Annual Meeting, November 2004, Denver, Colorado* ; (with Amy Hudson).

2004. Large Scale Application of In Situ Bionitrification. *Presentation at the 9<sup>th</sup> Annual Joint Services Environmental Management Conference , August 2004, San Antonio, Texas*, (with Amy Hudson).

2003. In Situ Biotenitrification – A Case Study. *Proceedings of NGWA Conference on Remediation: site Closure and the Total Cost of Clean-Up, November 13-14, 2003, New Orleans, Louisiana*: National Ground Water Association; p 378 (with Amy Hudson).
2001. Accelerating the Reductive Dechlorination Process in Groundwater. *Anaerobic Degradation of Chlorinated Solvents*, Magar V.S., et. al.: Battelle Press: Columbus, 2001; p. 205 (with D. South, J. Seracuse, D. Li).
1996. Removal of N-nitrosodimethylamine from Rocky Mountain Arsenal waters using innovative adsorption technologies. Technical report EL-96-11, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS (with E. C. Fleming, J. C. Pennington, N. R. Francingues, D. R. Felt, B. G. Wachob, R. A. Howe, and M. R. Colsman).
1990. Further studies of the synthesis of 1-naphthols and 4-hydroxy-5,6-dimethylbenzothiophene by protonation of  $\text{Cp}(\text{CO})_2\text{WCTol}$  and  $\text{Cp}(\text{CO})_2\text{WC}(2\text{-C}_4\text{H}_3\text{S})$  in the presence of alkynes and CO. *J. Organomet. Chem.*, 394, 251 (with W. C. Feng, H. Matsuzaka, G. L. Geoffroy, and A. L. Rheingold).
1990. The synthesis and characterization of size selective Pt-Ir clusters on metal oxide surfaces. Annual Research Review, Center for Catalytic Science and Technology, University of Delaware, October (with B. C. Gates, and A. L. Rheingold).
1989. Transient generation of the reactive carbene complex  $[\text{Cp}(\text{CO})_2\text{W}=\text{CH}(\text{Tol})]^+$  and its reactions with alkynes to form vinylcarbene, allyl, naphthol, diene, and metallafuran complexes. *J. Am. Chem. Soc.*, 111, 8383 (with J. B. Sheridan, D. B. Pourreau, W. C. Feng, G. L. Geoffroy, D. L. Staley, and A. L. Rheingold).
1989. In situ generation of the benzyldiene complex  $[\text{Cp}(\text{CO})_2\text{W}=\text{CH}(\text{Tol})]^+$  and its reaction with alkynes. *Advances in Metal Carbene Chemistry*, Schubert U. Ed.: Kluwer Academic Publishers: Dordrecht, 1989; p. 189 (with G. L. Geoffroy, J. B. Sheridan, and D. B. Pourreau).
1989. Cycloaddition of imines and  $\text{Bu}^t\text{N}=\text{O}$  with the carbyne complexes  $[\text{Cp}(\text{CO})_2\text{MCTol}]^+$  ( $\text{M}=\text{Mn, Re}$ ). *Organometallics*, 9, 1562 (with B. M. Handwerker, K. L. Nagle, G. L. Geoffroy, and A. L. Rheingold).
1989. New types of metallacycles formed by cycloaddition of imines and  $\text{Bu}^t\text{N}=\text{O}$  with Mn and Re carbyne complexes. *J. Am. Chem. Soc.*, 111, 369 (with B. M. Handwerker, G. L. Geoffroy, and A. L. Rheingold).
1989. Transient generation of the reactive carbene complex  $[\text{Cp}(\text{CO})_2\text{W}=\text{CH}(\text{Tol})]^+$  and its reactions with alkynes to form vinylcarbene, allyl, naphthol, and metallafuran complexes. Presented at 23rd Middle Atlantic Regional Meeting of the American Chemical Society, May (with J. B. Sheridan, D. B. Pourreau, G. L. Geoffroy, and A. L. Rheingold).
1988. Preparation and structural characterization of  $[\{\text{Cp}(\text{CO})_2\text{W}\}_2 \eta^4\text{TolCC}(\text{OH})\text{CTol}][\text{BF}_4] \cdot \text{CH}_2\text{Cl}_3$ . *Inorg. Chem.*, 27, 3248 (with J. B. Sheridan, G. L. Geoffroy, and A. L. Rheingold).
1988. Reaction of  $[\text{Cp}(\text{CO})_2\text{MCTol}]^+$  ( $\text{M}=\text{Mn, Re}$ ) with imines and hydrazones. *Third Chemical Congress of North America*, June (with B. M. Handwerker, G. L. Geoffroy, and A. L. Rheingold).

## Scott Graham

### Project Geologist

#### Professional summary

Mr. Graham, a Geologist and Environmental Scientist, has been working in the environmental consulting field since 1995. He has demonstrated ability to effectively manage projects, personnel, and budgets. He has extensive knowledge of environmental compliance, including site assessments, remedial feasibility testing, remediation system design and construction, reporting, risk assessment, project and lifecycle budget forecasting, case planning, client and regulatory liaison, and staff training and management. The majority of his project experience is in the governmental, real estate, and petroleum industries.

#### Employment history

Wood Environment & Infrastructure, Petaluma, CA, Technical Professional 3, 2017-Present

Amec Foster Wheeler Environment & Infrastructure, Inc., Petaluma, CA Project Geologist, 2014 to 2017

AMEC Environment & Infrastructure, Inc., Petaluma, CA, Project Geologist, 2011–2014

MACTEC Engineering and Consulting, Inc., Petaluma, CA, Project Geologist, 2005–2011

SCS Engineers, Santa Rosa, CA, Geologist, 6/2005–12/2005

Delta Environmental Consultants, Incorporated, Sacramento, Project Manager, 10/2004–5/2005

SECOR International, Incorporated, Sacramento, CA, Associate Geologist, 7/2003–10/2004

Environmental Resolutions, Incorporated, Novato, CA, Project Manager, 1/2001–6/2003

Environmental Resolutions, Incorporated, Novato, CA, Senior Staff Geologist, 4/2000–1/2001

Environmental Resolutions, Incorporated, Novato, CA, Staff Geologist, 7/1998–4/2000

Environmental Resolutions, Incorporated, Novato, CA, Environmental Technician, 5/1995–7/1998

#### Non-professional certifications and training

CPR/AED

Defensive Driving

First Aid

HAZWOPER 40 Hour

HAZWOPER 8 Hour Refresher

HAZWOPER 8 Hour Supervisor

OSHA 10 Hour Construction Safety and Health

OSHA 30 Hour Construction Safety and Health

U.S. Army Corps of Engineers Construction Quality Management for Contractors

Doyle Scholarship, Santa Rosa Junior College, 1988

#### Representative projects

Beale Air Force Base, 2017, Yuba City, CA, Field Geologist. As Field Geologist, oversaw installation of soil borings and monitoring wells. Scope: Perform remedial investigation tasks as associated with the Air Force's PFAS Investigation activities. Tasks include planning, driller oversight, and soil and groundwater sampling.

March Air Force Base, 2017, Riverside County, CA, Field Geologist. As Field Geologist, oversaw installation of soil borings and monitoring wells. Scope: Perform remedial

Years with Wood: 13

Years' Experience: 23

#### Education

Bachelor of Science, Geology, California State University, Sonoma, 1995

Associate of Science, Science, Santa Rosa Junior College, 1991

#### Location

West US - Petaluma

#### Languages

English



Continued...

investigation tasks as associated with the Air Force's PFAS Investigation activities. Tasks include planning, driller oversight, and soil and groundwater sampling.

Alameda Naval Air Force Base, 2016 and 2017, Alameda, CA, Field Geologist. As Field Geologist oversaw the installation and development of groundwater monitoring wells. Tasks include permitting, driller oversight, soil and groundwater sampling.

Borehole Field Verification Activities, 2016 to 2018, California Department of Transportation (Caltrans), Various Cities and Counties, CA. As Field Geologist, Perform Field verification of the presence and location of geotechnical borings and wells throughout the state. Tasks include planning, research of online databases, QA/QC of historical documents, and field verification activities associated with locating geotechnical borings and wells installed at various construction sites throughout the state.

ABB Chico 2012, Chico, CA 107652, 880,000, 2010. Field Geologist. As Field Geologist, oversaw installation of monitoring wells. Scope: Perform remedial investigation/feasibility study tasks specified by the DTSC's Partial Consent Agreement issued to ABB Inc. to investigate and remediate impacted groundwater at the site. Tasks include litigation support and project management, monthly status reports, RI implementation, annual wellhead treatment system sampling, and quarterly groundwater monitoring. Chlorinated solvents and TCE were found along the Skyway plume.

Roadside Vegetated Treatment System (RVTS) Study Oversight 2007-2008, California Department of Transportation (Caltrans) - Environmental Program Office, Various Cities, CA, United States. 074859 RVTS, 250,080, 2010. Project Geologist. Responsible for conducting stormwater monitoring and maintenance activities at two sites (Napa and San Mateo) in Northern California. Collected water samples and tabulated data related to major storms at both sites. Scope: Monitoring oversight, data management, and reporting for 2007-2008 Roadside Vegetated Treatment Study (RVTS). Study designed to assess treatment performance of vegetated slopes with varied configurations of vegetative cover, dependent on slope and soil, for effectiveness of erosion control. Services also included post-storm monitoring of stormwater runoff; technical memorandum reviews; and updating of both Sampling & Analysis Plan and Health & Safety Plan.

Casmalia Resources Superfund Site Maintenance, Remedial Investigation / Feasibility Study (RI/FS), Groundwater Monitoring, Bingham McCutchen, LLP (formerly McCutchen, Doyle, Brown & Enerson), Casmalia, CA, United States. 990061, 21,900,000, 2009. Geologist. Responsible for assisting with non-aqueous phase liquid monitoring and well development via air lifting and WaTerra Pump under work conditions involving development and monitoring in Class C PPE. Scope: Site maintenance and management, RI/FS, regulatory compliance and support of investigation at a 252-acre, former Class I Superfund, Hazardous Waste Management Facility comprising five separate landfills and which included approximately 40,000 tons of industrial waste on site (with acids, caustics, solvents, pesticides and metals). Implemented 24-hour operating leachate collection and contaminated groundwater treatment system, and over 300 monitoring wells.

Chico Facility Regulatory Review Environmental Support Services, Major Chemical Manufacturing Company, CONFIDENTIAL CLIENT ABB, Inc.- Combustion Engineering (CE), Chico, CA, United States. 072198, 3,400,000, 2016. Geologist. Responsible for providing drilling/well construction oversight for installation of sonic wells. Finished long-term, out of town project on schedule with a minimum downtime. Assisted with preparation of RI/FS Work Plan, with drilling price quote and drilling set-up, and provided oversight of drilling and sampling. **DO NOT USE THIS PROJECT IN ANY PROPOSAL OR MARKETING MATERIALS WITHOUT FIRST CONTACTING THE AMEC PROJECT MANAGER. DUE TO LITIGIOUS OF THIS PROJECT, WHICH IS THE REASON IT IS BEING PERFORMED IN THE FIRST PLACE, THIS CLIENT DOES NOT WANT US TO USE THEIR PROJECTS IN ANY PUBLIC COMMUNICATIONS OR MARKETING EFFORTS WITHOUT FIRST OBTAINING THEIR PERMISSION.** Scope: Regulatory review and litigation-related environmental support services for former industrial building products manufacturer. Services include subsurface characterization, groundwater quality testing and sampling pertaining to characterizing the extent of a groundwater plume impacted by the historic disposal of solvents (PCE and TCE).

Signal Oil Semiannual Groundwater Sampling, Major Industrial Client, CONFIDENTIAL CLIENT Honeywell International, Inc., Edgewood, WA, United States. 031612, 38,000, 2007. Geologist. Responsible for site schedule, performing pre-drill protocols, writing HASP, coordinating equipment shipment for out of state locations, overseeing drilling of five hollow stem auger borings to collect soil and water data, performing quarterly monitoring, and sampling field work for the 4th quarter 2005; assisted in determining the extent of hydrocarbon contamination and future placement of oxygen releasing product injection. **DO NOT USE THIS PROJECT IN ANY PROPOSAL OR MARKETING MATERIALS WITHOUT FIRST CONTACTING THE AMEC PROJECT MANAGER. Although this project was not performed under the Alliance agreement, it should be considered CONFIDENTIAL in view of the client's recent mandate.** Scope: Semiannual groundwater monitoring and sampling of three onsite wells at site of former service station (approximately 110 ft. X 120 ft. site) and installation of soil borings. One well exhibits concentrations of fuel hydrocarbons.

Former Chemical Manufacturing Facility Perchlorate Investigation, Remediation, Confidential Chemical Manufacturer, CONFIDENTIAL CLIENT, Morgan Hill, CA, United States. 020905, 6,000,000, 2010. Geologist. Responsible for assisting in door-to-door sampling of privately-owned domestic wells, and well development of offsite monitoring wells using airlifting, and groundwater sampling using airlifting and a WaTerra pump. PLEASE CONTACT THE AMEC PROJECT MANAGER BEFORE USING THIS PROJECT IN ANY PROPOSAL OR MARKETING MATERIALS. Scope: Prepared and implemented



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several phases of remedial investigation to delineate lateral and vertical extent of perchlorate in soil and groundwater for design of an on-site remediation system at the site of a former flare manufacturing facility. Perchlorate has been detected in on-site soil, and on-site and off-site groundwater extending from the site and to depths in excess of 600 feet below ground surface. AMEC identified and implemented innovative monitoring well installation techniques, in situ aquifer testing procedures, and groundwater sampling methods. AMEC devised several monitoring and evaluation programs to save the client additional future remediation and monitoring well installation costs.

Hunters Point Naval Shipyard Parcel A Environmental Consulting Services, Lennar / BVHP, LLC, San Francisco, CA, United States. 053085, 850,000, 2012. Project Geologist. Provided review of and recommendations on existing documents. Lennar achieved compliance with regulatory requirements with Amec Foster Wheeler's assistance. Performed air/dust monitoring at Hunters Point. Scope: Environmental consulting services to support client's legal counsel, address special requests for information from project stakeholders, and present information at planning and technical meetings as part of ongoing effort to redevelop Parcel A of area formerly occupied by U.S. Naval shipyard. Provided review of and recommendations on existing documents. **Lennar achieved compliance with regulatory requirements with AMEC's assistance.**

Leviathan Mine Field Support (IWO), Atlantic Richfield Company, Markleeville, CA 115724, 75,600, 2011. Field Geologist. Performed drilling and exploration services at Leviathan Mine. Scope: Drilling and exploration services at Leviathan Mine. This site is an abandoned open-pit sulfur mine located in Alpine County, California. The mine is located at on the eastern slope of the Sierra Nevada at about 7,000-foot (2,100 m) elevation, 6 miles (9.7 km) east of Markleeville and 24 miles (39 km) southeast of Lake Tahoe. The mine site comprises approximately 250 acres.

Brownfields Land Recycling Program, Nevada Division of Environmental Protection (NDEP), Henderson, NV, United States. 010476, 850,000, 2007. Geologist. Responsible for writing the Work Plan and Sampling and Analysis Plan for future excavation work to remove lead contamination at a former firing range. Scope: Master Services Agreement for 4 years to provide brownfields assessment and cleanup services in a statewide program to recycle / redevelop brownfields sites. **Project included successful completion of cleanup of almost a century's worth of waste materials at the Northern Nevada Railway Museum (Ely, NV), which allowed continuation of preservation efforts, and should improve attendance and increase local revenue because more historical buildings on the site will soon be open to the public.**

Queen of the Valley Medical Center Geotechnical Engineering Services, St. Joseph Health System, Napa, CA 107815, 127,000, 2011. Field Geologist. Served as Field Geologist with responsibility for overseeing the exterior site grading and pavement construction. Scope: Geotechnical engineering services during the construction of the new, three-story acute care building in Napa. Building footprint dimensions are 105 x 225 feet.

Site Closure Environmental Services, The Presidio Trust, San Francisco, CA, United States. 008379, 6,655,330, 2011. Geologist. Oversaw the installation of Test pits to determine the extent of fill materials and contaminants, install soil borings and test pits to determine extent of asphalt roofing materials, log soils and debris across site, collect soil samples, and assist in results report. As a Field Geology Professional, conducted field operations for a subsurface investigation, assisted in writing a technical memorandum and Corrective Action Plan, wrote a Corrective Action Implementation Work Plan, and attended site meetings with clients and regulators. Also assisted with developing a master reference cost spreadsheet and providing quality assurance/control of several cost spreadsheets used to price remedial options for Corrective Action Plans. Produced investigation reports for multiple sites within the Presidio. Performed field investigations (i.e., surface sediments and shallow soil borings) at Building 1450/1451, Nike Facility, and Building 1369 sites to specify excavation areas, amounts to be excavated, procedures, and remedial methods to be used in site cleanup.

- ▶ For Fill Site 1 and Landfill 2, provided drilling oversight for the installation of hollow stem auger soil borings to delineate the boundaries of the debris, fill, and native materials.
- ▶ For Building 1065, developed construction completion report. Also authored Corrective Action Implementation Work Plan; oversaw field work, including excavation, collection of soil and water samples, land use control cap inspection; served as regulatory liaison between Presidio and regulators to complete work in a manner acceptable to all parties.
- ▶ Assisted with the production of pre-remedial investigation Work Plans, Corrective Action Plans, a technical memorandum, and investigation reports for multiple sites within the Presidio; performed field investigations (surface sediments and shallow soil borings) at Building 1450/1451, Nike Facility, and Building 1369 sites to specify excavation areas, amounts to be excavated, procedures, and remedial methods to be used in site cleanup.
- ▶ Oversaw the installation of Test pits to determine the extent of fill materials and contaminants, install soil borings and test pits to determine extent of asphalt roofing materials, log soils and debris across site, collect soil samples, and assist in results report.

Environmental services associated with site closure, including site investigation, risk assessment, feasibility study (FS), engineering design, data management, ecological risk assessment, remediation, and reporting at historic 1,416-acre former military base at the south end of the Golden Gate Bridge.

Environmental Services at 8 Army Reserve Centers, Kemron - North Division, Seven U.S. Department of the Army - Northern Region Contracting Center, US, United States. 040979, 3,387,120, 2010. Project Geologist. Responsible for

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remediation implementation for Camp Parks Site and organized remediation field efforts and reporting. Scope: Full range of environmental and technical services at eight U.S. Army installations in five states (Massachusetts, Connecticut, Rhode Island, Maine, and California) addressing soil and groundwater contamination at landfills, underground storage tank sites and other waste storage and disposal sites. Work included remedial investigations / feasibility studies (RI/FS) and environmental remediation design services.

Fort Ord Operable Unit (OU) Habitat Remedial Investigation / Feasibility Study (RI/FS), U.S. Army Corps of Engineers (USACE) – Huntsville District, Monterey, CA, United States. 027629 FTORD, 20,000,000, 2009. Project Geologist. 1) Responsible for gathering, reviewing, and summarizing historical data for a Basewide RI/FS. Assisted with the development of tables and site maps and addressed agency comments regarding the RI/FS. Assisted in developing and writing a Technical Memo for part of the Base detailing the site history and proposed scope of future work. 2) Assisted in data gathering and writing of a technical memorandum and assessment approach for multiple sites across Fort Ord. Assisted in design of the RI pathways and methods. Scope: Since 2004, AMEC has been conducting full remediation investigation / feasibility study (RI/FS) to address munitions and explosives of concern (MEC) at the Impact Area Munitions Response Area (MRA) for 6,500 acres of a 8,000-acre former U.S. Army training range complex (small arms to artillery fire). Activities included planning, site characterization, archival (historic) search, risk assessment (human health), feasibility study, and community relations support.

#### Unlinked Amec Foster Wheeler projects

Industrial Hygiene Services, 50 California Street, Shorenstein Realty Services, San Francisco, CA, United States. 8415180450. Ongoing. Industrial Hygiene Technician. Performed annual Heating, Ventilation, and Air Conditioning (HVAC) and Transmission Electron Microscopy (TEM) surveys and reporting to monitor the air quality and performance of the HVAC system to ensure compliance with applicable health and safety standards.

Environmental Services, MDC Engineered Process Solutions, Hayward and San Jose, CA, United States. 8615180420. Geology Professional. Performed site inspection (phase I environmental screening analysis) and comprehensive compliance audit of environmental program.

Environmental Services, California Paperboard Company, Santa Clara, CA, United States. OD13165230. December 2015. Geologic Professional. Performed permitting, job preparation and setup, and field oversight for the installation of two monitoring wells, direct push soil borings, and soil vapor wells. Performed site oversight for the removal and over excavation of three undocumented underground storage tanks (USTs) and performed set up and sampling of groundwater, over excavation soil samples, and soil vapor.

Environmental Services, Hertz Northfield QTA Facility, Oakland, CA, United States. Ongoing. Geologic Professional. Performed field oversight and reporting for the installation and sampling of 25 direct push soil borings, three test trenches, and six groundwater monitoring wells to evaluate the site conditions, transport mechanisms, and extent of the hydrocarbon plume. Performed oversight and soil sampling for over excavation and removal of impacted soils in source area.

Environmental Services, Alameda Naval Yard – Site 6, Alameda CA, United States. 5023136030. Geology Professional. Performed operations and oversight of 2 subcontractors during the extraction and injection activities of 30+ wells and 20,000 gallons of injection materials. Scheduling, set-up, and operation of post-injection groundwater monitoring activities.

Environmental services, Former Honeywell Site, Newark CA, United States. OD14171100. Geology Professional. Performed oversight and soil logging for the installation of 29 injection wells and four groundwater monitoring wells.

Environmental Investigation Chevron Estero Facility, Chevron, Morro Bay, CA, United States. OD11161540. Estimate completion: April through October 2012. Geologic Professional. Performed job preparation and field oversight for the installation of four well pairs using hollow stem auger and attempted water supply wells using air-rotary drilling techniques. Oversaw well development and pump testing of one water supply well. Helped to develop an asbestos monitoring/abatement plan and performed the asbestos monitoring and oversight during drilling through rock containing naturally occurring asbestos (NOA).

Environmental Services, Fort Hunter Liggett, U.S. Army, Jolon, CA, United States. 4084106586.02.3. June 2011. Geologic Professional. Performed field oversight for the installation of direct push borings using a membrane interface probe and a ultra-violet optical screening tool to detect free product and PAHs to get an estimate of the vertical and horizontal extent of the hydrocarbon plume and determine any data gaps in the monitoring well setup.

Santa Rosa Service Center, CONFIDENTIAL CLIENT, Pacific Gas and Electric, Santa Rosa, CA, United States. 013045005H.2. Geologic Professional. Performed field oversight for the installation of sub-slab and subsurface soil vapor sampling probes and direct push soil borings onsite and offsite. Soil vapor sampling probes and onsite soil borings were installed inside buildings using limited access rigs.

Mojave National Preserve, National Park Service, Mojave, CA, United States. Geology Professional. Performed planning, field oversight, sampling, and reporting in conjunction with excavation work at three sites within the preserve. Site work performed for auditing purposes and to allow for site closures.

Continued...

Site Conceptual Model and Corrective Action Plan, Mariposa Ranger Unit Headquarters, Mariposa, CA, United States. Geology Professional. Developed and wrote a Site Conceptual Model and Corrective Action Plan recommending hydrogen peroxide injection to treat residual hydrocarbon concentrations in groundwater at the subject site. Wrote the fourth quarter 2005 quarterly monitoring and sampling report.

Camp Parks, Corrective Action Plan, Dublin, CA, United States. Geology Professional. Wrote corrective action plan and helped to compile data from site conceptual model, assessment report, and CAP into one coherent report. Allowed for future excavation of contaminated soils and providing remedy in place to allow for property transfer. Provided oversight of excavation and injection activities to finish cleanup activities at site and help to develop results and closure report which allowed final site closure.

Circuit City, Puyallup, WA, United States. Geology Professional. Setup drilling, performed pre-drill protocols, wrote HASP, coordinated equipment shipment (for out of state job), and oversaw drilling of 2 hollow stem auger borings to geotechnical data for new loading dock.

Phase I Environmental Site Assessments, Pacific Oroville Power, Inc., Oroville, CA, United States. 3031122016. Geologic Professional. Performed a Phase 1 Environmental Site Assessment at the former power plant for use as due diligence as part of a potential property transaction. Wrote the report detailing the findings of the site visit.

## **Caitlin Elizabeth Brice, M.Sc.**

**315 Bellerose Dr. Apt. 2**

**San Jose, CA 95128**

**Tel. 954-651-3395**

[caity63@yahoo.com](mailto:caity63@yahoo.com)

[LinkedIn Profile](#)

### **EDUCATION**

#### **Nova Southeastern University, Master of Science in Marine Biology**

**May 2014**

Thesis title: "The Detection of Amazonian Manatees (*Trichechus inunguis*) Using Side-Scan Sonar and the Effect of Oil Activities on Their Habitats in Eastern Ecuador"

GPA: 3.79

[http://nsuworks.nova.edu/occ\\_stuetd/8/](http://nsuworks.nova.edu/occ_stuetd/8/)

GRE: Verbal – 530, Quantitative – 750, Writing – 4.5

#### **St. Andrews University, Introduction to Distance® Sampling**

**August 2012**

#### **Drury University, Bachelor of Arts in Biology and Chemistry (with Honors)**

**May 2009**

Minor in Global Studies

GPA 3.95

Summa Cum Laude

ACT: 31

### **PROFESSIONAL EXPERIENCE**

#### **Accutest Northern California, Quality Assurance Officer**

**Jan. 2015 – Present**

- Manage, enforce, and audit the quality systems, procedures, data, reports, and analyst competency at a certified environmental laboratory for conformance to NELAC, DOD, DOE, ISO, and EPA requirements, state specific requirements (CA, AK, AZ, OR, WA, NV), client specific objectives, and improvement of laboratory performance.

#### **Florida Spectrum Environmental Services, Inc., Quality Assurance Director**

**Dec. 2012-Jan. 2015**

- Direct, enforce, and audit the quality systems, procedures, data, reports, and analyst competency at five certified laboratories for conformance to NELAC, FDOH, FDEP, and EPA requirements, client specific objectives, and improvement of laboratory performance.

#### **Florida Spectrum Environmental Services, Inc.,**

**Feb. 2010 – Dec. 2012**

#### **Analytical Chemist and Microbiologist**

- Performed EPA methods in inorganics, organics, extractions, and microbiology in solid, water, and chemical matrices.
- Analyzed samples using HPLC, IC, GC/MS, Flow Analyzers, Discrete Analyzers, Block Digesters, Distillation Units, and Incubators.

### **RESEARCH EXPERIENCE**

#### **Nova Southeastern University, Graduate Research Assistant**

**August 2010 – May 2014**

- Collected water samples, conducted interviews, and performed side-scan sonar surveys to detect Amazonian Manatees and investigate their population ecology in the rivers and lagoons of the Amazon River basin in Eastern Ecuador. Field time: 6 weeks.

#### **Newfound Harbor Marine Institute Seacamp, Research Intern**

**May 2006**

- Surveyed marine life in Big Pine Key, FL.

## TEACHING EXPERIENCE

**Nova Southeastern University, Laboratory Assistant**

**Aug. 2009-May 2011**

- Assisted with the set-up and teaching of Biology 101 laboratory classes.

## PUBLICATIONS

**Brice, Caitlin E. 2014. "The Detection of Amazonian Manatees (*Trichechus inunguis*) Using Side-Scan Sonar and the Effect of Oil Activities on Their Habitats in Eastern Ecuador."**

[http://nsuworks.nova.edu/occ\\_stuetd/8](http://nsuworks.nova.edu/occ_stuetd/8).

**Brice, Caitlin. October 2011. "The Status of Amazonian Manatees (*Trichechus inunguis*) and Their Habitats in Eastern Ecuador". Sirennews. Number 56. [www.sirenian.org/sirennews/56OCT2011.pdf](http://www.sirenian.org/sirennews/56OCT2011.pdf)**

## PRESENTATIONS

**Florida Marine Mammal Health Conference, Poster Presenter** **April 2012**

"Oil Effects on the Amazonian Manatee (*Trichechus inunguis*) in Eastern Ecuador: Evaluating the Risks"

**Southeast and Mid Atlantic Marine Mammal Symposium, Oral Presenter** **March 2012**

"Oil Effects on the Amazonian Manatee (*Trichechus inunguis*) in Eastern Ecuador: Evaluating the Risks"

**19th Biennial Conference on the Biology of Marine Mammals, Oral Presenter** **Nov. 2011**

"The Status of Amazonian Manatees (*Trichechus inunguis*) and Their Habitats in Eastern Ecuador"

**Fifth Annual International Sirenian Symposium, Oral Presenter** **Nov. 2011**

"The Status of Amazonian Manatees (*Trichechus inunguis*) and Their Habitats in Eastern Ecuador"

## SKILLS

Superior Organization and Communication

Management of Multiple Teams Effectively Toward a Common Goal

Rapid Learning and Adaptability

Trained Protected Species Observer (PSO)

Certified PADI Open Water Diver

Proficient with Laboratory Internal Management Systems (LIMS), JMP®, Humviewer®, ArcGIS®,

Agilent ChemStation®, Distance® software, and Microsoft® Office

Intermediate Spanish Reading, Writing, and Conversational Skills

Violinist

## HONORS AND AWARDS

First Place - Southeast and Mid Atlantic Marine Mammal Symposium (2012)

Walter H. Hoffman Chemistry Award for outstanding academic performance (2009)

Beta Beta Beta, Chi Chapter Inductee – Biology Honor Society (2008)

Omicron Delta Kappa – Leadership Honor Society Inductee (2008)

National Honor Society (Inducted 2003)

Concert Master – Drury Chamber Orchestra and Drury String Quartet (2007-2009)

Girl Scout Gold Award Recipient (2008)

Community Leadership Scholarship (2005)

Elk's Lodge Scholarship (2005)

Presidential Academic Scholarship (2005)

Presidential Musical Scholarship for Violin (2005)

Women in Science Award (May 2005)

## **ORGANIZATIONS AND AFFILIATIONS**

Marine Animal Rescue Society (MARS) – Trained Volunteer  
The Society of Marine Mammalogy  
Florida Society of Environmental Analysts (FSEA)  
The NELAC Institute (TNI)  
American Chemical Society

## **REFERENCES**

Dr. Caryn Self-Sullivan, Ph.D.

Areas of Expertise: Marine Mammal Surveys and Surveys in Remote Areas  
Major Thesis Advisor - Nova Southeastern University Oceanographic Center  
Co-founder - Sirenian International, Inc.  
540-287-8207  
[cs1733@nova.edu](mailto:cs1733@nova.edu)

Dr. Donald McCorquodale, Ph.D.

Areas of Expertise: Environmental Assessments, Project Management, and Microbiology  
Thesis Committee Member - Nova Southeastern University Oceanographic Center  
Founder, Former Quality Assurance Director, Microbiologist, and Mentor - Florida Spectrum Environmental Services, Inc.  
954-258-4630  
[mccorq@nova.edu](mailto:mccorq@nova.edu)

Richard Vicchiarelli, M.S.

Areas of Expertise: Analytical Chemistry  
Chemist – Florida Spectrum Environmental Services, Inc.  
954-547-4296  
[vicchi@bellsouth.net](mailto:vicchi@bellsouth.net)

Dr. Daniel Gonzalez-Socoloske, Ph.D.

Areas of Expertise: Marine Mammal Surveys and Side-Scan Sonar Surveys  
Thesis Committee Member – Andrews University  
Associate Editor – Latin American Journal of Aquatic Mammals  
[gonzalezd@andrews.edu](mailto:gonzalezd@andrews.edu)

Dr. Roger Reep, Ph.D.

Areas of Expertise: Florida Manatees and Marine Mammal Surveys  
Thesis Committee Member – University of Florida  
[reepr@ufl.edu](mailto:reepr@ufl.edu)





## Professional Summary

**Name:** Norman Farmer  
**Title:** Corporate Technical Director,  
SGS Accutest Inc.

**Education:** BS Chemical Oceanography  
Florida Institute of Technology

Post Baccalaureate Study  
Florida Institute of Technology

### Employment History:

2014 – present	Accutest Laboratories Southeast, SGS-Accutest Technical Director, Corporate Technical Director
2001 – 2014	Accutest Laboratories Southeast Technical Director
1996 – 2001	Accutest Laboratories Southeast Organics Manager
1994 – 1996	Orlando Laboratories, Inc. Organics Supervisor (Semivolatiles)
1991 – 1994	Orlando Laboratories, Inc. Senior GC/MS Analyst
1990 – 1992	Orlando Laboratories, Inc. Extraction Supervisor

### Experience/Qualifications:

Mr. Farmer currently oversees the technical operation for SGS-Accutest. This includes co-ordinating projects between the facilities, project review, Research and Development oversight, instrumentation acquisition and method validation. In addition, Mr. Farmer is responsible for creating and maintaining project specific requirements in the LIMS and EDD development.

Mr. Farmer is also active on various regulatory committees and advisory groups.

Prior Mr. Farmer managed the Organics Department of Accutest Laboratories' Southeast Lab. The laboratory utilizes GC, GC/MS, and HPLC instrumentation to analyze samples by EPA 600 and 8000 Series Methods.

Mr. Farmer is familiar with the various QC and reporting criteria for Navy, U. S. Army Corps of Engineers, and AFCEE. Mr. Farmer reviews Quality Assurance Project Plans to ensure that all data quality objectives and reporting requirements are met by laboratory.



# ACCUTEST

## Professional Summary

**Name:** Elvin Kumar

**Title:** Project Manager  
SGS Accutest Inc. – Orlando

**Education:** Auckland University of Technology, New Zealand. **2004**  
Fiji Institute of Technology  
Bachelor of Applied Science (Environmental Studies)  
  
Fiji Institute of Technology  
Diploma in Environmental Science

### Additional Professional courses/Certificates

40 Hour HAZWOPER – 29CFR 1910.120(e)  
DOT 49 CFR 172.704 - Hazardous Material Transportation  
IATA-Shipping Dangerous Goods by Air  
Compliance Solution Occupational Trainers, Inc.

### Employment History:

2016-Present	SGS Accutest – Orlando Project Manager
2013-2016	SGS Accutest – San Jose Project Manager
2008-2013	Accutest Laboratories, Northern California Sample Control Manager/Safety Officer
2007-2008	Entech Analytical Labs, Santa Clara Laboratory Technician
2005-2006	Emperor Gold Mining Co., Fiji Islands Environmental Technician/EHS/Field Sampler

### Experience/Qualifications:

Mr. Kumar is currently a Project Manager for the SGS Accutest – Orlando, assisting both commercial clients and clients serving the Department of Defense. His background includes client services, sample management and routine interface with various departments to ensure timeliness of sample analyses. His responsibilities include management of client projects, addressing client inquiries and issues, and preparing sample bottle orders. Additionally, Mr. Kumar acts as a liaison between the clients and various laboratory departments to ensure timeliness of data and addressing project-specific requirements.



## Professional Summary

**Name:** Svetlana Izosimova  
**Title:** Quality Assurance Officer  
Southeast Regional Laboratory

**Education:** B.S./M.S. – Chemical Engineering  
Waste Recovery Technology – 1987, Leningrad Institute of Pulp  
and Paper Industry, Russia.

Ph.D. – Colloid Chemistry, “Physical-Chemical Basis of Pulp  
Deresination Using Surfactants” – 1991, Leningrad Institute of Pulp  
and Paper Industry, Russia.

### Employment History:

2001 – Present Accutest Laboratories Southeast, SGS Accutest - Orlando  
Quality Assurance Officer

2000 – 2001 STL Tampa East, Tampa, FL  
MS/Semivolatiles Section Leader

1999 – 2000 PBS J Analytical Services, Orlando, FL  
Quality Assurance Officer

1991 – 1998 PBS J Analytical Services, Orlando, FL  
GC/MS Analyst

1987 – 1991 Leningrad Institute of Pulp and Paper Industry, Russia  
Researcher, Junior Grade

### Experience/Qualifications:

Ms. Izosimova is currently the Quality Assurance Officer for Accutest Laboratories Southeast. She is responsible for implementing the Corporate Quality Assurance Program in the Southeast Laboratory. Ms. Izosimova has 25 years of experience in environmental analytical chemistry, organic and inorganic testing instrumentation, and industrial hygiene. Ms. Izosimova has served as a QA Officer for projects performed under U.S. Department of Defence.

## **ATTACHMENT C**

### **Field Documentation Forms**

1. Example Field Daily Logbook
2. Water Level Field Data Worksheet
3. Passive Diffusion Sampler (PDS) Groundwater Sampling Form
4. Groundwater Sampling and Pressure Levels Form for Westbay Wells
5. Water Level Indicator Calibration by Steel Tape
6. Ahtna Daily Site Safety Tailgate / Inspection Log
7. Task Specific Health and Safety Worksheet
8. Fort Ord Munitions and Explosives of Concern (MEC) Incident Reporting Form
9. Wood Chain of Custody Form
10. Ahtna Chain of Custody (Water / Soil)
11. Example Sample Labels
12. Post-Treatment Parameter Monitoring Form

# Field Activity Daily Logbook

Team 2  
SB/SK  
12/14/06

0950 @ MW-002-24-180 WL-187.97  
Cor. -.06  
SN 3 @ 214  
1002 sampled # 06506002031F  
Dropped 1 @ 3  
1009 @ MW-002-09-180R WL-156.08  
Cor. -.06  
SN 2 @ 199'  
1022 sampled # 06506002032F 033D  
1024  
Dropped 1 @ 2  
1029 @ MW-002-06-A WL-106.26  
Cor. -.06  
SN 6 @ 128'  
1039 Sampled # 06506002034F  
Dropped 1 @ 6  
1046 @ MW-002-06-180R WL-157.87  
Cor. -.06  
SN 4 @ 214'  
1053 sampled # 06506002035F (ms/msd)  
Dropped 1 @ 4  
1110 @ MW-002-07-180R WL-182.96  
Cor. -.06  
SN 3 @ 233'  
1117 sampled # 06506002036F  
Dropped 1 @ 3  
1123 @ MW-002-05-180 WL-155.49  
Cor. -.06  
SN 4 @ 215'  
1130 sampled # 06506002037F  
Dropped 1 @ 1

Team 2  
SB/SK  
Sounder 3639C  
Cor. -.06

0746 @ MW-02-04-180 WL-94.57  
Cor. -.06  
SN 2 @ 103'  
0757 sampled # 06506002024F  
Dropped 1 @ 2  
0808 @ MW-12-05-180 WL-74.61  
Cor. -.06  
SN 3 @ 88'  
0810 sampled # 06506012025F 026D  
Dropped 1 @ 3  
0835 @ MW-10-04-180 WL-259.75  
Cor. -.06  
SN 2 @ 271'  
0845 sampled # 06506010027F  
Dropped 1 @ 2  
0902 @ MW-002-25-A WL-129.38  
Cor. -.06  
SN 4 @ 146'  
0910 sampled # 06506002028F  
Dropped 1 @ 4  
0919 @ MW-002-53-180 WL-204.09  
Cor. -.06  
SN 5 @ 259'  
0927 sampled # 06506002029F  
Dropped 1 @ 5  
0934 @ MW-002-39-180 WL-203.99  
Cor. -.06  
SN 4 @ 244'  
0943 sampled # 06506002030F  
Dropped 1 @ 4



# Water Level Field Data Worksheet

Sampling DB; Version 7EX

For Event: WL2011Q2, 2011 2nd Quarter water levels

Team: 3      Sounder Serial #:      Calibration Diff :      Initials::      Scheduled Sampling Date: 06/20/ 2011

Station Name	Plate #	Notes	Avg. DTW ft)	Date	Time	Measured DTW:1	Measured DTW: 2	Calibration Difference from Steel Tape	Calc. DTW	Total Depth ft)	Measured Total Depth	Comments
MP-BW-34-492		westbay	140									
MP-BW-34-537		westbay	141									
MP-BW-35-242		westbay	146									
MP-BW-35-312		westbay	152									
MP-BW-35-366		westbay	152									
MP-BW-35-467		westbay	151									
MP-BW-35-527		westbay	151									
MP-BW-35-562		westbay	153									
MP-BW-35-402		westbay	152									
MP-BW-37-178	4	westbay	143							477.		
MP-BW-37-193	4	westbay	143							477.		
MP-BW-37-303	4	westbay	146							477.		
MP-BW-37-328	4	westbay	146							477.		
MP-BW-37-368	4	westbay	146							477.		
MP-BW-37-398	4	westbay	145							477.		
MP-BW-38-327	5	westbay	139							457.		
MP-BW-38-341	5	westbay	132							457.		
MP-BW-38-353	5	westbay	135							457.		
MP-BW-38-368	5	westbay	139							457.		
MP-BW-38-418	5	westbay	139							457.		
MP-BW-39-310	4	westbay	152							467.		
MP-BW-39-330	4	westbay	152							467.		
MP-BW-39-350	4	westbay	152							467.		
MP-BW-39-395	4	westbay	151							467.		
MP-BW-40-333	5	westbay	142							496.		

Tuesday, June 14, 2011

Reviewed by \_\_\_\_\_ Date \_\_\_\_\_

AMEC Environment & Infrastructure, Inc.

**wood.**

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Site Report:

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Water Level Indicator Serial #:

[illegible]

Quality Control Samples

Type	Sample No.



Groundwater Sampling  
and Pressure Levels Form  
for Westbay Wells

Project Number:

Task Manager

Technicians:

Recorded By:

Reviewed By:

(Signature) / (Initials)

(Signature) / (Initials)

Well Name:

Sample Date:

Barometric Pressure:

Sample Time:

Sample # First Port:

Client:

Location:

Probe Type:

Probe Serial No.:

USACE

Former Fort Ord

West Bay

Port Identification			Surface Functioning Tests Probe in Flushing Collar					Position Sampler	Pressure Test and Sample Collection Check at Port (Sample Collection)										
	Port No.	Port Name	Port Depth (Cable)	Arm Out Land Probe Shoe Out	Close Valve	Check Vacuum	Open Valve	Evacuate Container	Close Valve Shoe In	1. Locate Port 2. Arm Out 3. Land Probe	Pressure in MP Internal)	Shoe Out	Zone Pressure External)	Open Valve	Zone Pressure External)	Close Valve	Shoe In	Pressure in MP Internal)	Last 4 Digits of Sample #
	1	282		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
	2	317		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
	3	342		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
	4	397		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
	5	467		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
	6	537		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		

General Comments:

QC Sample #

Associated Sample:

Cooler Temp: °C

**Second Quarter, 2008**  
**4084086506 02.1.1**

**Fort Ord Quarterly Groundwater Monitoring Program**  
**Water Level Indicator Calibration by Steel Tape**

Well #:	
Steel Tape DTW:	
Date:	

Serial No.	Measured DTW	Calibration Differential

Reviewed by:	
Date:	

# AHTNA DAILY SITE SAFETY TAILGATE / INSPECTION LOG

## GENERAL DATA

Date:

Site:

Site Location:

AHTNA Site Manager:

AHTNA SSHO:

## DOCUMENTATION OF WORKDAY SAFETY MEETING (List Topics of Discussion):

Other items to address as appropriate (check those discussed):

<input type="checkbox"/> Scope of day's work	<input type="checkbox"/> OSHA's Focus Four	<input type="checkbox"/> Recent near miss / injuries / lessons
<input type="checkbox"/> Site SH&E Plan / Revisions	<input type="checkbox"/> Fall Hazards	<input type="checkbox"/> Lifting Safety / Materials Handling
<input type="checkbox"/> AHA's / PTSP's completed/reviewed?	<input type="checkbox"/> Electrical Hazards	<input type="checkbox"/> BBS Hazard Triggers <sup>1</sup>
<input type="checkbox"/> Emergency SOPs (i.e. rally pt., tele #s)	<input type="checkbox"/> Struck-by Hazards	<input type="checkbox"/> BBS Trigger Controls <sup>2</sup>
<input type="checkbox"/> Communications Check	<input type="checkbox"/> Caught in / between Hazards	<input type="checkbox"/> Other (heat, noise, trench, confine sp)
<input type="checkbox"/> PPE Requirements	<input type="checkbox"/> Other Primary Hazards	

## MEETING ATTENDEES: (place \* next to subcontractor safety representatives)

NAME / COMPANY	NAME / COMPANY

SUBCONTRACTOR SAFETY REPs COMMENTS?

## DAILY INSPECTIONS: (SSHO shall initial each completed applicable inspection item)

Y	N	A	Inspection Item	Y	N	A	Inspection Item	Y	N	A	INSPECTION ITEM OTHER (List)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Postings/Plans (APP) readily avail.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Signs (No Smoking, Site Control)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Designated Parking / Traffic Control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PPE(head/eye/foot/hand/ear/body)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Subcontractor Safety Rep Involved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hi-Vis, PFD's, Ring Buoys, Etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Subcontractor / Task AHA's	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Excav./Trench/Spoils Protection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Subcontractor Equip. Inspections	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Confined Spaces Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Emergency Equip. (PFE's, FA Kits)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Physical Barriers / Covers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Eye Wash / Shower	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fall Hazards (Protected)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Communications Check	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ladders	ISSUES TO FOLLOW-UP (Immediately Correct Deficiencies if able)			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sanitation (Toilets, Hand Wash)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Power & Portable Hand Tools				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Water & Shade, Non-Pot Identified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Company Field Equipment				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Utilities Identified / Controlled	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Alarms / Seatbelts				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Material Storage Proper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	GFCI's, Whip-Checks, Slings				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Lay Down Areas Orderly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Exposed Rebar Protected				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Waste Containers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Safety / Health Behaviors:				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spill Control (Pads, Snakes, Drums)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Competent / Qualified Persons				

Immediately Correct any deficiencies. Note any uncorrected deficiencies on the APP Safety and Occupational Health Deficiency Tracking Log.

Comments/Field Notes:

I acknowledge that above elements performed (SSHO/Inspector signature):

Date:

<sup>1</sup> BBS Triggers: (e.g. Distractions, rushing, short-cuts, frustration, exhaustion, complacency, anger, multi-tasking, mind elsewhere)

<sup>2</sup> BBS Trigger Controls: (e.g. communicating, accountability, patience, relaxation techniques, healthy lifestyle, and adequate sleep).

AHTNA DAILY SITE SAFETY TAILGATE / INSPECTION LOG

Additional MEETING ATTENDEES: (place \* next to subcontractor safety representatives)

NAME / COMPANY		NAME / COMPANY

NOTES / COMMENTS / SKETCHES





TASK SPECIFIC HEALTH AND SAFETY WORKSHEET  
SUPPLEMENT TO THE PROGRAM HEALTH AND SAFETY PLAN

This worksheet shall be used in conjunction with the AHTNA Accident Prevention Plan, March 2015, and the U.S. Army Corps of Engineers Safety and Health Manual, EM 385-1-1, November 2014.

GENERAL PROJECT INFORMATION

Project Number: \_\_\_\_\_ Date: \_\_\_\_\_  
Site or Activity Description: \_\_\_\_\_ Prepared by: \_\_\_\_\_  
Location Description: \_\_\_\_\_ Reviewed by: \_\_\_\_\_

**TASK DESCRIPTION (Check all that apply)**

_____ Sample Location Marking	_____ Hand augering	_____ Water level surveys
_____ Geophysics borehole clearance	_____ Soil gas survey	_____ Sediment sampling
_____ Biological borehole clearance	_____ Geophysics	_____ Biological inventory
_____ Monitoring well installation	_____ Groundwater sampling	_____ Hazardous waste handling /mgmt
_____ Soil Borings	_____ Soil sampling	_____ Hydropunch
_____ Trenching	_____ Other (specify _____)	

**SITE HAZARDS (check all that apply)**

_____ Contaminated water		
_____ VOC	_____ Pesticides	_____ Ionizing radiation (specify) _____
_____ SOC	_____ Petroleum	
_____ Metals	_____ Chlorinated hydrocarbons	_____ Non-ionizing radiation (specify) _____
_____ PCB	_____ Other (specify _____)	
		_____ Noise
_____ Contaminated Soil		_____ Biological hazards (specify) <u>mountain lions, dogs,</u>
_____ VOC	_____ Pesticides	spiders, snakes, ticks, poison oak _____
_____ SOC	_____ Petroleum	_____ Temperature extremes Heat _____ Cold _____
_____ Metals	_____ Chlorinated hydrocarbons	_____ Overhead/underground utilities
_____ PCB	_____ Other (specify _____)	_____ Vehicle traffic
		_____ Air traffic/noise
_____ Contaminated Air		_____ Unexploded ordnance (UXO)
_____ VOC	_____ Pesticides	_____ Equipment/mechanical
_____ SOC	_____ Petroleum	_____ Other (specify _____)
_____ Metals	_____ Chlorinated hydrocarbons	
_____ PCB	_____ Other (specify _____)	



I have read and become familiar with all aspects of the Site Safety and Health Plan. I also understand that the Site Safety and Health Plan may be supplemented with other site-specific health and safety documents for which I will be held equally responsible.

NAME	DATE	COMPANY	SIGNATURE

## USACE PROJECT SITE SAFETY LOG

### GENERAL DATA

Job # \_\_\_\_\_

Activity \_\_\_\_\_

Location Description \_\_\_\_\_

### DOCUMENTATION OF DAILY MORNING SAFETY MEETING: TOPICS OF DISCUSSION (check all that apply)

\_\_\_\_\_ scope of work/SAP  
\_\_\_\_\_ potential hazards  
\_\_\_\_\_ health and safety plan highlights/revisions  
\_\_\_\_\_ emergency procedures  
\_\_\_\_\_ PPE requirements  
\_\_\_\_\_ equipment calibration  
\_\_\_\_\_ special topics (specify \_\_\_\_\_)

### MEETING ATTENDEES:

NAME	DATE	COMPANY	SIGNATURE

### DAILY INSPECTIONS: (Site crew chief shall initial each completed inspection)

\_\_\_\_\_ PPE  
\_\_\_\_\_ field equipment  
\_\_\_\_\_ vehicles  
\_\_\_\_\_ safety equipment  
\_\_\_\_\_ field health and safety binder in vehicle  
\_\_\_\_\_ first aid kit  
\_\_\_\_\_ required eyewash station filled, and charged  
\_\_\_\_\_ fire extinguisher  
\_\_\_\_\_ communication check  
method \_\_\_\_\_  
time \_\_\_\_\_

Note any deficiencies:

\_\_\_\_\_  
\_\_\_\_\_

I acknowledge that the above health and safety program self audit and inspections have been performed prior to the initiation of scheduled work.

Signature of Site Safety and Health Officer (SSHO) \_\_\_\_\_

**LIST OF AUTHORIZED VISITORS NOT NORMALLY ASSIGNED TO THIS SITE**

(Note: SSHO must initial verification that each personnel record is present in the field binder.)

NAME	HAZWOPER CERTIFICATION	MEDICAL CLEARANCE	RESPIRATOR FIT TEST	FIRST AID/CPR

# FORT ORD MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) INCIDENT REPORTING FORM

If you recognize any object that resembles munitions or explosives on current or former Fort Ord property, retreat to a safe location, and report the finding to the **appropriate agencies immediately** (see below)

## A. PROVIDE THE FOLLOWING INFORMATION:

Name of Person Reporting:	Telephone:
Agency:	Fax:
Date & Time of Incident/Discovery:	
Description of Item Found (refer to the "Safety Alert" pamphlet if possible):	
Location (direction from nearest road/building, attach map if possible):	
GPS Coordinate Location: (Type of Instrument, NAD83 California State Plan Coordinates Zone IV, feet)	
Describe how the item was found:	

## CONTACT THE APPROPRIATE AGENCIES IMMEDIATELY:

Initial when completed	Mon– Thu (6 a.m. – 5 p.m.) Contact and FAX Form to:	Contact Number	Date & Time Called
	USACE Ordnance Safety Specialist or MMRP Site Safety Manager	Ph: (831) 884-9925 ext.226 Cell: (831) 760-2571 Fax:(831) 884-9030 Ph: (831) 242-7919 Fax:(831) 242-7019 Cell: (831) 760-2575	
	<b>Fri – Sun (24 Hours)</b> 60 <sup>th</sup> Civ Engr Sqdn EOD	Phone: (707) 424-5517	
	Note: If 60 <sup>th</sup> Civ Engr Sqdn EOD is contacted, notify the MMRP Site Safety Manager: (831) 242-7919, Cell (831) 760-2575.		

## B. To be completed by USACE Ordnance Safety Specialist when applicable (Mon – Thu)

Form Received By:		Date & Time:
Identification of Item Found:		
Extent of Area Surveyed:		Name of digital file for picture (date):
Disposition of Item:		
<b>Fax completed form</b> to MMRP Site Safety Mgr Bldg 4463 Gigling Rd, POM (Fort Ord) when response complete	Fax: (831) 242-7091 Phone: (831) 242-7919	Date & Time:

## C. To be completed by MMRP Site Safety Manager:

Acknowledge Completed Form Received:	Date & Time:
Regulatory Agencies Notified (Date):	



F1008-E

## CHAIN OF CUSTODY

## WATER / SOIL

**Chain of Custody #:**

---

Carbon Copies: White - Laboratory    Yellow - Ahtna

[illegible]





## POST-TREATMENT PARAMETER MONITORING FORM

### Project Information:

Project and Task No.: \_\_\_\_\_

**Project Name:** \_\_\_\_\_

Date: \_\_\_\_\_

Field Personnel Name/s:

**Well Information:**

Well ID:

**Total Depth:** \_\_\_\_\_ **Well Diameter:** \_\_\_\_\_

**Three Casing Volumes:** \_\_\_\_\_

### Parameter Collection Information:

Method of Monitoring: ☐ Purging ☐ Downhole Meter

**Downhole Meter Type and ID:**

**Pump Type and ID:** \_\_\_\_\_

Multi-Meter Type and ID:

**Meter Calibration Completed (except Temperature)<sup>1</sup>:** ☐

**Water Level Information:**

**Initial Depth to Water:** \_\_\_\_\_

**Depth to Water after Monitoring:** \_\_\_\_\_

[illegible]

**NOTES:**

<sup>1</sup> If the Horiba U-50 Series multi-meter is used, calibration should occur daily. If the YSI 6-Series Multi-Parameter Water Quality Sonde with downhole probe is used, calibration is performed by the vendor and field calibration is not required for field events lasting less than 1 month, unless field conditions present erroneous data or the Sonde experiences mechanical issues.

## **ATTACHMENT D**

### **Three Phase Quality Control Process and Documentation**

**INVESTIGATION, MONITORING, O&M PROJECTS  
PREPARATORY PHASE INSPECTION COVER SHEET**

Contract No.: \_\_\_\_\_

Date: \_\_\_\_\_

Task No.: \_\_\_\_\_

Location/Project: \_\_\_\_\_

**A. Key Personnel Present:**

	<u>Name</u>	<u>Position</u>	<u>Company</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____

**B. Submittals:**

1. Review submittals and/or submittal register. Have all applicable submittals been approved?

Yes\_\_\_ No\_\_\_

If No, what items have not been submitted?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

\_\_\_\_\_  
USACE Representative Signature

\_\_\_\_\_  
Quality Control Manager Signature



INVESTIGATION, MONITORING, O&M PROJECTS: PREPARATORY PHASE INSPECTION CHECKLIST				
Assessment Activity	Assessment Mechanism	Person(s) Responsible	Response Action	Completed by/Date
Have planning documents been prepared in accordance with the statement of work, regulatory requirements, and contract requirements?	Quality control review of document by Project Manager and QC reviewer.	Project Manager, QC Reviewer	Modify document as directed by reviewers	
Prior to project activities: Have planning documents been read by appropriate project personnel (including subcontractors) before work is conducted.	Documentation (e.g., sign-off form, note to file, email acknowledgement) that document has been read and requirements are understood.	Subcontractors as required. Project Manager, Task Manager, and Project Chemist to check signoff and forms.	Direct project personnel to read relevant documents.	
Prior to project activities: Has required preliminary work (e.g., clearance activities, permits, site access) been completed in accordance with project plan.	Comparison of information obtained from preliminary work completion assessment as specified in the project planning document(s).	Project Manager, Safety and Health Officer, QC Manger/Reviewer, Task Manager, Project Chemist, Field Staff	Delay startup if necessary preliminary work has not been completed. Implement corrective actions by directing appropriate personnel or subcontractors to complete necessary preliminary work.	
Prior to project activities: Are staff and subcontractors prepared to implement project activities according to planning documents?	Review and discussion of planned activities prior to implementation.	Project Manager, Safety and Health Officer, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Delay startup if staff and subcontractors are not prepared to implement activities <i>in</i> accordance with specification.	
Prior to project activities: Is necessary field equipment available and in acceptable working order?	Compare field equipment list with planned activities. Compare field equipment calibration documentation with project goals specified in the SAP.	Project Manager, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Delay startup if equipment is unavailable or not in proper working order. Implement corrective actions to include use of alternate equipment, or recalibration of available equipment.	

**INVESTIGATION, MONITORING, O&M PROJECTS  
INITIAL PHASE INSPECTION COVER SHEET**

Contract No.: \_\_\_\_\_

Date: \_\_\_\_\_

Task No.: \_\_\_\_\_

Location/Project: \_\_\_\_\_

Description and Location of Work Inspected: \_\_\_\_\_

---

**A. Key Personnel Present:**

	<u>Name</u>	<u>Position</u>	<u>Company</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____
	_____	_____	_____

\_\_\_\_\_  
Quality Control Manager Signature

INVESTIGATION, MONITORING, O&M PROJECTS: INITIAL PHASE INSPECTION CHECKLIST				
Assessment Activity	Assessment Mechanism	Person(s) Responsible	Response Action	Completed by/Date
Beginning of project activity: Is work being performed according to project plans?	Conduct field and laboratory audits.	Project Manager, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Stop work if audits indicate significant deviation from project plan. Implement immediate or long- term corrective actions. Communicate deficiencies to USACE Project Manager.	
Early phase of project: Have necessary audits been performed?	Review project phase and check to see if required audits have <i>been</i> satisfactorily completed.	Project Manager, Project Manager, Quality Control System Manager	Stop work if reviewer decides that absence of audit jeopardizes successful implementation of project plans. Immediately schedule necessary audits.	
Ongoing throughout project: Are daily quality control reports being prepared according to contract requirements?	Review Content and delivery schedules of daily quality control reports.	Project Manager, Task Manager, Project Chemist, Project Staff	Correct deficiencies in reports or reporting delays.	
Ongoing throughout project: Do project plans adequately address any changes in project activities or goal?	Compare data gathered to assess conformance to the project plan and conceptual site model.	Project Manager, Safety and Health Officer, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Stop work if assessor decides that project plan deficiencies are significant. Implement corrective action to include modification of project plans. Notify USACE Project Manager.	
Ongoing throughout project: Do project plans adequately address any changes in project activities or goals?	Compare data gathered to assess conformance to the conceptual site model, data quality objectives, and project plan.	Project Manager, Quality Control System Manager, Task Manager, Project Chemist, data users and evaluators.	Propose additional data collection activities to fill data gaps. Notify USACE Project Manager. Revise or update planning documents as appropriate.	

## INVESTIGATION, MONITORING, O&M PROJECTS FOLLOW-UP PHASE INSPECTION COVER SHEET

Contract No.: \_\_\_\_\_  
Task No.: \_\_\_\_\_  
Location/Project: \_\_\_\_\_

Date: \_\_\_\_\_

Project/Area of Inspection: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### A. Key Personnel Present:

	<u>Name</u>	<u>Position</u>	<u>Company</u>
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

### B. Definable Features of Work:

Status of Inspection:

[illegible]

## Quality Control Manager

INVESTIGATION PROJECT FOLLOW-UP PHASE INSPECTION CHECKLIST					
Assessment Activity	Assessment Mechanism	Person(s) Responsible	Response Action	Completed by/Date	
Reporting phase of project: Have data reports been prepared in accordance with project plans?	Compare data reports to specifications detailed in planning documents.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, data users and evaluators.	Revise documents and reports as appropriate.		
After draft report submittal or project completion: Are reports adequate to meet client and regulatory agency requirements?	Review client and agency comments. Prepare responses to comments.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, data users and evaluators.	Revise documents and reports as appropriate.		
Have other definable features of work been completed in accordance to project requirements	Compare definable features of work with project requirements.	Project Manager, Quality Control Manager	Complete definable feature of work as required.		

## **ATTACHMENT E**

### **ADR Library and Qualifier Tables**



# Project Accuracy and Precision Report

eQapp Name: FtOrd\_UFP\_QAPP\_Rev7

Description: Quality Assurance Project Plan Former Fort Ord, California

Analyte Name	Analyte Label (CAS)	Lower Rejection (%)	Lower Recovery (%)	Upper Recovery (%)	Upper Rejection (%)	RPD (%)
Method: EPA6010C Matrix: AQ						
QC Type: LCS						
ANTIMONY	7440-36-0		80.00	120.00		20.00
COPPER	7440-50-8		80.00	120.00		20.00
LEAD	7439-92-1		80.00	120.00		20.00
QC Type: MS						
ANTIMONY	7440-36-0		80.00	120.00		20.00
COPPER	7440-50-8		80.00	120.00		20.00
LEAD	7439-92-1		80.00	120.00		20.00
Method: EPA8260-SIM Matrix: AQ						
QC Type: LCS						
1,1-DICHLOROETHANE	75-34-3		81.00	122.00		15.00
1,1-DICHLOROETHYLENE	75-35-4		78.00	137.00		18.00
1,2-DICHLOROETHANE	107-06-2		75.00	125.00		14.00
1,2-DICHLOROETHENE (TOTAL)	540-59-0		76.00	127.00		17.00
1,2-DICHLOROPROPANE	78-87-5		76.00	124.00		14.00
1,3-Dichloropropene (total)	542-75-6		75.00	120.00		23.00
BENZENE	71-43-2		81.00	122.00		14.00
CARBON TETRACHLORIDE	56-23-5		76.00	136.00		23.00
CHLOROFORM	67-66-3		80.00	124.00		15.00
CIS-1,2-DICHLOROETHYLENE	156-59-2		78.00	120.00		15.00
METHYLENE CHLORIDE	75-09-2		69.00	135.00		16.00
TETRACHLOROETHYLENE	127-18-4		76.00	135.00		16.00
TRICHLOROETHYLENE	79-01-6		81.00	126.00		15.00
VINYL CHLORIDE	75-01-4		69.00	159.00		18.00

Analyte Name	Analyte Label (CAS)	Lower Rejection (%)	Lower Recovery (%)	Upper Recovery (%)	Upper Rejection (%)	RPD (%)
Method: EPA8260-SIM						
QC Type: MS						
1,1-DICHLOROETHANE	75-34-3		81.00	122.00		15.00
1,1-DICHLOROETHYLENE	75-35-4		78.00	137.00		18.00
1,2-DICHLOROETHANE	107-06-2		75.00	125.00		14.00
1,2-DICHLOROETHENE (TOTAL)	540-59-0		76.00	127.00		17.00
1,2-DICHLOROPROPANE	78-87-5		76.00	124.00		14.00
1,3-Dichloropropene (total)	542-75-6		75.00	120.00		23.00
BENZENE	71-43-2		81.00	122.00		14.00
CARBON TETRACHLORIDE	56-23-5		76.00	136.00		23.00
CHLOROFORM	67-66-3		80.00	124.00		15.00
CIS-1,2-DICHLOROETHYLENE	156-59-2		78.00	120.00		15.00
METHYLENE CHLORIDE	75-09-2		69.00	135.00		16.00
TETRACHLOROETHYLENE	127-18-4		76.00	135.00		16.00
TRICHLOROETHYLENE	79-01-6		71.00	126.00		15.00
VINYL CHLORIDE	75-01-4		69.00	159.00		18.00
QC Type: SURR						
1,2-DICHLOROETHANE-D4	17060-07-0	30.00	74.00	125.00		
TOLUENE-D8	2037-26-5	30.00	88.00	111.00		
Method: EPA9056A						
QC Type: LCS						
Chloride	1003		90.00	110.00		
QC Type: MS						
Chloride	1003		90.00	110.00		20.00

# Project Holding Time Report

eQapp Name: FtOrd\_UFP\_QAPP\_Rev7  
Description: Quality Assurance Project Plan Former Fort Ord, California

Analyte Group		Sampling to Analysis	Sampling to Extraction	Sampling to Leaching	Leaching to Extraction	Leaching to Analysis	Extraction to Analysis	Units	Rejection Factor
Method: EPA6010C	Matrix: AQ								
	Primary	180.00						Days	2.00
Method: EPA8260-SIM	Matrix: AQ								
	Primary	14.00						Days	2.00
Method: EPA9056A	Matrix: AQ								
	Primary	28.00						Days	2.00

Project Target Analyte Reporting Limit    Ian    Contamination    and La    Field Duplicate RPD Criteria

eQapp Name:    FtOrd\_UFP\_QAPP\_Rev7  
Description:    Quality Assurance Project Plan    Former Fort Ord, California

Target Analyte Name	Analyte La el CAS	Quantitation Limit	Detection Limit	Units	Ian Contamination Rule	La Dup RPD	FieldDup RPD
<b>Method: EPA6010C                      Matrix: AQ</b>							
ANTIMONY	7440-36-0	6.0	5.0	ug/L	5.00	20.00	30.00
COPPER	7440-50-8	10	5.0	ug/L	5.00	20.00	30.00
LEAD	7439-92-1	10	3.0	ug/L	5.00	20.00	30.00
<b>Method: EPA8260-SIM                      Matrix: AQ</b>							
1,1-DICHLOROETHANE	75-34-3	0.50	0.25	ug/L	5.00	20.00	30.00
1,1-DICHLOROETHYLENE	75-35-4	0.50	0.25	ug/L	5.00	20.00	30.00
1,2-DICHLOROETHANE	107-06-2	0.50	0.25	ug/L	5.00	20.00	30.00
1,2-DICHLOROETHENE (TOTAL)	540-59-0	1.0	0.25	ug/L	5.00	20.00	30.00
1,2-DICHLOROPROPANE	78-87-5	0.50	0.25	ug/L	5.00	20.00	30.00
1,3-Dichloropropene (total)	542-75-6	0.50	0.25	ug/L	5.00	20.00	30.00
BENZENE	71-43-2	0.50	0.25	ug/L	5.00	20.00	30.00
CARBON TETRACHLORIDE	56-23-5	0.50	0.25	ug/L	5.00	20.00	30.00
CHLOROFORM	67-66-3	0.50	0.25	ug/L	5.00	20.00	30.00
CIS-1,2-DICHLOROETHYLENE	156-59-2	0.50	0.25	ug/L	5.00	20.00	30.00
METHYLENE CHLORIDE	75-09-2	2.0	1.0	ug/L	10.00	20.00	30.00
TETRACHLOROETHYLENE	127-18-4	0.50	0.25	ug/L	5.00	20.00	30.00
TRICHLOROETHYLENE	79-01-6	0.50	0.25	ug/L	5.00	20.00	30.00
VINYL CHLORIDE	75-01-4	0.10	0.050	ug/L	5.00	20.00	30.00
<b>Method: EPA9056A                      Matrix: AQ</b>							
Chloride	1003	250	0.50	mg/L	5.00	20.00	30.00

**ADR**
**Data Qualification Table**

Description	VOA	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Difference Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Difference Lower Rejection	J-	R
Continuing Calibration Verification Percent Difference Upper Estimation	J+	
Continuing Calibration Verification Percent Difference Upper Rejection	J+	UJ
Continuing Calibration Verification Relative Response Factor	J	UJ
Continuing Tune	J	R
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	R
Field Blank Contamination	U	
Initial calibration Correlation Coefficient	J	UJ
Initial Calibration Percent Relative Standard Deviation	J	UJ
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Difference Lower Estimation	J-	UJ
Initial Calibration Verification Percent Difference Lower Rejection	J-	R
Initial Calibration Verification Percent Difference Upper Estimation	J+	
Initial Calibration Verification Percent Difference Upper Rejection	J+	UJ
Initial Calibration Verification Relative Response Factor	J	UJ
Initial Tune	J	R
Internal Standard Estimation	J	UJ
Internal Standard Rejection	J	R
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	R
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	R
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	R
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	R
Method Blank Contamination	U	
Preservation	J-	UJ
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	R
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	R
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	R
Surrogate Recovery Lower Estimation	J-	UJ
Surrogate Recovery Lower Rejection	J-	R
Surrogate Recovery Upper Estimation	J+	
Surrogate Recovery Upper Rejection	J+	R
Temperature Estimation	J-	UJ
Temperature Rejection	J-	R
Trip Blank Contamination	U	

## ADR

## Data Qualification Table

Description	Metals	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Recovery Lower Rejection	R	R
Continuing Calibration Verification Percent Recovery Upper Estimation	J+	
Continuing Calibration Verification Percent Recovery Upper Rejection	R	
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	R
Field Blank Contamination	U	
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Initial Calibration Verification Percent Recovery Lower Rejection	R	R
Initial Calibration Verification Percent Recovery Upper Estimation	J+	
Initial Calibration Verification Percent Recovery Upper Rejection	R	
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	R
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	R
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	R
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	R
Method Blank Contamination	U	
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	R
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	R
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	R
Trip Blank Contamination	U	



## ADR

## Data Qualification Table

Description	GenChem	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Recovery Lower Rejection	R	R
Continuing Calibration Verification Percent Recovery Upper Estimation	J+	
Continuing Calibration Verification Percent Recovery Upper Rejection	R	
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	R
Field Blank Contamination	U	
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Initial Calibration Verification Percent Recovery Lower Rejection	R	R
Initial Calibration Verification Percent Recovery Upper Estimation	J+	
Initial Calibration Verification Percent Recovery Upper Rejection	R	
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	R
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	R
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	R
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	R
Method Blank Contamination	U	
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	R
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	R
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	R
Trip Blank Contamination	U	

## **ATTACHMENT F**

### **Analytical Laboratory Certifications**



# CERTIFICATE OF ACCREDITATION

## ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

**SGS North America Inc. - Orlando**  
**4405 Vineland Road, Suite C-15**  
**Orlando, FL 32811**

has been assessed by ANAB  
and meets the requirements of international standard

**ISO/IEC 17025:2005**

**and DoD Quality Systems Manual for Environmental  
Laboratories (DoD QSM V 5.1.1)**

while demonstrating technical competence in the fields of

**TESTING**

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations and/or tests to which this accreditation applies.

L2229  
Certificate Number

  
ANAB Approval

Certificate Valid: 12/05/2018-12/15/2021  
Version No. 003 Issued: 12/05/2018



This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



ANSI-ASQ National Accreditation Board

**SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND DOD  
QUALITY SYSTEMS MAUAL FOR ENVIRONMENTAL  
LABORATORIES (DOD QSM V 5.1.1)**

**SGS North America Inc. - Orlando**

4405 Vineland Road, Suite C-15

Orlando, FL 32811

Svetlana Izosimova, Ph. D., QA Officer

407-425-6700

**TESTING**

Valid to: **December 15, 2021**

Certificate Number: **L2229**

**Environmental**

Drinking Water		
Technology	Method	Analyte
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 rev. 1.1	N-Ethyl perfluorooctanesulfonamidoacetic acid



Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2-Dibromoethane (EDB)
GC/ECD	EPA 504.1	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2,3-Trichloropropane (1,2,3-TCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 608.3; EPA 8081B	4,4'-DDD
GC/ECD	EPA 608.3; EPA 8081B	4,4'-DDE
GC/ECD	EPA 608.3; EPA 8081B	4,4'-DDT
GC/ECD	EPA 608.3; EPA 8081B	Aldrin
GC/ECD	EPA 608.3; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	delta-BHC
GC/ECD	EPA 608.3; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608.3; EPA 8081B	alpha-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	Dieldrin
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan I
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan II
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608.3; EPA 8081B	Endrin
GC/ECD	EPA 608.3; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608.3; EPA 8081B	Endrin ketone
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor epoxide



Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 608.3; EPA 8081B	Methoxychlor
GC/ECD	EPA 608.3; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorvos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel





Non-Potable Water		
Technology	Method	Analyte
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)



Non-Potable Water		
Technology	Method	Analyte
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-Range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 624.1; EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 624.1; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	4-Chlorotoluene



Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624.1; EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 624.1; EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromoform
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Carbon disulfide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 624.1; EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)



Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 624.1; EPA 8260B/C	Methyl Acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 624.1; EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methylene chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Styrene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Toluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Vinyl acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Vinyl chloride





Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Xylene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	m,p-Xylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 625.1; EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625.1; EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1; EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625.1; EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 625.1; EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625.1; EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 625.1; EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D	2-Chlorophenol
GC/MS	EPA 625.1; EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene



Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D	2-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625.1; EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 625.1; EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625.1; EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 625.1; EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 625.1; EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 625.1; EPA 8270D	4-Chloroaniline
GC/MS	EPA 625.1; EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 625.1; EPA 8270D	4-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4'-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 625.1; EPA 8270D	Acetophenone
GC/MS	EPA 625.1; EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 625.1; EPA 8270D	Atrazine
GC/MS	EPA 625.1; EPA 8270D	Benzaldehyde
GC/MS	EPA 625.1; EPA 8270D	Benzidine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene





Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 625.1; EPA 8270D	Benzoic acid
GC/MS	EPA 625.1; EPA 8270D	Benzyl alcohol
GC/MS	EPA 625.1; EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))
GC/MS	EPA 625.1; EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625.1; EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Carbazole
GC/MS	EPA 625.1; EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 625.1; EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 625.1; EPA 8270D	Dibenzofuran
GC/MS	EPA 625.1; EPA 8270D	Diethyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 625.1; EPA 8270D	Hexachlorobenzene



Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 625.1; EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 625.1; EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 625.1; EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625.1; EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 625.1; EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 625.1; EPA 8270D	Phenol



Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 625.1; EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 610	1-Methylnaphthalene
HPLC	EPA 610	2-Methylnaphthalene
HPLC	EPA 610	Acenaphthene
HPLC	EPA 610	Acenaphthylene
HPLC	EPA 610	Anthracene
HPLC	EPA 610	Benzo(a)anthracene
HPLC	EPA 610	Benzo(a)pyrene
HPLC	EPA 610	Benzo(b)fluoranthene
HPLC	EPA 610	Benzo(g h i)perylene
HPLC	EPA 610	Benzo(k)fluoranthene
HPLC	EPA 610	Chrysene
HPLC	EPA 610	Dibenz(a,h)anthracene
HPLC	EPA 610	Fluoranthene
HPLC	EPA 610	Fluorene
HPLC	EPA 610	Indeno(1,2,3-cd)pyrene
HPLC	EPA 610	Naphthalene
HPLC	EPA 610	Phenanthrene
HPLC	EPA 610	Pyrene
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)



Non-Potable Water		
Technology	Method	Analyte
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2',6,6'-Tetranitro-4,4'-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MXN
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorodecanoic Acid



Non-Potable Water		
Technology	Method	Analyte
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoropentanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD <sup>2</sup>	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD <sup>2</sup>	6:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD <sup>2</sup>	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)





Non-Potable Water		
Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
ICP	EPA 200.7; EPA 6010C/D	Aluminum
ICP	EPA 200.7; EPA 6010C/D	Antimony
ICP	EPA 200.7; EPA 6010C/D	Arsenic
ICP	EPA 200.7; EPA 6010C/D	Barium
ICP	EPA 200.7; EPA 6010C/D	Beryllium





Non-Potable Water		
Technology	Method	Analyte
ICP	EPA 200.7; EPA 6010C/D	Cadmium
ICP	EPA 200.7; EPA 6010C/D	Calcium
ICP	EPA 200.7; EPA 6010C/D	Chromium
ICP	EPA 200.7; EPA 6010C/D	Cobalt
ICP	EPA 200.7; EPA 6010C/D	Copper
ICP	EPA 200.7; EPA 6010C/D	Iron
ICP	EPA 200.7; EPA 6010C/D	Lead
ICP	EPA 200.7; EPA 6010C/D	Magnesium
ICP	EPA 200.7; EPA 6010C/D	Manganese
ICP	EPA 200.7; EPA 6010C/D	Molybdenum
ICP	EPA 200.7; EPA 6010C/D	Nickel
ICP	EPA 200.7; EPA 6010C/D	Potassium
ICP	EPA 200.7; EPA 6010C/D	Selenium
ICP	EPA 200.7; EPA 6010C/D	Silver
ICP	EPA 200.7; EPA 6010C/D	Sodium
ICP	EPA 200.7; EPA 6010C/D	Strontium
ICP	EPA 200.7; EPA 6010C/D	Thallium
ICP	EPA 200.7; EPA 6010C/D	Tin
ICP	EPA 200.7; EPA 6010C/D	Titanium
ICP	EPA 200.7; EPA 6010C/D	Vanadium
ICP	EPA 200.7; EPA 6010C/D	Zinc
ICP/MS	EPA 200.8; EPA 6020A/B	Aluminum
ICP/MS	EPA 200.8; EPA 6020A/B	Antimony
ICP/MS	EPA 200.8; EPA 6020A/B	Arsenic
ICP/MS	EPA 200.8; EPA 6020A/B	Barium
ICP/MS	EPA 200.8; EPA 6020A/B	Beryllium
ICP/MS	EPA 200.8; EPA 6020A/B	Cadmium
ICP/MS	EPA 200.8; EPA 6020A/B	Calcium
ICP/MS	EPA 200.8; EPA 6020A/B	Chromium
ICP/MS	EPA 200.8; EPA 6020A/B	Cobalt
ICP/MS	EPA 200.8; EPA 6020A/B	Copper
ICP/MS	EPA 200.8; EPA 6020A/B	Iron
ICP/MS	EPA 200.8; EPA 6020A/B	Lead
ICP/MS	EPA 200.8; EPA 6020A/B	Magnesium
ICP/MS	EPA 200.8; EPA 6020A/B	Manganese
ICP/MS	EPA 200.8; EPA 6020A/B	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A/B	Nickel



Non-Potable Water		
Technology	Method	Analyte
ICP/MS	EPA 200.8; EPA 6020A/B	Potassium
ICP/MS	EPA 200.8; EPA 6020A/B	Selenium
ICP/MS	EPA 200.8; EPA 6020A/B	Silver
ICP/MS	EPA 200.8; EPA 6020A/B	Sodium
ICP/MS	EPA 200.8; EPA 6020A/B	Strontium
ICP/MS	EPA 200.8; EPA 6020A/B	Thallium
ICP/MS	EPA 200.8; EPA 6020A/B	Tin
ICP/MS	EPA 200.8; EPA 6020A/B	Titanium
ICP/MS	EPA 200.8; EPA 6020A/B	Vanadium
ICP/MS	EPA 200.8; EPA 6020A/B	Zinc
CVAA	EPA 7470A	Mercury
CVAA	EPA 245.1	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 350.1	Ammonia, Gas Diffusion Option
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate+Nitrite
Manual Colorimetry	EPA 365.3	Orthophosphate
Manual Colorimetry	EPA 365.3	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 1664B; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)



Non-Potable Water		
Technology	Method	Analyte
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)
Electrometric Methods	EPA 120.1	Specific conductivity
Combustion	EPA 9060A	Total Organic Carbon
Combustion	SM 5310B-11	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	Method	Type
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct injection
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 610; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)



Solid and Chemical Materials		
Technology	Method	Analyte
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 8081B	4,4'-DDD
GC/ECD	EPA 8081B	4,4'-DDE
GC/ECD	EPA 8081B	4,4'-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)



Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T





Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	AK-103	Residual range organics (RRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)





Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	sec-Butylbenzene



Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Carbon disulfide
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl Acetate
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)



Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene (total)
GC/MS	EPA 8260B/C	m,p-Xylene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane



Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Nitroaniline



Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4'-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene





Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine





Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene



Solid and Chemical Materials		
Technology	Method	Analyte
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2',6,6'-Tetranitro-4,4'-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoropentanesulfonic Acid



Solid and Chemical Materials		
Technology	Method	Analyte
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD <sup>2</sup>	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD <sup>2</sup>	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD <sup>2</sup>	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD <sup>2</sup>	6:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD <sup>2</sup>	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-1515	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)



Solid and Chemical Materials		
Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
ICP	EPA 6010C/D	Aluminum
ICP	EPA 6010C/D	Antimony
ICP	EPA 6010C/D	Arsenic
ICP	EPA 6010C/D	Barium
ICP	EPA 6010C/D	Beryllium
ICP	EPA 6010C/D	Cadmium
ICP	EPA 6010C/D	Calcium
ICP	EPA 6010C/D	Chromium
ICP	EPA 6010C/D	Cobalt
ICP	EPA 6010C/D	Copper
ICP	EPA 6010C/D	Iron
ICP	EPA 6010C/D	Lead
ICP	EPA 6010C/D	Magnesium
ICP	EPA 6010C/D	Manganese
ICP	EPA 6010C/D	Molybdenum



Solid and Chemical Materials		
Technology	Method	Analyte
ICP	EPA 6010C/D	Nickel
ICP	EPA 6010C/D	Potassium
ICP	EPA 6010C/D	Selenium
ICP	EPA 6010C/D	Silver
ICP	EPA 6010C/D	Sodium
ICP	EPA 6010C/D	Strontium
ICP	EPA 6010C/D	Thallium
ICP	EPA 6010C/D	Tin
ICP	EPA 6010C/D	Titanium
ICP	EPA 6010C/D	Vanadium
ICP	EPA 6010C/D	Zinc
ICP/MS	EPA 6020A/B	Aluminum
ICP/MS	EPA 6020A/B	Antimony
ICP/MS	EPA 6020A/B	Arsenic
ICP/MS	EPA 6020A/B	Barium
ICP/MS	EPA 6020A/B	Beryllium
ICP/MS	EPA 6020A/B	Cadmium
ICP/MS	EPA 6020A/B	Calcium
ICP/MS	EPA 6020A/B	Chromium
ICP/MS	EPA 6020A/B	Cobalt
ICP/MS	EPA 6020A/B	Copper
ICP/MS	EPA 6020A/B	Iron
ICP/MS	EPA 6020A/B	Lead
ICP/MS	EPA 6020A/B	Magnesium
ICP/MS	EPA 6020A/B	Manganese
ICP/MS	EPA 6020A/B	Molybdenum
ICP/MS	EPA 6020A/B	Nickel
ICP/MS	EPA 6020A/B	Potassium
ICP/MS	EPA 6020A/B	Selenium
ICP/MS	EPA 6020A/B	Silver
ICP/MS	EPA 6020A/B	Sodium
ICP/MS	EPA 6020A/B	Strontium
ICP/MS	EPA 6020A/B	Thallium
ICP/MS	EPA 6020A/B	Tin
ICP/MS	EPA 6020A/B	Titanium
ICP/MS	EPA 6020A/B	Vanadium





Solid and Chemical Materials		
Technology	Method	Analyte
ICP/MS	EPA 6020A/B	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Ignitability	EPA 1010A MOD	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	Method	Type
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup





Solid and Chemical Materials		
Technology	Method	Analyte
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2229
2. Not compliant with QSM V5.1.1 Table B-15

  
Vice President

## **ATTACHMENT G**

### **Response to Comments on the Draft QAPP**

## Responses to Comments submitted by the Central Coast Regional Water Quality Control Board (CCRWQCB)<sup>1</sup>

**SPECIFIC COMMENT 1: Section 3.1.3 Known Contaminants and Section 3.6.1 – Worksheet #15a: VOCs by EPA Method 8260-SIM:** Section 3.1.3 indicates that known contaminants, or contaminants of concern (COCs), were identified during Remedial Investigations at the sites and documented in the decision documents for each site. The COCs for each site are listed in Section 3.6.1, Worksheet #15a. Based on a review of groundwater analytical data for the site, it appears that select wells were historically sampled and analyzed for 1,2,3-trichloropropane (1,2,3-TCP). This constituent was ruled out as a potential COC however, the detection limits were above the California Maximum Contaminant Level (MCL) of 0.005 micrograms per liter (µg/L) that was adopted in 2017. Therefore, the Water Board recommends selecting one key groundwater monitoring well (i.e.: the well with the highest concentrations of a known COC) at each of the OU2, Sites 2/12, and OUCTP Areas to sample and analyze for 1,2,3-TCP to confirm non-detectable results using a detection limit below the MCL. In 2018, the municipal water supply wells in the former Fort Ord Area (FO-29 through FO-31) were sampled and analyzed for 1,2,3-TCP using a detection limit below 0.005 µg/L. 1,2,3-TCP was not detected in the samples collected from the municipal water supply wells.

**RESPONSE TO SPECIFIC COMMENT 1:** *It is acknowledged the analytical detection limits for groundwater samples historically collected at the former Fort Ord are higher than the current California MCL, but additional sampling and analysis for 1,2,3-TCP is not warranted based on the following lines of evidence:*

- *Common uses of 1,2,3-TCP included use as a paint and varnish remover, and a cleaning and degreasing agent.<sup>2</sup> These uses would be consistent with historical uses of other solvents, including carbon tetrachloride (CT), tetrachloroethene (PCE), and trichloroethene (TCE), at the former Fort Ord when it was an active military installation. However, while CT, PCE, and TCE have historically been detected in groundwater, soil, and soil gas at the former Fort Ord at concentrations exceeding MCLs or screening levels by several orders of magnitude, there have been no corresponding detections of 1,2,3-TCP, indicating there was no significant usage of this compound.*
- *The vapor pressure of 1,2,3-TCP (3.1 mmHg at 25°C) and the calculated Henry's law constant ( $3.17 \times 10^{-4}$  atm-m<sup>3</sup>/mol at 25°C) suggest volatilization from either dry or moist soil to the atmosphere will be a significant environmental process.<sup>3</sup> Therefore, if there was any release of 1,2,3-TCP to the ground surface, it is likely most or all of it would have volatilized to the atmosphere before it could leach to groundwater.*
- *Other media, including soil and soil gas, have been sampled and analyzed for 1,2,3-TCP at various sites across the former Fort Ord, including OU1, OU2, OUCTP, and Sites 2/12, and 1,2,3-TCP has never been detected, further indicating no significant usage of this compound at the former Fort Ord.*

<sup>1</sup> In a letter dated March 22, 2019 (see Administrative Record No. BW-2785G.4).

<sup>2</sup> Agency for Toxic Substances and Disease Registry: Toxicological Profile for 1,2,3-Trichloropropane, May 2019: <https://www.atsdr.cdc.gov/toxprofiles/tp57.pdf>

<sup>3</sup> Ibid.

- *CT and TCE have historically been detected in municipal water supply wells FO-29, FO-30, and FO-31, and these compounds are associated with identified upgradient operable units; however, as noted in the comment, 1,2,3-TCP has not been detected in these wells. Because 1,2,3-TCP is a chlorinated solvent with high mobility, it would be expected to be present concurrently with CT and TCE; however, its absence indicates there is no upgradient source.*

**SPECIFIC COMMENT 2: Section 3.1.4 – Fate and Transport Considerations, OU2 and OUCTP:** The subsections for OU2 and OUCTP indicate the aquifers that are impacted by COCs. In the subsection for Sites 2/12 please add the aquifer(s) impacted by COCs.

**RESPONSE TO SPECIFIC COMMENT 2:** *The text was revised per the comment.*

**SPECIFIC COMMENT 3: Section 3.1.4 – Fate and Transport Considerations, OU2 and OUCTP:** In the subsection for OUCTP consider adding the following discussion related to TCE in the Lower 180-Foot Aquifer: *Due to the lateral discontinuity in the Intermediate 180-Foot Aquitard between the Upper and Lower 180-Foot Aquifers, existing TCE data for the A-Aquifer in the OU2 Area and for the Upper and Lower 180-Foot Aquifers in the OUCTP and OU2 Areas will be reviewed and evaluated to determine the source of TCE concentrations above the California MCL of 5 µg/L in the Lower 180-Foot Aquifer. Please cite reference documents that include information on the discontinuity of the Intermediate 180-Foot Aquitard, as appropriate.*

**RESPONSE TO SPECIFIC COMMENT 3:** *Text was added to Section 3.1.4 to provide more detail about the migration of CT in the affected aquifers at OUCTP, and to note the presence of TCE in the Lower 180-Foot Aquifer and its possible association with OU2. However, the Quality Assurance Project Plan (QAPP) is a guidance document for groundwater sampling and analysis activities at the former Fort Ord; therefore, the suggested discussion would be more appropriately included in the “Suggested Monitoring Modifications” section of the OUCTP Fourth Quarter 2018 through Third Quarter 2019 Groundwater Monitoring Report.*

**SPECIFIC COMMENT 4: Section 3.1.8 – Geology and Hydrogeology:** This section indicated that the aquifers consist predominantly of fine to coarse-grained sands which are separated by silty clay or clayey fine-grained sand aquitards. Please consider including additional information on the aquitards such as that the Fort Ord Salinas Valley Aquitard pinches out to the west towards the Pacific Ocean and that the Intermediate 180-Foot Aquitard that separates the Upper 180-Foot Aquifer and Lower 180-Foot Aquifer appears to be laterally discontinuous in the eastern portion of the former Fort Ord near the OU2 and OUCTP Areas. Additionally, please cite reference documents that include information on the aquitards, as appropriate.

**RESPONSE TO SPECIFIC COMMENT 4:** *The text was revised per the comment.*

**SPECIFIC COMMENT 5: Section 3.2.1 – Step 1: State the Problem, OUCTP Lower 180-Foot Aquifer:** Consider adding the following discussion related to TCE detections in the Lower 180-Foot Aquifer: *Due to the lateral discontinuity in the Intermediate 180-Foot Aquitard between the Upper and Lower 180-Foot Aquifers, existing TCE data for the A-Aquifer in the OU2 Area and for the Upper and Lower 180-Foot Aquifers in the OUCTP and OU2 Areas will be reviewed and evaluated to determine the source of recent detections of TCE above the California MCL of 5 µg/L in the Lower 180-Foot Aquifer. Please cite reference*

documents that include information on the discontinuity of the Intermediate 180-Foot Aquitard, as appropriate.

**RESPONSE TO SPECIFIC COMMENT 5:** Consistent with the response to Specific Comment 3, text was added to the OUCTP Lower 180-Foot Aquifer subsection of Section 3.2.1 to note the presence of TCE in the Lower 180-Foot Aquifer and its possible association with OU2. Accordingly, Section 3.2.2 was revised to identify additional study goals to address the revised problem statement.

**SPECIFIC COMMENT 6: Section 3.2.6 – Step 6: Specify Performance or Acceptance Criteria, OU2, Sites 2/12, and OUCTP GWMP:** This section includes the following information: VOCs in groundwater at the former Fort Ord range in concentration from ND to 27.4 micrograms per liter (µg/L) PCE (at Sites 2/12), 19.6 µg/L TCE (at site OU2), and 6.5 µg/L CT (at OUCTP), the primary COCs at these sites (as measured in the Third Quarter 2016 GWMP). Please update the ranges in concentrations of VOCs in groundwater with the concentrations measured in the Third Quarter 2017 GWMP.

**RESPONSE TO SPECIFIC COMMENT 6:** The data was updated with Third Quarter 2018 GWMP information in the OU2, Sites 2/12, and OUCTP GWMP subsection of Section 3.2.6.

**SPECIFIC COMMENT 7: Section 3.5.16 – Project Schedule:** In the table for the general project schedule under the activity column OU2 GWMP is listed twice. It appears that Sites 2/12 GWMP is missing from the list. Please modify the activity list as appropriate.

**RESPONSE TO SPECIFIC COMMENT 7:** The table was revised per the comment.

**SPECIFIC COMMENT 8: Section 4.1.5 – Worksheet #17c1: Sites 2/12 GWMP and Figure 2:** Following submittal of the Draft QAPP for review, Ahtna requested a modification to the Sites 2/12 GWMP in an email on February 25, 2019 and the Water Board approved the modifications by email on February 28, 2019. Provided that the United States Environmental Protection Agency (USEPA) and Department of Toxic Substances Control (DTSC) concur, please update the sampling frequency for well MW-12-26-180U from quarterly to annual on Worksheet #17c1 and Figure 2.

**RESPONSE TO SPECIFIC COMMENT 8:** Worksheet #17c1 and Figure 2 were edited to move MW-12-26-180U from quarterly to annual monitoring frequency.

**SPECIFIC COMMENT 9: Section 4.1.7 – Worksheet #17c3: OUCTP A-Aquifer GWMP and Figure 8A:** Following submittal of the draft QAPP for review, Ahtna requested modifications to the OUCTP A-Aquifer GWMP in an email on February 25, 2019 and the Water Board approved the modifications by email on February 28, 2019. Provided that the EPA and DTSC concur, please update the following on Worksheet #17c3 and Figure 8A:

- Modify the sampling frequency for wells EW-BW-132-A, EW-BW-163-A, EW-BW-167-A, EW-BW-168-A, and EW-BW-169-A from quarterly to annual.
- Remove wells EW-BW-161-A, EW-BW-162-A, EW-BW-164-A, EW-BW-165-A, MW-BW-16-A, and MW-BW-57-A from the sampling program.
- Include quarterly DO/ORP monitoring at wells MW-BW-87-A and MW-BW-91-A.

**RESPONSE TO SPECIFIC COMMENT 9:** Worksheet #17c3 and Figure 8A were edited to change the frequency of monitored wells as described above, with the following exceptions:

- *EW-BW-163-A is removed from the program.*
- *EW-BW-165-A sampling frequency is reduced from quarterly to annual.*
- *MW-BW-87-A and MW-BW-91-A casing diameters are too small for the DO/ORP meter; therefore, they were substituted with EW-BW-161-A and EW-BW-164-A for DO/ORP monitoring.*
- *MW-BW-30-A sampling frequency was increased to annual.*



## Responses to Comments submitted by the Fort Ord Community Advisory Group (FOCAG)<sup>1</sup>

**COMMENT 1:** To begin, please reference and review previous responses found on the Administrative Record

BW-2327E.1

OU2-630F

And this from the CCRWQCB dated December 19, 1986 [http://docs.fortordcleanup.com/ar\\_pdfs/AR-OU2-019//ou2-019.pdf](http://docs.fortordcleanup.com/ar_pdfs/AR-OU2-019//ou2-019.pdf). To quote a portion: “The plan does not fully address the extent of contamination in the deeper aquifers. For example, Marina’s Well No. 10 is perforated solely in the 900 foot aquifer. The well has shown Trichloroethane contamination. The source of the contamination is most likely from the shallower aquifers. This should be addressed in your sampling plan.”

The current document, Version 7, does not address VOC contamination in the Marina Coast Water District supply wells that draw water from the 900-foot aquifer. How often are these wells tested for VOCs? Have the sources of the contamination been determined? Is the water being pumped from these three 900-foot deep wells still being blended to meet State water quality standards?

**RESPONSE TO COMMENT 1:** *The U.S. Department of the Army (Army) conducted a basewide hydrogeologic evaluation and determined volatile organic compound (VOC) contamination in groundwater at the former Fort Ord does not impact the 400-Foot Aquifer and 900-Foot Aquifer.<sup>2</sup> Drinking water supplied by the Marina Coast Water District (MCWD) meets all Federal, State, and local regulatory standards. MCWD regularly tests drinking water quality and reports the results in an annual Consumer Confidence Report (CCR) found at [www.mcwd.org](http://www.mcwd.org). Water quality data and operational information are available at MCWD. Contact information for MCWD is available at [https://mcwd.org/customer\\_service\\_contact.html](https://mcwd.org/customer_service_contact.html).*

**COMMENT 2:** Large Army burns on the former Army Training Range lands called Site 39 was a common occurrence. The Army would extinguish these brush and ordnance fires. We ask, where are the test results for Perfluorooctanoic Acid and Perfluorooctane Sulfonate in the groundwater beneath Site 39? Because a good portion of Site 39 sits directly atop the Seaside Groundwater Basin.

**RESPONSE TO COMMENT 2:** *The Army is currently conducting a basewide review of historical activities at the former Fort Ord that may have resulted in releases of PFOA/PFOS to soil and groundwater, and the results will be included in a report scheduled to be issued in summer 2019. Based on the preliminary results of this review, there is no suspected release of perfluorooctanoic acid (PFOA) or perfluorooctane sulfonate (PFOS) at Site 39. During prescribed burning at the former Fort Ord, fire foam or retardant may be used for pretreatment of the containment line around the burn unit, or to extinguish fires that have gone outside the containment line; however, these are Class A foams or retardants designed for use on combustible materials, such as wood, and not Class B foams designed for use on petroleum-based fires that may contain PFOA or PFOS. Additionally, the Fort Ord fire department historically used water tenders and not foam for fighting fires at Site 39.*

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<sup>1</sup> In a letter dated March 8, 2019 (see Administrative Record No. BW-2785G.2). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.

<sup>2</sup> See Administrative Record No. BW-1283A.

*As required by the federal third Unregulated Contaminant Monitoring Rule, water systems in the vicinity of the former Fort Ord, including the MCWD and California American Water, collected and analyzed drinking water samples for PFOA and PFOS from 2013 to 2015 and there were no detections. Analytical results are available in a downloadable Microsoft Excel file at the State Water Resources Control Board (SWRCB) website under the heading "Findings in California Drinking Water:"*

[https://www.waterboards.ca.gov/drinking\\_water/certlic/drinkingwater/PFOA\\_PFOS.html](https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/PFOA_PFOS.html)

*The SWRCB has also issued orders to public water systems in the vicinity of the former Fort Ord requiring testing for PFOA and PFOS. The SWRCB will also prepare a map of the sampling completed to date by the end of summer 2019. The map, along with a spreadsheet of all available data, will be made available to the public.*

**COMMENT 3:** Please have the document tell of the decision to create an unlined landfill and transfer contamination and waste from one cell to another new one across the road at OU2.

**RESPONSE TO COMMENT 3:** *When the Fort Ord Landfills were receiving waste from 1956 to 1987, the waste was placed in shallow unlined trenches; however, the remedial action for the Fort Ord Landfills does not include creating an unlined landfill, and no new landfill cells were created as part of the remedy for OU2. In accordance with the Record of Decision, Operable Unit 2, Fort Ord Landfills (OU2 ROD)<sup>3</sup> and OU2 Area A Explanation of Significant Differences (ESD),<sup>4</sup> waste was consolidated in the existing landfill areas south of Imjin Parkway and an engineered cover system, including a linear low-density polyethylene liner, was constructed over the top of the waste. With implementation of the remedy, the overall area of the Fort Ord Landfills decreased by approximately 20 percent.<sup>5</sup>*

*Regardless, the information requested to be included in the Quality Assurance Project Plan (QAPP) is not relevant because the QAPP is a guidance document for groundwater sampling and analysis activities at the former Fort Ord; however, the OU2 Landfills QAPP is referenced in Section 3.1.3, and this document contains detailed information about the Fort Ord Landfills and the OU2 remedy.*

**COMMENT 4: Page 18, Section 3.1.8 Geology and Hydrology:** The two paragraphs are insufficient. During the 1990's the Army BRAC held Community Involvement Workshops (C.I.W.). The community was informed that there was an impermeable clay aquitard that prevented contamination from flowing into the Lower 180-ft aquifer. Some community members expressed skepticism at the time. Later we learned that, Oops, guess there was a hole in the aquitard.

**RESPONSE TO COMMENT 4:** *Additional information regarding the system of aquifers and aquitards at the former Fort Ord was added to Section 3.1.8.*

**COMMENT 5: Page 19, Section 3.2.1 Step 1: State the Problem:** We suggest that since water and VOC contaminants run downhill, that the 900-ft aquifer be studied, and reported on too.

**RESPONSE TO COMMENT 5:** *See response to Comment 1.*

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<sup>3</sup> See Administrative Record No. OU2-480.

<sup>4</sup> See Administrative Record No. OU2-458.

<sup>5</sup> See Administrative Record No. OU2-630B.

**COMMENT 6:** Was the source of the Meningitis outbreak among the troops training at Fort Ord in the 1962-1964 time frame ever determined?

**RESPONSE TO COMMENT 6:** *There was no determination of the source as noted in the following article: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1515912/>.*

**COMMENT 7:** **Page 19-20, Sites 2/12, second paragraph, regarding contamination of the groundwater by COC's and seawater intrusion.** The FOCAG asks about a timeline here because initially wells had to be closed and moved inland and the reason given, at the time, was because of chloride concentrations (sea water).

**RESPONSE TO COMMENT 7:** *In 1940 and 1941 there were nine water supply wells constructed in the Main Garrison area (some in the vicinity of Sites 2/12). Two of these were never used and most of the others pumped sand and produced water with high chloride concentrations. Seven of the water supply wells were decommissioned in 1951 or 1952, and the last two were decommissioned in 1989. From 1942 until 1984, additional water supply wells were constructed further inland. Most of these have been decommissioned, with only FO-29, FO-30, and FO-31 remaining.<sup>6</sup> Wells constructed in the Sites 2/12 area since 1989 have been for groundwater monitoring and groundwater extraction and treatment, not for water supply. Because seawater intrusion can damage groundwater remediation equipment, the Army measures chloride concentrations annually at Sites 2/12 in select groundwater wells, as noted in QAPP Worksheet #17c1, to ensure groundwater extraction and treatment activities do not make seawater intrusion worse in this area.*

**COMMENT 8:** **Page 20, OU2;** Please make it clear that moving a portion of the landfill to an unlined landfill contributed to the migration of contaminants downward into the aquifers. Secondly, the three wells referenced; FO-29, FO-30, and FO-31, located near the OU2 area are the Marina Coast Water District's source wells. The MCWD currently serves residential and commercial service connections on former Fort Ord and the City of Marina.

**RESPONSE TO COMMENT 8:** *Excavating waste from Landfills Area A on the north side of Imjin Parkway and consolidating it with waste in Landfills Areas B through F on the south side of Imjin Parkway did not contribute to migration of COCs to groundwater. The remedy for the Fort Ord Landfills is functioning as designed and is protective of human health and the environment.<sup>7</sup> The engineered landfill cover system, constructed in accordance with the remedy identified in the OU2 ROD, is specifically designed to prevent migration of contaminants to the groundwater. Migration of contaminants from the Fort Ord Landfills to groundwater that occurred prior to construction of the engineered cover system has been mitigated through extraction and treatment of landfill gas and groundwater per the requirements of the OU2 ROD (see also the response to Comment 3).*

*The text was revised to state that MCWD owns and operates FO-29, FO-30, and FO-31 as part of the water supply system for the former Fort Ord and the City of Marina.*

**COMMENT 9:** **Page 21, 3.2.2, Step 2: Identify the Goals of the Study:** We call your attention to the second "bullet" below OU2 and Sites 2/12 GWTS. GWTS stands for Ground Water Treatment Systems. It

<sup>6</sup> See Administrative Record No. BW-2002A.

<sup>7</sup> See Administrative Record No. OU2-480.

states here that, “Assess whether GWTS effluent meets discharge requirements before it is used for groundwater recharge or onsite for non-potable construction purposes (dust control, soil compaction, etc.)” We ask that you please expand this to include analysis of the goal of the Monterey Peninsula Water Management District’s plan to inject treated sewer water, and water used for washing pesticides from produce, and other waste water, directly into the ground above a portion of the Seaside Groundwater Basin. This is a groundwater recharge effort, and we ask for clarification as to how much Fort Ord GWTS effluent might, or will, be mixed with this either intentionally or unintentionally?

**RESPONSE TO COMMENT 9:** *It is assumed the comment is referring to the Pure Water Monterey project, which includes replenishment of the Seaside Groundwater Basin with purified recycled water.<sup>8</sup> This type of analysis is not within the scope of the QAPP, which is a guidance document for groundwater sampling and analysis activities at the former Fort Ord. However, according to the Final Engineering Report, Monterey One Water Pure Water Monterey Groundwater Replenishment Project, replenishment is to occur via four injection wells that will recharge the Santa Margarita Aquifer and the Paso Robles Aquifer.<sup>9</sup> No mixing of purified recycled water and the Army’s groundwater treatment systems (GWTS) treated effluent can occur because:*

- *The Santa Margarita Aquifer and the Paso Robles Aquifer are significantly deeper than, and not hydrologically connected to, the Upper 180-Foot Aquifer being recharged by the Army’s GWTS.*
- *The northern boundary of the Seaside Groundwater Basin is at least 1.6 miles south of the Army’s closest groundwater recharge structures.*
- *The general groundwater flow direction in the Seaside Groundwater Basin is to the west (i.e., parallel to flow in the Upper 180-Foot Aquifer).*

**COMMENT 10:** Bottom of page 22, Footnote 7 states, “Antimony, copper, and lead are the primary metals found in spent ammunition deposited in the Fort Ord landfills. MCL’s are used to evaluate concentrations of these dissolved metals in groundwater near the Fort Ord Landfills; however, the groundwater being monitored is not intended for use as drinking water.” The FOCAG asks for clarification of this footnote. Also, Army training involved dozens of chemicals. We understand the intent wasn’t to drink it. But it is in the groundwater now, or headed there. Please reference the Administrative record for FOCAG document OTH-253 dated 01/02/2010.

**RESPONSE TO COMMENT 10:** *Footnote 7 was revised to clarify that:*

- *Detected concentrations of antimony, copper, and lead are compared to Federal and California Maximum Contaminant Levels (MCLs) because there are no Aquifer Cleanup Levels (ACLs) for these metals identified in the OU2 ROD.*
- *The groundwater being monitored is not intended for use as drinking water because it is within the Prohibition Zone of the Special Groundwater Protection Zone.*

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<sup>8</sup> At its public meeting on March 9, 2017, the Central Coast Regional Water Quality Control Board adopted waste discharge and water recycling requirements for the Pure Water Monterey Advanced Water Purification Facility and Groundwater Replenishment Project; a copy of the order is available at [https://www.waterboards.ca.gov/centralcoast/board\\_decisions/adopted\\_orders/](https://www.waterboards.ca.gov/centralcoast/board_decisions/adopted_orders/)

<sup>9</sup> The Engineering Report is available at <http://purewatermonterey.org/wp/wp-content/uploads/M1W-Final-Title-22-Engineering-Report-April-2019.pdf>

*Section 3.2.1 of the QAPP was also revised to clarify the rationale for monitoring for antimony, copper, and lead in groundwater near the Fort Ord Landfills. Results of the sampling for metals analysis described in QAPP Worksheet #17c2 are in the OU2 reports for Third Quarter groundwater monitoring events, which are included in the Administrative Record. Concentrations of these metals in groundwater samples are all below MCLs.*

*Based on the reference to Administrative Record No. OTH-253, it is assumed the comment is concerned with chemical warfare material (CWM) contaminating groundwater at the former Fort Ord. There is no evidence of CWM having been used at the former Fort Ord. A comprehensive search was conducted at Fort Ord and did not uncover any evidence in records, interviews, or other information sources to indicate that chemical weapons were ever stored, used, or buried at Fort Ord. Evidence indicates the only CWM used at the former Fort Ord were Chemical Agent Identification Sets, which were used to train soldiers to recognize and protect themselves from chemical agents. In addition, more than 13 million anomalies have been investigated and more than 300,000 cubic yards of contaminated soil have been excavated during investigations and removals at Fort Ord without any evidence of CWM.<sup>10</sup>*

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<sup>10</sup> Technical Memorandum, CWM-Related Responses and Reports, Administrative Record No. OE-0726.

## **ATTACHMENT H**

### **Response to Comments on the Draft Final QAPP**



## Responses to Comments submitted by the Central Coast Regional Water Quality Control Board (Water Board)<sup>1</sup>

In the Draft Final QAPP, Ahtna provides Attachment G: Responses to Comments Submitted by the Central Coast Regional Water Quality Control Board on the Draft QAPP. The Water Board has the following comments on the responses provided in Attachment G:

**COMMENT 1:** In Specific Comment 1, the Water Board recommended selecting one key groundwater monitoring well (i.e.: the well with the highest concentration of a known COC) at each of the OU2, Sites 2/12, and OUCTP Areas to sample and analyze for 1,2,3-Trichloropropane (1,2,3 -TCP) to confirm non-detectable results using a detection limit below the California Maximum Contaminant Limit (MCL) of 0.005 micrograms per liter (µg/L).

In response to Specific Comment 1, Ahtna acknowledged the analytical detection limits for groundwater samples historically collected at the former Fort Ord are higher than the current California MCL, but additional sampling and analysis for 1,2,3-TCP is not warranted based on the following lines of evidence:

- Common uses of 1,2,3-TCP included use as a paint and varnish remover, and a cleaning and degreasing agent. These uses would be consistent with historical uses of other solvents, including carbon tetrachloride (CT), tetrachloroethene (PCE), and trichloroethene (TCE), at the former Fort Ord when it was an active military installation. However, while CT, PCE, and TCE have historically been detected in groundwater, soil, and soil gas at the former Fort Ord at concentrations exceeding MCLs or screening levels by several orders of magnitude, there have been no corresponding detections of 1,2,3-TCP, indicating there was no significant usage of this compound.
- The vapor pressure of 1,2,3-TCP (3.1 mmHg at 25°C) and the calculated Henry's law constant ( $3.17 \times 10^{-4}$  atm-m<sup>3</sup>/mol at 25°C) suggest volatilization from either dry or moist soil to the atmosphere will be a significant environmental process.<sup>2</sup> Therefore, if there was any release of 1,2,3-TCP to the ground surface, it is likely most or all of it would have volatilized to the atmosphere before it could leach to groundwater.
- Other media, including soil and soil gas, have been sampled and analyzed for 1,2,3-TCP at various sites across the former Fort Ord, including OU1, OU2, OUCTP, and Sites 2/12, and 1,2,3-TCP has never been detected, further indicating no significant usage of this compound at the former Fort Ord.

The Water Board appreciates the information provided in response to Specific Comment 1. Based on this information at a minimum the Central Coast Water Board recommends that the OU2 Groundwater Treatment System influent be sampled and analyzed for 1,2,3-TCP using a detection limit below the MCL of 0.005 µg/L. This data would confirm that 1,2,3-TCP is not present in the influent groundwater extracted as part of the groundwater remediation activities. If 1,2,3-TCP is present in influent groundwater extracted for treatment and recharge back into the aquifer, an effluent sample should also

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<sup>1</sup> In a letter dated July 17, 2019 (see Administrative Record No. BW-2785G.4).

<sup>2</sup> Ibid.

be collected confirm that 1,2,3-TCP is removed to levels below the MCL prior to recharge back into the aquifer.

**RESPONSE TO COMMENT 1:** *The U.S. Department of the Army (Army) agrees to collecting a sample at the influent to the Operable Unit 2 (OU2) groundwater treatment plant (GWTP) to analyze for 1,2,3-TCP using a detection limit below the MCL of 0.005 µg/L. The sample will be collected during a regularly scheduled quarterly groundwater monitoring event or concurrently with GWTP process monitoring. Depending on the analytical results, the Army will evaluate the need for additional sampling in consultation with the Water Board.*

**COMMENT 2:** In response to Specific Comment 9, Worksheet #17c3 and Figure 8A were updated to remove well EW-BW-162-A from the OUCTP A-Aquifer sampling program. Well EW-BW-162-A appears on Figure 8A as a well that will be monitored for water levels however this well is not included on Worksheet #17c3.

Please update Worksheet #17c3 to show that well EW-BW-162-A will continue to be monitored for water levels.

**RESPONSE TO COMMENT 2:** *Figure 8A was revised to remove well EW-BW-162-A, and this well was not added to Worksheet #17c3. Per QAPP decision criteria, this well will not be monitored for chemicals of concern or for water levels.*

## Appendix 7-D

### Monterey County Quality Assurance Project Plan

Quality Assurance Project Plan (QAPP)  
For  
Water Quality Monitoring  
Associated with the Salinas Valley Integrated  
Water Management Plan (SVIWMP)

EPA R9#03-238  
X-97994701-0



Monterey County Water Resources Agency  
P.O. Box 930  
Salinas, CA 93902  
Telephone: (831) 755-4860  
Fax: (831) 424-7935  
**Website: <http://www.mcwra.co.monterey.ca.us>**

## 1.0 PROJECT MANAGEMENT

### 1.1 TITLE AND APPROVAL PAGE

Quality Assurance Project Plan  
For  
Water Quality Monitoring Associated with  
The Salinas Valley Integrated Water Management Plan (SVIWMP)  
EPA R9#03-238  
X-97994701-0

Prepared by:  
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Prepared for:  
US EPA Region 9  
75 Hawthorne Street  
San Francisco, CA 94105-3901

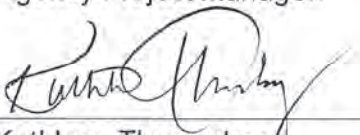
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#### Approval Signatures

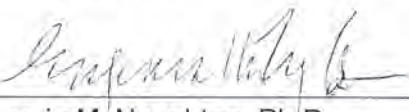
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Elizabeth Krafft  
Agency Project Manager:


8/12/07  
Date:

  
Kathleen Thomasberg  
Agency Project QA/Task Manager:

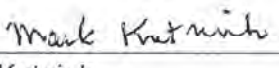
8/17/07  
Date:

  
Eugenia McNaughton, Ph.D.  
USEPA Region 9 QA Program Manager:

10/22/07  
Date:

  
Carolyn Yale  
USEPA Region 9 Project Officer:

12/3/07  
Date:

  
Mark Kutnink  
USEPA Region 9 Chemist:

22 Oct 2007  
Date:



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### 1.3 DISTRIBUTION LIST

The following is a list of organizations and persons who will receive copies of the approved QA Project Plan and any subsequent revisions:

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#### 1.4 PROJECT/TASK ORGANIZATION

The organization responsible for overseeing this ground water monitoring program is the Monterey County Water Resources Agency (Agency). This project is funded through a grant from the Environmental Protection Agency (EPA), under the authority of Section §104 (b)(3) of the Clean Water Act. This project falls under the Monitoring and Assessment funding category. The Monterey County Health Department's Consolidated Chemistry Laboratory is a California state certified laboratory that will perform the chemical analyses for this ground water monitoring program. The laboratory will use standard analytical methods.

The roles and responsibilities of those involved in the implementation of the ground water monitoring program are described below. An organizational chart for the program is shown below.

Project Manager is the responsible official who will oversee the preparation of grants and the fiscal management of the project.

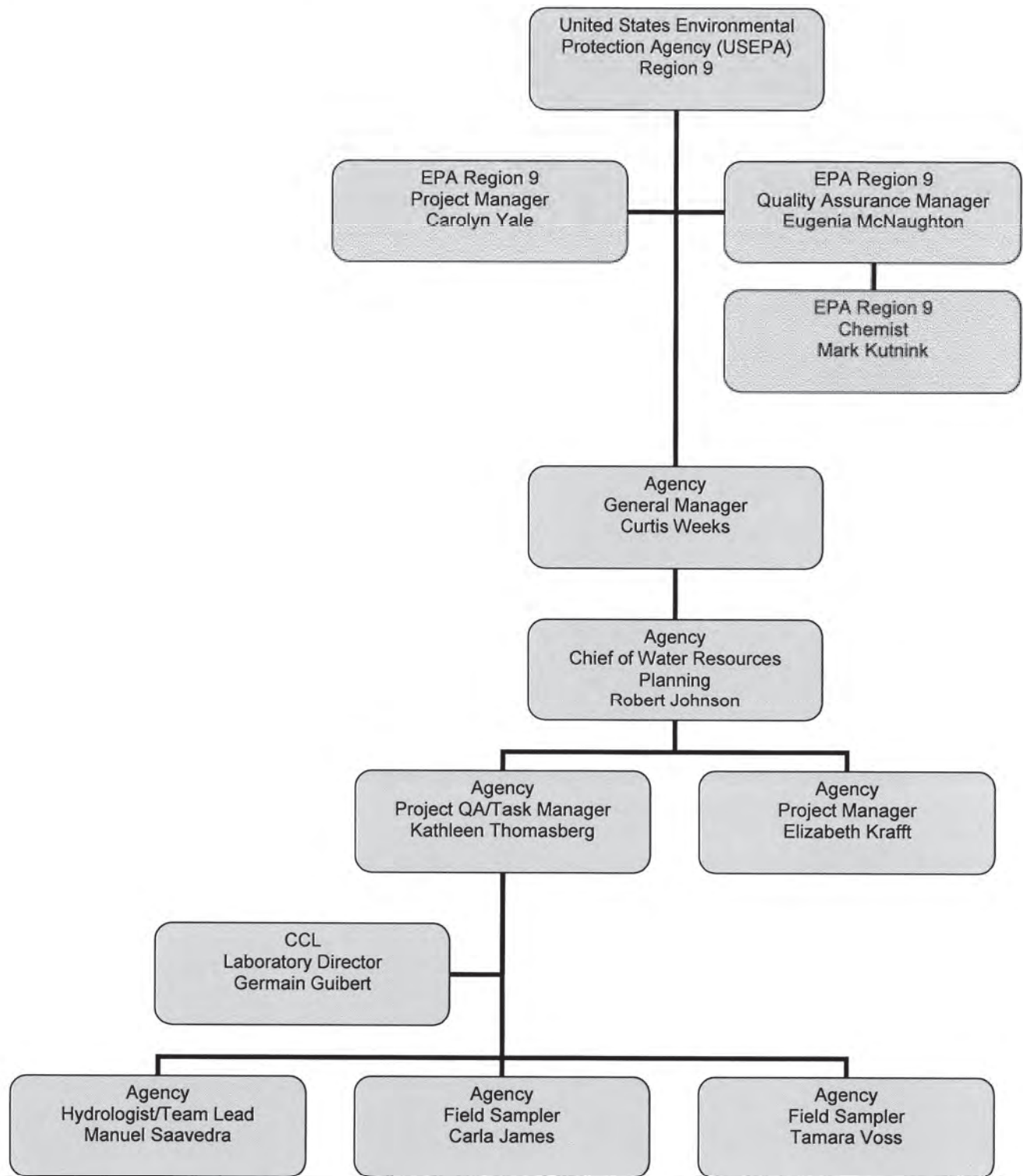
Project QA Manager is in charge of establishing the QA/QC protocols found in the QAPP as part of the sampling and analysis procedures. The QA Manager will also review and assess all analytical data from the contract laboratory and will be the liaison regarding data quality issues and concerns. She may stop all actions, including those conducted by the contract laboratory and will be responsible for ensuring that any amended versions of the QAPP are distributed to the organizations and individuals listed in Section 1.3.

Project Task Manager will oversee the ground water monitoring program. She will ensure that all QAPP protocols are followed and will oversee the writing and revisions of the QAPP. Since the Agency's Water Quality Department is not large, the Project Task Manager will function in the dual role of Task Manager and QA Manager.

Hydrologist/Team Lead will be responsible for coordinating with the Water Resources Technicians/ Field Samplers to review field and analytical requirements, documentation, and sampling schedules.

Water Resources Technicians/Field Samplers will be responsible for sample collection and communication with the contract laboratory regarding the sampling shipment schedule. They are also responsible for writing the QAPP.

ORGANIZATIONAL CHART





## 1.5 PROBLEM DEFINITION/BACKGROUND

### 1.5.1 Background

The Monterey County Water Resources Agency's (Agency) mission is to manage, protect, and enhance the quantity and quality of water for present and future generations of Monterey County (County). Monterey County, located along the California Central Coast, covers 3,322 square miles (8604 km<sup>2</sup>) and has a resident population of 424,842 (Fact Finder, 2007). The County supports a \$3.4 billion agricultural industry (Ag Commission, 2006) and a \$1.75 billion tourism industry (EPA Grant R9#03-238). The primary land use within the Salinas Valley is agricultural. Since the 1940's, irrigated acreage within the valley has increased substantially. Coastal regions of California are subject to rapid urbanization, and the milder coastal climate supports year-round intensive cultivation of many high-value crops (Hunt et al, 2003). As agricultural and urban areas have expanded, so have the water needs of the County (EPA Grant R9#03-238).

The Agency uses a network of wells to monitor ground water conditions in the Salinas Valley Ground Water Basin (Basin) (Geomatrix, 2001). The Basin is situated entirely within the County (EPA Grant R9#03-238). The Salinas Valley is surrounded by the Gabilan and Diablo Ranges on the east, by the Sierra de Salinas and Santa Lucia Range on the west, and is drained by the Salinas River, which empties into Monterey Bay in the north (DWR 1946a) (Fig 1). Four subareas based on differences in local hydrogeology and recharge have been identified (White Paper, 1995; DWR, 2003). These are known as the Pressure, East Side, Forebay, and Upper Valley subareas (Fig 2). These subareas are hydrologically and hydraulically connected (EPA Grant R9#03-238); all information collected to date indicates there are no barriers to the horizontal flow (of ground water) between these subareas (White Paper, 1995). The "boundaries" between these subareas have been identified as zones of transition between different depositional environments in past millennia (White Paper, 1995).

The primary surface water features overlying and influencing the Basin's hydrology are the Salinas River and its tributaries, the Nacimiento and San Antonio reservoirs, and the Monterey Bay (EPA Grant R9#03-238). The Salinas River extends approximately 120 miles from the river's headwaters in San Luis Obispo County, near Santa Margarita, and flows north/northwest and discharges into the Monterey Bay National Marine Sanctuary near Moss Landing in Monterey County (EPA Grant R9#03-238). The Nacimiento and San Antonio reservoirs, located in the upper watershed, serve as storage and flood control for the Basin.

Ground water recharge in Salinas Valley is principally from infiltration from the Salinas River, Arroyo Seco Cone, and to a much lesser extent, from deep percolation of rainfall (White Paper, 1995). Deep percolation of applied irrigation water is the second largest component of the ground water budget, but because it represents recirculation of existing ground water rather than an inflow of "new" water, it is not considered a source of recharge (White Paper, 1995). Nitrate contamination of ground water poses a significant threat to the beneficial use of ground water for drinking water and for some agricultural water uses (White Paper, 1995). Nitrate concentrations exceed drinking water standards in some parts of the Basin (MCWRA, 1997). The principal source of nitrates to ground water is almost certainly excess fertilizer that is leached by rainfall and applied irrigation water (White Paper, 1995).

Seawater intrusion is another source of inflow to the Basin, but because it is not usable freshwater it is also excluded as a source of recharge (White Paper, 1995). Historically, ground water flowed from subareas to the south and east through the (Pressure) and seaward to discharge zones in the walls of the submarine canyon in Monterey Bay (Durbin et al 1978; Greene 1970). Within the Pressure subarea, due to the impermeable nature of the clay aquitard above the 180-Foot Aquifer,



recharge from precipitation, agricultural return flows, or river flow is nil (DWR, 2003). Instead, recharge is from underflow originating in Upper Valley areas such as the Arroyo Seco Cone and Salinas River bed or the East Side subarea, and more recently, from seawater intrusion (DWR, 2003). Heavy pumping of the Pressure-180 Foot and Pressure-400 Foot aquifers has caused significant seawater intrusion into both of these aquifers, which was first documented in the 1930's (DWR 1946a). Ground water flow in the northernmost area of the Pressure subarea has been directed from the Monterey Bay inland since this time (DWR, 2003). With increased pumping in the East Side subarea since the 1970's, ground water flow is dominantly northeast in the Pressure's central and southern locations (DWR, 2003).

Declining ground water levels in the Pressure and East Side subareas, Basin overdraft, ground water contamination, including nitrate and seawater intrusion are serious concerns for the Agency. (EPA Grant R9#03-238)

### *1.5.2 Program Objectives*

The Agency is charged with management of the Basin's ground water resources. Much of the Agency's investigative work pertaining to the occurrence and use of ground water is to identify the quality, quantity, and temporal trends of ground water resources within the County. A network of monitoring wells provides the information needed to manage and protect ground water resources and sustain beneficial uses. In order for the Agency to develop projects to mitigate problems, such as seawater intrusion, local ground water overdraft, and high nitrate concentrations, the Agency must first implement an effective and accurate monitoring program to identify the extent of the potential problem.

The Ground Water Quality Monitoring Objectives are:

- continued monitoring of the ambient ground water quality, including general minerals
- continued monitoring of coastal aquifers (including Pressure Deep Aquifer) for detection of advancing seawater intrusion
- continued monitoring to determine distribution of conductivity in ground water
- continued monitoring to determine distribution of nitrate in ground water and identification of problem areas

Ambient ground water quality will be used to establish a cohesive and succinct Water Quality Management Plan in accordance to the work begun under EPA-I and continued under EPA-II. For the purposes of this QAPP, the EPA-I grant has funded the Agency to develop this QAPP. The EPA-II grant is funding the Agency to implement the sampling described in the QAPP.

### *1.5.3 Program Goals*

The ground water monitoring objectives in the Salinas Valley will be met by the goal of sampling all 344 wells located throughout the four subareas within the Salinas Valley Ground Water Basin, during the 2007 summer field season.

The ground water monitoring objectives along the coast, specifically located within the Pressure subarea will be met by the goal of sampling all 85 monitoring wells, during the 2007 summer field season.

The Agency's overarching goal for this program is the continued monitoring of the Basin's ambient ground water for use in the management of this important resource, and *not* for the purpose of regulatory control.



## 1.6 PROJECT/TASK DESCRIPTION

### 1.6.1 Work Statement and Produced Products

The Salinas Valley Ground Water monitoring will sample 344 wells located throughout the Salinas Valley Ground Water Basin for ten constituents (Table 1). Each well will be sampled once. Samples will be collected during the 2007 summer agricultural growing season and analyzed for a complete mineral panel. The Coastal Ground Water monitoring will sample 85 wells located within the area of historic seawater intrusion. Each well in the Coastal Program will be sampled once a month during the agricultural growing season. The first month's sample will be analyzed for complete mineral panel and the two remaining sampling events will be analyzed for partial mineral panel (three constituents) (Table 1). All water monitoring samples will be delivered the same day as collected to the contract laboratory for analysis.

All ground water sampling locations are accessible using a 4-wheel drive vehicle. All samples will be collected as a grab sample. All sampling locations will be recorded using global positioning system (GPS) equipment, and digital pictures will be taken at each site.

After laboratory analysis and data validation is completed, a technical memorandum (EPA II, XP-96995301 Task 2 Water Quality Assessment) will be written and submitted to US EPA. The technical memorandum, EPA II, XP-96995301 Task 2 Water Quality Assessment, will include result tables for chloride, nitrate, and specific conductivity, and maps of chloride, nitrate, and specific conductivity gradient contours.

### 1.6.2 Constituents to be monitored and measurement techniques

Samples will be sent to an off-site laboratory for analysis. Ground water samples will be analyzed for either complete or partial mineral panels. A complete mineral panel includes calcium, cation-anion balance, chloride, conductivity, magnesium, nitrate, pH, potassium, sodium, sulfate, and total alkalinity. A partial mineral panel consists of chloride, conductivity, and nitrate.

Sample analysis will be performed at the Monterey County Consolidated Chemistry Laboratory (CCL), which is part of the Environmental Health Department. Listed below is the laboratory's contact information and ELAP Certification number.

<i>Laboratory Name</i>	<i>Contact Information</i>	<i>Abbreviation</i>
<b>Monterey County Consolidated Chemistry Laboratory</b> ELAP Certification No 1395	1270 Natividad Road Salinas, CA 93906 Phone: 831-755-4516 Fax: 831-755-4652 <a href="http://www.co.monterey.ca.us/health">http://www.co.monterey.ca.us/health</a>	CCL

### 1.6.3 Project Schedule

The proposed project schedule is summarized below.

---

#### **Prior to Sample Collection**

- January 2006 - : Develop project strategy
- January 2007
- 15 January, 2007 : Submit Draft QA Project Plan
- 22 March, 2007 : Receive review comments on QA Project Plan from US EPA
- 6 July, 2007 : Submit Draft Final QA Project Plan
- 13 July, 2007 : Obtain QA Project Plan approval (to begin fieldwork)
- 20 July, 2007 : Submit Final QA Project Plan (signatory copy) EPA R9#03-238; X-97994701-0

#### **Sample Collection**

- August 2007 - : Coastal Ground Water (each well 3x, once per month)
- September 2007
- August 2007 - : Salinas Valley Ground Water (each well 1x)
- September 2007

#### **Post Sample Collection**

- November 2007 : Compile all remaining laboratory analyses reports
  - 1 - 15 December, 2007 : Evaluate laboratory data for QA/QC requirements
  - 15 December, 2007 : Copy of analytical results sent to well owner/operators
  - 16 - 31 December, 2007 : Summarize and tabulate data
  - January 2008 : Write Technical Memorandum (EPA II, XP-96995301 Task 2 Water Quality Assessment)
  - March 2008 : Submit Technical Memorandum (EPA II, XP-96995301 Task 2 Water Quality Assessment) to US EPA
- 

### 1.6.4 Geographical Setting

The Salinas Ground Water Basin encompasses approximately 537.5 square miles (1,392 km<sup>2</sup>). The regional ground water flow is to the northwest. Seawater intrusion is a result of coastal pumping (Figure 3). Ground water pumping can dramatically impact localized coastal ground water flow.

### 1.6.5 Constraints

Ground water samples must be taken from the well while the pump is operating to ensure that the sample is representative of the aquifer and not standing water within the well casing. The Agency wants to measure the water quality when the aquifers are stressed due to pumping. For this reason the 2007 field sampling season will coincide with the agricultural irrigation season.



## 1.7 DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

This section describes the data objectives of the project and defines the measurement performance criteria deemed necessary to meet those objectives.

### 1.7.1 Objectives and Project Decisions

In Monterey County the Salinas Valley and Coastal Ground Water ambient monitoring programs are designed to characterize the ground water quality conditions of the Basin. All data generated from the sampling program in this project are tabulated as they have been over the many years of the program. Data generated from these monitoring activities allows the Agency to track changes in ground water quality over time and to assess potential impacts to ground water in the Basin. Water resource management and policy decisions may follow based on maps and tabulated data generated as a part of this project (program).

For the coastal ground water sampling program, the general mineral data are evaluated to determine if seawater intrusion is progressing landward as indicated by increasing well chloride values. The chloride values for all wells are evaluated, and then the 500mg/L chloride isochlor contours are mapped for the two coastal aquifers. When the maps are published, the information generated by MCWRA staff and approved by the MCWRA Board of Directors, is posted and passed on to Monterey County departments, regional government regulatory agencies, and public / private entities via the MCWRA web page, presentations, public meetings, and networking.

Monterey County departments such as the Planning Department and Health Department utilize the advancement of seawater as it relates to potable water and public health, while the agricultural community becomes aware of the proximity of their wells to the intrusion advancement, and the possible need for funds to drill new, deeper, wells and destroy the older high nitrate wells. Actions by regulators, depending on the entity, are related to prioritization of Regional Watershed and Water Quality Action Plans, and the associated success of MCWRA capital projects to halt seawater intrusion as governed by the State Water Resources Control Board adjudication process.

Actions by the MCWRA after the landward advancement of seawater have been ongoing for many years. Actions include consideration of more stringent Monterey County well drilling ordinances for assuring the continued prevention of cross-aquifer contamination in the coastal Salinas Valley, "Zone 6 Drilling Standards", April 19, 1988; the development and implementation of the Monterey County Recycling Projects, a tertiary treatment plant and treated water distribution system, to help further reduce agricultural pumping in the coastal Salinas Valley for halting seawater intrusion; and future use of these data will be utilized by the newly established Seaside Watermaster for comparison to and the development of the Monterey Peninsula seawater intrusion front.

For the Salinas Valley general mineral ground water sampling program, nitrate data tabulation and map representation has been the focus of the MCWRA for many years. All results over the laboratory's practical quantitative limit generated from this program are tabulated to evaluate the minimum, maximum, median, and mean value of nitrate as  $\text{NO}_3$  in mg/L for each of the Salinas Valley Hydrogeologic Subareas.

For the Salinas Valley monitoring program, the Agency sends the general mineral testing results, including nitrate, to the well owners/growers who operate the wells sampled. Also, in this transmittal, the well operators are also provided with a conversion sheet of the nitrate concentration from mg/L nitrate as  $\text{NO}_3$  to pounds of nitrate per acre inch of water, agricultural terms. If a nitrate



value in ground source water is elevated, then that growers can incorporate this available nitrate into their fertilizer crop scheduling. This is a method for growers to reduce applied nitrate to crops, while maintaining maximum crop productivity.

And, as with the Coastal monitoring program, the tabulated and mapped Salinas Valley nitrate data are posted and passed on to Monterey County departments, regional government regulatory agencies, and public / private entities via the MCWRA web page.

The MCWRA uses the well nitrate data during the technical well application review process. Monterey County Health Department (Health Department) issues well permits after the Agency provides a technical review of well applications for new, abandoned, or repaired wells. The well application proposal is evaluated with other well construction and water quality within a one miles radius of the new well and represented on a map. Agency staff makes qualitative recommendations to the Health Department on the new well's sanitary seal based on other well seals, the perforated intervals, and the nitrate values of wells in the area. The final decision for the well construction is made by the Health Department after the well drilling progresses.

Actions taken by the MCWRA are conditional. If extreme nitrate values are observed in agricultural production wells, then re-sampling of the wells may take place to confirm the elevated concentrations and may lead to increased sampling points for wells in the same vicinity and with the same well design. Continued increases in Salinas Valley ground water nitrate values could lead to special nitrate investigations on movement of nitrate in ground water and also outreach to the public on the reduction of nitrate to the environment.

#### *1.7.2 Action Limits/Levels*

Since the overarching goal for this project is the continued monitoring of ambient ground water, the Agency has set no specific water quality standards. As a result, the laboratory's practical quantitation limits (PQL) will serve as the Project Action Levels (PALs). Table 1 provides a listing of the parameter to be sampled and a summary of the laboratory's method detection limit, those minimum concentrations that can be detected above the instrumental background/baseline signal noise. Table 1 also provides the PQL, lowest calibration standard and PALs required by the Agency for the QAPP. The quality limits listed are deemed acceptable by the Agency to meet the project objectives.

#### *1.7.3 Measurement Performance Criteria*

The objective of data collection for this Monitoring Project is to produce data that represent the *in situ* conditions of the ground water. This objective will be achieved by using accepted standard methods for water collection and analysis and defining data quality indicators (DQIs) for each analytical parameter. The DQIs include accuracy, precision, comparability, sensitivity, completeness, and representativeness and are defined below and presented in Table 2. Some DQIs will be assessed quantitatively, while others will be qualitatively assessed. Example calculations have been provided for quantitative assessments and appropriate quality control (QC) samples have been identified. Laboratory Data Quality Objectives are given in Table 3.

**Accuracy**, or bias, is a measure of how close a result is to the expected value of the target analyte in a sample. Accuracy will be determined by the analysis of certified reference materials and matrix spikes, where the results can be compared with an expected value and expressed as %recovery. This is an assessment of laboratory analytical methods. For Laboratory Control Samples (LCS), it will be expressed as %recovery by the following equation:



$$\% \text{Recovery} = \frac{X}{T} \times 100$$

where,

X = Measured concentration  
T = True spiked concentration

or, for Matrix Spike (MS) samples, by the following equation:

$$\% \text{Recovery} = \frac{(B - A)}{T} \times 100$$

where,

B = Measured concentration of spiked sample  
A = Measured concentration of unspiked sample  
T = True spiked concentration

The frequency of the LCS and MS samples associated with the analytical parameters will be 5%. MS and MSD samples will be spiked at 3-10 times the native sample concentration.

Accuracy/bias as related to contamination involves both field and laboratory components. Field blanks will be collected at a frequency of 5%. Laboratory blanks will be prepared and analyzed at a one per batch or 5% frequency.

**Precision** is concerned with the ability to quantitatively repeat results. To demonstrate the precision of a method or instrument, field duplicates will be collected, analyzed, and their results compared. Precision is expressed as relative percent difference (RPD) by the following equation:

$$\text{RPD (\%)} = \frac{|X_1 - X_2|}{(X_1 + X_2) / 2} \times 100$$

where,

X<sub>1</sub> = Original sample concentration  
X<sub>2</sub> = Duplicate sample concentration  
|X<sub>1</sub> - X<sub>2</sub>| = Absolute value of X<sub>1</sub> - X<sub>2</sub>

Field duplicates will be collected at a frequency of 10% for the first two sampling events. If the criterion of <25% RPD is met, then the remaining field duplicates will be collected at a 5% frequency. Laboratory duplicates will be prepared and analyzed at a one per batch or 5% frequency.

**Comparability** of the data can be defined as the similarity of data generated by different monitoring programs. Comparability helps to measure the scientific coherence and validity of a project. This objective is addressed primarily by using standard sampling and analytical procedures. Additionally, comparability of analytical data is addressed by result comparison of certified reference materials.

**Sensitivity** of the analytical instrument or method is the ability to detect and quantify an analytical parameter at the concentration level of interest. Sensitivity can be evaluated by method or instrument detection limit studies (MDL and IDL) or calculated practical quantitative limits (PQL) and method report limits (MRL).



**Completeness** is a measure of the amount of successfully collected and validated data relative to the amount of data planned to be collected for the project. Project completeness is typically based on the percentage of the data needed for the program or study to reach statistically valid conclusions. Because the SVIWMP is a monitoring program, data that are not successfully collected for a specific sample event or site can typically be recollected at a later sampling event. For this reason, most of the data planned for collection can not be considered statistically critical, and it is difficult to set a meaningful objective for data completeness. However, some reasonable objectives for the data are desirable, if only to measure the effectiveness of the Monitoring Program. %Completeness will be expressed by the following equation:

$$\%Completeness = \frac{N}{T} \times 100$$

where,

N = Number of usable results

T = Total number of samples planned to be collected

A completeness goal of 90% has been set for the ground water monitoring program.

**Representativeness** can be defined as the degree to which the environmental data generated by the monitoring program accurately and precisely represent actual environmental conditions. This objective is addressed by the overall design of the monitoring program. Specifically, assuring the representativeness of the data is addressed primarily by selecting appropriate locations, methods, times, and frequencies of sampling for each environmental parameter, and by maintaining the integrity of the sample after collection. Representativeness judges how well a single sample can describe the conditions of an entire sample population. Accurate, artifact-free sampling procedures and appropriate sample homogenization achieve representativeness.

## 1.8 TRAINING REQUIREMENTS/CERTIFICATION

### 1.8.1 Training of Field Personnel

A specialized training requirement for this project is for the use of Global Positioning Systems (GPS) Technology. Training in the use of handheld GPS units and software will be performed on an individual basis between the trainer and the trainee. Training will be provided by staff experienced in the use of GPS and Geographic Information Systems (GIS).

Field personnel will also be given initial instructions prior to the beginning of sample collection activities. These initial instructions will help familiarize the field personnel with sample collection containers, sample handling techniques, chain-of-custody forms, and sample transport. New field personnel will be accompanied by a trainer in the field as part of the initial instructions. All field samplers have completed a four-hour training session in the field. Training included confirmation of the well ID electrical meter tag number and MCWRA tag number, recognizing the appropriate sampling port, sample collection technique, proper handling of the sample during transportation to the lab, and accurate completion of the chain-of-custody forms. The completion of field training session has been documented in the Agency's personnel files.

All field personnel will follow sample collection procedures from accepted methods for the collection of ground water. Sample collection will follow protocols in accordance with recommended guidelines established by the U.S. Geological Survey (USGS) for ground water collection as described in the



National Field Manual for the Collection of Water-Quality Data, U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9. Field personnel will be familiar with the above-mentioned document.

Field personnel will also read and be familiar with this Quality Assurance Project Plan (QAPP) prior to beginning any sample collection activities.

### *1.8.2 Training of Laboratory Personnel*

No specialized training of laboratory personnel is required for this project. The ground water constituents to be analyzed by the laboratory are routine and do not require additional expertise. In addition, the laboratory's QA plan notes that analysts 'must conduct sufficient preliminary tests using the methodology and typical samples to demonstrate competence in the use of the measurement procedure'.

### *1.8.3 GPS Training Documentation*

Documentation of field personnel training for GPS includes: the name of the staff member being trained, the training date, the name of the trainer (instructor), and a checklist of satisfactory completion of each step. These training records are stored inside a monitoring binder and filed in the Agency's Water Quality Section. A sample GPS training record is attached in Appendix A.

Training documentation of laboratory personnel for routine methods is kept on file at the Consolidated Chemistry Laboratory (CCL). The CCL has written a policy regarding laboratory personnel training in their lab QA plan.

## **1.9 DOCUMENTATION AND RECORDS**

### *1.9.1 QA Project Plan Distribution*

The MCWRA Hydrologist/ Team Lead will safeguard the original QAPP and any subsequent revisions (both hard and electronic), plus keep a record of the distribution list in order to send out amendments to the QAPP and retrieve any obsolete versions (from the individuals listed earlier in section 1.3).

### *1.9.2 Field Documentation and Records*

All field documentation generated by the sampling program will be kept on file in the Water Quality Section of the Agency. Field documentation includes field sheets, chain of custody (COC) forms, photographs, and labels (see Appendix B for examples of each).

#### *1.9.2.1 Field Sheets*

Field sheets are used to aid in the identification of each ground water source (well). The field sheets list the name of each well (as assigned by the well owner) and the State Well Number. The field sheets also contain a section that describes who the sampler should contact in order to have a well turned on, where to find the sample port, etc. The sampler is responsible for recording the sample date and time on the field sheet. Site observations should be written in the comments section of the field sheet, and initialed by the sampler. Site observations may include information such as detailed directions to the well location, changes to the electrical meter tag number, and the owner contact name and phone number. Field sheets also contain PG&E electrical meter numbers, which can be either verified or updated while the sampler is in the field.



Field sheets are double-checked by the sampler for completeness and accuracy while still in the field. The sampler should look for: incomplete and/or missing data/omissions, incorrect or invalid information, and clarity problems. Any discrepancies should be cleared up before the sampler leaves the field. Data that has been entered by one field sampler will be reviewed by a different field sampler to verify that no transcription errors have occurred. These data entry reviews will take place at least weekly.

Original field sheets are categorized (according to Coastal wells or Salinas Valley wells) inside binders which are kept in the Water Quality Section at the Agency for a period of 10 years. After such time, the copies are transferred to the Monterey County Record Retention Center and archived for a period of 5 years.

Data collected on field sheets will also be recorded electronically and stored in an Access database inside a shared network drive that is backed-up on a daily basis. These electronic records will be retained permanently.

#### *1.9.2.2 Chain Of Custody (COC) Forms*

Chain-of-custody (COC) forms will be provided by the Consolidated Chemistry Laboratory and filled out while the sampler is in the field. The COC will accompany the samples at all times in order to insure the custodial integrity of the samples. A sample is considered to be in custody if it is: in someone's physical possession, in someone's view, locked up, or secured in an area that is restricted to authorized personnel.

Care should be taken to protect the COC from physical damage (i.e., water, wind, etc). The COC will have the following information:

- Client Code
- Client Name
- Client Address
- Client Phone Number
- Client Fax Number
- Report Attention
- Sampler Name
- Collection Date
- Collection Time
- Sample Site (identified by state well identification number) or QC sample (if appropriate)
- Sample Type (all of the samples in this project will be **grab** samples)
- Matrix (all of the samples in this project will be **ground water** samples)
- Analyses Requested

Upon relinquishing the sample(s) to the Consolidated Chemistry Laboratory, the sampler will sign and date the COC form. Lab personnel will then receive the sample(s), mark the date and time received, assign unique lab identification numbers (lab IDs) to each sample, and sign the COC form. The signed COC form is then photocopied; the lab keeps the original, and a copy is given to the sampler.

Hard copies of COC forms are categorized (Coastal wells or Salinas Valley wells) inside binders which are kept in the Water Quality Section at the Agency for a period of 10 years. After such time,



the copies are transferred to the Monterey County Record Retention Center and archived for a period of 5 years.

Electronic COC information is also stored in an Access database inside a shared network drive that is backed-up on a daily basis. These electronic records will be retained permanently.

#### *1.9.2.3 Photographs*

The Agency maintains a photo catalog which contains photographs of the Coastal well site locations. The photo catalog is carried into the field to assist with the identification of each well. If there are significant changes to the appearance of the well site, then staff will take a new digital photo. The old photo in the catalog will then be replaced with a copy of the new photo. Photographs will be taken of the Salinas Valley wells after confirming the correct well location of each.

Two photographs of each well location will be taken using a high resolution digital camera. One photograph will be from a distance of 100 ft. or more to aid in the identification of the correct site location. The second photograph will be a close up of the well and pump head, which will be used to verify location of the correct sampling port. Printed hard copies of these two photographs for each well will be kept in the photo log book and labeled with the state well identification number as listed on the field sheets.

Photographs will serve to help verify information entered into the field sheets. Photographs are stored in an electronic database and labeled according to site number and date last photographed. Previous photos will be archived electronically for retrieval purposes if the need arises.

#### *1.9.2.4 Labels*

Labels for each sample site are pre-printed on Avery (size 5163) sheets (10 labels per sheet). Indelible ink will be used on the labels and clear packing tape will be applied over the label to prevent it from coming off if it gets wet. Each label will have the following information:

- Sample Site (pre-printed)
- Collection Date (to be filled out in the field)
- Collection Time (to be filled out in the field)
- Analyses Requested (complete or partial mineral panel)
- Sampler Name (to be filled out in the field)
- Comments (if any)

The sample site name (state well identification number) will serve as the unique identifier for each sample (e.g. 14S/02E-08M02). When the samplers arrive at the CCL a unique in-house lab number is assigned to each sample.

#### *1.9.2.5 Field Quality Control Sample Records*

Quality Control samples from the field will be identified using the state well identification number plus either -1 or -2 (e.g. 14S/02E-08M02-1, for a field blank).

- -1 = Field Blank
- -2 = Field Duplicate



### *1.9.3 Laboratory Documentation and Records*

The Consolidated Chemistry Laboratory will keep a sample receiving log containing the completed COC forms submitted with the samples collected for this project. The CCL will keep records of all analyses performed as well as associated QC information, including: laboratory blanks, laboratory duplicates, matrix spikes, matrix spike duplicates and laboratory control samples. Hard copy data of analytical results will be maintained for three years by the CCL. The CCL maintains a Laboratory Information Management System (LIMS) which will be used to store electronic data.

The data generated by the CCL for each sampling event will be compiled into individual data reports. The individual data reports will include the following information:

- Sample results and associated Quantitative Limits (QLs)
- Cation-Anion Balance Sheet
- QC check sample records and acceptance criteria for the following:
  - Laboratory Control Sample(s)
  - Matrix Spike(s)
  - Matrix Spike Duplicate(s)
  - Analytical Duplicate(s)
  - Method Blank(s)
- Project narrative including a discussion of problems or unusual events (including, but not limited to, topics such as: receipt of samples in incorrect, broken, or leaky containers, with improperly or incompletely filled out COC forms; receipt and/or analysis of samples after the holding times have expired; summary of QC results exceeding acceptance criteria; etc.)

The above information is logged into the LIMS database at CCL.

The Public Health Chemist of the Consolidated Chemistry Laboratory will be responsible for reviewing, validating, and/or qualifying results on the data reports. Any deviations from sample preparation, analysis, and/or QA/QC procedures will be documented. Departure from QC acceptance limits will be highlighted. Once the data reports are finalized, the hard copy will be sent to the Project QA Manager at the Agency.

At the end of the sampling season, all data for both programs (Coastal and Salinas Valley) will be electronically transferred to the Agency. After data verification, the Agency Hydrologist/ Team Lead will upload the data to the Agency's Water Resources Agency Information Management System (WRAIMS) relational database.

### *1.9.4 Technical Reviews and Evaluations*

Technical reviews and evaluations are limited to Field Activities and Laboratory Data Review Checklists.

#### *1.9.4.1 Field Activities Review Checklist*

Field personnel will be required to fill out a Field Activities Review Checklist as part of the double-check process upon returning from the field after each sampling event (see Appendix C).

#### *1.9.4.2 Laboratory Data Review Checklist*

Laboratory data reports from the CCL will be routed to the Project QA Manager at the Agency, who will do a preliminary assessment of the data. The data reports will then be given to the Agency



Hydrologist/ Team Lead who will be responsible for completing a Laboratory Data Review Checklist (see Appendix C).

#### *1.9.5 Technical Memorandum*

The Agency Project QA Manager is responsible for the preparation of the technical memorandum. The technical memorandum will be written in the "post sample collection" phase (see section 1.6.3). The technical memorandum will be submitted to USEPA for review by the EPA Region 9 Project Manager.

The technical memorandum will contain the following elements:

- Table of results for Chloride
- Table of results for Nitrate
- Table of results for Specific Conductance
- Map of Chloride contours for 500 mg/L values
- Map of Nitrates showing those sites which have values above and below the Drinking Water Standard Limit of 45 mg/L (nitrate as NO<sub>3</sub>)
- Map of Conductivity contours

## **2.0 DATA GENERATION AND ACQUISITION**

### **2.1 SAMPLING DESIGN**

In the Salinas Valley, there are four hydrogeologic subareas: Pressure, East Side, Forebay, and Upper Valley. All four subareas were selected using a directed sampling design approach. These subareas were selected deliberately based on knowledge from previous monitoring work to contain analytes of interest, specifically nitrate and conductivity in the Salinas Valley Program, and chloride and conductivity in the Coastal Program. Actual sampling sites/wells within the Salinas Valley Basin Monitoring Program were chosen using a non-deliberate sampling approach. The wells included are acquired opportunistically. Site accessibility is a key issue for sampling. Permission of property owners must be secured before accessing private wells.

There are just over 1700 active wells in the Salinas Valley. Of this total number of wells, 344 wells make up the Salinas Valley Ground Water program and 85 wells make up the Coastal Ground Water program. The wells that make up these two programs have all been sampled in the past; some have data sets as far back as the 1950's, when this was a State of CA Department of Public Works (now the Department of Water Resources) program. The Agency wants to keep as complete and continuous a data set for each of these wells as possible.

Due to the time constraints the Agency is facing during this shortened 2007 field season, June - September, staff will prioritize which wells within the Salinas Valley portion of this project will be sampled. Wells to be sampled first will be located within approximately one mile radius of municipalities and industries (such as vegetable packing plants). We refer to these areas as high beneficial use areas. Ground water wells will be identified by State Well Numbers (Township, Range, Section, and Subsection).

All wells are high production agricultural wells. All wells are sampled in the same way, if the pump is in operation then a sample will be collected. If the pump is not operating then the field sampler will note it on the field sheets and come back to the well at a later date when the well is in operation. The pump must be operating for a sample to be collected. The age of well does not alter sampling



protocols. If a well is found to have been abandoned since the Agency last sampled the well, a notation will be made on the field sheets and the well will be removed from future sampling efforts.

#### 2.1.1 Salinas Valley Ground Water

While it is known that high levels of nitrates exist in some aquifers of the Salinas Valley Ground Water Basin, a significant sampling effort to determine the extent in the ground water has not been conducted by the Agency for several years. There are a total of 344 sample locations within the Salinas Valley monitoring program. Sample locations are operational ground water wells, the majority of which are used for agricultural irrigation. The Pressure subarea has 158 wells, the East Side subarea has 66 wells, the Forebay has 84 wells, and the Upper Valley has 35 wells (Figures 4-7). Each of these wells will be sampled once during the 2007 summer field season (July-September). The primary criterion currently used to determine if a well will be included in the Salinas Valley monitoring program has been its status as previously sampled. This program is an ongoing ambient ground water monitoring program and continuity in sampling the same wells each field year is of prime importance, especially for water quality trend analysis. Other factors that are important in deciding if a well should be included in the monitoring program are; copy of the well completion report (commonly referred to as the driller's log), location of the perforation interval along the well casing to determine which aquifer is sampled, age of the well, and construction method used to drill the well. Additionally it is useful to know the proximity of the well to other water use (industrial, municipal, or domestic) areas. A list of Salinas Valley well names and locations are given in Table 4. All wells on this program are planned to be part of the monitoring design for subsequent years. Until these monitoring wells are abandoned or destroyed, they will remain part of this program.

#### 2.1.2 Coastal Ground Water

The Agency currently conducts a seawater intrusion monitoring and mapping program (EPA II). This program will continue to evaluate the extent and status of seawater intrusion in the coastal areas of the Salinas Valley Basin (EPA II). The Coastal portion of the ground water program contains 85 wells, most of which are located in the Pressure subarea (Figure 8). Each well will be sampled three times, once each month of the summer 2007 field season (July-September). The first sample collection at each well will be analyzed for a complete mineral panel (Table 1), and following two collections will be analyzed for a partial mineral panel (Table 1). There are 21 wells located in the Pressure 180-Foot Aquifer, 52 wells within the Pressure 400-Foot Aquifer, two wells with perforations within both the Pressure 180-Foot and 400-Foot Aquifers, four wells are located within the Pressure Deep Zone Aquifer, three in the East Side Deep Aquifer, one in the East Side Shallow Aquifer, and one in the Prunedale Aquifer. The principal criterion for inclusion in the Coastal monitoring program is historical sampling and well availability. Additional criteria for selecting a well for inclusion into the Coastal monitoring program are: a well completion report, location of the perforation interval along the well casing to determine which aquifer is sampled (180, 400, or deep zone AQ), well age, and well construction type. A list of Coastal sites and their representative aquifers are listed in Table 5.

It can not be stressed enough how important the continued monitoring of these ground water wells are for the Agency to meet its mission of monitoring the quality of the County's ground water resources. Some of these well have been sampled since the 1950's and the loss of such a long term water quality record within the County of Monterey would irreplaceable.



## 2.2 SAMPLING METHODS

The objectives of the sampling procedure are to minimize changes in ground water chemistry during sample collection and transport to the laboratory, and to maximize the probability of obtaining a representative, reproducible ground water sample. This well-volume purging procedure provides a reproducible sampling technique with the goal that the samples obtained will represent water quality over the entire screen interval of the well.

Standing water in the well casing can be of a different chemical composition than that contained in the aquifer to be sampled. Solutes may be adsorbed on to, or desorbed from the well casing material, oxidation may occur, and biological activity is possible. Therefore, the stagnant water within the well must be purged so that the sample is representative of the aquifer. As a result, a well may be sampled only after the pump has been in operation for at least 15-20 minutes.

All the wells included in this project, from both the Salinas Valley area and the Coastal monitoring area are high production agricultural wells that contain deep turbine pumps operating at 500-1200 gallons per minute (gpm). Over the years of managing the ambient monitoring program, the Agency has determined that operating a deep turbine pump for 15-20 minutes before taking a sample is sufficient time to clear the entire well casing of three well volumes for ensuring a representative well sample. For referencing well casing volume, the Agency uses the well casing size provided in the well completion reports (driller's log) for each of the wells included in this monitoring program (National Field Manual for the Collection of Water-Quality Data, Chapter A2).

Sample bottles and caps are rinsed three times with ambient ground water prior to collection. The sample container is then filled, tightly capped, and labeled. No field sample filtration is required. Samples are put into a cooler with ice immediately and maintained at 4°C and delivered to the laboratory daily. See Table 6 for sample collection requirements. Extra sample containers, caps and field supplies will be carried in the truck as back-up should any problem arise in the field. Additionally, the Field Sampler will carry and maintain an updated hardcopy of the QAPP in the field to be used as a reference.

The following precautions will be followed in order to limit sampling error at the wellhead:

- Operate the pump long enough to produce water that is representative of the aquifer and not stagnant water from the casing.
- Take samples at the wellhead or near the wellhead and away from fertilizer injection ports.

Sample collection will follow protocols in accordance with recommended guidelines established by the U. S. Geological Survey (USGS) for ground water collection as described in the National Field Manual for the Collection of Water-Quality Data.

The National Field Manual for the Collection of Water-Quality Data, U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9 is maintained as a web-based document and is located at <http://pubs.water.usgs.gov/twri9A>. Updates and revisions for the National Field Manual can be found using this web-based approach.

## 2.3 SAMPLE HANDLING AND CUSTODY

This section describes how all samples will be treated after collection, during transport, and upon arrival at the CCL. It also includes information on proper sample disposal after laboratory analysis.



### 2.3.1 Sample Containers and Preservatives

Sample containers to be used in this project are high density polyethylene (HDPE), one pint (~0.5 L) and 0.5 gallon (~2 liter) sizes, for partial mineral or complete mineral analyses, respectively. The Agency has used these same sample container types during previous years of this ongoing ambient monitoring program and has never had any problems with container contamination issues. Field blanks will be closely monitored and, should a problem arise, corrective actions will be taken. Only one container (pint or half gallon) is needed per sampling site to provide the necessary volume to run the required lab analyses (see Table 6). Sample containers and caps are purchased in bulk from a plastic container manufacturer (Consolidated Container Company). The caps for the containers are packaged separately. The containers and caps are clean upon receipt, as long as they arrive with the outer cardboard packaging intact. The containers will be kept in a closed, dry environment away from the outside elements. Sterility is not of importance because this sampling project does not include microbiological testing. As previously mentioned, all containers and caps will be rinsed three times with ambient sample water prior to sample collection.

Sample containers are labeled with pre-printed labels, which lists which panel of analytes is requested, either complete mineral or partial mineral. The collection date, collection time, and sampler name are recorded in the field with an indelible marker. After being filled out, labels will be covered with clear plastic tape (packaging type) to protect the labels from destruction during transport.

No chemical *field preservation* of the samples is required. All samples will be kept at  $4\pm 2^{\circ}\text{C}$ .

Preservation of samples, if required prior to analysis, will be the responsibility of the contract lab (CCL). Part of the CC lab sample receiving protocols includes lab personnel verifying, at the time of sample receipt, if any samples require lab preservation. Refer to Table 6 for listings of preservatives for specific analytes.

### 2.3.2 Sample Packaging and Transport

All samples will be handled, prepared, transported and stored in a manner so as to minimize contamination and spills. After collection, sample caps will be checked for tightness, and the samples will be put in ice chests immediately. During travel between sites, ice chest lids will be kept tightly closed in order to keep the samples at the correct temperature and protect them from sunlight. Ice used for maintaining sample temperature will be double-bagged inside durable plastic bags (Ziploc type) and be of sufficient quantity so that all samples will be stored at  $4\pm 2^{\circ}\text{C}$ . Maximum holding times for specific analytes are listed in Table 6.

### 2.3.3 Sample Custody

Chain of custody (COC) procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of the analytical results. A completed chain of custody form is to accompany the samples to the contract laboratory (CCL). Requirements for COC paperwork can be found in Section 1.9.2.2 of this document.

All samples collected for this project will be transported from the field to the CCL via an Agency vehicle. The field sampler will deliver the samples directly to the CCL daily; there will be no intermediary transfers. Samples need to arrive at the CCL no later than 15:00, to ensure log-in and laboratory preservation. Personnel at the CCL will examine the samples for correct documentation and holding times. The CCL will follow sample custody procedures as outlined in their QA plan (see Appendix D).



#### 2.3.4 Sample Disposal

All samples remaining after successful completion of analyses will be disposed of properly. It is the responsibility of the personnel at the CCL to ensure that all applicable regulations are followed in the disposal of samples or related chemicals. Sample disposal procedures used by the CCL are discussed in their QA plan (see Appendix D).

### 2.4 ANALYTICAL METHODS

All samples will be analyzed at the County Consolidated Chemistry Laboratory (CCL). Analyses will be performed following either EPA approved methods or methods from *Standard Method for the Examination of Water and Wastewater, 18<sup>th</sup> Edition*, see Table 1 (CCL's QA Manual cites 18<sup>th</sup> Edition, see Appendix D). Standard operating procedures (SOPs) from CCL have been included in Appendix D for each of the analyses. Should there be any deviation from these SOPs the Laboratory Director must contact the Project QA Manager.

The CCL will submit a data report and associated QC results after analyses are complete to the Project QA Manager. This data report is described in Section 1.9.3. After a preliminary assessment the Project QA Manager will pass the data on to the Team Lead, who will review the data report and QC results and evaluate its quality and usability in addressing the Project objectives.

### 2.5 QUALITY CONTROL

#### 2.5.1 Field Sampling Quality Control

The assessment of field measurements will be determined from the collection and analysis of field blanks and field duplicates. For this monitoring program the field blanks will be collected at one every 20 samples or a frequency of 5%. Field duplicates will be collected at a frequency of 10% for the first two sampling events. If the criterion of <25% RPD is met, then the remaining field duplicates will be collected at a 5% frequency. Analytical acceptance criteria and corrective actions for field QC are listed in Table 2.

Deionized (DI) water will be acquired from the CCL and kept at  $4\pm 2^{\circ}\text{C}$ , while transported into the field. Field blank samples will be obtained by pouring DI water into a pint (~500 mL) HDPE sample container that has been triple-rinsed with DI water at the sampling location. The container will be tightly capped, placed in the cooler and delivered to the contract laboratory. Field blanks are labeled with the sampling location (State Well Number) followed by "-1".

Field blanks will be used to evaluate the collection process (from field sampling through sample analysis) for contamination from exposure to ambient conditions, from sample containers or from improper sampling and handling technique. If target analytes are found in field blanks, sampling and handling procedures will be reevaluated and corrective actions taken. Corrective actions may consist of, but are not limited to, re-training of field personnel, discussions with the contract laboratory, invalidation or qualifying of results.

Field duplicates will be collected for every analytical parameter. The duplicate sample will be collected immediately after collection of the native, following the same sampling protocols. Field duplicates are labeled with the sampling location (State Well Number) followed by "-2".

Field duplicates will be used to evaluate the precision of the sample collection through analysis. The combined variability from sampling and analysis technique, in addition to sample heterogeneity, will



be assessed using field duplicates. If acceptance criteria are exceeded, field sampling and handling protocols will be reviewed and problems corrected. These may consist of, but are not limited to, additional training, revised sampling techniques and reevaluation of sampling location.

#### *2.5.2 Laboratory Analyses Quality Control (Contract Laboratory)*

The Monterey County Consolidated Chemistry Laboratory's (CCL) personnel are responsible for analytical Quality Control. Standard laboratory quality control elements include method blanks, laboratory control samples, analytical duplicates, matrix spikes and calibration procedures. Laboratory data quality objectives include QC acceptance criteria, frequency of analysis, and corrective actions. These data quality objectives and quality control elements for CCL are described in its QA Manual (Appendix D) and SOPs (Appendix D) and are listed in Table 3. After examination of these documents, the Agency believes that the laboratory will be able to meet the project data quality needs. Any deviation from these written procedures must be documented by the laboratory and reported to the Project QA Manager.

### **2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS**

Testing, inspection, and maintenance of laboratory equipment are the responsibility of the Monterey County Consolidated Chemistry Laboratory and are detailed in its QA manual in Appendix D.

### **2.7 INSTRUMENT CALIBRATION AND FREQUENCY**

Instrument calibrations are the responsibility of the Monterey County Consolidated Chemistry Laboratory and acceptance criteria for calibrations are detailed in its QA manual in Appendix D.

### **2.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES**

#### *2.8.1 Initial Inspection of Supplies*

As mentioned previously in Section 2.3.1, sample containers are purchased in bulk from an outside vendor who specializes in supplying plastics to the beverage industry. An initial inspection will be conducted upon receipt of each shipment. Each shipment will be considered acceptable for use if *all* of the following are true:

- The shipment arrives with the outer cardboard packaging intact.
- The containers are the correct type (HDPE) and size (0.5 gal/~2L or 1 pint/~0.5L).
- The insides of the containers are dry.
- The insides of the containers are free of dirt or any particulate matter.

#### *2.8.2 Field Inspection of Supplies*

Immediately prior to sample collection, field samplers will visually inspect each sample container for the following:

- Dirt or any particulate matter
- Cracks of any size
- Improper fit of the cap on the container

If the field sampler observes any of the above, then the container will be discarded and an acceptable container will be used instead.



### **2.8.3 Laboratory Inspection of Supplies**

CCL will be responsible for establishing inspection and acceptance criteria for supplies that adhere to their internal QA/QC policies.

## **2.9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)**

Non-direct measurement data will not be used during this monitoring program. Should at some time in the future the Agency decide to use data from an external source, QA/QC requirements will be established. Should this occur, an addendum to this QAPP will be submitted to USEPA.

## **2.10 DATA MANAGEMENT**

Data, as related to documentation and records, will be managed as outlined earlier in Section 1.9 of this QAPP.

In addition, the CCL will group QA/QC data under a separate client code so that QA/QC data can be filtered from regular sample data before being uploaded into the Agency's Data Management System (WRAIMS). This allows the Agency a greater flexibility both in quickly and easily accessing the data that included QA/QC samples for initial review, and increased flexibility in uploading and moving large data sets.

## **3.0 ASSESSMENT AND RESPONSE ACTIONS**

This section lists review procedures that will be taken to ensure all the protocols outlined in the QAPP are consistently followed.

### **3.1 REVIEWS**

#### **3.1.1 Readiness Reviews**

Water Resources Technicians/ Field Samplers will be trained by the Hydrologist/Team Lead before any field sampling begins. Training will cover proper sample collection and handling and the completion of all paperwork (COCs, field logbooks, etc). The Team Lead will ensure that Field Samplers have properly prepared all collection containers, paperwork and other supplies needed to complete a successful sampling event. Any problems discovered during the readiness review will be corrected before the Samplers begin work.

#### **3.1.2 Field Reviews**

The Team Lead will be responsible for overseeing that all field activities are in compliance with Agency protocols. The Team Lead will be available via phone should any questions arise while the Samplers are in the field. The Team Lead will also review all field paperwork such as COCs and field logbooks for completion. Additionally the field QC samples (field blanks and duplicates) will be used to evaluate the individual Sampler's technique. If problems are exposed they will be corrected straight away so that all further samples are valid. A stop-work order may be issued by the Project QA Manager at any time if a discrepancy or error is found that could negatively affect the data being collected.



### *3.1.3 Post Sampling Reviews*

Post sampling reviews will be conducted following each sampling event in order to ensure all information is complete. Reviews will be conducted by the Field Sampler due to the small size of the staff. They will include evaluation of sampling activities and field documentation and will take place in the office, not in the field. Findings will be passed on to the Team Lead and the Project QA Manager to be incorporated into the next field event.

### *3.1.4 Laboratory Data Reviews*

The Team Lead will be responsible for reviewing the laboratory's data for completeness and accuracy. The data will also be checked to determine that all specified methods were used and all related QC data was provided with the sample analytical results. These reviews will take place immediately upon receipt of data reports from the laboratory. This will ensure that any method deviations are corrected or explained, and any missing or incomplete data are provided. The Project QA Manager has the authority to request re-testing of laboratory data if it is invalid or would otherwise compromise the quality of the resulting project conclusions.

## **3.2 REPORTS**

The Project QA Manager will be responsible for the technical memorandum (EPA R9# 03-238 Task 3.3) which will be provided in March 2008 to US EPA. The technical memorandum (EPA R9# 03-238 Task 3.3) will include result tables for chloride, nitrate, and specific conductivity, and maps of chloride, nitrate, and specific conductivity gradients. The technical memorandum will include a summary of any significant QA/QC issues and how they were resolved. It is currently understood that this project is of short enough duration that only a final technical memorandum to the EPA is necessary.

## **4.0 DATA VALIDATION AND USABILITY**

### **4.1 DATA VERIFICATION AND VALIDATION**

Data review is the in-house examination to ensure that the data have been recorded, transmitted, and processed correctly. The Team Lead is responsible for the data review. This examination will check for data entry errors, calculation errors, and data omission errors. If possible these errors will be corrected.

#### *4.1.1 Field Data*

Field data include logbooks, photographs, and COCs. The Field Sampler is responsible for reviewing the field data at the end of the sampling event. This includes determining that all information is complete and any deviations from the sampling methodologies are documented using the Field Activities Review Checklist (Appendix C).

#### *4.1.2 Laboratory Data*

Initial evaluation of the laboratory data are carried out by the CCL in agreement with protocols listed in their SOPs and QA manual. The Team Lead will also conduct an independent review of the data and QC parameters as described in sections 3.1.4 and using the Laboratory Data Review Checklist as detailed in section 1.9.4.4 and Appendix C.

#### **4.2 RECONCILIATION WITH USER REQUIREMENTS**

The purpose of the continued ambient monitoring of the Salinas Valley Basin Ground Water is to assess the water quality to manage and protect ground water resources. For data to be useful in developing the overarching Salinas Valley Integrated Water Management Plan, it must first meet the requirement of this QA project Plan. The Project QA Manager will be responsible for making the final evaluation of the data's usability in meeting the Project objectives. All data passing this final evaluation will then be used to establish a cohesive and succinct Water Quality Management Plan in accordance to the work begun under EPA-I and continued under EPA-II. Additionally, the Agency will integrate these ground water quality data with previously collected data for use in trend analysis.



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## **FIGURES**





#### Legend

■ Water Bodies/ Channels

## Monterey County, California

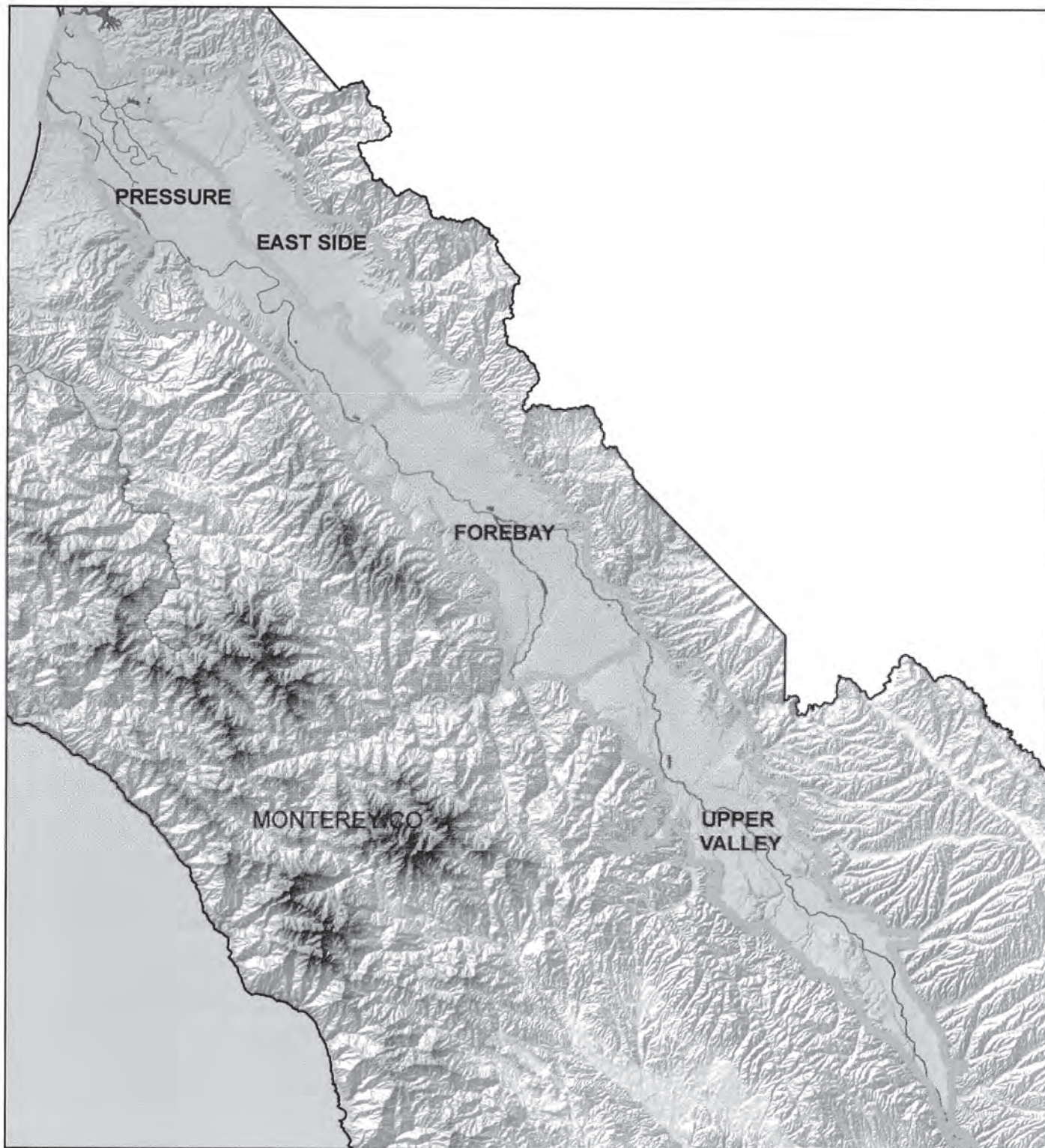
Figure 1



Note: The scale and configuration of all information shown herein are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007





**Legend**

■ Water Bodies/ Channels

## Salinas Valley Aquifers

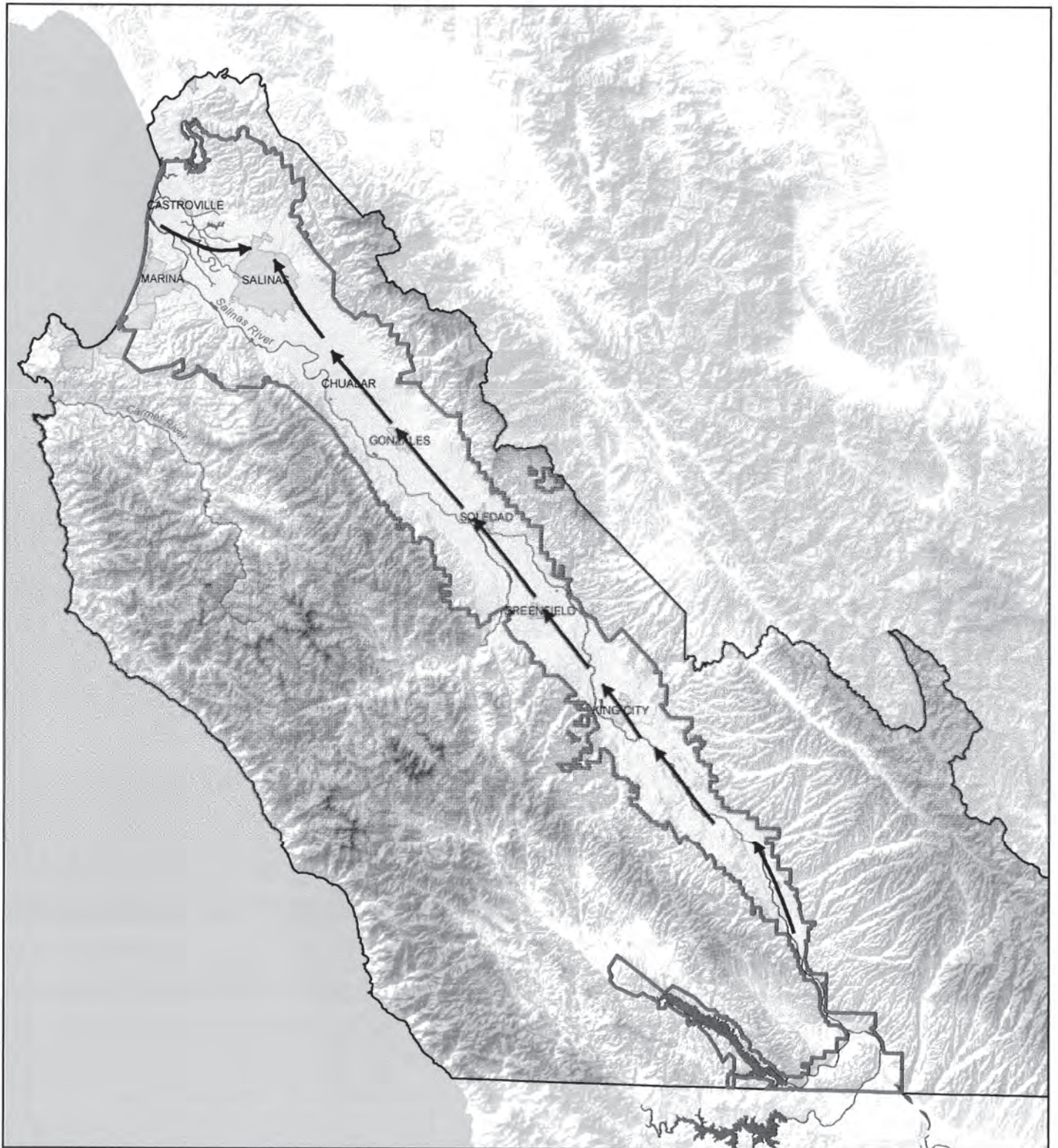
Figure 2



Note: The scale and configuration of all information shown herein are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007









## Ground Water Flow Direction in the Salinas Valley

Figure 3

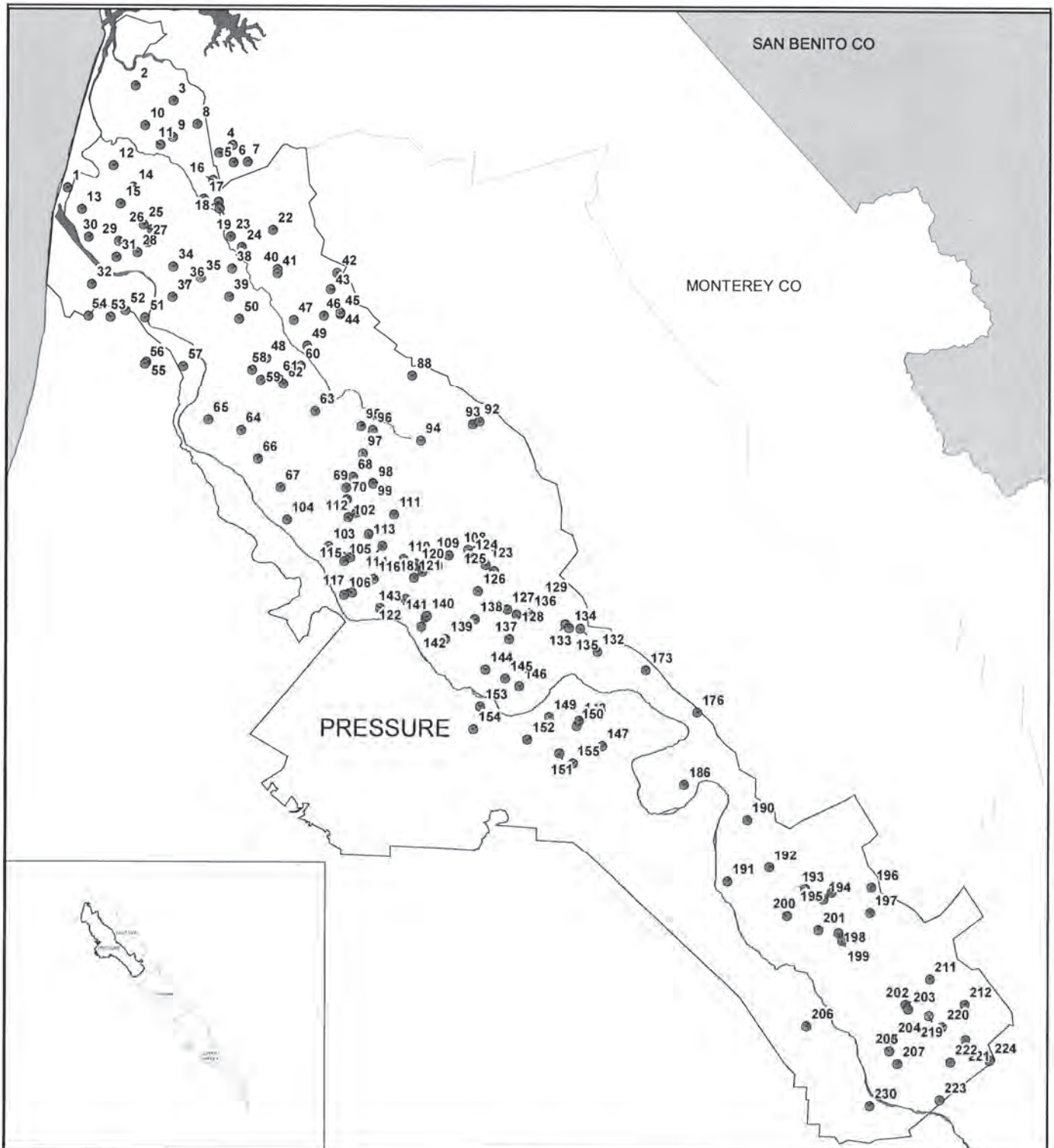
### Legend

-  Ground Water Flow Direction
-  Assessment Zone 2C
-  Monterey County
-  Rivers and Other Bodies of Water



Note: The scale and configuration of all information shown herein are approximate and are not intended as a guide for survey or design work.

Map Date: July 6, 2007



**Legend:**

● Study Well

▬ Rivers

**SUBAREA**

▭ SUBAREA

▭ PRESSURE

**Salinas Valley Wells in the Pressure Subarea**

**Figure 4**



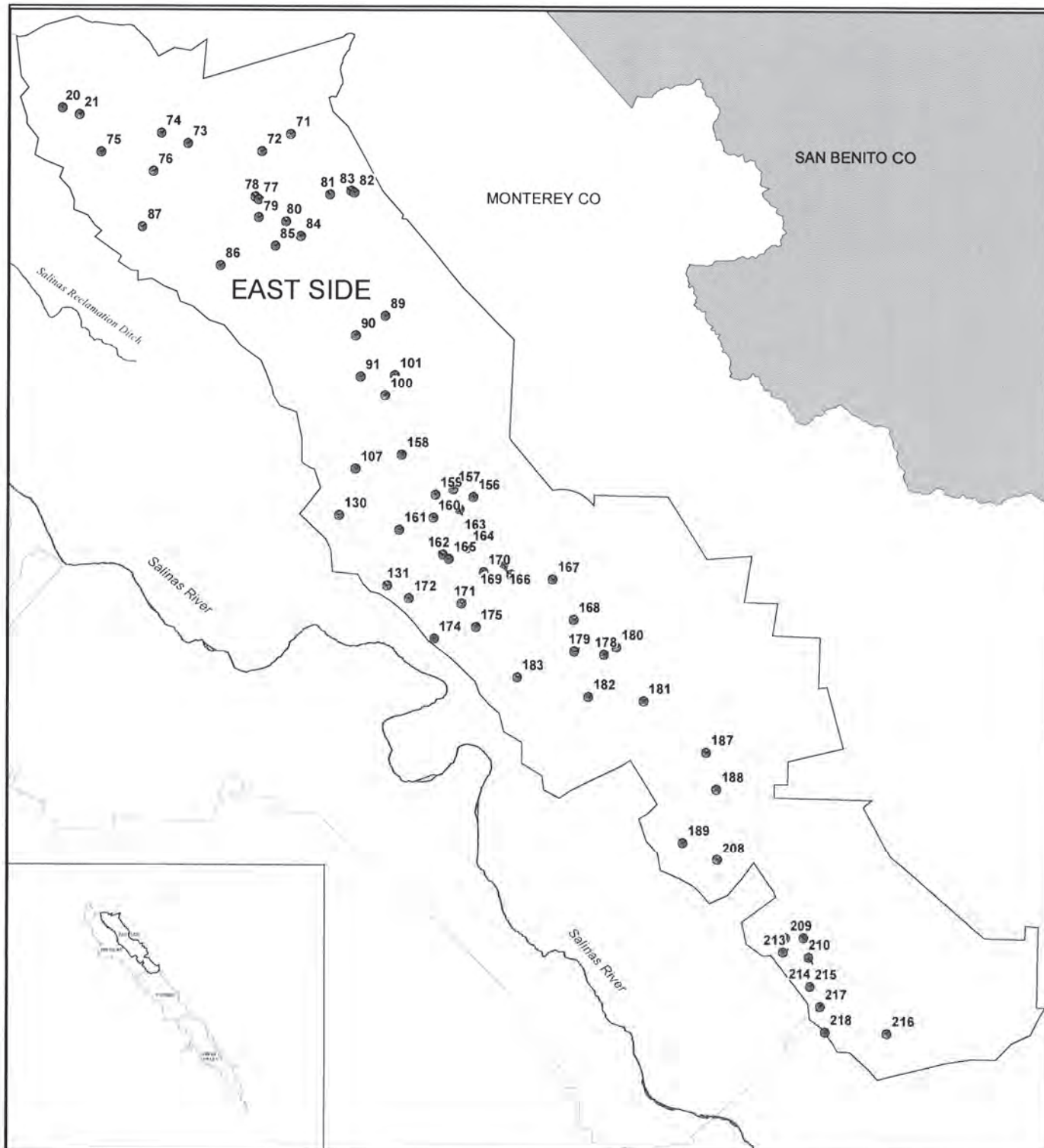
0 0.75 1.5 2.25 3 Miles



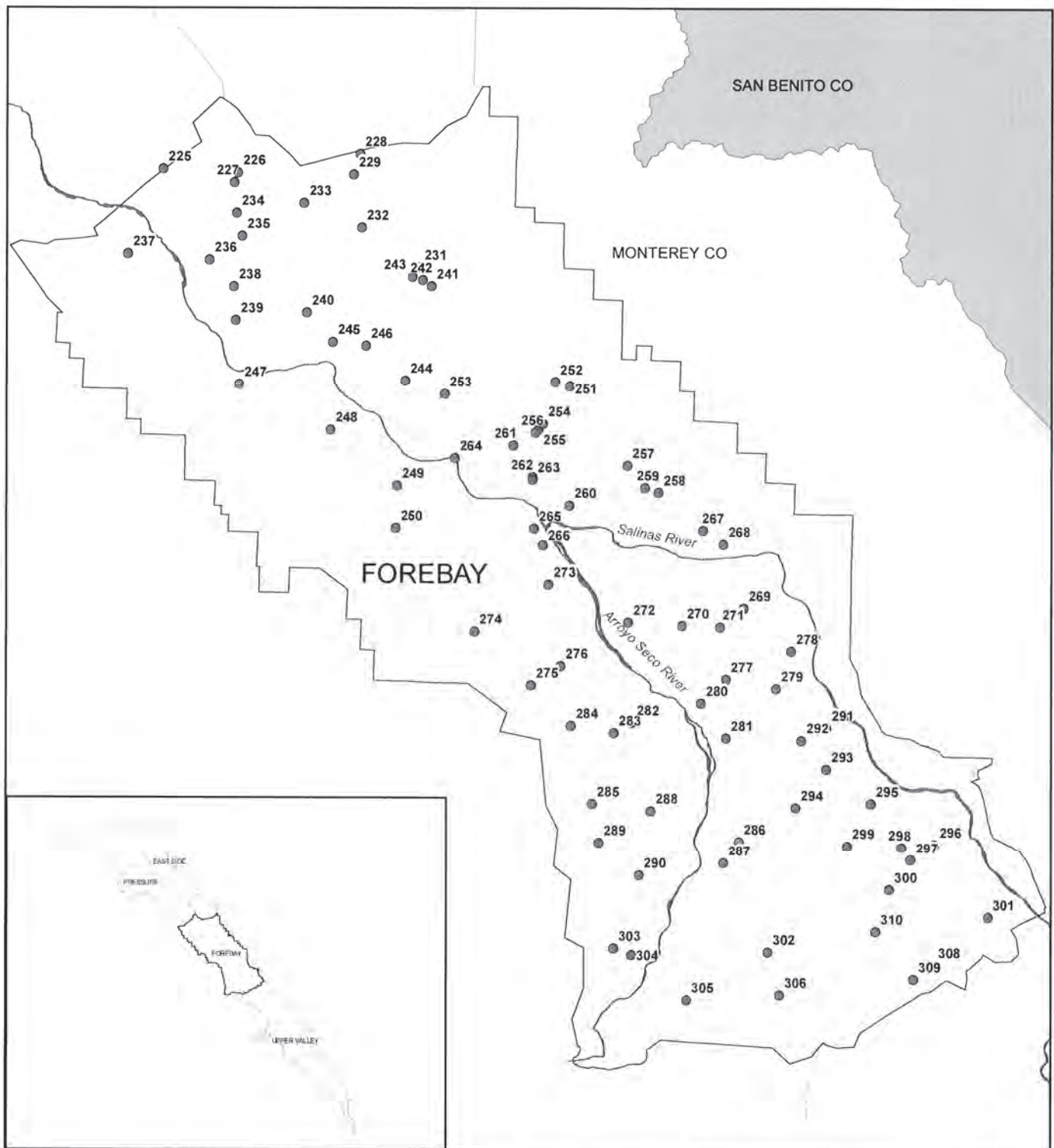
Note: The scale and configuration of all information shown herein are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007









**Legend:**

● Study Well

▬ Rivers

**SUBAREA**

▭ SUBAREA

▭ FOREBAY

## Salinas Valley Wells in the Forebay Subarea

Figure 6

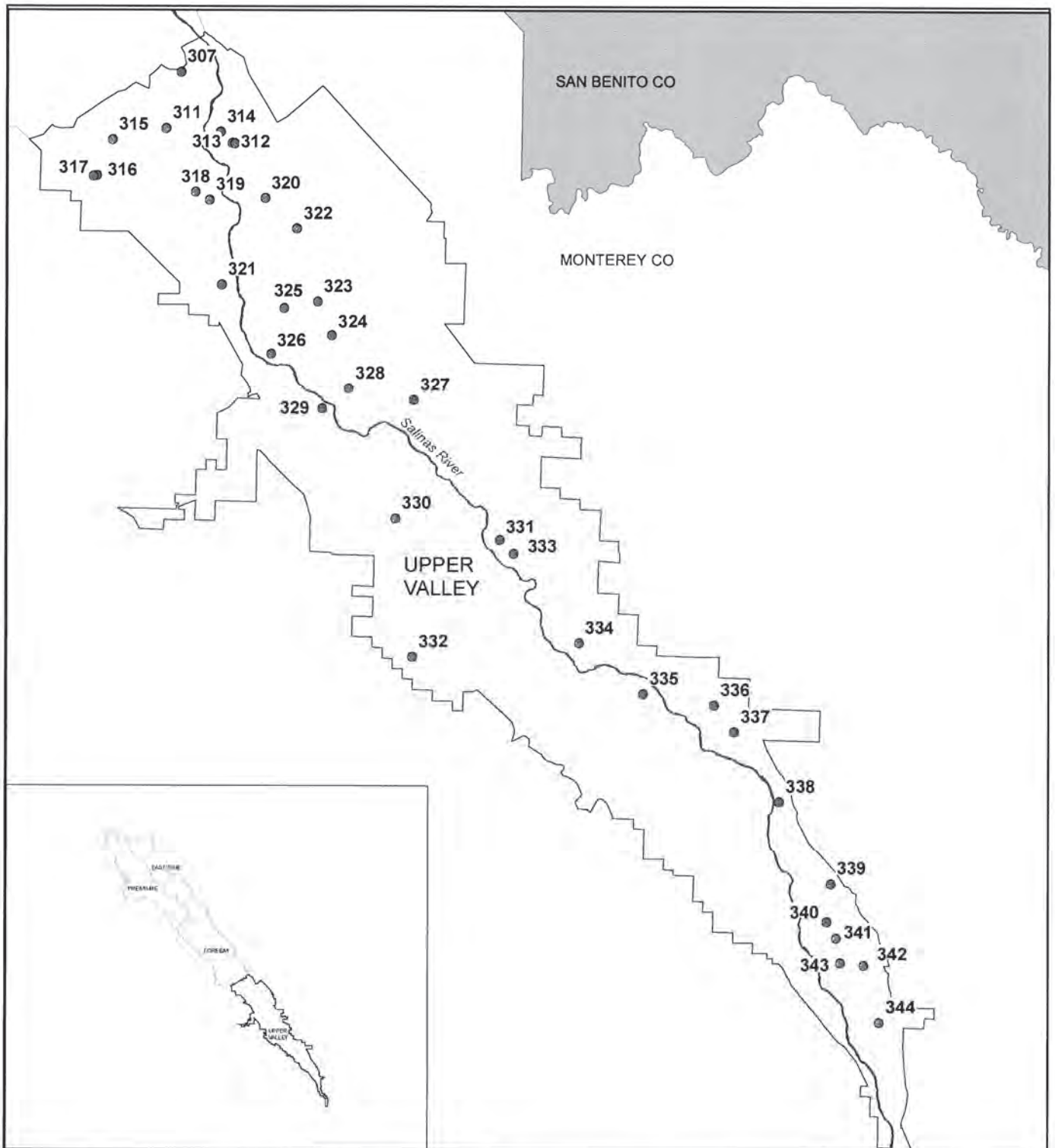


0 0.75 1.5 2.25 3 Miles



Note: The scale and configuration of all information shown herein are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



**Legend:**

- Study Well
- Rivers

**SUBAREA**

□ SUBAREA

□ UPPER VALLEY

**Salinas Valley Wells in the Upper Valley Subarea**

**Figure 7**

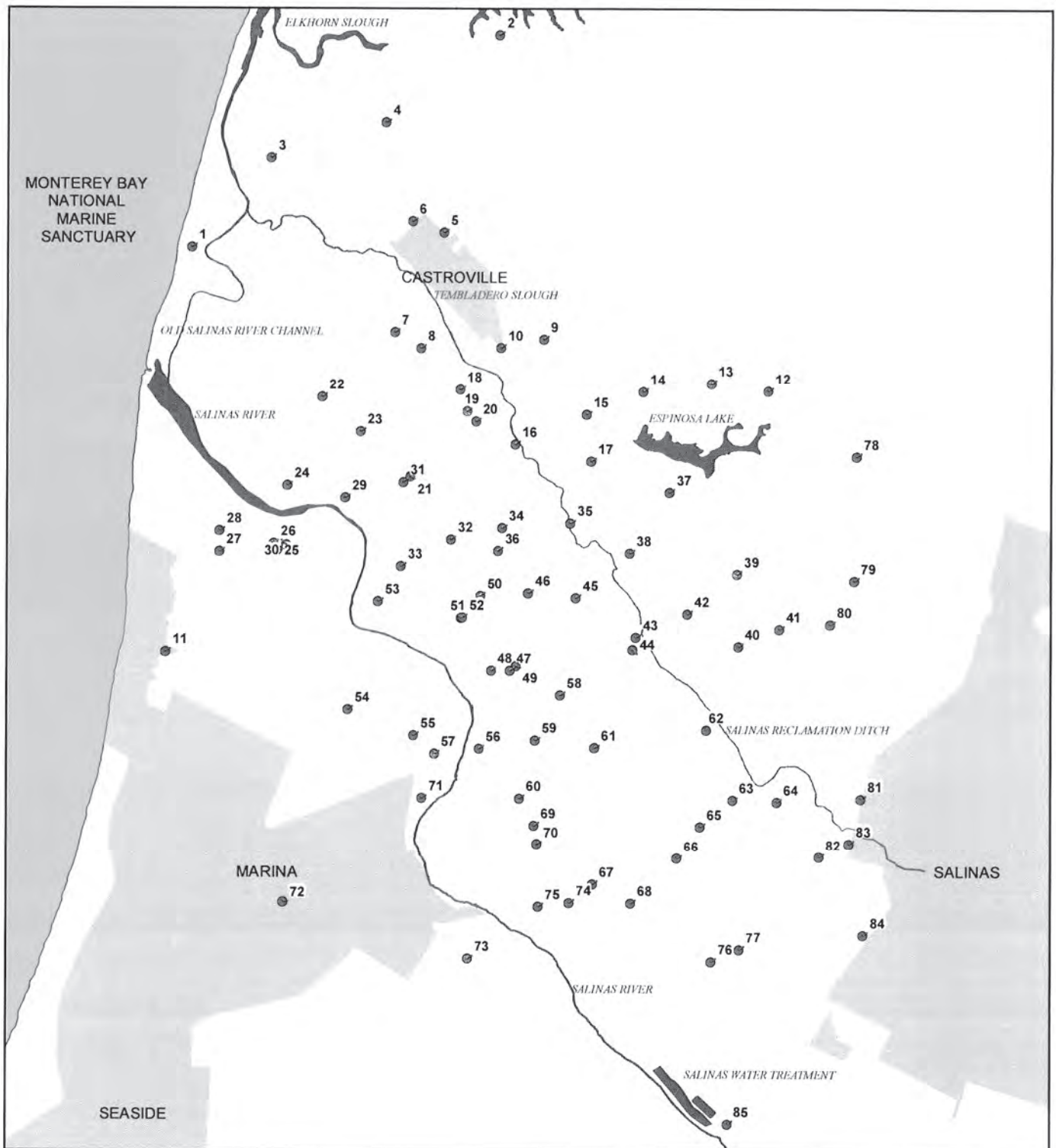


0 0.75 1.5 2.25 3 Miles



Note: The scale and configuration of all information shown herein are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



## Coastal Ground Water Monitoring Program Wells

Figure 8

### Legend:

- Study Well
- Cities
- Water Bodies/ Channels



Note: The scale and configuration of all information shown herein are approximate and are not intended as a guide for survey or design work.

Map Date: July 02, 2007

## TABLES



Table 1 COMPLETE MINERAL PANEL ANALYTES

<b>ANALYTE</b>	<b>METHOD</b>	<b>LABORATORY MDL **</b>	<b>LABORATORY PQL</b>	<b>LOWEST CALIB. STD.</b>	<b>PAL</b>
Calcium (Ca)	SM 3111 B <sup>1</sup>	0.02 mg/L	1.0 mg/L	1.0 mg/L	1.0 mg/L
CATION ANION BALANCE	Calculated	--	--	--	--
*Chloride (Cl)	EPA 300.0 <sup>2</sup>	0.01 mg/L	1.0 mg/L	0.1 mg/L	1.0 mg/L
*Conductivity (SEC)	SM 2510 B	1 umho/cm @ 25 C	1 umho/cm @ 25 C	N/A	1 umho/cm @ 25 C
Magnesium (Mg)	SM 3111 B	0.005 mg/L <sup>1</sup>	1.0 mg/L	0.1 mg/L	1.0 mg/L
*Nitrate (NO3)	EPA 300.0	0.002 mg/L <sup>2</sup>	1.0 mg/L	0.1 mg/L	1.0 mg/L
pH (Laboratory)	SM 4500-H B	pH Units (2 sig figs)	pH Units (2 sig figs)	N/A	pH Units (2 sig figs)
Potassium (K)	SM 3111 B	0.025 mg/L <sup>1</sup>	0.1 mg/L	0.1 mg/L	0.1 mg/L
Sodium (Na)	SM 3111 B	0.03 mg/L <sup>1</sup>	1.0 mg/L	0.1 mg/L	1.0 mg/L
Sulfate (SO4)	EPA 300.0	0.03 mg/L <sup>2</sup>	1.0 mg/L	0.1 mg/L	1.0 mg/L
Total Alkalinity (as CaCO3)	SM 2320 B	1.0 mg/L	1.0 mg/L	N/A	1.0 mg/L

<sup>1</sup> = MDL study completed February 2007

<sup>2</sup> = MDL study completed May 2007

\* = Partial Mineral Panel analytes

\*\* = These are the laboratory's latest MDLs and supersede the MDLs listed in Appendix D-1.

MDL = method detection limit; PQL = practical quantitative limit; PAL = project action level

All laboratory results are bracketed by calibration standards. No "estimated" results  
(below the lowest calib std and above the MDL) are given to the Agency.



Table 2 QUALITY CONTROL REQUIREMENTS FOR LABORATORY ANALYSES

QA PROCEDURE	QA PARAMETER	FREQUENCY	CRITERION	CORRECTIVE ACTION
Field Blank	Field Contamination	1/20 field samples; 5% frequency	<MDL	Recollect sampling event or flag data if unable recollect
Field Duplicate	Field Precision	1/10 field samples for first two events; if criterion is met, then 1/20 field samples	RPD < 25%	Recollect sampling event or flag data if unable recollect
Method Blank	Analytical Contamination	3 per analytical batch	< RL	Reanalyze analytical batch
LCS (CRM)	Accuracy	1 per analytical batch	80-120% REC	Reanalyze analytical batch
Analytical Duplicate	Analytical Precision	1 per analytical batch	RPD < 25%	Reanalyze analytical batch
Matrix Spike	Matrix Interference and Accuracy	1 per analytical batch; at 3-10x the native conc.	75-125% REC	Reanalyze analytical batch
Matrix Spike Duplicate	Precision and Accuracy	1 per analytical batch; at 3-10x the native conc.	RPD <25%	Reanalyze analytical batch
Continuing Calibration	Analytical Control	1 per 10 sample runs	80-120% of initial slope	Reanalyze analytical batch
Assess percent of data successfully collected	Data Completeness	N/A	90%	N/A

MDL=Method Detection Limit; RPD=Relative Percent Difference; RL=Report Limit;

REC=Recovery; LCS=Laboratory Control Sample; CRM=Certified Reference Material

An analytical batch is defined as 20 or fewer samples.

Table 3 LABORATORY DATA QUALITY OBJECTIVES (DQOs)

<i><b>ANALYTE</b></i>	<i><b>METHOD BLANK</b></i>	<i><b>LCS (CRM)</b></i>	<i><b>ANALYTICAL DUPLICATE</b></i>	<i><b>MATRIX SPIKE</b></i>	<i><b>MATRIX SPIKE DUPLICATE</b></i>	<i><b>CONTINUING CALIBRATION</b></i>
Calcium (Ca)	yes	yes	yes	yes	yes	yes
Chloride (Cl)	yes	yes	yes	yes	yes	yes
Conductivity (SEC)	yes	yes	yes	no	no	yes
Magnesium (Mg)	yes	yes	yes	yes	yes	yes
Nitrate (NO <sub>3</sub> )	yes	yes	yes	yes	yes	yes
pH (Laboratory)	no	yes	yes	no	no	yes
Potassium (K)	yes	yes	yes	yes	yes	yes
Sodium (Na)	yes	yes	yes	yes	yes	yes
Sulfate (SO <sub>4</sub> )	yes	yes	yes	yes	yes	yes
Total Alkalinity (as CaCO <sub>3</sub> )	yes	yes	yes	no	no	yes



Table 4 SALINAS VALLEY WELLS AND LOCATIONS

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
13S/01E-36J01	PRESSURE 900	1	5741483.0	2170847.00002
13S/02E-20M02	PRESSURE 400	2	5748878.5	2182094.25003
13S/02E-21N01	PRESSURE 400	3	5753018.5	2180456.75002
13S/02E-27L01	PRESSURE 180	4	5759500.0	2175572.50002
13S/02E-27M01	PRESSURE 400	5	5758010.0	2174784.50002
13S/02E-27P01	PRESSURE 400	6	5759593.5	2173660.50002
13S/02E-27Q02	PRESSURE 400	7	5761129.5	2173768.75002
13S/02E-28B01	PRESSURE 400	8	5755624.0	2177900.75002
13S/02E-28E01	PRESSURE 400	9	5752984.0	2176434.75002
13S/02E-29F02	PRESSURE 400	10	5749961.0	2177732.25002
13S/02E-29J01	PRESSURE 400	11	5751657.5	2175604.25002
13S/02E-31A02	PRESSURE 900	12	5746516.5	2173308.00002
13S/02E-31N02	PRESSURE 400	13	5743060.5	2168496.25002
13S/02E-32M02	PRESSURE 900	14	5748673.0	2170965.00002
13S/02E-32N01	PRESSURE 400	15	5747285.0	2169132.75003
13S/02E-33H03	PRESSURE 180	16	5757325.5	2171726.00002
13S/02E-33R01	PRESSURE 180	17	5756359.5	2169699.75003
13S/02E-34M02	PRESSURE 180	18	5757952.0	2169365.25003
13S/02E-34N01	PRESSURE 180	19	5758043.5	2168657.25003
13S/02E-36J01	EAST SIDE BOTH	20	5772057.0	2168257.00002
14S/02E-01A01	EAST SIDE	21	5773736.0	2167596.00002
14S/02E-02E02	PRESSURE 400	22	5763989.0	2166284.00003
14S/02E-03F02	PRESSURE 180	23	5759284.0	2165549.00003
14S/02E-03K02	PRESSURE 400	24	5760546.0	2164390.00002
14S/02E-05F04	PRESSURE 400	25	5749784.5	2166850.50002
14S/02E-05G03	PRESSURE 400	26	5750701.5	2166258.50002
14S/02E-05K01	PRESSURE 400	27	5750303.5	2164892.00002
14S/02E-05P02	PRESSURE 400	28	5749120.0	2163754.25002
14S/02E-06J03	PRESSURE 400	29	5747119.5	2164986.75002
14S/02E-06L01	PRESSURE 900	30	5743826.5	2165438.75002
14S/02E-06R02	PRESSURE 400	31	5746852.5	2163229.50003
14S/02E-07K01	PRESSURE 400	32	5744199.0	2160286.75002
14S/02E-08A01	PRESSURE 400	33	5751818.0	2162226.75002
14S/02E-09D03	PRESSURE 400	34	5753098.5	2162246.50002
14S/02E-09H03	PRESSURE 400	35	5756070.0	2161048.75002



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
14S/02E-09L02	PRESSURE 400	36	5754291.5	2160250.25002
14S/02E-09N01	PRESSURE 400	37	5752950.5	2158867.00003
14S/02E-10C01	PRESSURE 400	38	5759437.0	2162015.75002
14S/02E-10P02	PRESSURE 400	39	5759125.0	2158942.75002
14S/02E-11C01	PRESSURE 180	40	5764471.5	2161959.50002
14S/02E-11D01	PRESSURE 180	41	5764508.5	2161568.25002
14S/02E-12B01	PRESSURE 400	42	5771184.5	2161614.00002
14S/02E-12L02	PRESSURE 400	43	5770434.5	2159815.50002
14S/02E-12Q01	PRESSURE 400	44	5771537.0	2157088.75002
14S/02E-13B02	PRESSURE 180	45	5771526.0	2157219.75003
14S/02E-13D01	PRESSURE 180	46	5769699.5	2156883.75002
14S/02E-14B01	PRESSURE 180	47	5766275.0	2156434.00002
14S/02E-14N03	PRESSURE 400	48	5763230.0	2152205.50003
14S/02E-14R01	PRESSURE 180	49	5767842.5	2153580.50002
14S/02E-15B01	PRESSURE 400	50	5760275.5	2156533.25002
14S/02E-17B02	PRESSURE 400	51	5749990.5	2156598.25002
14S/02E-17C01	PRESSURE 180	52	5747844.0	2157381.75003
14S/02E-18A01	PRESSURE 400	53	5746233.0	2156686.25002
14S/02E-18C01	PRESSURE 400	54	5743827.5	2156787.25002
14S/02E-20B01	PRESSURE 180	55	5750165.5	2151711.75003
14S/02E-20B02	PRESSURE 180	56	5750001.0	2151554.75003
14S/02E-21F02	PRESSURE 180	57	5754169.5	2151251.50002
14S/02E-22H01	PRESSURE 400	58	5761690.5	2150902.75002
14S/02E-22H02	PRESSURE 180	59	5762674.0	2149777.00002
14S/02E-23A01	PRESSURE 180	60	5767130.0	2151399.50002
14S/02E-23F01	PRESSURE 180	61	5764570.5	2149971.00002
14S/02E-23L03	PRESSURE 400	62	5765164.5	2149382.00002
14S/02E-25D03	PRESSURE 400	63	5768753.5	2146325.50002
14S/02E-27K01	PRESSURE 180	64	5760536.0	2144212.25002
14S/02E-28H02	PRESSURE 180	65	5756940.5	2145354.75002
14S/02E-34A03	PRESSURE 400	66	5762394.5	2141097.75002
14S/02E-35L02	PRESSURE 400	67	5764879.0	2137944.25002
14S/02E-36H01	PRESSURE 180	68	5773015.5	2139158.50003
14S/02E-36J02	PRESSURE 400	69	5772268.5	2137939.00002
14S/02E-36R02	PRESSURE 400	70	5772326.5	2136698.50002
14S/03E-02E03	EAST SIDE BOTH	71	5794727.5	2165742.50002
14S/03E-03K01	EAST SIDE BOTH	72	5791884.0	2164011.25002



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
14S/03E-04E01	EAST SIDE BOTH	73	5784479.5	2164809.75002
14S/03E-05B02	EAST SIDE BOTH	74	5781839.5	2165837.25002
14S/03E-06L01	EAST SIDE SHALLOW	75	5775895.0	2163924.50003
14S/03E-08C01	EAST SIDE BOTH	76	5781050.5	2162072.25002
14S/03E-10F02	EAST SIDE	77	5791569.0	2159330.50002
14S/03E-10F03	EAST SIDE BOTH	78	5791236.5	2159578.00002
14S/03E-10P01	EAST SIDE	79	5791544.0	2157558.25002
14S/03E-10R02	EAST SIDE BOTH	80	5794251.5	2157151.00002
14S/03E-11H01	EAST SIDE SHALLOW	81	5798504.0	2159823.00002
14S/03E-12E01	EAST SIDE SHALLOW	82	5800865.5	2160009.25003
14S/03E-12E02	EAST SIDE	83	5800608.5	2160173.25003
14S/03E-14D01	EAST SIDE SHALLOW	84	5795697.5	2155748.25003
14S/03E-15H03	EAST SIDE BOTH	85	5793222.5	2154777.00002
14S/03E-16K03	EAST SIDE	86	5787748.0	2152845.50003
14S/03E-17D01	EAST SIDE	87	5779979.0	2156594.00002
14S/03E-20D01	PRESSURE 400	88	5779540.0	2150357.75002
14S/03E-24H01	EAST SIDE SHALLOW	89	5803951.0	2147934.50002
14S/03E-24N01	EAST SIDE	90	5801060.0	2146002.50002
14S/03E-25L02	EAST SIDE BOTH	91	5801508.5	2141975.75002
14S/03E-28B02	PRESSURE 400	92	5786919.0	2145249.50002
14S/03E-28F02	PRESSURE 400	93	5786200.6	2144963.98574
14S/03E-29L04	PRESSURE 180	94	5780547.4	2143125.21920
14S/03E-30E01	PRESSURE 180	95	5773899.5	2144670.25003
14S/03E-30F02	PRESSURE 180	96	5775180.5	2144268.50002
14S/03E-30N01	PRESSURE 180	97	5774083.5	2141696.50002
14S/03E-31F01	PRESSURE 180	98	5775271.5	2138346.50003
14S/03E-31F02	PRESSURE 400	99	5775228.5	2138492.00002
14S/03E-36A01	EAST SIDE SHALLOW	100	5803921.0	2140085.50002
14S/04E-30N01	EAST SIDE BOTH	101	5804847.5	2142132.00001
15S/02E-01A03	PRESSURE 400	102	5772482.0	2134724.00002
15S/02E-01K01	PRESSURE 180	103	5770291.5	2131514.75002
15S/02E-02G01	PRESSURE 400	104	5765615.0	2134401.50002
15S/02E-12A01	PRESSURE 400	105	5772051.5	2129878.50002
15S/02E-12R01	PRESSURE 400	106	5772057.5	2126203.25003
15S/03E-01L01	EAST SIDE	107	5801038.5	2132896.75002
15S/03E-04K03	PRESSURE 400	108	5785732.5	2131172.00002
15S/03E-04N03	PRESSURE 400	109	5783621.0	2130577.75002



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
15S/03E-05N01	PRESSURE 180	110	5778619.0	2130164.00003
15S/03E-06A03	PRESSURE 180	111	5777613.0	2135010.00002
15S/03E-06D02	PRESSURE 400	112	5773392.0	2135175.75002
15S/03E-06F02	PRESSURE 400	113	5774781.5	2132857.75002
15S/03E-06K01	PRESSURE 400	114	5776302.5	2131605.50002
15S/03E-07D02	PRESSURE 400	115	5772729.0	2130304.25002
15S/03E-07G01	PRESSURE 400	116	5775356.0	2127909.75002
15S/03E-07N01	PRESSURE 180	117	5772911.5	2126430.50002
15S/03E-08B04	PRESSURE 400	118	5780790.5	2128738.25002
15S/03E-08C06	PRESSURE 180	119	5780025.5	2129640.75003
15S/03E-08C07	PRESSURE 400	120	5780124.5	2129385.50002
15S/03E-08F07	PRESSURE 400	121	5779786.0	2128096.50002
15S/03E-08N03	PRESSURE 400	122	5778859.5	2125760.50002
15S/03E-09B01	PRESSURE 180	123	5787613.5	2129526.50003
15S/03E-09C01	PRESSURE 180	124	5785912.0	2130387.75002
15S/03E-09H02	PRESSURE 180	125	5788543.5	2128841.50003
15S/03E-09K04	PRESSURE 400	126	5786815.0	2126625.50003
15S/03E-10P01	PRESSURE 180	127	5789973.0	2124641.25002
15S/03E-10P03	PRESSURE 180	128	5790992.5	2124075.25002
15S/03E-10R02	PRESSURE 180	129	5793537.5	2125764.25002
15S/03E-12E02	EAST SIDE BOTH	130	5799472.0	2128349.25000
15S/03E-13J02	EAST SIDE	131	5804170.5	2121482.50002
15S/03E-13N01	PRESSURE 180	132	5799834.5	2120075.00003
15S/03E-14C01	PRESSURE 180	133	5796323.5	2123063.75002
15S/03E-14G01	PRESSURE 180	134	5796738.0	2122656.50003
15S/03E-14H01	PRESSURE 180	135	5797941.0	2122606.00002
15S/03E-15B01	PRESSURE 400	136	5792336.0	2124219.00002
15S/03E-15L02	PRESSURE 180	137	5790177.0	2121393.00002
15S/03E-16B03	PRESSURE 400	138	5786481.0	2123545.50002
15S/03E-16M01	PRESSURE 180	139	5783233.5	2121388.25002
15S/03E-17B01	PRESSURE 180	140	5781259.5	2123911.75003
15S/03E-17B02	PRESSURE 180	141	5781099.5	2123757.50002
15S/03E-17G01	PRESSURE 180	142	5780630.0	2122750.25002
15S/03E-18B01	PRESSURE 180	143	5776074.5	2124737.50002
15S/03E-21A01	PRESSURE 180	144	5787617.0	2118056.00002
15S/03E-22F02	PRESSURE 180	145	5789756.5	2117099.00002
15S/03E-22G01	PRESSURE 180	146	5791343.0	2116241.25002



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
15S/03E-25L01	PRESSURE 180	147	5800408.5	2109728.50003
15S/03E-26A01	PRESSURE 400	148	5797857.5	2112518.00002
15S/03E-26D01	PRESSURE 180	149	5794548.5	2112893.75003
15S/03E-26H02	PRESSURE 180	150	5797573.5	2111904.75002
15S/03E-26P01	PRESSURE 400	151	5795686.5	2108925.25002
15S/03E-27J01	PRESSURE 400	152	5792207.5	2110413.00002
15S/03E-28B02	PRESSURE 400	153	5787075.5	2113993.25002
15S/03E-28G01	PRESSURE 180	154	5786358.0	2111546.50003
15S/03E-35B05	PRESSURE 180	155	5797153.0	2107813.50003
15S/04E-05K01	EAST SIDE	156	5812585.0	2130171.00001
15S/04E-05M01	EAST SIDE BOTH	157	5810608.5	2130920.50001
15S/04E-06D04	EAST SIDE BOTH	158	5805535.0	2134296.75001
15S/04E-06R01	EAST SIDE BOTH	159	5808832.0	2130397.50001
15S/04E-07A01	EAST SIDE BOTH	160	5808667.0	2128112.25001
15S/04E-07E02	EAST SIDE	161	5805290.0	2126918.25001
15S/04E-07R01	EAST SIDE SHALLOW	162	5809617.5	2124497.75001
15S/04E-08C01	EAST SIDE SHALLOW	163	5811226.0	2128961.75001
15S/04E-08L01	EAST SIDE BOTH	164	5812038.0	2125163.50001
15S/04E-08N01	EAST SIDE BOTH	165	5810237.5	2124086.00001
15S/04E-09N01	EAST SIDE	166	5815679.0	2123673.25001
15S/04E-15D02	EAST SIDE SHALLOW	167	5820525.5	2122131.50001
15S/04E-15P02	EAST SIDE BOTH	168	5822591.0	2118164.75001
15S/04E-16D01	EAST SIDE BOTH	169	5816370.5	2122604.00001
15S/04E-17B01	EAST SIDE	170	5813674.5	2122802.00001
15S/04E-17P02	EAST SIDE SHALLOW	171	5811444.0	2119748.75001
15S/04E-18L01	EAST SIDE	172	5806258.0	2120249.25001
15S/04E-19D02	PRESSURE 400	173	5805231.0	2118084.25001
15S/04E-19H03	EAST SIDE	174	5808765.0	2116311.75003
15S/04E-20B02	EAST SIDE SHALLOW	175	5812893.0	2117437.00001
15S/04E-20N01	PRESSURE 400	176	5810999.0	2113437.25001
15S/04E-20Q01	EAST SIDE	177	5813019.5	2113916.75003
15S/04E-22J01	EAST SIDE	178	5825620.5	2114797.50001
15S/04E-22L02	EAST SIDE BOTH	179	5822626.0	2115130.25001
15S/04E-23M01	EAST SIDE	180	5826800.0	2115510.00001
15S/04E-26G01	EAST SIDE	181	5829452.0	2110273.75001
15S/04E-27G01	EAST SIDE BOTH	182	5824082.0	2110658.00001
15S/04E-28C01	EAST SIDE	183	5817013.0	2112539.50001



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
15S/04E-28C01	EAST SIDE	184*	*	*
15S/04E-29K03	EAST SIDE	185*	*	*
15S/04E-32E01	PRESSURE 180	186	5809573.0	2105524.75003
15S/04E-36H01	EAST SIDE BOTH	187	5835591.5	2105235.00001
15S/04E-36R02	EAST SIDE BOTH	188	5836592.5	2101652.75001
16S/04E-01L02	EAST SIDE	189	5833261.5	2096387.25003
16S/04E-04C01	PRESSURE 400	190	5816563.5	2101653.00001
16S/04E-08J01	PRESSURE 180	191	5814399.5	2094772.87501
16S/04E-09A01	PRESSURE 180	192	5818962.5	2096385.75001
16S/04E-10K01	PRESSURE 400	193	5822871.5	2093933.87501
16S/04E-10R02	PRESSURE 400	194	5824891.5	2092808.00001
16S/04E-11E02	PRESSURE 400	195	5825734.0	2093587.12501
16S/04E-12M01	PRESSURE 400	196	5830110.0	2094179.62501
16S/04E-13D01	PRESSURE 400	197	5829977.5	2091400.75001
16S/04E-14M01	PRESSURE 400	198	5826507.0	2089158.00001
16S/04E-14M02	PRESSURE 400	199	5826934.0	2088314.12501
16S/04E-15D01	PRESSURE 180	200	5820915.5	2091029.00003
16S/04E-15H02	PRESSURE 400	201	5824314.0	2089470.00001
16S/04E-24R01	PRESSURE 400	202	5833826.5	2081330.00003
16S/04E-25A01	PRESSURE 400	203	5834115.0	2080854.00001
16S/04E-25K01	PRESSURE 180	204	5832503.0	2077482.12501
16S/04E-25Q01	PRESSURE 400	205	5832125.5	2076199.75001
16S/04E-27G01	PRESSURE 180	206	5823057.0	2078926.75001
16S/04E-36B01	PRESSURE 180	207	5833029.5	2074811.87501
16S/05E-07G01	EAST SIDE BOTH	208	5836648.0	2094674.00003
16S/05E-17P01	EAST SIDE BOTH	209	5843361.0	2086999.12503
16S/05E-17R01	EAST SIDE SHALLOW	210	5845212.0	2087024.25003
16S/05E-19F01	PRESSURE 180	211	5836477.0	2084158.37503
16S/05E-19R01	PRESSURE 180	212	5840423.0	2081360.37503
16S/05E-20C01	EAST SIDE	213	5843125.0	2085585.12503
16S/05E-20H01	EAST SIDE	214	5845691.0	2085074.25003
16S/05E-20R01	EAST SIDE BOTH	215	5845834.0	2082220.00003
16S/05E-27G01	EAST SIDE	216	5853466.8	2077678.05320
16S/05E-28D01	EAST SIDE BOTH	217	5846865.0	2080272.25003
16S/05E-28P01	EAST SIDE BOTH	218	5847355.5	2077784.37503
16S/05E-30C01	PRESSURE 180	219	5836401.5	2080129.50003
16S/05E-30G01	PRESSURE 180	220	5837912.0	2078876.87503



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
16S/05E-30J02	PRESSURE 400	221	5840526.5	2077512.50003
16S/05E-31A01	PRESSURE 180	222	5838804.0	2075067.12503
16S/05E-31Q01	PRESSURE 180	223	5837656.0	2070857.75003
16S/05E-32C01	PRESSURE 180	224	5843159.0	2075228.62503
16S/05E-32M01	FOREBAY	225	5840439.0	2072879.00003
16S/05E-33F01	FOREBAY	226	5847064.0	2072544.75003
16S/05E-33Q01	FOREBAY	227	5846731.0	2071679.00003
16S/05E-35C01	FOREBAY	228	5857923.0	2074215.75003
16S/05E-35L01	FOREBAY	229	5857341.0	2072381.25003
17S/04E-01D01	PRESSURE 180	230	5829970.4	2070190.88233
17S/05E-01R01	FOREBAY	231	5863270.5	2064114.75003
17S/05E-02G01	FOREBAY	232	5858061.5	2067655.75001
17S/05E-03B01	FOREBAY	233	5852910.5	2069821.37503
17S/05E-04C01	FOREBAY	234	5846947.5	2068985.25003
17S/05E-04K01	FOREBAY	235	5847433.5	2066928.37503
17S/05E-04N01	FOREBAY	236	5844523.0	2064819.50003
17S/05E-06Q01	FOREBAY	237	5837274.0	2065350.12503
17S/05E-09G01	FOREBAY	238	5846689.0	2062431.75003
17S/05E-09Q01	FOREBAY	239	5846868.5	2059437.25003
17S/05E-10Q01	FOREBAY	240	5853142.5	2060133.00003
17S/05E-12B01	FOREBAY	241	5864362.0	2062470.37503
17S/05E-12B02	FOREBAY	242	5863570.5	2063023.50003
17S/05E-12B03	FOREBAY	243	5862636.0	2063300.00003
17S/05E-13L02	FOREBAY	244	5861995.0	2054065.12503
17S/05E-14D01	FOREBAY	245	5855476.7	2057512.98904
17S/05E-14G01	FOREBAY	246	5858431.5	2057156.87503
17S/05E-21A01	FOREBAY	247	5847203.9	2053734.78530
17S/05E-23L01	FOREBAY	248	5855276.5	2049667.00003
17S/05E-25L01	FOREBAY	249	5861282.5	2044709.87503
17S/05E-36F02	FOREBAY	250	5861156.5	2040988.13679
17S/06E-16N01	FOREBAY	251	5876658.0	2053579.37503
17S/06E-17R01	FOREBAY	252	5875370.0	2053960.00003
17S/06E-19D01	FOREBAY	253	5865512.0	2052870.75003
17S/06E-20K01	FOREBAY	254	5874270.5	2050202.50003
17S/06E-20Q02	FOREBAY	255	5873861.0	2049734.12503
17S/06E-20Q03	FOREBAY	256	5873624.0	2049413.37503
17S/06E-27E03	FOREBAY	257	5881725.5	2046512.12503



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
17S/06E-27K01	FOREBAY	258	5884526.5	2044144.50003
17S/06E-27L01	FOREBAY	259	5883319.0	2044534.62503
17S/06E-28N01	FOREBAY	260	5876603.5	2042971.37503
17S/06E-29C01	FOREBAY	261	5871659.0	2048323.00003
17S/06E-29K01	FOREBAY	262	5873377.5	2045490.50003
17S/06E-29Q01	FOREBAY	263	5873361.0	2045274.25003
17S/06E-30F01	FOREBAY	264	5866434.0	2047190.00003
17S/06E-32G01	FOREBAY	265	5873481.5	2040947.12503
17S/06E-32J02	FOREBAY	266	5874264.0	2039466.50003
17S/06E-35F01	FOREBAY	267	5888535.0	2040776.00003
17S/06E-35J01	FOREBAY	268	5890370.5	2039573.75003
18S/06E-01E01	FOREBAY	269	5892201.0	2033873.12503
18S/06E-02N01	FOREBAY	270	5886656.0	2032336.12503
18S/06E-02R01	FOREBAY	271	5890070.0	2032210.75003
18S/06E-03P01	FOREBAY	272	5881836.0	2032629.37503
18S/06E-05H01	FOREBAY	273	5874765.0	2035980.12503
18S/06E-07A01	FOREBAY	274	5868250.5	2031805.25003
18S/06E-08R01	FOREBAY	275	5873246.0	2027074.87503
18S/06E-09M02	FOREBAY	276	5875856.5	2028751.00003
18S/06E-11J01	FOREBAY	277	5890622.5	2027590.87503
18S/06E-12A01	FOREBAY	278	5896424.0	2030093.87503
18S/06E-12R02	FOREBAY	279	5895096.5	2026768.25003
18S/06E-14B01	FOREBAY	280	5888379.5	2025469.87503
18S/06E-14R01	FOREBAY	281	5890625.0	2022391.37503
18S/06E-15F01	FOREBAY	282	5882187.0	2023781.12503
18S/06E-15M01	FOREBAY	283	5880584.0	2022838.50003
18S/06E-16L01	FOREBAY	284	5876773.5	2023478.50003
18S/06E-21Q01	FOREBAY	285	5878665.0	2016542.37503
18S/06E-25F01	FOREBAY	286	5891762.0	2013188.12503
18S/06E-26R01	FOREBAY	287	5890408.5	2011271.25003
18S/06E-27A01	FOREBAY	288	5883864.0	2015914.75003
18S/06E-28J01	FOREBAY	289	5879251.0	2013091.87503
18S/06E-34B01	FOREBAY	290	5882838.0	2010128.37503
18S/07E-18K01	FOREBAY	291	5899619.5	2023322.62503
18S/07E-18P01	FOREBAY	292	5897367.5	2022162.75003
18S/07E-19G02	FOREBAY	293	5899561.5	2019657.12503
18S/07E-19N01	FOREBAY	294	5896875.0	2016213.75002



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
18S/07E-20K01	FOREBAY	295	5903526.5	2016596.50003
18S/07E-28K01	FOREBAY	296	5909064.5	2012996.12503
18S/07E-28N02	FOREBAY	297	5906995.5	2011573.25003
18S/07E-29J01	FOREBAY	298	5906172.5	2012704.50003
18S/07E-29M01	FOREBAY	299	5901432.0	2012790.87503
18S/07E-32G02	FOREBAY	300	5905129.0	2008896.37503
18S/07E-34P02	FOREBAY	301	5913853.5	2006429.50003
19S/06E-01H01	FOREBAY	302	5894418.0	2003322.50003
19S/06E-03E02	FOREBAY	303	5880577.0	2003637.62503
19S/06E-03K01	FOREBAY	304	5882172.5	2003068.00003
19S/06E-11C01	FOREBAY	305	5887118.5	1999053.25003
19S/06E-12A01	FOREBAY	306	5895441.5	1999532.50003
19S/07E-03H02	UPPER VALLEY	307	5916058.0	2002263.25003
19S/07E-04G01	FOREBAY	308	5908976.0	2002192.50003
19S/07E-04Q01	FOREBAY	309	5907241.5	2000938.12503
19S/07E-05B02	FOREBAY	310	5903922.5	2005128.00003
19S/07E-10P02	UPPER VALLEY	311	5914112.0	1994937.37503
19S/07E-13D01	UPPER VALLEY	312	5923060.5	1993005.87503
19S/07E-13D02	UPPER VALLEY	313	5922703.0	1993016.87503
19S/07E-13D03	UPPER VALLEY	314	5921177.5	1994464.25003
19S/07E-16D01	UPPER VALLEY	315	5907215.0	1993447.25003
19S/07E-20A01	UPPER VALLEY	316	5904728.0	1988737.75003
19S/07E-20A02	UPPER VALLEY	317	5905140.0	1988780.50003
19S/07E-23F01	UPPER VALLEY	318	5917918.5	1986682.87503
19S/07E-23G01	UPPER VALLEY	319	5919819.5	1985678.50003
19S/07E-24H02	UPPER VALLEY	320	5927076.5	1985899.12503
19S/07E-36N01	UPPER VALLEY	321	5921376.0	1974705.75003
19S/08E-30A01	UPPER VALLEY	322	5931268.5	1981945.62503
20S/08E-05C02	UPPER VALLEY	323	5933968.0	1972500.37503
20S/08E-05R03	UPPER VALLEY	324	5935855.5	1968133.00003
20S/08E-06B01	UPPER VALLEY	325	5929631.0	1971657.50003
20S/08E-07E01	UPPER VALLEY	326	5927847.5	1965744.25003
20S/08E-15H03	UPPER VALLEY	327	5946414.0	1959720.37503
20S/08E-16C01	UPPER VALLEY	328	5938055.0	1961243.37501
20S/08E-17K03	UPPER VALLEY	329	5934573.0	1958618.62503
20S/08E-34G01	UPPER VALLEY	330	5944061.5	1944379.50003
20S/08E-36R01	UPPER VALLEY	331	5957517.0	1941628.62503

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
21S/08E-15J01	UPPER VALLEY	332	5946267.0	1926489.62503
21S/09E-06C01	UPPER VALLEY	333	5959365.5	1939884.62503
21S/09E-16E02	UPPER VALLEY	334	5967913.5	1928310.37503
21S/09E-22J01	UPPER VALLEY	335	5976378.5	1921774.75003
21S/09E-24Q01	UPPER VALLEY	336	5985537.5	1920320.00003
21S/10E-30E02	UPPER VALLEY	337	5988110.5	1916891.25003
21S/10E-32N01	UPPER VALLEY	338	5993930.5	1907839.00003
22S/10E-09P01	UPPER VALLEY	339	6000619.0	1897117.87503
22S/10E-16P01	UPPER VALLEY	340	6000072.0	1892154.87503
22S/10E-21C01	UPPER VALLEY	341	6001268.5	1890089.75003
22S/10E-22N01	UPPER VALLEY	342	6004921.0	1886561.87503
22S/10E-28B01	UPPER VALLEY	343	6001816.0	1886849.25003
22S/10E-34G01	UPPER VALLEY	344	6007012.0	1879185.87503

<sup>1</sup> State Plane Coordinate System, California Zone IV, Feet, North American Datum 1983

\*Coordinates to be collected



Table 5 COASTAL WELLS AND LOCATIONS

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
13S/01E-25R01	PRESSURE 900	1	5742345.5	2174687.00002
13S/02E-15M01	PRUNEDALE	2	5757881.5	2185405.50002
13S/02E-19Q03	PRESSURE 900	3	5746313.5	2179184.50002
13S/02E-20J01	PRESSURE 400	4	5752096.0	2180981.25002
13S/02E-28L02	PRESSURE BOTH	5	5755055.5	2175441.75002
13S/02E-28M02	PRESSURE 400	6	5753447.0	2175997.50002
13S/02E-32J03	PRESSURE 400	7	5752560.0	2170401.75002
13S/02E-33N04	PRESSURE 400	8	5753898.0	2169605.00002
13S/02E-34G01	PRESSURE 400	9	5760129.5	2170052.25002
13S/02E-34M01	PRESSURE 400	10	5757997.5	2169621.75002
14S/01E-13J02	PRESSURE 400	11	5741048.0	2154289.50002
14S/02E-01C01	EASTSIDE DEEP	12	5771477.5	2167454.25002
14S/02E-02A02	EASTSIDE DEEP	13	5768561.0	2167823.50002
14S/02E-02C03	PRESSURE 400	14	5765109.0	2167416.00002
14S/02E-03H01	PRESSURE 400	15	5762283.0	2166255.50002
14S/02E-03M02	PRESSURE 400	16	5758710.5	2164740.50002
14S/02E-03R02	PRESSURE 400	17	5762517.0	2163892.75002
14S/02E-04B01	PRESSURE 400	18	5755909.0	2167499.00002
14S/02E-04G02	PRESSURE 400	19	5756262.0	2166403.75002
14S/02E-04H01	PRESSURE 400	20	5756715.0	2165886.25002
14S/02E-04N03	PRESSURE 400	21	5753365.0	2163112.75002
14S/02E-05C03	PRESSURE 400	22	5748893.5	2167132.50002
14S/02E-05K02	PRESSURE 400	23	5750829.0	2165370.75002
14S/02E-07A01	PRESSURE 400	24	5747142.5	2162655.25002
14S/02E-07J02	PRESSURE 400	25	5746655.0	2159408.25002
14S/02E-07J03	PRESSURE DEEP ZONE	26	5746476.9	2159735.06998
14S/02E-07L04	PRESSURE 400	27	5743780.0	2159328.00002
14S/02E-07L05	PRESSURE 400	28	5743784.5	2160380.50002
14S/02E-08C03	PRESSURE 400	29	5750055.0	2162036.75002
14S/02E-08M02	PRESSURE 400	30	5747103.0	2159672.50002
14S/02E-09D04	PRESSURE 400	31	5753016.5	2162818.75002
14S/02E-09K02	PRESSURE 400	32	5755450.0	2159946.25002
14S/02E-09N02	PRESSURE 400	33	5752897.5	2158609.50002
14S/02E-10E02	PRESSURE 400	34	5758062.0	2160525.75002
14S/02E-10H01	PRESSURE 400	35	5761492.0	2160761.75002



STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
14S/02E-10M02	PRESSURE 400	36	5757853.5	2159387.75002
14S/02E-11B01	PRESSURE 400	37	5766446.0	2162325.25002
14S/02E-11M03	PRESSURE 400	38	5764448.5	2159266.75002
14S/02E-12N02	PRESSURE 180	39	5769893.5	2158219.50002
14S/02E-13F01	PRESSURE 180	40	5769952.5	2154587.75002
14S/02E-13G01	PRESSURE 400	41	5772057.5	2155470.50002
14S/02E-14A01	PRESSURE 400	42	5767367.0	2156210.25002
14S/02E-14L02	PRESSURE 180	43	5764775.5	2155024.75003
14S/02E-14L03	PRESSURE 400	44	5764610.5	2154419.75002
14S/02E-15A01	PRESSURE 400	45	5761774.5	2157015.50002
14S/02E-15C02	PRESSURE 400	46	5759385.5	2157259.00002
14S/02E-15L02	PRESSURE 180	47	5758452.0	2153366.00003
14S/02E-15N01	PRESSURE 400	48	5757522.5	2153353.25002
14S/02E-15P01	PRESSURE 400	49	5758767.5	2153584.50002
14S/02E-16A02	PRESSURE 400	50	5756957.5	2157123.50002
14S/02E-16G01	PRESSURE 400	51	5755957.0	2155999.50002
14S/02E-16H01	PRESSURE 400	52	5756041.0	2156035.25002
14S/02E-17A02	PRESSURE 400	53	5751744.5	2156837.50002
14S/02E-20B03	PRESSURE 900	54	5750210.5	2151407.25003
14S/02E-21E01	PRESSURE 400	55	5753561.0	2150101.50003
14S/02E-21J01	PRESSURE 180	56	5756896.0	2149447.75002
14S/02E-21L01	PRESSURE 180	57	5754605.0	2149175.75002
14S/02E-22B01	PRESSURE 400	58	5760986.0	2152124.75002
14S/02E-22L01	PRESSURE 400	59	5759725.0	2149855.00002
14S/02E-22P02	PRESSURE 180	60	5758952.5	2146937.25002
14S/02E-23M01	PRESSURE 180	61	5762708.0	2149478.75002
14S/02E-24E01	PRESSURE 180	62	5768326.5	2150393.25002
14S/02E-24P02	PRESSURE 400	63	5769670.0	2146858.75002
14S/02E-24Q01	PRESSURE 180	64	5771942.5	2146772.50003
14S/02E-25D04	PRESSURE 180	65	5768019.0	2145519.50003
14S/02E-26J03	PRESSURE 400	66	5766847.5	2143883.00002
14S/02E-26N03	PRESSURE 180	67	5762617.0	2142567.75002
14S/02E-26P01	PRESSURE 180	68	5764519.0	2141615.00003
14S/02E-27C02	PRESSURE 400	69	5759686.0	2145562.00002
14S/02E-27F02	PRESSURE 180	70	5759825.0	2144647.75002
14S/02E-28C01	PRESSURE 400	71	5753983.5	2146953.50002
14S/02E-32D06	PRESSURE 180	72	5746981.0	2141653.75003

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING <sup>1</sup>	FALSE NORTHING <sup>1</sup>
14S/02E-33P01	PRESSURE BOTH	73	5756348.0	2138806.75003
14S/02E-34A04	PRESSURE 180	74	5761465.0	2141623.00002
14S/02E-34B03	PRESSURE 180	75	5759909.5	2141431.00002
14S/02E-36E01	PRESSURE 180	76	5768600.0	2138685.00002
14S/02E-36G01	PRESSURE 400	77	5770039.0	2139297.50002
14S/03E-06L02	EASTSIDE DEEP	78	5775957.0	2164155.50002
14S/03E-07P02	EASTSIDE SHALLOW	79	5775832.0	2157899.00003
14S/03E-18E02	PRESSURE 400	80	5774633.5	2155704.50003
14S/03E-19Q02	PRESSURE 180	81	5776192.0	2146948.50002
14S/03E-30E03	PRESSURE 400	82	5774081.0	2143975.75002
14S/03E-30F01	PRESSURE 180	83	5775609.5	2144673.00002
14S/03E-31B01	PRESSURE 180	84	5776312.0	2140030.50002
15S/02E-12C01	PRESSURE 180	85	5769441.0	2130513.75002

<sup>1</sup> State Plane Coordinate System, California Zone IV, Feet, North American Datum 1983



Table 6 REQUIREMENTS FOR SAMPLE COLLECTION<sup>1</sup>

ANALYTE	CONTAINER TYPE	SAMPLE VOLUME	PRESERVATIVE	HOLDING TIME
Calcium (Ca)	polyethylene (HDPE <sup>2</sup> )	200 mL <sup>3</sup>	HNO <sub>3</sub> pH<2	3 days w/o pres. 6 months w/ pres.
CATION ANION BALANCE <sup>4</sup>	N/A Calculation	N/A Calculation	N/A Calculation	N/A Calculation
Chloride (Cl) <sup>5</sup>	polyethylene (HDPE <sup>1</sup> )	100 mL <sup>2</sup>	4±2°C	28 days
Conductivity (SEC) <sup>5</sup>	polyethylene (HDPE <sup>1</sup> )	100 mL <sup>2</sup>	4±2°C	28 days
Magnesium (Mg)	polyethylene (HDPE <sup>1</sup> )	200 mL <sup>2</sup>	HNO <sub>3</sub> pH<2	3 days w/o pres. 6 months w/ pres.
Nitrate (NO <sub>3</sub> ) <sup>5</sup>	polyethylene (HDPE <sup>1</sup> )	100 mL <sup>2</sup>	none HSO <sub>4</sub> ; pH<2	48 hours at 4° C 28 days
pH (Laboratory)	polyethylene (HDPE <sup>1</sup> )	30 mL <sup>2</sup>	none	48 hours at 4° C
Potassium (K)	polyethylene (HDPE <sup>1</sup> )	200 mL <sup>2</sup>	HNO <sub>3</sub> pH<2	3 days w/o pres. 6 months w/ pres.
Sodium (Na)	polyethylene (HDPE <sup>1</sup> )	200 mL <sup>2</sup>	HNO <sub>3</sub> pH<2	3 days w/o pres. 6 months w/ pres.
Sulfate (SO <sub>4</sub> )	polyethylene (HDPE <sup>1</sup> )	100 mL <sup>2</sup>	4±2°C	28 days
Total Alkalinity (as CaCO <sub>3</sub> )	polyethylene (HDPE <sup>1</sup> )	100 mL <sup>2</sup>	4±2°C	14 days

<sup>1</sup> = CCL QA Manual and SOPs

<sup>2</sup> = High Density Polyethylene

<sup>3</sup> = only one 0.5 gal (~2L) container is needed for all analyses

<sup>4</sup> = Cation anion balance is a calculation

<sup>5</sup> = Analytes in partial mineral panel, one pint (~500 mL) container is need for analyses

Monterey County Water Resources Agency  
EPA R9#03-238  
X-97994701-0  
2 August, 2007

## APPENDICES

## **APPENDIX A**

### **GLOBAL POSITIONING SYSTEM (GPS) TRAINING**

**Appendix A-1: GPS Training Record**

**Appendix A-2: TSC1 Asset Surveyor Manual**

**Appendix A-3: Pro XR/XRS Receiver Manual**

## Geographic Positioning System (GPS) Training Record

Name of Trainee
Name of Trainer
Date of Training

	Satisfactory Completion / Understanding
Verification of access to Pathfinder Office software	
Preparation of data dictionary	
Set-up of equipment	
Trimble® TSC1 Asset Surveyor <sup>1</sup>	
Trimble® Pro XR Receiver <sup>1</sup>	
Connector cables	
Batteries (Asset Surveyor and Receiver)	
Confirmation of communication between Asset Surveyor and Receiver	
Acquiring satellites	
Setting up and checking critical settings	
-logging intervals	
-PDOP mask <sup>2</sup>	
Proper packing and unpacking of equipment	
Transferring data files from Asset Surveyor to the computer	

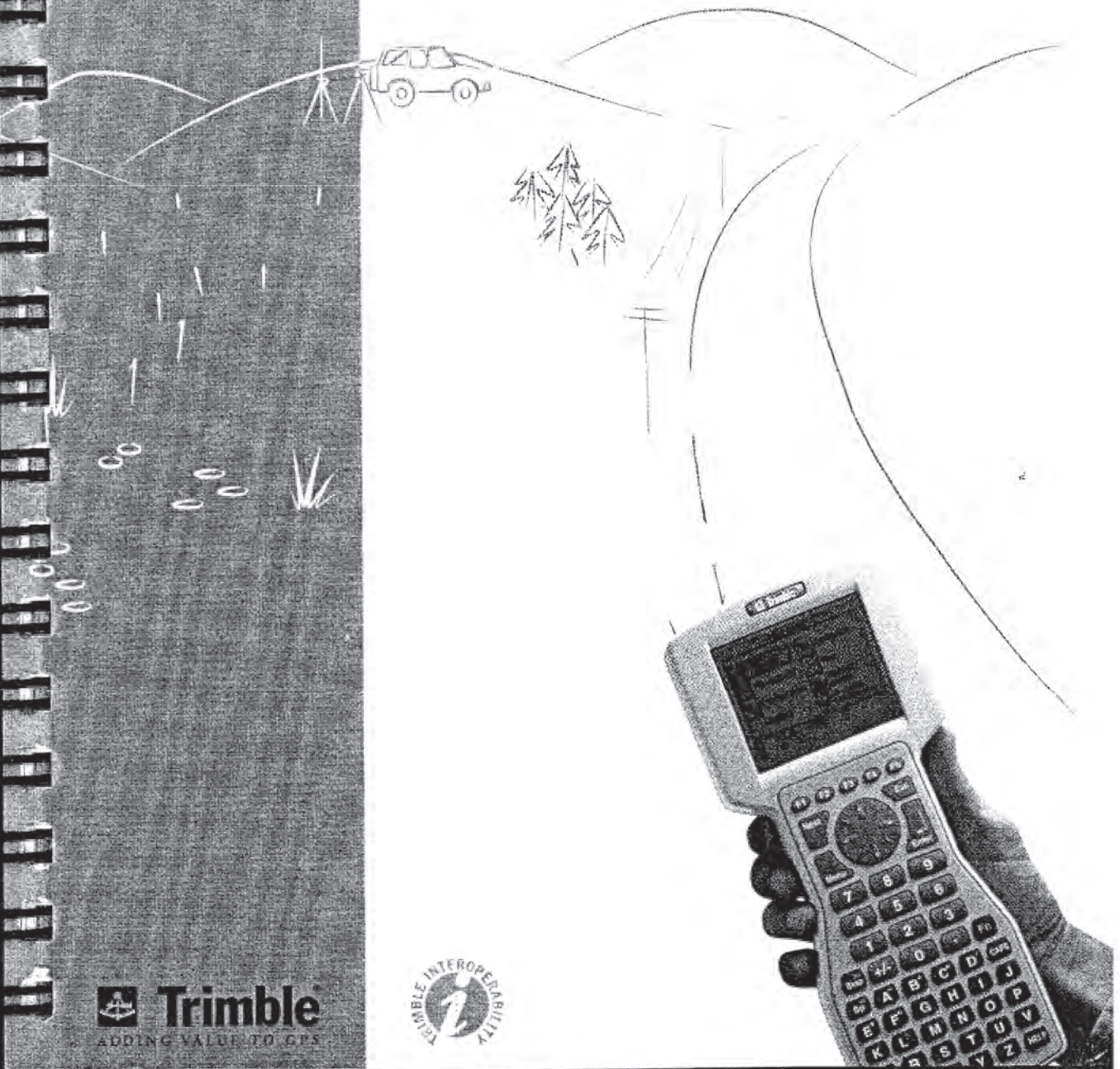
<sup>1</sup> The Agency uses Trimble® products, the GPS industry standard.

<sup>2</sup> PDOP = Position Dilution Of Precision



# TSC1 Asset Surveyor

## Operation Manual



**Trimble**

ADDING VALUE TO GPS





# TSC1 Asset Surveyor

## *Operation Manual*

Part Number 34182-05-ENG

Version 5.00

October 1999

Revision A

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# 1 Quick Setup

---

The instructions in this chapter are a simplified version of the various steps found in Chapters 4, 5, and 6 of this manual. The purpose of the simplified version is to provide quick setup guides with reasonable default values that can be distributed to field crews to ensure proper setup of rover or base station receivers.

Data is logged to the TSC1 with the Asset Surveyor software. For full details on configuration and data collection, refer to the *TSC1 Asset Surveyor Software User Guide*.



---

**Note** – The steps outlined in this chapter do not include steps required to collect data using carrier phase information. For instructions on how to collect high accuracy features, see Chapter 7, Carrier Phase Data Collection.

---

## 1.1 Before Leaving the Office

1. Install the Pathfinder Office software on your office computer (refer to the *Pathfinder Office Getting Started Guide*).
2. Using the Pathfinder Office software, prepare any data files or data dictionaries you require, and transfer them to the TSC1. If you want to update GPS or attribute information on features stored in a GIS, import the data files and data dictionary into Pathfinder Office and then transfer them to the TSC1. You may also want to transfer any waypoint and coordinate system files to the datalogger.





3. Check that you have all the required equipment, and that it is operational. Set up and connect your GPS system (the appendix for your GPS receiver lists the equipment and shows you how to connect it).
4. If the GPS receiver has an On/Off switch, turn it on (the Series 4000, GPS Total Station 4700, GPS Total Station 4800, Site Surveyor 4400 and 4600LS receivers have an On/Off switch).

Start the Asset Surveyor software to check that it and the GPS receiver are communicating correctly. If communication is established, the GPS status line appears. If communication fails, an error message pops up on the screen.

5. Check all critical settings in the Asset Surveyor software.

You should also check non-critical and display settings, especially if the system has been used by someone else recently. For details of how to configure Asset Surveyor, refer to the *TSC1 Asset Surveyor Software User Guide*.

6. Turn everything off and pack it into carrying cases if you have to travel a significant distance to the survey site. Pack spare sets of batteries if you expect to operate the receiver for any length of time.

## 1.2 In the Field

1. Travel to the survey site, remembering to carry all the required equipment with you.
2. Reassemble the system.
3. If the GPS receiver has an On/Off switch, turn it on. Then start the Asset Surveyor software, if it is not already on.



Wait until the GPS receiver acquires enough satellites to start computing GPS positions, before beginning to work. The number of satellites being tracked displays on the status line.

You should now change some of the configuration settings as follows:


**Main menu**

- |                         |  |
|-------------------------|--|
| 1. <i>Configuration</i> | Highlight <i>Configuration</i><br>then press the  key |
|-------------------------|--|


**Configuration menu**

- |                             |   |
|-----------------------------|---|
| 2. <i>GPS rover options</i> | Press  |
| 3. <i>Logging options</i>   | Press  |

**Logging options screen**

- |                             |   |
|-----------------------------|---|
| 4. <i>Point feature</i>     | Synchronized with the base station  |
| 5. <i>Line/area</i>         | Synchronized with the base station  |
| 6. <i>Not in feature</i>    | Synchronized with the base station  |
| 7. <i>Minimum positions</i> | 3   |
| 8. <i>Allow GPS update</i>  | 'Warn first'  |
| 9. <i>Warning distance</i>  | 'Any'   |
| 10. To accept               | Press  |

**Position filters screen**

- |                          |   |
|--------------------------|---|
| 11. <i>Position mode</i> | 'Manual 3D' or 'Overdet. 3D'<br>depending on canopy density                                 |
| 12. <i>PDOP mask</i>     | 4 or 6 (depending on receiver)  |
| 13. To accept            | Press  |



4. Create a new data file, associating the correct data dictionary with it. Alternatively, re-open an existing data file.
5. Begin collecting data. Collect, review and update all the features necessary.
6. Close the data file.
7. Disconnect and repack the components of the system. Remember to turn off the GPS receiver, if it has an On/Off switch. Return to your office.

### 1.3 Back in the Office

1. Transfer the data files from the TSC1 to the PC using the Pathfinder Office software.
2. Use the Pathfinder Office software for differential correction, plotting, and exporting the data file(s) to a GIS.
3. Recharge the TSC1 datalogger and GPS receiver batteries.


### 1.4 Rover Configuration

Use the following procedure to set up your system in a rover configuration.


From the *Utilities* menu, select *Factory defaults*. This resets the Asset Surveyor software to its default configuration and then restarts the datalogger.





**Antenna options screen**

- 14. *Height* Height to antenna's phase center
- 15. *Measure* 'Vertical'
- 16. *Type* For a list of antenna types, see the *TSC1 Asset Surveyor Software User Guide*
- 17. *Confirm* Select 'Per feature', 'Per file', or 'Never'
- 18. To accept Press 



**GPS rover options menu**

- 19. To return to the *Configuration* menu Press 


**Configuration menu**

- 20. *Communication options* Press 
- 21. *Real-time input options* Press 

**Real-time input options screen**

- 22. RTCM age limit 5 or 10 (depending on your radio)
- 23. To accept Press 
- 24. To return to the *Configuration* menu Press 

**Configuration menu**

- 25. To exit the *Configuration* menu Press 







### 1.4.1 Data Collection

Use the following procedure to set up your system for rover data collection.

#### Main menu

1. Select *Data collection* and press 

#### Data collection menu

2. Create a data file  
Select *Create new file*:  
Press  and then press   
-or-  
Open an existing data file  
Select *Open existing file*.  
Press   
Select an existing file to append to or update, and press 
3. To exit *Data collection* Press  and press  to confirm exit



## 1.5 Base Station Configuration

Use the following procedure to set up your system in a base station configuration.

#### Main menu



1. *Configuration* Highlight *Configuration* then press the  key

#### Configuration menu


2. *GPS base station options* Press 
3. *Logging options* Press 



**Logging options screen**

- |   |   |
|---|---|
| 4. <i>Measurements</i>                        | One to five seconds (depending on rover interval and free space)                          |
| 5. To accept                                  | Press  |
| 6. To return to the <i>Configuration</i> menu | Press  |

**Configuration menu**

- |  |   |
|--|---|
| 7. To exit the <i>Configuration</i> menu | Press  |
|--|---|

### 1.5.1 Base Station Data Collection

Use the following procedure to set up your system for base station data collection.

#### **Main menu**

1. *Data collection* Press 


#### **Data collection menu**

2. *Create base file* Press 

#### **Create File screen**







3. *Create file* Press 

#### **Antenna options screen**



4. *Height* Height to antenna's phase center
5. *Measure* 'Vertical'
6. *Type* For a list of antenna types, see the *TSC1 Asset Surveyor Software User Guide*
7. *To accept* Press 



**Reference Position screen**

8. Enter reference position Type lat/lon (or north/east) and altitude, and press 
- OR-
- Use an existing waypoint Press , select the waypoint and press 
- OR-
- Use an approximate position Press  and press 
- OR-
- Leave as is and set in the Pathfinder Office software Press 

**Base Station screen**

9. To exit *Base station* Press  and press  to confirm exit.



## Key Symbols



The Asset Surveyor software uses both *hard* (that is, physical) keys on a keypad and *soft* (that is, visual) keys on the datalogger's screen.

Hard (physical) keys on the TSC1 keypad are indicated as follows:

, , , and so on.

Softkeys on the TSC1 screen are indicated as follows:

, , , and so on.

A softkey is activated by pressing the corresponding function key (...) on the TSC1 keypad.

## Warnings, Cautions, Notes, and Tips

Warnings, cautions, notes, and tips draw attention to important information, and indicate its nature and purpose.



---

**Warning** – Warnings alert you to situations that could cause personal injury or unrecoverable data loss.

---



---

**Caution** – Cautions alert you to situations that could cause hardware damage or software error.

---



---

**Note** – Notes give additional significant information about the subject to increase your knowledge, or guide your actions.

---



---

**Tip** – Tips indicate a shortcut or other time- or labor-saving hint that can help you make better use of the product.

---

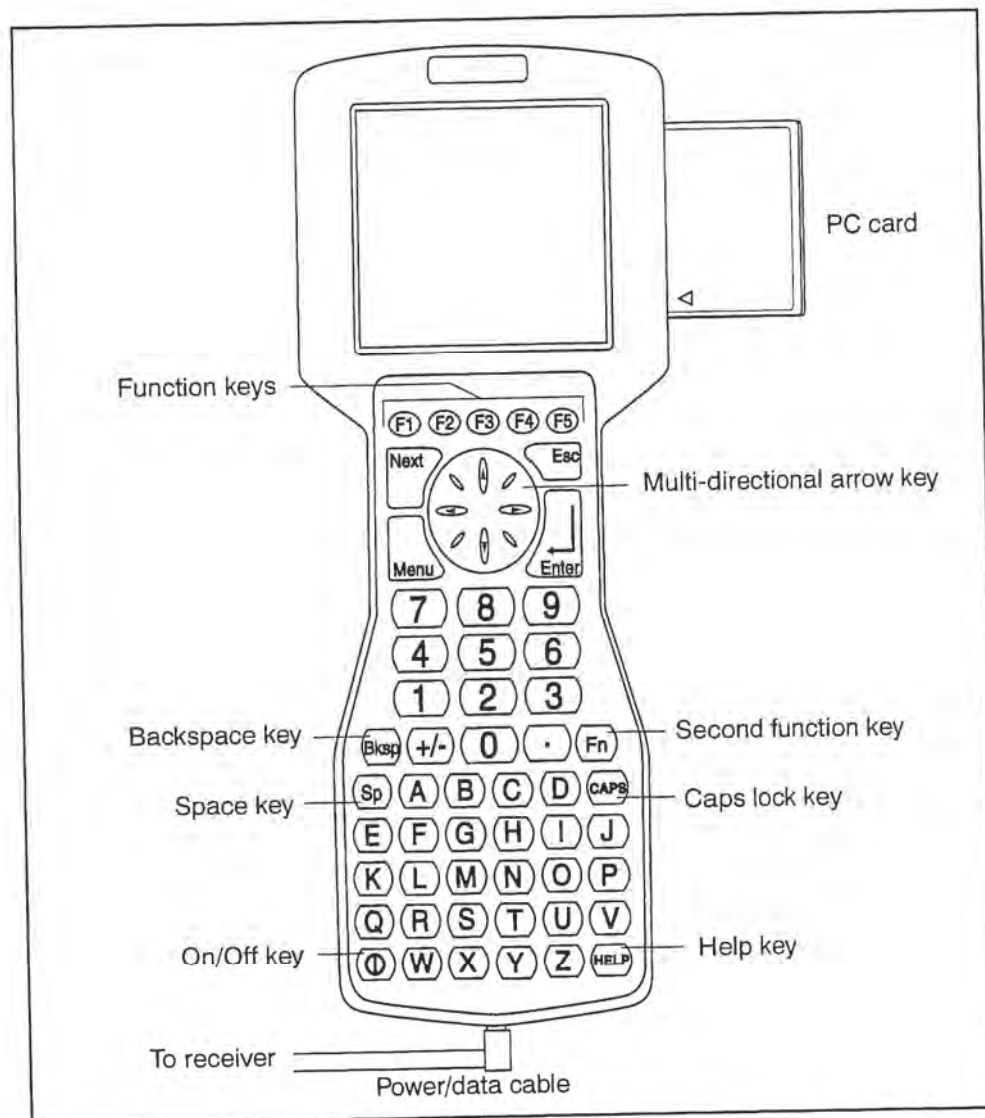
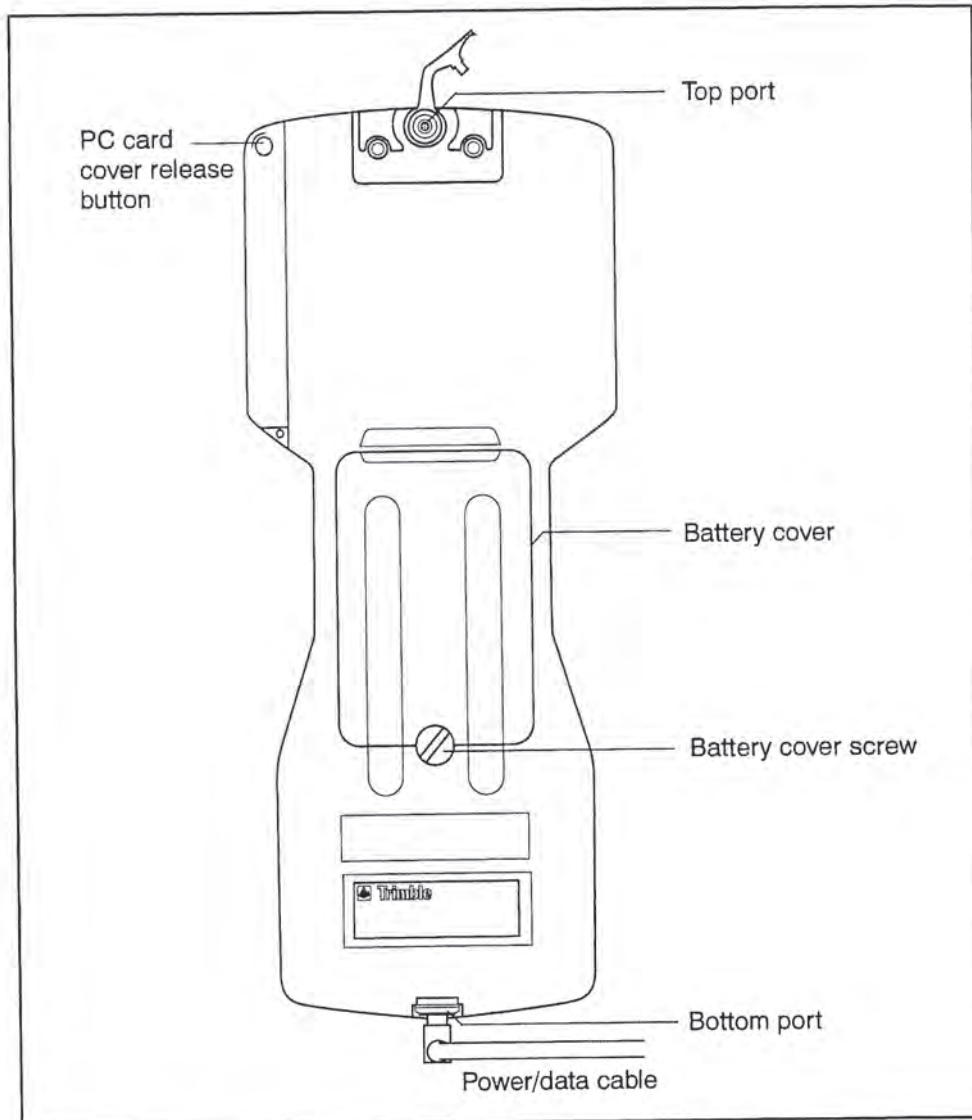



Figure 3-1 Front View of the TSC1 Datalogger







**Figure 3-2 Back View of the TSC1 Datalogger**

## 3.2 Turning the TSC1 Datalogger On and Off







To turn on the TSC1 datalogger, make sure that power is supplied (see Power Sources, page 3-11). Then press the green on/off key marked .

To turn off the TSC1, hold down  for one second.



**Tip** – For the location of the  key and other keys on the TSC1 datalogger's keypad, refer to Figure 3-1.

### 3.2.1 Hard Keys

Hard keys are the physical keys on the TSC1 keypad, such as , , , , , and . Use these keys to enter data and to access different screens.

### 3.2.2 Alternate Keys
















Alternate keys give some hard keys a second function. Some of the second functions are displayed on the hard keys in small yellow lettering. To use a second function, press the  hard key and then press the alternate hard key.


Table 3-1 shows some of the functions that you can access using alternate keys.

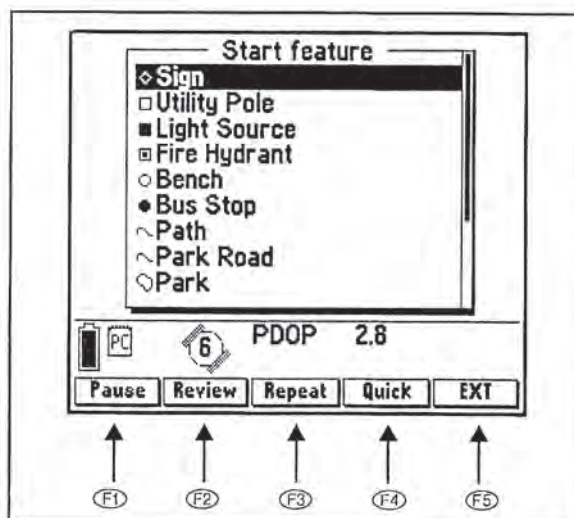
**Table 3-1 Useful Second Functions**

Keys	Function
 	Page down
 	Page up
 	Home
 	End
 	Previous screen
 	Contrast up
 	Contrast down




### 3.2.3 Softkeys



Softkeys are displayed on the bottom line of the TSC1 screen. A softkey corresponds to the adjacent hard key: (F1), (F2), (F3), (F4), (F5). Press the hard key to activate the softkey on the screen. To activate the  softkey, for example, press (F1). See Figure 3-3.



**Figure 3-3 How Function Keys Correspond to Softkeys**


Softkeys relate to particular forms or fields and only appear when these forms or fields are accessed. For example, the  softkey only appears when a line feature is opened for data collection, as this functionality applies to line features only.

### 3.2.4 Menu Key



To return to the *Main menu* at any time, press the  hard key. Use this key in conjunction with the  key to move around the Asset Surveyor screens quickly.



### 3.2.5 Next Key

To simplify the task of moving around menus, the  hard key offers quick access to open screens (windows).

### 3.2.6 Help Key

Press the  hard key at any time to obtain further information about a topic. When you press it, the *Help* menu appears. To exit *Help*, press  from the *Help* menu.

## 3.3 Screen

The TSC1 has an LCD screen. This screen responds to heat, and prolonged exposure to full sunlight can cause it to darken. If the screen does darken, turn it away from direct sunlight until it returns to normal.







---

**Caution** – Repeated exposure to direct sunlight can cause the screen to degrade.



---

### 3.3.1 Contrast

To increase the screen contrast, press  .

To decrease the screen contrast, press  .

### 3.3.2 Backlight

To toggle the screen backlight on and off, press  .



# Pro XR/XRS

## Receiver Manual



 **Trimble**



# Pro XR/XRS

## *Receiver Manual*

Part Number 31172-20-ENG

Revision A

May 1998

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## 4 Pro XR/XRS System Equipment

---

This chapter provides details of the equipment associated with the Pro XR and Pro XRS receivers and shows how to assemble the equipment.

### 4.1 Pro XR Receiver Front Panel

The Pro XR receiver, shown in Figure 4-1, is mounted in a weatherproof housing.

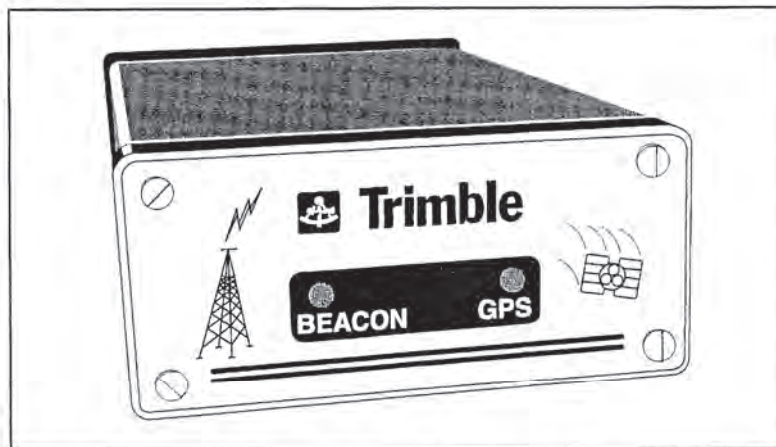


Figure 4-1 Pro XR Receiver Front Panel



### 4.2.1 Pro XR Status Lights

The two status lights on the front panel of the Pro XR receiver provide the status information listed in Table 4-1.

**Table 4-1 Pro XR Status Lights**

	GPS	Beacon
<b>OFF</b>	Unit not powered up	Unit not powered up or beacon function is disabled
<b>FAST FLASH</b>	Searching for satellites	Searching for MSK signals
<b>SLOW FLASH</b>	Found one or more satellites. Not enough for a position fix.	Found MSK signal. RTCM data has not been sent to GPS receiver.
<b>ON</b>	Performing position fixes	Good RTCM data is being provided to the GPS receiver



## 4.3 Back Panel

The Pro XR and Pro XRS receivers have two serial communications ports (RS232) and an antenna cable port. The serial communications ports, shown in Figure 4-3, are 12-pin(m) bulkhead connectors located on the back panel of the Pro XR and Pro XRS receivers.

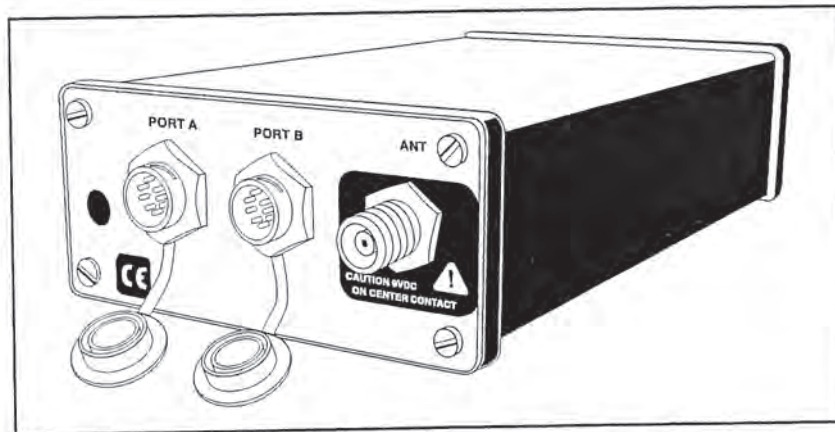


Figure 4-3 Pro XR/XRS Receiver Back Panel

### 4.3.1 Port A

Port A offers RS232 communication standards. It is designed for NMEA-0183 output and RTCM input.

### 4.3.2 Port B

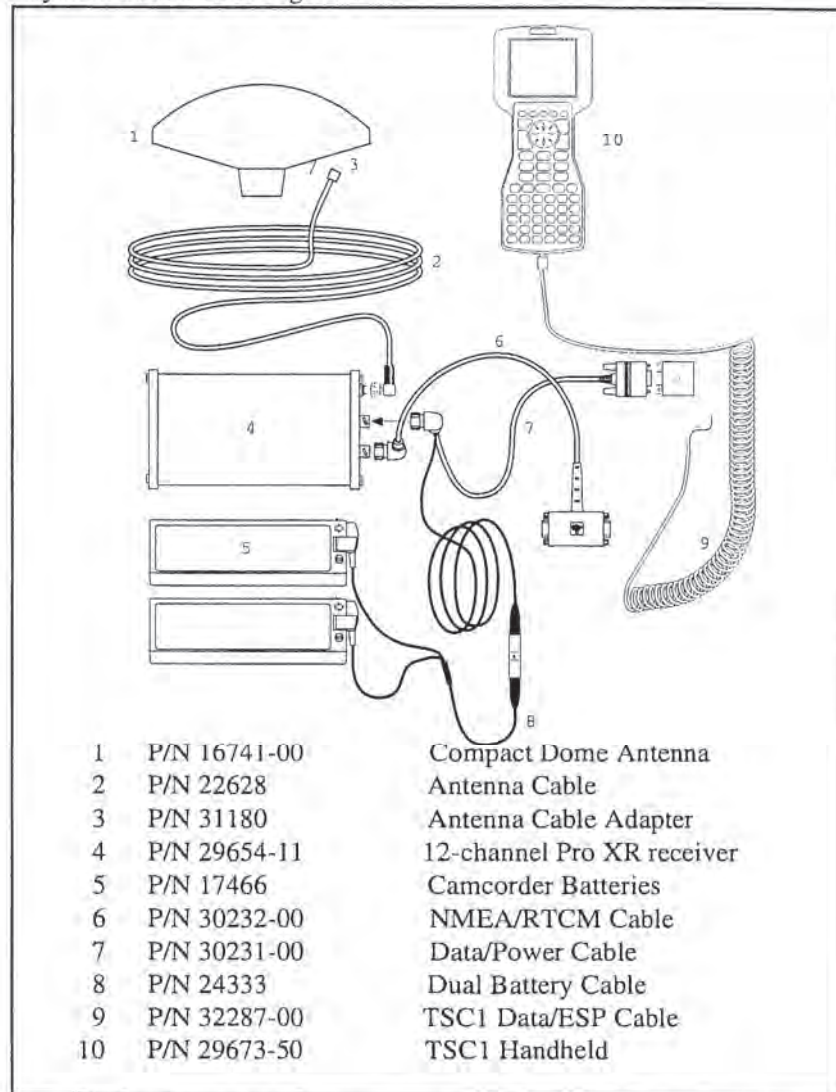
Port B also offers RS232 communication standards. It is designed for two-way data flow, external sensor input and power.

### 4.3.3 Antenna Port

The antenna connector is a TNC(f) connector located on the far right on the back panel of the Pro XR or Pro XRS receiver.

#### 4.4 GPS Pro XR Cabling

To use the TSC1 handheld with a GPS Pro XR receiver, connect the system as shown in Figure 4-4.



**Figure 4-4 GPS Pro XR / TSC1 Connection Diagram**

## 4.7 Pro XR/XRS System Hip Pack

The Pro XR and Pro XRS systems come equipped with an ergonomic hip pack carrying system, see Figure 4-18. The receiver, batteries and antenna are carried in the field using this hip pack/strapping system.

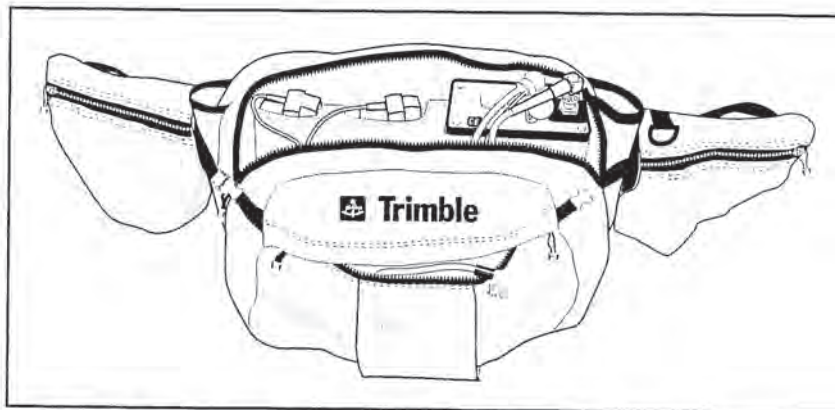


Figure 4-18 Pro XR/XRS System Hip Pack

### 4.7.1 Pro XR/XRS Hip Pack Contents

The Pro XR and Pro XRS systems are packed so that they are almost ready for use. The items not included in the hip pack are three 1-foot antenna poles, one 6-inch antenna pole and the data collector cable (P/N 30233-00 for TDC1, P/N 30234 for TDC2, or P/N 30236 for Field Computer/MC-V). These are located inside the shipping case.

The large interior of the hip pack contains: the Pro XR or Pro XRS receiver, two camcorder batteries, the power/data cable, and the camcorder power cable. All of these are set up inside the pack and ready for use. The exterior pocket of the hip pack contains a 3-meter antenna cable attached to the receiver and routed through a passage between the large interior pocket and exterior pocket. Both the data collector cable and antenna are routed out of the exterior pocket through the double zipper.



To route the data collector cable:

1. Locate the data collector cable and connect it to the data power cable, DE-9 connector labeled TO RECEIVER.
2. Once connected, feed the coiled cable through the passage and into the exterior pocket.

#### 4.7.2 Wearing and Adjusting the Hip Pack

The Pro XR/XRS hip pack, once adjusted to suit, is comfortable and easy to use. See Figure 4-19.

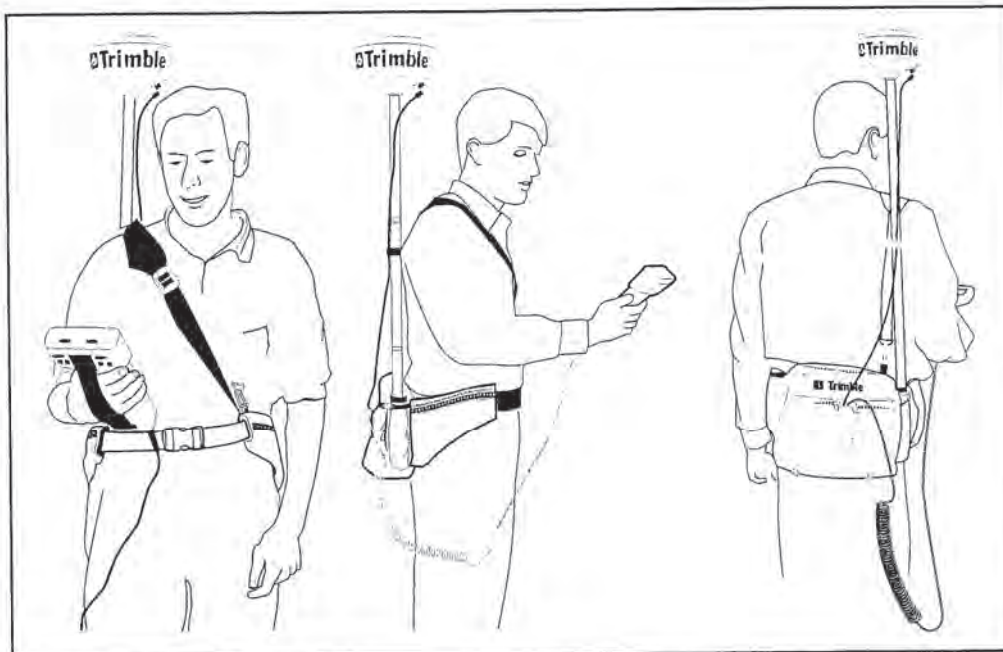


Figure 4-19 View of Hip Pack Setup

### Antenna

When wearing the hip pack, the antenna height should be 3-4 inches above your head. The number of antenna pole sections required varies depending on your height. For example, if you are 5'5" tall, you may need two 1-foot and one 6-inch pole sections. If you are 6'2" tall, you may need three 1-foot poles. Try out different pole heights.

To set up the antenna with the hip pack:

1. Attach the pole sections together and connect the antenna onto the top of the pole sections.
2. Attach the pole/antenna to the hip pack.
3. Choose the side of your body that you prefer the antenna to be on and slide the pole sections into the small sleeve on that side of the hip pack.

### Hip Pack and Strap

To adjust the hip pack and strap:

1. Connect the strap to the rear D-ring on the side of the pack on which the antenna is located.
2. Connect the other end of the strap to the D-ring on the belt on the opposite of the bag.
3. Slide the antenna pole through the velcro connection on the strap.
4. Put the strap over your head and across your opposite shoulder.

At this point, the shoulder strap should lead naturally from the antenna pole across your chest to the belt.

5. Buckle the hip pack around your waist/hip area so that the belt buckle is centered in the middle of your body.

The pack should adjust to fit close to the small of your back.



6. Adjust the front and back straps so the shoulder strap is situated squarely on your shoulder.
7. Put the pack on by slipping the strap over your head and across your body and then buckling the belt of the hip pack.

The hip pack includes side compression straps that can be pulled towards you to hold the pack firmly and comfortably against your back.

Remove the hip pack/strap by unbuckling the belt and slipping the strap over your head.

The hip pack and strap can also double as a shoulder bag. Tuck the belt portion of the pack into the webbing material on the back of the pack and hook the strap on the large D-rings of the pack. The unit can now be carried on your shoulder instead of around your waist.

The pack has extra room in the interior and exterior pockets for additional items you may need in the field. The hip pack also includes straps on the bottom of the pack to secure an extra sweater or coat while in the field.

## 4.8 Optional Range Poles and Tripods

Range poles and tripods are very useful when collecting carrier phase data. The height of the antenna can be accurately measured, and the antenna can be held still easily, compared to an antenna mounted from the hip pack.

## **APPENDIX B**

### **FIELD DOCUMENTATION**

**Appendix B-1: Example of Field Sheet**

**Appendix B-2: Example of Chain of Custody Form (COC)**

**Appendix B-3: Example of Photo-Log**

**Appendix B-4: Example of Sample Labels**

# MONTEREY COUNTY WATER RESOURCES AGENCY - COASTAL GROUND WATER MONITORING PROGRAM June 2007

F CODE	SWID	STATUS	AQUIFER	USE	WELL NAME	METER No	PLANT No	SAMPLE PT	VISIT DATE	APPT. DATE	SAMPLE DATE	SAMPLE TIME	SMPLER	REMARKS
886	14S/02E-24E01	ACTIVE	P400	AG	R3P1	4571R8	92205	DL						D'Arrigo Bros. R5P1. Tag #1164. Well is at corner of San Jon Rd and Hwy 183. Go twice then call Ed Mora 206-9164 or Jesse Aragon 909-9073. See photo
331	14S/02E-16E01	ACTIVE	P180	AG	BARDIN 12	0R1749	92428	Faucet on booster						T & A Bardin #12. Tag #1037. Well on Hitchcock Rd. off Blanco St. Go twice, then call Dennis. See photo
673	14S/02E-13E01	ACTIVE	P180	AG	SAN JON B	R39873	95522	DL						See Mist San Jon well B. Tag #1186. Call Chris. Three day notice. See photo
975	14S/02E-12N02	CSIP-SBI	P180	AG		92593R	91785	DL						Schneider Domestic well. Tag #2960. Run for 30 min. to stabilize conductivity. EC = 2920 (Jul '04). Call Tim Schneider 449-0874. Two week notice. Take EC meter, a bucket and last years results. See photo
1055	14S/02E-15A01	CSIP-SUPP	P400	AG	15A01	R69587	94951	DL			6/12/2007	9 05 00 AM		CSIP-SUPP Well 15A1. PCA site #17. Go twice, then call Bill or Jesse. See photo
1324	14S/02E-15C02	CSIP-SUPP	P400	AG	15C02	42542R		DL			6/12/2007	8:55:00 AM		CSIP-SUPP Well 15C2. Tag #2838. PCA site #19. Go twice, then call Bill or Jesse. See photo
861	14S/02E-15P01	CSIP-SBA	P400	AG	MORO COJO #1 (YARD)	31535R	95209	DL						Higashi Farms. Moro Cojo #1. By house and shed. Call Peter. 2 day notice. See photo
279	14S/02E-16H01	CSIP-SBA	P400	AG	CONLEY	91R418		DL						Higashi Farms. Connelly Ranch well. Tag #2856. Call Peter Ouellet 57926 or Charlie 578-7416. See photo. INACTIVE
2779	14S/02E-21E01	ABAN	P400	AG	MARINA-ARMSTRONG WELL	02384R		DL						Armstrong, Marina-Armstrong well. Tag #2062. SW of MRWPCA, sample from ball valve on pressure/flow control valve. Jack Armstrong 455-1901. See photo. INACTIVE
766	14S/02E-22P02	ACTIVE	P180	AG	VIERRA #1	1843T	95485	truck fill valve						Crown Packing. Vierra #1. Tag #1095. Call Bill or Jose. Two day notice. See photo
859	14S/02E-15N01	CSIP-SBA	P400	AG	MORO COJO #2	3538R4	95037	DL						Higashi Farms. Moro Cojo #2. Big yellow truck-fill. Call Peter. 2 day notice. See photo
1282	14S/02E-24P02	ACTIVE	P400	AG	BORONDA SCHOOLHOUSE #1	93258T		DL						Crown Packing. Boronda Schoolhouse well. Tag #1099. Call Bill Sullivan 214-4650 or Jose Luis Lepe 970-6889. Well next to house/metal shed on McFadden Road, close to elem. school. Two day notice. See photo
22929	14S/02E-28H04	ACTIVE	PDEEP	AG	JACKS YARD									New Deep aquifer well located 54 mi W of Cooper Rd & 27 mi S of McFadden Rd on the Nissen Rd



MONTEREY COUNTY CONSOLIDATED CHEMISTRY LABORATORY  
1270 NATIVIDAD ROAD, SALINAS, CALIFORNIA 93906 Phone (831) 755-4516

### Chain of Custody:

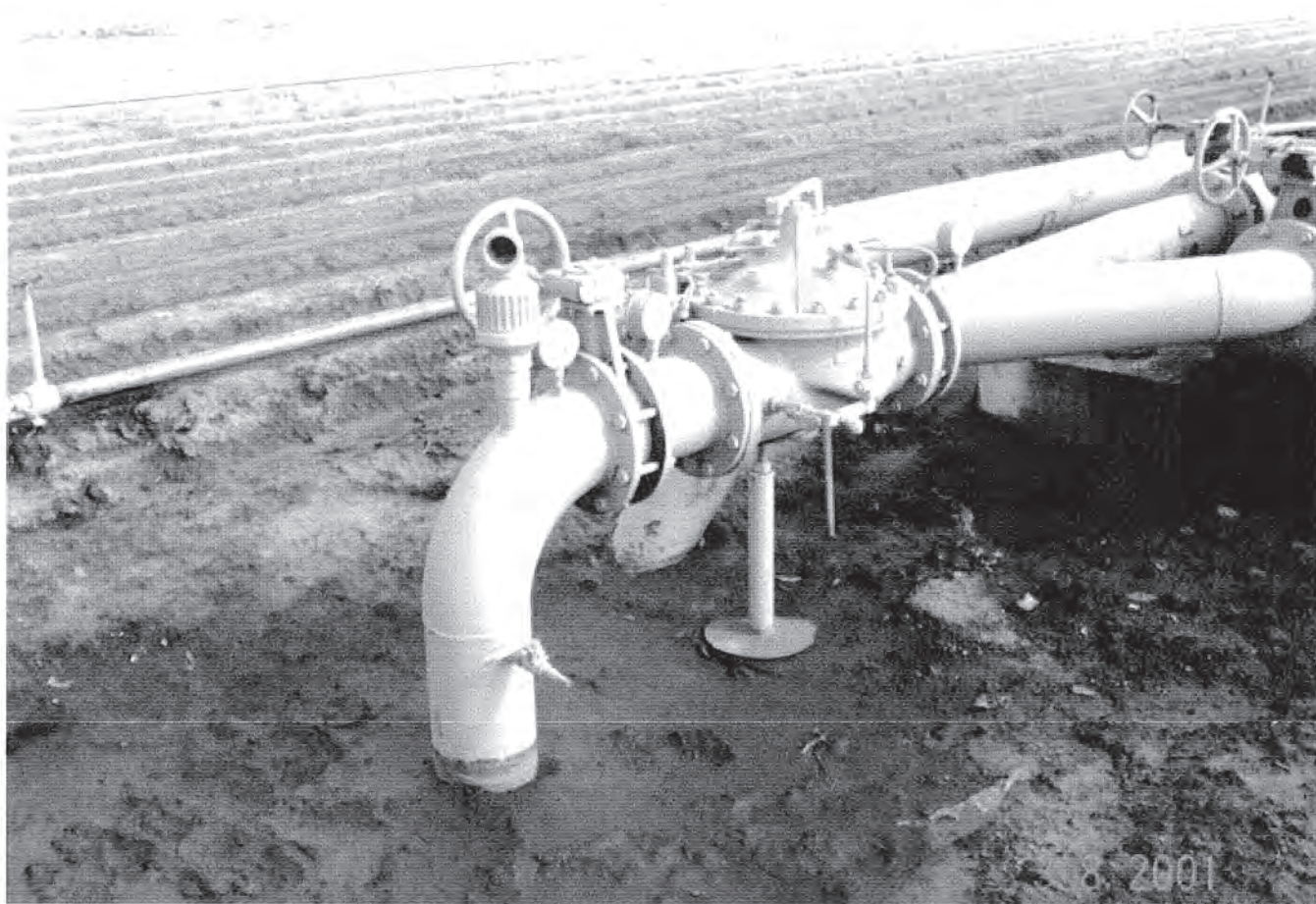
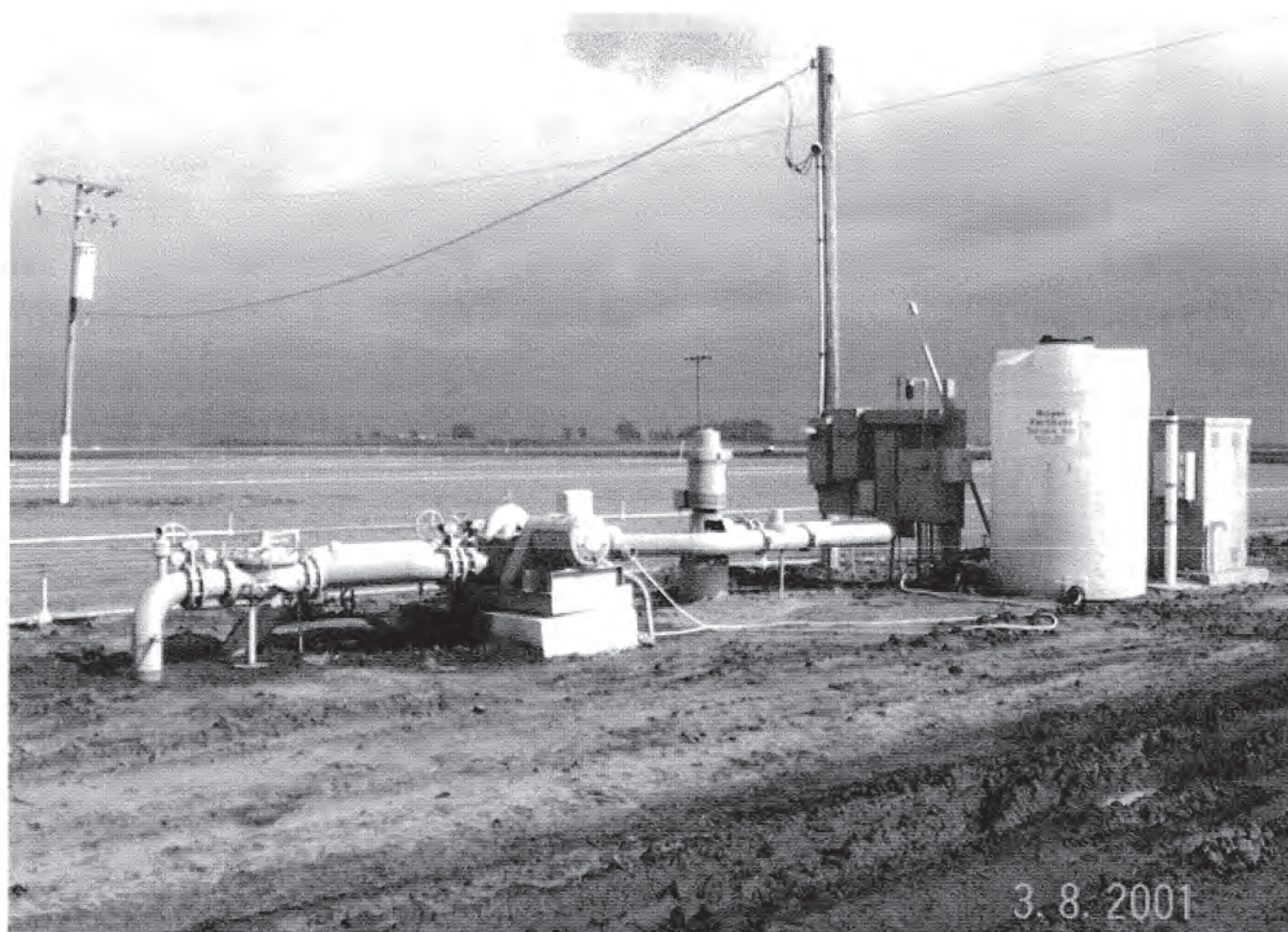
Collected by (Print & sign):	Received by:	Date & Time:
Relinquished by:	Received for Laboratory:	Date & Time:

[illegible]

(1) **D=**Drinking Water (Specify as routine, repeat or replacement)      **W=**Wastewater (Specify as grab or composite)      **O=**Other (identify)

<input type="checkbox"/> Payment received with delivery	Amount: _____	Sample comments (irregularities/preservation, billing information if different than reporting):  
	Check: _____	
	Initials: _____	
	Date: _____	
Receipt #:		







15S/04E-07A01

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

15S/04E-08M04

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

15S/04E-15D02

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

15S/04E-17P02

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

15S/04E-19H03

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

15S/04E-20B02

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

15S/04E-26G01

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

15S/04E-36H01

Sampling Date:

Sampler:

Sampling Time:

Comments:

Complete General Mineral Analyses

## **APPENDIX C**

### **REVIEW CHECKLISTS**

**Appendix C-1: Field Activities Review Checklist**

**Appendix C-2: Laboratory Data Review Checklist**

## Field Activities Review Checklist

Sampling Location(s): \_\_\_\_\_

Sampling Date: \_\_\_\_\_

Item	Yes	No	NA	Comment
All required information was entered into field sheets in ink, and sheets were signed and dated by the field sampler.				
Deviations from SOPs, along with any pertinent verbal approval authorizations and dates, were documented on the field sheets.				
Samples were collected at the correct sites.				
The correct number of samples for each type of analysis and the correct volume was collected (0.5 gal/ ~2L for complete mineral panel OR one pint/ ~0.5L for partial mineral panel).				
Acceptable sample containers, appropriate for the intended analysis, were used.				
Field blanks were collected, and at the correct frequency (one every 25 samples).				
Field duplicates were collected, and at the correct frequency (one every 25 samples).				
Samples were packed with double-bagged ice and transported at the proper temperature ( $4\pm 2^{\circ}\text{C}$ ).				
Chain of custody (COC) documents were completed properly.				
Sample holding times were not exceeded during field operations. See Table 6 (QAPP).				

Reviewer's Name (print): \_\_\_\_\_

Reviewer's Signature: \_\_\_\_\_

Reviewer's Title: \_\_\_\_\_

Date of Review: \_\_\_\_\_

## Laboratory Data Review Checklist

Sampling Location(s): \_\_\_\_\_

Sampling Date: \_\_\_\_\_

Item	Yes	No	NA	Comment
Samples arrived at the laboratory at the proper temperature ( $4\pm 2^{\circ}\text{C}$ ).				
All requested analyses were performed and were documented in the analytical report.				
Analyses were performed according to the methods specified in the approved QA Project Plan.				
Holding times for extraction and analysis were not exceeded. See Table 6 (QAPP).				
Field Blanks results were below MDLs and were analyzed at a frequency of one every 25 samples.				
Field Duplicate results were $\leq 25\%$ RPD and were analyzed at a frequency of one every 25 samples.				
Method detection limits were included in the report.				
A narrative summarizing the analyses and describing any analysis problems was included in the data report.				
Data qualifiers and flags were explained in the data report.				
Initial calibration data were within laboratory SOP defined acceptance criteria ( $r^2 \geq 0.995$ ) for all analyses.				
Method blanks were performed at 3 per analytical batch, and were below MDL.				
Laboratory Control Sample (LCS) data were included for all analyses for every analytical batch.				
Laboratory Control Sample Results were within 80-120% recovery.				



Item	Yes	No	NA	Comment
Analytical Duplicate data were included for all analyses for every analytical batch.				
Analytical Duplicate results were < 25% RPD.				
Matrix spike data were included for all pertinent analyses for every analytical batch, and recoveries were within 75-125%.				
Matrix spike additions were at 3-10x the native.				
Matrix spike duplicates were ≤ 25% RPD.				
Continuing calibration data were within QAPP defined acceptance criteria (80-120% of initial slope) for all analyses.				

Reviewer's Name (print):

Reviewer's Signature:

Reviewer's Title:

Date of Review:



## **APPENDIX D**

### **MONTEREY COUNTY CONSOLIDATED CHEMISTRY LABORATORY**

#### **QA MANUAL AND STANDARD OPERATING PROCEDURES**

**Appendix D-1: QA Manual**

**Appendix D-2: Specific Conductance, based on SM 2510 B**

**Appendix D-3: pH, based on SM 4500-H B**

**Appendix D-4: Total Alkalinity, based on SM 2320 B**

**Appendix D-5: Metals, based on SM 3111 B**

**Appendix D-6: Anions, based on EPA 300.0**

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## ORGANIZATION AND RESPONSIBILITY

On October 11, 1988, the Monterey County Board of Supervisors, in Resolution No. 88-508, authorized the Director of the County Health Department and the General Manager of Monterey County Flood Control and Water Conservation District (MCFC&WCD) to consolidate laboratory services for their respective programs into one facility. A Laboratory Steering Committee, comprised of representatives from both agencies, was established for the purpose of providing the planning, operation, and future development of the Consolidated Environmental Laboratory.

Each year the Steering Committee develops a Memorandum of Agreement (MOA) that describes and confirms the services to be provided by the Health Department to the Water Resources Agency (formerly the Flood Control and Water Conservation District) and defines the responsibilities of each party. In addition to providing laboratory support for the Health Department and the Water Resources Agency, the Consolidated Chemistry Laboratory provides analytical services to the Monterey Regional Water Pollution Control District, the County Department of Public Works and numerous water supply systems and wastewater treatment facilities.

The Consolidated Environmental Laboratory is accredited by the State Department of to perform tests in the following fields: 1) microbiology of drinking water and waste water; 2) inorganic chemistry and physical properties of drinking water; 3) analysis of toxic chemical elements in drinking water; 4) wastewater inorganic chemistry, nutrients and demand; and 5) toxic chemical elements in wastewater. A list of analyses and methods used in the laboratory is included in Appendix A.

The following is a brief description of the staff support for the Consolidated Chemistry Laboratory:

1. Director - Plans, organizes and controls laboratory operations. Coordinates laboratory interactions with other programs in the Health Department. Administers laboratory budget, billing and purchasing. Develops laboratory policy and procedures and supervises staff.
2. Public Health Chemist – Principal analyst. Performs complex organic and inorganic chemical analysis, evaluates and implements laboratory methods, develops and maintains quality assurance, reports results and maintains records, purchases equipment and supplies, provides technical consultation to Environmental Health and Water Resources Agency. Trains analysts and documents competency
3. Water Quality Specialist- Performs broad range of professional scientific work related to water quality and environmental issues; is proficient in



performing water quality analyses and managing the laboratory water quality database. Interpret and explain regulatory guidelines to clients.

4. Public Health Microbiologists - Assist Public Health Chemist in performing microbiological analyses and performing quality control.
5. Laboratory Assistant - Prepares culture media and reagents, assists in the processing of specimens, performs low to moderately complex environmental analyses and clinical analyses where interpretation or medical judgement is not required.
5. Laboratory Helper - Washes and sterilizes glassware and supplies. Prepares and labels mailing containers and specimen collection kits. Accession laboratory specimens. Sterilizes and disposes infectious waste. Maintains stockroom.
6. Typist-Clerk II - Enters clients and laboratory results into computer. Prints reports/forms. Prepares billing statements; receives and accounts for payments. Distributes laboratory results, and maintains laboratory files.

## QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

Quality Assurance (QA) includes all aspects of laboratory operation that affect the accuracy and reliability of sample test results. In addition to quality control of the analytical test process, quality assurance practices include: 1) proper sample collection, receiving and holding, 2) proper maintenance of equipment, 3) accurate data reduction, validation and reporting; and, 4) periodic performance and systems audits.



## CUSTODY, HOLDING AND DISPOSAL OF SAMPLES

Quality assurance includes proper labeling of samples, proper completion of the chain of custody/analysis request form, proper collection, preservation and storage of samples, proper accessioning of samples, and proper disposal of the sample.

- 1) Sample Collection/Labeling. Sample collection is a coordinated effort between the client and the laboratory. The laboratory will provide clients with appropriate sample containers and sample collection/preservation instructions. The laboratory will also request duplicates and blanks according to client's sample plan requirements. All samples submitted for testing should be appropriately labeled. Sample containers provided by our laboratory have a suitable label which should be filled out at the time of sampling by the sample collector. The following information must be provided with all samples:
  - a) Sample identification - submitters identification of sample (e.g. well number)
  - b) Location - an address or brief description of the place the sample was taken,
  - c) Time and date taken.
  - d) Name of sample collector.
  - e) Any preservatives
- 2) Chain of Custody/Analysis Request Form. A Chain of Custody/Analysis Request form should accompany all samples (see Appendix B). The Chain of Custody/Analysis Request form must include the following information: submitter name and address; sample identification; location of sample collection; date & time of collection; sample type; analysis to be performed; signatures of persons involved in the collection and chain of possession; and inclusive dates of possession.
- 3) Sample Receiving. Laboratory personnel receiving samples should assure that samples are properly collected, labeled, and the Custody/Analysis Request form has been completed:
  - a) The laboratory assistant receiving the specimen must sign and date the Custody/Analysis Request form. Make sure that any special requests made by the client are recorded under the comments section of the form
  - b) Assign each sample a unique laboratory identification number. Place



preprinted lab number on analysis request form and sample container. When a sample is collected in multiple containers for different analyses, each container should receive the same laboratory number. (Exception: sample containers for analytes requiring a rapid turnaround time (e.g. coliforms) may receive separate number to expedite reporting).

- c) Check that the samples meet the criteria described in Table 1006:I Summary of Special Sampling or Handling Requirements in 18<sup>th</sup> ed. of *Standard Methods for the Examination of Water and Wastewater* (Appendix C)
  - i) Samples should be collected in a suitable container; samples collected in bottles of unknown origin or questionable cleanliness should be brought to the attention of the Water Quality Specialist or the Public Health Chemist.
  - ii) Samples should be adequately labeled
  - iii) Samples should be checked for proper preservative, holding time, and holding temperature.
  - iv) Samples should be adequately sealed. Notify public health chemist if there is evidence of leakage. Verify that adequate sample volume exists to perform requested analysis.
- d) NOTE: Samples that are not properly identified or are otherwise unsuitable for testing (e.g. improperly preserved or exceeding holding/transport time) are recorded on the "Sample Invalidation Log" and the Water Quality Specialist or Public Health Chemist notifies the client. Samples not meeting collection/preservation criteria may be tested only if resampling is impossible; results from such samples must be qualified on the laboratory report by comments describing sample deficiency.
- 4) When the sample meets criteria for acceptance by the laboratory, required preservatives are added immediately and the sample is stored under conditions specified by the analytical method to be used. For samples requiring thermal preservation, a laboratory refrigerator and freezer is available. The temperature is maintained at 4 degrees and below -10°C respectively. Temperatures are monitored each day.
- 5) Chain of Custody/Analysis Request forms are given to the clerk to enter into a password protected computer laboratory information management system. Refer to "Water Sample Entry" in Clerical Manual for instructions on sample log-in.
- 6) Disposal of samples: Upon completion of all analyses, any remaining

sample will be stored for at least one month prior to disposal. Chain-of-Custody form, worksheets and lab reports are retained for three years.

NOTE: Longer retention of samples or data may be required when legal action is probable. The samples and any associated extracts or digests are disposed of following recommendations found in the book, *Prudent Practices for Disposal of Chemicals from Laboratories*, National Academy Press, Washington, D.C. 1983.



## CALIBRATION PROCEDURES AND FREQUENCY

Calibration is the process for determining the correctness of the assigned values of the physical standards used or the scales of the measuring instruments. Calibration accuracy is critically dependent on the reliability of the standards used for the required comparisons. Only the highest quality chemicals are used to provide necessary standard solutions, and due care is exercised in their preparation. The concentrations of the calibration standards bracket the expected concentration of the analyte in the samples. No data is reported beyond the range of calibration of the methodology. The calibration data, when plotted graphically, is referred to as a calibration curve. The calibration must be done under the same instrumental and chemical conditions as those that will exist during the measurement process. The frequency of calibration depends on the accuracy requirements of the investigation and the stability of the instrument used for the measurements:

At a minimum, three different dilutions of the standard will be measured when an analysis is initiated. Correlation coefficient must be  $> 0.995$ . Reportable analytical results are those within the range of the standard dilutions used. Do not report values above the highest standard. The lowest reportable value is the Method Detection Limit (MDL), providing that the lowest calibration standard is less than 10 times the MDL.

- 1) Atomic Absorption Spectrophotometers - Two approaches are used to calibrate atomic absorption spectrophotometers. These methods are direct comparison and standard additions.
  - a) Direct comparison is the simple approach, and can be used with many instruments to give a direct readout of the concentration of an element in an unknown sample. To obtain good precision (e.g., 1-2% coefficient of variation), the absorbance levels measured must be about 0.1 to 0.6 units. Standard and sample solutions should be similar in bulk matrix constituents, particularly acid and salt content. Interference suppressants are used in all solutions when required. A number of standards (usually three to five in increasing concentration) as well as a blank, are prepared to cover the concentration range. A volume of type II reagent water with the same amounts of acids as the samples and standards) will be used for calibration blank. These solutions are run in absorbance to check linearity of the calibration curve.
  - b) The method of standard additions is used when samples contains severe matrix interference. In this case it is possible to add small amounts of conventional standard solutions, in increasing amounts, to aliquots of each sample. A calibration graph can then be constructed. This method will often be used in work with the graphite furnace.

- 2) UV-VIS Spectrophotometer - The calibration procedure for the UV-VIS spectrophotometer is similar to that for the A.A. spectrophotometers. An integration interval is not required as the signal is very stable. It is important to use blanks and allow at least 1/2 hour warm up time.
- 3) PH Meters - The proper calibration of pH meters requires the use of two buffer solutions and a thermometer. The two buffer solutions must cover the expected range of samples to be tested. A third buffer is used to confirm calibration. The pH meter should be calibrated each day. The temperature of the buffers must be entered into the meter.
- 4) Conductivity Meter - The conductivity meter does not require frequent calibration but should be checked against a known standard each day of use. Recalibrate when there is significant deviation with the value of the standard.
- 5) Ion Chromatograph- Calibration of the Ion Chromatograph is performed at least once each year and whenever: 1) Controls are out of range; or, 2) the column, suppressor or detector is changed.
- 6) Inductively Coupled Plasma/Mass Spectrometer – Calibration of the ICP-MS is performed every day of analysis and whenever controls are out of range. See the SOP for more information.



## ANALYTICAL PROCEDURES

The laboratory employs only methods approved by Environmental Laboratory Accreditation Program. Analysts must conduct sufficient preliminary tests using the methodology and typical samples to demonstrate competence in the use of the measurement procedure.

Each time an analytical procedure is performed controls are included and duplicate samples and known additions are tested to insure accuracy and precision. Results are not reported unless all controls are within acceptance limits referenced in Standard Methods 18th Edition, 1992.

To monitor reliability of analytical measurements, data is periodically obtained on detection limits, accuracy, precision and recovery.

## ACQUISITION, REDUCTION, VALIDATION OF REPORTING DATA

The analytical chemist is responsible for describing and reporting the data in an appropriate manner. In order to insure the accurate transcription, calculation and reporting of analytical data, the chemist will adhere to the following quality assurance procedures.

- 1) Use documented procedures and record all significant experimental details in such a way that the measurements could be reproduced by a competent analyst at a later date.
- 2) All measurements are made so that results are representative of the matrix (soil, water, etc.) and conditions being measured.
- 3) Report data only to the number of significant figures consistent with their limits of uncertainty.
- 4) Report data with the proper units of concentration. Units should be chosen which clearly indicate whether the concentration is in terms of weight by weight, weight by volume or volume by volume. Unless otherwise specified, all data are calculated and reported in standard units to allow comparison with data reported by other laboratories.
- 5) The analytical methodology used will be cited. The raw data for each sample, along with reagent blanks, control, and spiked samples will be suitably identified if included in the report. If average values are reported, an expression of the precision, including the number of measurements, must be included.
- 6) The report should include date and place of sampling, sampling point, the name of the sample collector, identification as to type of sample, date and time of submittal to the lab, date of analysis, name of the analyst, and the result. Any conditions which may effect the interpretation of the data should be noted in the report.. All results will be reviewed by a Water Quality Specialist or Public Health Chemist before a final report is released.
- 7) Laboratory records will be retained in a permanent file for three years.
- 8) Retain samples for one month after issuing final report and retain data and documentary evidence for three years.



## INTERNAL QUALITY CONTROL

Quality Control (QC) may be defined as those measures undertaken in the laboratory to maintain the analytical testing process within acceptable limits of accuracy and precision.

The Quality Control Program consists of the following elements: documentation of operator competence, recovery of known additions, analysis of externally supplied standards, analysis of method blanks, and testing of replicate samples:

- 1) Operator competence The principal analyst is responsible for: 1) developing a standardized training syllabus for the methods employed in the laboratory; 2) assuring that test personnel are adequately trained; 3) assessing the competency of test personnel, and 4) maintaining documentation of training and competency of all test personnel.
  - a) Before test personnel are permitted to do reportable work, competency in performing the analysis is to be demonstrated. Commonly, the analyst performs replicate analysis under the supervision of the principal analyst. General limits for acceptable work are found in Standard Methods 18th Edition, 1992 in Table 1020 :I.
  - b) After initial demonstration of competency, the principal analyst will assure test personnel maintain competency through testing internal or external proficiency test samples at least once each year.
- 2) With each batch of samples tested, controls will be tested to verify the accuracy of results as described below. Controls used with each method are outlined in Appendix D.
  - a) Recovery of known additions as part of all regular analytical protocols except titrimetric and gravimetric methods. Use known additions to verify the absence of matrix effects. Spiked samples shall be analyzed with a minimum frequency of ten percent of the samples per matrix per batch of samples. Spike recovery must be between 80-120% for potable water (75-125% for waste water). When a spike sample fails to meet this criteria, retest all samples following the last acceptable spike sample. Spike recovery calculated as % of the known addition recovered.
  - b) Analyze control standards with a minimum frequency of ten percent of the samples per matrix, per batch of samples. If there are less than 10 samples in a batch, at least one per matrix per batch must be analyzed. The concentration of the sample shall be within the working range of the method. Sources of these samples include but are not limited to: performance evaluation samples from the EPA, commercially available standards, or standards prepared in-house but from sources different

from calibration standard. Control standards must be within the published acceptance range (for external controls). If the control standard does not have a published acceptance range, recovery of the control should be within 10% of the known value. When a control standard fails to meet this criteria, retest all samples following the last acceptable control.

- c) Method blanks will be analyzed with each batch of samples. The use of method blanks provides a measurement of laboratory contamination. Blanks cannot exceed the minimum detection level. See Appendix A.
- d) Replicate samples will be analyzed with a minimum frequency of ten percent of samples per matrix, per batch of samples for drinking water. For wastewater the requirement is 5%. If there are less than ten samples per batch, at least one sample per matrix per batch must be analyzed. If the analyte is not detected, replicate matrix spike samples will be analyzed. The percent difference between replicate samples must be within 20% for potable water (25% for wastewater). When a replicate sample fails to meet this criteria, retest all samples following the last acceptable replicates. Duplicate % difference calculated as the difference as a percent of the mean.  $[100(X1-X2)/avg]$ .
- e) In addition to the control standards tested with each run, an external reference standard for each analyte will be tested at least once each quarter.

All of the quality assurance control procedures will be followed in the laboratory. All documentation for these checks should be available for inspection by laboratory management.



## PREVENTIVE MAINTENANCE

As part of the QA plan, the laboratory has a comprehensive preventive maintenance program. Balances, spectrophotometers, and other instruments undergo routine maintenance and accuracy checks by a manufacturer's representative or by laboratory personnel as described below. All preventive maintenance performed in-house is documented on preventive maintenance forms. Instruments which undergo routine professional maintenance have labels affixed to indicate date of last servicing. Manufacturer's instructions and service manuals are readily accessible.

Adequate spare parts are kept on hand to perform routine maintenance and minimize downtime. The spectrophotometers have maintenance contracts that provide for immediate servicing in the event of malfunction. Equipment records documenting preventive maintenance and emergency servicing/repairs are kept for a minimum of three years.

- 1) Thermometer/temperature-reading instruments: Accuracy of thermometers or recording instruments are checked annually against a certified National Bureau of Standards (NBS) thermometer or one traceable to NBS and conforming to NBS specifications. All thermometers are relabeled with date calibrated and correction factor.
- 2) Balance: Balance accuracy is verified each week using ASTM type 1 reference weights. Accuracy checks are documented on preventive maintenance chart. Balances are serviced and certified annually through a maintenance contract. Type 1 weights are re-certified at least every five years.
- 3) pH meter: pH meters are standardized with at least two NIST traceable standard buffers (pH 4.0, 7.0, or 10.0) and compensated for temperature before each series of tests. A third buffer is used to confirm calibration. Date buffer solutions when opened and discard buffer after expiration date on bottle. Buffers prepared from powders are replaced after four weeks.
- 4) Water deionization unit: Conductivity of the RO and Nanopure water is checked each month. A heterotrophic plate count on Nanopure water is also performed monthly. Filters are changed as indicated by conductivity readings and heterotrophic plate count. Records are maintained on preventive maintenance chart. Water is tested annually for bacteriologic quality and heavy metals.
- 5) Autoclave: Autoclave charts are used to document date, time, temperature and contents of each load. Chem-di indicators and heat sensitive tape are used with each load to identify materials that have been autoclaved; results are recorded on autoclave chart. Autoclave performance is



checked each month with biological indicator (e.g. spore suspension). Autoclaves are serviced quarterly under maintenance contract. The accuracy of autoclave recording thermometer is checked annually. The autoclave operating temperature is monitored on a weekly basis.

- 6) Refrigerator: Temperatures are recorded daily and units defrosted and cleaned as needed. All media and reagents stored in the refrigerator are labeled.
- 7) Freezer: Temperatures are recorded daily. Identify and date materials stored. Defrost and clean semiannually; discard outdated materials.
- 8) Ultraviolet sterilization lamps: Unit is cleaned monthly by wiping lamps with a soft cloth moistened with ethanol. Test lamps quarterly with UV light meter and replace if they emit less than 70 % of initial output or if agar spread plates containing 200 to 250 microorganisms, exposed to the light for 2 minutes, do not show a count reduction of 99%.
- 9) Water bath: Fecal coliform water bath is checked twice daily. All other water baths are checked each day of use.
- 10) Incubator: Check and record temperature twice daily (morning and afternoon) on the shelf areas in use. Locate incubator where room temperature is in the range of 16 to 27O C.
- 11) Fume hoods/Biological Safety Cabinets: Fume hoods are checked once each month using a velometer; readings are recorded on preventive maintenance chart. Hoods and safety cabinets are certified annually through service contract.

## PERFORMANCE AND SYSTEMS AUDITS

Corrective action is required when data is outside of predetermined limits for acceptability. The corrective actions can be triggered by the following quality assessment activities: Control Chart analysis; proficiency evaluation testing; and QA audits.

### 1) CONTROL CHART ANALYSIS:

The laboratory's quality assessment techniques will be used to maintain the precision and accuracy of all laboratory analyses within a state of statistical control. Precision and accuracy measurements are the best way to assess analytical performance. Precision is the degree of reproducibility of a particular analytical procedure. Accuracy is a measure of the agreement between an experimental determination and the true value.

- a) PRECISION - Assess precision by replicate analysis, by repeated analysis of a stable standard, or by analysis of known additions to samples. Precision is specified by the standard deviation of the results. The formula for determining standard deviation (SD) is:

$$SD = \sqrt{\sum (X_i - \bar{X})^2 / (N - 1)}$$

$X_i$  is the value of the individual measurements;  $\bar{X}$  is the mean of all measurements for a given sample and  $N$  is the number of measurements.

The purpose of determining precision is to establish the typical variance of the method in the absence of any matrix influence. In the course of determining precision, there are two cases that indicate there is a problem with the precision data:

- i) The measured values show wide variation from one to another for a given day.
- ii) The measured values show little variance from one to another for a given day, but the mean and standard deviation show wide variation from one day to another.

If either of the above occurs, factors such as sample homogeneity, instrument calibration, or analyst error should be checked, documented, and corrected. The precision measurements should then be repeated.

- b) ACCURACY - The best method to determine accuracy is to spike an aliquot of reagent water with a known amount of the constituent being measured and analyze the sample. The amount spiked should be at least five to ten times greater than the analytical detection limit.



To evaluate the data accuracy, the percent recovery of the spike must be determined. The formula for determining percent recovery is:

$$\% \text{ recovery} = [100(S - S1) \div S2]$$

Where S is the concentration of the spiked sample; S1 is the concentration of the unspiked sample; S2 is the concentration of the spike added to the sample.

If the percent recovery deviates significantly from 100% and the method has not demonstrated significant bias, the problem must be detected and corrected prior to continuing the analysis. Sources of this problem include incorrect standard or spike solution concentration or a problem in the procedural detection system.

Precision, accuracy, and detection limits for all methods used in the laboratory is comparable to values referenced in Standard Methods 18th Edition, 1992 and EPA Methods for Chemical Analysis of Water and Wastes, March 1983.

- 2) **PERFORMANCE EVALUATION SAMPLES:** The laboratory director is responsible for enrolling the laboratory in ELAP approved proficiency testing program(s) and assuring that proficiency testing is performed for all regulated tests. The principal analyst (Public Health Chemist) will conduct and document internal proficiency testing at least once a year for tests where proficiency testing is not available. Proficiency test samples are treated in the same manner as routine samples (ie. tested the same number of times, tested using personnel who routinely perform testing, tested using routine methods and tested during patient testing).
- 3) **QUALITY ASSURANCE AUDIT:** The quality assurance program will be audited quarterly and any deviations from the program will signal corrective action to be taken. Quality assurance audit will be documented in a written report. The audit will include the following aspect:
  - a) Competency of test personnel must be evaluated annually and be documented
  - b) Evidence of the systematic use of control samples, replicate measurements and reference materials all in conjunction with control charts.
  - c) Proper labeling of reagents and samples.
  - d) Use of approved methods.

- e) Results on blind samples.
- f) Acceptable safety equipment and procedures.
- g) Quality assurance reports generated on a regular basis.
- h) Documentation on equipment performance and maintenance.
- i) Training records.
- j) All relevant files accessible and organized.
- k) Laboratory personnel following good laboratory practices.
- l) Laboratory personnel following good measurement practices

The Public Health Chemist will be responsible for initiating and documenting any corrective action necessary. Corrective action will be documented on the appropriate control chart, performance evaluation report, or QA audit report. No data shall be reported until the cause of the problem is located and corrected or the laboratory demonstrates the cause was a random event and no longer affects data. Although the elimination of events requiring corrective action may not be achieved, a reduction in the repetition of these events is the objective of this program.

## REFERENCES FOR QUALITY ASSURANCE DOCUMENT

- 1) Standard Method for the Examination of Water and Wastewater, 18th edition, 1992.
- 2) Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019, March 1979, USEPA.
- 3) Manuals for the Certification of Laboratories Analyzing Drinking Water Criteria and Procedures/Quality Assurance. EPA QAMS-005/80, Interim Guidelines, EPA-570/9-82-009, USEPA.
- 4) Methods for Chemical Analysis for Water and Waste. EPA-600/4-79-020, March 1983.

Written by: Gerry Guibert & David Holland

Date: May 1993

Revised: January 1999

Revised: September 21, 2004

Approved by: \_\_\_\_\_

(Laboratory Director's Signature)



Monterey County  
Consolidated Chemistry Laboratory

**ANALYTICAL METHODS FOR WATER ANALYSIS**

PARAMETER	HOLD TIMES	METHOD REFERENCE	MDL	UNITS
Free Chlorine	.25 h; ASAP	SM 4500-Cl G	0.02	mg/L
Total Chlorine	.25 h; ASAP	SM 4500-Cl G	0.05	mg/L
Enterococcus	8 h	IDEXX	1/100 ml	
Heterotrophic Plate Count	8 h	SM 9215 B	1	CFU
E. coli – MPN	6 h waste 8 h source 30 h potable	SM 9221 B	2/100 ml	
Fecal Coliform – MPN	6 h waste 8 h source 30 h potable	SM 9221 B	1/100 ml	
Total Coliform – MPN	6 h waste 8 h source 30 h potable	SM 9221 B	2/100 ml	
Total Coliform – Quantitray	6 h waste 8 h source 30 h potable	SM 9223	1/100 ml	
E. coli – Presence/Absence	30 h potable	SM 9223	1/100 ml	
Total Coliform – P/A	30 h potable	SM 9223	1/100 ml	
pH	.25 h; ASAP	SM4500H B		pH units
Bicarbonate	ASAP (with pH)	SM 2320 B	10	mg/L
Calcium Carbonate	ASAP (with pH)	SM 2320 B	1	mg/L
Carbonate	ASAP (with pH)	SM 2320 B	1	mg/L
Solids	24 h	SM 2540 F	0.1	mL/L
Color Determination	48 h	SM 2120 B	2	CU
Odor	NS; 48 h (rec 6h)	SM 2150 B	1	TON
Turbidity	48 h	SM 2130 B	0.05	NTU
Nitrate	48 h	EPA 300.0	1	mg/L
Nitrite as (N)	48 h	SM 4500 NO2-B	10	ug/L
Total Dissolved Solids	7 d	SM 2540 C	5	mg/L
Total Suspended Solids	7 d	SM 2540 D	5	mg/L
Alkalinity	14 d	SM 2320 B	1.0	mg/L, CaCO <sub>3</sub>
Bromide	28 d	EPA 300.0	1	mg/L
Chloride	28 d	EPA 300.0	1	mg/L
Fluoride	28 d	EPA 300.0	0.02	mg/L
Sulfate	28 d	EPA 300.0	1	mg/L
Conductivity	28 d	SM 2510 B	1	umhos at 25C
Ammonia (N)	28 d	SM 4500 NH <sub>3</sub> F	0.05	mg/L
Orthophosphate	NS; 28 d	SM 4500 P E	0.03	mg/L
Total Phosphorus	28 d	SM 4500 P E	0.03	mg/L

Monterey County  
Consolidated Chemistry Laboratory

PARAMETER	HOLD TIMES	METHOD REFERENCE	MDL	UNITS
Aluminum	6 months	EPA 200.8	5	ug/L
Antimony	6 months	EPA 200.8	0.5	ug/L
Arsenic	6 months	EPA 200.8	1	ug/L
Barium	6 months	EPA 200.8	0.5	ug/L
Beryllium	6 months	EPA 200.8	0.5	ug/L
Cadmium	6 months	EPA 200.8	0.5	ug/L
Chromium	6 months	EPA 200.8	5	ug/L
Copper	6 months	EPA 200.8	0.5	ug/L
Iron	6 months	SM 3111B	100	ug/L
Lead	6 months	EPA 200.8	0.5	ug/L
Manganese	6 months	EPA 200.8	0.5	ug/L
Mercury	6 months	EPA 200.8	0.25	ug/L
Nickel	6 months	EPA 200.8	0.5	ug/L
Selenium	6 months	EPA 200.8	5	ug/L
Silver	6 months	EPA 200.8	5	ug/L
Thallium	6 months	EPA 200.8	0.5	ug/L
Zinc	6 months	EPA 200.8	5	ug/L
Calcium	6 months	SM 3111B	1.0	mg/L
Magnesium	6 months	SM 3111B	0.1	mg/L
Potassium	6 months	SM 3111B	0.1	mg/L
Sodium	6 months	SM 3111B	0.1	mg/L
Hardness as CaCO <sub>3</sub>	6 months	SM 2340 B	1.0	mg/L
Boron	6 months	SM 4500 B B	0.1	mg/L



Shaded areas for laboratory use only

## Chain of Custody:

Collected by (Print & sign):	Received by:	Date & Time:
Relinquished by:	Received for Laboratory:	Date & Time:

Client Name:			Report Attention:			ANALYSES REQUESTED														
Address:			Copy to:																	
City, State, Zip:			Phone:			Fax:														
Laboratory Number	Sample ID or System #	Sample Site or Description	Collection Date & Time	Matrix <sup>(1)</sup> 1-Routine 2-Repeat 3-Replacement	No. of Containers	Coliform	MMO	Quant	Low-D	Nitrate										

<sup>(1)</sup> D=Drinking Water (Specify as routine, repeat or replacement) W=Wastewater (Specify as grab or composite) O=Other (identify)

[ ] Payment received with delivery		Amount:	Sample comments (irregularities/preservation, billing information if different than reporting):	
Check:		Initials:		
Receipt #:		Date:		

**SPECIFIC CONDUCTANCE**  
**EPA 120.1/SM 2510 B**  
**umhos at 25°C**

**Scope and Application:**

This method is applicable to drinking, surface and saline waters, domestic and industrial wastes and acid rain.

**Summary of Method:**

The specific conductance of a sample is measured by use of a self-contained conductivity meter, the YSI Model 32. The conductivity meter is used in the temperature compensated mode.

**Sample Criteria & Acceptability:**

A minimum of 100 ml sample should be submitted in a clean container provided by the laboratory. Samples can be stored for up to 28 days at 4°C. The samples must be brought to room temperature before testing. If the sample does not meet the above criteria, document it on the worksheet but perform the test.

**Reagents:**

0.02 Molar Standard Potassium Chloride Solution:

1. Dry 0.85 g of Reagent Grade Potassium Chloride (KCl) for 4 hours at 105°C. Use immediately or store in a desiccator until use.
2. Dissolve 0.7456g of pre-dried potassium chloride in a 1 liter Class A volumetric flask using deionized water.
3. Label the flask with Potassium Standard Solution, 0.7456 g KCl/L, date made, outdate of 3 months, and initial.
4. Alternately, order two 500 ml containers of the Traceable Conductivity Calibration Standard near the 1414 micromho/cm range; from Fisher Scientific, Cat No. 09-328-11.

**Control**

1. Check deionized water. It should read less than 1 umho. If the reading is higher, clean cell and repeat reading of deionized water. If reading is still high, notify the Chemist.
2. Use current Quality Control sample with each run. The control must be in range before proceeding with specimens. The 0.01 M KCl can be used as control.

**Conductance Meter Maintenance:**

1. Store cell in deionized water. If the cell has been stored dry, soak in deionized water for 24 hours.
2. Check the platinum black coating on the electrode. If the coating appears thin or if it is flaking off the electrode, the cell should be cleaned and the electrodes replatinized. See "Instruction Manual YSI Model 32 Conductance Meter" pages 11 and 12 for instructions.
3. The electrode should be cleaned and replatinized every four months. Record the preventative maintenance on the "PM Worksheet".



### Conductance Meter Calibration Check:

Instrument must be standardized with KCl solution before daily use.

1. Pour 50 ml of the standard potassium chloride solution into a 250 ml beaker. Alternately, immerse the conductivity cell and thermometer in the Rinse Bottle, then transfer to the Read Bottle for actual reading
2. Immerse conductivity cell in sample. The electrodes must be submerged and the electrode chamber must be free of trapped air. Tap the cell to remove any bubbles, and dip it two or three times to assure proper wetting.
3. Rotate the Range Switch to the lowest range position that gives a reading (within range) on the display. An over-range value is indicated by a "1" followed by blanks. An under-range value is indicated by a reading followed by a small letter "u". Readings may be in error when operating in the under range conditions. On the 0.1 – 2 micromho range; allow extra time to stabilize.
4. The conductance value of the solution is displayed on the meter. The units in which it is to be read are determined by the Range Switch, either in mU or in uU (or milli and micro siemens).

2 uU, 20 uU, 200 uU reading = final result

2 mU, 20 mU, 200 mU readings x 1000 = final result

5. Use the table below to check accuracy of cell constant:

Conductivity of 0.01 M KCl	
Temperature in Centigrade	Micro-ohms/cm
21	1305
22	1332
23	1359
24	1386
25	1413
26	1441
27	1468
28	1496

6. If the standard is within range, rinse the cell three times with deionized water, and start testing unknowns as described in steps 2-4.

### Reporting:

Report results to three significant figures. Report in units of micromhos per centimeter at 25 °C

### References:

1. Instruction Manual YSI Model 32 Conductance Meter", Item 060818, PN A32018 R, October 88 EP
2. Methods for Chemical Analysis of Water and Wastes", EPA- 600/ 4-79-020, March 1983, pages 120.1-1 to 120.1-3.
3. "Standard Methods for the Examination of Water and Wastewater", 18th Edition, 1992.

Written by: David Perez, Date: February 1993

Revised: January 12, 2007

Approved by: \_\_\_\_\_  
Chemist

**pH**  
**SM 4500-H B**  
**Electrometric**

### **Scope and Application**

Application to drinking, surface, ground and saline waters as well as acid rain, and wastewater (domestic and industrial).

### **Principle of Operation**

pH is defined as the negative logarithm of the hydrogen ion concentration in moles per liter. The pH scale goes from zero to fourteen with a value of seven units to be considered neutral. Values below seven are acid; values above seven are basic. It is important to note that a one-unit change in pH represents a ten-fold change in the concentration of the hydrogen ion.

pH has a great impact on almost all biological and chemical processes used for water and wastewater treatment, and proper measurement of this value is critical. pH is measured using a pH meter consisting of a potentiometer, glass pH electrode, reference electrode and temperature compensating device. When calibrating the instrument, use two buffers that bracket the expected pH value for greatest accuracy.

### **Specimen collection and Handling**

Collect sample in plastic or glass container. Test sample immediately upon receiving and/or within two hours after collection.

### **Instrument Calibration:**

Two buffer calibration:

1. Fill a 50 ml beaker with up to 30 ml of pH 7 buffer. Add a stir bar and set the knob on the magnetic stirrer to the second line on the dial (slow spin). Place the electrode in the pH 7 buffer; make sure that the reference electrode is filled with KCl and is open. Allow the electrode to equilibrate for 5 minutes.
2. Release Standby button and press the pH button. Measure the temperature of the buffer solution and set the temperature control. Turn the large slope knob to 100 and the inner knob fully clockwise.
3. Adjust the calibration control until the readout displays 7.00. Press the mv button and record the mv reading on the worksheet. Remove electrodes from the buffer and rinse with deionized water.
4. Fill a 50 ml beaker with up to 30 ml of pH 4 buffer. Add a stir bar and set the knob on the magnetic stirrer to the second line on the dial (slow spin). Place the electrode in the pH 4 buffer and allow the electrode to equilibrate for 5 minutes. Press the pH button.
5. Adjust the slope knob until the readout displays 4.00. Press the mv button and record the mv reading on the worksheet. Remove electrodes from the buffer and rinse with deionized water.
6. Fill a 50 ml beaker with up to 30 ml of pH 6.86 buffer. Add a stir bar and set the knob on the magnetic stirrer to the second line on the dial (slow spin). Place the electrode in the pH 6.86 buffer and allow the electrode to equilibrate for 5 minutes. Press the pH button and record the result on the worksheet and quality control graph. PH should be  $6.86 \pm 0.1$ ; notify chemist if out of range.
7. Rinse the electrodes with deionized water.



8. Record mv readings of calibration buffers. Calculate change in millivolts and divide by 3. The result should be  $58 \pm 2$  mv.
9. If the slope is within limits, begin testing unknowns. If the slope is out of range, re-calibrate the pH meter. If the second calibration slope is out of range, notify the chemist.

### Controls

1. Run every tenth specimen in duplicate. The duplicates should be within 20% of each other.
2. Check the 6.86 control buffer after every tenth specimen. Record the results on the worksheet and quality control chart.

### Procedure

Once the pH meter has been calibrated, the unknown samples can be tested.

1. Pour 30 ml of unknown (or 50 ml of unknown if also testing for alkalinity) into a 150 ml beaker containing a small stir bar. Start the stirrer. Keep the automatic stirrer at a constant moderate rate (The speed is marked on the dial by a pen marking).
2. Allow the display to stabilize, and record the results on the worksheet.
3. Rinse the electrode with deionized water between specimens. Blot dry with a 'kimwipe'. Do not rub the electrode; the static electricity can alter readings.

### Reporting

Report the result to the nearest tenth (0.1).

### References:

1. "Method for Chemical analysis of Water and Wastes", EPA 600/4-79-020, Revised March 1983.
2. Standard Methods for the Examination of Water and Wastewater 18th edition 1992

Written by: David Perez  
Date: December 1994

Approved by: \_\_\_\_\_  
Chemist

## Total Alkalinity SM 2320 B Titration

### Principle

Total alkalinity is defined as the acid-neutralizing capability of water. It is reported as due to bicarbonate ( $\text{HCO}_3$ ), carbonate ( $\text{CO}_3$ ), and hydroxide ( $\text{OH}$ ). Unaltered sample is titrated potentiometrically to pH 8.3 endpoint for "carbonate" alkalinity and 4.5 endpoint for "bicarbonate" alkalinity.

**Note: Samples with a pH less than 8.3 (i.e. most drinking water samples) are reported as having non-detectable hydroxide and carbonate alkalinity; for these samples total alkalinity is due entirely to the bicarbonate content of the water. Bicarbonate alkalinity (as  $\text{HCO}_3$ ) can be calculated from total alkalinity (as  $\text{CaCO}_3$ ) by multiplying by a factor of 1.22.**

Applicable to drinking and surface waters, domestic and industrial wastes, and saline waters.

### Sample Criteria & Acceptability

Samples should be submitted in clean containers provided by the laboratory. A minimum of 100ml of sample should be submitted for testing. Samples, which cannot be tested within 24 hours of collection, should be stored at  $4^\circ\text{C}$  and tested within 14 days. If any sample does not meet the above criteria, document it on the worksheet but perform the test.

### Equipment

1. pH meter that can read to 0.05 pH units.
2. Two 1,000 ml Class A volumetric flasks.
3. Magnetic stirrer and magnetic stir bars.
4. Two 100 mL beakers.
5. One 250 mL flask
6. One 50 mL graduated cylinder

### Reagents

The day before preparing standardize sulfuric acid, dry 0.1 g of Tris Buffer for at least 3 hours at  $103^\circ\text{C}$  (overnight is acceptable). After drying, immediately weigh out the Tris buffer. If that is not possible, store the reagent in the desiccators until used.

1. Standardized 0.02 N  $\text{H}_2\text{SO}_4$  (sulfuric acid) + 0.004 units:

The concentrated  $\text{H}_2\text{SO}_4$  and stock 1.0 N  $\text{H}_2\text{SO}_4$  may be found in acid cabinet below hood.

- a. Prepare a 1.0 N  $\text{H}_2\text{SO}_4$  Stock Solution: Fill a 1,000 ml Class A volumetric flask three quarters full with deionized water. Carefully add 28.0 mL of concentrated  $\text{H}_2\text{SO}_4$  using a 25 mL and 3 mL Class A volumetric pipette. Fill to the mark with deionized water and mix. Transfer to plastic bottle and label as 1.0 N  $\text{H}_2\text{SO}_4$  Stock Solution, date made, outdate of 1 year, and initial. Cap tightly.
- b. Prepare a standardized 0.02 N  $\text{H}_2\text{SO}_4$ .
  1. Fill a 1,000 mL Class A volumetric flask three quarters full with deionized water. Carefully add 20.0 mL of the Stock  $\text{H}_2\text{SO}_4$  using a 20 mL Class A pipette. Fill to mark and mix thoroughly.
  2. Weigh out between 0.0700 to 0.0800 g of Tris buffer using the analytical balance. Record the weight of the Tris Buffer to four places in the "Standard & Reagent Preparation" notebook. Add the buffer to 250 mL flask containing 25 mL of deionized water and stir bar; mix.



3. Add 3 drops of Hach Brom Cresol Green-Methyl Red indicator solution (Hach cat. number 451) to the Tris buffer solution.
  4. Fill the titrating buret with the 0.02 N H<sub>2</sub>SO<sub>4</sub> solution. Titrate the solution until a stable pink color is reached. Record the volume of reagent used.
  5. Calculations:  

$$\text{Normality of H}_2\text{SO}_4 = \text{Wt of Tris Buffer (g)} \div (0.121137 \text{ g/meq Tris} \times \text{mL of 0.02 N H}_2\text{SO}_4 \text{ used})$$

Example:  

$$0.0879 \text{ g Tris Buffer} \div (0.121137 \text{ g/meq Tris} \times 35.7 \text{ ml H}_2\text{SO}_4) = 0.0203 \text{ N H}_2\text{SO}_4$$
  6. Transfer the 0.02 N H<sub>2</sub>SO<sub>4</sub> to a one liter plastic bottle. Record the normality on the bottle, date made, outdate of 3 months, and initial. Store at room temperature.
2. Alternatively, order 0.02 N H<sub>2</sub>SO<sub>4</sub>, already prepared and standardized from a vendor such as Fisher Scientific. Record lot on QC worksheet.

### Controls

1. Run deionized water as blank. Value of blank should be less than 2 mg/L of calcium carbonate (approximately 0.1 mL of H<sub>2</sub>SO<sub>4</sub>).
2. Use one quality control standard. This is a solution of sodium bicarbonate (100 mg/l). Run once with each set of samples and record results on control chart. Consult chemist if out of control situation exists.
3. Run every 10<sup>th</sup> specimen in duplicate. Calculate the relative standard deviation (RSD) of the replicates using the following formula:  $\text{RSD} = \text{SD} \div \text{mean} \times 100$ . The RSD should be less than 10%. If the replicates are outside of this range, repeat the specimen a third time. Check with the chemist for instructions.
4. Each quarter an external reference sample is to be analyzed. In the case of results exceeding acceptance values, document corrective action. Place any corrective action records in proficiency file

### Procedure:

If applicable, standardize the pH meter each day of use (see supplemental procedure). Record slope with offset on worksheet.

Run the blank and control first. If the control is within range (range found in the "QC Inorganic True Value" binder), run the samples. Repeat the control if it is out of range. Notify the chemist if the control is out of range a second time.

1. Add 50 mL of control or sample to a 100 ml beaker containing a magnetic stir bar. Set magnetic stirrer at low speed.
2. Carefully lower pH probe into the solution. **If the pH is above 8.3 consult principal analyst!**
3. Fill the titrating buret to the zero mark with the standardized H<sub>2</sub>SO<sub>4</sub>. Carefully add the H<sub>2</sub>SO<sub>4</sub> to the sample until a pH of  $4.5 \pm 0.05$  is reached.
4. Record the volume of H<sub>2</sub>SO<sub>4</sub> added to the sample, to the nearest tenth, on the chemistry worksheet.

5. Rinse the pH electrode with deionized water. Measure out the next sample, refill the buret, and titrate the next specimen.

### Calculations:

Use the following formula to calculate the alkalinity as mg/L of calcium carbonate.

**Exception:** For alkalinity below 20 mg/L use low alkalinity calculation procedure (refer to SM2320B part 5)

$$\text{mg/L} = (\text{mL of H}_2\text{SO}_4 - 0.1) \times \text{normality of H}_2\text{SO}_4 \times (50,000 \div \text{ml of sample})$$

Example (for 50 ml sample):

$$(28.6 \text{ mL} - 0.1) \times 0.02 \times (50,000 \div 50 \text{ ml}) = 570 \text{ mg/L of Calcium Carbonate}$$

or

$$(28.6 \text{ ml} - 0.1 \text{ ml}) \times (20) = 570 \text{ mg/L of Calcium Carbonate}$$

### Reporting

Report in **whole** numbers; round off to 3 significant figures. Examples:

2,902.5 = 2,900; 1,125.9 = 1,130; 23.65 = 24

### References

Standard Methods for the Examination of Water and Wastewater 18th edition 1992

Written by: David Perez

Date: January 1993

Revised by: G. R. Guibert

Date: August, 1998

Approved by: \_\_\_\_\_  
Principal Analyst



# **Varian Flame AA Procedure**

## **SM 3111B**

### **For Ca, Mg, Na, K and Fe**

#### **Principle:**

In flame atomic absorption spectrometry, a sample is aspirated into a flame and atomized. A light beam is directed through the flame, into a monochromator and into a detector that measures the amount of light absorbed. Because each metal has its own characteristic absorption wavelength, a source lamp composed of that element is used. The amount of energy absorbed in the flame is proportional to the concentration of the element in the sample.

#### **Sample Collection/Handling:**

Use metal free collection bottle to collect sample. Collect one liter of sample. Smaller volumes (not less than 200 ml) can be used if necessary. On collection, acidify samples to pH <2 with 1:1 nitric acid, usually 3ml per liter. If samples are not acidified at time of collection, add acid upon receipt in lab and hold for minimum of 16 hours before analysis.[40 CFR 141.23(K)].

#### **Sample Preparation:**

Samples containing particulate or organic material require pretreatment before analysis. Samples with a turbidity <1 NTU, no odor and single phase may be analyzed directly. Digest all other samples before determining total metals.

#### **Digestion Procedure for total metals:**

Drinking water samples with turbidity >1 NTU can be analyzed following digestion with nitric acid. See procedure SM 3030E (Nitric Acid Digestion). Wastewater samples are better digested using method SM 3030F part b (Nitric Acid-Hydrochloric Acid Digestion). Report as total recoverable metal.

#### **Sample criteria:**

Except as noted, specimens that do not meet the criteria below should be immediately reported as "no test" with an explanatory note:

1. Samples submitted in improper collection container.
2. Sample inadequately identified. (Sample has no identification, or cannot be matched to a laboratory request form).
3. Sample quantity insufficient
4. Sample container broken or leaked in transit.

#### **Special Instructions:**

All glassware and pipettes used in this procedure must be cleaned using glassware-cleaning procedure. See document in kitchen.

#### **Reagents:**

1. Nitric Acid (HNO<sub>3</sub>). Use high purity nitric acid 1+1.
2. Lanthanum solution (1.11%): Dissolve 58.65 g lanthanum oxide in 250 ml of conc HCL. Add slowly with stirring until dissolved and dilute to about 900 ml. Allow to cool for a few hours then dilute to final 1000 ml volume. Used for Ca, Mg, Na, and K analysis.
3. Calcium solution: Dissolve 630 mg calcium carbonate, CaCO<sub>3</sub>, in 50 ml of 1+5 HCL. If necessary, boil gently to obtain complete solution. Cool and dilute to 1000 mL with water. Used for Fe analysis.
4. Standard Metal solutions: Standard metal solutions are prepared from 1000 mg/l AA or ICP-MS standards purchased from Ricca Chemical company, Spex Certiprep, LabChem, Fisher Scientific or VWR. A standard from EM scientific (ICP Multi-element Standard) is very convenient for calibration standards.
5. Deionized Water from Millipore system – metal free water.



**Instrument Set-up:**

Use the Varian Spectra 300AA operating in the flame mode with Air Acetylene burner.

1. Turn on exhaust hood. Switch is located in the corner by the Chemistry room refrigerator. Note: Turn switch until it clicks on. If you continue turning the switch after it clicks, the airflow will be reduced.
2. Turn on "Acetylene" gas cylinder located outside in the "Safety Storage" shed. The correct door housing the tank is labeled "Acetylene". Pressure should be set at 8-9 PSI.  
Note: The cylinder valve is opened by turning the handle only 1/4 turn counterclockwise. Replace cylinder when pressure in tank drops below 100 psi. This prevents acetone from entering instrument.
3. Check the Varian Spectra AA 300A unit to see if the burner is installed.
4. Check to see if the cathode lamp required is in the correct socket position, and it is lined up in the "Operating Lamp"  
Note: Lamps are stored in the top drawer located directly across from the GTA 96 Graphite Tube Atomizer (next to hood).
5. Turn on the equipment in the following order (allow a 20 minute warm-up period):  
Note: If the computer is already on, turn it off.
  - a. Spectra AA 300A: switch located on lower right front of instrument.
  - b. IBM PC and Printer: Turn surge suppressor on (power supply); hit reset button.

*Once the unit has been set-up, program the machine for testing by:*

1. Start at the "C:" prompt. Press "M" and "Enter".
2. Press "Spectra Flame"
3. Press "Index" (F10). Enter number 10, "Sequence Selection", press "Enter" key.
4. Select element to be tested
5. Press "Sequence Control" (F6). Enter number of samples to be tested.
6. Press "Index" (F10), enter number 6, "Optimization", press "Enter" key.
7. The Screen will display two signal bar graphs. Check the previous week worksheet for the "Photomultiplier voltage" reading.
8. Maximize the lamp signal of the Cathode tube using the two thumbscrews located on the back of the lamp socket (see figure 5.8).
  - a. Watch the bar graph as you turn one thumbscrew. Once the value reaches .9 or greater press "Rescale" (F1).
  - b. Check the Photomultiplier Voltage display on the screen, after rescaling. If the voltage is higher than the preceding week, continue adjusting and rescaling until the proper voltage is reached. If you are unable to reach the proper voltage, try adjusting the second screw.
  - c. Note: Normally the voltage stays the same from week to week, but as the lamp nears the end of its usefulness, the voltage reading will go up. If a new lamp is installed, the starting voltage may be different than the previous lamp. Record millivolt reading on worksheet.
9. After adjusting for maximum signal, hit "Rescale" (F1). The photomultiplier voltage will be displayed. If the reading matches the previous week, record the voltage on the new worksheet. If it is out of range, readjust lamps. If voltage is still out of range, notify Chemist.



10. Press "Index" (F10) key and select "Standards" (number 7). Verify that the values of the standards are correct (see previous worksheet for standard values). To select a value to change, use the up and down arrows. Enter the correct value with the keyboard.
11. Check to see that drain hose, located below the Spectra 300A, is inserted into the drain bottle. (empty after each use).
12. Press "Index" key, enter number 18 (Signal Graphics), and press "Enter".
13. Press "Shift" and "Instrument Zero" (F10).
14. Light burner by pressing ignite button. Aspirate DI water for about 10 minutes. This will allow burner temperature to stabilize.

***Standard and Sample Preparation:***

Required sample preparation depends on the metal form being measured.

***Procedure for Ca, Mg, Na, and K***

1. Label the 10 ml beakers with the standard value; label the sample beakers with the last three numbers of the tiny tab number. Using the adjustable pipette, pipette 1.0 ml of sample or standard into each disposable beakers.
2. Add 9.0 ml of 1.11% lanthanum to each sample or standard using the adjustable pipette.
3. Repeat the process once again by diluting 1 ml of the diluted sample to 10 ml with the 1.11% Lanthanum. The samples have now been diluted 1:10 and 1:100. Alternatively use proportionally smaller volumes (i.e. .5 ml sample and 4.5 ml of 1.11% lanthanum).
4. The standards are prepared from stock solutions that when diluted 1:10 will give the necessary concentrations for calibration. The stock solutions are prepared from 1000 ppm standard metal solutions purchased from Ricca Chemical Co. Record dates of preparation and expiration (3 months) in sample prep manual.
5. The final concentration of calibration standards will be,
  1. Ca: 1.00, 3.00, 5.00 and 10.00 mg/l
  2. Mg 0.10, 0.50, 1.00 and 1.50 mg/l
  3. Na 0.10, 0.50, 1.00, 1.50 and 2.50 mg/l
  4. K 0.10, 0.50, 1.00, 1.50 and 2.50 mg/l
6. Set report format: Go back to index by pressing the "Index" (F10) key, then select the "Report Format" (number 13). Here you can enter the name of the operator, batch name, and date. No other changes are usually necessary.
7. Start program: Press the "Start" (F11). The screen will show the message "Select Lamp 3"; press "Start" (F11). The program will now run to completion.
8. Calibration of other Metals besides Fe/Mn: The other metals tested by flame AA does not require an ionization suppressor and can be directly aspirated. See specific method on computer for required calibration standards.

***Standard and Sample Preparation: Procedure for Fe:***

1. Label the sample beakers with the last three numbers of the tiny tab number. Using the adjustable pipette, pipette 1.0 ml of Ca solution into each disposable beakers.
2. Add 4.0 ml of sample to each beaker using the adjustable pipette.
3. The standards are prepared from 1000 ppm standard metal solutions purchased from LabChem or Spex Certiprep. Add 20 ml Ca solution and 1 ml conc HNO<sub>3</sub> to each 100 ml of standard prepared. Record dates of preparation and expiration (3 months) in sample prep manual.
4. The final concentration of Fe calibration standards will be: 0.3, 0.5, 1.0, and 3.00 mg/l
5. Set report format: Go back to index by pressing the "Index" (F10) key, then select the "Report Format" (number 13). Here you can enter the name of the operator, batch name, and date. No other changes are usually necessary.
6. Start program: Press the "Start" (F11). The screen will show the message "Select Lamp 3"; press "Start" (F11). The program will now run to completion.

**Quality Control:**

1. Analyze a Blank after every 10 samples to verify baseline stability. Rezero when necessary.
2. Duplicate Spikes - replicate spikes are to be performed on 10% of samples. Recovery of spike in drinking water should be between 80% and 120% with a precision of 20%. Recovery of spike in wastewater should be between 75-125% with a precision of 25%. Spike level should not exceed MCL for analyte. Spiking solutions are available from Crescent Chemical Co. or SPEX.
3. External Reference Sample - Analyze a known reference sample after initial calibration and after every ten samples to confirm the test is in control.
4. See Table 3111:III in Standard Methods for recommended concentrations of standards to be run, limits of acceptability, and reported single operator precision data.
5. Analyze External Reference Sample on quarterly basis. Solutions available from APG, ERA or SPEX.

**CRITERIA FOR ACCEPTABILITY OF RUN**

1. Recoveries of spikes and controls are within acceptable range.
2. Blank values below detection levels.
3. Acceptable levels of precision.

NOTE: If any of the acceptance criteria are not met, the analyst must stop the run, correct the problem and retest the samples.

**OUT OF CONTROL PLAN**

No sample should be reported until the all acceptance criteria have met. Or the out-of-control condition has been corrected and any problems or departure from protocol identified.

**Trouble Shooting:**

1. PROBLEM - poor precision,  
Check alignment of hollow cathode lamp. Check that capillary hose is not clogged. Make sure burner is clean and flame appears smooth and even. Replace pinched or crimped capillary tubing.
2. PROBLEM - error message  
Refer to instrument service manual



### 3. PROBLEM - Contamination

Check supplies associated with sample collection for contamination. Check rinse water, sample diluent, pipettes, sample cups. Make sure work area is free from dust.

#### **Shutdown Procedure:**

Turn off acetylene, IBM PC, and AA300, and exhaust hood, in that order.

#### **Calculations:**

The results will be printed and should be recorded on a worksheet. The dilution factor must be shown and considered in the calculations.

#### **Reporting:**

1. The data from the printout should be transferred to the worksheet. Verify that controls were within acceptable range and that duplicates are within range.
2. The lab clerk enters the results into the computer. Results are reported in units and number of significant figures consistent with MDL of method.

#### **References:**

1. "Analytical Methods for Flame Atomic Absorption Spectrometry" Varian Techtron Pty, Limited, 1989.
2. "Standard Methods for the Examination of Water and Wastewater"  
18th Edition 1992 by APHA, AWWA, and the WEF.

Written by: David Holland  
Date: January 1999

Approved by: \_\_\_\_\_  
Laboratory Director

DETERMINATION OF INORGANIC ANIONS  
BY ION CHROMATOGRAPHY (EPA METHOD 300.0)  
USING THE DIONEX DX-80 ION ANALYZER

**PRINCIPLE**

This method determines the following inorganic anions: fluoride, chloride, nitrite, bromide, nitrate, phosphate and sulfate.

A small volume of sample (approx. 1 ml) is loaded into the ion chromatograph. The injection valve injects 10 ul of the sample into the flow of eluent. The eluent (a  $\text{NaHCO}_3$  -  $\text{Na}_2\text{CO}_3$  solution) flows continuously through the IC and serves as a carrier for the 10 ul of sample and facilitates in the separation process.

The anions of interest are separated using suppressed conductivity detection, and are identified and quantified by comparing data to those obtain from a standard solution. The major parts of the system are the liquid eluent, high pressure pump, sample injector, guard column, the separator column, the chemical suppressor and the conductivity detector. The guard column protects the separator column, which separates the anions based on their size and charge. The function of the suppressor is to chemically reduce the background conductivity of the electrolytes in the eluent, and to convert the sample anions into a more conductive form. The detector then detects the conductivity of the solution, which varies depending on the concentrations of the anions (higher conductivity indicates a greater concentration of the anion).

**SAMPLE CRITERIA**

The holding times for drinking water samples are as follows:

$\text{F}^-$	28 days
$\text{Cl}^-$	28 days
$\text{NO}_2^-$	48 hours
$\text{NO}_3^-$	48 hours
$\text{SO}_4^-$	28 days
$\text{Br}^-$	28 days

Samples submitted for IC testing routinely should be run within 48 hours of collection, especially for nitrite and nitrate. If testing needs to be delayed, the sample can be preserved with sulfuric acid; preserved samples can be held for up to 28 days and the nitrate results reported as combined Nitrate/Nitrite. Any samples not tested within specified holding times should be identified on the worksheet.

Samples bottles dedicated for IC testing only are placed on the IC bench. As soon as a sample is setup, place it on the white tray for easier storage. After 6 weeks the containers should be emptied and discarded. Nondedicated samples (i.e. those also submitted for additional testing) should be returned to the designated cart after IC testing.



## QUALITY ASSURANCE

**Operator competency** - Ion chromatography may be performed only by analysts who have been trained and who have demonstrated competency with the procedure. One check consists of preparing the calibration standards and calibrating the I.C. An r-value of 0.995 or higher (correlation coefficient of 99.95%) in the linear fit type must be attained for each analyte of interest. Another way to demonstrate competence is to run a minimum of four replicate analyses of an independently prepared sample. Each analyte of interest in the sample should have a known concentration between 5 and 50 times the MDL.

**Blank** - A blank consisting of nanopure water should be included at the beginning of each run. The results for the blank must be below the MDL for each analyte.

**Control standard(s)** - Controls representing two concentration levels for each analyte (ICMIX HIGH & ICMIX LOW) must be analyzed as described below. The source of the analytes used to prepare these controls must be different from the source used to prepare the calibration standards. An ICMIX HIGH stock solution of the 7 anions with the following final concentrations:

<i>Anion</i>	<i>Final Conc</i>	<i>Preparation in 500 ml volumetric flask</i>
Fl <sup>-</sup>	20 ppm	10 ml of 1000 ppm Fl std
Cl <sup>-</sup>	100 ppm	50 ml of 1000 ppm Cl std
NO <sub>2</sub>	65.5 ppm	10 ml of 1000 ppm NO <sub>2</sub> -N std
Br <sup>-</sup>	20 ppm	10 ml of 1000 ppm Br std
NO <sub>3</sub>	100 ppm	50 ml of 1000 ppm NO <sub>3</sub> std
PO <sub>4</sub>	100 ppm	50 ml of 1000 ppm PO <sub>4</sub> std
SO <sub>4</sub>	100 ppm	50 ml of 1000 ppm SO <sub>4</sub> std

should be kept on hand. Use this undiluted at the beginning of the run and after every tenth sample. Each week, prepare an ICMIX LOW solution from the ICMIX HIGH solution as follows: Using a 100 ml volumetric flask add 1 ml of ICMIX HIGH using the 1 ml volumetric pipet and fill to mark with nanopure water. Record date made in the IC logbook under Quality Control. Run the IC LOW at the beginning of the days run and after every 10<sup>th</sup> sample after the IC HIGH. The percent recovery for each anion should be between 90 and 110%.

**Duplicate spikes** – Duplicate spikes should be run after every tenth sample. The spike should not be less than four times the MDL, and it should increase each anion concentration by more than 25% of the background value. A suitable spike can be prepared by adding one part ICMIX HIGH to three parts sample. The average percent recovery for each anion should be between 80 and 120%. The duplicate spikes should be within 10% of each other. Record average percent recovery of spikes and duplicate percent difference on worksheets. Note: if the concentration of the spike is less than 25% of the background concentration, the spike recovery should not be calculated.

If any of the above control criteria are not met, do not report sample results until the problem has been resolved.



**External controls & chart analysis** - In addition to the control standards tested with each batch of samples, an external reference standard (i.e. SPEX IC standard or WS proficiency sample) should be tested on a quarterly basis; however we like to run one at the end of each run.

### **CALIBRATION FOR GROUNDWATER (DRINKING WATER AND MONITORING WELLS):**

Calibration for groundwater samples is described below. Calibration should be performed whenever: 1) controls are out of range; 2) a new batch/lot of eluent/regenerant is made or 3) when a column, suppressor or detector is changed.

1. Prepare 1/10, 1/100, 1/1000 dilutions of the calibration standard ordered from Dionex, which contains 20 mg/l fluoride, 100mg/l chloride, 100 mg/L nitrite, 100 mg/L bromide, 100 mg/l nitrate, 200 mg/L phosphate and 100 mg/l sulfate.
2. Run calibration standards beginning with the highest dilution (1/1000) first.
3. Create calibration sequence: File – New – Sequence – Standards – Next. Skip section on Choosing Timebase – name the sequence *calibMMDDYEAR* and initials – Next – Done.
4. Add sequence to batch file before starting
5. After all four calibration standards have been ran, check the calibration curve.
  - a) Double click on any of the calibration standards (Cal Std 1). You will get a chromatograph
  - b) Click on Calibration Plot icon, upper right corner or click on VIEW – Calibration Plot. You will see a graph of the first analyte along with the correlation coefficient percentage for each analyte. Only analytes with percentage of 99.5 or greater are acceptable. Generally try for a 99.98% for an average of all seven analytes to pass quality control checks. See the principle analyst if the result is a lesser value.
  - c) The mean retention times and detection range are automatic on the DX-80 Ion Analyzer and can not be changed or edited.

### **PREPARE MDL STUDY**

The Method Detection Limit is the lowest concentration of a substance that can be identified with accuracy and confidence by a certain method or analysis.

- 1) Prepare a Cal Std 1 level each analyte separately using the secondary standards (not Dionex mix)
- 2) Make seven replicates of this dilution and run through the Ion Analyzer under the Unknown Method.
- 3) Collect data and calculate the standard deviation for the seven replicates. Multiply the standard deviation values by 3.143. This number will be the Method Detection Limit.

### **GENERATE BACKLOG REPORT:**

- 1) On a network computer – not the Instrument computer. Double click on LABWORKS icon. Enter password. Click on OK. Click on backlog. Click on analysis code. Click on OK. Type in #ICANION. Click on OK. Click on display report. Click on print. Click on exit until you are out.
- 2) Check the clipboard to see if a worksheet has been initiated listing samples that need repeat testing; if so, append worksheet with samples on backlog report.
  - a) Account for all specimens on backlog report
    - i) Samples may have been tested in a previous run but not recorded. Record these results and give to the clerk.
    - ii) If a sample appears on the backlog but needs to be tested by a different method (i.e. wastewater), inform the clerk so that the analysis ordered can be modified.
  - b) Include any "new" samples on the I.C. bench that have not yet been entered into the computer.

### **SAMPLE PREPARATION**

Groundwater (drinking water and monitoring wells) should be filtered through 0.45 um membrane filters before injection:

- 1) Rinse the syringe once with the sample water. Then fill syringe with about 10 ml of sample water.
- 2) Filter a minimum of 2 ml of sample through the 0.45 membrane into a labeled autosampler vial discarding the first few drops.
- 3) Place autosampler cap on vial and press down using the provided tool. Make sure the cap goes in straight and remove any air bubbles seen in the vial (invert or knock gently).
- 4) Place sample in autosampler rack. The order in the rack must match that on the schedule.  
Note: If you suspect the result of a sample to be above that of the calibration standard for an analyte, make an appropriate dilution. Check by measuring conductivity – anything greater than 700 uS will need to be diluted.
- 5) Include duplicate spikes for every 10<sup>th</sup> sample. Add 1 part ICMIX high to 3 parts filtered sample. Then IC HIGH, LRB, IC LOW. The laboratory reagent blank (LRB) is necessary to minimize carry over as the IC low is 100 times less than the High. Double check any samples where analyte concentrations are low after a high sample to verify analyte is even detected.

Samples which may contain high concentrations of chloride or organic contaminants (Carmel Area Wastewater District and ESF), are run on the DX-100 and require additional filtering through Dionex OnGuard P, Dionex OnGuard Ag, and Dionex OnGuard H filters before injection. See supplemental procedures.



### SYSTEM START-UP:

- 1) Ensure the **eluent** bottle is at least  $\frac{1}{4}$  full. If it is less, depending on size of run, prepare new eluent (and regenerant):
  - a) Prepare 2 liters of a final eluent concentration of 8.0 mM Sodium Carbonate and 1.0 mM Sodium Bicarbonate by diluting one Dionex AS 14A Eluent Concentrate bottle (P/N 057060) into two 1L-volumetric flasks. Bring each to volume (1000 ml) with nanopure water. Makes 2 liters.
  - b) Use the designated filter/vacuum flask, a filter funnel, a clean 0.45um membrane filter, and a large magnetic stir bar to degas the eluent. Pour the eluent into the filter funnel and turn on the vacuum. Set the magnetic sticker at medium to high speed. Once all the eluent has been filtered, keep the vacuum and magnetic stirrer on for 15-20 minutes, allowing the eluent to degas.
  - c) Turn off the magnetic stirrer and the vacuum. Remove the filter funnel. Carefully decant the degassed eluent into the eluent bottle, without aerating. Make sure the cap is on tightly, and the tubes are securely attached.
- 2) Whenever new eluent is prepared, new **regenerant** must also be made.
  - a) Prepare 2 liters of a final anion regenerant concentration of 72 mN Sulfuric Acid by adding one Dionex Anion Regenerant Concentrate bottle (P/N 057559) to two liters of nanopure water.
  - b) Mix in the regenerant in the designated filter flask using the stir bar and degas for 15-20 minutes.
  - c) Turn off the magnetic stirrer and the vacuum. Remove the filter funnel. Carefully decant the degassed regenerant into the REGEN bottle, without aerating. Make sure the cap is on tightly, and the tubes are securely attached.

### DX-80 OPERATION

- 1) Turn on nitrogen gas cylinder (main knob only), autosampler (rear right hand corner), ion analyzer (rear panel right hand side) and computer.
- 2) Double click on Peaknet to open computer program. **File – Panels\Dionex DX-80 System** for the Control Panel.
- 3) Under the DX-80 Status click on **CONNECT** to connect analyzer to computer
- 4) Turn on the pump by clicking the **ON** button on the DX-80 Control Panel. **Prime** the pump by turning the pump head waste valve knob counter clockwise and leaving it open for about 5 seconds. Close the pump valve knob by turning clockwise until secure. After changing to new eluent, it is a good idea to leave pump valve open until all air bubbles have been purged – look for the air bubbles coming out the eluent bottle until it reaches the waste line at the pump. This will allow any air bubbles to be pumped to waste instead of through the columns.
- 5) Allow the system to **equilibrate** for 30 minutes minimum, generally one hour if new eluent is used. Once ready, the **operating pressure** should be 2000+- 300 psi (usu 2100



psi); and the operating **total conductivity** background should be < 30 uS (usually 25.00uS). You can offset the background and zero the reading by clicking the Autozero button on the Control Panel.

- 6) To begin a run, create a sequence worksheet by clicking on **File – New – Sequence**. (May have to do this twice if worksheet is not already open.)
  - a. It will then prompt you to choose Standard or Unknowns. Choose **Unknowns - Next**
  - b. Skip **next** screen where it prompts you to specify timebase,
  - c. **Estimate** number of unknowns (you can always add or delete samples from sequence when done.
  - d. Fill out file name you wish to save the file. We save under **MMDDYEAR** and **initials**: (05052002tl) and press **enter**.
  - e. Press **Done** when prompted to exit wizard.
  - f. A worksheet will appear where sample identifications can be added after the calibration data (line #5). Follow printed worksheet – first include a *blank, ic low, ic high, lrb*, then the samples. Note for the first set, the lrb is listed as a sample. *Duplicate spikes* are required for every 10<sup>th</sup> sample or a minimum of 10% of samples. Finish off sequence with a known quality control standard, usually a proficiency standard such as *WS 60* or Ultra QC and another blank (LRB).
  - g. Change *dilution factor* if sample was diluted; default is one. Save by pressing the SAVE icon (floppy disk).
- 7) To start the run – click on **Batch – Edit – Add** – double click on the newly created sequence, or the one you want run – then **Start** to begin.
- 8) Make sure autosampler vials are in order and the green light is on 'Run' not 'Hold'.
- 9) Record date, total conductivity and pressure in the log notebook at which the run has started.
- 10) During or after the run, verify that the blank and QCs (IC HIGH, IC LOW, IC CHECK) are within range. If not stop the run by clicking on **Batch – Stop - after current sample**, and notify principal analyst to investigate and solve the problem before resuming the run.

## REPORTING RESULTS

- 1) When run is complete the analyst performing the run is responsible for recording and reporting results. Review each chromatogram to verify that the peaks were properly identified. Retention times may shift if there was a sudden change in pressure. Changes to the peak name can be made by a right click on the peak and choosing the correct analyte then save.
- 2) The results are found on the worksheet next to the sample ID and can be exported to an excel file for accuracy calculation:
  - a) Click on any sample cell – i.e. ic low, cell will be outlined.



- b) Click on **File – Batch Report – Export** (unclick the Printout option- computer is not connected to any printer) – **Excel file format**
  - c) For sheets to be exported, choose only “ **Summary – INJ vs. Area, Ht, Amt.**” Unclick the Integration, Calibration, Peak analysis, Summary-INJ vs. Anion, and Audit Trail options as they are extra and rarely needed for our purpose.
  - d) Click on **Finish** then **OK** on batch menu. Status will appear and when transfer is complete, press **OK** to exit.
- 3) To copy exported file onto a floppy, right click on Start icon on lower left screen and choose EXPLORE for Windows Explorer. Under **C:\Chromel\Export** folders are the files just exported. Highlight the correct sequence and drag to **A:\** drive to copy file. (Make sure you have a floppy disk inserted).
- 4) Open exported file under an EXCEL program – the instrument computer does not have one so use a network computer. You will see three types of charts: first- Sample vs. Area, second - Sample vs. Height, and third - Sample vs. Amount. Copy all of the **Sample vs. Amount** table to an old/previous excel file.
- 5) The Excel Results worksheet is permanently saved under **G:\Laboratory\Data\Water\IC Data\2002\** under the correct month. It is also saved in Tess’ computer under **C:\My Documents\IC Data\** and correct year and month. Easiest way to create the worksheet is to open a previously saved file (of the same year and month) and then cut and paste the data. There are two worksheets in each file, one for the complete results, the other for the raw data (the Sample vs Amount table exported from peaknet).
  - a) Before any changes are made, save the file under a new name: MMDDYY and initials
  - b) On RAW worksheet, delete old table and replace with recently ran sequence data. Add a column between Sample ID and Fluoride Amount for the dilution factor.
  - c) Change Date Analyzed and Analyst if applicable. Calibrations are generally done once a month with the most recent noted under Date of Calibration – change if necessary.
  - d) **Copy** and paste data results from raw worksheet onto Results worksheet under correct sample name. Use the **Paste Special option – Values** - to retain similar fonts on results worksheet. **% Recoveries** will be automatically calculated as will **% Differences**, and **Averages** for the duplicate spikes but references to certain cells may need to be changed for the correct result.
  - e) Verify that all QC are accurate before entering into labworks.
- 6) For drinking water, results should be recorded as ND – Not Detected for levels below DLR (Detection Limit for Reporting) as follows:
  - a) Fluoride            0.1 mg/L
  - b) Nitrate            2.0 mg/L
  - c) Sulfate            0.5 mg/L
  - d) Bromide           0.1 mg/L
  - e) Chloride, Nitrite, Phosphate 1.0 mg/L
  - f) Any samples with readings above the calibration range (20 mg/L fluoride, 100 mg/l chloride, nitrite, bromide, nitrate, sulfate, and 200 mg/l phosphate) needs to be diluted and

repeated in the next run. List these samples on a new worksheet with the appropriate dilution and place the worksheet on the clipboard.

- 7) Do not report results if control/spike values do not fall within limits (refer to section on quality control). If controls, spikes, etc. are out of range, notify the principal analyst. If controls are within limits, date and initial the worksheet and give the worksheet to the clerk for data entry. When the worksheet and backlog are returned place them in the binder.

### **SHUT DOWN**

After the run is complete the Ion Analyzer can be shut down. The IC should be shut down on weekends if the system is not in operation on Friday night so as not to damage the suppressor unit:

- 1) On the Control Panel screen of Peaknet - turn **OFF** pump and **DISCONNECT** DX-80
- 2) Close Peaknet.
- 3) Turn off DX-80, autosampler and close nitrogen cylinder valve.

### **PREVENTIVE MAINTENANCE:**

- 1) Each quarter, replace the bed supports on guard column
- 2) Maintain the following spare parts. These items are considered consumables:
  - a) Anion Refill Kit (Part No. 057069) contains 4 bottles each of AS14A eluent and anion regenerant concentrate.
  - b) AS14A anion separator column, 3 mm (Part No. 056901)
  - c) AS14G anion guard column (Part No. 056899)
  - d) AMMS III suppressor (Part No. 056751)
  - e) DS5 Detection Stabilizer (Part No. 057290T)

### **DOS AND DON'TS**

- \* Try to make additions, changes, and deletions to the sequence during the middle of a run and then save immediately. If the changes are not saved immediately, the program may get confused on which sequence to use and will freeze. If this happens, wait until the current sample is completed, turn off all equipment and wait for about 15 minutes before restarting.
- \* Be gentle when loading samples onto the autosampler, especially the first rack. If racks are installed too roughly, conveyor belt may get stuck and samples will not be injected in the proper sequence.



**REFERENCES:**

- 1) DX-80 Ion Chromatograph with SRS Control Operator's Manual, Dionex Corporation, 2002.
- 2) Methods for the Determination of Inorganic Substances in Environmental Samples, Method Number 300.0, Determination of Inorganic Anions by Ion Chromatography, John D. Pfaff, U.S. Environmental Protection Agency, 1993.
- 3) Standard Methods, 18th Edition, 1992. Part 4110.

Originally written by: Johanna Rosen for DX-100

Date: 12-96

Updated by: Theresa Lam for DX-80 Ion Analyzer

Date: 05-02

Approved by: \_\_\_\_\_  
(Lab Director's signature)

## Appendix 7-E

### **Watermaster's Seaside Basin Monitoring and Management Program**

# **SEASIDE BASIN MONITORING AND MANAGEMENT PROGRAM**

**Approved by the Seaside Groundwater Basin Watermaster Board  
May 17, 2006**

# **SEASIDE BASIN MONITORING AND MANAGEMENT PROGRAM**

## **Seaside Groundwater Basin Watermaster Board**

- Chairman: Mayor Ralph Rubio, City of Seaside
- Vice Chairman: Bob Costa, Laguna Seca Subarea Landowner
  - Secretary/Clerk: Director Michelle Knight, Monterey Peninsula Water Management District
- Treasurer: Mayor Dan Albert, City of Monterey
  - Mayor David Pendergrass, City of Sand City
- Steve Leonard, California-American Water Company
  - Mayor Joseph Russell, City of Del Rey Oaks
    - Jerry Smith, District 4 Supervisor, Monterey County/Monterey County Water Resources Agency
  - Paul Bruno, Coastal Subarea Landowner

## **Seaside Groundwater Basin Watermaster Board Technical Committee**

- Andrew Bell, District Engineer, Monterey Peninsula Water Management District
  - Curtis Weeks, General Manager, Monterey County Water Resources Agency
- Joe Oliver, Water Resources Manager, Monterey Peninsula Water Management District
  - Keith Larson, Director, Water Resources, California-American Water Company
- Dave Berger, General Manager, Monterey Peninsula Water Management District
  - John Fischer, Member of the Public
- Steve Leonard, Vice President and Manager, California-American Water Company
  - Steve Matarazzo, Community Development Director, City of Sand City
  - Tim O'Halloran, Senior Engineer, City of Seaside
- Diana Ingersoll, Deputy City Manager – Resource Management Services, City of Seaside



# Seaside Basin Monitoring and Management Program

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# **Seaside Basin Monitoring and Management Program**

## **I.**

### **Introduction**

This Seaside Basin Monitoring and Management Program (“Program”) is adopted by the Seaside Basin Watermaster to comply with the Judgment entered in the Seaside Groundwater Basin Adjudication (California American Water v. City of Seaside, Monterey County Superior Court, Case Number M66343) and to ensure that the Seaside Groundwater Basin (“Basin”) is protected and managed as a perpetual source of water for beneficial uses.

The Judgment required the preparation of a comprehensive monitoring and management plan for the Seaside Basin (Monitoring and Management Plan”) consistent with the criteria set forth in Exhibit A (Appendix 1) of the Judgment. The Technical Committee appointed by the Seaside Basin Watermaster Board has chosen to name this document the “Program” versus the “Plan” referred to in the Judgment. This was necessary to clarify that the tasks and schedule set forth in this document is the program that will create the Seaside Basin Monitoring and Management Plan.

The Program sets forth actions that will be taken to: (a) monitor current overdraft conditions and the present threat of potential seawater intrusion into the Coastal Subarea of the Basin; (b) develop and import supplemental water supplies for the purpose of eliminating Basin overdraft and the associated threat of seawater intrusion, and (c) establish procedures that will be implemented to address seawater intrusion should seawater intrude into the onshore portions of the Basin. All costs of undertaking the actions set forth within this Program shall be paid from the Monitoring and Management Program component of the Watermaster Budget, set forth in Section III.L.3.J.iv of the Judgment. The Court’s Decree calls for the Seaside Basin Watermaster to develop a Basin Management Program within one year of the Court’s judgment. The following is a description of the scope of work for the management program, the monitoring program and schedule that will be undertaken by the Watermaster over the next 12 to 18 months to complete the Basin Management Program.

## **II.** **Basin Monitoring Program**

### **A. Basin Overview**

The Seaside Groundwater Basin has been characterized as underlying an approximately 19 to 24 square mile area at the northwestern corner of the Salinas Valley, adjacent to Monterey Bay. The general location of the basin and its four subareas are shown in **Figure 1**, which is from a study updating the condition of the basin completed by the Monterey Peninsula Water Management District (MPWMD) in 2005 (Yates and others, 2005. *Seaside Groundwater Basin: Update on Water Resource Conditions*. Prepared for MPWMD, April 14, 2005). The basin underlies a hilly coastal plain that slopes northward toward the Salinas Valley and westward toward Monterey Bay. The basin area includes Sand City, a portion of Monterey, and much of the cities of Seaside and Del Rey Oaks, as well as a portion of unincorporated Monterey County. In addition, the basin underlies most of the land occupied by the former Fort Ord military base. The basin consists of a sedimentary sequence of water-bearing materials that overly the relatively impermeable shales of the Monterey Formation. The two principal geologic units in terms of water supply potential are known as the “Paso Robles aquifer”, consisting of interbedded sand, gravel and clay deposits of continental origin, and the underlying “Santa Margarita aquifer”, consisting of a loose to weakly-cemented marine sandstone.

### **B. Basin Monitoring Background**

Current water resource monitoring in the Seaside Groundwater Basin can be categorized into the following five principal types: groundwater production monitoring, groundwater level monitoring, groundwater quality monitoring, surface water monitoring, and precipitation monitoring. The history of development and current status of each category is briefly reviewed in this section.

#### **1. Groundwater Production Monitoring**

The early history of groundwater development in the Seaside Basin was not well documented. Prior to about 1950, the majority of groundwater extractions in the coastal area were assumed to be associated with small farming operations. The earliest recorded production dates to the mid-1950's, when municipal wells were installed in the coastal area of the basin by several small water systems that were acquired in the mid-1960's and subsequently consolidated into the main California American Water (Cal-Am) system that serves the Monterey Peninsula area. Other early metered production records were kept for wells in the coastal area supplying Fort Ord and the City of Seaside. A coordinated program of collecting and reporting groundwater production in the basin was established by the MPWMD in 1980. This program requires annual reporting of water production (surface water and groundwater) from all sources within the MPWMD's boundary, which encompasses most of the Seaside Basin area. Currently, there is no surface water production from the Seaside Basin, and the only known groundwater



production occurring within the basin outside of the MPWMD boundary is limited to production from Monterey County Parks Department wells at the eastern end of the Laguna Seca subarea of the Seaside Basin. In addition to the annual reporting requirement, MPWMD regulations require more comprehensive management for the Cal-Am water distribution system, as this system derives its supply from more than one hydrological management unit (i.e., the Carmel River Basin and Seaside Basin). This is accomplished under MPWMD regulations through the Quarterly Water Supply Budget Strategy program, in which projected production quantities for each of Cal-Am's production sources are developed on a quarterly basis, and actual production is tracked daily.

## **2. Groundwater Level Monitoring**

The earliest groundwater level data collected in the Seaside Basin were from the municipal wells in the coastal area, beginning in the mid-1950's. The coverage was sparse, however, and limited to a small area of the basin. Water level data collection in the coastal area became more consistent when Cal-Am began operations in the mid-1960's, but the lack of long-term, spatially-distributed groundwater level data compromised the ability to rigorously assess the condition of the basin in studies conducted during the 1970's and 1980's. The Monterey County Water Resources Agency (MCWRA) periodically monitored several wells in the basin until that monitoring was curtailed due to budget constraints in the early 1990's. Basic groundwater data collection improved beginning at that same time as the MPWMD undertook a program of installing dedicated monitor wells in each aquifer at key locations in and near the coastal area of the basin. A network of dedicated monitor wells was preferable in that the water level data are more indicative of conditions outside of the direct influence of production wells. The dedicated monitor well network has been expanded since then, and is now comprised of 24 wells at 14 locations in and near the coastal and northern portions of the basin, and an additional 16 wells at 12 locations in and near the Laguna Seca subarea. The locations of monitor and production wells in and near the basin are shown on **Figure 2**. Presently, the MPWMD collects water level data monthly from 19 of the 24 monitor wells in and near the coastal subareas. Seven of these monitor wells are also equipped with automatic dataloggers (i.e., recording pressure transducer units) set to record hourly water levels to complement monitoring as part of the MPWMD Aquifer Storage and Recovery (ASR) program in the basin. The MPWMD collects water level data semi-annually (in Spring and Fall to correspond with anticipated seasonal high and low water levels) from 16 monitor wells in and near the Laguna Seca subarea. In addition to water levels collected by the MPWMD, Cal-Am currently collects and reports to MPWMD monthly water levels from 14 active and inactive production wells in the coastal subareas, and 7 wells in the Laguna Seca subarea. .

## **3. Groundwater Quality Monitoring**

Historically, groundwater quality data were sparse and were not readily available to adequately support characterization of groundwater quality in the basin in the early resource studies conducted in the 1970's and 1980's. In the early 1990's, the MPWMD

began a program to collect groundwater quality data from coastal monitor wells in the basin. This program has been expanded since then and now includes twelve (12) monitor wells at six (6) locations (**Figure 3**). Groundwater quality samples are currently collected annually and analyzed for a suite of inorganic parameters (i.e., general minerals) to assess long-term trends or changes that could indicate seawater intrusion. Based on the assessment of data from the MPWMD coastal monitor wells, there has been no indication of seawater intrusion into either of the basin's principal aquifers – the Paso Robles Formation or Santa Margarita Sandstone. In addition to the groundwater quality data collected by the MPWMD from its coastal wells, both the City of Seaside and Cal-Am collect complete general mineral groundwater quality data at least annually from their municipal production wells that serve water for potable use, as per requirements from the California Department of Health Services.

#### **4. Surface Water Monitoring**

Because dune sands cover much of the land area over the basin, precipitation falling on the basin does not produce appreciable surface runoff but directly infiltrates through the sandy soils. The exception is Arroyo Del Rey, which drains a portion of the Laguna Seca subarea. The U.S. Geological Survey measured discharge from this channel at Del Rey Oaks from 1966 to 1978, when this recording station was discontinued. The MPWMD re-established this as a recording station in 2002, and continuous streamflow records are currently maintained for this site.

#### **5. Precipitation Monitoring**

There are no long-term records of precipitation from monitoring stations within the Seaside Basin. Accordingly, basin precipitation estimates in previous water resources investigations have been based on records from nearby recording stations. The recent hydrogeologic assessment of the basin conducted for Cal-Am relied primarily on long-term records available from the National Oceanographic and Atmospheric Administration (NOAA) Station #045795 in Monterey (CH2M HILL, 2004, *Hydrogeologic Assessment of the Seaside Groundwater Basin*. Prepared for Somach, Simmons & Dunn and California American Water, January 2004. See page 2-2).

### **C. Basin Monitor Well Construction Program**

#### **1. Purpose**

Notwithstanding the current groundwater monitoring efforts as described above, the Court recognizes that the present monitor well network is lacking adequate coverage in and near the Northern Coastal subarea of the basin, considered to be most vulnerable to seawater intrusion. Additionally, there are few existing monitor well control points to adequately define conditions along the northern basin boundary in the Northern Inland subarea. This section describes the Watermaster's planned exploratory drilling and monitor well construction activities that are designed to enhance the efficiency and utility

of the existing basin monitoring network. This program is based on the description provided in Exhibit A of the *Decision*, attached as Appendix 1 of this program. Any proposed departures from that description and the basis for them are also described herein.

To ensure that the coastal area is adequately monitored to detect potential seawater intrusion, exploratory drilling, geophysical surveying and monitor well construction will be undertaken. Based on current knowledge of the availability of existing subsurface control points in and near the coastal area of the basin, monitor wells shall be initially constructed at a minimum of four (4) additional coastal “sentinel” monitor well sites (*“Sentinel” monitor well sites* refers to the network of monitor well sites closest to the coastline in and near the Seaside Basin, which can serve as a first line of defense in detecting potential seawater intrusion) at approximately 3,000 feet spacing, in the area along the coast northeast of existing monitor well “WMD-PCA-W”. It is anticipated that the four coastal sites will be selected from the six potential target areas sites that are shown on **Figure 4**. Four sites are in a line near the coastline and two sites are slightly farther from the coastline and in between the most coastal sites, to provide secondary coverage if seawater intrusion should occur in narrow lobes or fingers. The actual locations for the new coastal “sentinel” well sites must be carefully selected based on nearness to the coastline, coastal erosion potential, site logistics, and long-term access constraints.

In addition, two (2) inland sites near the northern basin boundary shall be selected for exploratory drilling and monitor well construction. The recommended target areas for these sites are also shown on **Figure 4**. Information developed from these inland sites will support an improved understanding of the occurrence and nature of the aquifer systems and groundwater levels in the vicinity of the northern basin boundary where there are no existing monitor or production wells, and will support long-term monitoring in the basin.

As a planning goal, it is anticipated that these new monitor well installations can be completed within approximately 18 months of the Court’s approval of this document, as shown in **Figure 5**. A breakdown of the proposed schedule by task is also included in Section V. Based on previous experiences by the MPWMD in installing similar coastal and inland monitor wells in the basin, land availability, authorization and access are key issues that must be overcome to successfully site and construct the monitor wells. The optimal locations for the new coastal monitor wells are along the coastal bluffs of the former Fort Ord military base, on land that is currently under the jurisdiction of the U.S. Army, but ultimately planned for transfer to the California Department of Parks and Recreation (CDPR). Accordingly, approval of such activity in this area of former Fort Ord will require the acquisition of a long-term easement, and will likely include authorizations from the Army Base Realignment And Closure (BRAC) office, the Fort Ord Reuse Authority (FORA), the County of Monterey, and the CDPR. As an alternate option, if land use approvals prove too difficult or lengthy for the coastal bluff locations, consideration will be given to siting the new coastal monitor wells along the inactive railroad alignment through the former Fort Ord coastal area. The Transportation Agency

of Monterey County (TAMC) has recently acquired this property from the Union Pacific Railroad. Sites along the railroad alignment are less ideal in that they are approximately 500 to 1,500 feet farther from the coastline than the coastal bluff sites, but the approval process for use of these sites is anticipated to be less time consuming, and the MPWMD has already initiated discussions with TAMC on this issue. In any event, additional documentation from the Court endorsing its order to install the additional coastal monitor wells may be beneficial for the Watermaster to receive timely authorization for these monitor well installations.

As explained above, given the complexity of land use constraints and jurisdictional authority in the local setting, it is not likely that the exploratory drilling program can be conducted in the precise fashion described in Exhibit A of the *Decision*. Additionally, it is not envisioned that the exploratory drilling and geophysical surveys will be conducted as separate advance activities to facilitate subsequent siting of the new monitor well locations. Rather, monitor well clusters shall be installed at each of the carefully selected sites described above, with monitor well design and number of wells at each site guided by the lithologic and geophysical data to be collected in the manner described below. This is based on the MPWMD's past experience with exploratory drilling in the basin, wherein the actual occurrence of, and lithologic conditions within, each aquifer were variable from site to site, making it difficult to presume the monitor well designs and number of wells to be completed in advance. It is also noted that timely completion of the exploratory drilling and monitor well installation program described herein will require specialized drilling contractor services that may not be available locally, and could be limited by contractor availability.

## **2. Exploratory Borehole Drilling Program**

A pilot borehole shall be constructed at each site, with the total depth targeted for the top of the Monterey Formation, which represents the effective base of the freshwater bearing formations at nearby locations in the basin. Total drilling depth at each site is anticipated to be 1,500 to 2,500 feet. Borehole lithologic samples (i.e., grab samples) shall be collected at ten-foot intervals (with the exception of any depths in the borehole at which continuous core samples can be collected). All collected lithologic samples shall be prepared and placed into labeled cases for storage and future inspection.

## **3. Geophysical Surveys**

Upon completion of pilot drilling to the total depth, a complete suite of open borehole geophysical logs shall be run, including resistivity, spontaneous potential, caliper, temperature, gamma ray, and electromagnetic conductivity (EM) logs. These geophysical logs will provide a basis for describing the distribution of aquifers, occurrence of fine-grained interbeds and confining units between aquifers, water quality variations with depth, and the nature of groundwater flow and potential seawater intrusion, as was completed for a recent similar deep coastal monitor well construction project to the north of the Seaside Basin in the City of Marina (Hanson and others, 2002).



*Geohydrology of a Deep-Aquifer System Monitoring-Well Site at Marina, Monterey County, California.* U.S. Geological Survey Water-Resources Investigations Report 02-4003. Prepared in cooperation with the Monterey County Water Resources Agency (see page 12 for geophysical data description). In addition to the borehole geophysical logs, additional geophysical logging shall be conducted on the deepest cased well at each site and shall include gamma ray and EM logs. This additional logging will allow for comparisons with future annual geophysical logging surveys at each site as part of the ongoing monitoring program for early detection of salinity changes (i.e., potential seawater intrusion) into discrete zones within the aquifer system, that may otherwise go undetected by standard water quality sample collection.

## **5. New Monitoring Wells**

Monitor well design shall be by multiple-well clusters at each site, either in the same or separate boreholes, unless an alternate well construction technique is authorized. Where present at each site, separate well casing strings shall be constructed with screened intervals within each recognized aquifer of the basin (e.g., Aromas Sand, Paso Robles, Santa Margarita) to provide a detailed vertical characterization of water levels and quality through the aquifer system. If observed conditions warrant, more than one well casing may be installed in each aquifer to more discretely characterize variable conditions in specific zones within the aquifer; however, this cannot be determined in advance of the exploratory drilling, as described above. For estimating purposes, it is assumed that four (4) wells will be installed at each well site cluster. The screened interval of each casing string shall be separated from other well completions by isolation seals if multiple wells are constructed in the same borehole. Each monitor well casing shall be a minimum two-inch inside diameter, and the deepest casing string at each well cluster shall be a minimum three-inch inside diameter to accommodate cased well geophysical logging tools.

## **D. Comprehensive Basin Production, Water Level and Water Quality Program**

### **1. Purpose**

The comprehensive monitoring program described herein is intended to guide ongoing data collection efforts in the basin to efficiently and economically provide the pertinent groundwater resource data that will establish a defensible basis for future decision-making by the Watermaster. Monitoring data collection tasks are described according to well location in or near the Seaside Basin. Coastal “sentinel” monitor wells refers to the closest monitor well sites to the coastline. Inland monitor wells refers to the monitor well locations in and near the Northern Inland and Laguna Seca subareas, and those monitor wells in the Southern and Northern Coastal subareas that are not included in the coastal sentinel monitor well network. “Production wells” refers to such wells in all four subareas of the basin.

## **2. Creation of Consolidated Basic Groundwater Resource Database**

Currently, groundwater resource monitoring within the Seaside Basin is being conducted by several entities as described above in Section B. Basin Monitoring Background. A consolidated database will allow pertinent groundwater data to be more efficiently organized, managed and housed in a single location to facilitate: (a) ongoing data collection efforts, (b) data storage and retrieval, (c) distribution of basic data to Watermaster members and other interested parties, and (d) preparation of annual and periodic reports to the Watermaster. A database shall be created to contain all pertinent historical basic groundwater resource data (i.e., well production, level, quality) with proper annotations as to data sources, as well as all ongoing groundwater resource data collected on behalf of the Watermaster. The database will also include pertinent information on well type, location and construction details. In addition to the data organizational benefit, the consolidated database is intended to resolve any differences or discrepancies in existing datasets that have been compiled by separate entities. The MPWMD currently maintains a groundwater database that includes some of the features described herein. The Watermaster will need to determine if the MPWMD's database should be expanded or a new database should be created for this purpose. A breakdown of the proposed schedule by task is shown on Figure 5, and also is included in Section V.

## **3. Monitoring of Coastal “Sentinel” Monitor Wells**

### **a) Water Level Monitoring**

All coastal sentinel monitor wells (existing and proposed) shall be monitored on at least a monthly interval to record manual water level measurements. In addition, all coastal sentinel monitor wells shall be equipped with automatic dataloggers to continuously record groundwater levels in each aquifer measured. The dataloggers will be set to record no less frequently than a daily interval and will be downloaded at least quarterly. The dataloggers will be calibrated/confirmed initially and on at least a quarterly basis with the manual water level measurements. All collected data will be entered into the consolidated groundwater resource database on a quarterly basis.

### **b) Water Quality Monitoring**

All coastal sentinel monitor wells (existing and proposed) shall be sampled on a quarterly interval by extraction of water samples (using standard sampling protocols) for chemical analysis by a state-approved laboratory. Parameters to be analyzed will at a minimum include the full general inorganic mineral suite. All collected water quality data will be entered into the consolidated groundwater resource database on a quarterly basis. Proposed new monitor wells may be sampled on a more frequent basis during the first year after construction to establish water quality variability at these locations. In addition, all coastal sentinel monitor wells (existing and proposed) shall be equipped with automatic dataloggers to continuously record groundwater quality (electrical conductivity and/or chloride) in each aquifer measured. The dataloggers will be set to record no less frequently than a daily interval and will be downloaded at least quarterly. The dataloggers will be calibrated/confirmed initially

and at least quarterly with the chemical analysis data collected at each monitor well. On an annual basis, geophysical logs will be run at the deepest well at each of the new coastal sentinel monitor well sites. Also, an existing inactive Cal-Am production well in the Northern Coastal subarea, known as the “Del Monte Test” well, will be evaluated for possible inclusion with the coastal sentinel monitor well network.

#### **4. Monitoring of Inland Monitor Wells**

##### **a) Water Level Monitoring**

All inland monitor wells (existing and proposed) shall be monitored for water levels on at least a quarterly interval (This is an increased frequency from the semi-annual to annual water level monitoring recommended in the report: Yates and others, 2002, *Laguna Seca Subarea, Phase III Hydrogeologic Update*, prepared for MPWMD, November 2002 (see page 65)). In addition, at least two monitor well sites in the Laguna Seca subarea shall be equipped with automatic dataloggers to continuously record groundwater levels in each aquifer measured (This follows from a recommendation to instrument monitor wells to better understand water level variations in the report: Yates and others, 2002, *Laguna Seca Subarea, Phase III Hydrogeologic Update*, prepared for MPWMD, November 2002. See page 65). The dataloggers will be set to record no less frequently than a daily interval and will be downloaded at least quarterly. The dataloggers will be calibrated/confirmed initially and on at least a quarterly basis with the manual water level measurements. All collected data will be entered into the consolidated groundwater resource database on a quarterly basis.

##### **b) Water Quality Monitoring**

Regularly scheduled water quality monitoring is not anticipated for the inland monitor wells, with the following exceptions: (a) the full general inorganic mineral suite of parameters shall be analyzed initially and quarterly for the first year, for any newly-constructed inland monitor wells to characterize background water quality at new locations, and (b) any water quality monitoring as part of special studies that may be directed by the Watermaster.

#### **5. Monitoring of Production Wells**

##### **a) Water Level Monitoring**

All active and inactive production wells in the basin owned and/or operated by a Watermaster member shall have static (i.e., non-pumping) water levels collected and recorded a minimum of once per month. It shall be the responsibility of each owner/operator of a Watermaster member production well to report monthly water level measurements to the Watermaster on an annual basis for inclusion of these data in the consolidated groundwater resource database.

## **b) Water Quality Monitoring**

All active production wells in the coastal subareas of the basin owned and/or operated by a Watermaster member shall have a water quality sample from each well collected and analyzed by a state-approved laboratory for the full general inorganic mineral suite a minimum of once per year. It shall be the responsibility of each owner/operator of a Watermaster member production well to report water quality analytical results to the Watermaster on an annual basis for inclusion of these data in the consolidated groundwater resource database.

## **6. Reporting of Monitoring Data**

It is anticipated that initially the Watermaster shall receive and distribute to members and interested parties a summary report of water resources data collected on behalf of the Watermaster on a quarterly basis. The quarterly reports shall include the reporting of water level and water quality data collected from the existing and proposed monitor wells as described herein. In addition, the monitor well data shall be summarized along with other information required in the Watermaster annual reports to be prepared and filed with the Court. Groundwater monitoring data will be prepared to conform to State Standards where appropriate or required.

## **E. Estimated Monitoring Program Costs**

At this time only a preliminary “order of magnitude” estimate (*“Order of magnitude” cost estimates* refers to approximate costs with an estimated accuracy of +/- 40%.) of costs is available for the basin monitoring functions described in this Program. It is anticipated that refined costs will be available once proposals for exploration, monitoring and data management have been received, reviewed and authorized by the Watermaster. One-time costs for exploratory drilling, geophysical surveying and monitor well construction are estimated at \$1,080,000. One-time costs for development of the basic groundwater database, and purchase and installation of water level/water quality dataloggers are estimated at \$62,000. First year annual costs for groundwater database maintenance, and coastal and inland well monitoring are estimated at \$61,680. A more detailed breakdown of estimated monitoring program costs is included in **Figure 6**. “Order of Magnitude” Cost Estimate Summary for Basin Monitoring Program Portion.



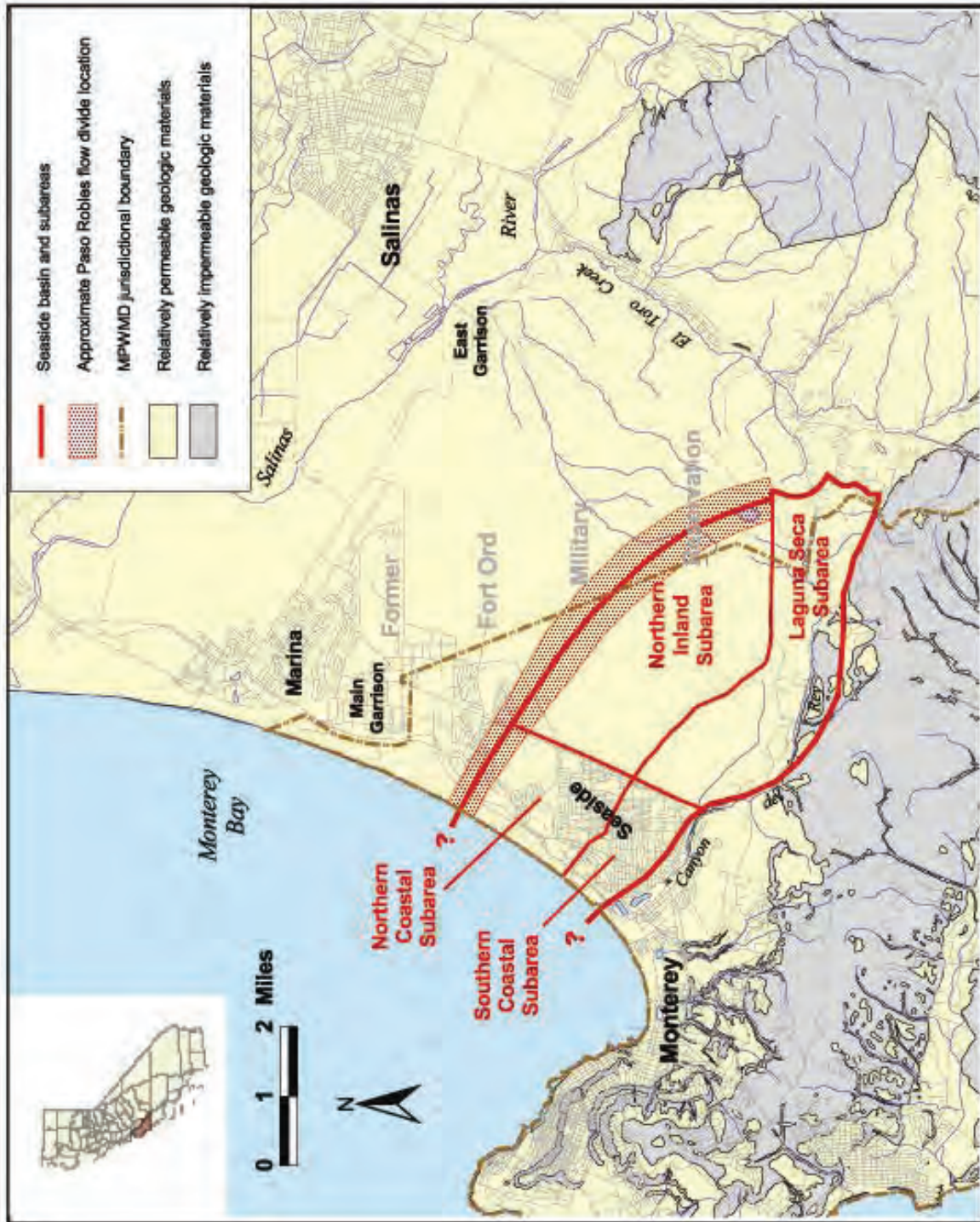


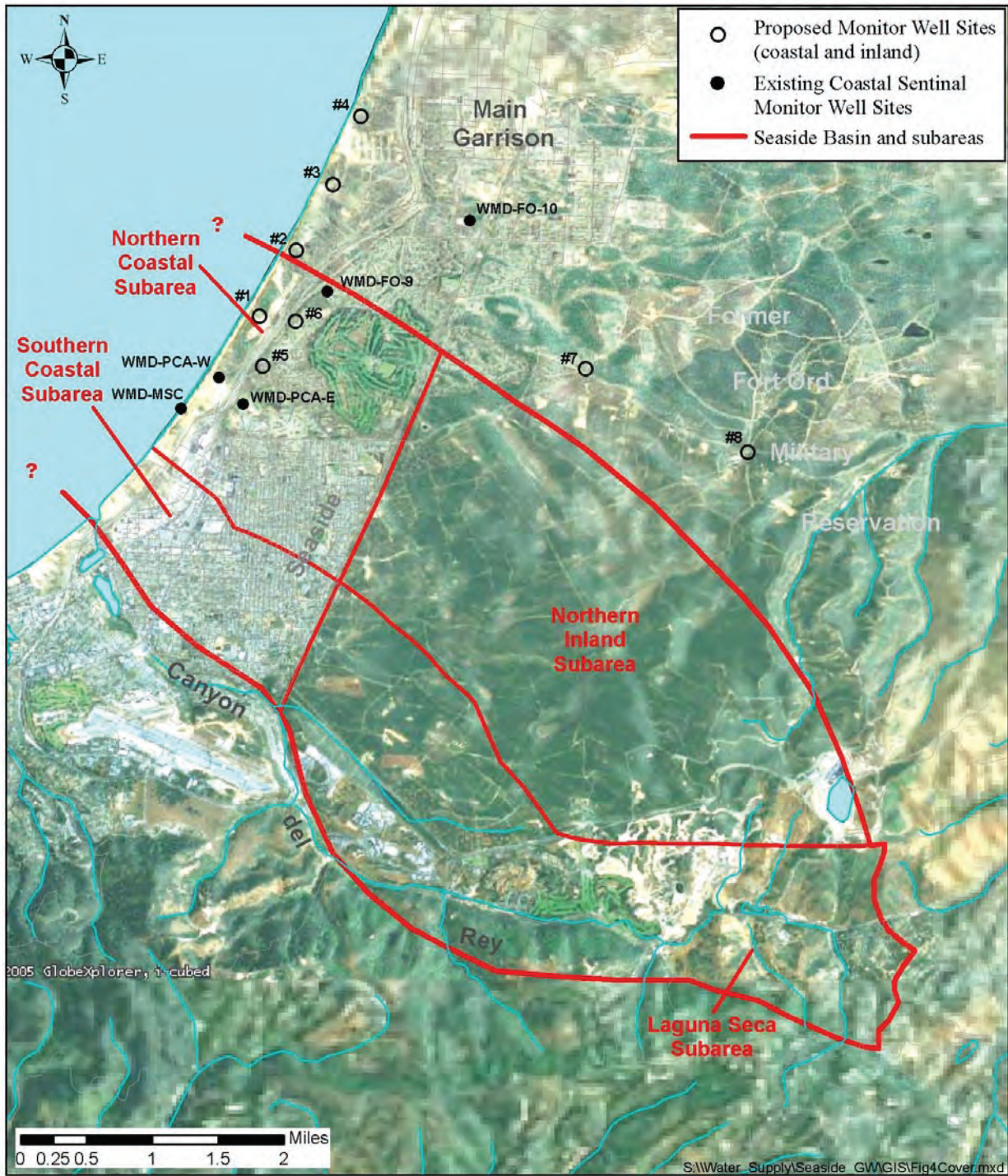
Figure 1. Location of the Seaside Groundwater Basin







**Figure 3. Location of Existing Coastal Groundwater Quality Monitor Wells in an Near the Seaside Basin**



**Figure 4. Location of Existing Coastal Sentinel Monitor Well Sites and Proposed Monitor Well Sites (Coastal and Inland) In and Near the Seaside Basin**



**Figure 5. Schedule by Task for Select Basin Monitoring Program Elements**

No.	Task	Duration (Days)	Start	Finish
<b>Basin Monitor Well Construction Program</b>				
1	Develop scope of services and RFP for consultant program oversight	60	7/1/2006	8/31/2006
2	Review proposals, secure oversight consultant contract	30	9/1/2006	9/30/2006
3	Oversight consultant completes site acquisition approvals	180	10/1/2006	3/31/2007
4	Develop scope of services and request bids for drilling/monitor wells	90	1/1/2007	3/31/2007
5	Review bids, secure contract(s)	30	4/1/2007	4/30/2007
6	Drill, equip and collect initial monitoring data	150	5/1/2007	9/30/2007
7	Prepare and submit completion report to Watermaster	60	9/1/2007	10/31/2007
<b>Creation of Consolidated Basic Groundwater Resource Database</b>				
1	Develop database RFP	30	7/1/2006	7/31/2006
2	Review proposals, select consultant	30	8/1/2006	8/31/2006
3	Develop and approve database format	30	9/1/2006	9/30/2006
4	Populate database (historical data from all sources)	60	10/1/2006	11/30/2006
5	Populate database (current monitoring data)	30	12/1/2006	12/31/2006
6	Prepare database documentation report	30	1/1/2007	1/31/2007

Prepared for Seaside Basin Watermaster, May 2006

**Figure 6. Seaside Basin Monitoring and Management Program “Order of Magnitude”  
Cost Estimate Summary for Basin Monitoring Program Portion**

Task	Cost / Unit	# of Units	Cost / Site	# of Sites	One-Time Cost	Annual Cost
Exploratory drilling / geophysical surveying / monitor well construction						
Assume average TD = 1,800 feet; \$100/ft lump sum	\$100	1800	\$180,000	6	\$1,080,000	
Basic groundwater resource database						
Develop / populate: 200 hours	\$70	200			\$14,000	
Annual maintenance: 40 hours/quarter x 4/yr	\$70	160				\$11,200
Monitoring of coastal "sentinel" monitor wells						
Purchase/install WL/WQ dataloggers (6 existing wells; 16 new wells)	\$2,000	22			\$44,000	
Manual WL monitoring: 8 hrs/mo x 12 mo/yr	\$70	96				\$6,720
WQ sample collection: 3 hrs/pers/site x 2 pers x 4/yr	\$70	24	\$1,680	8		\$13,440
WQ sample lab analyses: \$200/sample gen. Minerals x 4/yr x 22 wells	\$200	4		22		\$17,600
Annual maintenance, WL/WQ dataloggers: 16 hrs/quarter x 4/yr	\$70	64				\$4,480
Annual geophysical surveys	\$1,500			4		\$6,000
Monitoring of inland monitor wells						
Manual WL monitoring: 8 hrs/quarter x 4/yr	\$70	32				\$2,240
Purchase/install WL/WQ dataloggers (2 existing wells)	\$2,000	2			\$4,000	
<b>TOTAL ONE-TIME COST</b>					<b>\$1,142,000</b>	
<b>TOTAL ANNUAL COST (first year)</b>						<b>\$61,680</b>

**NOTES:**

1. Cost estimates are at the preliminary “order of magnitude” level, with estimated accuracy of +/- 40%.
2. Cost estimates are subject to change as plans and scope are refined by Watermaster

### **III.** **Basin Management Program**

#### **A. Development of a Seaside Basin Management Plan**

##### **1. Program Objectives**

The objectives of the Basin Management Program, as stated in the Court's *Decision*, are to optimize groundwater pumping, control seawater intrusion, and return the Basin to equilibrium through implementation of conservation methods, through the importation of supplemental water for direct use and Basin replenishment. The Program will serve as the technical roadmap for future basin management decisions to achieve the management objectives in a cost-effective manner while balancing potential socio-economic impacts to users of Seaside Basin groundwater. The Program will be developed in a way that provides flexibility in the future to respond to changing conditions in the basin and new information that becomes available as the basin monitoring program is implemented.

##### **2. Program Development**

The Watermaster will oversee the development of the plan, utilizing member agency staff expertise and/or consultants where appropriate to conduct detailed technical analyses and investigations. The Watermaster should seek available grants and loans for plan development through the California Department of Water Resources or from other resources available to assist in alternative regional solutions that support the plan.

##### **3. Key Program Elements**

The Seaside Basin Management program will consist of the following key elements:

- a) Development and implementation of a program for collecting and analyzing data related to groundwater production, water levels, water use, land use, rainfall, and other pertinent information useful in managing the basin. The Plan will outline the criteria and protocol to be used in triggering basin management actions. The MPWMD currently has an extensive data collection and management system that includes much of the data that will be required as part of the Seaside Basin Management Program. The MPWMD program will be evaluated during Plan development for use as a base upon which necessary data collection and storage enhancements can be made.
- b) Development of an enhanced Seaside Basin groundwater model to be used in developing improved estimates of natural and secondary basin recharge, Total Useable Storage Space for the Seaside Basin, Operating Safe Yield, Natural Safe Yield, and basin management strategies. Technical consultants will be utilized for

the task of developing a model and modifying existing groundwater models wherever possible. Existing models that will be evaluated for modification include but are not limited to: Laguna Seca Phase III Report (Yates et. al 2002), Sand City Desalination studies (Feeney & Williams, 2004), and Seaside Basin adjudication trial model (Durbin, 2005). No model development cost estimates have been provided in this document. A formal technical review of the models will be conducted in order to develop a scope of work and budget for the project.

- c) Development of recommendations regarding implementation of strategies to import supplemental water supplies into the basin, including:
- Substitution of alternative supplies for Basin groundwater (including in-lieu recharge).
  - Direct aquifer replenishment of pumping in exceedence of basin Natural Safe Yield.

Potential water sources for the above strategies include reclaimed water for irrigation of large turf areas and/or direct recharge, surplus Carmel River Water for aquifer replenishment during the winter months, and local desalination projects such as that proposed by Sand City and regional desalination project, such as that proposed by California American Water. Supplemental supplies will be evaluated with regard to cost and environmental constraints to implementation. Plan recommendations will include concrete steps for project implementation over specific time periods, including near-term and long-term actions.

- d) Development of strategies for redistribution of pumping to avoid various adverse impacts within the basin.



## IV. Seawater Intrusion Contingency Program

### A. Objective

If seawater intrusion is detected in a coastal production or monitoring well, it is imperative that pumping stresses be reduced so that the seawater is not pulled further inland or otherwise spread into a larger area of the Basin where it may contaminate additional wells. Accordingly, the objective of the Seawater Intrusion Contingency Program is to set forth the actions that will be undertaken if seawater intrusion is detected in a coastal well to prevent the seawater from contaminating larger portions of the Basin. The purpose of this section is describe how the presence and extent of seawater intrusion will be determined by the analysis of the existing and the future enhanced coastal seawater intrusion water quality monitoring program. The seawater intrusion contingency planning process to address the detection and presence of seawater intrusion will then be discussed.

### B. Seawater Intrusion Analysis

In order to detect and determine the extent of seawater intrusion, the mechanism of seawater intrusion must first be defined and then described. The analysis of the water quality monitoring data and mapping of the extent of seawater intrusion will follow.

#### 1. Seawater Intrusion – Description of Problem and Process

Intensification of water use on ground water resources can cause the depletion of groundwater storage and lower groundwater levels in a basin. Declining groundwater levels to an elevation below mean sea level may eventually cause inflow of seawater into aquifers along coastal areas. As seawater moves inland, ground water chloride values increase over time.

#### 2. Seawater Intrusion - Definition

For the purposes of defining when actions described in Section C of the program will be taken, the seaside groundwater basin aquifers will be defined as seawater intruded when the chloride concentrations in a coastal monitor well reach approximately 100 mg/l and 250 mg/l for the Paso Robles and Santa Margarita formations respectively. For a coastal production well, the standard will be when chloride concentrations reach 250 mg/l, given that some production wells have multiple aquifer completions with water quality that reflects a blend from these sources. These standards will be used until more comprehensive standards based on historical water quality data at individual monitor and production wells can be developed. Each monitoring well and production well in the groundwater network will be evaluated on site-specific criteria. In addition, the Watermaster will institute interim standards for notice of potential seawater intrusion so that appropriate preventative actions may be taken. Interim notice for seawater intrusion will be defined as a 50 percent increase above ambient chloride concentrations for any

specific monitoring well location. Generally accepted laboratory protocols and hydrogeologic methods will be employed for the determinations of seawater intrusion.

### **3. Description of Water Quality Related to Seawater Intrusion**

The California Safe Drinking Water Secondary Standard for chloride ranges from the recommended maximum for drinking water of 250 mg/L chloride and an upper limit of 500mg/L chloride. By the time chlorides reach the latter concentration, many times the wells are abandoned or destroyed due to unacceptable aesthetic qualities such as taste due to mineralization. The standards mentioned above dictate that, for drinking water purposes, chloride concentrations will be the primary water quality indicator for the determination of seawater intrusion. Other complementary inorganic parameter concentrations will also provide supplemental data for water quality trend analysis and aquifer water quality characterization (calcium, magnesium, sodium, potassium, sulfate, and nitrate) called “fingerprinting”. The analysis of these combined parameters will determine aquifer impacts by seawater intrusion.

Background chloride values may vary by aquifer depending on aquifer characteristics. For this reason, chloride values generated from the water quality monitoring program will be referenced to the 100mg/L and 250 mg/L chloride concentrations to determine aquifer impacts by seawater intrusion. In the coastal Salinas Valley, the agricultural community recognizes chloride values under 100mg/L as excellent to good irrigation quality. After determining if seawater intrusion is present, the observance of increasing chloride trends from the baseline up to 250mg/L chloride will be analyzed to determine the advancement of seawater intrusion. It must be noted that seawater intrusion is a gradual process due to the chemical interactions between the geologic formations in the aquifers and seawater. It is critical that the Watermaster Board is kept informed whenever chloride levels reach levels in excess of the interim standard so that appropriate action can be taken.

### **4. Data Analysis Tools and Data Analysis**

The water quality data analysis exercise requires certain tools. These tools include different types of computer software to digitally identify the location of wells, to quality check data, and to generate graphs, diagrams, and chloride contour lines. Before a thorough analysis of the water quality data can begin, the following software will be required:

- Geographic Positioning System (GPS) equipment to provide latitude/longitude location for study wells
- Excel to graph chloride trends for each well
- Water quality graphing software to represent water quality data in “stiff” and “trilinear” diagrams
- ArcView GIS 3.3 to generate chloride contour lines

Once the software is obtained and personnel are trained, immediate evaluation of the existing monitoring data can begin. Compilation of the data in a central database will be required along with data checking for correctness and GPS digital locations for all wells

must be obtained. If the existing study wells have historical data, the first step is to graph the chloride values for each well to determine any increasing trends over time. The next step is to determine the “fingerprint” or the water quality characteristics for each well with the use of stiff diagrams. Stiff diagrams show the complete inorganic suite of water quality data concentrations represented on a graph. This provides instant recognition the “fingerprint” of water being pumped from each of the aquifers. Like aquifer wells will have similar water quality fingerprints. The next water quality graphing step, prior to contouring the well chloride data, is to create a trilinear diagram for multiple wells. The inorganic water quality concentrations for each well will be represented on one graph in comparison to the same constituent concentrations of seawater. This graph enables the analyst to determine inorganic parameter concentration trends toward varying degrees of seawater intrusion. Using generally accepted standards, it must be confirmed whether elevated chloride concentrations are an anomaly or are due to seawater intrusion. The last step in the water quality data analysis is to contour the chloride data for each of the coastal monitoring wells on a map to compare and contrast chloride values. To contour, the following protocol will be followed utilizing ArcView GIS 3.3:

- Create a .dbf file that includes facility codes, chloride values and sampling dates information
- Import .dbf file into Arc-View
- In Arc-View, open a new view
- In the menu bar, under View choose the add Theme button and add the shape file with wells to be contoured
- In the View window, “open the tables of active themes”, which will bring up the attributes table
- Open both the .dbf file and the study wells shape file, join the tables
- Choose create contours under Surface in the view window
  - Create contours, select Output Grid Extent option
  - Choose spline method to interpolate surface type field
  - Choose chloride for “Z” value field
  - Choose appropriate weight and number of points (hint: start with default values to see what the default contour looks like)
- Classify quantiles using Legend Editor menu
  - Choose chloride value for value field. Classify according to chloride concentration e.g. 100 mg/L, 250 mg/L, or 500 mg/L
  - Assign line type according to chloride concentrations

After the draft chloride contour map is generated, multiple technical review sessions must take place by all entities, MPWMD, Cal Am, and MCWRA, to evaluate the data representation. This will enable the entities to determine if the data are correctly being represented on the map, and if so, lead to the implementation of an action program. Well production amounts, seasonal precipitation, and water conservation efforts in each of the geographic areas will be useful in interpreting the chloride contour map. Once this first step is completed to determine the baseline chloride contours, a more thorough evaluation will be accomplished once the data is generated from the new coastal dedicated monitoring wells.

Take note that there are other, less routinely used, data analysis tools available to further delineate seawater intrusion and its advancement. Some tools, among others, include water quality stable isotope analysis and periodic well borehole geophysics.

The data analysis of seawater intrusion will be performed on an annual basis beginning January 2007 after the period of monitoring during heavy pumping is completed from May through November 2006.

### **C. Actions to be Taken Subsequent to Detection of Seawater Within in a Coastal Well**

The following actions are to be taken in accordance with Exhibit A of the *Decision (Case No. M66343)*

1. If seawater intrusion is detected in a coastal production or monitoring well ("Contaminated Well"), the Contaminated Well will discontinue pumping and all other wells that produce groundwater from the intruded aquifer that are within one-half mile of the affected monitoring well ("Threatened Wells") will immediately reduce their monthly production to the equivalent of one-half of their average monthly production<sup>1</sup> within the previous five years upon notification from Watermaster of the detection of seawater intrusion within the Contaminated Well.
2. Watermaster shall increase monitoring of groundwater levels within the one-half mile radius of the Contaminated Well to determine if the requisite pumping reductions sufficiently affect groundwater gradients to prevent the further spread of seawater intrusion toward the Threatened Wells. This increased monitoring effort will include installing at least one new monitoring well as a sentinel well between the Contaminated Well and the nearest down-gradient active Threatened Well.
3. After six months of reduced pumping of the Threatened Wells, the threat of further seawater intrusion will be re-evaluated. If the requisite pumping reductions have failed to sufficiently affect groundwater gradients to prevent the further spread of seawater intrusion toward the Threatened Wells, those wells will further reduce their monthly production to the equivalent of one-third of their average monthly production within the previous five years upon notification by Watermaster that such further reductions are required.
4. After another six months of monitoring, the direction of groundwater gradients will again be evaluated. If there continues to be a groundwater gradient that would pull the detected seawater towards the Threatened Wells, then the Threatened Wells shall discontinue pumping, unless in Watermaster's determination, doing so would create a public health and/or safety risk.
5. If, after the initial discovery of the initial seawater intrusion, seawater is encountered



in an additional monitoring or production well, pumping reductions will be required for nearby threatened production wells (i.e., production wells within one half mile of the recently contaminated well) in the same manner as set forth above for first Contaminated Well.

If the implementation of the procedures set forth above cause a production well to reduce its pumping or to cease pumping altogether, all reasonable efforts shall be undertaken by the Watermaster and all other Parties that Produce Groundwater from the Basin to insure that the lost production capacity and associated water supply for that well owner/operator will be replaced by redistributing pumping, or provision of replacement water from other sources.

#### **D. Efforts to Redistribute or Replace Water Lost Because of Seawater Intrusion Contingency Plan**

The Monterey Peninsula has faced the constant specter of water shortage for decades. The Monterey Peninsula Water Management District has developed an *Expanded Conservation and Standby Rationing Plan* (included in the program as Appendix 2) that responds to a number of water supply shortage scenarios. Saltwater intrusion and subsequent management of an event will require planning and coordination of all Seaside Basin users

In the event that supplies cannot immediately be replaced with supplies from other Seaside Basin wells or from outside sources, the Monterey Peninsula Water Management District would, in conjunction with California American Water, implement the appropriate actions called for in the *Expanded Conservation and Standby Rationing Plan* (MPWMD Regulation XV, Rules 160 – 175) for the Cal Am service area. The plan will be amended by January 2007 as needed to use detected seawater intrusion episodes as a trigger for the implementation of the plan to also include the Seaside Water Main System.

A contingency planning program will enable quick action to take place to address any seawater intrusion scenario that may arise from the annual analysis of the seawater intrusion water quality.

# V. Basin Monitoring and Management Program Implementation Schedule

No.	Task	Duration (Days)	Start	Finish	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October
<b>2006</b>																				
<b>Groundwater Modeling for Seaside Basin Thorough Consultant:</b>																				
1.	Review ID groundwater models, select best model for enhancement	61	07/01/2006	08/31/2006																
2.	Develop groundwater model for enhanced recharge project	59	08/01/2006	10/30/2006																
3.	Advise select consultant, execute contract																			
4.	Complete model development & calibration, run scenario evaluations,	180	10/01/2006	03/30/2007																
5.	develop improved estimates of basin recharge and safety yield	29	04/01/2007	04/30/2007																
<b>Seaside Basin Management Program:</b>																				
1.	Develop scope of services & budget for consultant	60	07/01/2006	08/30/2006																
2.	Advise select consultant, execute contract	90	09/01/2006	11/30/2006																
3.	Develop & implement Seaside Basin Watermaster Database & data collection & analysis protocol	180	12/01/2006	05/30/2007																
4.	Evaluate options for importation of supplemental water supplies into the Seaside Basin, develop action plan	89	12/01/2006	02/28/2007																
5.	improved basin management	122	04/30/2007	08/30/2007																
6.	Develop action plan to avoid adverse impacts on the basin	152	02/28/2007	07/30/2007																
7.	Drill Seaside Basin Management Plan Report for Watermaster review	121	06/01/2007	09/30/2007																
8.	Produce Final Seaside Basin Management Plan	29	10/01/2007	10/30/2007																
<b>Basin Monitor Well Construction Program:</b>																				
1.	Develop scope of services and RFP for consultant program oversight	60	07/01/2006	08/31/2006																
2.	Advise select consultant, execute contract	180	09/01/2006	05/31/2007																
3.	Overnight consultant complete site acquisition approvals	90	01/01/2007	03/31/2007																
4.	Develop scope of services and request bids for drilling monitor wells	30	04/01/2007	04/30/2007																
5.	Revise bids, execute contract(s)	30	05/01/2007	05/31/2007																
6.	Drill, equip and collect initial monitoring data	30	06/01/2007	06/30/2007																
7.	Prepare data submit completion report to Watermaster	60	09/01/2007	10/31/2007																
<b>Creation of Consolidated Basic Groundwater Resource Database:</b>																				
1.	Develop database RFP for consultant	30	07/01/2006	07/31/2006																
2.	Advise select consultant	30	08/01/2006	08/31/2006																
3.	Develop and approve database format	30	09/01/2006	09/30/2006																
4.	Populate database (historical data from all sources)	60	10/01/2006	11/30/2006																
5.	Populate database (current monitoring data)	30	12/01/2006	12/31/2006																
6.	Prepare database documentation report	30	01/01/2007	01/31/2007																
<b>2007</b>																				

## **Appendix 1**

**Exhibit A of the *Decision* in the Superior Court of the State of California in and for the  
County of Monterey, Case No. M66343**

## Principles and Procedures of the Seaside Basin Monitoring and Management Plan

### Introduction

This document sets forth the criteria that will guide the Watermaster in creating the Seaside Basin Monitoring and Management Plan. It also establishes a procedure for dealing with seawater intrusion, should the same occur, during the time the Watermaster is developing its plan of action to deal with such an eventuality.

### Plan Criteria

Within sixty days of entry of the Judgment by the Court, the Watermaster will submit for the Court's approval a Monitoring and Management Plan containing details for implementation of the following actions:

- a. *Exploratory borehole drilling program.* About four exploratory boreholes shall be drilled along the shoreline and the northern boundary of the Basin to depths ranging from 500 to 1500 feet, the depth being controlled by the depth of the Monterey formations. Lithologic samples shall be collected and classified for every one foot of drilling. A full suite of geophysical logs shall be collected. The data collected as part of this program shall be compared to other well data in the Seaside Basin to further refine the hydrogeologic conceptual model in the areas between the production wells and saline groundwater.
- b. *Geophysical surveys.* Geophysical surveys shall be performed along the shoreline and the northern boundary of the Basin, intersecting the test borehole locations. The results of the geophysical surveys shall be calibrated against the test borehole data. The borehole data and the surveys shall be analyzed to characterize the near shore hydrology and to locate and design new monitoring wells.
- c. *New monitoring wells.* About four to six monitoring well clusters shall be drilled and installed along the shoreline and the northern boundary of the Basin. Each cluster shall consist of at least four to five wells to provide a detailed vertical characterization of head and water quality through the aquifer system. The Watermaster shall coordinate the placement of the wells with MPWMD, which already has some monitoring wells in place with plans to drill more, to avoid duplication of effort and cost inefficiencies.
- d. *Design and implementation of a piezometric and water quality monitoring program.* Pressure transducers and ionic probes (EC and C1) shall be installed in each well at each cluster. These probes will record water levels and water quality on a frequent interval (every 15 minutes for water levels, and every day for water quality). Where possible, similar probes will be installed in the pumping wells to record water levels and on/off cycles. Grab samples will be obtained periodically to true up the ionic probes. These data will be analyzed to assess the state of seawater



- intrusion, reveal groundwater barriers within the aquifer system, and more accurately estimate aquifer system parameters.
- e. *Development and implementation of a management program.* The objectives of the management program will be to optimize pumping, halt seawater intrusion, and return the Basin to equilibrium through implementation of conservation methods; replacement of water drawdown by substitution of reclaimed water, where appropriate, infusion of imported water into the aquifer; and utilization of controlled pumping schedules through analysis of real-time monitoring.
  - f. *Develop criteria for use by the Watermaster in determining any modification of the Operating Yield.*

The management program will include periodic review of monitoring information and the use of this review to guide near-term and long-term groundwater pumping. If seawater is detected by the MPWMD monitoring wells currently in place, or by pumping wells, or by the monitoring well system contemplated by this document, the Watermaster shall follow the procedures developed pursuant to the mandate of the following paragraph. If it is detected before such procedures are in place, the Watermaster shall follow the procedure set forth in the *Interim Contingency Procedure to Contain Seawater Intrusion*, infra.

Within one year after entry of the Judgment by the Court, the Watermaster will:

- (a) develop improved estimates of the natural and secondary recharge within the Seaside Basin;
- (b) develop and implement a program for collecting groundwater production, water use, and land use data for the Seaside Basin and appropriate adjacent areas;
- (c) develop a suitable groundwater model of the Seaside Basin and appropriate adjacent areas;
- (d) develop a plan of action to be implemented to avoid various adverse effects in the Basin, including seawater intrusion; and
- (e) develop a plan of action to contain seawater intrusion, should it occur.

The plan of action to avoid adverse effects in the Basin shall include a timeline for the importation of Non-Native water for spreading or injection into the Basin, and for acquisition of recycled water in lieu of Native Water production, and shall outline concrete steps to be taken to secure both Non-Native Water and recycled water.

#### *Interim Contingency Procedure to Contain Seawater Intrusion*

If Seawater intrusion is detected in the Basin during the development of the Watermaster's Management Plan, the following contingency plan will be set in motion to prevent seawater from contaminating larger portions of the Basin:

- a. *Detection in a coastal monitoring well.* If seawater intrusion is detected in a coastal monitoring well, it is imperative that pumping stresses be reduced so that seawater is not pulled inland to producing wells. To accomplish this, all wells that produce from the intruded aquifer that are within one-half mile of the affected monitoring well will reduce their production to the equivalent of one-half their previous five-year pumping average. Monitoring of groundwater levels within the one-half mile radius

of the affected well will be increased to determine if groundwater gradients following reductions in pumping have been modified sufficiently to prevent further seawater intrusion. This increase in monitoring effort will include installing at least one new monitoring well as a sentinel between the affected monitoring well and the nearest down-gradient active production well. After six months of reduced pumping, the threat of further seawater intrusion will be re-evaluated. If there continues to be a groundwater gradient that would pull the detected seawater toward producing wells, the pumping wells within one-half mile of the affected monitoring well will further reduce pumping to one-third of their previous five-year pumping average. After another six months of monitoring, the direction of groundwater gradients will again be evaluated. If there continues to be a groundwater gradient that would pull the detected seawater towards producing wells, then the wells with reduced pumping will discontinue pumping. If, after the initial discovery of intrusion, seawater is encountered in an additional monitoring well, pumping reductions will be required for nearby producing wells in the same manner as for the first intruded monitoring well.

- b. *Detection in a production well.* If seawater intrusion is encountered in a production well, that well will discontinue pumping. In addition, all wells that produce from the intruded aquifer that are within one-half mile of the affected well will reduce their production to the equivalent of one-half of their previous five-year pumping average. The sequence of threat evaluation, subsequent pumping reductions, and installation of new monitoring wells will be the same as for that in subparagraph a.

If the implementation of the procedures set forth above causes a production well to reduce its pumping or to cease pumping altogether, all reasonable efforts must be undertaken by the Watermaster to insure that lost production will be replaced by redistributing pumping, further conservation efforts on the part of all parties, or provision of replacement water from other sources.

## **Appendix 2**

***Expanded Conservation and Standby Rationing Plan,***  
**by the Monterey Peninsula Water Management District**

**REGULATION XV. EXPANDED WATER CONSERVATION AND STANDBY RATIONING  
PLAN**



## **RULE 160 - GENERAL PROVISIONS**

- A. All water users within the Monterey Peninsula Water Management District shall be subject to the District's water waste and non-essential water use prohibitions.
- B. Prohibitions against water waste and non-essential water use shall be enforced by the District and its designated agents in accordance with Rule 171 (Water Waste Fees).
- C. Stage 1 Water Conservation shall be implemented upon the effective date of this regulation.
- D. Stage 1 Water Conservation parallels Cal-Am's Phase IV Mandatory Water Conservation program that was designed to meet the Carmel Valley water production limits set by the SWRCB and approved by the Public Utilities Commission. Stages 1 through 3 Water Conservation is intended to achieve the Carmel Valley water production limits set by the State Board. Stage 4 Water Rationing through Stage 7 Water Rationing are intended to respond to limitations in supply caused by inadequate system inflow and storage.
- E. Stage 1 Water Conservation through Stage 3 Water Conservation shall apply to water users of the Cal-Am water distribution system where that system derives its source of supply from the Monterey Peninsula Water Resources System (MPWRS) for as long as Cal-Am is subject to water production goals and limitations enforced by the SWRCB.
- F. Stage 4 Water Rationing through Stage 7 Water Rationing may apply to all water distribution system users and water users within the Monterey Peninsula Water Resources System as a response to limited water supply. These stages shall also serve as responses to emergency situations where immediate reductions in water use are necessary to ensure public health, safety or welfare. This regulation authorizes the Board of Directors to, from time to time, determine by Resolution that any water distribution system or set of water users within the Monterey Peninsula Water Management District shall be subject to Stages 4 Water Rationing through Stage 7 Water Rationing as provided in this ordinance.
- G. As to water derived from the MPWRS, Cal-Am shall maintain unaccounted for water use in its MPWRS distribution system at or below seven (7) percent. Average losses of more than seven (7) percent during the most recent twelve-month period shall be considered water waste. This limitation shall not affect any Cal-Am system east of, and including, the Ryan Ranch subunit.
- H. Cal-Am shall amend its Urban Water Management Plan to conform to the policies and procedures described in this ordinance. A copy of the plan and amendment shall be filed with the District within 180 days of the effective date of this ordinance. The plan shall comply with the California Water Code, Division 6, Part 2.6.

*Amended by Ordinance No. 119 (3/21/2005)*

## **RULE 161 - STAGE 1 WATER CONSERVATION**

- A. Stage 1 Water Conservation is defined as the first stage in the District's Expanded Water Conservation and Standby Rationing Plan that takes action to maintain Cal-Am water derived from the MPWRS below regulatory constraints by increasing conservation activities and preparing for further stages of conservation and rationing. During Stage 1 Water Conservation, Cal-Am shall have the goal of maintaining its annual (October 1 through September 30) water production from the Carmel Valley below 11,285 acre-feet. This quantity may be modified by the SWRCB. Assuming a maximum annual production of 4,000 acre-feet from the Seaside Coastal Basin, this equates to a Cal-Am system production limit of 15,285 acre-feet. Each water user deriving water from the Cal-Am system that derives its source of supply from the MPWRS shall comply with District water waste and non-essential water use prohibitions and shall participate to the extent possible in voluntarily reducing water use.
- B. All water users with the Monterey Peninsula Water Management District shall comply with water waste and non-essential water use prohibitions.

*Rule added by Ordinance No. 92 (1/29/99)*

## **RULE 162 - STAGE 2 WATER CONSERVATION**

- A. Stage 2 Water Conservation is defined as the second stage in the District's Expanded Water Conservation and Standby Rationing Plan that takes action to maintain Cal-Am water use from the MPWRS below regulatory constraints by requiring implementation of Landscape Water Budgets for large irrigators of three acres or more, large residential water users and water users with dedicated landscape water meters.
- B. Stage 2 Water Conservation shall be enforced when Cal-Am production from the MPWRS has exceeded the year-to-date at month-end target as displayed in Table 1.

The monthly distribution of water production shown in Table 1 between sources in the Carmel River Basin and in the coastal subareas of the Seaside Groundwater Basin shall be approved by the Board of Directors as part of the Quarterly Water Supply Strategy and Budget process. The Board shall hold public hearings to consider the water supply budgets for Cal-Am's main system during the Board's regular meetings in September, December, March, and June, at which time the Board may modify Table 1 by Resolution.

*Amended by Ordinance No. 119 (3/21/2005)*



Table 1  
REGULATORY WATER PRODUCTION TARGETS  
FOR CALIFORNIA AMERICAN WATER MAIN SYSTEM FROM SOURCES  
WITHIN THE MONTEREY PENINSULA WATER RESOURCES SYSTEM

Month	Monthly Target	Year-to-Date At Month-End Target
October	1,379	1,379
November	1,113	2,492
December	984	3,476
January	958	4,434
February	894	5,328
March	1,047	6,375
April	1,209	7,584
May	1,405	8,989
June	1,527	10,516
July	1,628	12,144
August	1,649	13,793
September	1,492	15,285
TOTAL	15,285	

- C. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 1 Water Conservation shall remain in force. Requirements may be modified or superseded by actions taken in future stages of the Expanded Water Conservation and Standby Rationing Plan.
- D. Implementation of Landscape Water Budgets: All water users required to obtain a Landscape Water Budget under District Rule 172 are required to manage outdoor irrigation within the Landscape Water Budget assigned to the property.
- E. Water use in excess of the established Landscape Water Budget shall be considered Water Waste and shall be subject to District Rule 171.
- F. Sunset of Stage 2 Water Conservation: Without further action of the Board of Directors, the provisions of Stage 2 Water Conservation shall be rescinded and revert to Stage 1 Water Conservation upon compliance with the year-to-date at month-end production goal for two consecutive months in the subsequent water year.
- G. Notice: Cal-Am shall provide an annual reminder notice to MPWRS users with Landscape Water Budgets to report modifications in landscaping which could alter an existing budget.
- H. Monthly Consumption Reports: During any Stage 2, 3, 4, 5, 6, or 7, Cal-Am shall provide the District with monthly consumption reports in a format approved by the District. Reports shall be provided within fifteen (15) days of the close of the preceding month.

*Rule added by Ordinance No. 92 (1/28/99); Ordinance No. 119 (3/21/05)*

## **RULE 163 - STAGE 3 WATER CONSERVATION**

- A. Stage 3 Water Conservation is defined as the third stage in the District's Expanded Water Conservation and Standby Rationing Plan that takes action to maintain Cal-Am water use in the MPWRS below regulatory constraints. It is triggered when the year-to-date at month-end production target for Cal-Am from the MPWRS is exceeded twice by the average of Cal-Am's year-to-date production from the MPWRS for each month during the October through March period or exceeded once by the average of Cal-Am's year-to-date production from the MPWRS for each month during the April through September period. It provides a procedure to enable emergency temporary increases in the upper block volume rates and requires increased action by Cal-Am to reduce unaccounted-for water and monthly reporting of actions taken. Stage 3 Water Conservation may also be triggered upon Resolution of the Board of Directors when there is a need for an immediate water use reduction in response to an unexpected water production increase.

Upon implementation of Stage 3 Water Conservation, Cal-Am shall immediately submit a plan to the General Manager to reduce unaccounted for water uses to seven (7) percent or less measured by the most recent twelve-month rolling average and shall immediately act on such plan. Cal-Am shall provide a progress report to the Board of Directors monthly until Stage 3 is sunset.

- B. Regulatory Trigger: Stage 3 Water Conservation shall be enforced when any of the following criteria has been met: 1) the average of Cal-Am's year-to-date production from the MPWRS for each month has exceeded the year-to-date at month-end production target for Cal-Am from the MPWRS as displayed in Table 1 for a second time during the period from October 1 through March 31 in any water year, or 2) the average of Cal-Am's year-to-date production from the MPWRS for each month has exceeded the year-to-date at month-end production target for Cal-Am from the MPWRS as displayed in Table 1 once during the period from April 1 through September 30 in any water year, or 3) a Resolution has been adopted by the Board in accord with Section C below.
- C. Emergency Trigger: Stage 3 Water Conservation shall be implemented upon Resolution of the Board of Directors when there is need for an immediate water use reduction requirement in response to an unexpected water production increase.
- D. Sunset of Stage 3 Water Conservation: Without further action by the Board of Directors, the provisions of Stage 3 Water Conservation shall be rescinded upon compliance with the year-to-date at month-end production goal for two consecutive months in the subsequent water year. Water users of Cal-Am when that water system derives water from the MPWRS shall revert to Stage 1 Water Conservation.

Regulatory compliance during a period of Stage 4 Water Rationing shall not cause a sunset of this provision.

- E. Notice: Cal-Am shall provide notice of mandatory water conservation with each bill prepared for water users of the Cal-Am system
- F. Cal-Am Emergency Use Rates: Cal-Am shall implement the California Public Utilities Commission (CPUC) approved emergency rate schedule to respond to Stage 3 water reduction requirements. Cal-Am shall file an Advice Letter with the CPUC to implement Emergency Use Rates, however, only after it has first met and conferred with the District at least five days in advance of that filing. The General Manager may waive this time period for good cause.

*Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*



## **RULE 164 - STAGE 4 WATER RATIONING**

- A. Stage 4 Water Rationing is defined as the fourth stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 15 percent reduction goal from system production limits for non-Cal-Am water users. Fifteen percent reductions in the Cal-Am system are achieved through Stage 3 Water Conservation.
- B. Trigger.
  - 1. Water Supply Limitation Trigger. Stage 4 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 4 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 27,807 acre-feet and greater than 21,802 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.
  - 2. Emergency Trigger. Stage 4 Water Rationing shall be implemented upon Resolution of the Board of Directors when there is need for an immediate water use reduction requirement in response to an unexpected water supply shortage.
- C. Requirements previously imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.
- D. The provisions of Stage 3 Water Conservation shall be implemented for all water users of the Cal-Am water distribution system, unless specifically exempt from Stage 4 Water Rationing by action of the Board of Directors.
- E. Sunset of Stage 4 Water Rationing.
  - 1. Water Supply Availability. Stage 4 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 27,807 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 4 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.
  - 2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of

Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 4 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert to Stage 2 Water Conservation.

3. Emergency. Upon correction of a water supply limitation caused by an emergency, Stage 4 Water Rationing shall sunset without action by the Board.

F. Notice.

1. Upon direction of the General Manager, all water distribution system operators affected by Stage 4 Water Rationing shall notify water users of the system that reductions in water use are necessary and that stricter water rationing may be imminent. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.
2. As appropriate, Cal-Am shall notify its water users that excessive use rates will be imposed upon the effective date of Stage 4 Water Rationing.
3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS. Contact shall be via first class mail and shall explain the restrictions placed on the use of private wells during Stage 4 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.

*Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*

## **RULE 165 - STAGE 5 WATER RATIONING**

A. Stage 5 Water Rationing is defined as the fifth stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 20 percent reduction goal from the system production limit. Reductions are achieved by water use cutbacks by user category and by per-capita water rations and a moratorium on water permits that intensify water use.

B. Implementation.

1. Water Supply Limitation Trigger. Stage 5 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 5 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 21,802 acre-feet and greater than 15,615 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.

The General Manager may delay implementation of Stage 5 Water Rationing to ensure adequate operation of the program. Delays authorized by the General Manager shall not exceed 90 days.

2. Emergency. Implementation shall also occur following urgency action by Resolution of the Board of Directors declaring that an emergency situation exists and immediate 20 percent reductions in water use from a distribution system's production limit are necessary to ensure public health, safety or welfare.

C. Sunset of Stage 5 Water Rationing.

1. Water Supply Availability. Stage 5 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 21,802 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 5 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.
2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 5 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert

to Stage 2 Water Conservation.

If Cal-Am production exceeds the year-to-date at month's end production goal as shown in Rule 162, Table 1, Cal-Am water users shall revert to Stage 2 Water Conservation.

- D. Affected Water Users. Stage 5 Water Rationing shall apply to all water users within the MPWRS. As necessary to ensure adequate water supplies, the Board of Directors may act within its discretion to authorize activation of Stage 5 Water Rationing within one or more water distribution systems in the District.
- E. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 4 Water Conservation shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.
- F. Moratorium. On October 1 following implementation of Stage 5 Water Rationing, the District shall suspend the issuance of water permits associated with intensification in use. This provision shall not suspend the issuance of water permits that utilize public or private Water Use Credits or where issuance of a permit is required by prior agreement of the District.
- G. Reduction Goal. Stage 5 Water Rationing achieves water use reductions of 20 percent of the Cal-Am and non-Cal-Am system production limits in each user category as follows: Residential single-family and multi-family, commercial/ industrial, public authority, golf course, "other," non-revenue metered uses, and reclaimed water users.
- H. Notice.
  - 1. Cal-Am shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the Cal-Am system via first-class mail at least thirty (30) days before the first day of rationing. Further, Cal-Am shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, Cal-Am shall provide each responsible party with a survey form upon request.
  - 2. All water distribution system operators affected by Stage 5 Water Rationing shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the water distribution system via first-class mail at least thirty (30) days before the first day of rationing. Further, the distribution system operator shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, the water distribution system operator shall provide each responsible party with a survey form



at least once each calendar year. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.

3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS at least thirty (30) days before the first day of Stage 5 Water Rationing. Contact shall be via first class mail and shall explain the restrictions placed on the use of private wells during Stage 5 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.
- I. Rations by Category. Water rations shall be determined by user category. Each water user within the Monterey Peninsula Water Resources System shall be classified in one of the following groups: Residential Single-Family and Multi-Family, Commercial/Industrial, Public Authority, Golf Course, “other,” Non-Revenue Metered Use, and Reclaimed Water Users.
- J. Reduced Annual Cal-Am Annual Production During Stage 5 Water Rationing. The Cal-Am annual production limit shall be reduced by 20 percent during Stage 5 Water Rationing. The resulting production limit shall be further reduced by a water rationing contingency determined by the Board. Seven (7) percent of the remainder shall be the maximum Cal-Am unaccounted for water use ration. The remaining water shall be the Cal-Am annual production limit for all user categories.
- K. Non-Cal-Am Annual Production Limits During Stage 5 Water Rationing. Available production for other water distribution systems subject to Stage 5 Water Rationing shall be determined using the same methodology as for Cal-Am without including a deduction for unaccounted for water uses. The non-Cal-Am annual production limit for the Monterey Peninsula Water Resources System shall be used as the maximum production limit.
- L. Establishing the Rations. Rations for each user category shall be determined by the General Manager by dividing the reduced available production by the percentage of use. The percentage of use for each user group shall be determined by the most recent unrationed reporting year (July 1 through June 30) data provided by Cal-Am for water users of that portion of Cal-Am that derives water from the MPWRS, and by data provided by the District from its annual well reporting program for non-Cal-Am distribution systems.
  1. Residential Water Users. Each residential water user either served by a water meter reported as “single-family residential” by the water distribution system or served by a private well shall have an equal portion of the water available to the single-family residential category based upon the number of residents reported on the survey form.

2. Multi-Family Residential Water Users. Each multi-family residential water user either served by a water meter reported as “multi-family residential” by the water distribution system or served by a private well shall have an equal portion of the water available to the multi-family residential category based upon the number of residents reported on the survey form with the following exception:
  - a. Multi-family residential sites with common laundry facilities on a separate water meter shall receive a one-unit water ration for each dwelling unit that has access to the facility. Each dwelling unit located on the multi-family residential site that has access to the common laundry facility shall have the dwelling unit ration reduced by one unit of water.
3. Commercial/Industrial Water Users. Each commercial/industrial water user either served by a water meter reported as “commercial” or “industrial” by the water distribution system shall have a base ration determined by applying the current commercial water use factors.
  - a. Mixed Use Water Users. Mixed-use water users shall be classified as commercial uses for the purposes of this program.
4. Public Authority. Public Authority Uses shall be rationed by jurisdiction. Each Public Authority water user may combine multiple accounts or connections when the accounts are located within one jurisdiction.
5. Golf Courses. Golf Courses supplied water exclusively by the Cal-Am or non-Cal-Am water distribution systems or wells may be rationed individually or, upon request to the General Manager, as a group.
6. Other. Water users utilizing portable water meters or hydrant meters shall be required to employ Best Management Practices. Cal-Am shall be required to report monthly to the District the location and responsible party for all portable water meters and the amount of use from those meters. As deemed necessary to achieve the imposed reduction in use, the District may condition use of temporary connections.
7. Non-Revenue Metered Users. Non-Revenue Metered Uses shall be rationed as a group with the following exception:
  - a. Irrigation required by the Mitigation Program adopted when the Water Allocation Program Environmental Impact Report was adopted in 1990, and as required by SWRCB Order No. WR 95-10, shall not be subject to reductions in use. Required irrigation of the riparian corridor shall be identified and reported separately from other non-revenue metered uses.

8. Non-Cal-Am Wells. Regulations for rationing non-Cal-Am wells located within the MPWRS that are not supplying water to a distribution system shall be considered by the Board prior to implementation of Stage 5 Water Rationing.
9. Recycled Water Users. Recycled Water Irrigation Areas receiving water from the CAWD/PBCSD Wastewater Reclamation Project shall be subject to Stages 5 Water Rationing and higher for potable water used during an interruption or emergency, in accordance with contractual agreements between the District and the respective owners of the Recycled Water Irrigation Areas.
  - a. Before Project Expansion Is Completed. Under the agreements operative before the Project Expansion is Completed (as the capitalized terms are defined in Rule 23.5), the owners of the Recycled Water Irrigation Areas shall have the respective irrigation requirements thereof satisfied to the same degree as any non-Project golf course or open space which derive their source of supply from the Cal-Am system. The irrigation requirements of the Recycled Water Irrigation Areas will be determined based on the most-recent non-rationed four-year average irrigation water demand, including both Recycled Water and potable water, for each Recycled Water Irrigation Areas. The use of Recycled Water, when available in sufficient quantities to satisfy the irrigation requirements of the Recycled Water Irrigation Areas, shall not be restricted by this requirement.

Each Recycled Water Irrigation Area shall be entitled to receive the average irrigation requirement determined above, reduced by the percentage reduction required by the current stage of rationing. If the quantity of Recycled Water that is available is less than the quantity of water that the Recycled Water Irrigation Area is entitled to, potable water shall be provided to make up the difference and satisfy the irrigation requirements of the Recycled Water Irrigation Area to the same degree that the irrigation requirements of non-Project golf course and open space users are being satisfied.

The District shall ensure that the water provided during water rationing is of adequate quality. If the quality does not satisfy the contractual agreement operative before the Project Expansion is deemed Completed (as the capitalized terms are defined in Rule 23.5), potable water shall be provided in sufficient quantities to improve the quality of the reclaimed water.

This Subsection L.9.a shall cease to be operative once the Project Expansion is deemed to be Completed (as the capitalized terms are defined in Rule 23.5), and shall thereafter be of no force or effect.

- b. When Project Expansion Is Completed. Under the agreements operative once the Project Expansion is deemed Completed (as the capitalized terms are defined in Rule 23.5), the owners of the Recycled Water Irrigation Areas shall have the respective irrigation requirements thereof satisfied to the same degree as any non-Project golf course or open space which derives its source of supply from the Cal-Am system. The irrigation requirements of the Recycled Water Irrigation Areas will be determined based on the most-recent non-rationed four-year average irrigation water demand, including both Recycled Water and potable water, for each respective Recycled Water Irrigation Area.

Each Recycled Water Irrigation Area shall be entitled to receive the average irrigation requirement determined above, reduced by the percentage reduction required by the current stage of rationing. If the quantity of Recycled Water that is available is less than the quantity of water that the Recycled Water Irrigation Area is entitled to, potable water shall be provided to make up the difference and satisfy the irrigation requirements of the Recycled Water Irrigation Areas to the same degree that the irrigation requirements of non-Project golf course and open space users are being satisfied.

The preceding sentence shall not apply to the extent that the irrigation requirements of any Recycled Water Irrigation Area are met with water legally available to Buyer from any source other than the Carmel River System or the Seaside Groundwater Basin, including percolating ground water underlying Buyer's Property, to make up any such difference.

When Recycled Water (as defined in Rule 23.5) is available in sufficient quantities to satisfy the irrigation requirements of the Recycled Water Irrigation Areas, such irrigation shall not be subject to Stages 5 Water Rationing and higher, and neither potable water nor any water described in the preceding sentence (whether or not it is potable) shall be used for irrigation of the Recycled Water Irrigation Areas except to the extent allowed in the circumstances described in the next two sentences.



If there is an Interruption in Recycled Water deliveries to any Recycled Water Irrigation Area(as the capitalized terms are defined in Rule 23.5), the temporary use of potable water for irrigating each such Recycled Water Irrigation Area is authorized in the manner described in Rule 23.5, Subsection F.

If MPWMD has adopted an ordinance in response to any emergency caused by drought, or other threatened or existing water shortage pursuant to section 332 of the Monterey Peninsula Water Management Law, said ordinance shall prevail over contrary provisions of this Rule. Notwithstanding the preceding sentence, potable water shall be made available for irrigating tees and greens of the Recycled Water Irrigation Areas in sufficient quantities to maintain them in good health and condition during an Interruption, without any limitation on the duration.

The District shall have no obligation to furnish potable water for irrigation of the Recycled Water Irrigation Areas except in the circumstances set forth above in this Subsection L.9.b.

If (1) an emergency or major disaster is declared by the President of the United States, or (2) a “state of war emergency,” “state of emergency,” or “local emergency,” as those terms are respectively defined in Government Code section 8558, has been duly proclaimed pursuant to the California Emergency Services Act, with respect to all or any portion of the territory of MPWMD, the provisions of this Subsection L.9.b shall yield as necessary to respond to the conditions giving rise to the declaration or proclamation.

This Subsection L.9.b shall be of no force or effect until the Project Expansion is deemed Completed (as the capitalized terms are defined in Rule 23.5), and shall thereafter be operative and of full force and effect.

*Added by Ordinance No. 119 (3/21/2005)*

## **RULE 166 - STAGE 6 WATER RATIONING**

- A. Stage 6 Water Rationing is defined as the sixth stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 35 percent reduction goal from system production limits. Reductions are achieved by water use cutbacks by user category and by per-capita water rations and a moratorium on water permits that utilize water credits.
- B. Implementation.
  - 1. Water Supply Limitation Trigger. Stage 6 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 6 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 15,615 acre-feet and greater than 9,610 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.
  - 2. Implementation shall also occur following urgency action by Resolution of the Board of Directors declaring that an emergency situation exists and immediate 35 percent reductions in water use from a distribution systems production limit are necessary to ensure public health, safety or welfare.
- C. Sunset of Stage 6 Water Rationing.
  - 1. Water Supply Availability. Stage 6 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 15,615 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 6 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.
  - 2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 6 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert to Stage 2 Water Conservation.
- D. Affected Water Users. Stage 6 Water Rationing shall apply to all water users within the Monterey Peninsula Water Resources System. As necessary to ensure

adequate water supplies, the Board of Directors may act within its discretion to authorize activation of Stage 6 Water Rationing within one or more water distribution systems in the District.

- E. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 5 Water Rationing shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.
- F. Moratorium. On October 1 following implementation of Stage 6 Water Rationing, the District shall suspend the issuance of water permits that utilize a public or private Water Use Credit.
- G. Reduction Goal. Stage 6 Water Rationing achieves water use reductions of 35 percent of the Cal-Am and non-Cal-Am system production limits in each user category as follows: Residential single-family and multi-family, commercial/ industrial, public authority, golf course, "other," non-revenue metered uses, and reclaimed water users.
- H. Notice
  - 1. Cal-Am shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the Cal-Am system via first-class mail at least thirty (30) days before the first day of rationing. Further, Cal-Am shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, Cal-Am shall provide each responsible party with a survey form upon request.
  - 2. All water distribution system operators affected by Stage 6 Water Rationing shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the water distribution system via first-class mail at least thirty (30) days before the first day of rationing. Further, the distribution system operator shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, the water distribution system operator shall provide each responsible party with a survey form at least once each calendar year. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.
  - 3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS at least thirty (30) days before the first day of Stage 6 Water Rationing. Contact shall be via first class mail and shall explain the restrictions placed on the use of

private wells during Stage 6 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.

- I. Rations by Category. Water rations shall be determined by user category. Each water user within the Monterey Peninsula Water Resources System shall be classified in one of the following groups: Residential Single-Family and Multi-Family, Commercial/Industrial, Public Authority, Golf Course, "other," Non-Revenue Metered Use, and Reclaimed Water Users.
- J. Reduced Annual Cal-Am Annual Production During Stage 6 Water Rationing. The Cal-Am annual production limit shall be reduced by 35 percent during Stage 6 Water Rationing. The resulting production limit shall be further reduced by a water rationing contingency determined by the Board. Seven (7) percent of the remainder shall be the maximum Cal-Am unaccounted for water use ration. The remaining water shall be the Cal-Am annual production limit for all user categories.
- K. Non-Cal-Am Annual Production Limits During Stage 6 Water Rationing. Available production for other water distribution systems subject to Stage 6 Water Rationing shall be determined using the same methodology as for Cal-Am without including a deduction for unaccounted for water uses. The non-Cal-Am annual production limit for the Monterey Peninsula Water Resources System shall be used as the maximum production limit.
- L. Establishing the Rations. Rations for each user category shall be determined by the General Manager by dividing the reduced available production by the percentage of use and by taking into consideration residential water needs to ensure health, safety and welfare. The percentage of use for each user group shall be determined by the most recent unrationed reporting year (July 1 through June 30) data provided by Cal-Am for water users of that portion of Cal-Am that derives water from the MPWRS, and by data provided by the District from its annual well reporting program for non-Cal-Am distribution systems.
  - 1. All water users shall be rationed by user category as outlined in Rule 165 (Stage 5 Water Rationing).
- M. The Board shall consider adopting restrictions on non-residential outdoor water use that may include any or all of the following: Limit outdoor watering to one day per week, one day every other week, or prohibit outdoor irrigation with water from the effected water resource system(s); prohibit irrigation of non-turf areas with water from the affected water resource system(s); reduce golf course irrigation from the effected water distribution system(s) to a percentage of the amount required to water tees, greens and landing areas only. The use of reclaimed water, when available, shall not be restricted by this requirement.



- N. Elimination or modification of commercial/industrial variances for Best Management Practices. The General Manager shall be authorized to require a percentage reduction of all commercial/industrial water users granted a variance for complying with BMPs for the type of use. The amount of the percentage reduction shall be determined by the General Manager following review of the success of commercial/industrial rationing during Stage 5 Water Rationing prior to Stage 6 Water Rationing.
- O. All water users shall cease operation and maintenance of all ornamental water uses (fountains, ponds, etc.) that use water from the effected water supply system(s). Ornamental water uses supplied with water from other sources shall clearly display information about the source of water on or immediately adjacent to the use;
- P. Prohibition on Use of Water for Dust Control. The use of water from the Monterey Peninsula Water Resources System shall be prohibited for dust control purposes, except by prior approval of the General Manager. Decisions of the General Manager shall be final.

*Rule added by Ordinance No. 92 (1/29/99); Amended by Ordinance No. 119 (3/21/2005)*

## **RULE 167 - STAGE 7 WATER RATIONING**

- A. Stage 7 Water Rationing is defined as the seventh stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 50 percent reduction goal from system production limits. Reductions are achieved by water use cutbacks by user category and by per-capita water rations and a moratorium on water permits that utilize water credits.
- B. Implementation.
  - 1. Water Supply Limitation Trigger. Stage 7 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 7 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 9,610 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.
  - 2. Implementation shall also occur following urgency action by Resolution of the Board of Directors declaring that an emergency situation exists and immediate 50 percent reductions in water use from a distribution system's production limit are necessary to ensure public health, safety or welfare.
- C. Sunset of Stage 7 Water Rationing.
  - 1. Water Supply Availability. Stage 7 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 9,610 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 7 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.
  - 2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 7 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert to Stage 2 Water Conservation.
- D. Affected Water Users. Stage 7 Water Rationing shall apply to all water users within the Monterey Peninsula Water Resources System. As necessary to ensure adequate water supplies, the Board of Directors may act within its discretion

to authorize activation of Stage 7 Water Rationing within one or more water distribution systems in the District.

- E. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 6 Water Rationing shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.
- F. Reduction Goal. Stage 7 Water Rationing achieves water use reductions of 50 percent of the Cal-Am and non-Cal-Am system production limits in each user category as follows: Residential single-family and multi-family, commercial/ industrial, public authority, golf course, "other," non-revenue metered uses, and reclaimed water users.
- G. Notice.
  - 1. Cal-Am shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the Cal-Am system via first-class mail at least thirty (30) days before the first day of rationing.

Further, Cal-Am shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, Cal-Am shall provide each responsible party with a survey form upon request.
  - 2. All water distribution system operators affected by Stage 7 Water Rationing shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the water distribution system via first-class mail at least thirty (30) days before the first day of rationing. Further, the distribution system operator shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, the water distribution system operator shall provide each responsible party with a survey form at least once each calendar year. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.
  - 3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS at least thirty (30) days before the first day of Stage 7 Water Rationing. Contact shall be via first class mail and shall explain the restrictions placed on the use of private wells during Stage 7 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.

- H. Rations by Category. Water rations shall be determined by user category. Each water user within the Monterey Peninsula Water Resources System shall be classified in one of the following groups: Residential Single-Family and Multi-Family, Commercial/Industrial, Public Authority, Golf Course, "other," Non-Revenue Metered Use, and Reclaimed Water Users.
- I. Reduced Annual Cal-Am Annual Production During Stage 7 Water Rationing. The Cal-Am annual production limit shall be reduced by 50 percent during Stage 7 Water Rationing. The resulting production limit shall be further reduced by a water rationing contingency determined by the Board. Seven (7) percent of the remainder shall be the maximum Cal-Am unaccounted for water use ration. The remaining water shall be the Cal-Am annual production limit for all user categories.
- J. Non-Cal-Am Annual Production Limits During Stage 7 Water Rationing. Available production for other water distribution systems subject to Stage 7 Water Rationing shall be determined using the same methodology as for Cal-Am without including a deduction for unaccounted for water uses. The non-Cal-Am annual production limit for the Monterey Peninsula Water Resources System shall be used as the maximum production limit.
- K. Establishing the Rations. Rations for each user category shall be determined by the General Manager by dividing the reduced available production by the percentage of use and by taking into consideration residential water needs to ensure health, safety and welfare. The percentage of use for each user group shall be determined by the most recent unrationed reporting year (July 1 through June 30) data provided by Cal-Am for water users of the Cal-Am distribution system that derives water from the MPWRS, and by data provided by the District from its annual well reporting program for non-Cal-Am distribution systems.
  - 1. All water users shall be rationed by user category as outlined in Rule 165 (Stage 5 Water Rationing).
- L. The Board shall reconsider adopting restrictions on non-residential outdoor water use that may include any or all of the following not adopted during Stage 6 Water Rationing: Limit outdoor watering to one day per week, one day every other week, or prohibit outdoor irrigation with water from the effected water resource system(s); prohibit irrigation of non-turf areas with water from the effected water resource system(s); reduce golf course irrigation from the effected water distribution system(s) to a percentage of the amount required to water tees, greens and landing areas only. The use of reclaimed water, when available, shall not be restricted by this requirement.
- M. Elimination or modification of commercial/industrial variances for Best Management Practices. The General Manager shall be authorized to require a percentage reduction of all commercial/industrial water users granted a variance



for complying with BMPs for the type of use. The amount of the percentage reduction shall be determined by the General Manager following review of the success of commercial/industrial rationing during Stage 6 Water Rationing prior to Stage 7 Water Rationing.

- N. Prohibition On The Use of Portable Water Meters and Hydrant Meters. Water users utilizing portable water meters or hydrant meters shall be required to cease use of water from the effected water supply system(s). Each water user reporting as “other” by the distribution system shall be notified by the distribution system operator of this requirement. Portable water meters shall be returned to the water company at least 30 days before the implementation of Stage 7 Water Rationing.

*Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*

## **RULE 168 - WATER BANKS**

- A. Water banks shall be available to each water user during Stages 5 through 7 Water Rationing. A water bank shall allow each water user to accrue the unused portion of a monthly ration for use in the current calendar year.
- B. Water banks shall be reset to zero on January 1 of each year. Ten (10) percent of the remaining water bank on December 31 shall be credited to the following year's water bank for three months to allow the establishment of a new bank.
- C. On April 1, each water bank shall be reduced by the amount of banked water carried over on January 1. Water banks may not carry less than a zero balance.

*Rule added by Ordinance No. 92 (1/28/99)*

## **RULE 169 - WATER RATIONING VARIANCE**

- A. The General Manager shall assign additional water beyond the ration established in Stage 4 Water Rationing through Stage 7 Water Rationing in the following circumstances upon submittal of the appropriate variance request form and fees.
- B. The following variances shall be considered for additional water during Stages 4 through 7 Water Rationing.
  - 1. Medical and/or sanitation needs certified by a doctor;
  - 2. Hospital and/or health care facilities that have achieved all Best Management Practices for those uses;
  - 3. Drinking water for large livestock;
  - 4. Commercial/Industrial users that can demonstrate compliance with all BMPs appropriate for the type of use and where there is minimal exterior water use on the water meter or water supply serving the use;
  - 5. Leaks, when an invoice is provided by a licensed plumber or contractor;
  - 6. Commercial Laundromats with signs advising full loads only;
  - 7. Business in a home on a case-by-case basis;
  - 8. Riparian irrigation when required as a condition of a riverbank restoration permit issued by the District or as a condition of a riverbank erosion protection permit issued by the District.
  - 9. Emergency, extreme, or unusual situations on a case-by-case basis;
- C. No Variance. The following categories of water use shall not qualify for special consideration under the provisions of this regulation:
  - 1. Visitors other than those occupying short-term residential housing as defined in Rule 11 (Definitions) when the property owner has submitted a completed survey form with the applicable information about the occupancy of the site;
  - 2. Irrigation, other than variances allowed by Rule 169 of this regulation.
  - 3. Filling spas, ponds, fountains, etc.;
  - 4. Long-term leaks that are not repaired after reasonable notice.

- D. Waiver of Excess Fees by Variance Application. Any qualifying water user may seek to have all or part of the water waste fee for excess water use waived or forgiven through the Rationing Variance process set forth in this Rule. Any water user may seek relief from the water waste fee upon substantial evidence that the excess water use was beyond the user's control, and was not reasonably correctable in a timely fashion due to special and unique circumstances. Due diligence must be shown to forgive any water waste caused by a leak; under no circumstance shall a leak justify the forgiveness of an excess use fee for more than three billing periods. The applicant shall further demonstrate that all reasonable means have been taken to conserve water and minimize future water use.
1. The General Manager or his agent may grant any application to waive water waste fees upon submittal of the appropriate evidence to warrant a variance. All applicants for variance shall submit the appropriate Variance Request Form and processing fee of \$60. Any action to waive a water waste fee shall be recorded in writing and include a written explanation to substantiate and justify the waiver;
  2. Although inspections shall not be required in all cases, District staff shall use spot or random inspections as necessary to verify an applicant's eligibility for a water rationing variance.
  3. Each person making written application for a variance shall be notified in writing of the disposition of their application. Decisions of the General Manager are final.

*Rule added by Ordinance 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*



## **RULE 170 - WATER USE SURVEY**

### **A. Stage 1 Water Conservation Survey**

1. Cal-Am shall conduct a confidential survey of all water users of the Cal-Am system that derive their source of supply from the MPWRS. This survey shall be required upon the effective date of this regulation. The survey shall request information to determine the number of permanent residents in each dwelling unit and the lot size of each residential site with permitted water service; the types of uses and amount of water use on non-residential sites; and the number of users and types of use(s) served by each water meter. Only information deemed appropriate for the effective operation of this program will be requested.

Cal-Am shall conduct the survey within 45 days of the effective date of Stage 1 Water Conservation. Survey forms shall be completed by the responsible party and returned to Cal-Am within 30 days of mailing. The District shall have visual access to this data during Stages 1 through 3 Water Conservation and shall be provided with a summary of the results of the survey by census tract within 105 days of the effective date of Stage 1 Water Conservation. Cal-Am shall maintain survey information by census tract and shall provide unrestricted access to individual water use records when the District is actively investigating a variance, appeal or other rationing program action.

### **B. Stage 4 Water Rationing Survey.**

1. The General Manager shall conduct a survey of MPWRS water users not deriving their source of supply from Cal-Am prior to effective date of Stage 5 Water Rationing. The survey shall request information to determine the number of permanent residents in each dwelling unit and the lot size of each residential site with permitted water use; the types of uses and amount of water use on non-residential sites; and the number of users and types of use(s) served by each water meter or connection. Only information deemed appropriate for the effective operation of this program will be requested.
2. The District shall mail the survey form to water users not supplied water by Cal-Am. Survey forms shall be completed by the responsible party and returned to the District within 30 days of mailing. The District shall preserve the confidentiality of this survey data.

### **C. Administration of Survey Data.**

1. Cal-Am Water Users. Cal-Am shall maintain survey data for all MPWRS water users supplied water by Cal-Am and shall provide the District with access to all data. Cal-Am shall provide the District with an annual

summary of survey information, or more frequently as required by the General Manager. Cal-Am shall preserve the confidentiality of survey data.

2. Non-Cal-Am Water Users. During Stage 5 Water Rationing through Stage 7 Water Rationing, the District shall maintain survey data for all water users supplied water from non-Cal-Am sources subject to those stages.
3. A full or partial survey may be conducted as deemed necessary by the District to maintain accurate data.
4. District staff shall maintain the confidentiality of Cal-Am and non-Cal-Am residential customer survey data. Violations of this provision shall be enforced as a misdemeanor under District law.

D. Reporting.

1. Responsibility of Water User.
  - a. Each responsible party shall be responsible for accurately reporting the number of permanent residents in the dwelling unit or units or other information deemed appropriate for the effective operation of the program as requested on the survey form.
  - b. Upon activation of a water meter, each responsible party shall complete a survey form.
    - i. Cal-Am Water Users. The completed survey form shall be submitted to Cal-Am by customers of that distribution system.
    - ii. Non-Cal-Am Water Users. The completed survey form shall be submitted to the District or its agent by all other distribution systems users required to complete a survey form during Stage 5 Water Rationing through Stage 7 Water Rationing.
  - c. All responsible parties shall submit revised survey forms whenever there is a change in the number of permanent residents in a residential dwelling unit or whenever there is a change in a water user category in non-residential uses. Revised survey forms should be submitted to the appropriate party as indicated in Rule 170, D, 1, b.
  - d. Property owners of short-term residential housing rentals shall provide information about the average number of annual occupants and the average rate of occupancy to the appropriate party as indicated in Rule 170, D, 1, b.

2. Misrepresentation Violation. Any water user intentionally over-reporting the number of permanent residents in a dwelling unit or other information pertinent to establishing a water ration during Stages 4, 5, 6 and 7 Water Rationing may be charged with a misdemeanor punishable as an infraction as provided by Section 256 of the Monterey Peninsula Water Management District Law, Statutes of 1981, Chapter 986. Violations carry a maximum penalty of up to \$250 for each offense. Each separate day or portion thereof during which any violation occurs or continues without a good-faith effort by the responsible water user to correct the violation, may be deemed to constitute a separate offense, and upon conviction thereof, may be separately punishable.
3. Penalties for Misreporting. In addition to any charge for misrepresenting information as provided in Rule 170, D-2, any or all of the following may be further imposed by the General Manager or his agent during Stages 4, 5, 6 and 7 Water Rationing where the violation occurs and continues without a good-faith effort by the responsible water user to correct the violation. Decisions pursuant to this rule are appealable under Rule 70 (Appeals).
  - a. Intentional misrepresentation may be considered a violation of the water waste provisions and shall subject the water user to a fee for water waste; and/or
  - b. Intentional misrepresentation may cause the loss of any water bank accrued and shall cause the responsible party to be ineligible to accrue a water bank for a period of sixty (60) months; and/or
  - c. Intentional misrepresentation may cause the assignment of a reduced water ration that may be as low as a ration for one person for a period of twelve (12) months following implementation of Stages 4, 5, 6 or 7 Water Rationing.
4. Audit. The District may periodically audit the survey data for accuracy. Upon question, the District may request additional evidence of residency to demonstrate the number of permanent residents at that site as defined in Rule 11 (Definitions).

*Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*

## **RULE 171 - WATER WASTE FEES**

- A. Each occurrence of Water Waste or Non-Essential Water Use, as those terms are defined by Rule No. 11 (Definitions), which continues after the water user has had reasonable notice to cease and desist that type of water use shall constitute a flagrant occurrence.
- B. A \$50 fee per day or portion thereof shall be assessed for each flagrant occurrence of Water Waste or Non-Essential Water Use. The fee shall accumulate daily until the occurrence is corrected.
- C. A \$150 fee per day or portion thereof shall be imposed for each subsequent occurrence (including multiple occurrences) of Water Waste or Non-Essential Water Use which occurs within 18 months of the first occurrence. The fee shall accumulate daily until the occurrence is corrected.
- D. All fees shall be paid within 30 days.
- E. Within the 30 day period, a water user may seek waiver or forgiveness of all or part of the Water Waste fees on the basis of hardship. The water user must provide the District with a written explanation as to why the fees should not be collected. Staff shall be authorized to determine whether or not fees should be waived in full or in part, with the final decision resting with the General Manager.
- F. After 30 days, fees which have not been paid or waived may result in a lien being placed on the property served by the water account.
- G. Repeated occurrences of Water Waste or Non-Essential Water Use, which continue or occur after the water user has had a reasonable notice to cease and desist that type of water use, or which continues or occurs after the water user has had a reasonable opportunity to cure any defect causing that type of water use, shall provide cause for the placement of a flow restrictor within the water line or water meter.
- H. Decisions pursuant to this rule are appealable under Rule 70 (Appeals).

*Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*



## **RULE 172 - LANDSCAPE WATER AUDITS**

- A. Landscape Water Audits shall be conducted under the supervision of an individual who has been certified by the Irrigation Association to conduct audits and establish Landscape Water Budgets. Each audit shall be signed by that person, who shall attest that the audit was performed under his/her direction.
- B. Landscape Water Audits and Landscape Water Budgets shall be offered by the District and/or Cal-Am or their agent free of charge to all water users of Cal-Am with dedicated landscape meters, large irrigated areas over three acres, and large residential water users. Water use records shall be reviewed annually to identify new water users required to establish a Landscape Water Budget by this rule. Cal-Am shall provide the District with copies of all completed Landscape Water Audits and Landscape Water Budgets.
  - 1. Cal-Am water users shall be required to obtain Landscape Water Audits and establish Landscape Water Budgets if the property:
    - a. Has a dedicated landscape water meter; or
    - b. Is an irrigated area of greater than three acres; or
    - c. Is a large residential water user.
  - 2. All Landscape Water Budgets must be prepared by an individual certified by the Irrigation Association.
  - 3. All water users required to complete a Landscape Water Audit and establish a Landscape Water Budget shall have the option of obtaining a Landscape Water Audit and Landscape Water Budget from Landscape Irrigation Auditor of their choice at their own expense if the auditor is certified by the Irrigation Association.
  - 4. Landscape Water Audits not conducted by the District and/or Cal-Am shall be reported on a Landscape Water Budget Application. Landscape Water Budget Applications shall be submitted to Cal-Am. Cal-Am shall forward a copy to the District within ten (10) days. Landscape Water Audits not performed by the District or Cal-Am are subject to review and acceptance by the District. Landscape Water Audits and Landscape Water Budgets rejected by the District may be appealed to the Board of Directors pursuant to Rule 70 (Appeals).
  - 5. Landscape Irrigation Auditors shall arrange on-site visits to compile water records to review historic use, measure irrigated sites, identify plant materials by general groups, determine irrigation water requirements, and estimate potential dollar and water savings. Landscape Irrigation Auditors shall also develop system testing strategies, check pressure and flow rates, and conduct water application distribution tests. Data shall

be collected to determine irrigation uniformity and efficiency. Soil samples shall be examined to determine soil types and root zone depths. Landscape Irrigation Auditors shall observe system operations, locate irrigation zones, prepare site audit maps and visually identify broken or misaligned equipment. All data from field tests shall be summarized and this information used to generate monthly irrigation base schedules. A copy of the Landscape Water Budget Application shall be provided to the water user. One copy of the Landscape Water Budget Application shall be submitted to Cal-Am. Cal-Am shall forward a copy to the District within ten (10) days.

6. Cal-Am shall provide quarterly compliance status notices to each water user required to follow a mandatory Landscape Water Budget.
- C. Modifications To Audited Landscapes. Following significant modification to an existing audited landscape, a new Landscape Water Audit shall be conducted to establish an appropriate Landscape Water Budget. It shall be the responsibility of the property owner to ensure that a Landscape Water Audit is conducted within 60 days of any such change and to submit a new Landscape Water Budget Application to Cal-Am.
- D. Reporting and Analysis. Cal-Am shall preserve water use records and budgets for water users subject to this provision of law for such time as the Expanded Water Conservation and Standby Rationing Plan remains effective. Updated Landscape Water Budgets shall supersede previous data. Quarterly, a report shall be compiled by Cal-Am and provided to the District showing the account information and comparing the Landscape Water Budget with actual consumption. During Stages 2 and 3, Cal-Am shall provide the District with monthly consumption reports for all customers with Landscape Water Budgets.
- E. Landscape Irrigation Restrictions in the Cal-Am system that derives its source of supply from the MPWRS. Unless watering is by drip irrigation, through a hand-held hose with a positive action shut-off nozzle, or performed by a professional gardener or landscaper, the following schedule shall apply:
  1. Odd Numbered Properties shall water after 5 p.m. or before 9 a.m. on Saturdays and Wednesdays only. This schedule shall also apply to properties located on the South or West side of the street in cities where no street address is available.
  2. Even Numbered Properties shall water after 5 p.m. or before 9 a.m. on Sundays and Thursdays only. This schedule shall also apply to properties located on the North or East side of the street in cities where no street address is available.

*Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*

## **RULE 173 - REGULATION OF MOBILE WATER DISTRIBUTION SYSTEMS**

- A. No person, extractor, owner or operator shall operate a mobile water distribution system without first securing a written permit from the District. In accordance with Monterey County Code (e.g., Title 15.20), no applications will be accepted or permitted for bulk hauled water for permanent potable use. Applications for establishment of a mobile water distribution system shall be made pursuant to Rule 22 (Action On Application For Permit To Create/Establish A Water Distribution System) and shall be investigated, considered, determined, and acted upon on the same terms and conditions as provided for the approval, conditional approval or denial of a creation establishment permit as stated in that rule. The application shall identify each source of supply and the location of each use. For any subpotable mobile water distribution system within the California-American Water Company (Cal-Am) service area, a condition of approval shall require that Cal-Am be notified so that a back-flow protection device can be installed pursuant to Monterey County Code Title 17.
- B. In the event prior authorization is not obtained by reason of an emergency or health related situation, authorization for the Mobile Water Distribution System permit shall be sought from the District by submittal of a complete application compliant with Rule 21, within five working days following commencement of the emergency or health related event.
- C. Delivery and/or receipt of water from an unpermitted Mobile Water Distribution System shall be deemed water waste, and shall be subject to fine, restriction, and cease and desist order as set forth in Rule 171.

*Rule added by Ordinance No. 92 (1/28/99); amended by Ordinance No. 96 (3/19/2001)*

## **RULE 174 - REGULATION OF WELL OWNERS/OPERATORS AND EXTRACTORS**

- A. During a water supply emergency, each owner/operator or extractor of a private water well or other water-gathering facility shall comply with the provisions of this regulation, as they relate to such well.

*Rule added by Ordinance No. 92 (1/28/99)*



## **RULE 175 - WATER RATIONING ENFORCEMENT**

### **A. Enforcement During Stages 4 through 7 Water Rationing.**

1. Courtesy Notice. For the first instance of excess water use beyond the ration in Stages 4 through 7 Water Rationing, a water user shall be given written notice by the water system operator of the excess use and shall be notified that such violation constitutes water waste and a water waste fee of \$50 per day shall be collected in the event the water user again exceeds that user's water ration during any future billing cycle under Stages 4 through 7 Water Rationing. If the water user complies with all water rationing and water waste and non-essential water use requirements during the next month following the first instance of excess use, the excess use fee shall be deferred.

If the water user again exceeds that user's water ration during any following month, the water waste fee of \$50 per day shall be imposed immediately and shall accumulate daily until the occurrence is corrected.

2. Second Offense. Upon the second occurrence of excess water use (including any prior excess water use during any prior stage) a water user shall be charged with water waste and assessed a fee of \$150 per day for the second offense, plus the previously deferred \$50 first offense fee, by the District or its agent. The \$150 fee shall accumulate daily until the occurrence is corrected.

3. Third Offense.

A third occurrence of excess water use (including any prior excess water use during any prior stage) shall result in an excess water use charge equivalent to the Cal-Am per unit water charge at the water user's level of use multiplied by the number of units over a water ration, plus \$150 per day as provided in Rule 171 (Water Waste Fees). A third occurrence of excess water use shall provide cause for the installation of a flow restrictor in the water meter or water supply providing water to the property where the over-use occurred. Restrictors shall remain in place until conditions are reduced to Stage 2 Water Conservation or a less restrictive stage. All costs for the installation and removal of a flow restrictor shall be charged to the property owner of the site subjected to this action.

4. Fourth Offense. A fourth occurrence of water use in excess of the water ration shall result in fees and charges listed for a third offense and shall result in the installation of a flow restrictor by the system operator in the water meter or water supply providing water to the property where the over-use occurred. Restrictors shall remain in place until conditions are reduced to Stage 3 Water conservation or to a less restrictive stage. All costs for the installation and removal of a flow restrictor shall be charged to the property owner of the site subjected to this action.

- B. Flow Restrictor Exemption. Exemptions to the installation of a flow restrictor as a means to enforce the water ration shall occur when there are provable risks to the health, safety and/or welfare of the water user. An exemption shall be made for water meters serving three or more multi-family dwelling units by substituting an excess water use charge of \$150 times the number of dwelling units located on the meter during each month in which a violation of the water ration occurs. The responsible party shall be liable for payment of all excess water use charges.
- C. All notices and assessments of water waste and/or excess water use charges made by a water distribution system operator shall be reported to the District.

*Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)*

## Appendix 7F

### List of Water Quality Monitoring Network Monitoring Sites

**Appendix 7-F. List of Water Quality Monitoring Network Monitoring Sites**

Site Name	Water System Name	Well Screen Information			Coordinates (NAD 83)		Monitoring Data Range	
		Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Screen Length (ft)	Latitude	Longitude	First Year	Last Year
2700536-002	CORRAL DE TIERRA ESTATES WC	-	-	-	36.570	-121.726	6/9/2002	10/24/2017
2700536-004	CORRAL DE TIERRA ESTATES WC	120	250	130	36.570	-121.726	9/8/2002	12/26/2019
2700775-001	TIERRA VERDE MWC	200	356	156	36.568	-121.731	8/7/1986	5/31/2015
2700775-002	TIERRA VERDE MWC	100	440	340	36.567	-121.731	2/26/2004	12/19/2019
2701142-001	HORN WS	54	100	46	36.587	-121.712	8/7/1986	1/8/2019
2701227-001	SAN BENANCIO SCHOOL WS	320	460	140	36.578	-121.717	6/23/2006	5/30/2012
2701367-002	TIERRA MEADOWS HOA WS	220	260	40	36.565	-121.734	3/24/2006	12/6/2012
2701681-001	EXXON STATION WS	40	200	160	36.578	-121.727	12/28/2005	9/13/2019
2701740-001	BLUFFS WS	271	309	38	36.639	-121.705	4/6/1987	12/10/2019
2701740-012	BLUFFS WS	-	-	-	36.626	-121.687	6/25/2008	3/7/2018
2701822-001	ROBLEY PROPERTY MWS	335	585	250	36.557	-121.741	9/11/1986	12/16/2019
2701822-002	ROBLEY PROPERTY MWS	320	390	70	36.557	-121.744	9/3/2003	12/16/2019
2701935-001	MOUNT TORO RANCHOS MWA	-	-	-	36.544	-121.670	4/28/2003	3/26/2018
2701935-002	MOUNT TORO RANCHOS MWA	550	830	280	36.544	-121.670	6/23/2003	12/17/2019
2701959-001	TIERRA VISTA MWC	230	250	20	36.555	-121.696	6/5/1997	12/31/2019
2702030-001	CYPRESS COMMUNITY CHURCH WS	370	430	60	36.582	-121.728	3/30/2011	10/2/2019
2702315-001	CORRAL DE TIERRA COUNTRY CLUB WS	180	440	260	36.568	-121.727	3/25/2004	12/10/2019
2710006-004	CAL AM WATER COMPANY - AMBLER PARK	160	360	200	36.575	-121.725	7/2/1984	12/11/2019
2710006-005	CAL AM WATER COMPANY - AMBLER PARK	160	420	260	36.574	-121.727	6/19/1990	12/4/2018
2710006-006	CAL AM WATER COMPANY - AMBLER PARK	160	460	300	36.575	-121.725	4/7/1994	12/11/2019
2710006-009	CAL AM WATER COMPANY - AMBLER PARK	-	-	-	36.576	-121.716	9/13/2011	12/11/2019
2710012-007	CWSC SALINAS HILLS	260	540	280	36.606	-121.699	10/20/1986	10/11/2018
2710017-008	MARINA COAST WATER DISTRICT	160	1540	1380	36.672	-121.782	9/19/1984	12/17/2019
2710017-009	MARINA COAST WATER DISTRICT	970	1170	200	36.677	-121.779	1/6/1986	12/17/2019
2710017-026	MARINA COAST WATER DISTRICT	-	-	-	36.662	-121.755	11/5/1985	12/17/2019
2710017-027	MARINA COAST WATER DISTRICT	-	-	-	36.667	-121.751	8/7/1985	12/17/2019
2710017-028	MARINA COAST WATER DISTRICT	-	-	-	36.662	-121.746	8/7/1985	12/17/2019
2710017-033	MARINA COAST WATER DISTRICT	-	-	-	36.660	-121.741	5/4/2011	12/17/2019
2710017-034	MARINA COAST WATER DISTRICT	-	-	-	36.649	-121.727	12/7/2011	12/17/2019



Site Name	Water System Name	Well Screen Information			Coordinates (NAD 83)		Monitoring Data Range	
		Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Screen Length (ft)	Latitude	Longitude	First Year	Last Year
2710021-003	CAL AM WATER COMPANY - TORO	-	-	396	36.571	-121.745	9/15/1987	10/8/2019
2710021-004	CAL AM WATER COMPANY - TORO	-	-	200	36.571	-121.744	11/10/1987	12/11/2019
AGC100000001-CCGC_0108	-	-	-	-	36.645	-121.717	3/10/2014	3/10/2014
AGC100000001-CCGC_0132	-	-	-	-	36.659	-121.736	3/13/2014	3/13/2014
AGC100000001-CCGC_0615	-	-	-	-	36.664	-121.736	8/25/2015	8/25/2015
AGL020003793-DOM	-	-	-	-	36.569	-121.736	12/30/2017	12/30/2017
AGL020003810-CCGC_0108	-	271	309	38	36.645	-121.717	6/1/2017	5/1/2019
AGL020003815-HOME_BM	-	-	-	-	36.631	-121.709	6/1/2017	5/1/2019
AGL020003815-HOME_KG	-	-	-	-	36.630	-121.704	6/1/2017	5/1/2019
AGL020003815-HOME_SM	-	-	-	-	36.632	-121.717	6/1/2017	5/1/2019
AGL020028240-RIVER1_I	-	-	-	-	36.622	-121.684	11/28/2017	9/23/2019
AGL020028240-RIVER2_I	-	-	-	-	36.623	-121.682	11/28/2017	9/23/2019

## Appendix 7-G (Ag Order 4.0)

### Central Coast Ag Order 4.0 Monitoring and Reporting Program

**STATE OF CALIFORNIA  
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL COAST REGION**

**GENERAL WASTE DISCHARGE REQUIREMENTS  
FOR  
DISCHARGES FROM IRRIGATED LANDS**

**ORDER NO. R3-2021-0040**

**April 15, 2021**

**ORDER**

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## **Attachments**

Attachment A – Additional Findings and Regulatory Considerations  
Attachment B – Monitoring and Reporting Program (MRP)  
Attachment C – Acronyms, Abbreviations, and Definitions

## **THE CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, CENTRAL COAST REGION FINDS:**

### **Part 1, Section A. Findings**

#### **Background and Purpose**

1. As described in the Water Quality Control Plan for the Central Coastal Basin (Basin Plan), the central coast region of California represents approximately 7.2 million acres of land. There are approximately 540,000 acres of irrigated land and approximately 3,000 agricultural operations that may be generating wastewater that falls into the category of discharges of waste from irrigated lands.
2. The central coast region has more than 17,000 miles of surface waters (linear streams/rivers and approximately 4,000 square miles of groundwater basins that are, or may be, affected by discharges of waste from irrigated lands. Of the nine hydrologic regions in the state, the central coast region is the most groundwater dependent region with approximately 86% of its water supply being derived from groundwater.
3. The State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards (Regional Water Boards) are the principal state agencies with primary responsibility for the coordination and control of water quality for the health, safety and welfare of the people of the state pursuant to the Porter-Cologne Water Quality Control Act (Porter-Cologne Act, codified in Water Code Division 7). The legislature, in the Porter-Cologne Act, directed the state, through the Water Boards, to exercise its full power and jurisdiction to protect the quality of the waters in the state from degradation and to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible, and considering precipitation, topography, population, recreation, agriculture, industry, and economic development (Water Code section 13000).
4. Since the issuance of the first Agricultural Order in 2004 and subsequent Agricultural Orders in 2012 and 2017, the California Regional Water Quality Control Board, Central Coast Region (Central Coast Water Board) has compiled additional and substantial empirical data demonstrating that water quality conditions in agricultural areas of the region continue to be severely impaired or polluted by waste discharges from irrigated agricultural operations and activities that impair beneficial uses. The main impacts from irrigated agriculture in the central coast region are nitrate discharges to groundwater and associated drinking water impacts, nutrient discharges to surface water, pesticide discharges

and associated toxicity, sediment discharges, and degradation of riparian and wetland areas and the associated impairment or loss of beneficial uses.

5. The objectives of this Order are:

- a. Protect and restore beneficial uses and achieve water quality objectives specified in the Basin Plan for commercial irrigated agricultural areas in the central coast region by:
  - i. Minimizing nitrate discharges to groundwater,
  - ii. Minimizing nutrient discharges to surface water,
  - iii. Minimizing toxicity in surface water from pesticide<sup>1</sup> discharges,
  - iv. Protecting riparian and wetland habitat, and
  - v. Minimizing sediment discharges to surface water.
- b. Effectively track and quantify achievement of 5.a.i through 5.a.v over a specific, defined time schedule.
- c. Comply with the State's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Policy), the State Antidegradation Policy, relevant court decisions such as those pertaining to *Coastkeeper et al*/ lawsuits, the precedential language in the Eastern San Joaquin Watershed Agricultural Order, and other relevant statutes and water quality plans and policies, including total maximum daily loads in the central coast region.

6. This Order regulates discharges of waste from irrigated lands by requiring individuals subject to this Order to comply with the terms and conditions set forth herein to ensure that such discharges do not cause or contribute to the exceedance of any regional, state, or federal numeric or narrative water quality objectives or impair any beneficial uses in waters of the state and of the United States.

7. Water Code section 13260(a) requires that any person discharging waste or proposing to discharge waste that could affect the quality of the waters of the state, other than into a community sewer system, must file with the appropriate Regional Board a report of waste discharge (ROWD) containing such information and data as may be required by the Central Coast Water Board, unless the Central Coast Water Board waives such requirement.

8. Water Code section 13263(a) requires the Central Coast Water Board to prescribe waste discharge requirements (WDRs), or waive WDRs, for the discharge. The requirements must implement the Basin Plan and must take into

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<sup>1</sup> A pesticide is any substance intended to control, destroy, repel, or otherwise mitigate a pest. The term pesticide is inclusive of all pest and disease management products, including insecticides, herbicides, fungicides, nematicides, rodenticides, algicides, etc.

consideration the beneficial uses to be protected and the water quality objectives reasonably required for that purpose, other waste discharges, the need to prevent nuisance, and the provisions of Water Code section 13241.

9. Water Code section 13263(b) states that, in prescribing requirements, the Central Coast Water Board need not authorize the utilization of the full waste assimilation capacities of the receiving waters.
10. Water Code section 13263(e) states that for WDRs, "Upon application by any affected person, or on its own motion, the regional board may review and revise requirements. All requirements shall be reviewed periodically."
11. This Order does not create a vested right to discharge; all discharges are a privilege, not a right, as described in Water Code section 13263(g).
12. Water Code section 13263(i) authorizes the Central Coast Water Board to prescribe general WDRs for a category of discharges if the Central Coast Water Board finds or determines that all the criteria listed below apply to the discharges in that category. Discharges associated with irrigated agricultural operations that will be regulated under this Order are consistent with these criteria and therefore a general order is appropriate.
  - a. The discharges are produced by the same or similar operations.
  - b. The discharges involve the same or similar type of waste.
  - c. The discharges require the same or similar treatment standards.
  - d. The discharges are more appropriately regulated under general WDRs than individual WDRs.
13. Water Code section 13243 authorizes the Central Coast Water Board, in WDRs, to specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted.
14. Water Code section 13267(a) authorizes the Central Coast Water Board to, in establishing or reviewing waste discharge requirements, or in connection with any action to any plan or requirement authorized by the Porter-Cologne Act, investigate the quality of any waters of the state within the region. The monitoring and reporting requirements as set forth in Attachment B are established under Water Code section 13267(b).
15. Water Code section 13267(c) authorizes the Central Coast Water Board or its authorized representatives to, in conducting an investigation of the quality of waters of the state within the region, inspect the facilities of the Discharger upon consent, issuance of a warrant, or in an emergency affecting public health or safety, to ascertain compliance with this Order and to ascertain whether the



purpose of the Porter-Cologne Act are being met. Inspections under Water Code section 13267(c) include sampling and monitoring.

16. Water Code section 13304 authorizes the Central Coast Water Board to, upon making the requisite findings, issue a cleanup and abatement order (CAO) that requires Dischargers to provide emergency and long-term alternative water supplies or replacement water service, including wellhead treatment, to each affected public water supplier or private well owners. A CAO is a separate action from this Order; this Order does not require Dischargers to provide alternative water supplies or replacement water.

### **Public Participation Process**

17. In August 2017, Central Coast Water Board staff held a series of listening sessions throughout the central coast region to solicit stakeholder input on potential improvements to the previous agricultural order. The Central Coast Water Board discussed the input received from stakeholders during the September 2017 board meeting.
18. In February 2018, the Central Coast Water Board published an initial study to begin soliciting input related to environmental review for the California Environmental Quality Act (CEQA), in preparation for developing a draft Environmental Impact Report (EIR). A 73-day public comment period was held for the initial study. In March 2018, Central Coast Water Board staff held a series of public CEQA scoping meetings throughout the region. Input received during the public comment period and public scoping meetings has been considered in the development of the draft EIR.
19. In March and May 2018, Central Coast Water Board meetings included informational items dedicated to a review of water quality conditions associated with agricultural activities and discharges. The March 2018 informational item focused on surface water quality conditions and agricultural discharges and the May 2018 informational item focused on groundwater quality conditions and nitrate impacts to groundwater. Both informational items incorporated presentations from several outside speakers.
20. In September 2018, the Central Coast Water Board's public meeting was dedicated to a workshop for agricultural order stakeholders. Panels of agricultural, environmental, and environmental justice representatives gave presentations to the board in response to a series of questions staff proposed:
  - a. What can growers and the regional board do to demonstrate quantifiable progress to minimize nitrate discharge to groundwater to achieve water quality objectives?

- b. What can growers and the regional board do to demonstrate quantifiable progress to minimize nutrient discharge to surface waters to achieve water quality objectives?
  - c. What can growers and the regional board do to demonstrate quantifiable progress to minimize toxicity in surface waters from pesticide discharges to achieve water quality objectives?
  - d. What can growers and the regional board do to ensure that riparian and wetland habitat is protected due to agricultural activities and discharges?
  - e. What can growers and the regional board do to demonstrate quantifiable progress to minimize sediment discharge to achieve water quality objectives?
  - f. How can the regional board use discharge permit requirements to ensure current and future affordable, safe, and clean water for drinking and environmental uses?
21. In November 2018, the Central Coast Water Board published a set of five conceptual options tables that serve as the Central Coast Water Board's framework to address the questions posed in the September 2018 meeting. The Central Coast Water Board reviewed and discussed the options tables during its public meeting in November, and a 64-day written public comment period was subsequently held to solicit detailed stakeholder input. Central Coast Water Board staff held a series of outreach meetings throughout the region during the comment period.
22. In March 2019, after the 64-day public comment period, the Central Coast Water Board published updated versions of the five conceptual options tables. During the public meetings in March and May 2019, the Central Coast Water Board discussed the updated tables and received additional stakeholder comment.
23. In September 2019, during its public meeting, the Central Coast Water Board held a workshop focused on co-managing food safety and environmental protection, the role of riparian vegetation in water quality and beneficial use protection, and Discharger experiences with food safety challenges.
24. On February 21, 2020, the Central Coast Water Board published the draft Order and draft EIR and began a 45-day public comment period. The comment period was extended twice and closed on June 22, 2020.
25. In June 2020, Central Coast Water Board staff conducted three outreach meetings, which included presentations of the draft Order and draft EIR, and a question and answer session for attendees. These outreach meetings were conducted virtually via the Zoom platform, due to the COVID-19 pandemic.
26. Beginning on September 10, 2020 and continuing to January 8, 2021, the Central Coast Water Board held 10 days of Board meetings to receive oral comments

from the public and to discuss the draft Order. During these meetings, three of which were devoted entirely to receiving public comment and Board engagement with stakeholders, the Board deliberated on the draft Order using a consensus-based approach through which they directed staff on the development of a revised Order.

27. On January 26, 2021, the Central Coast Water Board circulated a revised draft Order for a 30-day public comment period that closed on February 25, 2021. Central Coast Water Board staff subsequently considered the public comments and developed a proposed Order for Board consideration during an April 14-15, 2021, public hearing.
28. The Central Coast Water Board, in a public hearing held on April 14-15, 2021, has heard and considered all comments pertaining to the discharge and proposed Order.
29. After considering all comments pertaining to this General Permit during a public hearing on April 14-16, 2021, this Order was found consistent with the findings in this Part 1 and Attachment A.
30. Any person aggrieved by this action of the Central Coast Water Board may petition the State Water Board to review the action in accordance with California Water Code section 13320 and title 23 California Code of Regulations sections 2050 and following. The State Water Board must receive the petition by 5:00 p.m., within 30 calendar days of the date of adoption of this Order at the following address, except that if the thirtieth day following the date of adoption falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day:

State Water Resources Control Board  
Office of Chief Counsel  
P.O. Box 100, 1001 I Street  
Sacramento, CA 95812-0100

Or by email at [waterqualitypetitions@waterboards.ca.gov](mailto:waterqualitypetitions@waterboards.ca.gov)

For instructions on how to file a petition for review, see  
[http://www.waterboards.ca.gov/public\\_notices/petitions/water\\_quality/wqp\\_etition\\_instr.shtml](http://www.waterboards.ca.gov/public_notices/petitions/water_quality/wqp_etition_instr.shtml).

## **Scope of Order**

### ***Irrigated Lands and Agricultural Discharges Regulated Under this Order***

31. This Order regulates (1) discharges of waste from commercial irrigated lands, including, but not limited to, land planted to row, vineyard, field and tree crops where water is applied for producing commercial crops; (2) discharges of waste from commercial nurseries, nursery stock production, and greenhouse operations with soil floors that do not have point source-type discharges and are not currently operating under individual WDRs; and (3) discharges of waste from lands that are planted to commercial crops that are not yet marketable, such as vineyards and tree crops.
32. Discharges from irrigated lands regulated by this Order include discharges to surface water and groundwater, through mechanisms such as irrigation return flows, percolation, tailwater, tile drain water, stormwater runoff flowing from irrigated lands, stormwater runoff conveyed in channels or canals resulting from the discharge from irrigated lands, and runoff resulting from frost control or operational spills. These discharges can contain wastes that could affect the quality of waters of the state and impair beneficial uses.
33. This Order also regulates agricultural activities such as the removal or degradation of riparian vegetation resulting in the loss or degradation of instream beneficial uses.

### ***Dischargers Regulated Under this Order***

34. This Order regulates both landowners and operators of commercial irrigated lands on or from which there are discharges of waste or activities that could affect the quality of any surface water or groundwater or result in the impairment of beneficial uses (Dischargers). Dischargers are responsible for complying with the conditions of this Order. Both the landowner and the operator of the irrigated agricultural land are Dischargers under this Order. The Central Coast Water Board will hold both the landowner and the operator liable for noncompliance with this Order, regardless of whether the landowner or the operator is the party to enroll under this Order.
35. For the purposes of this Order, irrigated lands producing commercial crops are those operations that have one or more of the following characteristics:
  - a. The landowner or operator has obtained a pesticide use permit from a local County Agricultural Commissioner;



- b. The crop is sold, including but not limited to 1) an industry cooperative, 2) a harvest crew/company, or 3) a direct marketing location, such as certified Farmers Markets;
- c. The federal Department of Treasury Internal Revenue Service for 1040 Schedule F Profit or Loss from Farming is used to file federal taxes.

36. The electronic Notice of Intent (eNOI) serves as a report of waste discharge ROWD) for the purposes of this Order.

37. The Central Coast Water Board recognizes that certain limited resource growers<sup>2</sup> as defined by the U.S. Department of Agriculture) may have difficulty achieving compliance with this Order. The Central Coast Water Board will prioritize assistance for these growers, including but not limited to technical assistance, grant opportunities, and necessary flexibility to achieve compliance with this Order (e.g., adjusted monitoring, reporting, or time schedules).

***Agricultural Dischargers Not Covered Under this Order and Who Must Apply for Individual Waste Discharge Requirements***

38. This Order does not cover point source-type discharges from commercial nurseries, nursery stock production, greenhouses, or other operations. This Order does not cover discharges of waste from fully contained greenhouse operations (i.e., those that have no groundwater discharge due to impermeable floors but may have other discharges associated with the operation). These operations must either eliminate all such discharges of waste or submit a ROWD to apply for individual WDRs as set forth in Water Code section 13260.

**Enforcement for Noncompliance**

39. The State Water Board's Water Quality Enforcement Policy (Enforcement Policy) describes progressive enforcement action for violations of WDRs when appropriate. However, the Enforcement Policy recommends formal enforcement as a first response to more significant violations. Progressive enforcement is an escalating series of actions that allows for the efficient and effective use of enforcement resources to 1) assist cooperative Dischargers in achieving compliance; 2) compel compliance for repeat violations and recalcitrant violators; and 3) provide a disincentive for noncompliance. Progressive enforcement

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<sup>2</sup> The term "Limited Resource Farmer or Rancher" means a participant:

- With direct or indirect gross farm sales not more than the current indexed value in each of the previous two years, and
- Who has a total household income at or below the national poverty level for a family of four, or less than 50 percent of county median household income in each of the previous two years.

A Self-Determination Tool is available to the public and may be completed on-line or printed and completed hardcopy at the USDA website: [Limited Resource Farmer/Rancher Self Determination Tool](#).

actions may begin with informal enforcement actions such as a verbal, written, or electronic communication between the Central Coast Water Board and a Discharger. The purpose of an informal enforcement action is to quickly bring the violation to the Discharger's attention and to give the Discharger an opportunity to return to compliance as soon as possible. The highest level of informal enforcement is a Notice of Violation.

40. The Enforcement Policy recommends formal enforcement actions for the highest priority violations, chronic violations, and/or threatened violations. Violations of this Order that will be considered a priority include, but are not limited to:

- a. Failure to obtain required regulatory coverage;
- b. Failure to achieve numeric limits;
- c. Falsifying information or intentionally withholding information required by applicable laws, regulations, or an enforcement order;
- d. Failure to monitor or provide complete and accurate information as required;
- e. Failure to pay annual fees, penalties, or liabilities; and
- f. Failure to submit required reports on time.

41. Water Code section 13350 provides that any person who violates WDRs may be 1 subject to administrative civil liability imposed by the Central Coast Water Board or State Water Board in an amount of up to \$5,000 per day of violation, or up to \$10 per gallon of waste discharged; or 2 subject to civil liability imposed by a court in an amount of up to \$15,000 per day of violation, or up to \$20 per gallon of waste discharged. The actual calculation and determination of administrative civil penalties must be consistent with the Enforcement Policy and the Porter-Cologne Act.

### **Additional Findings and Regulatory Considerations**

42. Attachment A to this Order, incorporated herein, includes additional findings that further describe the Water Board's legal and regulatory authority; compliance with CEQA requirements; applicable plans and policies adopted by the State Water Board and the Central Coast Water Board that contain regulatory conditions that apply to the discharge of waste from irrigated lands; and the rationale for this Order, including descriptions of the environmental and agricultural resources in the central coast region and impacts to water quality and beneficial uses from agricultural discharges.

43. The Central Coast Water Board encourages Dischargers to participate in third-party groups or programs (e.g., certification program, watershed group, water quality coalition, monitoring coalition, or other third-party effort) to facilitate and document compliance with this Order. Third-party programs can be used to implement outreach and education, monitoring and reporting, management practice and/or water quality improvement projects. Regionally scaled third-party

programs addressing multiple Order requirements are preferred to provide economies of scale to reduce Discharger costs, maximize effectiveness, and streamline Water Board oversight; however, watershed- or basin-scale third-party programs of limited scope may be appropriate under certain circumstances and should be coordinated to the extent practicable for consistency and effectiveness. Commodity group certification programs may also be effective in facilitating compliance with this Order. Dischargers participating in an Executive Officer approved third-party program may be subject to permit fee reductions or alternative compliance pathways that substantively comply with this Order.

44. The Central Coast Water Board acknowledges that it will take time to develop meaningful and effective third-party programs that facilitate compliance with this Order. The Order considers this by allowing an initial grace period for the phasing in of various requirements. The phasing in of various requirements is also intended to allow Water Board staff time to develop online reporting tools and templates and to conduct outreach and education to help Dischargers and service providers come up to speed on the new requirements.
45. Third-party programs are discussed in **Part 2, Section A**. The Central Coast Water Board will provide more detailed third-party expectation documents and/or third-party program requests for proposals (RFPs) to inform and solicit third-party program proposals for Executive Officer consideration.
46. The Executive Officer may make non-substantive changes to the Order to correct typographical errors or to maintain consistency within the Order or between the Order and its Attachments, e.g., to conform changes made during the Order development process that were inadvertently not carried through the entire Order. The Board will provide public notice of the non-substantive changes.

**IT IS HEREBY ORDERED** that Order No. R3-2017-0002 is terminated as of the effective date of this Order except for the purposes of enforcement, and that pursuant to Water Code sections 13260, 13263, and 13267, Dischargers enrolled in this Order, their agents, successors, and assigns, must comply with the following terms and conditions to meet the provisions contained in Water Code Division 7 and regulations, plans, and policies adopted thereunder.

**Part 2, Section A. Enrollment, Fees, Termination, General Provisions, and Third-Party Programs**

1. This Order is effective upon adoption by the Central Coast Water Board.
2. Except where stated otherwise, all requirements of this Order apply to all Dischargers.

**Enrollment**

3. Enrollment in this Order requires the submittal of the electronic Notice of Intent (eNOI) pursuant to Water Code section 13260. Submittal of all other technical reports pursuant to this Order is required pursuant to Water Code section 13267. Failure to submit technical reports or the attachments in accordance with the time schedules established by this Order or Monitoring and Reporting Program (MRP), or failure to submit a complete technical report (i.e., of sufficient technical quality to be acceptable to the Executive Officer), may subject the Discharger to enforcement action pursuant to Water Code sections 13261, 13268, or 13350. Dischargers must submit technical reports in the format specified by the Executive Officer.
4. Dischargers who are not currently enrolled in the existing agricultural order must submit to the Central Coast Water Board a complete eNOI prior to discharging. Upon submittal of a complete and accurate eNOI, the Discharger is enrolled under this Order, unless otherwise informed by the Executive Officer.
5. Dischargers who were enrolled in Order R3-2017-0002 as of the effective date of this Order are automatically enrolled in this Order. Within 120 days of Order adoption, enrolled Dischargers must update their eNOI.
6. In the case where an operator may be operating for a period of less than 12 months, the landowner must submit the eNOI. In all other cases, either the landowner or the operator must submit the eNOI. Both the landowner and the operator are Dischargers and considered a responsible party for compliance with the requirements of this Order.
7. **Prior to any discharge or commencement of activities that may cause a discharge**, including land preparation prior to crop production, any Discharger



proposing to control or own a new operation or ranch that has the potential to discharge waste that could directly or indirectly reach waters of the state and/or affect the quality of any surface water and/or groundwater must submit an eNOI.

8. **Within 60 days** of any change in operation or ranch information, the Discharger must update the eNOI.
9. **Within 60 days** of any change in control or ownership of an operation, ranch, or land presently owned or controlled by the Discharger, the Discharger must notify the succeeding owner and operator of the existence of this Order.
10. **Within 60 days** of acquiring control or ownership of an existing operation or ranch, the succeeding Discharger must submit an eNOI.
11. Dischargers must submit all the information required in the eNOI form, including but not limited to the following information for the operation and individual ranch:
  - a. Assessor parcel numbers (APNs) covered by enrollment,
  - b. Landowner s ,
  - c. Operator s ,
  - d. Contact information,
  - e. Third-party program membership,
  - f. Location of operation, including specific ranch es),
  - g. Map with discharge locations and groundwater wells identified,
  - h. Type and number of groundwater wells located on ranch parcels,
  - i. Total and irrigated acreage,
  - j. Crop types grown,
  - k. Irrigation system type,
  - l. Discharge type,
  - m. Chemical use,
  - n. Slope,
  - o. Impermeable surfaces,
  - p. Presence and location of any waterbodies on or adjacent to the ranch.
  - q. Status of drinking water notification to well users
12. Dischargers or groups of Dischargers seeking regulatory requirements tailored to their specific operation, ranch, geographic area, or commodity may submit an ROWD to obtain an individual order and MRP, or request the development of a general order for a specific type of discharge (e.g., commodity-specific general order . This Order remains applicable to those Dischargers until the Central Coast Water Board adopts such an individual order, MRP, or general order, and, if applicable, the Dischargers are enrolled in the general order.
13. Dischargers seeking enrollment in this Order must submit a statement of understanding of the conditions of this Order and MRP signed by the Discharger

landowner or operator with the eNOI. If the operator signs and submits the electronic NOI, the operator must provide a copy of the complete NOI form to the landowner s .

14. Coverage under this Order is not transferable to any person except after the succeeding Discharger's submittal to the Central Coast Water Board of an updated eNOI and approval by the Executive Officer.

## Fees

15. Dischargers must pay a fee to the State Water Resources Control Board in compliance with the fee schedule contained in Title 23 California Code of Regulations.
16. Dischargers must pay any relevant third-party program fees e.g., Surface Water Third-Party Monitoring Program (aka Cooperative Monitoring Program or CMP necessary to comply with monitoring and reporting conditions of this Order or they must comply with monitoring and reporting requirements individually.
17. For Dischargers who choose to participate in a third-party program, failure to pay third-party program fees voids a selection or notification of the option to participate in the third-party program and hence requires Dischargers to immediately comply with individual groundwater protection and/or surface water protection requirements.

## Termination

18. **Immediately**, if a Discharger wishes to terminate coverage under this Order for the operation or an individual ranch, the Discharger must submit a complete Notice of Termination (NOT), in a format specified by the Executive Officer. Termination from coverage is the date the termination request is approved, unless specified otherwise. All discharges must cease before the date of termination, and any discharges on or after the date of termination are violations of this Order, unless covered by other WDRs or waivers of WDRs. All required monitoring and reporting are due **within 60 days of the termination or March 1 following the termination date**, whichever is sooner, unless otherwise directed by the Executive Officer.

## General Provisions

19. The unauthorized discharge of any waste not specifically regulated by this Order, is prohibited.
20. The discharge of waste at a location or in a manner different from that described in the eNOI is prohibited.

21. Dischargers must comply with the Monitoring and Reporting Program (MRP , incorporated herein as Attachment B.
22. All forms, reports, documents, and laboratory data must be submitted to the Central Coast Water Board electronically through the State Water Board's database systems (e.g., GeoTracker, CEDEN,<sup>3</sup> etc.).
23. Dischargers are defined in this Order as both the landowner and the operator of irrigated agricultural land on or from which there are discharges of waste from irrigated agricultural activities that could affect the quality of any surface water or groundwater. The Central Coast Water Board will hold both the landowner and the operator liable for noncompliance with this Order.
24. The Executive Officer may propose, and the Central Coast Water Board may adopt, individual WDRs for any Discharger at any time.
25. The Central Coast Water Board or the Executive Officer may, at any time, terminate applicability of this Order with respect to an individual Discharger upon written notice to the Discharger.
26. Noncompliance with requirements in this Order is grounds for enforcement action and/or termination of coverage for waste discharges under this Order, subjecting the Discharger to enforcement under the Water Code for further discharges of waste to surface water or groundwater.
27. The fact that it would have been necessary to halt or reduce the permitted discharge activity to maintain compliance with this Order is not a defense for the Discharger's violations of this Order.
28. Provisions of this Order are severable. If any provision of this Order is found invalid, the remainder of this Order will not be affected.
29. Upon the Central Coast Water Board's or Executive Officer's request and within a reasonable timeframe, Dischargers must submit any information required to determine compliance with this Order or to determine whether there is cause for modifying or terminating this Order.
30. Under authority of Water Code section 13267 c), the Discharger must allow the Central Coast Water Board, or an authorized representative, upon consent or other documents as may be required by law, to do the following:
  - a. Enter upon the Discharger's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this Order,

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<sup>3</sup> CEDEN is the California Environmental Data Exchange Network.

- b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order,
  - c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order, and
  - d. Collect samples from and monitor waters of the state within or bordering property subject to this Order, at reasonable times for the purposes of assuring compliance with this Order or as otherwise authorized by the Water Code. The sampling and monitoring may include and is not limited to domestic and irrigation wells, surface receiving waters, and edge of field discharges to surface waters.
31. This Order may be reopened to address changes in statutes, regulations, plans, policies, or case law that govern water quality requirements for the discharges regulated herein.

### **Order Effectiveness Evaluation**

32. To facilitate an adaptive management process to inform modifications to the Order, the Central Coast Water Board will receive annual updates from its staff and, as appropriate, third party groups or programs during public meetings regarding the implementation of this Order. The purpose of the updates is to evaluate and report out on individual discharger and third-party group compliance; identify successes, challenges, and emerging science and management practices; consider potential Order modifications as may be appropriate at five-year intervals; and generally inform the Board and public regarding the Order's effectiveness towards achieving the stated objectives.

### **Third-Party Programs**

33. Dischargers may comply with portions of this Order by participating in third-party groups or programs (e.g., certification program, watershed group, water quality coalition, monitoring coalition, or other third-party effort approved by the Executive Officer. In this case, the third-party will assist individual Dischargers in achieving compliance with this Order, including implementing water quality improvement projects and required monitoring and reporting as described in the MRP. Compliance with the requirements of this Order is still required for all members of the third-party program; however, the third-party may propose modified monitoring and reporting for approval by the Executive Officer. Third-party program proposals will be evaluated on a case-by-case basis relative to their ability to document compliance with this Order as part of a request for proposal process and as further informed by a forthcoming third-party expectations document.



34. Interested persons may seek discretionary review by the Central Coast Water Board of the Executive Officer's approval or denial of the following work plans:
- Third-party program groundwater quality trend monitoring and reporting.
  - Third-party program surface receiving water quality trend monitoring and reporting.
  - Individual and third-party program follow-up surface receiving water implementation.
35. Interested persons seeking discretionary review by the Central Coast Water Board must submit their request in writing no later than 30 days from the date of the Executive Officer's approval or denial of the work plans noted above.
36. This Order includes specific provisions and an alternative compliance pathway for third-party programs that will also be subject to a third-party request for proposal process and Executive Officer review and approval. Dischargers participating in a third-party administered alternative compliance pathway program, and that remain in good standing as defined in this Order and/or Executive Officer approved third-party work plan, are subject to the third-party program requirements in lieu of individual requirements as specified. The third-party alternative compliance pathway program's assessment and evaluation for groundwater protection and the regional groundwater quality trend monitoring program described in **Part 2, Section C.1** must be closely aligned and coordinated such that they are effectively measuring the objectives the programs are trying to achieve.
37. Third-party program proposals must include and identify specific membership eligibility requirements, for approval by the Executive Officer, to evaluate whether third-party program members are in good standing. Members that are not in good standing with the membership eligibility requirements lose their membership and must immediately comply with individual groundwater protection and/or surface water protection requirements. At a minimum, third-party program proposals must include membership eligibility requirements and follow-up consequences that are triggered, including revocation of membership eligibility, to address the following scenarios where members are no longer in good standing:
- a. Non-payment of fees
  - b. Non-submittal of information
  - c. Non-participation in education/outreach or site visits
  - d. Failure to implement / adapt management practices
38. Consistent with the Water Board's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Policy), the ineffectiveness of a third-party program through which a Discharger participates in nonpoint source control efforts cannot be used as a justification for lack of individual

discharger compliance. Dischargers continue to be responsible for complying with this Order individually.

39. Dischargers who elect to join one or more third-party programs to facilitate compliance with this Order must retain their membership with the third parties in good standing. If the Discharger does not meet the requirements of membership in a particular third-party program, then the Discharger is responsible for complying with all requirements in this Order individually. If the Discharger is in good standing of another third-party program for another purpose, that third-party program's requirements still apply. For example, a Discharger may no longer be a member in good standing of the third-party alternative compliance pathway program but could still be a member in good standing for a third-party surface receiving water quality trend monitoring and reporting program. For this example, Dischargers may become eligible to rejoin the third-party alternative compliance pathway program by demonstrating compliance with individual groundwater protection requirements.
40. Dischargers who elect to join an approved third-party program must notify the approved third-party program administrator of their election to participate in the third-party program within 60 days of: 1) approval of the third-party program, and/or 2) the Discharger's enrollment in this Order, whichever is later.
41. The third-party program administrator must notify the Central Coast Water Board of Dischargers electing to participate within 90 days of the third-party program approval, and then provide member participation updates on a quarterly basis thereafter. At a minimum, participating Discharger information provided to the Central Coast Water Board must include operation enrollment information (e.g., AW numbers and operation names) and ranch enrollment information (e.g., GeoTracker AGL numbers and ranch names) in a format specified by the Executive Officer.
42. Third-party programs must meet the following minimum criteria:
  - a. Effectiveness of scale and scope – The program must be of sufficient scale and scope relative to its intended purpose to maximize Discharger participation, implementation effectiveness and Order compliance. Although regionally scaled programs are preferred, watershed- or basin-scale programs will be considered as needed to address localized water quality issues.
  - b. Clearly stated goals and objectives – The program must have meaningful and clearly stated goals, objectives, and associated performance metrics relevant to the Order requirements that are the focus of the program.
  - c. Management and administration – The program must have a well-defined and robust governance and administrative structure with clearly defined roles and responsibilities.

- d. Capacity and expertise – The program must demonstrate sufficient technical, managerial, and financial capacity to successfully achieve its goals and objectives.
- e. Physical presence – The program should have a physical presence in the central coast region, including staff and a headquarters, that can assist its members on a continual and as-needed basis. If the third-party program administrator does not have or plan to have a physical presence in the region, they must demonstrate they can effectively establish, maintain, and engage with core membership without a headquarters in the central coast region.
- f. Transparency and accountability – The program must provide regular assessments of its performance relative to its stated goals and objective based on meaningful performance metrics. This includes reporting of water quality data and farm-level data as needed to document compliance with this Order.
- g. Membership and fee accounting – The program must track and provide ongoing accounting of its Discharger membership and fees to document Discharger compliance.
- h. Data management – The program must upload data as required by this Order to the Water Boards' various data management systems (e.g., CEDEN, GeoTracker, etc.).
- i. Member requirements – The program must have clearly stated and enforced Discharger membership eligibility requirements and report out on them as needed to document compliance.
- j. Coordination – The program must consider and coordinate with other third-party programs/groups or local entities as may be appropriate to create consistency; leverage the efforts, infrastructure and expertise of others; and streamline the program to maximize effectiveness (e.g., coordination with Groundwater Sustainability Agencies [GSAs], flood control management agencies, watershed restoration and management entities, etc.).
- k. Continuing education – The program must include continuing education opportunities as appropriate either directly through the program or through coordination with other third-party programs/groups or local entities to ensure its members obtain technical skills and assistance necessary to achieve compliance with the limits established in this Order. In the instance of third-party monitoring programs, membership outreach and education should be implemented to inform members about the monitoring results relative to meeting specific water quality objectives, numeric targets, numeric interim quantifiable milestones, or numeric limits.
- l. Specific project plan documents – The program must have a detailed work plan including a Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP) as may be appropriate based on the program goals and objectives and associated Order requirements.

43. The Central Coast Water Board's review of third-party program proposals will consider the criteria outlined above relative to overall program effectiveness, with an emphasis on approving programs that can effectively assist their members in complying with the requirements of this Order.

## **Part 2, Section B. Planning, Education, Management Practices, and CEQA**

### **Farm Water Quality Management Plan (Farm Plan)**

1. Dischargers must develop, implement, and update as necessary a Farm Water Quality Management Plan (Farm Plan) for each ranch. A current copy of the Farm Plan must be maintained by the Discharger and must be submitted to the Central Coast Water Board upon request. At a minimum, the Farm Plan must include the discrete sections listed below. Additional details regarding each section are included in subsequent sections of this Order. Certain elements included in the Farm Plan must be reported on; however, in general, the Farm Plan is a planning and recordkeeping tool used by Dischargers to manage various aspects of their agricultural operation.
  - a. Irrigation and Nutrient Management Plan (INMP)
  - b. Pesticide Management Plan (PMP)
  - c. Sediment and Erosion Management Plan (SEMP)
  - d. Water Quality Education
  - e. CEQA Mitigation Measure Implementation
2. The INMP, PMP, and SEMP sections of the Farm Plan must include information on management practice implementation and assessment. Elements of the INMP are reported on in the Total Nitrogen Applied report or INMP Summary report. Elements of all the sections listed above are reported on in the Annual Compliance Form (ACF). Additional information on the monitoring and reporting requirements related to each of these sections is included in the MRP.
3. Where required by the Executive Officer based on groundwater quality or surface water quality conditions or exceedances of the numeric targets, numeric interim quantifiable milestones, or numeric limits established in this Order, the Farm Plan must incorporate ranch-level groundwater or surface water discharge monitoring information described in the MRP. The ranch-level groundwater and surface water discharge monitoring must be designed and implemented to inform improved management practices to protect groundwater and surface water quality.
4. Dischargers must maintain all records related to compliance with this Order for a minimum of ten years. Records include, but are not limited to, monitoring information, calculations, management practice implementation and assessment, education records, and all required reporting and information used to submit



complete and accurate reports. Third parties that have been approved by the Executive Officer to assist Dischargers with complying with this Order, for example in the form of water quality monitoring, must also maintain all records for a minimum of ten years. Records must be submitted to the Central Coast Water Board upon request or as required by this Order or an approved work plan.

### **Continuing Education**

5. Dischargers must attend outreach and education events annually to obtain technical skills and assistance necessary to achieve compliance with the numeric targets, numeric interim quantifiable milestones, and numeric limits established by this Order. Outreach and education events should focus on meeting water quality objectives and protecting beneficial uses by identifying water quality problems, implementing pollution prevention strategies, and implementing management practices and assessment designed to protect water quality and beneficial uses and resolve water quality problems to achieve compliance with this Order. Records of participation in continuing education must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.
6. Dischargers who exceed the fertilizer nitrogen application targets or limits, nitrogen discharge targets or limits, numeric interim quantifiable milestones, or surface receiving water limits must complete additional relevant water quality education sufficient to fully inform the implementation of additional or improved management practices and assessment to avoid future exceedances.
7. A copy of this Order and MRP must be kept at the ranch for reference by operating personnel. Key operating and site management personnel must be familiar with the content of both documents.

### **Management Practice Implementation and Assessment**

8. Dischargers must implement management practices and assessment, as necessary, to improve and protect water quality, protect beneficial uses, achieve compliance with applicable water quality objectives, achieve the numeric targets, numeric interim quantifiable milestones, and numeric limits established in this Order. Management practices implementation and assessment must be documented in the appropriate section of the Farm Plan (e.g., irrigation and nutrient management practices and assessment must be documented in the INMP section of the Farm Plan). Dischargers must report on management practice implementation and assessment in the ACF, as described in the MRP. Dischargers may demonstrate management practice effectiveness at ranch-level or watershed-scale.

## **CEQA Mitigation Measure Implementation, Monitoring, and Reporting**

9. Impacts and mitigation measures identified in CEQA Mitigation Monitoring and Reporting Program (MMRP) are set forth in the Final Environmental Impact Report (FEIR at Appendix D, which is incorporated by reference. Mitigation measures identified in the FEIR for this Order are required to be implemented as described in Appendix D unless exempted by another law or regulation. These mitigation measures will substantially reduce environmental effects of the project. The mitigation measures included in this Order have eliminated or substantially lessened all significant effects on the environment, where feasible. Where noted, some of the mitigation measures are within the responsibility and jurisdiction of other public agencies. Such mitigation measures can and should be adopted, as applicable, by those other agencies.
10. Dischargers must report on mitigation measure implementation electronically in the Annual Compliance Form (ACF), as described in the MRP.

### **Part 2, Section C.1. Groundwater Protection**

1. Dischargers may not be subject to all provisions of **Part 2, Section C.1** if they are members in good standing with the third-party alternative compliance pathway program included within **Part 2, Section C.2**.

### **Phasing**

2. Ranches are assigned the Groundwater Phase Area of the groundwater basin where the ranch is located based on the relative level of water quality and beneficial use impairment and risk to water quality. All ranches are assigned a Groundwater Phase Area of 1, 2, or 3. Groundwater Phase 1 areas represent greater water quality impairment and higher risk to water quality relative to Groundwater Phase 2 and 3 areas.
3. The requirements and implementation schedules for groundwater protection are based on the groundwater phase areas, listed in **Table C.1-1** and shown on the maps in **Figure C.1-1**.
4. In the event that a ranch spans multiple Groundwater Phase areas, the ranch will be assigned the earlier phase. For example, a ranch that spans both Groundwater Phase 1 and Groundwater Phase 2 areas will be assigned to Groundwater Phase 1.
5. The Groundwater Phase Area assigned to each ranch will be displayed on the ranch eNOI in GeoTracker.

## **Irrigation and Nutrient Management Plan**

6. Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses both groundwater and surface water. This section applies to the groundwater related INMP requirements and the surface water related INMP requirements are contained within **Part 2, Section C.3** of this Order. The INMP is a section of the Farm Plan and must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the INMP Summary report. At a minimum, the elements of the INMP related to groundwater protection must include:
  - a. Monitoring and recordkeeping necessary to submit complete and accurate reports, including the ACF, Total Nitrogen Applied (TNA) report, and INMP Summary report.
  - b. Planning and management practice implementation and assessment that results in compliance with the fertilizer nitrogen application limits in **Table C.1-2** and the nitrogen discharge targets and limits in **Table C.1-3**.
  - c. Descriptions of all irrigation, nutrient, and salinity management practices implemented and assessed on the ranch.
  - d. When INMP certification is required, e.g., as a follow-up action or as a consequence for not meeting the quantifiable milestones and time schedules below, the INMP certification shall include the following:

The person signing this Irrigation and Nitrogen Management Plan INMP certifies, under penalty of law, that the INMP was prepared under his/her direction and supervision, that the information and data reported is to the best of his/her knowledge and belief, true, accurate, and complete, and that he/she is aware that there are penalties for knowingly submitting false information. The qualified professional signing the INMP may rely on the information and data provided by the Discharger and is not required to independently verify the information and data.

The qualified professional signing the INMP below further certifies that he/she used sound irrigation and nitrogen management planning practices to develop irrigation and nitrogen application recommendations and that the recommendations are informed by applicable training to minimize nitrogen loss to surface water and groundwater. The qualified professional signing the INMP is not responsible for any damages, loss, or liability arising from subsequent implementation of the INMP by the Discharger in a manner that is inconsistent with the INMP's recommendations for nitrogen application. This certification does not create any liability or claims for environmental violations.

Qualified professional certification:

*"I, \_\_\_\_\_, certify this INMP in accordance with the statement above."*

\_\_\_\_\_ (Signature)

The discharger additionally agrees as follows:

*"I, \_\_\_\_\_, Discharger, have provided information and data to the certifier above that is, to the best of my knowledge and belief, true, accurate, and complete, that I understand that the certifier may rely on the information and data provided by me and is not required to independently verify the information and data, and that I further understand that the certifier is not responsible for any damages, loss, or liability arising from subsequent implementation of the INMP by me in a manner that is inconsistent with the INMP's recommendations for nitrogen application. I further understand that the certification does not create any liability for claims for environmental violations."*

### **Quantifiable Milestones and Time Schedules**

7. As shown in **Table C.1-2**, the fertilizer nitrogen application limits go into effect December 31, 2023.
8. As shown in **Table C.1-3**, the nitrogen discharge targets go into effect December 31, 2023 and nitrogen discharge limits go into effect December 31, 2027.

### ***Fertilizer Nitrogen Application Limits***

9. Dischargers must not apply fertilizer nitrogen **A<sub>FER</sub>** at rates greater than the limits in **Table C.1-2**. Compliance with fertilizer nitrogen application limits is assessed for each specific crop reported in the TNA report or INMP Summary report.

### ***Nitrogen Discharge Targets and Limits***

10. This Order requires Dischargers to submit information on nitrogen applied (**A**) and nitrogen removed (**R**). This Order also establishes nitrogen discharge targets and limits based on the calculation of nitrogen applied minus nitrogen removed **A-R** using the formulas below. Nitrogen must not be discharged at rates greater than the targets and limits in **Table C.1-3**. Compliance with nitrogen discharge targets and limits is assessed annually for the entire ranch in the INMP Summary



report through one of the **three compliance pathways** shown below.  
Compliance with all pathways is not required.

**Compliance Pathway 1:**

$$A_{FER} + (C \times A_{COMP} + (O \times A_{ORG} + A_{IRR} - R = \text{Nitrogen Discharge})$$

OR

**Compliance Pathway 2:**

$$A_{FER} + (C \times A_{COMP} + (O \times A_{ORG} = R$$

OR

**Compliance Pathway 3:**

$$A_{FER} + C \times A_{COMP} + (O \times A_{ORG} - R = \text{Nitrogen Discharge}$$

**In all formulas,  $R = R_{HARV} + R_{SEQ} + R_{SCAVENGE} + R_{TREAT} + R_{OTHER}$**

- a.  **$A_{FER}$**  is the amount of fertilizer nitrogen applied in pounds per acre.
- b.  **$C$**  is the compost discount factor used to represent the amount of compost nitrogen mineralized during the year that the compost was applied.
- c.  **$A_{COMP}$**  is the total amount of compost nitrogen applied in pounds per acre.
- d.  **$O$**  is the organic fertilizer discount factor used to represent the amount of nitrogen mineralized during the first 12 weeks in the year it was applied.
- e.  **$A_{ORG}$**  is the total amount of organic fertilizer or amendment nitrogen applied in pounds per acre.
- f.  **$A_{IRR}$**  is the amount of nitrogen in pounds per acre applied in the irrigation water estimated from the volume required for crop evapotranspiration (ET) or volume of water applied.
- g.  **$R$**  is the amount of nitrogen removed from the field through harvest, sequestration, or other removal methods, in pounds per acre.
- h.  **$R_{HARV}$**  is the amount of nitrogen removed from the field through harvest or other removal of crop material.
- i.  **$R_{SEQ}$**  is the amount of nitrogen removed from the field through sequestration in woody materials of permanent or semi-permanent crops.
- j.  **$R_{SCAVENGE}$**  is the amount of nitrogen credited as removed from the field through nitrogen scavenging cover crops utilized during the wet/rainy season, nitrogen scavenging high carbon amendments during the wet/rainy season, or high carbon woody materials applied as mulch to the crop ground surface.
- k.  **$R_{TREAT}$**  is the amount of nitrogen removed from the ranch through a quantifiable treatment method (e.g., bioreactor).

- I. **ROTHER** is the amount of nitrogen removed from the ranch through other methods not previously quantified.
11. The Central Coast Water Board encourages the use of irrigation water nitrogen as a method of reducing the amount of fertilizer nitrogen applied to crops. The use of irrigation water nitrogen is typically referred to as “pump and fertilize” and is incentivized through compliance pathway 2 and 3 in [Table C.1-3](#). The amount of irrigation water nitrogen is not used in the compliance calculation in these compliance pathways. The amount of irrigation water nitrogen must be reported regardless of the compliance pathway.
12. The Central Coast Water Board encourages the use of compost to improve soil health, nutrient and carbon sequestration, and water holding capacity consistent with the state’s Healthy Soils Initiative. All compost nitrogen (**ACOMP** applied to the ranch must be reported in the TNA report or INMP Summary report; however, the use of compost is incentivized through the option for Dischargers to use a compost “discount” factor (**C** . Dischargers may use the compost discount factor provided by the Central Coast Water Board in the MRP or may determine their own discount factor. The discounted compost nitrogen must, at a minimum, represent the amount of compost mineralized during the year the compost was applied to the ranch. If the Discharger uses their own compost discount factor, they must maintain records of the method used to determine the compost discount factor in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request.
13. The Central Coast Water Board encourages the use of organic fertilizers and amendments to improve soil health, nutrient and carbon sequestration, and water holding capacity consistent with the state’s Healthy Soils Initiative. All organic fertilizer and amendment nitrogen (**AORG** applied to the ranch must be reported in the TNA report or INMP Summary report; however, the use of organic fertilizers and amendments is incentivized through the option for Dischargers to use an organic fertilizer “discount” factor (**O** . Dischargers may use the organic fertilizer discount factor associated with the products C:N ratio, provided by the Central Coast Water Board in the MRP. The discounted organic fertilizer nitrogen must, at a minimum, represent the amount of organic fertilizer mineralized during the first 12 weeks the organic fertilizer was applied to the ranch. The Discharger must maintain records of the organic products used and their associated C:N ratios in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request. The following products are not eligible to receive an organic fertilizer discount: a) products with no organic compounds (long chain carbon) molecules, such as conventional fertilizer, slow release fertilizers, b) products that do not depend on microbial mineralization to release nitrogen to mineral form to make it available for crop uptake, c) products without

C:N ratio information available, and d) organic liquid fertilizers that are in the liquid and/or emulsified form (excluding organic foliar applications).

14. The amount of **crop material** removed through harvest or other methods ( $R_{HARV}$  must be calculated using the formula described below. Dischargers must either use the crop-specific conversion coefficient values found in the MRP or develop their own conversion coefficient values following the approved method in the MRP. If Dischargers develop their own conversion coefficient, they must maintain information on the method used in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request.

$R_{HARV}$     **Conversion Coefficient x Material Removed**

- a. The **Conversion Coefficient** is a crop-specific coefficient used to convert from units of material removed per acre to units of nitrogen removed per acre.
  - b. **Material Removed** is the amount of nitrogen-containing material removed from the field, in units of pounds per acre.
15. The amount of nitrogen removed through **sequestration** in woody material of permanent or semi-permanent crops ( $R_{SEQ}$  must be estimated by the Discharger. Dischargers must maintain records detailing how they estimated the amount of nitrogen sequestered in their permanent crops. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.
16. The Central Coast Water Board encourages Dischargers to implement best management practices that reduce nitrogen leaching in the wet/rainy season and improve soil healthy. Dischargers may claim a nitrogen scavenging credit ( $R_{SCAVENGE}$ ) one time per year for each ranch acre by utilizing any of the four options provided by the Central Coast Water Board in the MRP. The total acres receiving the nitrogen scavenging credit may not exceed the ranch acres. Dischargers electing to claim the nitrogen scavenging credit must ensure that their cover crop, high carbon amendment, or high carbon woody materials meets the definitions of a nitrogen scavenging cover crop, nitrogen scavenging high carbon amendment, or high carbon woody materials as noted in the MRP and Definitions. Substantiating records for this credit must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.
17. The Central Coast Water Board encourages Dischargers to develop and implement innovative methods for removing nitrogen from the environment to improve water quality. Dischargers may use treatment methods (e.g., bioreactors) on their ranch by participating in collective treatment programs or

systems<sup>4</sup> to remove nitrogen from groundwater or surface water and may count this towards their nitrogen removal **R** value if they are able to quantify the amount of nitrogen removed from ranch discharge to groundwater or surface water. This quantified removal through treatment or other innovative methods must be reported as **R<sub>TREAT</sub>**. Dischargers electing to account for this nitrogen removal must monitor the volume and concentration of water entering and exiting the ranch or collective treatment system and calculate the amount of nitrogen removed. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

18. If Dischargers remove additional nitrogen through means other than removing crop material (**R<sub>HARV</sub>**), sequestration (**R<sub>SEQ</sub>**), scavenging credit (**R<sub>SCAVENGE</sub>**), or treatment methods (**R<sub>TREAT</sub>**), they must quantify and report this additional removal as **R<sub>OTHER</sub>**. Dischargers must maintain records detailing how they calculated **R<sub>OTHER</sub>**. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.
19. The discharge of nitrogen in excess of the nitrogen discharge **targets** in **Table C.1-3** may result in additional requirements, including obtaining additional education, INMP certification by a qualified professional, implementing additional or improved management practices, and increased monitoring and/or reporting.
20. The discharge of nitrogen in excess of the nitrogen discharge **limits** in **Table C.1-3** may result in additional requirements, including obtaining additional education, INMP certification by a qualified professional, implementing additional or improved management practices, increased monitoring and reporting, and/or progressive enforcement actions.
21. Dischargers who apply more fertilizer nitrogen (**A<sub>FER</sub>**) than the fertilizer nitrogen application limits in **Table C.1-2** to any specific crop **and** who are able to demonstrate compliance with the **final** nitrogen discharge limits, as shown in **Table C.1-3**, are exempt from the fertilizer nitrogen application limit.
22. Dischargers who can quantifiably demonstrate that their ranches pose no threat to surface water quality or groundwater quality may submit a technical report to the Executive Officer for review. If approved, the Discharger is not required to conduct the nitrogen application **A** or removal (**R**) monitoring and reporting or to submit the INMP Summary report, regardless of what Groundwater Phase area the ranch is in. The technical report must demonstrate that nitrogen applied at the ranch does not percolate below the root zone in an amount that could

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<sup>4</sup> Collective treatment programs or systems may be installed or implemented outside the ranch boundaries at a downstream or downflow collective discharge point from multiple ranches to remove nitrogen from groundwater or surface water from each ranch participating in the collective treatment program or system.



degrade groundwater and does not migrate to surface water through discharges, including drainage, runoff, or sediment erosion. Dischargers must provide the Executive Officer with annual updates to confirm that the exemption is still applicable. Failure to provide sufficient annual updates confirming that the exemption is still applicable will result in an immediate reinstatement of the requirement to submit the INMP Summary report for applicable Dischargers. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway for groundwater protection.

23. Dischargers who can quantifiably demonstrate that their ranch is achieving the **final** nitrogen discharge limits, as shown in **Table C.1-3**, are not required to submit the nitrogen removal (**R**) reporting in the INMP Summary report, regardless of what Groundwater Phase area the ranch is in. Example situations where this may apply include participation in an approved third-party program that certifies that the Discharger is meeting the final discharge limit and will continue to do so for the duration of the Discharger's participation in the approved third-party program, or by submitting a technical report, subject to Executive Officer review, that quantifies the amount of nitrogen discharge based on the volume and nitrogen concentration of all discharges from the ranch. In these situations, confirmation of membership in the approved third-party program or Executive Officer approval of a submitted technical report constitute compliance with the nitrogen removed **R** reporting requirement in the INMP Summary report. This exemption only applies to removal **R**) in the INMP Summary report; all other requirements, including the TNA report, still apply as described in this Order. Dischargers must provide the Executive Officer with annual updates to confirm that the exemption is still applicable. Failure to provide sufficient annual updates confirming that the exemption is still applicable will result in an immediate reinstatement of the requirement to submit the nitrogen removal **R** reporting information in the INMP Summary report for applicable Dischargers. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway for groundwater protection.
24. Dischargers, groups of dischargers or commodity groups who can quantify the amount of nitrogen discharged from their ranch or for specific crops or via specific management practices by directly monitoring it at the points of discharge can propose an alternative monitoring methodology to comply with the nitrogen discharge targets and limits, in lieu of using the A-R compliance formulas. Example situations where this may apply includes greenhouse, nursery, container production or intensive crop production where irrigation and drain water is captured and allows for direct monitoring of discharges. For these types of situations, it may be easier to monitor nitrogen discharge than to calculate the amount of nitrogen removed at harvest for each one of the many different crops and plants being grown. Dischargers must submit a request to the Executive

Officer with a technical report of the methodology proposed to quantify nitrogen discharges. The methodology must include enough information to quantify the amount of nitrogen discharged and confirm compliance with the nitrogen discharge targets and limits, as shown in [Table C.1-3](#) or [Table C.2-2](#) (for Dischargers participating in the Third-Party Alternative Compliance Pathway Program for Groundwater Protection described in [Part 2, Section C.2](#)). Acceptable methodologies must include direct measurements of the volume and nitrogen concentration of the water discharged from each ranch per acre and year. Executive Officer approval of the methodology must be granted before the discharger begins reporting nitrogen discharge based on the proposed methodology. Dischargers who obtain Executive Officer approval to directly monitor their nitrogen discharge from their ranches will not be required to submit nitrogen removal reporting in the INMP Summary report. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway program for groundwater protection.

25. The initial 2027 nitrogen discharge limits, as shown in [Table C.1-3](#) will be re-evaluated based on Discharger reported nitrogen applied and removed data, new science, and management practice implementation and assessment before becoming effective.

## Monitoring and Reporting

26. Dischargers must report on management practice implementation and assessment electronically in the **ACF**, as described in the MRP.
27. Dischargers must record and report total nitrogen applied to all crops grown on the ranch, electronically in the TNA report form, as described in the MRP.
28. Dischargers must track and record the following elements of the INMP Summary report that are not included in the TNA report: total nitrogen removed from the ranch and information on irrigation water application and discharge volumes. Dischargers must submit this information electronically in the INMP Summary report form as described in the MRP.
29. The INMP Summary report contains the same nitrogen application information as the TNA report, plus additional information related to nitrogen removed and irrigation management. **Therefore, the INMP Summary report satisfies the TNA report requirement and an additional TNA report is not required to be submitted when the INMP Summary report is submitted to the Central Coast Water Board.**
30. Dischargers must conduct **irrigation well monitoring and reporting prior to the start of groundwater quality trend monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP.

31. Dischargers must conduct **on-farm domestic well monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP.
32. Dischargers must conduct **groundwater quality trend monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP. This requirement applies to all Dischargers enrolled in this Order, regardless of how many wells are currently present on their ranch.
  - a. Dischargers who elect to perform groundwater quality trend monitoring and reporting as part of a **third-party** effort must form or join a third-party. The third-party must submit a work plan for Executive Officer review by the dates and covering the areas specified in the MRP unless it is associated with the Third-Party Alternative Compliance Pathway for Groundwater Protection described in **Part 2, Section C.2**. The work plan must be approved by the Executive Officer prior to implementation. Once approved by the Executive Officer, the work plan must be implemented.
  - b. Dischargers who elect to perform groundwater quality trend monitoring and reporting individually must submit a work plan for Executive Officer review, by the date specified in the MRP, based on their ranch location. The work plan must be approved by the Executive Office prior to implementation. The work plan must describe how the ranch-level groundwater quality trend monitoring program will evaluate groundwater quality trends over time and assess the impacts of agricultural discharges on groundwater quality. Once approved by the Executive Officer, the work plan must be implemented. Dischargers without a well on their property may comply with individual ranch-level groundwater quality trend monitoring and reporting requirements by implementing one of the options specified in the MRP.
33. When required by the Executive Officer based on groundwater quality data or significant and repeated exceedance of the nitrogen discharge targets or limits, Dischargers must complete **ranch-level groundwater discharge monitoring and reporting**, either individually or as part of a third-party effort as described in the MRP. Water Board staff will coordinate with Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming requirement. When ranch-level groundwater discharge monitoring and reporting is required, a work plan, including a SAP and QAPP, must be submitted for Executive Officer review prior to implementation. Once approved by the Executive Officer, the work plan must be implemented. Ranch-level groundwater discharge monitoring may be discontinued with the approval of the Executive Officer when the Discharger comes into compliance with the nitrogen discharge targets or limits, or the discharge has otherwise ceased.

## **Part 2, Section C.2. Third-Party Alternative Compliance Pathway for Groundwater Protection**

1. Dischargers that are members in good standing in the third-party alternative compliance pathway program are subject to the provisions of this **Part 2, Section C.2**, unless otherwise stated. For purposes of this section, such Dischargers are referred to as “participating Dischargers.”

Participating dischargers:

- a. Are not subject to fertilizer nitrogen application limits in **Table C.1-2**, which are enforceable by the Central Coast Water Board.
  - b. Are not subject to nitrogen discharge limits in **Table C.1-3**, which are enforceable by the Central Coast Water Board.
  - c. Are subject to targets, which if exceeded result in consequences outlined in this **Part 2, Section C.2**.
  - d. Are not subject to ranch-level groundwater discharge monitoring and reporting.
  - e. Are generally provided more time to achieve fertilizer nitrogen application targets and nitrogen discharge targets, relative to non-participating dischargers.
2. Prior to the initiation of the work plan process outlined below and in the MRP for this third-party alternative compliance pathway program, entities wishing to implement the third-party alternative compliance pathway program described in this **Part 2, Section C.2** must submit a third-party alternative compliance pathway program proposal consistent with the third-party program requirements outlined in **Part 2, Section A** of this Order, as well as the request for proposal process and associated third-party program expectations document forthcoming after Order adoption. For purposes of this section, the entity approved to implement the third-party alternative compliance pathway is referred to as the approved third-party alternative compliance pathway program administrator.
3. Participating Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses groundwater. The INMP is a section of the Farm Plan and must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the INMP Summary report. At a minimum, the elements of the INMP related to groundwater and surface water protection for participating Dischargers in a third-party program must include:
  - a. Monitoring and recordkeeping necessary to submit complete and accurate reports, including the Annual Compliance form (ACF), Total Nitrogen Applied (TNA) report, and INMP Summary report.



- b. Planning and management practice implementation and assessment that results in compliance with the fertilizer nitrogen application targets in [Table C.2-1](#), the nitrogen discharge targets in [Table C.2-2](#), and groundwater protection area targets to be determined and approved by the Executive Officer.
- c. Descriptions of all irrigation, nutrient, and salinity management practices implemented and assessed on the ranch.

### Quantifiable Milestones and Time Schedules

4. As shown in [Table C.2-1](#), the fertilizer nitrogen application targets go into effect December 31, 2024 for participating Dischargers in the third-party alternative compliance pathway.
5. As shown in [Table C.2-2](#), the nitrogen discharge targets go in to effect during the third year of this Order (December 31, 2024) for participating Dischargers in the third-party alternative compliance pathway.

### Fertilizer Nitrogen Application Targets

6. Participating Dischargers must not apply fertilizer nitrogen ( $A_{FER}$  at rates greater than the **targets** in [Table C.2-1](#). Compliance with fertilizer nitrogen application targets is assessed annually for each specific crop reported in the TNA report or INMP Summary report.
7. Participating Dischargers that apply fertilizer nitrogen  $A_{FER}$  at rates greater than the **targets** in [Table C.2-1](#) one year after the compliance date are subject to follow-up by the approved third-party program administrator, which could include additional education and/or implementation of additional or improved management practices.
8. Participating Dischargers that apply fertilizer nitrogen  $A_{FER}$  at rates greater than the **targets** in [Table C.2-1](#) for a two-year running average after the compliance date, are no longer eligible to participate in the third-party alternative compliance pathway program and must comply with the individual groundwater protection requirements in [Part 2, Section C.1](#). Water Board staff will coordinate with participating Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming individual groundwater protection requirements.

### Nitrogen Discharge Targets

9. Participating Dischargers must not discharge nitrogen at rates greater than the **targets** in [Table C.2-2](#). Compliance with nitrogen discharge targets is assessed

annually for the entire ranch using INMP Summary report information. Participating Dischargers must comply with at least one of the nitrogen discharge compliance pathways described in **Part 2, Section C.1** by the compliance date.

10. The final year 2028 nitrogen discharge **targets**, as shown in **Table C.2-2** will be re-evaluated based on discharger reported nitrogen applied and removed data, new science, management practice effectiveness assessment and evaluation, and groundwater protection area collective numeric interim and final targets before becoming effective.
11. Participating Dischargers that discharge nitrogen in excess of the nitrogen discharge **targets** in **Table C.2-2** one year after the compliance date are subject to follow-up by the approved third-party alternative compliance pathway program administrator, which could include additional education and/or implementation of additional or improved management practices.
12. Participating Dischargers that discharge nitrogen in excess of the year 2024 or 2026 nitrogen discharge **targets** in **Table C.2-2** for a two-year running average, must obtain annual INMP certification by a qualified professional until nitrogen discharge targets are achieved for a two-year running average. The INMP certification must include the certification language outlined in **Part 2, Section C.1**.
13. Participating Dischargers that discharge nitrogen in excess of the final nitrogen discharge target in **Table C.2-2** for a three-year running average after the compliance date, are no longer eligible to participate in the third-party alternative compliance pathway program and must comply with individual groundwater protection requirements in **Part 2, Section C.1**. Water Board staff will coordinate with participating Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming individual groundwater protection requirements.

### **Groundwater Protection Areas, Formulas, Values, and Targets**

14. The approved third-party alternative compliance pathway program administrator, on behalf of its participating Dischargers, must develop and submit incremental 35%, 70%, and 100% work plans for Executive Officer approval, as described in the MRP. The 35% and 70% work plans will be subject to Executive Officer approval following a 30-day written public period and a public meeting to receive public comments and board input.
15. The incremental draft and final work plans must include the following:

- a. Clearly defined objectives and scientific justification for all proposed groundwater protection (GWP) areas, formulas, values, and collective numeric interim and final targets.
  - b. Scientific justification in support of the proposed GWP areas with respect to, but not limited to, geology, hydrogeology, groundwater basin and subbasin areas, recharge areas, land uses, cropping patterns, and potential membership coverage by acreage and number of members. The proposed GWP areas, formula, values, and collective interim and final targets must be tied together and scaled in a way that will allow for the effective evaluation of water quality and beneficial use protection and compliance with GWP interim and final targets on both a collective and individual basis.
  - c. A program to assess and evaluate the performance and effectiveness of the third-party alternative compliance pathway program's collective numeric interim and final targets in achieving tangible groundwater quality improvements over time at the individual GWP area scale. The assessment and evaluation program must be scaled – spatially and temporally – in coordination with the regional groundwater quality trend monitoring program described in **Part 2, Section C.1** of the third-party program over time.
  - d. Criteria and associated follow-up actions or consequences that the third-party alternative compliance pathway program administrator will implement if individual participating Dischargers do not meet collective numeric interim and final targets, and third-party program membership eligibility requirements including membership probation and revocation to address recalcitrant participating Dischargers.
16. The final work plans must be approved by the Executive Officer prior to implementation. Once approved by the Executive Officer, the work plans must be implemented.
17. Compliance with the collective numeric interim and final targets for a GWP area shall be determined by aggregating data from participating Dischargers within a GWP area to determine if the combined nitrogen discharge is achieving collective compliance with the GWP Area numeric interim and final targets.
18. Although compliance with GWP collective numeric interim and final targets is assessed using the combined nitrogen discharge of participating Dischargers in a GWP area, GWP collective numeric interim and final targets must be designed such that there is a clear and quantifiable means of assessing individual ranch level contribution to the success or failure of complying with the GWP area collective numeric interim and final targets.

19. Participating Dischargers in a GWP area that exceed the GWP collective numeric interim or final targets by 20% or more, as evaluated individually and on an annual basis, are subject to follow-up by the approved third-party alternative compliance pathway program administrator, which could include additional education or implementation of additional or improved management practices.
20. All participating Dischargers in a GWP area that exceeds the collective numeric interim and final GWP targets by 20% or more for a 3-year running average after the compliance date, are no longer eligible to participate in the third-party alternative compliance pathway program and must comply with the individual groundwater protection requirements in **Part 2, Section C.1**.

### **Monitoring and Reporting**

21. Participating Dischargers must submit ACF, TNA, and INMP Summary information according to requirements outlined in **Part 2, Section C.1**, and as described in the MRP.
22. Participating Dischargers must submit ACF, TNA, and INMP Summary information according to the groundwater phase assigned to each ranch. Groundwater phases are outlined in **Part 2, Section C.1**.
23. Participating Dischargers must submit groundwater monitoring and reporting information according to requirements outlined in **Part 2, Section C.1** and as described in the MRP, either individually or as part of a third-party program.

### **Part 2, Section C.3. Surface Water Protection**

#### **Priority Areas (Individual)**

1. Ranches are assigned the Surface Water Priority area of the HUC-8 watershed where the ranch is located based on the relative level of water quality, beneficial use impairment and risk to water quality. All ranches are assigned a Surface Water Priority of 1, 2, 3, or 4. Surface Water Priority Area 1 areas represent greater water quality impairment and higher risk to water quality relative to Surface Water Priority Areas 2, 3, and 4.
2. The follow-up surface receiving water implementation requirements for surface water protection are based on the surface water priority areas, listed in **Table C.3-1** and shown on the map in **Figure C.3-1**.
3. In the event that a ranch spans multiple Surface Water Priority areas, the ranch will either be assigned the earlier priority or will be assigned the priority of the watershed or drainage unit that the ranch drains or discharges to, if specific discharge information is provided to the Central Coast Water Board.



4. The Surface Water Priority assigned to each ranch will be displayed in the ranch eNOI in GeoTracker.

### **Priority Areas (Third-Party Program)**

5. Ranches that are enrolled as part of an approved third-party follow-up surface receiving water implementation program are assigned the third-party program Surface Water Priority of high priority, medium priority, or low priority where the ranch is located, as shown in **Table C.3-1.3P** and the map shown in **Figure C-3.1. 3P**.
6. In the event that a ranch spans multiple third-party program Surface Water Priority areas, the ranch will either be assigned the earlier priority or will be assigned the priority of the watershed or drainage unit that the ranch drains or discharges to, if specific discharge information is provided to the Central Coast Water Board.
7. The third-party program Surface Water Priority assigned to each ranch will be displayed in the ranch eNOI in GeoTracker.

### **Irrigation and Nutrient Management**

8. Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses both groundwater and surface water. This section applies to the surface water related INMP requirements and the groundwater related INMP requirements are contained within **Part 2, Section C.1** of this Order. The INMP is a section of the Farm Plan, must be maintained in the Farm Plan (see **Part 2, Section B** and Farm Plan paragraph 14 below , and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the ACF, as described in the MRP.

### **Pesticide Management**

9. Dischargers must develop and implement a Pesticide Management Plan (PMP). The PMP is a section of the Farm Plan, must be maintained in the Farm Plan see **Part 2, Section B** and Farm Plan paragraph 14 below , and submitted to the Central Coast Water Board upon request. Summary information from the PMP must be submitted in the ACF, as described in the MRP.

### **Sediment and Erosion Management**

10. Dischargers must develop and implement a Sediment and Erosion Management Plan (SEMP). The SEMP is a section of the Farm Plan, must be maintained in the Farm Plan (see **Part 2, Section B** and Farm Plan paragraph 14 below , and submitted to the Central Coast Water Board upon request. Summary information from the SEMP must be submitted in the ACF, as described in the MRP.

### ***Impermeable Surfaces***

11. Ranches with either 50 to 100 percent of fields covered by impermeable surfaces defined in Attachment C of this Order , or with greater than or equal to 22,500 square feet (0.5 acre ) of impermeable surfaces must manage stormwater discharge duration, rate, and volume as described below.

- a. Stormwater discharge intensity from fields with impermeable surfaces must not exceed the stormwater discharge intensity from equivalent permeable field area for any storm event up to and including the 10-year storm event. The *Santa Barbara Urban Hydrograph Method* <sup>5</sup> and the *Rational Method* <sup>6</sup> are two methods for determining the stormwater discharge intensity match, however other similar methods to determine stormwater discharge intensity may be used.
- b. Stormwater discharge volume from fields with impermeable surfaces must not exceed the stormwater discharge volume from equivalent permeable field area for any storm event up to and including the 95<sup>th</sup> percentile, 24-hour storm event. The *Curve Number Method* <sup>7</sup> is a method for determining the stormwater discharge volume match, however other similar methods to determined stormwater discharge volume may be used.
- c. Description and time schedules of management practices, treatment, and/or control measures implemented to meet design storm requirements and mitigate for increased stormwater runoff from impermeable surfaces must be kept in the Farm Plan. Methods for assessing the effectiveness of each management practice, treatment, and/or control measure include calculation of peak and runoff volumes, visual inspection, photo documentation, and local precipitation event data, however other storm event measurement types and recordkeeping that determine the effectiveness of management practices may be used.

### **Farm Plan**

12. At a minimum, the elements of the Farm Plan related to surface water protection must include:

- a. Monitoring and recordkeeping necessary to submit complete and accurate reports, including the ACF.

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<sup>5</sup> The Santa Barbara Urban Hydrograph Method is based on the curve number approach and is useful for sheet flow over a plane surface, called overland flow.

<sup>6</sup> The Rational Method is used to determine peak discharge from runoff in a given area.

<sup>7</sup> The Curve Number Method was developed by the Soil Conservation Service to estimate runoff from rainfall on agricultural fields and provides runoff depth that can be used to calculate runoff volume.

- b. Planning and management practice implementation and assessment that results in compliance with the surface water limits in [Table C.3-2](#) (TMDL areas) and [Table C.3-3](#) (non-TMDL areas) for nutrients, [Table C.3-4](#) (TMDL areas) and [Table C.3-5](#) (non-TMDL areas) for pesticides and toxicity, and [Table C.3-6](#) (TMDL areas) for sediment and [Table C.3-7](#) (non-TMDL areas) for turbidity that apply to a ranch based on the ranch location.
- c. Descriptions of all management practices implemented on the ranch, as follows:
  - i. All irrigation, nutrient, and salinity management practices i.e., INMP .
  - ii. All pesticide management practices (i.e., PMP , including pesticide application characteristics (e.g., timing, formulations, wind, and rainfall monitoring, etc.) and any integrated pest management (IPM) practices implemented (e.g., scouting, beneficial insects, etc.).
  - iii. All sediment, erosion, irrigation, stormwater, road, agricultural drainage pump, and impermeable surface management practices (i.e., SEMP).

### Quantifiable Milestones and Time Schedules

- 13. Dischargers in an area **with an established TMDL** ([Figure C.3-2](#) for Nutrient TMDL areas, [Figure C.3-3](#) for Pesticide and Toxicity TMDL areas, and [Figure C.3-4](#) for Sediment TMDL areas) for a pollutant must not cause or contribute to an exceedance of the pollutant's surface receiving water limit in [Table C.3-2](#) for nutrients, [Table C.3-4](#) for pesticides and toxicity, and [Table C.3-6](#) for sediment in accordance with the compliance dates specified in the applicable table.
- 14. Dischargers in an area **without an established TMDL** for a pollutant must not cause or contribute to an exceedance of the pollutant's surface receiving water limit in [Table C.3-3](#) for nutrients, [Table C.3-5](#) for pesticides and toxicity, and [Table C.3-7](#) for turbidity in accordance with the compliance dates specified in the applicable table.
- 15. The surface receiving water limits in [Table C.3-3](#) for nutrients, [Table C.3-5](#) for pesticides and toxicity, and [Table C.3-7](#) for turbidity, apply to all Dischargers unless a specific surface receiving water limit based on a TMDL in [Table C.3-2](#) for nutrients, [Table C.3-4](#) for pesticides and toxicity, and [Table C.3-6](#) for sediment applies to a Discharger.
- 16. Dischargers in areas where the water quality for a pollutant is better (i.e., of higher quality) than the applicable limit in [Table C.3-2](#) (TMDL areas) and [Table C.3-3](#) (non-TMDL areas) for nutrients, [Table C.3-4](#) (TMDL areas) and [Table C.3-5](#) (non-TMDL areas) for pesticides and toxicity, and [Table C.3-6](#) (TMDL areas) for sediment and [Table C.3-7](#) (non-TMDL areas) for turbidity must

not cause or contribute to an increase of that pollutant in receiving waters, except as consistent with the antidegradation findings of this Order.

17. The discharge of pollutants from a ranch that cause or contribute to an exceedance of the applicable limits after the compliance date in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C.3-5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity may result in additional requirements, including obtaining additional education, implementing additional or improved management practices, follow-up monitoring and reporting, ranch-level surface discharge monitoring and reporting, and progressive enforcement actions.

### Monitoring and Reporting

18. Dischargers must complete **surface receiving water monitoring and reporting** as described in the MRP, either individually or through a third-party monitoring program approved by the Executive Officer. Dischargers, either individually or through a third-party monitoring program, must submit a work plan, including a SAP and QAPP as described in the MRP, for Executive Officer review prior to implementation. Once approved by the Executive Officer, the work plan must be implemented. The work plan must include applicable monitoring for the pollutants in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C.3-5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity and must describe the actions that will be taken to achieve the limits in the tables.
19. Dischargers must develop a **follow-up surface receiving water implementation work plan**, either individually or through a third-party program. The work plan due date is based on the Surface Water Priority of the ranch.
- a. Individual Dischargers that are not part of a third-party program approved to develop and implement follow-up surface receiving water implementation work plan(s) must submit an individual work plan by the dates specified below, based on the ranch's Surface Water Priority Area defined in **Table C.3-1** of the Order:
    - i. March 1, 2023 for Surface Water Priority 1 areas
    - ii. March 1, 2024 for Surface Water Priority 2 areas
    - iii. March 1, 2025 for Surface Water Priority 3 areas
    - iv. March 1, 2026 for Surface Water Priority 4 areas
  - b. Third-party program(s) approved to develop and implement follow-up surface receiving water implementation work plan(s) on behalf of participating Dischargers must submit work plan(s) by the dates specified below, based



on the third-party program surface water priority area. Third-party program surface water priority areas are defined in **Table C.3-1.3P** of the Order:

- i. March 1, 2024 for High Priority areas
  - ii. March 1, 2026 for Medium Priority areas
  - iii. March 1, 2028 for Low Priority and All Other areas
- c. The work plan must include numeric interim quantifiable milestones and follow-up actions, such as outreach, education, and management practice implementation and assessment, and, where applicable for pollutant source identification and abatement, additional surface receiving water monitoring locations. Numeric quantifiable milestones include numeric interim quantifiable milestones for relevant constituents (e.g., pollutant load or concentration) and numeric interim quantifiable milestones for management practices implemented that confirm progress towards reducing the discharge of relevant constituents (e.g., volume of discharge water diverted to treatment systems, treatment system pollutant reduction, distance of riparian area improvements, acres no longer receiving conventional pesticide applications). The work plan must include a SAP and QAPP. The work plan must describe the implementation measures that will be taken to reduce the discharge of relevant pollutants and achieve the applicable surface water numeric limits by the compliance dates in **Table C.3-2** (TMDL areas and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C.3-5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity. The work plan must be submitted for Executive Officer review prior to implementation. Once approved, the work plan must be implemented.
- d. Prior to the applicable compliance dates in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C.3-5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity, Dischargers who elect to participate in a third-party program to develop and implement their work plan will not be subject to ranch-level surface discharge monitoring and reporting.
- e. Work plans must take into consideration the level of water quality impairment identified through surface receiving water monitoring. Work plans for areas with persistent exceedances of the surface water limits in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C.3-5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity must identify follow-up actions to restore degraded areas and meet surface receiving water limits (e.g., numeric interim quantifiable milestones, outreach, education, management practice implementation and

assessment) and additional surface receiving water monitoring locations for pollutant source identification and abatement. Work plans for areas that are already achieving the surface water limits in [Table C.3-2](#) (TMDL areas) and [Table C.3-3](#) (non-TMDL areas) for nutrients, [Table C.3-4](#) (TMDL areas) and [Table C.3.5](#) (non-TMDL areas) for pesticides and toxicity, and [Table C.3-6](#) (TMDL areas) for sediment and [Table C.3-7](#) (non-TMDL areas) for turbidity must identify actions to be taken to protect the high-quality areas (e.g., numeric interim quantifiable milestones, outreach and education). Numeric quantifiable milestones include numeric interim quantifiable milestones for relevant constituents (e.g., pollutant load or concentration) and numeric interim quantifiable milestones for management practices implemented that confirm progress towards reducing the discharge of relevant constituents (e.g., volume of discharge water diverted to treatment systems, treatment system pollutant reduction, distance of riparian area improvements, acres no longer receiving conventional pesticide applications).

- f. Dischargers who elect to develop their work plan individually and whose ranches are located in areas where surface receiving water monitoring shows an exceedance of an applicable surface water limit in [Table C.3-2](#) (TMDL areas) and [Table C.3-3](#) (non-TMDL areas) for nutrients, [Table C.3-4](#) (TMDL areas) and [Table C.3.5](#) (non-TMDL areas) for pesticides and toxicity, and [Table C.3-6](#) (TMDL areas) for sediment and [Table C.3-7](#) (non-TMDL areas) for turbidity after the applicable compliance deadline may be subject to ranch-level surface discharge monitoring and reporting.

20. When required by the Executive Officer, based on surface receiving water quality data or significant and repeated exceedance of the surface water quality limits in [Table C.3-2](#) (TMDL areas) and [Table C.3-3](#) (non-TMDL areas) for nutrients, [Table C.3-4](#) (TMDL areas) and [Table C-3.5](#) (non-TMDL areas) for pesticides and toxicity, and [Table C.3-6](#) (TMDL areas) for sediment and [Table C.3-7](#) (non-TMDL areas) for turbidity, Dischargers must complete **ranch-level surface discharge monitoring and reporting** as described in the MRP. Dischargers can complete this requirement either individually or as part of a third-party program effort. Water Board staff will coordinate with Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming requirement. When ranch-level surface discharge monitoring and reporting is required, a work plan, including a SAP and QAPP, must be submitted for Executive Officer review prior to implementation. Once approved by the Executive Officer, the work plan must be implemented. Ranch-level surface discharge monitoring may be discontinued with the approval of the Executive Officer when the Discharger comes into compliance with the surface receiving water limits, or the discharge has otherwise ceased.

21. Dischargers must report on nutrient, pesticide, and sediment and erosion control management practice implementation and assessment electronically in the ACF, as described in the MRP.
22. Dischargers whose ranches have impermeable surfaces must report on stormwater management practice implementation and assessment electronically in the ACF, as described in the MRP.
23. Dischargers with waterbodies within or bordering their ranch must measure and report the current riparian area (average width and length, in feet) in the ACF, as described in the MRP.

## **Part 2, Section D. Additional Requirements and Prohibitions**

### **Waste Discharge Control and Prohibitions**

1. Except in compliance with this Order, Dischargers must not cause or contribute to exceedances of applicable water quality objectives, as defined in Attachment A, must protect all beneficial uses for inland surface waters, enclosed bays, and estuaries, and for groundwater, as outlined in sections 3.3.2 and 3.3.4 of the Basin Plan, and must prevent nuisance as defined in Water Code section 13050.
2. Dischargers must achieve applicable Total Maximum Daily Load (TMDL Load Allocations (LAs) by achieving the surface water receiving limits established in this Order. Dischargers must incorporate planning elements from applicable TMDLs into the appropriate section of their Farm Plan and, as appropriate, into their follow-up surface receiving water implementation work plan(s).
3. Dischargers that anticipate exceeding a limit or condition of the Order after the final compliance date has passed may request a time schedule order pursuant to Water Code section 13300 for the Central Coast Water Board's consideration. A time schedule order must be requested 18 months in advance of a Discharger or a group of Dischargers anticipating that they will not be able to achieve the receiving water limit by the compliance date. At a minimum, the request for a time schedule order must include information outlined in Attachment A (Additional Findings). Dischargers may either individually request a time schedule order or may jointly request a time schedule order with other Dischargers subject to the same groundwater or surface receiving water limit.
4. The discharge of rubbish, refuse, trash, irrigation tubing or tape, or other solid wastes into surface waters is prohibited. The placement of such materials where they discharge or have the potential to discharge to surface waters is prohibited.
5. The discharge of chemicals such as fertilizers, fumigants, pesticides, herbicides, or rodenticides down a groundwater well casing is prohibited.

6. The discharge of chemicals, including those used to control wildlife (such as bait traps or poison), directly into surface waters or groundwater is prohibited. The placement of chemicals in a location where they may be discharged to surface waters or groundwater is prohibited.
7. Dischargers who apply fertilizers, fumigants, pesticides, herbicides, rodenticides, or other chemicals through an irrigation system must have functional and properly maintained backflow prevention devices installed at the well or pump to prevent pollution of groundwater and surface water that comply with any applicable DPR requirements or local ordinances. Backflow prevention devices used to protect water quality must be those approved by the United States Environmental Protection Agency (USEPA), DPR, State Water Board Division of Drinking Water, or the local public health or water agency.
8. Dischargers must properly destroy all abandoned groundwater wells, exploration holes or test holes, as defined by Department of Water Resources (DWR) Bulletin 74-81 and revised in 1988, in such a manner that they will not produce water or act as a conduit for mixing or otherwise transfer groundwater or waste pollutants between permeable zones or aquifers. Well destruction must be performed in compliance with any applicable DWR requirements or local ordinances (including local well destruction permitting requirements).
9. This Order does not authorize the discharge of pollutants from point sources to waters of the United States, including wetlands. Where required, Dischargers must obtain authorization for such discharges by obtaining a Clean Water Act (CWA) section 402 National Pollutant Discharge Elimination System (NPDES) permit or a CWA section 404 dredge and fill permit.
10. Dischargers who utilize containment structures (such as retention ponds or reservoirs) to achieve treatment or control of the discharge of waste must manage, construct, and maintain such containment structures to avoid discharges of waste to groundwater and surface water that cause or contribute to exceedances of water quality objectives or impairment of beneficial uses. Dischargers may choose the method of compliance appropriate for the individual ranch, which may include, but is not limited to:
  - a. Implementing chemical treatment (such as enzymes);
  - b. Implementing biological treatment (such as wood chips);
  - c. Recycling or reusing contained water to minimize infiltration or discharge of waste;
  - d. Minimizing the volume of water in the containment structure to minimize percolation of waste; and/or
  - e. Minimizing percolation of waste via a synthetic, concrete, clay, or low permeability soil liner.

11. Dischargers must implement proper handling, storage, disposal, and management of fertilizers, fumigants, pesticides, herbicides, rodenticides, and other chemicals to prevent or control the discharge of waste to waters of the state that causes or contributes to exceedances of water quality standards. All chemical storage areas must have appropriate secondary containment structures to protect water quality and prevent discharge through spillage, mixing, or seepage.
12. Dischargers must implement water quality protective management practices such as source control or treatment) to prevent erosion, reduce stormwater runoff quantity and velocity, and hold fine particles in place.
13. Dischargers must minimize the presence of bare soil vulnerable to erosion and soil runoff to surface waters and implement erosion control, sediment, and stormwater management practices in non-cropped areas, such as unpaved roads and other heavy use areas.
14. Dischargers who utilize agricultural drainage pumps must implement management practices to dissipate flow and prevent channel and/or streambank erosion resulting in increased sediment transport and turbidity within surface water.
15. Dischargers must comply with any applicable stormwater permits.
16. Dischargers must implement best practicable treatment or control (BPTC) measures for the construction and maintenance of farm roads to minimize erosion and sediment discharges that contribute to nonpoint source pollution.
17. Dischargers must ensure that all farm roads are, to the extent possible, hydrologically disconnected from waters of the state by installing disconnecting drainage features, increasing the frequency of (inside) ditch drain relief as needed, constructing out-sloped roads, constructing energy dissipating structures, avoiding concentrating flows in unstable areas, and performing inspection and maintenance as needed to optimize access road performance.
18. Dischargers must ensure that farm road surfacing, especially within a segment leading to waters of the state, minimizes sediment delivery to waters of the state and maximizes road integrity.
19. Dischargers must ensure that farm roads are out-sloped whenever possible to promote even drainage of the farm road surface, prevent the concentration of stormwater flow within an inboard or inside ditch, and to prevent disruption of the natural sheet flow pattern off a hill slope to waters of the state.



20. Farm road stormwater drainage structures must not discharge onto unstable slopes, earthen fills, or directly into waters of the state. Drainage structures must discharge onto stable areas with straw bales, slash, vegetation, and/or rock riprap.
21. If used, chemical toilets or holding tanks must be maintained in a manner appropriate for the frequency and conditions of usage, sited in stable locations, and located outside of areas bordering surface waterbodies.
22. Dischargers who produce and apply compost in-house must comply with the following requirements:
  - a. Materials and activities on-site must not cause, threaten to cause, or contribute to conditions of pollution, contamination, or nuisance;
  - b. Activities must be set back at least 100 feet from the nearest surface waterbody and/or the nearest water supply well;
  - c. Dischargers must implement practices to minimize or eliminate the discharge of waste that may adversely impact the quality or beneficial uses of waters of the state;
  - d. Dischargers must manage the application of water to compost (including from precipitation events) to reduce the generation of wastewater;
  - e. Working surfaces must be designed to prevent, to the greatest extent possible, ponding, infiltration, inundation, and erosion, notwithstanding precipitation events, equipment movement, and other aspects of the facility operations;
  - f. Dischargers must maintain the following records in the Farm Plan. These records must be submitted to the Central Coast Water Board upon request.
    - i. Total operational footprint of compost activities (in acres), including ancillary activities;
    - ii. Compost operation records to provide background information on the composting operation history and a description of methods and operation used, including the following: feedstock types, volumes, sources, and suppliers. Description of the method of composting (e.g., windrow, static, forced air, mechanical). Description of how residuals are removed from the feedstocks and managed and/or disposed of.
    - iii. Description of water supply.
    - iv. Map detailing the location and size (in acres) of the working surface used for the storage of incoming feedstocks, additives, and amendments (receiving area); active and curing composting; final product; drainage patterns; location of any groundwater monitoring wells and water supply wells within and/or near the property boundary; location and distance (in feet) to nearby water supply wells (e.g., municipal supply, domestic supply, agricultural wells) from the nearest property boundary of the operation; identification of all surface waterbodies, including streams, ditches, canals, and other drainage

- courses; and distances from the nearest property boundary of the operation to these surface waterbody areas.
  - v. Records of appropriate monitoring (dependent on method of composting for composting to develop final product (temperature, turning, air flow, etc.).
  - vi. Records of final product use, including locations and volumes.
23. Disturbance (e.g., removal, degradation, or destruction) of existing, naturally occurring, and established native riparian vegetative cover (e.g., trees, shrubs, and grasses), unless authorized or exempted (e.g., Clean Water Act [CWA] section 404 permit and CWA section 401 certification, WDRs, waivers of WDRs, a California Department of Fish and Wildlife [CDFW] Lake and Streambed Alteration Agreement, or municipal ordinance), is prohibited. Dischargers must avoid disturbance in riparian areas to minimize waste discharges and protect water quality and beneficial uses.
24. In the case where disturbance of riparian areas is authorized, Dischargers must implement appropriate and practicable measures to avoid, minimize, and mitigate erosion and discharges of waste.

### **Additional Requirements**

25. Upon the Central Coast Water Board's request, Dischargers must submit information regarding compliance with any DPR adopted or approved surface water or groundwater protection requirements to the Central Coast Water Board.
26. Upon the Central Coast Water Board's request, Dischargers must submit proof of an approved Lake and Streambed Alteration Agreement or other authorization or release from the CDFW to the Central Coast Water Board for any work conducted within the bed, bank, and channel, including riparian areas, of parcels enrolled in this order, that has the potential to result in erosion and discharges of waste to waters of the State.
27. Upon the Central Coast Water Board's request, Dischargers must submit proof of a Clean Water Act section 404 dredge and fill permit from the United States Army Corps of Engineers (USACE) for any work that has the potential to discharge wastes considered "fill" material, such as sediment, to waters of the United States to the Central Coast Water Board.
28. Dischargers must comply with DWR Bulletin 74-81 and supplement 74-90, Water Code sections 13700 through 13755, and any local permitting requirements associated with installation of new wells.
29. This Order does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in

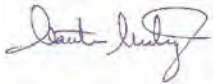
the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C. sections 1531 to 1544). If a "take" will result from any act authorized under this Order, the Dischargers must obtain authorization for an incidental take prior to taking action. Dischargers are responsible for meeting all applicable requirements of the California and federal Endangered Species Acts for the discharge authorized by this Order.

30. Dischargers or a representative authorized by the Discharger must sign technical reports submitted to the Central Coast Water Board to comply with this Order. Any person signing or submitting a document must provide the following certification, whether written or implied:

*"In compliance with Water Code section 13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision, following a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."*

## **CERTIFICATION**

I, Matthew T. Keeling, Executive Officer, do hereby certify that this General Order with all its attachments is a full, true, and correct copy of an order adopted by the California Regional Water Quality Control Board, Central Coast Region on April 15, 2021.



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Matthew T. Keeling, Executive Officer

## **Tables and Figures**

**Tables and Figures related to Part 2, Section C.1. Groundwater Protection**

**Table C.1-1. Groundwater Phase Areas**

<b>Groundwater Basin<sup>1</sup></b>	<b>Groundwater Phase</b>
Gilroy-Hollister Valley - Llagas Area	Phase 1, Phase 2
Salinas Valley - Forebay Aquifer	Phase 1, Phase 2
Salinas Valley - Upper Valley Aquifer	Phase 1, Phase 2
Santa Maria River Valley - Santa Maria	Phase 1, Phase 2
Santa Ynez River Valley	Phase 1, Phase 3
Corralitos - Pajaro Valley	Phase 2
Gilroy Hollister Valley - North San Benito	Phase 2
Salinas Valley - 180/400 Foot Aquifer	Phase 2
Salinas Valley - East Side Aquifer	Phase 2
San Luis Obispo Valley	Phase 2
All Other Basins and Areas Outside of Basins	Phase 3

<sup>1</sup>As defined in the 2019 California Department of Water Resources Bulletin 118.



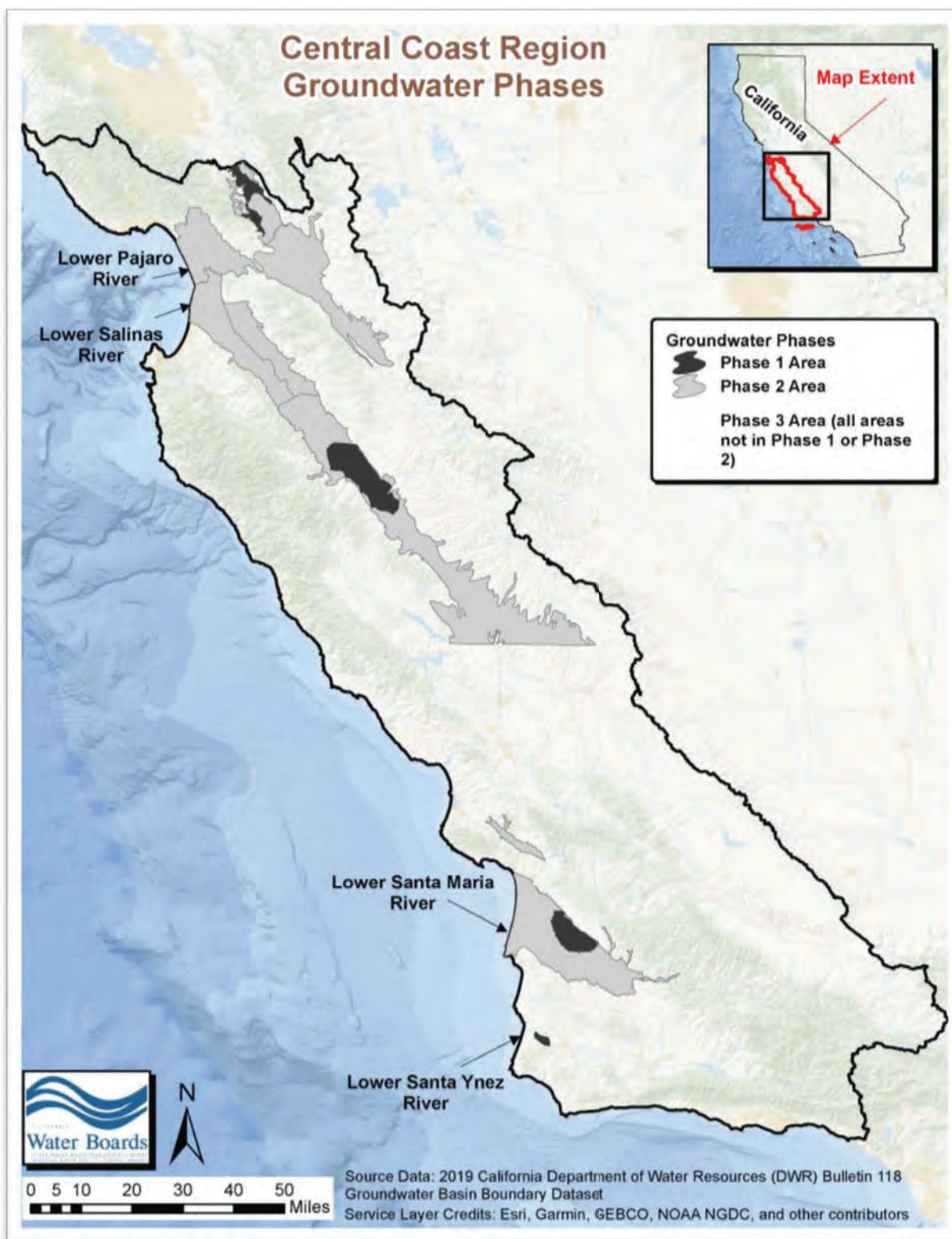


Figure C.1-1: Groundwater Phase Areas

**Table C.1-2. Compliance Dates for Fertilizer Nitrogen Application Limits**

<b>Crop</b>	<b>90<sup>th</sup> Percentile A<sub>FER</sub> =</b>	<b>Compliance Date</b>	<b>85<sup>th</sup> Percentile A<sub>FER</sub> =</b>	<b>Compliance Date</b>
Broccoli	295	12/31/2023	280	12/31/2025
Cauliflower	310		285	
Celery	360		330	
Lettuce	275		255	
Spinach	245		230	
Strawberry	320		295	
All Other Crops	500		480	

Note: For crops grown for less than one year (e.g., broccoli, lettuce, etc. , units are in pounds of nitrogen per acre per crop. In the situation where a Discharger grows a crop more than once during the year, e.g. grows a spring lettuce and a fall lettuce, the application limit applies to each of the crops separately: no more than 275 pounds of nitrogen per acre can be applied to the spring lettuce crop and no more than 275 pounds of nitrogen per acre can be applied to the fall lettuce crop. The two lettuce crops can be reported on separately or can be averaged together. For crops grown for more than one year (e.g., grapes, trees, etc.), units are in pounds of nitrogen per acre per year. The 90<sup>th</sup> and 85<sup>th</sup> percentile fertilizer nitrogen application limits were determined by using year 2014 to 2019 total nitrogen applied (TNA) reporting information.

**Table C.1-3. Compliance Dates for Nitrogen Discharge Targets and Limits**

<b>Compliance Pathway 1</b> $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R$	<b>Compliance Date</b>		
	Target	500	12/31/2023
	Target	400	12/31/2025
	Limit	300	12/31/2027
	Limit	200	12/31/2031
	Limit	150	12/31/2036
	Limit	100	12/31/2041
	Limit	50	12/31/2051
OR			
<b>Compliance Pathway 2</b> $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) = R$	<b>Compliance Date</b>		
	Target	A R	12/31/2023
	Target	A R	12/31/2025
	Limit	A R	12/31/2027
	Limit	A R	12/31/2031
	Limit	A R	12/31/2036
	Limit	A R	12/31/2041
	Limit	A R	12/31/2051
OR			
<b>Compliance Pathway 3</b> $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) - R$	<b>Compliance Date</b>		
	Target	300	12/31/2023
	Target	200	12/31/2025
	Limit	100	12/31/2027
	Limit	0	12/31/2031
	Limit	-50	12/31/2036
	Limit	-100	12/31/2041
	Limit	-150	12/31/2051

Note: All units are in pounds of nitrogen per acre per year and represent all crops grown and harvested on the entire ranch. The initial 2027 nitrogen discharge limits will be re-evaluated based on discharger reported nitrogen applied and removed data, new science, and management practice implementation and assessment before becoming effective.

**A<sub>FER</sub>** is the amount of fertilizer nitrogen applied in pounds per acre.

**C** is the compost discount factor used to represent the amount of compost nitrogen mineralized during the year that the compost was applied.

**A<sub>COMP</sub>** is the total amount of compost nitrogen applied in pounds per acre.

**A<sub>IRR</sub>** is the amount of nitrogen in pounds per acre applied in the irrigation water estimated from the volume required for crop evapotranspiration ET or volume of water applied.

**O** is the organic fertilizer discount factor used to represent the amount of nitrogen mineralized during the first 12 weeks in the year it was applied.

**A<sub>ORG</sub>** is the total amount of organic fertilizer or amendment nitrogen applied in pounds per acre.

**R** is the amount of nitrogen removed from the field through harvest, sequestration, or other removal methods, in pounds per acre.

**Note:** Report due dates to confirm compliance with the fertilizer application limits and nitrogen discharge targets and limits are included in the MRP.

**Tables and Figures related to Part 2, Section C.2. Third-Party Alternative Compliance Pathway for Groundwater Protection**

**Table C.2-1. Compliance Dates for Fertilizer Nitrogen Application Targets (Alternative Compliance Pathway)**

Crop	90 <sup>th</sup> Percentile A <sub>FER</sub> =	Compliance Date	85 <sup>th</sup> Percentile A <sub>FER</sub> =	Compliance Date
Broccoli	295	12/31/2024	280	12/31/2026
Cauliflower	310		285	
Celery	360		330	
Lettuce	275		255	
Spinach	245		230	
Strawberry	320		295	
All Other Crops	500		480	

Note: For crops grown for less than one year (e.g., broccoli, lettuce, etc.), units are in pounds of nitrogen per acre per crop. In the situation where a Discharger grows a crop more than once during the year, e.g. grows a spring lettuce and a fall lettuce, the application limit applies to each of the crops separately: no more than 275 pounds of nitrogen per acre can be applied to the spring lettuce crop and no more than 275 pounds of nitrogen per acre can be applied to the fall lettuce crop. The two lettuce crops can be reported on separately or can be averaged together. For crops grown for more than one year (e.g., grapes, trees, etc.), units are in pounds of nitrogen per acre per year. The 90<sup>th</sup> and 85<sup>th</sup> percentile fertilizer nitrogen application targets were determined by using year 2014 to 2019 total nitrogen applied (TNA) reporting information.

**Table C.2-2. Compliance Dates for Nitrogen Discharge Targets (Alternative Compliance Pathway)**

<b>Compliance Pathway 1</b> $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R$	Target	Compliance Date
	500	12/31/2024
	400	12/31/2026
	300	12/31/2028
OR		
<b>Compliance Pathway 2</b> $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) = R$	Target	Compliance Date
	A R	12/31/2024
	A R	12/31/2026
	A R	12/31/2028
OR		
<b>Compliance Pathway 3</b> $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) - R$	Target	Compliance Date
	300	12/31/2024
	200	12/31/2026
	100	12/31/2028

Notes: All units are in pounds of nitrogen per acre per year and represent all crops grown and harvested on the entire ranch. All compliance pathway variables are defined above under [Table C.1-3](#). The final 2028 nitrogen discharge targets will be re-evaluated based on discharger reported nitrogen applied and removed data, new science, management practice implementation and assessment, and third-party GWP collective numeric interim and final targets before becoming effective.



**Tables and Figures related to Part 2, Section C.3. Surface Water Protection**

**Table C.3-1. Surface Water Priority Areas**

<b>HUC-8 Number<sup>1</sup></b>	<b>HUC-8 Name</b>	<b>Surface Water Priority</b>
18060008	Santa Maria	Priority 1
18060005	Salinas	Priority 2
18060002	Pajaro	Priority 3
18060015	Monterey Bay	Priority 3
18060010	Santa Ynez	Priority 3
18050003	Coyote	Priority 4
18050006	San Francisco Coastal South	Priority 4
18060004	Estrella	Priority 4
18060006	Central Coastal	Priority 4
18060003	Carrizo Plain	Priority 4
18060007	Cuyama	Priority 4
18060009	San Antonio	Priority 4
18060013	Santa Barbara Coastal	Priority 4
18060014	Santa Barbara Channel Islands	Priority 4
18070101	Ventura	Priority 4

<sup>1</sup>As defined by the National Hydrography Dataset Plus Watershed Boundary Dataset

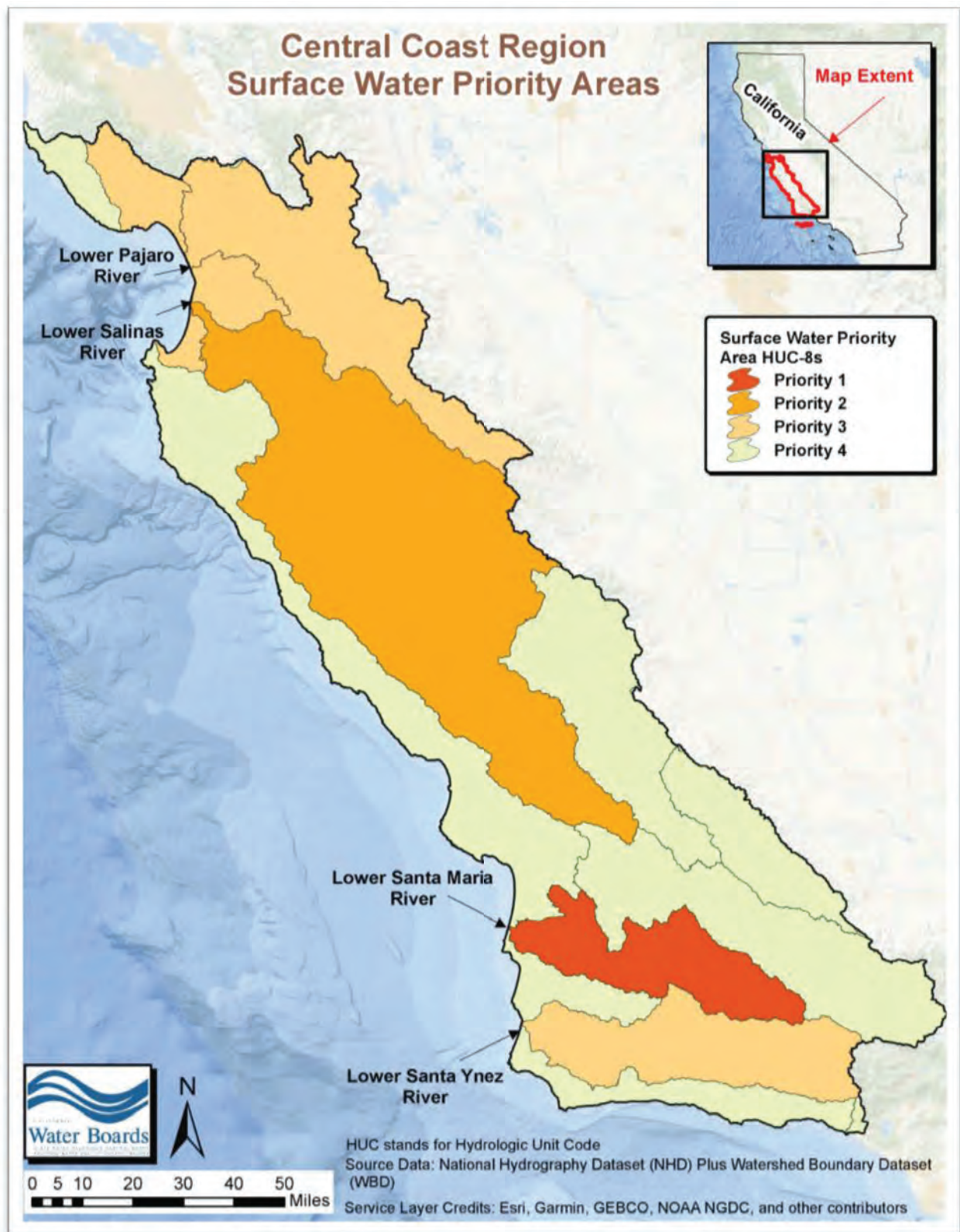


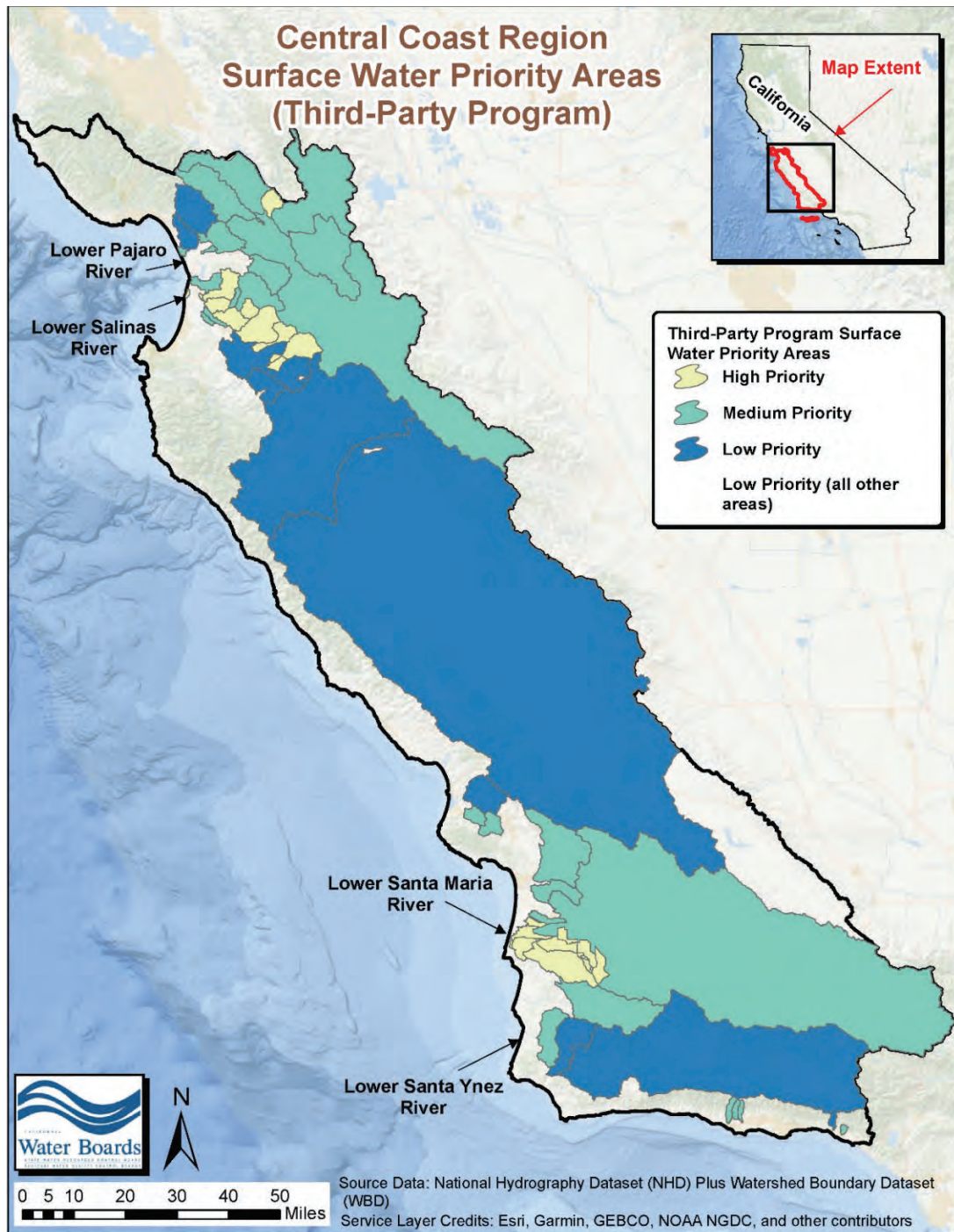
Figure C-3.1: Surface Water Priority Areas

**Table C.3-1.3P. Surface Water Priority Areas (Third-Party Program)**

<b>High Priority</b>	
305FUF	Furlong Creek at Frazier Lake Road
309ALG	Salinas Reclamation Canal at La Guardia
309CCD	Chualar Creek west of Highway 101
309CRR	Chualar Creek North Branch east of Highway 101
309ESP	Espinosa Slough upstream from Alisal Slough
309JON	Salinas Reclamation Canal at San Jon Road
309MER	Merrit Ditch upstream of Highway 183
309NAD	Natividad Creek upstream of Salinas Reclamation Canal
309OLD	Old Salinas River at Monterey Dunes Way
309QUI	Quail Creek at culvert on east side of Highway 101
309TEH	Tembladero Slough at Haro Street
312BCC	Bradley Canyon Creek at Culvert
312BCJ	Bradley Channel at Jones Street
312GVS	Green Valley at Simas
312MSD	Main Street Canal upstream of Ray Road at Highway 166
312OFC	Oso Flaco Creek at Oso Flaco Lake Road
312ORC	Orcutt Solomon Creek upstream of Santa Maria River
312ORI	Orcutt Solomon Creek at Highway 1
312SMA	Santa Maria River at Estuary
<b>Medium Priority</b>	
305BRS	Beach Road Ditch at Shell Road
305CAN	Carnadero Creek upstream of Pajaro River
305CHI	Pajaro River at Chittenden Gap
305FRA	Pajaro River Millers Canal at Frazier Lake Road
305LCS	Llagas Creek at Southside Avenue
305PJP	Pajaro River at Main Street
305SJA	San Juan Creek at Anzar Road
305TSR	Tequisquita Slough upstream of Pajaro River at Shore Road
305WCS	Watsonville Creek at Elkhorn Road / Hudson Landing
309ASB	Alisal Slough at White Barn
309BLA	Blanco Drain below Pump
309GAB	Gabilan Creek at Boronda Road
309MOR	Moro Cojo Slough at Highway 1
309RTA	Santa Rita Creek at Santa Rita Creek Park
310LBC	Los Berros Creek at Century Road
310PRE	Prefumo Creek at Calle Joaquin
310USG	Arroyo Grande Creek at old USGS Gauge
310WRP	Warden Creek at Wetlands Restoration Preserve
312OFN	Little Oso Flaco Creek
312SMI	Santa Maria at Highway 1
313SAE	San Antonio Creek at San Antonio Road east
314SYN	Santa Ynez River at 13 <sup>th</sup>
315BEF	Bell Creek at Winchester Canyon Park
315FMV	Franklin Creek at Mountain View Lane
315GAN	Glenn Annie Creek
315LCC	Los Carneros Creek at Calle Real

<b>Low Priority</b>	
305COR	Salsipuedes Creek downstream of Corralitos Creek upstream of HWY 129
305WSA	Watsonville Slough at San Andreas Road
309GRN	Salinas River Mid) at Elm Road in Greenfield
309SAC	Salinas River at Chualar
309SAG	Salinas River at Gonzales River Road Bridge
309SSP	Salinas River Lower) at Spreckles Gauge
310CCC	Chorro Creek upstream of Chorro Flats
314SYF	Santa Ynez River at Flordale
314SYL	Santa Ynez River at River Park
315APF	Arroyo Paredon Creek at Foothill Bridge
All Other Areas	Low priority also includes all other areas not in high or medium priority areas





**Figure C-3.1.3P: Surface Water Priority Areas (Third-Party Program)**



**Table C.3-2. Compliance Dates for Nutrient Limits (TMDL areas)**

<b>TMDL Project Name</b>	<b>Constituent</b>	<b>Matrix</b>	<b>Limit<sup>1</sup></b>	<b>Units<sup>2</sup></b>	<b>Compliance Date</b>
Arroyo Paredon Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Bell Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Franklin Creek Nutrients TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Franklin Creek Nutrients TMDL	Total Nitrogen, as N	Water Column	Wet Season: 8.0	mg/L	3/4/2034
Franklin Creek Nutrients TMDL	Total Phosphorous	Water Column	Wet Season: 0.3	mg/L	3/4/2034
Franklin Creek Nutrients TMDL	Total Nitrogen, as N	Water Column	Dry Season: 1.1	mg/L	3/4/2044
Franklin Creek Nutrients TMDL	Total Phosphorous	Water Column	Dry Season: 0.075	mg/L	3/4/2044
Glen Annie Canyon, Tecolotito Creek, & Cameros Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Los Berros Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Los Osos Creek, Warden Creek, and Warden Lake Wetland Nutrient TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032

<b>TMDL Project Name</b>	<b>Constituent</b>	<b>Matrix</b>	<b>Limit<sup>1</sup></b>	<b>Units<sup>2</sup></b>	<b>Compliance Date</b>
Lower Salinas River Watershed Nutrient TMDL	Ammonia (Un-ionized), as N3	Water Column	0.025	mg/L	12/31/2032
Lower Salinas River Watershed Nutrient TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Lower Salinas River Watershed Nutrient TMDL	Total Nitrogen, as N4	Water Column	Wet Season: 8.0	mg/L	5/7/2034
Lower Salinas River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Wet Season: 8.0	mg/L	5/7/2034
Lower Salinas River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Wet Season: 0.3	mg/L	5/7/2034
Lower Salinas River Watershed Nutrient TMDL	Total Nitrogen, as N4	Water Column	Dry Season: 1.7	mg/L	5/7/2044
Lower Salinas River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Dry Season: 1.4 – 6.41	mg/L	5/7/2044
Lower Salinas River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Dry Season: 0.07 – 0.131	mg/L	5/7/2044
Pajaro River Watershed Nutrient TMDL	Ammonia (Un-ionized), as N3	Water Column	0.025	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032

<b>TMDL Project Name</b>	<b>Constituent</b>	<b>Matrix</b>	<b>Limit<sup>1</sup></b>	<b>Units<sup>2</sup></b>	<b>Compliance Date</b>
Pajaro River Watershed Nutrient TMDL	Total Nitrogen, as N	Water Column	Wet Season: 8.0	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Wet Season: 8.0	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Wet Season: 0.3	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Total Nitrogen, as N5	Water Column	Dry Season: 1.1 – 2.11	mg/L	7/12/2041
Pajaro River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Dry Season: 1.8 – 3.91	mg/L	7/12/2041
Pajaro River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Dry Season: 0.04 – 0.141	mg/L	7/12/2041
San Luis Obispo Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Santa Maria River Watershed Nutrients TMDL	Ammonia (Un-ionized), as N3	Water Column	0.025	mg/L	12/31/2032
Santa Maria River Watershed Nutrients TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032

<b>TMDL Project Name</b>	<b>Constituent</b>	<b>Matrix</b>	<b>Limit<sup>1</sup></b>	<b>Units<sup>2</sup></b>	<b>Compliance Date</b>
Santa Maria River Watershed Nutrients TMDL	Nitrate, as N	Water Column	Wet Season or Year-Round: 5.7 – 8.01	mg/L	5/22/2034
Santa Maria River Watershed Nutrients TMDL	Orthophosphate, as P	Water Column	Wet Season or Year-Round: 0.08 – 0.31	mg/L	5/22/2034
Santa Maria River Watershed Nutrients TMDL	Nitrate, as N	Water Column	Dry Season: 4.3	mg/L	5/22/2044
Santa Maria River Watershed Nutrients TMDL	Orthophosphate, as P	Water Column	Dry Season: 0.19	mg/L	5/22/2044

<sup>1</sup>The Lower Salinas River Watershed Nutrient TMDL, Pajaro River Watershed Nutrient TMDL, and Santa Maria River Watershed Nutrient TMDL include load allocations for specific waterbody reaches within the TMDL project area. The limits for those TMDLs are summarized in this table as ranges; however, the exact load allocation values for each reach apply as described in the TMDL and Basin Plan and will be assessed as numeric limits for the purposes of this Order.

<sup>2</sup>mg/L is milligrams per liter.

<sup>3</sup>Calculated using total ammonia and onsite instream measurements (field measurements of pH and water temperature.

<sup>4</sup>Total nitrogen TMDL load allocation applies to Moro Cojo Slough only.

<sup>5</sup>Total nitrogen TMDL load allocation applies to the following sloughs: Watsonville, Harkins, Gallighan, and Struve.

Table C.3-3. Compliance Dates for Nutrient Limits (Non-TMDL areas)

Constituent Group	Constituent	Matrix	Limit	Units <sup>1</sup>	Compliance Date
Nutrients	Nitrate, as Nitrogen	Water Column	10.0	mg/L	12/31/2032
Nutrients	Ammonia (un-ionized), as Nitrogen <sup>2</sup>	Water Column	0.025	mg/L	12/31/2032

<sup>1</sup>mg/L is milligrams per liter.

<sup>2</sup>Calculated using total ammonia and onsite instream measurements (field measurements of pH and water temperature).



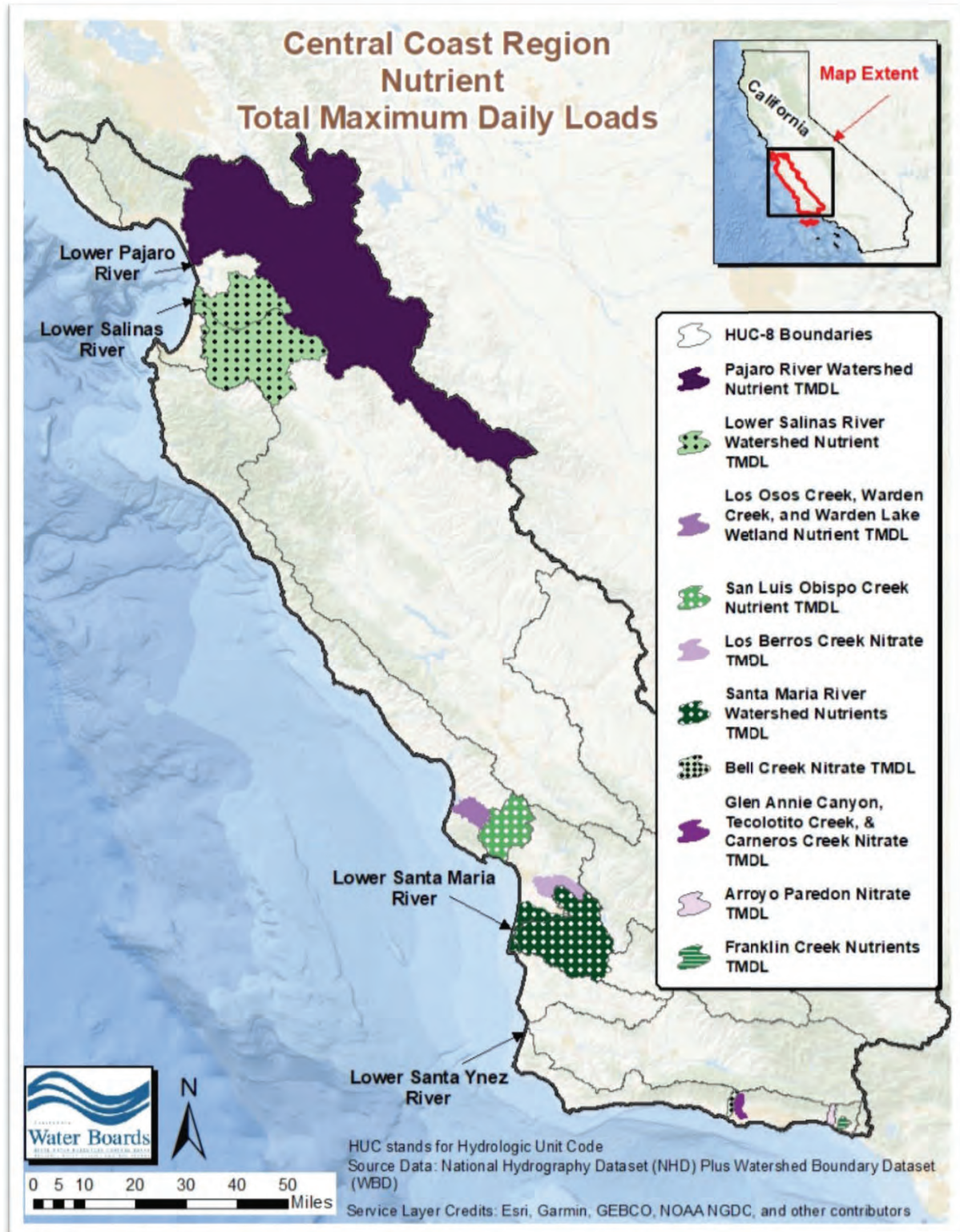


Figure C.3-2: Nutrient TMDL Areas

**Table C.3-4. Compliance Dates for Pesticide and Toxicity Limits (TMDL areas)**

<b>TMDL Project Name</b>	<b>Constituent<sup>1</sup></b>	<b>Matrix</b>	<b>Limit<sup>2</sup></b>	<b>Units<sup>3</sup></b>	<b>Compliance Date</b>
Arroyo Paredon Diazinon TMDL	Additive Toxicity Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU $\leq$ 1.0	TU	12/31/2032
Arroyo Paredon Diazinon TMDL	Diazinon	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032
Lower Salinas River Watershed Chlorpyrifos and Diazinon TMDL	Chlorpyrifos <sup>4</sup>	Water Column	CCC: 0.015 CMC: 0.025	µg/L	12/31/2032
Lower Salinas River Watershed Chlorpyrifos and Diazinon TMDL	Diazinon <sup>4</sup>	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032
Lower Salinas River Watershed Chlorpyrifos and Diazinon TMDL	Additive Toxicity Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU $\leq$ 1.0	TU	12/31/2032

<b>TMDL Project Name</b>	<b>Constituent<sup>1</sup></b>	<b>Matrix</b>	<b>Limit<sup>2</sup></b>	<b>Units<sup>3</sup></b>	<b>Compliance Date</b>
Lower Salinas River Watershed Sediment Toxicity and Pyrethroids in Sediment TMDL	Additive Toxicity (Pyrethroids)	Sediment	Sum of Pyrethroid TU < 1.0	TU	12/31/2032
Lower Salinas River Watershed Sediment Toxicity and Pyrethroids in Sediment TMDL	Aquatic Toxicity	Sediment	No significant toxic effect, 10-day, chronic exposure with <i>Hyaletia azteca</i>	Survival endpoint	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Additive Toxicity (Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU ≤ 1.0	TU	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Chlorpyrifos	Water Column	CCC: 0.015 CMC: 0.025	µg/L	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Diazinon	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032

<b>TMDL Project Name</b>	<b>Constituent<sup>1</sup></b>	<b>Matrix</b>	<b>Limit<sup>2</sup></b>	<b>Units<sup>3</sup></b>	<b>Compliance Date</b>
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Aquatic Toxicity	Sediment	No significant toxic effect, 10-day, chronic exposure with <i>Hyaletella azteca</i>	Survival and reproduction endpoints	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Aquatic Toxicity	Water Column	No significant toxic effect, 7-day, chronic exposure with <i>Ceriodaphnia dubia</i>	Survival and reproduction endpoints	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Additive Toxicity Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU ≤ 1.0	TU	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Chlorpyrifos	Water Column	CCC: 0.015 CMC: 0.025	µg/L	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Diazinon	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032

<b>TMDL Project Name</b>	<b>Constituent<sup>1</sup></b>	<b>Matrix</b>	<b>Limit<sup>2</sup></b>	<b>Units<sup>3</sup></b>	<b>Compliance Date</b>
Santa Maria River Watershed Toxicity and Pesticide TMDL	Malathion	Water Column	CCC: 0.028 CMC: 0.17	µg/L	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Additive Toxicity (Pyrethroids)	Sediment	Sum of Pyrethroid TU $\leq$ 1.0	TU	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Aquatic Toxicity	Sediment	No significant toxic effect, 10-day, chronic exposure with <i>Hyaletta azteca</i>	Survival endpoint	Not Defined <sup>5</sup>
Santa Maria River Watershed Toxicity and Pesticide TMDL	Aquatic Toxicity	Water Column	No significant toxic effect, 6-8 day, chronic exposure with <i>Ceriodaphnia dubia</i>	Survival and reproduction endpoints	Not Defined <sup>5</sup>
Santa Maria River Watershed Toxicity and Pesticide TMDL	4,4'-DDT (p,p-DDT)	Sediment	6.5	µg/kg o.c.	10/29/2044



<b>TMDL Project Name</b>	<b>Constituent<sup>1</sup></b>	<b>Matrix</b>	<b>Limit<sup>2</sup></b>	<b>Units<sup>3</sup></b>	<b>Compliance Date</b>
Santa Maria River Watershed Toxicity and Pesticide TMDL	4,4'-DDE (p,p-DDE)	Sediment	5.5	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	4,4'-DDD (p,p-DDD)	Sediment	9.1	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Total DDT Sediment)	Sediment	10.0	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Chlordane	Sediment	1.7	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Dieldrin	Sediment	0.14	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Endrin	Sediment	550.0	µg/kg o.c.	10/29/2044

<b>TMDL Project Name</b>	<b>Constituent<sup>1</sup></b>	<b>Matrix</b>	<b>Limit<sup>2</sup></b>	<b>Units<sup>3</sup></b>	<b>Compliance Date</b>
Santa Maria River Watershed Toxicity and Pesticide TMDL	Toxaphene	Sediment	20.0	µg/kg o.c.	10/29/2044

<sup>1</sup>Toxic units and/or additive toxicity units are calculated using the relevant biological indicators, as described in the applicable TMDL, e.g. LC50, CCC, or CMC.

<sup>2</sup>CCC is Criterion Continuous Concentration or chronic (4-day (96-hour average), not to be exceeded more than once in a three year period; CMC is Criterion Maximum Concentration or acute (1- hour average) not to be exceeded more than once in a three year period; the sum of additive toxicity is calculated by dividing each measured chemical concentration by that chemical's criterion (CCC or CMC) and summing those values as defined in the staff report for the respective TMDL project.

<sup>3</sup>µg/L is micrograms per liter; µg/kg is micrograms per kilogram; ng/g is nanograms per gram; o.c. means normalized for sediment organic carbon content; ppb is parts per million.

<sup>4</sup>Apply only when one of the two compounds chlorpyrifos or diazinon) is present.

<sup>5</sup>A time schedule for aquatic toxicity was not identified in the Santa Maria River Watershed Toxicity and Pesticide TMDL; therefore, Dischargers in this area must comply with the aquatic toxicity compliance date defined in Table C.3-2.

**Table C-3.5. Compliance Dates for Pesticide and Toxicity Limits (Non-TMDL areas)**

<b>Constituent Group</b>	<b>Constituent</b>	<b>Matrix</b>	<b>Limit<sup>1</sup></b>	<b>Units<sup>2</sup></b>	<b>Compliance Date</b>
Pesticides	Acetamiprid	Water Column	2.10	µg/L	12/31/2032
Pesticides	Atrazine	Water Column	60.0	µg/L	12/31/2032
Pesticides	Bifenthrin	Sediment	0.52	µg/g o.c.	12/31/2032
Pesticides	Chlorpyrifos	Water Column	0.023	µg/L	12/31/2032
Pesticides	Chlorpyrifos	Sediment	1.77	µg/g o.c.	12/31/2032
Pesticides	Clothianidin	Water Column	0.05	µg/L	12/31/2032
Pesticides	Cyanazine	Water Column	27.0	µg/L	12/31/2032
Pesticides	Cyfluthrin	Sediment	1.08	µg/g o.c.	12/31/2032
Pesticides	Cypermethrin	Sediment	0.38	µg/g o.c.	12/31/2032
Pesticides	Danitol fenpropathrin)	Sediment	1.10	µg/g o.c.	12/31/2032
Pesticides	Demeton-s-methyl sulfoxide (oxydemeton- methyl	Water Column	46	µg/L	12/31/2032
Pesticides	Diazinon	Water Column	0.105	µg/L	12/31/2032
Pesticides	Dichlorvos	Water Column	0.0058	µg/L	12/31/2032
Pesticides	Dimethoate	Water Column	0.50	µg/L	12/31/2032
Pesticides	Dinotefuran	Water Column	23.5	µg/L	12/31/2032
Pesticides	Disulfoton Disyton)	Water Column	0.01	µg/L	12/31/2032
Pesticides	Diuron	Water Column	80.0	µg/L	12/31/2032
Pesticides	Esfenvalerate	Sediment	1.54	µg/g o.c.	12/31/2032
Pesticides	Fenvalerate	Sediment	1.54	µg/g o.c.	12/31/2032
Pesticides	Glyphosate	Water Column	26,600	µg/L	12/31/2032
Pesticides	Imidacloprid	Water Column	0.01	µg/L	12/31/2032
Pesticides	Cyhalothrin, lambda	Sediment	0.45	µg/g o.c.	12/31/2032
Pesticides	Linuron	Water Column	0.09	µg/L	12/31/2032
Pesticides	Malathion	Water Column	0.049	µg/L	12/31/2032
Pesticides	Methamidophos	Water Column	4.50	µg/L	12/31/2032
Pesticides	Methidathion	Water Column	0.66	µg/L	12/31/2032
Pesticides	Paraquat	Water Column	< 36.9	µg/L	12/31/2032
Pesticides	Parathion-methyl	Water Column	0.25	µg/L	12/31/2032
Pesticides	Permethrin	Sediment	10.83	µg/g o.c.	12/31/2032

Constituent Group	Constituent	Matrix	Limit <sup>1</sup>	Units <sup>2</sup>	Compliance Date
Pesticides	Phorate	Water Column	0.21	µg/L	12/31/2032
Pesticides	Phosmet	Water Column	0.80	µg/L	12/31/2032
Pesticides	Simazine	Water Column	40.0	µg/L	12/31/2032
Pesticides	Thiacloprid	Water Column	0.97	µg/L	12/31/2032
Pesticides	Thiamethoxam	Water Column	0.74	µg/L	12/31/2032
Pesticides	Trifluralin	Water Column	2.40	µg/L	12/31/2032
Toxicity	Sediment Toxicity	Sediment	No significant effect based on chronic or acute toxicity to applicable test organism	Survival, growth, and reproduction endpoints <sup>3</sup>	12/31/2032
Toxicity	Water Column Toxicity	Water Column	No significant effect based on chronic or acute toxicity to applicable test organism	Survival, growth, and reproduction endpoints <sup>3</sup>	12/31/2032
Toxicity	Toxic Units	Sediment	Sum of additive toxicity ≤ 1	Toxic Unit (TU) <sup>4</sup>	12/31/2032
Toxicity	Toxic Units	Water Column	Sum of additive toxicity ≤ 1	Toxic Unit (TU) <sup>4</sup>	12/31/2032

<sup>1</sup>Attachment A to this Order describes the sources of the limits established in this table.

<sup>2</sup>µg/L is micrograms per liter; µg/kg is micrograms per kilogram; ng/g is nanograms per gram; o.c. means normalized for sediment organic carbon content; ppb is parts per million.

<sup>3</sup>Toxicity determinations will be pass/fail based on a comparison of the test organism's response (survival, growth, and reproduction) to the water sample compared to the control using the Test of Significant Toxicity (TST statistical approach), or a statistical t-test, based on the toxicity provisions in the State Water Board *Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries in California* in draft). If a sample is declared "fail" (i.e., toxic for any endpoint, then the limit is not met. The most sensitive test species for each constituent must be used when evaluating toxicity.

<sup>4</sup>Toxic units (TU) and/or additive toxicity units are calculated using the relevant biological indicators, e.g. LC50, CCC, or CMC as follows:

Calculate additive toxicity for organophosphate pesticides in non-TMDL watersheds as defined in the TMDL for Chlorpyrifos and Diazinon in the Lower Salinas River Watershed; and calculate TUs for pyrethroid pesticides in non-TMDL watersheds as defined in the TMDL for Sediment Toxicity and Pyrethroids in the Lower Salinas River Watershed.

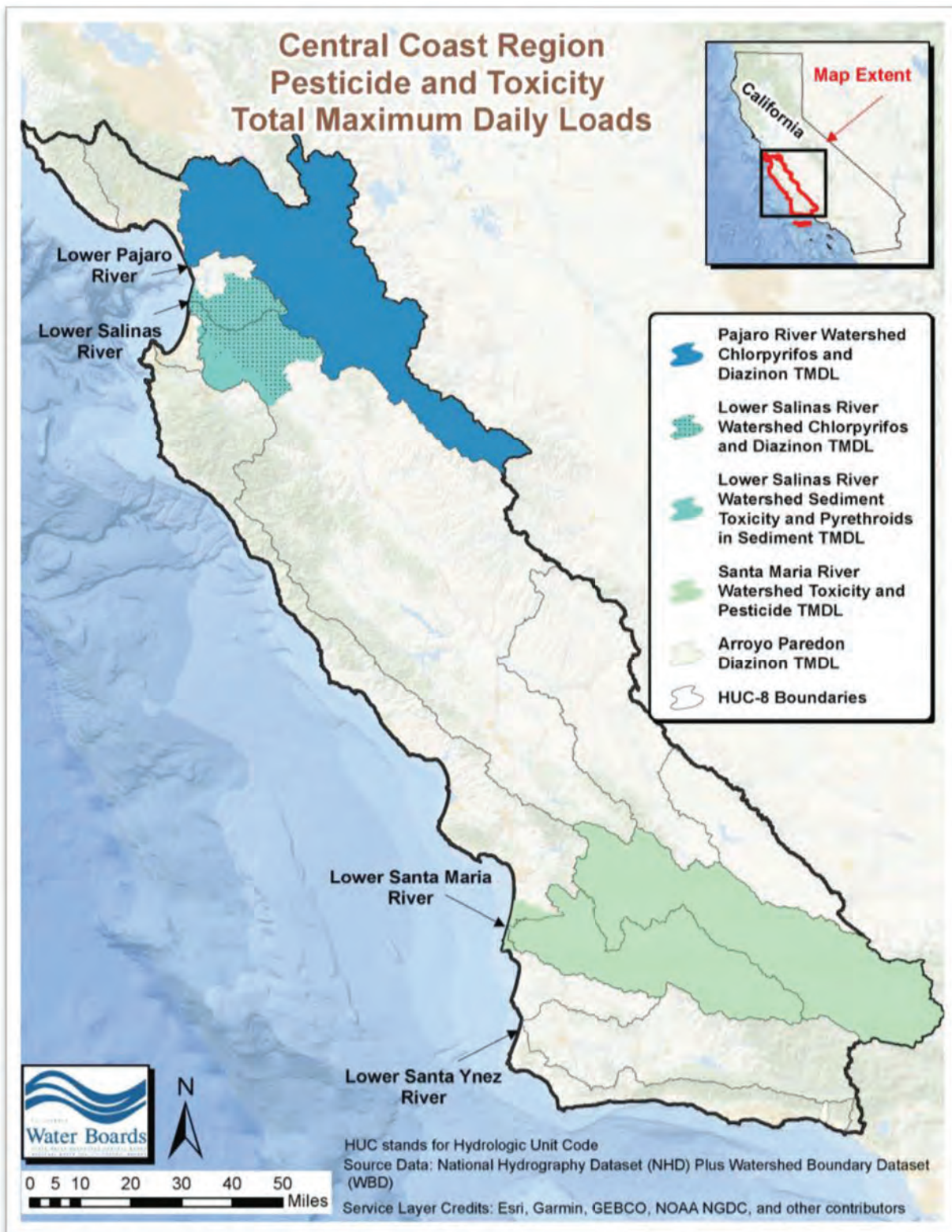


Figure C.3-3: Pesticide and Toxicity TMDL Areas



Table C.3-6. Compliance Dates for Sediment Limits (TMDL areas)

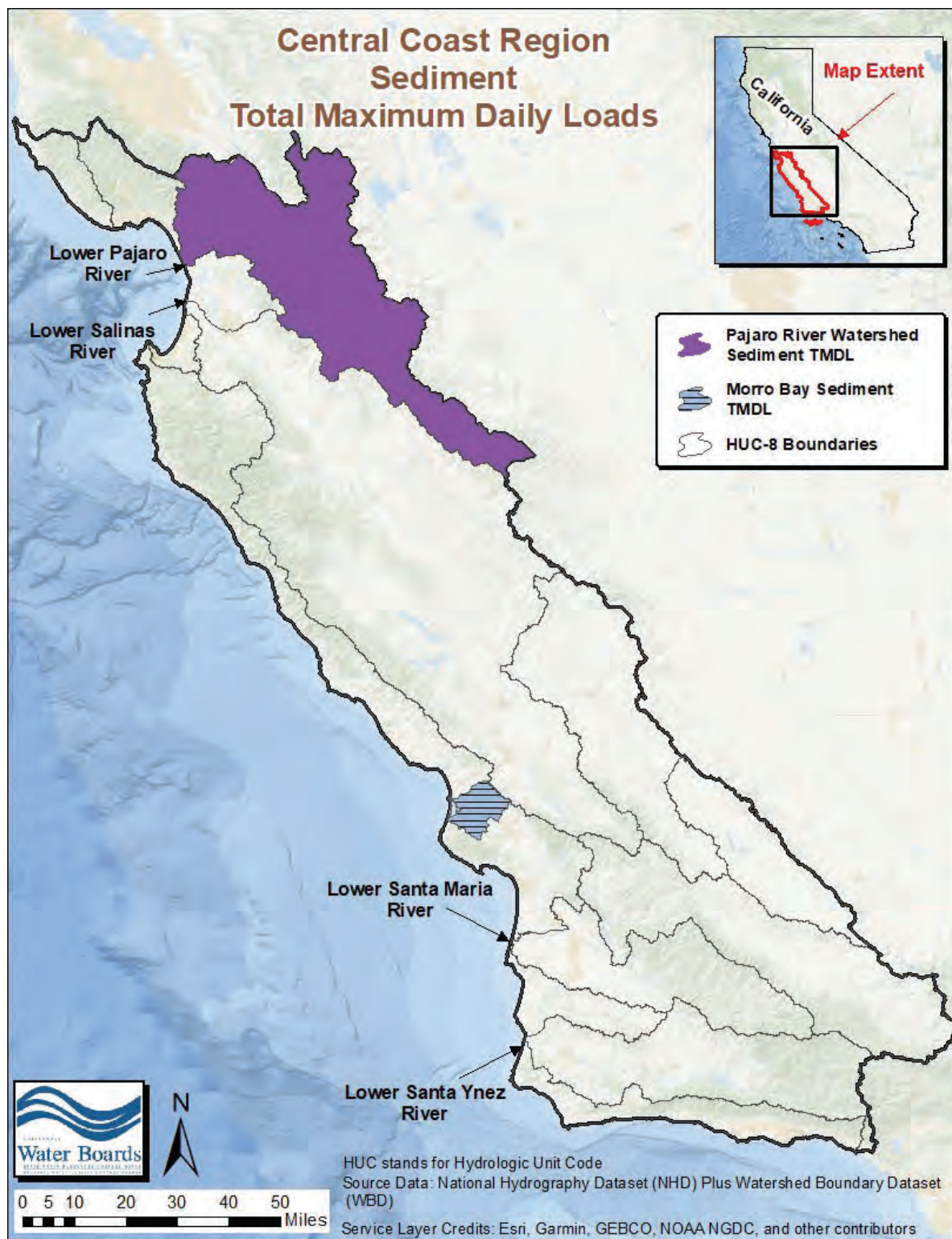
TMDL Project Name	Constituent	Limit <sup>1</sup>	Units	Compliance Date
Morro Bay Sediment TMDL	Sediment	285 – 6,662	Tons of sediment per year	12/3/2053
Pajaro River Watershed Sediment TMDL	Sediment	447 – 4,114	Tons of sediment per year	11/27/2051

<sup>1</sup>The Morro Bay Sediment TMDL and Pajaro River Watershed Sediment TMDL include load allocations for specific waterbody reaches within the TMDL project area. The limits for those TMDLs are summarized in this table as ranges; however, the exact load allocation values for each reach apply as described in the TMDL and Basin Plan and will be assessed as numeric limits for the purposes of this Order.

Table C.3-7. Compliance Dates for Turbidity Limits (Non-TMDL areas)

Constituent Group	Constituent	Beneficial Use	Limit	Units <sup>1</sup>	Compliance Date
Physical Parameters and General Chemistry	Turbidity	WARM	40.0	NTU	12/31/2032
Physical Parameters and General Chemistry	Turbidity	COLD	25.0	NTU	12/31/2032

<sup>1</sup>NTU is nephelometric turbidity units



**Figure C.3-4: Sediment TMDL Areas**

## Appendix 7-G (Ag Order 3.0)

### Central Coast Ag Order 3.0 Monitoring and Reporting Program

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL COAST REGION**

**MONITORING AND REPORTING PROGRAM  
ORDER NO. R3-2017-0002-01**

**TIER 1**

**DISCHARGERS ENROLLED UNDER  
CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR  
DISCHARGES FROM IRRIGATED LANDS**

This Monitoring and Reporting Program Order No. R3-2017-0002-01 (MRP) is issued pursuant to California Water Code (Water Code) sections 13267 and 13269, which authorize the California Regional Water Quality Control Board, Central Coast Region (hereafter Central Coast Water Board) to require preparation and submittal of technical and monitoring reports. Water Code section 13269 requires a waiver of waste discharge requirements to include as a condition the performance of monitoring and the public availability of monitoring results. *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*, Order No. R3-2017-0002 (Order) includes criteria and requirements for three tiers. This MRP sets forth monitoring and reporting requirements for **Tier 1 Dischargers** enrolled under the Order. A summary of the requirements is shown below.

**SUMMARY OF MONITORING AND REPORTING REQUIREMENTS FOR TIER 1:**

- |         |   |
|---------|---|
| Part 1: | Surface Receiving Water Monitoring and Reporting ( <i>cooperative or individual</i> ) |
| Part 2: | Groundwater Monitoring and Reporting ( <i>cooperative or individual</i> )             |

Pursuant to Water Code section 13269(a) 2 , monitoring requirements must be designed to support the development and implementation of the waiver program, including, but not limited to, verifying the adequacy and effectiveness of the waiver's conditions. The monitoring and reports required by this MRP are to evaluate effects of discharges of waste from irrigated agricultural operations and individual farms/ranches on waters of the state and to determine compliance with the Order.

**MONITORING AND REPORTING BASED ON TIERS**

The Order and MRP include criteria and requirements for three tiers, based upon those characteristics of individual farms/ranches at the operation that present the highest level of waste discharge or greatest risk to water quality. Dischargers must meet conditions of the Order and MRP for the appropriate tier that applies to their land and/or the individual farm/ranch. Within a tier, Dischargers comply with requirements based on the

specific level of discharge and threat to water quality from individual farms/ranches. The lowest tier, Tier 1, applies to dischargers who discharge the lowest level of waste amount or concentration) or pose the lowest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. The highest tier, Tier 3, applies to dischargers who discharge the highest level of waste or pose the greatest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. Tier 2 applies to dischargers whose discharge has a moderate threat to water quality. Water quality is defined in terms of regional, state, or federal numeric or narrative water quality standards. Per the Order, Dischargers may submit a request to the Executive Officer to approve transfer to a lower tier. If the Executive Officer approves a transfer to a lower tier, any interested person may request that the Central Coast Water Board conduct a review of the Executive Officer's determination.

## **PART 1. SURFACE RECEIVING WATER MONITORING AND REPORTING REQUIREMENTS**

The surface receiving water monitoring and reporting requirements described herein are generally a continuation of the surface receiving water monitoring and reporting requirements of Monitoring and Reporting Program Order No. 2012-0011-01, as revised August 22, 2016, with the intent of uninterrupted regular monitoring and reporting during the transition from Order No. R3-2012-0011-01 to Order No. R3-2017-0002-01.

Monitoring and reporting requirements for surface receiving water identified in Part 1.A. and Part 1.B. apply to Tier 1 Dischargers. Surface receiving water refers to water flowing in creeks and other surface waters of the State. Surface receiving water monitoring may be conducted through a cooperative monitoring program on behalf of Dischargers, or Dischargers may choose to conduct surface receiving water monitoring and reporting individually. Key monitoring and reporting requirements for surface receiving water are shown in Tables 1 and 2.

### **A. Surface Receiving Water Quality Monitoring**

1. Dischargers must elect a surface receiving water monitoring option cooperative monitoring program or individual receiving water monitoring to comply with surface receiving water quality monitoring requirements, and identify the option selected on the Notice of Intent (NOI).
2. Dischargers are encouraged to choose participation in a cooperative monitoring program (e.g., the existing Cooperative Monitoring Program or a similar program) to comply with receiving water quality monitoring requirements. Dischargers not participating in a cooperative monitoring program must conduct surface receiving water quality monitoring individually that achieves the same purpose.



3. Dischargers (individually or as part of a cooperative monitoring program must conduct surface receiving water quality monitoring to a) assess the impacts of their waste discharges from irrigated lands to receiving water, b) assess the status of receiving water quality and beneficial use protection in impaired waterbodies dominated by irrigated agricultural activity, c) evaluate status, short term patterns and long term trends (five to ten years or more) in receiving water quality, d) evaluate water quality impacts resulting from agricultural discharges (including but not limited to tile drain discharges), e) evaluate stormwater quality, f) evaluate condition of existing perennial, intermittent, or ephemeral streams or riparian or wetland area habitat, including degradation resulting from erosion or agricultural discharges of waste, and g) assist in the identification of specific sources of water quality problems.

#### Surface Receiving Water Quality Sampling and Analysis Plan

4. **By March 1, 2018, or as directed by the Executive Officer**, Dischargers (individually or as part of a cooperative monitoring program) must submit a surface receiving water quality Sampling and Analysis Plan (SAAP) and Quality Assurance Project Plan (QAPP ; this requirement is satisfied if an approved SAAP and QAPP addressing all surface receiving water quality monitoring requirements described in this Order has been submitted pursuant to Order No. R3-2012-0011 and associated Monitoring and Reporting Programs. Dischargers (or a third party cooperative monitoring program) must develop the Sampling and Analysis Plan to describe how the proposed monitoring will achieve the objectives of the MRP and evaluate compliance with the Order. The Sampling and Analysis Plan may propose alternative monitoring site locations, adjusted monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water. The Executive Officer must approve the Sampling and Analysis Plan and QAPP.
5. The Sampling and Analysis Plan must include the following minimum required components:
  - a. Monitoring strategy to achieve objectives of the Order and MRP;
  - b. Map of monitoring sites with GIS coordinates;
  - c. Identification of known water quality impairments and impaired waterbodies per the 2010 Clean Water Act 303 d List of Impaired Waterbodies List of Impaired Waterbodies);
  - d. Identification of beneficial uses and applicable water quality standards;
  - e. Identification of applicable Total Maximum Daily Loads;
  - f. Monitoring parameters;
  - g. Monitoring schedule, including description and frequencies of monitoring events;

h. Description of data analysis methods;

6. The QAPP must include receiving water and site-specific information, project organization and responsibilities, and quality assurance components of the MRP. The QAPP must also include the laboratory and field requirements to be used for analyses and data evaluation. The QAPP must contain adequate detail for project and Water Board staff to identify and assess the technical and quality objectives, measurement and data acquisition methods, and limitations of the data generated under the surface receiving water quality monitoring. All sampling and laboratory methodologies and QAPP content must be consistent with U.S. EPA methods, State Water Board's Surface Water Ambient Monitoring Program (SWAMP) protocols and the Central Coast Water Board's Central Coast Ambient Monitoring Program (CCAMP). Following U.S. EPA guidelines<sup>1</sup> and SWAMP templates<sup>2</sup>, the receiving water quality monitoring QAPP must include the following minimum required components:
- a. Project Management. This component addresses basic project management, including the project history and objectives, roles and responsibilities of the participants, and other aspects.
  - b. Data Generation and Acquisition. This component addresses all aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and quality control activities are employed and are properly documented. Quality control requirements are applicable to all the constituents sampled as part of the MRP, as described in the appropriate method.
  - c. Assessment and Oversight. This component addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of the assessment is to provide project oversight that will ensure that the QA Project Plan is implemented as prescribed.
  - d. Data Validation and Usability. This component addresses the quality assurance activities that occur after the data collection, laboratory analysis and data generation phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the MRP objectives.

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<sup>1</sup> USEPA. 2001 (2006) USEPA Requirements for Quality Assurance Project Plans (QA/R-5) Office of Environmental Information, Washington, D.C. USEPA QA/R-5

<sup>2</sup> [http://waterboards.ca.gov/water\\_issues/programs/swamp/tools.shtml#qa](http://waterboards.ca.gov/water_issues/programs/swamp/tools.shtml#qa)

7. The Central Coast Water Board may conduct an audit of contracted laboratories at any time in order to evaluate compliance with the QAPP.
8. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may also revise the Sampling and Analysis Plan, including adding, removing, or changing monitoring site locations, changing monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water.

#### Surface Receiving Water Quality Monitoring Sites

9. The Sampling and Analysis Plan must, at a minimum, include monitoring sites to evaluate waterbodies identified in Table 1, unless otherwise approved by the Executive Officer. The Sampling and Analysis Plan must include sites to evaluate receiving water quality impacts most directly resulting from areas of agricultural discharge (including areas receiving tile drain discharges). Site selection must take into consideration the existence of any long term monitoring sites included in related monitoring programs e.g. CCAMP and the existing CMP). Sites may be added or modified, subject to prior approval by the Executive Officer, to better assess the pollutant loading from individual sources or the impacts to receiving waters caused by individual discharges. Any modifications must consider sampling consistency for purposes of trend evaluation.

#### Surface Receiving Water Quality Monitoring Parameters

10. The Sampling and Analysis Plan must, at a minimum, include the following types of monitoring and evaluation parameters listed below and identified in Table 2:
  - a. Flow Monitoring;
  - b. Water Quality physical parameters, metals, nutrients, pesticides);
  - c. Toxicity (water and sediment);
  - d. Assessment of Benthic Invertebrates.
11. All analyses must be conducted at a laboratory certified for such analyses by the State Department of Public Health (CDPH) or at laboratories approved by the Executive Officer. Unless otherwise noted, all sampling, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, U.S. EPA, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link: <http://www.cdph.ca.gov/certlic/labs/Documents/ELAPLablist.xls>

12. Water quality and flow monitoring is used to assess the sources, concentrations, and loads of waste discharges from individual farms/ranches and groups of Dischargers to surface waters, to evaluate impacts to water quality and beneficial uses, and to evaluate the short term patterns and long term trends in receiving water quality. Monitoring data must be compared to existing numeric and narrative water quality objectives.
13. Toxicity testing is to evaluate water quality relative to the narrative toxicity objective. Water column toxicity analyses must be conducted on 100% (undiluted) sample. At sites where persistent unresolved toxicity is found, the Executive Officer may require concurrent toxicity and chemical analyses and a Toxicity Identification Evaluation (TIE) to identify the individual discharges causing the toxicity.

#### Surface Receiving Water Quality Monitoring Frequency and Schedule

14. The Sampling and Analysis Plan must include a schedule for sampling. Timing, duration, and frequency of monitoring must be based on the land use, complexity, hydrology, and size of the waterbody. Table 2 includes minimum monitoring frequency and parameter lists. Agricultural parameters that are less common may be monitored less frequently. Modifications to the receiving water quality monitoring parameters, frequency, and schedule may be submitted for Executive Officer consideration and approval. At a minimum, the Sampling and Analysis Plan schedule must consist of monthly monitoring of common agricultural parameters in major agricultural areas, including two major storm events during the wet season (October 1 – April 30).
15. Storm event monitoring must be conducted within 18 hours of storm events, preferably including the first flush run-off event that results in significant increase in stream flow. For purposes of this MRP, a storm event is defined as precipitation producing onsite runoff (surface water flow capable of creating significant ponding, erosion or other water quality problem. A significant storm event will generally result in greater than 1-inch of rain within a 24-hour period.
16. Dischargers (individually or as part of a cooperative monitoring program) must perform receiving water quality monitoring per the Sampling and Analysis Plan and QAPP approved by the Executive Officer.

#### **B. Surface Receiving Water Quality Reporting**

##### Surface Receiving Water Quality Data Submittal

1. Dischargers (individually or as part of a cooperative monitoring program) must submit water quality monitoring data to the Central Coast Water Board electronically, in a format specified by the Executive Officer and compatible with SWAMP/CCAMP electronic submittal guidelines, each January 1, April 1, July 1, and October 1.

#### Surface Receiving Water Quality Monitoring Annual Report

2. **By July 1, 2017**, and every July 1 annually thereafter, Dischargers (individually or as part of a cooperative monitoring program) must submit an Annual Report, electronically, in a format specified by the Executive Officer including the following minimum elements:
  - a. Signed Transmittal Letter;
  - b. Title Page;
  - c. Table of Contents;
  - d. Executive Summary;
  - e. Summary of Exceedance Reports submitted during the reporting period;
  - f. Monitoring objectives and design;
  - g. Monitoring site descriptions and rainfall records for the time period covered;
  - h. Location of monitoring sites and map(s);
  - i. Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible;
  - j. Summary of water quality data for any sites monitored as part of related monitoring programs, and used to evaluate receiving water as described in the Sampling and Analysis Plan.
  - k. Discussion of data to clearly illustrate compliance with the Order and water quality standards;
  - l. Discussion of short term patterns and long term trends in receiving water quality and beneficial use protection;
  - m. Evaluation of pesticide and toxicity analyses results, and recommendation of candidate sites for Toxicity Identification Evaluations (TIEs);
  - n. Identification of the location of any agricultural discharges observed discharging directly to surface receiving water;
  - o. Laboratory data submitted electronically in a SWAMP/CCAMP comparable format;
  - p. Sampling and analytical methods used;
  - q. Copy of chain-of-custody forms;
  - r. Field data sheets, signed laboratory reports, laboratory raw data;
  - s. Associated laboratory and field quality control samples results;
  - t. Summary of Quality Assurance Evaluation results;



- u. Specify the method used to obtain flow at each monitoring site during each monitoring event;
- v. Electronic or hard copies of photos obtained from all monitoring sites, clearly labeled with site ID and date;
- w. Conclusions.

## **PART 2. GROUNDWATER MONITORING AND REPORTING REQUIREMENTS**

Groundwater monitoring may be conducted through a cooperative monitoring and reporting program on behalf of growers, or Dischargers may choose to conduct groundwater monitoring and reporting individually. Qualifying cooperative groundwater monitoring and reporting programs must implement the groundwater monitoring and reporting requirements described in this Order, unless otherwise approved by the Executive Officer. An interested person may seek review by the Central Coast Water Board of the Executive Officer's approval or denial of a cooperative groundwater monitoring and reporting program.

Key monitoring and reporting requirements for groundwater are shown in Table 3.

### **A. Groundwater Monitoring**

1. Dischargers must sample private domestic wells and the primary irrigation well on their farm/ranch to evaluate groundwater conditions in agricultural areas, identify areas at greatest risk for nitrogen loading and exceedance of drinking water standards, and identify priority areas for follow up actions.
2. Dischargers must sample at least one groundwater well for each farm/ranch on their operation, including groundwater wells that are located within the property boundary of the enrolled county assessor parcel numbers (APNs). For farms/ranches with multiple groundwater wells, Dischargers must sample all domestic wells and the primary irrigation well. For the purposes of this MRP, a "domestic well" is any well that is used or may be used for domestic use purposes, including any groundwater well that is connected to a residence, workshop, or place of business that may be used for human consumption, cooking, or sanitary purposes. Groundwater monitoring parameters must include well screen interval depths (if available), general chemical parameters, and general cations and anions listed in Table 3.
3. Dischargers must conduct two rounds of monitoring of required groundwater wells during calendar year 2017; one sample collected during spring **March - June**) and one sample collected during fall **September - December** .
4. Groundwater samples must be collected by a qualified third party (e.g., consultant, technician, person conducting cooperative monitoring) using proper sampling methods, chain-of-custody, and quality assurance/quality

control protocols. Groundwater samples must be collected at or near the well head before the pressure tank and prior to any well head treatment. In cases where this is not possible, the water sample must be collected from a sampling point as close to the pressure tank as possible, or from a cold-water spigot located before any filters or water treatment systems.

5. Laboratory analyses for groundwater samples must be conducted by a State certified laboratory according to U.S. EPA approved methods; unless otherwise noted, all monitoring, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, United States Environmental Protection Agency, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link below: [http://www.waterboards.ca.gov/centralcoast/water\\_issues/programs/ag\\_waivers/docs/resources4growers/2016\\_04\\_11\\_labs.pdf](http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/resources4growers/2016_04_11_labs.pdf)
6. If a discharger determines that water in any domestic well exceeds 10 mg/L of nitrate as N, the discharger or third party must provide notice to the Central Coast Water Board within 24 hours of learning of the exceedance. For domestic wells on a Discharger's farm/ranch that exceed 10 mg/L nitrate as N, the Discharger must provide written notification to the users within 10 days of learning of the exceedance and provide written confirmation of the notification to the Central Coast Water Board.

The drinking water notification must include the statement that the water poses a human health risk due to elevated nitrate concentration, and include a warning against the use of the water for drinking or cooking. In addition, Dischargers must also provide prompt written notification to any new well users (e.g. tenants and employees with access to the affected well), whenever there is a change in occupancy.

For all other domestic wells not on a Discharger's farm/ranch but that may be impacted by nitrate, the Central Coast Water Board will notify the users promptly.

The drinking water notification and confirmation letters required by this Order are available to the public.

## **B. Groundwater Reporting**

1. **Within 60 days of sample collection**, Dischargers must coordinate with the laboratory to submit the following groundwater monitoring results and information, electronically, using the Water Board's GeoTracker electronic deliverable format (EDF):
  - a. GeoTracker Ranch Global Identification Number

- b. Field point name (Well Name)
  - c. Field Point Class (Well Type)
  - d. Latitude
  - e. Longitude
  - f. Sample collection date
  - g. Analytical results
  - h. Well construction information (e.g., total depth, screened intervals, depth to water , as available
- 2. Dischargers must submit groundwater well information required in the electronic Notice of Intent (eNOI) for each farm/ranch and update the eNOI to reflect changes in the farm/ranch information within 30 days of the change. Groundwater well information reported on the eNOI includes, but is not limited to:
  - a. Number of groundwater wells present at each farm/ranch
  - b. Identification of any groundwater wells abandoned or destroyed (including method destroyed) in compliance with the Order
  - c. Use for fertigation or chemigation
  - d. Presence of back flow prevention devices
  - e. Number of groundwater wells used for agricultural purposes
  - f. Number of groundwater wells used for or may be used for domestic use purposes (domestic wells .

### **PART 3. GENERAL MONITORING AND REPORTING REQUIREMENTS**

#### **A. Submittal of Technical Reports**

1. Dischargers must submit reports in a format specified by the Executive Officer. A transmittal letter must accompany each report, containing the following penalty of perjury statement signed by the Discharger or the Discharger's authorized agent:

*"In compliance with Water Code §13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision following a system designed to assure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment".*

2. If the Discharger asserts that all or a portion of a report submitted pursuant to this Order is subject to an exemption from public disclosure (e.g. trade secrets or secret processes), the Discharger must provide an explanation of how those portions of the reports are exempt from public disclosure. The

Discharger must clearly indicate on the cover of the report typically an electronic submittal that the Discharger asserts that all or a portion of the report is exempt from public disclosure, submit a complete report with those portions that are asserted to be exempt in redacted form, submit separately in a separate electronic file) unredacted pages to be maintained separately by staff). The Central Coast Water Board staff will determine whether any such report or portion of a report qualifies for an exemption from public disclosure. If the Central Coast Water Board staff disagrees with the asserted exemption from public disclosure, the Central Coast Water Board staff will notify the Discharger prior to making such report or portions of such report available for public inspection.

## **B. Central Coast Water Board Authority**

1. Monitoring reports are required pursuant to section 13267 of the California Water Code. Pursuant to section 13268 of the Water Code, a violation of a request made pursuant to section 13267 may subject you to civil liability of up to \$1000 per day.
2. The Water Board needs the required information to determine compliance with Order No.R3-2017-0002. The evidence supporting these requirements is included in the findings of Order No.R3-2017-0002.

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John M. Robertson  
Executive Officer

March 8, 2017

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Date

**Table 1. Major Waterbodies in Agricultural Areas<sup>1</sup>**

Hydrologic SubArea	Waterbody Name	Hydrologic SubArea	Waterbody Name
30510	Pajaro River	30920	Quail Creek
30510	Salsipuedes Creek	30920	Salinas Reclamation Canal
30510	Watsonville Slough	31022	Chorro Creek
30510	Watsonville Creek <sup>2</sup>	31023	Los Osos Creek
30510	Beach Road Ditch <sup>2</sup>	31023	Warden Creek
30530	Carnadero Creek	31024	San Luis Obispo Creek
30530	Furlong Creek <sup>2</sup>	31024	Prefumo Creek
30530	Llagas Creek	31031	Arroyo Grande Creek
30530	Miller's Canal	31031	Los Berros Creek
30530	San Juan Creek	31210	Bradley Canyon Creek
30530	Tesquisquita Slough	31210	Bradley Channel
30600	Moro Cojo Slough	31210	Green Valley Creek
30910	Alisal Slough	31210	Main Street Canal
30910	Blanco Drain	31210	Orcutt Solomon Creek
30910	Old Salinas River	31210	Oso Flaco Creek
30910	Salinas River (below Gonzales Rd.)	31210	Little Oso Flaco Creek
30920	Salinas River (above Gonzales Rd. and below Nacimiento R.)	31210	Santa Maria River
30910	Santa Rita Creek <sup>2</sup>	31310	San Antonio Creek <sup>2</sup>
30910	Tembladero Slough	31410	Santa Ynez River
30920	Alisal Creek	31531	Bell Creek
30920	Chualar Creek	31531	Glenn Annie Creek
30920	Espinosa Slough	31531	Los Carneros Creek <sup>2</sup>
30920	Gabilan Creek	31534	Arroyo Paredon Creek
30920	Natividad Creek	31534	Franklin Creek

<sup>1</sup> At a minimum, monitoring sites must be included for these waterbodies in agricultural areas, unless otherwise approved by the Executive Officer. Monitoring sites may be proposed for addition or modification to better assess the impacts of waste discharges from irrigated lands to surface water. Dischargers choosing to comply with surface receiving water quality monitoring, individually (not part of a cooperative monitoring program) must only monitor sites for waterbodies receiving the discharge.

<sup>2</sup> These creeks are included because they are newly listed waterbodies on the 2010 303(d) list of Impaired Waters that are associated with areas of agricultural discharge.



**Table 2. Surface Receiving Water Quality Monitoring Parameters**

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
<b>Photo Monitoring</b>		
Upstream and downstream photographs at monitoring location		With every monitoring event
<b><u>WATER COLUMN SAMPLING</u></b>		
<b>Physical Parameters and General Chemistry</b>		
Flow (field measure) (CFS) following SWAMP field SOP <sup>9</sup>	.25	Monthly, including 2 stormwater events
pH (field measure)	0.1	"
Electrical Conductivity field measure) (µS/cm	2.5	"
Dissolved Oxygen (field measure) (mg/L)	0.1	"
Temperature (field measure) °C)	0.1	"
Turbidity NTU	0.5	"
Total Dissolved Solids (mg/L	10	"
Total Suspended Solids (mg/L)	0.5	"
<b>Nutrients</b>		
Total Nitrogen (mg/L)	0.5	Monthly, including 2 stormwater events
Nitrate + Nitrite (as N) (mg/L)	0.1	"
Total Ammonia (mg/L)	0.1	"
Unionized Ammonia (calculated value, mg/L)		"
Total Phosphorus (as P) mg/L)	0.02	"
Soluble Orthophosphate (mg/L)	0.01	"
Water column chlorophyll a µg/L)	1.0	"
Algae cover, Floating Mats, % coverage	-	"
Algae cover, Attached, % coverage	-	"
<b>Water Column Toxicity Test</b>		
Algae - <i>Selenastrum capricornutum</i> (96-hour chronic; Method 1003.0 in EPA/821/R-02/013)	-	4 times each year, twice in dry season, twice in wet season
Water Flea – <i>Ceriodaphnia dubia</i> 7-day chronic; Method 1002.0 in EPA/821/R-02/013)	-	"
Midge - <i>Chironomus spp.</i> 96-hour acute; Alternate test species in EPA 821-R-02-012	-	"

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
Toxicity Identification Evaluation (TIE)	-	As directed by Executive Officer
<b>Pesticides<sup>2</sup> /Herbicides µg/L</b>		
<b>Organophosphate Pesticides</b>		
Azinphos-methyl	0.02	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Chlorpyrifos	0.005	"
Diazinon	0.005	"
Dichlorvos	0.01	"
Dimethoate	0.01	"
Dimeton-s	0.005	"
Disulfoton (Disyton)	0.005	"
Malathion	0.005	"
Methamidophos	0.02	"
Methidathion	0.02	"
Parathion-methyl	0.02	"
Phorate	0.01	"
Phosmet	0.02	"
<b>Neonicotinoids</b>		
Thiamethoxam	.002	"
Imidacloprid	.002	"
Thiacloprid	.002	"
Dinotefuran	.006	"
Acetamiprid	.01	"
Clothianidin	.02	"
<b>Herbicides</b>		
Atrazine	0.05	"
Cyanazine	0.20	"
Diuron	0.05	"
Glyphosate	2.0	"
Linuron	0.1	"
Paraquat	0.20	"
Simazine	0.05	"
Trifluralin	0.05	"
<b>Metals µg/L</b>		
Arsenic total) <sup>5,7</sup>	0.3	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Boron (total) <sup>6,7</sup>	10	"
Cadmium total & dissolved <sup>4,5,7</sup>	0.01	"

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
Copper (total and dissolved) <sup>4,7</sup>	0.01	"
Lead total and dissolved) <sup>4,7</sup>	0.01	"
Nickel (total and dissolved) <sup>4,7</sup>	0.02	"
Molybdenum (total) <sup>7</sup>	1	"
Selenium (total) <sup>7</sup>	0.30	"
Zinc (total and dissolved) <sup>4,5,7</sup>	0.10	"
<b>Other (µg/L)</b>		
Total Phenolic Compounds <sup>8</sup>	5	2 times in 2017, once in spring (April-May and once in fall August-September
Hardness mg/L as CaCO <sub>3</sub>	1	"
Total Organic Carbon (ug/L	0.6	"
<b><u>SEDIMENT SAMPLING</u></b>		
Sediment Toxicity - <i>Hyaella azteca</i> 10-day static renewal EPA, 2000)		2 times each year, once in spring (April-May and once in fall (August-September
<b>Pyrethroid Pesticides in Sediment µg/kg</b>		
Gamma-cyhalothrin	2	2 times in both 2017 and 2018, once in spring April-May and once in fall (August-September of each year, concurrent with sediment toxicity sampling
Lambda-cyhalothrin	2	"
Bifenthrin	2	"
Beta-cyfluthrin	2	"
Cyfluthrin	2	"
Esfenvalerate	2	"
Permethrin	2	"
Cypermethrin	2	"
Danitol	2	"
Fenvalerate	2	"
Fluvalinate	2	"
<b>Other Monitoring in Sediment</b>		
Chlorpyrifos (µg/kg)	2	"
Total Organic Carbon	0.01%	"
		"
Sediment Grain Size Analysis	1%	"

<sup>1</sup>Monitoring frequency may be used as a guide for developing alternative Sampling and Analysis Plans implemented by individual growers.

<sup>2</sup>Pesticide list may be modified based on specific pesticide use in Central Coast Region. Analytes on this list must be reported, at a minimum.

<sup>3</sup>Reporting Limit, taken from SWAMP where applicable.

<sup>4</sup>Holmgren, Meyer, Cheney and Daniels. 1993. Cadmium, Lead, Zinc, Copper and Nickel in Agricultural Soils of the United States. J. of Environ. Quality 22:335-348.

<sup>5</sup>Sax and Lewis, ed. 1987. Hawley's Condensed Chemical Dictionary. 11<sup>th</sup> ed. New York: Van Nostrand Reinhold Co., 1987. Zinc arsenate is an insecticide.

<sup>6</sup><http://www.coastalagro.com/products/labels/9%25BORON.pdf>; Boron is applied directly or as a component of fertilizers as a plant nutrient.

<sup>7</sup>Madramootoo, Johnston, Willardson, eds. 1997. Management of Agricultural Drainage Water Quality. International Commission on Irrigation and Drainage. U.N. FAO. SBN 92-6-104058.3.

<sup>8</sup><http://cat.inist.fr/?aModeleafficheNcpsidt=14074525>; Phenols are breakdown products of herbicides and pesticides. Phenols can be directly toxic and cause endocrine disruption.

<sup>9</sup>See SWAMP field measures SOP, p. 17

mg/L – milligrams per liter; ug/L – micrograms per liter; ug/kg – micrograms per kilogram;

NTU – Nephelometric Turbidity Units; CFS – cubic feet per second.

**Table 3. Groundwater Sampling Parameters**

Parameter	RL	Analytical Method <sup>3</sup>	Units
pH	0.1	Field or Laboratory Measurement EPA General Methods	pH Units
Specific Conductance	2.5		µS/cm
Total Dissolved Solids	10		mg/L
Total Alkalinity as CaCO <sub>3</sub>		EPA Method 310.1 or 310.2	
Calcium	0.05	General Cations <sup>1</sup> EPA 200.7, 200.8, 200.9	
Magnesium	0.02		
Sodium	0.1		
Potassium	0.1		
Sulfate SO <sub>4</sub>	1.0	General Anions EPA Method 300 or EPA Method 353.2	
Chloride	0.1		
Nitrate + Nitrite (as N) <sup>2</sup> or Nitrate as N	0.1		

<sup>1</sup>General chemistry parameters (major cations and anions) represent geochemistry of water bearing zone and assist in evaluating quality assurance/quality control of groundwater monitoring and laboratory analysis.

<sup>2</sup>The MRP allows analysis of "nitrate plus nitrite" to represent nitrate concentrations (as N). The "nitrate plus nitrite" analysis allows for extended laboratory holding times and relieves the Discharger of meeting the short holding time required for nitrate.

<sup>3</sup>Dischargers may use alternative analytical methods approved by EPA.

RL – Reporting Limit; µS/cm – micro siemens per centimeter

**Table 4. Tier 1 - Time Schedule for Key Monitoring and Reporting Requirements (MRPs)**

REQUIREMENT	TIME SCHEDULE <sup>1</sup>
Submit Sampling And Analysis Plan and Quality Assurance Project Plan (SAAP/QAPP) for Surface Receiving Water Quality Monitoring ( <i>individually or through cooperative monitoring program</i> )	By March 1, 2018, or as directed by the Executive Officer; satisfied if an approved SAAP/QAPP has been submitted pursuant to Order No. R3-2012-0011 and associated MRPs
Initiate surface receiving water quality monitoring ( <i>individually or through cooperative monitoring program</i> )	Per an approved SAAP and QAPP
Submit surface receiving water quality monitoring data ( <i>individually or through cooperative monitoring program</i> )	Each January 1, April 1, July 1, and October 1

Submit surface receiving water quality Annual Monitoring Report ( <i>individually or through cooperative monitoring program</i> )	By July 1 2017; annually thereafter by July 1
Initiate monitoring of groundwater wells	First sample from March-June 2017, second sample from September-December 2017
Submit groundwater monitoring results	Within 60 days of the sample collection

<sup>1</sup> Dates are relative to adoption of this Order, unless otherwise specified.



**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL COAST REGION**

**MONITORING AND REPORTING PROGRAM  
ORDER NO. R3-2017-0002-02**

**TIER 2**

**DISCHARGERS ENROLLED UNDER  
THE CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR  
DISCHARGES FROM IRRIGATED LANDS**

This Monitoring and Reporting Program Order No. R3-2017-0002-02 (MRP) is issued pursuant to California Water Code (Water Code) sections 13267 and 13269, which authorize the California Regional Water Quality Control Board, Central Coast Region (hereafter Central Coast Water Board) to require preparation and submittal of technical and monitoring reports. Water Code section 13269 requires a waiver of waste discharge requirements to include as a condition the performance of monitoring and the public availability of monitoring results. *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*, Order No. R3-2017-0002 (Order) includes criteria and requirements for three tiers. This MRP sets forth monitoring and reporting requirements for **Tier 2 Dischargers** enrolled under the Order. A summary of the requirements is shown below.

**SUMMARY OF MONITORING AND REPORTING REQUIREMENTS FOR TIER 2:**

- |         |  |
|---------|--|
| Part 1: | Surface Receiving Water Monitoring and Reporting ( <i>cooperative or individual</i> )  |
| Part 2: | Groundwater Monitoring and Reporting ( <i>cooperative or individual</i> )<br>Total Nitrogen Applied Reporting ( <i>required for subset of Tier 2 Dischargers if farm/ranch growing any crop with high nitrate loading risk to groundwater</i> ); |
| Part 3: | Annual Compliance Form   |

Pursuant to Water Code section 13269(a) 2), monitoring requirements must be designed to support the development and implementation of the waiver program, including, but not limited to, verifying the adequacy and effectiveness of the waiver's conditions. The monitoring and reports required by this MRP are to evaluate effects of discharges of waste from irrigated agricultural operations and individual farms/ranches on waters of the state and to determine compliance with the Order.

## **MONITORING AND REPORTING BASED ON TIERS**

The Order and MRP include criteria and requirements for three tiers, based upon those characteristics of the individual farms/ranches at the operation that present the highest level of waste discharge or greatest risk to water quality. Dischargers must meet conditions of the Order and MRP for the appropriate tier that applies to their land and/or the individual farm/ranch. Within a tier, Dischargers comply with requirements based on the specific level of discharge and threat to water quality from individual farms/ranches. The lowest tier, Tier 1, applies to dischargers who discharge the lowest level of waste amount or concentration) or pose the lowest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. The highest tier, Tier 3, applies to dischargers who discharge the highest level of waste or pose the greatest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. Tier 2 applies to dischargers whose discharge has a moderate threat to water quality. Water quality is defined in terms of regional, state, or federal numeric or narrative water quality standards. Per the Order, Dischargers may submit a request to the Executive Officer to approve transfer to a lower tier. If the Executive Officer approves a transfer to a lower tier, any interested person may request that the Central Coast Water Board conduct a review of the Executive Officer's determination.

### **PART 1. SURFACE RECEIVING WATER MONITORING AND REPORTING REQUIREMENTS**

The surface receiving water monitoring and reporting requirements described herein are generally a continuation of the surface receiving water monitoring and reporting requirements of Monitoring and Reporting Program Order No. 2012-0011-02, as revised August 22, 2016, with the intent of uninterrupted regular monitoring and reporting during the transition from Order No. R3-2012-0011-02 to Order No. R3-2017-0002-02.

Monitoring and reporting requirements for surface receiving water identified in Part 1.A. and Part 1.B. apply to Tier 2 Dischargers. Surface receiving water refers to water flowing in creeks and other surface waters of the State. Surface receiving water monitoring may be conducted through a cooperative monitoring program on behalf of Dischargers, or Dischargers may choose to conduct surface receiving water monitoring and reporting individually. Key monitoring and reporting requirements for surface receiving water are shown in Tables 1 and 2. Time schedules are shown in Table 4.

#### **A. Surface Receiving Water Quality Monitoring**

1. Dischargers must elect a surface receiving water monitoring option cooperative monitoring program or individual receiving water monitoring to comply with surface receiving water quality monitoring requirements, and identify the option selected on the Notice of Intent (NOI).

2. Dischargers are encouraged to choose participation in a cooperative monitoring program (e.g., the existing Cooperative Monitoring Program or a similar program) to comply with receiving water quality monitoring requirements. Dischargers not participating in a cooperative monitoring program must conduct surface receiving water quality monitoring individually that achieves the same purpose.
3. Dischargers (individually or as part of a cooperative monitoring program) must conduct surface receiving water quality monitoring to a) assess the impacts of their waste discharges from irrigated lands to receiving water, b) assess the status of receiving water quality and beneficial use protection in impaired waterbodies dominated by irrigated agricultural activity, c) evaluate status, short term patterns and long term trends (five to ten years or more) in receiving water quality, d) evaluate water quality impacts resulting from agricultural discharges (including but not limited to tile drain discharges), e) evaluate stormwater quality, f) evaluate condition of existing perennial, intermittent, or ephemeral streams or riparian or wetland area habitat, including degradation resulting from erosion or agricultural discharges of waste, and g) assist in the identification of specific sources of water quality problems.

#### Surface Receiving Water Quality Sampling and Analysis Plan

4. **By March 1, 2018, or as directed by the Executive Officer**, Dischargers (individually or as part of a cooperative monitoring program) must submit a surface receiving water quality Sampling and Analysis Plan (SAAP) and Quality Assurance Project Plan (QAPP ; this requirement is satisfied if an approved SAAP and QAPP addressing all surface receiving water quality monitoring requirements described in this Order has been submitted pursuant to Order No.R3-2012-0011 and associated Monitoring and Reporting Programs. Dischargers (or a third party cooperative monitoring program) must develop the Sampling and Analysis Plan to describe how the proposed monitoring will achieve the objectives of the MRP and evaluate compliance with the Order. The Sampling and Analysis Plan may propose alternative monitoring site locations, adjusted monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water. The Executive Officer must approve the Sampling and Analysis Plan and QAPP.
5. The Sampling and Analysis Plan must include the following minimum required components:
  - a. Monitoring strategy to achieve objectives of the Order and MRP;
  - b. Map of monitoring sites with GIS coordinates;

- c. Identification of known water quality impairments and impaired waterbodies per the 2010 Clean Water Act 303 d List of Impaired Waterbodies List of Impaired Waterbodies);
  - d. Identification of beneficial uses and applicable water quality standards;
  - e. Identification of applicable Total Maximum Daily Loads;
  - f. Monitoring parameters;
  - g. Monitoring schedule, including description and frequencies of monitoring events;
  - h. Description of data analysis methods;
6. The QAPP must include receiving water and site-specific information, project organization and responsibilities, and quality assurance components of the MRP. The QAPP must also include the laboratory and field requirements to be used for analyses and data evaluation. The QAPP must contain adequate detail for project and Water Board staff to identify and assess the technical and quality objectives, measurement and data acquisition methods, and limitations of the data generated under the surface receiving water quality monitoring. All sampling and laboratory methodologies and QAPP content must be consistent with U.S. EPA methods, State Water Board's Surface Water Ambient Monitoring Program (SWAMP) protocols and the Central Coast Water Board's Central Coast Ambient Monitoring Program (CCAMP). Following U.S. EPA guidelines<sup>1</sup> and SWAMP templates<sup>2</sup>, the receiving water quality monitoring QAPP must include the following minimum required components:
- a. Project Management. This component addresses basic project management, including the project history and objectives, roles and responsibilities of the participants, and other aspects.
  - b. Data Generation and Acquisition. This component addresses all aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and quality control activities are employed and are properly documented. Quality control requirements are applicable to all the constituents sampled as part of the MRP, as described in the appropriate method.
  - c. Assessment and Oversight. This component addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of the assessment is to provide project oversight that

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<sup>1</sup> USEPA 2001 (2006) USEPA requirements for Quality Assurance Project Plans QA/R-5) Office of Environmental Information, Washington, D.C. USEPA QA/R-5

<sup>2</sup> [http://waterboards.ca.gov/water\\_issues/programs/swamp/tools.shtml#qa](http://waterboards.ca.gov/water_issues/programs/swamp/tools.shtml#qa)

will ensure that the QA Project Plan is implemented as prescribed.

- d. Data Validation and Usability. This component addresses the quality assurance activities that occur after the data collection, laboratory analysis and data generation phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the MRP objectives.
7. The Central Coast Water Board may conduct an audit of contracted laboratories at any time in order to evaluate compliance with the QAPP.
  8. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may also revise the Sampling and Analysis Plan, including adding, removing, or changing monitoring site locations, changing monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water.

#### Surface Receiving Water Quality Monitoring Sites

9. The Sampling and Analysis Plan must, at a minimum, include monitoring sites to evaluate waterbodies identified in Table 1, unless otherwise approved by the Executive Officer. The Sampling and Analysis Plan must include sites to evaluate receiving water quality impacts most directly resulting from areas of agricultural discharge (including areas receiving tile drain discharges). Site selection must take into consideration the existence of any long term monitoring sites included in related monitoring programs e.g. CCAMP and the existing CMP). Sites may be added or modified, subject to prior approval by the Executive Officer, to better assess the pollutant loading from individual sources or the impacts to receiving waters caused by individual discharges. Any modifications must consider sampling consistency for purposes of trend evaluation.

#### Surface Receiving Water Quality Monitoring Parameters

10. The Sampling and Analysis Plan must, at a minimum, include the following types of monitoring and evaluation parameters listed below and identified in Table 2:
  - a. Flow Monitoring;
  - b. Water Quality physical parameters, metals, nutrients, pesticides);
  - c. Toxicity (water and sediment);
  - d. Assessment of Benthic Invertebrates.



11. All analyses must be conducted at a laboratory certified for such analyses by the State Department of Public Health (CDPH) or at laboratories approved by the Executive Officer. Unless otherwise noted, all sampling, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, U.S. EPA, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link: <http://www.cdph.ca.gov/certlic/labs/Documents/ELAPLablist.xls>
12. Water quality and flow monitoring is used to assess the sources, concentrations, and loads of waste discharges from individual farms/ranches and groups of Dischargers to surface waters, to evaluate impacts to water quality and beneficial uses, and to evaluate the short term patterns and long term trends in receiving water quality. Monitoring data must be compared to existing numeric and narrative water quality objectives.
13. Toxicity testing is to evaluate water quality relative to the narrative toxicity objective. Water column toxicity analyses must be conducted on 100% (undiluted) sample. At sites where persistent unresolved toxicity is found, the Executive Officer may require concurrent toxicity and chemical analyses and a Toxicity Identification Evaluation (TIE) to identify the individual discharges causing the toxicity.

#### Surface Receiving Water Quality Monitoring Frequency and Schedule

14. The Sampling and Analysis Plan must include a schedule for sampling. Timing, duration, and frequency of monitoring must be based on the land use, complexity, hydrology, and size of the waterbody. Table 2 includes minimum monitoring frequency and parameter lists. Agricultural parameters that are less common may be monitored less frequently. Modifications to the receiving water quality monitoring parameters, frequency, and schedule may be submitted for Executive Officer consideration and approval. At a minimum, the Sampling and Analysis Plan schedule must consist of monthly monitoring of common agricultural parameters in major agricultural areas, including two major storm events during the wet season (October 1 – April 30).
15. Storm event monitoring must be conducted within 18 hours of storm events, preferably including the first flush run-off event that results in significant increase in stream flow. For purposes of this MRP, a storm event is defined as precipitation producing onsite runoff (surface water flow capable of creating significant ponding, erosion or other water quality problem. A

significant storm event will generally result in greater than 1-inch of rain within a 24-hour period.

16. Dischargers (individually or as part of a cooperative monitoring program must perform receiving water quality monitoring per the Sampling and Analysis Plan and QAPP approved by the Executive Officer.

## **B. Surface Receiving Water Quality Reporting**

### Surface Receiving Water Quality Data Submittal

1. Dischargers (individually or as part of a cooperative monitoring program) must submit water quality monitoring data to the Central Coast Water Board electronically, in a format specified by the Executive Officer and compatible with SWAMP/CCAMP electronic submittal guidelines, each January 1, April 1, July 1, and October 1.

### Surface Receiving Water Quality Monitoring Annual Report

2. **By July 1, 2017**, and every July 1 annually thereafter, Dischargers (individually or as part of a cooperative monitoring program) must submit an Annual Report, electronically, in a format specified by the Executive Officer including the following minimum elements:
  - a. Signed Transmittal Letter;
  - b. Title Page;
  - c. Table of Contents;
  - d. Executive Summary;
  - e. Summary of Exceedance Reports submitted during the reporting period;
  - f. Monitoring objectives and design;
  - g. Monitoring site descriptions and rainfall records for the time period covered;
  - h. Location of monitoring sites and map(s);
  - i. Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible;
  - j. Summary of water quality data for any sites monitored as part of related monitoring programs, and used to evaluate receiving water as described in the Sampling and Analysis Plan.
  - k. Discussion of data to clearly illustrate compliance with the Order and water quality standards;
  - l. Discussion of short term patterns and long term trends in receiving water quality and beneficial use protection;
  - m. Evaluation of pesticide and toxicity analyses results, and recommendation of candidate sites for Toxicity Identification Evaluations (TIEs);

- n. Identification of the location of any agricultural discharges observed discharging directly to surface receiving water;
- o. Laboratory data submitted electronically in a SWAMP/CCAMP comparable format;
- p. Sampling and analytical methods used;
- q. Copy of chain-of-custody forms;
- r. Field data sheets, signed laboratory reports, laboratory raw data;
- s. Associated laboratory and field quality control samples results;
- t. Summary of Quality Assurance Evaluation results;
- u. Specify the method used to obtain flow at each monitoring site during each monitoring event;
- v. Electronic or hard copies of photos obtained from all monitoring sites, clearly labeled with site ID and date;
- w. Conclusions.

## **PART 2. GROUNDWATER MONITORING AND REPORTING REQUIREMENTS**

Groundwater monitoring may be conducted through a cooperative monitoring and reporting program on behalf of growers, or Dischargers may choose to conduct groundwater monitoring and reporting individually. Qualifying cooperative groundwater monitoring and reporting programs must implement the groundwater monitoring and reporting requirements described in this Order, unless otherwise approved by the Executive Officer. An interested person may seek review by the Central Coast Water Board of the Executive Officer's approval or denial of a cooperative groundwater monitoring and reporting program.

Key monitoring and reporting requirements for groundwater are shown in Table 3.

### **A. Groundwater Monitoring**

1. Dischargers must sample private domestic wells and the primary irrigation well on their farm/ranch to evaluate groundwater conditions in agricultural areas, identify areas at greatest risk for nitrogen loading and exceedance of drinking water standards, and identify priority areas for follow up actions.
2. Dischargers must sample at least one groundwater well for each farm/ranch on their operation, including groundwater wells that are located within the property boundary of the enrolled county assessor parcel numbers (APNs). For farms/ranches with multiple groundwater wells, Dischargers must sample all domestic wells and the primary irrigation well. For the purposes of this MRP, a "domestic well" is any well that is used or may be used for domestic use purposes, including any groundwater well that is connected to a residence, workshop, or place of business that may be used for human consumption, cooking, or sanitary purposes. Groundwater monitoring

parameters must include well screen interval depths (if available), general chemical parameters, and general cations and anions listed in Table 3.

3. Dischargers must conduct two rounds of monitoring of required groundwater wells during calendar year 2017; one sample collected during spring **March - June)** and one sample collected during fall **September - December** .
4. Groundwater samples must be collected by a qualified third party (e.g., consultant, technician, person conducting cooperative monitoring) using proper sampling methods, chain-of-custody, and quality assurance/quality control protocols. Groundwater samples must be collected at or near the well head before the pressure tank and prior to any well head treatment. In cases where this is not possible, the water sample must be collected from a sampling point as close to the pressure tank as possible, or from a cold-water spigot located before any filters or water treatment systems.
5. Laboratory analyses for groundwater samples must be conducted by a State certified laboratory according to U.S. EPA approved methods; unless otherwise noted, all monitoring, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, United States Environmental Protection Agency, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link below:  
[http://www.waterboards.ca.gov/centralcoast/water\\_issues/programs/ag\\_waivers/docs/resources4growers/2016\\_04\\_11\\_labs.pdf](http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/resources4growers/2016_04_11_labs.pdf)
6. If a discharger determines that water in any domestic well exceeds 10 mg/L of nitrate as N, the discharger or third party must provide notice to the Central Coast Water Board within 24 hours of learning of the exceedance. For domestic wells on a Discharger's farm/ranch, that exceed 10 mg/L of nitrate as N, the Discharger must provide written notification to the users within 10 days of learning of the exceedance and provide written confirmation of the notification to the Central Coast Water Board.

The drinking water notification must include the statement that the water poses a human health risk due to elevated nitrate concentration, and include a warning against the use of the water for drinking or cooking. In addition, Dischargers must also provide prompt written notification to any new well users (e.g. tenants and employees with access to the affected well), whenever there is a change in occupancy.

For all other domestic wells not on a Discharger's farm/ranch but that may be impacted by nitrate, the Central Coast Water Board will notify the users promptly.

The drinking water notification and confirmation letters required by this Order are available to the public.

## **B. Groundwater Reporting**

- 1. Within 60 days of sample collection,** Dischargers must coordinate with the laboratory to submit the following groundwater monitoring results and information, electronically, using the Water Board's GeoTracker electronic deliverable format (EDF):
  - a. GeoTracker Ranch Global Identification Number
  - b. Field point name (Well Name)
  - c. Field Point Class (Well Type)
  - d. Latitude
  - e. Longitude
  - f. Sample collection date
  - g. Analytical results
  - h. Well construction information (e.g., total depth, screened intervals, depth to water , as available
- 2.** Dischargers must submit groundwater well information required in the electronic Notice of Intent (eNOI) for each farm/ranch and update the eNOI to reflect changes in the farm/ranch information within 30 days of the change. Groundwater well information reported on the eNOI includes, but is not limited to:
  - a. Number of groundwater wells present at each farm/ranch
  - b. Identification of any groundwater wells abandoned or destroyed including method destroyed) in compliance with the Order
  - c. Use for fertigation or chemigation
  - d. Presence of back flow prevention devices
  - e. Number of groundwater wells used for agricultural purposes
  - f. Number of groundwater wells used for or may be used for domestic use purposes (domestic wells .

## **C. Total Nitrogen Applied Reporting**

- 1.** By March 1, 2018, and by March 1 annually thereafter, Tier 2 Dischargers growing any crop with a high potential to discharge nitrogen to groundwater must record and report total nitrogen applied for each specific crop that was irrigated and grown for commercial purposes on that farm/ranch during the preceding calendar year (January through December .

Crops with a high potential to discharge nitrogen to groundwater are: beet, broccoli, cabbage, cauliflower, celery, Chinese cabbage (napa), collard, endive, kale, leek, lettuce (leaf and head), mustard, onion (dry and green),



spinach, strawberry, pepper (fruiting , and parsley.

Total nitrogen applied must be reported on the Total Nitrogen Applied Report form as described in the Total Nitrogen Applied Report form instructions.

Total nitrogen applied includes any product containing any form or concentration of nitrogen including, but not limited to, organic and inorganic fertilizers, slow release products, compost, compost teas, manure, and extracts.

2. The Total Nitrogen Applied Report form includes the following information:
  - a. General ranch information such as GeoTracker file numbers, name, location, acres.
  - b. Nitrogen concentration of irrigation water
  - c. Nitrogen applied in pounds per acre with irrigation water
  - d. Nitrogen present in the soil
  - e. Nitrogen applied with compost and amendments
  - f. Specific crops grown
  - g. Nitrogen applied in pounds per acre with fertilizers and other materials to each specific crop grown
  - h. Crop acres of each specific crop grown
  - i. Whether each specific crop was grown organically or conventionally
  - j. Basis for the nitrogen applied
  - k. Explanation and comments section
  - l. Certification statement with penalty of perjury declaration
  - m. Additional information regarding whether each specific crop was grown in a nursery, greenhouse, hydroponically, in containers, and similar variables.

### **PART 3. ANNUAL COMPLIANCE FORM**

Tier 2 Dischargers must submit annual compliance information, electronically, on the Annual Compliance Form. The purpose of the electronic Annual Compliance Form is to provide information to the Central Coast Water Board to assist in the evaluation of threat to water quality from individual agricultural discharges of waste and measure progress towards water quality improvement and verify compliance with the Order and MRP. Time schedules are shown in Table 4.

#### **A. Annual Compliance Form**

1. **By March 1, 2018, and updated annually thereafter by March 1,** Tier 2 Dischargers must submit an Annual Compliance Form electronically, in a

format specified by the Executive Officer. The electronic Annual Compliance Form includes, but is not limited to the following minimum requirements<sup>1</sup>:

- a. Question regarding consistency between the Annual Compliance Form and the electronic Notice of Intent (eNOI);
- b. Information regarding type and characteristics of discharge (e.g., number of discharge points, estimated flow/volume, number of tailwater days);
- c. Identification of any direct agricultural discharges to a stream, lake, estuary, bay, or ocean;
- d. Identification of specific farm water quality management practices completed, in progress, and planned to address water quality impacts caused by discharges of waste including irrigation management, pesticide management, nutrient management, salinity management, stormwater management, and sediment and erosion control to achieve compliance with this Order; and identification of specific methods used, and described in the Farm Plan consistent with Order Provision 44.g., for the purposes of assessing the effectiveness of management practices implemented and the outcomes of such assessments;
- e. Proprietary information question and justification;
- f. Authorization and certification statement and declaration of penalty of perjury.

## **PART 5. GENERAL MONITORING AND REPORTING REQUIREMENTS**

### **A. Submittal of Technical Reports**

1. Dischargers must submit reports in a format specified by the Executive Officer. A transmittal letter must accompany each report, containing the following penalty of perjury statement signed by the Discharger or the Discharger's authorized agent:

*"In compliance with Water Code § 13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision following a system designed to assure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment".*

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<sup>1</sup> Items reported in the Annual Compliance Form are due by March 1, 2018, and annually thereafter, unless otherwise specified.

2. If the Discharger asserts that all or a portion of a report submitted pursuant to this Order is subject to an exemption from public disclosure (e.g. trade secrets or secret processes), the Discharger must provide an explanation of how those portions of the reports are exempt from public disclosure. The Discharger must clearly indicate on the cover of the report (typically an electronic submittal) that the Discharger asserts that all or a portion of the report is exempt from public disclosure, submit a complete report with those portions that are asserted to be exempt in redacted form, submit separately (in a separate electronic file) unredacted pages (to be maintained separately by staff). The Central Coast Water Board staff will determine whether any such report or portion of a report qualifies for an exemption from public disclosure. If the Central Coast Water Board staff disagrees with the asserted exemption from public disclosure, the Central Coast Water Board staff will notify the Discharger prior to making such report or portions of such report available for public inspection.

#### **B. Central Coast Water Board Authority**

1. Monitoring reports are required pursuant to section 13267 of the California Water Code. Pursuant to section 13268 of the Water Code, a violation of a request made pursuant to section 13267 may subject you to civil liability of up to \$1000 per day.
2. The Water Board needs the required information to determine compliance with Order No. R3-2017-0002. The evidence supporting these requirements is included in the findings of Order No. R3-2017-0002.

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John M. Robertson  
Executive Officer

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March 8, 2017

Date

**Table 1. Major Waterbodies in Agricultural Areas<sup>1</sup>**

Hydrologic SubArea	Waterbody Name	Hydrologic SubArea	Waterbody Name
30510	Pajaro River	30920	Quail Creek
30510	Salsipuedes Creek	30920	Salinas Reclamation Canal
30510	Watsonville Slough	31022	Chorro Creek
30510	Watsonville Creek <sup>2</sup>	31023	Los Osos Creek
30510	Beach Road Ditch <sup>2</sup>	31023	Warden Creek
30530	Carnadero Creek	31024	San Luis Obispo Creek
30530	Furlong Creek <sup>2</sup>	31024	Prefumo Creek
30530	Llagas Creek	31031	Arroyo Grande Creek
30530	Miller's Canal	31031	Los Berros Creek
30530	San Juan Creek	31210	Bradley Canyon Creek
30530	Tesquisquita Slough	31210	Bradley Channel
30600	Moro Cojo Slough	31210	Green Valley Creek
30910	Alisal Slough	31210	Main Street Canal
30910	Blanco Drain	31210	Orcutt Solomon Creek
30910	Old Salinas River	31210	Oso Flaco Creek
30910	Salinas River (below Gonzales Rd.)	31210	Little Oso Flaco Creek
30920	Salinas River above Gonzales Rd. and below Nacimiento R.)	31210	Santa Maria River
30910	Santa Rita Creek <sup>2</sup>	31310	San Antonio Creek <sup>2</sup>
30910	Tembladero Slough	31410	Santa Ynez River
30920	Alisal Creek	31531	Bell Creek
30920	Chualar Creek	31531	Glenn Annie Creek
30920	Espinosa Slough	31531	Los Carneros Creek <sup>2</sup>
30920	Gabilan Creek	31534	Arroyo Paredon Creek
30920	Natividad Creek	31534	Franklin Creek

<sup>1</sup> At a minimum, monitoring sites must be included for these waterbodies in agricultural areas, unless otherwise approved by the Executive Officer. Monitoring sites may be proposed for addition or modification to better assess the impacts of waste discharges from irrigated lands to surface water. Dischargers choosing to comply with surface receiving water quality monitoring, individually (not part of a cooperative monitoring program) must only monitor sites for waterbodies receiving the discharge.

<sup>2</sup> These creeks are included because they are newly listed waterbodies on the 2010 303(d) list of Impaired Waters that are associated with areas of agricultural discharge.

**Table 2. Surface Receiving Water Quality Monitoring Parameters**

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
<b>Photo Monitoring</b>		
Upstream and downstream photographs at monitoring location		With every monitoring event
<b><u>WATER COLUMN SAMPLING</u></b>		
<b>Physical Parameters and General Chemistry</b>		
Flow (field measure) (CFS) following SWAMP field SOP <sup>9</sup>	.25	Monthly, including 2 stormwater events
pH (field measure)	0.1	"
Electrical Conductivity field measure) (µS/cm	2.5	"
Dissolved Oxygen (field measure) (mg/L)	0.1	"
Temperature (field measure) °C)	0.1	"
Turbidity NTU	0.5	"
Total Dissolved Solids (mg/L	10	"
Total Suspended Solids (mg/L)	0.5	"
<b>Nutrients</b>		
Total Nitrogen (mg/L)	0.5	Monthly, including 2 stormwater events
Nitrate + Nitrite (as N) (mg/L)	0.1	"
Total Ammonia (mg/L)	0.1	"
Unionized Ammonia (calculated value, mg/L)		"
Total Phosphorus (as P) mg/L)	0.02	"
Soluble Orthophosphate (mg/L)	0.01	"
Water column chlorophyll a µg/L)	1.0	"
Algae cover, Floating Mats, % coverage	-	"
Algae cover, Attached, % coverage	-	"
<b>Water Column Toxicity Test</b>		
Algae - <i>Selenastrum capricornutum</i> (96-hour chronic; Method 1003.0 in EPA/821/R-02/013)	-	4 times each year, twice in dry season, twice in wet season
Water Flea – <i>Ceriodaphnia dubia</i> 7-day chronic; Method 1002.0 in EPA/821/R-02/013)	-	"
Midge - <i>Chironomus spp.</i> 96-hour acute; Alternate test species in EPA 821-R-02-012	-	"



Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
Toxicity Identification Evaluation (TIE)	-	As directed by Executive Officer
<b>Pesticides<sup>2</sup> /Herbicides µg/L</b>		
<b>Organophosphate Pesticides</b>		
Azinphos-methyl	0.02	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Chlorpyrifos	0.005	"
Diazinon	0.005	"
Dichlorvos	0.01	"
Dimethoate	0.01	"
Dimeton-s	0.005	"
Disulfoton (Disyton)	0.005	"
Malathion	0.005	"
Methamidophos	0.02	"
Methidathion	0.02	"
Parathion-methyl	0.02	"
Phorate	0.01	"
Phosmet	0.02	"
<b>Neonicotinoids</b>		
Thiamethoxam	.002	"
Imidacloprid	.002	"
Thiacloprid	.002	"
Dinotefuran	.006	"
Acetamiprid	.01	"
Clothianidin	.02	"
<b>Herbicides</b>		
Atrazine	0.05	"
Cyanazine	0.20	"
Diuron	0.05	"
Glyphosate	2.0	"
Linuron	0.1	"
Paraquat	0.20	"
Simazine	0.05	"
Trifluralin	0.05	"
<b>Metals (µg/L)</b>		
Arsenic (total) <sup>5,7</sup>	0.3	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Boron (total) <sup>6,7</sup>	10	"

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
Cadmium total & dissolved <sup>4,5,7</sup>	0.01	"
Copper (total and dissolved) <sup>4,7</sup>	0.01	"
Lead total and dissolved <sup>4,7</sup>	0.01	"
Nickel (total and dissolved) <sup>4,7</sup>	0.02	"
Molybdenum (total) <sup>7</sup>	1	"
Selenium (total) <sup>7</sup>	0.30	"
Zinc (total and dissolved) <sup>4,5,7</sup>	0.10	"
<b>Other (µg/L)</b>		
Total Phenolic Compounds <sup>8</sup>	5	2 times in 2017, once in spring (April-May and once in fall August-September
Hardness mg/L as CaCO <sub>3</sub>	1	"
Total Organic Carbon (ug/L	0.6	"
<b><u>SEDIMENT SAMPLING</u></b>		
Sediment Toxicity - <i>Hyaella azteca</i> 10-day static renewal EPA, 2000)		2 times each year, once in spring (April-May and once in fall (August-September
<b>Pyrethroid Pesticides in Sediment µg/kg</b>		
Gamma-cyhalothrin	2	2 times in both 2017 and 2018, once in spring April-May and once in fall (August-September of each year, concurrent with sediment toxicity sampling
Lambda-cyhalothrin	2	"
Bifenthrin	2	"
Beta-cyfluthrin	2	"
Cyfluthrin	2	"
Esfenvalerate	2	"
Permethrin	2	"
Cypermethrin	2	"
Danitol	2	"
Fenvalerate	2	"
Fluvalinate	2	"
<b>Other Monitoring in Sediment</b>		
Chlorpyrifos (µg/kg)	2	"
Total Organic Carbon	0.01%	"
		"
Sediment Grain Size Analysis	1%	"

<sup>1</sup>Monitoring is ongoing through all five years of the Order, unless otherwise specified. Monitoring frequency may be used as a guide for developing alternative Sampling and Analysis Plan.

<sup>2</sup>Pesticide list may be modified based on specific pesticide use in Central Coast Region. Analytes on this list must be reported, at a minimum.

<sup>3</sup> Reporting Limit, taken from SWAMP where applicable.

<sup>4</sup> Holmgren, Meyer, Cheney and Daniels. 1993. Cadmium, Lead, Zinc, Copper and Nickel in Agricultural Soils of the United States. J. of Environ. Quality 22:335-348.

<sup>5</sup> Sax and Lewis, ed. 1987. Hawley's Condensed Chemical Dictionary. 11<sup>th</sup> ed. New York: Van Nostrand Reinhold Co., 1987. Zinc arsenate is an insecticide.

<sup>6</sup> <http://www.coastalagro.com/products/labels/9%25BORON.pdf>; Boron is applied directly or as a component of fertilizers as a plant nutrient.

<sup>7</sup> Madramootoo, Johnston, Willardson, eds. 1997. Management of Agricultural Drainage Water Quality. International Commission on Irrigation and Drainage. U.N. FAO. SBN 92-6-104058.3.

<sup>8</sup> <http://cat.inist.fr/?aModele=afficheN&cpsid=14074525>; Phenols are breakdown products of herbicides and pesticides. Phenols can be directly toxic and cause endocrine disruption.

<sup>9</sup> See SWAMP field measures SOP, p. 17

mg/L – milligrams per liter; ug/L – micrograms per liter; ug/kg – micrograms per kilogram;

NTU – Nephelometric Turbidity Units; CFS – cubic feet per second;

**Table 3. Groundwater Monitoring Parameters**

Parameter	RL	Analytical Method <sup>3</sup>	Units
pH	0.1	Field or Laboratory Measurement EPA General Methods	pH Units
Specific Conductance	2.5		µS/cm
Total Dissolved Solids	10		mg/L
Total Alkalinity as CaCO3	1	EPA Method 310.1 or 310.2	
Calcium	0.05	General Cations <sup>1</sup> EPA 200.7, 200.8, 200.9	
Magnesium	0.02		
Sodium	0.1		
Potassium	0.1		
Sulfate SO4	1.0	General Anions EPA Method 300 or EPA Method 353.2	
Chloride	0.1		
Nitrate + Nitrite (as N) <sup>2</sup> or Nitrate as N	0.1		

<sup>1</sup> General chemistry parameters (major cations and anions) represent geochemistry of water bearing zone and assist in evaluating quality assurance/quality control of groundwater sampling and laboratory analysis.

<sup>2</sup> The MRP allows analysis of "nitrate plus nitrite" to represent nitrate concentrations (as N). The "nitrate plus nitrite" analysis allows for extended laboratory holding times and relieves the Discharger of meeting the short holding time required for nitrate.

<sup>3</sup> Dischargers may use alternative analytical methods approved by EPA.

RL – Reporting Limit; µS/cm – micro siemens per centimeter

**Table4. Tier 2 - Time Schedule for Key Monitoring and Reporting Requirements (MRPs)**

REQUIREMENT	TIME SCHEDULE <sup>1</sup>
Submit Sampling And Analysis Plan and Quality Assurance Project Plan (SAAP/QAPP for Surface Receiving Water Quality Monitoring <i>(individually or through cooperative monitoring program)</i>	By March 1, 2018, or as directed by the Executive Officer; satisfied if an approved SAAP/QAPP has been submitted pursuant to Order No. R3-2012-0011 and associated MRPs
Initiate surface receiving water quality monitoring <i>individually or through cooperative monitoring program</i>	Per an approved SAAP and QAPP
Submit surface receiving water quality monitoring data <i>individually or through cooperative monitoring program</i>	Each January 1, April 1, July 1, and October 1
Submit surface receiving water quality Annual Monitoring Report <i>(individually or through cooperative monitoring program)</i>	By July 12017: annually thereafter by July 1
Initiate monitoring of groundwater wells	First sample from March-June 2017, second sample from September-December 2017
Submit electronic Annual Compliance Form	March 1, 2018 and every March 1 annually thereafter
Submit groundwater monitoring results	Within 60 days of the sample collection
<b><i>Tier 2 Dischargers with farms/ranches growing high risk crops:</i></b> Report total nitrogen applied on the Total Nitrogen Applied form	March 1, 2018 and every March 1annually thereafter

<sup>1</sup> Dates are relative to adoption of this Order or enrollment date for Dischargers enrolled after the adoption of this Order, unless otherwise specified.

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL COAST REGION**

**MONITORING AND REPORTING PROGRAM  
ORDER No. R3-2017-0002-03**

**TIER 3**

**DISCHARGERS ENROLLED UNDER  
CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR  
DISCHARGES FROM IRRIGATED LANDS**

This Monitoring and Reporting Program Order No. R3-2017-0002-03 (MRP) is issued pursuant to California Water Code (Water Code) sections 13267 and 13269, which authorize the California Regional Water Quality Control Board, Central Coast Region (hereafter Central Coast Water Board) to require preparation and submittal of technical and monitoring reports. Water Code section 13269 requires a waiver of waste discharge requirements to include as a condition, the performance of monitoring and the public availability of monitoring results. *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*, Order No. R3-2017-0002 (Order), includes criteria and requirements for three tiers. This MRP sets forth monitoring and reporting requirements for **Tier 3 Dischargers** enrolled under the Order. A summary of the requirements is shown below.

**SUMMARY OF MONITORING AND REPORTING REQUIREMENTS FOR TIER 3:**

- |         |  |
|---------|--|
| Part 1: | Surface Receiving Water Monitoring and Reporting ( <i>cooperative or individual</i> )  |
| Part 2: | Groundwater Monitoring and Reporting ( <i>cooperative or individual</i> )<br>Total Nitrogen Applied Reporting ( <i>required for subset of Tier 3 Dischargers if farm/ranch growing any crop with high nitrate loading risk to groundwater</i> ); |
| Part 3: | Annual Compliance Form   |
| Part 5: | Individual Surface Water Discharge Monitoring and Reporting  |
| Part 6: | Irrigation and Nutrient Management Plan ( <i>required for subset of Tier 3 Dischargers if farm/ranch has High Nitrate Loading Risk</i> )   |
| Part 7: | Water Quality Buffer Plan ( <i>required for subset of Tier 3 Dischargers if farm/ranch contains or is adjacent to a waterbody impaired for temperature, turbidity or sediment</i> )  |

Pursuant to Water Code section 13269(a) 2, monitoring requirements must be designed to support the development and implementation of the waiver program, including, but not limited to, verifying the adequacy and effectiveness of the waiver's conditions. The monitoring and reports required by this MRP are to evaluate effects of discharges of waste from irrigated agricultural operations and individual farms/ranches on waters of the state and to determine compliance with the Order.



## **MONITORING AND REPORTING BASED ON TIERS**

The Order and MRP includes criteria and requirements for three tiers, based upon those characteristics of the individual farms/ranches at the operation that present the highest level of waste discharge or greatest risk to water quality. Dischargers must meet conditions of the Order and MRP for the appropriate tier that applies to their land and/or the individual farm/ranch. Within a tier, Dischargers comply with requirements based on the specific level of discharge and threat to water quality from individual farms/ranches. The lowest tier, Tier 1, applies to dischargers who discharge the lowest level of waste amount or concentration) or pose the lowest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. The highest tier, Tier 3, applies to dischargers who discharge the highest level of waste or pose the greatest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. Tier 2 applies to dischargers whose discharge has a moderate threat to water quality. Water quality is defined in terms of regional, state, or federal numeric or narrative water quality standards. Per the Order, Dischargers may submit a request to the Executive Officer to approve transfer to a lower tier. If the Executive Officer approves a transfer to a lower tier, any interested person may request that the Central Coast Water Board conduct a review of the Executive Officer's determination.

### **PART 1. SURFACE RECEIVING WATER MONITORING AND REPORTING REQUIREMENTS**

The surface receiving water monitoring and reporting requirements described herein are generally a continuation of the surface receiving water monitoring and reporting requirements of Monitoring and Reporting Program Order No. 2012-0011-03, as revised August 22, 2016, with the intent of uninterrupted regular monitoring and reporting during the transition from Order No. R3-2012-0011-03 to Order No. R3-2017-0002-03.

Monitoring and reporting requirements for surface receiving water identified in Part 1.A. and Part 1.B. apply to Tier 3 Dischargers. Surface receiving water refers to water flowing in creeks and other surface waters of the State. Surface receiving water monitoring may be conducted through a cooperative monitoring program on behalf of Dischargers, or Dischargers may choose to conduct surface receiving water monitoring and reporting individually. Key monitoring and reporting requirements for surface receiving water are shown in Tables 1 and 2. Time schedules are shown in Table 5.

#### **A. Surface Receiving Water Quality Monitoring**

1. Dischargers must elect a surface receiving water monitoring option cooperative monitoring program or individual receiving water monitoring to comply with surface receiving water quality monitoring requirements, and identify the option selected on the Notice of Intent (NOI).

2. Dischargers are encouraged to choose participation in a cooperative monitoring program (e.g., the existing Cooperative Monitoring Program or a similar program) to comply with receiving water quality monitoring requirements. Dischargers not participating in a cooperative monitoring program must conduct surface receiving water quality monitoring individually that achieves the same purpose.
3. Dischargers (individually or as part of a cooperative monitoring program) must conduct surface receiving water quality monitoring to a) assess the impacts of their waste discharges from irrigated lands to receiving water, b) assess the status of receiving water quality and beneficial use protection in impaired waterbodies dominated by irrigated agricultural activity, c) evaluate status, short term patterns and long term trends (five to ten years or more) in receiving water quality, d) evaluate water quality impacts resulting from agricultural discharges (including but not limited to tile drain discharges), e) evaluate stormwater quality, f) evaluate condition of existing perennial, intermittent, or ephemeral streams or riparian or wetland area habitat, including degradation resulting from erosion or agricultural discharges of waste, and g) assist in the identification of specific sources of water quality problems.

#### Surface Receiving Water Quality Sampling and Analysis Plan

4. **By March 1, 2018, or as directed by the Executive Officer**, Dischargers (individually or as part of a cooperative monitoring program) must submit a surface receiving water quality Sampling and Analysis Plan (SAAP) and Quality Assurance Project Plan (QAPP); this requirement is satisfied if an approved SAAP and QAPP addressing all surface receiving water quality monitoring requirements described in this Order has been submitted pursuant to Order No. R3-2012-0011 and associated Monitoring and Reporting Programs. Dischargers (or a third party cooperative monitoring program) must develop the Sampling and Analysis Plan to describe how the proposed monitoring will achieve the objectives of the MRP and evaluate compliance with the Order. The Sampling and Analysis Plan may propose alternative monitoring site locations, adjusted monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water. The Executive Officer must approve the Sampling and Analysis Plan and QAPP.
5. The Sampling and Analysis Plan must include the following minimum required components:
  - a. Monitoring strategy to achieve objectives of the Order and MRP;
  - b. Map of monitoring sites with GIS coordinates;

- c. Identification of known water quality impairments and impaired waterbodies per the 2010 Clean Water Act 303 d List of Impaired Waterbodies List of Impaired Waterbodies);
  - d. Identification of beneficial uses and applicable water quality standards;
  - e. Identification of applicable Total Maximum Daily Loads;
  - f. Monitoring parameters;
  - g. Monitoring schedule, including description and frequencies of monitoring events;
  - h. Description of data analysis methods;
6. The QAPP must include receiving water and site-specific information, project organization and responsibilities, and quality assurance components of the MRP. The QAPP must also include the laboratory and field requirements to be used for analyses and data evaluation. The QAPP must contain adequate detail for project and Water Board staff to identify and assess the technical and quality objectives, measurement and data acquisition methods, and limitations of the data generated under the surface receiving water quality monitoring. All sampling and laboratory methodologies and QAPP content must be consistent with U.S. EPA methods, State Water Board's Surface Water Ambient Monitoring Program (SWAMP) protocols and the Central Coast Water Board's Central Coast Ambient Monitoring Program (CCAMP). Following U.S. EPA guidelines<sup>1</sup> and SWAMP templates<sup>2</sup>, the receiving water quality monitoring QAPP must include the following minimum required components:
- a. Project Management. This component addresses basic project management, including the project history and objectives, roles and responsibilities of the participants, and other aspects.
  - b. Data Generation and Acquisition. This component addresses all aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and quality control activities are employed and are properly documented. Quality control requirements are applicable to all the constituents sampled as part of the MRP, as described in the appropriate method.
  - c. Assessment and Oversight. This component addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of the assessment is to provide project oversight that

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<sup>1</sup> USEPA. 2001 (2006) USEPA Requirements for Quality Assurance Project Plans (QA/R-5) Office of Environmental Information, Washington, D.C. USEPA QA/R-5

<sup>2</sup> [http://waterboards.ca.gov/water\\_issues/programs/swamp/tools.shtml#qa](http://waterboards.ca.gov/water_issues/programs/swamp/tools.shtml#qa)

will ensure that the QA Project Plan is implemented as prescribed.

- d. Data Validation and Usability. This component addresses the quality assurance activities that occur after the data collection, laboratory analysis and data generation phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the MRP objectives.
7. The Central Coast Water Board may conduct an audit of contracted laboratories at any time in order to evaluate compliance with the QAPP.
  8. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may also revise the Sampling and Analysis Plan, including adding, removing, or changing monitoring site locations, changing monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water.

#### Surface Receiving Water Quality Monitoring Sites

9. The Sampling and Analysis Plan must, at a minimum, include monitoring sites to evaluate waterbodies identified in Table 1, unless otherwise approved by the Executive Officer. The Sampling and Analysis Plan must include sites to evaluate receiving water quality impacts most directly resulting from areas of agricultural discharge (including areas receiving tile drain discharges). Site selection must take into consideration the existence of any long term monitoring sites included in related monitoring programs e.g. CCAMP and the existing CMP). Sites may be added or modified, subject to prior approval by the Executive Officer, to better assess the pollutant loading from individual sources or the impacts to receiving waters caused by individual discharges. Any modifications must consider sampling consistency for purposes of trend evaluation.

#### Surface Receiving Water Quality Monitoring Parameters

10. The Sampling and Analysis Plan must, at a minimum, include the following types of monitoring and evaluation parameters listed below and identified in Table 2:
  - a. Flow Monitoring;
  - b. Water Quality physical parameters, metals, nutrients, pesticides);
  - c. Toxicity (water and sediment);
  - d. Assessment of Benthic Invertebrates.

11. All analyses must be conducted at a laboratory certified for such analyses by the State Department of Public Health (CDPH) or at laboratories approved by the Executive Officer. Unless otherwise noted, all sampling, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, U.S. EPA, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link: <http://www.cdph.ca.gov/certlic/labs/Documents/ELAPLablist.xls>
12. Water quality and flow monitoring is used to assess the sources, concentrations, and loads of waste discharges from individual farms/ranches and groups of Dischargers to surface waters, to evaluate impacts to water quality and beneficial uses, and to evaluate the short term patterns and long term trends in receiving water quality. Monitoring data must be compared to existing numeric and narrative water quality objectives.
13. Toxicity testing is to evaluate water quality relative to the narrative toxicity objective. Water column toxicity analyses must be conducted on 100% (undiluted) sample. At sites where persistent unresolved toxicity is found, the Executive Officer may require concurrent toxicity and chemical analyses and a Toxicity Identification Evaluation (TIE) to identify the individual discharges causing the toxicity.

#### Surface Receiving Water Quality Monitoring Frequency and Schedule

14. The Sampling and Analysis Plan must include a schedule for sampling. Timing, duration, and frequency of monitoring must be based on the land use, complexity, hydrology, and size of the waterbody. Table 2 includes minimum monitoring frequency and parameter lists. Agricultural parameters that are less common may be monitored less frequently. Modifications to the receiving water quality monitoring parameters, frequency, and schedule may be submitted for Executive Officer consideration and approval. At a minimum, the Sampling and Analysis Plan schedule must consist of monthly monitoring of common agricultural parameters in major agricultural areas, including two major storm events during the wet season (October 1 – April 30).
15. Storm event monitoring must be conducted within 18 hours of storm events, preferably including the first flush run-off event that results in significant increase in stream flow. For purposes of this MRP, a storm event is defined as precipitation producing onsite runoff (surface water flow capable of creating significant ponding, erosion or other water quality problem. A



significant storm event will generally result in greater than 1-inch of rain within a 24-hour period.

16. Dischargers (individually or as part of a cooperative monitoring program) must perform receiving water quality monitoring per the Sampling and Analysis Plan and QAPP approved by the Executive Officer.

## **B. Surface Receiving Water Quality Reporting**

### Surface Receiving Water Quality Data Submittal

1. Dischargers (individually or as part of a cooperative monitoring program) must submit water quality monitoring data to the Central Coast Water Board electronically, in a format specified by the Executive Officer and compatible with SWAMP/CCAMP electronic submittal guidelines, each January 1, April 1, July 1, and October 1.

### Surface Receiving Water Quality Monitoring Annual Report

2. **By July 1, 2017**, and every July 1 annually thereafter, Dischargers (individually or as part of a cooperative monitoring program) must submit an Annual Report, electronically, in a format specified by the Executive Officer including the following minimum elements:
  - a. Signed Transmittal Letter;
  - b. Title Page;
  - c. Table of Contents;
  - d. Executive Summary;
  - e. Summary of Exceedance Reports submitted during the reporting period;
  - f. Monitoring objectives and design;
  - g. Monitoring site descriptions and rainfall records for the time period covered;
  - h. Location of monitoring sites and map(s);
  - i. Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible;
  - j. Summary of water quality data for any sites monitored as part of related monitoring programs, and used to evaluate receiving water as described in the Sampling and Analysis Plan.
  - k. Discussion of data to clearly illustrate compliance with the Order and water quality standards;
  - l. Discussion of short term patterns and long term trends in receiving water quality and beneficial use protection;

- m. Evaluation of pesticide and toxicity analyses results, and recommendation of candidate sites for Toxicity Identification Evaluations (TIEs);
- n. Identification of the location of any agricultural discharges observed discharging directly to surface receiving water;
- o. Laboratory data submitted electronically in a SWAMP/CCAMP comparable format;
- p. Sampling and analytical methods used;
- q. Copy of chain-of-custody forms;
- r. Field data sheets, signed laboratory reports, laboratory raw data;
- s. Associated laboratory and field quality control samples results;
- t. Summary of Quality Assurance Evaluation results;
- u. Specify the method used to obtain flow at each monitoring site during each monitoring event;
- v. Electronic or hard copies of photos obtained from all monitoring sites, clearly labeled with site ID and date;
- w. Conclusions.

## **PART 2. GROUNDWATER MONITORING AND REPORTING REQUIREMENTS**

Groundwater monitoring may be conducted through a cooperative monitoring and reporting program on behalf of growers, or Dischargers may choose to conduct groundwater monitoring and reporting individually. Qualifying cooperative groundwater monitoring and reporting programs must implement the groundwater monitoring and reporting requirements described in this Order, unless otherwise approved by the Executive Officer. An interested person may seek review by the Central Coast Water Board of the Executive Officer's approval or denial of a cooperative groundwater monitoring and reporting program.

Key monitoring and reporting requirements for groundwater are shown in Table 3.

### **A. Groundwater Monitoring**

1. Dischargers must sample private domestic wells and the primary irrigation well on their farm/ranch to evaluate groundwater conditions in agricultural areas, identify areas at greatest risk for nitrogen loading and exceedance of drinking water standards, and identify priority areas for follow up actions.
2. Dischargers must sample at least one groundwater well for each farm/ranch on their operation, including groundwater wells that are located within the property boundary of the enrolled county assessor parcel numbers (APNs). For farms/ranches with multiple groundwater wells, Dischargers must sample all domestic wells and the primary irrigation well. For the purposes of this MRP, a "domestic well" is any well that is used or may be used for domestic

use purposes, including any groundwater well that is connected to a residence, workshop, or place of business that may be used for human consumption, cooking, or sanitary purposes. Groundwater monitoring parameters must include well screen interval depths (if available), general chemical parameters, and general cations and anions listed in Table 3.

3. Dischargers must conduct two rounds of monitoring of required groundwater wells during calendar year 2017; one sample collected during spring **March - June**) and one sample collected during fall **September - December** .
4. Groundwater samples must be collected by a qualified third party (e.g., consultant, technician, person conducting cooperative monitoring) using proper sampling methods, chain-of-custody, and quality assurance/quality control protocols. Groundwater samples must be collected at or near the well head before the pressure tank and prior to any well head treatment. In cases where this is not possible, the water sample must be collected from a sampling point as close to the pressure tank as possible, or from a cold-water spigot located before any filters or water treatment systems.
5. Laboratory analyses for groundwater samples must be conducted by a State certified laboratory according to U.S. EPA approved methods; unless otherwise noted, all monitoring, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, United States Environmental Protection Agency, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link below:  
[http://www.waterboards.ca.gov/centralcoast/water\\_issues/programs/ag\\_waivers/docs/resources4growers/2016\\_04\\_11\\_labs.pdf](http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/resources4growers/2016_04_11_labs.pdf)
6. If a discharger determines that water in any domestic well exceeds 10 mg/L of nitrate as N, the discharger or third party must provide notice to the Central Coast Water Board within 24 hours of learning of the exceedance. For domestic wells on a Discharger's farm/ranch that exceed 10 mg/L nitrate as N, the Discharger must provide written notification to the users within 10 days of learning of the exceedance and provide written confirmation of the notification to the Central Coast Water Board.

The drinking water notification must include the statement that the water poses a human health risk due to elevated nitrate concentration, and include a warning against the use of the water for drinking or cooking. In addition, Dischargers must also provide prompt written notification to any new well users (e.g. tenants and employees with access to the affected well), whenever there is a change in occupancy.

For all other domestic wells not on a Discharger's property, the Central Coast Water Board will notify the users promptly.

The drinking water notification and confirmation letters required by this Order are available to the public.

## **B. Groundwater Reporting**

- 1. Within 60 days of sample collection,** Dischargers must coordinate with the laboratory to submit the following groundwater monitoring results and information, electronically, using the Water Board's GeoTracker electronic deliverable format (EDF):
  - a. GeoTracker Ranch Global Identification Number
  - b. Field point name (Well Name)
  - c. Field Point Class (Well Type)
  - d. Latitude
  - e. Longitude
  - f. Sample collection date
  - g. Analytical results
  - h. Well construction information (e.g., total depth, screened intervals, depth to water , as available
- 2.** Dischargers must submit groundwater well information required in the electronic Notice of Intent (eNOI) for each farm/ranch and update the eNOI to reflect changes in the farm/ranch information within 30 days of the change. Groundwater well information reported on the eNOI includes, but is not limited to:
  - a. Number of groundwater wells present at each farm/ranch
  - b. Identification of any groundwater wells abandoned or destroyed including method destroyed) in compliance with the Order
  - c. Use for fertigation or chemigation
  - d. Presence of back flow prevention devices
  - e. Number of groundwater wells used for agricultural purposes
  - f. Number of groundwater wells used for or may be used for domestic use purposes (domestic wells

## **C. Total Nitrogen Applied Reporting**

- 1.** By March 1, 2018, and by March 1 annually thereafter, Tier 3 Dischargers growing any crop with a high potential to discharge nitrogen to groundwater must record and report total nitrogen applied for each specific crop that was irrigated and grown for commercial purposes on that farm/ranch during the preceding calendar year (January through December .

Crops with a high potential to discharge nitrogen to groundwater are: beet,

broccoli, cabbage, cauliflower, celery, Chinese cabbage (napa), collard, endive, kale, leek, lettuce (leaf and head), mustard, onion (dry and green), spinach, strawberry, pepper (fruiting , and parsley.

Total nitrogen applied must be reported on the Total Nitrogen Applied Report form as described in the Total Nitrogen Applied Report form instructions.

Total nitrogen applied includes any product containing any form or concentration of nitrogen including, but not limited to, organic and inorganic fertilizers, slow release products, compost, compost teas, manure, and extracts.

2. The Total Nitrogen Applied Report form includes the following information:
  - a. General ranch information such as GeoTracker file numbers, name, location, acres.
  - b. Nitrogen concentration of irrigation water
  - c. Nitrogen applied in pounds per acre with irrigation water
  - d. Nitrogen present in the soil
  - e. Nitrogen applied with compost and amendments
  - f. Specific crops grown
  - g. Nitrogen applied in pounds per acre with fertilizers and other materials to each specific crop grown
  - h. Crop acres of each specific crop grown
  - i. Whether each specific crop was grown organically or conventionally
  - j. Basis for the nitrogen applied
  - k. Explanation and comments section
  - l. Certification statement with penalty of perjury declaration
  - m. Additional information regarding whether each specific crop was grown in a nursery, greenhouse, hydroponically, in containers, and similar variables.

### **PART 3. ANNUAL COMPLIANCE FORM**

Tier 3 Dischargers must submit annual compliance information, electronically, on the Annual Compliance Form. The purpose of the electronic Annual Compliance Form is to provide information to the Central Coast Water Board to assist in the evaluation of threat to water quality from individual agricultural discharges of waste and measure progress towards water quality improvement and verify compliance with the Order and MRP. Time schedules are shown in Table 5.

#### **A. Annual Compliance Form**



1. **By March 1, 2018, and updated annually thereafter by March 1,** Tier 3 Dischargers must submit an Annual Compliance Form electronically, in a format specified by the Executive Officer. The electronic Annual Compliance Form includes, but is not limited to the following minimum requirements<sup>1</sup>:
  - a. Question regarding consistency between the Annual Compliance Form and the electronic Notice of Intent (eNOI);
  - b. Information regarding type and characteristics of discharge (e.g., number of discharge points, estimated flow/volume, number of tailwater days);
  - c. Identification of any direct agricultural discharges to a stream, lake, estuary, bay, or ocean;
  - d. Identification of specific farm water quality management practices completed, in progress, and planned to address water quality impacts caused by discharges of waste including irrigation management, pesticide management, nutrient management, salinity management, stormwater management, and sediment and erosion control to achieve compliance with this Order; and identification of specific methods used, and described in the Farm Plan consistent with Order Provision 44.g., for the purposes of assessing the effectiveness of management practices implemented and the outcomes of such assessments;
  - e. Proprietary information question and justification;
  - f. Authorization and certification statement and declaration of penalty of perjury.

## **PART 5. INDIVIDUAL SURFACE WATER DISCHARGE MONITORING AND REPORTING REQUIREMENTS**

Monitoring and reporting requirements for individual surface water discharge identified in Part 5.A. and Part 5.B. apply to Tier 3 Dischargers with irrigation water or stormwater discharges to surface water from an outfall. Outfalls are locations where irrigation water and stormwater exit a farm/ranch, or otherwise leave the control of the discharger, after being conveyed by pipes, ditches, constructed swales, tile drains, containment structures, or other discrete structures or features that transport the water. Discharges that have commingled with discharges from another farm/ranch are considered to have left the control of the discharger. Key monitoring and reporting requirements for individual surface water discharge are shown in Tables 4A and 4B. Time schedules are shown in Table 5.

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<sup>1</sup> Items reported in the Annual Compliance Form are due by March 1 2018, and annually thereafter, unless otherwise specified.

## **A. Individual Surface Water Discharge Monitoring**

1. Tier 3 Dischargers must conduct individual surface water discharge monitoring to a) evaluate the quality of individual waste discharges, including concentration and load of waste in kilograms per day for appropriate parameters, b) evaluate effects of waste discharge on water quality and beneficial uses, and c) evaluate progress towards compliance with water quality improvement milestones in the Order.

### Individual Sampling and Analysis Plan

2. **By March 1, 2018, or as directed by the Executive Officer**, Tier 3 Dischargers must submit an individual surface water discharge Sampling and Analysis Plan (SAAP) and QAPP to monitor individual discharges of irrigation water and stormwater that leaves their farm/ranch from an outfall. The Sampling and Analysis Plan and QAPP must be submitted to the Executive Officer; this requirement is satisfied if an approved SAAP and QAPP addressing all individual surface water discharge monitoring requirements described in this Order has been submitted pursuant to Order No. R3-2012-0011 and associated Monitoring and Reporting Programs.
3. The Sampling and Analysis Plan must include the following minimum required components to monitor irrigation water and stormwater discharges:
  - a. Number and location of outfalls (identified with latitude and longitude or on a scaled map);
  - b. Number and location of monitoring points;
  - c. Description of typical irrigation runoff patterns;
  - d. Map of discharge and monitoring points;
  - e. Sample collection methods;
  - f. Monitoring parameters;
  - g. Monitoring schedule and frequency of monitoring events;
4. The QAPP must include appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, quality control activities, and documentation.
5. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may require modifications to the Sampling and Analysis Plan or Tier 3 Dischargers may propose Sampling and Analysis Plan modifications for Executive Officer approval, when modifications are justified to accomplish the objectives of the MRP.

### Individual Surface Water Discharge Monitoring Points

6. Tier 3 Dischargers must select monitoring points to characterize at least 80% of the estimated maximum irrigation run-off discharge volume from each farm/ranch based on that farm's/ranch's typical discharge patterns<sup>1</sup>, including tailwater discharges and discharges from tile drains. Sample must be taken when irrigation activity is causing maximal run-off. Load estimates will be generated by multiplying flow volume of discharge by concentration of contaminants. Tier 3 Dischargers must include at least one monitoring point from each farm/ranch which drains areas where chlorpyrifos or diazinon are applied, and monitoring of runoff or tailwater must be conducted within one week of chemical application. If discharge is not routinely present, Discharger may characterize typical run-off patterns in the Annual Report. See Table 4A for additional details.
7. Tier 3 Dischargers must also monitor storage ponds and other terminal surface water containment structures that collect irrigation and stormwater runoff, unless the structure is 1) part of a tail-water return system where a major portion of the water in such structure is reapplied as irrigation water, or 2) the structure is primarily a sedimentation pond by design with a short hydraulic residence time (96 hours or less) and a discharge to surface water when functioning. If multiple ponds are present, sampling must cover at least those structures that would account for 80% of the maximum storage volume of the containment features. See Table 4B for additional details. Where water is reapplied as irrigation water. Dischargers shall document reuse in the Farm Plan.

### Individual Surface Water Discharge Monitoring Parameters, Frequency, and Schedule

8. Tier 3 Dischargers must conduct monitoring for parameters, laboratory analytical methods, frequency and schedule described in Tables 4A and 4B. Dischargers may utilize in-field water testing instruments/equipment as a substitute for laboratory analytical methods if the method is approved by U.S. EPA, meets reporting limits (RL) and practical quantitation limits (PQL) specifications in the MRP, and appropriate sampling methodology and quality assurance checks can be applied to ensure that QAPP standards are met to ensure accuracy of the test.

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<sup>1</sup> The requirement to select monitoring points to characterize at least 80% of the estimated maximum irrigation run-off based on typical discharge patterns is for the purposes of attempting to collect samples that represent a majority of the volume of irrigation run-off discharged; however the Board recognizes that predetermining these locations is not always possible and that sampling results may vary. The MRP does not specify the number or location of monitoring points to provide maximum flexibility for growers to determine how many sites necessary and exact locations are given the anticipated site-specific conditions.

9. Tier 3 Dischargers must initiate individual surface water discharge monitoring per an approved Sampling and Analysis Plan and QAPP, unless otherwise directed by the Executive Officer.

## **B. Individual Surface Water Discharge Reporting**

### Individual Surface Water Discharge Monitoring Data Submittal

**By March 1, 2018**, and annually thereafter by March 1, Tier 3 Dischargers must submit individual surface water discharge monitoring data and information to the Central Coast Water Board electronically, in a pdf format, containing at least the following items, or as otherwise approved by the Executive Officer:

- a. Electronic laboratory data
  - All reports of results must contain Ranch name and Global ID, site name(s), project contact, and date.
  - Electronic laboratory data reports of chemical results shall include analytical results, as well as associated quality assurance data including method detection limits, reporting limits, matrix spikes, matrix spike duplicates, laboratory blanks, and other quality assurance results required by the analysis method.
  - Electronic laboratory data reports of toxicity results shall include summary results comparable to those required in a CEDEN file delivery, including test and control results. For each test result, the mean, associated control performance, calculated percent of control, statistical test results and determination of toxicity, must be included. Test results must specify the control ID used to calculate statistical outcomes.
  - Field data results, including temperature, pH, conductivity, turbidity and flow measurements, any field duplicates or blanks, and field observations.
  - Calculations of un-ionized ammonia concentrations
  - Calculations of total flow and pollutant loading (for nitrate, pesticides if sampled, total ammonia, and turbidity (include formulas);
- b. Narrative description of typical irrigation runoff patterns;
- c. Location of sampling sites and map(s);
- d. Sampling and analytical methods used;
- e. Specify the method used to obtain flow at each monitoring site during each monitoring event;
- f. Photos obtained from all monitoring sites, clearly labeled with location and date;
- g. Sample chain-of-custody forms do not need to be submitted but must be made available to Central Coast Water Board staff, upon request.

## PART 6. IRRIGATION AND NUTRIENT MANAGEMENT PLAN

Monitoring and reporting requirements related to the Irrigation and Nutrient Management Plan (INMP) identified in Part 6.A., and 6.B, apply to Tier 3 Dischargers identified by the Executive Officer that are newly enrolled in Order No. R3-2017-0002, and Tier 3 Dischargers that were subject to Irrigation and Nutrient Management Plan Requirements in Order R3-2012-0011 per MRP Order No. R3-2012-0011-03. Time schedules are shown in Table 5.

### A. Irrigation and Nutrient Management Plan Monitoring

1. Tier 3 Dischargers required in Order No. R3-2012-0011 to develop and initiate implementation of an Irrigation and Nutrient Management Plan (INMP) certified by a Professional Soil Scientist, Professional Agronomist, or Crop Advisor certified by the American Society of Agronomy, or similarly qualified professional, are required to update (as necessary) and implement their INMP throughout the term of this Order.
2. The Executive Officer will assess whether an INMP is required for new Tier 3 Dischargers that enroll in Order No. R3-2017-0002 during the term of the Order. The Executive Officer will use the criteria established in Order No. R3-2012-0011 to make this assessment. If a Tier 3 Discharger is required to develop an INMP, the Tier 3 discharger must develop and initiate implementation of an Irrigation and Nutrient Management Plan (INMP) certified by a Professional Soil Scientist, Professional Agronomist, or Crop Advisor certified by the American Society of Agronomy, or similarly qualified professional, **within 18 months** of the Executive Officer's assessment of the INMP requirement.
3. The purpose of the INMP is to budget and manage the nutrients applied to each farm/ranch considering all sources of nutrients, crop requirements, soil types, climate, and local conditions in order to minimize nitrate loading to surface water and groundwater in compliance with this Order. The professional certification of the INMP must indicate that the relevant expert has reviewed all necessary documentation and testing results, evaluated total nitrogen applied relative to typical crop nitrogen uptake and nitrogen removed at harvest, with consideration to potential nitrate loading to groundwater, and conducted field verification to ensure accuracy of reporting.
4. Tier 3 Dischargers required to develop and initiate implementation an (INMP) must include the following elements in the INMP. The INMP is not submitted to the Central Coast Water Board, with the exception of the INMP Effectiveness Report:
  - a. Proof of INMP certification;
  - b. Map locating each farm/ranch;
  - c. Identification of crop nitrogen uptake values for use in nutrient balance calculations;



- d. Record keeping annually by either Method 1 or Method 2:
  - e. To meet the requirement to record total nitrogen in the soil, dischargers may take a nitrogen soil sample (e.g. laboratory analysis or nitrate quick test) or use an alternative method to evaluate nitrogen content in soil, prior to planting or seeding the field or prior to the time of pre-sidedressing, or at an alternative time when it is most effective to determine nitrogen present in the soil that is available for the next crop and to minimize nitrate leaching to groundwater. The amount of nitrogen remaining in the soil must be accounted for as a source of nitrogen when budgeting, and the soil sample or alternative method results must be maintained in the INMP.
  - f. Identification of irrigation and nutrient management practices in progress (identify start date), completed (identify completion date), and planned (identify anticipated start date) to reduce nitrate loading to groundwater to achieve compliance with this Order.
  - g. Description of methods Discharger will use to verify overall effectiveness of the INMP.
5. Tier 3 Dischargers must evaluate the effectiveness of the INMP. Irrigation and Nutrient Management Plan effectiveness monitoring must evaluate reduction in new nitrogen<sup>1</sup> loading potential based on minimized fertilizer use and improved irrigation and nutrient management practices in order to minimize new nitrogen loading to surface water and groundwater. Evaluation methods used may include, but are not limited to analysis of groundwater well monitoring data or soil sample data, or analysis of trends in new nitrogen application data.

## **B. Irrigation and Nutrient Management Plan Reporting**

1. **By March 1, 2019**, Tier 3 Dischargers required to develop and initiate implementation of an INMP must submit an INMP Effectiveness Report to evaluate reductions in nitrate loading to surface water and groundwater based on the implementation of irrigation and nutrient management practices in a format specified by the Executive Officer. Dischargers in the same groundwater basin or subbasin may choose to comply with this requirement as a group by submitting a single report that evaluates the overall effectiveness of the broad scale implementation of irrigation and nutrient management practices identified in individual INMPs to protect groundwater. Group efforts must use data from each farm/ranch (e.g., data from individual groundwater wells, soil samples, or nitrogen application). The INMP

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<sup>1</sup> New nitrogen is nitrogen from fertilizers, amendments, and other nitrogen sources applied other than nitrogen present in groundwater.

Effectiveness Report must include a description of the methodology used to evaluate and verify effectiveness of the INMP.

## **PART 7. WATER QUALITY BUFFER PLAN**

Monitoring and reporting requirements related to the Water Quality Buffer Plan identified in Part 7.A. and Part 7.B. apply to Tier 3 Dischargers that have farms/ranches that contain or are adjacent to waterbody identified on the List of Impaired Waterbodies as impaired for temperature, turbidity, or sediment). Time schedules are shown in Table 5.

### **A. Water Quality Buffer Plan**

1. **By 18 months following enrollment in Order No. R3-2017-0002 of a Tier 3 farm/ranch**, Tier 3 Dischargers adjacent to or containing a waterbody identified on the List of Impaired Waterbodies as impaired for temperature, turbidity or sediment must submit a Water Quality Buffer Plan (WQBP) to the Executive Officer that protects the listed waterbody and its associated perennial and intermittent tributaries. The purpose of the Water Quality Buffer Plan is to prevent waste discharge, comply with water quality standards e.g., temperature, turbidity, sediment, and protect beneficial uses in compliance with this Order and the following Basin Plan requirement:

Basin Plan Chapter 5, p. V-13, Section V.G.4 – Erosion and Sedimentation, *“A filter strip of appropriate width, and consisting of undisturbed soil and riparian vegetation or its equivalent, must be maintained, wherever possible, between significant land disturbance activities and watercourses, lakes, bays, estuaries, marshes, and other water bodies. For construction activities, minimum width of the filter strip must be thirty feet, wherever possible....”*

2. The Water Quality Buffer Plan must include the following or the functional equivalent, to address discharges of waste and associated water quality impairments:
  - a. A minimum 30 foot buffer as measured horizontally from the top of bank on either side of the waterway, or from the high water mark of a lake and mean high tide of an estuary ;
  - b. Any necessary increases in buffer width to adequately prevent the discharge of waste that may cause or contribute to any excursion above or outside the acceptable range for any Regional, State, or Federal numeric or narrative water quality standard e.g., temperature, turbidity ;

- c. Any buffer less than 30 feet must provide equivalent water quality protection and be justified based on an analysis of site-specific conditions and be approved by the Executive Officer;
  - d. Identification of any alternatives implemented to comply with this requirement, that are functionally equivalent to described buffer;
  - e. Schedule for implementation;
  - f. Maintenance provisions to ensure water quality protection;
  - g. Annual photo monitoring;
2. The WQPB must be submitted using the Water Quality Buffer Plan form, or, if an alternative to the WQBP is submitted, in a format approved by the Executive Officer.
3. **By March 1, 2019**, Tier 3 Dischargers that submitted a WQBP pursuant to Order No. R3-2012-0011 or Order No. R3-2017-0002, are required to update as necessary and implement their WQBP, and annually submit a WQBP Status Report of their WQBP implementation using the Water Quality Buffer Plan form, or, if an alternative to the WQBP was submitted, an Alternative to WQBP Status Report, electronically, in a format approved by the Executive Officer.

## **PART 8. GENERAL MONITORING AND REPORTING REQUIREMENTS**

### **A. Submittal of Technical Reports**

1. Dischargers must submit reports in a format specified by the Executive Officer (reports will be submitted electronically, unless otherwise specified by the Executive Officer . A transmittal letter must accompany each report, containing the following penalty of perjury statement signed by the Discharger or the Discharger's authorized agent:

*"In compliance with Water Code §13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision following a system designed to assure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment".*

2. If the Discharger asserts that all or a portion of a report submitted pursuant to this Order is subject to an exemption from public disclosure (e.g. trade secrets or secret processes), the Discharger must provide an explanation of how those portions of the reports are exempt from public disclosure. The

Discharger must clearly indicate on the cover of the report (typically an electronic submittal) that the Discharger asserts that all or a portion of the report is exempt from public disclosure, submit a complete report with those portions that are asserted to be exempt in redacted form, submit separately in a separate electronic file unredacted pages (to be maintained separately by staff). The Central Coast Water Board staff will determine whether any such report or portion of a report qualifies for an exemption from public disclosure. If the Central Coast Water Board staff disagrees with the asserted exemption from public disclosure, the Central Coast Water Board staff will notify the Discharger prior to making such report or portions of such report available for public inspection.

#### **B. Central Coast Water Board Authority**

1. Monitoring reports are required pursuant to section 13267 of the California Water Code. Pursuant to section 13268 of the Water Code, a violation of a request made pursuant to section 13267 may subject you to civil liability of up to \$1000 per day.
2. The Water Board needs the required information to determine compliance with Order No.R3-2017-0002. The evidence supporting these requirements is included in the findings of Order No.R3-2017-0002.

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John M. Robertson  
Executive Officer

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Date

**Table 1. Major Waterbodies in Agricultural Areas<sup>1</sup>**

Hydrologic SubArea	Waterbody Name	Hydrologic SubArea	Waterbody Name
30510	Pajaro River	30920	Quail Creek
30510	Salsipuedes Creek	30920	Salinas Reclamation Canal
30510	Watsonville Slough	31022	Chorro Creek
30510	Watsonville Creek <sup>2</sup>	31023	Los Osos Creek
30510	Beach Road Ditch <sup>2</sup>	31023	Warden Creek
30530	Carnadero Creek	31024	San Luis Obispo Creek
30530	Furlong Creek <sup>2</sup>	31024	Prefumo Creek
30530	Llagas Creek	31031	Arroyo Grande Creek
30530	Miller's Canal	31031	Los Berros Creek
30530	San Juan Creek	31210	Bradley Canyon Creek
30530	Tesquisquita Slough	31210	Bradley Channel
30600	Moro Cojo Slough	31210	Green Valley Creek
30910	Alisal Slough	31210	Main Street Canal
30910	Blanco Drain	31210	Orcutt Solomon Creek
30910	Old Salinas River	31210	Oso Flaco Creek
30910	Salinas River (below Gonzales Rd.)	31210	Little Oso Flaco Creek
30920	Salinas River (above Gonzales Rd. and below Nacimiento R.)	31210	Santa Maria River
30910	Santa Rita Creek <sup>2</sup>	31310	San Antonio Creek <sup>2</sup>
30910	Tembladero Slough	31410	Santa Ynez River
30920	Alisal Creek	31531	Bell Creek
30920	Chualar Creek	31531	Glenn Annie Creek
30920	Espinosa Slough	31531	Los Carneros Creek <sup>2</sup>
30920	Gabilan Creek	31534	Arroyo Paredon Creek
30920	Natividad Creek	31534	Franklin Creek

<sup>1</sup> At a minimum, monitoring sites must be included for these waterbodies in agricultural areas, unless otherwise approved by the Executive Officer. Monitoring sites may be proposed for addition or modification to better assess the impacts of waste discharges from irrigated lands to surface water. Dischargers choosing to comply with surface receiving water quality monitoring, individually (not part of a cooperative monitoring program) must only monitor sites for waterbodies receiving the discharge.

<sup>2</sup> These creeks are included because they are newly listed waterbodies on the 2010 303(d) list of Impaired Waters that are associated with areas of agricultural discharge.



**Table 2. Surface Receiving Water Quality Monitoring Parameters**

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
<b>Photo Monitoring</b>		
Upstream and downstream photographs at monitoring location		With every monitoring event
<b><u>WATER COLUMN SAMPLING</u></b>		
<b>Physical Parameters and General Chemistry</b>		
Flow (field measure) (CFS) following SWAMP field SOP <sup>9</sup>	.25	Monthly, including 2 stormwater events
pH (field measure)	0.1	"
Electrical Conductivity field measure) (µS/cm	2.5	"
Dissolved Oxygen (field measure) (mg/L)	0.1	"
Temperature (field measure) °C)	0.1	"
Turbidity NTU	0.5	"
Total Dissolved Solids mg/L)	10	"
Total Suspended Solids (mg/L)	0.5	"
<b>Nutrients</b>		
Total Nitrogen (mg/L)	0.5	Monthly, including 2 stormwater events
Nitrate + Nitrite (as N) (mg/L)	0.1	"
Total Ammonia (mg/L)	0.1	"
Unionized Ammonia (calculated value, mg/L)		"
Total Phosphorus (as P) mg/L)	0.02	"
Soluble Orthophosphate (mg/L)	0.01	"
Water column chlorophyll a µg/L)	1.0	"
Algae cover, Floating Mats, % coverage	-	"
Algae cover, Attached, % coverage	-	"
<b>Water Column Toxicity Test</b>		
Algae - <i>Selenastrum capricornutum</i> (96-hour chronic; Method 1003.0 in EPA/821/R-02/013)	-	4 times each year, twice in dry season, twice in wet season
Water Flea – <i>Ceriodaphnia dubia</i> 7-day chronic; Method 1002.0 in EPA/821/R-02/013)	-	"
Midge - <i>Chironomus spp.</i> 96-hour acute; Alternate test species in EPA 821-R-02-012	-	"

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
Toxicity Identification Evaluation (TIE)	-	As directed by Executive Officer
<b>Pesticides<sup>2</sup> /Herbicides µg/L</b>		
<b>Organophosphate Pesticides</b>		
Azinphos-methyl	0.02	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Chlorpyrifos	0.005	"
Diazinon	0.005	"
Dichlorvos	0.01	"
Dimethoate	0.01	"
Dimeton-s	0.005	"
Disulfoton (Disyton)	0.005	"
Malathion	0.005	"
Methamidophos	0.02	"
Methidathion	0.02	"
Parathion-methyl	0.02	"
Phorate	0.01	"
Phosmet	0.02	"
<b>Neonicotinoids</b>		
Thiamethoxam	.002	"
Imidacloprid	.002	"
Thiacloprid	.002	"
Dinotefuran	.006	"
Acetamiprid	.01	"
Clothianidin	.02	"
<b>Herbicides</b>		
Atrazine	0.05	"
Cyanazine	0.20	"
Diuron	0.05	"
Glyphosate	2.0	"
Linuron	0.1	"
Paraquat	0.20	"
Simazine	0.05	"
Trifluralin	0.05	"
<b>Metals (µg/L)</b>		
Arsenic total) <sup>5,7</sup>	0.3	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Boron (total) <sup>6,7</sup>	10	"
Cadmium total & dissolved <sup>4,5,7</sup>	0.01	"

Parameters and Tests	RL <sup>3</sup>	Monitoring Frequency <sup>1</sup>
Copper (total and dissolved) <sup>4,7</sup>	0.01	"
Lead total and dissolved) <sup>4,7</sup>	0.01	"
Nickel (total and dissolved) <sup>4,7</sup>	0.02	"
Molybdenum (total) <sup>7</sup>	1	"
Selenium (total) <sup>7</sup>	0.30	"
Zinc (total and dissolved) <sup>4,5,7</sup>	0.10	"
<b>Other (µg/L)</b>		
Total Phenolic Compounds <sup>8</sup>	5	2 times in 2017, once in spring (April-May and once in fall August-September
Hardness mg/L as CaCO <sub>3</sub>	1	"
Total Organic Carbon (ug/L	0.6	"
<b><u>SEDIMENT SAMPLING</u></b>		
Sediment Toxicity - <i>Hyalella azteca</i> 10-day static renewal EPA, 2000)		2 times each year, once in spring (April-May and once in fall (August-September
<b>Pyrethroid Pesticides in Sediment µg/kg</b>		
Gamma-cyhalothrin	2	2 times in both 2017 and 2018, once in spring (April-May and once in fall (August-September of each year, concurrent with sediment toxicity sampling
Lambda-cyhalothrin	2	"
Bifenthrin	2	"
Beta-cyfluthrin	2	"
Cyfluthrin	2	"
Esfenvalerate	2	"
Permethrin	2	"
Cypermethrin	2	"
Danitol	2	"
Fenvalerate	2	"
Fluvalinate	2	"
<b>Other Monitoring in Sediment</b>		
Chlorpyrifos (µg/kg)	2	"
Total Organic Carbon	0.01%	"
		"
Sediment Grain Size Analysis	1%	"

<sup>1</sup>Monitoring is ongoing through all five years of the Order, unless otherwise specified. Monitoring frequency may be used as a guide for developing alternative Sampling and Analysis Plan.

<sup>2</sup>Pesticide list may be modified based on specific pesticide use in Central Coast Region. Analytes on this list must be reported, at a minimum.

<sup>3</sup>Reporting Limit, taken from SWAMP where applicable.

<sup>4</sup> Holmgren, Meyer, Cheney and Daniels. 1993. Cadmium, Lead, Zinc, Copper and Nickel in Agricultural Soils of the United States. J. of Environ. Quality 22:335-348.

<sup>5</sup> Sax and Lewis, ed. 1987. Hawley's Condensed Chemical Dictionary. 11<sup>th</sup> ed. New York: Van Nostrand Reinhold Co., 1987. Zinc arsenate is an insecticide.

<sup>6</sup> <http://www.coastalagro.com/products/labels/9%25BORON.pdf>; Boron is applied directly or as a component of fertilizers as a plant nutrient.

<sup>7</sup> Madramootoo, Johnston, Willardson, eds. 1997. Management of Agricultural Drainage Water Quality. International Commission on Irrigation and Drainage. U.N. FAO. SBN 92-6-104058.3.

<sup>8</sup> <http://cat.inist.fr/?aModeleafficheNcpsidt=14074525>; Phenols are breakdown products of herbicides and pesticides. Phenols can be directly toxic and cause endocrine disruption.

<sup>9</sup> See SWAMP field measures SOP, p. 17

mg/L – milligrams per liter; ug/L – micrograms per liter; ug/kg – micrograms per kilogram;

NTU – Nephelometric Turbidity Units; CFS – cubic feet per second;

**Table 3. Groundwater Monitoring Parameters**

Parameter	RL	Analytical Method <sup>3</sup>	Units
pH	0.1	Field or Laboratory Measurement EPA General Methods	pH Units
Specific Conductance	2.5		µS/cm
Total Dissolved Solids	10		mg/L
Total Alkalinity as CaCO <sub>3</sub>	1	EPA Method 310.1 or 310.2	
Calcium	0.05	General Cations <sup>1</sup> EPA 200.7, 200.8, 200.9	
Magnesium	0.02		
Sodium	0.1		
Potassium	0.1		
Sulfate SO <sub>4</sub>	1.0	General Anions EPA Method 300 or EPA Method 353.2	
Chloride	0.1		
Nitrate + Nitrite (as N) <sup>2</sup> or Nitrate as N	0.1		

<sup>1</sup> General chemistry parameters (major cations and anions) represent geochemistry of water bearing zone and assist in evaluating quality assurance/quality control of groundwater monitoring and laboratory analysis.

<sup>2</sup> The MRP allows analysis of “nitrate plus nitrite” to represent nitrate concentrations (as N). The “nitrate plus nitrite” analysis allows for extended laboratory holding times and relieves the Discharger of meeting the short holding time required for nitrate.

<sup>3</sup> Dischargers may use alternative analytical methods approved by EPA.

RL – Reporting Limit; µS/cm – micro siemens per centimeter

**Table 4A. Individual Discharge Monitoring for Tailwater, Tile drain, and Stormwater Discharges**

Parameter	Analytical Method <sup>1</sup>	Maximum PQL	Units	Min Monitoring Frequency
Discharge Flow or Volume	Field Measure	---	CFS	a d
Approximate Duration of Flow	Calculation	---	hours/month	
Temperature (water)	Field Measure	0.1	° Celsius	
pH	Field Measure	0.1	pH units	

Electrical Conductivity	Field Measure	100	µS/cm	
Turbidity	SM 2130B, EPA 180.1	1	NTUs	
Nitrate + Nitrite (as N)	EPA 300.1, EPA 353.2	0.1	mg/L	
Ammonia	SM 4500 NH3, EPA 350.3	0.1	mg/L	
Chlorpyrifos <sup>2</sup>	EPA 8141A, EPA 614	0.02	ug/L	b c) (d)
Diazinon <sup>2</sup>				
Ceriodaphnia Toxicity 96-hr acute)	EPA-821-R-02-012	NA	% Survival	
Hyalella Toxicity in Water 96-hr acute)	EPA-821-R-02-012	NA	% Survival	

<sup>1</sup> In-field water testing instruments/equipment as a substitute for laboratory analysis if the method is approved by EPA, meets RL/PQL specifications in the MRP, and appropriate sampling methodology and quality assurance checks can be applied to ensure that QAPP standards are met to ensure accuracy of the test.

<sup>2</sup> If chlorpyrifos or diazinon is used at the farm/ranch, otherwise does not apply. The Executive Officer may require monitoring of other pesticides based on results of downstream receiving water monitoring.

a Two times per year during primary irrigation season for farms/ranches less than or equal to 500 acres, and four times per year during primary irrigation season for farms/ranches greater than 500 acres. Executive Officer may reduce sampling frequency based on water quality improvements.

b) Once per year during primary irrigation season for farms/ranches less than or equal to 500 acres, and two times per year during primary irrigation season for farms/ranches greater than 500 acres.

c) Sample must be collected within one week of chemical application, if chemical is applied on farm/ranch;

d) Once per year during wet season (October – March) for farms/ranches less than or equal to 500 acres, and two times per year during wet season for farms/ranches greater than 500 acres, within 18 hours of major storm events;

CFS – Cubic feet per second; NTU – Nephelometric turbidity unit; PQL – Practical Quantitation Limit;

NA – Not applicable

**Table 4B. Individual Discharge Monitoring for Tailwater Ponds and other Surface Containment Features**

Parameter	Analytical Method <sup>1</sup>	Maximum PQL	Units	Minimum Monitoring Frequency
Volume of Pond	Field Measure	1	Gallons	a d
Nitrate + Nitrite (as N)	EPA 300.1, EPA 353.2	50	mg/L	

<sup>1</sup> In-field water testing instruments/equipment as a substitute for laboratory analysis if the method is approved by EPA, meets RL/PQL specifications in the MRP, and appropriate sampling methodology and quality assurance checks can be applied to ensure that QAPP standards are met to ensure accuracy of the test.

a) Four times per year during primary irrigation season; Executive Officer may reduce monitoring frequency based on water quality improvements.

d Two times per year during wet season October – March, within 18 hours of major storm events)

**Table 5. Tier 3 - Time Schedule for Key Monitoring and Reporting Requirements (MRPs)**

REQUIREMENT	TIME SCHEDULE <sup>1</sup>
Submit Sampling And Analysis Plan and Quality Assurance Project Plan (SAAP/QAPP for Surface Receiving Water Quality Monitoring ( <i>individually or</i>	By March 1, 2018, or as directed by the Executive Officer; satisfied if an approved SAAP/QAPP has been submitted pursuant



<i>through cooperative monitoring program</i>	to Order No. R3-2012-0011 and associated MRPs
Initiate surface receiving water quality monitoring <i>individually or through cooperative monitoring program</i>	Per an approved SAAP and QAPP
Submit surface receiving water quality monitoring data <i>individually or through cooperative monitoring program</i>	Each January 1, April 1, July 1, and October 1
Submit surface receiving water quality Annual Monitoring Report <i>individually or through cooperative monitoring program</i>	By July 1 2017; annually thereafter by July 1
Initiate monitoring of groundwater wells	First sample from March-June 2017, second sample from September-December 2017
Submit individual surface water discharge SAAP and QAPP	By March 1, 2018 or as directed by the Executive Officer; waived if an approved SAAP and QAPP has been submitted and being implemented pursuant to Order No. R3-2012-0011.
Initiate individual surface water discharge monitoring	As described in an approved SAAP and QAPP
Submit individual surface water discharge monitoring data	March 1, 2018, and every March 1 annually thereafter
Submit electronic Annual Compliance Form	March 1, 2018 and every March 1 annually thereafter
Submit groundwater monitoring results	Within 60 days of the sample collection
Submit Water Quality Buffer Plan or alternative	Within 18 months of enrolling new Tier 3 farm/ranch in Order
Submit Status Report on Water Quality Buffer Plan or alternative	March 1, 2019
<b><i>Tier 3 Dischargers with farms/ranches growing high risk crops:</i></b>	
Report total nitrogen applied on the Total Nitrogen Applied form	March 1, 2018 and every March 1 annually thereafter
Submit INMP Effectiveness Report	March 1, 2019

<sup>1</sup> Dates are relative to adoption of this Order, unless otherwise specified.

**Appendix 8-A**  
**Groundwater Elevation SMCs**



#### Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

#### Management Areas

- Marina-Ord Area
- Corral de Tierra

#### Abbreviations

MO Measurable Objectives

#### Notes

1. All locations are approximate.

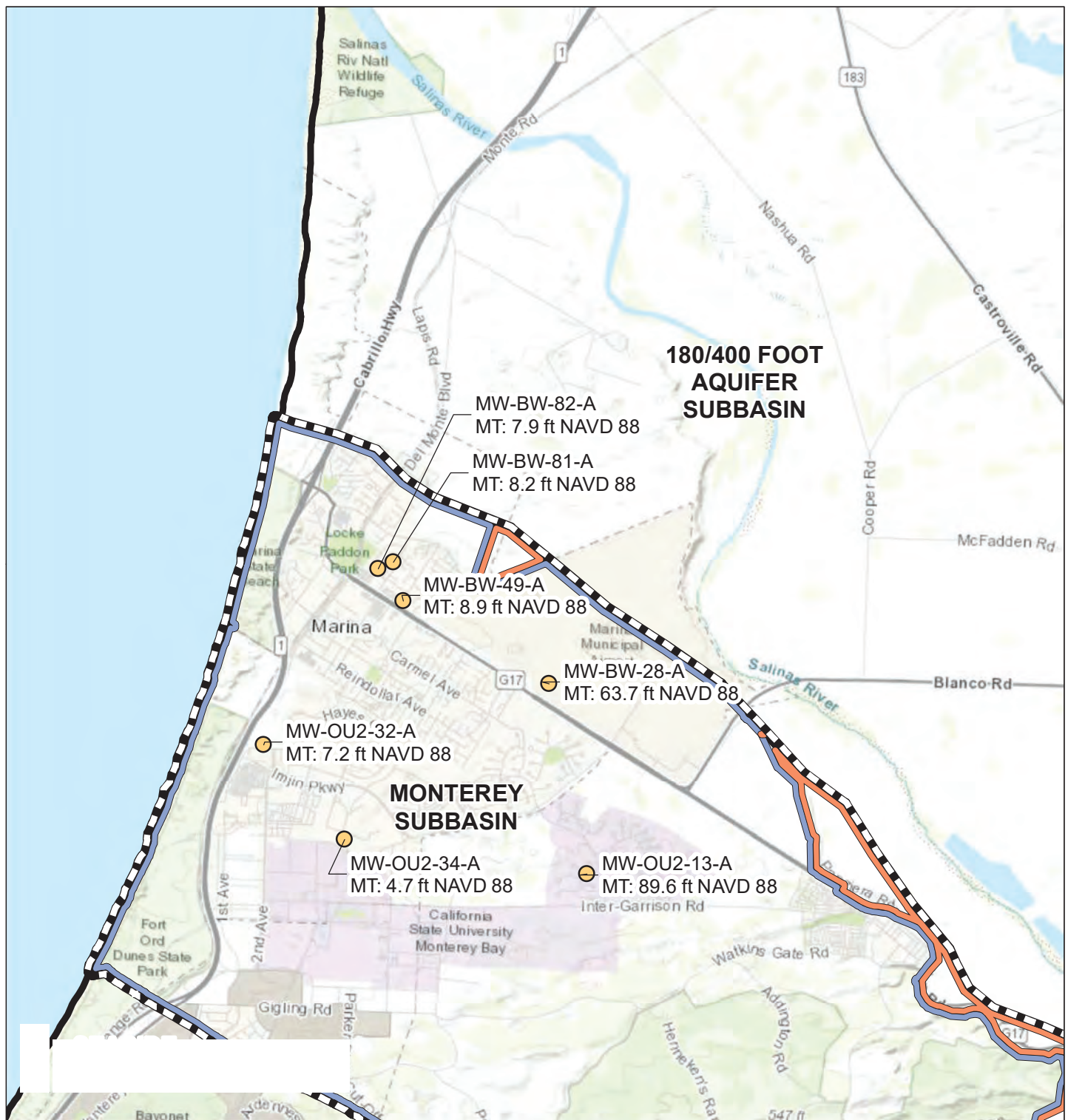
#### Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Measurable Objectives Dune Sand Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
April 2021

**Figure 8A-1**



#### Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

- Management Areas**
- Marina-Ord Area
  - Corral de Tierra

#### Abbreviations

MT = Minimum Thresholds

#### Notes

1. All locations are approximate.

#### Sources

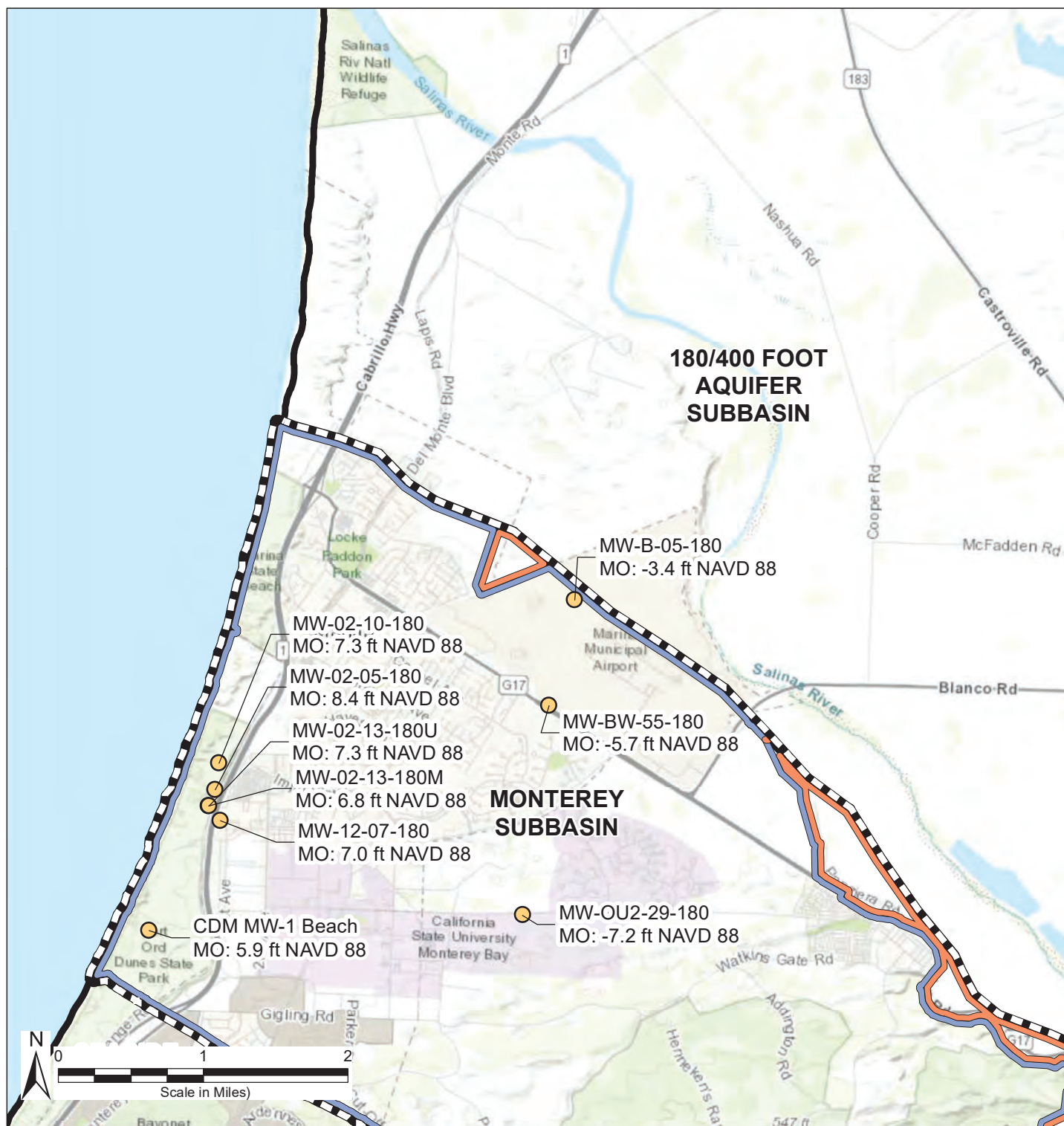
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Minimum Thresholds Dune Sand Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
April 2021

**Figure 8A-2**





### Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

### Management Areas

- Marina-Ord Area
- Corral de Tierra Area

### Abbreviations

MO Measurable Objectives

### Notes

1. All locations are approximate.

### Sources

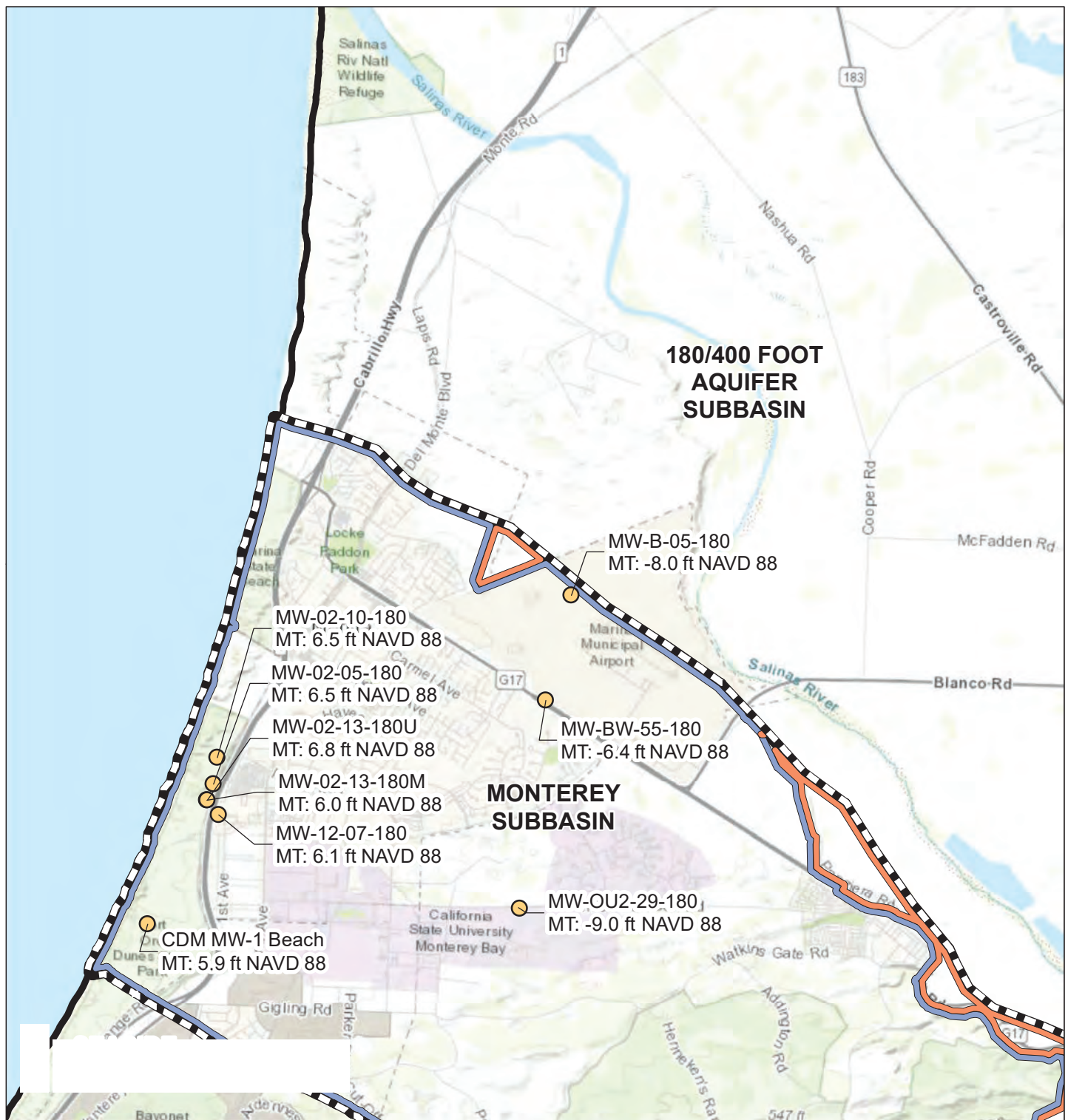
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

## Groundwater Elevation Measurable Objectives Upper 180-Foot Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
April 2021

**Figure 8A-3**





#### Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

- Management Areas**
- Marina-Ord Area
  - Corral de Tierra

#### Abbreviations

MT = Minimum Thresholds

#### Notes

1. All locations are approximate.

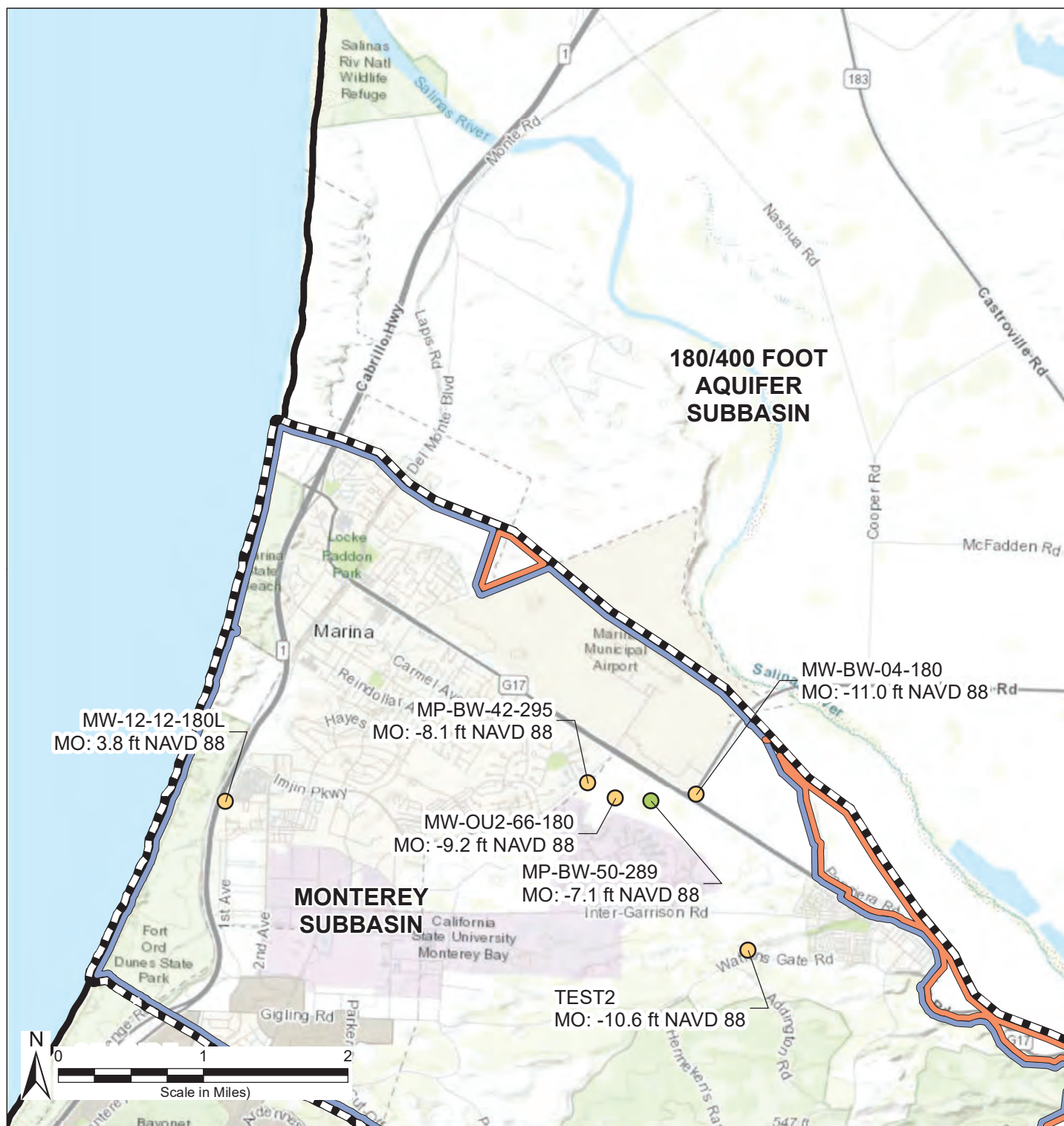
#### Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Minimum Thresholds Upper 180-Foot Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
April 2021

**Figure 8A-4**



#### Sources

- Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
- DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Measurable Objectives Lower 180-Footer Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
April 2021

**Figure 8A-5**





#### Legend



Monterey Subbasin



Other Groundwater Subbasins within Salinas Valley Basin

#### Representative Monitoring Sites for Groundwater Elevations



Lower 180-Foot Aquifer



Lower 180-Foot, 400-Foot Aquifer

#### Abbreviations

MT = Minimum Thresholds

#### Notes

1. All locations are approximate.

#### Management Areas

Marina-Ord Area

Corral de Tierra Area

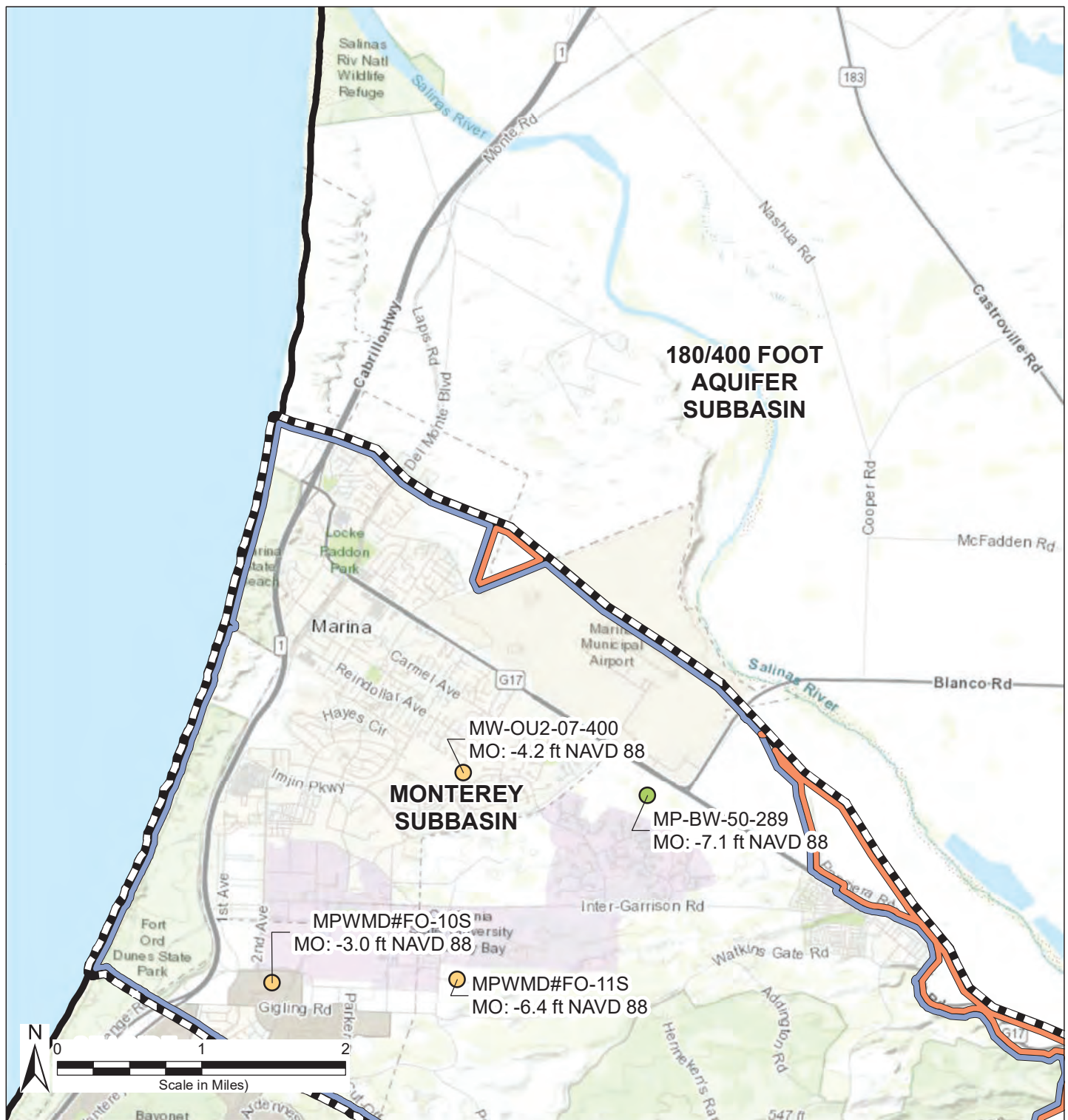
#### Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Minimum Thresholds Lower 180-Foot Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
November 2021

**Figure 8A-6**



### Legend



Monterey Subbasin



Other Groundwater Subbasins within Salinas Valley Basin

### Representative Monitoring Sites for Groundwater Elevations



400-Footer Paso Robles Aquifer)



Lower 180-Footer, 400-Footer Aquifer

### Abbreviations

MO Measurable Objectives

### Notes

1. All locations are approximate.

### Management Areas

 Marina-Ord Area

 Corral de Tierra Area

### Sources

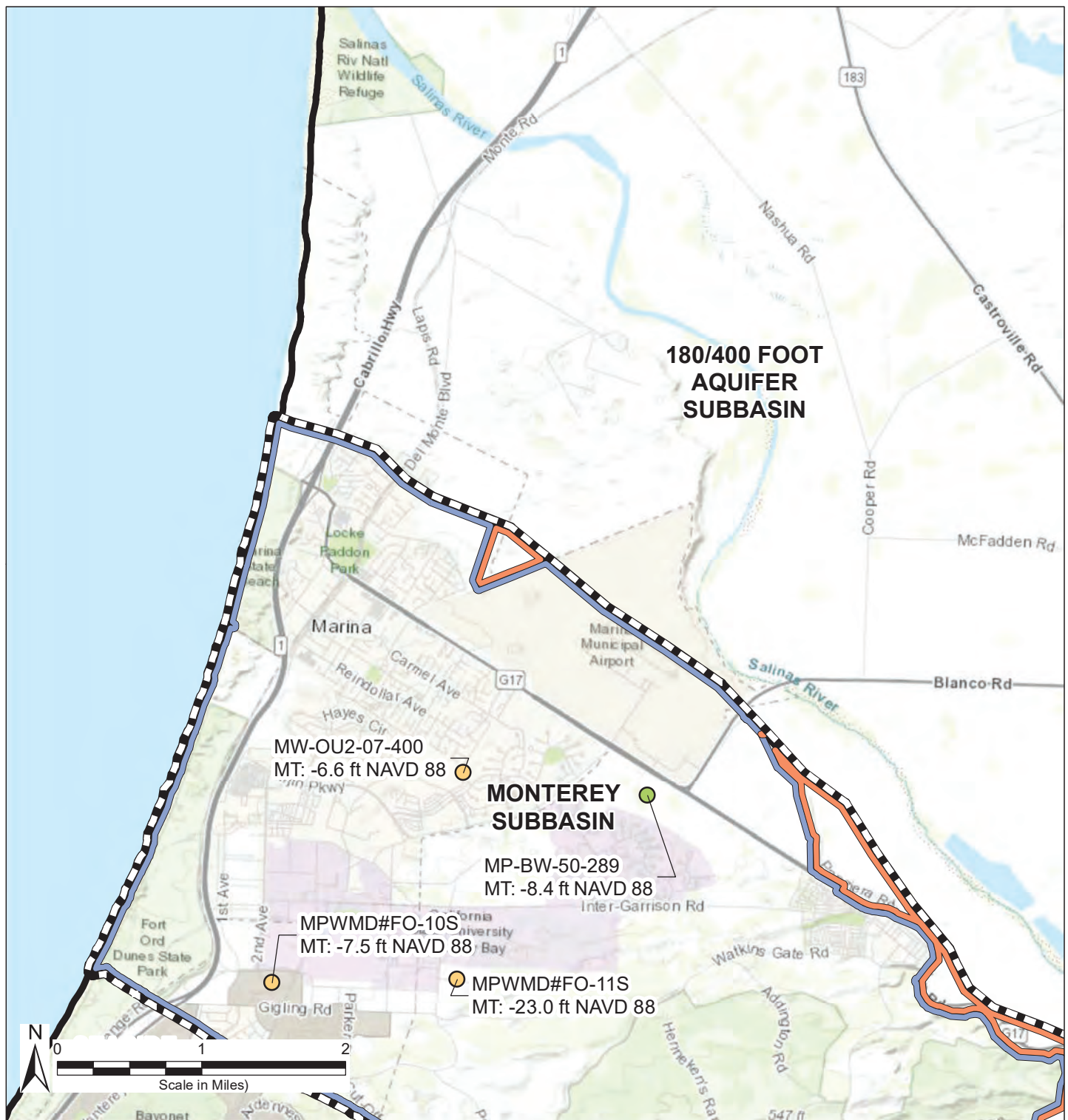
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

## Groundwater Elevation Measurable Objectives 400-Footer Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
November 2021

**Figure 8-8**





#### Legend



Monterey Subbasin



Other Groundwater Subbasins within Salinas Valley Basin

#### Representative Monitoring Sites for Groundwater Elevations



400-Footer Aquifer Paso Robles Aquifer)



Lower 180-Footer, 400-Footer

#### Abbreviations

MT = Minimum Thresholds

#### Notes

1. All locations are approximate.

#### Management Areas

Marina-Ord

Corral de Tierra

#### Sources

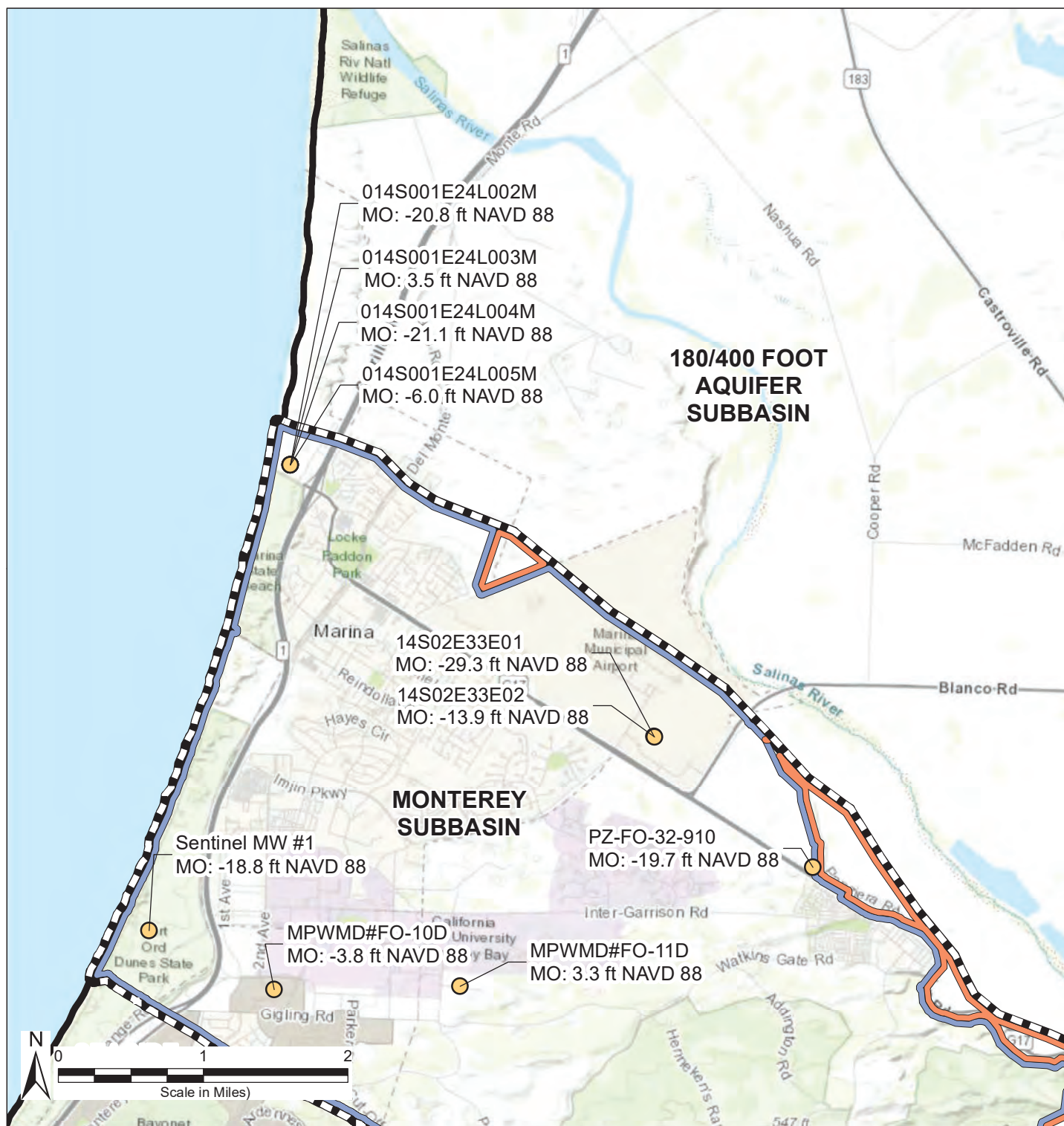
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Minimum Thresholds 400-Footer Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
April 2021

**Figure 8A-8**





### Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

- Management Areas**
- Marina-Ord Area
  - Corral de Tierra

### Abbreviations

MO Measurable Objectives

### Notes

1. All locations are approximate.

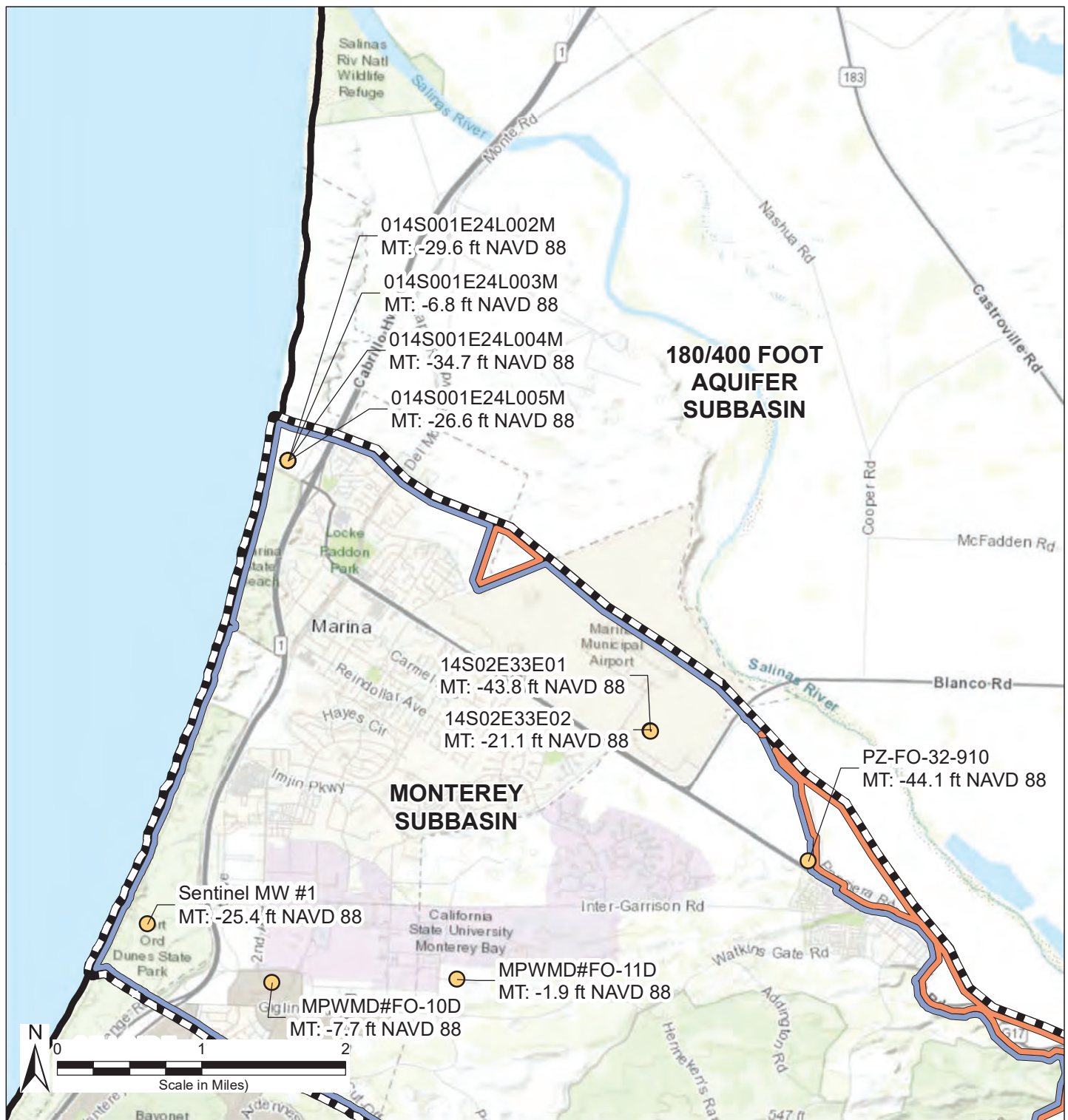
### Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

## Groundwater Elevation Measurable Objectives Deep Aquifers

Monterey Subbasin  
Groundwater Sustainability Plan  
November 2021

**Figure 8A-9**



### Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

### Management

- Marina-Ord
- Corral de Tierra

### Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Abbreviations

MT = Minimum Thresholds

### Notes

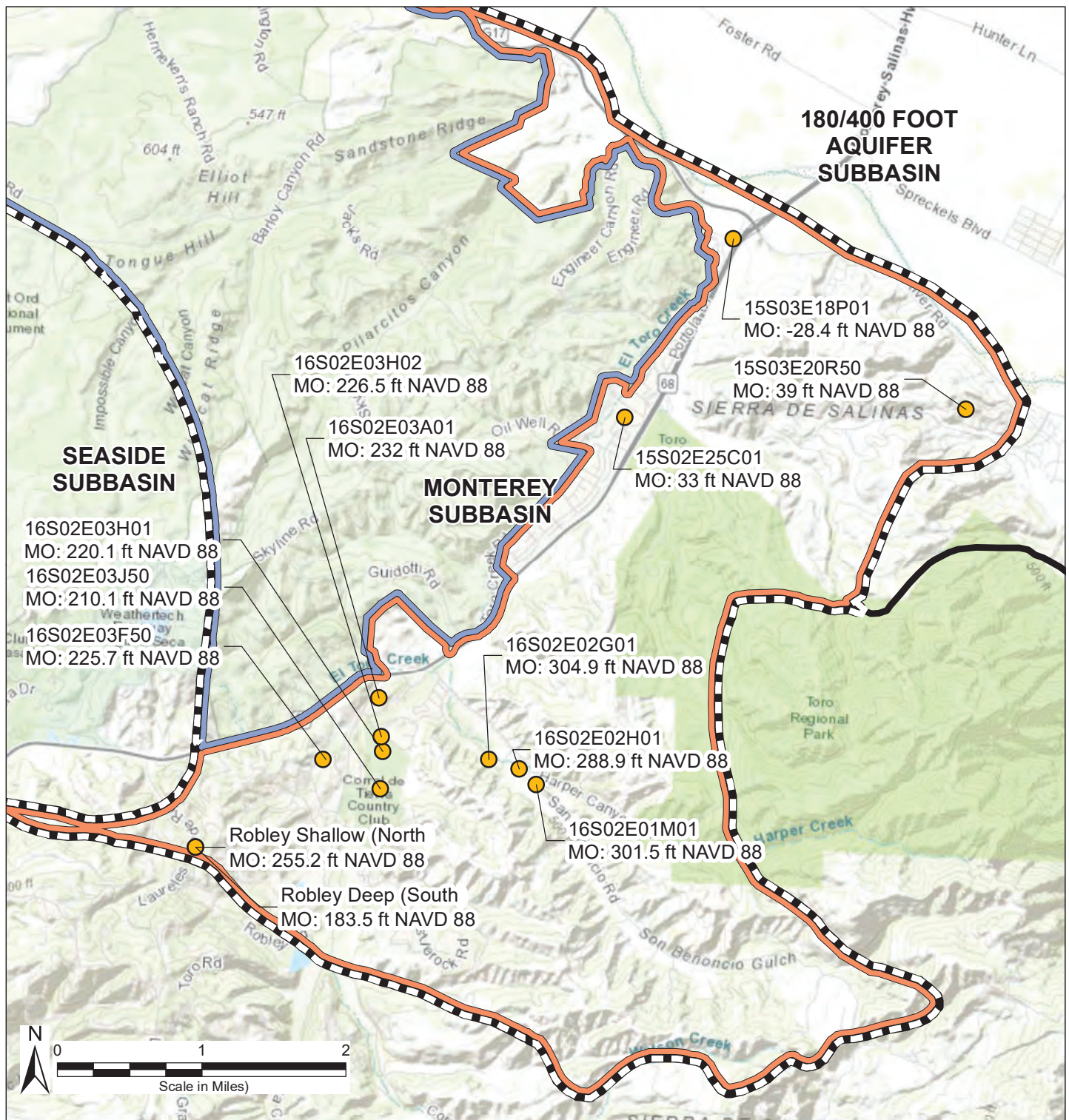
1. All locations are approximate.

## Groundwater Elevation Minimum Thresholds Deep Aquifers

Monterey Subbasin  
Groundwater Sustainability Plan  
April 2021

**Figure 8A-10**





#### Sources

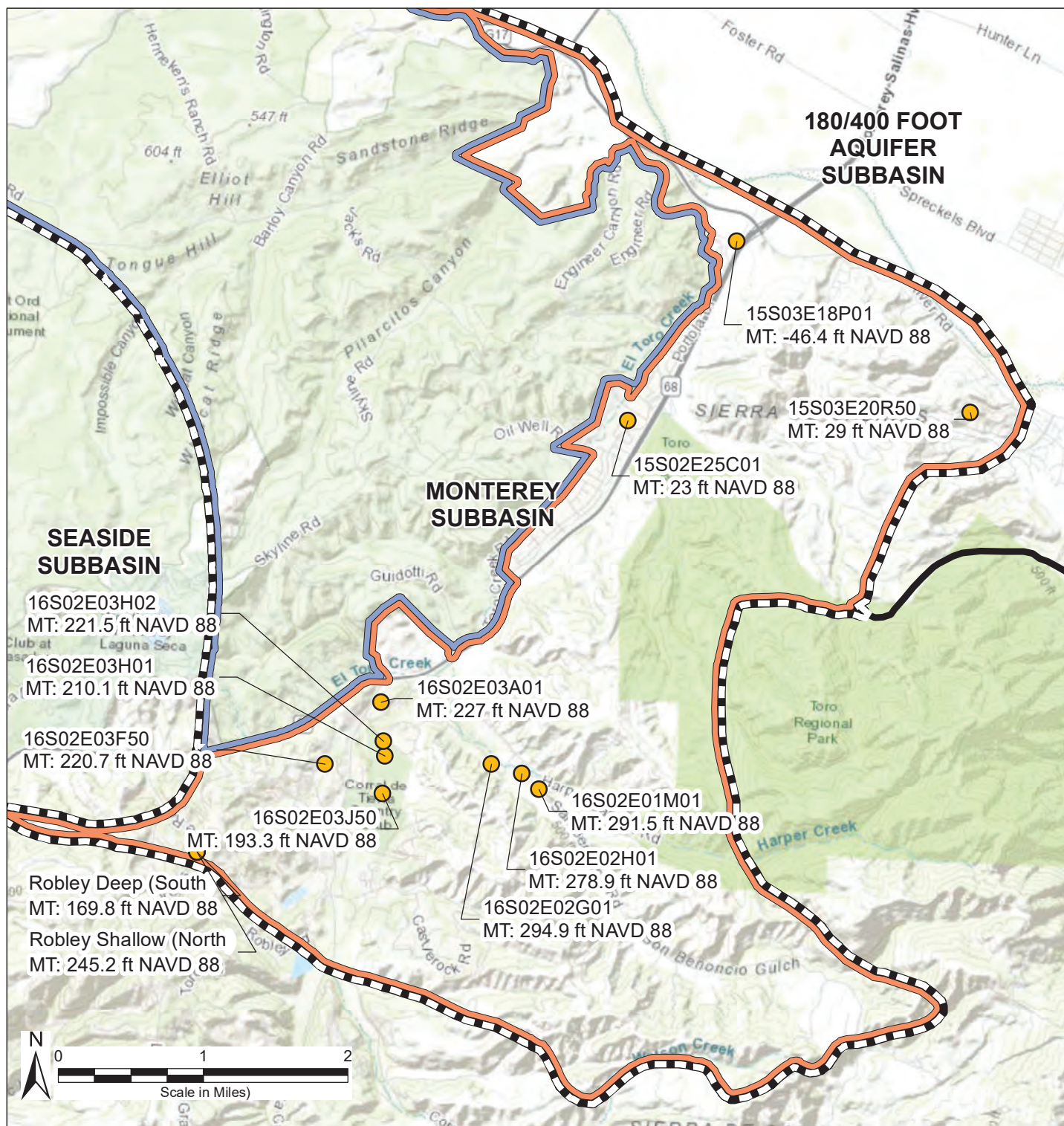
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 24 June 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Measurable Objectives El Toro Primary Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
June 2021

**Figure 8A-11**





#### Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

#### Management Areas

- Marina-Ord Area
- Corral de Tierra Area

#### Abbreviations

MT = Minimum Thresholds

#### Notes

1. All locations are approximate.

#### Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 24 June 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

### Groundwater Elevation Minimum Thresholds El Toro Primary Aquifer

Monterey Subbasin  
Groundwater Sustainability Plan  
June 2021

**Figure 8A-12**

## **Appendix 8-B**

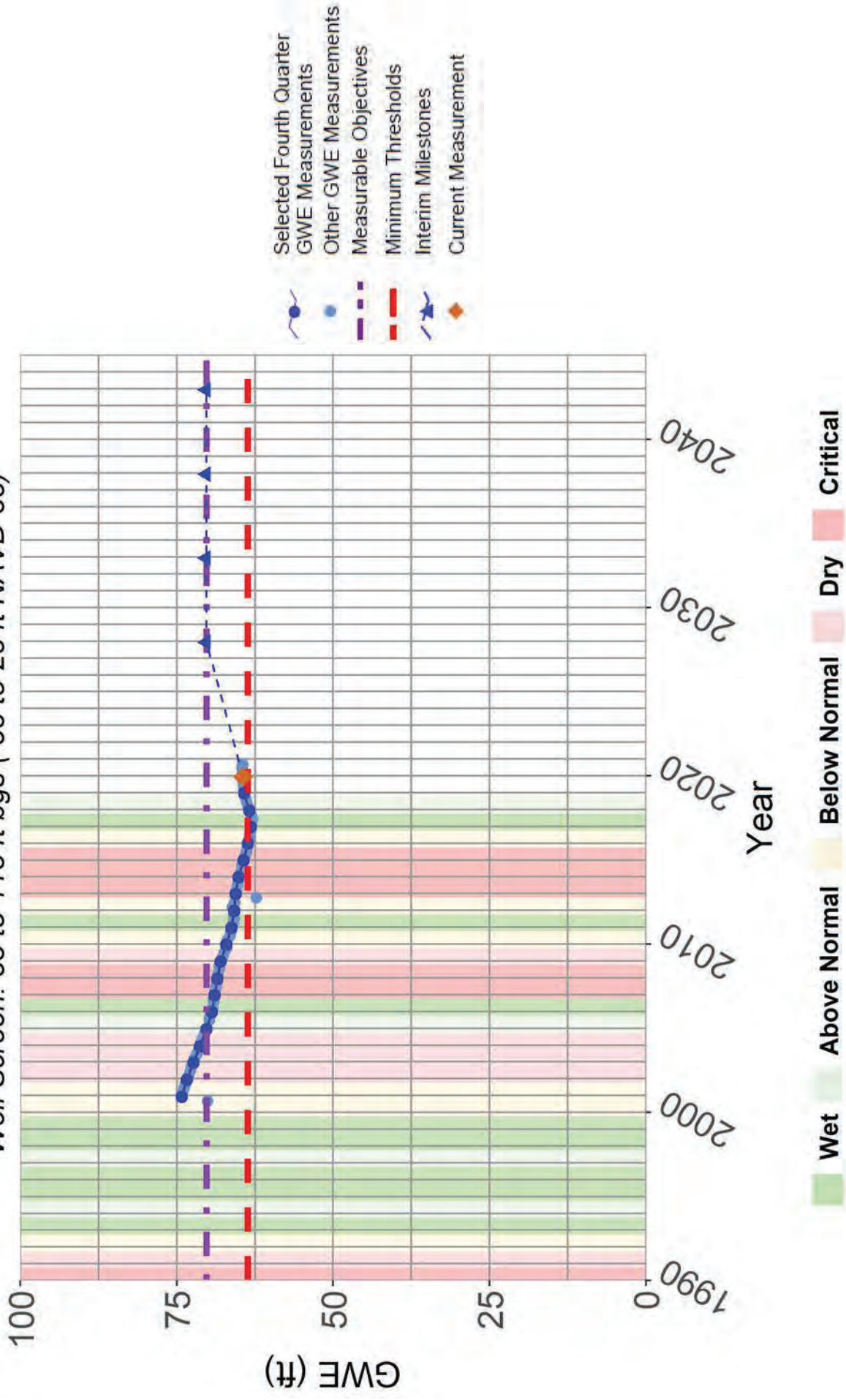
### **Groundwater Elevation Interim Milestones**



# MW-BW-28-A

Dune Sand Aquifer

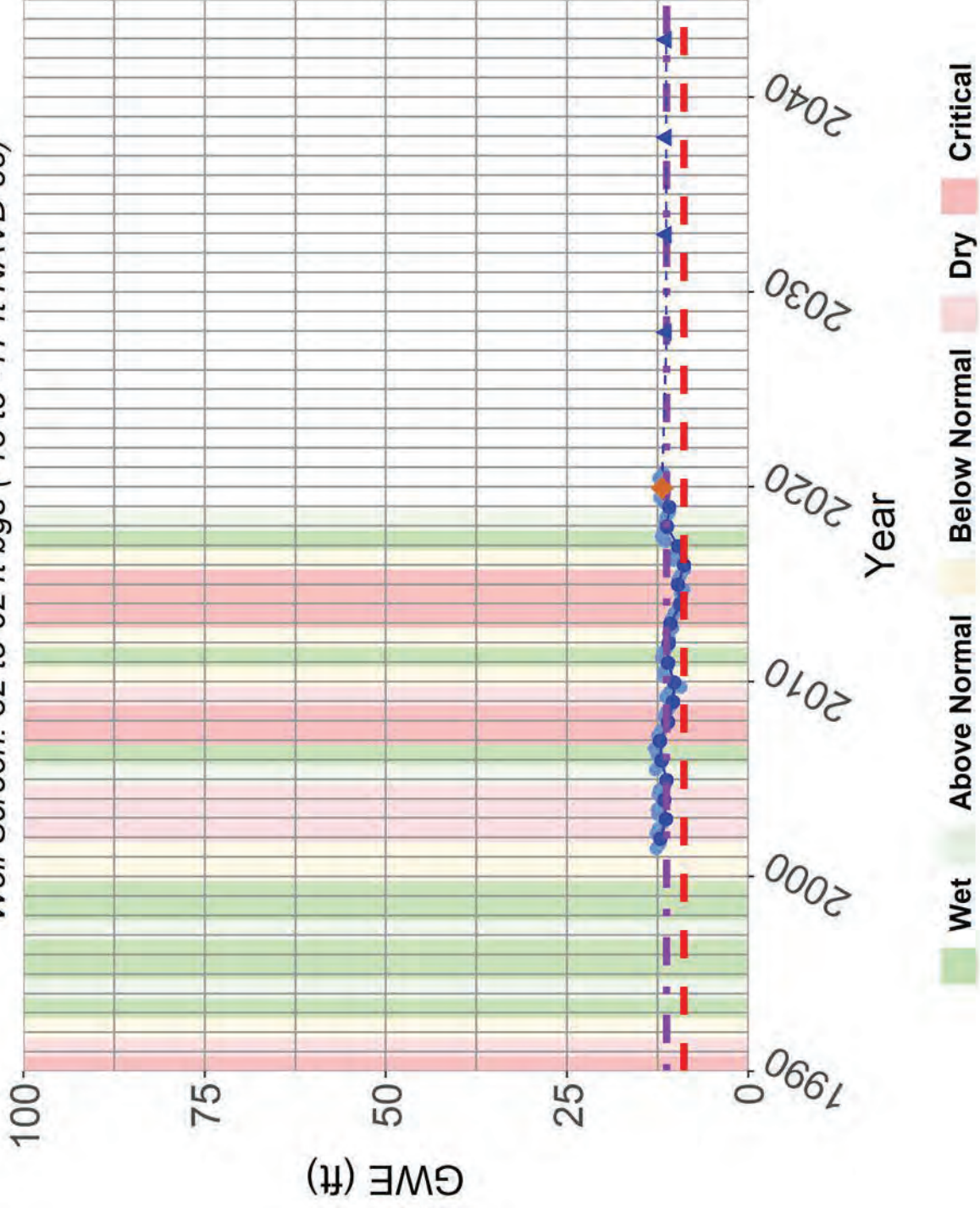
Well Screen: 83 to 113 ft bgs ( 58 to 28 ft NAVD 88)



# MW-BW-49-A

Dune Sand Aquifer

Well Screen: 32 to 62 ft bgs ( 13 to -17 ft NAVD 88)

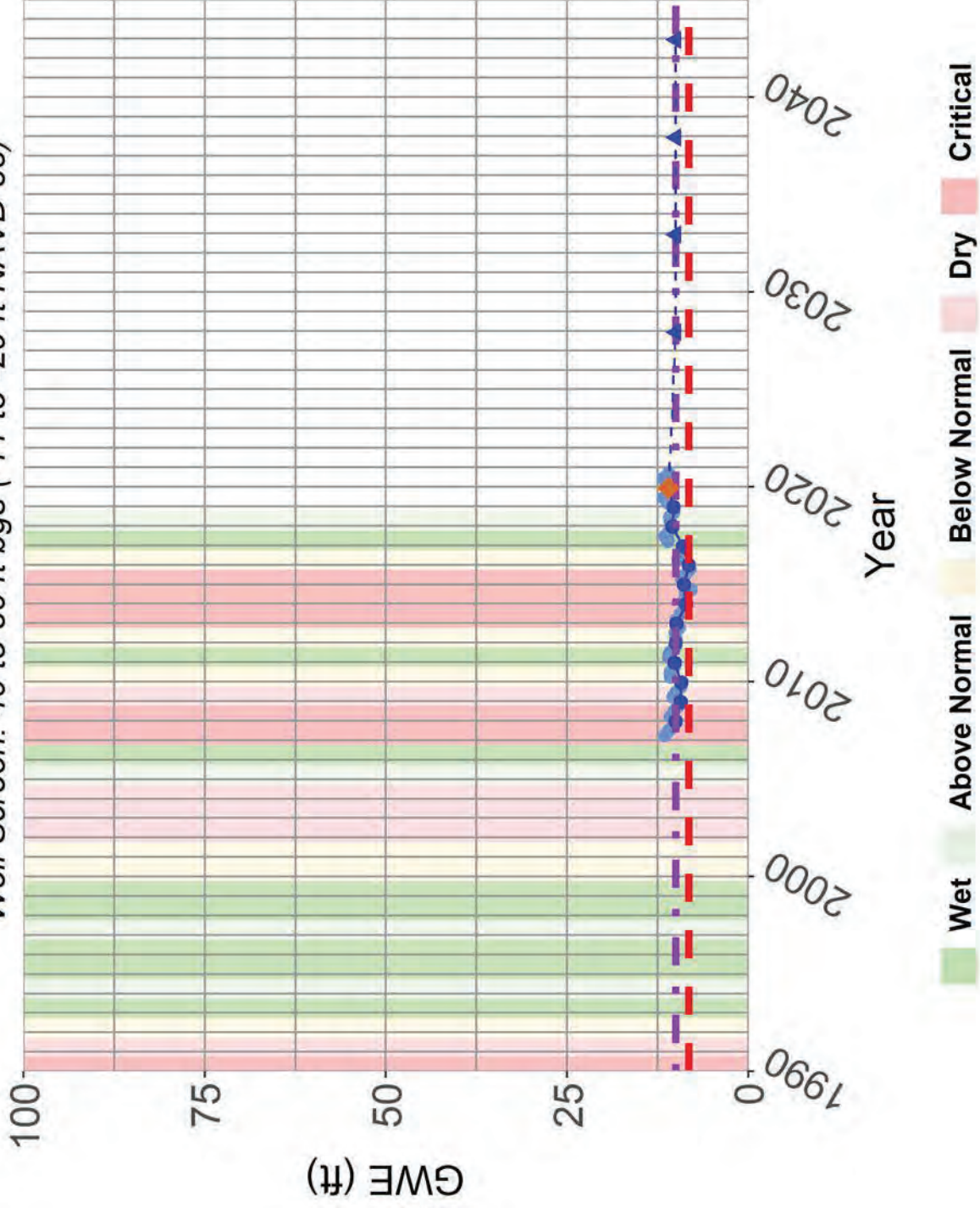




# MW-BW-81-A

Dune Sand Aquifer

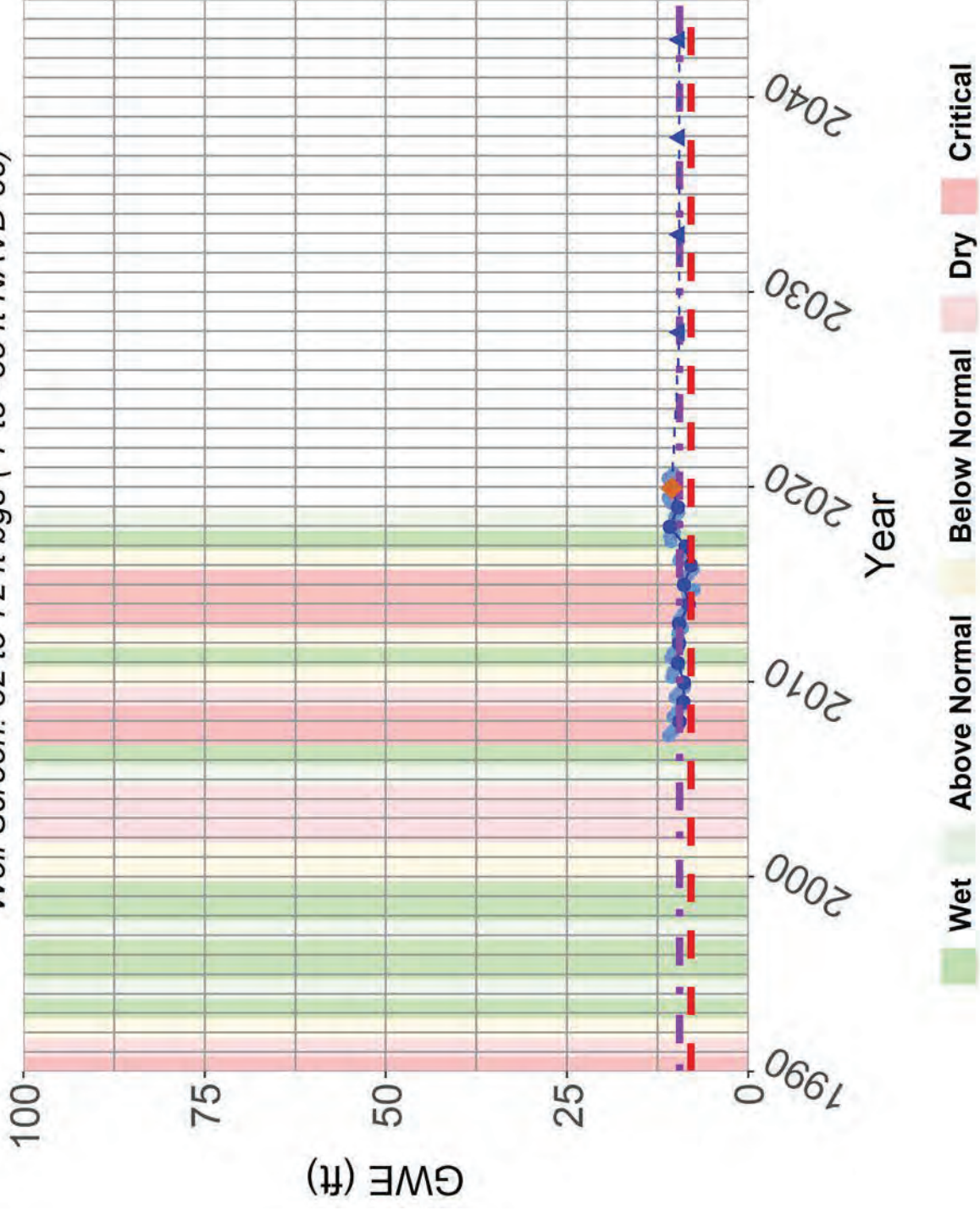
Well Screen: 40 to 80 ft bgs ( 11 to -29 ft NAVD 88)



# MW-BW-82-A

Dune Sand Aquifer

Well Screen: 32 to 72 ft bgs ( 7 to -33 ft NAVD 88)

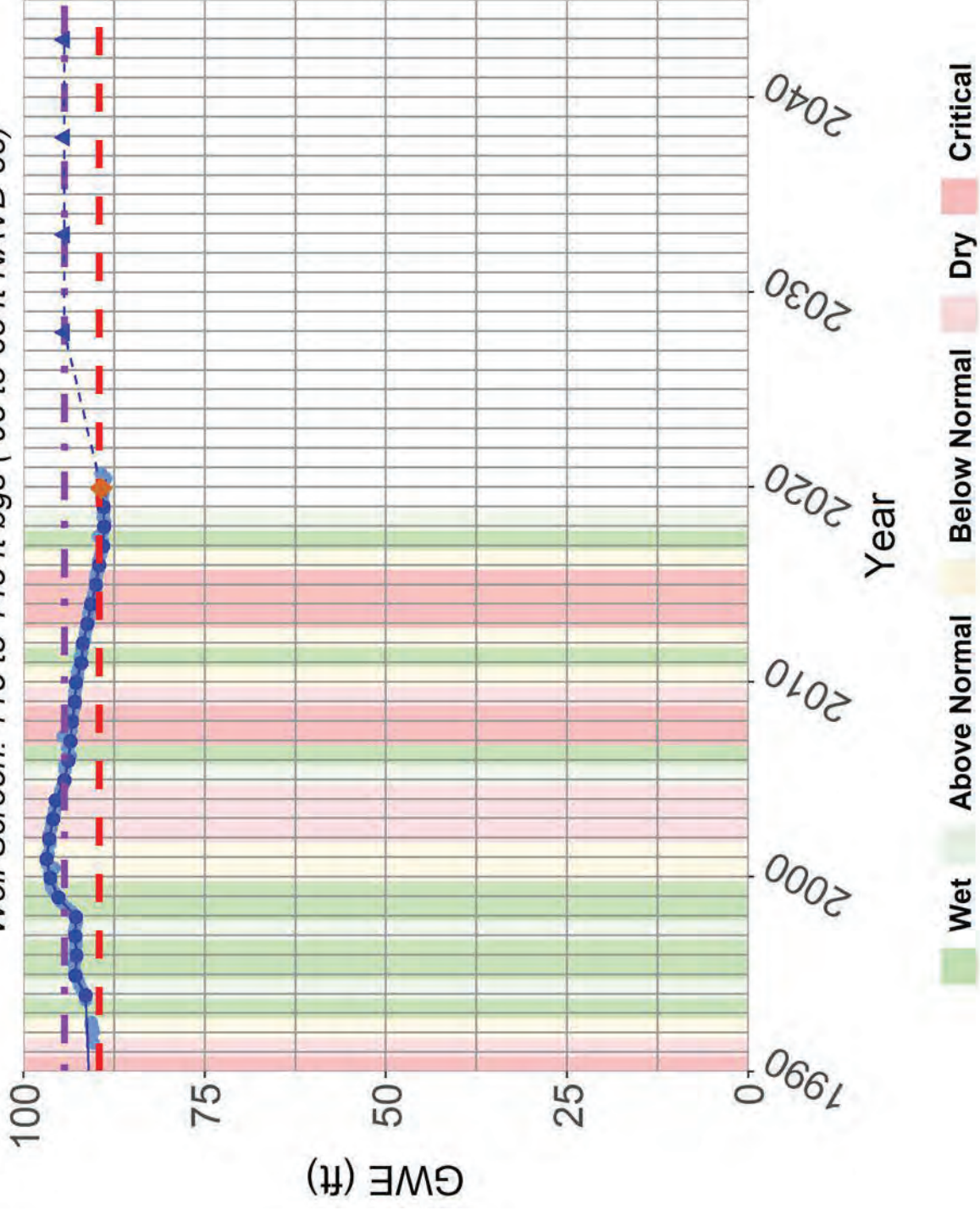




# MW-OU2-13-A

Dune Sand Aquifer

Well Screen: 115 to 145 ft bgs ( 95 to 65 ft NAVD 88)

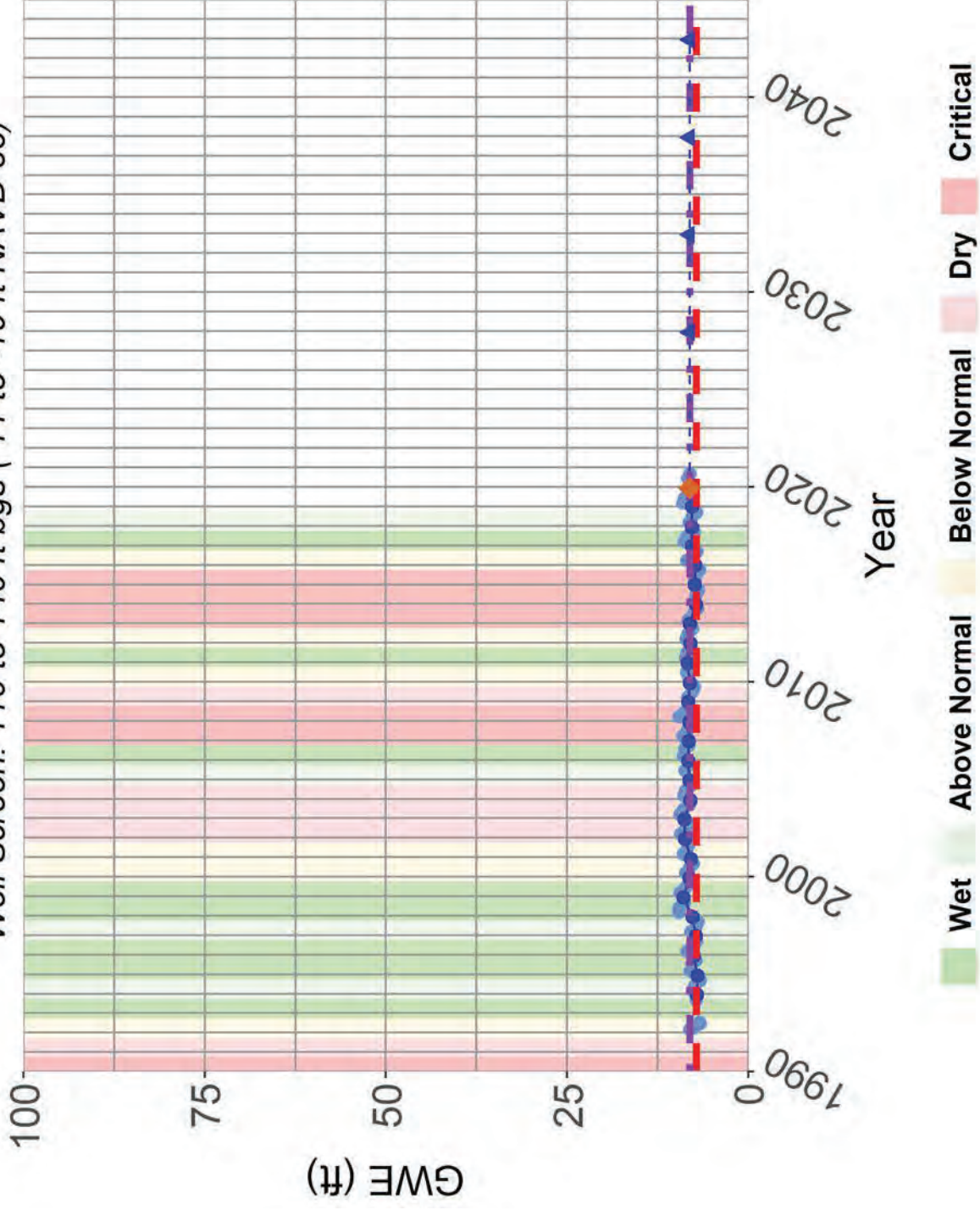




# MW-OU2-32-A

Dune Sand Aquifer

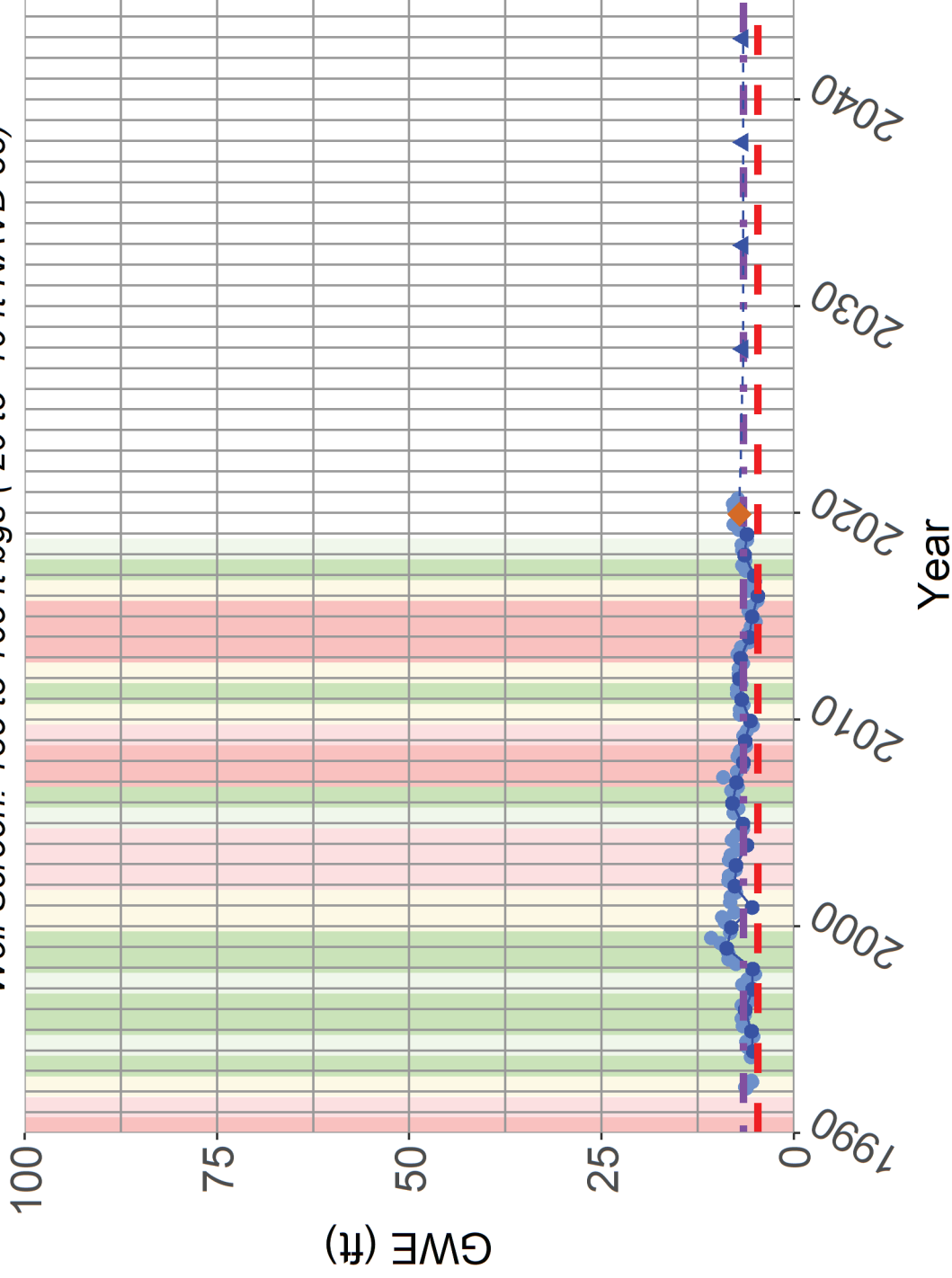
Well Screen: 110 to 140 ft bgs ( 11 to -19 ft NAVD 88)



# MW-OU2-34-A

Dune Sand Aquifer

Well Screen: 135 to 165 ft bgs ( 20 to -10 ft NAVD 88)



GWF (ft)

Year

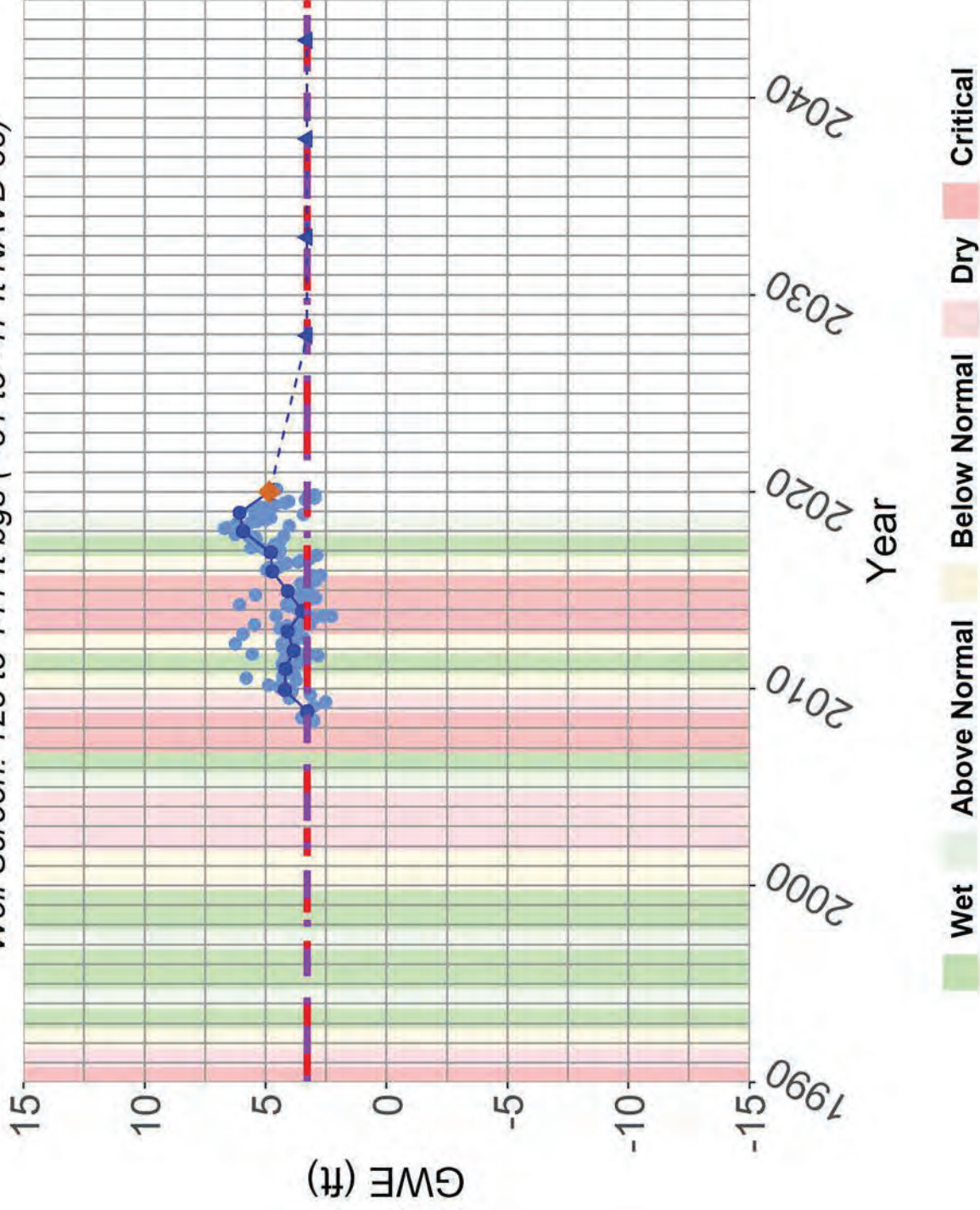
- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- Measurable Objectives
- Minimum Thresholds
- Interim Milestones
- Current Measurement

Wet Above Normal Below Normal Dry Critical

# CDM MW-1 Beach

Upper 180-Foot Aquifer

Well Screen: 125 to 141 ft bgs ( -31 to -47 ft NAVD 88)

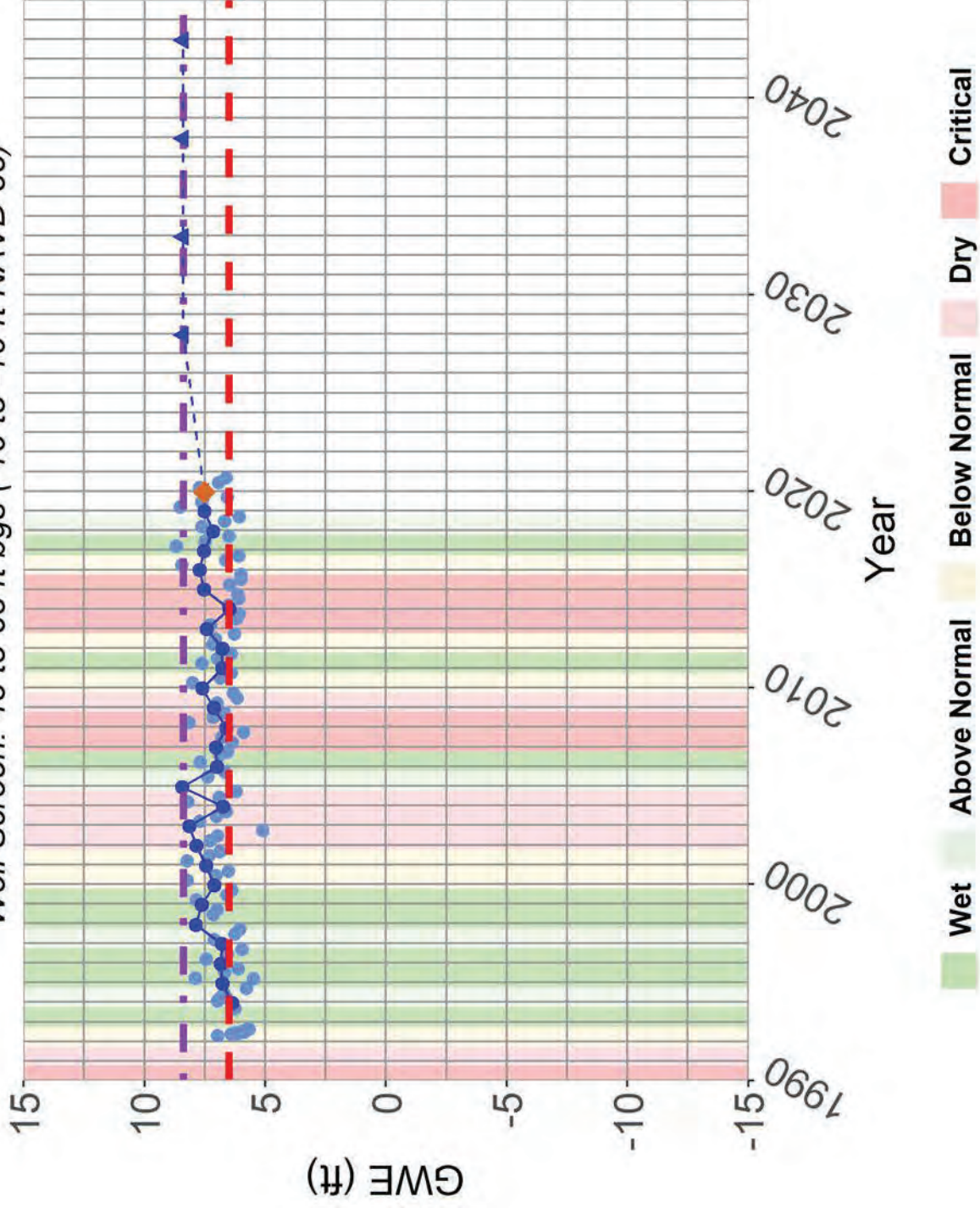




# MW-02-05-180

Upper 180-Foot Aquifer

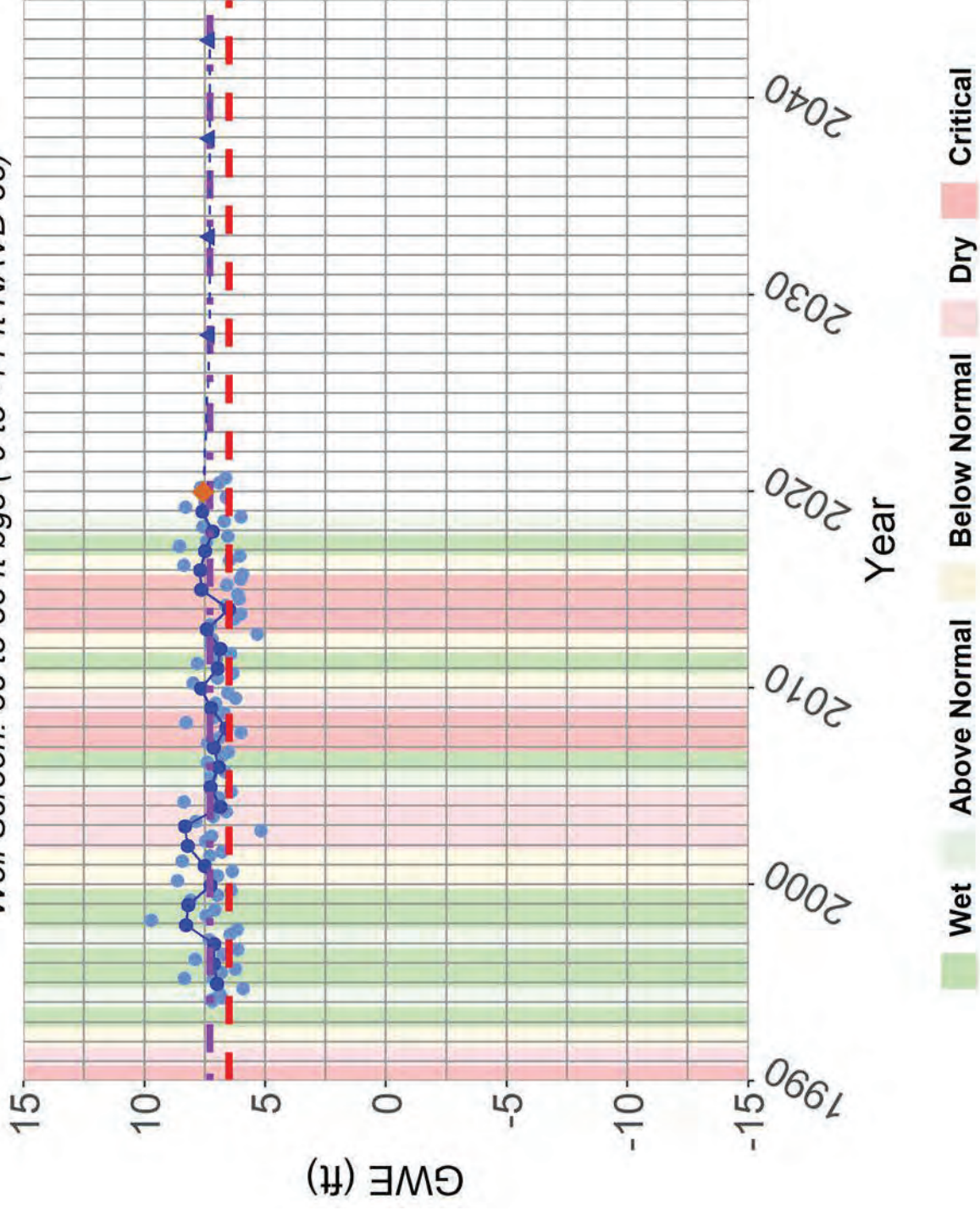
Well Screen: 48 to 68 ft bgs ( 10 to -10 ft NAVD 88)



# MW-02-10-180

Upper 180-Foot Aquifer

Well Screen: 38 to 58 ft bgs ( 9 to -11 ft NAVD 88)

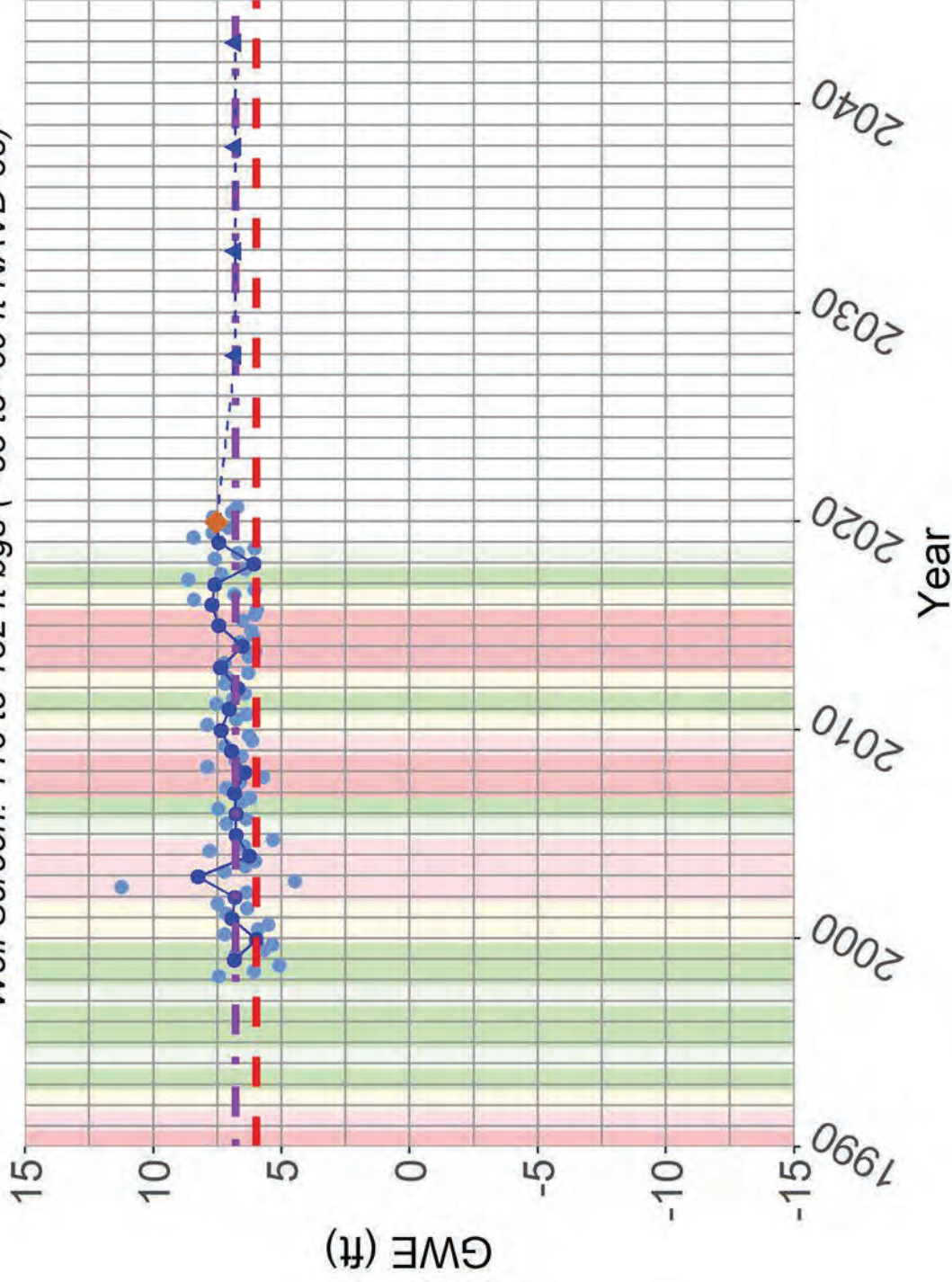




# MW-02-13-180M

Upper 180-Foot Aquifer

Well Screen: 116 to 132 ft bgs ( -53 to -69 ft NAVD 88)



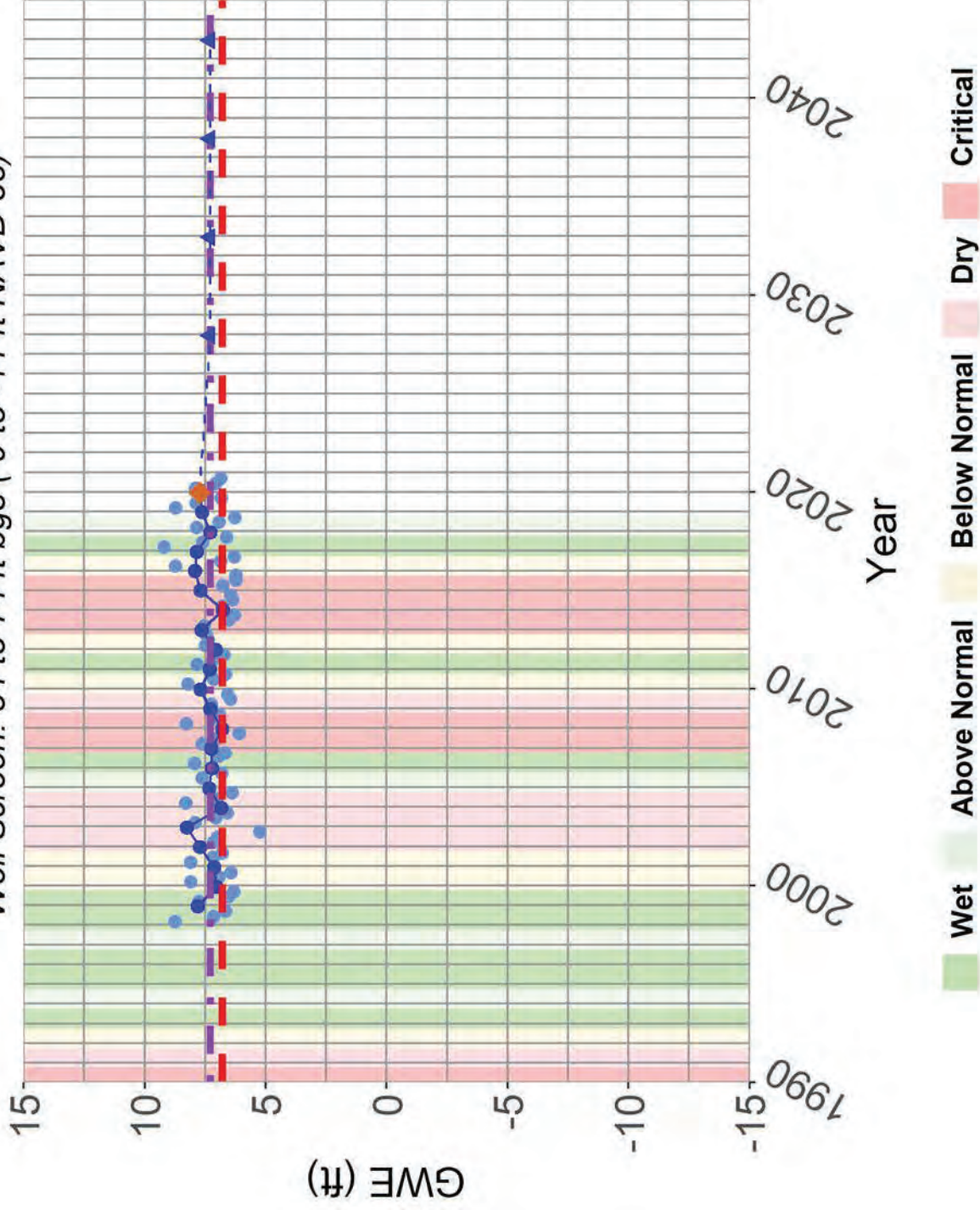
- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- Measurable Objectives
- Minimum Thresholds
- Interim Milestones
- Current Measurement

Wet Above Normal Below Normal Dry Critical

# MW-02-13-180U

Upper 180-Foot Aquifer

Well Screen: 54 to 74 ft bgs ( 9 to -11 ft NAVD 88)

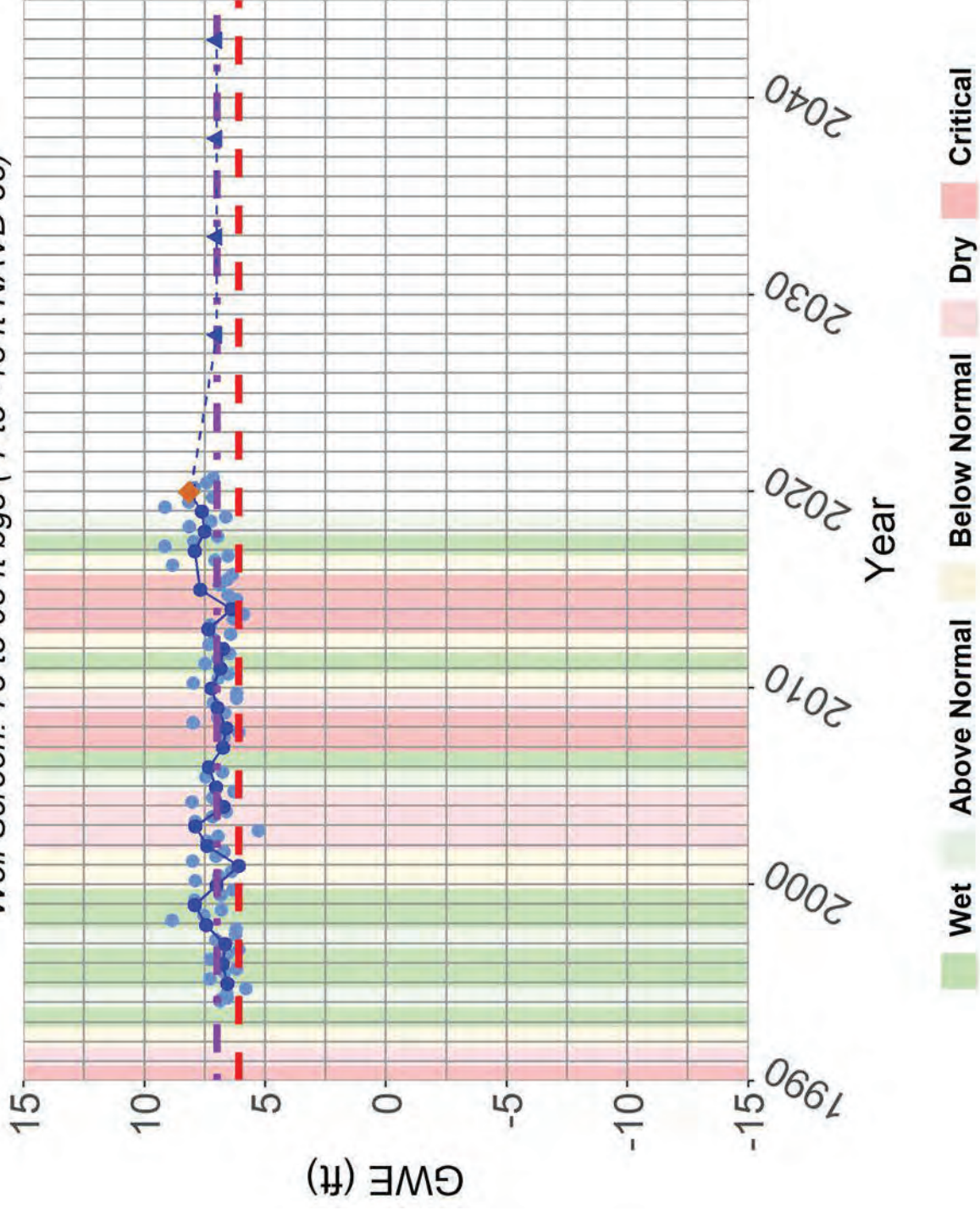




# MW-12-07-180

Upper 180-Foot Aquifer

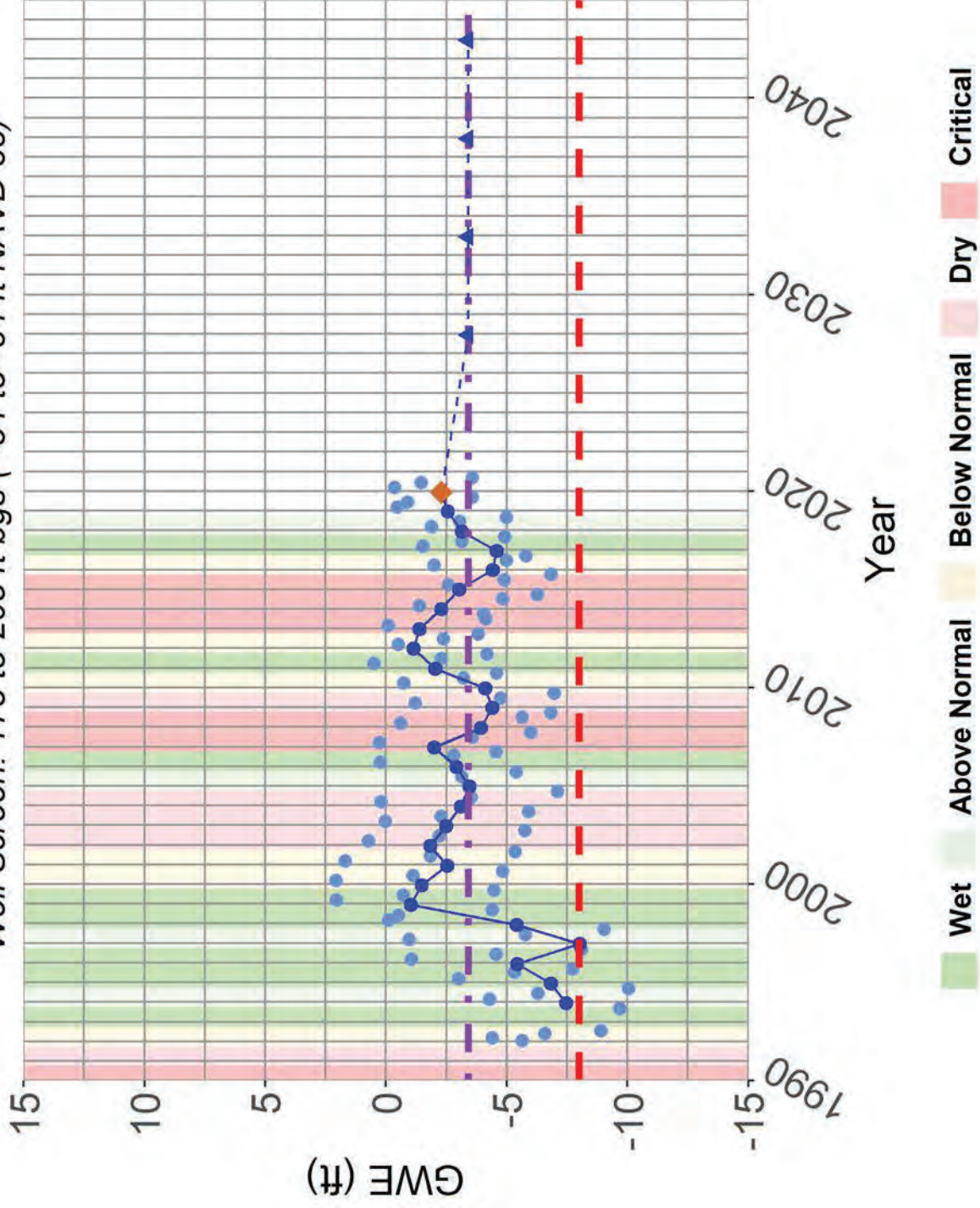
Well Screen: 73 to 93 ft bgs ( 7 to -13 ft NAVD 88)



# MW-B-05-180

Upper 180-Foot Aquifer

Well Screen: 175 to 205 ft bgs ( -54 to -84 ft NAVD 88)

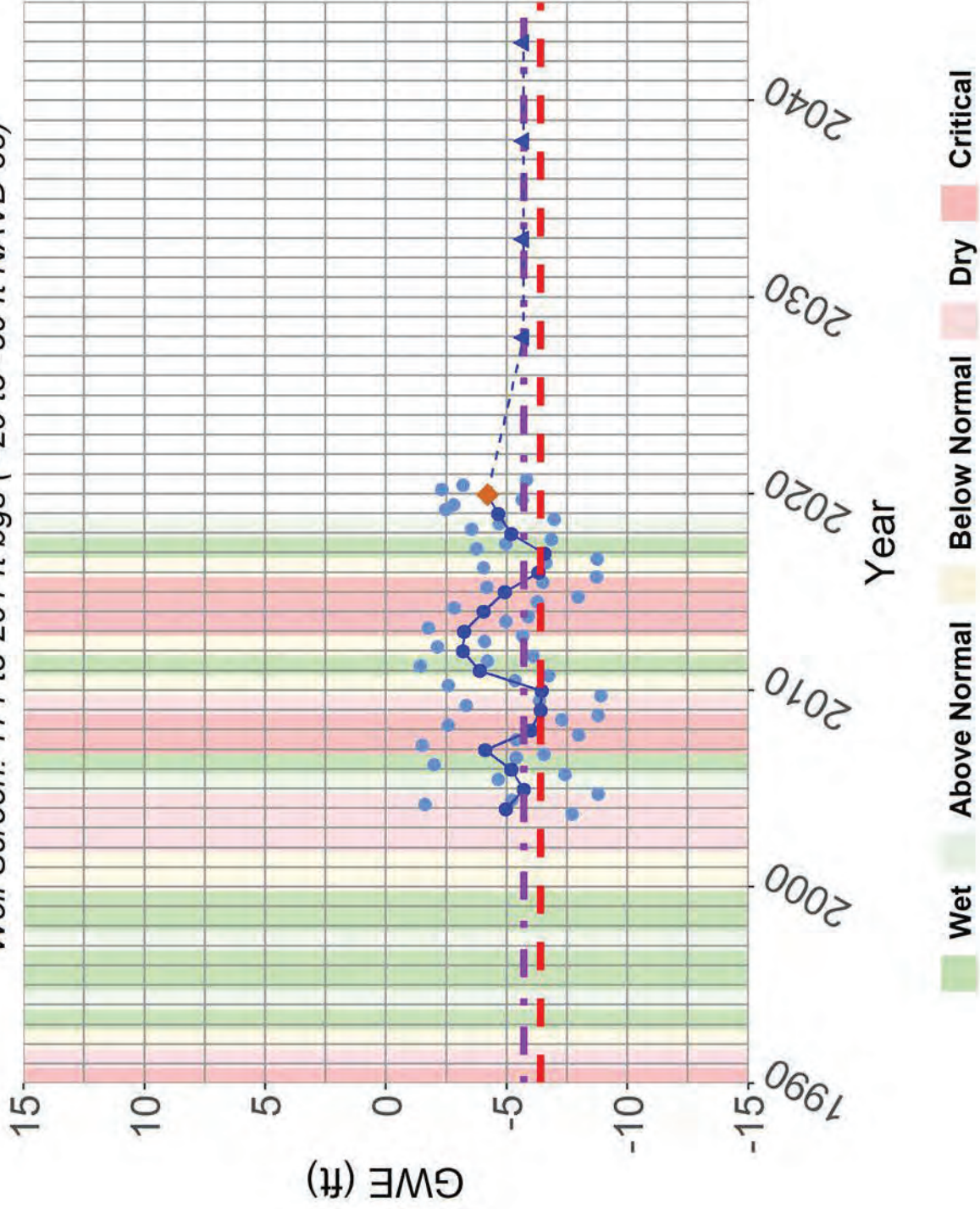




# MW-BW-55-180

Upper 180-Foot Aquifer

Well Screen: 171 to 201 ft bgs ( -29 to -59 ft NAVD 88)

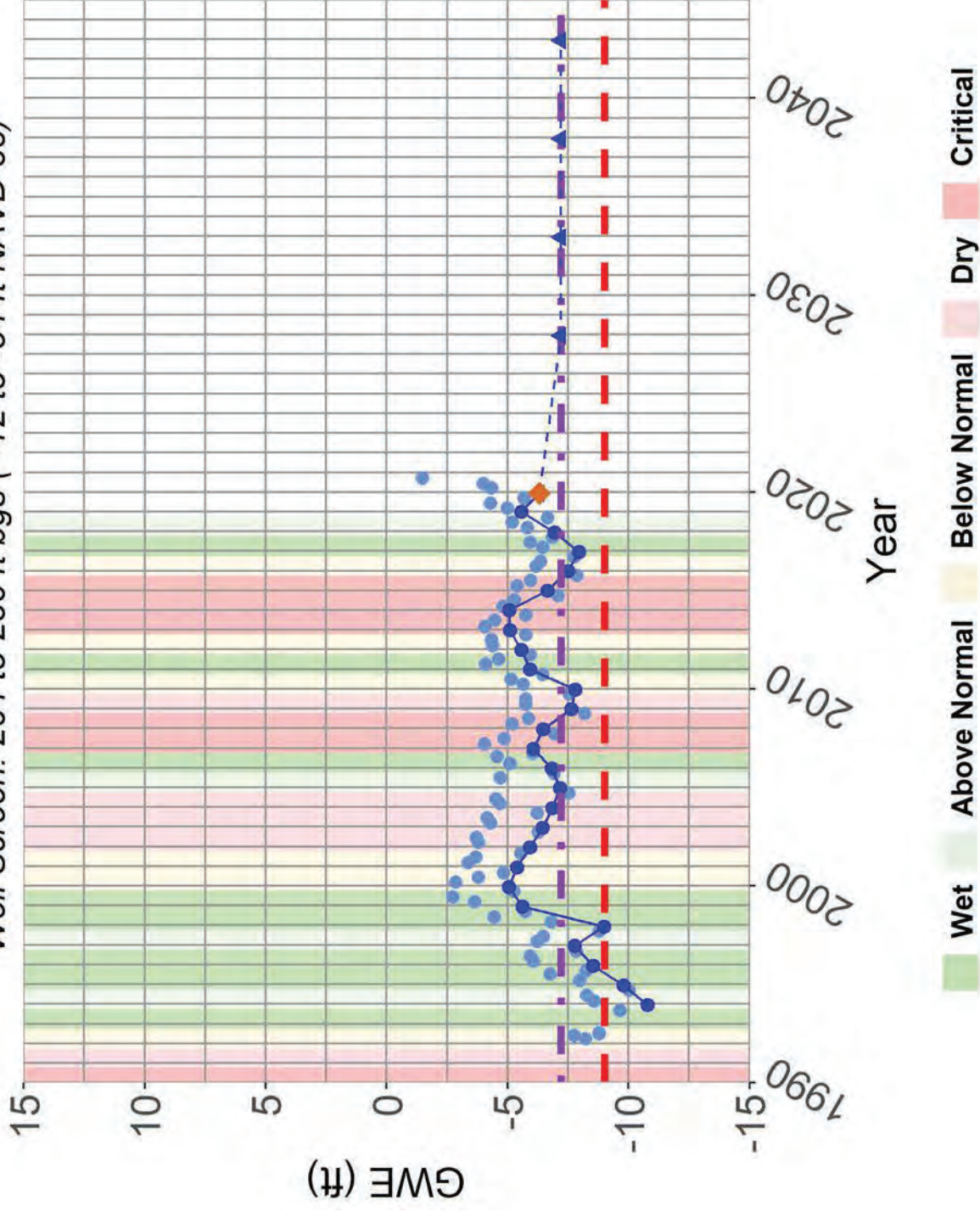




# MW-OU2-29-180

Upper 180-Foot Aquifer

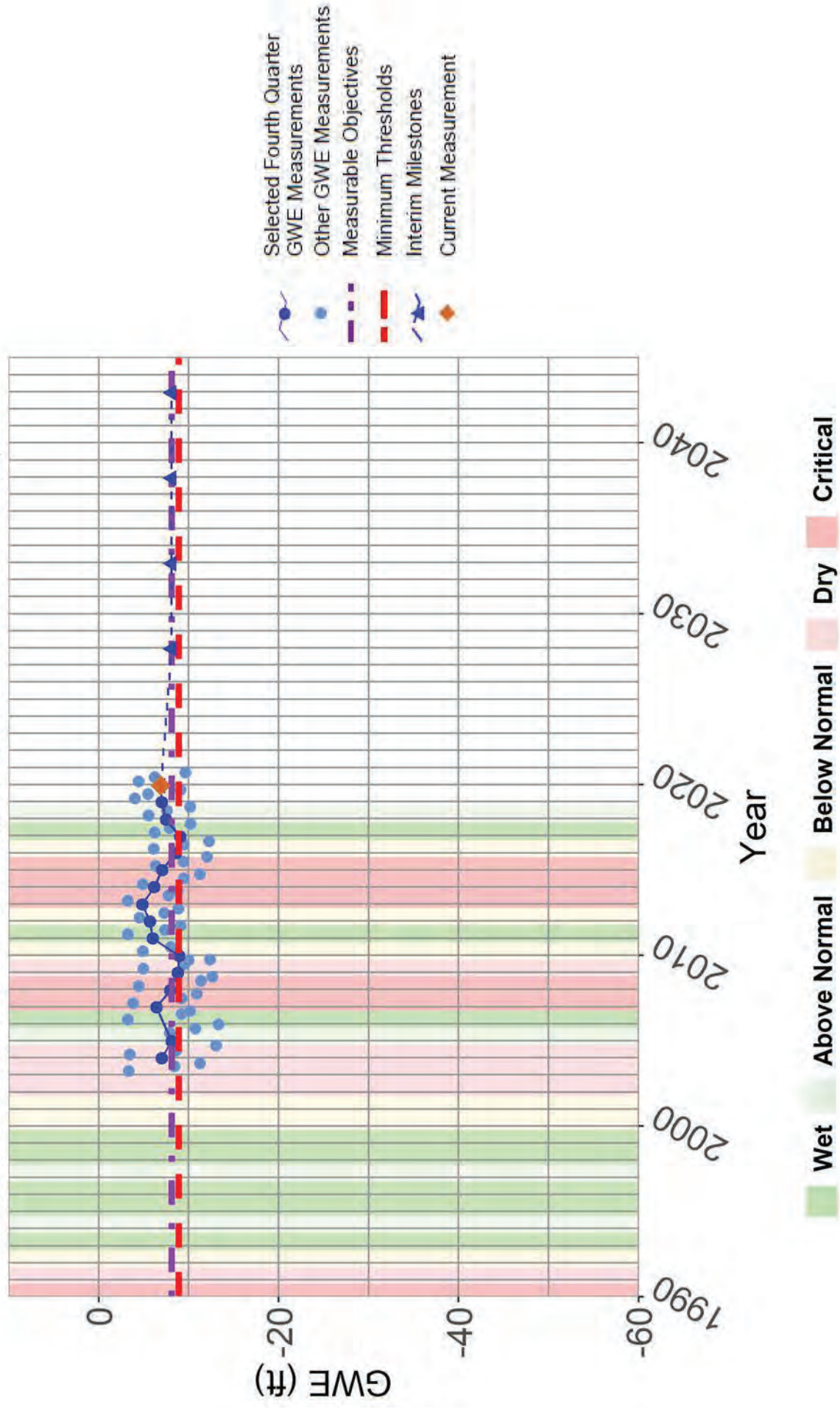
Well Screen: 264 to 286 ft bgs ( -12 to -34 ft NAVD 88)



# MP-BW-42-295

Lower 180-Foot Aquifer

Well Screen: 295 to 295 ft bgs ( -145 to -145 ft NAVD 88)

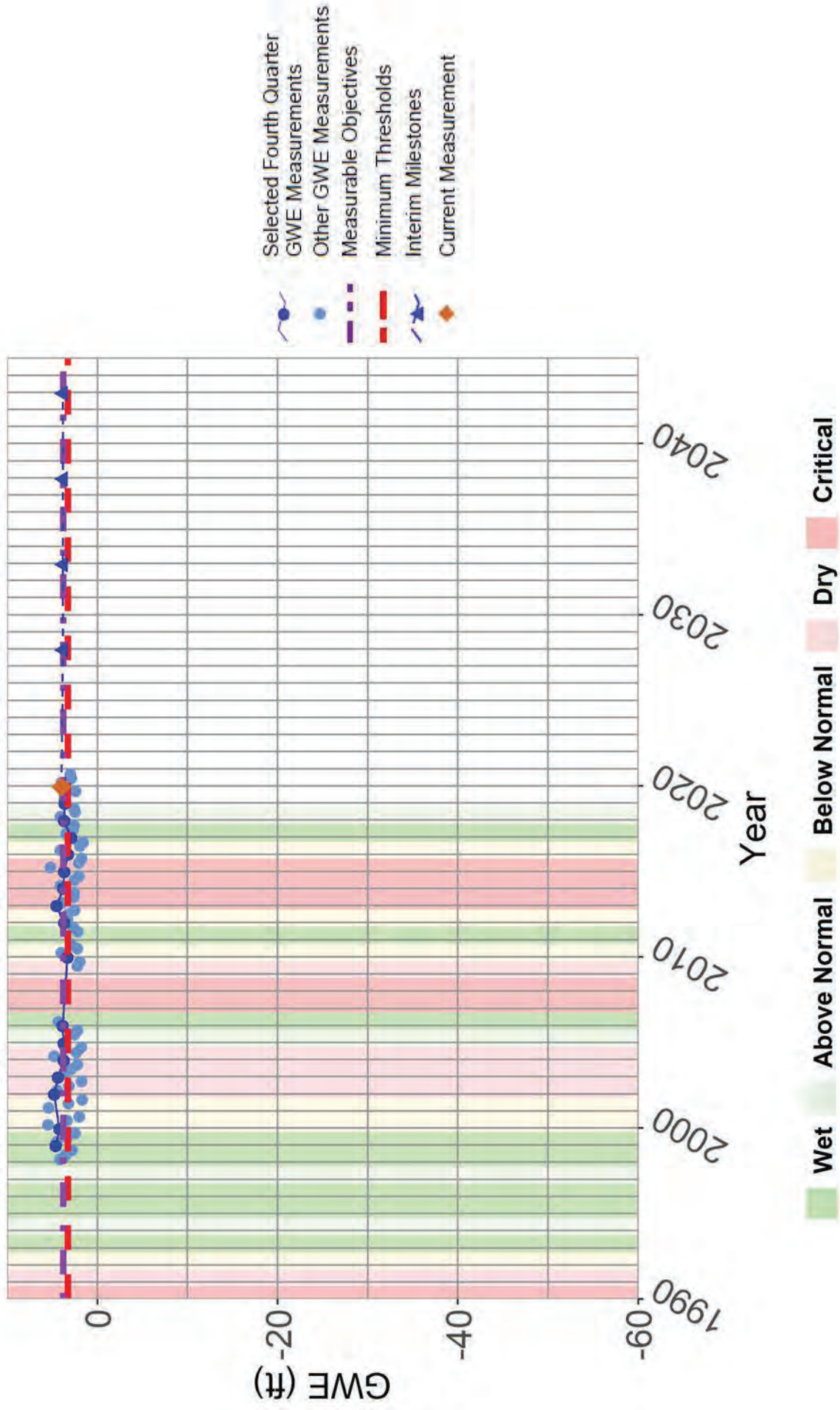




# MW-12-12-180L

Lower 180-Foot Aquifer

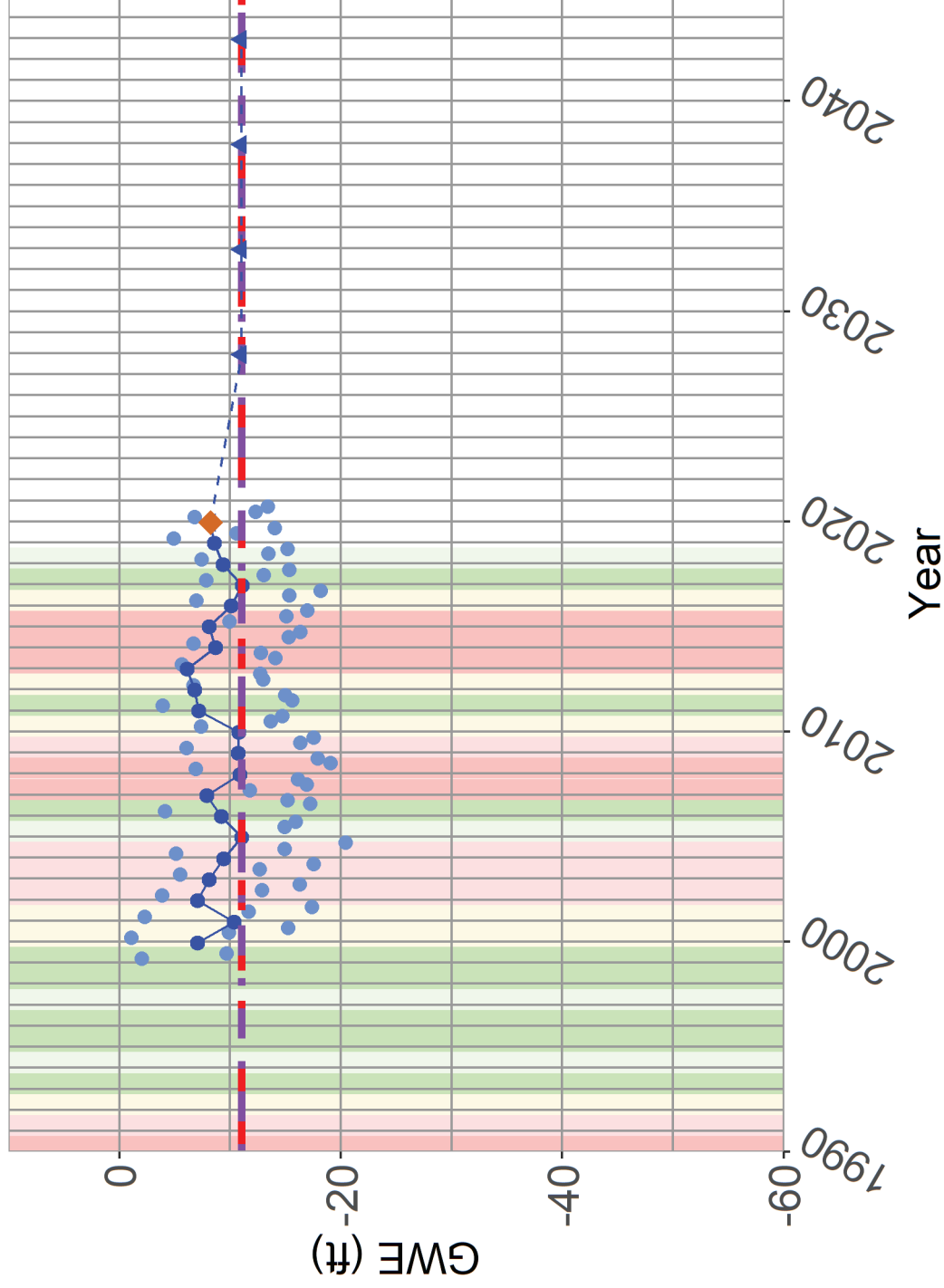
Well Screen: 161 to 176 ft bgs ( -88 to -103 ft NAVD 88)



# MW-BW-04-180

Lower 180-Foot Aquifer

Well Screen: 343 to 363 ft bgs ( -204 to -224 ft NAVD 88)



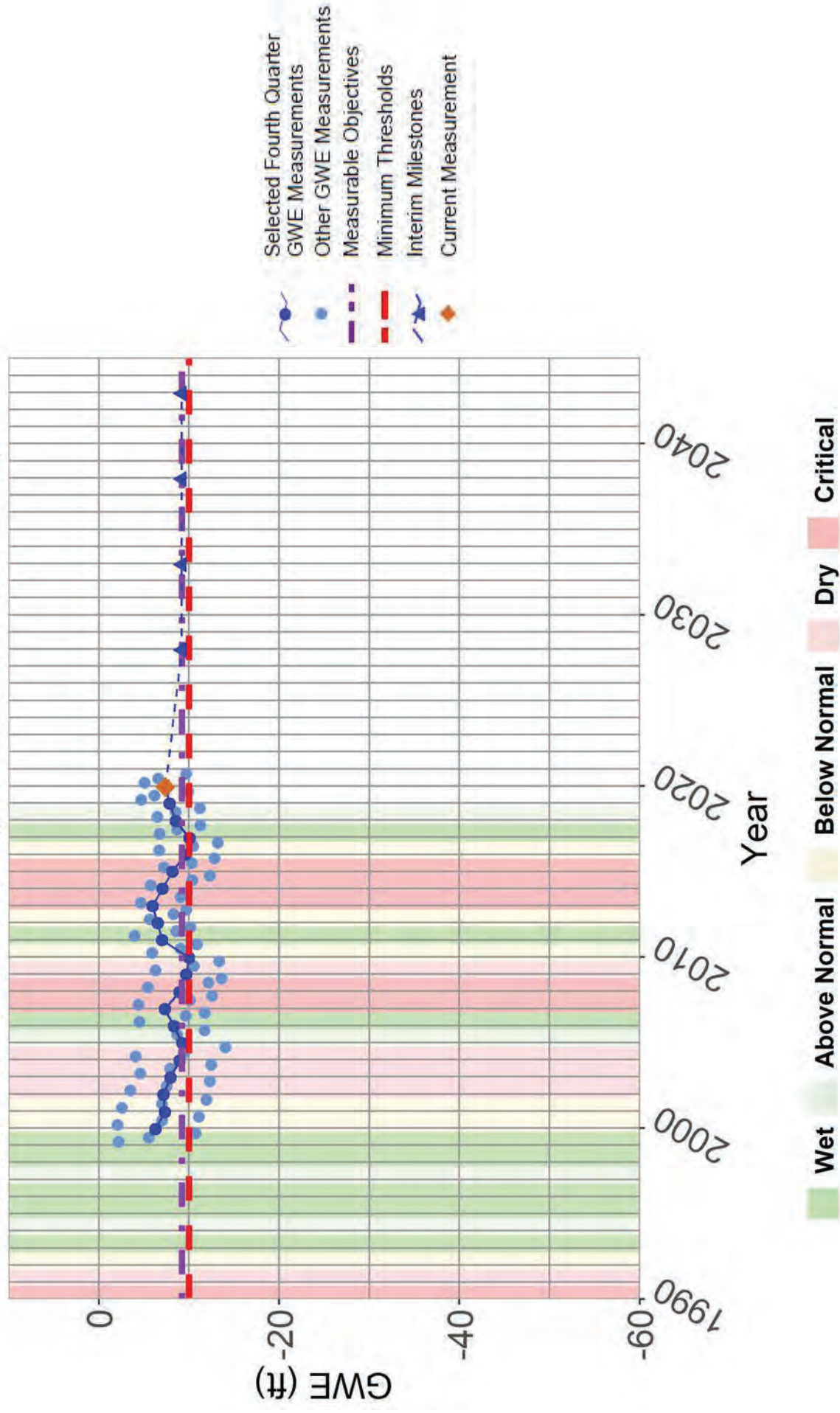
- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- Measurable Objectives
- Minimum Thresholds
- Interim Milestones
- Current Measurement

Wet Above Normal Below Normal Dry Critical

# MW-OU2-66-180

Lower 180-Foot Aquifer

Well Screen: 318 to 338 ft bgs ( -174 to -194 ft NAVD 88)

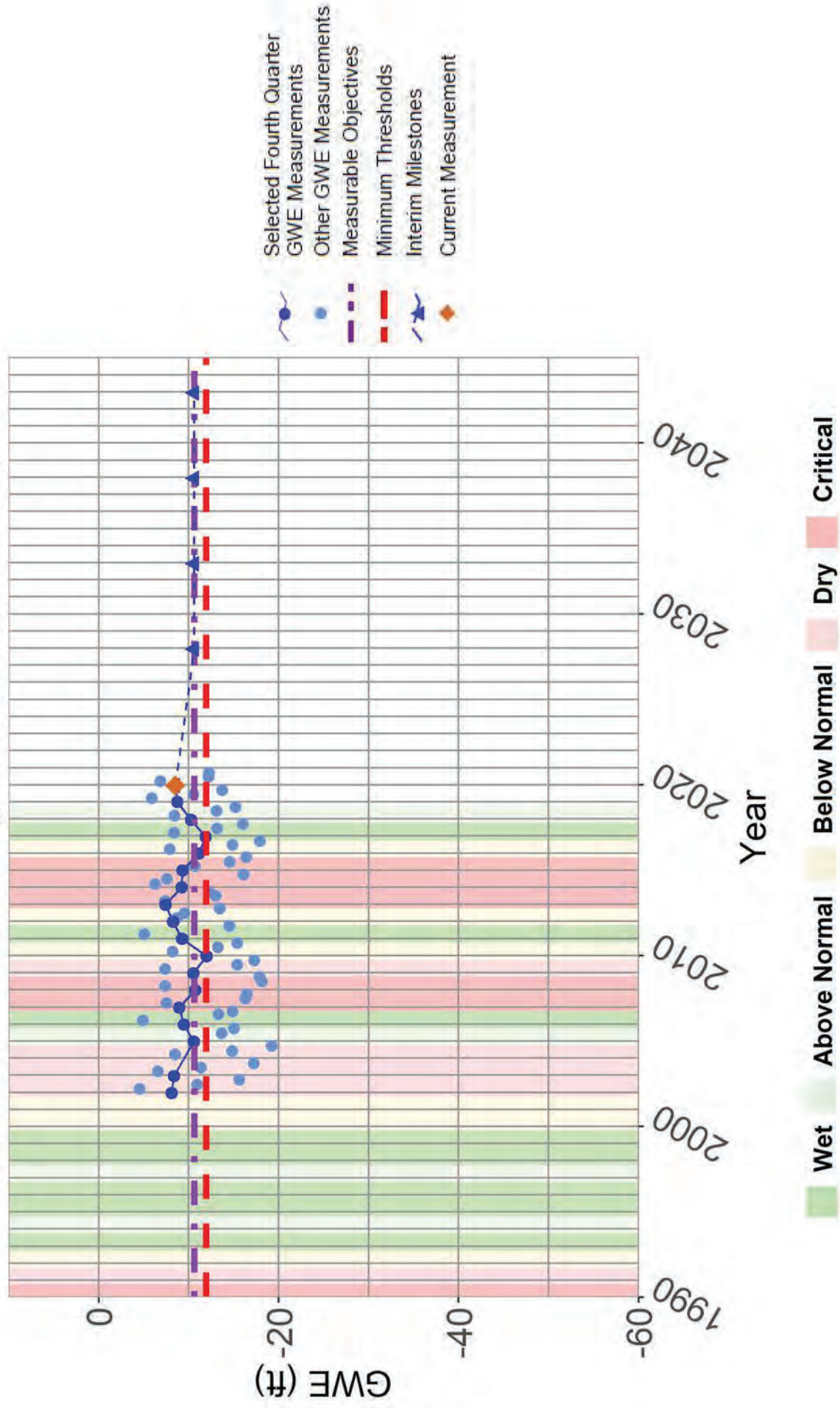




# TEST2

Lower 180-Foot Aquifer

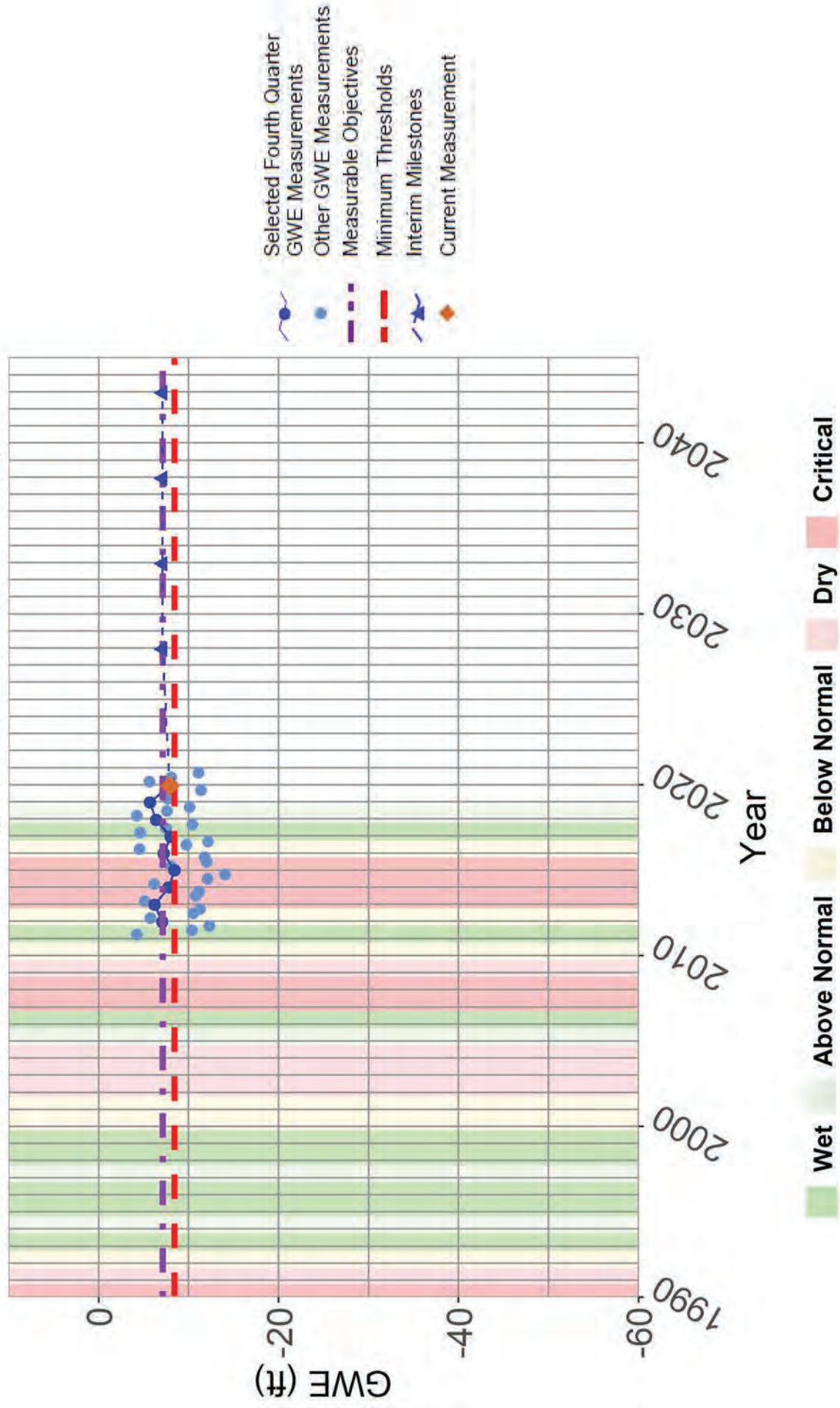
Well Screen: 345 to 420 ft bgs ( -95 to -170 ft NAVD 88)



# MP-BW-50-289

Lower 180-Foot, 400-Foot Aquifer

Well Screen: 287 to 292 ft bgs ( -150 to -155 ft NAVD 88)

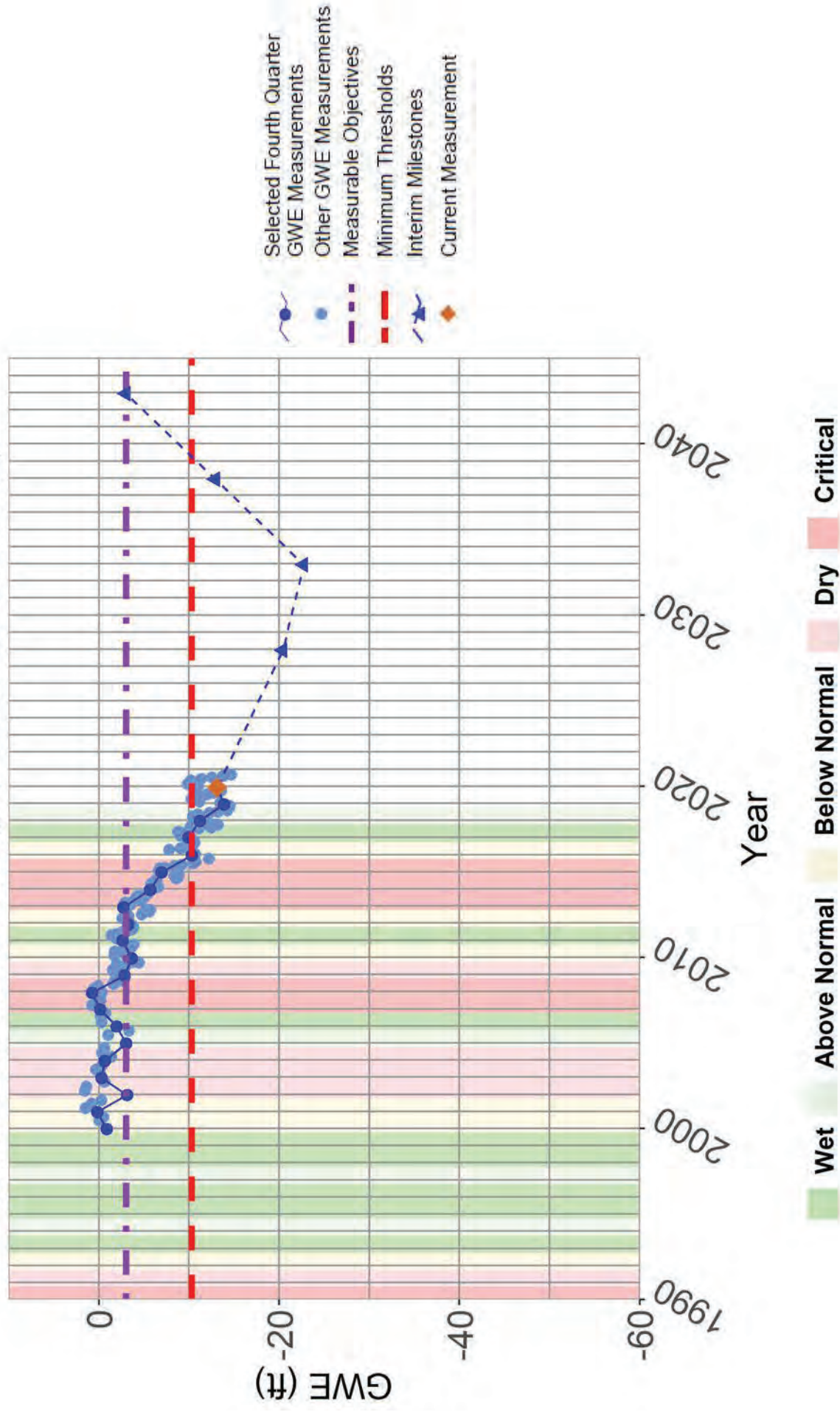




# MPWMD#FO-10S

400-Foot Aquifer

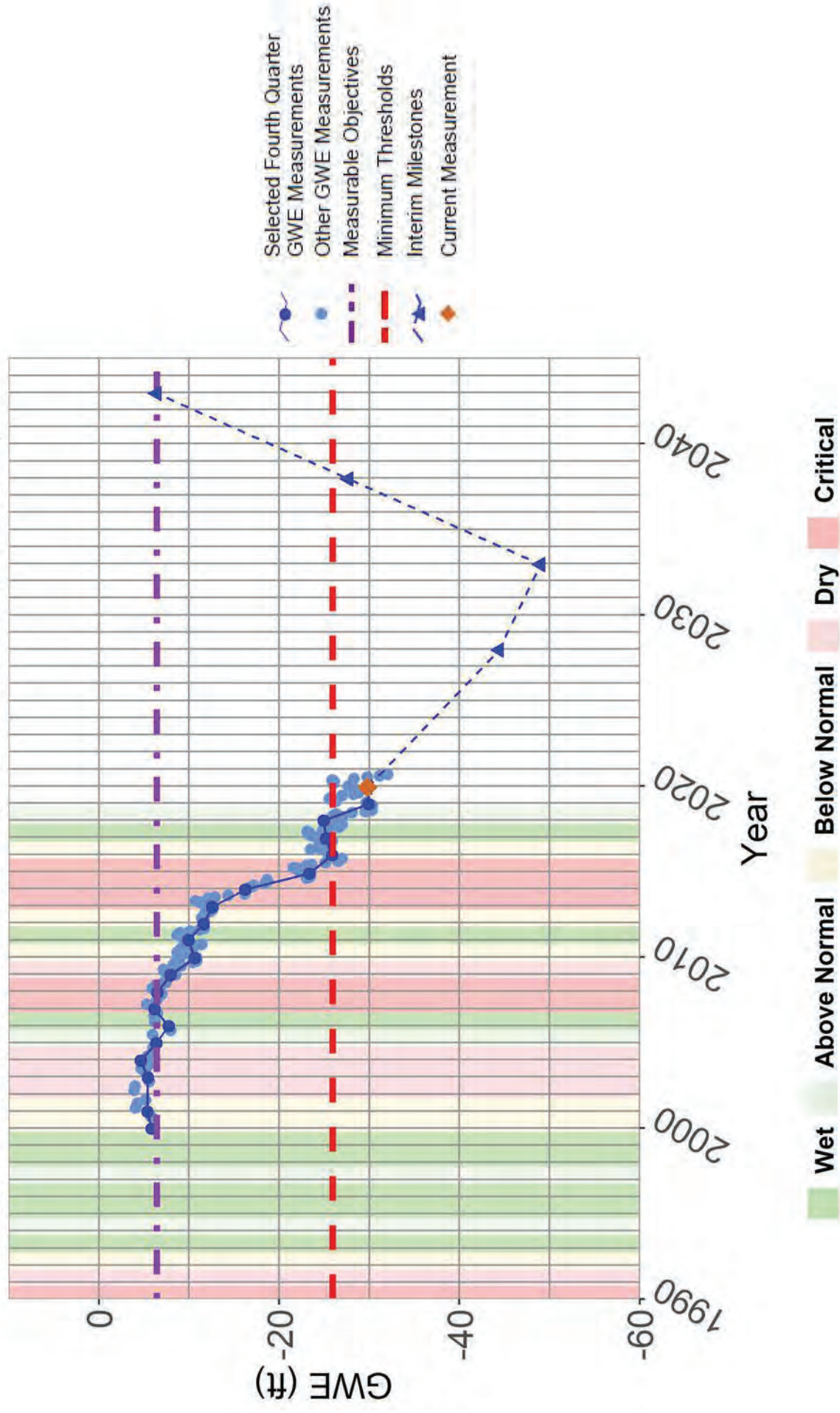
Well Screen: 620 to 640 ft bgs ( -419 to -439 ft NAVD 88)



# MPWMD#FO-11S

400-Foot Aquifer

Well Screen: 1090 to 1120 ft bgs ( -757 to -787 ft NAVD 88)

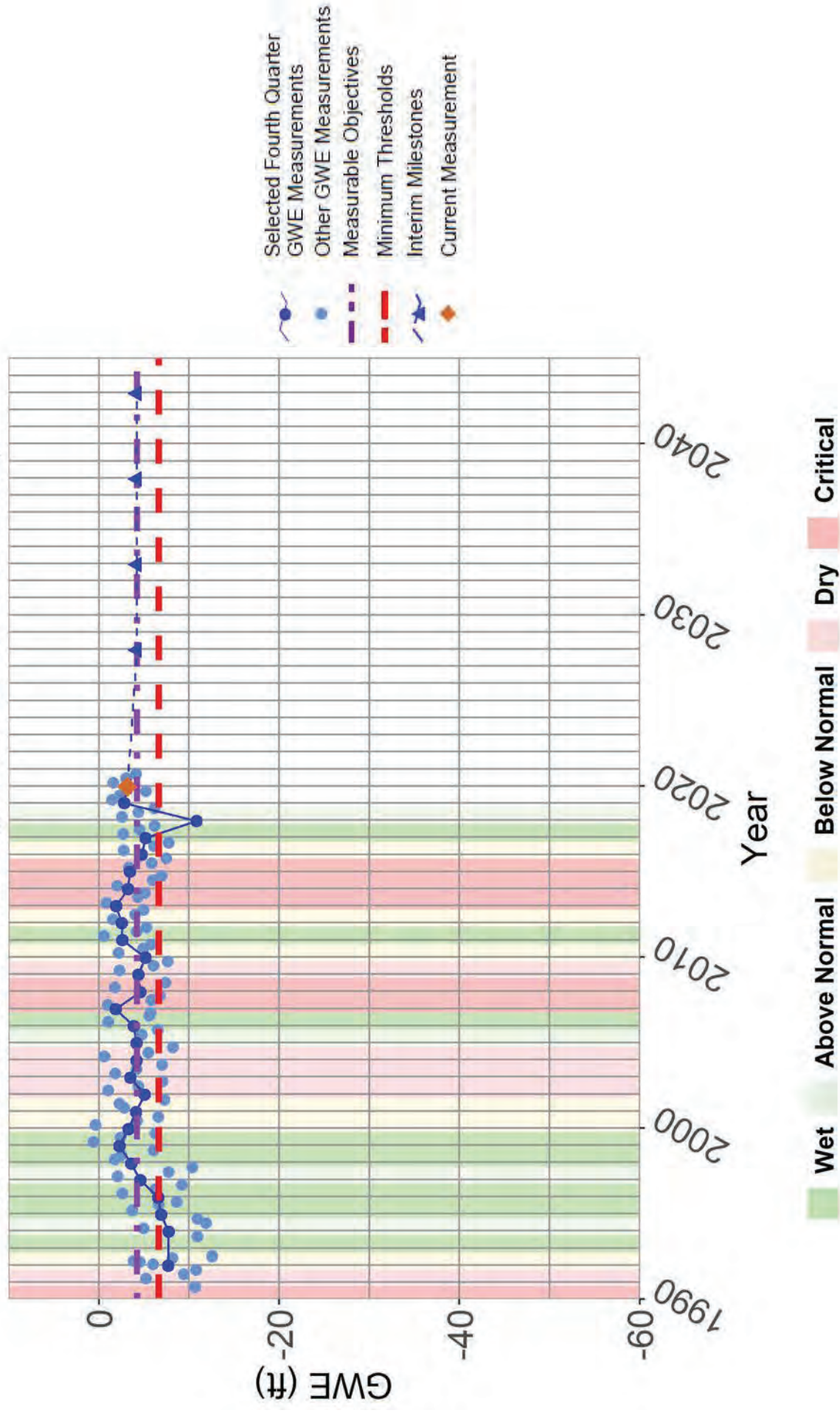




# MW-OU2-07-400

400-Foot Aquifer

Well Screen: 382 to 579 ft bgs ( -207 to -404 ft NAVD 88)

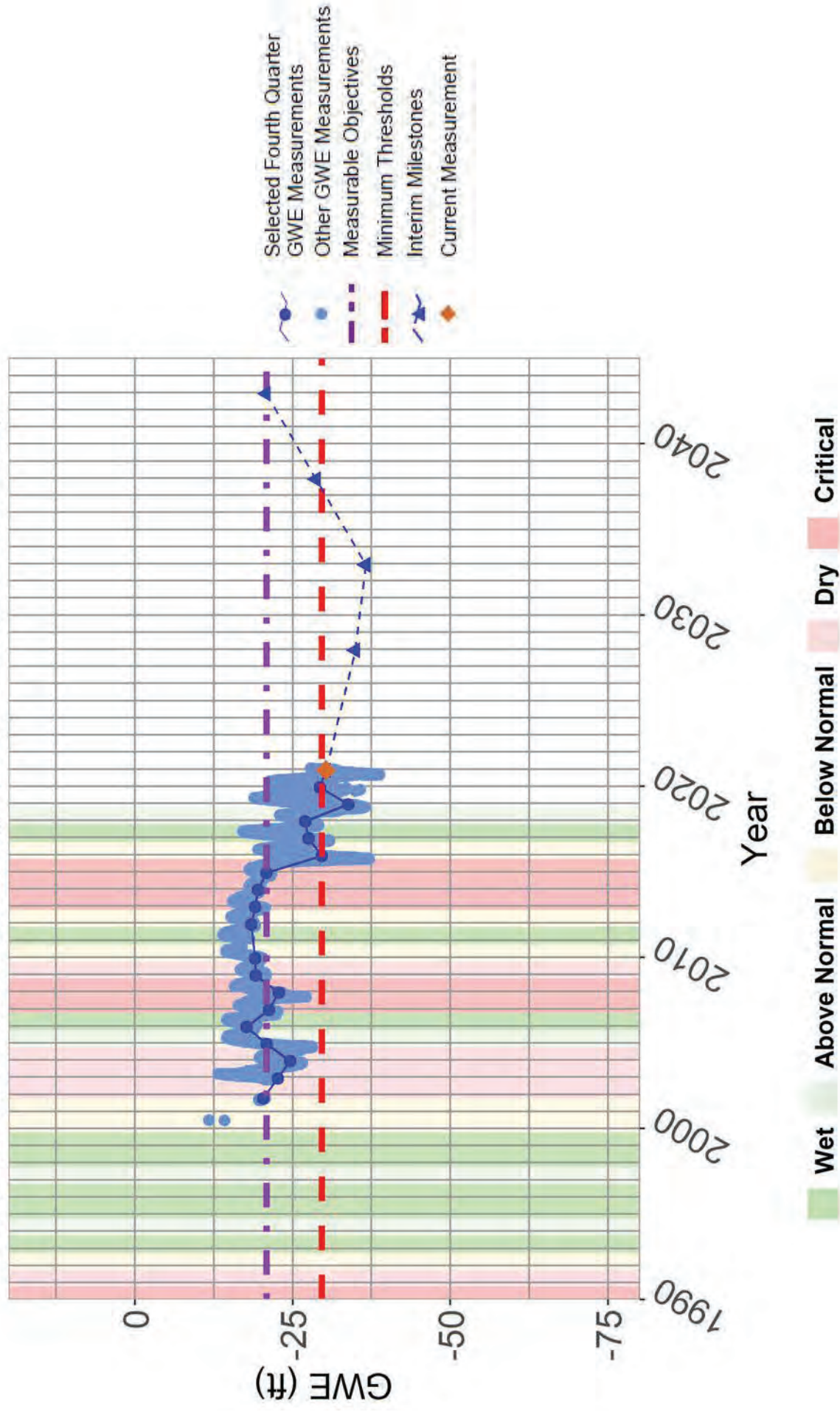




# 014S001E24L002M

Deep Aquifers

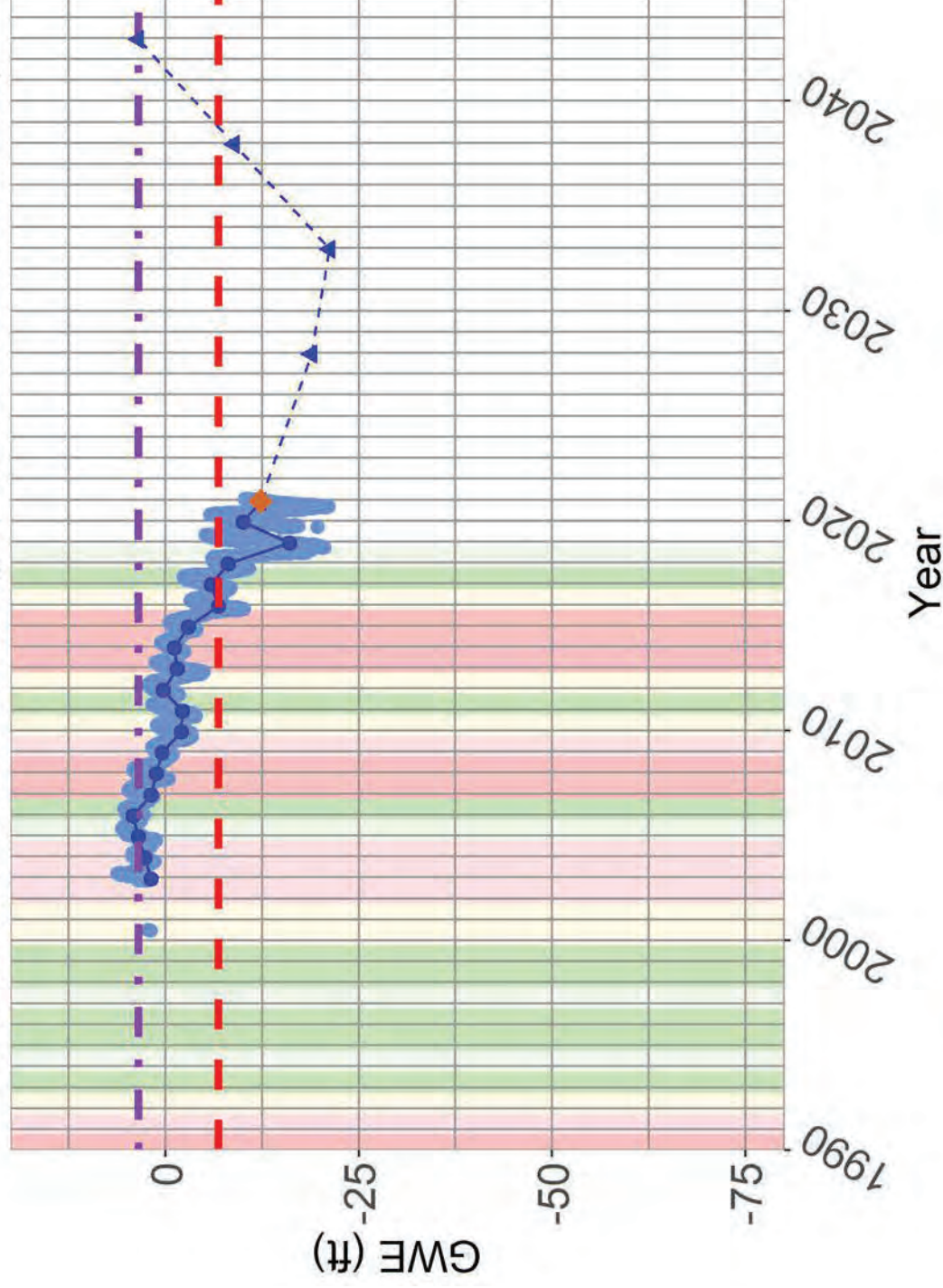
Well Screen: 1820 to 1860 ft bgs ( -1757 to -1797 ft NAVD 88)



# 014S001E24L003M

Deep Aquifers

Well Screen: 1410 to 1430 ft bgs ( -1347 to -1367 ft NAVD 88)



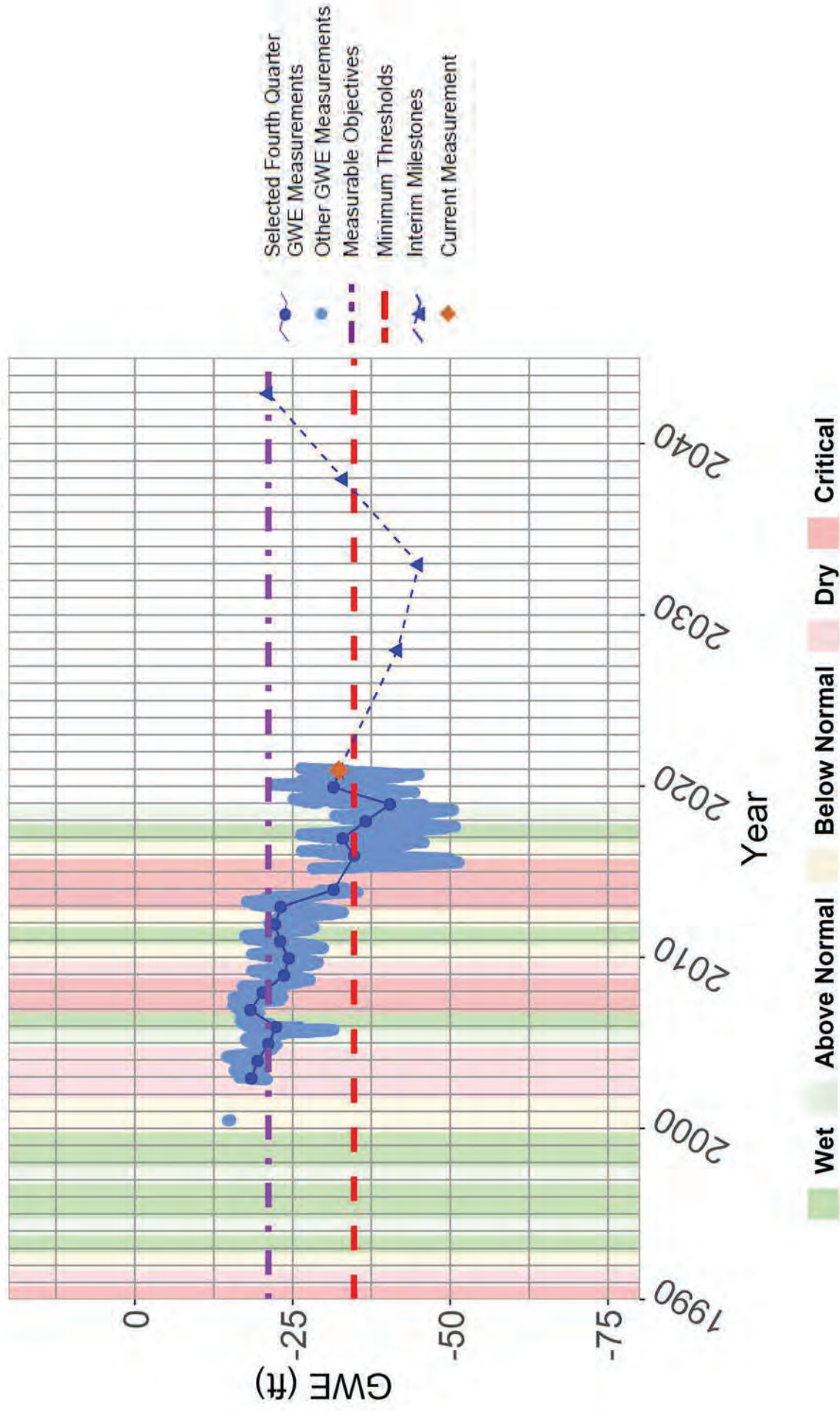
- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- Measurable Objectives
- Minimum Thresholds
- Interim Milestones
- Current Measurement



# 014S0001E24L004M

Deep Aquifers

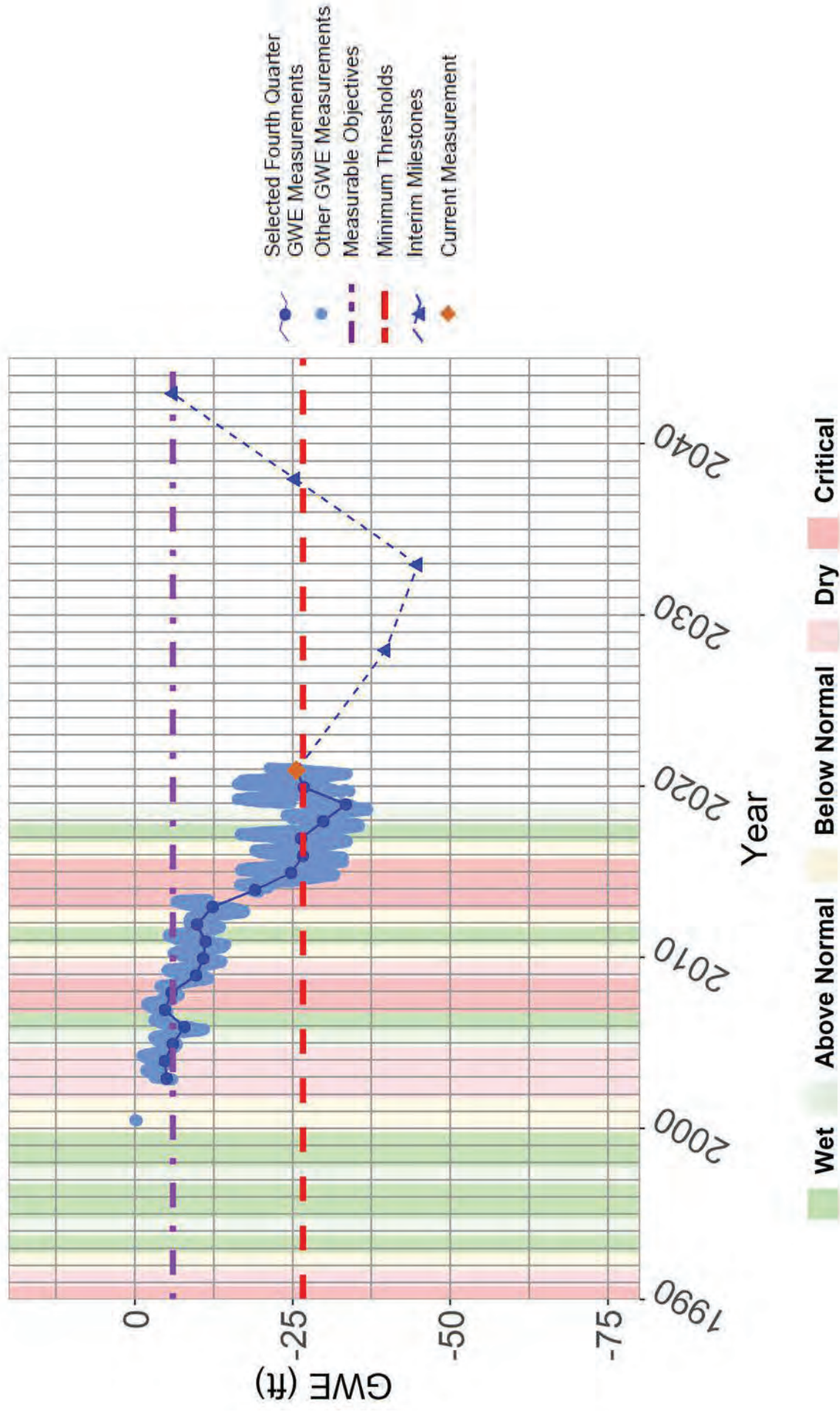
Well Screen: 1040 to 1060 ft bgs ( -977 to -997 ft NAVD 88)



# 014S001E24L005M

Deep Aquifers

Well Screen: 930 to 950 ft bgs ( -867 to -887 ft NAVD 88)

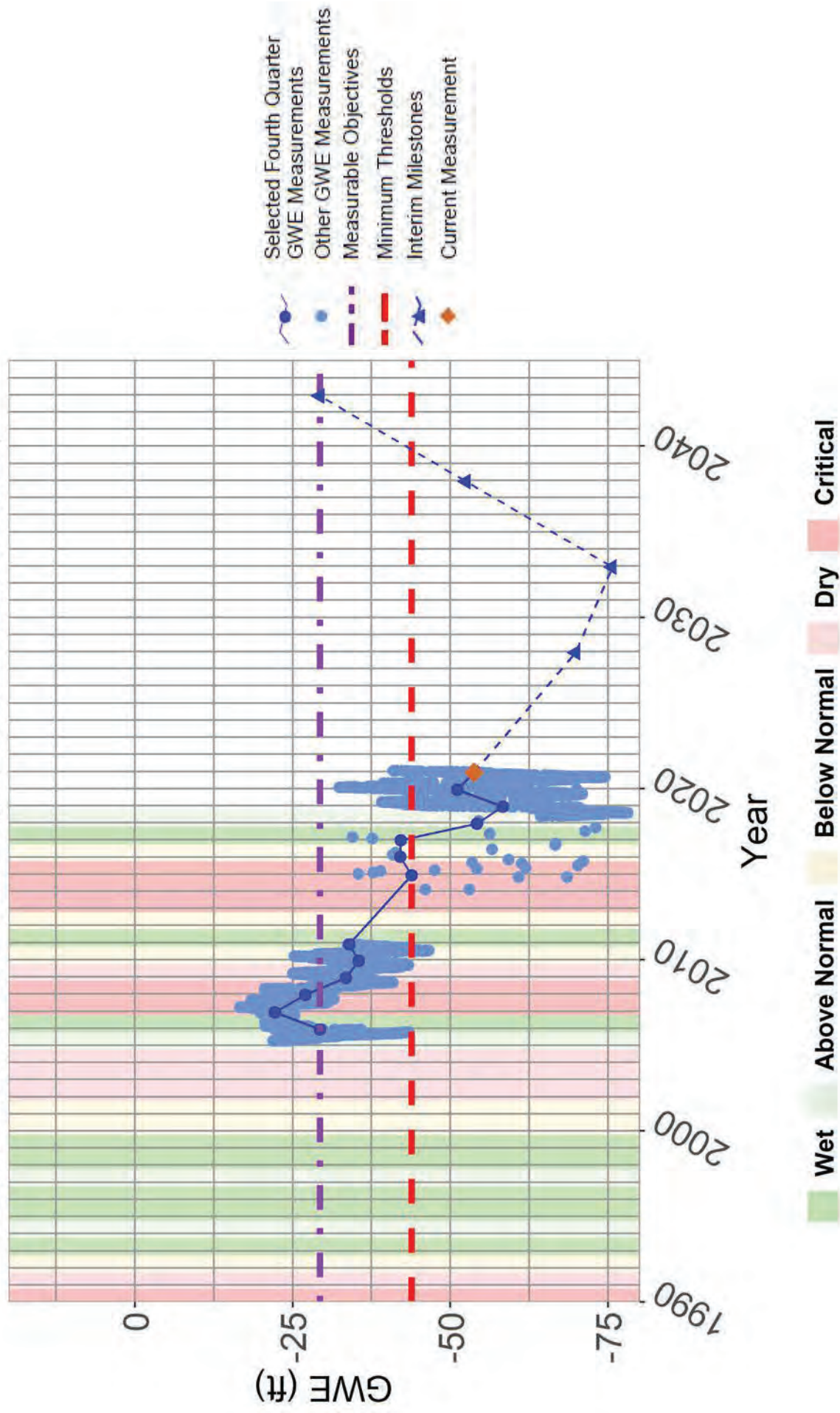




# 14S02E33E01

## Deep Aquifers

Well Screen: 1045 to 1095 ft bgs ( -906 to -956 ft NAVD 88)

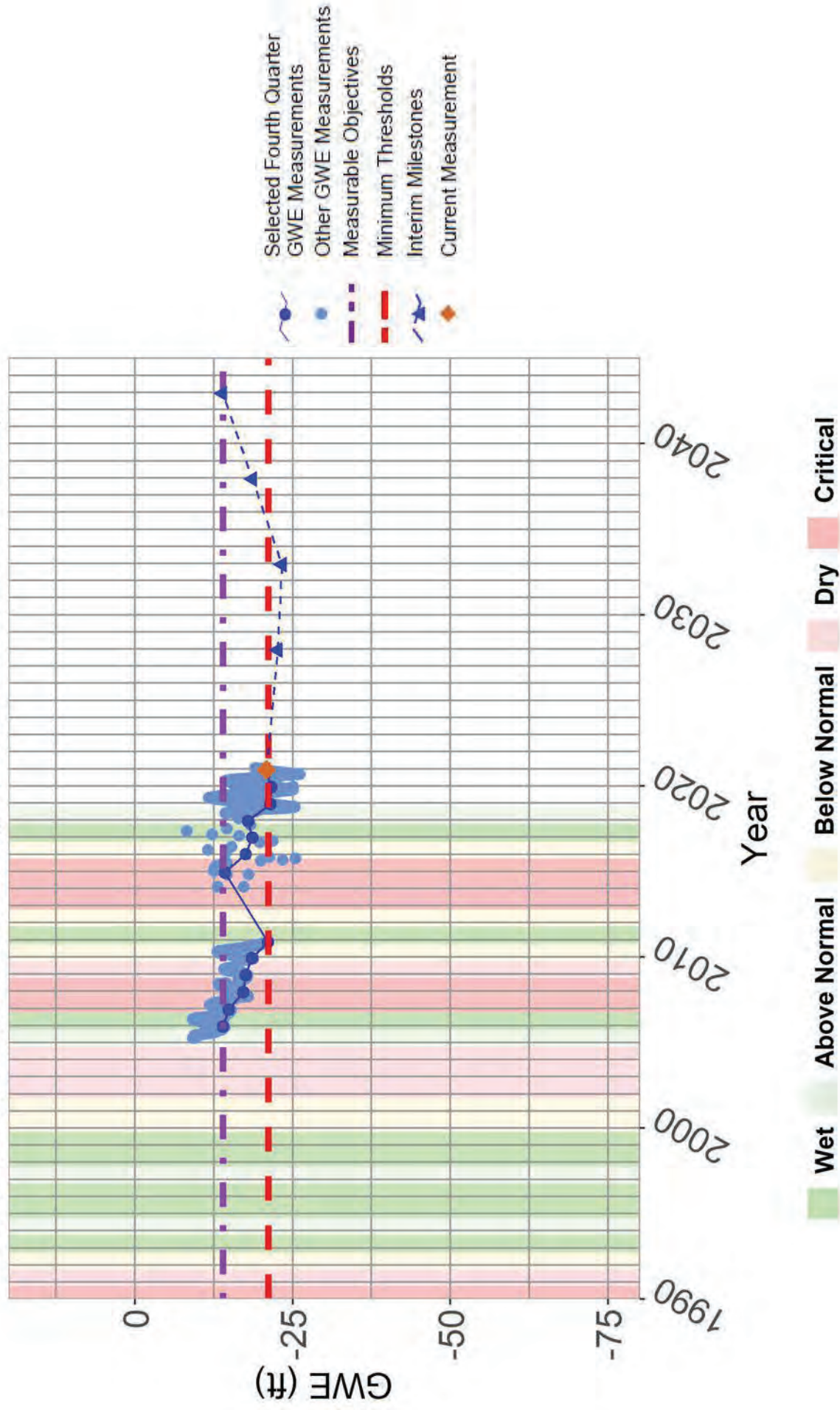




# 14S02E33E02

Deep Aquifers

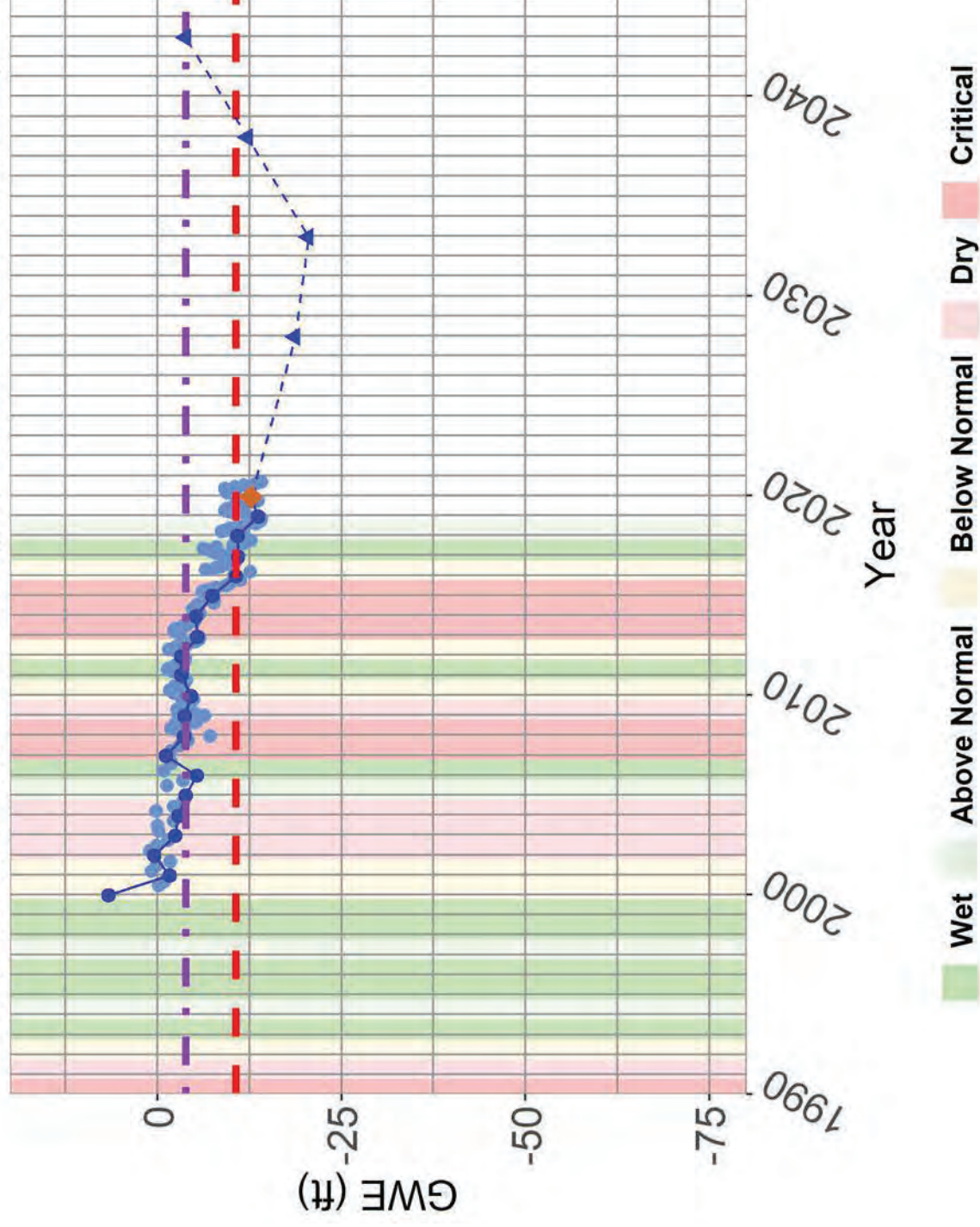
Well Screen: 1680 to 1760 ft bgs ( -1542 to -1622 ft NAVD 88)



# MPWMD#FO-10D

Deep Aquifers

Well Screen: 1380 to 1410 ft bgs ( -1179 to -1209 ft NAVD 88)

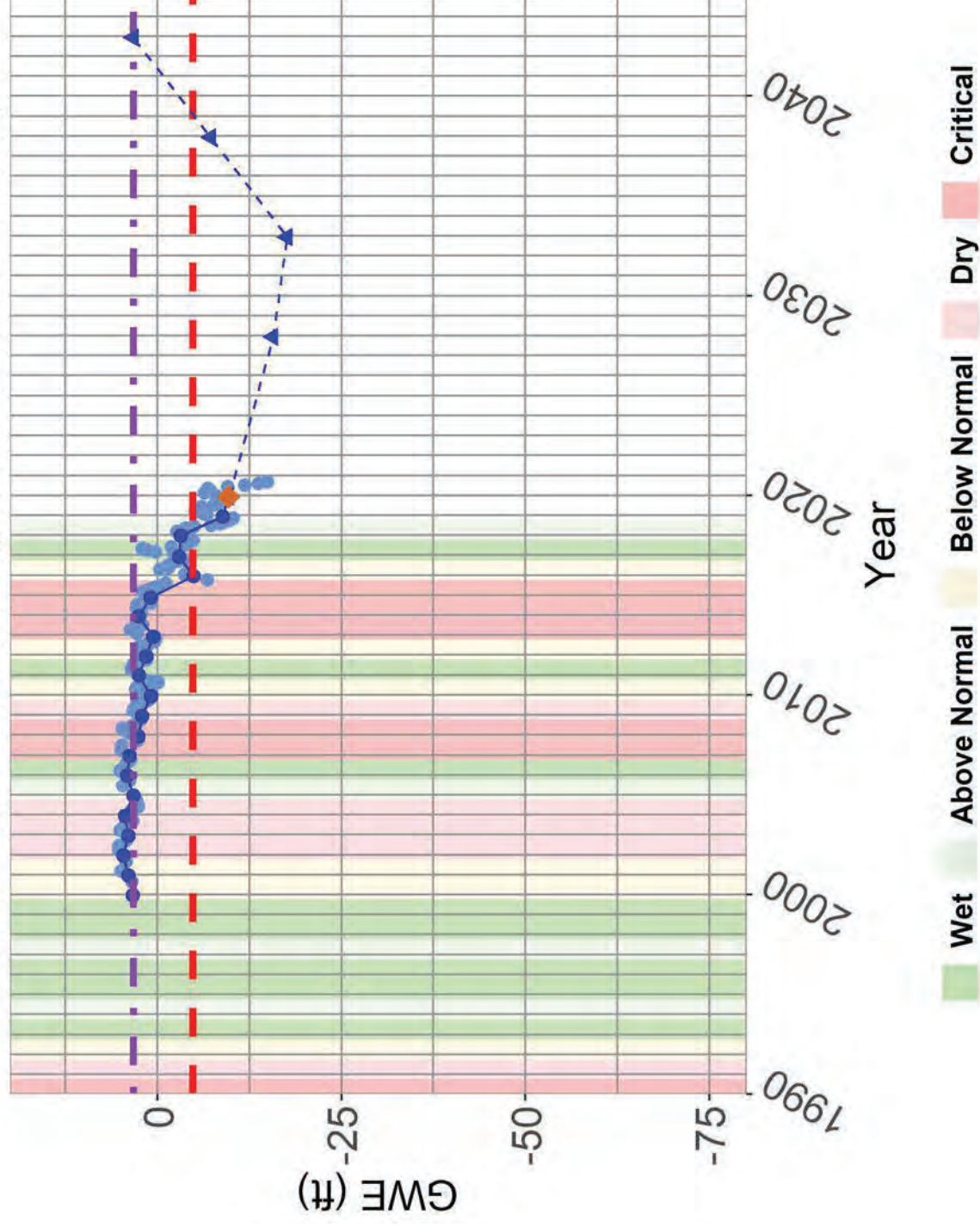




# MPWMD#FO-11D

Deep Aquifers

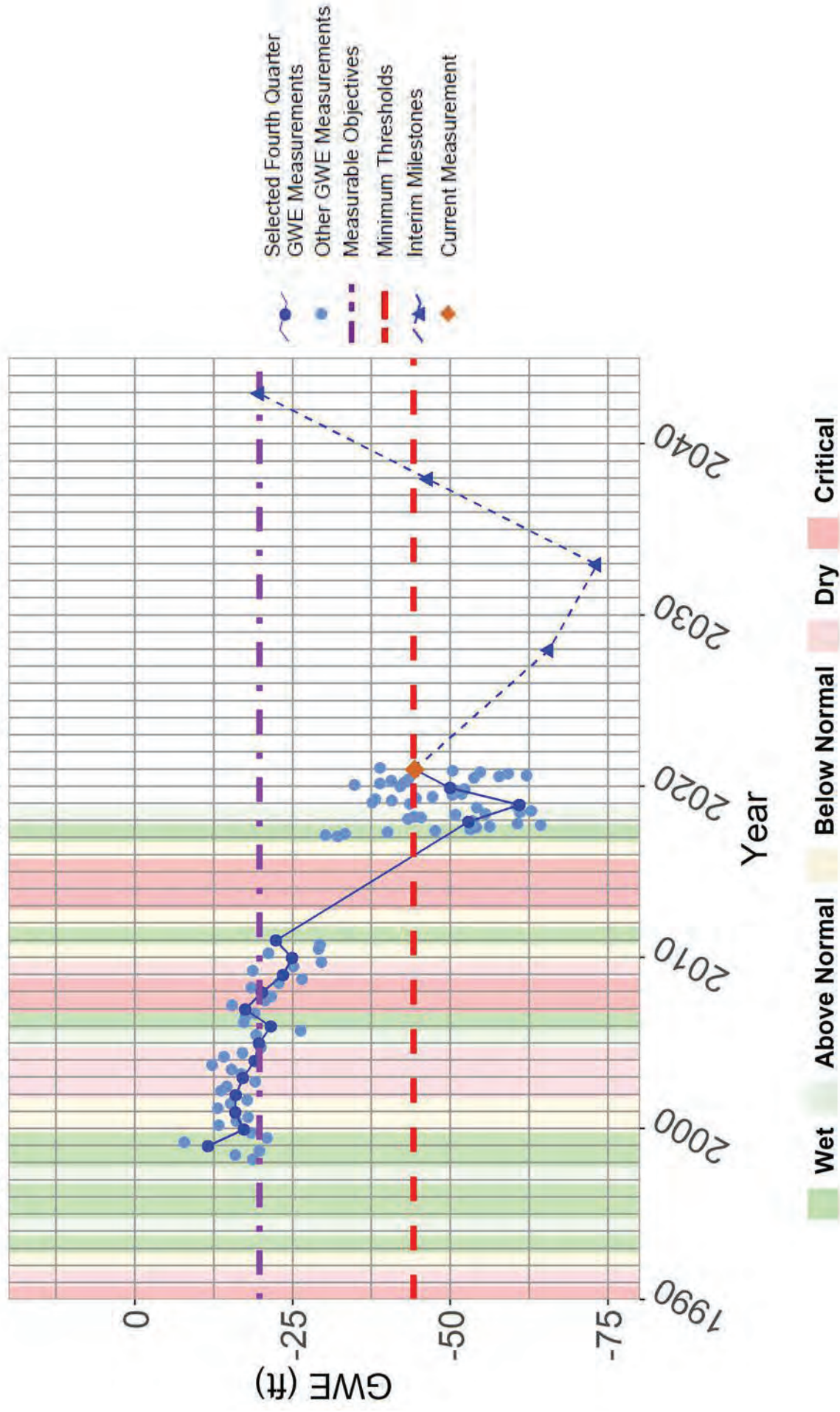
Well Screen: 700 to 730 ft bgs ( -367 to -397 ft NAVD 88)



# PZ-FO-32-910

Deep Aquifers

Well Screen: 890 to 910 ft bgs ( -700 to -720 ft NAVD 88)

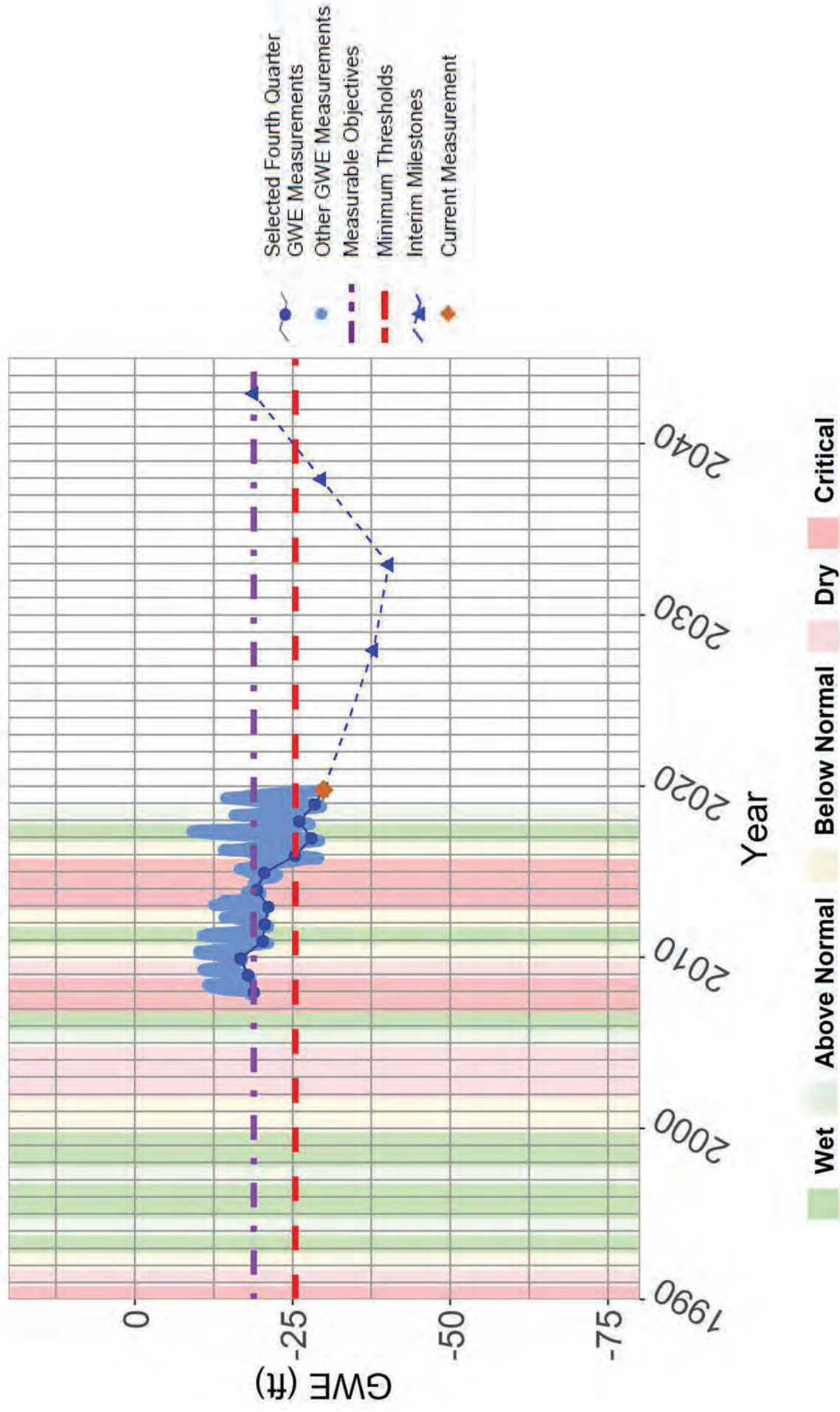




# Sentinel MW #1

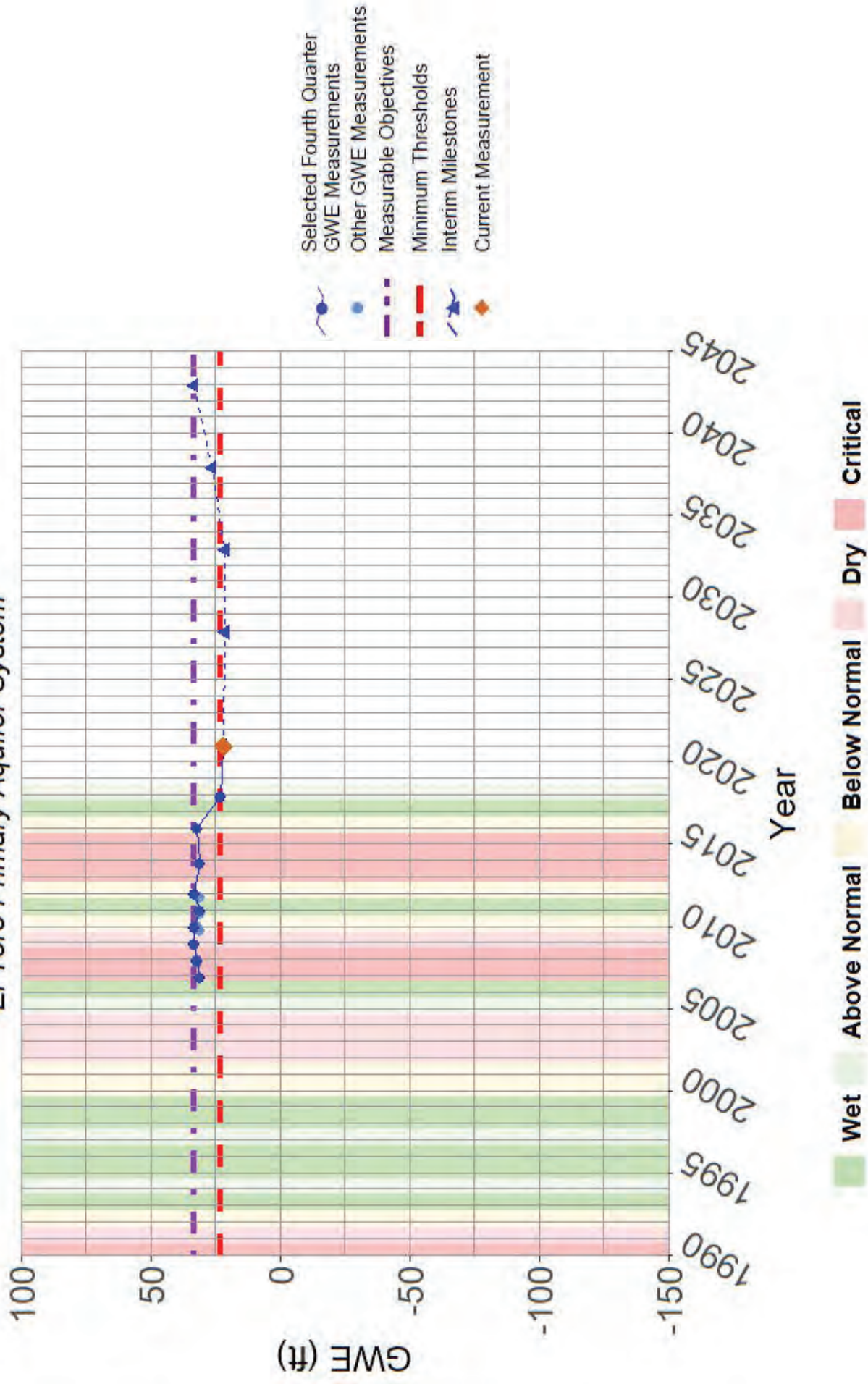
Deep Aquifers

Well Screen: 1130 to 1490 ft bgs ( -1037 to -1397 ft NAVD 88)



# 15S02E25C01

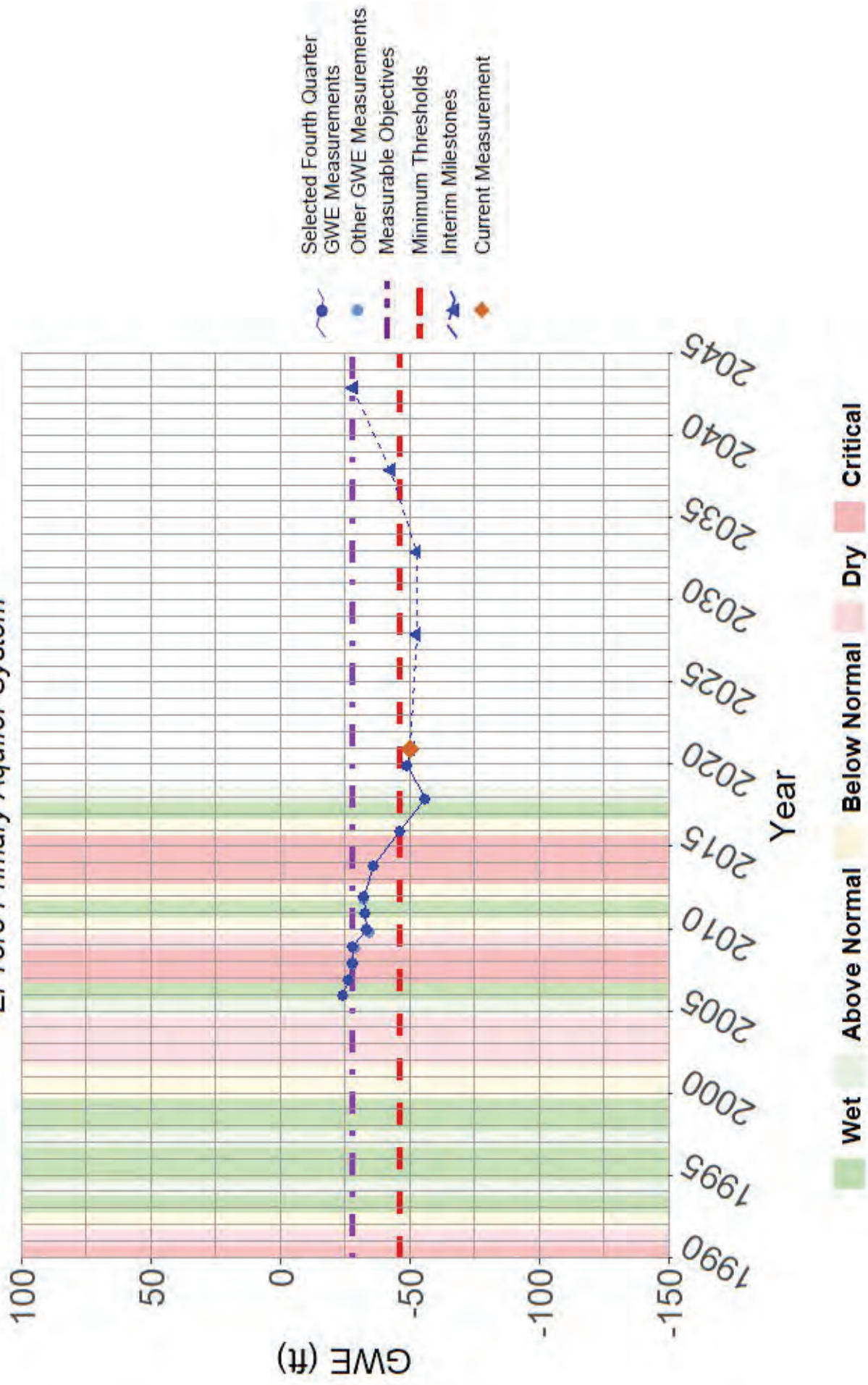
El Toro Primary Aquifer System





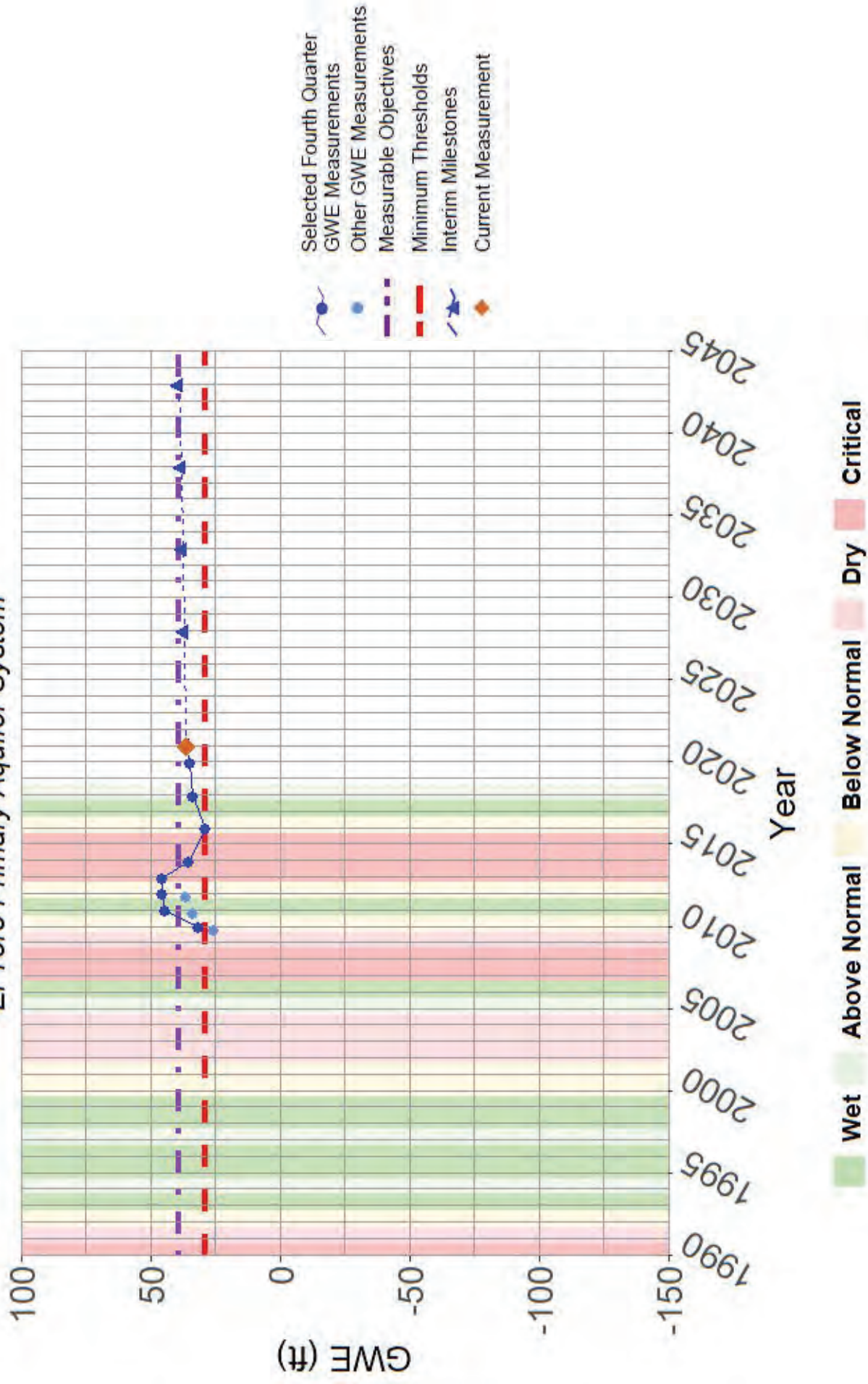
# 15S03E18P01

El Toro Primary Aquifer System



# 15S03E20R50

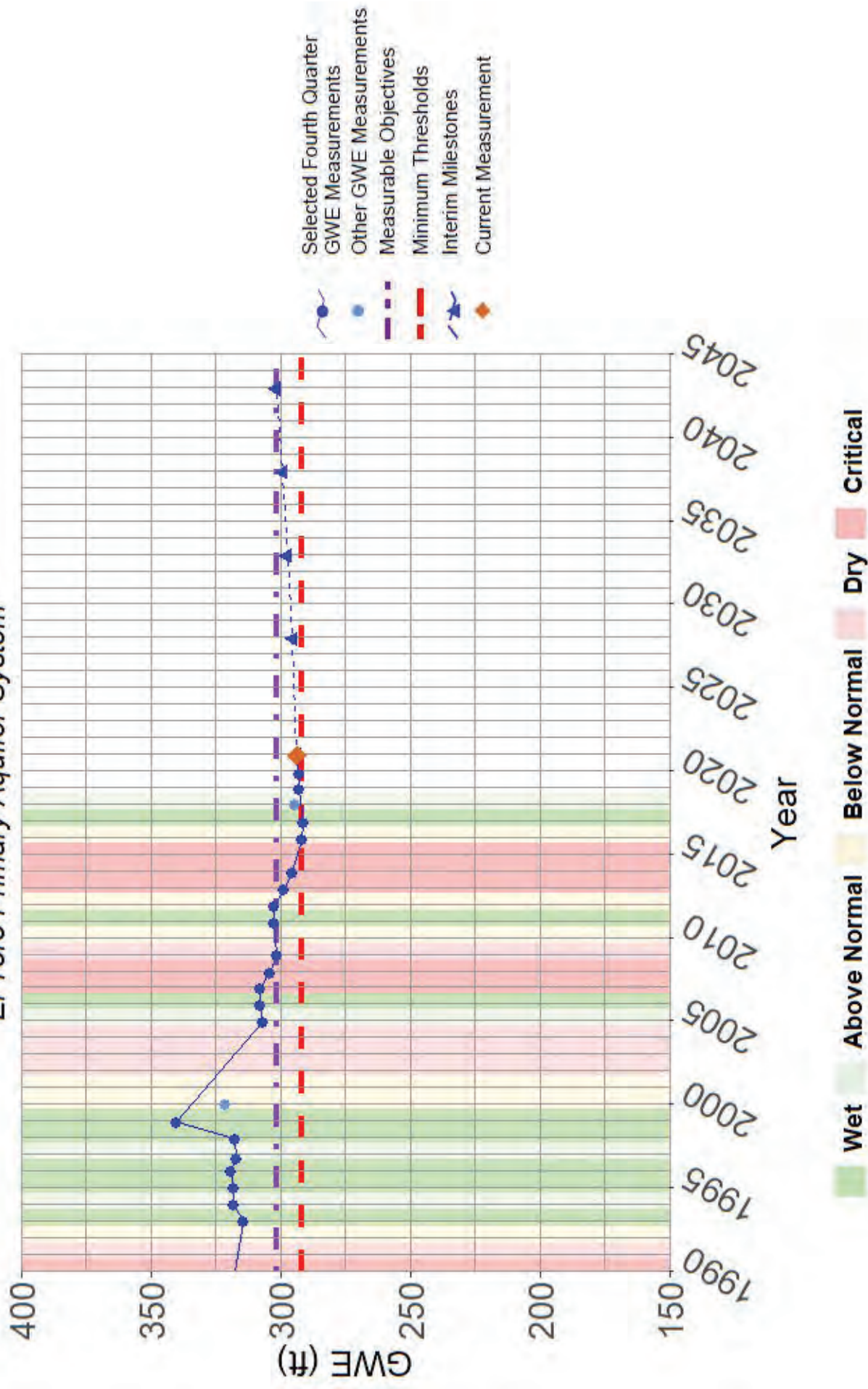
El Toro Primary Aquifer System





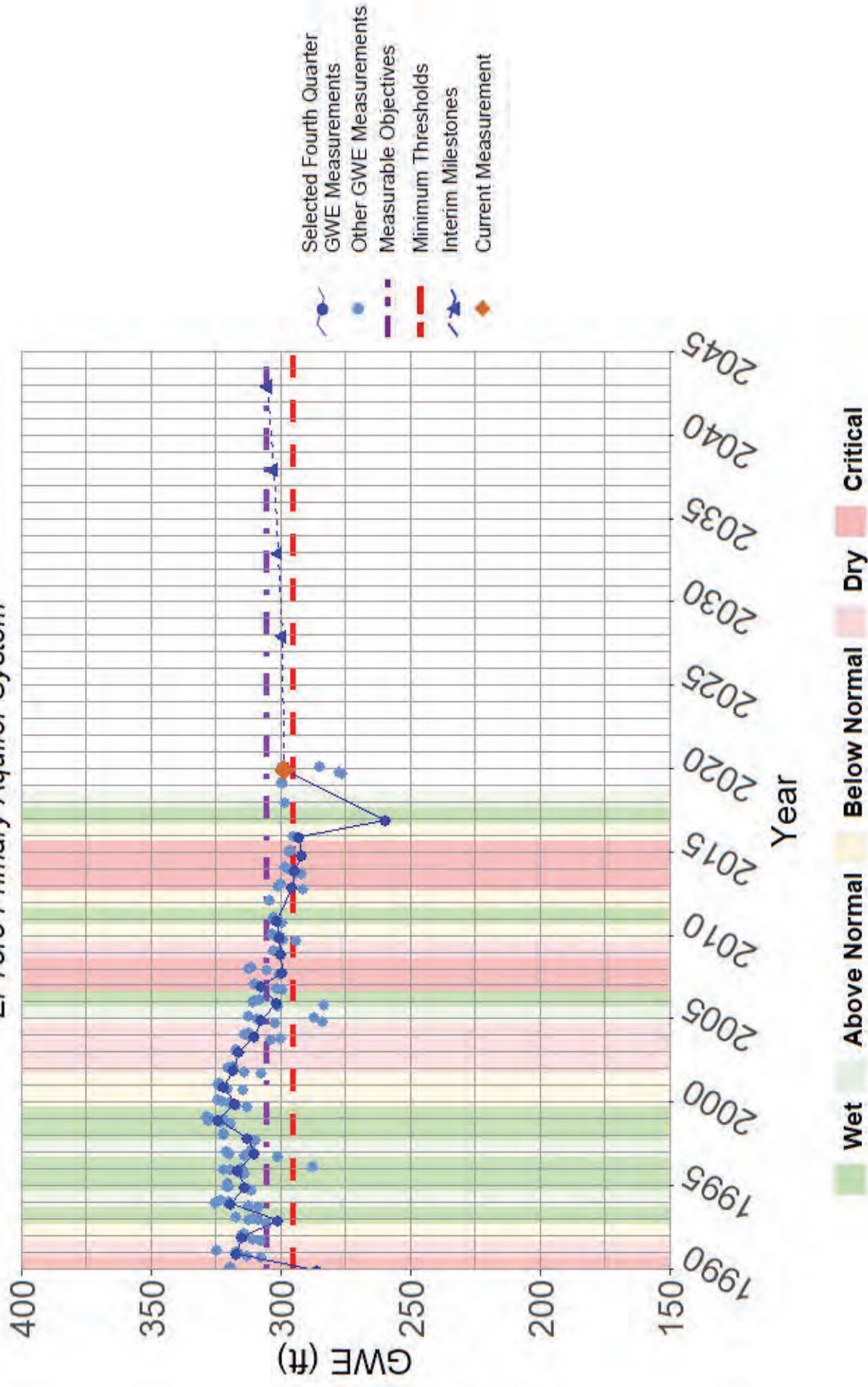
# 16S02E01M01

El Toro Primary Aquifer System



# 16S02E02G01

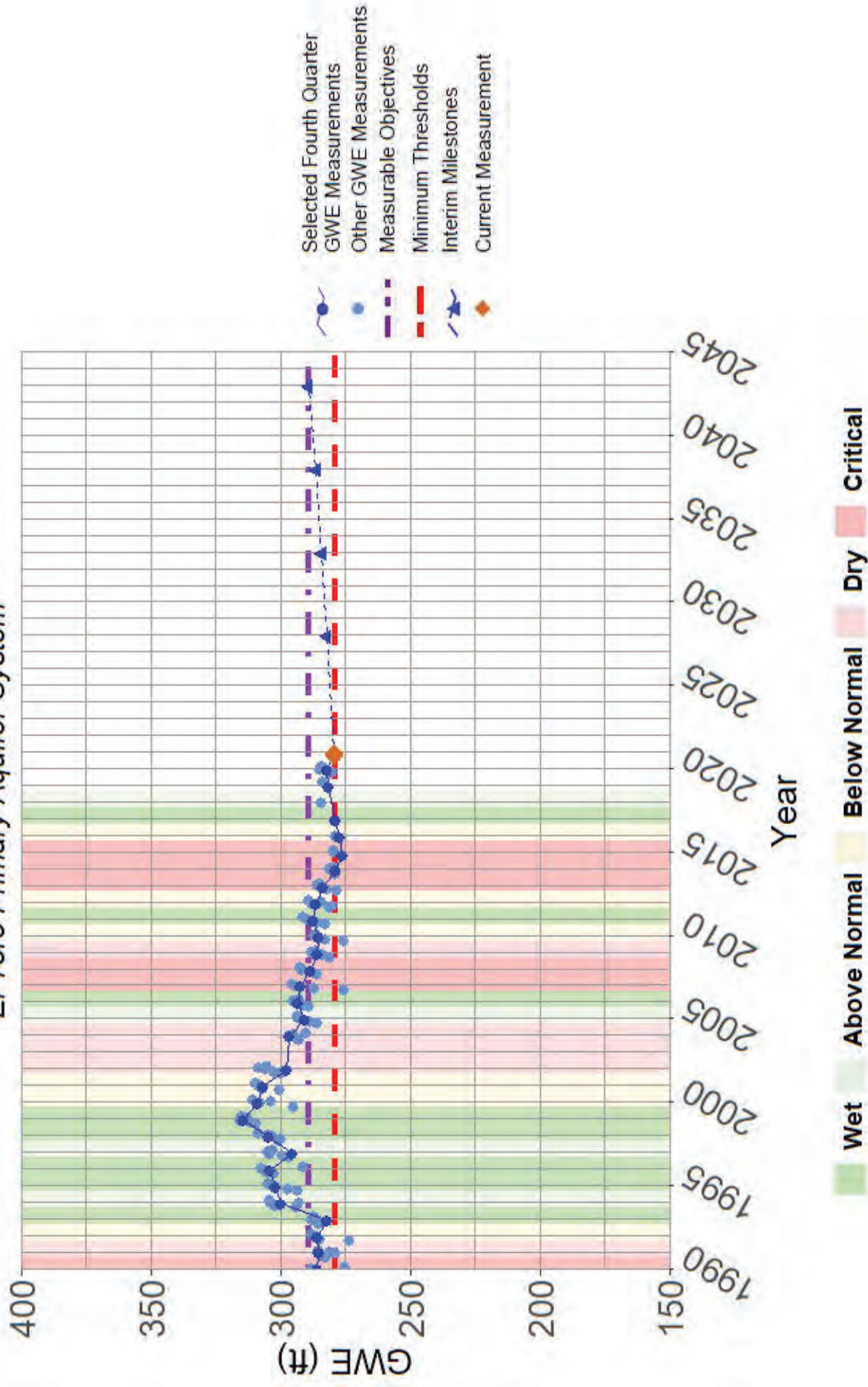
El Toro Primary Aquifer System





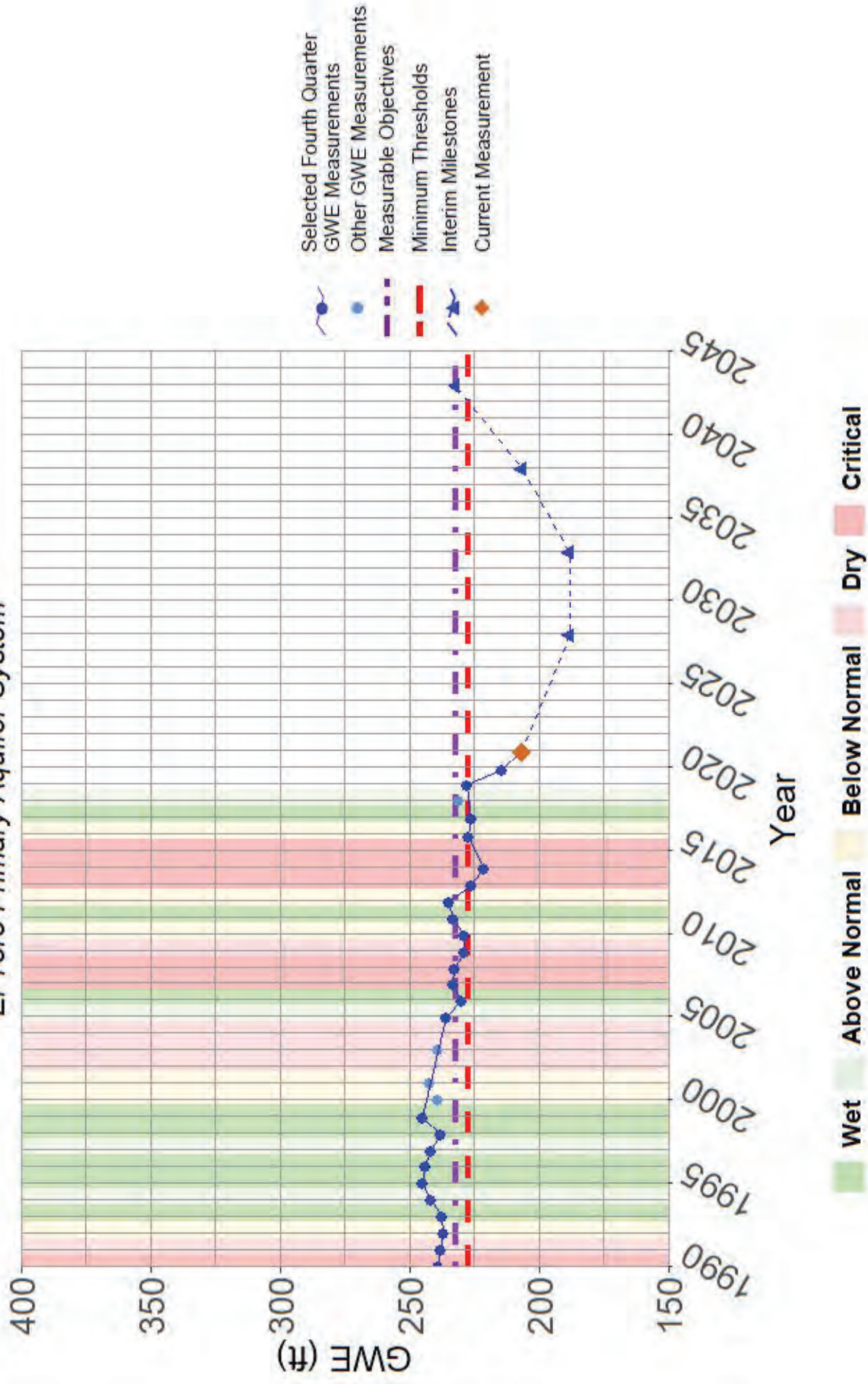
# 16S02E02H01

El Toro Primary Aquifer System



# 16S02E03A01

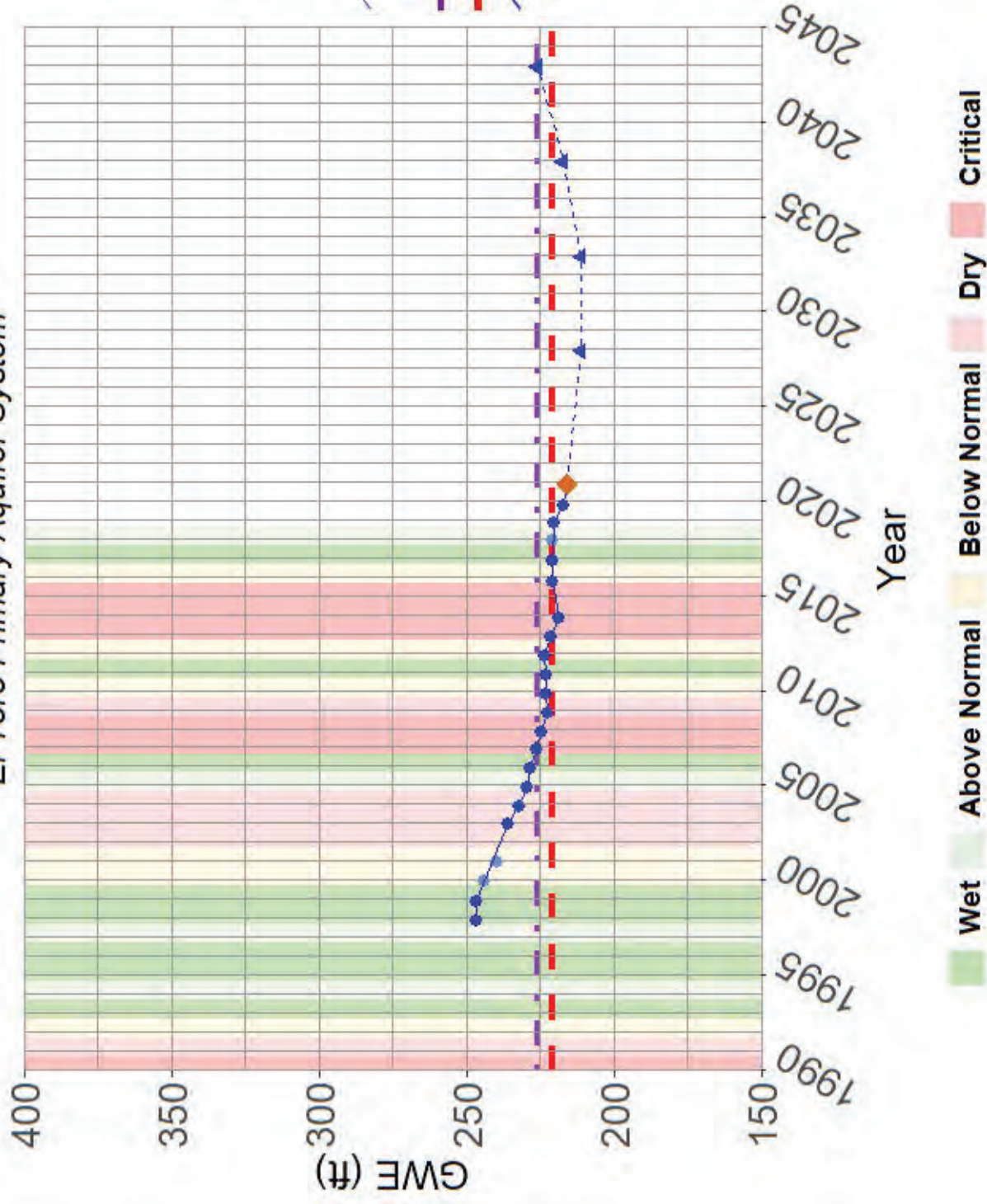
El Toro Primary Aquifer System





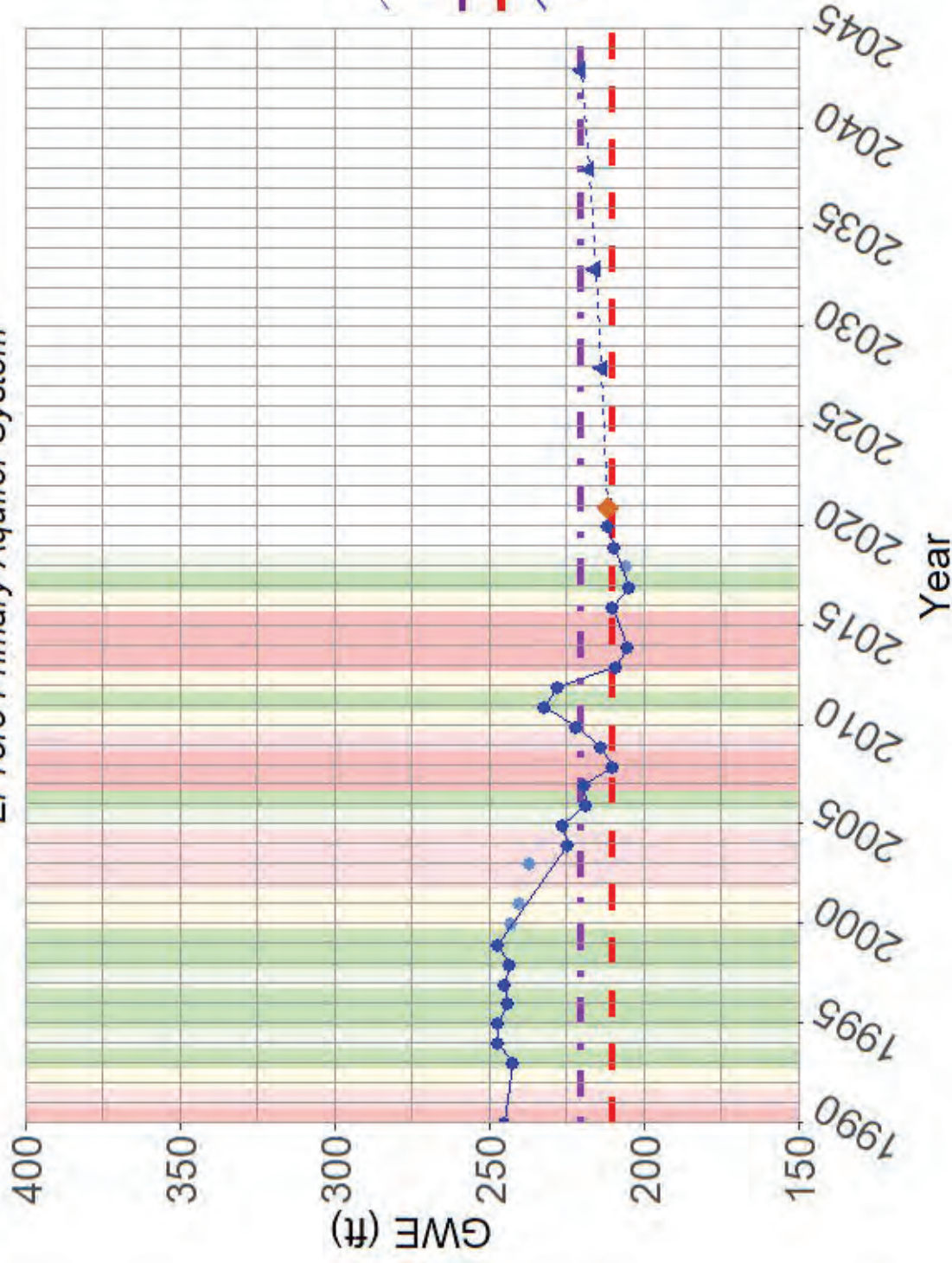
# 16S02E03F50

El Toro Primary Aquifer System



# 16S02E03H01

El Toro Primary Aquifer System

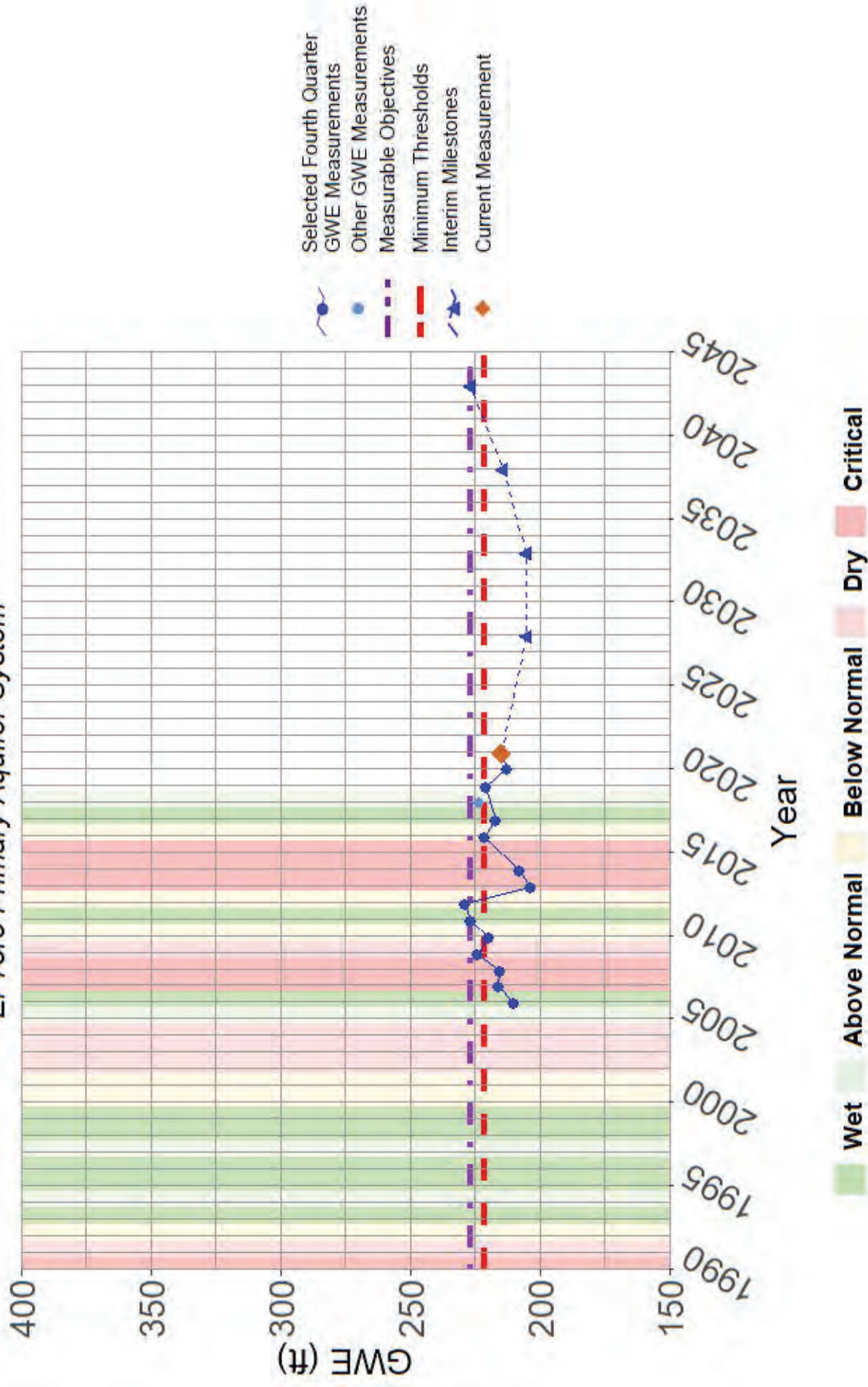


Wet Above Normal Below Normal Dry Critical



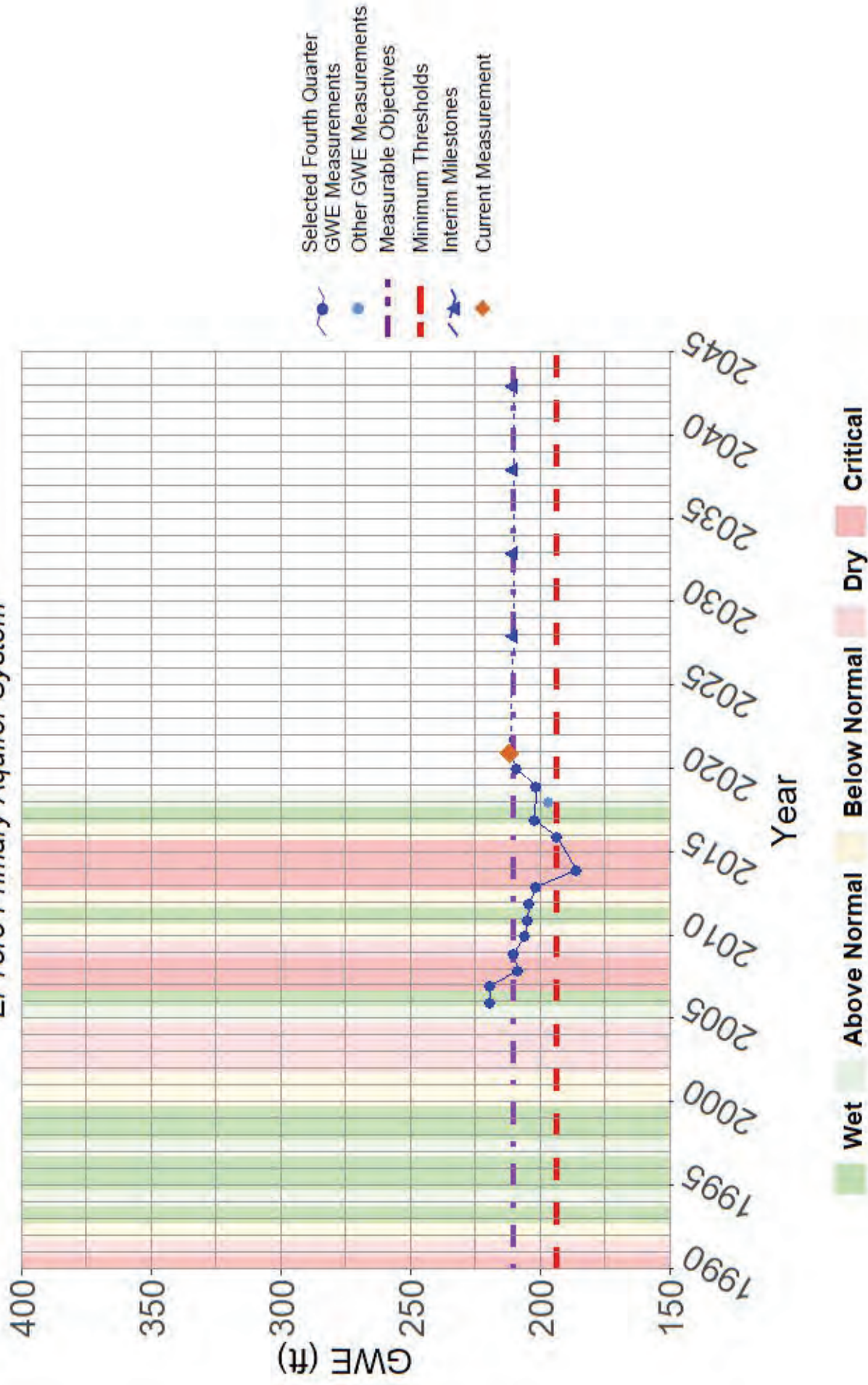
# 16S02E03H02

El Toro Primary Aquifer System



# 16S02E03J50

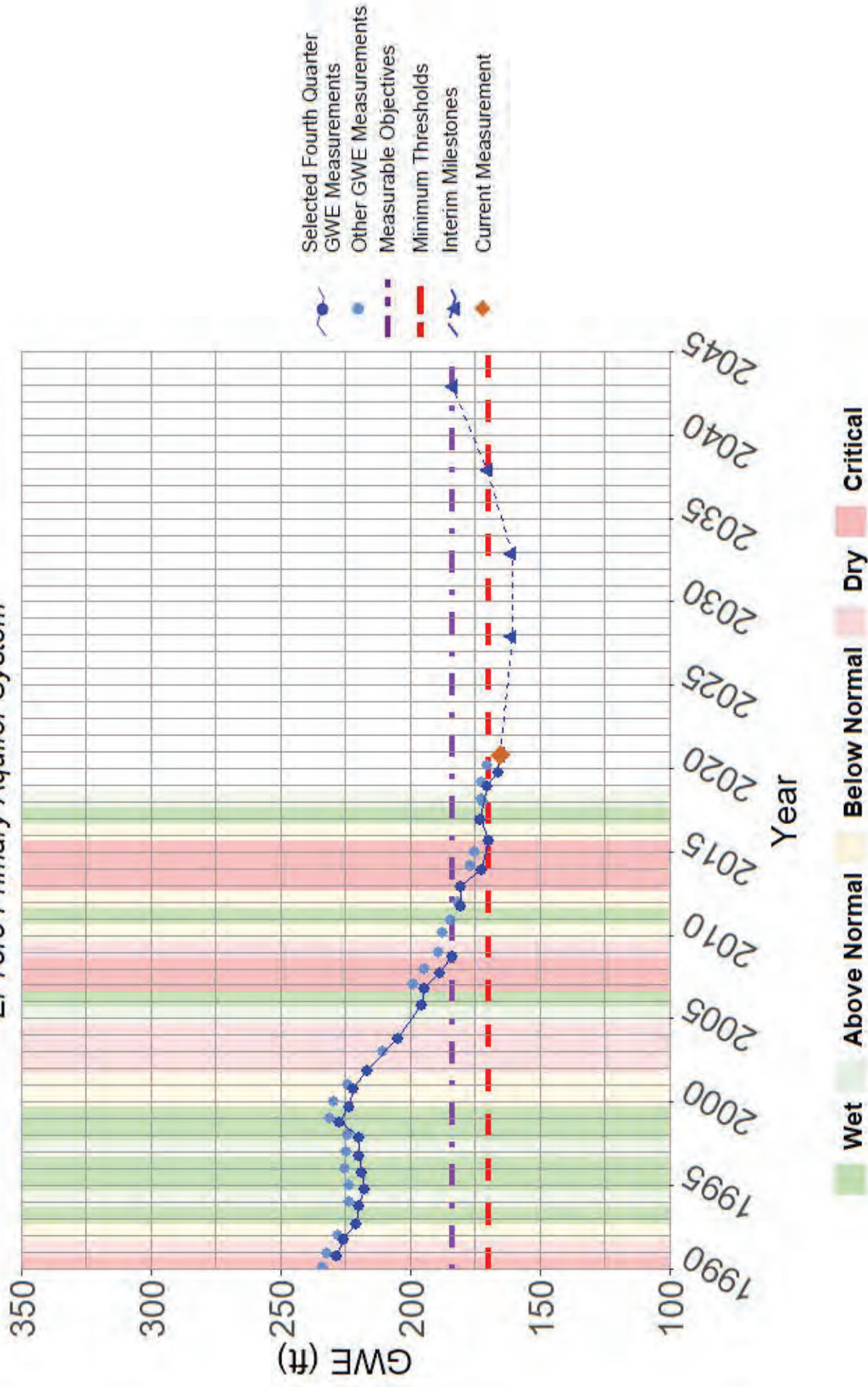
El Toro Primary Aquifer System





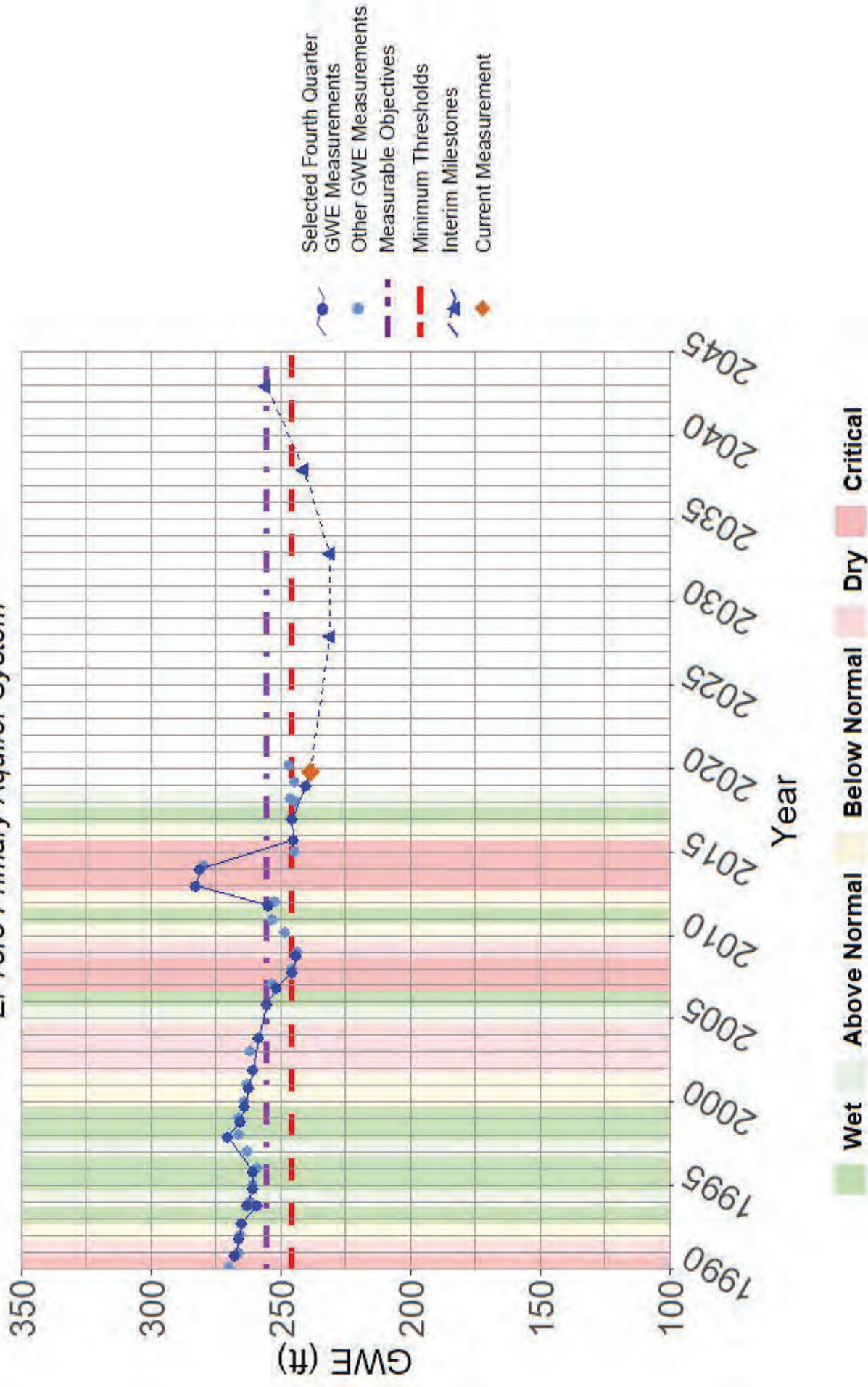
# Robley Deep (South)

El Toro Primary Aquifer System



# Robley Shallow (North)

El Toro Primary Aquifer System



## Appendix 9-A

### Detailed Cost Estimates

**R1 - Winter Release with ASR and Direct Delivery**



**Capital and Annualized Costs  
Winter Release with ASR  
Preliminary Cost Estimate)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		12,900
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$181,134,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$14,170,000
7	Annual O&M Cost		\$		\$5,223,000
8	Total Annualized Cost		\$		\$19,393,000
9	<b>Unit Cost</b>		<b>\$/AF</b>		<b>\$1,500</b>
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	180' Aquifer ASR Well Construction	8	EA	\$765,000	\$6,120,000
11	400' Aquifer ASR Well Construction	8	EA	\$1,530,000	\$12,240,000
12	Well Pumps, Motors, & Wellhead Infrastructure	16	EA	\$440,000	\$7,040,000
13	Electrical and Instrumentation	1	LS	\$1,056,000	\$1,056,000
14	Percolation Basins, Site Civil Work	16	25%	\$191,300	\$3,060,800
15	Land Access	21	AC	\$45,000	\$945,000
16	Distribution Pipeline (4 mile)	21,120	LF	\$650	\$13,728,000
17	Filtration and Disinfection System	1	LS	\$70,000,000	\$70,000,000
18	<b>SubTotal</b>				<b>\$114,189,800</b>
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
19	General Conditions			15%	\$17,128,500
20	Contractor Overhead and Profit			18%	\$20,554,200
21	Sales Tax			8.75%	\$2,997,500
22	Engineering, Legal, Administrative, Contingencies			20%	\$22,838,000
23	Bonds and Insurance			3%	\$3,425,700
24	<b>Total Capital Cost</b>				<b>\$181,134,000</b>
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
25	Power	1	LS	\$1,607,300	\$1,607,300
26	Treatment	1	LS	\$548,000	\$548,000
27	Equipment Repair & Replacement	1	LS	\$864,000	\$864,000
28	Operations Labor	1	LS	\$729,600	\$729,600
29	Miscellaneous	1	LS	\$603,900	\$603,900
30	Contingency			20%	\$870,600
31	<b>Total O&amp;M Annual Cost</b>				<b>\$5,223,000</b>

**NOTES:**

1. "Project Yield" based on: 49 CFS 22,000 GPM) and 36% facility up time, reflecting winter operation.
2. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: construction of 8 ASR wells in the 180-Foot Aquifer, 8 ASR wells in the 400-Foot Aquifer. Construction of a 23 MGD filtration/disinfection system for treating winter surface water flows prior to injection.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annual O M Cost" includes well and treatment facilities.

Conceptual Cost Estimate  
Project R1 Winter Release from Reservoirs - Direct Delivery

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
<b>Capital Costs</b>					
Surface Water Treatment Plant	1	LS	\$19,480,000	\$ 19,480,000	For this project, MCWD would fund a portion of the overall infrastructure costs according to their share of the overall flow through a regional treatment plant. The overall infrastructure costs for a 23 MGD treatment plant was assumed under the ASR component for \$70 million. MCWD's share of such a facility is assumed to be 6.4 MGD to produce 3,600 AFY of treated water, so the overall cost was converted to a \$/AF unit cost and was used to estimate MCWD's portion of the cost. Rounded up to the nearest \$10,000.
Piping from Salinas River Diversion to SWTP at Armstrong Ranch	6,000	LF	\$310	\$ 1,860,000	20-inch diameter pipeline at \$12/in-diameter foot plus 30% for various appurtenances (\$310/LF). Rounded up to the nearest \$10,000.
Piping from SWTP to MCWD Distribution System	10,000	LF	\$310	\$ 3,100,000	20-inch diameter pipeline at \$12/in-diameter foot plus 30% for various appurtenances (\$310/LF). Rounded up to the nearest \$10,000.
Contingency on Infrastructure Costs	30	%	Total Direct Costs \$24,440,000	\$ 24,440,000	Based on a Class 5 level estimate for conceptual cost estimates (AACEI, 2019).
Soft Costs: Planning, Environmental, Permitting, Engineering, Legal, Mitigation, etc.	30	%	\$31,772,000	\$ 9,531,600	Assumes 30% of capital costs
Contingency for Regional Coordination	5	%	\$31,772,000	\$ 1,588,600	An additional 5% contingency was added to account for coordination with regional stakeholders that would be involved in this project.
<b>Capital Costs Subtotal (rounded up to nearest \$100,000)</b>				<b>\$ 42,900,000</b>	
<b>Annualized over 25 year period at 6% interest</b>				<b>\$ 3,355,926</b>	
<b>Operating Costs</b>					
Annual Operating Costs for SWTP	1	LS	\$ 500,000	\$ 500,000	For this project, MCWD would fund a portion of the operating costs according to their share of the overall flow through a regional treatment plant. Operating costs for a 23 MGD treatment plant was assumed under the ASR component. MCWD's share of such a facility is assumed to be 6.4 MGD to produce 3,600 AFY of treated water, so the overall cost was converted to a \$/AF unit cost and was used to estimate MCWD's portion of the cost. Rounded up to the nearest \$10,000.
<b>Annual Operating and Overhead Cost Subtotal</b>				<b>\$ 500,000</b>	
<b>Total Costs</b>					
<b>Total Annualized Cost</b>				<b>\$ 3,860,000</b>	<b>per year over 25 years. Rounded up to nearest \$10,000</b>
<b>Total 25-Year Average Cost Per Acre-Foot (3,600 AFY)</b>				<b>\$ 1,100</b>	<b>per acre-foot. Rounded up to nearest \$100</b>

Abbreviations:  
AFY: acre feet per year  
ASR: Aquifer Storage and Recovery  
EA: each  
LF: lineal foot

LS: lump sum  
MCWD: Marina Coast Water District  
SWTP: surface water treatment plant

References  
AACEI, 2019. *Recommended Practices and Standards*, Association for the Advancement of Cost Engineering International, March 2019 Update.

## **R2 - Regional Municipal Supply**

**Capital and Annualized Costs  
Regional Alternative Water Supply Project  
(Preliminary Cost Estimate)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$309,387,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$24,203,300
7	Annual O&M Cost		\$		\$11,874,000
8	Total Annualized Cost		\$		\$36,077,300
9	<b>Unit Cost</b>		<b>\$/AFY</b>		<b>\$2,405</b>
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	SWRO Facility	13	MGD	\$14,000,000	\$182,000,000
11	Source Water Pipeline	58,080	LF	\$400	\$23,232,000
12	<b>Subtotal</b>				<b>\$205,232,000</b>
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
13	General Conditions			15%	\$30,784,800
14	Contractor Overhead and Profit			18%	\$36,941,800
15	Sales Tax			8.75%	\$17,957,800
16	Engineering, Legal, Administrative, Contingencies			20%	\$12,313,900
17	Bonds and Insurance			3%	\$6,157,000
18	<b>Total Capital Cost</b>				<b>\$309,387,000</b>
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
19	Desalination O&M	13	MGD	\$913,400	\$11,874,200
1	<b>Total O&amp;M Annual Cost</b>				<b>\$11,874,000</b>

**NOTES:**

1. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
2. "Interest Rate" selected within expected range for public-financing options.
3. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.



**Capital and Annualized Costs**  
**Regional Alternative Water Supply Project**  
**(Preliminary Cost Estimate)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$65,257,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$5,105,100
7	Annual O&M Cost		\$		\$1,318,000
8	Total Annualized Cost		\$		\$6,423,100
9	Unit Cost		\$/AFY		<b>\$428</b>
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$2,061,345	\$2,061,345
11	Environmental and Stormwater	1	LS	\$3,747,900	\$3,747,900
12	Pipeline to Salinas	52,700	LF	\$400	\$21,080,000
13	Pipeline to Salinas Hills	39,100	LF	\$300	\$11,730,000
14	Distribution Pump Station	11.6	MGD	\$350,000	\$4,060,000
15	Electrical, I&C	1	LS	\$609,000	\$609,000
16	<b>Subtotal</b>				<b>\$43,288,245</b>
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
17	General Conditions			15%	\$6,493,200
18	Contractor Overhead and Profit			18%	\$7,791,900
19	Sales Tax			8.75%	\$3,787,700
20	Engineering, Legal, Administrative, Contingencies			20%	\$2,597,300
21	Bonds and Insurance			3%	\$1,298,600
22	<b>Total Capital Cost</b>				<b>\$65,257,000</b>
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
23	Power	1	LS	\$664,780.25	\$664,780
24	Labor	1	LS	\$180,000	\$180,000
25	Equipment Repair & Replacement	1	LS	\$168,956	\$168,956
26	Contingency			30%	\$304,100
27	<b>Total O&amp;M Annual Cost</b>				<b>\$1,318,000</b>

**NOTES:**

1. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
2. "Interest Rate" selected within expected range for public-financing options.

**Capital and Annualized Costs**  
**Regional Alternative Water Supply Project**  
**(Preliminary Cost Estimate)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$70,623,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$5,524,800
7	Annual O M Cost		\$		\$1,458,000
8	Total Annualized Cost		\$		\$6,982,800
9	Unit Cost		\$/AFY		<b>\$466</b>
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$2,090,124	\$2,090,124
11	Environmental and Stormwater	1	LS	\$3,800,225	\$3,800,225
12	Pipeline to Salinas	52,700	LF	\$400	\$21,080,000
13	Pipeline to Salinas Hills	39,100	LF	\$300	\$11,730,000
14	Pipeline to Marina	9,850	LF	\$300	\$2,955,000
15	Distribution Pump Station	12.9	MGD	\$350,000	\$4,515,000
16	Electrical, I&C	1	LS	\$677,250	\$677,250
17	<b>Subtotal</b>				\$46,847,599
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
18	General Conditions			15%	\$7,027,100
19	Contractor Overhead and Profit			18%	\$8,432,600
20	Sales Tax			8.75%	\$4,099,200
21	Engineering, Legal, Administrative, Contingencies			20%	\$2,810,900
22	Bonds and Insurance			3%	\$1,405,400
23	<b>Total Capital Cost</b>				\$70,623,000
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
24	Power	1	LS	\$742,310.45	\$742,310
25	Labor	1	LS	\$192,000	\$192,000
26	Equipment Repair Replacement	1	LS	\$186,862	\$186,862
27	Contingency			30%	\$336,400
28	<b>Total O&amp;M Annual Cost</b>				\$1,458,000

**NOTES:**

- "Facility Life" selected based on 25-yr anticipated life of extraction wells.
- "Interest Rate" selected within expected range for public-financing options.

**Capital and Annualized Costs**  
**Regional Alternative Water Supply Project**  
**(Preliminary Cost Estimate)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$84,315,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$6,596,000
7	Annual O&M Cost		\$		\$1,515,000
8	Total Annualized Cost		\$		\$8,111,000
9	Unit Cost		\$/AFY		<b>\$541</b>
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$2,101,193	\$2,101,193
11	Environmental and Stormwater	1	LS	\$3,820,350	\$3,820,350
12	Pipeline to Salinas	52,700	LF	\$400	\$21,080,000
13	Pipeline to Salinas Hills	39,100	LF	\$300	\$11,730,000
14	Pipeline to Marina	9,850	LF	\$300	\$2,955,000
15	Pipeline to Castroville	29,500	LF	\$300	\$8,850,000
16	Distribution Pump Station	13.4	MGD	\$350,000	\$4,690,000
17	Electrical, I&C	1	LS	\$703,500	\$703,500
18	<b>Subtotal</b>				\$55,930,043
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
19	General Conditions			15%	\$8,389,500
20	Contractor Overhead and Profit			18%	\$10,067,400
21	Sales Tax			8.75%	\$4,893,900
22	Engineering, Legal, Administrative, Contingencies			20%	\$3,355,800
23	Bonds and Insurance			3%	\$1,677,900
24	<b>Total Capital Cost</b>				<b>\$84,315,000</b>
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
25	Power	1	LS	\$767,054.14	\$767,054
26	Labor	1	LS	\$204,000	\$204,000
27	Equipment Repair & Replacement	1	LS	\$194,211	\$194,211
28	Contingency			30%	\$349,600
29	<b>Total O&amp;M Annual Cost</b>				<b>\$1,515,000</b>

**NOTES:**

1. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
2. "Interest Rate" selected within expected range for public-financing options.
3. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.

### **R3 - Multi-benefit Stream Channel Improvements**



## Multi-benefit stream channel improvements

### Component 2

#### RCD Arundo Eradication Cost Estimate

Five-year cost for treating arundo (includes three herbicide treatments and mowing or hand-cutting if applicable)								
Work activity	Cost/acre for arundo control contractor	Cost/acre for biomonitoring	Cost/acre for biological surveys	Cost/acre for RCD program administration	Total Cost/acre	Estimated acres remaining	Total Cost (Low Estimate)	Total Cost (High Estimate)
Mowed arundo	\$ 10,350.00	\$ 356.04	\$ 2,127.50	\$ 2,495.50	\$ 15,329.04	700	\$ 10,730,328.00	\$ 13,949,426.40
Unmowed arundo	\$ 7,475.00	\$ 349.60	\$ 1,322.50	\$ 1,759.50	\$ 10,906.60	150	\$ 1,635,990.00	\$ 2,126,787.00
Hand-cut arundo	\$ 34,500.00	\$ 2,300.00	\$ 2,875.00	\$ 3,737.50	\$ 43,412.50	50	\$ 2,170,625.00	\$ 2,821,812.50
<b>Est. cost of initial + retreatment</b>							<b>\$ 14,536,943.00</b>	<b>\$ 18,898,025.90</b>

<b>Cost of O&amp;M</b>	
WCS completed treatment on approximately 21 river miles in 2020	\$151,599.00
Cost per river mile of 2020 treatment	\$7,219.00
Cost per river mile rounded up	\$7,500.00
*Cost includes biological surveys and monitoring	
*90 miles of river in Monterey County	
Cost for retreating whole river 1 time	\$675,000.00
Cost to re-treat equivalent of whole river five times over 25 years	\$3,375,000.00
Cost of helicopter survey to re-map arundo over whole river	\$400,000.00
RCD admin costs @ 20% of contractor cost	\$755,000.00
<b>Total cost for O&amp;M</b>	<b>\$4,130,000.00</b>
<b>Average annual cost (total cost/25 years)</b>	<b>\$165,200.00</b>

**Capital and Annualized Costs**  
**Multi-Benefit Stream Channel Improvement - Component 2 - Low Estimate**  
**(Preliminary Cost Estimate)**

<b>SUMMARY</b>					
<b>Line No.</b>	<b>Description</b>		<b>Units</b>		<b>Total</b>
1	Project Yield (high estimate)		acre-feet per year		20,880
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$14,536,943
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$1,100,000
7	Annual O&M Cost		\$		\$165,200
8	Total Annualized Cost		\$		\$1,265,200
9	Unit Cost		\$/AFY		\$60
<b>CAPITAL COSTS</b>					
<b>Line No.</b>	<b>Capital</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total Cost</b>
10	Mowed arundo	700	Acres	\$15,329	\$10,730,328
11	Unmowed arundo	150	Acres	\$10,907	\$1,635,990
12	Hand-cut arundo	50	Acres	\$43,413	\$2,170,625
13	<b>Subtotal</b>				\$14,536,943
<b>OPERATIONS AND MAINTENANCE</b>					
<b>Line No.</b>	<b>Markups</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total Cost</b>
16	O&M Estimate	1	LS	\$165,200	\$165,200
17	<b>Total O&amp;M Cost</b>				\$165,200

**NOTES:**

1. "Project Yield" based on: Range of 6,000 to 36,000 AF, assumed an average of 20,000 AF
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: Phase I and Phase II.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.
7. "Annual O&M Cost" estimate based on average annual needs for on going monitoring and maintenance (chemical treatment every 3 to 5 years).

**Capital and Annualized Costs**  
**Multi-Benefit Stream Channel Improvement - Component 2 - High Estimate**  
**(Preliminary Cost Estimate)**

<b>SUMMARY</b>					
<b>Line No.</b>	<b>Description</b>		<b>Units</b>		<b>Total</b>
1	Project Yield (low estimate)		acre-feet per year		2,790
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$18,898,026
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$1,500,000
7	Annual O&M Cost		\$		\$165,200
8	Total Annualized Cost		\$		\$1,665,200
9	Unit Cost		\$/AFY		\$600
<b>CAPITAL COSTS</b>					
<b>Line No.</b>	<b>Capital</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total Cost</b>
10	Mowed arundo	700	Acres	\$19,928	\$13,949,426
11	Unmowed arundo	150	Acres	\$14,179	\$2,126,787
12	Hand-cut arundo	50	Acres	\$56,436	\$2,821,813
13	<b>Subtotal</b>				\$18,898,026
<b>OPERATIONS AND MAINTENANCE</b>					
<b>Line No.</b>	<b>Markups</b>	<b>Quantity</b>	<b>Unit</b>	<b>Unit Cost</b>	<b>Total Cost</b>
16	O&M Estimate	1	LS	\$165,200	\$165,200
17	<b>Total O&amp;M Cost</b>				\$165,200

**NOTES:**

1. "Project Yield" based on: Range of 6,000 to 36,000 AF, assumed an average of 20,000 AF
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: Phase I and Phase II.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.
7. "Annual O&M Cost" estimate based on average annual needs for on going monitoring and maintenance (chemical treatment every 3 to 5 years).

### Component 3

**Capital and Annualized Costs**  
**Multi-Benefit Stream Channel Improvements - Component 3**  
**(Preliminary Opinion of Probable Cost)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		100
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$1,116,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$87,300
7	Annual O&M Cost		\$		\$6,000
8	Total Annualized Cost		\$		\$93,300
9	Unit Cost		\$/AF		\$930
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$52,000	\$52,000
11	Environmental and Stormwater	1	LS	\$103,000	\$103,000
12	Off-Stream Recharge Basin	8.5	AC	\$48,500	\$412,250
13	Land Acquisition	1	AC	\$45,000	\$45,000
14	<i>Subtotal</i>				\$612,250
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
15	Construction Contingency			30%	\$124,000
16	General Conditions			15%	\$92,000
17	Contractor Overhead and Profit			15%	\$92,000
18	Sales Tax			9.25%	\$11,300
19	Engineering, Legal, Administrative, Contingencies			30%	\$184,000
20	<b>Total Capital Cost</b>				\$1,116,000
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
21	Detention Basin Maintenance	1	LS	\$4,300	\$4,300
22	Contingency			30%	\$1,300
23	<b>Total O&amp;M Cost</b>				\$6,000

**NOTES:**

1. "Project Yield" based on: Assumed 100 acre-feet per year.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" includes land acquisition costs estimated for an area equivalent to 10% of required recharge basin area. Recharge basin unit cost assumes inclusion of site civil earthwork and access road improvements. Environmental and stormwater requirements are estimate at 15% of capital base costs for off-stream basins.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.



**Capital and Annualized Costs**  
**Winter Releases from Reservoirs, with Aquifer Storage and Recovery in the 180/400-Foot Aquifer Subbasin**  
**(Preliminary Cost Estimate)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		12,900
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$172,141,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$13,467,000
7	Annual O&M Cost		\$		\$5,223,000
8	Total Annualized Cost		\$		\$18,690,000
9	Unit Cost		\$/AFY		\$1,450
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	180' Aquifer ASR Well Construction	8	EA	\$765,000	\$6,120,000
11	400' Aquifer ASR Well Construction	8	EA	\$1,530,000	\$12,240,000
12	Well Pumps, Motors, & Wellhead Infrastructure	16	EA	\$440,000	\$7,040,000
13	Electrical and Instrumentation	1	LS	\$1,056,000	\$1,056,000
14	Percolation Basins, Site Civil Work	16	25%	\$191,300	\$3,060,800
15	Land Access	21	AC	\$45,000	\$945,000
16	Distribution Pipeline (4 mile)	21,120	LF	\$650	\$13,728,000
17	Filtration and Disinfection System	1	LS	\$70,000,000	\$70,000,000
18	<b>SubTotal</b>				\$114,189,800
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
19	General Conditions			15%	\$17,128,500
20	Contractor Overhead and Profit			18%	\$20,554,200
21	Sales Tax			8.75%	\$9,991,600
22	Engineering, Legal, Administrative, Contingencies			20%	\$6,851,400
23	Bonds and Insurance			3%	\$3,425,700
24	<b>Total Capital Cost</b>				\$172,141,000
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
25	Power	1	LS	\$1,607,300	\$1,607,300
26	Treatment	1	LS	\$548,000	\$548,000
27	Equipment Repair & Replacement	1	LS	\$864,000	\$864,000
28	Operations Labor	1	LS	\$729,600	\$729,600
29	Miscellaneous	1	LS	\$603,900	\$603,900
30	Contingency			20%	\$870,600
31	<b>Total O&amp;M Annual Cost</b>				\$5,223,000

**NOTES:**

1. "Project Yield" based on: 49 CFS (22,000 GPM) and 36% facility up time, reflecting winter operation.
2. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: construction of 8 ASR wells in the 180-Foot Aquifer, 8 ASR wells in the 400-Foot Aquifer. Construction of a 23 MGD filtration/disinfection system for treating winter surface water flows prior to injection.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annual O&M Cost" includes well and treatment facilities.

**M3 - Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse**

**Conceptual Cost Estimate**  
**Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse**  
2,400 AFY 180/400 Foot Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
<b>Capital Costs (a)</b>					
<i>AWPF Facility Expansion</i>					
AWPF Expansion Construction Cost	1	LS	\$10,930,000	\$ 10,930,000	Costs for a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018) based on a 30% design that was prepared. Costs were revised based on the increase in ENR CCI for San Francisco from February 2018 to October 2019 (approximately 2.9%) and then converted to a \$/AF unit cost. This unit cost was used to estimate the cost of a 2,745 AFY expansion. Rounded up to the nearest \$10,000.
<i>Well Injection Facilities</i>					
Mobilization and Demobilization	5	%	\$16,983,216	\$ 849,161	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assumed same as M1W project.
General Site Work and Piping	1	LS	\$1,891,000	\$ 1,891,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes shoring, SWPPP, and traffic control. Costs for items such as paving and site preparation are assumed to be the same as the M1W project, but pipelines are assumed to be smaller as described in Section 3.2 of TM 3.
Injection Well Installation and Testing	5	EA	\$960,000	\$ 4,800,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 560-foot borehole and 550-foot deep well. 130-feet of screen.
Production Well Installation and Testing	2	EA	\$620,000	\$ 1,240,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018) and similar recent projects. Assumes 560-foot borehole and 550-foot deep well. 130-feet of screen.
Site Work at Each Well Site	7	EA	\$860,000	\$ 6,020,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes site improvements, well pads and pedestals, well pumps, and site piping. For budgeting purposes, assume same sizes as M1W project
Monitoring Wells	4	EA	\$100,000	\$ 400,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 550-foot deep 4-inch monitoring well.
Backflush Basin and Associated Appurtenances	1	LS	\$15,000	\$ 15,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project (125-ft x 125-ft x 5-ft), and cut/fill can be balanced.
Electrical Building and Hydropneumatic Tank	1	LS	\$77,216	\$ 77,216	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project
Electrical, Instrumentation, and Controls for Wells	1	LS	\$2,360,000	\$ 2,360,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project.
Other Site Work (i.e. landscaping, road maintenance during construction, etc.)	1	LS	\$180,000	\$ 180,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project
<i>Purified Recycled Water Pipeline</i>					
Purified Recycled Water Pipeline from AWPf to Injection Wells	23,760	LF	\$250	\$ 5,940,000	Assume 4.5-mile pipeline from AWPf to injection wells. Assumed maximum flow of 2,900 GPM. 16-inch diameter pipeline at \$12/in-diameter foot plus 30% for various appurtenances (\$250/LF). Rounded up to the nearest \$10,000.
Contingency on Infrastructure Costs	30	%	\$34,702,377	\$ 10,410,713	Based on a Class 5 level estimate for conceptual cost estimates (AAACEI, 2019).
Contingency for Electrical Connection with PG&E at Each Well Site	7	EA	\$200,000	\$ 1,400,000	Assumes \$200,000 per well site for connection and routing power lines to site.
Soft Costs: Planning, Environmental, Permitting, Engineering, Legal, mitigation, etc.	30	%	\$45,113,090	\$ 13,533,927	Assumes 30% of capital costs
<b>Capital Costs Subtotal (rounded up to nearest \$100,000)</b>				<b>\$ 60,100,000</b>	
<b>Annualized over 25 year period at 6% interest</b>				<b>\$ 4,701,426</b>	

**Conceptual Cost Estimate**  
**Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse**  
 2,400 AFY 180/400 Foot Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
<b>Operating Costs</b>					
Annual Operating Costs for AWPf, injection wells, and Production Wells	1	LS	\$ 2,400,000	\$ 2,400,000	Costs for operation of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a \$/AF unit cost and used to estimate the cost of a 2,745 AFY expansion. An additional 5% was also added to account for the operational cost of each new production well. Rounded up to the nearest \$10,000.
Annual Overhead costs for AWPf, injection wells, and Production Wells	1	LS	\$ 410,000	\$ 410,000	Costs for overhead of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a \$/AF unit cost and used to estimate the cost of a 2,745 AFY expansion. An additional 5% was also added to account for the overhead cost of each new production well. Rounded up to the nearest \$10,000.
Annual Energy Costs for Production Wells	1	LS	\$ 300,000	\$ 300,000	Energy costs are based on 200 HP pumps and an electricity price of \$0.185/kWh. Energy costs for AWPf and injection wells are included in operating costs listed above. Rounded up to the nearest \$10,000.
<b>Annual Operating and Overhead Cost Subtotal</b>				<b>\$ 3,110,000</b>	

<b>Total Costs</b>					
<b>Total Annualized Cost</b>				<b>\$ 7,820,000</b>	<b>per year over 25 years. Rounded up to nearest \$10,000</b>
<b>Total 30-Year Average Cost Per Acre-Foot (2,400 AFY)</b>				<b>\$ 3,300</b>	<b>per acre-foot. Rounded up to nearest \$100</b>

**Abbreviations:**

AFY: acre feet per year  
 AWPf: advanced water purification facility  
 EA: each  
 ENR CCI: Engineering News-Record Construction Cost Index

gpm: gallons per minute  
 LF: lineal foot  
 LS: lump sum  
 M1W: Monterey One Water

MCWD: Marina Coast Water District

**Notes**

(a) Increase for general conditions, contractor overhead and profit, and sales tax are included in capital unit costs and thus are not added separately.

**References**

AACEI, 2019. *Recommended Practices and Standards*, Association for the Advancement of Cost Engineering International, March 2019 Update.  
 M1W, 2018. *Progress Report on Pure Water Monterey Expansion*, Monterey One Water, 10 May 2018.  
 Nellor et al, 2019, *Final Engineering Report, Pure Water Monterey Groundwater Replenishment Project*, Nellor Environmental Associates, Trussell Technologies, and Todd Groundwater, April 2019  
 SCI, 2018. *Schedule of Values for Pure Water Monterey, Injection Wells Ph2*, SCI Specialty Construction, May 2018.



**Conceptual Cost Estimate**  
**Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse**  
2,400 AFY Deep Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
<b>Capital Costs (a)</b>					
<i>AWPF Facility Expansion</i>					
AWPF Expansion Construction Cost	1	LS	\$10,930,000	\$ 10,930,000	Costs for a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018) based on a 30% design that was prepared. Costs were revised based on the increase in ENR CCI for San Francisco from February 2018 to October 2019 (approximately 2.9%) and then converted to a \$/AF unit cost. This unit cost was used to estimate the cost of a 2,745 AFY expansion. Rounded up to the nearest \$10,000.
<i>Well Injection Facilities</i>					
Mobilization and Demobilization	5	%	\$21,933,216	\$ 1,096,661	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assumed same as M1W project.
General Site Work and Piping	1	LS	\$1,421,000	\$ 1,421,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes shoring, SWPPP, and traffic control.
Injection Well Installation and Testing	5	EA	\$2,130,000	\$ 10,650,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 1,510-foot borehole and 1,500-foot deep well. 270-feet of screen.
Production Well Installation and Testing	1	EA	\$1,270,000	\$ 1,270,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018) and similar recent projects. Assumes 1,510-foot borehole and 1,500-foot deep well. 130-feet of screen.
Site Work at Each Well Site	6	EA	\$860,000	\$ 5,160,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes site improvements, well pads and pedestals, well pumps, and site piping. For budgeting purposes, assume same sizes as M1W project.
Monitoring Wells	4	EA	\$200,000	\$ 800,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 1,500-foot deep 4-inch monitoring well.
Backflush Basin and Associated Appurtenances	1	LS	\$15,000	\$ 15,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project (125-ft x 125-ft x 5-ft), and cut/fill can be balanced.
Electrical Building and Hydropneumatic Tank	1	LS	\$77,216	\$ 77,216	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project.
Electrical, Instrumentation, and Controls for Wells	1	LS	\$2,360,000	\$ 2,360,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Reduced by 40% due to half as many wells and one-quarter as many monitoring wells.
Other Site Work (i.e. landscaping, road maintenance during construction, etc.)	1	LS	\$180,000	\$ 180,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project.
<i>Purified Recycled Water Pipeline</i>					
Purified Recycled Water Pipeline from AWPf to Injection Wells	18480	LF	\$250	\$ 4,620,000	Assume 3.5-mile pipeline from AWPf to injection wells. Assumed maximum flow of 2,900 GPM. 16-inch diameter pipeline at \$12/in-diameter foot plus 30% for various appurtenances (\$250/LF). Rounded up to the nearest \$10,000.
<b>Total Direct Costs</b>				<b>\$ 38,579,877</b>	
Contingency on Infrastructure Costs	30	%	\$38,579,877	\$ 11,573,963	Based on a Class 5 level estimate for conceptual cost estimates (AAECI, 2019).
Contingency for Electrical Connection with PG&E at Each Well Site	6	EA	\$200,000	\$ 1,200,000	Assumes \$200,000 per well site for connection and routing power lines to site.
Soft Costs: Planning, Environmental, Permitting, Engineering, Legal, mitigation, etc.	30	%	\$50,153,840	\$ 15,046,152	Assumes 30% of capital costs
<b>Capital Costs Subtotal (rounded up to nearest \$100,000)</b>				<b>\$ 66,400,000</b>	
<b>Annualized over 25 year period at 6% interest</b>				<b>\$ 5,194,254</b>	

**Conceptual Cost Estimate**  
**Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse**  
 2,400 AFY Deep Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
<b>Operating Costs</b>					
Annual Operating Costs for AWPf, injection wells, and Production Wells	1	LS	\$ 2,400,000	\$ 2,400,000	Costs for operation of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a \$/AF unit cost and used to estimate the cost of a 2,145 AFY expansion. An additional 5% was also added to account for the operational cost of each new production well. Rounded up to the nearest \$10,000.
Annual Overhead costs for AWPf, injection wells, and Production Wells	1	LS	\$ 410,000	\$ 410,000	Costs for overhead of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a \$/AF unit cost and used to estimate the cost of a 2,145 AFY expansion. An additional 5% was also added to account for the overhead cost of each new production well. Rounded up to the nearest \$10,000.
Annual Energy Costs for Production Wells	1	LS	\$ 370,000	\$ 370,000	Energy costs are based on 250 HP pumps and an electricity price of \$0.185/KWH. Energy costs for AWPf and injection wells are included in operating costs listed above.
<b>Annual Operating and Overhead Cost Subtotal</b>				<b>\$ 3,180,000</b>	

<b>Total Costs</b>					
<b>Total Annualized Cost</b>				<b>\$ 8,380,000</b>	<b>per year over 25 years. Rounded up to nearest \$10,000</b>
<b>Total 30-Year Average Cost Per Acre-Foot (2,400 AFY)</b>				<b>\$ 3,500</b>	<b>per acre-foot. Rounded up to nearest \$100</b>

Abbreviations:  
 AFY: acre feet per year  
 AWPf: advanced water purification facility  
 EA: each  
 ENR CCI: Engineering News-Record Construction Cost Index

gpm: gallons per minute  
 LF: lineal foot  
 LS: lump sum  
 M1W: Monterey One Water

MCWD: Marina Coast Water District

**Notes**  
 (a) Increase for general conditions, contractor overhead and profit, and sales tax are included in capital unit costs and thus are not added separately.

**References**  
 AACEI, 2019. *Recommended Practices and Standards*, Association for the Advancement of Cost Engineering International, March 2019 Update.  
 M1W, 2018. *Progress Report on Pure Water Monterey Expansion*, Monterey One Water, 10 May 2018.  
 Nellor et al. 2019. *Final Engineering Report, Pure Water Monterey Groundwater Replenishment Project*, Nellor Environmental Associates, Trussell Technologies, and Todd Groundwater, April 2019  
 SCI, 2018. *Schedule of Values for Pure Water Monterey, Injection Wells Ph2*, SCI Specialty Construction, May 2018.

**M4 - Monitoring Well(s)**

Conceptual Cost Estimate  
Project M4: Drill and Construct Monitoring Wells

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
<b>Capital Costs (a)</b>					
400-Foot Aquifer Monitoring Wells	2	EA	\$100,000	\$ 200,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 550-foot deep 4-inch monitoring well.
Deep Aquifer Monitoring Wells	1	EA	\$200,000	\$ 200,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 1,500-foot deep 4-inch monitoring well.
			<i>Total Direct Costs</i>	<i>\$ 400,000</i>	
Contingency on Infrastructure Costs	30	%	\$400,000	\$ 120,000	
Geochemical Analysis of the Deep Aquifers	1	LS	\$250,000	\$ 250,000	Based on a Class 5 level estimate for conceptual cost estimates (AAACEI, 2019).
Soft Costs: Planning, Permitting, Engineering, Legal, mitigation, etc.	30	%	\$770,000	\$ 231,000	Based on cost estimates for similar projects Assumes 30% of capital costs
<b>Capital Costs Subtotal (rounded up to nearest \$100,000)</b>				<b>\$ 1,100,000</b>	

**Abbreviations:**

AFY: acre feet per year

EA: each

LS: lump sum

MCWD: Marina Coast Water District

**Notes**

(a) Increase for general conditions, contractor overhead and profit, and sales tax are included in capital unit costs and thus are not added separately.

**References**

AAACEI, 2019. *Recommended Practices and Standards*, Association for the Advancement of Cost Engineering International, March 2019 Update.

SCI, 2018. *Schedule of Values for Pure Water Monterey, Injection Wells Ph2*, SCI Specialty Construction, May 2018.



## C2 - Check Dams

**Capital and Annualized Costs**  
**Corral de Tierra - Project 3, Check Dams Along Streams**  
**Preliminary Opinion of Probable Cost)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		150
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$5,143,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$402,300
7	Annual O&M Cost		\$		\$22,000
8	Total Annualized Cost		\$		\$424,300
9	<b>Unit Cost</b>		<b>\$/AFY</b>		<b>\$2,830</b>
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$110,000	\$110,000
11	Environmental and Stormwater	1	LS	\$319,000	\$319,000
11	Earthwork/Site Preparation	1	LS	\$379,000	\$379,000
12	Channel Erosion Control Lining	1	LS	\$57,000	\$57,000
13	Rubber Dam	1	LS	\$1,060,000	\$1,060,000
14	Check Dam Support Building	625	SF	\$150	\$93,750
15	Electrical, I&C	1	LS	\$288,000	\$288,000
16	Land Acquisiton	10	AC	\$64,000	\$640,000
17	<i>Subtotal</i>				\$2,946,750
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
18	Plumbing Appurtenance Contingency			30%	\$346,000
19	General Conditions			15%	\$442,000
20	Contractor Overhead and Profit			15%	\$442,000
21	Sales Tax			9.25%	\$81,800
22	Engineering, Legal, Admininstrative, Contingencies			30%	\$884,000
23	<b>Total Capital Cost</b>				\$5,143,000
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
24	Power	1	LS	\$600	\$600
25	Labor	1	LS	\$9,600	\$9,600
26	Equipment Repair & Replacement	1	LS	\$5,200	\$5,200
27	Miscellaneous Allowance	1	LS	\$1,100	\$1,100
28	Contingency			30%	\$5,000
29	<b>Total O&amp;M Cost</b>				\$22,000

**NOTES:**

1. "Project Yield" based on: Assumed recharge of 150 AFY equivalent to 60% of the runoff volume from a 2-year, 24-hour event.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.

### **C3 - Recharge from Surface Water DiversionS**

**Capital and Annualized Costs**  
**Corral de Tierra - Project 1, Creek Diversion and Recharge**  
**(Preliminary Opinion of Probable Cost)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		160
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$5,950,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$465,500
7	Annual O&M Cost		\$		\$26,000
8	Total Annualized Cost		\$		\$491,500
9	Unit Cost		\$/AF		\$3,070
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$113,000	\$113,000
11	Environmental and Stormwater	1	LS	\$327,000	\$327,000
11	Earthwork/Site Preparation	1	LS	\$59,000	\$59,000
12	Diversion Structure	1	LS	\$140,000	\$140,000
13	Pipeline	3200	LF	\$250	\$800,000
14	Storage Basin (10 AF)	0	LS	\$177,000	\$0
15	Pump Station	1	LS	\$648,000	\$648,000
16	Equipment and Control Building	625	SF	\$150	\$93,750
17	Injection and Monitoring Wells	0	LS	\$2,051,000	\$0
18	Electrical, I&C	1	LS	\$185,000	\$185,000
19	Land Acquisition	15.7	AC	\$64,000	\$1,004,800
20	<i>Subtotal</i>				\$3,370,550
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
21	Plumbing Appurtenance Contingency			30%	\$463,000
22	General Conditions			15%	\$506,000
23	Contractor Overhead and Profit			15%	\$506,000
24	Sales Tax			9.25%	\$93,500
25	Engineering, Legal, Administrative, Contingencies			30%	\$1,011,000
26	<b>Total Capital Cost</b>				\$5,950,000
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
27	Power	1	LS	\$6,700	\$6,700
28	Labor (Diversion Facilities, Basin)	1	LS	\$3,200	\$3,200
29	Equipment Repair & Replacement	1	LS	\$4,000	\$4,000
30	Miscellaneous Allowance	1	LS	\$6,100	\$6,100
31	Contingency			30%	\$6,000
32	<b>Total O&amp;M Cost</b>				\$26,000

**NOTES:**

1. "Project Yield" based on: Analysis of USGS Gage Station 11152540 using the CA SWRCB's 90th Percentile/20% Method and applying a 0.67 reduction factor for the assumed, upstream diversion site.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.



## **C4 - Wastewater Recycling for Reuse**

**Capital and Annualized Costs**  
**Monterey Basin - Project No. 8, Toro Park Water Reclamation**  
**Preliminary Opinion of Probable Cost)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		232
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$28,635,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$2,240,100
7	Annual O&M Cost		\$		\$486,000
8	Total Annualized Cost		\$		\$2,726,100
9	Unit Cost		\$/AF		\$11,750
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$719,000	\$719,000
11	Environmental and Stormwater	1	LS	\$1,307,000	\$1,307,000
12	Tertiary Treatment Plant	1	LS	\$4,351,000	\$4,351,000
13	Reclaimed Water Lift Station	1	LS	\$345,000	\$345,000
14	Treated Water Storage Tank	1	EA	\$450,000	\$450,000
15	Pipeline	30,900	LF	\$250	\$7,725,000
16	Electrical, I&C	1	LS	\$199,000	\$199,000
17	Land Acquisition/Easements	1	LS	\$211,000	\$211,000
18	<i>Subtotal</i>				\$15,307,000
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
19	Plumbing Appurtenance Contingency			30%	\$3,861,000
20	General Conditions			15%	\$2,296,000
21	Contractor Overhead and Profit			15%	\$2,296,000
22	Sales Tax			9.25%	\$283,200
23	Engineering, Legal, Administrative, Contingencies			30%	\$4,592,000
24	<b>Total Capital Cost</b>				\$28,635,000
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
25	Power	1	LS	\$21,400	\$21,400
26	Tertiary Plant Operations	1	LS	\$30,300	\$30,300
27	Labor (Tank, Pipeline, Pump Stations)	1	LS	\$288,000	\$288,000
28	Equipment Repair & Replacement	1	LS	\$34,000	\$34,000
29	Contingency			30%	\$112,100
30	<b>Total O&amp;M Cost</b>				\$486,000

**NOTES:**

1. "Project Yield" based on: Beneficial reuse of treated wastewater flows to Toro Park WWTP, estimated at 232 AFY in Wallace Group memorandum, *Corral De Tierra Subarea Water and Wastewater Usage Analysis* (March 2021).
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.

**C7 - Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to  
Lower Corral de Tierra Valley (Artesian Well)**

**Capital and Annualized Costs**  
**Corral de Tierra - Project 2, Upper Corral de Tierra Artesian Well and Lower Corral de Tierra Recharge**  
**Preliminary Opinion of Probable Cost)**

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		160
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		\$		\$13,275,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		\$		\$1,038,500
7	Annual O&M Cost		\$		\$9,000
8	Total Annualized Cost		\$		\$1,047,500
9	<b>Unit Cost</b>		<b>\$/AFY</b>		<b>\$6,550</b>
<b>CAPITAL COSTS</b>					
Line No.	Capital	Quantity	Unit	Unit Cost	Total Cost
10	Mobilization/Demobilization	1	LS	\$297,000	\$297,000
11	Environmental and Stormwater	1	LS	\$863,000	\$863,000
11	Earthwork/Site Preparation	1	LS	\$19,000	\$19,000
12	Recharge Basin Inlet Structure	1	LS	\$16,000	\$16,000
13	Pipeline	20500	LF	\$225	\$4,612,500
14	Extraction Well	1	LS	\$207,000	\$207,000
15	Surge Tank	1	LS	\$137,000	\$137,000
16	Electrical, I&C	1	LS	\$86,000	\$86,000
17	Land Acquisiton	15.7	AC	\$64,000	\$1,004,800
18	<i>Subtotal</i>				\$7,242,300
Line No.	Markups	Quantity	Unit	Unit Cost	Total Cost
19	Plumbing Appurtenance Contingency			30%	\$1,487,000
20	General Conditions			15%	\$1,086,000
21	Contractor Overhead and Profit			15%	\$1,086,000
22	Sales Tax			9.25%	\$201,000
23	Engineering, Legal, Admininstrative, Contingencies			30%	\$2,173,000
24	<b>Total Capital Cost</b>				<b>\$13,275,000</b>
<b>OPERATIONS AND MAINTENANCE</b>					
Line No.	Description	Quantity	Unit	Unit Cost	Total Cost
25	Power	1	LS	\$0	\$0
26	Labor (Well Facility, Recharge Basin)	1	LS	\$4,000	\$4,000
27	Equipment Repair & Replacement	1	LS	\$2,500	\$2,500
28	Miscellaneous Allowance	1	LS	\$500	\$500
29	Contingency			30%	\$2,100
30	<b>Total O&amp;M Cost</b>				<b>\$9,000</b>

**NOTES:**

1. "Project Yield" based on: 100 gpm well capacity producing a mean of 160 AFY.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.



## Appendix 9-B

**The 2016 Pure Water Delivery and Supply Project Agreement and the 2017 Amendment**

**Pure Water Delivery and Supply Project Agreement Between  
Monterey Regional Water Pollution Control Agency and  
Marina Coast Water District**



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**THIS PURE WATER DELIVERY AND SUPPLY PROJECT** [hereinafter referred to as "Agreement"] is made this 8<sup>th</sup> day of April, 2016 ("Effective Date"), by and between Monterey Regional Water Pollution Control Agency ("PCA") and Marina Coast Water District ("MCWD"), hereinafter "Parties."

The PCA was formed as a California Joint Powers Agency by a Joint Exercise of Powers Agreement for the Monterey Regional Water Pollution Control Agency, effective June 29, 1979. The MCWD is a County Water District and political subdivision of the State of California, organized under Division 12, sections 30000 and following, of the California Water Code.

### **WITNESSETH**

**WHEREAS**, the 1997 Fort Ord Base Reuse Plan (BRP) identifies the availability of water as a resource constraint and the BRP estimates that an additional 2,400 AFY of water is needed to augment the existing groundwater supply to achieve the permitted development level as reflected in the BRP (Volume 3, figure PFIP 2-7); and,

**WHEREAS**, the Fort Ord Reuse Authority ("FORA") transferred ownership of all of the then existing Fort Ord water and sewer facilities to the Marina Coast Water District ("MCWD") under the 1998 Water/Wastewater Facilities Agreement; title was transferred in 2001; and,

**WHEREAS**, under Section 3.2.2 of the 1998 Water/Wastewater Facilities Agreement, FORA has the responsibility to determine, in consultation with MCWD, what additional water and sewer facilities are necessary for MCWD's Ord Community service area in order to meet the BRP requirements, and that, once FORA determines that additional water supply and/or sewer conveyance capacity is needed, under Section 3.2.1, it is MCWD's responsibility to plan, design, and construct such additional water and sewer facilities. Section 7.1.2 requires FORA to insure that MCWD recovers all of its costs for the new facilities and their operation; and,

**WHEREAS**, in 2002, MCWD, in cooperation with FORA, initiated the Regional Urban Water Augmentation Project (RUWAP) to explore water supply alternatives to provide the additional 2,400 AFY of water supply needed under the BRP; and

**WHEREAS**, as a result of an extensive environmental review, FORA and MCWD agreed to adopt a modified Hybrid Alternative, which would provide 1,427 AFY of recycled water to the Ord Community without the need for seasonal storage, and this in turn resulted in the FORA Board adopting Resolution 07-10 (May 2007), which allocated that 1,427 AFY of RUWAP recycled water to its member agencies having land use jurisdiction; and

**WHEREAS**, in June 2009, PCA and MCWD entered into a 50-year RUWAP Memorandum of Understanding, in which, subject to certain conditions specified therein, (a) PCA committed 650 AFY of summer recycled water to MCWD for the Ord Community; (b) MCWD affirmed its separate commitment of 300 AFY of summer recycled water to the Ord Community; and (c) PCA and MCWD committed to supply 477 AFY of recycled water during other months to the Ord Community - for a total of 1,427 AFY; and

**WHEREAS**, MCWD has been and continues to work collaboratively with FORA and with the PCA to carry out MCWD's obligation to provide the 1,427 AFY of recycled water for the Ord Community; and

**WHEREAS**, on May 31, 2013, PCA commenced environmental review of its Pure Water Monterey Groundwater Replenishment Project ("Pure Water Monterey Project"). The Pure Water Monterey Project is a water supply project that would serve northern Monterey County by providing: (1) purified recycled water for recharge of a groundwater basin that serves as drinking water supply; and (2) recycled water to augment the existing Castroville Seawater Intrusion Project's agricultural irrigation supply. The Pure Water Monterey Project includes a pipeline to transport purified recycled water from a new Advanced Water Treatment Plant ("AWT") at PCA's Regional Treatment Plant to new Injection Well Facilities overlying the Seaside Groundwater Basin ("Product Water Conveyance Pipeline"). The Environmental Impact Report ("EIR") for the Pure Water Monterey Project evaluated two alternative alignments for the Product Water Conveyance Pipeline, a Coastal Alignment and an alignment that follows the right-of-way for the existing and future RUWAP pipeline ("RUWAP Alignment"). The Pure Water Monterey Project EIR identified the environmental effects of constructing the Product Water Conveyance Pipeline along the RUWAP Alignment, and operating the Product Water Conveyance Pipeline for the Pure Water Monterey Project; however the EIR recognized that shared use of a single Product Water Conveyance Pipeline for both the Pure Water Monterey Project and to supply recycled water to MCWD for the RUWAP would necessitate further review under the California Environmental Quality Act ("CEQA"). Shared use of a single Product Water Conveyance Pipeline would necessitate expansion of the Advanced Water Treatment Plant in order to purify the recycled water destined for the RUWAP because all water flowing in the shared pipeline must be purified; by contrast if water to serve the RUWAP were conveyed in its own separate pipeline only tertiary treatment would be needed; and

**WHEREAS**, on September 8, 2015, MWCD and PCA tentatively agreed to work together on the Pure Water Monterey Project; and

**WHEREAS**, on October 8, 2015, the PCA Board unanimously voted to certify the EIR for the Pure Water Monterey Project and to approve the Pure Water Monterey Project. The PCA Board selected the RUWAP Alignment for the Product Water Conveyance Pipeline.

**WHEREAS**, on October 9, 2015, the FORA Board unanimously voted to adopt a resolution to endorse the Pure Water Monterey Project as an acceptable option as the recycled component of the RUWAP and, as part of the Pure Water Monterey Project implementation, the FORA Board will review and consider project component costs and scheduling through annual consideration of the FORA CIP and Ord Community Budgets.

**NOW, THEREFORE**, for and in reliance of the foregoing, the Parties hereby agree as follows:

## **DEFINITIONS**

For the purposes of this Agreement, the following definitions are provided:

- A. The term "Annexation Agreements" refers to the Annexation Agreement between MCWD and PCA dated April 25, 1989, and the Annexation Agreement between MCWD and WRA dated March 26, 1996. The individual Annexation Agreements are referenced herein by their respective dates.
- B. The term "AWT" or "AWT Facilities" or "Advanced Water Treatment Facilities" means the Advanced Water Treatment facilities as shown in Exhibit B at the PCA Regional Treatment Plant

for the Pure Water Monterey Project and includes the AWT-PCA, AWT Phase 1, and the AWT Phase 2. The AWT Facilities includes that segment of new pipeline shown on Exhibit B and located within the existing property lines of the Regional Treatment Plant property.

- C. The term “AWT Capacity Entitlement” shall mean the entitlement to the plant treatment capacity of the AWT which a Party has the right to use under this Agreement.
- D. The term “AWT-PCA” shall mean construction and operation of an advanced water treatment plant sized to produce 3,700 AFY of purified recycled water to deliver to the Seaside Groundwater Basin for the Pure Water Monterey Project as approved by the PCA Board in its Resolution Number 2015-24 on October 8, 2015 as part of the “Pure Water Monterey Project”.
- E. The term “AWT Phase 1” shall mean construction and operation of an expansion to the AWT-PCA to produce an additional 600 AFY of purified recycled water to deliver to the FORA land use jurisdiction members in addition to the 3,700 AFY of purified recycled water from the AWT-PCA to deliver to the Seaside Groundwater Basin, for a total production of purified recycled water of from the AWT Phase 1 of 4,300 AFY.
- F. The term “AWT Phase 2” shall mean construction and operation of an expansion to the AWT-PCA to produce an additional 827 AFY for a total of 1,427 AFY of purified recycled water to deliver to the FORA land use jurisdiction members in addition to the 3,700 AFY of purified recycled water from the AWT-PCA to deliver to the Seaside Groundwater Basin, for a total production of purified recycled water from the AWT Phase 2 of 5,127 AFY.
- G. The term “Drought Reserve” shall refer to storage of up to 1,000 acre-feet of water for potential use during a drought. During wet or normal water years, about 50% of the years, an additional 200 AFY may be conveyed through the Pipeline Facilities and injected in the winter months to develop the Drought Reserve, thereby increasing PCA’s use of the Pipeline Facilities to 3,700 AFY.
- H. The term “Existing Pipeline Facilities” shall be the existing recycled water pipeline (and appurtenances) constructed by MCWD and rights-of-ways, which will become part of the Product Water Conveyance Facilities as shown in Exhibit C.
- I. The term “Injection Well Facilities” shall mean collectively the Injection Well Facilities, turnouts, diversions and lateral pipelines connected to and beyond the Product Water Conveyance Facilities as shown in Exhibit C.
- J. The term “New Pipeline Facilities” shall mean the new recycled water pipeline sections (and appurtenances), booster plant, and rights-of-ways to convey purified recycled water as shown in Exhibit C which will become a part of the Product Water Conveyance Facilities. The beginning and ending points of the “New Pipeline Facilities” are shown in Exhibits A and C, respectively.
- K. The term “Parties” or “Both Parties” shall mean MCWD and PCA and their respective Boards.
- L. The term “Pipeline Facilities Entitlement” shall mean the entitlement to the capacity of the Pipeline Facilities which a Party has the right to use under this Agreement.
- M. The term “Product Water Conveyance Facilities”, “Pipeline Facilities”, and “RUWAP Conveyance Facilities” shall mean collectively the New Pipeline Facilities and the Existing Pipeline Facilities as shown in Exhibits C.



- N. The term "Pure Water Monterey Project" shall mean the full project that the PCA Board approved in its Resolution Number 2015-24 on October 8, 2015 including construction and operation of all source water facilities, Product Water Conveyance Facilities, AWT-PCA and other improvements to the Regional Treatment Plant, and Cal Am Distribution System Improvements described in such resolution and in the EIR for the Pure Water Monterey Project.
- O. The term "Pure Water Delivery and Supply Project Facilities" or "Project Facilities" shall mean collectively the AWT and the Product Water Conveyance Pipeline Facilities, as generally shown in Exhibit A. The term "Project Facilities components" shall refer severally to the AWT Facilities and the Pipeline Facilities. The Pure Water Delivery and Supply Project Facilities, as defined by this Agreement is a subset of certain components of the Pure Water Monterey Project and RUWAP Recycled Water Project including expansion of the AWT to implement this Agreement.
- P. The terms "reclaimed water", "reclaimed wastewater", and "recycled water" shall mean purified recycled water.
- Q. The term "RUWAP Distribution Facilities" shall mean those facilities connected to the Product Water Conveyance Facilities, which will be used to distribute MCWD's recycled water to MCWD's customers. The RUWAP Distribution Facilities are not a Project Facilities component.
- R. The term "RUWAP Recycled Project" shall mean the urban recycled water portion of the Regional Urban Water Augmentation Project (RUWAP) approved by the MCWD and FORA Boards. In 2002, MCWD, in cooperation with FORA, initiated the Regional Urban Water Augmentation Project (RUWAP) to explore water supply alternatives to provide an additional 2,400 AFY of water supply needed under the Base Reuse Plan. As a result of an extensive environmental review, FORA and MCWD agreed to adopt a modified Hybrid Alternative, which would provide 1,427 AFY of recycled water to the Ord Community without the need for seasonal storage, and this in turn resulted in the FORA Board adopting Resolution 07-10 (May 2007), which allocated that 1,427 AFY to its member agencies having land use jurisdiction. As a result of the Pure Water Monterey Project, the RUWAP Recycled Project includes MCWD's Pipeline Facilities Entitlement, the RUWAP Distribution Facilities, and MCWD's AWT Capacity Entitlement under this Agreement.
- S. The term "Source Water Facilities" shall mean the diversion facilities as approved in the "Pure Water Monterey Project" by the PCA Board in its Resolution Number 2015-24 on October 8, 2015.
- T. The term "summer months" shall mean the months of May, June, July, August, and September.

## **I. DESIGN, ENVIRONMENTAL, RIGHT-OF-WAY, AND CONSTRUCTION**

### **1.01 California Environmental Quality Act Compliance and Other Conditions**

- (a) Conditions Precedent and Drop Dead Dates: Nothing in this Agreement, except Section 1.01 (b), shall be deemed to constitute a binding obligation on either Party unless and until all of the following have occurred first:
- i. New Pipeline Facilities: MCWD must complete any necessary CEQA review for any change in the location of the New Pipeline Facilities as compared to the location of the

pipeline facilities as shown the EIR for the Pure Water Monterey Project by October 31, 2016. Further, upon completion of any such CEQA review, before this Agreement can take effect, MCWD and PCA must approve the change in location of the New Pipeline Facilities. In conducting the CEQA review, MCWD reserves all of its rights, powers and discretion with regard to any such change in location in pipeline facilities. This includes the authority to adopt mitigation measures and/or an alternative project design, configuration, capacity or location in order to reduce any identified significant environmental impacts; the authority to deny the change in location of pipeline facilities based on any significant environmental impact that cannot be mitigated (in which case this Agreement shall not take effect); and the authority to approve the change in location of pipeline facilities notwithstanding any significant environmental impact that cannot be mitigated, if MCWD determines that these impacts are outweighed by the project's social, economic or other benefits. PCA similarly reserves all of its rights, powers and discretion under CEQA with regard to any decision by PCA on whether and how to approve any change in location in pipeline facilities.

- ii. AWT: PCA must complete any necessary CEQA review for AWT Phase 1 and AWT Phase 2 by October 31, 2016. In conducting the CEQA review, PCA reserves all of its rights, powers and discretion with regard to the expansion of the AWT. This includes the authority to adopt mitigation measures and/or an alternative project design, configuration, capacity or location in order to reduce any identified significant environmental impacts; the authority to deny the expansion of the AWT based on any significant environmental impact that cannot be mitigated (in which case this Agreement shall not take effect); and the authority to approve the expansion of the AWT notwithstanding any significant environmental impact that cannot be mitigated, if PCA determines that these impacts are outweighed by the project's social, economic or other benefits. MCWD similarly reserves all of its rights, powers and discretion under CEQA with regard to any decision by MCWD on whether and how to approve any expansion of the AWT.
- iii. There must be no CEQA lawsuits challenging any of the Parties' approvals with respect to any change in the location of the New Pipeline Facilities or with respect to the AWT Phase 1 or AWT Phase 2; if any such lawsuits are filed, all such lawsuits must be favorably resolved to the satisfaction of both PCA and MCWD.
- iv. All necessary regulatory approvals must be obtained for the Pure Water Monterey Project, AWT, and the New Pipeline Facilities including regulatory approvals required for any change in the location of the New Pipeline Facilities as compared to the location evaluated in the EIR for the Pure Water Monterey Project by October 31, 2016.
- v. Funding must be secured by December 31, 2016 for the Pure Water Monterey Project and the RUWAP Distribution Facilities, including for any change in the location of the New Pipeline Facilities as compared to the location evaluated in the EIR for the Pure Water Monterey Project, for AWT Phase 1, and for the CEQA work for AWT Phase 2; provided, however, that this funding is not required for the completed design and construction of AWT Phase 2 for the provisions of this Agreement to take effect with regard to implementation of Phase 1.
- vi. All source water must be approved for the Pure Water Monterey Project, except for Lake El Estero and Tembladero Slough by October 31, 2016.
- vii. All approvals must be obtained from the California Public Utilities Commission for the

water purchase agreement under which Cal Am agrees to buy 3,500 acre-feet of water per year from the Pure Water Monterey Project by October 31, 2016.

(b) Key Dates and Conditions for Future Negotiations.

- i. If the Division of Financial Services of the State Water Resource Control Board fails to approve PCA's SRF loan Initial Funding Agreement by October 31, 2016, then MCWD and PCA agree to negotiate in good faith alternatives for providing recycled water (tertiary or purified) for potential customers.
- ii. If the Division of Financial Services of the State Water Resource Control Board approves PCA's initial funding agreement, then if the Division of Financial Services of the State Water Resource Control Board fails to approve MCWD's State Revolving Fund (SRF) loan Initial Funding Agreement and/or MCWD passes a Board resolution to discontinue work on the project by October 31, 2016, then MCWD shall transfer all work product (e.g. right-of-way, design, survey, environmental, bid documents, etc.) to PCA so PCA can continue progressing with the project. If the Division of Financial Services of the State Water Resource Control Board approves PCA's State Revolving Fund (SRF) Loan Final Funding Agreement but denies MCWD's State Revolving Fund (SRF) Loan Final Funding Agreement and MCWD does not identify alternate financing by December 31, 2016, MCWD shall transfer all work product to PCA for financing and constructing the New Pipeline Facilities.
  - a. PCA will pay MCWD for all project expenditures on any work products transferred (e.g. right-of-way, design, survey, environmental, and bid document development).
  - b. In the event that PCA assumes responsibility for the financing and construction of the product water conveyance facilities, MCWD would continue to maintain ownership of the Product Water Conveyance Facilities per 2.06 of this agreement, and would assume ownership upon satisfactory demonstration of no additional financial impact to PCA for providing the financing to construct the Product Water Conveyance Facilities.
- iii. If the Division of Financial Services awards PCA an interest rate that is lower than the interest rate awarded to MCWD and MCWD does not receive grant or other funds that could be applied to the New Pipeline Facilities that would reduce PCA's share of the New Pipeline Facilities cost by approximately the same amount as the difference in cost from MCWD's higher interest rate, then MCWD and PCA agree to negotiate in good faith alternatives for financing and constructing the New Pipeline Facilities.

1.02 MCWD's Obligations.

MCWD will fulfill the following obligations relating to the New Pipeline Facilities:

- (a) MCWD will be responsible for acquiring all rights-of-way needed for the New Pipeline Facilities.
- (b) MCWD will conduct any necessary CEQA review for the New Pipeline Facilities.
- (c) MCWD will complete the design and contract documents for the construction of the New Pipeline Facilities.
- (d) MCWD will finance, construct, and install the New Pipeline Facilities in substantial conformity

with designs and plans approved by the Parties in writing. MCWD will put the New Pipeline Facilities out to bid and administer the construction contract.

1.03. PCA's Obligations.

PCA will fulfill the following obligations relating to the AWT Facilities:

- (a) PCA will conduct any necessary CEQA review for the AWT including Phase 1 and Phase 2.
- (b) PCA will finance, construct, and install the AWT Phase 1, in substantial conformity with designs and plans approved by the Parties in writing. PCA will put the AWT Phase 1 out to bid, and administer the construction contract(s).
- (c) PCA will complete the design and contract documents for the AWT Phase 1.
- (d) PCA will provide, and MCWD shall have, an AWT Capacity Entitlement of 600 AFY of purified recycled water from the AWT Phase 1 facilities.
- (e) PCA will provide, and MCWD shall have, an AWT Capacity Entitlement of an additional 827 AFY of purified recycled water from the AWT Phase 2 for a total AWT Capacity Entitlement in the AWT facilities of 1,427 AFY.
- (f) Up until MCWD exercises its option for the AWT Phase 2 facilities, MCWD shall have the continuing right to 827 AFY of tertiary water as set forth in the Annexation Agreements and the 2009 RUWAP MOU (1,427 AFY less the 600 AFY of recycled water provided in the AWT Phase 1 facility). It is not intended or implied that this water would be used in the same pipeline as the advanced treated water.

1.04. Change Orders.

- (a) Change orders must be approved in writing.
- (b) Any change order or related set of change orders that increases the Pure Water Delivery and Supply Project Facilities cost by \$100,000 or more shall require the written consent of both parties within 30 days of presentation.
- (c) Any change order or related set of change orders that increases the Pure Water Delivery and Supply Project Facilities cost by less than \$100,000 or that lowers the Pure Water Delivery and Supply Project Facilities cost may be approved by the party designated herein to administer the contract, without the consent of the other party, except that a copy of any proposed or executed change order shall promptly be provided to the other party as soon as it is available. The contract administrator party shall not split up change order work so that approval of the combined change order work by the other party is not required.
- (d) Each party's contract administrator shall be authorized to give consent to change orders for that party. Neither party's consent to a change order will be unreasonably withheld or delayed.
- (e) This Change Orders section shall apply separately to the AWT and Product Water Conveyance Facilities. This section shall no longer apply to a component of the Pure Water Delivery and Supply Project Facilities on the date that the parties agree in writing that that such component has been completed and is ready to be used.



1.05. Project Schedule Cooperation between agencies.

- (a) Subject to the terms and conditions of this Agreement, PCA and MCWD shall work cooperatively and with diligence to obtain all permits, approvals, and financing to construct the Pure Water Delivery and Supply Project Facilities.
- (b) Both parties will develop an implementation schedule. Representatives of the parties will meet on a monthly basis, or more often if necessary, in order to ensure that the Pure Water Delivery and Supply Project Facilities are proceeding according to the schedule and in conformity with this contract and the approved plans and designs. Each party will make every reasonable effort to fulfill its obligations in a timely manner to meet the projects milestones and deadlines.

1.06. Right to inspect.

- (a) Each party shall have the right to inspect the Pure Water Delivery and Supply Project Facilities, while under construction and at any time thereafter during the term of this contract, upon the giving of reasonable advance notice to the party administering the construction contract. Such inspections may take place at any time during the day or night; however, night time inspections will not take place without at least one week's notice, except in case of emergency or by agreement between the parties.
- (b) Each party shall have the sole right to direct the construction work that such party is responsible to implement and the work of each party's own employees. Each party's right to inspect is for the purpose of observation only and not for the purpose of supervision of the work observed.

1.07. Ocean Outfall.

Nothing in this Agreement changes past agreements between the Parties to meet and confer in good faith to evaluate the environmental, technical, managerial, and financial feasibility of a project to use the Regional Treatment Plant outfall to transport and discharge brine byproduct from a future water desalination facility.

**II. PURE WATER DELIVERY AND SUPPLY PROJECT FACILITIES  
DESCRIPTION, OWNERSHIP, OPERATIONS, AND MAINTENANCE**

2.01. Location and Description of the Pure Water Delivery and Supply Project Facilities.

The Pure Water Delivery and Supply Project Facilities are shown generally in Exhibit A, attached hereto and made a part hereof and consist of the following sections:

- AWT (Exhibit B)
- New Pipeline Facilities (Exhibit C)
- Existing Pipeline Facilities (Exhibit C)

2.02. AWT Phase I

The AWT Phase I shall be sized to produce a minimum of 600 AFY of purified recycled water with the ability to produce a maximum day demand of 1.37 MGD for MCWD and in addition to produce a minimum of 3,700 AFY of purified recycled water with the ability to produce a maximum day demand of 4.0 MGD for the Pure Water Monterey Project.

2.03. Product Water Conveyance Facilities

- (a) The New and Existing Pipeline Facilities will have a minimum total conveyance capacity of



5,127 AFY.

- (b) PCA is prohibited from providing water to any customer within any MCWD service area through the use of any Pure Water Monterey Project Facility, either directly or through a third party, unless approved and authorized in writing by the MCWD Board of Directors. PCA agrees that it shall not authorize any third party to use any Pure Water Monterey Project Facility to serve water to any customer within any MCWD service area unless approved and authorized in writing by the MCWD Board of Directors.

2.04. Reserved

2.05. Future Expansion of Facilities (AWT Phase 2)

- (a) Subject to Section 1.01 (a) conditions, PCA will provide upon a written request from MCWD an additional AWT Capacity Entitlement for MCWD of up to and including 827 AFY of purified recycled water under AWT Phase 2 for a total AWT Capacity Entitlement of 1,427 AFY. PCA will not unreasonably delay implementing the request.
- (b) PCA will reserve physical space at the plant site and facilities for expanding the AWT should subsection (a) be triggered from time to time in the future.
- (c) Should MCWD request expanding the AWT beyond the AWT Phase 1 while there is sufficient time and funding capacity to include the further expansion in the Clean Water State Revolving Fund loan for the Pure Water Monterey Project, the costs for the AWT Phase 2 will be subject to the cost sharing section of this Agreement.
- (d) Subject to Section 2.05(b) above, PCA may expand the AWT and may construct additional reclamation facilities, at its sole cost and expense and without receiving the consent of MCWD, unless the Product Water Conveyance Facilities are disrupted or delivery of AWT water to MCWD is affected, then consent is required by MCWD in writing. Any increases in capacity and any additional reclamation facilities so constructed shall be used at PCA's discretion.

2.06. Ownership, Operation, and Maintenance of the Pure Water Delivery and Supply Project Facilities

- (a) PCA will own, operate, and maintain the AWT.
- (b) MCWD will own, operate and maintain the Product Water Conveyance Facilities. In addition, MCWD shall own a Pipeline Facilities Capacity Entitlement equal to 27.833% of the capacity of the Product Water Conveyance Facilities with a maximum annual use of 1,427 AFY during the initial term and any extended term of this Agreement. If and when the AWT Phase 2 is commercially operational and as shown on the table accompanying Section 3.02(b), the Parties recognize and agree that, during the summer months, MCWD's use of the Pipeline Facilities' capacity may exceed 27.833% of the instantaneous capacity and that MCWD is hereby authorized to exceed 27.833% during the summer months.
- (c) PCA shall own a Pipeline Facilities Capacity Entitlement equal to 72.167% of the capacity of the Product Water Conveyance Facilities with a maximum annual use of 3,700 AFY during initial term and any extended term of this Agreement. Parties recognize and agree that, during the months of November through February, PCA's use of the Pipeline Facilities' capacity may exceed 72.167% of the instantaneous capacity and that PCA is hereby authorized to exceed 72.167% during those specific months.

- (d) For the term of this Agreement, PCA shall maintain the AWT in good condition and repair and MCWD shall maintain the Product Water Conveyance Facilities in good condition and repair.
- (e) Both parties agree to coordinate operations and to share/integrate SCADA and other operational tools as necessary to facilitate efficient and effective operations of the Pure Water Delivery and Supply Project Facilities.

2.07. Decision-making authority.

In order to provide for the smooth and efficient operation of the Pure Water Delivery and Supply Project Facilities, MCWD and PCA will have the full authority to make and implement decisions with regard to activities and expenditures for the operations, and maintenance of their respective Project Facilities component without prior approval of the other party. All such activities shall be within the scope of services for operations and maintenance. All such expenditures shall be funded with the respective parties operational and maintenance budgets and/or the replacement reserves.

2.08. Outside Contracts.

When either Party deems it more appropriate for an outside contractor to make repairs or perform maintenance, bids may be solicited for contracts to perform this work.

2.09. Permits and approvals.

Each Party shall be responsible for obtaining and complying with all permits and approvals for the Project Facilities component that such Party owns that are necessary to perform its work under this Agreement.

2.10. Safety and loss prevention program.

MCWD and PCA will jointly develop, maintain, and implement a safety and loss prevention program for the Pure Water Delivery and Supply Project Facilities, and will provide appropriate training for its employees working on the facilities. This program will conform to all requirements set forth in CAL OSHA's Process Safety Management Program and US EPA's Risk Management Program, and will be revised and updated as new regulations are promulgated. All costs associated with the program will be included in the annual budget process.

2.11. Access to facilities.

Both MCWD and PCA personnel shall be provided access rights to all Pure Water Delivery and Supply Project Facilities with adequate notice and staff availability/chaperone.

2.12. Pure Water Coordinating Committee.

- (a) Within sixty days of the Effective Date of this Agreement, the parties shall establish and maintain a Pure Water Coordinating Committee which membership shall consist of at least one representative from each Party. A representative from each Party shall be the person who will be or who is responsible for the daily operations of a Pure Water Delivery and Supply Project Facilities component. The committee shall have access to and shall share all pertinent information in order to discuss and make recommendations for sustaining or improving the operations (including water quality), maintenance, and capital replacement efforts of the project.
- (b) Any financial changes approved by the Pure Water Coordinating Committee at a Committee meeting that require a budget modification will be submitted to both Boards of Directors for approval of the necessary budget modifications.

### 2.13. Unanticipated events/Emergency situations

- (a) Non-emergency circumstances or events may arise which were not anticipated in either the scopes of services or the budgets for the Pure Water Delivery and Supply Project Facilities. In this case, plans for addressing such circumstances or events, including justification and estimated amount of expenditures, will be submitted to the Pure Water Coordinating Committee for its review and recommendations. Before proceeding with those plans, each party must first give its written approval to incur any additional costs associated therewith consistent with the procurement policy of each agency.
- (b) If the event or circumstance constitutes an emergency situation which threatens health and safety, damage to property, or injury to persons, the Party having operational control of the affected Pure Water Delivery and Supply Project Facilities component will act as promptly and as efficiently as possible to mitigate the situation without waiting for approval by the Pure Water Coordinating Committee. The Pure Water Coordinating Committee will be advised as soon as possible thereafter of the mitigating actions taken and of any further action that may be necessary.

## **III. DELIVERY OF PURIFIED RECYCLED WATER**

### 3.01. Existing Allocations

- (a) Subject to the terms and conditions described in this Agreement, PCA agrees to treat and provide an annual amount of purified recycled water from PCA's and MCWD's entitlements to assure delivery of the agreed water commitments to the RUWAP Recycled Project approved by the FORA Board of Directors and allocated to FORA land use jurisdiction members. Up to 1,762 AFY of source water would be made available from PCA to provide a net 1,427 AFY of purified recycled water taking into account the assumption of a 19% loss resulting from the advanced water treatment processes with the following limitations unless the FORA Board of Directors agrees to an allocation of less than 1,427 AFY of net purified recycled water:
  - i. As stated in the 1996 Annexation Agreement, up to a maximum of 300 AFY of source water will be treated for MCWD's use between the months of April and September.
  - ii. As stated in the 2009 RUWAP MOU, up to a maximum of 650 AFY of source water will be made available from PCA entitlements between the months of May and August for recycled water use.
  - iii. As per the 2009 RUWAP MOU, Section 3.1, the Parties agreed to meet and confer in good faith to evaluate the environmental, technical, managerial, and financial feasibility of a groundwater recovery replenishment project to inject and store recycled water.
  - iv. As stated in Section IV 1(d) of the Amended and Restated Water Recycling Agreement between PCA and Monterey County Water Resources Agency which was approved in November 2015, PCA is allocated 650 AF of water by Water Resources Agency during the months of May through August.
- (b) The parties agree to commit to a process to determine the amount of MCWD's Fort Ord Water Rights. The process shall include MCWD, PCA, FORA, U.S. Army, and MCWRA meeting and discussing the various agreements, obtaining legal opinions as necessary, and drafting documentation to clarify each agency's opinion, agreement, or disagreement and next steps on this issue by January 31, 2017.

### 3.02 Demand Schedule.

- (a) According to Section 3.01 and subject to Section 2.03 of this Agreement, PCA will provide MCWD with purified recycled water according to the following typical nonbinding Schedule for AWT Phase 1 (~600 AFY of product water):

Approximate Demand Schedule (Phase 1):

Month	Demand (AF)			Needed Supply (AF)
	Others	Golf Course	Total	
January	7	16	23	28
February	5	11	16	19
March	8	19	27	33
April	16	40	56	70
May	26	62	88	108
June	26	63	89	110
July	27	65	92	113
August	22	54	76	94
September	20	49	69	85
October	12	29	41	51
November	5	12	17	21
December	2	5	7	9
Total	175	425	600	741

- (b) According to Section 3.01 and subject to Section 2.03 of this Agreement, PCA will provide MCWD with purified recycled water according to the following typical nonbinding Schedule for AWT Phase 2 project (ultimate build out of the AWT to the amount approved by the FORA Board of Directors pursuant to Resolution No. 07-10):

Approximate Demand Schedule (Phase 2):

Month	Demand (AF)			Needed Supply (AF)
	Others	Golf Course	Total	
January	38	16	54	66
February	26	11	37	46
March	45	19	64	79
April	94	40	134	166
May	146	62	208	257
June	149	63	212	261
July	153	65	218	269
August	127	54	181	224
September	116	49	165	203
October	68	29	97	120
November	28	12	40	50
December	12	5	17	21
Total	1002	425	1427	1762

### 3.03 Water Quality.

All water produced and delivered to MCWD shall meet all applicable standards of quality prescribed by the State of California (including, but not limited to, the regulations promulgated by



the State Health Department and set forth in the California Code of Regulations, Title 22), or by separate agreement of the parties, so that the water may be used for the purposes specified herein. The parties clarify their intent with regard to the required water quality and further agree that the AWT Facilities have been designed to produce purified recycled water for the injection and landscape irrigation and other authorized purposes. The Parties agree that the purified recycled water to be used for landscape irrigation and other authorized purposes shall be of the same water quality as the water used for injection.

3.04. Warranties.

PCA warrants that all water committed to MCWD pursuant to this Agreement shall be transferred to MCWD free and clear of all claims by any person or entity, except as otherwise specified.

3.05. Duty to monitor water quality; cessation in deliveries.

PCA will monitor the quality of water produced, in accordance with the Indirect Potable Reuse guidelines per the California Department of Drinking Water Title 22 Article 5.2 of the CCR.

3.06. Regulations to protect water quality.

PCA will, to the extent feasible, enact reasonable and appropriate regulations governing the kinds of wastes and other materials that may be discharged into the sewerage system, in order to protect the quality of water ultimately produced by the AWT.

3.07. Daily Operation.

The AWT will be in operation and will supply water to MCWD on a daily basis except for temporary periods of shut-down authorized by this Agreement or made necessary by circumstances beyond the control of PCA or MCWD.

3.08. Incidental Uses.

PCA may use such amounts of purified recycled water from the Pure Water Delivery and Supply Project Facilities as may be needed for the normal operation and maintenance of PCA's facilities, including, but not limited to, the backwash of injection wells.

3.09. Notice of temporary cessation of water deliveries.

PCA will give immediate notice to MCWD, by telephone and/or electronic communication to MCWD's General Manager, or to the person designated by the General Manager to receive such notices, with a prompt follow-up notice in writing, as soon as PCA becomes aware of the need to cease deliveries. In addition, whenever a cessation of deliveries occurs, PCA shall use every reasonable effort to restore service as soon as possible.

3.10. Interruptions of service.

- (a) No work of construction, remodeling, renovation, replacement, repairs, addition, or expansion authorized under this Agreement and performed on the AWT or Injection Well Facilities shall, either before, during, or after such work, interfere with, interrupt, or reduce the delivery of advanced treated water to MCWD under this Agreement, except that minor interferences, interruptions, or reductions shall be allowed when necessary, unavoidable, or beyond the control of PCA.
- (b) PCA shall schedule its planned maintenance activities on the AWT and the Injection Well Facilities to minimize interruption of distribution of purified recycled water. Unscheduled work to perform repairs or maintenance will be performed in the manner deemed by PCA to have the least impact on the supply of advanced treated water. In case of any interruption of service, PCA shall give notice in the same manner as required by this Agreement.



- (c) MCWD shall schedule its planned capital replacement, maintenance activities, and lateral tie-in's to the Product Water Conveyance Facilities to minimize interruption of distribution of purified recycled water. Unscheduled work to perform repairs or maintenance will be performed in the manner deemed by MCWD to have the least impact on the distribution of purified recycled water. In case of any interruption of service on the Product Water Conveyance Facilities, MCWD shall give notice in the same manner as required by this Agreement.

#### **IV. ESTIMATED COSTS, COST SHARING, FINANCING, AND BUDGETING**

##### **4.01. Estimated Costs of the Project**

- (a) The PCA submitted an SRF loan package in the amount of \$113,000,000 of which \$41,190,000 is for the Advanced Water Treatment Facilities. It is anticipated that project costs will be below this amount. MCWD submitted an SRF loan package in the amount of \$35,000,000 which includes \$22,600,000 for the RUWAP New Pipeline Facilities. It is also anticipated that project costs will be below this amount.
- (b) The estimated construction costs and proportional share of the New Pipeline Facilities and AWT Phase 1 are presented below. The cost allocations for the Pipeline Facilities are based upon a MCWD maximum use of 1,427 AFY per year and a PCA maximum use of 3,700 AFY. If any maximum use amount is exceeded, then the Parties agree to recalculate the allocations for the Pipeline Facilities, to true up those capital costs back to the date of this Agreement, and to agree on a true up amount and payment schedule. The estimated annual debt service cost share is located in Exhibit E:

<b>ESTIMATED CAPITAL COSTS</b>	<b>Total Amount</b>	<b>PCA Share</b>	<b>MCWD Share</b>
New Pipeline Facilities	\$ 22,600,000	\$ 16,309,742 72.167%	\$ 6,290,258 27.833%
AWT Phase 1	\$ 41,184,636	\$ 35,438,144 86.047%	\$ 5,746,492 13.953%
Existing Pipeline Facilities	\$ 1,389,000	\$ 1,002,400 72.167%	\$ 386,600 27.833%
<b>TOTAL</b>	<b>\$ 65,173,636</b>	<b>\$ 52,185,008 80.071%</b>	<b>\$ 12,988,628 19.929%</b>

- (c) Except for the \$1,389,000 in Section 4.02 (a) (iii) for the Existing Pipeline Facilities, the Parties agree that all dollar amounts in this Agreement, including exhibits, are estimates and that this Agreement shall be amended from time to time to reflect the actual dollar amounts when known.
- (d) Both Parties commit grant funds to the Project Facilities by the ratio of the costs of the Project Facilities to the total costs to each party for Project Facilities, Injection Facilities, RUWAP Distribution Facilities, and Source Water Facilities. Both Parties agrees to apply those grant funds towards the total capital costs of a Project Facilities component, to be allocated to each parties share of capital costs as defined in Section 4.02 (a). The following is an example:

**PRODUCT CONVEYANCE FACILITIES AND RUWAP  
DISTRIBUTION FACILITIES**

Total Project Cost	\$35 Million
Transmission Line	\$23 Million
PCA 71%	\$16.33 Million
MCWD 29%	\$ 6.67 Million
Distribution (ALL MCWD)	\$12 Million
Capital Cost Split (Grant Distribution %)	PCA \$16.33 Million (46.7%) MCWD \$18.67 Million (53.3%)
Assume \$17M in Grants	PCA \$7,939,000 MCWD \$9,061,000

**AWT, DIVERSION, INJECTION FACILITIES**

AWTF	\$40,000,000
PCA 72.17%	\$28,866,783
MCWD 27.83%	\$11,133,216
Diversion	\$947,765 + 5,649,339 ≈ \$6,600,000
PCA 100%	
Injection	\$10,668,000
PCA 100%	
Capital Distribution (Grant Distribution %)	
MCWD -AWTF	\$11,133,216 (19.44%)
PCA AWT+DIV+IND	\$46,134,783 (80.56%)
TOTAL	\$57,267,999
Assume \$15M in Grants	PCA \$12,084,000 MCWD \$2,916,000

Total Project Costs	\$92,267,999
Total Capital Cost Split	
PCA	\$62,464,783
MCWD	\$29,803,216
Total Assured Grants	\$32,000,000
Grant Amounts	
PCA	\$20,023,000
MCWD	\$11,977,000

**4.02. Cost Sharing: Capital and Replacement Costs**

(a) Both parties will pay their share of all capital and replacement costs for the Project Facilities based on its percentage share of AWT Capacity Entitlement and/or Pipeline Facilities Capacity Entitlement as follows:

- i. AWT Facilities: % of a party's AWT Capacity Entitlement in AFY to the total AWT Capacity Entitlement in AFY from both parties. For AWT Phase 1, PCA = 86.047% and MCWD = 13.953%. For AWT Phase 2, PCA = 72.167% and MCWD = 27.833%.
- ii. New Pipeline Facilities: PCA = 72.167% and MCWD = 27.833%.

- iii. Existing Pipeline Facilities: PCA = 72.167% and MCWD = 27.833%. The parties agree that the total value of MCWD's Existing Pipeline Facilities for purposes of this Agreement is \$1,390,000. The parties agree that the annual payment to MCWD shall be equal to this total value amortized over a 30 year period.

#### 4.03. Cost Sharing: Operations and Maintenance Costs

- (a) Both parties will pay their share of all operations and maintenance costs for the Pure Water Delivery and Supply Project Facilities based on actual use of the facilities based on the following:
  - i. AWT Facilities: % of AFY produced vs total from both parties
  - ii. Product Water Conveyance Facilities: % AFY through pipeline vs total from both parties
  - iii. Operations and Maintenance costs include, but are not limited to, the following: Power, chemicals, a Party's own or contracted labor and services, parts, materials, supplies, insurance, engineering, financial, and legal services, and such other cost categories agreed to by the Parties.

#### 4.04. Project Funding: Capital Costs

- (a) PCA applied for a Clean Water SRF loan to pay for the entire capital costs of AWT which shall include all of the design, contract documents, rights-of-way acquisition, and all work to construct the AWT.
- (b) MCWD applied for a Clean Water SRF loan to pay for the entire capital costs of the New Pipeline Facilities which shall include all of the design, contract document, rights-of-way acquisition, and CEQA work necessary, and all work to construct the New Pipeline Facilities.

#### 4.05. Project Funding: Replacement and Renewal Reserves

- (a) Each Agency shall establish a Replacement and Renewal Reserve Fund for the purpose of funding capital outlay projects on the Pure Water Delivery and Supply Project Facilities; assist in meeting any fiscal sustainability plan requirements for the Clean Water State Revolving Fund loans; and maintaining a proportional share of the State Revolving Fund loan's debt reserve requirement.
- (b) Each agency shall allocate sufficient funds in their annual budget to contribute to each Replacement and Renewal Reserve Fund in accordance with the capital cost sharing section of this Agreement. PCA will retain the replacement funds for those facilities in which they own and operate. MCWD will retain the replacement funds for those facilities in which they own and operate. Unless otherwise stated in Clean Water State Revolving Fund agreements, the following depreciation schedule related to operational equipment shall be used as a basis to establish annual funding of replacement reserves:

Equipment Type	Useful Life (Years)
Replacement Electrical	30
Replacement Instrumentation	15
Replacement Pumps & Motors	20
Motorized sluice gates	30
Replacement Wells & Ozonators	20

- (c) Two years prior to the completion of the thirty-year loan cycle, MCWD and PCA will develop a long-term Capital Improvement Plan, which includes establishing an appropriate level of Renewal and Replacement reserves. Any funds that are held in Reserves in excess of the Capital Improvement Plan will be refunded within ninety (90) days of the Plan's establishment.

4.06. Project Funding: Operations and Maintenance Costs

Each party shall place in their annual operating budget sufficient funds to pay for operations and maintenance according to the operations and maintenance cost sharing section of this Agreement.

Each party shall follow the recommended operation and maintenance schedules as suggested by the manufacturers throughout the initial term of this agreement.

4.07. Annual Budget Process.

Each year, in accordance with its normal budgeting schedule, both parties will adopt budgets sufficient to cover the capital, renewal, operation, and maintenance costs of their proportional share of the Pure Water Delivery and Supply Project Facilities.

4.08 Financial Obligations

Both Parties agree to pledge sufficient funds to meet their respective financial obligations under this Agreement by Board action.

**V. PAYMENTS AND ACCOUNTING**

5.01 Payment Schedule and Procedures.

(a) MCWD will make payments to PCA each year as follows:

- i. Thirty (30) days before the date the PCA's annual payment on the Clean Water State Revolving Fund loan for the Pure Water Monterey Project is due, MCWD will pay an amount equal to MCWD's proportional share of capital costs (debt service) as provided in Exhibit E.
- ii. By March 1 of each year, MCWD shall pay PCA the proportional share of the amortized replacement/renewal costs as identified in Exhibit E.
- iii. On a monthly basis, PCA will bill MCWD for Operation and Maintenance costs on an acre foot rate basis and actual demand.

(a) PCA will make payments to MCWD each year as follows:

- i. Thirty (30) days before the date the MCWD's annual payment on the Clean Water State Revolving Fund loan for the New Pipeline Facilities is due, PCA will pay an amount equal to PCA's proportional share of capital costs (debt service) as provided in Exhibit E.
- ii. By March 1 of each year, PCA shall pay MCWD the proportional share of the amortized replacement/renewal costs of the New Pipeline Facilities as identified in Exhibit E.
- iii. By June 30 of each year, PCA will pay an amount equal to PCA's proportional share of capital costs (debt service) for the construction of the Existing Pipeline Facilities funded by MCWD as provided in Exhibit E.



- iv. By June 30 of each year, PCA will pay MCWD the proportional share of the amortized replacement/renewal costs of the Existing Pipeline Facilities as identified in Exhibit E.
  - v. On a monthly basis, MCWD will bill PCA for the Operation and Maintenance costs for the Product Water Conveyance Facilities on an acre foot rate basis and actual demand.
- (b) At least thirty (30) days before capital or replacement payments are due, a request for payment shall be sent indicating the amount due, the date payment is due, and the nature of the payment.
  - (c) Payment requests for operation and maintenance costs will be billed monthly. The resulting payments will be due within thirty days of billing.
  - (d) Notwithstanding anything to the contrary contained herein, obligations to make payments shall be prioritized as follows, and the obligations in each category shall be subordinate to the obligations in each prior category, shall be on a parity with all other obligations in such category, and shall be senior to the obligations in each subsequent category:
    - i. Operation and maintenance
    - ii. Debt service on obligations incurred to finance the Pure Water Delivery and Supply Project Facilities and payments to any provider of credit enhancement for such obligations
    - iii. Replacement/renewal costs
  - (e) All requests for payment shall be promptly reviewed, approved for payment where such requests or portion thereof that are in conformity with this Agreement, and promptly submitted for payment. Disputed payment shall be resolved according to the Dispute Resolution Process in this Agreement.

#### 5.02. Application of loan payments by PCA.

- (a) All payments made by MCWD to PCA for the repayment of the Clean Water SRF loan shall be used for such repayment. Upon termination of any loan agreement, any unused funds retained by PCA shall be returned to MCWD within 60 days from the date of the approved PCA audit for the fiscal year in which the agreement was terminated.
- (b) All payments made by PCA to MCWD for the repayment of the Clean Water SRF loan shall be used for such repayment. Upon termination of any loan agreement, any unused funds retained by MCWD shall be returned to PCA within 60 days from the date of the approved MCWD audit for the fiscal year in which the agreement was terminated.

#### 5.03. Remedies for Delinquent Payments.

- (a) If either party should fail to make any payment required under this Agreement for a period of ninety (90) days or more after the due date, then upon fifteen (15) days' written notice, the party that is owed may act to proportionally reduce the activities for which payment is due; provided that no such reduction shall take effect if Dispute Resolution has been invoked and the full amount of the payment has been paid under protest.
- (b) In addition, if either party should fail to make any payment required under this Agreement for a period of ninety (90) days or more after the due date and Dispute Resolution has not been invoked, the party that is owed shall have the right to seek any appropriate judicial relief, at law

or in equity, for such default. Such relief may include, but need not be limited to, damages and injunctive relief.

#### 5.04 Allocations: Operations and Maintenance Rates

- (a) Operations and Maintenance Rates: Based on electronic timesheets and indirectly through each Agency's Cost Allocation Plan, all costs associated with the new AWT Facilities will be allocated directly to PCA's Pure Water Monterey Fund and all costs associated with the Product Water Conveyance Facilities will be allocated directly to MCWD's RUWAP Conveyance Facilities Fund. Indirect costs and direct costs will be used in the development of PCA's and MCWD's Operation and Maintenance Rates. Each Agency's Operation and Maintenance rate will be subject to review and/or development of a third party consultant of the respective Agency's selection. PCA's Operation and Maintenance component of the rate will be consistent with rates provided to entities who utilize Advanced Treated Water.
- (b) PCA and MCWD retain the right to transition from any cost allocation plan identified in 5.04 of this Agreement to a cost allocation model that is compliant with the Office of Management and Budget (OMB) Circular A-87 – Cost Principles for State, Local, and Indian Tribe Governments or a subsequent revision. Any cost allocation subject to this provision shall be accompanied by a Certificate of Cost Allocation Plan and be in compliance with Title 2 CFR, Part 200. All indirect costs charged to the Pure Water Monterey Fund and the RUWAP Conveyance Facilities Fund will be applied consistently with the results of this plan to ensure equity between costs centers and conformance with OMB standards.

#### 5.05. Accounting system.

Both parties will maintain an accounting system that is in conformity with generally accepted accounting principles (GAAP) and will allow for the segregation and tracking of all Replacement/Renewal reserves associated with the Project Facilities. Indirect costs shall not be applied to Replacement/Renewal Reserve contributions.

#### 5.06. Financial reports.

Both parties will provide an annual report of the proportional share of reserve funds retained for the purpose of renewing the Pure Water Delivery and Supply Project Facilities. This report will be provided by September 30 of each year; and include deposits made to the Repair/Renewal Reserve, proportional interest earned, and the proportional share of any replacement/renewal costs.

#### 5.07. Annual audit.

The accounting for the Pure Water Delivery and Supply Project Facilities will be subject to both parties Annual Audit. The Replacement/Renewal Reserve funds will be classified as Restricted on both parties Comprehensive Annual Financial Statement (CAFR). This Restricted classification will remain in effect through the term of this agreement, unless there are any new Governmental Accounting Standards Board (GASB) pronouncements or auditor comments that require a change in classification. A copy of each parties CAFR will be provided to the other by January following the close of the prior fiscal year.

#### 5.08. Right to inspect and audit records.

Both parties shall have the right to inspect the other's records pertaining to debt service payments associated with the Pure Water Delivery and Supply Project Facilities and contributions for Renewal/Replacement Reserves, upon reasonable advance notice. Both parties shall also have the right to audit the other's records pertaining to the Project Facilities and contributions for Renewal/Replacement Reserves, or to have them audited by an auditor selected by the other party at that party's sole cost and expense. Such audit may be performed at any time during regular business

hours, upon the giving of reasonable advance notice.

5.09. Reimbursement for overcharge or undercharge.

If any there is audit shows that the incorrect application of replacement/renewal reserves, each agency will have 90 days to comply with the audit findings. If an undercharge or an overcharge has occurred in monthly demand billings, each agency will have 90 days to refund or pay the identified difference.

5.10. Claims for Stranded Costs

The parties agree to commit to a process to determine the amount of each parties' claims for stranded costs. The process shall include MCWD and PCA meeting and discussing the documentation to clarify each agency's opinion, agreement, or disagreement and next steps on this issue by March 31, 2017.

## VI. INDEMNIFICATION.

6.01. Indemnification.

- (a) PCA shall indemnify, defend, and hold harmless MCWD , its officers, agents, and employees, from and against any and all claims, liabilities, and losses whatsoever against MCWD (including damages to property and injuries to or death of persons, court costs, and reasonable attorneys' fees) occurring or resulting to any and all persons, firms or corporations furnishing or supplying work, services, materials, or supplies in connection with the performance of this Agreement, and from any and all claims, liabilities, and losses occurring or resulting to any person, firm, or corporation for damage, injury, or death arising out of or connected with the PCA's performance or non-performance of its obligations pursuant to this Agreement caused in whole or in part by any negligent act or omission or willful misconduct of PCA, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, except to the extent caused by the negligence or willful misconduct of MCWD.
- (b) MCWD shall indemnify, defend, and hold harmless PCA, its officers, agents, and employees, from and against any and all claims, liabilities, and losses whatsoever against PCA (including damages to property and injuries to or death of persons, court costs, and reasonable attorneys' fees) occurring or resulting to any and all persons, firms or corporations furnishing or supplying work, services, materials, or supplies in connection with the performance of this Agreement, and from any and all claims, liabilities, and losses occurring or resulting to any person, firm, or corporation for damage, injury, or death arising out of or connected with the MCWD's performance or non-performance of its obligations pursuant to this Agreement caused in whole or in part by any negligent act or omission or willful misconduct of MCWD, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, except to the extent caused by the negligence or willful misconduct of PCA.

6.02. Procedure for Indemnification.

- (a) If any legal or administrative proceedings are instituted, or any claim or demand is asserted, by any third party which may give rise to any damage, liability loss or cost or expense with respect to which either party has agreed to indemnify the other party in this contract, then the indemnified party shall give the indemnifying party written notice of the institution of such proceedings, or the assertion of such claim or demand, promptly after the indemnified party first becomes aware thereof. However, any failure by the indemnified party to give such notice on such prompt basis shall not affect any of its rights to indemnification hereunder unless such failure materially and



adversely affects the ability of the indemnifying party to defend such proceeding.

- (b) The indemnifying party shall have the right, at its option and at its own expense, to utilize counsel of its choice in connection with such proceeding, claim or demand, subject to the approval of the indemnified party, which approval shall not be unreasonably withheld or delayed. The indemnifying party shall also have the right to defend against, negotiate with respect to, settle or otherwise deal with such proceeding, claim or demand. However, no settlement of such proceeding, claim or demand shall be made without the prior written consent of the indemnified party, which consent shall not be unreasonably withheld or delayed. The indemnified party may participate in any such proceeding with counsel of its choice at its own expense.
- (c) In the event, or to the extent, the indemnifying party elects not to, or fails to, defend such proceeding, claim or demand and the indemnified party defends against, settles or otherwise deals with any such proceeding, claim or demand, any settlement thereof may be made without the consent of the indemnifying party if it is given written notice of the material terms and conditions of such settlement at least ten days before a binding agreement with respect to such settlement is executed. However, nothing herein is intended to bar either party from submitting any dispute arising from this section to Dispute Resolution.
- (d) Each of the parties agrees to cooperate fully with each other in connection with the defense, negotiation or settlement or any such proceeding, claim or demand.

#### 6.03. Payment of indemnified claims.

The indemnifying party shall forthwith pay all of the sums owing to or on behalf of the indemnified party, upon the happening of any of the following events:

- (a) Upon the rendition of a final judgment or award with respect to any proceeding described in Section 6.02, above, by a court, arbitration board or administrative agency of competent jurisdiction and upon the expiration of the time in which an appeal therefrom may be made; or
- (b) Upon the making of a settlement of such proceeding, claim or demand; or
- (c) Upon the parties' making of a mutually binding agreement with respect to each separate matter indemnified thereunder.

#### 6.04. Contribution in the event of shared liability.

In the event any proceeding, claim or demand described in Section 6.01 is brought, in which allegations of fault are made against both the parties, the extent of indemnification shall be determined in accordance with the agreement of the parties, or, if there is no agreement, then in accordance with the findings of the court as to the relative contribution by each of the parties to the damage suffered by the party seeking indemnity with respect to such proceedings. If the court fails to make any such findings, then the matter shall be submitted to Dispute Resolution.

#### 6.05. Exclusion from O&M costs.

Amounts payable by either party as indemnification shall not be included in the operations and maintenance costs of the Project.

## **VII. INSURANCE**

#### 7.01. General insurance requirements.

Without limiting either parties duty to indemnify, both parties shall maintain in effect throughout the



term of this Agreement a policy or policies of insurance meeting the requirements hereinafter set forth. All such insurance required by this article shall meet the following requirements:

- (a) Each policy shall be with a company authorized by law to transact insurance business in the State of California, and shall be written on an occurrence form unless such insurance is only available at a reasonable cost if written on a claims made form.
- (b) Each policy shall provide that both parties shall be given notice in writing at least thirty days in advance of any change, cancellation or non-renewal thereof.
- (c) Except with respect to workers compensation insurance, each policy shall provide an endorsement naming both parties and its officers, agents and employees as additional insureds, or additional insureds, as applicable, and shall further provide that such insurance is primary to any other insurance maintained by either party.
- (d) Unless otherwise agreed by MCWD and PCA, if a party awards a contract for construction work for the Pure Water Delivery and Supply Project Facilities, that party shall require the general contractor to provide commercial general liability and motor vehicle liability insurance coverage at least equal to the coverages required under this Agreement and shall name both MCWD and PCA as an additional named insureds and shall further provide that such insurance is primary to any issuance maintained by MCWD or PCA.

7.02. Commercial general liability insurance.

- (a) MCWD and PCA shall maintain (and be named insured under) commercial general liability insurance covering all operations under this Agreement, with such coverages as the parties may agree upon from time to time. Each party shall be named as an additional insured on the other party's commercial general liability coverage.
- (b) Each party shall pay the annual cost of such insurance for the term of this Agreement. Such insurance costs shall be treated as an annual operation and maintenance cost for the AWT Facilities and the Product Water Conveyance Facilities. In addition, should this Agreement be terminated by the parties, the obligation to pay for such insurance regarding the Project shall be accordingly reduced.

7.03. Motor vehicle insurance.

Both parties shall maintain insurance covering all motor vehicles (including owned and non-owned) used in providing services under this Agreement, with a combined single limit of not less than \$2,000,000.

7.04. Property insurance.

- (a) PCA shall maintain insurance covering the AWT Facilities against loss or damage due to fire and other perils to the extent that such insurance is reasonably commercially available and within available funds for the Pure Water Monterey Project. MCWD shall maintain insurance covering the Product Water Conveyance Facilities against loss or damage due to fire and other perils to the extent that such insurance is reasonably commercially available and within available funds for the Project.
- (b) Subject to Subsection (a) above, the amount of the insurance shall not be less than the then-current replacement cost of the applicable Pure Water Delivery and Supply Project Facilities, without depreciation. Insurance coverage for the Pure Water Delivery and Supply Project Facilities under this section shall be reviewed and approved by both parties, which shall not

unreasonably withhold or delay its approval. Both parties shall provide each other with a copy of the insurance policy and shall give the other party thirty (30) days' advance notice of any cancellation or proposed change in the insurance required by this section, and any such change shall be subject to review and approval by the other party.

7.05. Workers' compensation insurance.

Each party shall maintain a workers' compensation plan covering all of its employees as required by Labor Code Sec 3700, either (a) through workers' compensation insurance issued by an insurance company, with coverage meeting the statutory limits and with a minimum of \$100,000 per accident for employer's liability, or (b) through a plan of self-insurance certified by the State Director of Industrial Relations, with equivalent coverage. If either party elects to be self-insured, the certificate of insurance otherwise required by this Agreement shall be replaced with a consent to self-insure issued by the State Director of Industrial Relations.

7.06. Certificate of insurance.

Each party shall file certificates of insurance with the other party, showing that it has in effect the insurance required by this contract. Each party shall file a new or amended certificate promptly after any change is made in any insurance policy which would alter the information on the certificate then on file.

7.07. Self-insurance up to and including the first \$1 million of liability.

Each party may elect to be self-insured or to participate in the self-insurance pool for up to and including the first \$1 million of liability under any insurance required to be provided by it under this Agreement, provided the other party first gives its written consent, which will not be unreasonably withheld or delayed. The parties shall enter into a separate written memorandum of understanding specifying the proportionate amount or share of such self-insurance costs to be allowed and allocated as annual operation and maintenance costs for the Pure Water Delivery and Supply Project Facilities.

7.08. Insurance costs.

Except as otherwise specifically provided for in this Agreement, the parties agree to determine as part of the annual budget process what annual insurance costs are to be allowed and allocated as annual operation and maintenance costs for the Pure Water Delivery and Supply Project Facilities.

7.09. Periodic increases in coverage requirements.

Not more frequently than every five (5) years, if in the opinion of an insurance broker or consultant retained jointly by the parties, the amount of any insurance coverage required by this Agreement is not adequate, the party responsible for providing that insurance coverage shall increase the amount of the insurance coverage as required by the insurance broker or consultant.

7.10. Duty to apply insurance proceeds.

If either party recovers any insurance proceeds on account of loss or damage to any Project Facilities component, such proceeds shall be applied to repair or replace the damaged portion of that Project Facilities component, and not otherwise. If either party is self-insured and any loss or damage occurs that would have been covered by insurance otherwise required to be maintained by such party under this Agreement, then such party shall provide the funds that would have been recovered had the party been insured and shall apply the funds to repair or replace the damaged portion of the Project Facilities component.

7.11. Losses Caused by Third Parties.

If any Project Facilities component is damaged or destroyed or any other personal injury, death, property damage or economic loss is incurred relating to any Project Facilities component

(collectively, "damage or loss") during the term of this Agreement, and excluding the amount of any such damage or loss covered in Section VI, Indemnification, then the responsible third party or parties shall be responsible for paying for any such damage or loss. If the funds or other consideration paid by either party pursuant to Section VI and by the third parties are insufficient to cover the total cost of the damage or loss, then the balance necessary to cover the total cost of the damage or loss shall be paid from the applicable reserve and, then to the extent the funds in the replacement reserve are inadequate, the balance will be allocated between the parties based upon the then Capital Cost allocation for the applicable Project Facilities component.

## **VIII. TERM OF AGREEMENT**

### **8.01. Term of Agreement.**

This Agreement shall become effective on the date hereinabove entered and terminate on December 31, 2055 unless extended in accordance with Section 8.02.

### **8.02. Automatic extension.**

This Agreement shall be automatically renewed for an additional 10-year period (an "extended term") unless a party is in default under this Agreement or unless one party provides the other party with written notice to terminate this Agreement upon expiration of the initial term or of any extended term. Any such notice must be provided to the other party at least three (3) full years prior to the expiration of any extended term. Unless such notice is provided, the parties agree that there shall not be a limit on the number of extended terms.

### **8.03. Conditions of agreement during term.**

All the terms of this Agreement shall remain in effect during any term, except as otherwise provided in this Agreement or as may be amended in writing which is signed by both parties.

### **8.04. Rights on Termination.**

- (a) Unless otherwise agreed upon in writing by the parties, upon any termination of this Agreement, MCWD shall have the continuing right to tertiary water as set forth in the Annexation Agreements and the 2009 RUWAP MOU. Except as provided in the Annexation Agreements and the 2009 RUWAP MOU, PCA shall provide facilities for treating the water beyond secondary treatment level at its sole cost and expense or through a cooperative agreement with MCWD or any other entity. Upon any termination of this Agreement, MCWD shall have the continuing right to receive the same quantity of tertiary treated water as MCWD was or would have been entitled to receive during any term of this Agreement so long as MCWD provides facilities at its sole cost and expense or through a cooperative agreement with PCA or any other entity for the delivery of such tertiary treated water and purified recycled water.
- (b) MCWD's and PCA's respective rights to tertiary treated water in accordance with this Agreement shall also survive termination.

## **IX. DISPUTE RESOLUTION**

### **9.01. Dispute resolution procedure.**

If any dispute arises between the parties as to the proper interpretation or application of this Agreement and/or the proper operation of the facilities, the parties shall resolve the dispute in accordance with this Article.



#### 9.02. Duty to meet and confer.

If any dispute under this Agreement arises, the parties shall first meet and confer, in an attempt to resolve the matter between themselves. Each party shall make all reasonable efforts to provide to the other party all the information that the party has in its possession that is relevant to the dispute, so that both parties will have ample information with which to reach a decision.

#### 9.03. Mediation and Binding Arbitration.

- (a) If the dispute is not resolved within sixty (60) days after the first meeting under Section 9.02, then either party may notify the other party that the notifying party elects to submit the dispute to mediation. If the other party agrees to submit the dispute to mediation, then the parties will jointly select a mediator. The terms of mediation shall be set by agreement of the parties and the mediator.
- (b) If the dispute is not resolved by meeting and conferring, and mediation does not occur or is unsuccessful, the parties may agree to submit the matter to binding arbitration. In that event, the parties will jointly select a single arbitrator. If the parties are unable to agree on a single arbitrator, then the parties shall request the Presiding Judge of the Monterey County Superior Court to appoint an arbitrator who has proven experience in the subject matter of the dispute. Any person selected as an arbitrator shall be a qualified professional with expertise in the area that is the subject of the dispute, unless the parties otherwise agree. The cost of the arbitrator shall be shared equally between the parties. Unless otherwise agreed by the parties, the arbitration shall be conducted in accordance with the rules of the American Arbitration Association ("Rules"); provided that the arbitration does not have to be handled through the American Arbitration Association. The parties agree that they will faithfully observe the Rules and will abide by and perform any award rendered by the arbitrator, and that a judgment of the court having jurisdiction may be entered on the award. Notwithstanding the Rules, discovery will be permitted and the provisions of the California Code of Civil Procedure Section 1283.05 are incorporated herein unless the parties agree otherwise. The parties hereby consent to the jurisdiction of the courts of Monterey County for the confirmation, correction or vacation of any arbitration award. The arbitrator may grant any remedy or relief deemed by the arbitrator just and equitable under the circumstances, whether or not such relief could be awarded in a court of law. The arbitrator will have no power to award punitive damages or other damages not measured by the party's actual damages against any party. This limitation of the arbitrator's powers under this Agreement shall not operate as an exclusion of the issue of punitive damages from this Agreement to arbitrate sufficient to vest jurisdiction in a court with respect to that issue. The arbitrator's award will be deemed final, conclusive and binding to the fullest extent allowed by California law, and may be entered as a final judgment in court.

### **X. GENERAL PROVISIONS**

#### 10.01. Compliance with laws.

Both parties will comply with all permit and licensing requirements applicable to the project, and will operate the project in accordance with all requirements of law and governmental regulations.

#### 10.02. Attorney's fees.

If either party commences an action against the other party arising out of or in connection with this Agreement, the prevailing party shall be entitled to have and recover from the losing party reasonable attorneys' fees and costs.



10.03. Amendments.

No amendment or modification shall be made to this Agreement, except in writing, approved by the respective Boards and duly signed by both parties.

10.04. Contract administrators.

- (a) MCWD hereby designates its General Manager as its contract administrator for this Agreement. All matters concerning this Agreement which are within the responsibility of MCWD shall be under the direction of or shall be submitted to the General Manager or such other MCWD employee in the MCWD as the General Manager may appoint. MCWD may, in its sole discretion, change its designation of the contract administrator and shall promptly give written notice to PCA of any such change.
- (b) PCA hereby designates its General Manager as its contract administrator for this Agreement. All matters concerning this Agreement which are within the responsibility of PCA shall be under the direction of or shall be submitted to the General Manager or such other PCA employee in the PCA as the General Manager may appoint. PCA may, in its sole discretion, change its designation of the contract administrator and shall promptly give written notice to MCWD of any such change.

10.05. Assignment.

Any assignment of this Agreement shall be void without the written consent of the non-assigning party, except that PCA shall have the right to assign all of its rights and obligations under this Agreement to a local governmental agency created by PCA for the sole purpose of assuming and performing all rights and obligations of PCA under the Pure Water Monterey Project and except that MCWD shall have the right to assign all of its rights and obligations under this Agreement to a local governmental agency created by MCWD for the sole purpose of assuming and performing all rights and obligations of MCWD under this Agreement; provided that in either case the local governmental agency assignee shall have adequate financial assets to insure its performance of all assigned obligations.

10.06. No Modification of MCWD Contract Entitlement.

Nothing in this Agreement is intended to, nor shall it be interpreted to, expand, limit or otherwise modify MCWD's existing contractual rights, entitlements, and obligations pursuant to either of the Annexation Agreements or the 2009 RUWAP MOU.

10.07. Negotiated Agreement.

This Agreement has been arrived at through negotiation between the parties. Neither party is to be deemed the party which prepared this Agreement within the meaning of Civil Code Sec. 1654.

10.08. Time is of essence.

Time is of the essence of this Agreement.

10.09. Headings.

The article and paragraph headings are for convenience only and shall not be used to limit or interpret the terms of this Agreement.

10.10. Entire Agreement.

This written Agreement, together with all exhibits attached hereto and incorporated by reference, is the complete and exclusive statement of the mutual understanding of the parties, except to the extent that this Agreement expressly refers to or requires the preparation of additional agreements. Any such additional agreement shall be in writing.

#### 10.11. Notices.

All notices and demands required under this Agreement shall be deemed given by one party when delivered personally to the principal office of the other party; when faxed to the other party, to the fax number provided by the receiving party; or five days after the document is placed in the US mail, certified mail and return receipt requested, addressed to the other party as follows:

##### To PCA:

General Manager  
MRWPCA  
5 Harris Court, Building D  
Monterey, CA 93940  
Fax: (831) 372-6178

##### To MCWD:

General Manager  
MCWD  
11 Reservation Road  
Marina, CA 93933  
Fax: (831) 883-5995

#### 10.12. Execution of documents.

(a) The parties will execute all documents necessary to complete their performance under this Agreement.

#### 10.13. Exhibits.

(a) The following exhibits are attached to this Agreement:

**Exhibit A: Pure Water Delivery and Supply Facilities**

**Exhibit B: AWT Facilities**

**Exhibit C: Product Water Conveyance Facilities**

**Exhibit D: Reserved**

**Exhibit E: Summary of Estimated Costs- Phase 1 only**

**Exhibit F: Financial and Construction Responsibilities of the Project Components**

**Exhibit G: Important Project Agreement Dates**

#### 10.14. Severability.

If any one or more of the terms, provisions, covenants or conditions of this Agreement are to any extent declared invalid, unenforceable, void or voidable for any reason whatsoever by a court of competent jurisdiction, the finding or order or decree of which becomes final, the Parties agree to amend the terms in a reasonable manner to achieve the intention of the Parties without invalidity. If the terms cannot be amended thusly, the invalidity of one or several terms will not affect the validity of the Agreement as a whole, unless the invalid terms are of such essential importance to this Agreement that it can be reasonably assumed that the Parties would not have contracted this Agreement without the invalid terms. In such case, the Party affected may terminate this Agreement by written notice to the other Party without prejudice to the affected Party's rights in law or equity.

#### 10.15. Waiver.

(a) No waiver of any right or obligation of any of the parties shall be effective unless in writing, specifying such waiver, executed by the party against whom such waiver is sought to be

enforced. A waiver by any of the parties of any of its rights under this Agreement on any occasion shall not be a bar to the exercise of the same right on any subsequent occasion or of any other right at any time.

10.16. Written Authorization.

- (a) For any action by any party which requires written authorization from the other party, the written authorization shall be signed by authorizing party's General Manager, or the General Manager's written designee.

**XII. EXECUTION**

In witness whereof, the parties execute this Agreement as follows:

PCA  
Dated: 4/8/2016  
Alma DeSaba  
Board Chair, Board of Directors

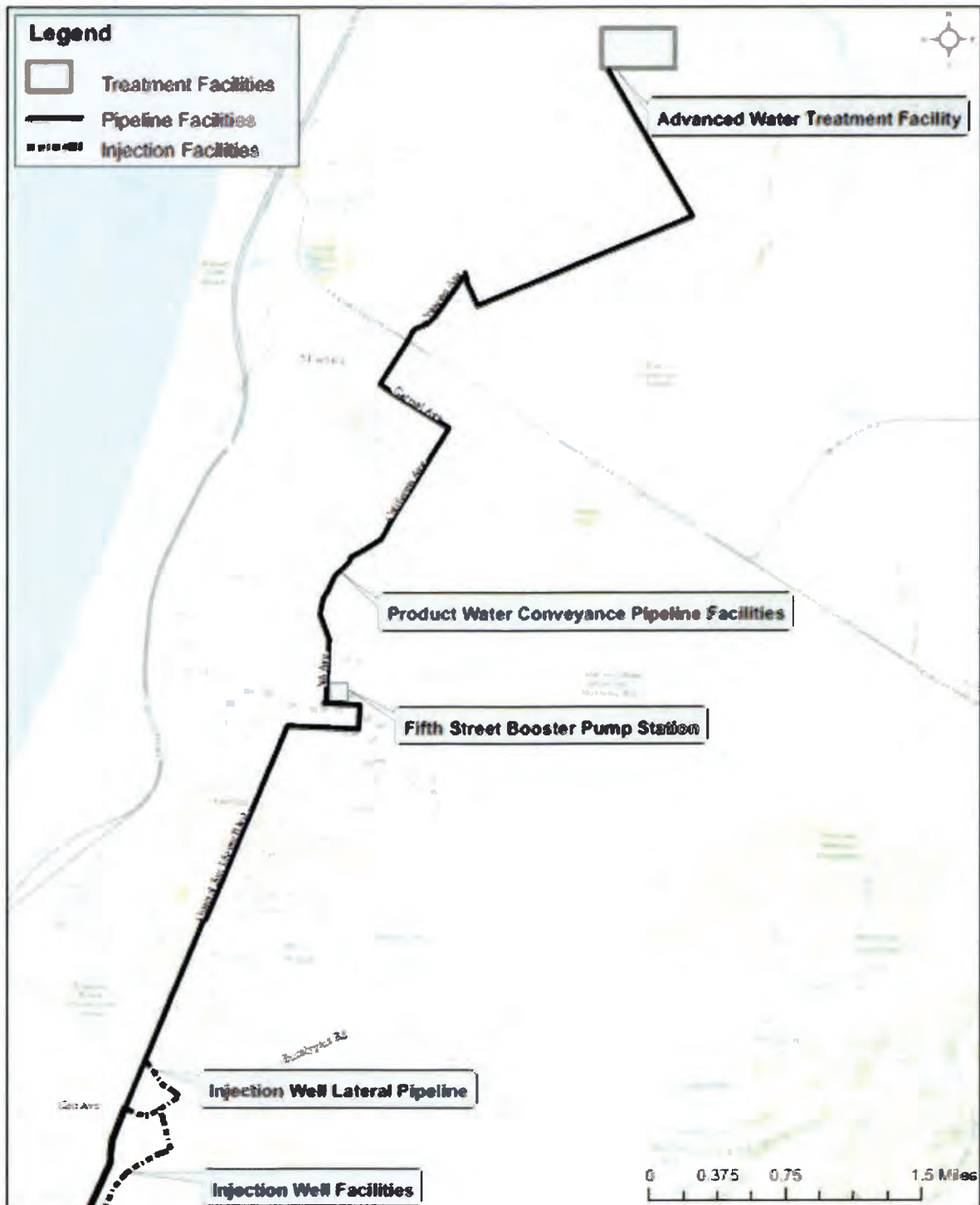
MCWD  
Dated: 4.7.16  
[Signature]  
President, Board of Directors

Approved as to form:

Dated: 4/8/2016  
Robert L. Welling  
Counsel, PCA

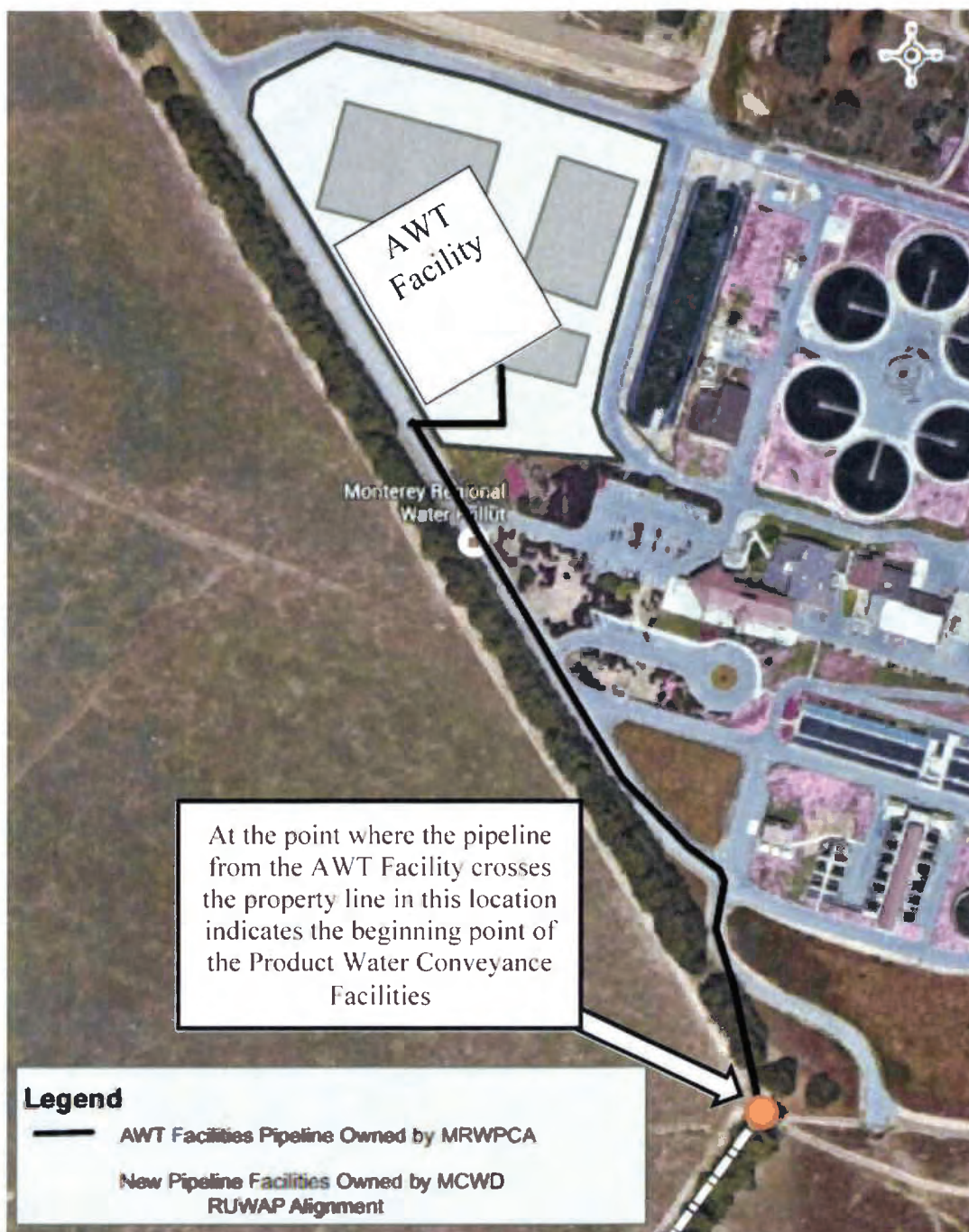
Dated: April 7, 2016  
Fogor K. Masuda  
Legal Counsel, MCWD

## Exhibit A: Pure Water Delivery and Supply Facilities



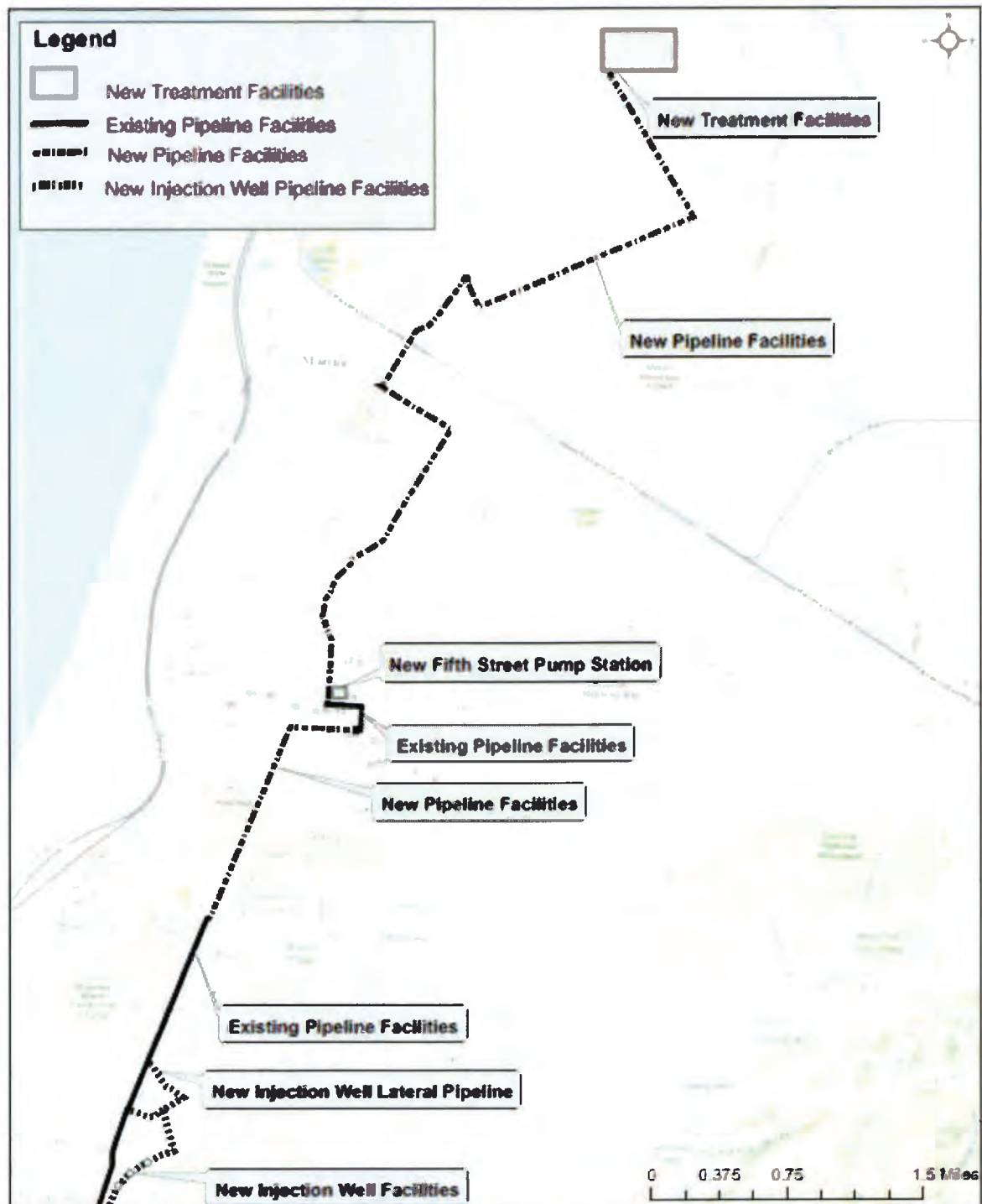


## Exhibit B: AWT Facilities



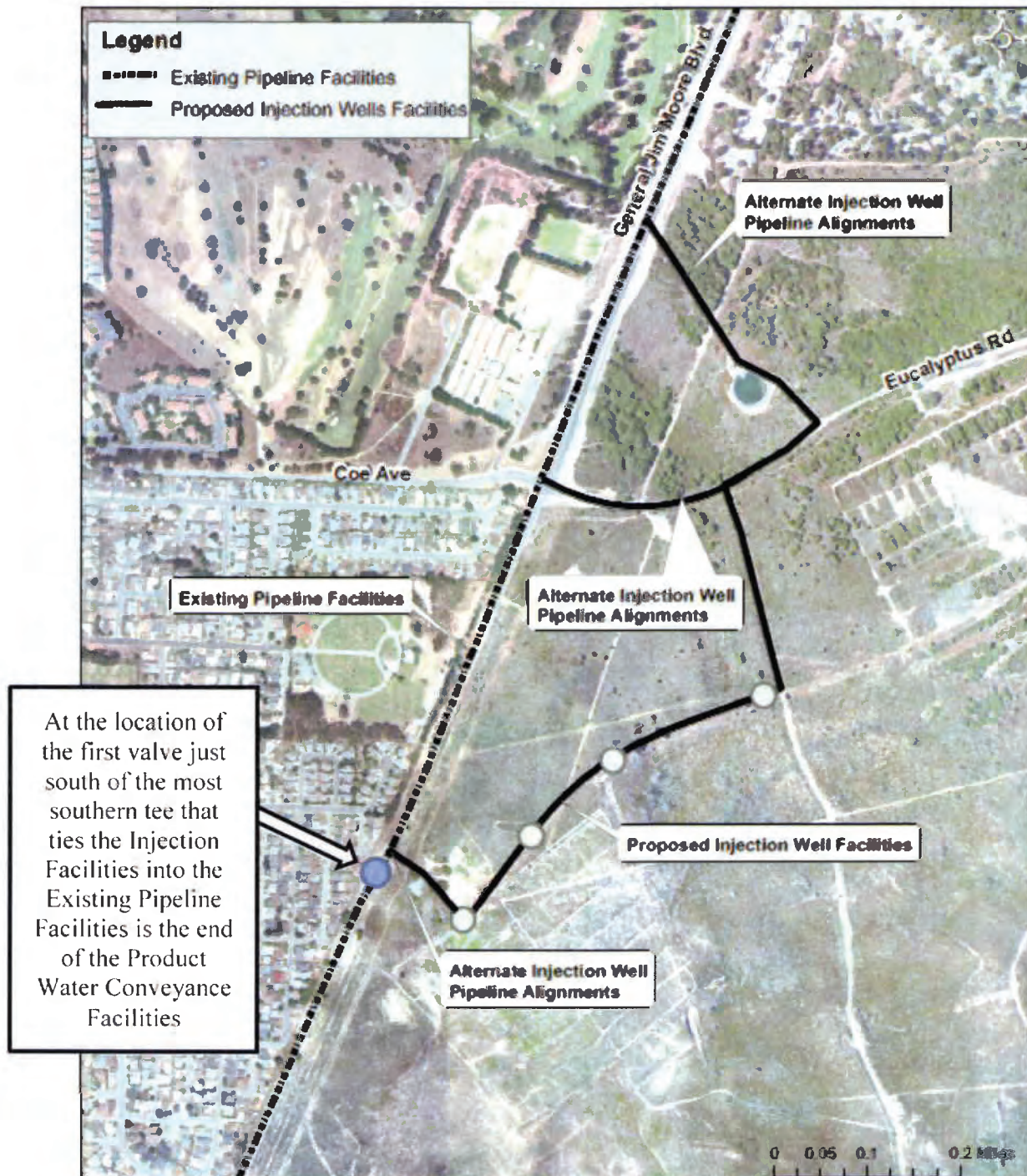
● Beginning of Product Water Conveyance Facilities

## Exhibit C (page 1 of 2): Product Water Conveyance Facilities





## Exhibit C (page 2 of 2): Product Water Conveyance Facilities



● End of Product Water Conveyance Facilities

Exhibit D: Reserved



## Exhibit E: Summary of Estimated Costs-Phase 1 Only

(Note: This table does not include potential grant funds or other capital contributions that may be received and applied to the project that would reduce the overall costs for PCA and/or MCWD).

<b>Est. Capital Costs</b>	PCA Share	MCWD Share	PCA Share	MCWD Share	Total Amount
New Pipeline Facilities	72.167%	27.833%	\$ 16,309,742	\$ 6,290,258	\$ 22,600,000
AWT Phase 1	86.047%	13.953%	\$ 35,438,144	\$ 5,746,492	\$ 41,184,636
Existing Pipeline Facilities	72.167%	27.833%	\$ 1,002,400	\$ 386,600	\$ 1,389,000
<b>TOTAL</b>	<b>80.938%</b>	<b>19.062%</b>	<b>\$ 52,750,285</b>	<b>\$ 12,423,351</b>	<b>\$ 65,173,636</b>

<b>Est. Annual Debt Service Costs</b>	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	\$ 631,972	\$ 243,736	\$ 875,707
AWT Phase 1	86.047%	13.953%	\$ 1,373,161	\$ 222,666	\$ 1,595,827
Existing Pipeline Facilities	72.167%	27.833%	\$ 54,502	\$ 21,020	\$ 75,522
<b>TOTAL</b>	<b>80.863%</b>	<b>19.137%</b>	<b>\$ 2,059,635</b>	<b>\$ 487,421</b>	<b>\$ 2,547,056</b>

<b>Est. Annual OM Costs</b>	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	86.047%	13.953%	\$ 146,054	\$ 23,684	\$ 169,738
AWT Phase 1	86.047%	13.953%	\$ 2,480,409	\$ 402,212	\$ 2,882,621
Existing Pipeline Facilities	86.047%	13.953%	\$ 4,595	\$ 745	\$ 5,340
<b>TOTAL</b>	<b>86.047%</b>	<b>13.953%</b>	<b>\$ 2,631,058</b>	<b>\$ 426,641</b>	<b>\$ 3,057,699</b>

<b>Est. Annual Renewal Costs</b>	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	\$ 56,110	\$ 21,640	\$ 77,750
AWT Phase 1	86.047%	13.953%	\$ 620,818	\$ 100,669	\$ 721,487
Existing Pipeline Facilities	72.167%	27.833%	\$ 2,005	\$ 773	\$ 2,778
<b>TOTAL</b>	<b>84.653%</b>	<b>15.347%</b>	<b>\$ 678,933</b>	<b>\$ 123,082</b>	<b>\$ 802,015</b>

<b>Est Total Annual Costs</b>		PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities		\$ 834,136	\$ 289,059	\$ 1,123,195
AWT Phase 1		\$ 4,474,388	\$ 725,547	\$ 5,199,935
Existing Pipeline Facilities		\$ 61,102	\$ 22,538	\$ 83,640
<b>TOTAL</b>		<b>\$ 5,369,626</b>	<b>\$ 1,037,145</b>	<b>\$ 6,406,770</b>

<b>Est. Total Demands and Cost/AF</b>	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
Phase 1 Demand	86.047%	13.953%	3,700	600	4,300
<b>Total Cost/AF</b>			<b>\$ 1,451</b>	<b>\$ 1,729</b>	<b>\$ 1,490</b>

Note: New Pipeline Facilities includes the piping and pump station facilities.

## Exhibit F: Financial and Construction Responsibilities of Project Components

Project Item	Who will perform the work and pay the initial invoices		How will costs be reconciled between MCWD and PCA
	MCWD	PCA	
New Pipeline Facilities CEQA	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities Design	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities Permits	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities Capital	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities O&M	X		PCA to reimburse MCWD based on OM Cost Share %
New Pipeline Facilities Renewal	X		PCA to reimburse MCWD based on Renewal Cost Share %
Existing Pipeline Facilities O&M	X		PCA to reimburse MCWD based on OM Cost Share %
Existing Pipeline Facilities Renewal	X		PCA to reimburse MCWD based on Renewal Cost Share %
RUWAP Distribution Facilities CEQA, Design, Permits, Capital, O&M, and Renewal	X		Not applicable.
AWT-PHASE 1 CEQA		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 1 Design		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 1 Permits		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT- PHASE 1 Capital		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 1 O&M		X	MCWD to reimburse PCA based on OM Cost Share %
AWT-PHASE 1 Renewal		X	MCWD to reimburse PCA based on Renewal Cost Share %
AWT-PHASE 2 CEQA		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 Design		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 Permits		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 Capital		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 O&M		X	MCWD to reimburse PCA based on OM Cost Share %
AWT-PHASE 2 Renewal		X	MCWD to reimburse PCA based on Renewal Cost Share %
Injection Facilities CEQA, Design, Permits, Capital, O&M, and Renewal		X	Not applicable.

## Exhibit G: Important Project Agreement Dates

Section 1.01 (a)	Milestone	Party	Key Date	Drop Dead Date
i	CEQA Approval-New Pipeline Facilities	MCWD		October 31, 2016
ii	CEQA Approval-AWT Phase 1 and AWT Phase 2	PCA		October 31, 2016
iii	No CEQA Lawsuits	BOTH		N/A
iv	Regulatory Approvals	PCA		October 31, 2016
v	SRF Funding Agreement	BOTH	October 31, 2016 Initial funding agreement	December 31, 2016 Final funding agreement
vi	Source waters approval	PCA		October 31, 2016
vii	CPUC approval	PCA		October 31, 2016

FIRST AMENDMENT TO  
PURE WATER DELIVERY AND SUPPLY PROJECT AGREEMENT  
BETWEEN MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY AND  
MARINA COAST WATER DISTRICT

WHEREAS, on April 8, 2016, Marina Coast Water District (MCWD) and Monterey Regional Water Pollution Control Agency entered into the Pure Water Delivery and Supply Project Agreement (Agreement).

The parties agree to amend the Pure Water Delivery and Supply Project Agreement as follows:

1. Everywhere the term “Monterey Regional Water Pollution Control Agency” or “PCA” is used, substitute the term “Monterey One Water” and “M1W,” respectively.
2. Delete Section 1.01 in its entirety. The Parties agree that this Amendment addresses all of the matters previously listed in Section 1.01.
3. Amend Section 1.03(a) as follows:

M1W has already completed the necessary CEQA review for the use of AWT Phase 1 water for irrigation. MCWD intends to use its AWT Phase 1 water for irrigation; however, to the extent that any portion of MCWD’s AWT Phase 1 water is to be used for injection, then any additional CEQA review necessary to address the use of that water for injection will be the responsibility of MCWD as described in Section 1.03(g) below.

Because of the uncertainty resulting from the possibility that a portion of MCWD’s AWT Phase 2 will be used for injection, details regarding Phase 2 implementation of MCWD’s AWT Phase 2 water for injection will require a separate agreement or an amendment to this agreement based upon the existing terms of this agreement.

4. Add as a new Section 1.03(g) to read: M1W agrees that MCWD may use water delivered by this project, subject to the following conditions:
  1. The CEQA work completed and approved by the M1W Board in October, 2017 describes a MCWD project that applies this water for irrigation. Any change to that CEQA work, from irrigation to injection and sale shall be at the sole expense of MCWD and M1W shall not be responsible for any delays that any such change might cause in the timing of delivery of water for injection to MCWD.
  2. If MCWD elects to inject, it will be responsible for permitting at its injection site but M1W agrees to help by providing all of the work product it completed for its injection well project, e.g., engineering report for the drinking water permit, to MCWD for its use.
  3. M1W injection well field and infrastructure will not be used for MCWD injection unless and until there is a future separate agreement between the parties hereto.
  4. Any costs for a change from irrigation to injection, e.g. CEQA, engineering, permitting, test well construction, modeling, etc. shall be the sole responsibility of MCWD. To the extent that M1W agrees to do work to assist MCWD, MCWD agrees



to pay any such invoices to M1W within the time period for payment specified by the service provider.

5. FORA agrees to any such change in use from irrigation to injection and agrees to continue to fund the project as agreed to in 7 (d) (ii) of this amendment.
  6. The portion of the 650 acre feet of summer delivery water that is not used by MCWD for AWT Phase 1 will be available for use by M1W. For AWT Phase 2, the entire amount of the 650 acre feet of summer delivery will be needed and used by MCWD and will no longer be available to M1W.
5. In Section 2.05(a), delete the words “Subject to Section 1.01(a) conditions” and substitute the following words, “Subject to Section 1.03(a)”.
6. In Section 3.01(b), delete “January 31, 2017” and substitute “December 31, 2018”.
7. Delete existing Section 4.01 in its entirety and replace with the following:
- (a) Reserved.
- (b) The estimated construction costs and proportional share of the New Pipeline Facilities and AWT Phase 1 are presented below (which also includes the Distribution, Diversion, and Injection Facilities to provide a total project cost perspective even though those are not part of the cost sharing). The cost allocations for the Pipeline Facilities are based upon a MCWD maximum use of 1,427 AFY and a M1W maximum use of 3,700 AFY. If any maximum use amount is exceeded, then the Parties agree to recalculate the allocations for the Pipeline Facilities, to true up those capital costs back to the date of this Agreement, and to agree on a true up amount and payment schedule.

Capital Facility	Costs (Millions)		
	M1W Share	MCWD Share	TOTAL
AWT Phase 1	\$ 56.79	\$ 9.21	\$ 66.00
New Pipeline Facilities	\$ 17.52	\$ 10.28	\$ 27.80
Existing Pipeline Facilities	\$ 1.00	\$ 0.39	\$ 1.39
Diversion Facilities	\$ 6.60	\$ -	\$ 6.60
Injection Facilities	\$ 10.67	\$ -	\$ 10.67
Distribution Facilities	\$ -	\$ 11.50	\$ 11.50
TOTAL	\$ 92.58	\$ 31.38	\$ 123.96

- (c) Except for the \$1.39 million in Section 4.01(b) for the Existing Pipeline Facilities, the Parties agree that all dollar amounts in this Agreement, including exhibits, are estimates.

(d) Grants and Capital Contributions from Third Parties.

i. Unless otherwise agreed in writing by the Parties, each Party is only required to apply grant funds and capital contributions from third parties to cover that Party's cost share of the Pure Water Delivery and Supply Project Facilities.

ii. FORA Capital Contribution. FORA and MCWD entered into the Reimbursement Agreement for Advanced Water Treatment Phase 1 and Product Water Conveyance Facilities of the RUWAP Recycled Project dated September 6, 2016 (the FORA-MCWD Reimbursement Agreement"), pursuant to Sections 3.2.2 and 7.1.2 of the 1998 Water/Wastewater Facilities Agreement (the "1998 Agreement"). If the FORA Board of Directors independently determines to provide \$2.3 million to M1W for M1W's share of costs for the Project, then MCWD agrees to not object. M1W agrees to enter into a separate reimbursement agreement with FORA. M1W acknowledges FORA's obligations to MCWD under Section 7.1.2 of the 1998 Agreement. M1W agrees that it shall not be entitled to any additional funds allocated to MCWD by FORA for RUWAP and/or for Water Augmentation under the Base Reuse Plan; however, nothing herein is intended to prevent M1W from seeking additional funds directly from FORA.

8. Add the following new Subsections iv, v, and vi to Section 4.02(a):

iv. The transmission main turnouts, any other expense shown to be exclusively for the MCWD distribution system, and the potable water facility included in MCWD's transmission pipeline construction contract are considered to be a part of the Distribution System for cost sharing purposes (e.g. MCWD pays for 100% of the Distribution System costs).

v. The 2.0 million gallon recycled water reservoir included in MCWD's transmission pipeline construction contract is considered to be 25% for Injection Facilities (M1W) and 75% for Distribution Facilities (MCWD) and therefore the parties will split the cost of the recycled water reservoir along these percentages.

9. Substitute the following for Sections 4.04(b):

(b) MCWD applied for a Clean Water SRF loan to pay for its cost share of the Project Facilities except for its cost share of the AWT Phase 1 treatment plant facilities. MCWD AWT costs for Phase 1 will be included in the SRF loan referenced in Section 4.04(a) (included within M1W's SRF loan).

10. Section 5.01 has two subsections "(a)." The second subsection (a) should be re-lettered subsection (b) and the following subsections (b), (c), (d), and (e) shall be re-lettered (c), (d), (e), and (f), respectively. Subsection 5.01(b)(i) shall be deleted because M1W's SRF loan includes M1W's share of the New Pipeline Facilities.

11. Subsection 5.02(b) shall be deleted because M1W's SRF loan includes M1W's share of the New Pipeline Facilities.

12. In Section 5.10, Claims for Stranded Costs, delete "March 31, 2017" and substitute "December 31, 2018".

13. Delete the existing Exhibit A and substitute the attached new Exhibit A.

14. Delete the existing Exhibit B and substitute the attached new Exhibit B.

15. Delete the existing Exhibit C (2 pages) and substitute the attached new Exhibit C (2 pages).

16. Delete the existing Exhibit E and substitute the attached Exhibit E.

17. Delete the existing Exhibit G.

18. Except as set forth in this First Amendment, all the provisions of the Agreement shall remain unchanged and in full force and effect.

In witness whereof, the parties execute this First Amendment as follows:

**M1W**

Dated: 11/29/2017  
Rudy Fischer  
Board Chair, Board of Directors

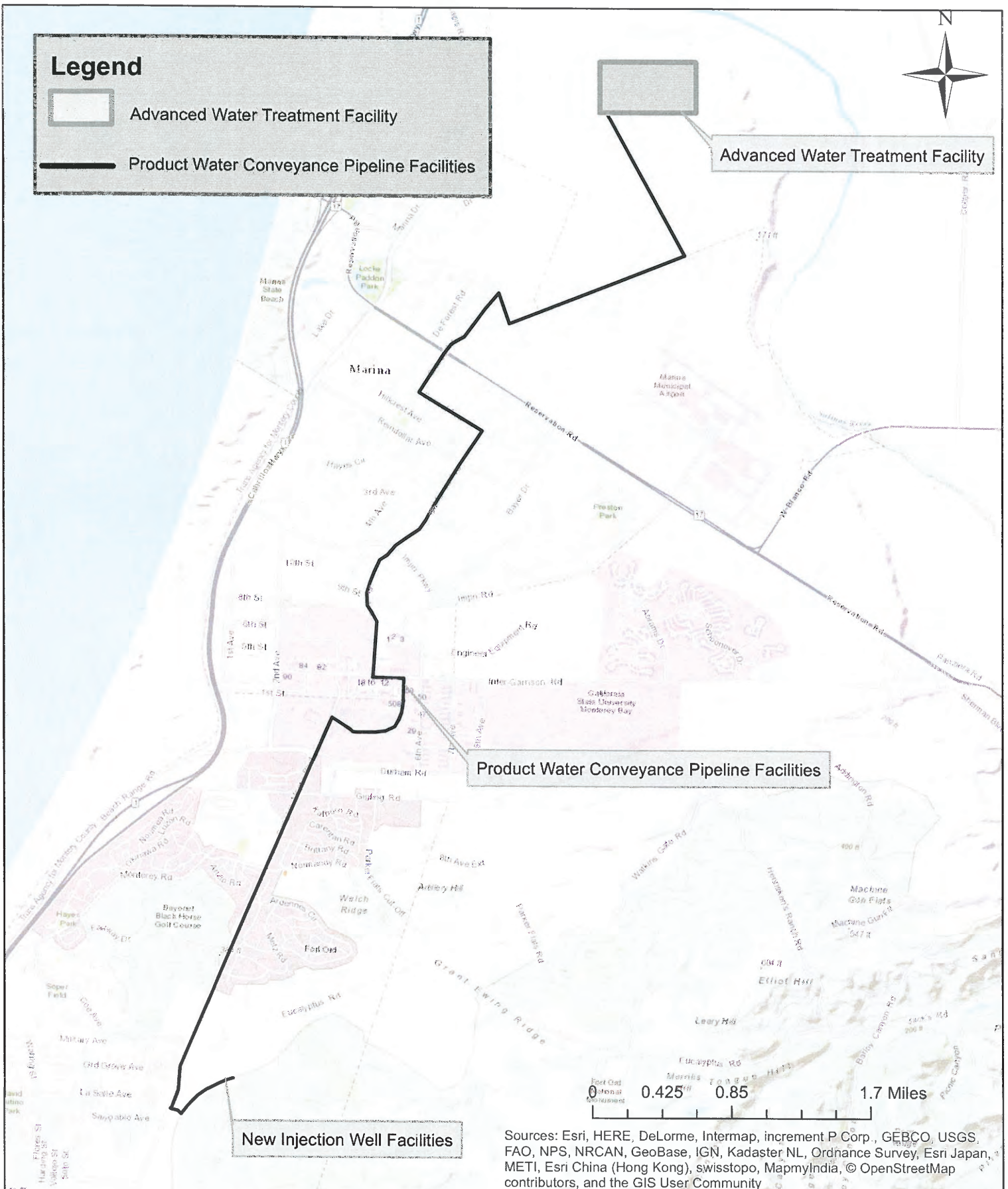
**MCWD**

Dated: 12.18.17  
[Signature]  
President, Board of Directors

Approved as to form:

Dated: John R. Wellington  
11/30/17  
Counsel, M1W

Dated: 12/18/17  
Regan K. McQuinn  
Legal Counsel, MCWD



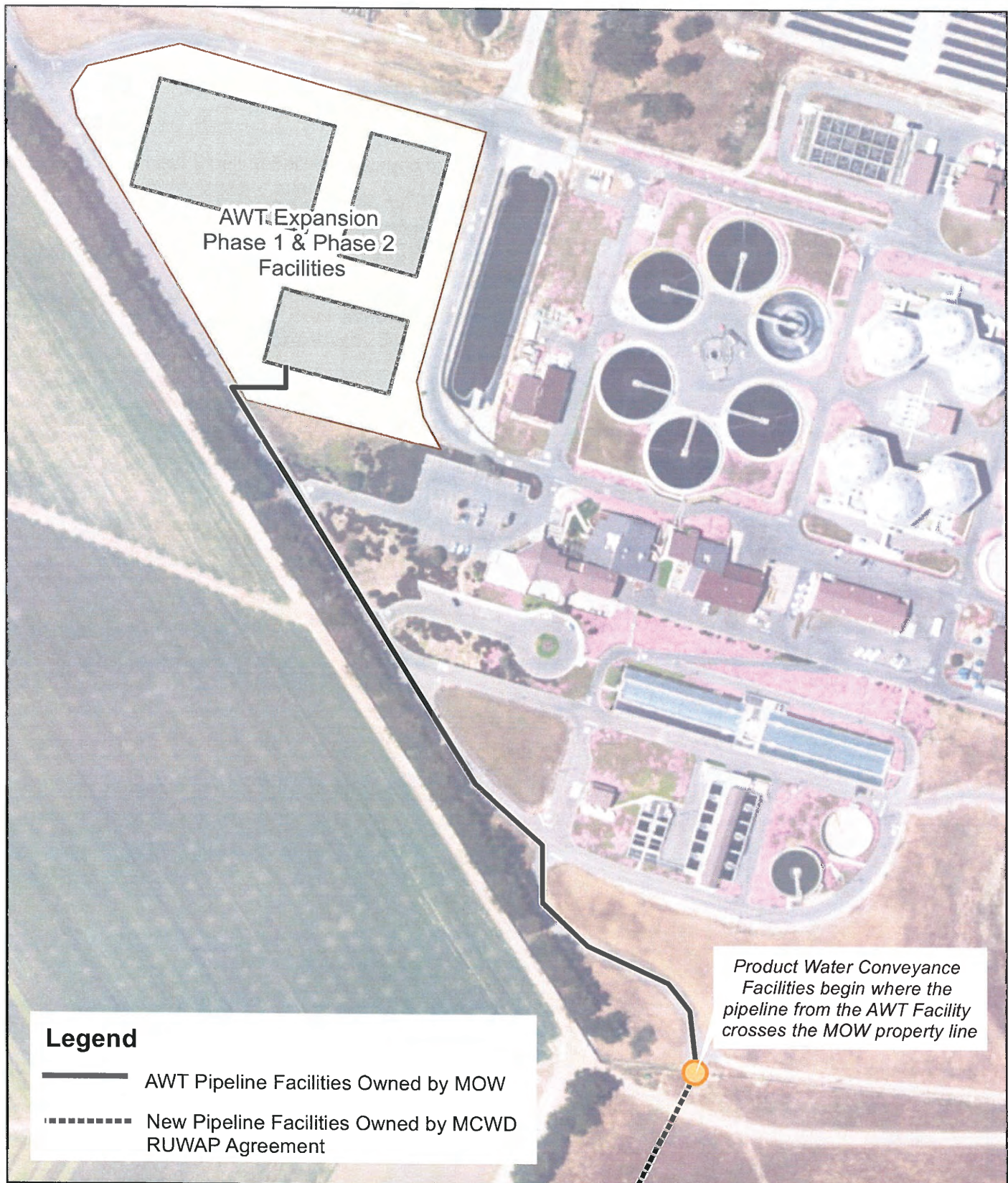
**Marina Coast Water District**  
 11 Reservation Road  
 Marina, CA 93933  
 mcwd.org

**Exhibit A**  
**Pure Water Delivery and Supply Facility**

**Drawn By:**  
 J.Hollida

**Date:**  
 10/16/2017





## Exhibit B

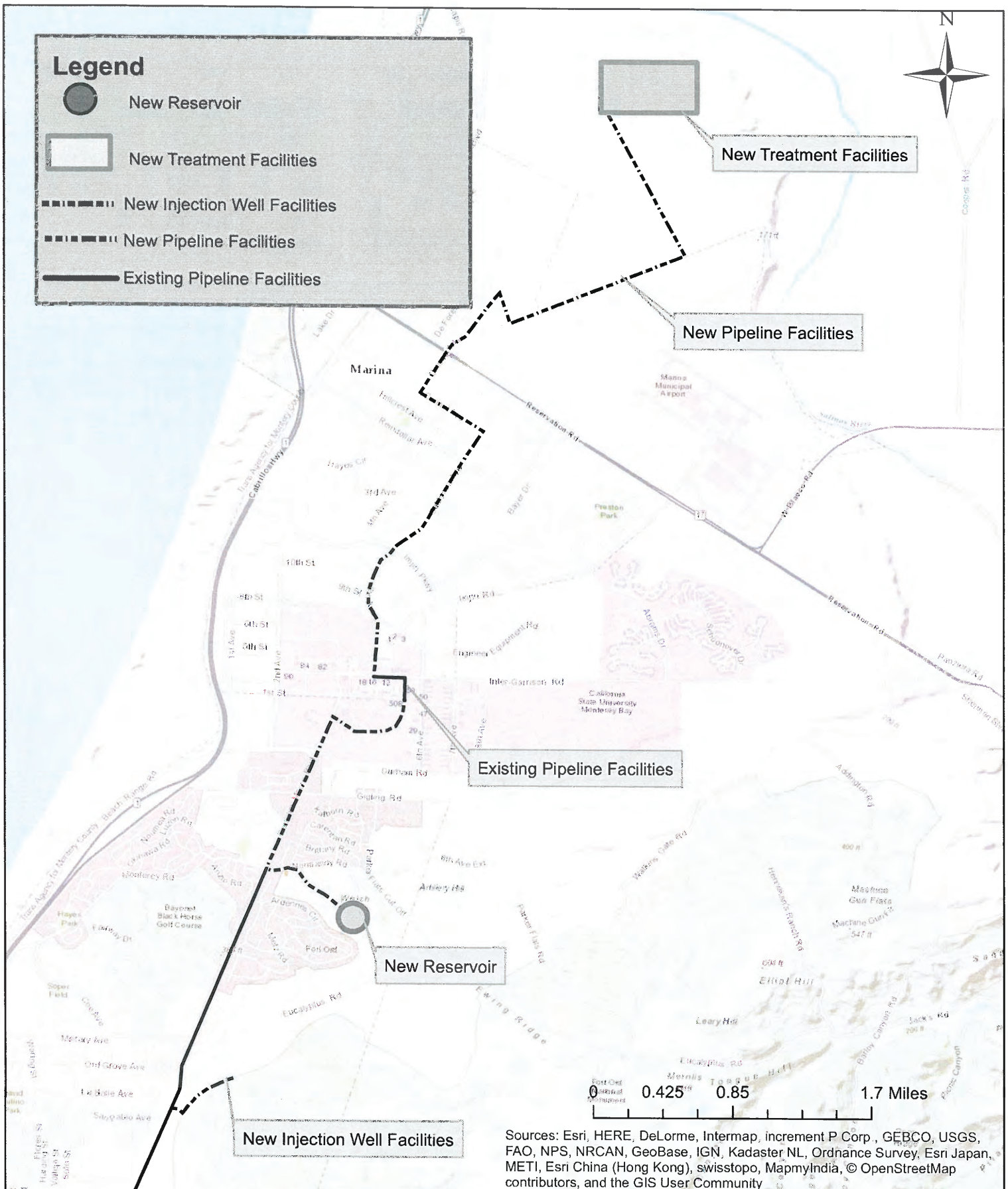
### Advanced Water Treatment Facility (Pure Water Monterey Project) Recycled Water Delivery and Supply Project



0 100 200  
Feet  
1 inch = 200 feet

November 2017  
Author: A. Racz





**Marina Coast Water District**  
 11 Reservation Road  
 Marina, CA 93933  
 mcwd.org

**Exhibit C**  
**Product Water Conveyance Facilities**

**Drawn By:**  
 J.Hollida

**Date:**  
 10/16/2017





**Legend**

- End of Product Water Conveyance Facilities
- Existing Pipeline Facilities
- Proposed Injection Well Facilities

At the location of the first valve just south of the most southern tee that ties the Injection Facilities into the Existing Pipeline Facilities is the end of the Product Water Conveyance Facilities

Proposed Injection Well Facilities

Injection Well Pipeline Alignment



**Marina Coast Water District**  
11 Reservation Road  
Marina, CA 93933  
mcwd.org

**Exhibit C**  
**Product Water Conveyance Facilities**

Drawn By:  
J.Hollida

Date:  
10/16/2017



## Exhibit E: Summary of Estimated Costs-Phase 1 Only

Note: This table is only cost estimates, and does not include financing reductions from either grant funds or capital contributions.

Est. Capital Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Total Amount
New Pipeline Facilities	72.167%	27.833%	\$ 16,537,790	\$ 6,378,210	\$ 22,916,000
RUWAP Distribution Facilities	0.000%	100.000%	\$ -	\$ 12,464,000	\$ 12,464,000
Blackhorse Reservoir	25.000%	75.000%	\$ 980,000	\$ 2,940,000	\$ 3,920,000
AWT Phase 1	86.047%	13.953%	\$ 56,790,698	\$ 9,209,302	\$ 66,000,000
Diversion Facilities	100.000%	0.000%	\$ 6,600,000	\$ -	\$ 6,600,000
Existing Pipeline Facilities	72.167%	27.833%	\$ 1,002,400	\$ 386,600	\$ 1,389,000
Injection Well Facilities	100.000%	0.000%	\$ 10,670,000	\$ -	\$ 10,670,000
<b>TOTAL</b>	<b>74.687%</b>	<b>25.313%</b>	<b>\$ 92,580,887</b>	<b>\$ 31,378,113</b>	<b>\$ 123,959,000</b>

Est. Annual Debt Service Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	\$ (640,808)	\$ (277,015)	\$ (917,823)
RUWAP Distribution Facilities	0.000%	100.000%	\$ -	\$ (541,329)	\$ (541,329)
Blackhorse Reservoir	25.000%	75.000%	\$ (37,973)	\$ (127,688)	\$ (165,662)
AWT Phase 1	86.047%	13.953%	\$ (2,200,532)	\$ (356,843)	\$ (2,557,375)
Diversion Facilities	100.000%	0.000%	\$ (255,738)	\$ -	\$ (255,738)
Existing Pipeline Facilities	72.167%	27.833%	\$ (38,841)	\$ (16,791)	\$ (55,632)
Injection Well Facilities	100.000%	0.000%	\$ (413,442)	\$ -	\$ (413,442)
<b>TOTAL</b>	<b>73.106%</b>	<b>26.894%</b>	<b>\$ (3,587,335)</b>	<b>\$ (1,319,666)</b>	<b>\$ (4,907,001)</b>

Est. Annual OM Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	86.047%	13.953%	\$ (146,054)	\$ (23,684)	\$ (169,738)
RUWAP Distribution Facilities	0.000%	100.000%	\$ -	\$ (75,000)	\$ (75,000)
Blackhorse Reservoir	25.000%	75.000%	\$ (6,250)	\$ (18,750)	\$ (25,000)
AWT Phase 1	86.047%	13.953%	\$ (2,480,395)	\$ (402,000)	\$ (2,882,621)
Diversion Facilities	100.000%	0.000%	\$ -	\$ -	\$ -
Existing Pipeline Facilities	86.047%	13.953%	\$ (4,595)	\$ (745)	\$ (5,340)
Injection Well Facilities	100.000%	0.000%	\$ -	\$ -	\$ -
<b>TOTAL</b>			<b>\$ (2,637,293)</b>	<b>\$ (520,179)</b>	<b>\$ (3,157,699)</b>

Est. Annual Renewal Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	\$ (165,378)	\$ (63,782)	\$ (229,160)
RUWAP Distribution Facilities	0.000%	100.000%	\$ -	\$ (124,640)	\$ (124,640)
Blackhorse Reservoir	25.000%	75.000%	\$ (9,800)	\$ (29,400)	\$ (39,200)
AWT Phase 1	86.047%	13.953%	\$ (567,907)	\$ (92,093)	\$ (660,000)
Diversion Facilities	100.000%	0.000%	\$ (66,000)	\$ -	\$ (66,000)
Existing Pipeline Facilities	72.167%	27.833%	\$ (10,024)	\$ (3,866)	\$ (13,890)
Injection Well Facilities	100.000%	0.000%	\$ (106,700)	\$ -	\$ (106,700)
<b>TOTAL</b>			<b>\$ (925,809)</b>	<b>\$ (313,781)</b>	<b>\$ (1,239,590)</b>

Est Total Annual Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities			\$ (952,240)	\$ (364,481)	\$ (1,316,721)
RUWAP Distribution Facilities			\$ -	\$ (740,969)	\$ (740,969)
Blackhorse Reservoir			\$ (54,023)	\$ (175,838)	\$ (229,862)
AWT Phase 1			\$ (5,248,834)	\$ (850,936)	\$ (6,099,996)
Diversion Facilities			\$ (321,738)	\$ -	\$ (321,738)
Existing Pipeline Facilities			\$ (53,460)	\$ (21,402)	\$ (74,862)
Injection Well Facilities			\$ (520,142)	\$ -	\$ (520,142)
<b>TOTAL</b>			<b>\$ (7,150,437)</b>	<b>\$ (2,153,627)</b>	<b>\$ (9,304,290)</b>

Key

Item in cost share agreement

Item not in cost share agreement