Groundwater Sustainability Plan

Monterey Subbasin

Marina Coast Water District Groundwater Sustainability Agency

Salinas Valley Basin Groundwater Sustainability Agency

DRAFT Chapters 1 through 4

August 26, 2020

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EXECUTIVE SUMMARY

TO BE COMPLETED AS PART OF FINAL DRAFT REVISION

1 INTRODUCTION

1.1 Purpose of the Groundwater Sustainability Plan (GSP or Plan)

The purpose of this Groundwater Sustainability Plan (GSP) is to meet the regulatory requirements set forth in the three-bill legislative package consisting of Assembly Bill (AB) 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (SGMA). SGMA defines sustainable groundwater management as the "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results". Undesirable results are defined by the Sustainable Groundwater Management Act (SGMA) as any of the following effects caused by groundwater conditions occurring throughout the basin:

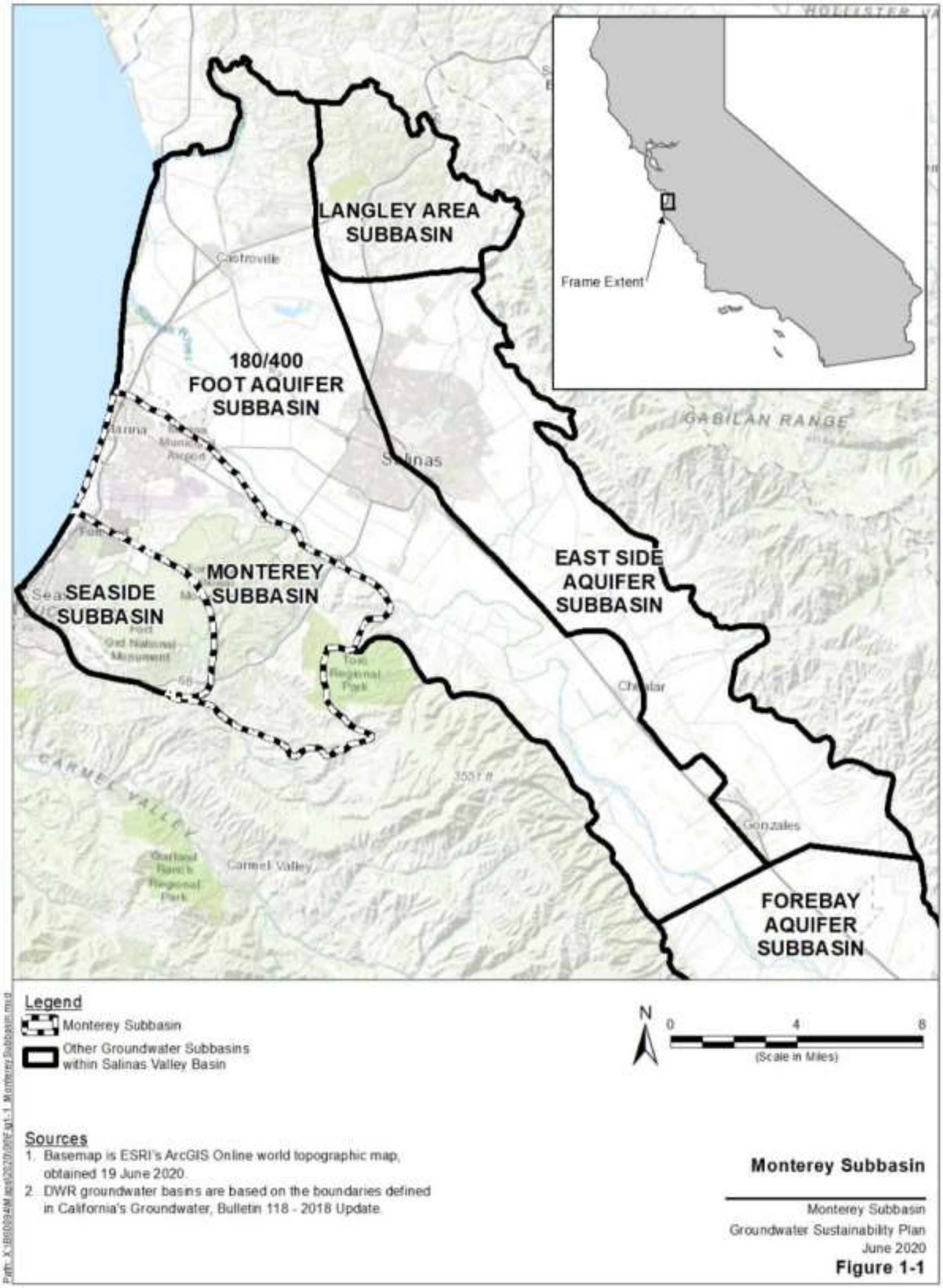
- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply;
- Significant and unreasonable reduction of groundwater storage;
- Significant and unreasonable seawater intrusion;
- Significant and unreasonable degraded water quality;
- Significant and unreasonable land subsidence; and/or
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

The Monterey Subbasin has been designated by the California Department of Water Resources (DWR) as medium priority. The Monterey Subbasin is one of the nine subbasins in the Salinas Valley. It is located at the northwestern end of the Salinas Valley and boarders the Pacific Ocean (**Figure 1-1**). This document satisfies the GSP requirement for the Monterey Subbasin and meets all of the regulatory standards.

This GSP has been co-developed by the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) to meet SGMA regulatory requirements by the January 31, 2022, deadline for medium and high priority basins while reflecting local needs and preserving local control over water resources. This GSP provides a path to achieve and document sustainable groundwater management within 20 years following Plan adoption and preserves the long-term sustainability of locally-managed groundwater resources now and into the future. This GSP was approved by the MCWD GSA Board on DATE and by the SVBGSA Board on DATE (Appendix N).

1.2 Sustainability Goal

TO BE COMPLETED AS PART OF FINAL DRAFT REVISION


LANGLEY AREA SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
EAST SIDE AQUIFER SUBBASIN
FOREBAY AQUIFER SUBBASIN
Castroville
Salinas
Chualar
Gonzales
Carmel Valley
GABILAN RANGE
CARMEL VALLEY
Frame Extent
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
N
0 4 8
(Scale in Miles)
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 19 June 2020.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
Monterey Subbasin
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 1-1

1.3 Agency Information

The Monterey Subbasin is within the jurisdiction of the MCWD GSA and SVBGSA. The GSA boundaries are shown on **Figure 1-2.**

1.3.1 Name and Mailing Address of the Agency

This GSP has been prepared by MCWD GSA and SVBGSA. The following contact information is provided for each GSA that is a signatory to this GSP, pursuant to California Water Code § 10723.8.

Marina Coast Water District Groundwater Sustainability Agency
Attn.: Keith Van Der Maaten, General Manager
11 Reservation Road
Marina, CA 93933
http://www.mcwd.org

Salinas Valley Groundwater Sustainability Agency
Attn.: Donna Meyers, General Manager
1441 Schilling Place
Salinas, CA 93901
https://svbgsa.org

1.3.2 Organization and Management Structure of the Agencies

1.3.2.1 MCWD GSA

The MCWD GSA is a single agency GSA formed by MCWD and covering the areas within the MCWD service area within Monterey Subbasin, except for those areas owned by a federal government entity and thus not subject to SGMA. The GSA areas are shown on **Figure 1-2**. The MCWD GSA Board is comprised of the members of the MCWD Board.

1.3.2.2 SVBGSA

The SVBGSA is a Joint Powers Authority (JPA). The JPA membership comprises the County of Monterey, Water Resources Agency of Monterey County, City of Salinas, City of Soledad, City of Gonzales, City of King, the Castroville Community Services District (CSD), and Monterey One Water (formerly the Monterey Regional Water Pollution Control Agency). The SVBGSA is governed and administered by an eleven-member Board of Directors, representing public and private groundwater interests throughout the Valley. When a quorum is present, a Majority Vote is required to conduct business. Some business items require a Super Majority Vote or a Super Majority Plus Vote. A Super Majority requires an affirmative vote by eight of the eleven Board members. A Super Majority Vote is required for:

- Approval of a GSP

- Amendment of budget and transfer of appropriations
- Withdrawal or termination of Agency members

A Super Majority Plus requires an affirmative vote by eight of the eleven Board members, including an affirmative vote by three of the four agricultural representatives. A Super Majority Plus Vote is required for:

- Decisions to impose fees not requiring a vote of the electorate or property owners
- Proposals to submit to the electorate or property owners' decisions to impose fees or taxes
- Limitations on well extractions (pumping limits)

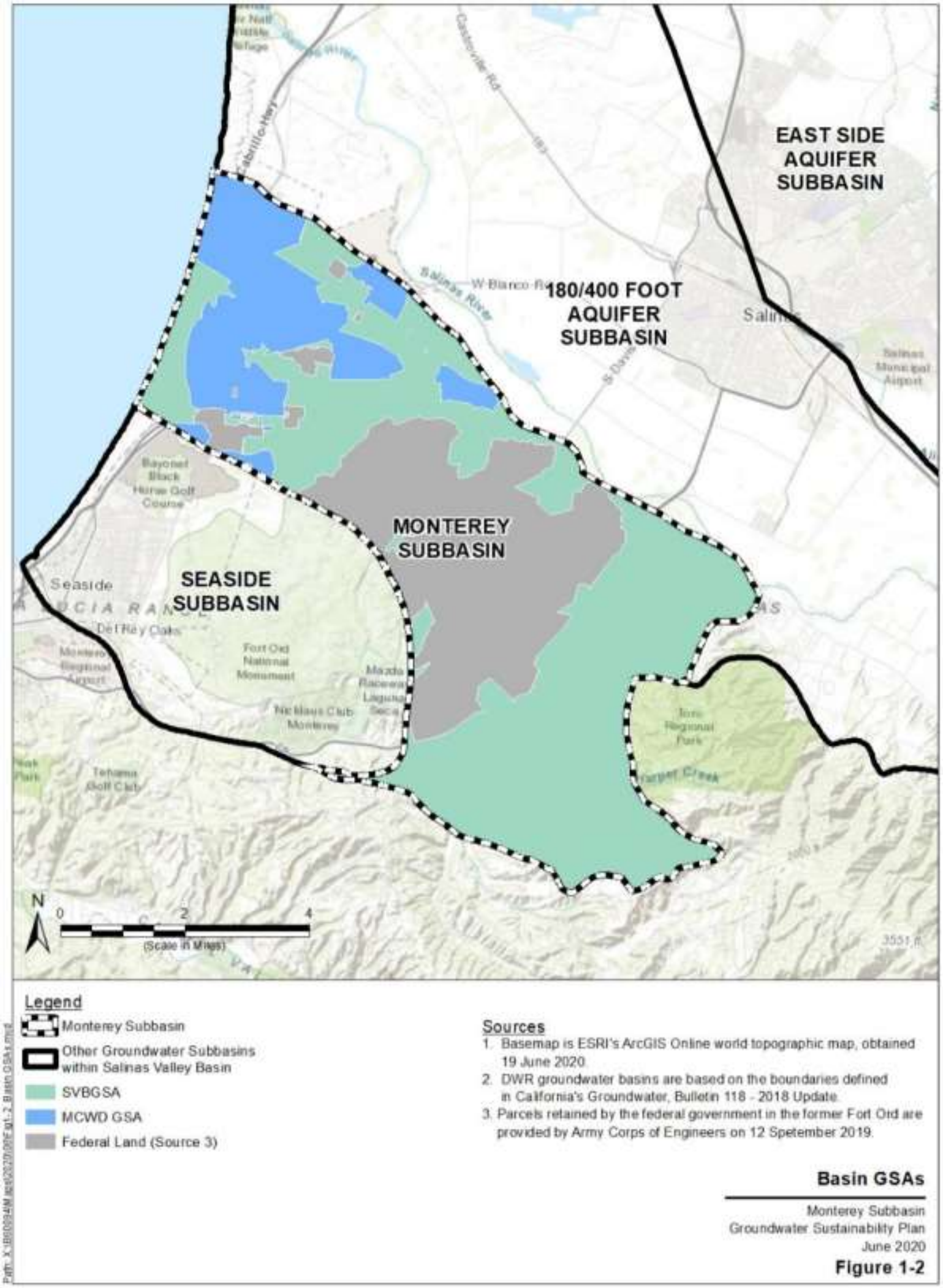
In addition to the Board of Directors, SVBGSA includes an Advisory Committee consisting of Directors and non-Directors. The Advisory Committee is designed to ensure participation by, and input to, the Board of Director by constituencies whose interests are not directly represented on the Board. The SVBGSA's GSA activities are led by a contract General Manager.

1.3.3 Plan Managers

The plan managers for this GSP are Keith Van Der Maaten, General Manager of the MCWD, and Donna Meyers, General Manager of the SVBGSA. The contact information for Mr. Van Der Maaten and Ms. Meyers is provided below.

Keith Van Der Maaten
General Manager
Marina Coast Water District
11 Reservation Road, Marina, CA93933-2099
831-883-5910
kvandermaaten@mcwd.org

Donna Meyers
General Manager
Salinas Valley Basin Groundwater Sustainability Agency
1441 Schilling Place
Salinas, CA 93901
meyersd@svbgsa.org
https://svbgsa.org


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Salinas River
W Blanco Rd
Seaside
Del Rey Oaks
Fort Ord National Monument
Toro Regional Park
(Scale in Miles)
0
2
4
N
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
SVBGSA
MCWD GSA
Federal Land (Source 3)
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 19 June 2020.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
3. Parcels retained by the federal government in the former Fort Ord are provided by Army Corps of Engineers on 12 Spetember 2019.
Basin GSAs
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 1-2

1.3.4 Legal Authority of the GSAs

Both GSAs involved in the development of this GSP were formed in accordance with the requirements of California Water Code § 10723 et seq.

1.3.4.1 MCWD GSA

MCWD GSA is formed in accordance with the requirements of California Water District Law, California Water Code §34000 by MCWD. MCWD provides water supply to residents within its service area within the City of Marina and the former Fort Ord, and is therefore a local agency under California Water Code §10721 with the authority to establish itself as a GSA.

1.3.4.2 SVBGSA

SVBGSA is a JPA that was formed in accordance with the requirements of California Government Code § 6500 et seq. In accordance with California Water Code § 10723 et seq, the JPA signatories are all cities, counties, and water agencies with water or land use authority and are all independently eligible to serve as GSAs:

- The County of Monterey has land use authority over the unincorporated areas of the County, including areas overlying the 180/400-Foot Aquifer Subbasin. The County of Monterey is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA.
- The Monterey County Water Resources Agency (MCWRA) is a California Special Act District with broad water management authority in Monterey County. The MCWRA is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA.
- The City of Salinas is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents. The City is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA.
- The City of Soledad is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents. The City is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA.
- The City of Gonzales is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents. The City is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA.
- The City of King is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents. The City is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA.
- The Castroville Community Services District is a local public agency of the State of California, organized and operating under the Community Services District Law, Government Code § 6100 et

seq. Castroville CSD provides water services to its residents. Castroville CSD is therefore a local agency under California Water Code § 10721 with the authority to establish itself as a GSA.

- Monterey One Water is itself a joint powers authority whose members include many members of the SVBGSA. Monterey One Water is a local agency under California Water Code § 10721 with authority to establish itself as a GSA.

Upon establishing itself as a GSA, the SVBGSA retains all the rights and authorities provided to GSAs under California Water Code § 10725 et seq. as well as the powers held in common by the members.

1.3.5 Coordination Agreements

As the MCWD GSA and SVBGSA have developed a single GSP for the entire Monterey Subbasin, a Coordination Agreement per GSP Regulation §357.4 is not required between these two parties. Nonetheless, MCWD GSA and SVBGSA have successfully entered into a Framework Agreement regarding responsibilities and coordination for GSP development in the 180/400 Subbasin and the Monterey Subbasin, included as Appendix 1-A. The Framework Agreement was adopted by MCWD GSA on December 2018 and SVBGSA on January 2019.

The Framework Agreement outlines the Management Areas to be established within the Subbasin, which are later formalized in this GSP (see **Figure 1-3** and detailed discussion below). According to the Framework Agreement, MCWD GSA has prepared GSP components for the Marina-Ord Management Area and SVBGSA has prepared GSP components for the Corral de Tierra Management Area. The Framework Agreement further establishes a basis for information developed by the two agencies to be integrated into a single GSP for the Monterey Subbasin, including a coordination and stakeholder engagement process, information exchange principles, as well as the acknowledgement that coordinated methodologies are to be developed for the water budget and monitoring network analysis.

1.4 Management Areas

This GSP establishes two Management Areas within the Monterey Subbasin in accordance with GSP Regulations § 351(r) and § 354.20. The Management Areas include

- Marina-Ord Area: This Management Area consists of the lands within the City of Marina and the former Fort Ord, which are generally located north of State Route 68; and
- Corral de Tierra Area: This Management Area consists of the remainder of the subbasin, which are generally south of State Route 68 and includes a parcel located between the City of Marina and the former Fort Ord.

The Management Areas are developed considering the differences in jurisdictional, water use sector, and aquifer characteristics within these areas.

Jurisdictional and water use sector information for the Subbasin is presented in Section 3.1. Water use sectors within the Marina-Ord Area includes municipal water use and minimal groundwater remediation use. The sole water purveyor within the Marina-Ord Area is the MCWD, which serves water within its service area and will serve any future redevelopment within the former Fort Ord. Water use sectors in the Corral de Tierra Area includes municipal water use supplied by various small water systems as well as agricultural and grazing water use.

Aquifer characteristics within these Management Areas are discussed in Section 4.2. In general, hydrostratigraphy in the vicinity of the City of Marina consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley. Within the southern Corral de Tierra area, the typical aquifer sequence recognized in the Salinas Valley is not present. Rather the hydrostratigraphy is directly correlated to the geologic units.

The Management Areas are developed to facilitate GSP implementation in these areas. Specifically, the establishment of the Marina-Ord Area allows MCWD GSA to plan, fund, and implement sustainable groundwater management for the redevelopment of the former Fort Ord, within and outside of its current jurisdictional area. Whereas, management approach to be undertaken by SVBGSA in the Corral de Tierra area will be tailored towards small individual water users.

1.5 Estimated Cost of Implementing the GSP and the Agencies' Approach to Meet Costs

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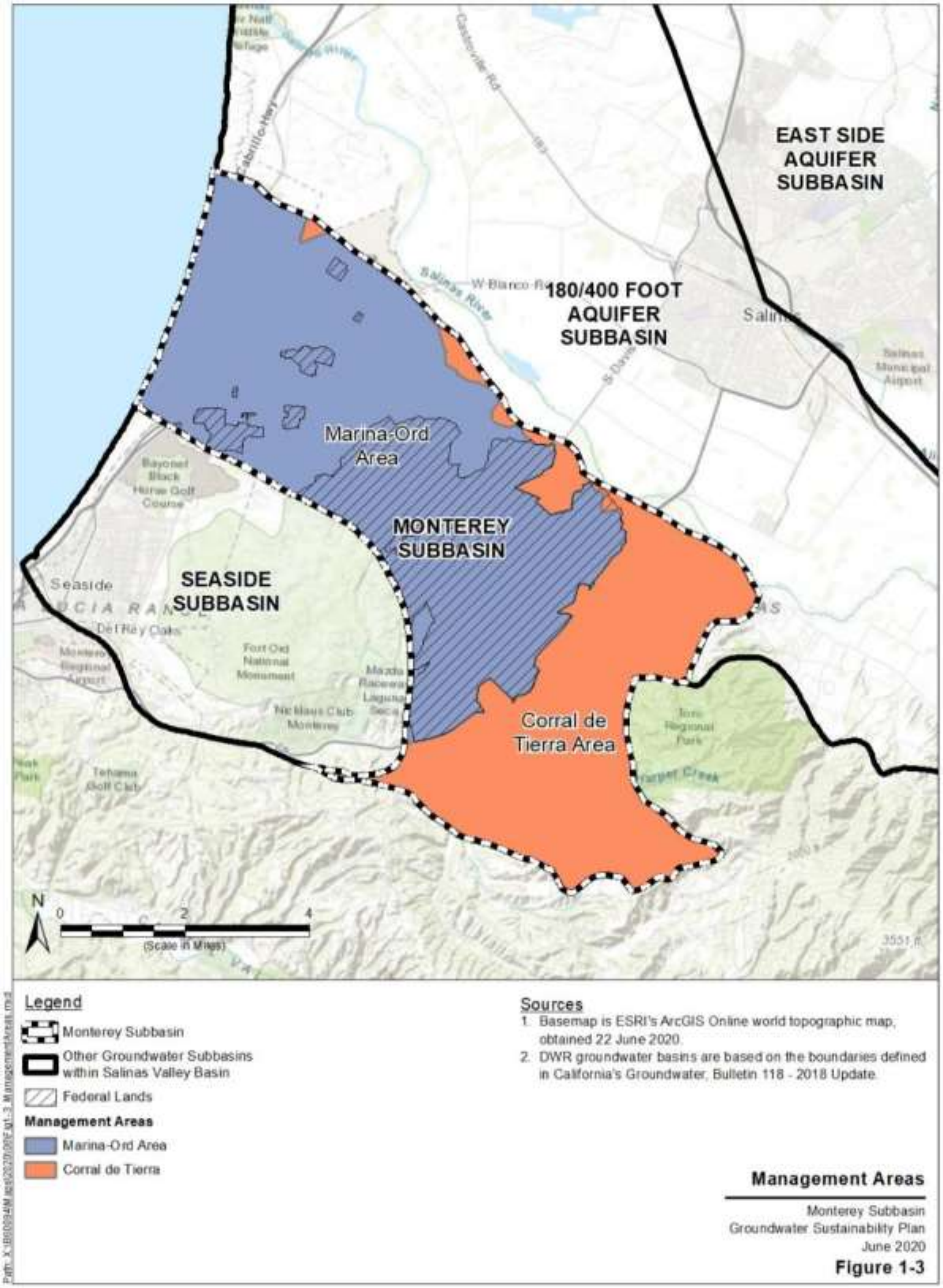


Management Areas

Monterey Subbasin
Groundwater Sustainability Plan
June 2020

Figure 1-3

1.6 Overview of this GSP

The GSP covers the entire Monterey Subbasin and is developed jointly by the MCWD GSA and the SVBGSA. This GSP is developed in concert with GSPs for five other Salinas Valley Groundwater Basin subbasins subject to SGMA: the 180/400-Foot Aquifer Subbasin, the Forebay Aquifer Subbasin, the Upper Valley Aquifer Subbasin, the Langley Area Subbasin, and the Eastside Aquifer Subbasin. Some of the projects and programs presented in this GSP are part of a cohesive set of projects and programs designed to achieve sustainability throughout the entire Salinas Valley Groundwater Basin. The Monterey Subbasin is referred to as the Subbasin throughout this GSP, and the collection of Salinas Valley Groundwater Basin subbasins are collectively referred to as the Basin or the Valley.

Chapter 2 details the stakeholders that participated, and process followed to develop this GSP. Stakeholders worked together to gather existing information, define sustainable management criteria for the Subbasin, and develop a list of projects and management actions.

Chapters 3 through 6 describes the basin setting, presents the hydrogeologic conceptual model, and describes historical and current groundwater conditions. It further establishes estimates of the historical, current, and future water budgets based on the best available information.

Chapter 7 and 8 proceeds to detail required monitoring networks and defines local sustainable management criteria.

Chapter 9 outlines projects and programs for reaching sustainability in the Subbasin by 2042.

Additionally, GSP topics are discussed respectively for the Marina-Ord and Corral de Tierra Areas as necessary, acknowledging the hydrogeological differences and data gaps between in these management areas. As part of the two GSAs collaborative GSP development process, components for the Marina-Ord Area were prepared by MCWD GSA and components for the Corral de Tierra Area were prepared by SVBGSA.

This GSP will be updated and adapted as new information and more refined models become available. This includes updating sustainable management criteria as well as projects and management actions to reflect updates and future conditions. Adaptive management will be reflected in the required five-year updates to GSPs and annual reports.

2 STAKEHOLDER ENGAGEMENT AND COMMUNICATION STRATEGY

TO BE ADDED

3 PLAN AREA

This section presents a description of the Plan Area, and a summary of the relevant jurisdictional boundaries and other key land use features potentially relevant to the sustainable management of groundwater in the Monterey Subbasin. This section also describes the water monitoring programs, water management programs, and general plans relevant to the Subbasin and their influence on the development and execution of this Groundwater Sustainability Plan (GSP).

3.1 Summary of Jurisdictional Areas and Other Features

3.1.1 Plan Area Setting

This GSP covers the entire Monterey Subbasin (Department of Water Resources [DWR] Basin 3-004.10), which encompasses 30,850 acres (or 48.2 square miles) in the northwestern Salinas Valley Groundwater Basin in the Central Coast region of California (see **Figure 3-1**). The Subbasin is covered by the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) and lies entirely within Monterey County. The Subbasin is bounded on the northeast by the 180/400 Foot Aquifer Subbasin (DWR Basin 3-004.01) and on the southwest by the Seaside Subbasin (DWR Basin 3-004.08).

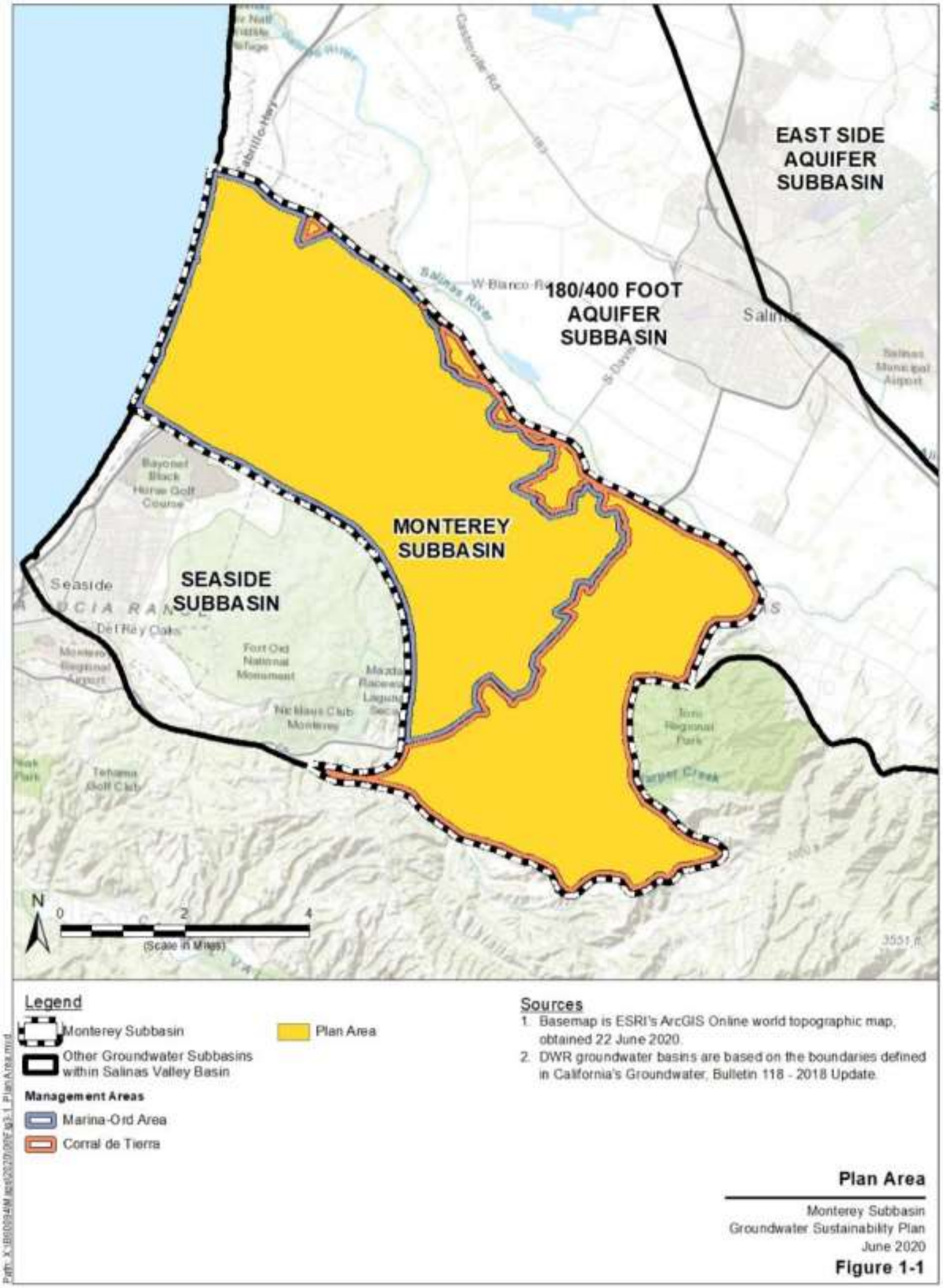
The GSAs have established two Management Areas within the subbasin, as discussed in Section 1.4 and shown on **Figure 3-1**. These Management Areas are described as follows:

- Marina-Ord Area: This Management Area consists of the lands within the City of Marina and the former Fort Ord; and
- Corral de Tierra Area: This Management Area consists of the remainder of the subbasin, which are generally south of State Route 68 and includes a parcel located between the City of Marina and the former Fort Ord.

Plan Area

Groundwater Sustainability Plan

Monterey Subbasin



3.1.2 Jurisdictional Boundaries

The Subbasin falls entirely within Monterey County and contains the municipalities of Marina and Seaside. The City of Marina is located in the northern portion of the Subbasin and is a community of approximately 22,000 residents (DOF, 2020). The City of Seaside is on Highway 1 approximately two miles south of the City of Marina and has a population of approximately 34,000 (DOF, 2020).

A large portion of the Subbasin was home to the 45-square mile former Fort Ord military base. The base was closed 1994 and has since been undergoing conversion to civilian use. As of 2019, most of the property transfers have been completed and environmental cleanup is ongoing. A large portion of the land is transferred to the Bureau of Land Management (BLM) as part of the National Conservation Lands and consists of the Fort Ord National Monument. A small portion of the base was retained by the U.S. Army for active military installation. As shown on **Figure 3-2**, a total of 9,200 acres of the Subbasin is federally owned lands managed by the U.S. Army and the BLM located at the former Fort Ord. Those lands are not subject to the Sustainable Groundwater Management Act (SGMA).

The Fort Ord Dunes State Park, a state-owned park, is located along the western boundary of the Subbasin adjacent to the Pacific Ocean, with a total area of 916 acres.

According to the information made available by the DWR[1] in support of GSP development, there are no tribal lands within or in the vicinity of the Subbasin.

Areas under federal and state jurisdiction are shown on **Figure 3-2**.

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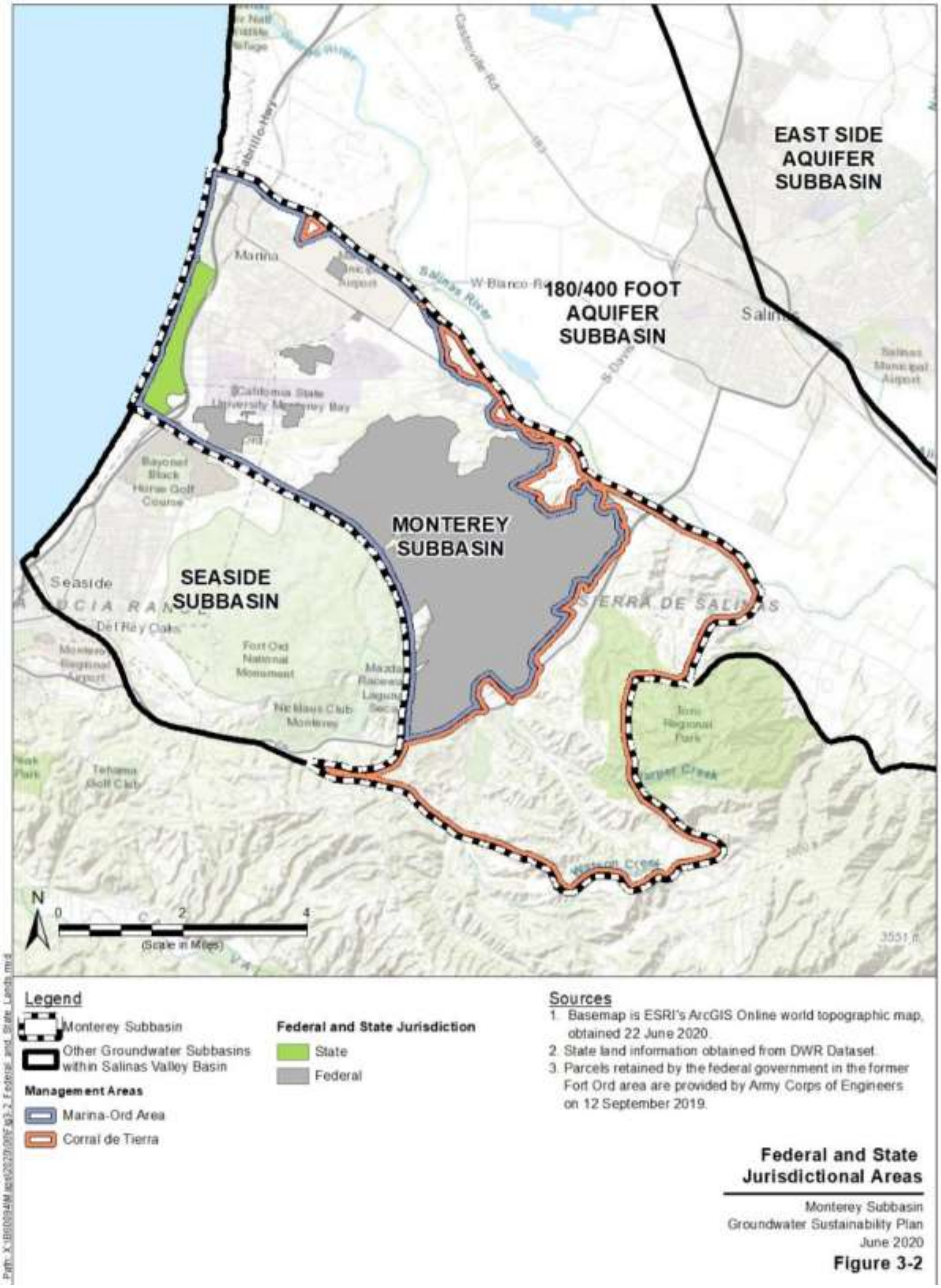
[1] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Marina
Seaside
Salinas River
W Blanco Rd
California State University Monterey Bay
Bayonet Black Horse Golf Course
Del Rey Oaks
Fort Ord National Monument
Nicklaus Club Monterey
Toro Regional Park
SIERRA DE SALINAS
Watson Creek
N
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2
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(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra
Federal and State Jurisdiction
State
Federal
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. State land information obtained from DWR Dataset.
3. Parcels retained by the federal government in the former Fort Ord area are provided by Army Corps of Engineers on 12 September 2019.
Federal and State Jurisdictional Areas
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-2

3.1.3 Agencies with Water Management Responsibilities

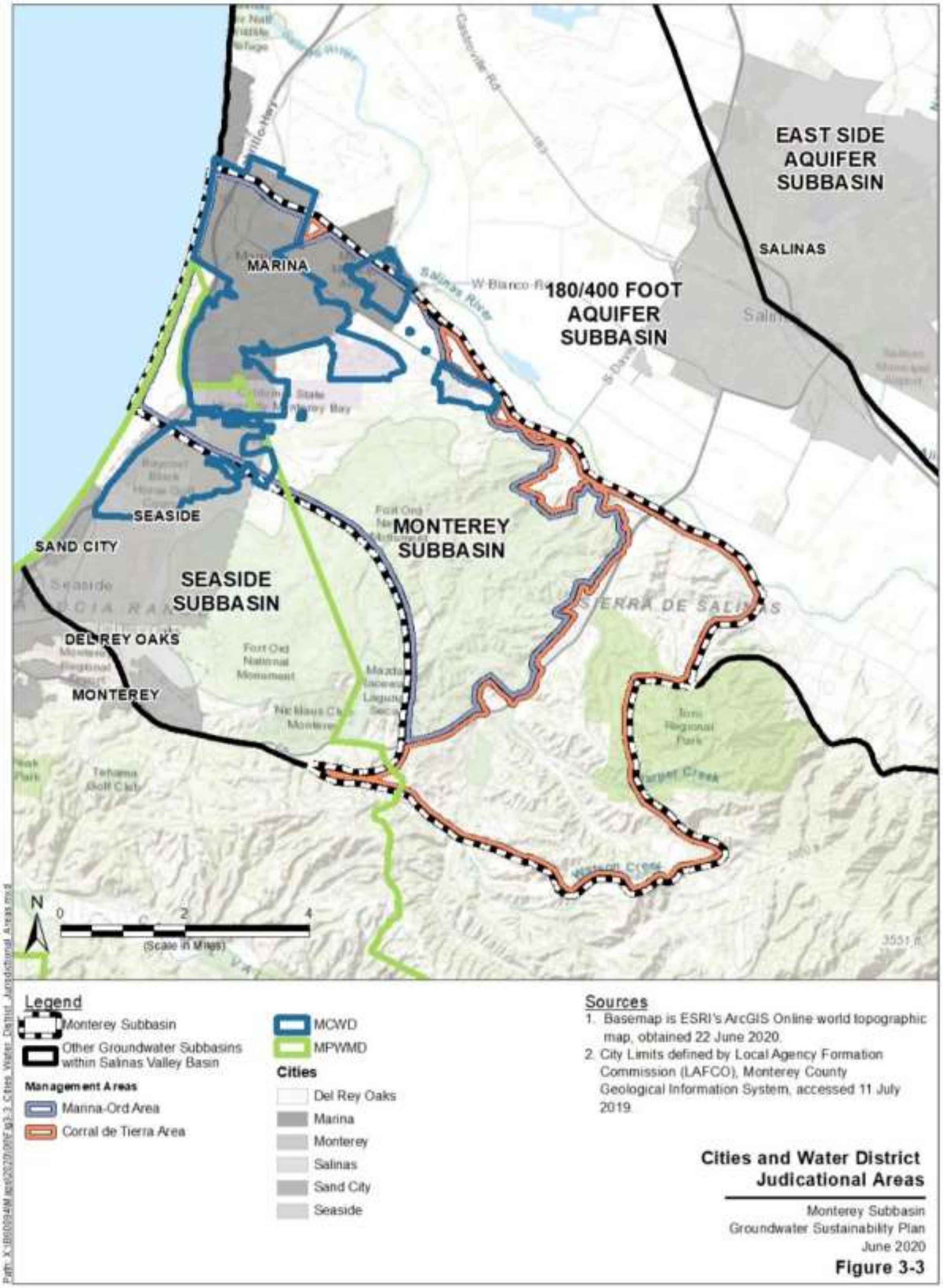
As shown on **Figure 3-3**, the main water supplier in the Subbasin is MCWD, which has a service area covering the entire City of Marina and all parcels within the Ord Subaarea that currently receive potable water or that have received final land use development approvals by the applicable land use jurisdiction within its jurisdictional boundary. Within the former Fort Ord, MCWD is the exclusive water purveyor to all non-Federal lands and to the U.S. Army for all Army and Federal facilities. By a 2001 deed from the Army through the Fort Ord Reuse Authority, MCWD owns all the water infrastructure within the former Fort Ord (MCWD, 2016). A small portion of MCWD's service area further extends into the 180/400-Foot Aquifer Subbasin.

The MCWD provides sewer collection services within its jurisdictional boundaries. Wastewater collected by MCWD is conveyed to the Monterey One Water (formerly Monterey Regional Water Pollution Control Agency) Regional Treatment Plant located in the 180/400 Foot Aquifer Subbasin.

The municipal water providers in the whole Monterey Subbasin are listed in **Table 3-1** and shown on **Figure 3-4**. There are also over 200 State Small Water Systems (5-14 connections) and Local Small Water Systems (2-4 connections) in the Monterey Subbasin that provide water.

Table 3-1: Municipal Water Providers in the Monterey Subbasin

Water System No	Agency Name	Acres
CA2710017	Marina Coast Water District	19,476
CA2710012	California Water Service Company - Salinas Hills	2,626
CA2710004	California American Water Company - Monterey District	2,368
CA2710021	Toro Water Service No 2710021	2,168
CA2700612	Laguna Seca Water Company	77
CA2702315	Corral De Tierra Country Club Water System	71
CA2701367	Tierra Meadows Home Owners Association Water System	44
CA2700775	Tierra Verde Mutual Water Company	21
CA2700731	Z Ranch Mutual Water Company	18
CA2702030	Cypress Community Church Water System	17
CA2700536	Corral De Tierra Estates Water Company	6
CA2701740	Bluffs Water System	6
CA2701681	Exxon Station Water System	1
CA2702009	Laguna Seca Recreation Water System	0
	Total	**26,898**


EAST SIDE AQUIFER SUBBASIN
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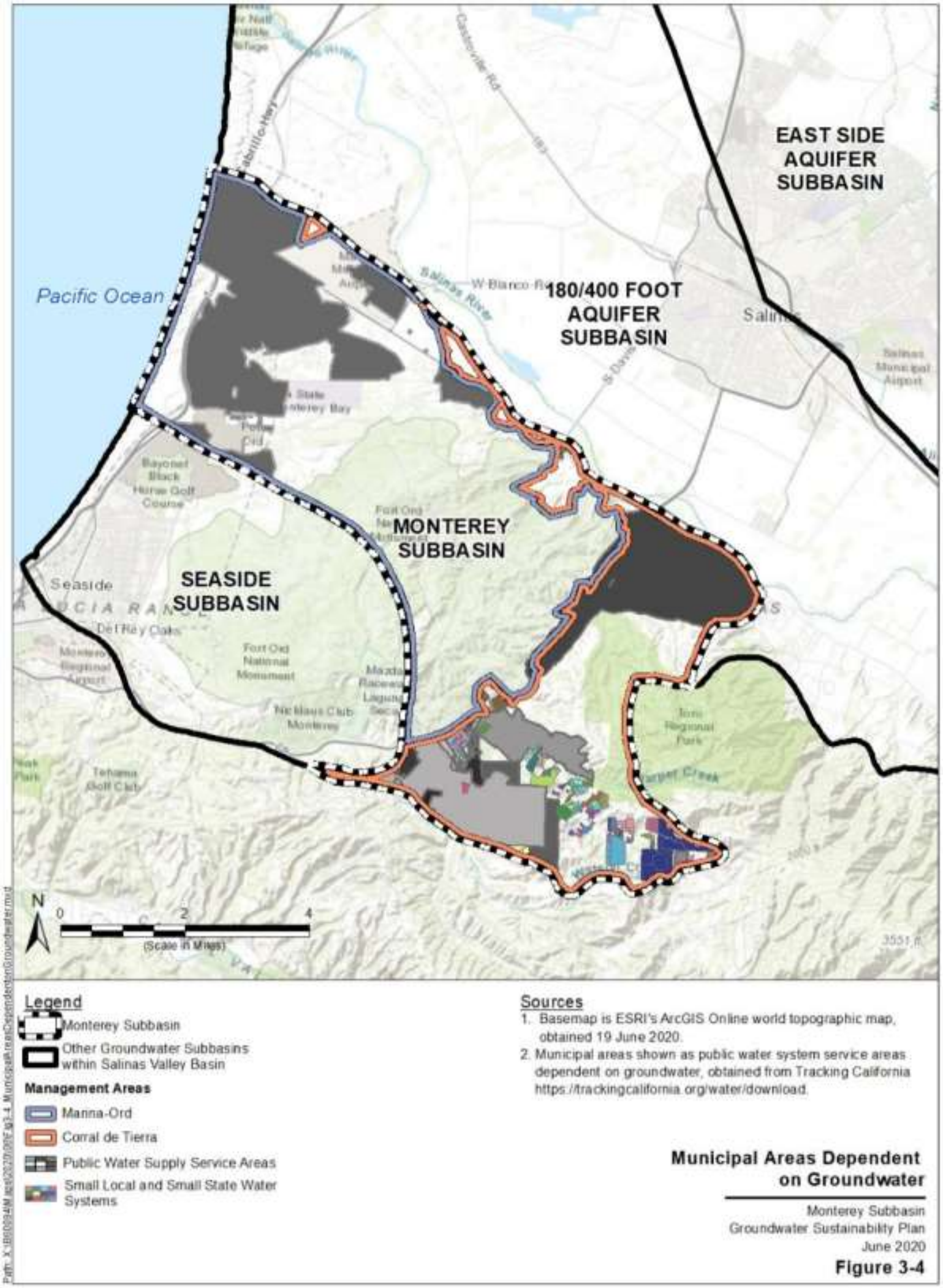
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra Area
MCWD
MPWMD
Cities
Del Rey Oaks
Marina
Monterey
Salinas
Sand City
Seaside
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. City Limits defined by Local Agency Formation Commission (LAFCO), Monterey County Geological Information System, accessed 11 July 2019.
Cities and Water District Judicational Areas
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-3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Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord
Corral de Tierra
Public Water Supply Service Areas
Small Local and Small State Water Systems
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 19 June 2020.
2. Municipal areas shown as public water system service areas dependent on groundwater, obtained from Tracking California https://trackingcalifornia.org/water/download.
Municipal Areas Dependent on Groundwater
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-4

Other agencies with water management responsibilities within the Subbasin include the Monterey County Water Resources Agency (MCWRA) and the Monterey Peninsula Water Management District (MPWMD). MCWRA governance areas includes all lands within Monterey County, which includes the subbasin. MPMWD manages groundwater and surface water in areas on the Monterey Peninsula and in the Carmel River Basin and includes the City of Seaside, which extends into the subbasin. Management programs of these agencies are further discussed in Section 3.2.

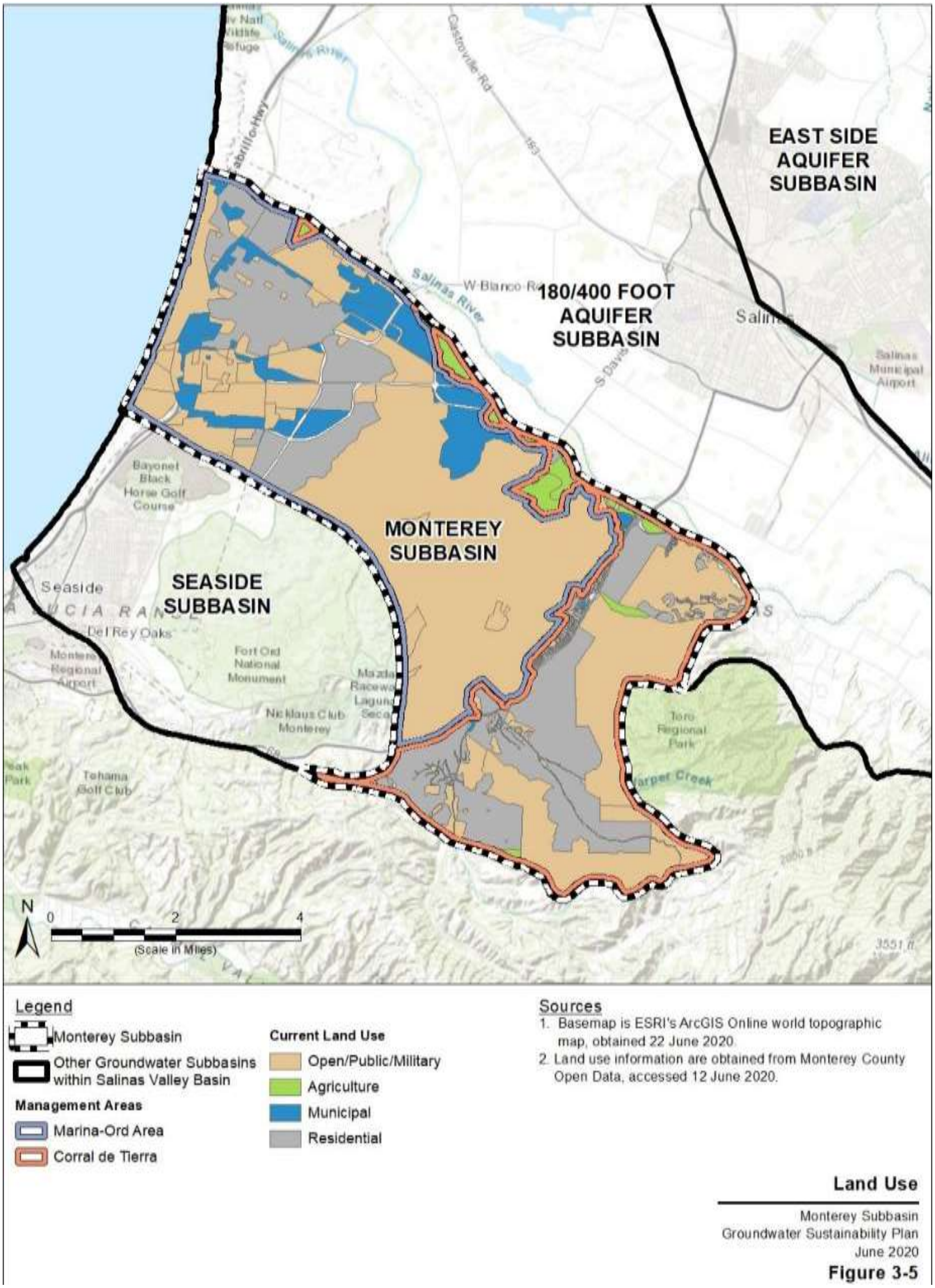
3.1.4 Adjudicated areas and Alternative areas

The Subbasin is not adjudicated and does not contain any areas covered by an Alternative plan. However, this subbasin shares a jurisdictional boundary with the Seaside Adjudicated Subbasin. This boundary is based on a presumed groundwater flow divide between the two subbasins and may be vulnerable to future pumping or impacts to the groundwater conditions in either subbasin. The adjudicated area is not managed by MCWD nor the SVBGSA.

3.1.5 Existing Land Use and Water Use

Land use planning authority in the Subbasin is the responsibility of the County of Monterey, the cities of Marina and Seaside, and the Fort Ord Reuse Authority, who oversees reuse planning at the former Fort Ord.

Figure 3-5 shows simplified land use designations within the Monterey Subbasin. The majority of the subbasin is undeveloped land. Urban is the primary developed land use within the subbasin, with approximately 5,500 acres of urban coverage. Small areas of agriculture, approximately 500 acres of truck nursery and berry crops, are located along the northern subbasin boundary adjoining the 180/400 Foot Aquifer Subbasin. Urban and agriculture water uses in the subbasin relies entirely on groundwater.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Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra
Current Land Use
Open/Public/Military
Agriculture
Municipal
Residential
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. Land use information are obtained from Monterey County Open Data, accessed 12 June 2020.
Land Use
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-5

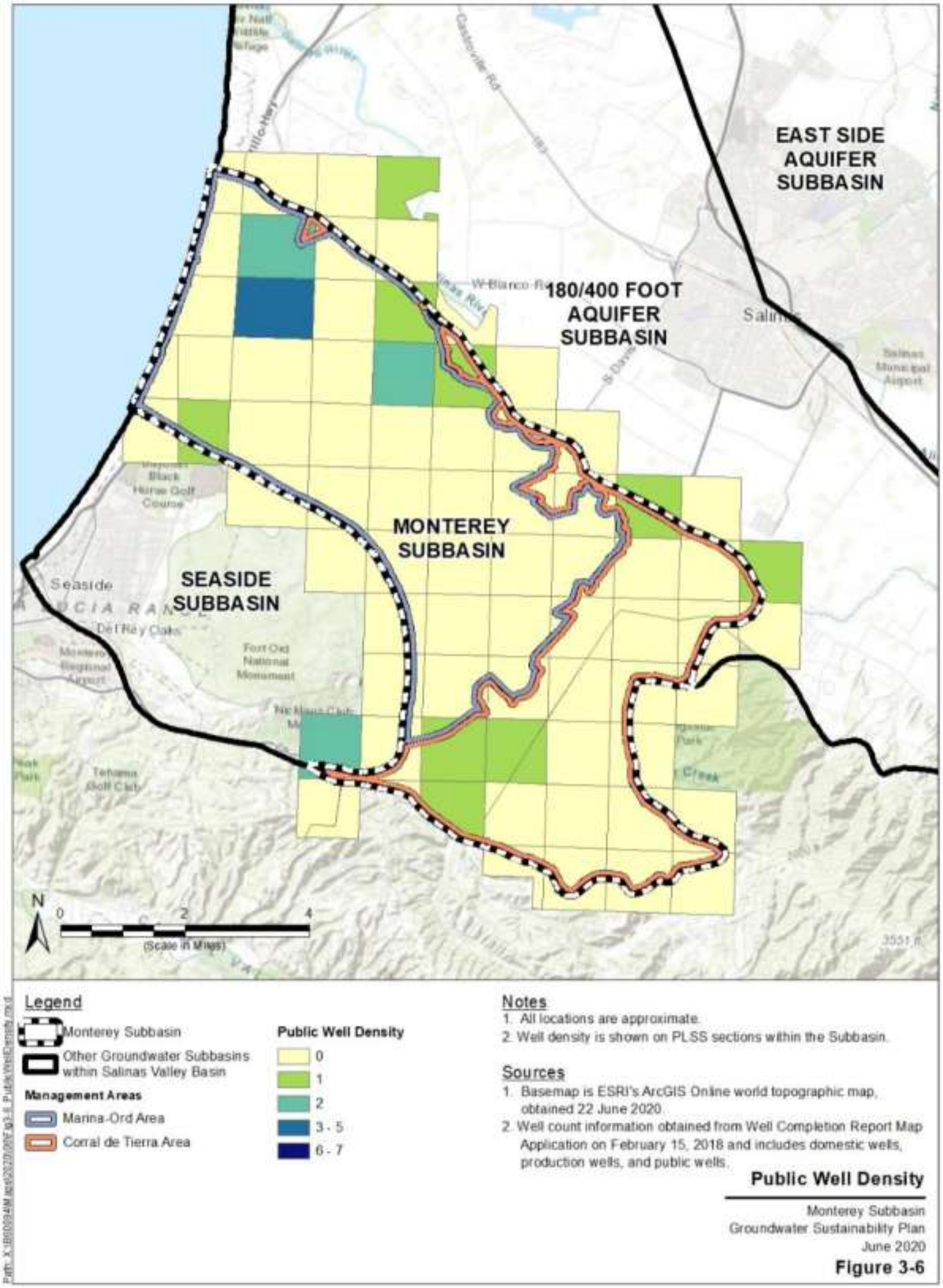
3.1.6 Well Density per Square Mile

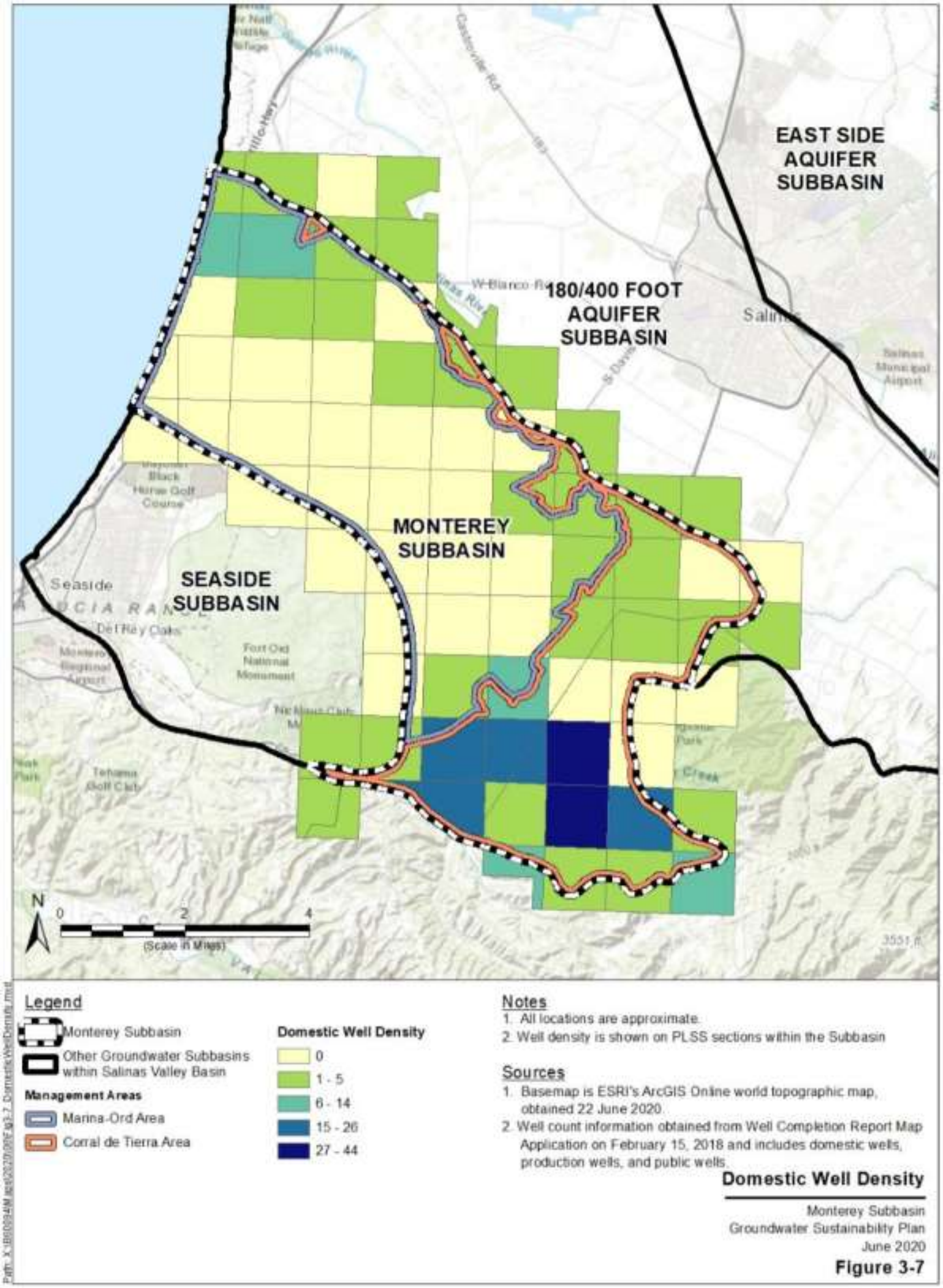
Figure 3-6 through **Figure 3-8** show the density of wells per square mile within the subbasin, based on Well Completion Report records compiled by DWR. According to these records, 102 production wells, 304 domestic wells, and 17 public supply wells have been installed within the Public Land Survey Systems (PLSS) sections that fall partially or entirely within the subbasin.

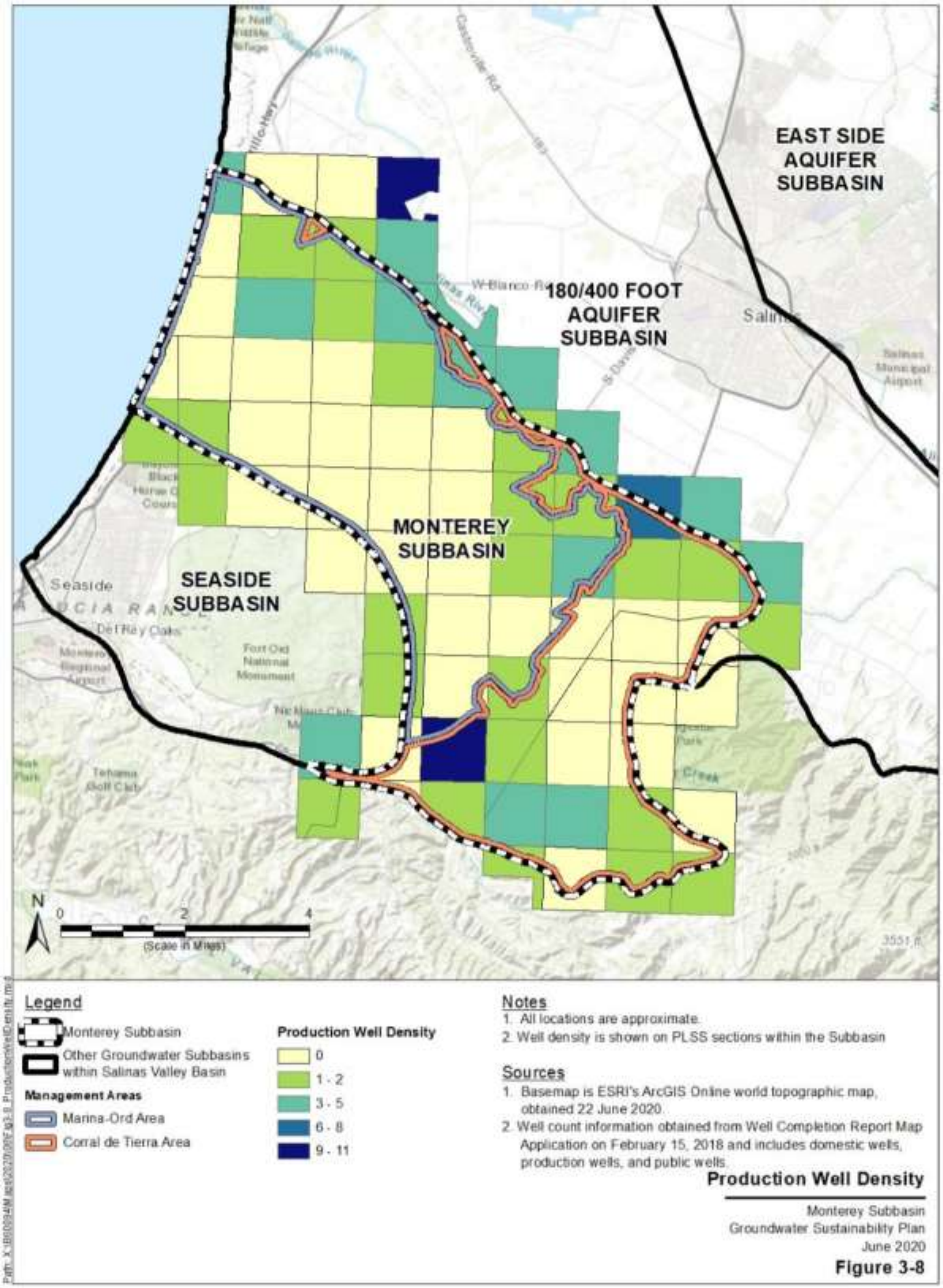
Groundwater is the primary water source for all water use sectors in the subbasin. Municipal areas dependent on groundwater within the subbasin are shown on **Figure 3-4**.

Within the Marina-Ord Area, MCWD is the exclusive water purveyor to all non-federal lands and to the Army for all Army and Federal facilities within the former Fort Ord. Due to well installation requirements of the Monterey County and the City of Marina (see Section 3.5.4), only a very small number of domestic wells that pre-date County and City ordinances exist within the Marina-Ord Area. Fort Ord contamination and seawater intrusion limits use of the majority of these wells. In turn, these communities rely on water service provided by MCWD. MCWD currently operates seven active production wells that supplies 3,200 to 4,200 acre-feet per year (AFY) to its residents.

Within the Corral de Tierra Area, there are hundreds of domestic wells and small community water system wells shown in **Figure 3-4** (GeoSyntec, 2007). The majority of these small systems are clustered in the Watson Creek and Harper Creek watersheds The most recent and best available published groundwater demand in the Corral de Tierra Area estimated a groundwater extraction rate of 1,256 AFY for the El Toro Planning area which is an area that encompasses the Calera Creek, Watson Creek, Corral de Tierra, San Benancio Gulch, and El Toro Creek watersheds. The report estimated this groundwater extraction based on reports published and data collected in the 1990s (GeoSyntec, 2007). The El Toro Planning area encompasses a large portion of the Corral de Tierra Area within the Monterey Subbasin as well as communities in the Sierra de Salinas immediately outside of the Subbasin. Therefore, the estimated volumes are not perfectly representative the current water use in the Corral de Tierra Area. Groundwater is primarily used for municipal, domestic, and agricultural purposes.


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Seaside
Del Rey Oaks
Fort Ord National Monument
Salinas
W Blanco Rd
Castroville Rd
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra Area
Public Well Density
0
1
2
3 - 5
6 - 7
Notes
1. All locations are approximate.
2. Well density is shown on PLSS sections within the Subbasin.
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. Well count information obtained from Well Completion Report Map Application on February 15, 2018 and includes domestic wells, production wells, and public wells.
Public Well Density
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-6


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Seaside
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra Area
Domestic Well Density
0
1 - 5
6 - 14
15 - 26
27 - 44
Notes
1. All locations are approximate.
2. Well density is shown on PLSS sections within the Subbasin
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. Well count information obtained from Well Completion Report Map Application on February 15, 2018 and includes domestic wells, production wells, and public wells.
Domestic Well Density
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-7


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Seaside
Del Rey Oaks
Fort Ord National Monument
W Blanco Rd
Salinas
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra Area
Production Well Density
0
1 - 2
3 - 5
6 - 8
9 - 11
Notes
1. All locations are approximate.
2. Well density is shown on PLSS sections within the Subbasin
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. Well count information obtained from Well Completion Report Map Application on February 15, 2018 and includes domestic wells, production wells, and public wells.
Production Well Density
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-8

3.2 Water Resources Monitoring and Management Programs

3.2.1 Existing Monitoring Programs

Existing groundwater monitoring in the Subbasin include:

- The California Statewide Groundwater Elevation Monitoring (CASGEM) Program tracks long-term groundwater elevation trends in groundwater basins throughout California. The CASGEM program's mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. In the Subbasin, MCWRA and MPWMD are the CASGEM monitoring entities.
- The United States Geological Survey (USGS) collects surface water and groundwater data across the United States. Existing USGS monitoring wells and stream gauges are located within the Monterey Subbasin.
- The Groundwater Ambient Monitoring and Assessment (GAMA) Program which is California's comprehensive groundwater quality monitoring program that was created by the State Water Resources Control Board (SWRCB) in 2000. The GAMA Program monitors groundwater quality trends throughout California, including within the Monterey Subbasin.
- The SWRCB's Division of Drinking Water monitors groundwater quality from public water system wells. There are 15 active public water systems located within the Subbasin.
- MCWD, MCWRA, and MPWMD each conduct periodic monitoring for groundwater elevation and quality in their production wells or selected wells in their respective areas. Additionally, MCWD has installed transducers in selected production wells.
- MCWRA collects groundwater extraction information from production wells in the Subbasin that have discharge pipes of three inches or greater in diameter. These data have been collected since 1993. Extraction information is self-reported by well owners and may be sparsely available.
- Multiple sites are monitoring groundwater quality as part of investigation or compliance monitoring programs through the Central Coast Regional Water Quality Control Board (CCRWQCB)
- The U.S. Army Corps of Engineers (the Army) conducts periodic monitoring for groundwater elevation and quality for remediation purposes in the former Fort Ord. Several additional sites are monitoring groundwater elevation and quality as part of investigation or compliance monitoring programs through the Central Coast Regional Water Quality Control Board.

Well locations of the above monitoring programs are shown on **Figure 3-9**.

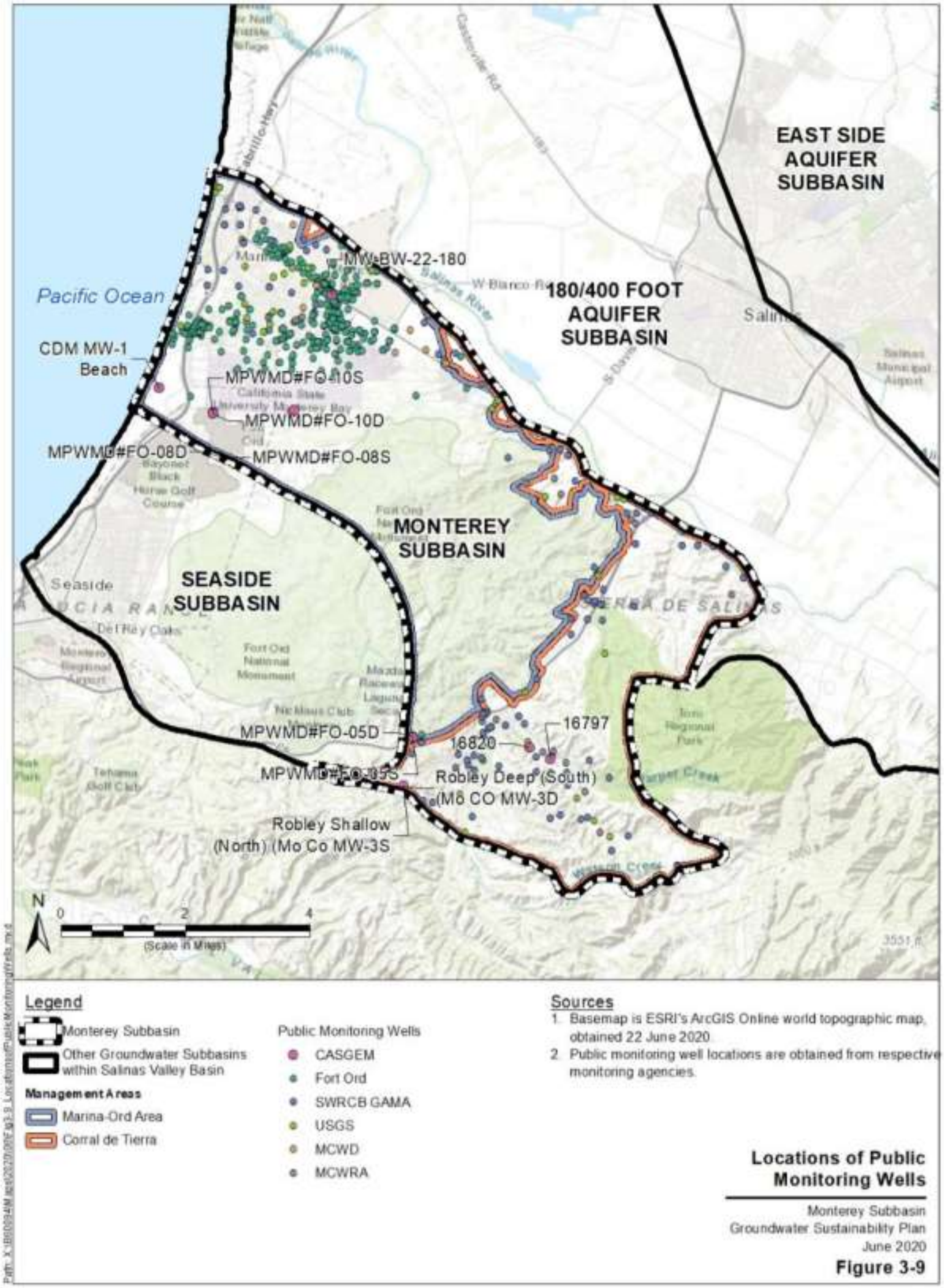
Groundwater elevation from CASGEM, USGS, SWRCB, as well as MCWRA, MPMWD, and the Army's monitoring networks, have been used to characterize groundwater level conditions (see Section 5.1 Groundwater Elevations and Flow Direction). Water quality data from MCWRA, MPMWD, and the Army's monitoring networks, in coordination the Airborne Electromagnetic (AEM) Surveys have been used to characterize seawater intrusion and identify water quality concerns (see Section 5.3 Seawater Intrusion and Section 5.4 Groundwater Quality Concerns).

For surface water, there are no surface water inflows beyond those produced from seasonal precipitation in the Subbasin (GeoSyntec, 2007). The USGS monitored stream flows for El Toro Creek at station 11152540 until 2001 (GeoSyntec, 2007). The logarithmic mean of 525 AFY is representative of average flows as shown in **Figure 4-32** and **Figure 4-33** in Section 4 (GeoSyntec, 2007). As of 2020, there are no active surface gauges in the Corral de Tierra area.

3.2.1.1 Limits to Operational Flexibility

The existing monitoring networks will be integral to the on-going monitoring and reporting that will be conducted pursuant to this GSP. For the above-mentioned monitoring programs, the Monterey Subbasin GSP will incorporate the CASGEM program into its monitoring network, as applicable. The MCWD, MCWRA (a member of SVBGSA), and MPWMD also conduct routine groundwater quality monitoring as part of their management efforts. These existing programs will continue and will inform GSP implementation. The Monterey Subbasin Monitoring Network is further described in Section 7 Monitoring Network.

Will revisit this discussion after development of the Monitoring Network chapter


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Pacific Ocean
MW-BW-22-180
CDM MW-1 Beach
MPWMD#FO-10S
MPWMD#FO-10D
MPWMD#FO-08D
MPWMD#FO-08S
MPWMD#FO-05D
MPWMD#FO-05S
16797
18820
Robley Deep (South) (Mo CO MW-3D
Robley Shallow (North) (Mo Co MW-3S
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra
Public Monitoring Wells
CASGEM
Fort Ord
SWRCB GAMA
USGS
MCWD
MCWRA
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. Public monitoring well locations are obtained from respective monitoring agencies.
Locations of Public Monitoring Wells
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-9

3.2.2 Existing Management Programs

The following groundwater management programs exists within the Monterey Subbasin.

3.2.2.1 Integrated Regional Water Management

The majority of the Monterey Subbasin falls within the Greater Monterey County Integrated Regional Water Management Region (Greater Monterey County Region), while a portion of the Subbasin along the southern boundary is within the Monterey Peninsula-Carmel Bay- South Monterey Bay Region (Monterey Peninsula Region). These portions of the Subbasin are therefore included in the Greater Monterey County Integrated Regional Water Management Plan (IWRMP) and the Monterey Peninsula Region IWRMP, respectively.

The Greater Monterey County Region includes the entire Monterey County excluding the Pajaro River Watershed Region and the Monterey Peninsula Region. The Greater Monterey County IRWMP was adopted in April 2013 and updated in September 2018. The water supply goals for the Greater Monterey County Region, according to the IRWMP (Monterey County, 2018), include the following:

- Improve water supply reliability and protect groundwater and surface water supplies;
- Protect and improve surface, groundwater, estuarine and coast water quality, and ensure the provision of high-quality, potable, affordable drinking water for all communities in the region;
- Develop, fund, and implement integrated watershed approaches to flood management through collaborative and community supported processes;
- Protect, enhance, and restore the region’s ecological resources while respecting the rights of private property owners;
- Promote regional communication, cooperation, and education regarding water resources management;
- Ensure the provision of high-quality, potable, affordable water and healthy conditions for disadvantage communities (DACs); and
- Adapt the region’s water management approach to deal with impacts of climate change using science-based approaches, and minimize the regional causal effects.

The Monterey Peninsula Region consists of approximately 350 square miles along the Monterey Bay and the Carmel River Valley. The Monterey Peninsula IRWMP was adopted in 2014 and is currently undergoing an update to comply with new IRWM Program Guidelines. Key goals and priorities for the Monterey Peninsula Region, according to the IRWMP (2014), include the following:

- Meet existing water supply replacement needs for the Carmel River system and Seaside Subbasin;
- Maximize use of recycled water and other reuse, including gray water systems, and stormwater capture and use;
- Improve ocean water quality, including Areas of Special Biological Significance (ASBS), by minimizing pollutants in stormwater discharges;

- Improve inland surface water quality for environmental resources (e.g. steelhead) and potable water supplies;
- Protect and improve water quality in groundwater basins;
- Develop regional projects and plans necessary to protect existing infrastructure and sensitive habitats from flood damage, erosion, and sea level rise, in particular, along the South Monterey Bay shoreline and Carmel Valley;
- Identify cooperative, integrate strategies for protecting both infrastructure and environmental resources, including from climate change impacts; and
- Foster collaboration among regional entities as an alternative to litigation.

IRWMP and GSP development are complimentary management processes. To the extent that the issues identified for the greater IRWMP regions affect the Subbasin, these issues will be identified in the following sections of this GSP. The implementation of this GSP will contribute to the sustainable use of water supplies within the IRWMP regions. The IRWM program is not expected to limit operational flexibility in the Subbasin.

3.2.2.2 MCWRA Management of the Salinas Valley Groundwater Basin

The MCWRA was formed in 1947 by State law, originally as the Monterey County Flood Control and Water Conservation District (MCFCWCD) and established by the Monterey County Flood Control and Water Conservation District Act (District Act). The prevention of seawater intrusion was a principal reason for the enactment of the District Act in 1947. Since then, the MCWRA has developed projects and programs to reduce the adverse impacts from pumping and seawater intrusion within the 180/400-Foot Aquifer Subbasin. As shown on **Figure 3-10**, Zones 2C, 2Y, and 2Z cover a majority of the Monterey Subbasin including most of the land north of Harper Canyon. The areas not covered by these zones include a small portion of the City of Marina, and San Benoncio Gulch and Calera Canyon along Corral de Tierra Road up to the intersection with State Route 68. A description of the zones is provided below[2]:

- Under provisions of the District Act, the MCFCWCD established the Zone 2 and Zone 2A benefit assessment zones to fund the construction of Nacimiento Reservoir and the San Antonio Reservoir, respectively. In 2003, MCWRA created 2C to fund operation and maintenance of the reservoirs and eliminate charges in Zones 2 and 2A.
- Zone 2Y was established to collect assessments for the operation and maintenance of the Castroville Seawater Intrusion Project.
- Zone 2Z was established to collect assessment for the operation and maintenance of the Salinas Valley Reclamation Project.

[2] Annexation Zone https://www.co.monterey.ca.us/home/showdocument?id=22209


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Marina
Seaside
Salinas River
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Management Areas
Marina-Ord Area
Corral de Tierra
Other Groundwater Subbasins within Salinas Valley Basin
MCWRA Zone 2C
MCWRA Zone 2Y
MCWRA Zone 2Z
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 26 June 2020.
2. MCWRA Zone 2C boundary obtained from Monterey County Open Data, accessed 10 June 2020.
MCWRA Zones
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-10

In 1990, the District Act was repealed and replaced by the existing Monterey County Water Resources Agency Act (Agency Act); however, much of the District Act was carried over into the Agency Act. The District Act and then the Agency Act have been the foundation of groundwater management within the Monterey County. Additional information on MCWRA monitoring programs and well permitting programs are provided in Sections 3.2.1 and 3.5.4, respectively.

1993 and 1996 Annexation Agreements. MCWRA established annexation zones to institute water supply projects and collect assessments to fund them under various Monterey County Ordinances (MCWRA 2019c). The two major historic groundwater users within the Subbasin, the Federal Government and the MCWD, respectively entered into annexation agreements with MCWRA in 1993 and 1996 to be annexed to Zones 2 and 2A[3]. The 1996 Annexation Agreement and Groundwater Mitigation Framework for Marina Area Lands was the fifteenth annexation to Zones 2 and 2A since 1991.[4] In the annexation agreements, the MCWRA recognized that MCWD and the Federal Government had been pumping groundwater for many years and had strong claims to groundwater rights[5] MCWD and the Federal Government agreed that all non-Federal lands within the annexed areas would pay assessments to MCWRA Zones 2 and 2A (later superseded by Zones 2C, 2Y, and 2Z) for regional projects to protect the Salinas Valley Groundwater Basin and reduce seawater intrusion. [[This GSP will identify the amount of assessments paid by Marina area and non-Federal Fort Ord lands, what those funds were used for, what benefits those lands have received from those payments, and what benefits those lands could receive in the future to help achieve groundwater sustainability within the Monterey Subbasin.]]

Under 1993 and 1996 Annexation Agreements, MCWRA recognized historical groundwater pumping rights of 3,020 AFY for MCWD to serve the City of Marina[6], and 6,600 AFY for the Federal Government to serve Fort Ord lands (MCWRA/U.S. Army, 1993; MCWRA/MCWD, 1996). In 2001, the Federal Government transferred ownership of the Fort Ord water system infrastructure and 4,871 AFY of the 6,600 AFY of groundwater under the 1993 Annexation Agreement to MCWD. MCWD is using the 4,871 AFY of groundwater to provide water service to those jurisdictions within the former Fort Ord, which are entitled to water service pursuant to the Fort Ord Base Reuse Plan (Section 3.5.1.4). Under a long-term water

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[3] The MCWRA Board of Directors adopted an Annexation Policy dated March 29, 1993, which provided for the process for lands not then included within Zones 2 and 2A to be annexed into both zones subject to the annexation process in Agency Act § 43, the preparation of final environmental documents, and the setting of annexation fees.

[4] 1996 Annexation Agreement, Section 3.1.

[5] Section 45 of the Agency Act provided MCWRA to develop a water allocation formula for groundwater users in the County "to preserve agricultural access to an adequate water supply and to preserve agriculture as a mainstay of the Salinas Valley economy". Board of Supervisors Resolution 91-476 adopted September 24, 1991, directed MCWRA staff to prepare information for a water allocation formula for Zone 2 and 2A and bring it back to the Board on or before January 1, 1992, and further directed MCWRA staff to prepare an emergency allocation ordinance for Zones 2 and 2A for consideration by the Board no later than April 1, 1992. While a draft report was prepared, the draft report was never approved by the Board.

[6] In addition, under the 1996 Annexation Agreement, 920 AFY of groundwater was allocated to Armstrong Ranch development, and 500 AFY (of brackish water) to CEMEX in the adjacent 180/400 Foot Aquifer Subbasin.

service agreement with the Army, MCWD provides water service to all Federal activities within the former Fort Ord utilizing the Army's groundwater pumping rights.

The 1993 and 1996 Annexation Agreements required MCWRA to develop a replacement potable water supply, such that most groundwater pumping within Fort Ord and Marina Area Lands could be curtailed. However, by Resolution 00-172 adopted on 25 April 2000, the County Board of Supervisors decreed that the MCWRA has no contractual obligation to fund a potable water system for Fort Ord and the Marina Area Lands. MCWD is developing new water supplies to support redevelopment of the former Fort Ord and to supplement its groundwater supplies. These efforts are incorporated in this GSP and discussed further in Section 9.1 Project Descriptions.

MCWRA Groundwater Export Prohibition. The Monterey County Water Resources Agency Act, § 52.21 prohibits the export of groundwater from any part of the Salinas Valley Groundwater Basin, including the Monterey Subbasin. In particular, the Act states:

> *For the purpose of preserving [the balance between extraction and recharge], no groundwater from that basin may be exported for any use outside the basin, except that use of water from the basin on any part of Fort Ord shall not be deemed such an export. If any export of water from the basin is attempted, the Agency may obtain from the superior court, and the court shall grant, injunctive relief prohibiting that exportation of groundwater.*

The Agency Act was adopted at a time when the Seaside Basin was considered to be hydrologically separate from the Salinas Valley Groundwater Basin, but the above Agency Act section expressly made use of Salinas Valley groundwater within any part of Fort Ord, even though within the Seaside Basin, as being exempt from the export prohibition. In 2003, DWR included the Seaside Basin within the Salinas Valley Groundwater Basin, which DWR now designates as the Seaside Subbasin.

County Moratorium on Accepting and Processing New Well Permits. On May 22, 2018, the Monterey County Board of Supervisors adopted Ordinance No. 5302 pursuant to Government Code Section 65858. The ordinance was an Interim Urgency Ordinance, which took effect immediately upon adoption. The ordinance prohibits the acceptance or processing of any applications for new wells in the defined Area of Impact within the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin, with stated exceptions including municipal wells and replacement wells. Pursuant to Section 65858, the ordinance was originally only effective for 45 days to July 5, 2018, but at the June 26, 2018 Board meeting, the Board of Supervisors on a 4-1 vote extended the ordinance to May 21, 2020, by adoption of Ordinance No. 5303. During the moratorium, the County has stated that it will conduct further studies to assess groundwater conditions in the Subbasin.

TO BE UPDATED TO REFLECT OUTCOME OF THE ORDINANCE EXTENSION

3.2.2.3 Groundwater Management Plans

MCWRA developed a Groundwater Management Plan (GMP) that is compliant with Assembly Bill 3030 and Senate Bill 1938 legislation (MCWRA, 2006). This GMP exclusively covered the Salinas Valley in

Monterey County. As discussed above, the MCWRA was established in 1947 with the responsibility to manage water resources in the Salinas Valley. Therefore prior to 2006, MCWRA has already been implementing a formal groundwater management program including surface water monitoring and groundwater monitoring. The GMP was developed to formalized and extend those ongoing management efforts in the Salinas Valley Groundwater Basin.

The GMP identified three objectives for groundwater management:

- **Objective 1**: Development of Integrated Water Supplies to Meet Existing and Projected Water Requirements. This objective encourages the integrated uses of various water sources, such as surface water, groundwater, recycled water, and possibly desalinated brackish and saline water to meet the water demand.
- **Objective 2**: Determination of Sustainable Yield and Avoidance of Overdraft. This objective is to assess groundwater basin conditions by quantifying basin yield and evaluating historical impacts including seawater intrusion and groundwater storage decline and to implement existing and new management measures to address those issues.
- **Objective 3**: Preservation of Groundwater Quality for Beneficial Use. This objective is to preserve groundwater quality by minimizing seawater intrusion and accumulations of minerals in the groundwater basin.

To meet these three objectives, the plan identified 14 elements that should be implemented by MCWRA:

- **Plan Element 1:** Monitoring of Groundwater Levels, Quality, Production, and Subsidence
- **Plan Element 2:** Monitoring of Surface Water Storage, Flow, and Quality
- **Plan Element 3:** Determination of Basin Yield and Avoidance of Overdraft
- **Plan Element 4:** Development of Regular and Dry Year Water Supply
- **Plan Element 5:** Continuation of Conjunctive Use Operations
- **Plan Element 6:** Short-Term and Long-Term Water Quality Management
- **Plan Element 7:** Continued Integration of Recycled Water
- **Plan Element 8:** Identification and Mitigation of Groundwater Contamination
- **Plan Element 9:** Identification and Management of Recharge Areas and Wellhead Protection Areas
- **Plan Element 10:** Identification of Well Construction, Abandonment, and Destruction Policies
- **Plan Element 11:** Continuation of Local, State and Federal Agency Relationships
- **Plan Element 12:** Continuation of Public Education and Water Conservation Programs
- **Plan Element 13:** Groundwater Management Reports

- **Plan Element 14:** Provisions to Update the Groundwater Management Plan

The GMP and GSP developments are complimentary management processes. To the extent that the issues identified for Monterey County affect the Monterey Subbasin, these issues will be identified in the following sections of this GSP. The implementation of this GSP will contribute to the sustainable use of water supplies within Monterey County.

3.2.2.4 Urban Water Management Plans

THIS SECTION IS CURRENTLY BASED ON 2015 UWMPS AND WILL BE REWRITTEN BEFORE FINAL DRAFT TO REFLECT 2020 UWMPS

Marina Coast Water District 2015 Urban Water Management Plan

The Marina Coast Water District was formed in 1960. Today MCWD serves municipal and industrial water uses within the City of Marina and the former Fort Ord. The MCWD most recently updated its Urban Water Management Plan (UWMP) in 2016 (MCWD, 2016). The UWMP describes the service area; reports historic and projected population; identifies historic and projected water demand by category (single-family, multi-family, commercial, industrial, institutional/government, and other); and describes the distribution system and identifies losses.

Water use during 2015 within the MCWD service area was approximately 3,200 AFY. The 2015 UWMP anticipates that projected water demand within the entire District would be 12,197 AFY by 2035, including 3,905 AFY within the City of Marina and 8,293 AFY for the existing and future developments within the Ord Community (i.e. former Fort Ord). This projected water demand by 2035 within the Ord Community is 1,693 AFY short of the 6,600 AFY groundwater supply outlined in the 1993 Annexation Agreement (MCWRA/U.S. Army, 1993; see Section 3.2.2.2)[7]. However, MCWD's recent water demand projection in its 2020 Master Plan (MCWD, 2020) projects that total buildout water demand (i.e. beyond 2035) for the entire District sums to approximately 9,300 AFY, significantly lower than that projected in the 2015 UWMP.

Additional water supplies such as recycled water will be used to meet this potential shortfall within the Ord Community. In 2021, MCWD will take delivery the first 600 AFY of advanced treated water from the Pure Water Monterey (PWM) Project out of MCWD's total 1,427 AFY PWM entitlement (see discussion of the PWM Project in Section 9.1 Project Descriptions). Post development of the 2015 UWMP, MCWD conducted a joint-study with FORA and Monterey One Water (M1W) that identified a new indirect potable reuse project to develop an additional 927 AFY identified as an additional water supply need under the Fort Ord Base Reuse Plan (EKI, 2020). The project is further described in Section 9.1.

[7] The 6,600 AFY of groundwater supply for MCWD's Ord Community service area was further allocated by FORA to each land use jurisdiction within the area. The 2015 UWMP further compared projected water demand by 2035 with groundwater supply allocation for each jurisdiction. Considering only the jurisdictions with shortfalls, the sum of jurisdictional shortfalls is anticipated to be 2,901 AFY by 2035.

MCWD is also a key potable and recycled water transmission hub owner connecting the North Marina and North Ord areas with the yet to be developed South Ord area, which includes portions of the Cities of Seaside, Del Rey Oaks, and Monterey. MCWD owns the potable water transmission pipeline, which MCWD will use to serve the South Ord area. The pipeline is currently being used by Cal Am for its Carmel River ASR Project to convey injection water and to convey recovered water to its Monterey District, but MCWD has the first priority of use as the pipeline's owner. It is anticipated that this potable pipeline will also be used to convey recovered PWM water for direct use in California American Water's Monterey District although no agreement for such use has been negotiated. MCWD also owns the new 10-mile transmission pipeline for the PWM Project, which will deliver advanced treated water to MCWD recycled water customers and to the PWM injection wells in the Seaside Subbasin.

In addition, the MCWD UWMP includes a number of demand management measures including:

- Water Waste Prevention Ordinances
- Metering
- Conservation Pricing
- Public Education and Outreach
- Programs to Assess and Manage Distribution System Real Loss
- Water Conservation Program Coordination and Staffing Support
- Water Survey Programs for Residential Customers
- Residential Plumbing Retrofits
- Residential Ultra-Low Flow Toilet Replacement Programs
- High-Efficiency Washing Machine Rebate Programs
- Commercial, Industrial, and Institutional Accounts
- Landscape Conservation Programs and Incentives

MCWD's implementation of demand management measures resulted in MCWD receiving state-wide recognition of its water conservation achievements during the last drought.

California Water Service – Salinas District 2015 Urban Water Management Plan

A portion of the California Water Service area extends into the area located along the northern portion of State Route 68 in the Corral de Tierra Area of the subbasin. Its 2015 Urban Water Management Plan (UWMP) (California Water Service, 2016) describes the service area; reports historic and projected population; identifies historical and projected water demand by category such as single-family, multi-family, commercial, industrial, institutional/government, and other; and describes the distribution system and identifies system losses.

The California Water Service UWMP also includes a number of demand management measures including:

- Water Waste Prevention Ordinances
- Metering
- Conservation Pricing
- Public Education and Outreach
- Programs to Assess and Manage Distribution System Real Loss
- Water Conservation Program Coordination and Staffing Support
- Rebates and give-aways
- Plumbing fixture replacement and Direct Installation Programs
- Irrigation equipment and landscape efficiency improvements

California Water Service's UWMP notes that groundwater will continue to remain as its sole supply due to uncertainties regarding the cost and implementation other options, such as surface water diversion or desalination. However, the UWMP recognizes that it would be beneficial for California Water Service to diversify its supply portfolio. There is currently one active production well and four inactive production wells within the Subbasin.

3.2.2.5 CCRWQCB Agricultural Order

In 2017 the Central Coast Regional Water Quality Control Board (CCRWQCB) issued Agricultural Order No. R3-2017-0002, a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (CCRWQCB, 2017). The permit requires that growers implement practices to reduce nitrate leaching into groundwater and improve receiving water quality. Specific requirements for individual growers are structured into three tiers based on the relative risk their operations pose to water quality.

Growers must enroll, pay fees, and meet various monitoring and reporting requirements according to the tier to which they are assigned. All growers are required to implement groundwater monitoring, either individually or as part of a cooperative regional monitoring program. Growers electing to implement individual monitoring and not participate in the regional monitoring program implemented by the Central Coast Groundwater Coalition (CCGC) are required to test all on-farm domestic wells and the primary irrigation supply well for nitrate or nitrate plus nitrite, and general minerals; including, but not limited to, TDS, sodium, chloride and sulfate.

Negotiations with the CCRWQCB staff and Board Members for the next iteration of the Agricultural Order are on-going, and expected to be finalized in early 2021, with the adoption of a new Irrigated Lands Regulatory Program (ILRP) Waste Discharge Requirements (WDR) for farming operations in the Salinas Valley Groundwater Basin area. As mandated by the SWRCB, specific reporting requirements for nitrogen applications and removal, irrigation and surface water discharge management, and groundwater quality monitoring will be included with quantifiable milestones. While the outcome is not certain, the expectation is that the next Agricultural Order will be more complex with additional compliance reporting measures for all growers.

3.2.2.6 Water Quality Control Plan for the Central Coast Basins

The Water Quality Control Plan for the Central Coastal Basin was most recently updated in September 2017 (SWRCB, 2017). The objective of the Basin Plan is to outline how the quality of the surface water and groundwater in the Central Coast Region should be managed to provide the highest water quality reasonably possible. Water Quality Objectives for both groundwater (drinking water and irrigation) and surface water are provided in the Basin Plan.

The Basin Plan lists beneficial users, describes the water quality which must be maintained to allow those uses, provides an implementation plan, details SWRCB and CCRWQCB plans and policies to protect water quality and a statewide surveillance and monitoring program, as well as regional surveillance and monitoring programs. The SWRCB's Sources of Drinking Water Policy, adopted in Resolution No. 88-63 and incorporated in its entirety in the CCRWQCB's Basin Plan, provides that water with TDS less than or equal to 3,000 mg/L is considered suitable or potentially suitable for drinking water beneficial uses.

Present and potential future beneficial uses for inland waters in the Basin are: surface water and groundwater as municipal supply; agricultural; groundwater recharge; recreational water; sport fishing; warm fresh water habitat; wildlife habitat; rare, threatened or endangered species; and, spawning, reproduction, and/or early development of fish.

3.2.2.7 Title 22 Drinking Water Program

The SWRCB Division of Drinking Water (DDW) regulates public water systems in the State to ensure the delivery of safe drinking water to the public. A public water system is defined as a system for the provision of water for human consumption that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Private domestic wells, wells associated with drinking water systems with less than 15 residential service connections, industrial, and irrigation wells are not regulated by the DDW.

The DDW enforces the monitoring requirements established in Title 22 of the California Code of Regulations (CCR) for public water system wells, and all the data collected must be reported to the DDW. Title 22 also designates the Maximum Contaminant Levels (MCLs) for various waterborne contaminants, including volatile organic compounds, non-volatile synthetic organic compounds, inorganic chemicals, radionuclides, disinfection byproducts, general physical constituents, and other parameters.

3.2.2.8 Limits to Operational Flexibility

This GSP has been developed to be coordinated with the requirements, management plans and monitoring programs administered by other jurisdictions in the area, including SVBGSA, MCWRA, MCWD GSA, CCRWQCB, and the Federal Government. For example:

- The IRWMP and GSP development are complimentary management processes. To the extent that the issues identified for the greater IRWMP region affect the Subbasin, these issues will be discussed in the following sections of this GSP. The implementation of this GSP will contribute to the sustainable use of water supplies within the IRWMP region and the IRWMP is not expected to limit operational flexibility in the Subbasin.
- The purpose and objective of MCWRA's groundwater management of the Subbasin, which focuses on providing regional solutions to protection of the basin and preventing seawater intrusion, aligns with the goals of this GSP. The GSP will augment and integrate with MCWRA's historical management of the subbasin.

Some of the existing management and regulatory programs include well registration, extraction monitoring, new well restrictions, pumping allowances and restrictions, recharge requirements and/or water quality protection standards that will limit operational flexibility. These limits to operational flexibility have already been incorporated into the projects and programs included in this GSP. Examples of limits on operational flexibility include:

- Pumping allowances in the MCWRA annexation agreements with MCWD and the Federal Government may restrict groundwater use. However, current groundwater use by MCWD within the City of Marina and the former Fort Ord are well below the annexation agreement pumping allowances. These agreements are not expected to adversely affect the Subbasin's ability to reach sustainability.
- The groundwater export prohibition included in the Agency Act prevents export of water out of the Subbasin. This prohibition is not expected to adversely affect the Subbasin's ability to reach sustainability.
- The Basin Plan and the Title 22 Drinking Water Program restrict the quality of water that can be recharged into the Subbasin as well as the location of groundwater recharge.
- Well construction restrictions within the Former Fort Ord (see Section 3.5.4.2) as well as the County's Interim Urgency Ordinance, which imposes a temporary moratorium on wells in the Area of Impact (see Section 3.5.4.3), may limit certain activities and the Subbasin GSAs' ability to access certain sources of water. However, the moratorium is not expected to adversely affect the Subbasin's ability to reach sustainability.

3.3 Conjunctive Use Programs

There is no existing conjunctive use program within the Monterey Subbasin. The Pure Water Monterey Project is an advance water recycling project with a conjunctive use component under by development MPWMD, M1W, and MCWD. The project is discussed in Section 9.1 Project Descriptions.

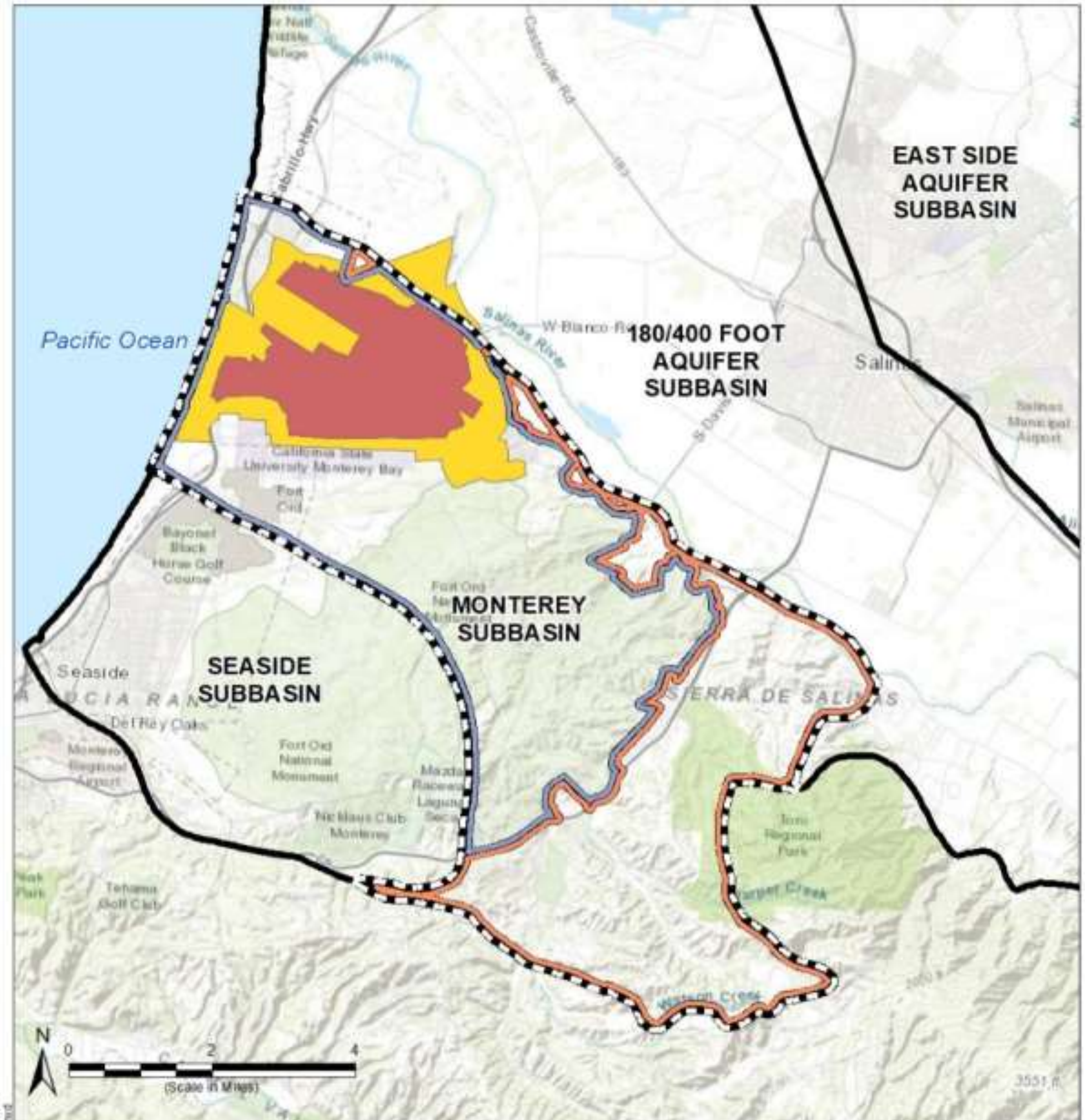
3.4 Groundwater Cleanup at the Former Fort Ord

The former Fort Ord military base consists of 27,827 acres across the Monterey, 180/400 Foot Aquifer, and Seaside Subbasins. Within the Monterey Subbasin, the former Fort Ord encompasses more than one half of the Subbasin's area. The Fort Ord military base was established in 1917 by the U.S. Army as a maneuver area and field artillery target range. The base was officially closed in 1994.

Remedial investigation and cleanup action at Fort Ord lead by the Army began in 1986. The cleanup activities at Fort Ord has included groundwater and soil remediation associated with industrial and waste disposal activities, and later included munitions cleanup. The site was added to the National Priorities List on 21 February 1990. The Army was designed as the lead agency and the U.S. Environmental Protection Agency (EPA) was designated as the lead regulatory agency for the Superfund process at Fort Ord. A Federal Facility Agreement was signed by the Army, U.S. EPA, the California Department of Toxic Substances Control, and the CCRWQCB in 1990.

As of 2020, groundwater remediation is ongoing at three sites: Operable Unit (OU) 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume (OUCTP), for volatile organic compound (VOC) constituents of concern.

Activity and use limitations are in place at the such as zoning restrictions, deed or access restrictions, and well installation restrictions. County Ordinance No. 04011 of 2005 was adopted to prohibit and/or regulate new water wells in areas within the former Fort Ord due to groundwater contamination constraints. Well construction is prohibited in areas overlying or adjacent to the contamination plumes in the former Fort Ord (i.e. Prohibition Zone) and is subject to special review in areas that may be impacted by the contamination plumes (i.e. Consultation Zone). The Prohibition and Consultation Zones were last updated in 2016 and are shown on **Figure 3-11**.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

- Marina-Ord
- Corral de Tierra

Fort Ord Special Groundwater Protection Zones

- Prohibition Zone
- Consultation Zone

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 19 June 2020.
2. U.S. Department of the Army, 2017. Final 4th Five-Year Review Report for Fort Ord Superfund Site, Monterey County, California, prepared by the Fort Ord Base Realignment and Closure Office, dated September 2017.

Notes

1. All locations are approximate.
2. Monterey County Ordinance No. 04001 (Monterey County Code Title 15, Chapter 15.08.140) prohibits and/or regulates contruction of new water wells within the Fort Ord groundwater protection zones shown herein, which overlay or are adjacent to the contamination plumes on the former Fort Ord. Current groundwater protection zone are obtained from Source 2.

Fort Ord Special Groundwater Protection (Contamination) Zones

Monterey Subbasin
Groundwater Sustainability Plan
June 2020

Figure 3-11

3.5 Land Use Elements or Topic Categories of Applicable General Plans

Monterey County and the cities of Marina and Seaside have land use authority over all or portions of the Monterey Subbasin. Additionally, the Fort Ord Reuse Authority oversees reuse of the former Fort Ord army base within the subbasin. Land use is an important factor in water management as described below. The following sections provide a general description of these land use plans and how implementation may affect groundwater in the Monterey Subbasin. The following descriptions were taken from publicly available general plans at the time of the GSP preparation.

3.5.1 General Plans and Other Land Use Plans

This section identifies relevant policies in the current General Plans that could: (1) affect water demands in the Monterey Subbasin (e.g., due to population growth and development of the built environment), (2) influence the GSP's ability to achieve sustainable groundwater use, and (3) affect implementation of General Plan land use policies.

3.5.1.1 Monterey County General Plan

Relevant elements of the Monterey County General Plan (Monterey County 2010) are summarized in **Table 3-1**.

Table 3-1. Monterey County General Plan Summary

Element	Goal / Policy	
Land Use	LU-1.4	Growth areas shall be designated only where an adequate level of services and facilities such as water, sewerage, fire and police protection, transportation, and schools exist or can be assured concurrent with growth and development. Phasing of development shall be required as necessary in growth areas in order to provide a basis for long-range services and facilities planning.
Open Space	OS-3.8	The County shall cooperate with appropriate regional, state and federal agencies to provide public education/outreach and technical assistance programs on erosion and sediment control, efficient water use, water conservation and re-use, and groundwater management. This cooperative effort shall be centered through the Monterey County Water Resources Agency.

Element	Goal / Policy	
et. seq. **Public Services**	GOAL PS-2	Assure an adequate and safe water supply to meet the county's current and long-term needs.
	PS-2.1	Coordination among, and consolidation with, those public water service providers drawing from a common water table to prevent overdrawing the water table is encouraged.
	PS-2.2	The County of Monterey shall assure adequate monitoring of wells in those areas experiencing rapid growth provided adequate funding mechanisms for monitoring are established in the CIFP.
	PS-2.3	New development shall be required to connect to existing water service providers where feasible. Connection to public utilities is preferable to other providers.
	PS-2.4	Regulations for installing any new domestic well located in consolidated materials (e.g., hard rock areas) shall be enacted by the County.
	PS-2.5	Regulations shall be developed for water quality testing for new individual domestic wells on a single lot of record to identify: a) Water quality testing parameters for a one-time required water quality test for individual wells at the time of well construction. b) A process that allows the required one-time water quality test results to be available to future owners of the well. Regulations pursuant to this policy shall not establish criteria that will prevent the use of the well in the development of the property. Agricultural wells shall be exempt from the regulation.
	GOAL PS-3	Ensure that new development is assured a long-term sustainable water supply.
	PS-3.1	Except as specifically set forth below, new development for which a discretionary permit is required, and that will use or require the use of water, shall be prohibited without proof, based on specific findings and supported by evidence, that there is a long-term, sustainable water supply, both in quality and quantity to serve the development [see Plan for list].
	PS-3.2	Specific criteria for proof of a Long-Term Sustainable Water Supply and an Adequate Water Supply System for new development requiring a discretionary permit, including but not limited to residential or commercial subdivisions, shall be developed by ordinance with the advice of the General Manager of the Water Resources Agency and the Director of the Environmental Health Bureau. A determination of a Long-Term Sustainable Water Supply shall be made upon the advice of the General Manager of the Water Resources Agency. The following factors shall be used in

Element	Goal / Policy	
		developing the criteria for proof of a long-term sustainable water supply and an adequate water supply system: [see Plan for list]
	PS-3.3	Specific criteria shall be developed by ordinance for use in the evaluation and approval of adequacy of all domestic wells. The following factors shall be used in developing criteria for both water quality and quantity including, but not limited to: [see Plan for list]
	PS-3.4	The County shall request an assessment of impacts on adjacent wells and instream flows for new high-capacity wells, including high-capacity urban and agricultural production wells, where there may be a potential to affect existing adjacent domestic or water system wells adversely or in-stream flows, as determined by the Monterey County Water Resources Agency. In the case of new high-capacity wells for which an assessment shows the potential for significant adverse well interference, the County shall require that the proposed well site be relocated or otherwise mitigated to avoid significant interference. The following factors shall be used in developing criteria by ordinance for use in the evaluation and approval of adequacy of all such high-capacity wells, including but not limited to: a) Effect on wells in the immediate vicinity as required by the Monterey County Water Resources Agency or Environmental Health Bureau. b) Effects of additional extractions or diversion of water on in-stream flows necessary to support riparian vegetation, wetlands, fish, and other aquatic life including migration potential for steelhead, for the purpose of minimizing impacts to those resources and species. This policy is not intended to apply to replacement wells.
	PS-3.5	The Monterey County Health Department shall not allow construction of any new wells in known areas of saltwater intrusion as identified by Monterey County Water Resources Agency or other applicable water management agencies: a) Until such time as a program has been approved and funded that will minimize or avoid expansion of salt water intrusion into useable groundwater supplies in that area; or b) Unless approved by the applicable water resource agency. This policy shall not apply to deepening or replacement of existing wells, or wells used in conjunction with a desalination project.
	PS-3.6	The County shall coordinate and collaborate with all agencies responsible for the management of existing and new water resources.

Element	Goal / Policy	
	PS-3.7	A program to eliminate overdraft of water basins shall be developed as part of the Capital Improvement and Financing Plan (CIFP) for this Plan using a variety of strategies, which may include but are not limited to: a) Water banking; b) Groundwater and aquifer recharge and recovery; c) Desalination; d) Pipelines to new supplies; and/or e) A variety of conjunctive use techniques. The CIFP shall be reviewed every five years in order to evaluate the effectiveness of meeting the strategies noted in this policy. Areas identified to be at or near overdraft shall be a high priority for funding.
	PS-3.8	Developments that use gray water and cisterns for multi-family residential and commercial landscaping shall be encouraged, subject to a discretionary permit.
	PS-3.9	A tentative subdivision map and/or vesting tentative subdivision map application for either a standard or minor subdivision shall not be approved until the applicant provides evidence of a long-term sustainable water supply in terms of yield and quality for all lots that are to be created through subdivision.
	PS-3.10	In order to maximize agricultural water conservation measures to improve water use efficiency and reduce overall water demand, the County shall establish an ordinance identifying conservation measures that reduce agricultural water demand.
	PS-3.11	In order to maximize urban water conservation measures to improve water use efficiency and reduce overall water demand, the County shall establish an ordinance identifying conservation measures that reduce potable water demand
	PS-3.12	The County shall maximize the use of recycled water as a potable water offset to manage water demands and meet regulatory requirements for wastewater discharge, by employing strategies including, but not limited to, the following: a) Increase the use of treated water where the quality of recycled water is maintained, meets all applicable regulatory standards, is appropriate for the intended use, and re-use will not significantly impact beneficial uses of other water resources. b) Work with the agricultural community to develop new uses for tertiary recycled water and increase the use of tertiary recycled water for irrigation of lands currently being irrigated by groundwater pumping. c) Work with urban water providers to emphasize use of tertiary recycled water for irrigation of parks, playfields, schools, golf courses, and other landscape areas to reduce potable water demand.

Element	Goal / Policy	
		d) d. Work with urban water providers to convert existing potable water customers to tertiary recycled water as infrastructure and water supply become available.
	PS-3.13	To ensure accuracy and consistency in the evaluation of water supply availability, the Monterey County Health Department, in coordination with the MCWRA, shall develop guidelines and procedures for conducting water supply assessments and determining water availability. Adequate availability and provision of water supply, treatment, and conveyance facilities shall be assured to the satisfaction of the County prior to approval of final subdivision maps or any changes in the General Plan Land Use or Zoning designations.
	PS-3.14	The County will participate in regional coalitions for the purpose of identifying and supporting a variety of new water supply projects, water management programs, and multiple agency agreements that will provide additional domestic water supplies for the Monterey Peninsula and Seaside basin, while continuing to protect the Salinas and Pajaro River groundwater basins from saltwater intrusion. The County will also participate in regional groups including representatives of the Pajaro Valley Water Management Agency and the County of Santa Cruz to identify and support a variety of new water supply, water management and multiple agency agreement that will provide additional domestic water supplies for the Pajaro Groundwater Basin. The County's general objective, while recognizing that timeframes will be dependent on the dynamics of each of the regional groups, will be to complete the cooperative planning of these water supply alternatives within five years of the adoption of the General Plan and to implement the selected alternatives within five years after that time.
	PS-3.15	The County will pursue expansion of the Salinas Valley Water Project (SVWP) by investigating expansion of the capacity for the Salinas River water storage and distribution system. This shall also include, but not be limited to, investigations of expanded conjunctive use, use of recycled water for groundwater recharge and seawater intrusion barrier, and changes in operations of the reservoirs. The County's overall objective is to have an expansion planned and in service by the date that the extractions from the Salinas Valley groundwater basin are predicted to reach the levels estimated for 2030 in the EIR for the Salinas Valley Water Project. The County shall review these extraction data trends at five-year intervals. The County shall also assess the degree to which the Salinas Valley Groundwater Basin (Zone 2C) has responded with respect to water supply and the reversal of seawater intrusion based upon the modeling protocol utilized in the Salinas Valley Water Project EIR. If the examination indicates that the growth in extractions predicted for 2030 are likely to be attained within ten years of the date of the review, or the groundwater basin has not responded with respect to water supply and reversal of seawater intrusion as predicted by the model, then the County shall convene and coordinate a working group made up of the Salinas Valley cities, the MCWRA, and other affected entities. The purpose will be to identify new

Element	Goal / Policy	
		water supply projects, water management programs, and multiple agency agreements that will provide additional domestic water supplies for the Salinas Valley. These may include, but not be limited to, expanded conjunctive use programs, further improvements to the upriver reservoirs, additional pipelines to provide more efficient distribution, and expanded use of recycled water to reinforce the hydraulic barrier against seawater intrusion. The county's objective will be to complete the cooperative planning of these water supply alternatives within five years and to have the projects on-line five years following identification of water supply alternatives.

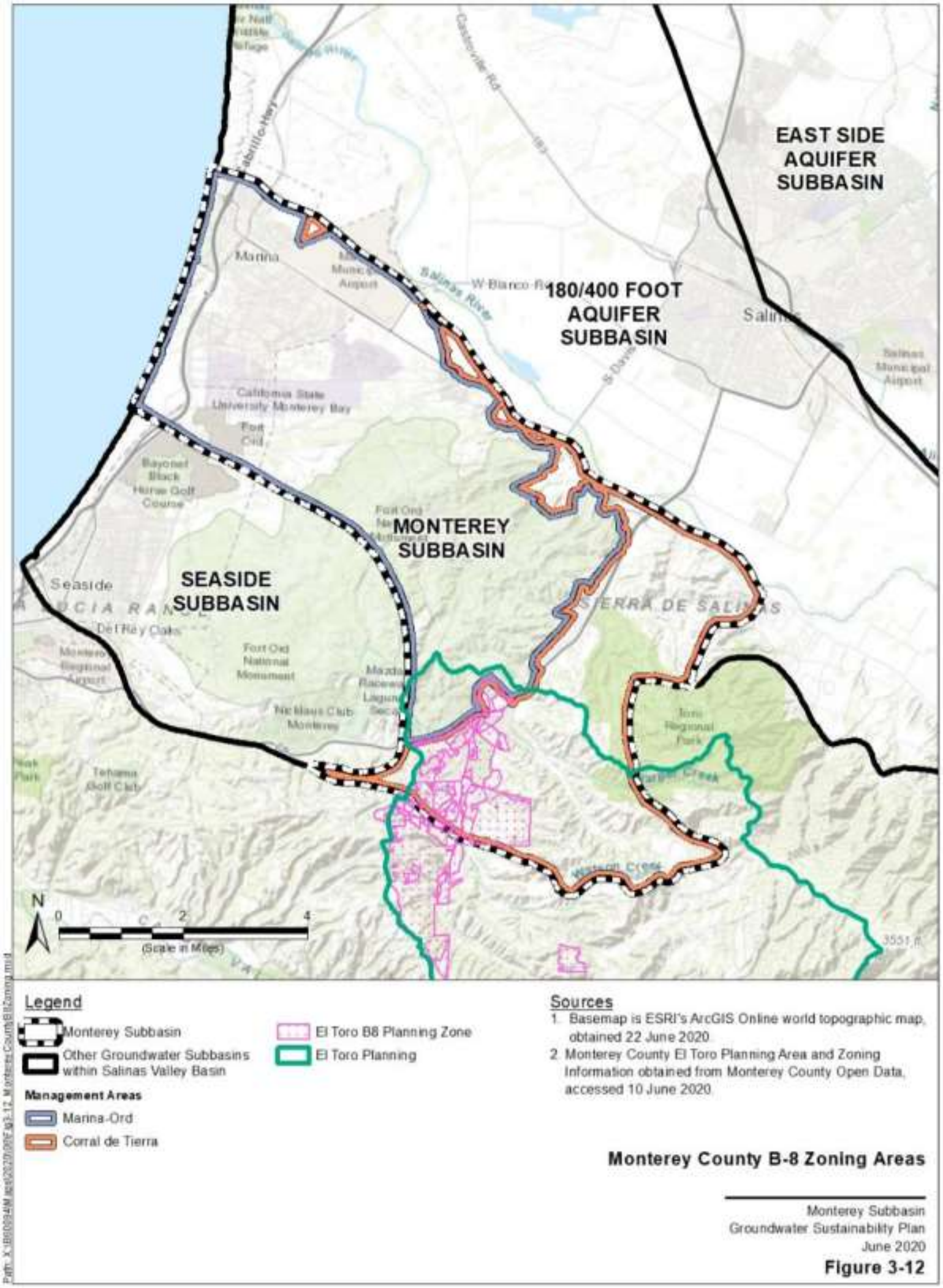
The Monterey County General Plan does not include population projections; however, the Association of Monterey Bay Area Governments (AMBAG) has developed population projections through 2050, as shown in **Table 3-3.**

The County imposed a B-8 Zoning overlay in 1992 to the western portions of the El Toro Planning area due to declining groundwater elevations and the concern for build-out demand negatively impacting future supplies. This overlay is shown in **Figure 3-12**. This zoning limits any development to single-family homes on lots that existed before 1991. This zoning overlay only covers a small portion of the Corral de Tierra Management area.

***Table 3-3**. Monterey County Population Projections (AMBAG, 2018)*

Geography	2015	2020	2025	2030	2035	2040	Change 2015-2040 Numeric	Change 2015-2040 Percent
AMBAG Region	**762,676**	**791,600**	**816,900**	**840,100**	**862,200**	**883,300**	**120,624**	**16%**
Monterey County	**432,637**	**448,211**	**462,678**	**476,588**	**489,451**	**501,751**	**69,114**	**16%**
Carmel-By-The-Sea	3,824	3,833	3,843	3,857	3,869	3,876	52	1%
Del Rey Oaks	1,655	1,949	2,268	2,591	2,835	2,987	1,332	80%
Gonzales	8,411	8,827	10,592	13,006	15,942	18,756	10,345	123%
Greenfield	16,947	18,192	19,425	20,424	21,362	22,327	5,380	32%
King City	14,008	14,957	15,574	15,806	15,959	16,063	2,055	15%
Marina	20,496	23,470	26,188	28,515	29,554	30,510	10,014	49%
Marina balance	19,476	20,957	22,205	22,957	23,621	24,202	4,726	24%
CSUMB (portion)	1,020	2,513	3,983	5,558	5,933	6,308	5,288	518%
Monterey	28,576	28,726	29,328	29,881	30,460	30,976	2,400	8%
Monterey balance	24,572	24,722	25,324	25,877	26,456	26,972	2,400	10%
DLI & Naval Postgrad	4,004	4,004	4,004	4,004	4,004	4,004	0	0%
Pacific Grove	15,251	15,349	15,468	15,598	15,808	16,138	887	6%
Salinas	159,486	166,303	170,824	175,442	180,072	184,599	25,113	16%
Sand City	376	544	710	891	1,190	1,494	1,118	297%
Seaside	34,185	34,301	35,242	36,285	37,056	37,802	3,617	11%
Seaside balance	26,799	27,003	27,264	27,632	28,078	28,529	1,730	6%
Fort Ord (portion)	4,450	4,290	4,340	4,490	4,690	4,860	410	9%
CSUMB (portion)	2,936	3,008	3,638	4,163	4,288	4,413	1,477	86%
Soledad	24,809	26,399	27,534	28,285	29,021	29,805	4,996	20%
Soledad balance	16,510	18,100	19,235	19,986	20,722	21,506	4,996	30%
SVSP & CTF	8,299	8,299	8,299	8,299	8,299	8,299	0	0%
Balance Of County	104,613	105,361	105,682	106,007	106,323	106,418	1,805	2%
San Benito County	**56,445**	**62,242**	**66,522**	**69,274**	**72,064**	**74,668**	**18,223**	**32%**
Hollister	36,291	39,862	41,685	43,247	44,747	46,222	9,931	27%
San Juan Bautista	1,846	2,020	2,092	2,148	2,201	2,251	405	22%
Balance Of County	18,308	20,360	22,745	23,879	25,116	26,195	7,887	43%
Santa Cruz County	**273,594**	**281,147**	**287,700**	**294,238**	**300,685**	**306,881**	**33,287**	**12%**
Capitola	10,087	10,194	10,312	10,451	10,622	10,809	722	7%
Santa Cruz	63,830	68,381	72,091	75,571	79,027	82,266	18,436	29%
Santa Cruz balance	46,554	49,331	51,091	52,571	54,027	55,266	8,712	19%
UCSC	17,276	19,050	21,000	23,000	25,000	27,000	9,724	56%
Scotts Valley	12,073	12,145	12,214	12,282	12,348	12,418	345	3%
Watsonville	52,562	53,536	55,187	56,829	58,332	59,743	7,181	14%
Balance Of County	135,042	136,891	137,896	139,105	140,356	141,645	6,603	5%

Sources: Data for 2015 are from the U.S. Census Bureau and California Department of Finance. Forecast years were prepared by AMBAG and PRB.


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Marina
Salinas River
W Blanco Rd
Salinas
California State University Monterey Bay
Fort Ord
Bayonet Black Horse Golf Course
Seaside
Del Rey Oaks
Fort Ord National Monument
Nicklaus Club Monterey
Toro Regional Park
Watson Creek
SIERRA DE SALINAS
N
0
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(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord
Corral de Tierra
El Toro B8 Planning Zone
El Toro Planning
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 22 June 2020.
2. Monterey County El Toro Planning Area and Zoning Information obtained from Monterey County Open Data, accessed 10 June 2020.
Monterey County B-8 Zoning Areas
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-12

3.5.1.2 City of Marina General Plan

The City of Marina was founded in 1915 and incorporated in 1975. The first General Plan was adopted in 1978. The overall goal of the Marina General Plan is "the creation of a community which provides a high quality of life for all its residents; which offers a broad range of housing, transportation, and recreation choices; and which conserves irreplaceable natural resources" (City of Marina, 2010).

The General Plan recognizes that future water demands will require changes in the management of water resources in the area. Water conservation, reclamation, and reuse will constitute major components of future water management efforts. The policies and programs of the General Plan are designed to promote water conservation, the use of recycled water to protect water quality, and to ensure that the demand of future community development does not exceed the capacity to provide water in an environmentally acceptable way [3.42].

The General Plan includes the following measures related to water-supply planning:

- New developments must have identified water sources [3.45].
- A 15% reserve will be maintained between demand and supply. When demand exceeds 85% of the available supply, no new development will be allowed until supplemental water sources are identified [3.47].

The primary responsibility for water resource management in Marina rests with MCWD as the water purveyor, and MCWRA as the entity responsible for managing the surface water and groundwater resources of the Salinas Valley Groundwater Basin.

3.5.1.3 City of Seaside General Plan

The City of Seaside is in the process of updating its general plan to a planning horizon of 2040. The plan "seeks to protect the coastal system and preserve the natural habitat that extends beyond the City's boundaries in balance with Seaside's desire to be developed as a well-rounded mixed use community. Equity, sustainability, collaboration, and innovation are centrally embedded in the General Plan goals, policies, and actions to achieve a mixed use urbanscape." (Seaside, 2019)

The primary responsibility for water resource management in the City of Seaside within the Monterey Subbasin rests with MCWD, as the water purveyor, and MCWRA, which is as the entity responsible for managing the surface water and groundwater resources of the Salinas Valley Groundwater Basin. The plan acknowledges an inadequate supply of water on the Monterey Peninsula as a constraint for new developments and establishes programs to work with MCWD to develop water conservation methods and secure water supply for both existing and proposed uses within the city.

The Seaside General Plan includes the following goals, policies, and implementation measures that are related to groundwater or land use management, and that could potentially influence the implementation of this GSP.

- **Goal HSC-8**: Buildings and landscapes that promote water conservation, efficiency, and the increased use of recycled water.
- **Goal HSC-11**: New construction that meets a high-level of environmental performance.
- **Goal CFI-2:** A sustainable water supply that supports existing community needs and long-term growth.
- **Goal CFI-3:** Clean and sustainable groundwater.

3.5.1.4 Fort Ord Base Reuse Plan

The former Fort Ord, which cover more than one half of the Subbasin's area, is currently under redevelopment. Redevelopment of the former Fort Ord was under oversight of the Fort Ord Reuse Authority (FORA), established in 1994 and recently terminated in June 2020. Prior to its termination, FORA allocated assets/liabilities and transitioned land use planning within former Fort Ord to each of the local jurisdictions, including the Cities of Marina and Seaside, the City of Monterey, and the County of Monterey. The governing document of Fort Ord's redevelopment, the Fort Ord Base Reuse Plan was incorporated into each individual jurisdictional area's land use plans, which are then incorporated into MCWD's UWMP as described in Section 3.2.2.4.

The Fort Ord Base Reuse Plan, Final Reassessment Report (EMC, 2012) projected a total water demand of 9,000 AFY at buildout. This projected water demand is an additional 2,400 AFY over and above the 6,600 AFY groundwater supply described under the 1993 Annexation Agreement (MCWRA/U.S. Army, 1993; see Section 3.2.2.2). Development of the 2,400 AFY of additional water supply was identified as one of the mitigation measures for redevelopment of the former Fort Ord. As described in Section 3.4 above, within the former Fort Ord, MCWD has been designated as the exclusive (1) water and sewer collection service provider and (2) developer and implementer of all new water supplies for all non-Federal lands. Under an exclusive contract with the Army, MCWD is responsible for providing water and sewer collection services for the Army and other Federal agencies within the former Fort Ord. Water demand projections associated with implementation of the Fort Ord Base Reuse Plan are included in MCWD's UWMP (Section 3.2.2.4).

The following efforts have been conducted by FORA and MCWD to support implementation of the Fort Ord Base Reuse Plan:

In 2005, the FORA and MCWD Boards of Directors both approved the Regional Urban Water Augmentation Project (RUWAP) Hybrid Alternative, which included recycled water and desalination supply components providing 1,200 AFY each. FORA and MCWD then agreed upon a modified RUWAP Hybrid Alternative that would provide 1,427 AFY of recycled water to the former Fort Ord (via the M1W Pure Water Monterey Project described in Section 9.1). The FORA Board Resolution No. 07-10 (May 2007) allocated the 1,427 AFY of RUWAP recycled water to the various land use jurisdictions (EMC, 2012).

In 2015, the FORA Board of Directors endorsed a joint water supply planning process between FORA, M1W, and MCWD to identify the "Additional Water Augmentation Component." In 2016, MCWD, M1W, and FORA entered into an agreement to fund an analysis to identify alternatives to supply the additional 973 AFY of Water Augmentation (i.e., the total of 2,400 AFY required by the EIR subtracted by 1,427 AFY to be provided by the RUWAP). The Three Parties (FORA, MCWD, and M1W) recognize there may be a number of options to meet the 973 AFY "Additional Water Augmentation Component," and through this Water Supply Augmentation Study, aim to systematically identify and evaluate the potential supply augmentation alternatives, and select a preferred option. The three-party Water Supply Augmentation Study began in 2018 and was completed in June 2020. Water supply options being evaluated include brackish water and seawater desalination, increased water conservation measures, additional ATW, and indirect potable reuse/groundwater recharge and replenishment (IPR). IPR was selected by the study as the water supply alternative and is discussed further in Section 9.1 Project Descriptions.

3.5.1.5 California Coastal Act and Local Coastal Programs

The Subbasin consists of approximately three miles of Monterey Bay coastline that are within the California Coastal Zone.

The California Coastal Act requires that local governments in the Coastal Zone create and implement Local Coastal Programs (LCPs) to conserve coastal dependent land use. The Cities of Marina and Seaside have approved LCPs for Coastal Zones within their respective incorporated limits. The LCPs each consists of a Local Coastal Land Use Plan (LCLUP) and a Local Coastal Implementation Plan (LCIP) (City of Marina 2013a, 2013b; City of Seaside 2013a, 2013b). Additionally, a portion of the Subbasin's Coastal Zone consists of the Fort Ord Dunes State Park managed by the California Department of Parks and Recreation which islocated west of Highway 1 and south of the City of Marina.

This GSP has been developed to be coordinated with the goals, policies, and requirements administered by the Marina and Seaside LCLUPs as well as the California Coastal Commission. Policies in the local LCLUPs related to habitat management have been incorporated into the sustainable management criteria included in this GSP. Requirements to obtain and comply with coastal development permits have been incorporated into the projects and management actions included in this GSP.

3.5.2 Effects of Land Use Plan Implementation on Water Demand

The general plans detailed above guide future growth and development within their jurisdictional areas. This additional growth, particularly with redevelopment of the former Fort Ord, may place additional demands on groundwater resources within the Subbasin. However, the goals, policies, and implementation measures established by the existing land use plans are complementary to sustainable groundwater management of the Subbasin relative to future land use development and conservation. For example:

- The Monterey County General Plan encourages the growth areas to be designated only where adequate level of services and facilities such as water exists or can be ensured concurrent with growth and development. The plan initiates a program to eliminate overdraft of water basins as part pf the Capital Improvement and Financing Plan (CIFP). The program includes various strategies such as water banking, groundwater and aquifer recharge as well as looking for new water sources such as expansion of the Salinas Valley Water Project (SVWP). The Monterey County General Plan aligns with the GSP.

- The City of Marina General Plan prohibits any new development that requires water allocation in excess of the available supply or in excess of its designated water allocation for that portion of former Fort Ord within the City. The plan encourages the City works closely with MCWD to supply water to the current infrastructures prior to or concurrent with new developments while the existing or new developments should utilize water more efficiently.
- The City of Seaside plans to remove water supply constraints for development and redevelopment of the City by working with regional water suppliers. The plan also encourages coordination with regional and local water suppliers and participations in water conservation programs.
- The Fort Ord Reuse Plan relies on the nearby cities, such as City of Seaside and City of Marina, and Monterey County to manage the former Ford Ord area. Implementation of former Fort Ord's redevelopment will be pursuant to these local jurisdictions' land use plans and policies.

3.5.3 Effects of GSP Implementation on Water Supply Assumptions

Successful implementation of this GSP will help to ensure that the subbasin groundwater supply is sustainably managed as set forth by SGMA. Therefore, implementation of this GSP is not anticipated to significantly affect the current water supply assumptions or land use plans.

Within the Marina-Ord Area, implementation of this GSP may induce management and project costs to be funded by MCWD to secure water supply for future development within the former Fort Ord, which will be supported by fees levied on such new developments for new water supplies. Within the Corral de Tierra Area, the water charges framework will promote voluntary pumping reductions and impose a tiered pumping fee structure. Therefore, implementation of this GSP may induce changes in the cost of groundwater, and as a result, changes in land use changes based on financial decisions by individual development within this area. However, there is no direct impact from the GSP implementation on land use management.

3.5.4 Well Permitting Process

The Monterey County Well Program[8] is responsible for well permitting within the subbasin, including the construction, destruction, and repairs or modifications of domestic, irrigation, agricultural, cathodic protection, monitoring or heat exchange wells.

[8] https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/wells

The Public Service element of the Monterey County General Plan addresses permitting of individual wells in rural or suburban areas. New residential or commercial lots in rural or suburban areas with limited utility services must be a minimum area of 2.5 acres if a well is the water source. Existing lots (of any size) can use an on-site well if they are outside of a water system service area. Existing lots within an established water system service area can use wells if they are greater than 2.5 acres or have a connection to a public sewage system. **Table 3-4** summarizes the Monterey County General Plan's water supply guidelines for new lots (Monterey County, 2010, Table PS-1). **Table 3-5** depicts the decision matrix from the Monterey County General Plan for permitting new wells for existing lots (Monterey County, 2010, Table 3-2).

Table 3-4. Monterey County Water Supply Guidelines for New Lots

Major Land Groups	Water Well Guidelines
Public Lands	Individual Wells Permitted in Areas with Proven Long-Term Water Supply
Agriculture Lands	Individual Wells Permitted in Areas with Proven Long-Term Water Supply
Rural Lands	Individual Wells Permitted in Areas with Proven Long-Term Water Supply
Rural Centers	Public System; Individual Wells Allowed in limited situations
Community Areas	Public System

Table 3-5. Monterey County Well Permitting Guidelines for Existing Lots

Characteristics of Property	Water Connection Existing or Available from the Water System	Not Within a Water System or a Water Connection Unavailable
Greater than or equal to 2.5 Acres connected to a Public Sewage System or an on-site wastewater treatment system	Process Water Well Permit	Process Water Well Permit
Less than 2.5 Acres and connected to a Public Sewage System	Process Water Well Permit	Process Water Well Permit
Less than 2.5 Acres and connected to an on-site wastewater treatment system	Do not Process Water Well Permit	Process Water Well Permit

On August 29, 2018, the State Third Appellate District Court of Appeal published an opinion in *Environmental Law Foundation v. State Water Resources Control Board* (No. C083239), a case that has the potential to impact future permitting of wells near navigable surface waters to which they may be hydrologically connected. The Court of Appeal found that while groundwater itself is not protected by the public trust doctrine, the doctrine does protect navigable waters from harm caused by extraction of groundwater if it adversely affects public trust uses. Further, it found that the County (Siskiyou County in this case), as a subdivision of the State, shares responsibility for administering the public trust. Monterey County is responsible for well permitting. Therefore, it has a responsibility to consider the potential impacts of groundwater withdrawals on public trust resources when permitting wells near areas where groundwater may be interconnected with navigable surface waters.

Additional prohibitions and restrictions on well drilling within the Monterey Subbasin area described below.

3.5.4.1 Marina Coast Water District Ordinance No. 31

MCWD Ordinance No. 31 (codified as Chapter 3.32 of the MCWD Code and Ordinances) prohibits water wells to be constructed or reconstructed within the boundary of MCWD, except wells constructed by the District. Exceptions apply to shallow wells that are less than one-hundred feet deep for non-potable purposes and wells that predate the ordinance.

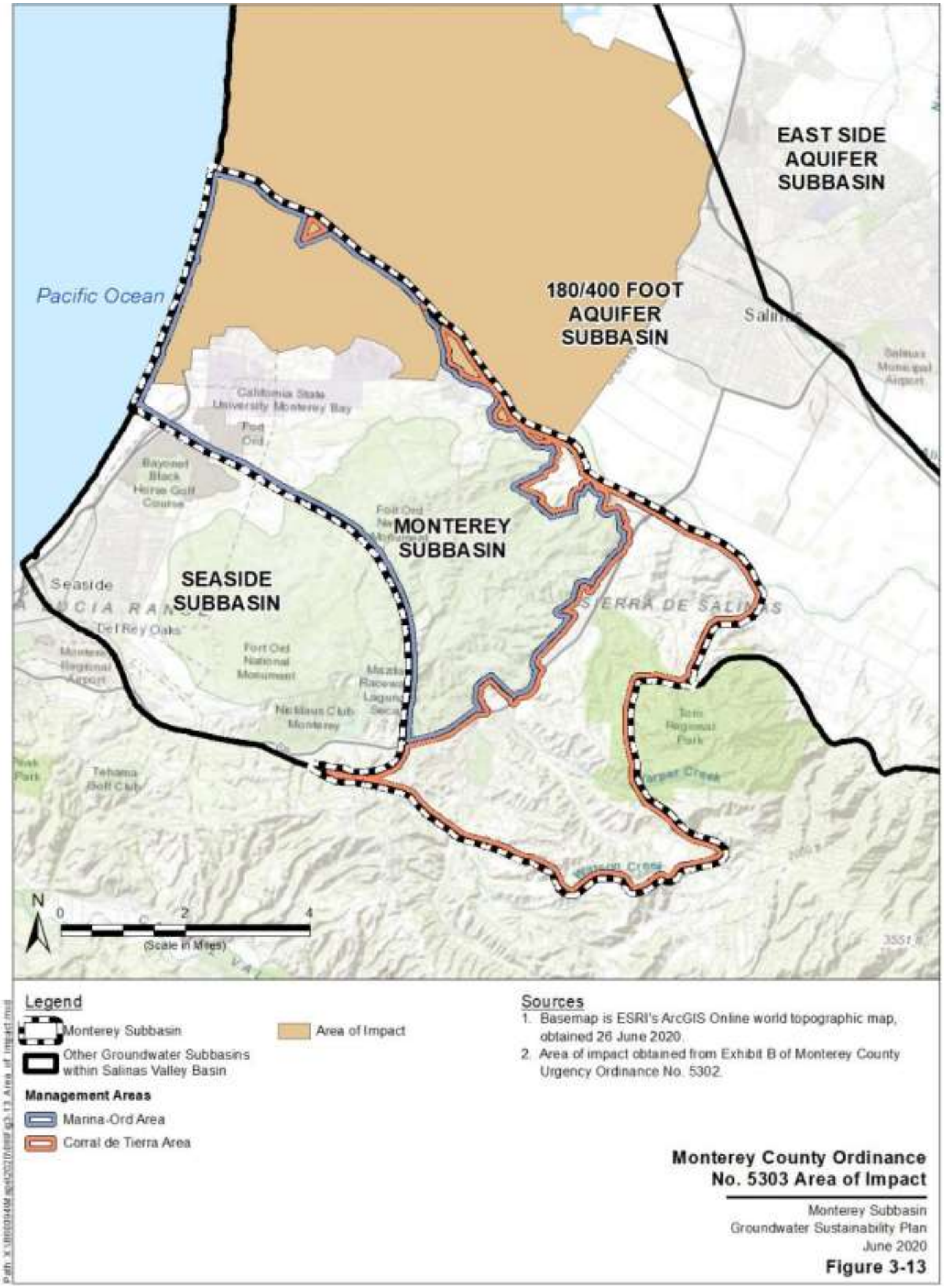
3.5.4.2 Well Construction Restrictions within the Former Fort Ord

County Ordinance No. 04011 of 2005 was adopted to prohibit and/or regulate new water wells in areas within the former Fort Ord due to groundwater contamination constraints. Well construction is prohibited in areas overlying or adjacent to the contamination plumes in the former Fort Ord (i.e. Prohibition Zone) and is subject to special review in areas that may be impacted by the contamination plumes (i.e. Consultation Zone). The Prohibition Zone and Consultation Zone within the former Fort Ord is shown on **Figure 3-11** above**.**

3.5.4.3 Interim Moratorium on New Well Permits within Area of Impact

On May 22, 2018, the Monterey County Board of Supervisors adopted Ordinance No. 5302 pursuant to Government Code Section 65858. The interim ordinance was an urgency measure to prohibit approval of wells in a defined, seawater intruded "Area of Impact" and in the Deep Aquifers of the Salinas Valley Groundwater Basin in the unincorporated area of Monterey County, due to the immediate threat to the public health, safety, and welfare posed by new wells in these areas. The ordinance imposed a moratorium on the County Health Department accepting and processing new well permits; it was not a moratorium on additional groundwater pumping from existing wells. It also had stated exceptions, including municipal wells and replacement wells. The ordinance was an Interim Urgency Ordinance which took effect immediately upon adoption. Pursuant to Section 65858, the ordinance was originally only effective for 45 days to July 5, 2018, but at the June 26 Board meeting, the Board of Supervisors on a 4-1 vote extended the ordinance to May 21, 2020, by adoption of Ordinance No. 5303.The "Area of Impact" overlaps with the northern third of the Subbasin, as shown on **Figure 3-13**. The County has indicated that it will conduct studies during the moratorium.

TO BE UPDATED TO REFLECT OUTCOME OF THE ORDINANCE EXTENSION


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
Pacific Ocean
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Seaside
Salinas
California State University Monterey Bay
SIERRA DE SALINAS
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Area of Impact
Management Areas
Marina-Ord Area
Corral de Tierra Area
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 26 June 2020.
2. Area of impact obtained from Exhibit B of Monterey County Urgency Ordinance No. 5302.
Monterey County Ordinance No. 5303 Area of Impact
Monterey Subbasin
Groundwater Sustainability Plan
June 2020
Figure 3-13

3.6 Additional GSP Elements

This section will be completed at a later stage of GSP development to address any component of the list below that was not addressed elsewhere in the GSP. If addressed in the GSP, a reference to where it is addressed will be provided.

(a) Control of saline water intrusion

(b) Wellhead protection

(c) Migration of contaminated groundwater

(d) Well abandonment and well destruction program

(e) Replenishment of groundwater extractions

(f) Conjunctive use and underground storage

(g) Well construction policies

(h) Groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects

(i) Efficient water management practices

(j) Relationships with State and federal regulatory agencies

(k) Land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity

(l) *Impacts on Groundwater Dependent Ecosystems*

4 HYDROGEOLOGIC CONCEPTUAL MODEL

This section presents the hydrogeologic conceptual model (HCM) for the Subbasin. As described in the Hydrogeological Conceptual Model Best Management Practices (BMP) document (DWR, 2016), an HCM provides, through descriptive and graphical means, and understanding of the physical characteristics of an area that affect the occurrence and movement of groundwater, including geology, hydrology, land use, aquifers and aquitards, and water quality. This HCM serves as a foundation for subsequent Basin Setting analysis including water budgets (Section 6),numerical models, monitoring network development (Section 7), and the development of sustainable management criteria (Section 8).

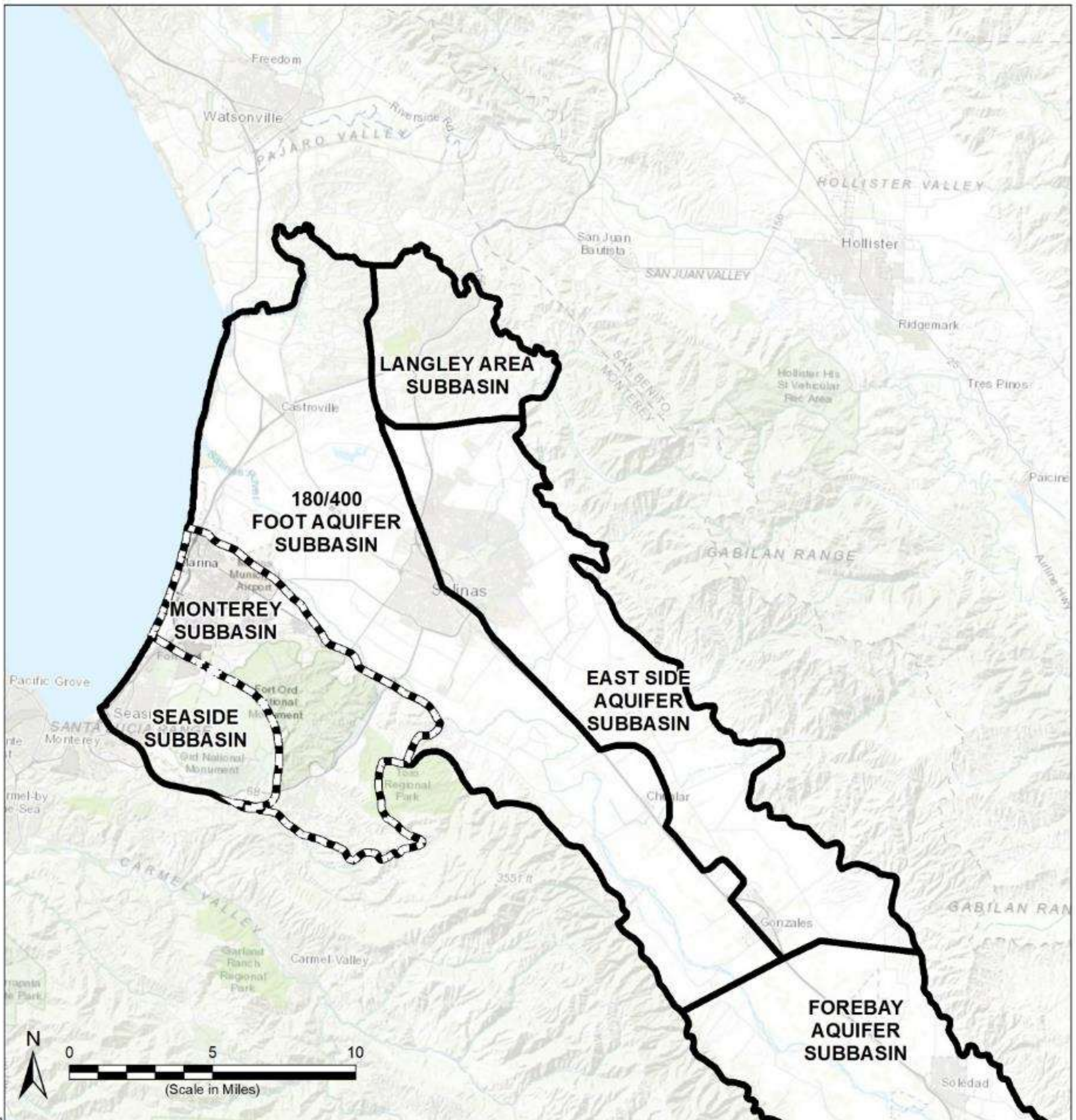
4.1 General Description

The Monterey Subbasin (Subbasin; DWR Basin No. 3-004.10) is located at the northwestern end of the Salinas Valley Groundwater Basin, an approximately 90-mile long alluvial basin underlying the elongated, intermountain valley of the Salinas River. The Subbasin includes the portions of the Monterey Bay coastal plain, south of the approximate location of the Reliz Fault, as well as upland areas to the southeast of the coastal plain. The Subbasin is bordered by the 180/400-Foot Aquifer Subbasin to the northeast and by the adjudicated Seaside Subbasin to the southwest (**Figure 4-1** and **Figure 4-2**).

4.1.1 Geological and Structural Setting

The Subbasin geology forms the physical framework in which groundwater occurs and moves. The geology described here is based on previously published scientific reports from investigations conducted by the USGS, State of California, other consulting firms, and academic institutions.

The Salinas Valley was formed through periods of structural deformation and periods of marine and terrestrial sedimentation in a tectonically active area on the eastern edge of the Pacific Plate. The water bearing sediments of the Salinas Valley are over 2,000 feet thick in places and are composed of unconsolidated marine and alluvial sediments of Pliocene and younger age (Brown & Caldwell, 2015). Within the Monterey Subbasin, the water-bearing strata include river and sand dune deposits of Holocene and Pleistocene age, the Aromas Sand and Paso Robles Formation of Plio-Pleistocene age, the Purisima Formation of Pliocene age, and the Santa Margarita Formation of Miocene age (Greene, 1970; Harding ESE, 2001; Geosyntec, 2007). The Monterey Formation of Miocene age represents the relatively non-water-bearing bedrock that underlies the Subbasin (see Section 4.1.2.2, Bottom of the Basin).



Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin

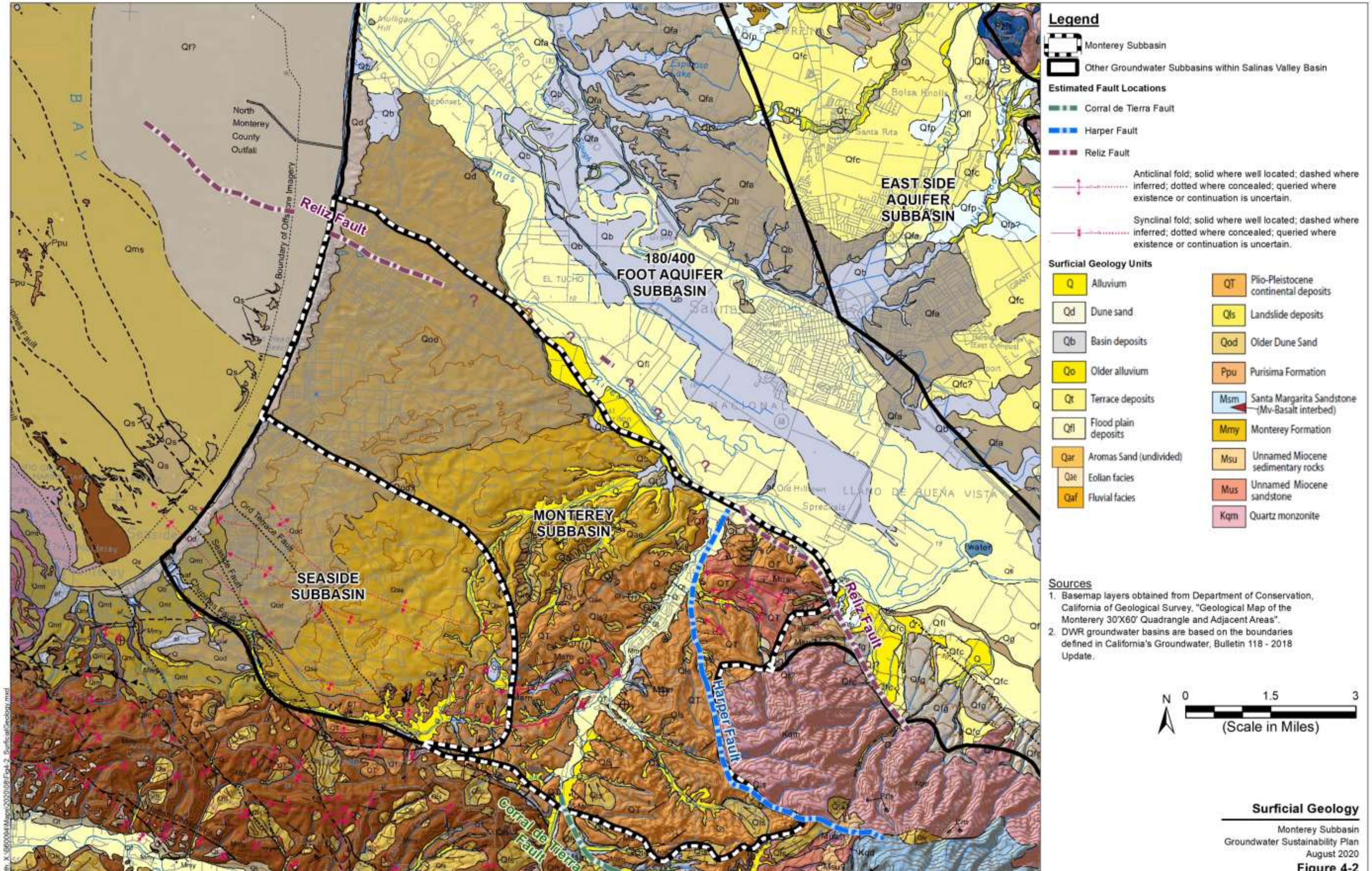
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 25 June 2020.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Path: X:\B60094\Maps\2020\06\Fig4-1_SalinasValleySubbasins.mxd

Salinas Valley Subbasins

Monterey Subbasin
Groundwater Sustainability Plan
June 2020

Figure 4-1



Surficial Geology

Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-2

4.1.1.1 Geologic Formations

Major geologic units of the Monterey Subbasin are described below, starting at the ground surface and moving downwards through the strata from youngest to oldest. The corresponding designation on **Figure 4-2** Surficial Geology are provided in parenthesis.

- *Alluvium, Flood Plain Deposits, Landslide Deposits (Q, Qfl, Qls)* – Holocene Alluvium consists of unconsolidated stream and basin deposits occur at the base of eastern Subbasin hillslopes. These deposits have gradational contacts the Floodpain Deposits (Qfl) that occur along El Toro Creek and its tributaries. The Floodpain Deposits consist predominately of unconsolidated layers of mixed sand, gravel, silt, and clay that were deposited in a fluvial environment by the Salinas River and its tributaries. Numerous landslides are present in upland portions of the subbasin such as San Benancio, Harper, and Corral de Tierra Canyons.
- *Older Dune Sand (Qod)* – This Pleistocene unit blankets most of the northwestern portions of the Subbasin and is the predominant surface deposit present in approximately one third of the Subbasin. This unit only exists southwest of the Salinas River and is up to 250 feet thick. This sand is predominately fine- to medium-grained, with thin, gentle to moderate cross-bedding (Harding ESE, 2001).
- *Older Alluvium (Qo)* – This Pleistocene unit comprises alternating, interconnected beds of fine-grained and coarse-grained deposits, predominately associated with alluvial fan depositional environments. The Older Alluvium underlies coastal Marina-Ord Area but is not exposed at the ground surface. This unit underlies the Older Dune Sand, and in the Marina-Ord Area has been referred to in some reports as Valley Fill Deposits, which is described as including an estuarine clay layer (Salinas Valley Aquitard) and an underlying sand and gravel fluvial sequence (Harding ESE, 2001).
- *Aromas Sand (Qae)* – This Pleistocene unit is composed of cross-bedded sands containing some clayey layers (Harding ESE, 2001). This unit was deposited in predominately in a eolian, high-energy alluvial, alluvial fan, and shoreline environments, with the predominant deposition environment being eolian (Harding ESE, 2001; Greene, 1970; Dupre, 1990). The Aromas Sand likely extends into the northern portion of the 180/400 Foot Aquifer Subbasin (MCWRA, 2017b). The Aromas Sand is exposed throughout the ridge and hilltops in the southeastern portion of the Subbasin, while the unit is buried beneath Older Dune Sand and Alluvium in the vicinity of the City of Marina. Thickness of the Aromas Sand varies within the Subbasin and is up to 300 feet thick (Harding ESE, 2001; Muir, 1982). Although a clayey or hard red bed is often observed at the basal contact with the underlying Paso Robles Formation, the stratigraphic relationship between the Aromas Sand and the Paso Robles Formation is difficult to discern due to lithologic similarities and the complex interface between them (Harding ESE, 2001; Dupre, 1990)

- *Paso Robles Formation (QT)* – This Pliocene to lower Pleistocene unit is composed of lenticular beds of sand, gravel, silt, and clay from terrestrial deposition (Thorup, 1976; Durbin *et al*, 1978). The depositional environment is largely fluvial but also includes alluvial fan, lake and floodplain deposition (Durbin, 1974; Harding ESE, 2001; Thorup, 1976; Greene, 1970). The individual beds of fine and coarse materials typically have thicknesses of 20 to 60 feet (Durbin *et al*, 1978). Durham (1974) reports that the thickness of the Paso Robles Formation is variable due to erosion of the upper part of the unit. Varying thicknesses ranging from 500 feet to 1,000 feet are found within the Subbasin. Outcrops of the Paso Robles Formation occur in the central and southern portions of the Subbasin.
- *Purisima Formation (Ppu)* – This Pliocene unit consists of interbedded siltstone, sandstone, conglomerate, clay and shale deposited in a shallow marine environment (Greene, 1977; Harding ESE, 2001). The Purisima Formation has been found in boreholes near the cities of Marina and Seaside; however, the unit is missing from the more inland portions of the Monterey and Seaside Subbasins (Harding ESE, 2001; HydroMetrics, 2009; Geosyntec, 200766). The Purisima Formation ranges in thickness from 500 to 1,000 feet (WRIME, 2003).
- *Santa Margarita Sandstone (Msm)* –The Miocene Santa Margarita Sandstone is a friable, arkosic sandstone. In the northern portion of the Subbasin, the Paso Robles Formation conformably overlays the Purisima Formation, which interfingers with the Santa Margarita Sandstone (Durbin, 2007; Hydrometrics, 2009). Towards the boundaries with the Seaside Subbasin and the Corral de Tierra Area, the Paso Robles unconformably overlays over the Santa Margarita Sandstone. Outcrops of the Santa Margarita Sandstone is found in the Corral de Tierra Area.
- *Monterey Formation (Mmy)* – The Monterey Formation (Miocene) is a shale or mudstone deposited in a shallow marine environment (Harding ESE, 2001; Greene, 1977). As discussed below, the Monterey Formation is relatively impervious. The top of the Monterey Formation is defined as the bottom of the Subbasin (Section 4.1.2.2).
- *Unnamed Miocene Sandstone (Mus)* – An unnamed Miocene sandstone unit (Mus) underlies the Monterey Formation. The Mus unit consists of an upper part of marine arkosic sandstone and conglomerate; and a lower part of continental sandstone and conglomerate (Wagner, et al. 2002). This unit is exposed in the Corral de Tierra Area near the eastern and southern Subbasin boundaries.
- *Unnamed Miocene Sedimentary Rocks (Msu)* – Miocene metamorphic sedimentary rocks (Msu) are deposited on granitic rocks of the Galiban Range (Kqm). The Msu unit is comprised of granitic conglomerate and arkosic sandstone of marine and non-marine sources (Wagner, et al. 2002). This unit is exposed in the Corral de Tierra Area near the eastern Subbasin boundary. These unnamed Miocene units (i.e. Mus and Msu) are approximately 250 feet thick (Geosyntec, 2007).

4.1.1.2 Surface Geology

As shown on **Figure 4-2**, the predominant surficial geologic unit covering the coastal plain portion of the Subbasin is "Qod" (i.e., Older Dune Sand [Pleistocene]). South of the coastal plain area, the Eolian facies of Aroma Sand “Qae” (Pleistocene) comprises the hills of the Fort Ord area. Further south near Highway 68 and in the Corral de Tierra area, the predominant surficial geologic unit is “QT” (Paso Robles Formation [Plio-Pleistocene]). Other minor units in the area include "Q” (Alluvium [Holocene]), and “Qls” (Landslide Deposits [Pleisto-Holocene]), found in thin strips along the intermittent tributaries to El Toro Creek, which is a tributary to the Salinas River (as discussed above); and "Qls" (landslide deposits) that exist in pockets in the upland areas.

4.1.2 Subbasin Extent

4.1.2.1 Lateral Basin Boundaries

The Monterey Subbasin is bounded by the following combination of Subbasin boundaries and physical boundaries of the Salinas Valley Basin:

Two subbasins are adjacent to the Monterey Subbasin.

1. The 180/400-Foot Aquifer Subbasin. The northeastern boundary with the 180/400-Foot Aquifer Subbasin is divided into two parts: the northern part coincides with a buried trace of the Reliz Fault (DWR, 2016); the southern part follows the contact between Aromas Sand / Paso Robles Formations (Qae/QT) and alluvium (Q). The Reliz Fault does not appear to be a barrier to groundwater flow between these subbasins (see Section 4.2.1.3).
2. The Seaside Subbasin. The southwestern boundary with the Seaside Subbasin is based on an inferred groundwater divide. The boundary with the Seaside Subbasin was formally established in the Seaside Basin Adjudication Amended Decision (Superior Court of California, 2007).

Two additional physical features bound the Monterey Subbasin.

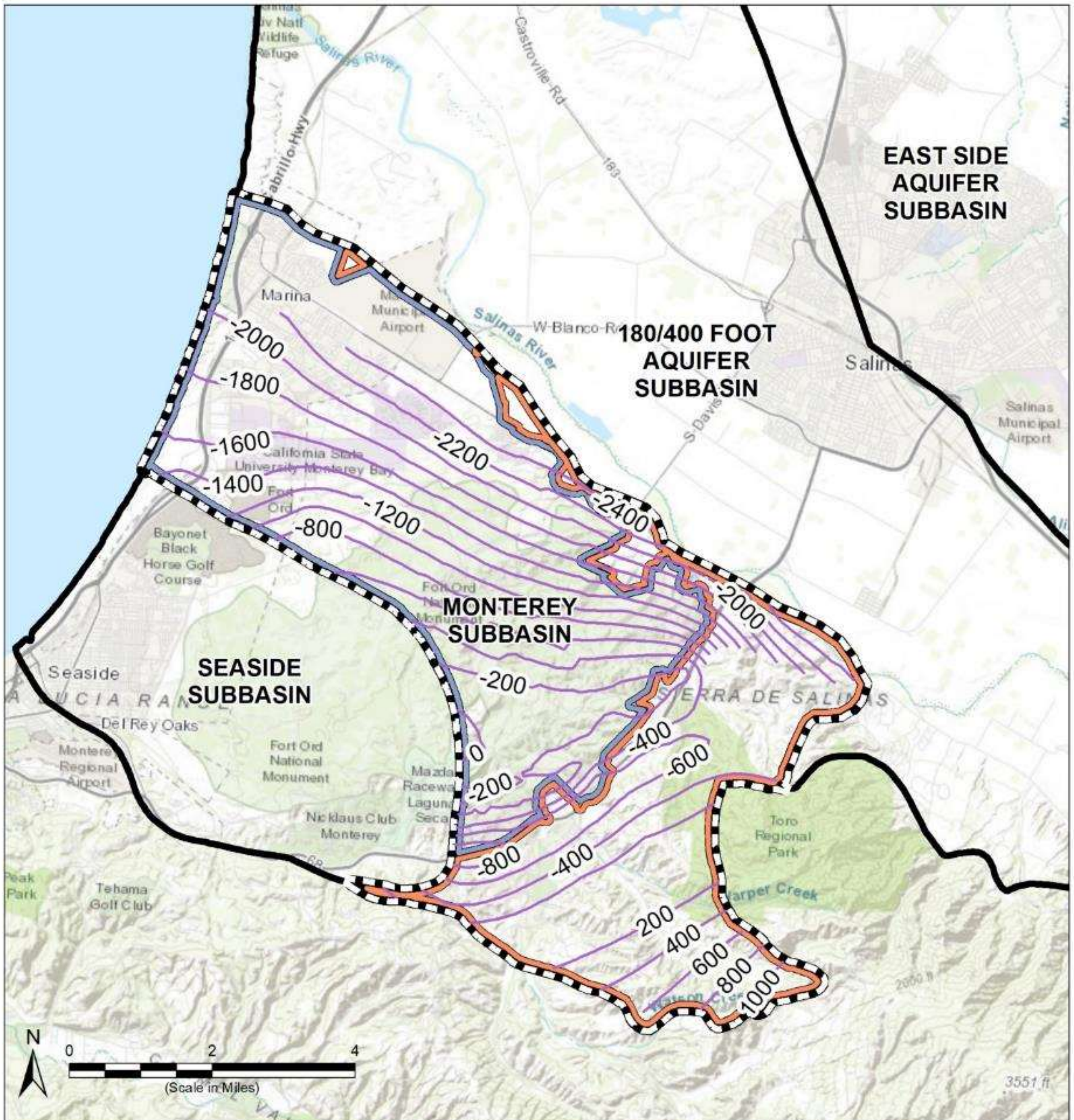
1. The Monterey Bay shoreline bounds the northwestern edge of the Subbasin.
2. The Sierra de Salinas bound the eastern and southern edge of the Subbasin. One part of this boundary follows the contact between Pleistocene units and the Cretaceous quartz monzonite, and another part of this boundary generally follows the contact between Pleistocene units and Miocene rocks as shown on **Figure 4-2**.

4.1.2.2 Bottom of the Basin

The bottom of the Monterey Subbasin is defined herein as the top of Monterey Formation. The Monterey Formation has low hydraulic conductivity as it is comprised of shale and diatomite (Yates, 2002) and yields water that is generally of low water quality (Geosyntec, 2007). **Figure 4-3** shows contours that define the top elevation of the Monterey Formation for most of the Monterey Subbasin.

The deepest groundwater production wells in the Subbasin generally extend to depths within the Purisima or Santa Margarita Formations above the Monterey Formation, and are found closer to the coast. Along the northeastern boundary of the Subbasin, where the Monterey Formation is overlain by the Purisima Formation (Durbin 2007, Yates and others 2005, Greene 1970, Greene 1977), the deepest groundwater extractions are from MCWD wells MCWD-10, -11, and -12, which are screened across Paso Robles and Purisima Formations from 780 ft bgs to 1,840 ft bgs. In the Corral de Tierra Area, many wells are screened in the Aromas Sand and Paso Robles Formation continental deposits as well as the Santa Margarita Sandstone. Slightly south of the Corral de Tierra Subbarea outside of the Subbasin, a number of wells tap both the Monterey Formation and the unnamed sandstone and conglomerate unit (GeoSyntec, 2007; Feeney, 2003).

The top of the Monterey Formation ranges from an elevation of 1,000 feet in the Corral de Tierra area to -2,400 feet near the coast, or from approximately 700 feet below land surface in the Corral de Tierra area to over 2,000 feet below land surface near the coast. As shown on **Figure 4-3** and **Figure 4-4**, there is a set of an east/northeast trending highs and lows on the surface of the Monterey Formation near the Ord-Corral de Tierra boundary. This reflects the mapped structural deformation of the unit in this area illustrated by the pink anticline and synclines in **Figure 4-2**. Additionally, the depth to the Monterey Formation can illustrate the structural, depositional, and erosional complexity which defines this hydrostratigraphic setting (**Figure 4-6**).



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Top of Monterey Fm. ft MSL

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

Fm. = formation
Ft MSL = feet mean sea level

Notes

1. All locations are approximate.

Sources

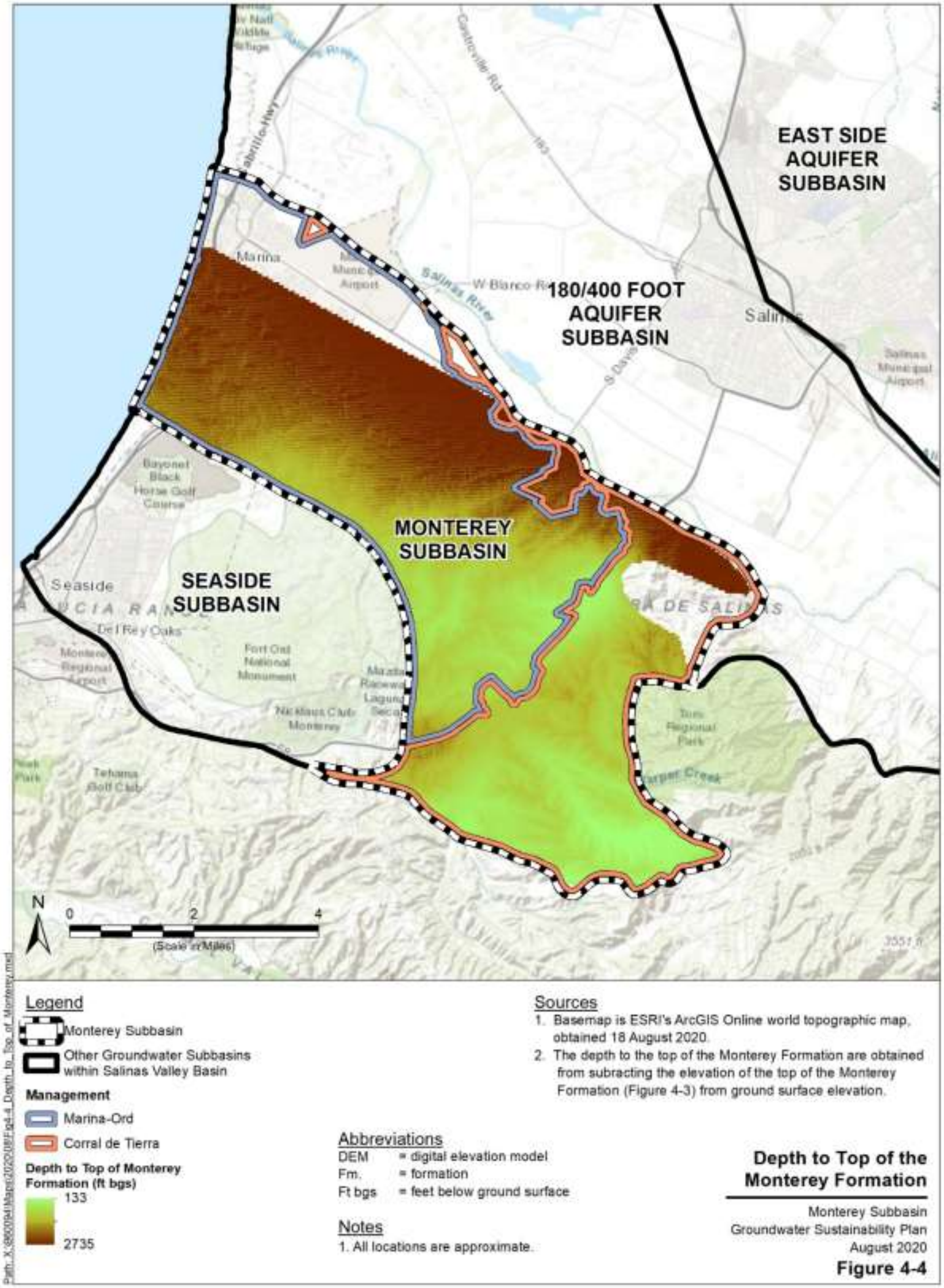
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 25 June 2020.
2. The elevations of the top of Monterey Fm. are obtained from the sources below:
   - Rosenberg (2001, 2009)
   - Staal. Gardner and Dunne (1987)
   - Feeney and Rosenberg (2003)

Bottom of the Basin – Top of the Monterey Formation

Monterey Subbasin
Groundwater Sustainability Plan
June 2020

Figure 4-3

Path: X:\B60094\Maps\2020\06\Fig4-3_Top_of_Monterey.mxd


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Marina
Seaside
Salinas River
W Blanco Rd
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management
Marina-Ord
Corral de Tierra
Depth to Top of Monterey Formation (ft bgs)
133
2735
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 18 August 2020.
2. The depth to the top of the Monterey Formation are obtained from subracting the elevation of the top of the Monterey Formation (Figure 4-3) from ground surface elevation.
Abbreviations
DEM = digital elevation model
Fm. = formation
Ft bgs = feet below ground surface
Notes
1. All locations are approximate.
Depth to Top of the Monterey Formation
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-4

4.1.3

Physical Characteristics

4.1.3.1 Topographic Information

Figure 4-55 shows the topography within the Monterey Subbasin. Topography generally slopes down to the northwest towards Monterey Bay, ranging from sea level at the shoreline to 1,900 ft msl in the southeastern corner of the Subbasin.

In the coastal area of the Subbasin, the topography is shaped by active coastal sand dunes, followed by a coastal plain and older stabilized sand dunes. Coastal sand dunes are present along a narrow quarter-mile-wide stretch of land where the Subbasin meets the bay. These coastal dunes rise to approximately 100 feet in elevation and grade eastward into a narrow coastal plain varying in width from one to two miles. Older sand dunes dominate the topography in the northwestern portion of the Subbasin and the majority of the Marina-Ord Area (CH2M, 2004).

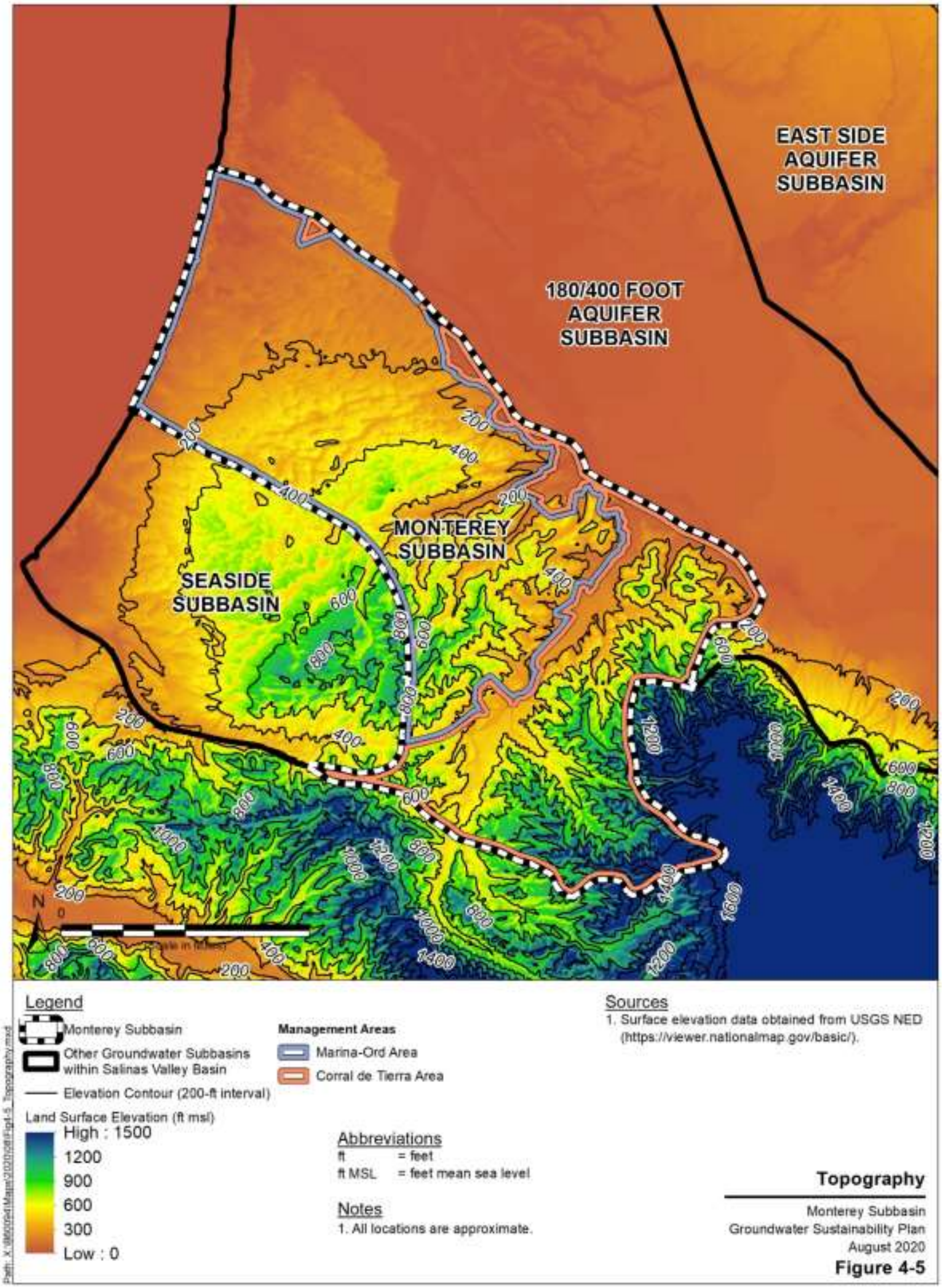
The topography of the southeastern uplands area is characterized by low hills and small sub-watersheds with well-defined drainages. Runoff from these areas is northeastward towards the Salinas River Valley by way of El Toro Creek or other smaller tributaries.

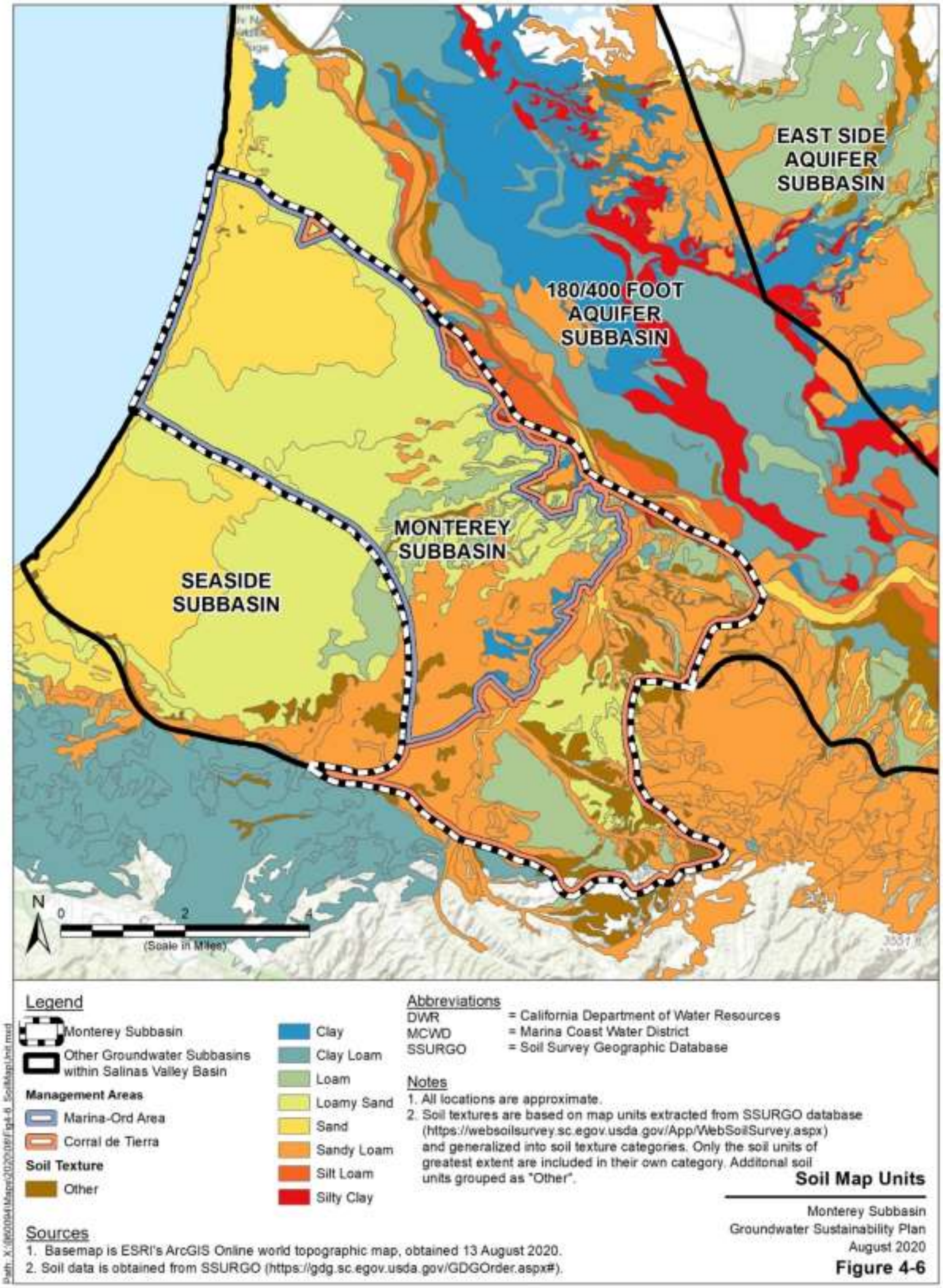
4.1.3.2 Soil Characteristics

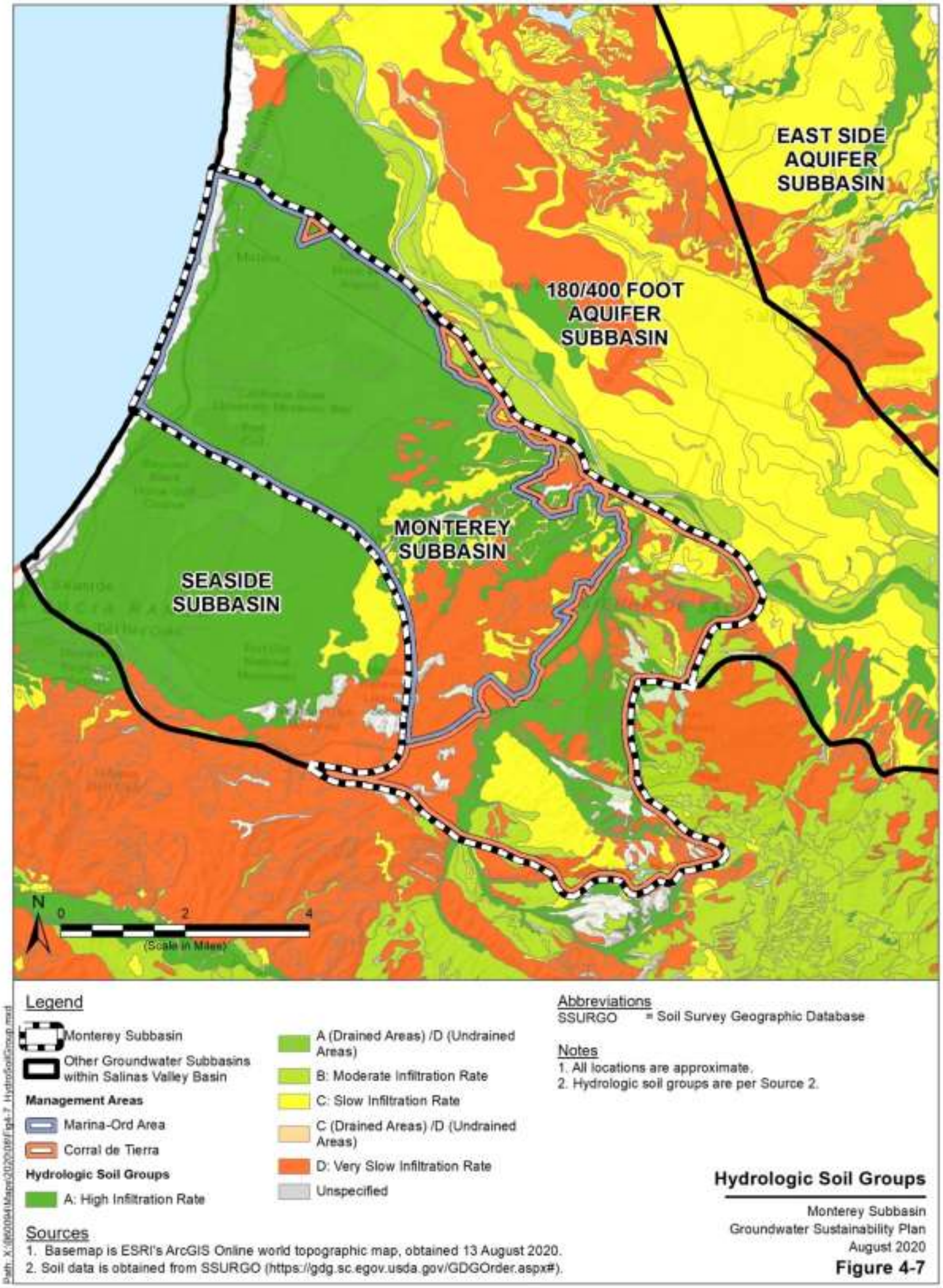
The soils of the Subbasin are derived from the underlying geologic formations and influenced by the historical and current patterns of climate and hydrology. Soil types can influence groundwater recharge and are an important consideration for the siting of potential artificial recharge projects.

Soils within the Subbasin are shown on **Figure 4-6**, and are based on the U.S Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Soil Survey Geographic Database (SSURGO). Soils within the Subbasin are relatively coarse in texture, with the predominant types being sand, loamy sand, and fine sandy loam. Textures are generally coarser near the coast and finer to the south.

Figure 4-7 shows the infiltration potential of soils based on SSURGO's Hydrologic Soil Group designations. Soils within the subbasin are predominantly of Hydrologic Soil Group A in the coastal plain area, indicating high infiltration rates and low runoff potential. In the Fort Ord hills area, soils predominately belong to Hydrologic Soil Groups C and D, with below average and low infiltration rates, respectively, and moderately high and high runoff potential, respectively. A mix of Hydrologic Soil Groups A through D exist in the Corral de Tierra area east of El Toro Creek.


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
200
400
600
800
1000
1200
1400
1600
N
0
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Elevation Contour (200-ft interval)
Land Surface Elevation (ft msl)
High : 1500
1200
900
600
300
Low : 0
Management Areas
Marina-Ord Area
Corral de Tierra Area
Abbreviations
ft = feet
ft MSL = feet mean sea level
Notes
1. All locations are approximate.
Sources
1. Surface elevation data obtained from USGS NED (https://viewer.nationalmap.gov/basic/).
Topography
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-5


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra
Soil Texture
Other
Clay
Clay Loam
Loam
Loamy Sand
Sand
Sandy Loam
Silt Loam
Silty Clay
Abbreviations
DWR = California Department of Water Resources
MCWD = Marina Coast Water District
SSURGO = Soil Survey Geographic Database
Notes
1. All locations are approximate.
2. Soil textures are based on map units extracted from SSURGO database (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) and generalized into soil texture categories. Only the soil units of greatest extent are included in their own category. Additonal soil units grouped as "Other".
Soil Map Units
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-6
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 13 August 2020.
2. Soil data is obtained from SSURGO (https://gdg.sc.egov.usda.gov/GDGOrder.aspx#).


EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra
Hydrologic Soil Groups
A: High Infiltration Rate
A (Drained Areas) /D (Undrained Areas)
B: Moderate Infiltration Rate
C: Slow Infiltration Rate
C (Drained Areas) /D (Undrained Areas)
D: Very Slow Infiltration Rate
Unspecified
Abbreviations
SSURGO = Soil Survey Geographic Database
Notes
1. All locations are approximate.
2. Hydrologic soil groups are per Source 2.
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 13 August 2020.
2. Soil data is obtained from SSURGO (https://gdg.sc.egov.usda.gov/GDGOrder.aspx#).
Hydrologic Soil Groups
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-7

4.1.3.3 Recharge and Discharge Areas

Most of the Marina-Ord Area has good recharge potential for the Dune Sand Aquifer which subsequently recharges the underlying 180-Foot and 400-Foot Aquifers due to the high infiltration potential of the soils. This recharge is discussed further below in the general water quality section. There is uncertainty regarding the location and recharge mechanism for the Deep Aquifer (see discussion for each aquifer in Section 4.2.1). Additionally, due to the prevailing hydraulic gradient, the Subbasin currently receives inflow of seawater across the coastal northwestern boundary. Return flow from urban irrigation is not likely a significant source of recharge, and there are currently no artificial recharge projects within the Subbasin. Discharge of groundwater from the subbasin is predominantly through groundwater pumping from private and municipal supply wells, as well as groundwater remediation extraction wells.

Soils of varying infiltration potential exist in the Corral de Tierra area. Recharge from precipitation to the Aromas Sand/Paso Robles continental deposits and the Santa Margarita Sandstone in the southern Corral de Tierra Area is approximately 2 to 3 inches of the total annual precipitation (GeoSyntec, 2007; Fugro, 1996). This equals around 10 to 20 percent of average precipitation, which is approximately 16 inches of rain per year (Fugro, 1996). There is also a minimal volume of recharge from septic systems, and it is assumed that this recharge is to the shallow alluvial sediments (Yates, 2002). Recharge to the unnamed sandstone and conglomerate likely occurs in areas of higher elevation in the Sierra de Salinas south of the Monterey Subbasin (GeoSyntec, 2007).

Groundwater discharge to El Toro Creek causes the creek to flow perennially starting at a location below the Corral de Tierra Country Club, according to several previous investigations. Streamflow data for the period 1961 to 2002 from USGS gage 11152540, located north of San Benancio Rd, indicate a mean annual streamflow of 1,590 AFY (GeoSyntec, 2007). It has not been determined what portion of this mean annual streamflow is attributable to groundwater discharge, and what portion is attributable to runoff.

4.2 Subbasin Hydrogeology

The Monterey Subbasin is hydrostratigraphically complex and represents a transition zone between the more defined, laterally continuous aquifer system along the central axis of the Salinas Valley and the less continuous aquifer systems towards the Sierra de Salinas. Past hydrostratigraphic analyses of the Subbasin has generally focused on the areas where groundwater production and remediation activities have occurred, i.e., in the vicinity of the City of Marina, in the eastern portion of the former Fort Ord, and within the southern Corral de Tierra area. These studies have identified unique hydrostratigraphic characteristics in both the northern and southern ends of the Subbasin and have defined different principal aquifers.

Hydrostratigraphy in the Marina-Ord Area consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley: the confined aquifers known as the 180-Foot Aquifer, the 400-Foot Aquifer, and the Deep Aquifer. Additionally, a deposit of permeable dune sands, known as the Dune Sand Aquifer forms a shallow aquifer in this area. The Dune Sand Aquifer overlies the Salinas Valley Aquifer (SVA) over a substantial portion of the Marina-Ord Area, but is in direct connection with the 180-Foot aquifer near the coast.

Within the southern Corral de Tierra area, the named aquifer sequence recognized in the Salinas Valley is not present (HLA, 1994). Instead, in these areas, the aquifers are described by their geologic names, such as the Aromas Sand, Paso Robles Formation, and Santa Margarita Sandstone (Geosyntec, 2007; Yates 2005). These geologic formations also comprise part of the principal aquifers in the northern Salinas Valley including the Marina-Ord Area. As discussed below, the geologic formations that comprise the Corral de Tierra aquifer system are the same sediments that comprise the 400-Foot Aquifer and the Deep Aquifers of the Marina-Ord Area. However, (1) the interconnectivity of each of these aquifers and (2) the connection of these geologic units where they occur in the Corral de Tierra highlands to the Marina-Ord coastal area is unknown based on currently available data.

Due to the lack of subsurface information between these two areas, the extent that these aquifer systems correlate and/or transition to each other is uncertain. For the purposes of this GSP, the hydrostratigraphy of the Marina-Ord Area and the Corral de Tierra Area are discussed separately below.

4.2.1 Hydrogeology in the Marina-Ord Area

The aquifer system beneath the Marina-Ord Area is discussed below and summarized in **Table 4-1.**

Table 4-1 Hydrostratigraphic Summary of the Marina-Ord Area

<table>
<tr><th rowspan="2">Principal Aquifers and Aquitards of the Marina-Ord Area</th><th rowspan="2">Geological Unit</th><th colspan="3">Interconnectivity</th></tr>
<tr><th>180/400 Foot Aquifer Subbasin (SVBGSA, 2020)</th><th>Corral de Tierra Area</th><th>Seaside Subbasin (Yates, 2005; HydroMetrics, 2009)</th></tr>
<tr><td>Dune Sand Aquifer</td><td>Recent Dune Sand (Qd)
Older Dune Sand (Qod)</td><td>“Shallow Sediments”</td><td rowspan="4">Landslides, older and younger flood plain deposits, undifferentiated Alluvium</td><td rowspan="4">Surficial Deposits</td></tr>
<tr><td>Salinas Valley Aquitard</td><td rowspan="3">Old Alluvium / Valley Fill Deposits (Qo/Qvf)</td><td>Salinas Valley Aquitard</td></tr>
<tr><td>180-Foot Aquifer</td><td>180-Foot Aquifer</td></tr>
<tr><td>Middle Aquitard</td><td>180/400-Foot Aquitard</td></tr>
<tr><td>400-Foot Aquifer</td><td>Aromas Sand (Qae);</td><td>400-Foot Aquifer</td><td rowspan="3">Aromas Sand/Paso Robles Formation Aquifer; Santa Margarita Formation Aquifer</td><td>Paso Robles Aquifer</td></tr>
<tr><td>Deep Aquitard</td><td>Paso Robles Formation (QT)</td><td>400/Deep Aquitard”</td><td>(2)</td></tr>
<tr><td>Deep Aquifers</td><td>Purisima Formation (Ppu)
Santa Margarita Formation (Msm)</td><td>Deep Aquifers</td><td>Santa Margarita/ Purisima Aquifer</td></tr>
</table>

Notes

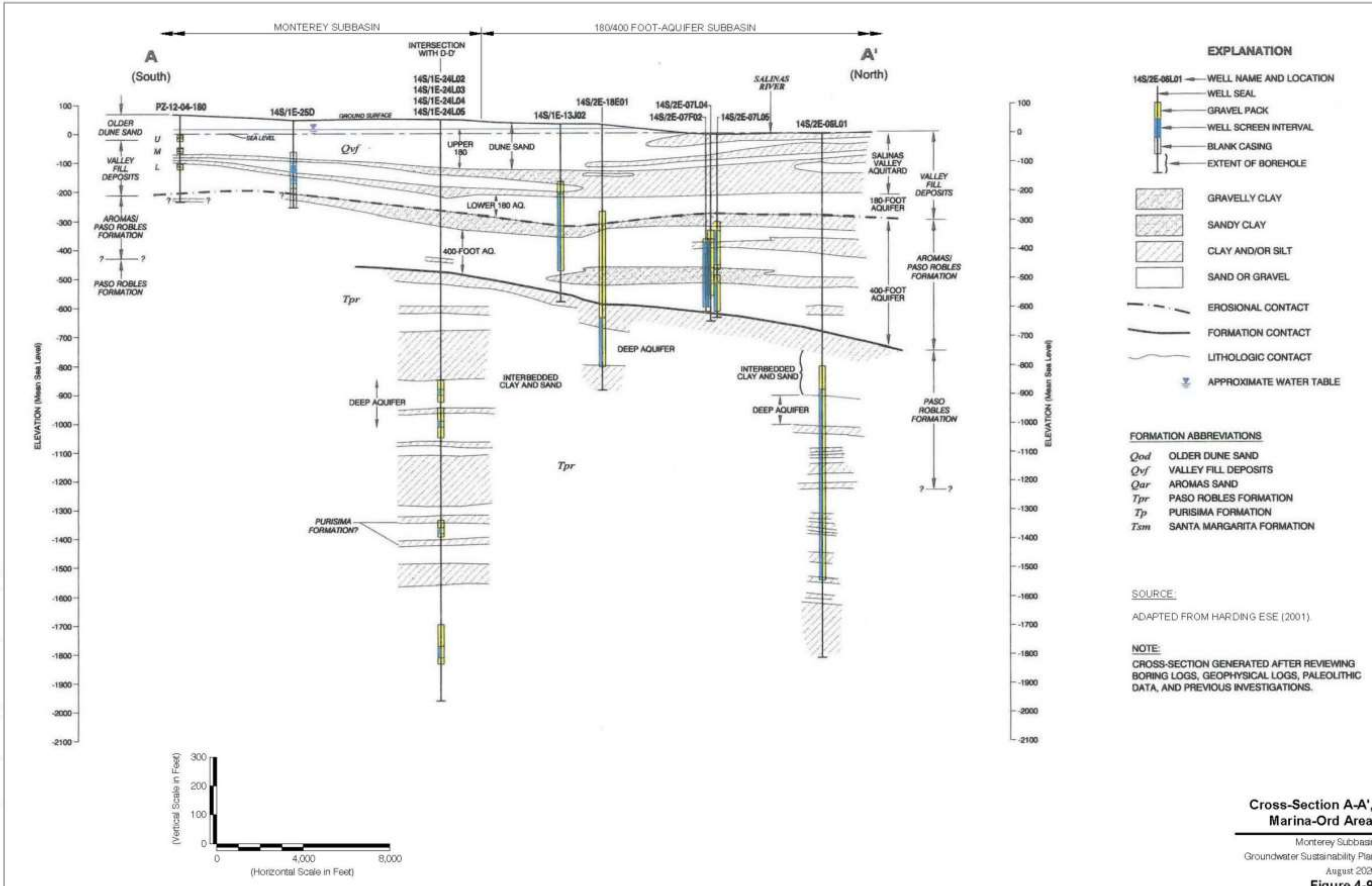
(1) Principal aquifers are **bolded**.

“Semi-continuous layers of blue clay” at the base of the Paso Robles Formation (HydroMetrics, 2009)

4.2.1.1 Cross-Sections

Figure 4-8 through **Figure 4-12** present cross-sections that illustrate the geologic setting and hydrostratigraphy beneath the Marina-Ord Area. These cross-sections are derived from *Hydrogeologic Investigation of the Salina Valley Basin in the Vicinity of the Fort Ord and Marina* (Harding ESE, 2001).


PRESSURE AREA
SVA BOUNDARY
VALLEY FILL DEPOSITS
CROSS-SECTION LOCATION
A'
B'
C'
D'
A
B
C
D
Monterey Bay
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
MARINA
MAIN GARRISON
EAST GARRISON
BOUNDARY OF FORMER FORT ORD
SALINAS RIVER
AIRFIELD
HENNEKEN
TEST1
TEST2
TEST3
TEST4
MPWMD#11
MW-OU2-07-400
MW-OU2-10-400
MCWD#07
MCWD#02
MCWD#01
MCWD#03
MCWD#-04
MCWD#05
FO-14
FO-27
FO-11
FO-18
14S/02E-08L01
14S/02E-07F02
14S/02E-07L05
14S/02E-07L03
14S/02E-07L04
14S/02E-18C01
14S/02E-21N01
14S/02E-28C01
14S/02E-22P02
14S/02E-22K01 (FONTES-1)
14S/02E-27C02
14S/02E-28J50
14S/01E-24L
14S/01E-25D (BEACH)
15S/02E-04C01 (FO-29)
15S/02E-08E (DB-1)
N
0
1
2
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Management Areas
Marina-Ord Area
Corral de Tierra
Notes
1. All locations are approximate.
Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap adapted from Plate 2 of Harding ESE, 2001.
Cross-Section Locations
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-8



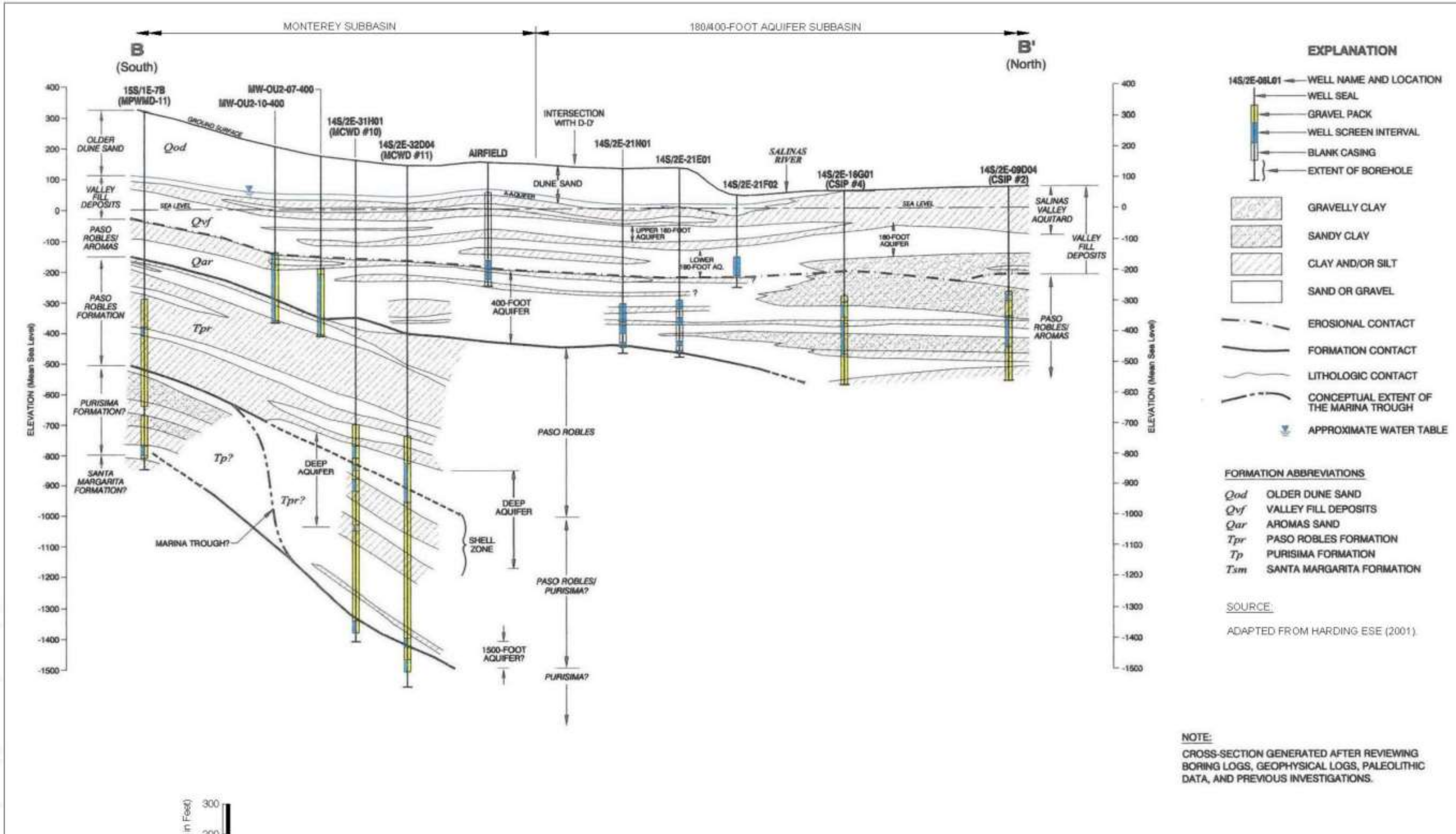
Cross-Section A-A', Marina-Ord Area

Monterey Subbasin Groundwater Sustainability Plan
August 2020

Figure 4-9

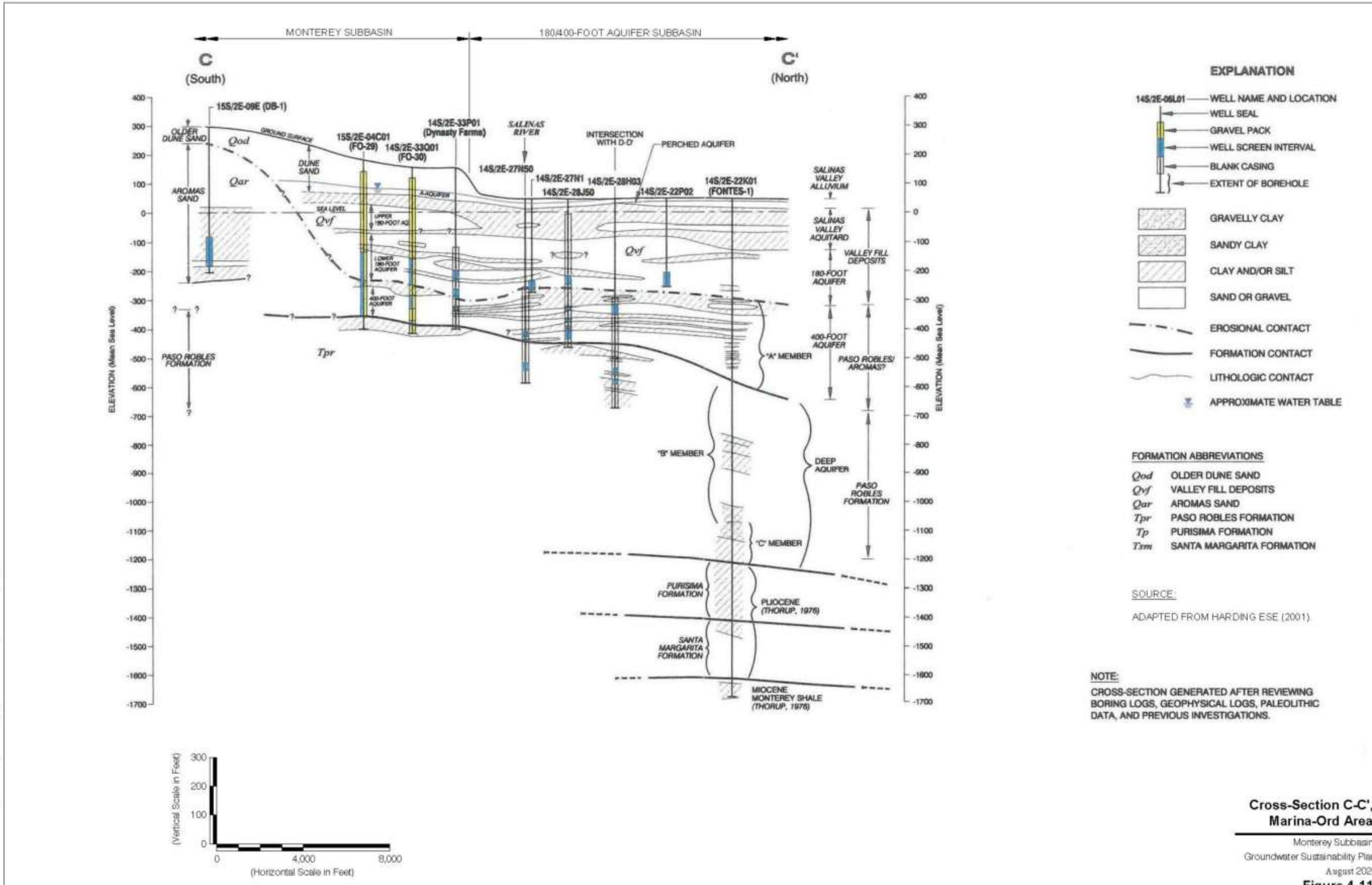
20200623.121603 G:\860094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18

20200623.121603 G:\860094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



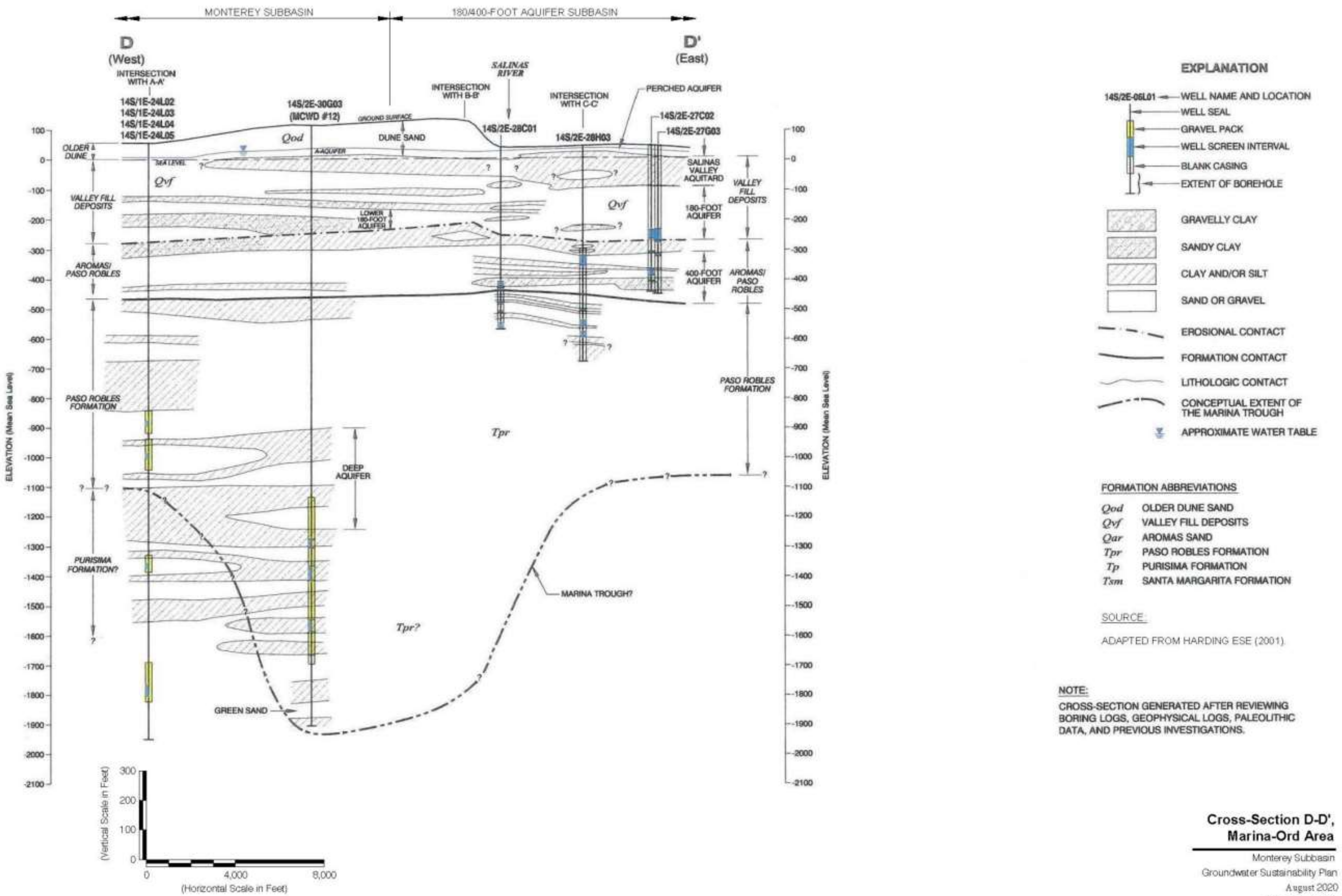
Cross-Section B-B', Marina-Ord Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-10



Cross-Section C-C', Marina-Ord Area

Figure 4-11



Cross-Section D-D', Marina-Ord Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-12

20200623.121603 G:\860094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18

4.2.1.2 Principal Aquifers

Hydrostratigraphy in the Marina and Ord Subbareas consists of a series of laterally continuous aquifers consistent with the aquifers forms the distinguishing hydrostratigraphic features of the northern Salinas Valley. Within the northern Salinas Valley, two relatively continuous layers of blue clay extend between Gonzales and Monterey Bay. The two clay layers create confined conditions in the two primary producing aquifers which are named after the typical depth at which they are found: the upper confined aquifer is referred to as the 180-Foot Aquifer, and the lower confined aquifer is referred to as the 400-Foot Aquifer. Therefore, the hydrostratigraphic discussion below for the Marina-Ord Area uses this same nomenclature. Principal aquifers and associated aquitards in the Marina-Ord Area of the basin are identified in the following hydrostratigraphic order, from shallowest to deepest:

- Principal Dune Sand Aquifer
- Salinas Valley Aquitard
- Principal 180-Foot Aquifer
- Middle Aquitard
- Principal 400-Foot Aquifer
- Deep Aquitard
- Principal Deep Aquifer

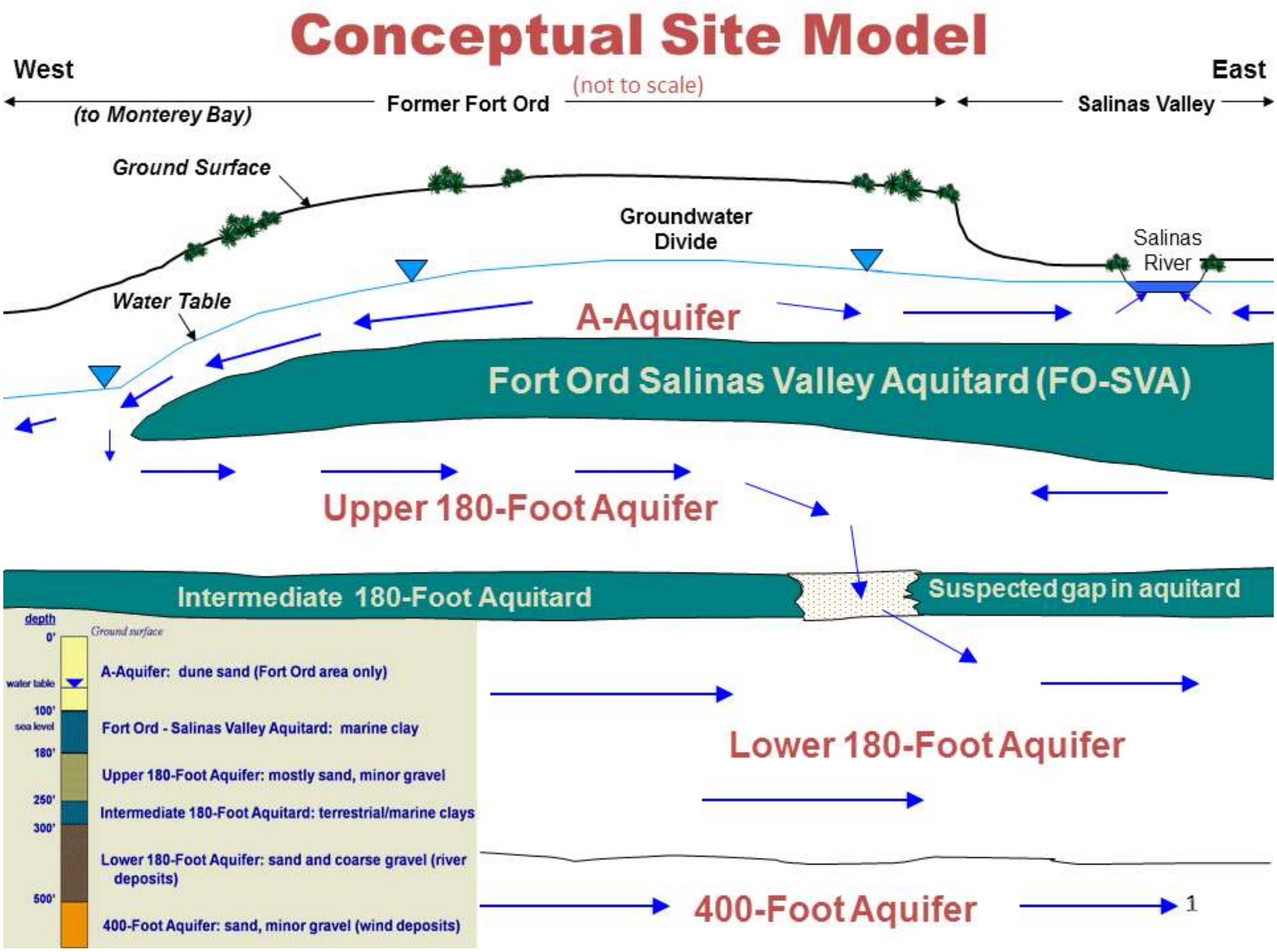
Cross-sections in the Marina and Ord Subbareas are shown on **Figure 4-8** through **Figure 4-12**. Details of each of the hydrostratigraphic units are described below.

Principal Dune Sand Aquifer

The Dune Sand Aquifer is composed of fine to medium, well sorted dune sands (Ahtna Engineering, 2013) of Holocene age. As shown on **Figure 4-2**, the dune sands that comprises this aquifer exist in the coastal plains south of the Salinas River. The Dune Sand Aquifer is also known as the “A-Aquifer” beneath Fort Ord (Harding Lawson Associates (HLA, 1994; Jordan et al., 2005; Harding ESE, 2001). Groundwater in the Dune Sand Aquifer is unconfined. The aquifer is perched further away from the coast in areas where the SVA exists and groundwater in the 180-Foot Aquifer has fallen below the bottom elevation of the Salinas Valley Aquitard. It is hydraulically connected to the underlying 180-Foot Aquifer in areas nearer to the coast. The average saturated thickness of the Dune Sand Aquifer is approximately 50 feet.

A groundwater divide exists in the Dune Sand Aquifer as shown in Section 5. West of the groundwater divide (see Section 5), groundwater in the Dune Sand Aquifer flows westward and recharges the 180-Foot Aquifer near the edge of the SVA, where it abruptly reverses flow eastward (i.e. inland) within the 180-Foot Aquifer. East of the groundwater divide, groundwater in the Dune Sand Aquifer flows northeastward towards the Salinas River. A conceptual model of this groundwater flow is shown on **Figure 4-13** below.

Figure 4-13. Conceptual Model of Marina-Ord Area Aquifers



Source: Fort Ord Cleanup. https://fortordcleanup.com/programs/groundwater/

This aquifer is recharged primarily by rainfall infiltration (HLA, 1994) and in turn provides a source of deep percolation into the lower aquifers. As shown on **Figure 4-7**, the sandy soils of this aquifer have high infiltration potential.

Extraction and infiltration activities associated with remediation in the former Fort Ord take place within the Dune Sand Aquifer. The measured horizontal hydraulic conductivity of the Dune Sand Aquifer ranges from 0.14 to 120 feet per day (ft/d), and vertical conductivity ranges from 0.6 to 4.0 ft/d (HLA, 1994; HLA, 1999; MACTEC, 2006; HydroGeoLogic, Inc., 2006; Jordan et al., 2005). Measured horizontal hydraulic conductivity of the Dune Sand Aquifer is shown on **Figure 4-14**, and the measured transmissivity of the Dune Sand Aquifer is shown on **Figure 4-15**.

Salinas Valley Aquitard

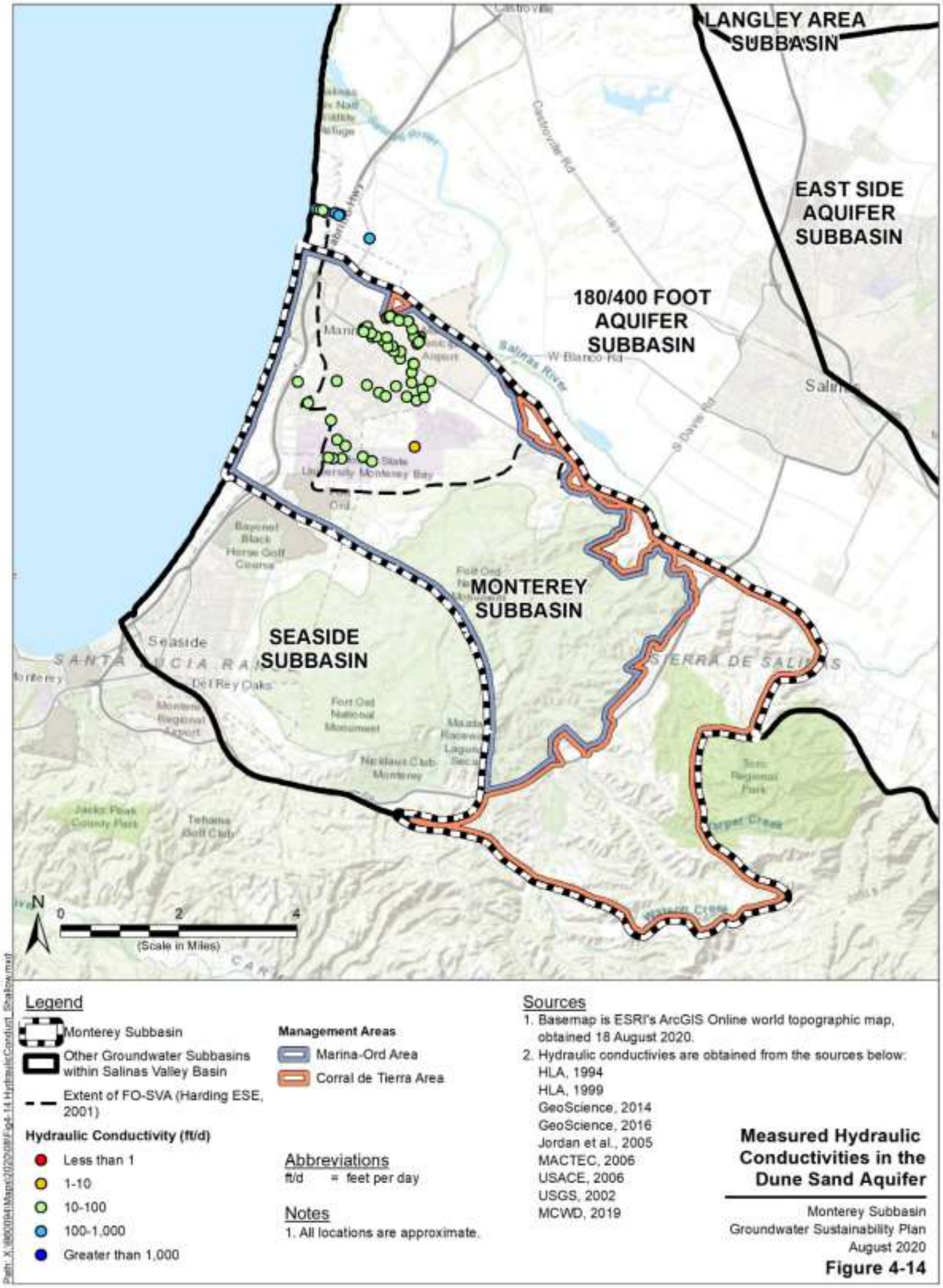
The Salinas Valley Aquitard (SVA) is primarily composed of laterally extensive clay and sandy clay layers. The elevation of the SVA top ranges from approximately 100 to -30 ft NAVD 88 where it exists within the Subbasin. Where it exists, the SVA act as a confining layer for the underlying 180-Foot Aquifer (Harding ESE, 2001).

Within the Subbasin, the SVA is continuous beneath the City of Marina and most of Fort Ord (Harding ESE, 2001; Kennedy/Jenks, 2004; Ahtna Engineering, 2013; MACTEC, 2006). The extent of the SVA is illustrated on **Figure 4-14** and **Figure 4-15**. As shown on these figures, the SVA thins towards the Monterey Subbasin/Seaside Subbasin boundary as well as toward the coast, where it appears to pinch out near Highway 1 (Harding ESE, 2001). The thinning and pinching out of the SVA in these locations increases the vertical hydraulic connection between the Dune Sand Aquifer and underlying 180-Foot Aquifer.

Airborne electromagnetics (AEM) data collected in the North Salinas Valley (Gottschalk I, Knight R, 2018) show that fresh groundwater exists in the vicinity of the Salinas River in the 180-Foot Aquifer and 400-Foot Aquifer zones. These data indicate that that the Salinas River may recharge these aquifers and that there may be gaps in the SVA near the river. Measured vertical hydraulic conductivity of the SVA in the former Fort Ord ranges from 5.7×10^{-5} to 2.8×10^{-3} ft/d (MACTEC, 2006).

Principal 180-Foot Aquifer

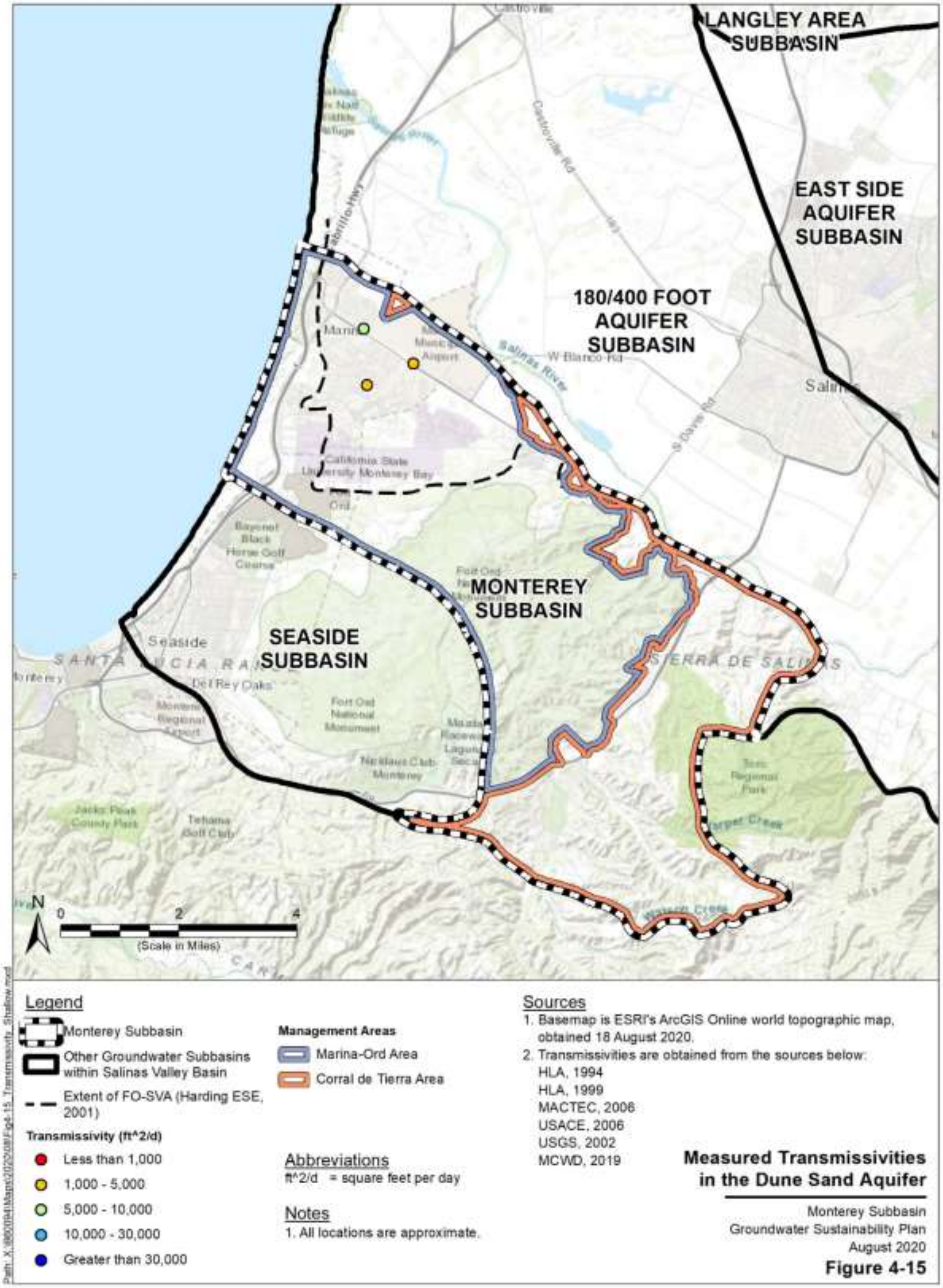
The 180-Foot Aquifer is comprised of valley fill material including fluvial sediments, older alluvium, and alluvial fan deposits (Greene, 1970). These gravels and sands are found in the vicinity of the City of Marina and extend a short distance southwest beyond the SVA (HLA, 1994). Beneath the ocean, the sediments “extend to submarine outcrops on the floor and canyon walls of Monterey Bay” (Harding ESE, 2001; Greene, 1977; DWR, 1946). As discussed above, the aquifer is confined where overlain by SVA/FO-SVA. It may become unsaturated towards the central Salinas Valley where groundwater elevation is lower than the bottom elevation of the SVA. The 180-Foot Aquifer is found generally at depths between 100 and 400 ft bgs beneath the Marina-Ord Area, with varying thickness.



Measured Hydraulic Conductivities in the Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-14


LANGLEY AREA SUBBASIN
EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Marina
Seaside
Del Rey Oaks
Castroville Rd
W Blanco Rd
Salinas River
SIERRA DE SALINAS
Salinas
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Extent of FO-SVA (Harding ESE, 2001)
Transmissivity (ft^2/d)
Less than 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 30,000
Greater than 30,000
Management Areas
Marina-Ord Area
Corral de Tierra Area
Abbreviations
ft^2/d = square feet per day
Notes
1. All locations are approximate.
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 18 August 2020.
2. Transmissivities are obtained from the sources below:
HLA, 1994
HLA, 1999
MACTEC, 2006
USACE, 2006
USGS, 2002
MCWD, 2019
Measured Transmissivities in the Dune Sand Aquifer
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-15

South of the City of Marina, in a portion of the former Fort Ord, the 180-Foot Aquifer is separated into an "upper" zone of sandy deposits with some gravel and a "lower" zone of gravel with sand and clay lenses; the two zones are separated by a thin clay layer (Ahtna Engineering, 2013). Data collected within the former Fort Ord show that significant head differences exist between the upper and lower zones of the 180-Foot Aquifer.

The 180-Foot Aquifer receives recharge from the overlying Dune Sand Aquifer as well as rainfall and surface water infiltration in areas where the SVA does not exist . As discussed above, groundwater from Dune Sand Aquifer recharges the 180-Foot Aquifer west of where the SVA pinches out. This recharge mechanism is also supported by the similar geochemistry between the Dune Sand Aquifer and the 180-Foot Aquifer (Section 4.2.1.4). Subsurface Inflows and outflows to the 180-Foot Aquifer also occur from 180-Foot Aquifer of the 180/400 Foot Aquifer Subbasin and from the Aromas Sand and Paso Robles Formations southeast of the former Fort Ord (HLA, 1994).

Groundwater extraction from the "upper" portion of the 180-Foot Aquifer are mainly associated with remediation[9]. There are some remediation activities in the "lower" portion of the aquifer. Three of MCWD's production wells are also screened across the lower 180-Foot Aquifer and 400-Foot Aquifer, though it appears that the 400-Foot Aquifer contributes much of the water to those wells based on geochemical assessment (HLA, 1994).

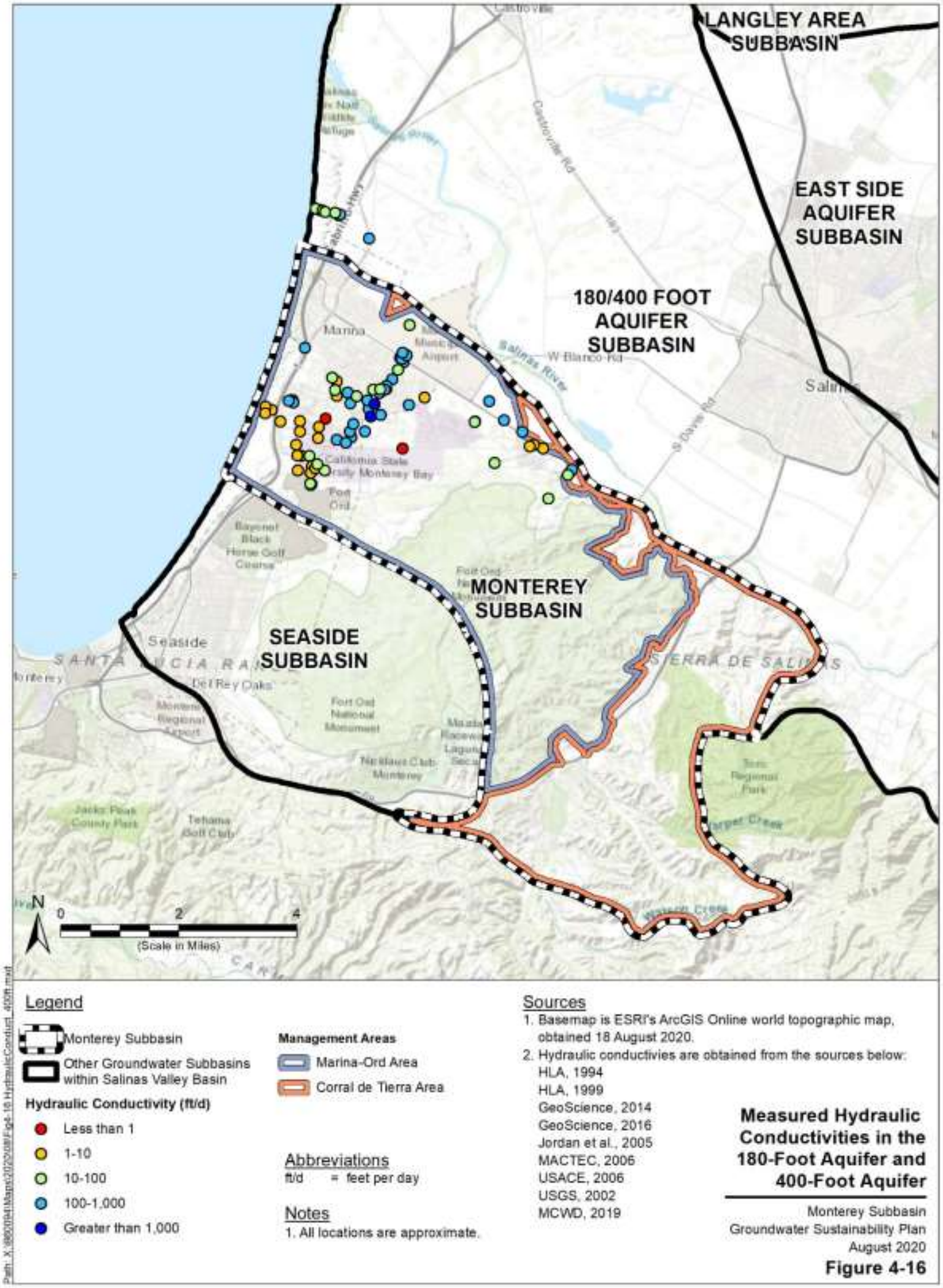
Measured horizontal hydraulic conductivities in the 180-Foot Aquifer in the Fort Ord area range from 1.7 to 390 ft/d[10] (HLA, 1994; HLA, 1999; MACTEC, 2006; HydroGeoLogic, Inc., 2006; Jordan et al., 2005). Measured horizontal hydraulic conductivities of the 180-Foot and 400-Foot Aquifers are shown on **Figure 4-16** and measured transmissivities of the 180-Foot Aquifer and 400-Foot Aquifer are shown on **Figure 4-17**.

Middle (180/400) Aquitard

The 180/400 Aquitard confines the 400-Foot Aquifer (Harding ESE, 2001; Kennedy/Jenks, 2004). However, beneath the majority of the Marina-Ord Area, this aquitard separating the 180-Foot Aquifer and 400-Foot Aquifer was not observed, while it was reported elsewhere beneath the former Fort Ord indicating the aquitard probably "varies laterally throughout the Fort Ord area" (MACTEC, 2006). Kennedy/Jenks (2004) also identifies Fort Ord as one of several locations where this aquitard is thin or discontinuous. This discontinuity allows the downward migration of intruded seawater from the local lower 180-Foot Aquifer to the 400-Foot Aquifer in the Fort Ord area.

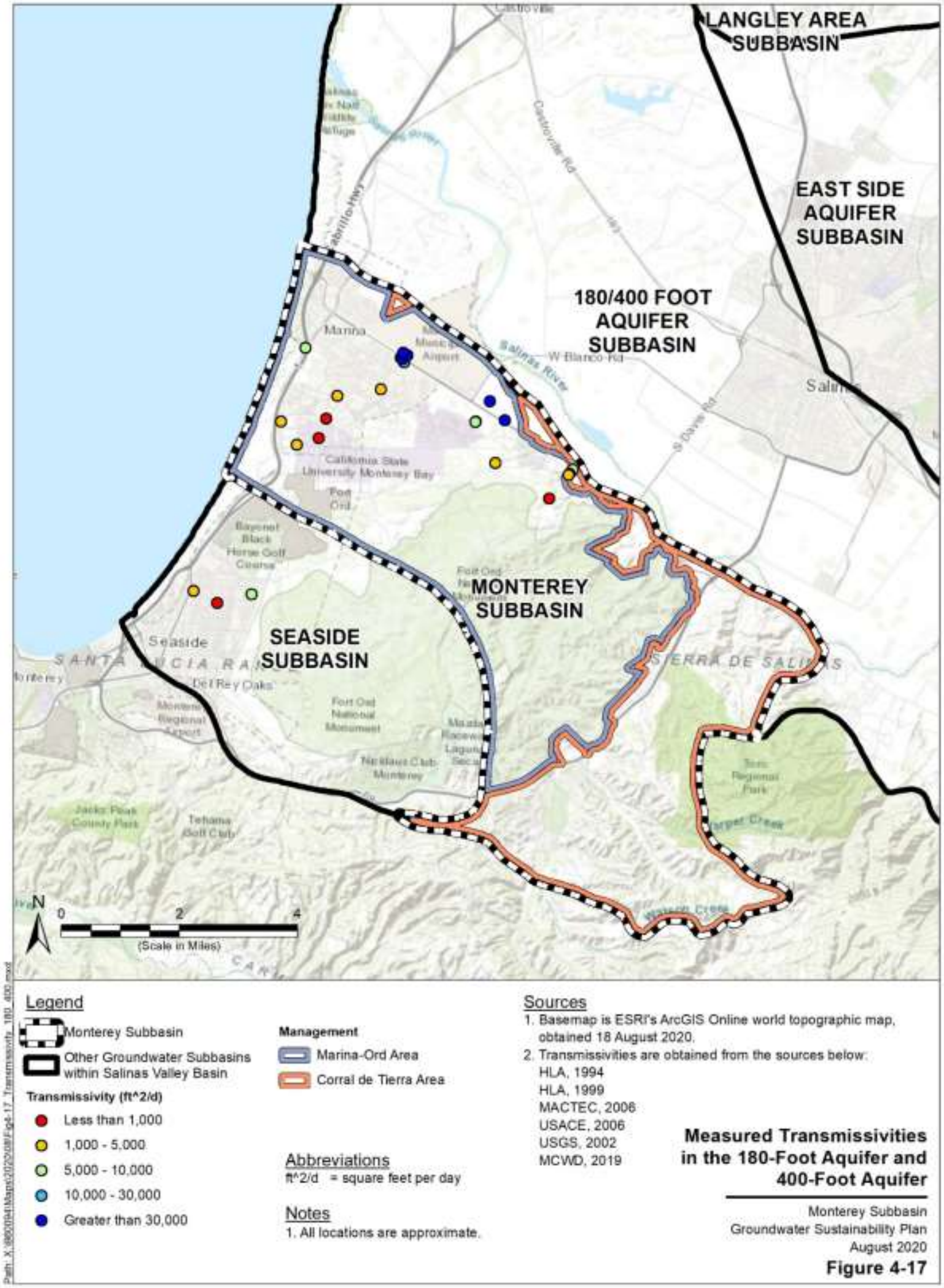
[9] Extracted groundwater for remediation purposes are re-infiltrated into the aquifer system.

[10] Measured hydraulic conductivity values and transmissivity values are based upon aquifer pumping tests and specific capacity data. Differences in measurement method may account for some of the wide range of values seen.



Measured Hydraulic Conductivities in the 180-Foot Aquifer and 400-Foot Aquifer

Figure 4-16



Measured Transmissivities in the 180-Foot Aquifer and 400-Foot Aquifer

Figure 4-17

Principal 400-Ft Aquifer

The 400-Foot Aquifer is comprised of fine to medium-grained sand (Ahtna Engineering, 2013) with clay lenses. The 400-Foot Aquifer appears to be composed of portions of the Aromas Sand and the shallow Paso Robles Formation (HLA, 1994; Harding ESE, 2001), although it is difficult to delineate where the two formations occur (Harding ESE, 2001). Harding ESE (2001) reported that there are one to three laterally continuous thin clay layers within the 400-Foot Aquifer beneath former Fort Ord.

The 400-Foot Aquifer occurs at depths of 350 to 700 ft bgs beneath the Marina-Ord Area with varying thickness. Beyond Inter-garrison Road to the southeast, a facies change occurs where the overlying aquitards thin out and the fluvial sands and gravels disappear (HLA, 1994). The Aromas Sand and Paso Robles Formation occur at shallower depths in this area before surfacing in the Fort Ord hills and Corral de Tierra area. However, the subsurface geology in Fort Ord hills area is not well known due to a lack of subsurface information.

The Lower 180-Foot Aquifer zone and the 400-Foot Aquifer in the vicinity of the City of Marina are functionally the same due to the missing Middle (180/400-Foot) Aquitard in this area. As discussed in Section 5, groundwater elevation from wells in the Lower 180-Foot Aquifer and 400-Foot Aquifer are congruent in the majority of the Marina-Ord Area.

Near the Monterey-Seaside subbasin boundary, a depression exists in the groundwater potentiometric surface of the 400-Foot Aquifer. This depression is observed in nested CASGEM monitoring wells MPWMD#FO-10 and MPWMD#FO-11. At these locations, groundwater elevations measured in the 400-Foot Aquifer are lower than surrounding areas and appear to have similar patterns with those measured in the Deep Aquifer (see Section 5). These data suggest that a potential connection may exist between the 400-Foot Aquifer and the Deep Aquifer in this area.

The 400-Foot Aquifer is one of the major groundwater production aquifers beneath the Marina-Ord Area. As mentioned above, three of MCWD's production wells are screened across the lower 180-Ft Aquifer and 400-Ft Aquifer. MCWD's water supply provided by these wells have decreased from approximately 60% to 30% of its demand over the past 10 years, and their production has ranged from 2,400 AFY to 600 AFY. As shown on **Figure 4-16**, the 180-Foot Aquifer and 400-Foot Aquifer are highly productive, with estimated horizontal hydraulic conductivities in the Fort Ord area ranging from 33 to 237 ft/d. MCWD's production wells MCWD-29, MCWD-30, and MCWD-31 have specific capacities ranging from 70 gallons per minute per foot ("gpm/ft") to 127.3 gpm/ft (MCWD, 2019).

Recharge to this aquifer likely occurs from both the overlying 180-Foot Aquifer and where the Aromas Sand and Paso Robles Formation crop out in the highland areas, in and near the Corral de Tierra Area. As shown in Section 6 below, groundwater flow direction in the 400-Foot Aquifer is strongly influenced by groundwater pumping in the Salinas Valley Groundwater Basin, inland of the Monterey Subbasin.

Due to its geologic composition, the 400-Foot Aquifer beneath the Marina-Ord Area is likely connected to the Aromas/Paso Robles aquifer and/or the Santa Margarita aquifer in the Corral de Tierra Area. Additionally, the 400-Foot Aquifer has been believed to be connected to the "shallow" or the Paso Robles aquifer in Seaside Subbasin (Yates, 2005), where it is consists of several continued water producing zones and unconfined zones where granular materials of the Paso Robles are in contact with surficial deposits ("Uppermost aquifer").

Deep Aquitard

The Deep Aquitard confines the underlying Deep Aquifer (Kennedy/Jenks, 2004). There is no analysis available for its spatial occurrence or geologic composition. It is likely comprised of Paso Robles Formation deposits based on information for the 400-Foot Aquifer and the Deep Aquifer.

Principal Deep Aquifer

The Deep Aquifer represents multiple aquifers and aquitards below the 400-Foot Aquifer without respect to geology. It is also locally named "900-Ft Aquifer" and "1,500-Ft Aquifer" (WRIME, 2003; Kennedy/Jenks, 2004). Within the Monterey Subbasin, the Deep Aquifer is comprised of the middle and lower portions of the Paso Robles Formation, the Purisima Formation and the Santa Margarita Sandstone (Hanson et al., 2002; Yates, 2005).

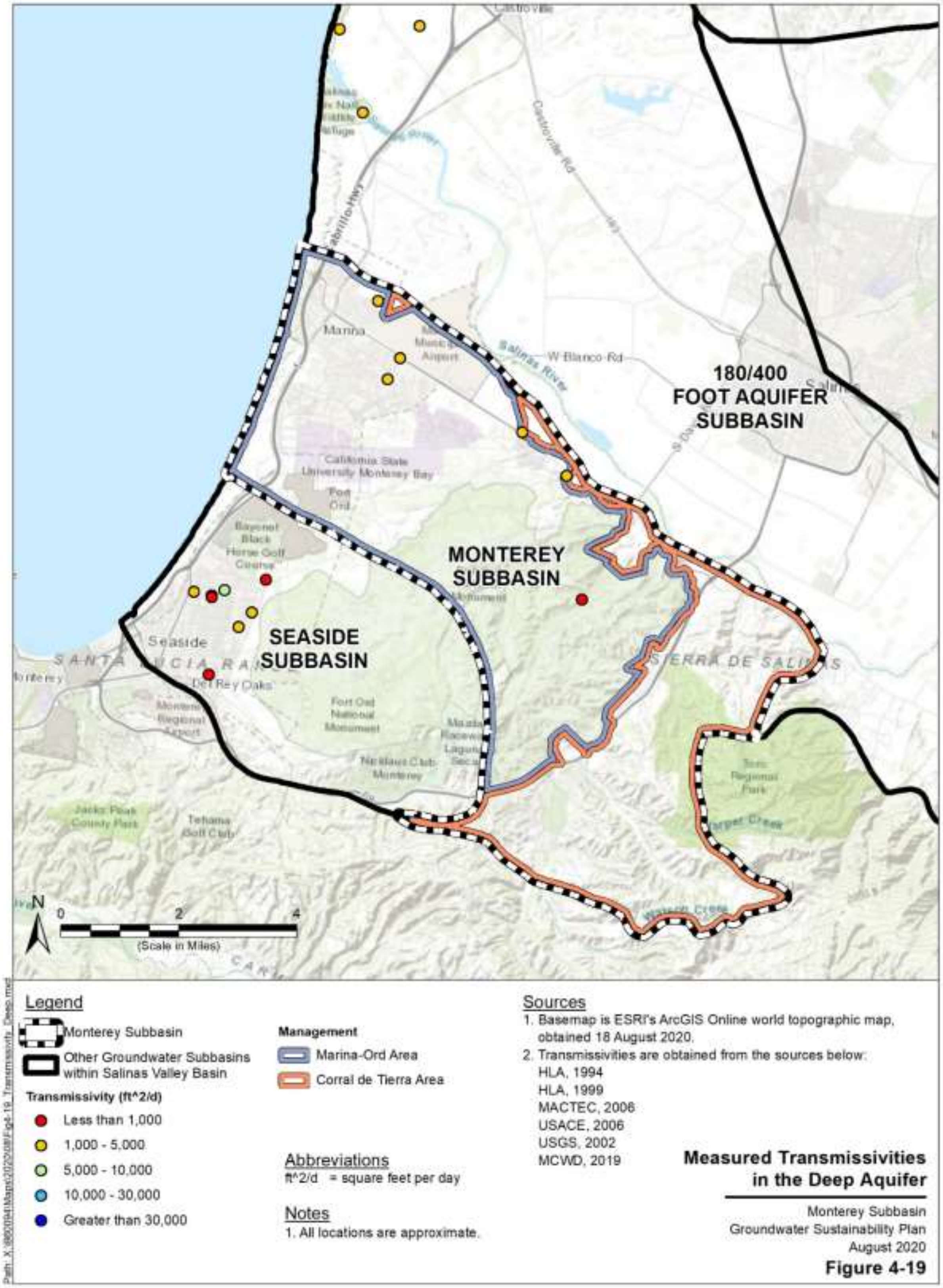
The Deep Aquifer is a major groundwater production aquifer beneath the Marina-Ord Area. Within the Marina-Ord Area, there are five MCWD production wells screened in the Deep Aquifer. MCWD's water supply provided by Deep Aquifer wells have increased from approximately 40% to 70% of its demand over the past 10 years, and production has ranged from 1,700 AFY to 3,200 AFY.

As shown on **Figure 4-18** and **Figure 4-19**, the Deep Aquifer generally has lower hydraulic conductivities and transmissivities than overlying 180-Foot and 400-Foot Aquifers. The measured horizontal hydraulic conductivity in Deep Aquifer ranges from 2.2 to 37 ft/d. Specific capacities of MCWD's Deep Aquifer wells range from 10.8 gpm/ft to 22.5 gpm/ft (MCWD, 2019).

The recharge mechanisms for the Deep Aquifer are not well known. There is likely some recharge from overlying aquifers, as downward vertical gradients exist (WRIME, 2003). Age dating of groundwater by USGS indicates that groundwater in the Deep Aquifer near the Monterey Coast may be 25,000 to 30,000 years old (USGS, 2002). An interval with dated marine water was found at approximately 1,000 ft bgs in this area. Additional work is scheduled to be conducted by MCWRA to assess the recharge to this aquifer zone (SVBGSA, 2020).

The Deep Aquifer is believed to be connected to the "deep" or Santa Margarita aquifer in Seaside Subbasin (Yates, 2005). Due to it geologic composition, the Deep Aquifer beneath the Marina-Ord Area may be connected to the Aromas Sand/Paso Robles aquifer and/or the Santa Margarita aquifer in the Corral de Tierra Area.


LANGLEY AREA SUBBASIN
EAST SIDE AQUIFER SUBBASIN
180/400 FOOT AQUIFER SUBBASIN
MONTEREY SUBBASIN
SEASIDE SUBBASIN
Marina
Salinas River
W Blanco Rd
California State University Monterey Bay
Seaside
Del Rey Oaks
SIERRA DE SALINAS
0
2
4
(Scale in Miles)
N
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Hydraulic Conductivity (ft/d)
Less than 1
1-10
10-100
100-1,000
Greater than 1,000
Management
Marina-Ord Area
Corral de Tierra Area
Abbreviations
ft/d = feet per day
Notes
1. All locations are approximate.
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 18 August 2020.
2. Hydraulic conductivies are obtained from the sources below:
HLA, 1994
HLA, 1999
GeoScience, 2014
GeoScience, 2016
Jordan et al., 2005
MACTEC, 2006
USACE, 2006
USGS, 2002
MCWD, 2019
Measured Hydraulic Conductivities in the Deep Aquifer
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-18


180/400
FOOT AQUIFER
SUBBASIN
MONTEREY
SUBBASIN
SEASIDE
SUBBASIN
Marina
W Blanco Rd
Salinas River
Castroville Rd
California State
University Monterey Bay
Seaside
Del Rey Oaks
Fort Ord
National
Monument
Tehama
Golf Club
SIERRA DE SALINAS
(Scale in Miles)
0
2
4
N
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Transmissivity (ft^2/d)
Less than 1,000
1,000 - 5,000
5,000 - 10,000
10,000 - 30,000
Greater than 30,000
Management
Marina-Ord Area
Corral de Tierra Area
Abbreviations
ft^2/d = square feet per day
Notes
1. All locations are approximate.
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 18 August 2020.
2. Transmissivities are obtained from the sources below:
HLA, 1994
HLA, 1999
MACTEC, 2006
USACE, 2006
USGS, 2002
MCWD, 2019
Measured Transmissivities
in the Deep Aquifer
Monterey Subbasin
Groundwater Sustainability Plan
August 2020
Figure 4-19

4.2.1.3 Structural Restrictions to Flow

There are no known structural restrictions to flow beneath the Marina-Ord Area.

A buried trace of the Reliz Fault (also known as the Reliz-King City Fault or King City Fault) has been said to generally align with the boundary between the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin (see **Figure 4-2**). However, the location of this fault is poorly constrained or defined. Beneath the bottom of the Subbasin, the Monterey Formation is displaced downward on the northeast side of the Reliz Fault by as much as 1,000 ft (Durbin, 2007). There is no sign of fault affecting "late Pleistocene or younger sediments" (HLA, 1994; WRIME 2003). This fault does not appear to impede groundwater flow in the Dune Sand Aquifer, the 180-Foot Aquifer, or the 400-Foot Aquifer, based on observed groundwater elevation and seawater intrusion conditions across the Subbasin boundary (see Section 5).

4.2.1.4 General Water Quality

This section presents a general discussion of the natural fresh groundwater quality in the Marina-Ord Area, focusing on general geochemistry. The distribution and concentrations of specific constituents of concern, including seawater intrusion, are discussed in Chapter 5. This discussion is based on data from previous reports. Piper diagrams of general water quality in each principal aquifer are shown on **Figure 4-20** through **Figure 4-23**.

Dune Sand Aquifer

Groundwater in the Dune Sand Aquifer has a sodium-chloride chemical character. West of the Dune Sand Aquifer groundwater divide, the groundwater flows westward and enters the 180-Foot Aquifer near the edge of the SVA (see **Figure 4-14**), where it reverses direction and flows eastward (HLA, 1994).

Groundwater in this aquifer is primarily fresh; minimal seawater intrusion has occurred in this aquifer.

180-Foot Aquifer

Water quality in the 180-Foot Aquifer beneath the Marina-Ord Area is distinct from the water quality in the Salinas Valley and has a more sodium-chloride chemical character (i.e., a higher proportion of sodium and chloride) (DKT, 1989 and HLA, 1994). Especially west of the SVA, groundwater quality is similar throughout the combined Dune Sand Aquifer and 180-Foot Aquifer (HLA, 1994). Groundwater in both aquifers is likely recharged from precipitation infiltrating through similar geologic materials. The Dune Sand Aquifer contributes recharge to the 180-Foot Aquifer, as groundwater from this aquifer flows westward until it reaches the SVA, after which it turns eastward within the 180-Foot aquifer.

The upper 180-Foot Aquifer is primarily fresh; seawater intrusion has occurred in the lower 180-Foot Aquifer in the northern portion of the Subbasin (see Section 5.2 Seawater Intrusion).

400-Foot Aquifer

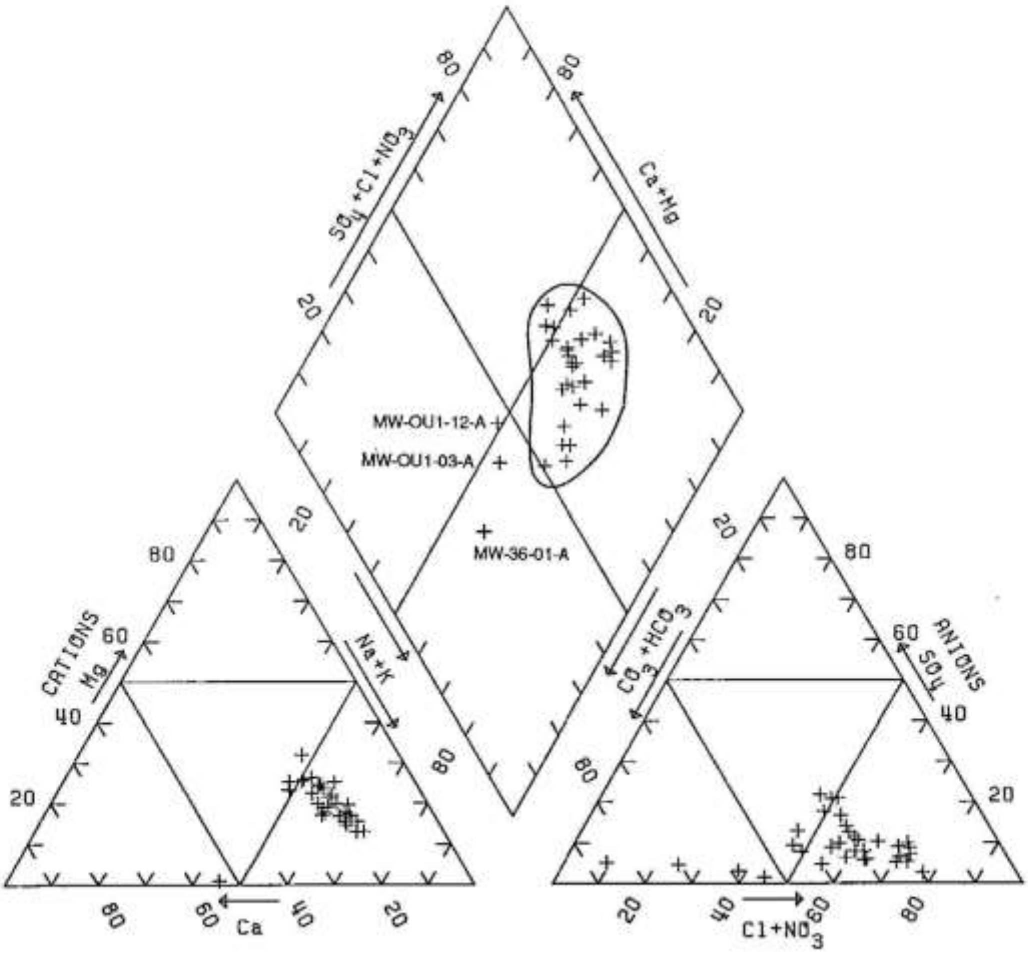
Water quality in the 400-Foot Aquifer is chemically distinct from the water quality of the overlying Dune Sand and 180-Foot Aquifer. The 400-Foot Aquifer has a calcium-bicarbonate chemical character (HLA, 1994). However, some wells shown on **Figure 4-16** have higher concentrations of chloride, which is indicative of seawater intrusion. Wells screened in the gravel layers of the 400-Foot Aquifer have elevated concentrations of sodium. This characteristic is similar to that of wells screened in the gravel layers of the 180-Foot Aquifer and those in the Salinas Valley (HLA, 1994).

Seawater intrusion has occurred in the 400-Foot Aquifer in the northern portion of the Subbasin.

Deep Aquifer

Groundwater in the Deep Aquifer system is distinct from the overlaying aquifers, having a sodium-bicarbonate chemical character with relatively low concentrations of calcium (Harding ESE, 2001; USGS, 2002). Water quality generally worsens (i.e., increasing chloride concentrations) with depth (WRIME, 2003). Ratios of chloride-to-boron and isotope analysis (^{18}O, ^{2}H, ^{3}H, ^{14}C) were used to infer the sources and age of groundwater (USGS, 2002). Groundwater in the upper portions of the Deep Aquifer had similar chloride-to-boron ratios to groundwater in the overlaying aquifers, which suggests a similar source of recharge. Groundwater in the deepest sections of the Deep Aquifer is enriched in chloride with respect to surface waters in the Salinas Valley and isotope analysis indicated the Deep Aquifer was not recharged under recent climatic conditions. Isotope analysis also revealed that the groundwater in the Deep Aquifer may have been recharged thousands of years ago (USGS, 2002).

No seawater intrusion was observed in the Deep Aquifer.



Legend:

+ A-Aquifer Water Sample

Ford Ord A-Aquifer Water Quality

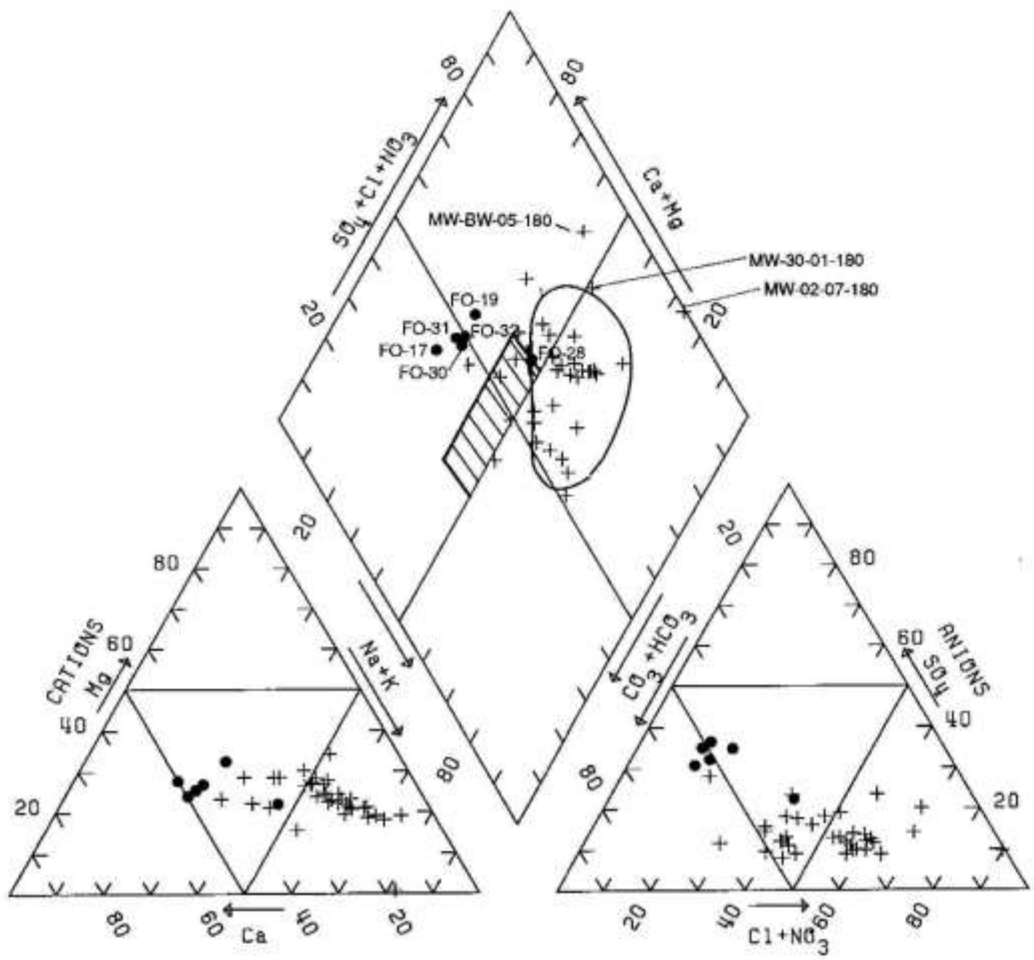
Source:

Adapted from HLA (1994).

Piper Diagram,
Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-20



Legend:

+ 180-Foot Aquifer Water Sample (1992 Data)

● Ford Ord Water-Supply Water Sample (1985 Data)

Ford Ord A-Aquifer Water Quality

Salinas Valley 180-Foot Aquifer Water Quality *(DKT, 1989)*

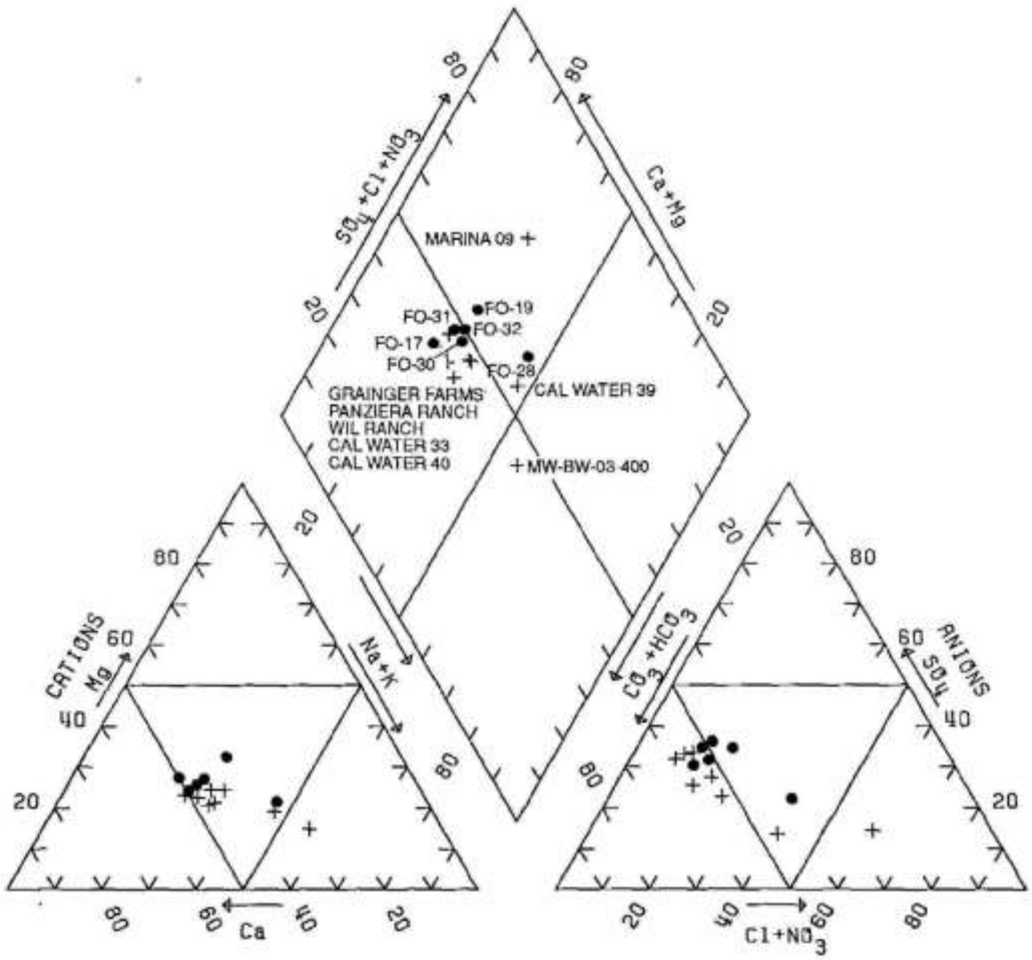
Source:

Adapted from HLA (1994).

Piper Diagram, 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-21



Legend:

+ 400-Foot Aquifer Water Sample (1992 Data)

● Ford Ord Water-Supply Water Sample (1985 Data)

Ford Ord A-Aquifer Water Quality

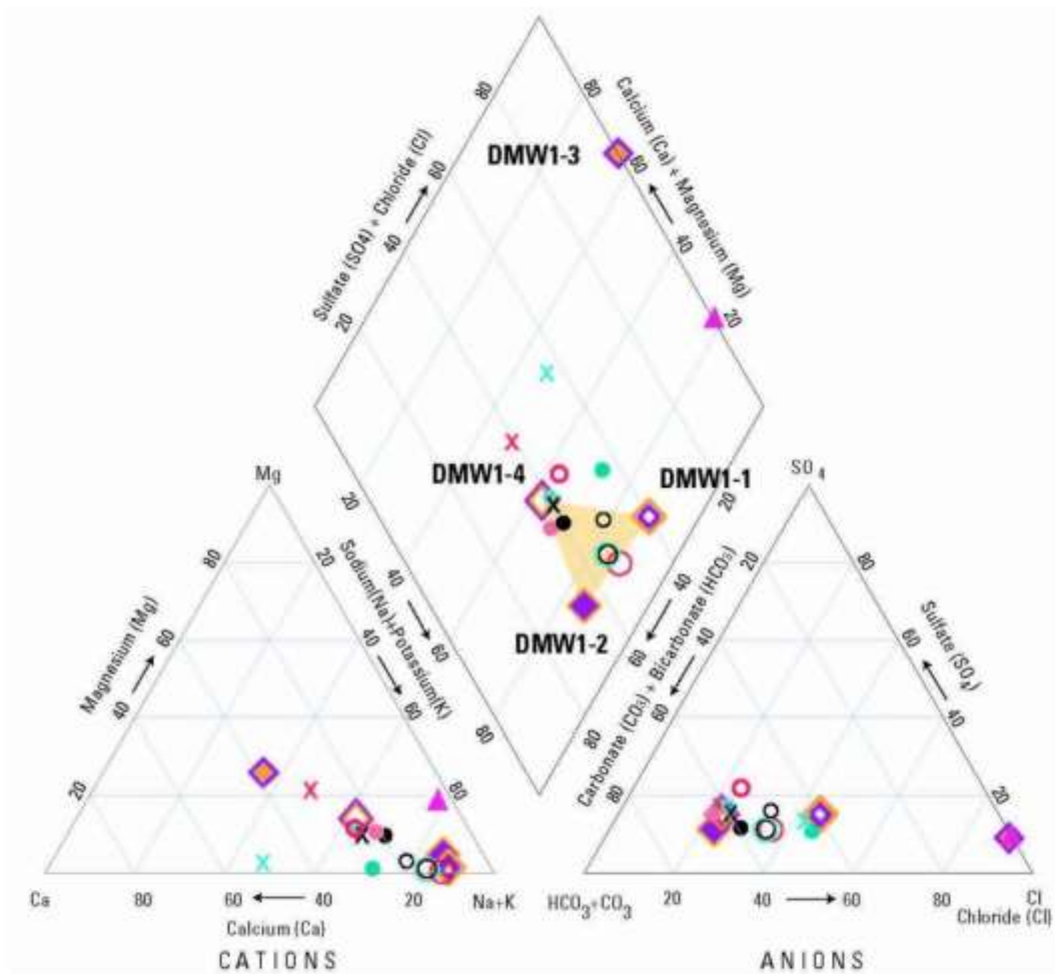
Source:

Adapted from HLA (1994).

Piper Diagram, 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-22



Legend:

Wells - Deep Aquifer Monitoring
14S/1E

- 24L5 [DMW1-4] (930'-950')
- 24L4 [DMW1-3] (1,040'-1,060')
- 24L3 [DMW1-2] (1,410'-1,430')
- 24L2 [DMW1-1] (1,820'-1,860')

(') - Indicatesdepth in feet below land surface

- Seawater

Wells - Water Supply
14S/2E

	1995	1997	2000	MCWD Well Number
31K2M	x	x	x	9
32	o	•	•	10
32D1	•	•	•	11
30	O	O	O	12

Source:

Adapted from USGS (2002).

Notes:

1. Trilinear diagram of major-ion chemistry for selected groundwater samples drom the deep-aquifer system in the Salinas Valley, 1995, 1997, and 2000 with samples from DMW1 wells, 2000.

Piper Diagram,
Deep Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-23

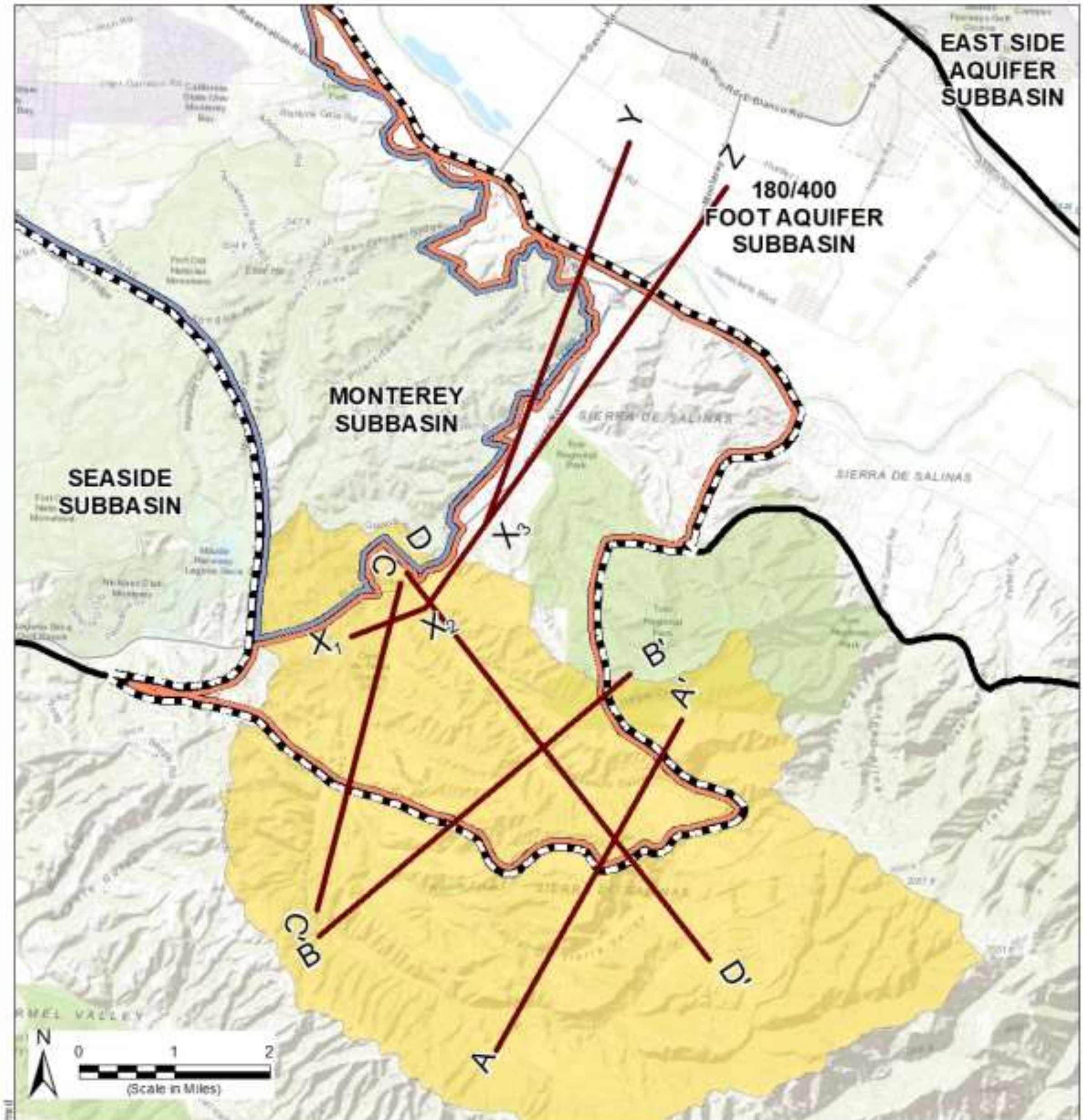
20200623.121603 G:\960094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18

4.2.2 Hydrogeology in the Corral de Tierra Area

4.2.2.1 Cross-Sections

Figures 4-24 through 4-29 present cross-sections that illustrate the geologic setting beneath the Corral de Tierra Area as well as a geologic map of the area that shows the geologic formations present at ground surface. The legends in each of the figures presents the age sequence of the geologic materials from the youngest unconsolidated Quaternary sediments to the oldest pre-Cretaceous basement rock where it may be present.

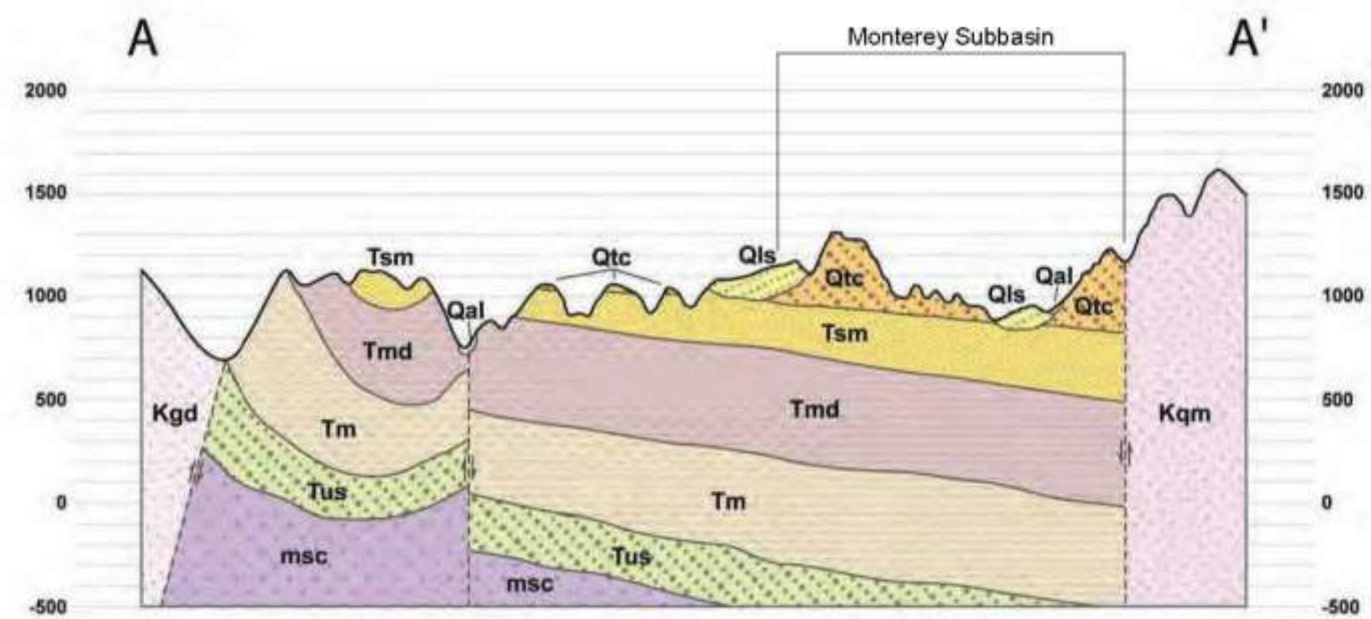
The cross-sections for the Corral de Tierra Area are derived from the *El Toro Groundwater Study* (GeoSyntec, 2007) and the *Supplement to the El Toro Study* (GeoSyntec, 2010). These cross-sections illustrate the faulted and warped geologic features of the area. In these cross sections, the alluvium mapped as Q or Qls on **Figure 4-2** is shown as Qal, Qyf, Qc, and Qof. The continental deposits shown as Qae and QT on the geologic map is shown as Qtc on these cross-sections. The Santa Margarita Formation shown as Msm on the geologic map is shown as Tsm on these cross-sections. The Monterey Formation shown as Mmy on the geologic map is show as Tm or Tmd on these cross-sections.



Cross-Section Locations
Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-24



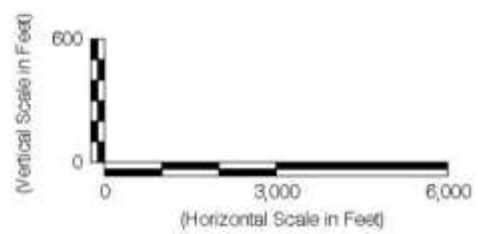
Legend:

- Qal - Alluvial Deposits
- Qls - Landslide Deposits
- Qtc - Continental Deposits (Aromas - Paso Robles)
- Tsm - Santa Margarita*
- Tmd - Monterey Formation (Upper Formation)
- Tm - Monterey Formation (Lower Formation)
- Tus - Basal Sands
- Kgd - Granodiorite
- Kqm - Garnetiferous Quartz Monzonite
- msu - Schist

* El Toro Primary Aquifer System

Source:

Adapted from GeoSyntec (2007).

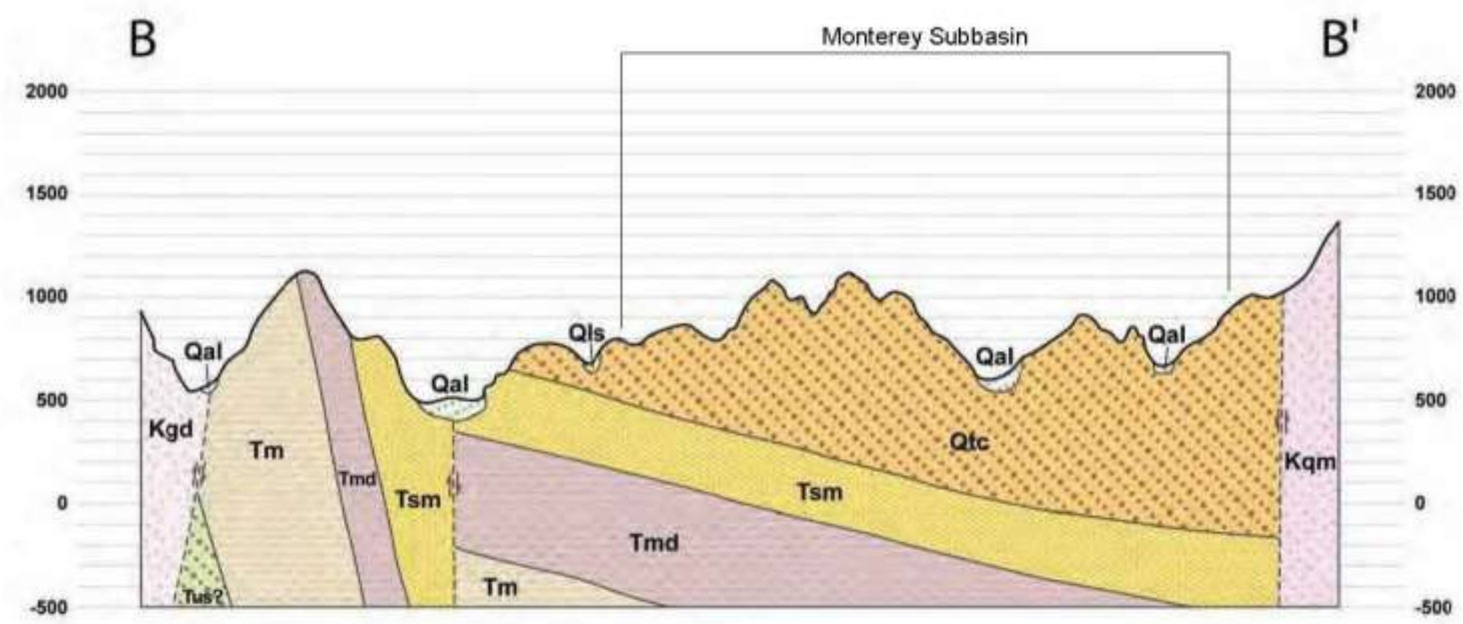


Cross-Section A-A', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-25

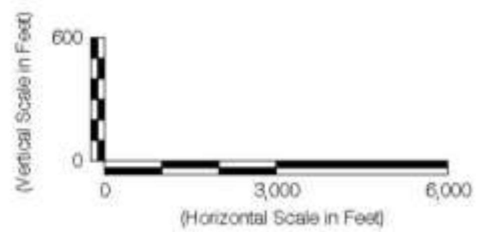
20200623.121603 G:\860094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



Legend:

- Qal - Alluvial Deposits
- Qls - Landslide Deposits
- Qtc - Continental Deposits (Aromas - Paso Robles)
- Tsm - Santa Margarita*
- Tmd - Monterey Formation (Upper Formation)
- Tm - Monterey Formation (Lower Formation)
- Tus - Basal Sands
- Kgd - Granodiorite
- Kqm - Garnetiferous Quartz Monzonite
- msu - Schist

* El Toro Primary Aquifer System



Source:

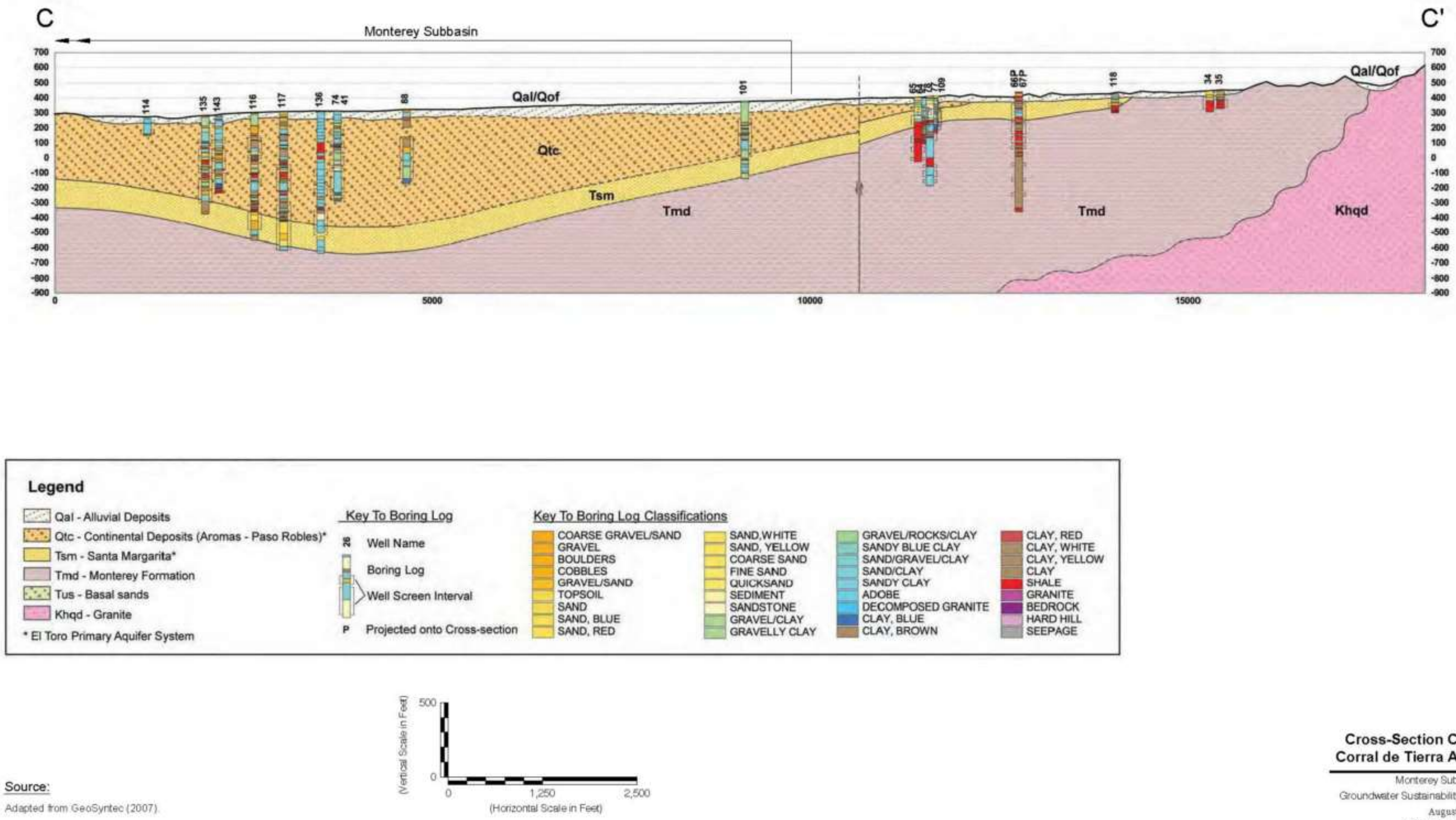
Adapted from GeoSyntec (2007).

Cross-Section B-B', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-26

20200623.121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



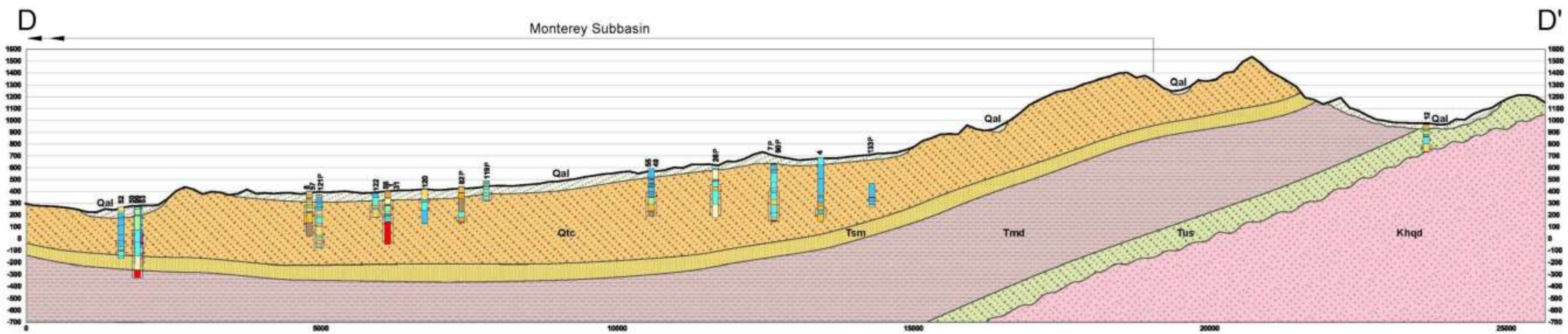
Source:
Adapted from GeoSyntec (2007).

Cross-Section C-C', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-27

20200623.121603 G:\860094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



Legend

- Qal - Alluvial Deposits
- Qtc - Continental Deposits (Aromas - Paso Robles)*
- Tsm - Santa Margarita*
- Tmd - Monterey Formation
- Tus - Basal sands
- Khqd - Granite

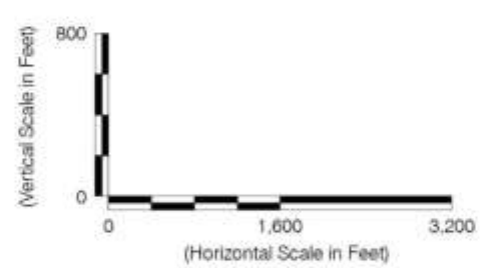
* El Toro Primary Aquifer System

Key To Boring Log

- 26 Well Name
- Boring Log
- Well Screen Interval
- P Projected onto Cross-section

Key To Boring Log Classifications

COARSE GRAVEL/SAND	SAND,WHITE	GRAVEL/ROCKS/CLAY	CLAY, RED
GRAVEL	SAND, YELLOW	SANDY BLUE CLAY	CLAY, WHITE
BOULDERS	COARSE SAND	SAND/GRAVEL/CLAY	CLAY, YELLOW
COBBLES	FINE SAND	SAND/CLAY	CLAY
GRAVEL/SAND	QUICKSAND	SANDY CLAY	SHALE
TOPSOIL	SEDIMENT	ADOBE	GRANITE
SAND	SANDSTONE	DECOMPOSED GRANITE	BEDROCK
SAND, BLUE	GRAVEL/CLAY	CLAY, BLUE	HARD HILL
SAND, RED	GRAVELLY CLAY	CLAY, BROWN	SEEPAGE



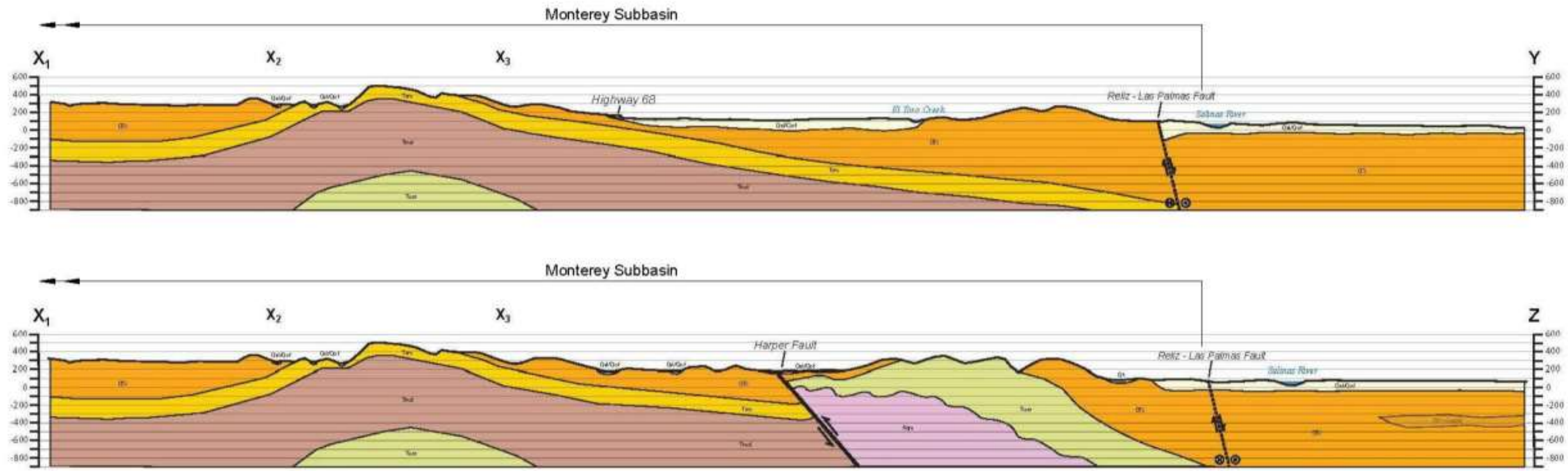
Source:

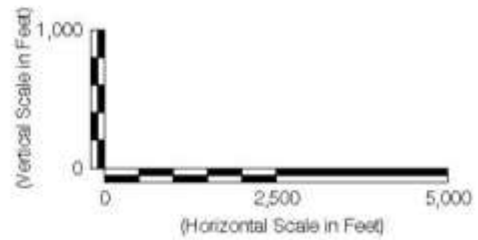
Adapted from GeoSyntec (2007).

Cross-Section D-D', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-28





Source:

Adapted from GeoSyntec (2010).

Cross-Sections X-Y and X-Z
Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-29

4.2.2.2 Principal Aquifers and Aquitards

The principal aquifers and aquitard definitions in the Corral de Tierra Area are directly correlated to the local geology. Groundwater is produced from two major geologic units: the Aromas Sands/Paso Robles Formation deposits and the Santa Margarita Sandstone. These principal aquifers are the same principal aquifers found in the Seaside Subbasin (Yates, 2002).

The shallowest water-bearing sediments within the Corral de Tierra area are thin and occur along stream corridors. These sediments range from 0 to 120 feet thick and are a part of the Holocene alluvium unit (GeoSyntec, 2007). The geologic map in **Figure 4-2** shows this unit as Q; the cross-sections in **Figure 4-24** through **Figure 4-29** show this unit as Qal and Qls. Several small domestic wells draw groundwater from these local alluvial aquifers, but these volumes of groundwater are minimal (GeoSyntec, 2007). Since this volume of groundwater is neither economic nor significant, these shallow sediments are not considered a principal aquifer. Groundwater in these sediments is hydraulically connected to the small streams found in the area (El Toro Creek, San Benancio Gulch, Watson Creek, and Calera Creek; see Section 4.3) (GeoSyntec, 2007).

Beneath the shallow sediments, the following series of principal aquifers are recognized as the distinguishing hydrostratigraphic features of this Area:

- Aromas Sands/Paso Robles Formation
- Santa Margarita Sandstone

Immediately outside the southern end of the Subbasin, small amounts of groundwater are also produced from the Monterey Formation and the unnamed sandstone/conglomerate which underlies the Monterey Formation (Anderson-Nichols and Co., 1981). Additional information regarding hydrogeology of these formations can be found in Geosyntec (2007) and HydroMetrics (2009).

Aromas Sands/Paso Robles Formation

Within the Corral de Tierra Area, the eolian Aromas Sands deposits are up to 200 feet thick and comprise the hills in the Area. The Paso Robles Formation comprises a series of nonmarine, semi-consolidated continental deposits that consist of fine to coarse-grained sands and gravels of Plio-Pleistocene age. Due to local variations of conformability, these units are sometimes referred to collectively as continental deposits (GeoSyntec, 2007). The geologic map in **Figure 4-2** shows the Aromas Sand and Paso Robles Formation units as Qae and QT, respectively. The Aromas Sand and Paso Robles units are grouped together and shown on the cross-sections as undifferentiated Qtc.

These deposits are geologically equivalent to the named 400-Foot Aquifers in the greater Salinas Valley Groundwater Basin based on their geologic ages and depositional characteristics (Kennedy-Jenks, 2004; HydroMetrics, 2009).

The primary uses of groundwater from the Aromas/Paso Robles continental deposits in the Corral de Tierra are domestic, municipal, and minimal agricultural supply.

Santa Margarita Sandstone

The Santa Margarita Sandstone is a Miocene-aged, marine, white, thick and locally cross-bedded, very fine to coarse-grained sandstone with an average thickness of 100 to 300 feet in the Subbasin. The geologic map in **Figure 4-2** shows this unit as Msm. In the geologic cross-sections, this unit is shown as Tsm.

This formation is geologically equivalent to the Deep Aquifer in the Marina-Ord Area and the greater Salinas Valley Groundwater Basin based on its geologic age and depositional characteristics (Kennedy-Jenks, 2004; HydroMetrics, 2009).

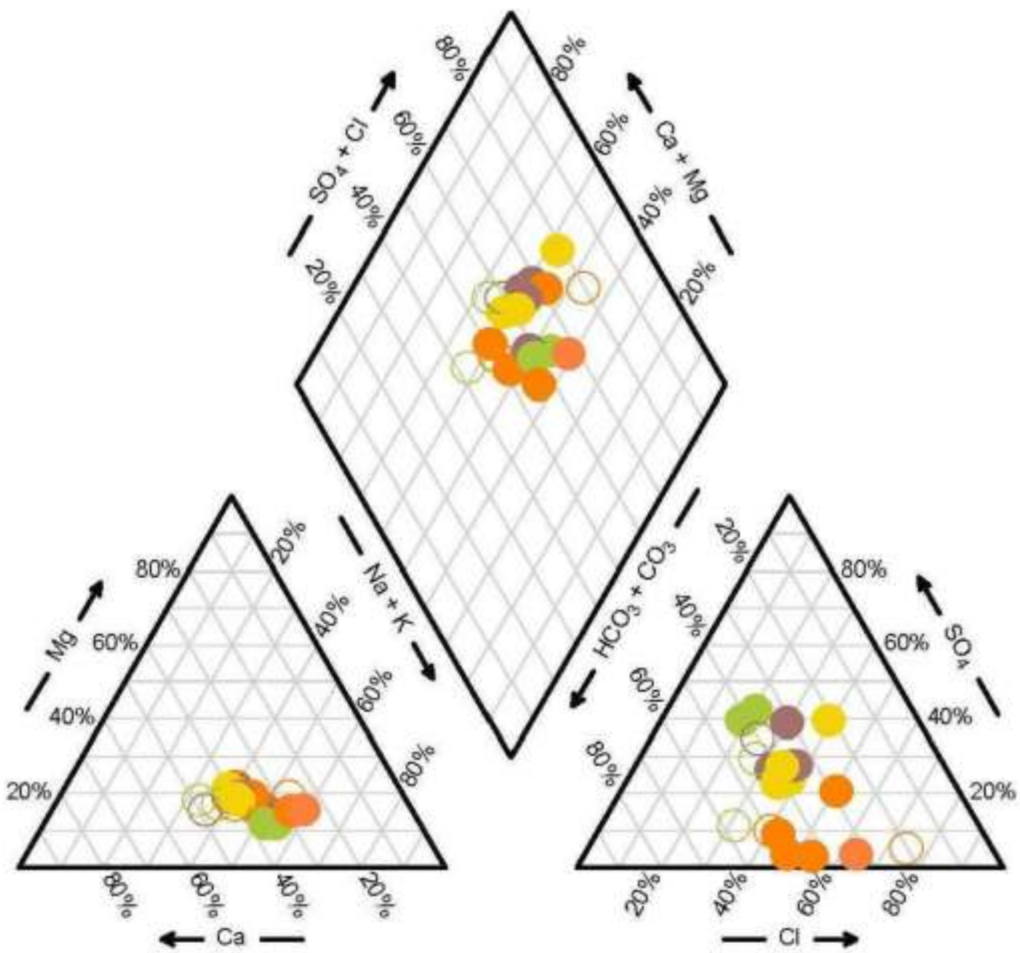
The primary uses of groundwater from the Santa Margarita Sandstone, are domestic, municipal, and agricultural supply.

4.2.2.3 Structural Restrictions to Flow

The Corral de Tierra Area is surrounded by several structural features. It is bounded on the east by the Reliz Fault and the Corral de Tierra Fault to the southwest (GeoSyntec, 2007). The Harper Fault is between these two other faults, closer to the Reliz Fault (GeoSyntec, 2007; Figure 2-28). All of these faults strike to the northwest and steeply dip to the northeast. A northeast striking syncline occurs roughly along Highway 68. A deeper anticlinal feature is shown in **Figure 4-2** near San Benancio Creek and appears to be orthogonal to the syncline which parallels Highway 68 (GeoSyntec 2010). Additional east-trending anticlines are shown near the boundary between the Seaside Subbasin and the Corral de Tierra Area (**Figure 4-2**). Despite all structural features which bound and deform the Corral de Tierra area, none seem to indicate any barrier to flow to the rest of the Monterey Subbasin, or to the neighboring Seaside or 180/400-Foot Aquifer Subbasins. Rather, the corner of the Seaside and Corral de Tierra boundary seems to be a location of divergence of groundwater flow, where some groundwater continues to the Seaside Subbasin by way of the Laguna Seca area, and some groundwater continues to the Marina area by way of the Fort Ord National Monument, as shown in Section 5.1 Groundwater Elevations. This corner features a dip-rise-dip appearance in the surface of the Monterey Formation as shown in the contours in **Figure 4-3**.

4.2.2.4 General Water Quality

As shown on **Figure 4-30**, the groundwater in the Corral De Tierra Subbasin has an intermediate chemical character (no dominant cation or anion) but the chemical composition varies slightly between lithologic units. Uniform moderate to high TDS concentrations were found throughout the Corral de Tierra Area, which suggests that the lithologic units are hydraulically interconnected, as is also suggested by groundwater levels. Isotope analysis further indicates that groundwater in the Corral de Tierra Area has limited mixing between the between lithologic units and similar recharge sources (Geosyntec, 2007).



Legend:

- QTc
- QTc + Tsm
- Tsm
- QTc + Tmd
- Tmd
- Tmd + Tus
- Tus

Source:

Adapted from GeoSyntec (2007).

Piper Diagram, Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
August 2020

Figure 4-30

20200623.121603 G:\660094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18

4.2.2.5 Aquifer Properties

The most comprehensive compilation of hydraulic conductivities in the Corral de Tierra Area comes from the *Seaside Groundwater Basin Modeling and Protective Groundwater Elevations* (HydroMetrics, 2009). This study describes a model that covers the adjudicated Seaside Subbasin and the Monterey Subbasin. This study collected previously published hydraulic conductivity values. Hydraulic conductivity estimated for each of the principal aquifers, and used in the model, are shown in Table 4-2. The study also estimated storage coefficients, which relate to an aquifer's ability to store groundwater, for each of the principal aquifers. These include specific yield (set at a value of 0.08 for the unconfined aquifers), and specific storage (set at a value of 0.0006 for the confined aquifers).

Table 4-2: Hydraulic Conductivity Values for the Corral de Tierra Area (from HydroMetrics WRI, 2009)

Hydraulic Conductivity (feet per day)	Aquifer	Source	Reference
20	Paso Robles	Pump test	Fugro West, Inc. (1997)
2		Model calibration	Yates et al. (2005)
16.4-25.4	Purisima	Pump test	CH2M Hill (2004)
63	Santa Margarita	Pump test	Fugro West, Inc. (1997)
3-5		Model calibration	Yates et al. (2005)

4.3 Surface Water Bodies

Surface water features and subwatersheds at the 12-digit Hydrological Code (HUC-12) level within the Subbasin are shown on **Figure 4-31**.

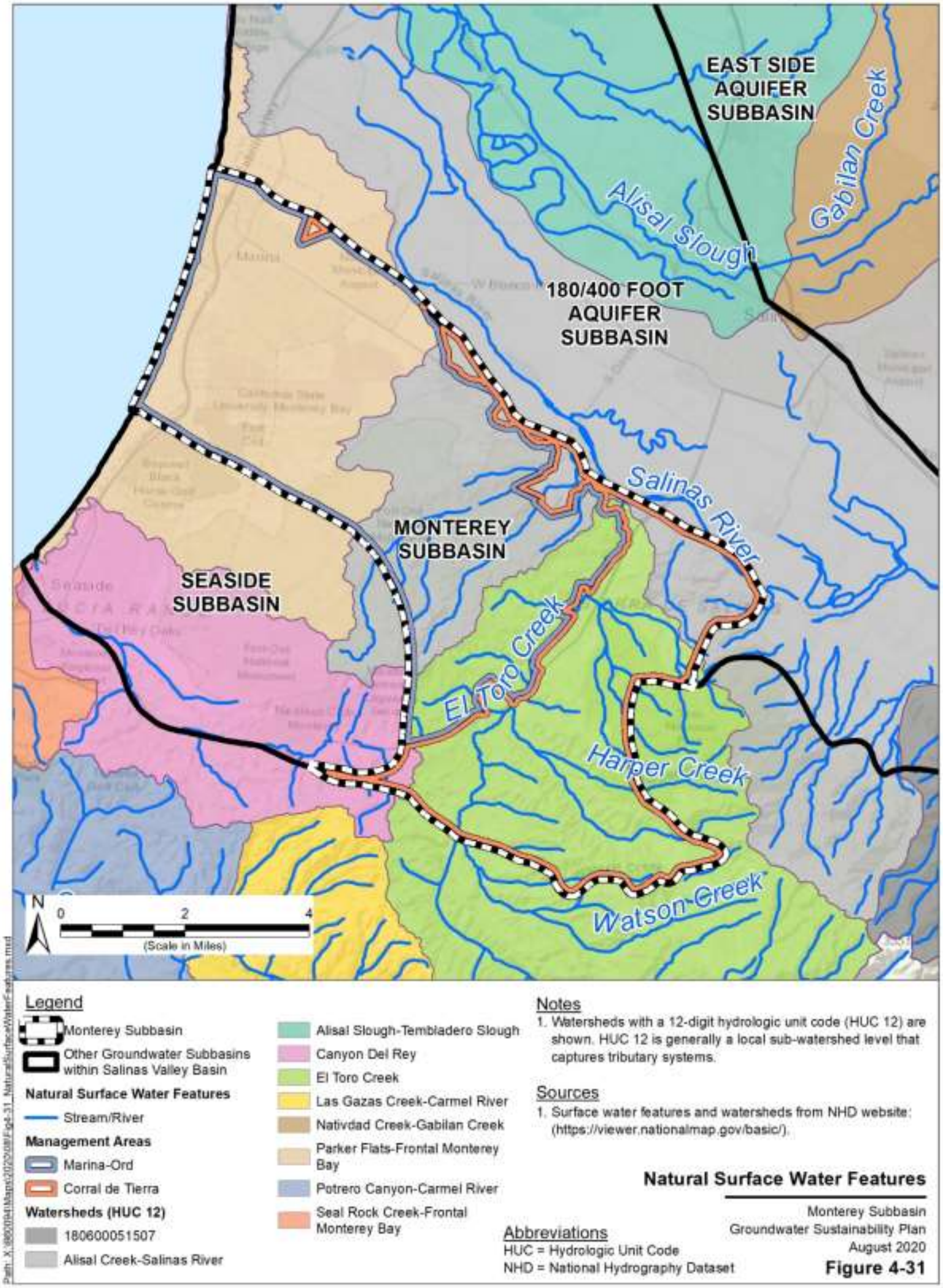

EAST SIDE AQUIFER SUBBASIN
Gabilan Creek
Alisal Slough
180/400 FOOT AQUIFER SUBBASIN
Salinas River
MONTEREY SUBBASIN
SEASIDE SUBBASIN
El Toro Creek
Harper Creek
Watson Creek
N
0
2
4
(Scale in Miles)
Legend
Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Natural Surface Water Features
Stream/River
Management Areas
Marina-Ord
Corral de Tierra
Watersheds (HUC 12)
180600051507
Alisal Creek-Salinas River
Alisal Slough-Tembladero Slough
Canyon Del Rey
El Toro Creek
Las Gazas Creek-Carmel River
Natividad Creek-Gabilan Creek
Parker Flats-Frontal Monterey Bay
Potrero Canyon-Carmel River
Seal Rock Creek-Frontal Monterey Bay
Notes
1. Watersheds with a 12-digit hydrologic unit code (HUC 12) are shown. HUC 12 is generally a local sub-watershed level that captures tributary systems.
Sources
1. Surface water features and watersheds from NHD website: (https://viewer.nationalmap.gov/basic/).
Abbreviations
HUC = Hydrologic Unit Code
NHD = National Hydrography Dataset
Natural Surface Water Features
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Figure 4-31

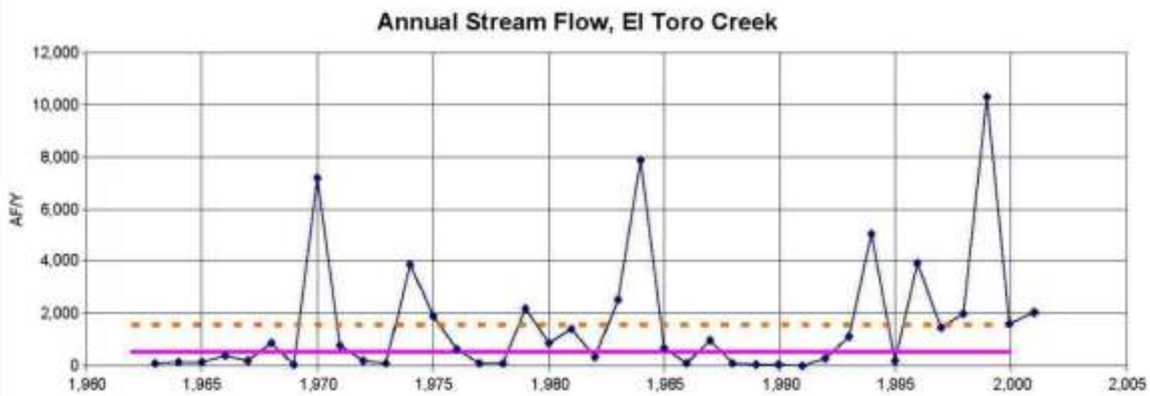
Coastal areas of the Subbasin drain toward Monterey Bay. Runoff is minimal due to the high rate of surface water infiltration into the permeable dune sand. Consequently, well-developed natural drainages are absent throughout much of this area (Harding, 2004).

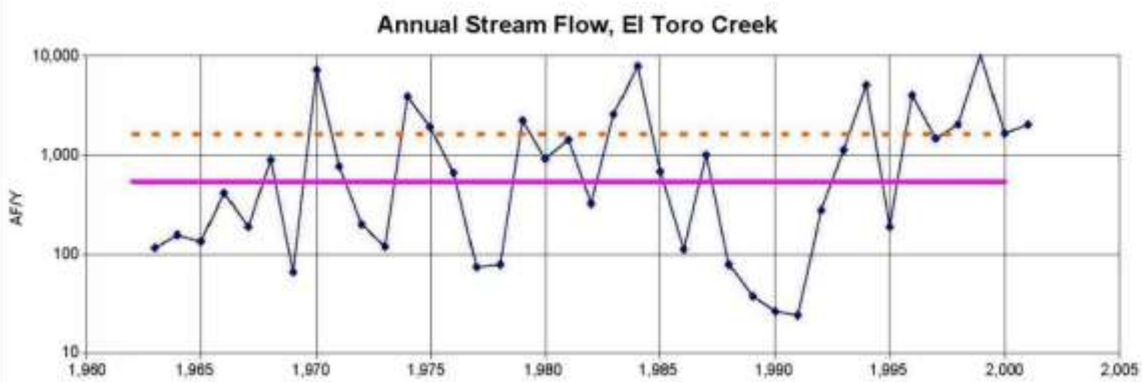
Small intermittent streams found in the Subbasin include the San Benancio Gulch, Watson Creek, and Calera Creek (GeoSyntec, 2007). These streams generally flow northeastward and are tributaries to the Salinas River. Flows in these creeks respond rapidly to rainfall, and they are usually dry in the summer months. These creeks have a “flashy” nature and readily lose water to streambed seepage. (Hydrometrics, 2009). These streams flow less than 25 percent of the year (GeoSyntec, 2007).

El Toro Creek is a perennial stream below the confluence with Watson Creek below the Corral de Tierra golf course (Feikhart, 2001). Recorded streamflows at USGS gage 11152540 from 1961 to 2001 indicate a mean annual streamflow of 1,590 AFY (GeoSyntec, 2007). This mean annual streamflow was calculated for the entire record from 1961 to 2001. However, El Toro Creek did not record flow every year, with notable dry periods from 1985 to 1992 (**Figure 4-32**).

Yates and others (2005) concluded that local streams (i.e., El Toro Creek and smaller streams) contribute insignificantly to groundwater recharge. Along limited reaches, these streams gain streamflow from groundwater discharge. However, the stream-aquifer exchanges are not thought to be significant to either the groundwater budget or to the response of the groundwater basin to pumping (Durbin, 2007).

Due to the intermittent nature and minimal amount of streamflow, there are no surface water rights registered with the SWRCB within the Subbasin.





Legend:

- Mean Annual Flow (AF/Y)
- Mean Annual Log Q = 525 AF/Y
- Mean Annual Q = 1,590 AF/Y

Source:

Adapted from GeoSyntec (2007).

Annual Stream Flow, El Toro Creek

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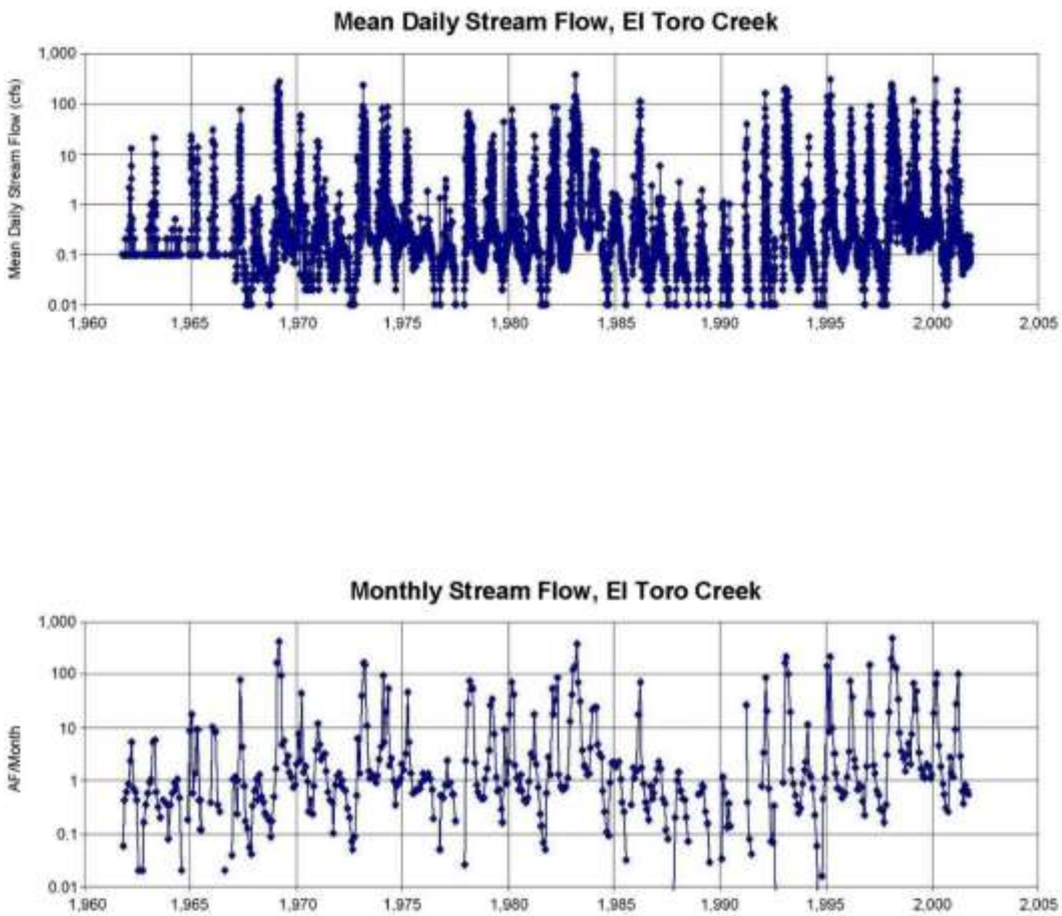
Figure 4-32

20200623 121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



Legend:

Mean Daily and Monthly Flow

Source:

Adapted from GeoSyntec (2007).

Daily and Monthly Stream Flow, El Toro Creek

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Figure 4-33

4.3.1 Source and Point of Delivery for Imported Water Supplies

There are no known sources of imported water for this subbasin. Groundwater is the only source of water for this subbasin.

4.4 Data Gaps

A significant portion of the subbasin remains undeveloped to date, which includes federal lands located in the Fort Ord hills area and lands in the lower El Toro Creek area (i.e. northern portion of the Corral de Tierra area). As such, limited to no subsurface information is available in these areas. Regardless, many comprehensive studies have been conducted in areas where groundwater development has been active; and the hydrogeologic conceptual model for those areas is well developed.

One significant data gap exists in the hydrogeologic conceptual model for the Subbasin. This data gap relates to the location and magnitude of recharge to the Marina-Ord Area Deep Aquifer, one of the major production aquifers within the Subbasin and within other subbasins of the Salinas Valley Groundwater Basin. As described in Chapters 7, the GSP will include ongoing data collection and monitoring that will allow continued refinement and quantification of the groundwater system. Chapter 10 includes activities to address the identified data gaps and improve the hydrogeologic conceptual model.