4.4 Groundwater Resources

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This section analyzes the potential for construction and operation of the Monterey Peninsula Water Supply Project (MPWSP or proposed project) to adversely impact local and regional groundwater resources. Specifically, this analysis focuses on how the proposed coastal extraction wells and aquifer storage and recovery (ASR) system improvements would change the groundwater levels, flow direction, and water quality in the groundwater aquifers adjacent to the coast and further inland beneath the Salinas Valley and within the Seaside Groundwater Basin. The analysis is based on site-specific investigations, review of various hydrogeologic models, maps, and technical reports, including available hydrogeologic and geotechnical reports from the California Department of Water Resources (DWR), United States Geological Survey (USGS), the California Geological Survey (CGS), project-specific investigations for various project components, and the general plans for Monterey County and the local cities.

4.4.1 Setting

This section describes the setting for groundwater resources for the areas that could be affected by the installation and operation of the seawater intake system and the ASR system, located in the Salinas Valley Groundwater Basin (SVGB) and Seaside Groundwater Basin (SGB), respectively.

4.4.1.1 Terminology and Concepts

Groundwater is the water occurring beneath the earth's surface and hydrogeology refers to the study of how that water interacts with the underlying geologic units of rock and soil. Most groundwater occurs in sand and gravel that was once deposited by water (referred to as alluvium), which has since been covered by layers of clay, silt, sand, and gravel. Fluvial deposits more specifically refer to clay, silt, sand, and gravel that were laid down by rivers and streams as a result of bank erosion where the material is transported and redeposited within the river system in the form of bars, points, and flood plains.

Coarse materials such as sand and gravel hold the most groundwater when saturated and are referred to as aquifers. Layers of finer-grained materials such as clay and silt restrict but do not prevent flow of groundwater and are referred to as aquitards. Aquifers can extend over many square miles and are referred to as basins.

A groundwater basin is defined as an aquifer or a stacked series of aquifers with reasonably well-defined boundaries in a lateral direction and a definable bottom. California's groundwater basins typically include one aquifer or a series of aquifers with intermingled aquitards. In general, groundwater basin boundaries are determined by physical attributes such as the lateral extent of aquifers, boundaries to flow such as bedrock, and groundwater divides. A divide is defined by a line on either side of which groundwater moves in opposite directions. A groundwater divide, like a surface water divide, separates distinct groundwater flow regions within an aquifer.

Depending on the type of geologic unit overlying a water-bearing zone, groundwater can be unconfined or confined. The water table in an unconfined aquifer does not have an overlying impermeable unit (aquitard) over it and thus the pressure is exerted by the overlying water and atmospheric pressure. Groundwater under these unconfined conditions flows from areas of high groundwater elevation to areas of low groundwater elevation. Under confined conditions, vertical flow from or to the aquifer is restricted by overlying aquitards. Groundwater under confined conditions flows from areas of high pressure to areas of low pressure and is influenced by 1) the pressure, weight, and confining nature of overlying sediments, 2) water entering the aquifers from areas of recharge, and 3) water leaving the aquifers through natural discharge or through the pumping of supply wells. When a well penetrating a confined aquifer is pumped, internal aquifer pressure is reduced, which can increase the flow of water towards the well.

4.4.1.2 Local and Regional Hydrogeology

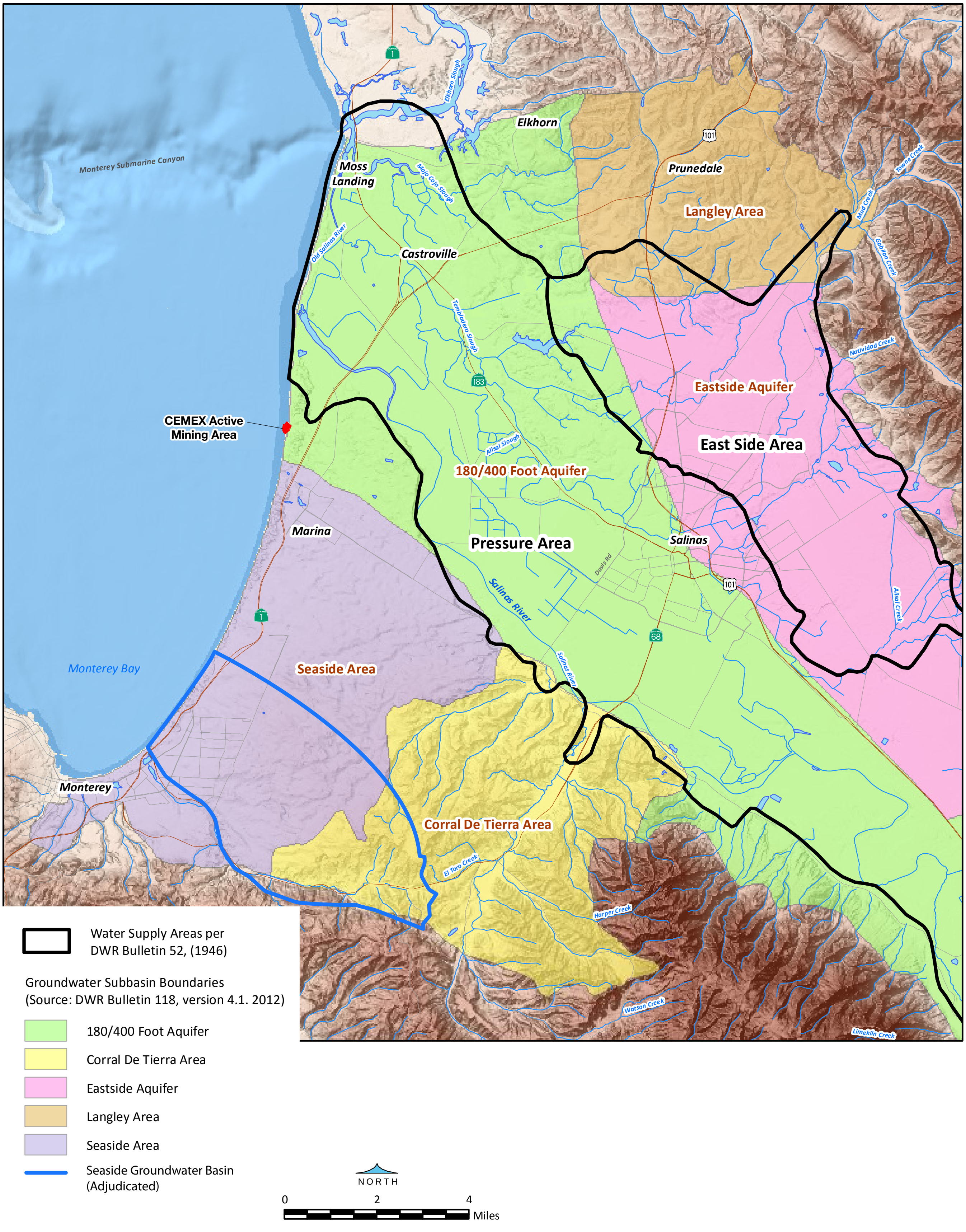
The following sections discuss the groundwater system that underlies the project area. The groundwater system described in this chapter reflects what the scientific community currently accepts as the most reasonable description of the subsurface geologic units and the depth and extent of aquifers and the aquitards. The comprehensive understanding of the groundwater system was developed through review of previous groundwater studies, published geologic maps, observation of well performance, water quality data, and findings from site-specific subsurface investigations and modeling. The data review and eventual formulation of a defensible and scientifically-based understanding of the local and regional hydrogeology required several months and was completed through the collaborative efforts of recognized experts in Monterey Bay coastal geology and groundwater, as well as stakeholders of groundwater use and management familiar with this region. This body of expertise is referred to as the Hydrogeology Working Group (HWG), which contains members that represent the Salinas Valley Water Coalition, the Monterey County Farm Bureau, California American Water Company (CalAm), and the California Public Utilities Commission CEQA team.[1] Consequently, the current understanding of the proposed project area groundwater system presented in this EIR represents the best information available for describing the hydrogeologic setting of the proposed project.

The following sections describe the groundwater basins, the aquifers and aquitard contained within those basins and the groundwater system underlying the seawater intake system desalination plant and the ASR system.

Salinas Valley Groundwater Basin

The Salinas Valley (valley) is within the southern Coast Ranges between the San Joaquin Valley and the Pacific Ocean, and is drained by the Salinas River. Extending approximately 150 miles from the La Panza Range north-northwest to its mouth at Monterey Bay, the valley drains approximately 5,000 square miles in Monterey and San Luis Obispo Counties (Brown and Caldwell, 2015). The valley is bounded on the west by the Santa Lucia Range and Sierra de Salinas, and on the east by the Gabilan and Diablo Ranges. The 560 square mile SVGB is the basin that underlies the Salinas Valley (MCWRA, 2006). The Monterey Bay acts as the northwestern boundary of the SVGB (Brown and Caldwell, 2015). The SVGB contains up to 10,000 to 15,000 feet of marine and terrestrial clay, sand, silt and gravel as old as 65 million years (DWR, 2004a). The proposed project components associated with groundwater extraction would be located primarily within the 84,400 acre, 132 square mile subarea of the SVGB known as the 180/400 Foot Aquifer Subbasin (DWR, 2004a). The 180/400 Foot Aquifer Subbasin boundaries generally coincide with those of the SVGB Pressure Subarea or Subbasin traditionally recognized by the Monterey County Water Resources Agency (MCWRA). For the modeling conducted for this proposed project, the modelers have updated the boundaries and names to reflect the currently available information, as shown on **Figure 4.4-1**, which illustrates the updated basin boundaries in the western part of the SVGB as used in the modeling for the proposed project (Geoscience, 2014a). In this EIR, the area shall be referred to as the Pressure Area.

1 Recognized experts in geology, hydrogeology and modeling, representing stakeholders of groundwater use and management in the project area, collaborated in the development of the conceptual model and the groundwater/surface water modeling efforts through the development of the Hydrogeology Working Group (HWG). The HWG developed a collaborative plan of investigation to assess the hydrogeologic conditions in the project area. The draft work plan provided a phased approach to progressively investigate the hydrogeology and the potential effects to aquifers from the use of subsurface slant wells for obtaining feedwater supply. The final workplan incorporated comments and recommendations by members of the HWG, and covered the investigative steps needed to evaluate the project impacts (Geoscience, 2013c). The final workplan became the hydrogeology investigation roadmap and resulted in the implementation of the field work and modeling efforts described in the approach to analysis, Section 4.4.3.2.



SOURCE: Geoscience, 2015c

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Figure 4.4-1
Groundwater Basins and Areas in the Western Salinas Valley Groundwater Basin

The hydrologic boundaries of the Pressure Area are the Salinas River to the north, the East Side Area to the east, the Seaside Basin to the south, and the Pacific Ocean to the west at the coast. The precise locations of these boundaries fluctuate depending on seasonal variations, longer-term climate changes, and local groundwater pumping. The north and south boundaries are groundwater divides; the western boundary is the Pacific Ocean. The eastern boundary between the Pressure Area and East Side Area is complex and is defined in recent studies as the depositional transition zone (fluvial to alluvial sediment) between the two subareas (Kennedy/Jenks, 2004).

Pressure Area Aquifers and Aquitards

Water-bearing geologic formations present within the Pressure Area include the Quaternary Alluvium (including the Dune Sands and Terrace Deposits), Aromas Sand, Paso Robles Formation, Purisima Formation, Santa Margarita Sandstone, and Monterey Formations. Not all geologic units are present in all areas. Section 4.2, Geology, Soils and Seismicity, provides a detailed description of these geologic units and **Table 4.4-1**, below, summarizes the characteristics as they relate to groundwater storage.

TABLE 4.4-1
SUMMARIZED CHARACTERISTICS OF WATER BEARING GEOLOGIC UNITS

Geologic Unit (Listed youngest to oldest)	Geologic Characteristics
Quaternary Alluvium	Includes Younger and Older Dune Sands. Younger, sparsely vegetated, active dunes are present along the coastline. Older dune deposits with more established vegetation are present in the inland. Shallow groundwater is not expected within the elevated dune deposits, except in localized low-lying areas along the coastline.
Terrace Deposits	Terrace Deposits are former alluvial fan and river floodplain deposits—which may also include marine terrace deposits—that generally consist of sand with some gravels. Terrace deposits at the CEMEX mining facility range from 150 to 163 feet in thickness.
Aromas Sand	Aromas Sand consist of both older river deposits and younger windblown deposits of unconsolidated, brown to red sands with interbeds of clay and poorly sorted gravels.
Paso Robles Formation	The Paso Robles Formation is a series of fine-grained, oxidized sand and silt beds that contain gravel beds interbedded with some calcareous beds. The formation is interfingered with the lower portion of the Aromas Sand and the upper portion of the Purisima Formation. The Paso Robles Formation is present at depths ranging from less than 100 feet to 600 feet in the northern portion of the project area.
Purisima Formation	The Purisima Formation consists of layered sand, silt, clay, shale, and some gravel deposited in near-shore and far-shore marine environments. The basal, or lowermost, unit of the Purisima Formation consists of relatively impermeable clay and shale.
Santa Margarita Formation	Santa Margarita Sandstone is a marine, coarse-grained sandstone that overlies the Monterey. Relatively small pieces of this unit are present beneath the project area in the Seaside vicinity at depths of about 800 feet deep just north of the Ord Terrace Fault and about 500 feet below the ground surface (bgs) in between the Ord Terrace and Seaside Faults.
Monterey Formation	Monterey Formation is a marine sedimentary unit generally consisting of siliceous and diatomaceous interbedded layers of mudstone, siltstone, sandstone, and claystone. Seams of the expandable clay bentonite are also present.

The Pressure Area is made up of distinct aquifers and aquitards that in some cases extend across several underlying geologic formations and collectively form the groundwater system within the subbasin. **Figure 4.4-2 is** a north to south graphic representation of the hydrogeologic setting showing the spatial relationships of the aquifers along the coast from Moss Landing to south of the CEMEX site. As shown, the Pressure Area consists of a series of aquifers at varying depths, which are in some locations separated by laterally extensive aquitards. The Pressure Area includes three prominent water supply aquifers and two, less notable, shallower aquifers. The primary aquifers, named for the average depth at which they occur, are the 180-Foot Aquifer, the 400-Foot Aquifer, and the 900-Foot (Deep) Aquifer, (Kennedy/Jenks, 2004; Geoscience, 2008, Geoscience 2014a).

Note that **Figure 4.4-2** identifies a "180-Foot Equivalent Aquifer." This unit is composed of terrace deposits that are different from the typical deposits of the inland 180-Foot Aquifer. However, the unit is at the same depth interval and is considered to be connected and equivalent to the 180 Foot Aquifer. Shallower, saturated sand dune deposits, referred to as the Dune Sand Aquifer, occur along the coast in the southern portion of the Pressure Area. The shallow aquifer underlying Moss Landing Area is referred to as the Perched A Aquifer and differs from the Dune Sands Aquifer because it is underlain by a defined layer of less permeable, fine-grained sediments, known as the Salinas Valley Aquitard (SVA). The primary aquifers and aquitards in the Pressure Area are discussed in further detail below.

Dune Sand Deposits and the Dune Sand Aquifer

Shallow groundwater is present in the Pressure Area and occurs above low-permeability clay units, such as the Salinas Valley Aquitard where present, or directly above the 180-Foot Aquifer or 180-Foot Equivalent Aquifer. The shallow groundwater is in the coastal Dune Sand units or in scattered, thin, discontinuous sandy layers both at the coast and inland. Dune Sand deposits are present along the coastal areas and generally extend less than a half-mile inland, while the older, more stabilized dunes extend up to 4 miles inland. Shallow groundwater is not expected to be present within much of the upper, younger Holocene-age[2] Dune Sand deposits, except in localized low-lying areas along the coastline. Groundwater is present within the underlying Pleistocene-age[3] Older Dune Sand. The Older Dune Sand extends to 85 to 95 feet below the ground surface (bgs) beneath the CEMEX site, and is about 60 feet thick at the locations of the proposed slant wells. Water quality of the Dune Sand Aquifer is directly influenced and controlled by seawater. This influence decreases inland where the infiltration of precipitation and applied agricultural water provide increasing influence. **Figure 4.4-3** presents a west to east cross section that illustrates the relationship of the aquifers and geologic units in the CEMEX area.

In the CEMEX area along the coast, the shallow groundwater bearing zone is referred to as the Dune Sand Aquifer and extends offshore beneath the ocean (Geoscience, 2014a). Most of the water in the Dune Sand Aquifer has been intruded by seawater due to proximity with the ocean and seawater intrusion and is considered saline to brackish (Kennedy/Jenks, 2004)[4].

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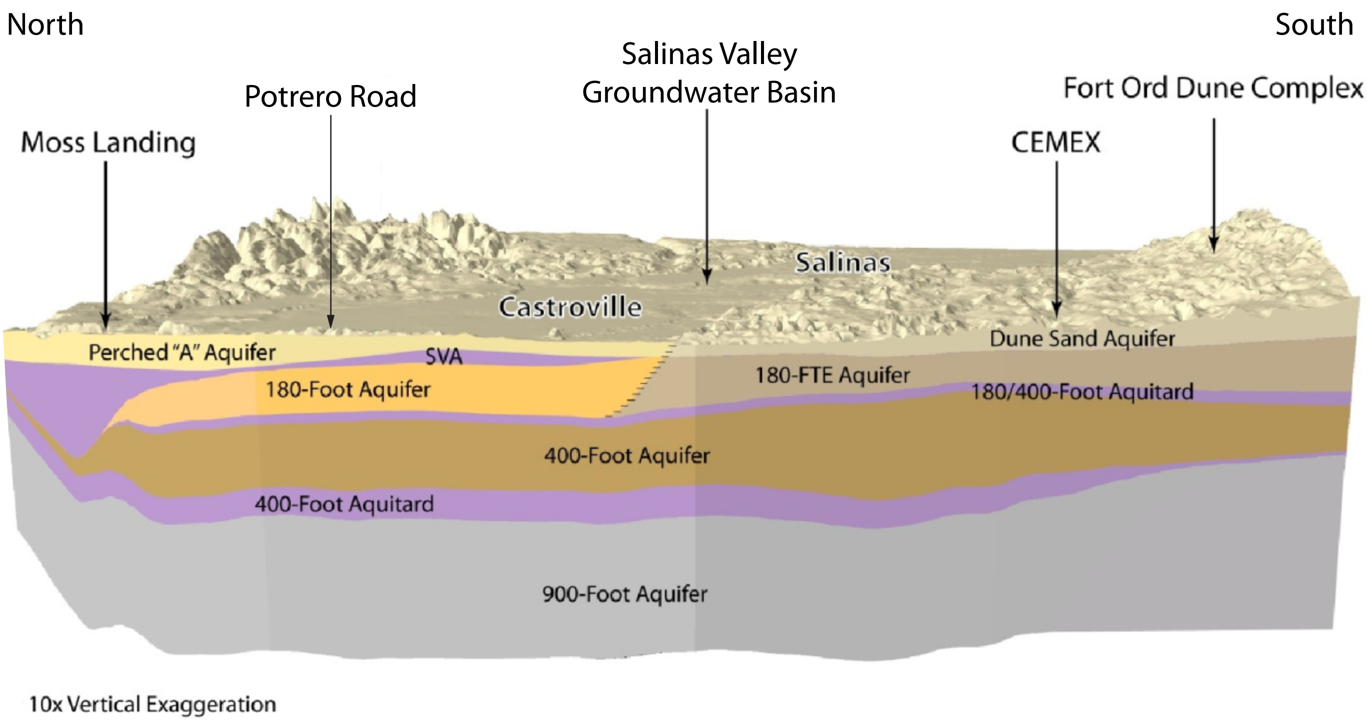
2 Holocene time is from the present to 11,000 years ago.
3 Pleistocene time was from 11,000 to 1.6 million years ago.
4 Saline water is water that has the approximate salinity of seawater, while brackish water is more saline than fresh water, but not as much as seawater.



SOURCE: Adapted from HydroMetric, 2009a

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Figure 4.4-2
Conceptual Model of Coastal Aquifers

Salinas Valley Aquitard

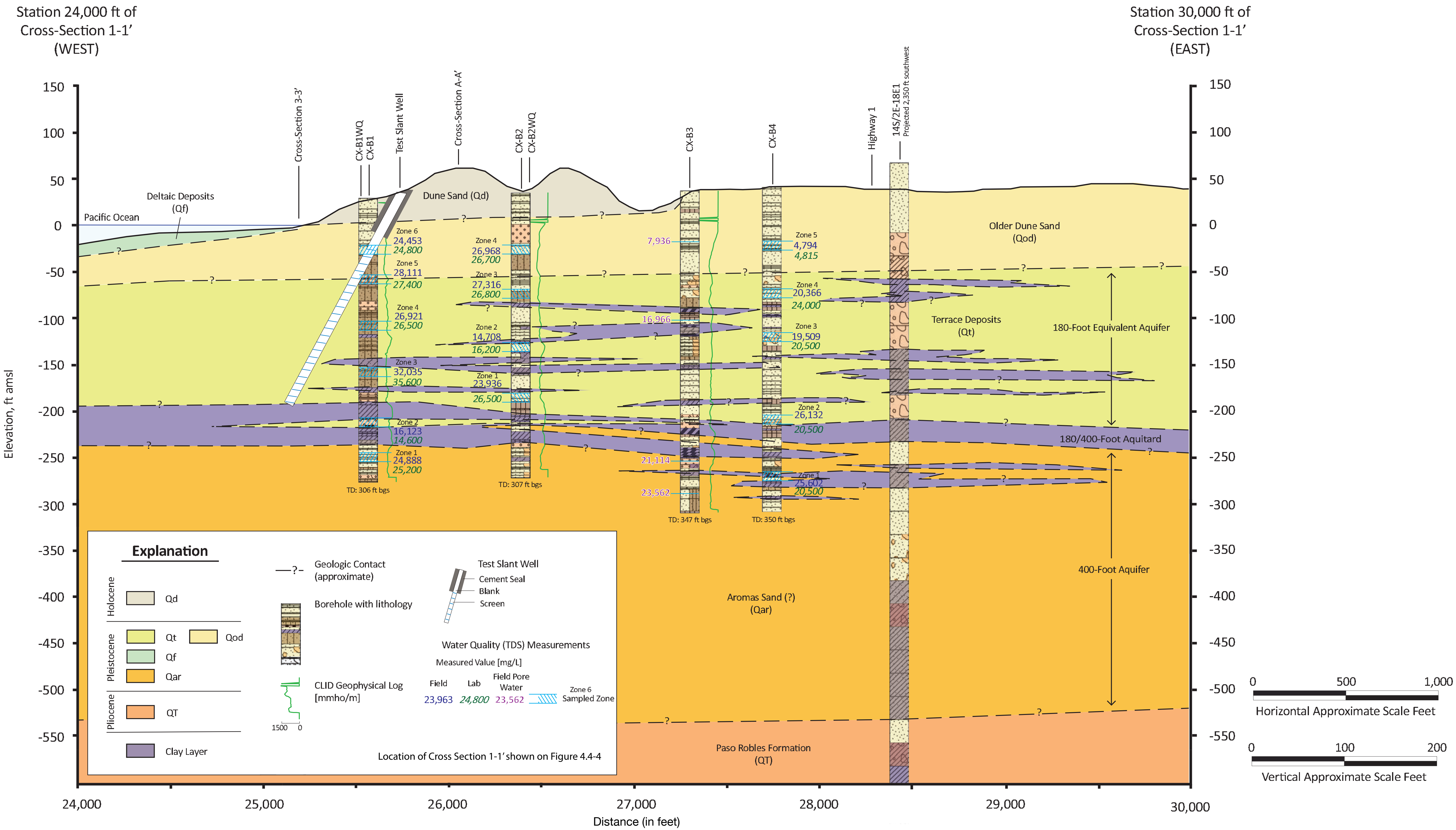
The Salinas Valley Aquitard is a blue or yellow sandy clay formation up to 100 to 150 feet thick located mostly north of and generally parallel with the northwest-flowing Salinas River (MCWRA, 2006; Kennedy/Jenks, 2004; Durbin et al., 1978; Geoscience, 2013a). **Figure 4.4-4** shows the extent and thickness of the Salinas Valley Aquitard updated with information provided through the subsurface exploratory program completed at the proposed CEMEX site (Geoscience, 2014a). The Salinas Valley Aquitard thins and becomes discontinuous away from the centerline of the unit and at the Pacific Ocean, and was not observed in the exploratory borings at the CEMEX site. Consequently, the Dune Sand Aquifer deposits lie directly on top of Terrace Deposits and are thought to be hydraulically connected to the underlying aquifer. The absence or discontinuous nature of the Salinas Valley Aquitard in the area of the proposed subsurface slant well locations results in unconfined conditions for the shallower sand units (e.g., the Dune Sand deposits). Elsewhere, where present, the Salinas Valley Aquitard overlies the 180-Foot Aquifer, creating confined to semiconfined conditions for the underlying aquifers.

180-Foot Aquifer and 180-Foot Equivalent Aquifer

The location of the 180-Foot Aquifer within the Salinas Valley is variable and extends across more than one stratigraphic or geologic unit. Various interpretations have correlated the aquifer to different combinations of stratigraphic units depending on the investigator, the area under study, and the investigators interpretation. Consistent with the hydrogeologic understanding developed to support the impact analysis of proposed project, the 180-Foot Aquifer has been correlated with the lower portions of the Quaternary Alluvium and the upper portions of the Aromas Sand (DWR, 2004a; Geoscience, 2008, 2013a, 2014a). The lenticular (lense shaped) sand and gravel bodies that make up the 180-Foot Aquifer indicate that they were originally deposited in a river (fluvial) where the more laterally extensive units represent river channels that migrated and shifted over time (Kennedy/Jenks, 2004). The 180-Foot Aquifer has been geophysically mapped into the Monterey Bay where the unit is open to the ocean several miles offshore (Greene, 1970; Eittreim et al., 2000).

As discussed above, the Dune Sand Aquifer deposits lie directly on top of the underlying Terrace Deposits in the area along the coast with no confining layer such as the Salinas Valley Aquitard to separate them. Based on the investigative work to correlate the hydrogeologic units of the Pressure Area these Terrace Deposits along the coast appear to be at the same depth, and have similar geologic characteristics compared with the inland Quaternary Alluvium of the 180-Foot Aquifer in the Salinas Valley (see **Figure 4.4-3**). Even though the Terrace Deposits are older than and lithologically different from the inland deposits of the 180-Foot Aquifer, the units are at the same depth interval and groundwater likely flows from one unit to the next. Therefore, considering the level to which these units correlate and to maintain consistency with the nomenclature used in this region, the aquifer interval is referred to as the 180-Foot Equivalent Aquifer (Geoscience, 2014a). At the CEMEX site, the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer are unconfined, as there are no extensive overlying low permeability clay units.

The Terrace Deposits of the 180-Foot Equivalent Aquifer are former alluvial fan and river floodplain deposits, with possibly some marine terrace deposits, containing sand, silt, and gravel, now buried under the coastal dunes. Groundwater is present within the Terrace Deposits. The lower portion of the proposed slant wells at the CEMEX site would be screened across these



SOURCE: Geoscience, 2015c

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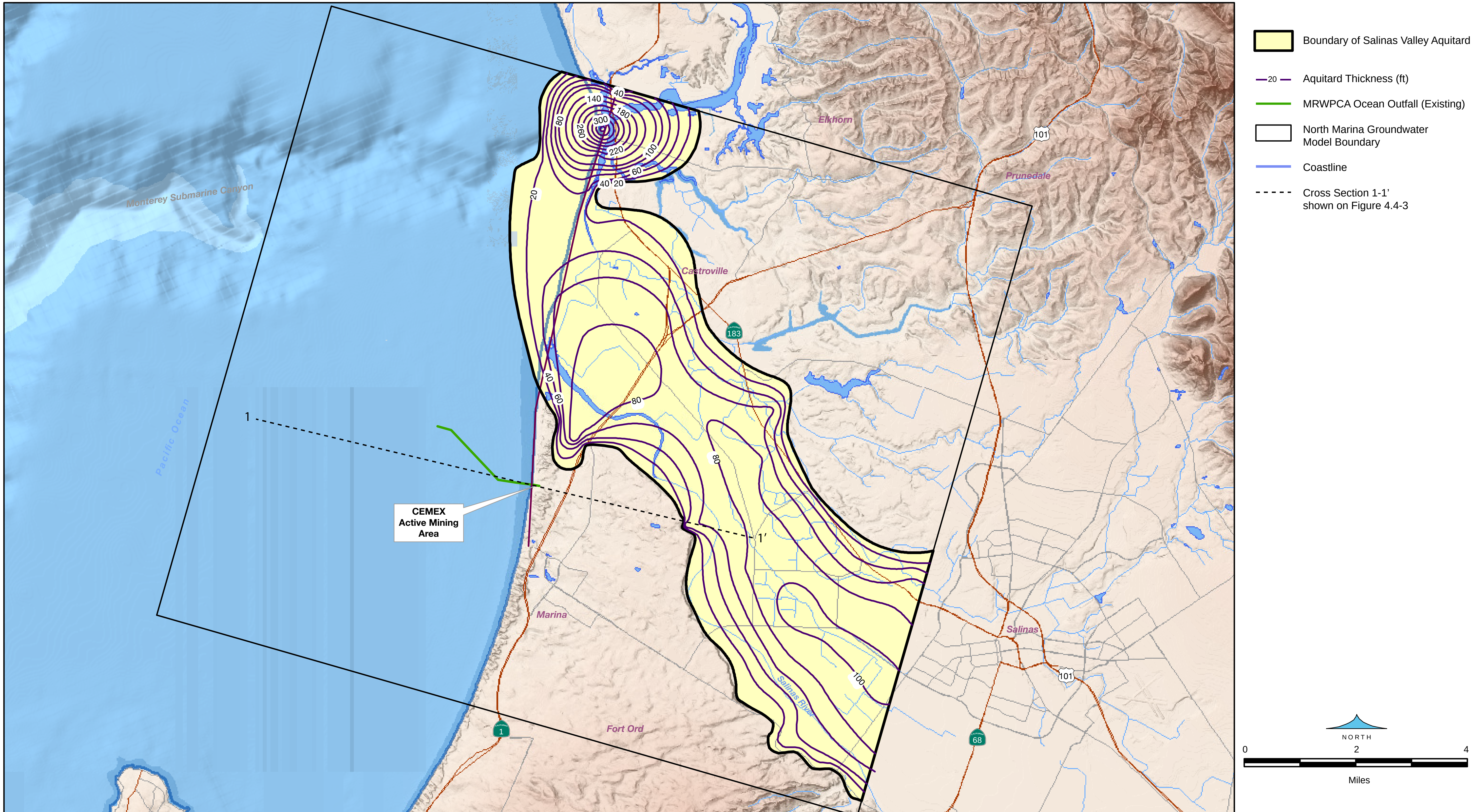
Figure 4.4-3
CEMEX Area Geologic Cross Section



SOURCE: Geoscience, 2015c

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Figure 4.4-4
Thickness of Salinas Valley Aquitard

deposits. The Terrace Deposits extend to 240 to 255 feet bgs beneath the CEMEX site, and are about 135 feet thick at the proposed slant well locations, thinning seaward. Based on the recent groundwater testing data, discussed in the Groundwater Quality subsection further below, the water quality of the 180-Foot Equivalent Aquifer is directly influenced and controlled by seawater. This influence extends for miles inland, as discussed below in the Seawater Intrusion section.

180/400-Foot Aquitard

As shown on **Figures 4.4-2** and **4.4-3**, the 180- and 400-Foot Aquifers are separated by the 180/400-Foot Aquitard (Kennedy/Jenks, 2004). The unit is commonly 50 to 100 feet thick, is rarely as much as 200 to 250 feet thick, and may be absent in some areas. This aquitard is present beneath the CEMEX site at about 220 feet bgs or about 200 feet below mean sea level (msl) and is 10 to 70 feet thick (Geoscience, 2014a).

400-Foot and 900-Foot Aquifers

The underlying 400-Foot Aquifer has been correlated with the Aromas Sand and the upper Paso Robles Formation (Geoscience, 2008; Yates et al., 2005). At the CEMEX site, the 400-Foot Aquifer is within the Aromas Sand (Geoscience, 2014a). The unconfined Pleistocene Aromas Sand consists of both older fluvial deposits and younger eolian (windblown) deposits. The eolian portion of the Aromas Sand crops out just east of the central and southern portion of the project area and extends beneath the project area to offshore on the continental shelf and in the Monterey submarine canyon (CGS, 2002). The unit is up to about 500 feet thick in the northern area and ranges in depth from near the surface to several hundred feet bgs (HydroMetrics, 2009a). The slant wells at the CEMEX site would not penetrate through the Aromas Sand or deeper geologic units. Based on the recent groundwater testing data, discussed in the Groundwater Quality subsection further below, the 400-Foot Aquifer is directly influenced by seawater. This influence extends for miles inland, as discussed below in the Seawater Intrusion section.

A blue marine clay separates the 400-Foot Aquifer from the underlying 900-foot (Deep) Aquifer (DWR, 2004a; Geoscience, 2008). The 900-Foot Aquifer has been correlated with the Paso Robles Formation, Purisima Formation, and Santa Margarita Sandstone (Yates et al., 2005). At the CEMEX site, the 900-Foot Aquifer is within the Paso Robles Formation (Geoscience, 2014a).

East Side Subbasin and Aquifers

The East Side Area is located inland to the east of the Pressure Area and encompasses about 125 square miles along the north side of the Salinas Valley from Gonzales to east of Castroville. The hydrologic boundaries of the East Side Area are generally the Pressure Area to the west, the Gabilan Range along the northeast, and a subarea referred to as the Forebay Subbasin to the south and southeast. With the exception of the relatively impermeable Gabilan Range, the precise locations of the boundaries fluctuate depending on seasonal variations, longer-term climate changes, and local groundwater pumping.

The hydrogeology and groundwater behavior is markedly different in the East Side Area due to the different depositional environments and geology (Kennedy/Jenks, 2004). The transition zone between these subbasins has been defined based on the transition from predominantly alluvial deposits within the East Side Subbasin to the fluvial deposits that make up the Pressure Area. The clay layers in the Pressure Area pinch out inland into the East Side Area. As noted above, the Salinas Valley Aquitard does not extend much into the East Side Area (Durbin et al., 1978). Water-bearing formations present within the East Side Area include Quaternary Alluvium (both alluvial fan and fluvial deposits), the Aromas Sand, and the Paso Robles and Purisima Formations (DWR, 2004b).

Seaside Groundwater Basin (SGB) and Aquifers

The SGB encompasses an area of approximately 24 square miles at the southwest corner of the Salinas Valley adjacent to the Pacific Ocean (Yates et al., 2005). The Seaside Basin is further subdivided into the Northern and Southern Subbasins separated by the Laguna Seca Anticline and a segment of the Ord Terrace Fault, which restrict groundwater flow between the subbasins (HydroMetrics 2009a). The two subbasins are further subdivided into coastal and inland subareas with the division boundary just west of General Jim Moore Boulevard.

The SGB consists of three aquifers that correspond with the sedimentary units within the Basin: the surficial Aromas Sand (**Table 4.4-1**) (which are considered to include the Dune Sands), a shallow aquifer, and a deep aquifer (HydroMetrics, 2009a). The surficial Aromas Sand Aquifer is unsaturated in many places and, therefore, not directly used for the production of potable groundwater because the proximity to the Pacific Ocean makes the water saline to brackish. The Sand City desalinization plant produced 208.37 acre-feet (af) in 2012 from this saline to brackish unit (CalAm, 2013).

The shallow aquifer is in the unconfined Paso Robles Formation (**Table 4.4-1**) and generally would correspond with the 400-Foot Aquifer to the north in the SVGB (HydroMetrics, 2009a). The thickness of the unit ranges from about 250 feet just north of the Ord Terrace Fault to over 500 feet in the central and northern portions of the project area. The Aromas Sand, Paso Robles Formation, and Purisima Formation[5] are not present in the project area south of the Seaside Fault. The proposed ASR injection/extraction wells would be drilled to about 1,000 feet bgs through the Paso Robles Formation into the deeper Santa Margarita Sandstone.

The deep aquifer is in the underlying confined Santa Margarita Sandstone (see **Table 4.4-1**) and the Purisima Formation and would generally correspond with the 900-Foot Aquifer in the SVGB. Groundwater resources in the SGB are derived from the Paso Robles Formation and Santa Margarita Sandstone; the Santa Margarita Sandstone transitions with the Purisima formation in the northern area of the SGB. The proposed ASR injection/extraction wells would be located in the Northern Subbasin close to the boundary with the SVGB and screened in the Santa Margarita Sandstone. The late Miocene[6] to Pliocene Santa Margarita Sandstone has surface outcrops east of the project area (CGS, 2002) and is up to 400 feet thick in places (Durbin, 2007). The proposed

[5] Note that the nomenclature of these individual units has evolved over time as subsequent investigators revised their understanding of the stratigraphy of the region. As reflected in this discussion, some investigators have referred to the Paso Robles and Purisima Formations collectively as "continental deposits."
[6] Miocene time was from 5.3 to 24 million years ago.

ASR injection/extraction wells would be drilled to about 1,000 feet bgs and screened within the Santa Margarita Sandstone.

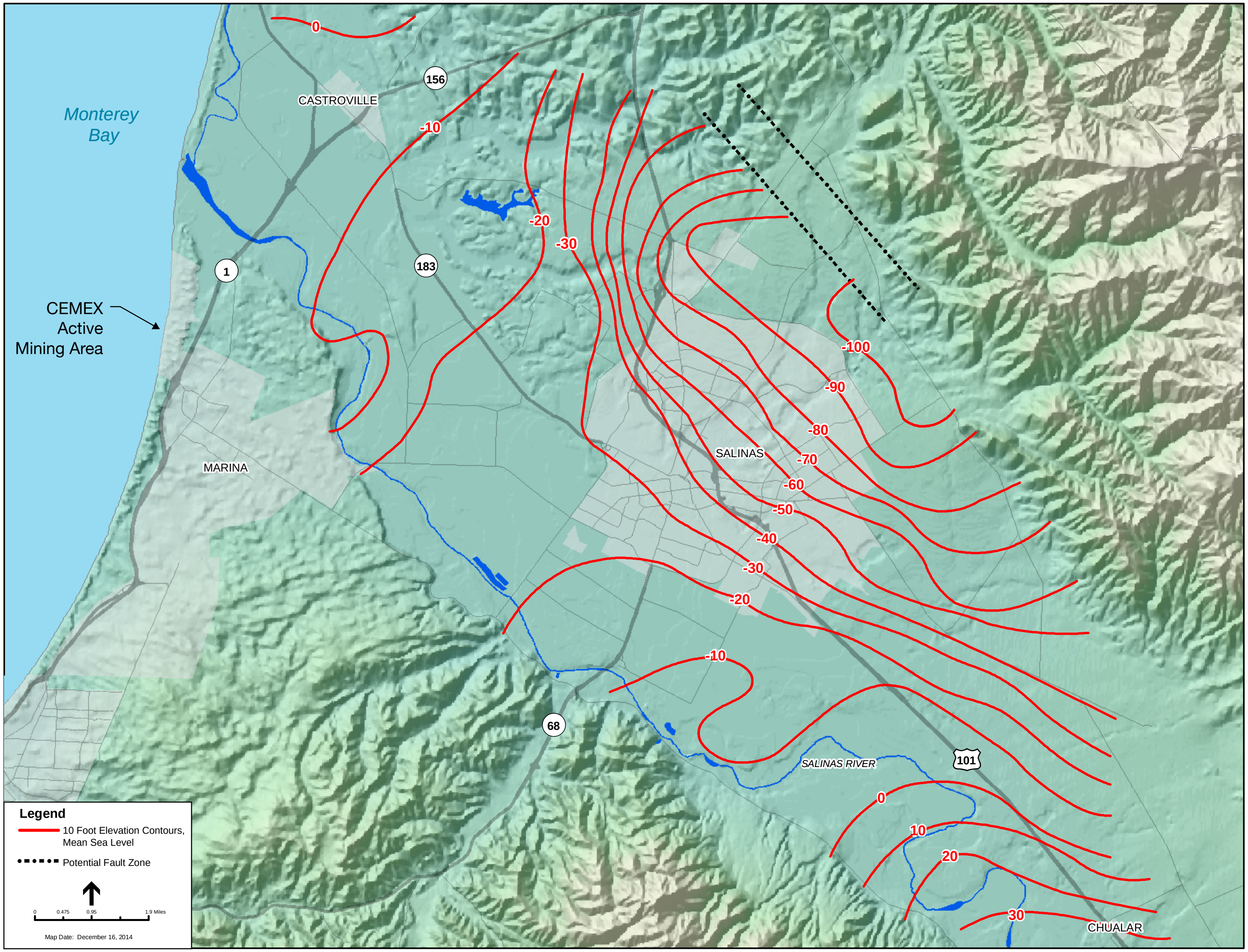
The northern hydrologic boundary of the SGB is a flow divide where groundwater to the north flows to the SVGB and groundwater to the south flows to the SGB (HydroMetrics, 2013). The northern boundary is a dynamic hydrologic divide, the location of which is dependent on seasonal rainfall patterns, longer-term climate variations, and pumping rates in the SVGB and the SGB. The current location of the boundary passes through the former Fort Ord military base south of the city of Marina. The northern boundaries of the shallow and the deep aquifers in the SGB are at different locations, as discussed in the Groundwater Flow subsection further below. The approximate flow divide between the SVGB and the SGB is based on groundwater elevation data obtained from the Paso Robles Formation and generally correlates with the 400-Foot Aquifer in the 180/400-Foot Aquifer Subbasin. The flow divide for the Santa Margarita Sandstone is different and appears to be located further north due to pumping and aquifer characteristics within the Santa Margarita Sandstone and the Deep Aquifer. The basin boundary in the Dune Sands deposits is also different, and is generally not defined because groundwater resources are generally not obtained from the Dune Sands within the Quaternary Alluvium and because the Dune Sands are in direct hydraulic communication with the ocean and only saturated along the coastal margin (ICF Jones & Stokes, 2008). The other hydrologic boundaries of the SGB are the Sierra de Salinas /Santa Lucia Range to the south and east, and the Pacific Ocean to the west at the coast.

4.4.1.3 Groundwater Flow and Occurrence

A groundwater basin is much like a surface water reservoir; when water is removed from storage, the water level drops until the supply is replenished. The replenishment of the aquifer, referred to as recharge, occurs when water enters the aquifer either from the surface or from adjacent aquifers. Along the coast, the ocean can also recharge the aquifers, and in some areas, this causes the salty water from the ocean to mix with the fresh groundwater, causing seawater intrusion. This section provides a brief history on groundwater elevation in the SVGB and SGB and how development has changed those how groundwater flows. The section also discusses how the groundwater inflow and outflow impact the balance in the groundwater basin.

Groundwater Elevations and Flow Directions

Before extensive pumping began in the Salinas Valley, the regional groundwater flow was predominantly toward the coast from inland areas. Since the 1940s, hydrogeologic studies have shown a regional decline in the groundwater table, which has resulted in a sea to land groundwater gradient in some coastal areas. The MCWRA conducts a groundwater monitoring program throughout the Salinas Valley that for the Fall 2013 monitoring event included 61 wells in the 180-Foot Aquifer and 103 wells in the 400-Foot Aquifer (Brown and Caldwell, 2015). Water-level data collected from wells within the study area indicate that the direction of groundwater flow is from the ocean to inland from along the coast to inland of Salinas, as shown on **Figures 4.4-5** and **4.4-6**.



SOURCE: MCRWA, 2014a

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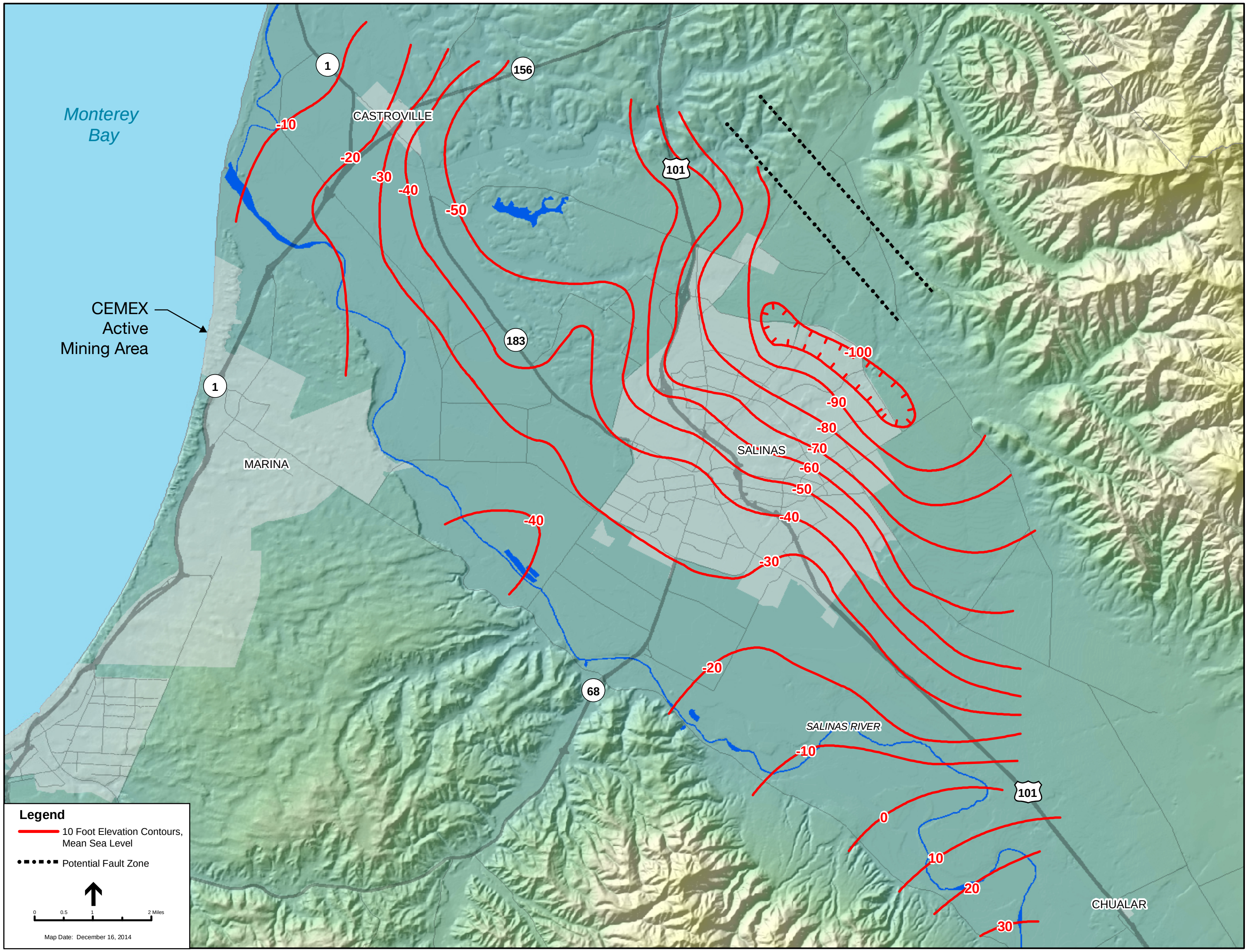
Figure 4.4-5
Salinas Valley Groundwater Basin - Groundwater Elevations in 180-Foot-Aquifer



SOURCE: MCRWA, 2014a

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Figure 4.4-6

Salinas Valley Groundwater Basin - Groundwater Elevations in 400-Foot-Aquifer

In the Pressure and East Side Areas, groundwater flows northwest from the upper reaches of the SVGB until it reaches the area of the city of Salinas area where groundwater in both the 180-Foot and 400-Foot Aquifers flows towards a groundwater depression north of the city (MCWRA, 2014a). Along the coast, flow in both the 180-Foot and 400-Foot Aquifers is towards the east (landward) and has resulted in seawater intrusion. At the proposed locations of the slant wells, the Dune Sand and 180-Foot Equivalent Aquifers along the coast are hydraulically connected to the Pacific Ocean, as verified by the saline chemistry of the groundwater samples collected from borings drilled along the coast (Geoscience, 2014a). The groundwater flow patterns within the Dune Sand Aquifer are not known but, based on the aquifer depth and geologic structure, it is reasonable to expect that they would be tidally controlled with little to no net horizontal flow in any particular direction.

A groundwater divide is present along the north side of the SGB separating groundwater flow paths between the SGB and the SVGB in both the shallow and deep aquifers as shown on **Figures 4.4-7** and **4.4-8**. As shown on **Figures 4.4-7** and **4.4-8**, the SGB has been divided into four subareas with the northern two comprising the Northern Subbasin and the southern two subareas comprising the Southern Subbasin. The proposed ASR injection/extraction wells would be located near the northern border of the Northern Subbasin. A groundwater depression is present in both the shallow and deep aquifers in the Northern Subbasin, resulting in some landward flow direction along the coast (HydroMetrics, 2013).

Basin Groundwater Balance

The groundwater balance describes the amount of water entering the groundwater system versus the water that leaves the system. Groundwater enters the system through recharge and can leave the system through groundwater pumping, natural discharge to surface streams. Groundwater recharge occurs due to percolation of rainfall, river and stream infiltration, underflow[7] originating in upper valley areas, and agricultural irrigation and other return flow[8], including enhanced groundwater recharge.[9] The capability of an overlying formation to provide a pathway for recharge depends on numerous factors. For example, recharge from direct percolation depends on the absence of near-surface clay layers that can impede the downward flow of water, as is the case in areas where the Salinas Valley Aquitard restricts the downward migration of water (see **Figure 4.4-4**). Similarly, the amount of recharge from underflow depends on the hydrologic interconnections of the water-bearing formations, as well as groundwater extraction occurring in upgradient areas within the basins. Historically, groundwater withdrawal within both the SVGB and the SGB has outpaced groundwater recharge of fresh water and has resulted in overdraft[10] and seawater intrusion conditions (MCWRA, 2014b; Kennedy/Jenks, 2004; HydroMetrics, 2013).

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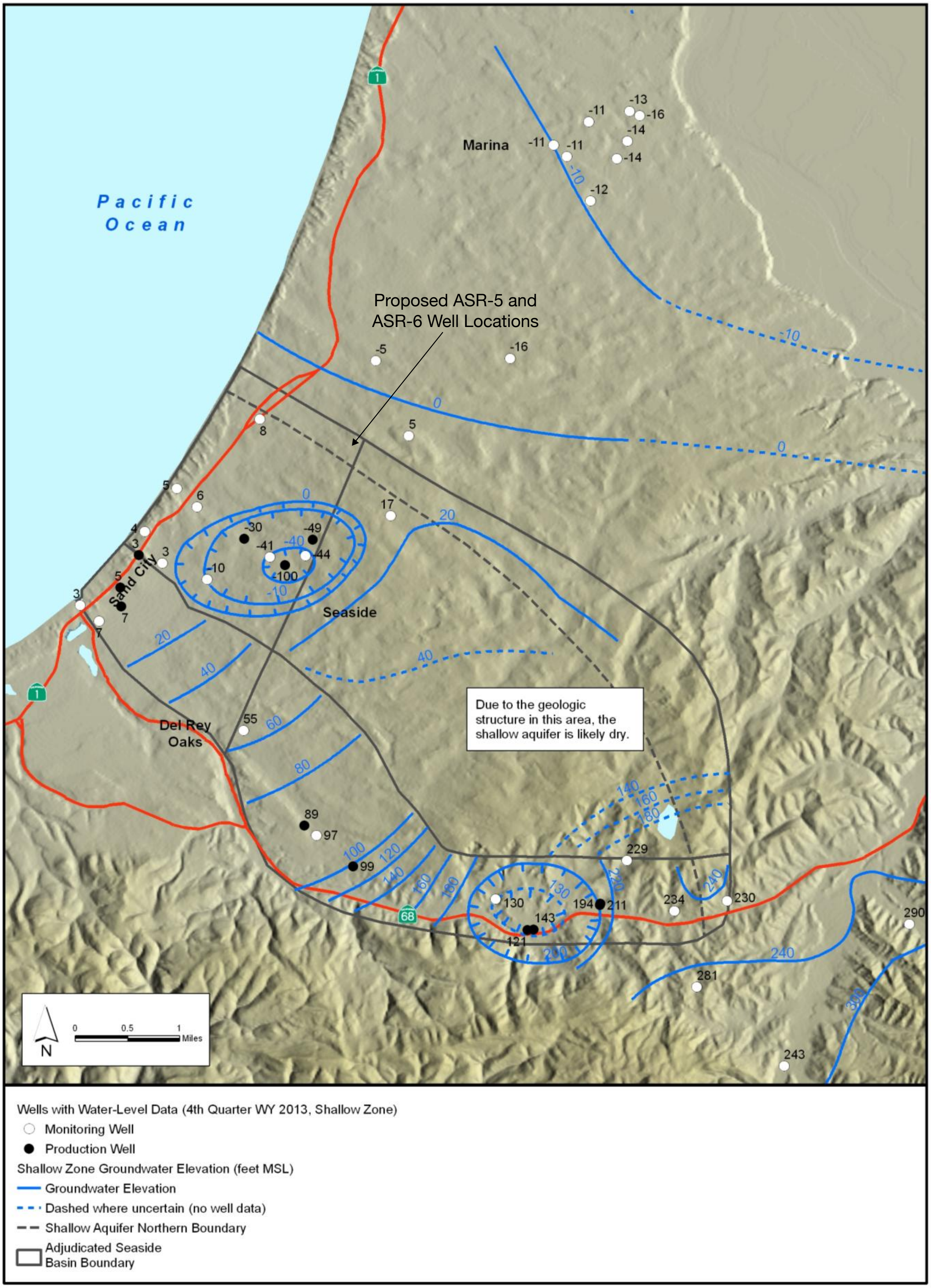
[7] Underflow refers to groundwater that is flowing through the subsurface aquifers from higher elevation or higher pressure areas to recharge downgradient water bearing sediments.

[8] Return flow is irrigation water that is applied to an area and which is not consumed in evaporation or transpiration and returns to a surface stream or aquifer.

[9] Enhanced recharge refers to projects that are intended to accelerate localized recharge such as infiltration basins. The Castroville Seawater Intrusion Project (CSIP) is an example of a recharge project.

[10] Groundwater overdraft occurs when the groundwater levels are lowered due to excessive pumping at a rate that is greater than natural recharge.



SOURCE: HydroMetrics, 2013

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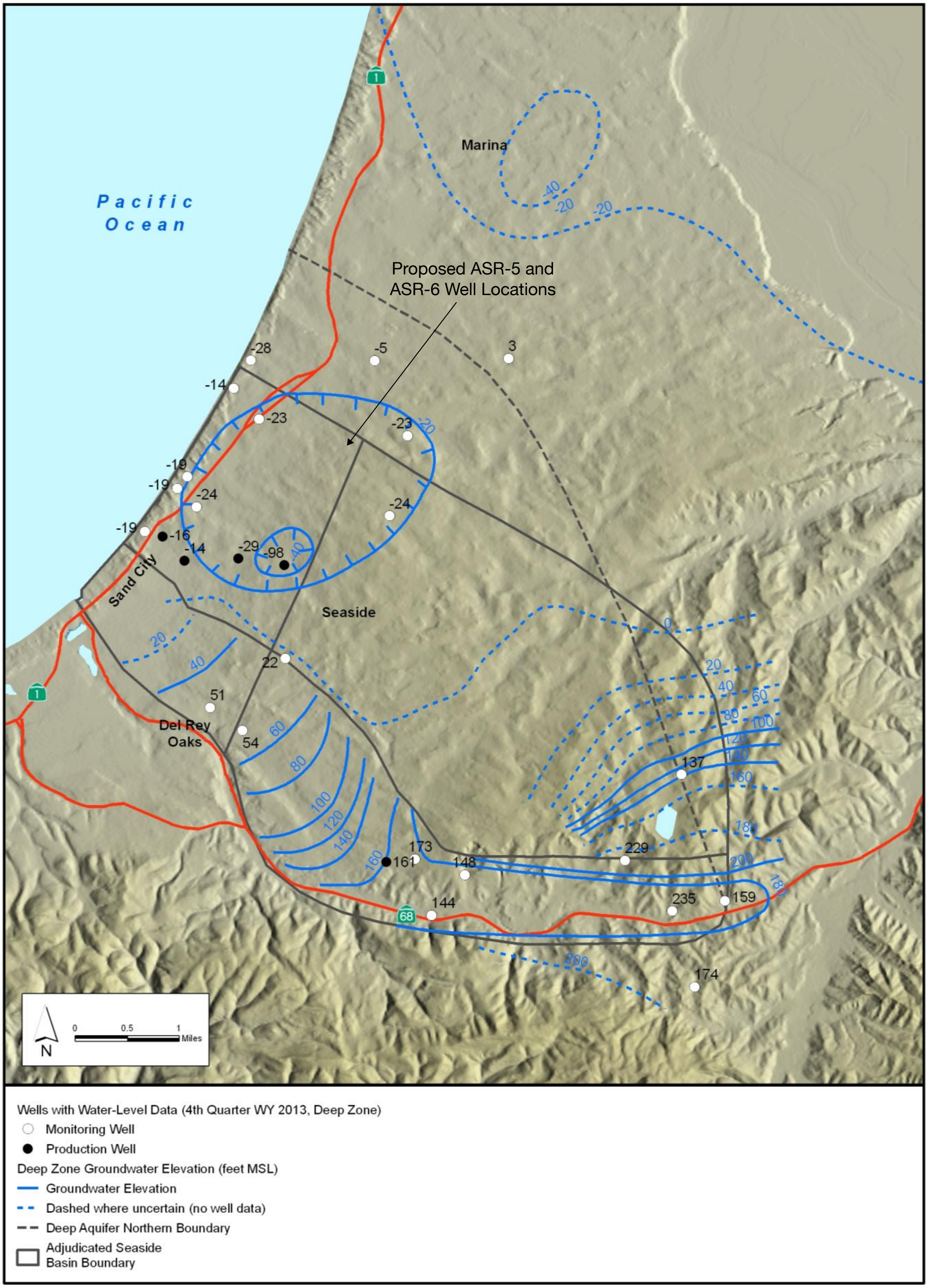
Figure 4.4-7

Groundwater Flow – Seaside Basin Shallow Zone, July/August 2013



SOURCE: HydroMetrics, 2013

Figure 4.4-8
Groundwater Flow – Seaside Basin Deep Zone, July/August 2013

Salinas Valley Groundwater Basin Balance

Inflows and Outflows

Information on the water balance (a quantitative accounting of the various components of flow entering and leaving a groundwater system) of the SVGB was obtained from the recent study conducted for the MCWRA describing the current state of the basin (Brown and Caldwell, 2015). The study described the water balance of the SVGB (rainfall, inflow, outflow, and changes in storage in the basin) averaged over 1958 to 1994. **Table 4.4-2** summarizes the water budget components by subarea. The study estimated the overall basin inflow at 504,000 acre-feet per year (afy), of which about 50 percent occurs as stream recharge, 44 percent occurs as deep percolation from agricultural return flows and precipitation, and 6 percent occurs as subsurface inflow from adjacent groundwater basins. Outflow from the basin was estimated at 555,000 afy, of which about 90 percent is groundwater pumping and the remainder occurring as evapotranspiration along riparian corridors.[11] The MCWRA estimated that in the lower basin portion of the Salinas Valley, recharge is by infiltration along the channel of the Salinas River (30 percent) and its tributaries (20 percent), irrigation return water (40 percent), and infiltration and precipitation over the valley floor, subsurface inflow, and seawater intrusion (10 percent) (MCWRA, 2006).

TABLE 4.4-2
WATER BALANCE OF SALINAS VALLEY GROUNDWATER BASIN

	Inflow		Outflow	
Subarea	Natural Recharge[a]	Subsurface Inflow	Groundwater Pumping[b]	Subsurface Outflow
Pressure	117,000	17,000	130,000	8,000
East Side	41,000	17,000	0	98,000
Forebay	154,000	31,000	20,000	148,000
Upper Valley	165,000	7,000	17,000	145,000

NOTES:
Reported volumes in afy
(a) Includes agricultural return flow, stream recharge, and precipitation
(b) Reported groundwater pumping is for 1998

SOURCE: Brown and Caldwell, 2015.

The estimated 555,000 afy of outflow subtracted from the estimated 504,000 afy of inflow results in basin overdraft. The consequence of this imbalance is the cause of the documented seawater intrusion within the basin, as discussed further in the seawater intrusion section below. Due to the current extent of seawater intrusion within the Pressure Area and the threat of additional seawater intrusion and other water quality deterioration in the SVGB, various programs have been designed to protect and restore the basin, as discussed below.

[11] The MCWRA State of the Basin Study included the SGB within the Pressure Subarea (180-400 Foot Aquifer Subbasin).

Groundwater Enhancement Programs in the SVGB

Groundwater recharge is promoted through a number of resource protection programs that are implemented throughout the SVGB. Specifically, the Salinas Valley Water Project (SVWP) has implemented and has proposed to implement, various programs with the objectives of stopping seawater intrusion, providing adequate water supplies to meet the current and future needs of the Salinas Valley, and improving the hydrologic balance of the SVGB. The SVWP programs identified to accomplish these objectives include modifications of the Nacimiento Spillway, the operation of Nacimiento and San Antonio Reservoirs, and Salinas River recharge, conveyance, and diversion. The two upstream reservoirs on the Salinas River are operated to regulate stream flow to maximize recharge to groundwater. Lake San Antonio was completed in 1967 and has a capacity of 335,000 af. Lake Nacimiento was completed in 1957 and has a capacity of 377,900 af (MCWRA, 2007). Flows are regulated to maximize groundwater recharge before entering the 180/400 Foot Aquifer Subbasin boundary due to the extent of the confining layers that prevent surface infiltration within the 180/400 Foot Aquifer Subbasin (RMC, 2006). The rate of recharge varies greatly from year to year, based on both the seasonal distribution of rainfall and the total annual precipitation. The operation of the reservoirs increases groundwater recharge by about 30,000 afy (RMC, 2003).

As part of the approved SVWP, changes and enhancements in reservoir operations have been implemented (these actions are referred to as SVWP Phase I) and will continue to be made through Phase II of the SVWP that further enhance water conservation. The diversion facility (inflatable rubber dam), constructed and in operation on the Salinas River as a part of the SVWP Phase I, captures excess river flows that supplement the agricultural water supply by routing flows of 30 cubic feet per second to the Castroville Seawater Intrusion Project (CSIP) storage reservoir. This serves as an in-lieu groundwater supply in that it reduces agricultural pumping of groundwater, as explained below. The SVWP Phase II currently plans to increase the diversion at the rubber dam by 30,000 afy and to develop and implement other actions that would result in routing 20,000 afy to the groundwater depression east of the city of Salinas.

The CSIP is a program that has distributed recycled water through the Monterey Regional Water Pollution Control Agency (MRWPCA) service area since 1998 (MCWRA, 2006; MRWPCA, 2013). Tertiary-treated wastewater is obtained from the MRWPCA and delivered to agricultural users within the Pressure and East Side Subbasins of the SVGB, reducing groundwater extraction in those areas. This type of redistribution of water resources provides a form of in-lieu groundwater recharge by effectively reducing groundwater extraction in those areas of the basin that are part of the CSIP area. As of 2012, the CSIP was delivering approximately 14,000 afy of recycled water to farm lands in the CSIP delivery area and has a goal of potentially increasing this volume to 22,000 afy (Phase II; MRWPCA, 2012).

Seaside Groundwater Basin (SGB) Recharge

For the time period of 2003 to 2007, SGB recharge including both primary recharge (percolation from rainfall and infiltration below stream beds) and secondary recharge components (irrigation return flows, leaks from water and sewer pipes, and septic system flows) was estimated to average 3,570 afy (HydroMetrics, 2009a).

In addition to natural recharge within the basin, active enhanced groundwater recharge has been occurring through an ASR program that was developed by the Monterey Peninsula Water Management District (MPWMD) and has operated since 2006. The locations of the existing and proposed ASR facilities are shown on **Figures 3-2** and **3-7**, including the four existing ASR injection/extraction wells. Under the ASR Program, Carmel River water is piped to the ASR wells located on the former Fort Ord military base, where it is then injected into the Santa Margarita Sandstone along the eastern side of the groundwater depression shown on **Figure 4.4-8**, and is stored for later extraction and use, as needed. **Table 4.4-3** summarizes the injection volumes (Pueblo Water Resources, 2014).

TABLE 4.4-3
SUMMARY OF ASR INJECTION VOLUMES

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2	175	168	160	351	411	12	60	182	1,111	1,117	131	295

All injection volumes in acre-feet

SOURCE: Pueblo Water Resources, 2014

Groundwater Extraction

Within Monterey County, groundwater is an important source of water supply for municipal and agricultural use. Groundwater extraction is monitored closely and reported on an annual basis for both groundwater basins. **Table 4.4-4** summarizes groundwater extraction within the northern SVGB and SGB from 2008 to 2012.

TABLE 4.4-4
GROUNDWATER EXTRACTION SUMMARY FOR THE SALINAS AND SEASIDE GROUNDWATER BASINS

	2008	2009	2010	2011	2012	2013
Salinas Valley Groundwater Basin						
180/400 Foot Aquifer Subbasin	130,139	121,165	103,544	105,172	113,898	117,242
Eastside Subarea	108,696	98,988	91,300	89,052	95,543	97,622
Seaside Groundwater Basin						
Coastal Subareas	4,242.1	3,514.0	3,676.9	3,298.4	2,962.8	2,983.52
Laguna Seca Subarea	1,029.9	1,060.6	867.7	4,151.5	870.1	912.27

All values in acre-feet

SOURCES: MCWRA, 2009, 2010, 2011, 2012, 2013, 2014c; SGB Watermaster, 2008 through 2013.

4.4.1.4 Groundwater Quality

Groundwater quality in the SVGB and SGB is influenced by a number of factors including natural geochemical properties and flow within the different hydrogeologic formations, groundwater pumping and induced seawater intrusion, land use practices, and accidental releases of contaminants into the environment. Other water quality concerns to the SGB, and particularly the Santa Margarita Sandstone, include changes in the aquifer water quality due to the presence of disinfection by-products (DBPs) in the injected water, and long-term changes in the geochemistry of the groundwater system. While this section focuses on water quality of the groundwater basins, Section 4.7, Hazards and Hazardous Materials, provides additional information on areas with contaminated soil and shallow groundwater.

Groundwater Quality at the Proposed Slant Well Locations

CalAm commissioned a subsurface soil investigation to further understand the existing subsurface geologic units and aquifer water quality at the locations of the proposed slant well locations on the CEMEX site. The investigation included borehole logging, soil sampling and groundwater sample analysis (Geoscience, 2013c). The subsurface investigation provided information and data to better characterize the subsurface stratigraphy and groundwater chemistry at various depth intervals. This subsurface data would also be used to inform the final design of the proposed slant wells. In addition, the information acquired regarding the subsurface materials, the groundwater flow characteristics, and water chemistry were used to further refine the groundwater models used in the analysis of project impacts.

The proposed slant wells would draw water from the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer from about 30 feet below msl to 200 feet below msl (Geosciences, 2014a). The soil borings drilled in the subsurface assessment ranged in depth from 250 feet bgs to 350 ft bgs and were identified as CX-C1, CX-B2, and CX-B4. Soil borings CX-B1 and CX-B2 were drilled closest to the ocean. Groundwater quality results are summarized below in **Table 4.4-5**. The chemical composition of seawater is also provided for comparison. As shown in **Table 4.4-5**, the sample collected from 182 to 192 feet bgs matches the chemistry of seawater. The total dissolved solids (TDS) concentration is 35,600 milligrams per liter (mg/L), and thus closely compares with the average seawater TDS concentration of 33,694 mg/L found along the central coast of California. The chloride concentration of 17,995 mg/L, is also similar to the average seawater chloride concentration of 18,537 mg/L found along the coast of California.

Groundwater Quality in the Santa Margarita Sandstone and the Seaside Groundwater Basin

Santa Margarita Sandstone overlies the Monterey Formation with sections of the unit present beneath the project area near Seaside at depths of about 800 feet. The proposed project would install two additional ASR injection/extraction wells (ASR-5 and ASR-6 Wells) in the Santa Margarita Sandstone in the northern subarea of the Seaside Basin to increase the injection, storage, and extraction capacity. The ASR system currently has four wells (Wells ASR-1 through ASR-4). Injection in Well ASR-1 occurred from 2001 through 2011 (ASR-1 is no longer active), in Well ASR-2 from 2010 to the present, and in Well ASR-3 from 2012 to the present (Pueblo Water Resources, 2014). Well ASR-4 is planned to become operational in 2015.

The water quality data used to establish existing water quality conditions within the Santa Margarita Sandstone were obtained from a previous study conducted in 2007 for the MPWMD, which involved evaluating the potential geochemical effects of injecting water treated drinking

TABLE 4.4-5
GROUNDWATER QUALITY AT CEMEX SITE

Chemical Parameter	CX-B1 51-61 feet	CX-B1 84-94 feet	CX-B1 134-134 feet	CX-B1 182-192 feet	CX-B2 55-65 feet	CX-B2 104-114 feet	CX-B2 161-171	CX-B2 215-225	Central Coast Seawater Average
Bicarbonate as HCO_3^-	126	154	117	204	127	124	157	179	103
Boron	2.40	2.80	2.88	1.54	2.36	2.58	0.86	1054	4.35
Bromide	38	41	38	49.6	44	45	23	38	64.5
Calcium	709	656	502	2,018	886	732	1,141	1,948	395
Carbonate as $CaCO_3$	ND	ND	ND	ND	ND	ND	ND	ND	--
Chloride	**13,675**	**14,755**	**14,050**	**17,995**	**14,464**	**14,099**	**7,408**	**13,026**	**18,537**
Conductivity (field)	30,803	35,167	34,907	41,546	34,162	34,532	18,875	31,029	--
Iron	57	171	814	1,780	121	nd	148	246	0.003
Magnesium	928	1,215	981	1,078	1,015	1,056	605	936	1,230
Nitrate as NO_3	3	2	2	ND	ND	2	2	nd	0.67
Nitrite as NO_2-N	ND	ND	ND	ND	ND	ND	0.2	nd	--
pH	7.18	7.05	6.82	6.79	7.2	7.2	7.4	7.0	7.5-8.5
Potassium	186	221	256	34	226	201	73	55	382
Sodium	6,219	7,500	7,968	8,612	6,536	6,643	2,437	5,135	10,329
Sulfate as SO_4	1,748	1,882	1,832	2,688	1,822	1,855	713	1,674	2,598
Total Dissolved Solids (Lab)	**24,800**	**27,400**	**26,500**	**35,600**	**26,700**	**26,800**	**16,200**	**26,500**	**33,694**

NOTES:

Reported chemical species are expressed as dissolved concentrations
ND = not detected above reporting limit
All concentrations in milligrams per liter (mg/L) except conductivity (micromhos per centimeter, umhos/cm) and pH (pH units)
The TDS and chloride concentrations are in **bold tex**t to highlight the concentrations relative to seawater.

SOURCE: Geoscience, 2014a for samples and most seawater values; Hem, 1989 for iron, nitrate, and pH seawater.

water into the Santa Margarita Sandstone (EcoEngineers, 2008). The study estimated the nature and magnitudes of potential dissolution and precipitation reactions, the potential for scaling or biofouling, and the post-injection concentrations of chemicals in the water as compared with drinking water standards. The study used Carmel River water treated to drinking water standards from the CalAm Begonia Iron Removal Plant and involved combining the treated water with rock material and native groundwater from the Santa Margarita Sandstone. After an 18 hour exposure period, the water mixture (referred to in the study as leachate) was reanalyzed for water quality constituents and the concentrations were compared with California Primary and Secondary MCL drinking water standards. The water chemistry of the initial treated water and the resulting leachates from two depth intervals are summarized below in **Table 4.4-6**. The results indicated that the leachate obtained from mixing treated water with the Santa Margarita Sandstone and its native water did not exceed drinking water standards and did not show significant differences in water quality.

Water Quality and the Existing ASR System

The ASR system well performance and water quality is documented in annual Summary of Operation reports prepared by Pueblo Water Resources (Pueblo). The discussions below for the ASR system draw on the Water Year 2013 monitoring activities unless otherwise cited (Pueblo Water Resources, 2014).

Because injection operations have occurred annually at the ASR-1 Well since 2002, the groundwater quality in the local area has been altered from the pre-injection, naturally-occurring conditions. Consequently, making a clear distinction between native and non-native water quality has become both complex and somewhat subjective. Water testing has indicated changes in native water quality from mixing injected potable water. This change was observed in distant wells, such as Well PCA-E, located 6,200 feet west of the ASR injection/extraction wells. Well PCA-E is a monitoring well operated by the MPWMD and screened in the Santa Margarita Sandstone. For the 2013 water year, groundwater in Well PCA-E was estimated to contain 22 to 30 percent injected potable water.

The chloride ion has historically been used for the ASR project as a tracer to track the general mixing, dilution, and interaction between injected and native groundwater. Chloride is very stable, highly soluble, and is present in both injected and native groundwater. Pueblo Water Resources has conducted ongoing monitoring to assess the response of the Santa Margarita Sandstone to the injection and extraction of treated water. The historical chloride concentration of the native groundwater within the Santa Margarita Sandstone has averaged approximately 120 mg/L in this area of the Seaside Basin. However, the injection of treated water into the Santa Margarita Sandstone has reduced the chloride concentrations. This conclusion is substantiated by the results of a groundwater quality sample obtained from the basin in the most recent sampling event in December 2012, which contained 34 mg/l of chloride, well below the average chloride concentration of 120 mg/L. Over time, repeated ASR injection, storage, and recovery cycles are expected to incrementally produce water that is similar in nature to that of the injected water, developing a buffer zone of mixed water that gradually increases over time.

TABLE 4.4-6
WATER CHEMISTRY RESULTS OF MIXING STUDY

Chemical Parameter	Treated Carmel River Water	Leachate 540-580 feet	Leachate 730-770 feet	California MCLs
Alkalinity as $CaCO_3$	129	130	128	NE
Aluminum	0.025	0.025	0.025	1 / 0.2 (Sec)
Ammonia Nitrogen	0.1	0.1	0.1	NE
Arsenic	ND (0.005)	ND (0.005)	ND (0.005)	0.010
Antimony	NR	ND (0.0005)	ND (0.0005)	0.006
Barium	0.056	0.039	0.043	1
Bromide	0.11	0.11	0.11	NE
Beryllium	NR	ND (0.0005)	ND (0.0005)	0.004
Cadmium	NR	ND (0.00025)	ND (0.00025)	0.005
Calcium	36	39	36	NE
Chloride	32	33	33	250 (Sec)
Dissolved Organic Carbon	1.4	1.6	3.4	NE
Chromium	NR	ND (0.0005)	ND (0.0005)	0.10
Cobalt	NR	ND (0.0005)	ND (0.0005)	NE
Dissolved Oxygen	7.43	nana	NA	NE
Electrical Conductivity	510	484	490	900 (Sec)
Fluoride	0.30	0.25	0.27	2
Iron	0.001	ND (0.02)	ND (0.02)	0.3 (Sec)
Lead	NR	ND (0.0005)	ND (0.0005)	0.015[a]
Magnesium	14	14	13	NE
Manganese	0.001	0.001	0.001	0.05 (Sec)
Mercury	NR	0.00017	0.00044	0.002
Molybdenum	NR	0.0031	0.0034	NE
Nickel	NR	0.0011	0.0014	0.10
Nitrate/Nitrite as NO_3	0.05	0.12	0.47	10
Oxygen Reduction Potential (ORP)	749	550	544	NE
pe (= ORP/59.16)	12.66	9.30	9.20	NE
Total Phosphorous	0.34	0.30	0.34	NE
Potassium	2.9	2.9	3.4	NE
pH	7.70	6.71	6.28	NE
Selenium	0.0017	0.0018	0.0021	0.05
Silicon	8.41	8.88	8.41	NE
Silver	NR	ND (0.0005)	ND (0.0005)	0.10[a]
Sodium	42	40	42	NE
Strontium	0.200	0.250	0.250	NE
Sulfate as SO_4	84.9	85.4	79.4	250 (Sec)
Thallium	NR	ND (0.0005)	ND (0.0005)	0.002
Uranium	0.0025	0.0025	0.0060	0.03
Vanadium	NR	0.00073	0.00086	0.05[a]
Zinc	0.210	0.034	0.84	0.5 (Sec)

NOTES:
MCLs = Primary Maximum Contaminant Levels also referred to as Primary Drinking Water Standards; Sec = Secondary MCLs
All concentrations in milligrams per liter (mg/L) except conductivity (micromhos per centimeter), ORP (millivolts), and pH (pH units)
NA = not analyzed ND = not detected above reporting limit NE = not established NR = not reported
a = Lead has a regulatory action level, not an MCL

SOURCE: EcoEngineers, 2008.

Disinfection By-Products (DBPs)

As a part of the current ASR program, Carmel River water is treated by removing iron and manganese, disinfecting the water with sodium hypochlorite, and injecting the potable water into the Santa Margarita Sandstone (Pueblo Water Resources, 2014). The potable water undergoes a chlorination process to disinfect it of possible microbiological contamination prior to injection into the Santa Margarita Sandstone. This chlorination process is known to produce DBPs, including trihalomethanes (THMs)[12] and haloacetic acids (HAAs)[13] that have regulatory limits for drinking water purposes.

While it has been successfully demonstrated at the Seaside Basin ASR site (as well as other ASR sites in California and elsewhere) that successive injection/storage/recovery cycles can yield fully potable water upon recovery, issues regarding the fate and stability of DBPs in the subsurface can also affect the potability of the recovered water. The monitoring results evaluated by Pueblo Water Resources indicate that the THMs do increase upon initial injection of treated surface water into the Santa Margarita Sandstone, but concentrations steadily decrease with time. Groundwater monitoring results indicate that over the course of that time, the pH has remained neutral (between 6 and 8), indicating relatively stable geochemical conditions. The DBP data collected during the 2013 water year indicated that THMs increased and peaked by the 60th day of storage, followed by a gradual decline. After approximately 90 to 150 days of storage, THMs had degraded to below the initial injection levels. HAAs degrade to below reporting limits by 90 to 100 days. More importantly, throughout the 2013 water year, THMs were below the MCL of 80 micrograms per liter and HAAs were below the MCL of 60 micrograms over liter. During the testing of the ASR project by Pueblo Water Resources described above, studies found that levels of hydrogen sulfide in the recovered water were much lower than natural groundwater concentrations prior to injection, indicating a lasting and significant improvement of water quality during subsurface water storage.[14] This observation suggests that an ancillary benefit of the ASR in the SGB may include the conditioning of the aquifer; i.e., the reduction of hydrogen sulfide in groundwater extracted, which subsequently reduces the amount of chemical treatment that needs to be performed at the Seaside Ozone Treatment Plant. According to a report that summarized the pilot study results for the ASR project, with continued ASR operations over time, the need for the ozone treatment plant may become unnecessary (Padre Associates, 2004).

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[12] Trihalomethanes (THMs) are a group of four chemicals that are formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The trihalomethanes are chloroform, bromodichloromethane, dibromochloromethane, and bromoform. The USEPA has published the Stage 1 Disinfectants/Disinfection Byproducts Rule to regulate total trihalomethanes at a maximum allowable annual average level of 80 parts per billion (USEPA, 2012).

[13] Haloacetic Acids (HAAs) are a group of chemicals that are formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The regulated haloacetic acids, known as HAAs, are: monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. The USEPA has published the Stage 1 Disinfectants/Disinfection Byproducts Rule to regulate HAAs at 60 parts per billion annual average (USEPA, 2012).

[14] The cause of hydrogen sulfide reduction is likely due to the effects of the injectate’s chlorine residual and dissolved oxygen content. These oxidizers react in the subsurface to stifle anaerobic bioactivity, which normally produces hydrogen sulfide. As the aquifer environment is altered and becomes inhospitable to anaerobes, hydrogen sulfide generation declines. This effect has also been observed in ASR wells in similar coastal aquifers in Santa Barbara, Alameda, and Ventura Counties.

Seawater Intrusion

Seawater intrusion is a condition typically defined as when chloride concentrations detected in groundwater monitoring and production wells exceed 500 mg/L because these concentrations are above the California Secondary Drinking Water Standards for drinking water (RMC, 2006). This drinking water standard was amended in 2006 to include a Maximum Recommended Level of 250 mg/L (Title 22 California Code of Regulations [CCR] Section 64449).

Salinas Valley Groundwater Basin

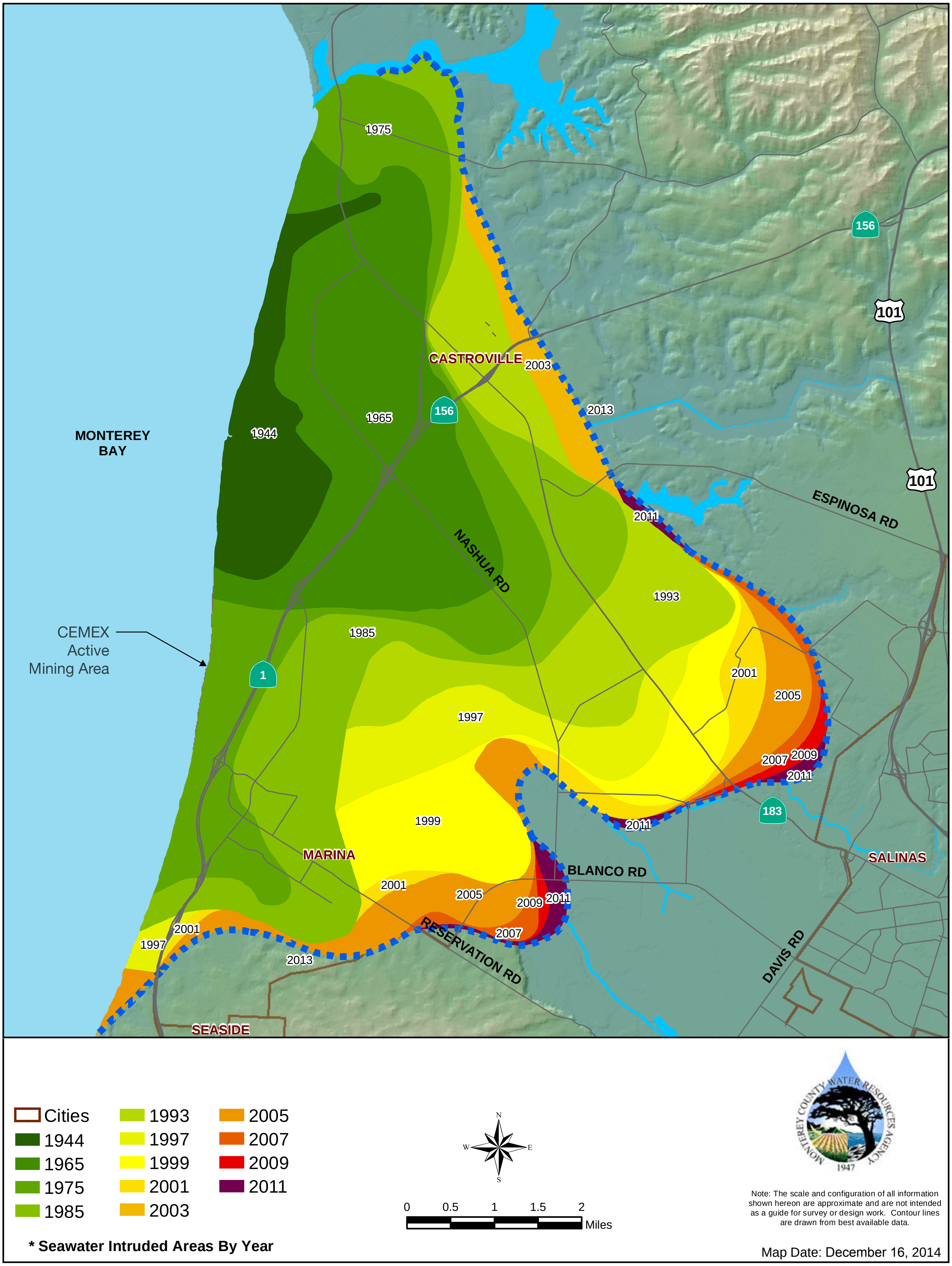
The SVGB is hydrologically connected to the Monterey Bay by ocean outcrops of the 180-Foot and 400-Foot Aquifers that outcrop a few miles offshore (Eittreim, et. al., 2000; Greene, 1970). The ocean outcrops provide a constant source of both pressure and direct recharge of seawater and facilitate the recharge of seawater into those aquifers along the coast when groundwater extraction exceeds natural recharge. As a result, a landward groundwater gradient has developed along the coast and induced groundwater recharge from the ocean since the mid-20th century. Seawater intrusion in the SVGB was first documented in 1946 (DWR, 1946). The overdraft condition has led to degradation of groundwater quality along the coast within the SVGB. **Figures 4.4-9** and **4.4-10** illustrate the seawater intrusion areas as of 2013 within the 180-Foot and 400-Foot Aquifers, respectively (MCWRA, 2014). The 2013 estimates of seawater intrusion within the 180-Foot and 400-Foot Aquifers indicate that seawater has intruded to a maximum of approximately 8 miles and 3.5 miles inland, respectively, inferred from chloride concentrations greater than 500 mg/L. The seawater intrusion has resulted in the degradation of groundwater supplies, requiring urban and agricultural supply wells within the affected area to be abandoned or destroyed (MCWRA, 2001).

Seaside Groundwater Basin

Groundwater pumping from aquifers in the SGB have exceeded recharge and fresh water inflows, resulting in pumping depressions near the coast, as shown on the groundwater flow maps for both the shallow aquifer zone (see **Figure 4.4-7**) and the deep aquifer zone (see **Figure 4.4-8**) (HydroMetrics, 2013). In addition, seawater intrusion has occurred just north of the SGB in the adjacent 180/400 Foot Aquifer Subbasin of the SVGB, as discussed above, and the boundary between the two basins is a groundwater divide, subject to migrating in response to variations in natural recharge and pumping on either side of the groundwater divide. HydroMetrics noted increased chloride concentrations in two wells along the coast, although the concentrations have not yet exceeded drinking water standards. These conditions all suggest that the SGB could be vulnerable to seawater intrusion.

Regional Sources of Groundwater Contamination

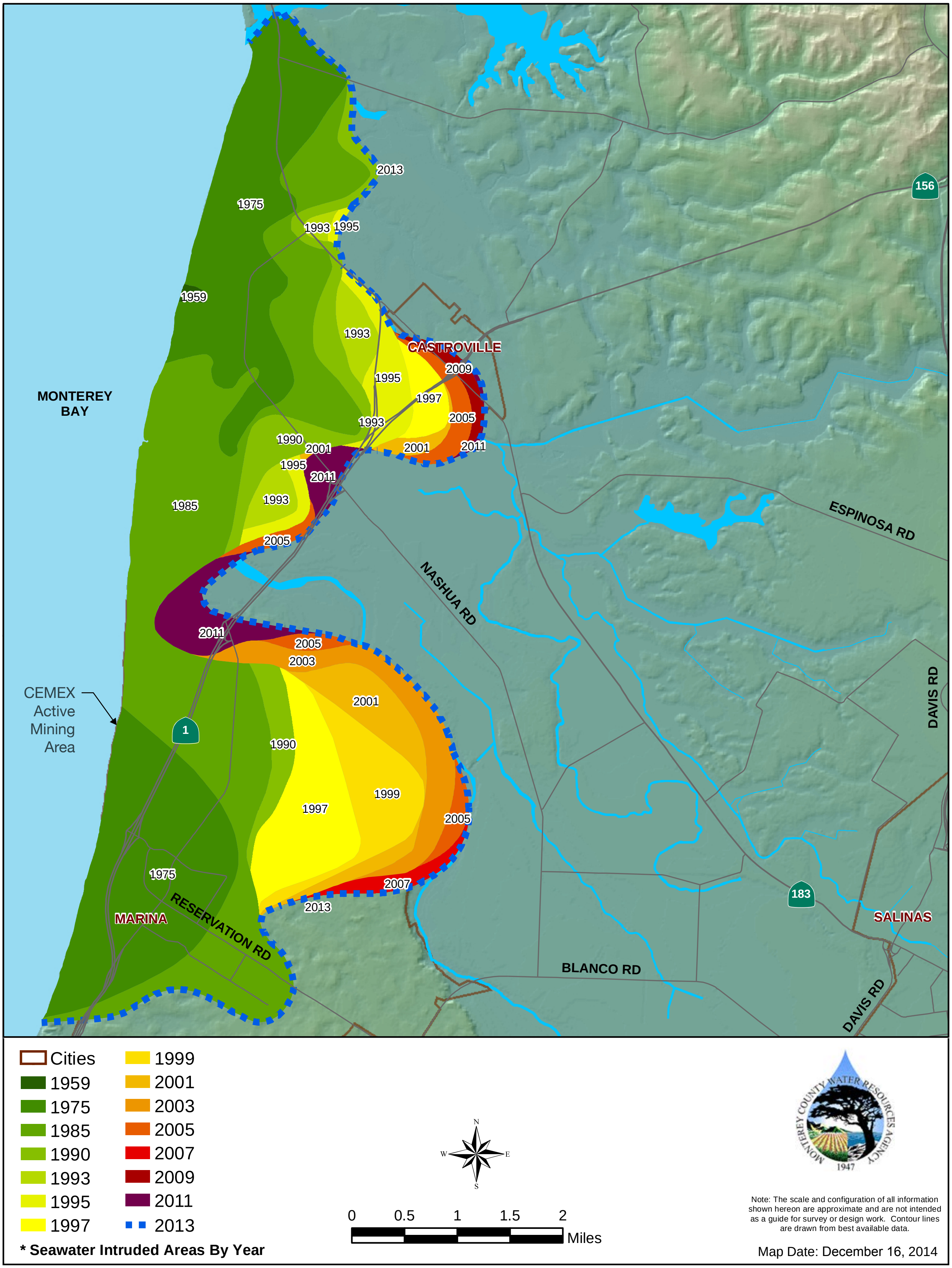
In the region, past industrial, commercial, or military sites have resulted in soil and groundwater contamination caused by past spills, leaking underground tanks, unlined chemical disposal sites or inadvertent land disposal of chemicals. In particular, groundwater in the aquifers located beneath the former Fort Ord military base, located within two miles southeast of the proposed slant well locations at CEMEX sand facility are contaminated with volatile organic compounds, mostly trichloroethene (TCE) and carbon tetrachloride. **Figures 4.7-1** and **4.7-**2 show the locations of the known plumes in the region and are discussed in Section 4.7, Hazards and



SOURCE: MCWRA, 2014b

205335.01 Monterey Peninsula Water Supply Project

Figure 4.4-9
Historic Seawater Intrusion in the
Salinas Valley Groundwater Basin - 180-Foot Aquifer



SOURCE: MCWRA, 2014b

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Figure 4.4-10
Historic Seawater Intrusion in the
Salinas Valley Groundwater Basin - 400-Foot Aquifer

Hazardous Materials. The closest of these contaminant plumes to the proposed slant wells, known as the OU1 TCE A-Aquifer Plume, the OUCTP A-Aquifer Plume, and the OUCTP Upper 180-Foot Aquifer Plume, are present in the indicated aquifers of the SVGB in the vicinity of Reservation Road, east of Del Monte Boulevard in Marina (Ahtna, 2015; HydroGeoLogic, 2015). These plumes have undergone considerable investigation, source removal, and remedial action, and the extent and concentrations have decreased over time.

4.4.2 Regulatory Framework

Many of the regulations described in Section 4.3, Surface Water Hydrology and Water Quality, also apply to groundwater resources including the Porter-Cologne Water Quality Control Act and Water Quality Control Plan (Basin Plan). Additional information regarding the Basin Plan for the Central Coast RWQCB is provided specific to groundwater resources.

4.4.2.1 State

State Water Resources Control Board (SWRCB) Resolution 68-16 Anti-Degradation Policy

The SWRCB has broad authority over discharges to waters of the State. In 1968, the SWRCB adopted an anti-degradation policy aimed at maintaining the high quality of waters in California through the issuance of Resolution No. 68-16 (“Statement of Policy with Respect to Maintaining High Quality Waters in California”), whereby actions that tend to degrade the quality of water are prohibited. Oversight of this policy is done through the RWQCBs (SWRCB, 1968). The anti-degradation policy states that:

- Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies.
- Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters must meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

SWRCB has interpreted Resolution No. 68-16 to incorporate the federal anti-degradation policy, which is applicable if a discharge that began after November 28, 1975, will lower existing surface water quality.

This policy would apply to the proposed seawater intake system, the treated water to be injected into the proposed ASR injection/extraction wells, and proposed Salinas Valley return water options, because these project elements would be required to comply with the state resolution maintaining the existing water quality.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) provides the basis for water quality regulation within California and defines water quality objectives as the limits or levels of water constituents that are established for reasonable protection of beneficial uses. The California SWRCB administers water rights, water pollution control, and water quality functions throughout the State, while the Central Coast RWQCB conducts planning, permitting, and enforcement activities. The Porter-Cologne Act requires the RWQCB to establish a regional Basin Plan with water quality objectives, while acknowledging that water quality may be changed to some degree without unreasonably affecting beneficial uses. Beneficial uses, together with the corresponding water quality objectives, are defined as standards, per federal regulations. Therefore, the regional basin plans form the regulatory references for meeting state and federal requirements for water quality control. Changes in water quality are allowed if the change is consistent with the maximum beneficial use of the state waters, it does not unreasonably affect the present or anticipated beneficial uses, and it does not result in water quality less than that prescribed in the water quality control plans. The Basin Plan regulations include groundwater. The Basin Plan for this location is discussed below in the local regulations subsection.

This Act would apply to the proposed seawater intake system and ASR injection/extraction wells because the injection would be required to comply with the Basin Plan objectives, discussed in the Local Regulations subsection further below.

Division of Water Rights Permit 20808C – Amended Permit for Diversion and Use of Water

Initially, Permit 20808 was issued for the New Los Padres Reservoir proposed project in1995. Subsequently, the Permit has been split and modified several times and now addresses additional requirements for the diversion of surface and understream flow from the Carmel River, protection of the Carmel Lagoon and fish habitat, and the injection and storage of Carmel River water in the Seaside Basin using the ASR injection/extraction wells. Permit 20808C modified or established the requirements relative to the ASR system. The requirements include establishing the maximum annual Carmel River diversion of 2,900 afy for injection and storage in the Seaside Basin, the timing and monitoring requirements for diversion, fish protection measures, and the rules for the recovery of the stored water. The current annual volume of stored water that can be recovered is 1,500 afy plus unrecovered carryover water from previous years, if available. In addition, the volume of recovered water may not exceed 1,500 af for a given year if the volume of water injected that year plus carryover from previous years does not equal 1,500 af. In that case, only the volume of water injected that year plus whatever carryover water is available, if any, may be recovered.

State Water Resources Control Board Order No. 2003-0003-DWQ, ***Statewide General Waste Discharge Requirements for Discharges to Land with a Low Threat to Water Quality***

SWRCB Order No. 2003-0003-DWQ established a statewide Waste Discharge Requirements (WDRs) order regulating certain wastes that are low volume discharges with minimal pollutant concentrations and that may be discharged to land without the preparation of a Report of Waste

Discharge. The order includes well development water, monitoring well purge water, and boring waste discharge. This order would allow the listed wastes to be discharged directly to the land surface so long as the discharge is effected in a controlled manner that does not result in erosion or other adverse effects. The Central Coast Regional Water Quality Control – General Order WQ-2011-0223, *Waste Discharge Requirements (WDR) NPDES General Permit for Discharges with Low Threat to Water Quality*, and the Central Coast Regional Water Quality Control - Resolution R3-2008-0010, *General Waiver for Specific Types of Discharges*, discussed further below, provide further details on how this would apply to the proposed project.

4.4.2.2 Regional and Local

Central Coast Regional Water Quality Control Plan (Basin Plan)

The Central Coast RWQCB, under the authority of the state Porter-Cologne Water Quality Control Act, is responsible for authorizing and regulating activities that may discharge wastes to surface water or groundwater resources. The preparation and adoption of water quality control plans (Basin Plans) are required by the California Water Code (Section 13240). According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and a program of implementation needed for achieving the objectives. Because beneficial uses, together with their corresponding water quality objectives, can be defined per federal regulations as water quality standards, the Basin Plans are regulatory references for meeting the state and federal requirements for water quality control. One significant difference between the State and Federal programs is that California's basin plans establish standards for groundwater in addition to surface water.

The Basin Plan for the Central Coast, originally adopted in 1971 and last amended in 2011, identifies the beneficial uses of water bodies and provides water quality objectives and standards for waters of the Central Coast of California. The listed beneficial uses for groundwater resources are

- Agricultural water supply (AGR)
- Municipal and domestic water supply (MUN)
- Industrial use (IND)

General objectives are established for tastes and odors, and radioactivity; for municipal and domestic supply, additional general objectives are established for bacteria, organic chemicals, and various chemical constituents; and for agricultural supply, general objectives follow the guidelines for water quality from the University of California Agricultural Extension Service guidelines. In addition, agriculture supply must be handled such that no controllable water quality factor shall degrade the quality of any groundwater resource or adversely affect long-term soil productivity.

The Central Coast RWQCB has established water quality objectives for selected groundwater resources; these objectives are intended to serve as a basis for evaluating water quality management in the basin. Specific water quality objectives have been defined for the 180-Foot Aquifer and 400-Foot Aquifer for the SVGB, as listed in **Table 4.4-7** below.

TABLE 4.4-7
GROUNDWATER QUALITY OBJECTIVES

Aquifer	Total Dissolved Solids	Chloride	Sulfate	Boron	Sodium	Nitrate as Nitrogen
180-Foot	1500	250	600	0.5	250	1
400-Foot	400	50	100	0.2	50	1

NOTES: All concentration are in milligrams per liter (mg/L)

SOURCE: RWQCB, 2011b.

This policy would apply to the proposed seawater intake system, basin return water options, and treated water to be injected into the proposed ASR injection/extraction wells because these project elements would be required to comply with the Basin Plan objectives for water quality.

Central Coast Regional Water Quality Control – General Order WQ-2011-0223, Waste Discharge Requirements (WDR) NPDES General Permit for Discharges with Low Threat to Water Quality

Similar to the SWRCB Order No. 2003-0003-DWQ described above, RWQCB General Order WQ-2011-0223 provides specific requirements for low-threat discharges, which are defined as discharges that contain minimal amounts of pollutants and pose little or no threat to water quality and the environment. Discharges that meet the following criteria are covered under this permit:

a) Pollutant concentrations in the discharge do not cause, have a reasonable potential to cause, or contribute to an excursion above any applicable water quality objectives, including prohibitions of discharge.

b) The discharge does not include water added for the purpose of diluting pollutant concentrations.

c) Pollutant concentrations in the discharge will not cause or contribute to degradation of water quality or impair beneficial uses of receiving waters.

d) Pollutant concentrations in the discharge shall not exceed the limits in the permit unless the Executive Officer determines that the applicable water quality control plan (i.e., Ocean Plan and/or State Implementation Policy) does not require effluent limits.

e) The discharge shall not cause acute or chronic toxicity in receiving waters.

f) The discharger shall demonstrate the ability to comply with the requirements of this General Permit.

The project-related discharges that would fall under this General Permit include small temporary discharges from water supply well installation (in this case, the proposed subsurface slant wells and ASR injection/extraction wells). These discharges may be treated and discharged on either a continuous or a batch basis.

Central Coast Regional Water Quality Control - Resolution R3-2008-0010, General Waiver for Specific Types of Discharges

In conjunction with the SWRCB Order No. 2003-0003-DWQ and Central Coast RWQCB General Order No. WQ-2011-0223, described above, RWQCB Resolution No. R3-2008-0010 waives the submittal of Reports of Waste Discharge and the issuance of WDRs for certain wastes that are low volume discharges with minimal pollutant concentrations. The order includes well development water, monitoring well purge water, and boring waste discharge. This order would allow the listed wastes to be discharged directly to the land surface so long as the discharge is in a controlled manner that does not result in erosion or other adverse effects. The RWQCB Resolution includes the injection and extraction of treated groundwater, such as with the ASR system, so long as the RWQCB reviews and approves of the system design and operation.

Central Coast Regional Water Quality Control - Resolution R3-2013-0032c, Central Coast Post-Construction Stormwater Requirements

In conjunction with the SWRCB Construction General Permit, Order No. 2003-0003-DWQ, the Central Coast RWQCB Resolution No. R3-2013-0032c provides specific post-construction storm water requirements. Both the state Construction General Permit and the Central Coast RWQCB Resolution R3-2013-0032c are described in detail in Section 4.2, Surface Water Hydrology and Quality. The RWQCB Resolution applies to projects that create or replace 2,500 square feet or more of impervious area, such as with the MPWSP Desalination Plant. The RWQCB Resolution applies to this Groundwater Resources section because it addresses project changes that would impact recharge to groundwater. The Resolution provides specific requirements to address stormwater runoff to minimize impervious surfaces, and minimize runoff by dispersing runoff to landscape or using permeable pavements.

MCWRA Act (1995) (Agency Act)

Under the Agency Act, MCWRA is authorized to provide for the control of the flood and storm waters of within its territory as well as the flood and storm waters of streams that have their sources outside the agency, but flow into MCWRA territory, and to conserve those waters for beneficial and useful purposes. Per the Agency Act, MCWRA is charged with preventing the waste or diminution of the water supply in its territory by, among other things, controlling groundwater extractions and prohibiting groundwater exportation from the SVGB. Specifically, section 9(v) of the Agency Act provides that MRCWRA has the power:

> To prevent the export of groundwater from the SVGB, except that use of water from the basin on any part of Fort Ord shall not be deemed such an export. Nothing in this act shall be deemed to prevent the development and use of the Seaside Groundwater Basin for use on any lands within or without that basin.

If any person or entity attempts to export groundwater from the SVGB, the MCWRA may seek from the Monterey Superior Court an injunction prohibiting such export.

The Agency Act further authorizes MCWRA to commission groundwater studies in order to determine whether any portion underlying MCWRA is threatened with the loss of useable groundwater supply and to adopt an ordinance prohibiting further extraction of groundwater from an area and depth defined by MCWRA.

MCWRA Ordinance 3709

The MCWRA Ordinance 3709 prohibits drilling into and groundwater pumping from the 180-Foot Aquifer within specific onshore areas, designated as Territories A and B. The Seawater Intake System would be located at the westernmost edge of Territory B. However, the source water for the proposed project would be extracted from subsurface slant wells located beneath the ocean floor, an area not located within the restrictive territories identified by Ordinance 3709.

Seaside Basin Watermaster (California Superior Court, Monterey California, Case No. M66343)

Through the adjudication of the Seaside Basin, the California Superior Court created the Seaside Basin Watermaster on March 26, 2006. The purpose of the Watermaster is to assist the Court in the administration and enforcement of the provisions of the Judgment, which pertains to overseeing and managing the groundwater resources of the Seaside Groundwater Basin. The Watermaster's objective is to help resolve the problems of lowered groundwater levels and the threat of seawater intrusion, which are the result of over-pumping of the Seaside Basin.

4.4.2.3 Proposed Project Consistency with Applicable State, Regional and Local Land Use Plans and Policies Relevant to Groundwater

Table 4.4-8 describes the state, regional, and local land use plans, policies, and regulations pertaining to groundwater that are relevant to the MPWSP and that were adopted for the purpose of avoiding or mitigating an environmental effect. A general overview of these policy documents is presented in Section 4.8, Land Use, Land Use Planning, and Recreation. Also included in **Table 4.4-8** is an analysis of project consistency with such plans, policies, and regulations. Where the analysis concludes the proposed project would not conflict with the applicable plan, policy, or regulation, the finding is noted and no further discussion is provided. Where the analysis concludes the proposed project may conflict with the applicable plan, policy, or regulation, the reader is referred to Section 4.4.3, Impacts and Mitigation Measures, for additional discussion.

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TABLE 4.4-8
APPLICABLE STATE, REGIONAL, AND LOCAL PLANS AND POLICIES RELEVANT TO GROUNDWATER RESOURCES

proposed project Planning Region	Applicable Planning Document	Plan Element/ Section	proposed project Component(s)	Specific Plan, Policy, or Ordinance	Relationship to Avoiding or Mitigating a Significant Environmental Impact	proposed project Consistency with Plan, Policy, or Ordinance
City of Marina (coastal zone & inland areas)	Marina Municipal Code	Water Wells	Subsurface slant wells and monitoring wells for Seawater Intake System	***Section 13.12.030 Permit—Required.*** No person shall construct, repair, reconstruct, abandon, or destroy any well unless a written permit has first been obtained from the County of Monterey.	This policy is intended to protect public health and safety by ensuring wells are properly constructed, maintained, and decommissioned.	Consistent: As described in Chapter 3, Project Description, the applicant proposes and would be required to obtain a Well Construction Permit from the Monterey County Department of Environmental Health prior to commencement of project well construction.
County of Monterey (coastal zone & inland areas)	Monterey County Code	Water Wells	Subsurface slant wells and monitoring wells for Seawater Intake System	***Section 15.08.030 Permit—Required*** a. No person shall construct, repair, reconstruct or destroy any well, abandoned well, cathodic protection well, observation well, monitoring well, or test well unless a written permit has first been obtained from the Health Officer of the County or his or her authorized representative as provided in this Chapter.	This policy is intended to protect public health and safety by ensuring wells are properly constructed, maintained, and decommissioned.	Consistent: As described in Chapter 3, Project Description, the applicant proposes and would be required to obtain a Well Construction Permit from the Monterey County Department of Environmental Health prior to commencement of project well construction.
County of Monterey (coastal zone & inland areas)	Monterey County Code	Water Wells	Subsurface Slant Wells and monitoring wells for Seawater Intake System	***Section 15.08.110 Technical Standards*** a. Standards. Standards for the construction, repair, reconstruction of or destruction of wells shall be as set forth in Chapter II and Appendices A, B, C D of the Department of Water Resources Bulletin No. 74-81, “Water Well Standards” (December, 1981).	This policy is intended to protect public health and safety by ensuring wells are properly constructed, maintained, and decommissioned.	Consistent: All wells within the State of California are required to be constructed in compliance with DWR Bulletin 74-81.
County of Monterey (coastal zone & inland areas)	Monterey County General Plan	Public Services	Source Water Pipeline, MPWSP Desalination Plant, Desalinated Water Pipeline, Brine Discharge Pipeline, Salinas Valley Return Pipeline, Valley Greens Pump Station (both site options), Main System--Hidden Hills and Ryan Ranch--Bishop Interconnection Improvements	***Policy PS-2.8:*** The County shall require that all projects be designed to maintain or increase the site’s pre-development absorption of rainfall (minimize runoff), and to recharge groundwater where appropriate. Implementation shall include standards that could regulate impervious surfaces, vary by project type, land use, soils and area characteristics, and provide for water impoundments (retention/detention structures), protecting and planting vegetation, use of permeable paving materials, bioswales, water gardens, and cisterns, and other measures to increase runoff retention, protect water quality, and enhance groundwater recharge.	This policy is intended to minimize the impacts of new impervious surfaces to increase runoff retention, protect water quality, and enhance groundwater recharge.	Consistent: The Seawater Intake System and water conveyance pipelines would be buried below the ground surface, mainly within existing developed or disturbed areas, and would therefore result in no effect on the absorption of rainfall. The MPWSP Desalination Plant and the Valley Greens Pump Station Option 1 would be constructed in unpaved areas and all rainwater would be routed to the permeable surrounding sandy soils. The Valley Greens Pump Station Option 2 would rebuild an existing station and have no net change in impervious surfaces.
County of Monterey (coastal zone & inland areas)	Monterey County General Plan	Public Services	Source Water Pipeline, MPWSP Desalination Plant, Desalinated Water Pipeline, Brine Discharge Pipeline, Salinas Valley Return Pipeline, Valley Greens Pump Station (both site options), Main System-Hidden Hills and Ryan Ranch-Bishop Interconnection Improvements	***Policy PS-2.9:*** The County shall use discretionary permits to manage construction of impervious surfaces in important groundwater recharge areas in order to protect and manage groundwater as a valuable and limited shared resource. Potential recharge area protection measures at sites in important groundwater recharge areas may include, but are not limited to, the following: a. Restrict coverage by impervious materials. b. Limit building or parking footprints. c. Require construction of detention/retention facilities on large-scale development project sites overlying important groundwater recharge areas as identified by Monterey County Water Resources Agency. The County recognizes that detention/retention facilities on small sites may not be practical, or feasible, and may be difficult to maintain and manage.	This policy is intended to preserve impervious surfaces to increase runoff retention, protect water quality, and enhance groundwater recharge.	Consistent: The Seawater Intake System and water conveyance pipelines would be buried below the ground surface, mainly within existing developed or disturbed areas, and would therefore result in no effect on recharge. The MPWSP Desalination Plant and the Valley Greens Pump Station Option 1 would be constructed in unpaved areas and all rainwater would be routed to the permeable surrounding sandy soils. The Valley Greens Pump Station Option 2 would rebuild an existing station and have no net change in impervious surfaces.
County of Monterey (coastal zone & inland areas)	Monterey County General Plan	Safety	Source Water Pipeline, MPWSP Desalination Plant, Desalinated Water Pipeline, Brine Discharge Pipeline, Salinas Valley Return Pipeline, Valley Greens Pump Station (both site options), Main System--Hidden Hills and Ryan Ranch--Bishop Interconnection Improvements	***Policy S-3.2:*** Best Management Practices to protect groundwater and surface water quality shall be incorporated into all development.	This policy is intended to protect surface water and groundwater quality from impacts of development.	Consistent: The proposed project would be subject to the state Construction General Permit, the Monterey County Grading Ordinance, the Monterey County Erosion Control Ordinance, and the RWQCB Resolution R3-2013-0032c, which require the implementation of specific construction-related BMPs to prevent concentrated stormwater run-on/runoff, soil erosion, and release of construction site contaminants. Discussion related to surface water quality is also discussed in Section 4.3 Surface Water Hydrology and Water Quality.

TABLE 4.4-8 (CONT.)
APPLICABLE STATE, REGIONAL, AND LOCAL PLANS AND POLICIES RELEVANT TO GROUNDWATER RESOURCES

proposed project Planning Region	Applicable Planning Document	Plan Element/ Section	proposed project Component(s)	Specific Plan, Policy, or Ordinance	Relationship to Avoiding or Mitigating a Significant Environmental Impact	proposed project Consistency with Plan, Policy, or Ordinance
County of Monterey (coastal zone)	North County Land Use Plan	Water Resources	Subsurface slant wells	***Policy 2.5.3 A.2.*** The County's long-term policy shall be to limit ground water use to the safe-yield level.	This policy is intended to maintain groundwater resources and reduce overdraft of basin groundwater supplies.	Consistent: The subsurface slant wells are designed to maximize the infiltration of seawater through the ocean floor and ocean outcrops into the slant wells. In the event that a fraction of the intake water is freshwater from the inland basin, that fraction of freshwater would be returned to the Salinas Valley Groundwater Basin through the CSIP program. This action would improve groundwater supplies and is therefore consistent.
Fort Ord Reuse Authority (City of Seaside)	Fort Ord Reuse Plan	Conservation	ASR Conveyance Pipeline, ASR Pump-to-Waste Pipeline, ASR Settling Basin, ASR Pump Station, Terminal Reservoir	**Hydrology and Water Quality Policy A-1:** At the project approval stage, the City shall require new development to demonstrate that all measures will be taken to ensure that runoff is minimized and infiltration maximized in groundwater recharge areas.	This policy is intended to preserve impervious surfaces to increase runoff retention, protect water quality, and enhance groundwater recharge.	Consistent: The above-ground components of the proposed ASR system would be constructed in unpaved areas. All rainwater would be routed to the surrounding unpaved sandy areas and allowed to infiltrate into the subsurface as recharge. The below-ground components would not affect groundwater recharge.

SOURCES: FORA, 1997; Monterey County, 1982; Monterey County, 2010

4.4.3 Impacts and Mitigation Measures

4.4.3.1 Significance Criteria

In accordance with Appendix G of the 2014 CEQA Guidelines, implementation of the proposed project would be considered to have a significant impact associated with groundwater resources if it would:

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)
- Violate any water quality standards or otherwise degrade water quality

In order to apply the above-listed questions from the CEQA Guidelines Appendix G, the following descriptions have been developed to elaborate on how the above-listed criteria are applied in the impact analyses in Sections 4.4.3.4 and 4.4.3.5, below. Implementation of the proposed project would be considered to have a significant impact associated with groundwater resources if:

- Construction of the proposed ASR injection/extraction wells were to result in discharges to groundwater resources that degrade groundwater quality
- Extraction from the subsurface slant wells were to lower groundwater levels in the Dune Sand Aquifer or the 180-Foot Equivalent Aquifer such that nearby municipal or private groundwater production wells were to experience a substantial reduction in well yield or physical damage (due to exposure of well screens and well pumps)
- Extraction from the subsurface slant wells were to adversely affect groundwater quality by exacerbating seawater intrusion in the SVGB
- Operation of the proposed ASR injection/extraction wells were to result in groundwater mounding, change groundwater gradients, or lower groundwater levels such that nearby municipal or private groundwater production wells were to experience a substantial reduction in well yield or physical damage (due to exposure of well pumps)
- Operation of the proposed ASR injection/extraction wells were to result in discharges to groundwater resources that degrade groundwater quality
- Injection of desalinated water treated to drinking water standards were to degrade the quality of native groundwater in the SGB

4.4.3.2 Approach to Analysis

This section describes the methodology and assumptions used to analyze project-related impacts. Four primary sources of data and information were used to guide the impact analysis presented in this section: 1) information obtained through subsurface investigations commissioned by CalAm to enhance the understanding of the lithology and groundwater quality at the site of the proposed slant wells, 2) groundwater modeling that used three mathematical predictive models to evaluate how project implementation would influence the local and regional groundwater behavior over time, 3) opinions of the SWRCB to provide context as to what constitutes harm to other groundwater users, as reported in its July 10, 2013, letter titled, "*The Final Review of California American Water Company's Monterey Peninsula Water Supply Proposed Project*," and, 4) available information on the operation of certain CalAm facilities. The following sections describe the details of the four primary elements of the impact analysis methodology.

Subsurface Investigations

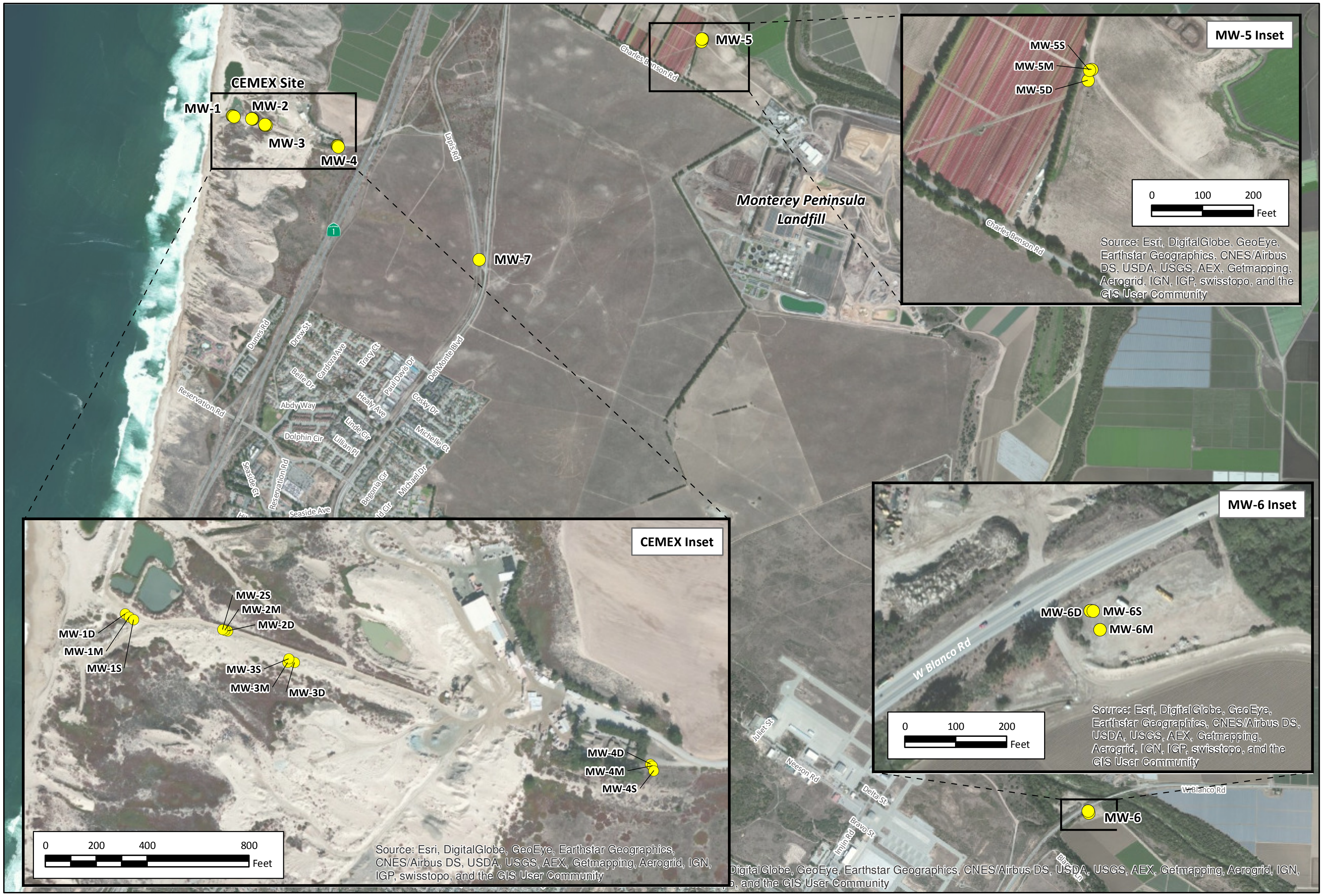
Until recently, knowledge of the subsurface geology at the proposed locations for the slant wells at the CEMEX site and the near vicinity was limited to a few nearby wells or detailed investigations at distant locations such as Marina State Beach or the former Fort Ord. Recognizing the need to obtain additional subsurface information for design of the proposed project, CalAm commissioned subsurface soil investigations at the CEMEX site and at the alternate intake location at Potrero Road. These field investigations acquired supplemental information to refine the understanding of subsurface geologic units, and the hydrogeologic properties of those units and to obtain current aquifer water quality data to refine input parameters of the groundwater modeling. Additionally, the subsurface stratigraphy and the groundwater chemistry at various depth intervals were used to refine and optimize construction details of the proposed slant well.

The investigations included drilling exploratory boreholes to identify and correlate the subsurface geologic units, collect groundwater quality data, and construct clusters of monitoring wells. The details of the subsurface exploration including boring logs, well construction details, field screening tests results, and laboratory analytical results are presented in the report titled, *Monterey Peninsula Water Supply Project Hydrogeologic Investigation Technical Memorandum TM 1, Summary of Results - Exploratory Boreholes* (Geosciences, 2014a). The Technical Memorandum, TM-1 is included in Appendix C3 of this EIR), and is also discussed in Section 4.2, Geology, Soils, and Seismicity.

To monitor the response of the aquifers to pumping and verify that the aquifers will respond as simulated by the groundwater modeling discussed below, CalAm installed a network of monitoring well clusters at the locations shown on **Figure 4.4-11**, along with a water level data logger in the pond that CEMEX uses to dredge sand (Geoscience, 2015c). Four of the monitoring well clusters are located west to east along the CEMEX access road, from near the proposed slant wells to near the CEMEX facility entrance. In addition, monitoring well clusters were also installed at the proposed desalination plant site on Charles Benson Road, at the intersection of Lapis Road and Del Monte Road, and along West Blanco Road about 4 miles southeast of the CEMEX site. The clusters monitor water levels and chemistry in the Dune Sand, 180-Foot Equivalent, and 400-Foot Aquifers.

Groundwater Modeling

Groundwater modeling was a primary analytical tool used to evaluate project impacts on groundwater resources. This section describes the groundwater models and how they were used to simulate the groundwater response to the pumping proposed by the project. The results of the groundwater modeling completed are presented in *Results of Test Slant Well Modeling at Proposed*



SOURCE: Geoscience, 2015c

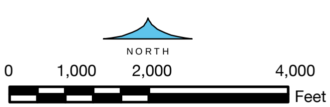


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Figure 4.4-11

Monitoring Well Locations

CEMEX Site and the *Draft Monterey Peninsula Water Supply Project Groundwater Modeling and Analysis* (Geoscience, 2014b, 2015c), which is included in **Appendices E1** and **E2** in this EIR.

Groundwater Models

What is a Groundwater Model?

Groundwater models are computer simulations that represent water flow in the environment using mathematical equations. By mathematically representing a simplified version of a hydrogeological system, reasonable scenarios can be predicted, tested, and compared. The applicability or usefulness of the model depends on how closely the mathematical equations approximate the physical system being modeled.

Setting up a standard groundwater model involves establishing the model domain, which is the area and depth within which the model simulates subsurface conditions. The model domain is established by placing a horizontal grid over the area to be modeled. Vertical layers are then established based on the subsurface geologic characteristics; permeable aquifer zones and less permeable aquitards (clay layers), for example, would each be separate layers. The grid and layers divide up the three-dimensional space of the domain into cells that resemble rectangular boxes, typically numbering in the thousands to millions. Using subsurface hydrogeological information from soil borings, well logs, geological mapping, and other information, each cell is assigned parameters to describe how water moves through that cell. Parameters typically include hydraulic conductivity (the ability of water to flow through a given material), permeability and porosity (the relative amount of open spaces between grains in the geologic material), and the direction of water flow into and out of each of the model cells. Boundary conditions are set where water would not flow, such as impermeable rock, the bottom of an aquifer, or a groundwater divide with an adjacent area.

Input parameters, which include natural and man-made elements that add or subtract water to the model, are then assigned to simulate the flow of water into and out of the model domain. Parameters such as infiltration from rainfall and incoming surface water streamflow would add water to the model. Parameters such as agricultural and municipal water supply well pumping would subtract water from the system. The input parameters can also be adjusted to account for anticipated future changes in conditions such as sea level rise or land use changes associated with general plan projections, including anticipated changes in urban and/or agricultural acres.

After the model has been populated with the existing and anticipated future conditions, it is then calibrated against known information. In the case of groundwater models, simulations are run to check how closely the model mimics the actual groundwater elevations of wells located within the modeled area. The various input parameters are then adjusted to calibrate areas, as needed, to enable the model to reasonably simulate the actual conditions.

Once the model has been calibrated, the model can be used to predict the effects of hydrological changes (like groundwater extraction or irrigation developments) on the behavior of the aquifer(s). The models used for this analysis tested the anticipated response of the aquifer(s) to various operating scenarios. The scenarios considered changes in land use conditions, rate and location of project pumping, and implementation of other water supply projects. The results of the scenarios are also compared against baseline (current) conditions to determine and identify potential effects or impacts.

Time Frame

The model scenarios are run over a set time period, beginning with the baseline conditions and extending out to a future point in time, typically set as the life span of a given project. Over this time period, land use, climate conditions, and, if located along the coast, sea level rise would be expected to change. The model addresses these anticipated changes as follows.

Extending into the future, land use within the area of a model is expected to change in response to population growth and the associated changes in water use, extent of impervious surfaces, and other land use changes that would affect the inflow and outflow of water to the basin. To account for these changes, the model used in the impact analysis for this project was set up with existing land use conditions (2012) and expected future land use conditions (2060) as projected by the general plans of the county and cities within the area to be modeled. These two land use year conditions essentially “bookend” the changes associated with cumulative land use changes. This enables the model to compare the effects of the proposed project to current and future land use conditions.

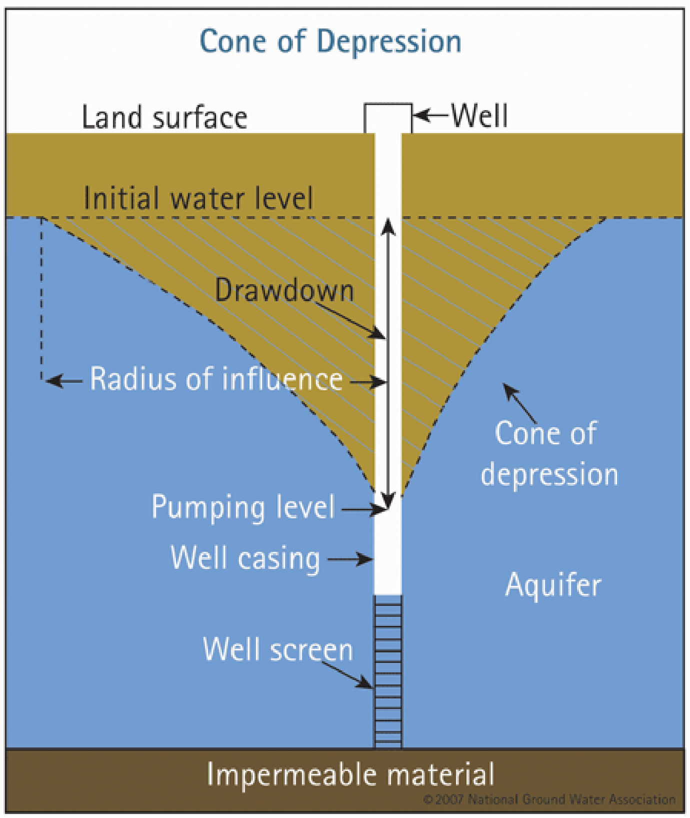
The water budget within the model is affected by future climate conditions, specifically the predicted future rainfall patterns. Wetter time periods result in a relative increase in the volume of water flowing into the modeled area; drier periods result in less water flowing into the modeled areas. To create a predicted future pattern of rainfall, models typically use the local past climate records over a selected period of time and apply those climate conditions to the future modeled time period. For instance, the models used for the analysis of the proposed project used hydrology and climatic conditions spanning a 63-year time period from 1949 to 2011. The selection of past climate records purposely includes both dry and wet climate periods (including wet or dry periods that extend for multiple years), so that the model can simulate the project response of the aquifers under both dry and wet climate conditions. The actual future sequence and length of future dry, moderate, and wet periods may not correspond to the model predictions of climate. In other words, the model results illustrate the affected area during a prolonged dry or wet period of time but do not mean that a prolonged dry or wet time period would occur at any specific time period. While applying the historical record into the future may not precisely mimic future climatic conditions, it provides a reasonable method to estimate future climatic trends over a model period.

For proposed projects located along the coast, the effects of sea level rise need to be accounted for. This is because the aquifers located on land do not necessarily end at the coast and can be connected to the ocean. For example, the 180-Foot Aquifer and the 400-Foot Aquifer within the SVGB are known to extend for several miles beneath the ocean floor into Monterey Bay, as discussed in in the Setting. As a consequence, water in the aquifer can flow seaward or landward, depending on the local circumstances. As previously discussed in the Setting, overdraft pumping in the SVGB has caused seawater intrusion, meaning that seawater has been flowing landward within the 180-Foot Aquifer. As discussed in Section 4.2, Geology, Seismicity, and Soils, sea level rise is expected to occur, resulting in a landward migration of the coastline. This also means that the elevation of the ocean will increase, adding more ocean water pressure on aquifers that are hydraulically connected to the ocean. The model includes this input to account for this added pressure.

Groundwater Model Terminology

Certain terminology is used in groundwater modeling to describe and illustrate the nature, extent, and movement of groundwater in aquifers, and the response of the aquifers to changes, such as pumping. In addition to calculated values (e.g., changes in the volume of water in storage), the spatial results of the model simulations are commonly expressed as maps that show the simulated response to the pumping of the wells under various scenarios. The maps show the cone of depression, the radius of influence, and particle tracking, terms that are described and illustrated below.

- **Cone of depression** – As water is extracted from a well, it would be pulled into the screened section of the slant wells and removed from the subsurface water-bearing unit. Groundwater elevations would decrease around the slant wells in a radial fashion, resulting in a "cone" of drawdown centered at the slant wells. This cone would be the steepest and deepest closest to the well screen and rapidly become flatter and shallower away from the slant wells.



SOURCE: http://www.ngwa.org/Fundamentals/use/PublishingImages/cone_of_depression.gif

- **Radius of influence** – The radial extent of the area affected by the slant wells (i.e., the area within which water levels are anticipated to decrease) is referred to as the radius of influence. The anticipated affected area is depicted using groundwater elevation contour maps. Similar to topographic elevation contours, groundwater contours show the shape and elevations of the groundwater surface. The maximum radius of influence is typically defined as the distance where the water levels are anticipated to decrease by some amount, such as one foot.

- **Particle tracking** – Using the groundwater elevation maps, the groundwater model can also generate particle tracking maps. Particle tracking maps show the flow path of a particle of water over time. In forward tracking, a particle is placed at a specific location (cell) in the model domain and the model then simulates the path the particle of water will take through other cells as model time moves forward. In reverse tracking, the model simulates the path of where the particle came from, to identify its source.

Limitations of Groundwater Models

Groundwater models simulate aquifer conditions based on a specific set of data that describes such parameters as the subsurface characteristics, groundwater flow, and land use. The more robust the data set, the more capable the model will be to accurately simulate subsurface conditions. Most groundwater models use conservative input parameters so the output overstates the actual aquifer response. Nevertheless, groundwater models are mathematical-based computer programs that rely on input parameters and, consequently, there is a certain degree of uncertainty. However, the models used to analyze the proposed project have been used previously to model basin wide groundwater and have benefited from input data derived from site-specific subsurface information. Given that and the fact that these models were calibrated with known data, the level of degree of uncertainty for this analysis is considered tolerable.

Groundwater Models Used for Project Analysis

Three models were used to predict the potential effects of project pumping on the SVGB. The Salinas Valley Integrated Groundwater and Surface Water Model (SVIGSM) is a regional model that simulates the entire Salinas Valley. The North Marina Groundwater Model (NMGWM) simulates an area that is centered at the mouth of the Salinas River and extends 5 to 7 miles in each direction. The Localized CEMEX Model is centered at the CEMEX active mining area in Marina, and extends approximately 1 mile in each direction. **Figure 4.4-12** shows the model boundaries for the NMGWM and the Localized CEMEX Model. The SVIGSM model provides input to the NMGWM in terms on inflows and outflows from the SVGB. The localized CEMEX model also provides input to the NMGWM by providing a finer grid (smaller cell size) near the slant wells where changes in water levels in response to pumping would be greater. **Table 4.4-9** summarizes the differences in detail between the models. **Table 4.4-10** correlates the geologic units, aquifers, and model layers of the SVIGSM, the NMGWM, and the localized CEMEX model.

TABLE 4.4-9
MODEL SIZE COMPARISONS

Parameter	SVIGSM	NMGWM	Focused CEMEX Model
Cell Size	About 256 acres	200 feet x 200 feet (less than one acre)	20 feet x 20 feet (400 square feet)
No. of Layers	3	8	12
No. of Cells	1,615	828,000	3,499,200
Model Run Time	Less than 1 hour	About 3 hours per scenario	About 100 hours

NOTE: the model run times do not include the setup time for input data.

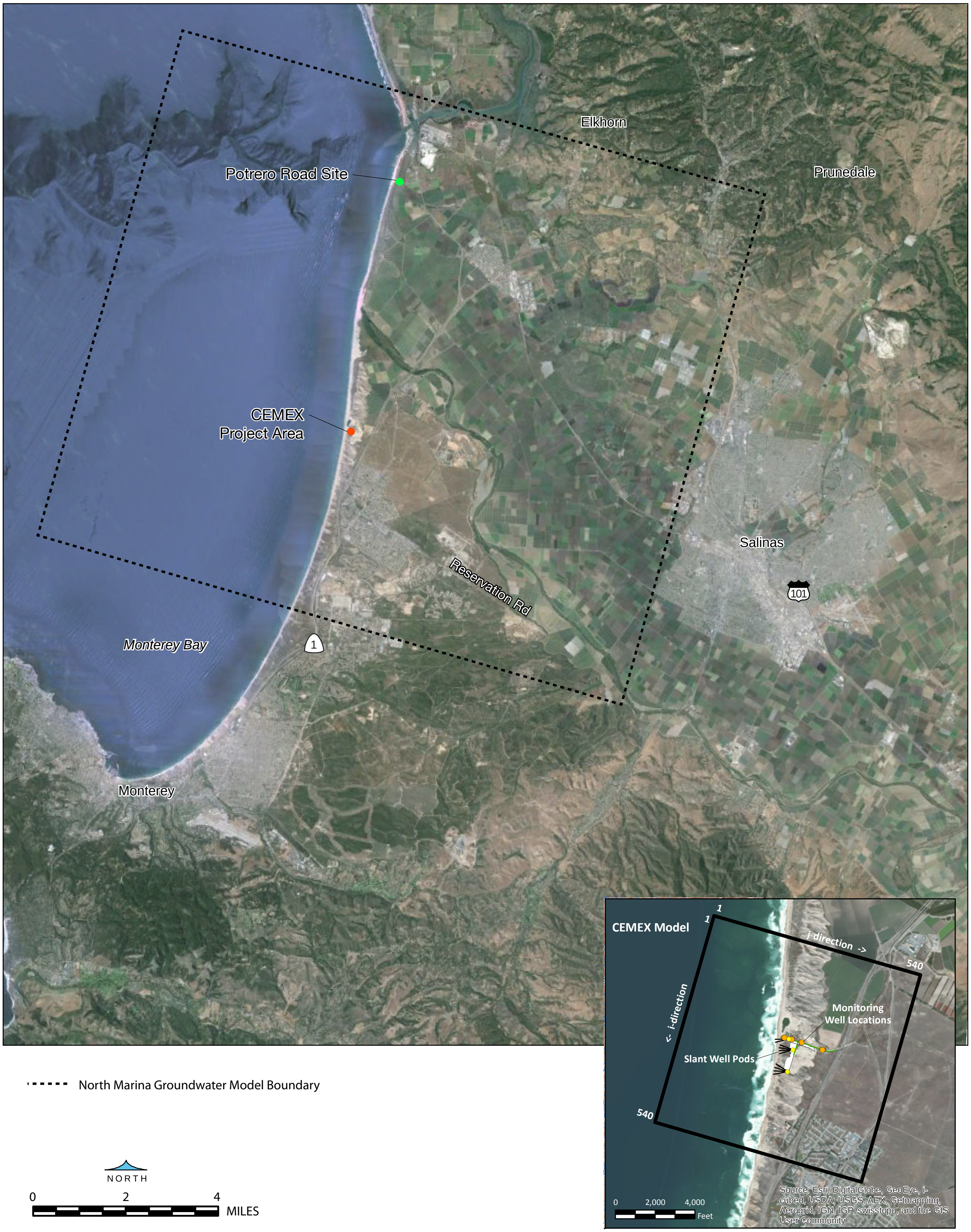
SOURCE: Geoscience, 2014b, 2015c.

TABLE 4.4-10
CORRELATION OF GEOLOGIC UNITS, AQUIFERS, AND MODEL LAYERS

180/400-Foot Aquifer Subbasin			CEMEX Area			Models and Corresponding Horizontal Model Layers		
Surface Geologic Units	**Surface Geologic Units Map Symbol**	**Hydro-stratigraphic Units**	**Surface Geologic Units**	**Surface Geologic Units Map Symbol**	**Hydro-stratigraphic Units**	**SVIGSM(a)**	**NMGWM**	**CEMEX Model**
Ocean Floor	Qf	Ocean Floor	Ocean Floor	Qf	Ocean Floor	Constant Head	1	1
Alluvium	Qal(b)	Perched "A" Aquifer	Dune Sand	Qd	Dune Sand Aquifer	1a	2	2
			Older Dune Sand	Qod				3
								4
Older Alluvium	Qo	Salinas Valley Aquitard	Older Terrace/ Marine Terrace	Qt (Qmt)	180-Foot Aquifer Equivalent		3	5
						1	4	6
Older Alluvium/ Marine Terrace	Qo/Qmt	180-Foot Aquifer Equivalent						7
Older Alluvium/ Older Alluvial Fan - Antioch	Qo/Qfa							8
Older Alluvial Fan – Placentia	Qfp	180/400-Foot Aquitard	Aromas Sand	Qar	180/400-Foot Aquitard	2a	5	9
Aromas Sand (Undifferentiated)	Qae	400-Foot Aquifer			400-Foot Aquifer	2	6	10
Aromas Sand – Eolian Facies	Qae							
Paso Robles Formation	QT	400-900-Foot Aquitard	Paso Robles Formation	QT	400-900-Foot Aquitard	3a	7	11
		900-Foot Aquifer			900-Foot Aquifer	3	8	12

NOTES:
[a] SVIGSM considers "a" layers to be aquitards (vertical hydraulic conductivity and thickness are input data)
[b] Subsurface Holocene geologic unit not mapped at surface

SOURCE: Geoscience, 2015c.



SOURCE: Geoscience, 2015c

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Figure 4.4-12
Groundwater Model Boundaries

Salinas Valley Integrated Groundwater and Surface Water Model

The SVIGSM is a basin-wide groundwater and surface water model that was originally developed for the purposes of providing Monterey County an analytical tool to use during the Salinas River Basin Management Plan process (Montgomery Watson, 1994). Previous SVIGSM model runs were then used to help develop the biological assessment for the SVWP in 2005. Model files used during the feasibility and environmental analyses of the 2008 SVWP were used to model the MPWSP.

The SVIGSM simulates groundwater flow over approximately 650-square miles of the SVGB. The model utilizes three (3) model layers (an aquitard and an aquifer for each model layer) corresponding to the 180-Foot Aquifer, 400-Foot Aquifer, and 900-Foot Aquifer. The cell size in the model is approximately 0.4 square miles or 256 acres. In general, the SVIGSM:

- Incorporates river and drainage systems as they pertain to groundwater recharge,
- Has the ability to model management strategies for the Nacimiento and San Antonio Reservoirs,
- Incorporates the minimum streamflow requirements issued by the National Marine Fisheries Service,
- Incorporates infiltration of surface water for varying soil types,
- Includes hydrologic aspects of various land management practices;
- Simulates the volume and geographical extent of seawater intrusion into the Salinas Valley from the Monterey Bay, and
- Incorporates existing and projected land use.

Each cell in the model has an orientation consistent with the general surface water drainage pattern and major stream systems, as well as groundwater flow directions. The output of the updated SVIGSM was used as input to update the project-specific NMGWM developed to simulate the existing and future project scenario conditions in the local area of the proposed seawater intake system (Geoscience, 2013c, 2014b, 2015c).

North Marina Groundwater Model

The NMGWM is a detailed hydrologic model covering approximately 149 square miles and includes Elkhorn Slough to Prunedale on the north side, Prunedale to south of Salinas on the east side, south of Salinas to just north of the Fort Ord Dunes State Park on the south side, and extending into Monterey Bay. The cell size is 200 feet by 200 feet. The NMGWM was originally developed in 2008 from the regional-scale SVIGSM using the aquifer parameters, recharge and discharge terms, and boundary conditions in the North Marina area. The model codes of MODFLOW[15] and MT3DMS[16] were combined into a single program that solves the coupled

[15] MODFLOW is a modular finite-difference flow model, which is a computer code that solves the groundwater flow equation. The program is used by hydrogeologists to simulate the flow of groundwater through aquifers. Since its original development in the early 1980s, the USGS has released a number of update versions and MODFLOW is now considered to be the de facto standard code for aquifer simulation.

[16] MT3DMS is a modular three-dimensional solute transport model for simulation of advection, dispersion, and chemical reactions of chemicals in groundwater systems.

flow and solute transport equations, along with additional modeling through the use of SEAWAT[17]. The combined modeling configuration simulates the existing conditions and the response of the aquifers under various pumping scenarios to evaluate the proposed project's effect on the existing basin conditions, including overdraft and seawater intrusion.

Although the aquifers' relationships in the NMGWM model are consistent with previous work by others, the recent focus on the optimal aquifer(s) to pump for the project source water supply has shifted from only the 180-Foot Equivalent Aquifer to a combination of the 180-Foot Equivalent Aquifer and the overlying Dune Sand Aquifer. Consequently, the modelers added an additional model layer for the Dune Sand Aquifer. The addition of the new model layer was based on the results of the site-specific borings, review and extension of existing geologic cross-sections, creation of revised geologic cross-sections, and evaluation of recent aquifer parameter information for the area. The areal extent and thickness of other model layers were also refined using the same aforementioned information. The NMGWM model layers and associated parameters such as horizontal and vertical hydraulic conductivity[18], specific storativity[19], specific yield[20], and leakage[21] were refined from the previous version using the data collected from the site-specific hydrogeologic investigations described in the work plan (Geoscience, 2013c, 2014b, 2015c). In addition, the NMGWM model incorporates the anticipated changes in sea level rise due to global climate change (ESA, 2013).

The NMGWM simulates changes to the aquifers over a 63 year time period. The results describe the changed conditions at specific points in time to illustrate the changed conditions under different climate conditions: 2012 (initial conditions; moderate period), 2027 (prolonged dry period), 2034 (moderate period), 2046 (prolonged wet), 2050 (moderate period), and 2074 (end of simulation; moderate period). Prolonged dry periods would result in a larger affected area; wetter periods would reduce the affected area. It is important to note that the future 63 years of climate were based on the past 63 years of climate in order to model anticipated dry, moderate, and wet periods of time. The actual future sequence and length of future dry, moderate, and wet periods may vary. In other words, the model results illustrate the affected area during a prolonged dry period but do not mean that a prolonged dry period will specifically occur around 2027 or any other particular time period. In addition, there is a delayed response by aquifers at depth to changes in climate patterns at the surface because of the time lag of water infiltrating down from the surface to the aquifers at depth. For example, the dry climate period simulated in 2027 is followed by a moderate period in 2034 and a wet period in 2046. However, the effects of the dry period will take time to appear in the aquifer and may linger and be the strongest during the later moderate 2034 time period. In this case, the recovery of the aquifer may not truly begin until the 2046 wet period.

[17] SEAWAT is a three-dimensional, variable-density ground water flow model coupled with multi-species solute and heat transport.
[18] Hydraulic conductivity is the rate of water flow through a cross sectional area of an aquifer.
[19] Specific storativity is the volume of water that can be extracted from a unit volume of an aquifer due to changes in the groundwater levels.
[20] Specific yield is the amount of water that will drain from an aquifer just due to gravity.
[21] Leakage is the flow of water from one hydrogeologic unit to another. The leakage may be natural, as through semi-impervious confining layer, or human-made, as through an uncased well.

Localized CEMEX Model

Because the monitoring well cluster locations on the CEMEX site are relatively close to the proposed slant well locations and because the NMGWM cell size is 200 feet by 200 feet, it was possible that the slant wells and monitoring well clusters might be located in the same model cell. This proximity could reduce the ability of the NMGWM to simulate the changing conditions between the slant and monitoring wells and to estimate the radius of influence during pumping. To address this, Geoscience developed the localized CEMEX model to more accurately model the local effects of slant well pumping. The CEMEX model was developed for the immediate area of the slant wells at the CEMEX site with a cell size of 20 feet by 20 feet (Geoscience, 2014b, 2015c). The purpose of the CEMEX model is to better evaluate the localized effects of pumping the slant wells, including the cone of depression and the changes to salinity. Ultimately, the results of this localized model were incorporated into the NMGWM results. **Figure 4.4-12** shows the model boundaries of this CEMEX model.

NMGWM Modeling Scenarios

Upon completion of the development of the NMGWM with the incorporation of input from the SVIGSM and localized CEMEX model, the NMGWM was run for various scenarios to simulate the aquifer response of proposed slant well pumping at the CEMEX site. The differing scenarios were developed based on location of the slant wells (the CEMEX site for the proposed project; and an alternate site at Potrero Road for the project alternative discussed in Chapter 7, Alternatives) or the pumping rate of the slant wells (24.1 million gallon per day [mgd] for the proposed project; and 15.5 mgd for a variation of the project discussed in Chapter 6, MPWSP Variant). These scenarios all hold the land use conditions constant at 2012. This was done in order to simulate the aquifer response to pumping that would occur only in response to the pumping by the proposed project and not due to land use changes over time. The simulated response of the aquifer to pumping combined with the land use changes anticipated to occur between 2012 and 2060 are discussed in Chapter 5, Cumulative Impacts.

For the proposed project, three scenarios were modeled at the CEMEX site. These scenarios simulate the aquifer conditions in a No Project scenario (baseline), the response to a proposed project pumping condition, and the Post-Project recovery response in the SVGB[22]. Details of the model parameters and simulation results are presented in the modeling report (Geoscience, 2015c). The scenarios were simulated to understand how the components of the proposed project might change the environmental baseline condition, as defined by 2012 land use conditions. The simulated scenarios for the CEMEX site are summarized in **Table 4.4-11** and discussed below.

Scenario 1n simulates the No Project Scenario, where the project is not implemented and the aquifers remain in their current condition. Scenario 3n simulates the Project Scenario where the project is implemented and the fraction of inland water pumped by the slant wells is returned to the basin as in-lieu groundwater recharge by distribution to the CSIP pond for delivery by MPWPCA to participating local growers. Land use patterns were held at 2012 conditions for Scenario 1n and 3n, in order to quantify the changes that would be caused only by the proposed

[22] Post Project recovery refers to how the aquifer responds after the proposed project ceases operation.

TABLE 4.4-11
MODELED SCENARIOS

Scenario		Land Use	Proposed Project(*)	MCWD 1.5 mgd Desalination Project
1n	No Project	2012	0	No
3n	Project	2012	24.1/9.1	No
4rf	Post-Project	2060	0	Yes

NOTES:
(*) Source water supply / product water in million gallons per day (mgd)
(n) Denotes no MCWD desalination project
(r) Denotes Post-Project rebound model run
(f) Denotes using 2060 land use assumptions

SOURCE: Geoscience, 2015c.

project. The Post-Project Scenario 4rf was then run to simulate the aquifer response if the proposed project operations were to cease in the year 2075.

All scenarios simulate the screened section of the slant wells as located adjacent to and offshore of the coastline. The SVIGSM and NMGWM input parameters included the estimated additional volume of ocean water that would result from the estimated rate of sea level rise. Initially, most of the screened sections of the slant wells would be beneath the seafloor. Over time, the entire length of the screened sections of the slant wells would still be beneath the sea floor but would become located offshore as the anticipated coastal retreat migrates the shoreline inland (see Section 4.2, Geology, Soils, and Seismicity).

To simulate annual rainfall, the hydrologic time period of 1949 through and including 2011 was used as input to the model for a total of 63 years of precipitation records. This time period was selected because it included both relatively dry and relatively wet periods of time. The model time was then run for the future 63 years through and including the year 2074 to simulate annual aquifer conditions under the various scenarios.

Only the future Post-Project Scenario (4rf) uses the cumulative 2060 land use conditions and assumes that the Marina Coast Water District will operate a proposed 1.5 mgd desalination plant using wells in the 180-Foot Aquifer located about 1.5 miles south of the CEMEX site. This scenario evaluates the nature and rate of the restoration of the aquifers to pre-project aquifer conditions.

Seaside Groundwater Basin Modeling

The proposed project includes the injection and storage of treated water in the Santa Margarita Sandstone in the SGB as an addition to the ASR program. Groundwater modeling was previously conducted as part of the development of the ASR program and was presented in the *Final Environmental Impact Report/Environmental Assessment for the Monterey Peninsula Water Management District Phase 1 Aquifer Storage and Recovery Project,* dated August 2006 (MPWMD, 2006). The 2006 ASR modeling results were used to understand the response of the aquifers in the SGB to changes and to inform basin management decisions, such as how to operate the ASR program. The results of the SGB modeling were used to evaluate the impacts of the proposed project on the SGB. The SGB model is described below.

The 2006 ASR modeling effort evaluated changes in groundwater levels and long term changes in groundwater storage in the Santa Margarita Aquifer from operation of the ASR wells. The groundwater model was developed utilizing the WinFlow software program, which simulates two-dimensional steady-state and transient groundwater flow and utilized published aquifer parameters for the Santa Margarita aquifer. The model simulated the groundwater level and storage response based on an approximate injection volume of 2,426 af over the course of 183 days and extraction volume of 2,002 af over the course of 153 days, which represented the range of likely “extreme” injection and extraction conditions that could be encountered over the life of the ASR project. The results of the groundwater modeling indicated that long term operation of the ASR program would result in a beneficial impact to SGB storage and groundwater levels at existing water supply wells.

Subsequently, HydroMetrics developed the Seaside Basin Groundwater Model for the Seaside Basin Watermaster based on MODFLOW-2005 and SEAWAT 2000 to assist with groundwater management decisions (HydroMetrics, 2009b). The model domain included both the Seaside Basin and the area outside and to the north of the Basin. The model simulates five geologic layers: Aromas Sand, upper Paso Robles aquifer, middle Paso Robles aquifer, lower Paso Robles aquifer, and Santa Margarita Sandstone/Purisima Formation. The model simulates groundwater conditions between January 1987 and December 2008. As a part of developing the conceptual model and groundwater simulation, HydroMetrics concluded that the Santa Margarita Sandstone is “highly confined beneath thick clay beds near the ocean, and it does not receive significant deep percolation recharge near the ocean.”

SWRCB Final Review of California American Water Company’s Monterey Peninsula Water Supply Project

The SWRCB evaluation of the proposed project was considered as guidance for the analysis of groundwater impacts because it elucidates and provides context for the nexus between the thresholds of significance used in this section and recommendations and considerations of the SWRCB relative to water rights. Please refer to Chapter 2, Water Demand, Supplies, and Water Rights, which discusses the legal aspects in further detail.

To provide further clarification, the SWRCB issued a review of the proposed project, dated July 31, 2013 (SWRCB, 2013). The SWRCB described its understanding of the physical setting, the components of the proposed project, and the legal analysis regarding the water to be produced by the slant wells.

The SWRCB reviewed the proposed project and provided specific investigation and modeling requirements to demonstrate that the proposed project “will not harm or cause injury to any other legal user of water” from the SVGB (SWRCB, 2013). The SWRCB identified three possible categories of injury that could occur from the MPWSP. The three foreseeable injuries that overlying users could experience are: (1) a reduction in the overall availability of fresh water due to possible incidental extraction by the MPWSP; (2) a reduction in water quality in those wells in a localized area within the capture zone (area of influence); and, (3) a reduction in groundwater elevations requiring users to expend additional pumping energy to extract water from the Basin.

From its review of the project, SWRCB stated that:

> "Key factors will be how much fresh water Cal-Am extracts as a proportion of the total pumped amount, (to determine the amount of water, that after treatment, would be considered desalinated seawater available for export as developed water); (2) whether pumping affects the water table level in existing users' wells, (3); whether pumping affects seawater intrusion within the Basin (4) how Cal-Am returns any fresh water it extracts to the Basin to prevent injury to others; and (5) how groundwater rights might be affected in the future if the proportion of fresh and seawater changes in the larger Basin area or the immediate area around Cal-Am's wells."

> "If overlying groundwater users are protected from injury, appropriation of water consistent with the principles discussed in this report may be possible. To export water outside the Basin, Cal-Am must show 1) the desalinated water it produces is developed water, 2) replacement water methods to return water to the Basin are effective and feasible, and 3) the MPWSP can operate without injury to other users. A physical solution could be employed to assure all groundwater users rights are protected."

The SWRCB provided the following recommended actions to support the conclusion of no harm:

> "Studies are needed to determine the extent of the Dune Sand Aquifer, the water quality and quantity of the Dune Sand Aquifer, the extent and thickness of the SVA and the extent of the 180-Foot Aquifer."

> "The effects of the MPWSP on the Basin [i.e., the SVGB] need to be evaluated. Specifically, a series of test boring/wells would be needed to assess the hydrogeologic conditions at the site. Aquifer testing also would be needed to establish accurate baseline conditions and determine the pumping effects on both the Dune Sand Aquifer and the underlying 180-Foot Aquifer. Aquifer tests should mimic proposed pumping rates."

> "Updated groundwater modeling will be needed to evaluate future impacts from the MPWSP. Specifically, modeling scenarios will need to be run to predict changes in groundwater levels, groundwater flow direction, and changes in the extent and boundary of the seawater intrusion front. Additional studies also will be necessary to determine how any extracted fresh water is replaced, whether through re-injection wells, percolation basins, or through existing recharge programs. It may also be necessary to survey the existing groundwater users in the affected area. The studies will form the basis for a plan that avoids injury to other groundwater users and protects beneficial uses in the Basin. To ensure that this modeling provides the best assessment of the potential effects of the MPWSP, it is important that any new information gathered during the initial phases of the groundwater investigation be incorporated into the groundwater modeling studies as well as all available information including current activities that could influence the groundwater quality in the Basin."

Operating Rules for the Injection and Extraction of Desalinated Water for the ASR Program

As previously discussed, the proposed project includes the injection and storage of treated water from the desalination plant into the Santa Margarita Sandstone in the SGB as an addition to the ASR program. The operating rules developed by CalAm and discussed below are part of the proposed project. The operating rules were evaluated to understand how CalAm would manage the additional injection and extraction of treated water into the SGB and to evaluate the impacts of the proposed project.

As shown on **Figure 3-7**, the ASR system has four existing wells and the proposed project would add two more wells. The additional wells would inject and extract water into the Santa Margarita Sandstone, which is used for drinking water supply. The impact of injecting and extracting additional water into the Santa Margarita Sandstone was considered to analyze whether the injection and extraction would adversely affect the aquifer or nearby water supply wells.

CalAm has developed operating rules that will manage the injection and extraction of the Carmel River and desalinated water sent to the ASR system (*Operations Rules for the Injection and Extraction of Desalinated Water into ASR Well System*, CalAm, 2014). The operating rules were developed to avoid injecting water to, or extracting water from the ASR system, in a manner that might damage the aquifer, or exacerbate overdraft or seawater intrusion. As previously discussed, the SGB is an adjudicated basin and the use of groundwater within the SGB is controlled by the Seaside Basin Watermaster.

Specifically, the operating rules specify that the location of the existing groundwater depression in the SGB must be reviewed each year and that extraction may only be conducted in wells located east (up gradient) of the center point of the depression and only in a certain preferential order (ASR wells first, then other specific production wells, as needed). This would avoid pumping from near the coastline, which could accelerate seawater intrusion. The operating rules also include limitations on the rate of injection to prevent over-pressurization and compression of plugging materials in the injection wells. The operation of the proposed project was compared to the operating rules of the ASR system to identify impacts and ensure compliance.

4.4.3.3 Summary of Impacts

The following impact analyses focus on potential effects on groundwater resources and water quality associated with implementation of the proposed project. The analyses of project impacts considered project plans, current conditions within the project area, applicable regulations and guidelines, and previous environmental assessments. **Table 4.4-12** summarizes the proposed project's impacts and significance determinations related to groundwater resources.

TABLE 4.4-12
SUMMARY OF IMPACTS – GROUNDWATER RESOURCES

Impacts	Significance Determinations
Impact 4.4-1: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during construction.	LS
Impact 4.4-2: Violate any water quality standards or otherwise degrade groundwater quality during construction.	LS
Impact 4.4-3: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during operations so as to expose well screens and pumps.	LS
Impact 4.4-4: Violate any water quality standards or otherwise degrade groundwater quality during operations.	LSM

NI = No Impact
LS = Less than Significant impact, no mitigation required
LSM = Less than Significant impact with mitigation

4.4.3.4 Construction Impacts and Mitigation Measures

Impact 4.4-1: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during construction. ***(Less than Significant)***

Impact 4.4-1 addresses the impacts to groundwater resources that could occur during the construction of the proposed project. In accordance with the significance criteria (Section 4.4.3.1, above), a significant impact would occur if construction activity reduced groundwater supplies or substantially hindered the ability of surface water to recharge the aquifer, resulting in lower groundwater levels. This impact analysis focuses on the impact to groundwater resources that are directly associated with construction activity, which, in this case, is depletion of groundwater supplies resulting from temporary groundwater use during the construction of the slant wells and the ASR injection/extraction wells. Impacts related to the decrease in recharge are considered in this EIR as operational impacts of the proposed project and are discussed in Impact 4.4-3.

Water Supply for Slant Well and ASR Drilling and Construction

The proposed slant wells and ASR injection/extraction wells would be constructed using a dual-wall, reverse circulation rotary drill rig.[23] In some large-scale drilling projects, similar to the proposed drilling and construction of the wells proposed under this project, large volumes of water may be required during the well drilling to reduce friction in the drill casing and to help flush rock fragments and pulverized material (cuttings) generated from drilling out of the

[23] Dual-wall, reverse circulation rotary drilling uses a drilling rig with two rotary drives. One drive rotates the outer drilling casing into the subsurface with a hardened drive or cutting shoe, while the other drive rotates an inner drill pipe and cutting bit. In reverse circulation, air or water is pumped under pressure down between the outer drill casing and inner drill pipe, and air, water, and cuttings are returned to the surface in the inner drill pipe. Upon reaching the desired depth, the inner drill string is removed and the well casing, filter pack, and surface seal is constructed inside the outer casing, allowing the well to be constructed while holding the native formation materials back from the borehole. Upon completion, the outer casing is withdrawn, leaving the constructed well in place.

borehole. The volume of water used for the well construction of the slant wells could be between 4 to 5 million gallons but could be much less and perhaps none depending on how the drilling proceeds (Geoscience, 2014c). Water required for ASR injection/extraction well construction would be less. For the proposed project, if well drilling water in large quantities is necessary, it would be purchased by an outside water purveyor and delivered to the drill site when needed by truck; water would not extracted from local groundwater sources. This impact is less than significant because water needed for construction of wells would not deplete local groundwater supplies.

Water Supply for Pipelines and Other Facility Construction

The proposed project pipelines and MPWSP Desalination Plant, Terminal Reservoir, ASR Pump Station, and Valley Greens Pump Station would be constructed using standard construction methods that would require water for dust suppression, concrete wash-outs, tire washing, and general site maintenance. Water needed for these operations would be purchased from a local water purveyor and delivered to the individual construction site by truck. Construction of these facilities would not require quantities of water over what is typically necessary for construction and groundwater pumping would not be necessary. Therefore, construction of the pipelines and support facilities would not adversely impact groundwater supplies and this impact is less than significant.

Impact Conclusion

Impacts associated with groundwater supplies and recharge during the construction of all project facilities would be less than significant.

Mitigation Measures

None Required.

Impact 4.4-2: Violate any water quality standards or otherwise degrade groundwater quality during construction. *(Less than Significant)*

This impact addresses the impacts to groundwater quality that could occur during the construction of the project. In accordance with the significance criteria (Section 4.4.3.1, above), a significant impact would occur if construction activity resulted in discharges to the groundwater to the extent that water quality standards for groundwater were exceeded or the groundwater quality became degraded. This impact analysis focuses on the impact to groundwater quality by construction operations such as well drilling, construction of pipelines, and other facilities associated with the project. Impacts relative to surface water quality are addressed in Section 4.3, Surface Water Hydrology and Water Quality.

Water Quality Impacts Associated with Construction of Slant Wells

The ten slant wells would be constructed at depths that would extend through the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer. The 180-Foot Equivalent Aquifer is likely hydrologically connected to the inland 180-Foot Aquifer, which is used for irrigation as well as drinking water supplies. Well drillers commonly add substances that assist in reducing friction on the drill casing or flushing drill cuttings back to the surface. These drilling fluids can consist of bentonite mud[24], foams, or other additives that may contain chemicals that could degrade groundwater quality immediately surrounding the well borehole. The proposed slant wells would be constructed using a dual rotary drill rig that would not use drilling fluids. Instead, the dual rotary method uses air, the water already in the geologic materials, and when necessary, additional potable water to circulate the drill cuttings. If potable water were added, the quality of that water would be better than the underlying brackish water, and therefore, would not result in groundwater degradation. Considering the drilling method and the use of only air and water to assist in drilling, there is no potential for groundwater degradation and the impact would be less than significant.

Water Quality Impacts Associated with Construction of ASR Injection and Extraction Wells

The ASR injection/extraction wells would be drilled without the use of drilling muds. However, when necessary and depending on the formation material encountered, certain commercially available additives could be combined with the drilling water to increase fluid viscosity and stabilize the walls of the boring to prevent reactive shale and clay from swelling and caving into the hole. Other products are used to enhance the drilling performance and help reduce the build-up of solids, decrease friction, and aid in reducing solids suspension. Drilling mud additives are commonly used by the well drilling industry for the drilling and installation of groundwater wells and are formulated not to contain chemicals that would lead to groundwater degradation. Because the additives are combined with the water and are circulated through the borehole annulus during drilling, they react locally within the borehole and do not migrate into the surrounding groundwater formation. The additives are noncorrosive, biodegradable, and do not contain chemicals that would degrade groundwater quality. Therefore, while the use of bentonite muds would be necessary during the drilling of the ASR injection/extraction wells, the potential for degradation to groundwater is low and the impact is less than significant. Management and disposal of drilling muds and slurries is addressed in Section 4.3, Surface Water Hydrology and Water Quality.

All Other Facilities (MPWSP Desalination Plant, Terminal Reservoir, ASR Pump Station, Valley Greens Pump Station, and All Pipelines)

The proposed pipelines would be constructed along the TAMC right-of-way, Monterey Peninsula Recreational Trail, and existing road rights-of-way. Valley Greens Pump Station site Option 1 would be constructed on an existing concrete pad. These facilities do not require construction activities that would intercept groundwater bearing zones and thus, would have a very low

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[24] Bentonite muds are clay slurry compounds containing bentonite clay which is used to seal and strengthen the sides of a borehole during well drilling.

potential of degrading groundwater quality. While pipeline trenches may encounter shallow groundwater, the construction operation of laying a pipeline and backfilling would not release contaminants into the shallow groundwater zone. This impact would be less than significant.

Impact Conclusion

Impacts associated with discharges to groundwater resources and impacts to groundwater quality during the construction of all project facilities would be less than significant.

Mitigation Measures

None Required.

4.4.3.5 Operations Impacts and Mitigation Measures

Impact 4.4-3: Deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level during operations so as to expose well screens and pumps. (*Less than Significant*)

Impact 4.4-3 addresses the impacts to groundwater supplies or recharge that could occur during the operation of the slant wells, ASR injection/extraction wells, and other project facilities. The slant wells would extract water from the Dune Sands Aquifer and the 180-Foot Equivalent Aquifer of the SVGB, while the ASR injection/extraction wells would periodically inject water into and extract groundwater from the Santa Margarita Sandstone in the SGB.

Impacts to Groundwater Supplies

Operation of Subsurface Slant Wells

At any given time, eight slant wells would be operational and two slant wells would be on standby or undergoing routine maintenance. These slant wells would be designed to collectively operate at an average pumping rate of approximately 24.1 mgd in order to provide a sufficient volume of feedwater such that the MPWSP Desalination Plant can produce the required 9.1 mgd of product water. The slant wells would be screened across both the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer.

Depletion of Groundwater Supply to Neighboring Production Wells or the CEMEX Pond

This analysis considers whether operation of the slant wells at the proposed pumping rate could draw groundwater levels down to a point where a neighboring well could become damaged or not operate. In accordance with the significance criteria (Section 4.4.3.1, above), a significant impact could occur if the operation of the proposed slant wells lowered groundwater elevations in neighboring wells exposing wells screens or well pumps.

Impacts from groundwater pumping at the proposed slant wells were analyzed by reviewing the modeling output from the NMGWM. This analysis compared the modeling output of the Project scenario (Scenario 3n) to the No Project (baseline) condition (Scenario 1n). The modeling shows that project pumping from the slant wells would cause a response in both the Dune Sand Aquifer and the 180-foot Equivalent Aquifer. The model outputs are presented as maps and are provided in **Figures 4.4-13,** which compares the anticipated changes in groundwater elevations in the Dune Sand Aquifer and **Figure 4.4-14**, which compares the anticipated changes in groundwater elevations in the 180-Foot Equivalent Aquifer, against baseline conditions.

As shown on the figures, project-related groundwater pumping from the slant wells would form a cone of depression with the area of influence extending outwards from the slant wells. The corresponding reductions in groundwater elevations are shown on the contour lines within the area of influence. The area where the contours are the deepest is adjacent to the pumping slant wells: a reduction of 15 feet in the Dune Sand Aquifer and 30 feet in the 180-Foot Equivalent Aquifer. With distance away from the pumping wells, the magnitude of drawdown is progressively reduced until the edge of the area of influence is reached. The edge of the area of influence, or the l-foot contour line furthest out marks the area where the NMGWM calculates the groundwater elevation decline of only one foot.

Table 4.4-13 shows the maximum distance that the radius of influence extends inland with a one foot groundwater level decrease from the slant wells given different types of climate conditions. As indicated on the table, the largest area of influence would be generated from the slant well pumping response in the 180-Equivalent Aquifer during a prolonged period of lower than normal rainfall (represented by model year 2027-dry year) followed by a period of moderate rainfall (represented by a model year 2034-moderate period). Note that the aquifer recovery would not occur until the relatively wetter time period of 2046. As previously explained, this is because there is a time lag from when the drier conditions begin and when the aquifer has fully responded to those drier conditions and the smaller volume of rainfall infiltration to the aquifer at depth. Once the aquifer has responded to the drier conditions with lower groundwater levels, there is a subsequent time lag for the aquifer to recover when the climate becomes wetter.

TABLE 4.4-13
MAXIMUM DISTANCE INLAND FROM THE PROPOSED SLANT WELLS WITH WATER LEVEL DECLINE OF ONE FOOT

Aquifer	Maximum Distance Inland in Miles from the Slant Wells with Water Level Decline of One Foot				
	September 2027 (Prolonged Dry)	September 2034 (Moderate Period)	September 2046 (Prolonged Wet)	September 2050 (Moderate Period)	September 2074 (End of Model Simulation)
DSA	**4.7**	**5.0**	**3.3**	**3.8**	**4.2**
180	**4.9**	**7.0**	**3.6**	**3.7**	**4.2**

NOTES:

DSA = Dune Sand Aquifer
180 = 180-Foot Equivalent Aquifer or 180-Foot Aquifer

SOURCE: Geoscience, 2015c.

Survey of Known Groundwater Production Wells within the Radius of Influence

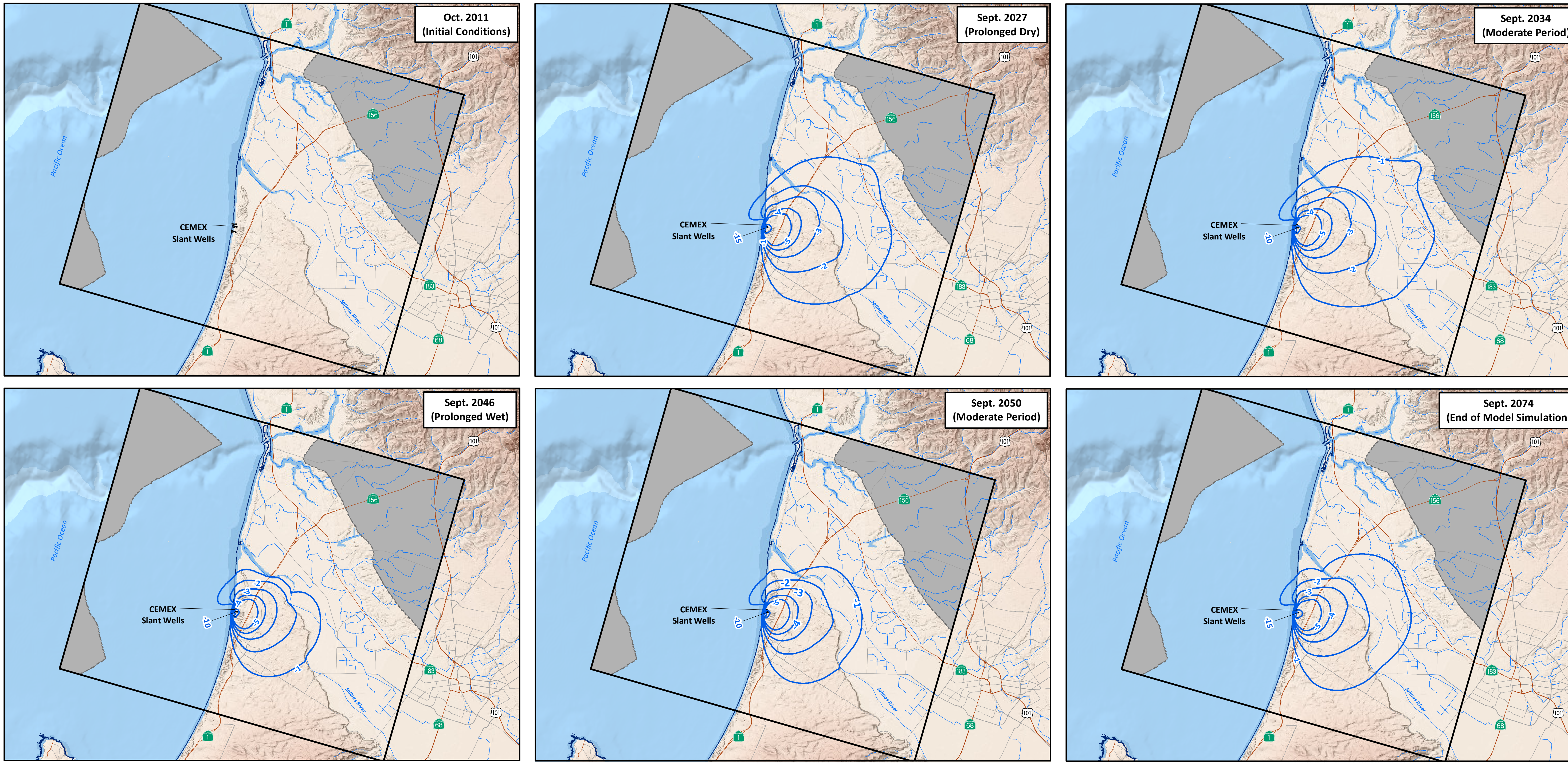
After establishing the depth and extent of the cone of depression and the resultant area of influence, the analysis identified the groundwater production wells in the area that could be adversely impacted by the slant well pumping. **Figure 4.4-15** shows the locations of the only known active or potentially active wells that draw water from the Dune Sand Aquifer, 180-Foot Equivalent Aquifer, or 400-Foot Aquifer, and are within the area of slant well pumping influence delimited by the 2-foot drawdown contour. The 2-foot draw down contour indicates where the model predicts the groundwater elevation would be drawn down by 2-feet as a result of project pumping at the proposed slant wells. These wells are also summarized in **Table 4.4-14**. Although slant well pumping influence could extend up to 7 miles, as indicated by the 1-foot drawdown contour (see **Table 4.4-13**)**,** this analysis focuses only on the nearby groundwater production wells within the 2-foot drawdown contour. The groundwater production wells within the 2-foot drawdown contour have the highest potential to experience measurable declines as a result of slant well pumping. The well survey did not include wells between 1-foot and 2-foot contours (with the exception of select monitoring wells located in the city of Marina) and those outside the 1-foot drawdown contour because the effects from pumping would be minor (2-feet or less). Drawdown of less than two feet in groundwater production wells would not lower groundwater levels to such a degree that groundwater would be below the pump intakes or the well screen would be exposed. It is reasonable to expect water levels in a groundwater production wells can fluctuate between 0 and 2 feet from seasonal variations in regional groundwater levels.

TABLE 4.4-14
KNOWN ACTIVE SUPPLY WELLS WITHIN TWO MILES OF THE SLANT WELLS

Well Owner	Well Number	Aquifer	Use	Status
Monterey Peninsula Landfill	14S/02E-17K1	180	Dust Suppression	Potentially Active
Monterey Peninsula Landfill	14S/02E-17K2	DSA and 180	Dust Suppression	Active
Monterey Peninsula Landfill	14S/02E-17R1	DSA and 180	Dust Suppression	Active
Monterey Peninsula Landfill	14S/02E-21F	180	None	Inactive
CEMEX	South Well	400	Production	Active
CEMEX	North Well	400	None	Inactive
MRWPCA Wastewater Treatment Plant	14S/02E-20B01	400	None	Inactive
MRWPCA Wastewater Treatment Plant	14S/02E-20B02	400	Operations	Inactive
MRWPCA Wastewater Treatment Plant	14S/02E-20B03	900	Operations	Active
Unknown	14S/02E-17L01	400	Unknown	Active
Unknown	14S/02E-07L04	400	Unknown	Potentially Active
Unknown	14S/02E-07H	400	Unknown	Unknown
Bill Baillee	14S/02E-07H01	400	Domestic	Active
AgLand Trust	14S/02E-18C01	Unknown	Unknown	Unknown

NOTES:
MRWPCA = Monterey Regional Water Pollution Control Agency
DSA = Dune Sand Aquifer
180 = 180-Foot Equivalent Aquifer or 180-Foot Aquifer
400 = 400-Foot Aquifer
900 = 900-Foot Aquifer

SOURCE: Geoscience, 2015c, c; MWRMD, 2003.



North Marina Groundwater Model Boundary

No Flow Cell

Mean High Tide

-5 Change in Groundwater Elevation (ft)

Note: 180-FTE = 180-Foot Equivalent Aquifer

CEMEX Slant Wells (Feedwater Supply of 24.1 MGD)

NORTH

0 2 4 8 Miles

SOURCE: Geoscience, 2015c

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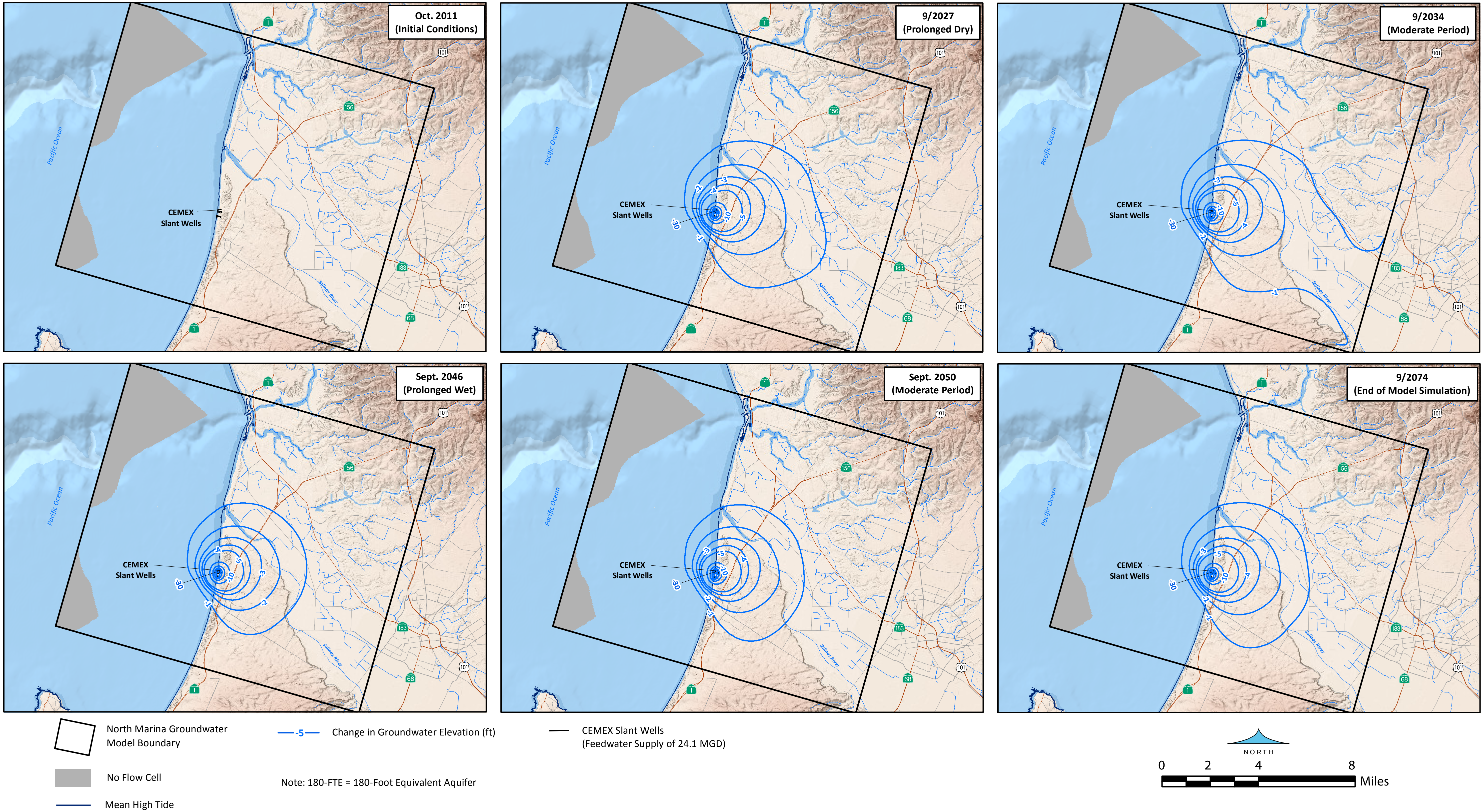
Figure 4.4-13

Changes in Groundwater Elevations for Dune Sand Aquifer between Project and No Project (Scenarios 3n vs. 1n)



SOURCE: Geoscience, 2015c

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Figure 4.4-14
Changes in Groundwater Elevations for 180-Foot Equivalent Aquifer between Project and No Project (Scenarios 3n vs. 1n)

SOURCE: Geoscience, 2015c

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Figure 4.4-15

Known Active Wells in the Dune Sand Aquifer, 180-Foot Equivalent Aquifer, or 400-Foot Aquifer within Two Miles of the Proposed Project

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As shown on **Figures 4.4-9** and **4.4-10**, the 180-Foot Aquifer and the 400-Foot Aquifer have been intruded by seawater in coastal areas since at least 1944, with the intrusion currently extending up to 8 and 3.5 miles further inland, respectively. Consequently, wells that are located within the radius of influence and screened in the 180-Foot and 400-Foot Aquifers have been brackish-to-saline for years, and are no longer serving irrigation or potable uses. Additional information on the groundwater production wells that are within the 2-foot drawdown contour are discussed below.

CEMEX Well. The CEMEX facility operates one water supply well, referred to as the South Well, located about 1,600 feet southeast of the insertion point of the proposed slant wells. The well extracts water from the 400-Foot Aquifer through a well screen set between 400 and 506 feet. The well screen of the active South Well is separated from the intake portion of the slant wells by the 180/400-Foot Aquitard. The slant wells would extract groundwater from the offshore portion of the Dune Sand and 180-Foot Equivalent Aquifers and not the 400-Foot Aquifer. The localized CEMEX model (Geosciences, 2014b) simulated a drawdown of less than 0.2 foot (2.4 inches) in the area around the CEMEX well in the 400-Foot Aquifer after eight months of pumping the test well at 2,500 gallons per minute. As discussed in the Baseline Water Report, the water levels in the monitoring wells screened in the 400-Foot Aquifer have shown a response to tidal fluctuations but no apparent response to the 5-day constant-discharge pumping test (Geoscience, 2015b). The proposed slant wells would have a higher pumping rate. However, because the CEMEX Well is screened in the 400-foot aquifer, if there is a measured response in that well, it would likely be minor and not expose the well screens, damage the wells, or decrease the well yield. CEMEX also has a North Well screened in the 400-Foot Aquifer but this well is inactive.

Monterey Peninsula Landfill. The Monterey Peninsula Landfill, located immediately southeast of the proposed desalination plant site on Charles Benson Road, has four wells that are screened across the Dune Sand Aquifer or the 180-Foot Equivalent Aquifer and are located within the area that might experience a decrease in groundwater elevation of one foot or more (MRWMD, 2003). The landfill uses three of the water supply wells for dust control; the fourth well is inactive, and all of the wells have high chloride concentrations. The well pumps are set close to the bottom of each of the wells and are tens of feet below the groundwater level. Therefore, the modeled groundwater level decrease of 2 to 3 feet would not expose the well pumps, which are at a much greater depth. In addition, this water is already saline-to-brackish due to seawater intrusion and would continue to have no other beneficial uses other than for dust control.

Monterey Regional Water Pollution Control Agency. The Monterey Regional Water Pollution Control Agency Wastewater Treatment Plant, located just southeast of the proposed MPWSP Desalination Plant, has three wells but only the well screened across the 900-Foot Aquifer is active. The one active well is used for domestic purposes (i.e., drinking water, washing, toilets). The pumping of the proposed slant wells in the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer would not impact the 400-Foot Aquifer or the deeper 900-Foot Aquifer.

AgLand Trust Wells. Ag Land Trust has indicated that it has one well that is active and located about one mile northeast of the proposed slant wells in the agricultural fields somewhere just south of Well 14S/02E-07L04. However, field reconnaissance conducted by Geoscience could not locate the well. In addition, the SWRCB does not have any record of a well at the location indicated by AgLand Trust (SWRCB, 2015). The Ag Land Trust well, if it exists and is active, is believed to be screened in the 400-Foot Aquifer or deeper because the Dune Sand Aquifer, 180-Foot Equivalent Aquifer, and 400-Foot Aquifer have been brackish-to-saline for years in this area and an irrigation well at this location would be too salty for agricultural irrigation. In addition, the pumping of the proposed slant wells in the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer would not impact the 400-Foot Aquifer or the deeper 900-Foot Aquifer because of the separating aquitards.

Unknown and Private Well Owners. There are three local wells with unknown owners and one well owned by Bill Baillee that are screened across the 400-Foot Aquifer. As noted above, the pumping of the proposed slant wells in the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer would not impact the 400-Foot Aquifer because of the separating aquitard.

Municipal Wells. The nearest municipal water supply wells are the City of Marina's Wells 10, 11, and 12, located more than 2 miles to the southeast in the eastern portions of Marina and screened in the 900-Foot Aquifer (MCWD, 2005). Further east and south, the Ord Community (former Fort Ord military base; east and south of the city of Marina and now a part of the MCWD service area) is supplied by Wells 29, 30, and 31, located 5 or more miles to the southeast along Reservation Road in unincorporated Monterey County and screened in the lower 180-Foot Aquifer and the 400-Foot Aquifers (MCWD, 2005). These municipal wells are either outside of the radius of influence or not pumping water from the Dune Sand or 180-Foot Aquifers.

Conclusion of Impact Analysis – Groundwater Supply to Neighboring Production Wells

The NMGWM model results indicate that project-related pumping at the slant wells would elicit a response in the groundwater in the Dune Sands Aquifer and the 180-Foot Equivalent Aquifer resulting in a cone of depression with an area of influence that extends outward from the wells up to 7 miles (180-Foot Equivalent Aquifer after a dry period). While drawdown would be deepest at the slant well location (up to 10 feet west of Highway 1), areas within the area of influence could experience a decline in groundwater elevations of up to 5 feet in areas east of Highway 1. In accordance with the significance criteria, significant impact of the project would occur if the drawdown caused by the slant well pumping caused drawdown in a neighboring well such that the well screen of well pump would be exposed, causing damage or the inability of the well to produce water. The survey of local groundwater wells indicate that none of the wells located in the area of influence would be adversely impacted by the drawdown caused by project pumping either because the well pumps and screens are deeper than the predicted drawdown, the well is no longer used, or the well is screened in an aquifer that is not hydrologically connected to the Dune Sands Aquifer or the 180-Foot Equivalent Aquifer. Consequently, the impact of the project on neighboring, local groundwater wells is less than significant.

Depletion of Groundwater Supply from the SVGB

Operation of the slant wells at the proposed pumping rate could cause changes in the groundwater flow direction such that groundwater from inland groundwater sources in the SVGB would be captured and drawn into the seawater intake system. In accordance with the significance criteria (Section 4.4.3.1, above), a significant impact could occur if the operation of the proposed slant wells would substantially deplete the groundwater supply from inland sources within SVGB. This impact reflects the SWRCB concern that groundwater users could be harmed by the project's use of water from inland areas of the SVGB, especially the 180-Foot Aquifer (see Section 4.4.3.2, Approach to Analysis).

This impact was analyzed by using particle tracking maps developed through the NMGWM to illustrate the source of water entering the slant wells. The modeling results assess whether and how much water might be drawn from inland water sources and plot the predicted pathway of water entering the slant wells before and during operations. **Figure 4.4-16** illustrates the water particle flow paths at the CEMEX site in the 180-Foot Equivalent Aquifer where the water particles are reverse tracked starting from the slant wells and moving upgradient along the flow path back toward the source of the water. As shown on **Figure 4.4-16**, the majority of water entering the slant wells is anticipated to originate from west of the slant wells, ultimately from the ocean by infiltration through the ocean floor. A much smaller volume of water would originate within a narrow flow path originating from inland areas.

The NMGWM estimated the volume of inland water would be about 7 percent under 2012 land use conditions after the pumping has started and the cone of depression has stabilized after a few months. Based on the feedwater supply of 24.1 mgd, this would be about 1,889 afy. Over time, the land use conditions could change as envisioned by the county and city general plans. By the time 2060 land use conditions have occurred, the percentage of inland water would have decreased to an average of about 4 percent or about 1,080 afy, in response to the combined changes in land use in the inland areas. Over the life of the proposed project, this would be an average of about 5.5 percent or about 1,485 afy. The project proposes to return to the basin via the CSIP ponds as in-lieu groundwater recharge, the volume of water withdrawn from the basin by the proposed slant wells.

Particle Tracking Analysis Beyond the Radius of Influence. Six forward particle tracks were modeled using the NMGWM in the area northeast of the CEMEX site between Prunedale and Castroville. Modeling these tracks was necessary to verify that groundwater beyond the area of influence of the proposed slant wells (i.e. outside of the 1-foot groundwater drawdown line described above) would not be drawn into the slant wells, thereby depleting groundwater sources further inland. In forward tracking, a simulated "particle" of water is placed at a starting point and the model predicts its flow path into the future. The forward tracking was modeled comparing both the No Project (Scenario 1n) to the Project (Scenario 3n). As shown on **Figure 4.4-17,** the individual particle flow paths migrated from east to northeast, likely in response to the groundwater depression located in the East Side Area and not the pumping at the slant wells. Simulations with and without the proposed project showed identical flow paths, indicating that the influence of the groundwater pumping at the slant wells would not reach beyond the modeled area of influence of the proposed slant well pumping and groundwater from these areas would not be drawn to the slant wells.

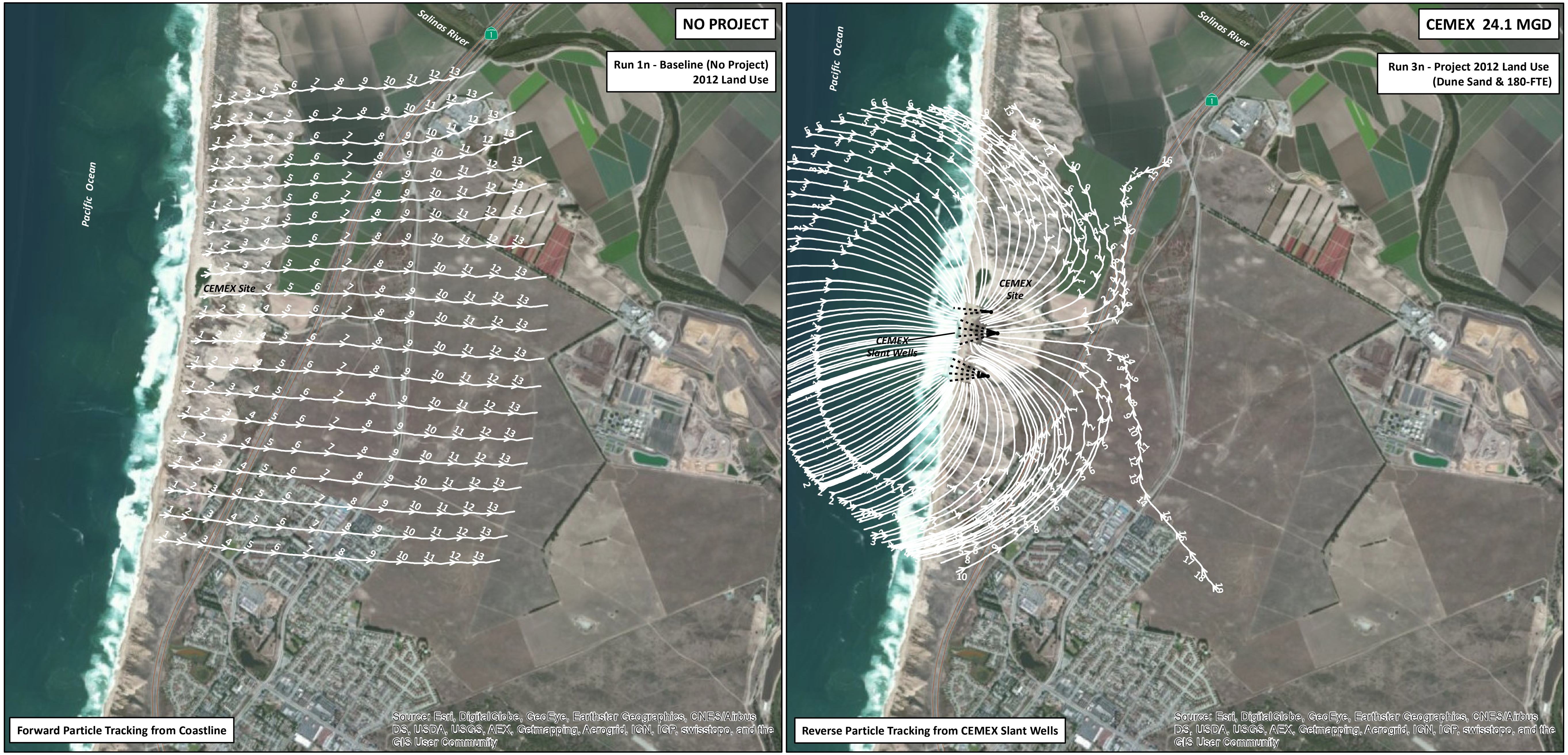
Test Slant Well. Coastal Development Permit #A-3-MRA-14-0050 dated December 8, 2014 granted CalAm permission to construct, operate, and decommission a test slant well at the CEMEX facility. The first Phase of the test slant well investigation commenced with the construction of a 724-foot long test well drilled at an angle of 19 degrees below horizontal at the CEMEX site. Construction began on December 27, 2014 and was completed through the five-day pumping test on April 8, 2015.

Special Condition 11 of the Coastal Development Permit, "Protection of Nearby Wells," requires the MPWSP HWG to establish baseline water and TDS levels prior to commencing the long term pumping tests. The provisions accompanying Special Condition 11, and the Technical Memorandum summarizing activities supporting construction and preliminary testing of the test slant well, including the established baseline water and TDS levels, can be found at http://www.watersupplyproject.org/testwellmonitoring. The long-term pumping test began in mid-April 2015, and results will be provided in the Final EIR, as available.

As shown on **Figure 4.4-3**, the installation of the test slant well revealed that the clay layers on the inland side of the test slant well do not extend seaward (Geoscience, 2015c). This suggests that the modeled estimate of the inland water volume is likely conservative because there could be less resistance to the infiltration of ocean water through the sea floor to the slant wells than anticipated.

Conclusion of Impact Analysis - Depletion of Groundwater Supply from the SVGB

The NMGWM was used to estimate the volume of inland water drawn to the slant wells and to simulate the pathways of water particles to assess whether the proposed groundwater extraction from the slant wells at CEMEX would deplete groundwater supplies from inland sources within the SVGB. Particle tracking indicated that a portion of the feedwater to the slant wells would be drawn from inland groundwater sources. The modeling results estimated that the slant wells would draw an average of about 5.5 percent or 1,485 afy of the feedwater from inland SVGB water sources. As part of the proposed project, the inland water drawn from the SVGB would not be depleted, but would be returned to the SVGB as in-lieu groundwater recharge to the CSIP pond. Particle tracking beyond the limits of the slant well area of influence did not identify a response to the pumping of the slant wells. Since the proposed project would return what small percentage of groundwater that is extracted from the SVGB to the SVGB through in-lieu groundwater recharge, pumping at the slant wells would not deplete groundwater resources in the SVGB and therefore, this impact would be less than significant.



EXPLANATION

white line	Particle Travel Path
white arrow	Direction of Particle Travel and Travel Time (1 Year Increments)

Slant Wellhead
Blank Casing
Well Screen

CEMEX Slant Wells
(Feedwater Supply of 24.1 MGD)

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,500 5,000
Feet

SOURCE: Geoscience, 2015c

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Figure 4.4-16
Particle Flow Map for the 180-Foot Equivalent Aquifer
No Project vs. Project Scenarios

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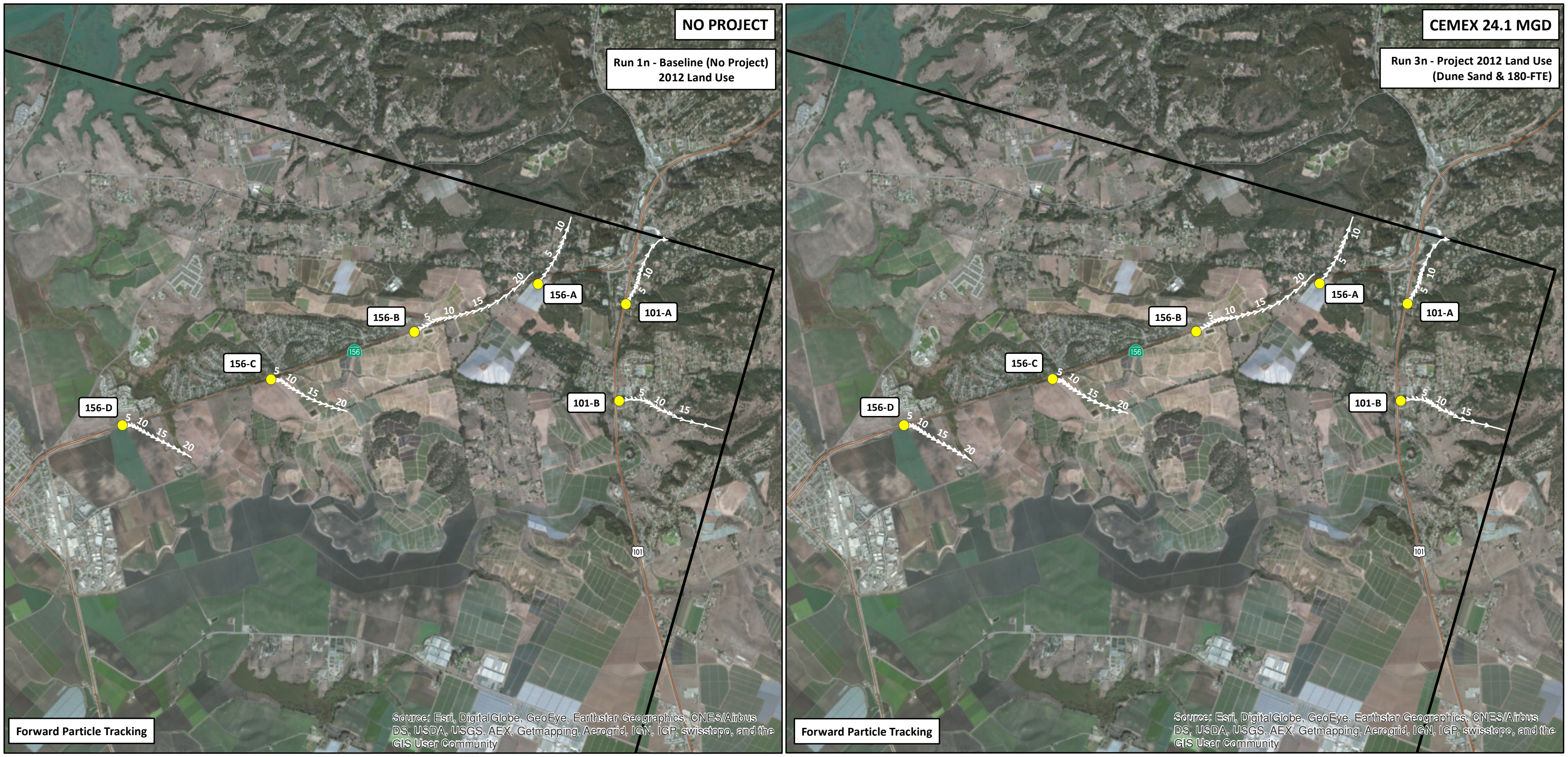

EXPLANATION

white line — Particle Travel Path

white arrow — Direction of Particle Travel and Travel Time (1 Year Increments)

North Marina Groundwater Model Boundary

156-A — Particle Release Point and Designation

Note: 180-FTE = 180-Foot Equivalent Aquifer

NORTH

0 2,000 4,000 8,000 Feet

Run 1n - Baseline (No Project) 2012 Land Use

Run 3n - Project 2012 Land Use (Dune Sand & 180-FTE)

SOURCE: Geoscience, 2015c

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Figure 4.4-17

Particle Tracking Near Prunedale

Operation of the ASR Injection/Extraction Wells

The MPWSP Desalination Plant would generate approximately 9.1-mgd of desalinated water. Depending on precipitation and the water supply demands in any given year, the volume of treated desalinated water routed to the ASR system would vary but would be about 2,100 afy. The injection of this additional water into the confined Santa Margarita Sandstone would result in short-term groundwater mounding, although an excessive rate of injection could damage the aquifer, reducing its ability to transmit water (Pueblo Water Resources, 2013). Alternately, the extraction of groundwater could result in lower groundwater levels. Operation of the ASR injection/extraction wells could cause changes in the groundwater flow direction or reduce the ability to transmit water. In addition, if the extraction of groundwater exceeded the injection volume on an annual basis, the size and extent of the existing groundwater depression in the SGB would increase in size as a direct result of the proposed project. In accordance with the significance criteria (Section 4.4.3.1, above), a significant impact could occur if operation of the proposed ASR injection/extraction wells were to result in groundwater mounding, change groundwater gradients, or lower groundwater levels such that nearby municipal or private groundwater production wells were to experience a substantial reduction in well yield or physical damage (due to exposure of well pumps).

Analysis of ASR Operations in the SGB

The following discussion describes the existing groundwater conditions and how the planned operation of the ASR injection/extraction wells would avoid adverse impacts. **Figure 4.4-7** shows the groundwater surface and flow patterns in July/August 2013 in the Shallow Zone Aquifer of the SGB, within which the ASR injection/extraction wells would be screened, along with the location of local water supply production wells. A groundwater depression is present to the south-southwest of the ASR system and is the result of historical overdraft.

The MPWMD's ASR EIR (2006) analyzed the impacts to groundwater storage and water levels in the SGB. The analysis presented a pilot study and a groundwater model to evaluate the impacts to groundwater storage in the SGB through operation of the ASR program. The analysis determined that up to 2,426 afy could be injected through the implementation of the ASR program, of which up to 2,003 afy would be extracted. The findings of the analysis concluded that injecting excess treated Carmel River water into the ASR injection/extraction wells was beneficial to groundwater storage within the SGB, so long as extraction did not exceed injection on an annual basis.

Since the MPWMD's ASR project was approved with injection beginning in 2001, 2 afy to 1,117 afy of excess Carmel River have been injected into and extracted from storage for a total of about 4,175 af through 2013 (Pueblo Water Resources, 2014). Although the program has not achieved the annual volume of water evaluated in the ASR EIR (2,426 afy), the groundwater monitoring results indicate that the injection and extraction of water does not adversely affect groundwater storage in the SGB. However, the MPWMD ASR program can only divert winter flows from the Carmel River on a seasonal basis that are in excess of in-river needs, and as such, is rainfall dependent. Furthermore, it does not increase storage in the SGB, since the injected Carmel River water is subsequently pumped back out to reduce CalAm's pumping from the Carmel River and/or the SGB.

The proposed project would include the installation of two additional ASR injection/extraction wells to increase the reliability of the ASR program to inject and extract Carmel River water, and to allow for the injection and ultimate extraction of treated desalinated water. However, the injection and extraction volumes of water from the desalination plant would be managed such that there would be no net change to the storage of groundwater on an annual basis. Water injected in a particular year but not used in that same year could be stored for the next year.

In addition, CalAm is required to return to the basin 700 afy for the next 25 years to mitigate for its overdraft of the SGB (Seaside Groundwater Basin Watermaster, 2012b). To accomplish this payback, CalAm would extract only 774 afy of their 1,474 afy SGB adjudicated allocation. The payback of 700 afy for 25 years would result in the retention of 17,500 afy in storage, reducing the historical overdraft of the SGB.

Impact Conclusion – Operation of the ASR Injection/Extraction Wells

A significant impact could occur if operation of the proposed ASR injection/extraction wells caused groundwater mounding, change groundwater gradients, or lower groundwater levels such that nearby municipal or private groundwater production wells were to experience a substantial reduction in well yield or physical damage (due to exposure of well pumps). The analysis concluded that the injection/extraction would be managed so that the injection and extraction of water provided from the desalination plant would not constitute a net change in storage. Because the storage in the aquifer would remain constant, impacts related to mounding, change in groundwater flow directions and excessive extraction would not occur and the impact would be less than significant.

Operation of All Other Proposed Project Components

None of the other proposed facilities would involve the injection or extraction of groundwater. Therefore, there would be no impact to groundwater supplies from the operation of the monitoring wells, MPWSP Desalination Plant, Terminal Reservoir, pipelines, and pump stations.

Impact Conclusion Groundwater Supplies

The impact analysis of the Seawater Intake System was based primarily on the NMGWM model simulations and the response of monitoring wells to the 5-day constant-discharge pumping test discussed above. None of the wells located in the area of influence would be adversely impacted by the drawdown caused by project pumping and the impact of the project on neighboring, local groundwater wells is less than significant. Since the proposed project would return the small percentage of groundwater that is extracted from the SVGB pumping at the slant wells would not deplete groundwater resources in the SVGB, and the impact would be less than significant.

Management of the ASR injection and extraction would ensure that operation of the proposed ASR injection/extraction wells would remain constant and therefore would not cause groundwater mounding, change groundwater gradients, or lower groundwater levels. Impacts associated with ASR operation are considered less than significant.

Operation of the monitoring wells, the MPWSP Desalination Plant, the Terminal Reservoir, the pipelines, or the pump stations would not interfere with, extract from, or inject into the groundwater aquifers in the SVGB or SGB. Consequently, there would be no impact associated with these facilities.

Recognizing the long-term nature of the proposed project and the need to provide continued verification that the project would not contribute to lower groundwater levels in neighboring wells within the SVGB, the project applicant has proposed as part of the project to expand the existing regional groundwater monitoring program to include the area where groundwater elevations are anticipated to decrease in the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer (see **Figures 4.4-13** and **4.4-14**). The Applicant Proposed Mitigation Measure, included in this EIR as **Applicant Proposed Mitigation Measure 4.4-3 (Groundwater Monitoring and Avoidance of Well Damage)**, would ensure that a groundwater monitoring program is in place before and during groundwater pumping operations in the affected area to verify that the seawater intake system performs as expected (Svindland, 2015). The monitoring program proposed under **Applicant Proposed Mitigation Measure 4.4-3** would detect changes to local groundwater elevations and quality, and evaluate whether those changes could damage neighboring active wells. Implementation of **Applicant Proposed Mitigation Measure 4.4-3** is not necessary to address any significant project effect, but instead further bolsters the conclusion that the impact of the proposed project on nearby active wells would be less than significant.

Applicant Proposed Mitigation Measure

Applicant Proposed Mitigation Measure 4.4-3 applies only to the Seawater Intake System.

Applicant Proposed Mitigation Measure 4.4-3: Groundwater Monitoring and Avoidance of Well Damage.

Immediately following project approval, the project applicant, working with the MCWRA, shall fund and develop a groundwater monitoring and reporting program that expands the current regional groundwater monitoring network to include the area near the proposed slant wells. Once expanded, the groundwater monitoring program would monitor groundwater levels and water quality within the area where groundwater elevations are anticipated to decrease in the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer (see **Figures 4.4-13** and **4.4-14**) and within at least one mile outside of the predicted radius of influence. Area of groundwater monitoring shall be determined by MCWRA and the MPWSP Hydrogeology Working Group (HWG). The elements of the groundwater monitoring program required under this mitigation measure are described below.

- Using a current survey of wells within the pumping influence of the slant wells, offer to private and public well owners the opportunity to participate in a voluntary groundwater monitoring program to conduct groundwater elevation and quality monitoring. The voluntary groundwater monitoring program shall include retaining an independent hydrogeologist to evaluate the conditions and characteristics (e.g. well depth, well screen interval, pump condition, flow rate) of participating wells prior to the start of slant well pumping. Water elevation and quality monitoring shall begin following initial groundwater well assessment.

- Based on a review of the well network of voluntary well owners, identify areas lacking adequate groundwater data and if deemed necessary, install new monitoring wells. These new wells would be in the 180-Foot Aquifer.

- Seven clusters of monitoring wells were recently completed on and near the CEMEX property. These well clusters monitor various depths within the Dune Sand Aquifer, the 180-Foot Aquifer, and the 400-Foot Aquifer and shall be included in the monitoring network.

- Using the groundwater data developed through the voluntary well monitoring program and those data gathered at the new monitoring wells, evaluate whether project pumping is causing a measureable and consistent drawdown of local groundwater levels in nearby wells that is distinguishable from seasonal groundwater level fluctuation. In the event that a consistent and measureable drawdown is identified, determine if the observed degree of drawdown would damage or otherwise adversely affect active water supply wells. Adverse effects from lowered groundwater levels in existing active groundwater supply wells can include cavitation due to exposure of the well screen, water elevation declines that draw water below pump intakes, reduced well yields and pumping rates, and changes in groundwater quality indicating that project pumping is drawing lower quality water toward the well. Adverse effects would only occur in active wells; inactive wells would not be considered for mitigation.

- If it is determined that a nearby active groundwater well has been damaged or otherwise negatively affected by the project pumping of the slant wells, the project applicant shall coordinate with the active well owner to arrange for an interim water supply and begin developing a mutually agreed upon course of action to repair or deepen the existing well, restore groundwater yield by improving well efficiency, provide long term replacement of water supply, or construct a new well.

Applicant Proposed Mitigation Measure 4.4-3 would monitor changes in the groundwater surface elevations caused by the proposed pumping at the slant wells through a voluntary program and use of new groundwater monitoring wells. If it is determined that the project is causing groundwater levels to damage local active wells, this mitigation measure would ensure that active wells are repaired or replaced.

Impacts to Groundwater Recharge

The proposed project could interfere with groundwater recharge by decreasing groundwater elevations from groundwater pumping, thereby disrupting the existing surface water–groundwater interaction on the Salinas River or creating additional impervious surfaces through the construction of project facilities. Impervious surfaces reduce the volume of rainwater that infiltrates down to the aquifer. In accordance with the Significance Criteria (see Section 4.4.3.1), a significant impact would occur if the proposed project interferes substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. The proposed project's contribution to alteration of the surface water-groundwater interaction and the increase in impervious surfaces is discussed below.

Impacts of the Project on the Surface Water-Groundwater Interaction at the Salinas River

As a river flows over the land surface, it may lose water to the subsurface or gain water by intersecting groundwater from the underlying water table[25], depending on the depth to groundwater relative to the level of the river bed. This surface water-groundwater interaction causes groundwater to discharge to streams in some areas and surface water to infiltrate to the subsurface aquifers in others. The two conditions are referred to as a gaining stream (the river gains water from the aquifer) or a losing stream (the river loses water to the aquifer). In the case of the proposed project, the Salinas River would be affected because some portions of the river overlie the area where the pumping from the slant wells would decrease water levels by one foot or more. Project pumping could affect water level in the Dune Sand Aquifer because this unit is unconfined and shallow. If groundwater elevations were lowered beneath the river, the surface water-groundwater interaction between the river and underlying aquifer would adjust and the losing stream section of the river would increase in length. This additional length of losing stream would increase recharge from the surface water to groundwater.

As shown on **Figure 4.4-13**, the area where groundwater levels in the Dune Sand Aquifer are anticipated to decrease by one foot or more beneath the Salinas River extends from the coastline to a maximum of about 7 miles inland under simulated drought conditions. However, most of the area beneath the Salinas River that would be affected would only experience a decrease of one to two feet, with a maximum of almost 3 feet in one area. Where the river is currently a gaining stream, the elevation of the water table would be equal to or higher than the elevation of the river water surface and recharge from the water table to the river would occur. The NMGWM estimates that the average annual increase of surface water loss to the underlying aquifer, as a result of the proposed project, would be about 183 afy (Geoscience, 2015c). Considering that the volume of water flowing to the ocean by the Salinas River in 2012 was about 250,000 afy, the change of 183 afy or 0.07 percent is considered a minor. The project would cause a small increase in the amount of surface water loss to the underlying aquifer, however, it is not considered a substantial interference to groundwater recharge and would be a less than significant impact.

Impacts of the Project on the Surface Water-Groundwater Interaction at CEMEX

As shown on **Figure 3-3**, the CEMEX facility has several ponds on its property. The largest pond, located to the north of the slant wells, is the source of the sand mined by CEMEX. The impact analysis of proposed project pumping effects on recharge considered the largest pond to determine whether the proposed project would have an adverse impact on its recharge or on the current sand mining operations.

Pond Operation. Winter storm surges push sand with very little silt or clay particles over the beach and into the largest pond, and the sand settles to the bottom of the pond. CEMEX then dredges the sand from the pond, sorts the sand into different grain sizes depending on the desired end product, and washes the sand to remove residual salts from seawater. The wash water is routed to the smaller ponds located north and east of the location of the proposed slant wells,

25 The water table is the surface of the shallowest aquifer that is unconfined and open to the overlying atmosphere. In this case, the groundwater surface of the Dune Sand Aquifer or the inland Perched A Aquifer would be the water table.

where the seawater seeps into the sand and migrates back to the ocean. The larger, deeper sand source pond is in an area composed entirely of sand. The water level in the largest pond is controlled by the ocean tides (Geoscience, 2015b). The smaller, shallower wash water ponds are fed entirely by the wash water and are not directly connected to either the ocean or to the underlying groundwater; wash water either evaporates or infiltrates into the shallow sand and migrates to the ocean.

A water level transducer was installed in the large dredge pond on the CEMEX property to monitor changes in water elevations. The most recent monitoring report indicates that the pond is tidally influenced (Geoscience, 2015a, b) due to the immediate proximity of the pond to the ocean. In addition, the pond water level monitoring indicates that the sand mining operations conducted on Monday through Friday also affect pond water levels. Pond water levels fluctuate and decrease during the week as sand and water is pumped out of the pond and then stabilize on Saturday and Sunday when the sand mining operations are closed.

Impact Analysis for CEMEX Dredging Pond Drawdown. The large CEMEX dredge pond is located within 200 feet of the shoreline and the bottom of the dredge pond is assumed to be at about 10 to 20 feet below the surface water level in the pond (Geoscience, 2015b). The water level in the pond is in hydraulic connection with the ocean, receiving ocean water as seepage through the beach sand and occasional storm surges over the beach and into the pond. The storm surges are the source of the sand being mined. Tidal changes occur in the dredge pond, which are the same as the tidal changes in the ocean. This impact analysis is based on the analysis completed for the test well, completed in September 2014 and is also informed by data that was generated in April 2015 after a five-day constant discharge pump test of the test slant well.

In the September 2014 analysis, the localized CEMEX model was used to determine whether the dredge pond would be influenced by pumping at the proposed test well operating at 2,500 gallons per minute (gpm) (Geoscience, 2014b). The localized CEMEX model simulates the response of the Dune Sand Aquifer in its second, third, and fourth vertical layers. The depth of the large dredge pond falls within the second and part of the third model layer so the response in the dredge pond would be captured as a response in the upper portion of Dune Sand Aquifer. The CEMEX model simulated the test well pumping for 8-months at 2,500 gpm. The results of the model run showed a drawdown at the dredge pond of about 1 foot. If a drawdown of 1 foot occurred for a pumping rate of 2,500 gpm from one well (the test slant well), there is a possibility that additional drawdown would occur in the pond during operation of the all of the proposed slant wells, which would operate at the combined pumping rate of 24.1 mgd or about 16,736 gpm. However, when compared to the daily tidal fluctuations in the dredge pond water levels of up to eight feet throughout the year, the decline in the water surface of any depth would be masked by the consistent recharge from the ocean.

Subsequently, the April 2015, five-day constant-discharge pumping test was conducted after a water level transducer had been installed in the dredging pond and had been collecting data since March 8, 2015 (Geoscience, 2015b). The transducer showed a series of cyclical fluctuations from March 8 through March 21, followed by relatively flat levels through April 2, followed by similar pattern of cyclical fluctuations at similar elevations through April 11. The cyclical fluctuations are due to a combination of tidal influence and the routine dredging of the pond for sand. The early March fluctuations, which occurred before the pumping test, and the early April fluctuations, which occurred during the pumping test, show a similar pattern at about the same water level, indicating that the water level in the CEMEX pond is not being influenced by the pumping of the test slant well. This also indicates that as the pond is dredged, the water levels quickly recover with seawater seeping through the loose sand on the beach.

While pumping at the slant wells could elicit a drawdown response in the large dredge pond over extended pumping, the magnitude of that response would not interfere with recharge to the Dune Sand Aquifer nor would it inhibit sand mining operations by depleting available water supplies to the pond. This impact is less than significant.

Impacts from Impervious Surfaces

Seawater Intake System. The completed seawater intake system at CEMEX would consist of ten subsurface slant wells and associated pipelines, an aboveground electrical control panel, and an aboveground electrical control building. The well heads and pipelines would be completed below ground. Precipitation would continue to infiltrate into the subsurface sands and flow around the buried well head structure to the water table or migrate to the ocean. The electrical panel and electrical control building would create about 56 square feet of impervious surfaces within the coastal sand dunes, where the surrounding and underlying soil is loose sand. This minor amount of added impervious surface would not reduce potential recharge area of the shallow aquifer.

ASR Injection/Extraction Wells. Each of the two new ASR injection/extraction wells, pumps and electrical control system would be housed in a 900-square-foot concrete pump house. The two 900-square-foot pump houses would be surrounded by unpaved soil. Rainwater falling on the pump houses would flow off the structures into the surrounding unpaved areas and would infiltrate down to the water table. Therefore, there would be no reduction to groundwater recharge.

MPWSP Desalination Plant. The MPWSP Desalination Plant would consist of several structures that would result in the creation of about 15 acres of new impervious surfaces that would restrict rainfall from infiltrating into the subsurface. However, rainwater falling on these structures would be routed to the surrounding area that would remain unpaved. Rainwater would still be able to infiltrate into the subsurface and recharge the underlying aquifer. Therefore, there would be no reduction to groundwater recharge.

Terminal Reservoir and ASR Pump Station. The Terminal Reservoir would consist of two water storage tanks that would be constructed on a concrete pad covering 1.8-acres within a fenced 7-acre area. The ASR Pump Station would be placed within a concrete pump house constructed on the same concrete pad. The concrete pad would create new impervious surface that would restrict rainfall from infiltrating into the subsurface. Rainwater falling on this structure would be routed to the surrounding area that would remain unpaved. Rainwater would still be able to infiltrate into the subsurface and recharge the underlying aquifer. Therefore, there would be no reduction in groundwater recharge.

Valley Greens Pump Station. The 600-square-foot Valley Greens Pump Station has two options. For Option 1, a new pump station would be constructed in an unpaved area. The surrounding area would remain unpaved providing a route for rainwater falling on the pump station to infiltrate back into the ground and recharge the underlying aquifer. For Option 2, the existing pump station would be rebuilt on the same location, resulting in no new or additional impervious surface. The Valley Greens Pump Station would not result in a reduction to groundwater recharge at either location.

Pipelines. Construction workers would install over 30 miles of pipelines within or adjacent to existing roads and recreational trails. Most pipeline segments would be installed using conventional open-trench technology. The typical trench width would be 6 feet and the overall construction corridor for pipeline construction would vary from 50 to 100 feet, depending on the size of the pipe being installed. The trenches would be backfilled and the surfaces restored to their pre-existing conditions. Therefore, there would be no change to the existing amount of impervious surfaces and no change to the existing volume of groundwater recharge.

Impact Conclusion Groundwater Recharge

The proposed project would cause a minor increase in the amount of water surface water lost to the underlying aquifer on the Salinas River, however, it is not considered a substantial interference to groundwater recharge and would be a less than significant impact. While pumping at the slant wells could cause drawdown in the large dredge pond over extended pumping, the magnitude of that response would not interfere with recharge to the Dune Sand Aquifer nor would it negatively impact the operations of the CEMEX sand mining operations. Facilities proposed for the project would slightly increase the amount of impervious surfaces in the project area but it would not reduce the potential for surface water to recharge the underlying aquifers. Impacts associated with changes to groundwater recharge during the operation of all project facilities would be less than significant.

Mitigation Measure

None required.

Impact 4.4-4: Violate any water quality standards or otherwise degrade groundwater quality during operations. (*Less than Significant*)

Impact 4.4-4 addresses the impacts to groundwater quality during the operation of the proposed project. Water quality considerations associated with the project operations include the exacerbation of sea water intrusion and the potential for the proposed project to cause new contamination or extend the limits of existing groundwater contamination through pumping at the seawater intake system, ASR injection/extraction wells, and other project facilities. The slant wells would extract water from the Dune Sands Aquifer and the 180-Foot Equivalent Aquifer of the SVGB, while the ASR wells would periodically inject water into and extract groundwater from the Santa Margarita Sandstone in the SGB.

Impacts to Groundwater Quality

Operation of Subsurface Slant Wells

Impact of the Project on Seawater Intrusion

As shown on **Figures 4.4-9** and **4.4-10**, the current location of the seawater/freshwater interface is about 8 miles inland in the 180-Foot Aquifer and 3.5 miles inland in the 400-Foot Aquifer. Once operational, the proposed slant wells would extract 24.1 mgd from the subsurface. This extraction would be an adverse impact if it were to cause the seawater/freshwater interface to migrate further inland. In accordance with the Significance Criteria (Section 4.4.3.1), a significant impact would occur if extraction at the subsurface slant wells were to adversely affect groundwater quality by exacerbating seawater intrusion in the SVGB.

Figure 4.4-16 illustrates the flow paths of water in the vicinity of the proposed slant wells and compares the current conditions (No Project) with the model-predicted flow paths under Project conditions. Note that under the current conditions, seawater is continuing to migrate inland, maintaining the current condition of seawater intrusion.

To visualize the mechanics of this migration, consider the location of the seawater/freshwater interface prior to the development of the Salinas Valley. Before the installation of water supply wells in the Salinas Valley, there was a balance between the seawater in the ocean and the groundwater in the aquifers in the inland areas. Surface water within the watershed would infiltrate down into the aquifer, but it would be at a higher elevation than the surface of the ocean. Gravity requires that the difference in elevation forces the freshwater in the inland areas to migrate down and press back against the seawater. The resulting location of the seawater/freshwater interface would have been somewhere closer to the ocean than it is now.

With the development of the Salinas Valley, water supply wells were installed and groundwater was extracted out of the aquifer. This action reduced the weight of water on the inland side of the seawater/freshwater interface, creating a pressure imbalance, and resulted in the landward migration of the interface to its current location of up to 8 miles inland in the 180-Foot Aquifer.

With the implementation of the proposed project, a portion of the intruding seawater would be removed from the coast through pumping at the seawater intake system. Once removed, the pressure on the seawater flowing landward at the coast would be reduced within the localized area affected by the proposed project pumping. The pressure reduction would interrupt the inland flow of seawater instead of allowing the seawater to continue to migrate inland. This would cause the seawater/freshwater interface to migrate back towards the ocean, thus reducing the extent of the area currently affected by seawater intrusion.

The proposed project would extract groundwater from the coast and reduce the inland migration rate of the seawater/freshwater interface. The proposed project would therefore facilitate the reduction of seawater intrusion and the proposed project impacts are considered less than significant.

Impacts of the Project Associated with Existing Groundwater Remediation Systems

Occasionally, past industrial, commercial, or military sites have residual soil and groundwater contamination caused by past spills, leaking underground tanks, unlined chemical disposal sites or inadvertent land disposal of chemicals. When contaminated groundwater is found at these sites, a common remedy is to pump it out, treat it, and either dispose of it or use it for non-potable supply; this process is referred to as "pump and treat". Pumping contaminated water out of the ground requires extraction wells that, similar to the slant wells proposed by the proposed project, can create a cone of depression and an accompanying area of influence. When the area of influence of a pump and treat site intersects that of another water extraction system, the cones of depression interfere with each other and can cause the groundwater contamination to spread into previously uncontaminated areas.

During the operation of the Seawater Intake System, the proposed slant wells located at the CEMEX facility would produce a radius of influence in groundwater in the Dune Sand Aquifer and the 180-Foot Equivalent Aquifer, as shown on **Figures 4.4-13** and **4.4-14** and discussed in Impact 4.4-3. Within the CEMEX area, the NMGWM anticipates that groundwater elevations could decrease and that decrease could incrementally affect groundwater flow directions. If there are nearby inland sites that are remediating contaminated groundwater in the same aquifers and are located within the radius of influence of the slant wells, then the pumping of the slant wells could interfere with those remediation activities, pulling contaminated groundwater into currently uncontaminated areas and degrading the existing water quality. This would violate the state non-degradation policy of maintaining the existing water quality. In accordance with the Significance Criteria (Section 4.3.3.1) a significant impact would occur if the Project created a condition that would violate water quality standards or otherwise degrade water quality.

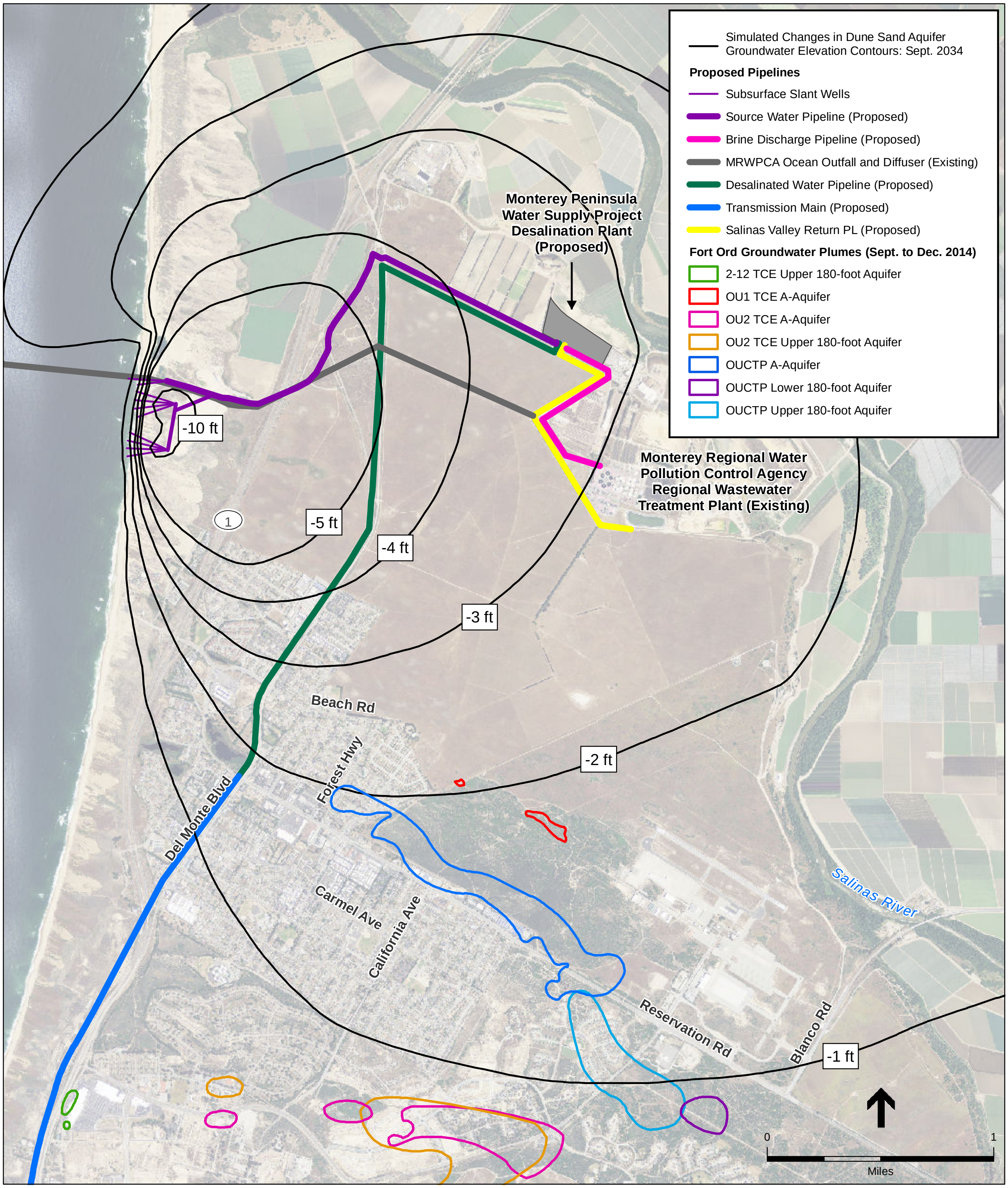
The United States Army (U.S. Army) has been conducting investigation and cleanup activities at the former Fort Ord military reservation since 1986 (Fort Ord Base Realignment and Closure Office, U.S. Army, 2012). The ongoing remediation will continue until contaminant levels in the groundwater are reduced to at or below action clean-up levels and are protective of human health. The northwestern border or the former Fort Ord is located within two miles southeast of the seawater intake system.

As discussed in the Setting for Section 4.7, Hazards and Hazardous Materials, the former Fort Ord military base has several plumes of contaminated groundwater located southeast of the seawater intake system, as shown on **Figure 4.7-1**. Source removal and ongoing groundwater remediation efforts have effectively reduced the contaminant concentrations and extents in these plumes. As shown on **Figure 4.4-18**, three of the closest plumes to the slant wells are located within the area that the NMGWM estimates groundwater levels would decrease by one to two feet in the Dune Sand Aquifer and the 180-Foot Aquifer. The figure shows similar groundwater elevation decreases for the Dune Sand Aquifer and the 180-Foot Aquifer. The A-Aquifer is a shallow inland aquifer above the 180-Foot Aquifer and is not known to be hydraulically connected to the Dune Sand Aquifer at the proposed slant well locations. However, if the two aquifers are hydraulically connected, the modeling for slant wells operation anticipates during a prolonged dry period, groundwater levels could decrease between one and two feet and extend to the plumes, as indicted on **Figure 4.4-18**. This decrease in groundwater elevations could influence the plumes to migrate further northwest into currently uncontaminated areas and degrade water quality. The possible overlap of the slant well radius of influence with each of these plumes is discussed below.

OU1 TCE A-Aquifer Plume. The OU1 TCE A-Aquifer Plume, located about 2.25 miles southeast of the proposed slant wells, is contaminated by TCE and is being cleaned up using pump-and-treat technology. At its maximum operation, the treatment system for the OU1 TCE A-Aquifer Plume had 15 extraction wells operating throughout the extent of the plume, including at the westernmost edge of the plume (HydroGeoLogic, 2015). As cleanup of the plume has proceeded, the extent of the plume has become smaller as TCE concentrations have decreased in the groundwater. The operation of the extraction wells also contain the plume and prevent its migration further west because groundwater flows toward the extraction wells. As measured during the September 2014 monitoring event, the cone of depression around the westernmost extraction wells was about ten feet below the surrounding groundwater levels within 100 feet of the extraction wells. With a cone of depression of ten or more feet, the one to two foot decrease in groundwater levels caused by the proposed slant wells would be unable to overcome the cone of depression at the extraction wells. Therefore, with the ongoing extraction system, the impact of the slant wells would be less than significant and no mitigation is required.

OUCTP A-Aquifer Plume. The OUCTP A-Aquifer Plume, located about 2 miles southeast of the slant wells, is contaminated by carbon tetrachloride. This plume was previously under remediation by pump-and-treat technology, similar to the OU1 TCE Plume described above (Ahtna, 2015). However, the extraction system is no longer used. The OUCTP A-Aquifer Plume is currently being treated using in-situ bioremediation. Bioremediation technology injects nutrients or other chemicals into the aquifer to stimulate the naturally occurring microbes to biodegrade the contaminants. As a consequence, there are no longer any operational extraction wells producing cones of depression. If the radius of influence of the proposed slant wells does reach the western portion of the OUCTP A-Aquifer Plume, then the decrease in groundwater elevations could alter the existing groundwater flow direction. This change in flow direction could result in pulling the OUCTP Plume further northwest, spreading the contamination to areas that are not now contaminated. As previously discussed, this location is about 2 miles from the slant wells. At this distance, the NMGWM simulations decrease in accuracy and the anticipated one to two foot groundwater elevation decrease within the radius of influence is less certain to extend this far. Nonetheless, the simulation indicates that the decrease in groundwater elevations is possible and would result in a significant impact. This impact would be reduced to less than significant with the implementation of **Mitigation Measure 4.4-4 (Groundwater Monitoring and Avoidance of Impacts to Groundwater Remediation Plumes)**, which would require CalAm to monitor groundwater flow directions at the nearby known contaminated groundwater plumes and to work with the responsible parties if the proposed project would adversely impact those ongoing remediation efforts.

OUCTP Upper 180-Foot-Aquifer Plume. The OUCTP Upper 180-Foot Aquifer Plume, located a little over 3 miles southeast of the slant wells, is using pump-and-treat technology for groundwater remediation (Ahtna, 2015). At its largest, the treatment system had seven extraction wells operating



SOURCE: ESRI, 2007; DTSC, 2013; MCALUC, 1996; Geoscience, 2015c; RWQCB, 2015; Ahtna, 2015; Hydro Geologic, 2015

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Figure 4.4-18
Simulated Groundwater Elevation Changes at Former Fort Ord Plumes

throughout the extent of the plume, including at the westernmost edge of the plume. As cleanup of the plume has proceeded, the extent of the plume has become smaller as concentrations in the groundwater have decreased. Currently, only one extraction well is in operation in the central area of the plume. The operation of the extraction well also serves to contain the plume and prevent its migration further west because groundwater flows toward the extraction well and cannot escape further west. As measured during the December 2014 monitoring event, the cone of depression around the extraction well was about 22 feet below the surrounding groundwater levels. With a cone of depression of ten or more feet, the one to two foot decrease in groundwater levels caused by the proposed slant wells would be unable to overcome the cone of depression at the extraction wells. Therefore, with the ongoing extraction system, the impact of the slant wells would be less than significant and no mitigation is required.

Impacts Associated with ASR Injection/Extraction Wells

Interference with Existing Groundwater Remediation Systems. The injection of desalinated product water into the proposed ASR-5 and ASR-6 Wells would increase groundwater elevations and the volume of water in underground storage. This increase in groundwater elevations would alter groundwater flow patterns in the vicinity of the proposed ASR-5 and ASR-6 Wells. If there are nearby sites that are remediating contaminated groundwater in the Santa Margarita Sandstone aquifer and are located within the area where groundwater elevations are expected to rise, then the increase of groundwater elevations could interfere with those remediation activities, pushing contaminated groundwater into currently uncontaminated areas and degrading the existing water quality.

As previously discussed, the addition of the ASR injection/extraction wells would increase the capacity to inject and store water in the Santa Margarita Sandstone in the SGB. The SGB is separated by a groundwater divide from the SVGB to the north, where the former Fort Ord sites discussed above are located. As previously discussed, the injection and extraction of water from the desalination plant into the SGB would be operated such that there would be no net change in storage on an annual basis.

The target aquifer for injection and storage is in the Santa Margarita Sandstone at a depth of about 1,000 feet below the ground surface. Currently, a groundwater depression caused by historical overdraft is located to the south of the ASR system with its center close to General Jim Moore Boulevard, as shown on **Figure 4.4-4**. The presence of this groundwater depression would cause the additional water injected and stored in the Santa Margarita Sandstone to flow toward that depression to the south. Consequently, only groundwater remediation sites with groundwater contamination in the Santa Margarita Sandstone at about 1,000 feet below the ground surface and located within the area between the ASR injection/extraction wells and the center of the groundwater depression could be affected. As shown on **Figure 4.7-2**, the nearest contaminated sites are located along Del Monte Boulevard, near the coast and west of the groundwater depression; however, the contamination is in the surficial Aromas Sand Aquifer. There are no known contaminated sites undergoing groundwater remediation in the area between the ASR injection/extraction wells and the edge of the groundwater depression. Therefore, the potential for the ASR injection/extraction wells operation to interfere with groundwater remediation activities at nearby contaminated sites would low and thus, this impact is less than significant.

Addition of Treated Water to the Santa Margarita Aquifer. The ASR component for the proposed project would continue to utilize and augment the existing ASR system, which currently consists of four ASR injection/extraction wells located on General Jim Moore Boulevard that store water in the Santa Margarita Sandstone in the SGB. The expansion includes the construction of two additional ASR injection/extraction wells along General Jim Moore Boulevard (see **Figure 3-7**) that would increase the reliability of storing Carmel River water in the SGB, and would facilitate the injection, storage, and extraction of desalinated water. The seawater pumped from the slant wells would be treated to potable drinking water standards at the proposed desalination plant and pumped through the water supply distribution system to the SGB, where the water would be injected into the ASR injection/extraction wells for later recovery during dry periods (see **Figure 3-2**). As discussed in the Setting, the primary water quality concern associated with ASR projects using potable water is that DBPs, including THMs and HAAs, are formed during the disinfection process. Additionally, the injection of oxygenated water could potentially alter the geochemistry of the groundwater and increase the concentration of minerals in groundwater.

The existing ASR system treats surface water from the Carmel River to drinking water standards and then injects that treated water into storage in the Santa Margarita Sandstone for later extraction and use. As discussed in the Setting, the MPWMD conducted investigations to evaluate the effects of injecting water treated to drinking water standards into the Santa Margarita Sandstone. Their investigations, as well as ongoing monitoring, concluded that the DBPs do increase upon initial injection of treated surface water into the Santa Margarita Sandstone, but concentrations steadily decreased with time and the existing conditions are restored over the course of six to eight months (Pueblo Water Resources, 2014). Groundwater monitoring results indicate that over the course of that time, the pH remains neutral (between 6 and 8), indicating relatively stable geochemical conditions.

The RWQCB currently regulates the ASR project under Permit 20808C. The MPWMD continues to conduct groundwater studies and monitoring to document the changes to the groundwater system due to ASR, and to ensure that the ASR project does not degrade groundwater quality within the SGB. The RWQCB will continue to require a monitoring and response program for continued operation of the project and to protect groundwater quality in the Santa Margarita Sandstone. Expansion of the ASR project would require the approval from the RWQCB for implementation, which would require a similar level of water quality testing and monitoring to ensure that the injected water would not degrade the receiving groundwater in the SGB.

In accordance with the significance criteria, this impact would be significant if the addition of treated desalinated water into the current ASR system resulted in degradation of the existing groundwater quality. **Table 4.4-15** compares the water chemistry of the treated Carmel River water to the water chemistry of desalinated water currently produced by the Sand City desalination plant. The Sand City desalination plant uses the same technology that would be used by the proposed desalination plant, so the resulting water chemistry would be similar. As shown in **Table 4.4-15**, the water chemistry of the treated Carmel River water is similar to the Sand City desalination plant product water. Therefore, it would be reasonable to expect that the Santa Margarita Sandstone would have the same reaction to the injection of the treated desalination plant water as to the treated Carmel River water. This is a less than significant impact.

TABLE 4.4-15
WATER CHEMISTRY OF TREATED CARMEL RIVER WATER AND SAND CITY DESALINATED WATER

Chemical Parameter	Treated Carmel River Water	Treated Sand City Desalinated Water
Alkalinity as $CaCO_3$	129	55 - 125
Aluminum	0.025	nd (0.010)
Ammonia Nitrogen	0.1	Na
Arsenic	nd (0.005)	nd (0.001)
Antimony	Na	nd (0.0004)
Barium	0.056	0.014
Boron	Na	0.5 – 0.877
Bromide	0.11	Na
Beryllium	Na	nd (0.0003)
Cadmium	Na	nd (0.001)
Calcium	36	18 – 45
Chloride	32	72
Dissolved Organic Carbon	1.4	Na
Chromium	Na	nd (0.007)
Cobalt	Na	Na
Dissolved Oxygen	7.43	9.77
Electrical Conductivity	510	315 – 690
Fluoride	0.30	0.10
Iron	0.001	nd (0.06)
Lead	Na	nd (0.001)
Magnesium	14	nd (1) – 8
Manganese	0.001	nd (0.010)
Mercury	Na	nd (0.0002)
Molybdenum	Na	0.003
Nickel	Na	0.001
Nitrate/Nitrite as NO_3	0.05	Na
Oxygen Reduction Potential (ORP)	749	128.8
Ortho-Phosphate	Na	nd (0.77)
Total Phosphorous	0.34	Na
Potassium	2.9	nd (5)
pH	7.70	7.51
Selenium	0.0017	nd (0.002)
Silicon	8.41	nd (10) – 12
Silver	Na	nd (0.010)
Sodium	42	51.9
Strontium	0.200	0.131
Sulfate as SO_4	84.9	19.2
Thallium	Na	nd (0.0003)
Uranium	0.0025	Na
Vanadium	Na	nd (0.050)
Zinc	0.210	nd (0.050)

NOTES: All concentrations in milligrams per liter (mg/L) except conductivity (micromhos per centimeter), ORP (millivolts), and pH (pH units)

na = not analyzed
nd = not detected above reporting limit in parentheses

SOURCE: EcoEngineers, 2008; Sand City Desalination Plant, 2011, 2014.

Maintenance of the ASR Wells. ASR injection/extraction wells sites are susceptible to well plugging because all water sources have at least some level of suspended solids that can include particulates, bionutrients, or oxidants (Pueblo Water Resources, 2014). During injection, a trace amount of suspended solids is collected in the gravel pack of the well, the aquifer material surrounding the gravel pack of the well, and in the silt trap of the well pipe.[26] Over time, the accumulated silt will clog the pore spaces of the well gravel pack and native aquifer materials, restricting the flow of aquifer water into the well and reducing well efficiencies. As a part of the routine operation of the ASR injection/extraction wells, each well must be periodically cleaned to maintain well efficiency. The process of periodically cleaning the wells involves backflushing the wells and pumping out the turbid water. The inappropriate discharge of this turbid, sediment-laden, backflush water could adversely affect groundwater resources.

The well maintenance activities of the existing ASR injection/extraction wells have indicated that a weekly frequency of backflushing keeps the aquifer pore spaces clear of sediment and maintains well efficiencies (Pueblo Water Resources, 2014). The backflushing process consists of the following steps:

- Removing the well pump assembly
- Mechanically brushing the wells screens to dislodge sediment
- Bailing out the sediment-laden water
- Airlifting and swabbing the well pipe
- Chemically treating the well screen with glycolic acid and hydrochloric acid to remove and inhibit scale growth in the well screens
- Airlifting and swabbing the well pipe
- Chlorination of the well overnight, followed by airlifting to remove the chlorine solution the next day

Reports indicate that the initial discharge of backwash is a deep orange-brown turbid water, becoming cloudy after about 5 minutes, and clear within about 15 to 20 minutes for each screen interval being cleaned (Pueblo Water Resources, 2014). The effectiveness of the backflushing is checked by 10 minute specific capacity tests to verify the return of the well efficiency.

The discharge water would be pumped through subsurface piping to either the existing backwash percolation basin located along the west side of General Jim Moore Boulevard between the existing Wells ASR-3 and ASR-4 or to a new backwash percolation basin to be constructed just east of general Jim Moore Boulevard across from the intersection with San Pablo Avenue (**Figure 3-7**). The new backwash basin would be 4,800-square-feet and 12 feet deep. The basin would be unlined to allow the discharge water to infiltrate into the subsurface soils, eventually migrating down back into the aquifer and leaving the sediment in the basin. The sediment would be periodically removed and disposed at an appropriate disposal site. The depth to groundwater beneath the backwash basin is about 350 or more feet bgs (Pueblo Water Resources, 2013). It is

[26] The silt trap of the well is a blank (no well screen openings) section of well pipe below the well screen that provides a place for sediment to accumulate without clogging the well screen.

reasonable to expect that a 350 foot deep water column of sediments would be adequate to successfully remove the sediment and polish the water before the water infiltrates back into the aquifer.

As a part of the project design, the periodic backflushing of ASR-5 and ASR-6 Wells would use the same process used for the existing ASR injection/extraction wells. Pipelines would be constructed to connect ASR-5 and ASR-6 Wells into the existing pipeline system that includes the pipeline that discharges to the existing backwash percolation basin. Routing the discharge water to the existing backwash percolation basin and infiltrating it through soil would remove the sediments. Considering this process would be conducted when needed, water quality impacts associated with discharge water would be less than significant impact.

MPWSP Desalination Plant and All Pipelines and Conveyance Facilities

No other project facilities would inject or extract water. Therefore, these project facilities would cause no impact related to groundwater quality or interference with existing groundwater remediation activities.

Impact Conclusion

The proposed project would result in a less than significant impact related to interference with existing groundwater remediation activities, with the possible exception of the OU1 TCE A-Aquifer Plume and two of the OUCTP plumes at the former Fort Ord. The impact would be reduced to less than significant with the implementation of **Mitigation Measure 4.4-4**, described below.

Mitigation Measure

Mitigation Measure 4.4-4 applies only to the Seawater Intake System.

Mitigation Measure 4.4-4: (Groundwater Monitoring and Avoidance of Impacts to Groundwater Remediation Plumes).

Immediately following project approval, the project applicant shall incorporate the future quarterly groundwater elevation monitoring results for the OU1 TCE A-Aquifer Plume and the two OUCTP plumes into the well monitoring program described above in **Applicant Proposed Mitigation Measure 4.4-3** until the OU1 TCE A-Aquifer Plume and the two OUCTP plumes have been appropriately remediated and the RWQCB no longer requires remediation activities. Groundwater elevation data shall be obtained from the periodic monitoring reports developed by the Army and its contractors. The elements of the additions to the groundwater monitoring program required under this mitigation measure are described below.

- Using the most recent monitoring reports available through the U.S. Army and its contractors, the groundwater elevations in the A-Aquifer and the Upper 180-Foot Aquifer for wells at and downgradient of the westernmost edge of the OU1 TCE A-Aquifer Plume and the two OUCTP plumes shall be incorporated into the well monitoring program described above for **Applicant Proposed Mitigation Measure 4.4-3**.

- The results shall be evaluated on a quarterly basis to assess whether the radius of influence from the proposed seawater intake system has reached the edge of the OU1 TCE A-Aquifer Plume and the two OUCTP plumes. A determination shall be made regarding the possibility that the Project pumping could affect the extent of the plumes. In the event that the analysis concludes that the proposed slant wells may affect the extent of the OU1 TCE A-Aquifer Plume and the two OUCTP plumes, then the project applicant shall contact and work with the U.S. Army to address the potential impact by reimbursing the Army for the additional costs to expand the existing treatment systems to include remediating areas where the slant wells have migrated the contamination to previously remediated areas. CalAm shall consider using existing groundwater remediation and monitoring wells that remain on the site to expand the existing treatment systems.

- When the ongoing remediation of the OU1 TCE A-Aquifer Plume and the two OUCTP plumes has been completed and the RWQCB authorizes closure of the OU1 TCE A-Aquifer Plume and the two OUCTP plumes activities, then this mitigation measure shall no longer apply.

Mitigation Measure 4.4-4 would monitor changes in the groundwater surface elevations caused by the proposed pumping at the slant wells near the OU1 TCE A-Aquifer Plume and the two OUCTP Plumes. If it is determined that proposed project pumping is interfering with and possibly expanding the area contaminated by the Fort Ord plumes, this mitigation measure would ensure that plumes do not expand and would reduce the impacts to less than significant.

All other Project Components

The operation of the MPWSP Desalination Plant, monitoring wells, Terminal Reservoir, pipelines, and pump stations would not involve the use of or discharges to groundwater. Therefore, there would be no impact relative to groundwater quality.

Impact Conclusion Groundwater Quality

For the slant wells, the seawater/freshwater interface would migrate back toward the ocean, which would be considered a less than significant impact. For the slant wells, the potential impact of interference with existing remediation systems would be reduced to less than significant with the implementation of **Applicant Proposed Mitigation Measure 4.4-3** and **Mitigation Measure 4.4-4**. For the ASR injection/extraction wells, the net addition of water would be considered a less than significant impact. For the ASR injection/extraction wells, the potential impact of interference with existing remediation systems would be less than significant. The operation of all other project facilities would have no impact to groundwater quality.

Therefore, for the proposed project as a whole, the potential operations impacts would be less than significant with mitigation, relative to groundwater quality.

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