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# Salinas Valley Groundwater Basin Monterey Subbasin Groundwater Sustainability Plan

## Executive Summary

MARINA COAST WATER DISTRICT

Salinas Valley Basin Groundwater Sustainability Agency

Prepared by:

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MONTGOMERY & ASSOCIATES

# Acknowledgement

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# EXECUTIVE SUMMARY

## ES.1 Introduction

On September 16, 2014, the California legislature enacted the Sustainable Groundwater Management Act (SGMA) whose primary purpose is to achieve and/or maintain sustainability within the state's high and medium priority groundwater basins. Key tenets of SGMA are the concept of local control, use of best available data and science, and active engagement and consideration of all beneficial uses and users of groundwater. As such, SGMA empowers certain local agencies to form Groundwater Sustainability Agencies (GSAs) whose purpose is to manage basins sustainably through the development and implementation of Groundwater Sustainability Plans (GSPs). Under SGMA, GSPs are required to contain certain elements, the most significant of which include: a Sustainability Goal; a description of the area covered by the GSP ("Plan Area"); a description of the Basin Setting, including the hydrogeologic conceptual model, historical and current groundwater conditions, and a water budget; locally-defined sustainability criteria; networks and protocols for monitoring sustainability indicators; and a description of projects and/or management actions that will be implemented to achieve or maintain sustainability. SGMA also requires a significant element of stakeholder outreach to ensure that beneficial uses and users of groundwater are given the opportunity to provide input into the GSP development and implementation process.

This GSP covers the entire Monterey Subbasin (Department of Water Resources [DWR] Basin 3-004.10), which encompasses 30,850 acres (or 48.2 square miles) in the northwestern Salinas Valley Groundwater Basin in the Central Coast region of California (Figure ES-1). The Monterey Subbasin (Subbasin) has been designated by the California Department of Water Resources (DWR) as medium priority. As such, the Subbasin is required to develop a GSP by January 2022 and achieve sustainability by 2042. The GSP has been co-developed by the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) pursuant to a Framework Agreement. The Framework Agreement outlines the Management Areas to be established within the Subbasin, which are later formalized in this GSP. The Framework Agreement further establishes a basis for information developed by the two agencies to be integrated into a single GSP for the Monterey Subbasin.

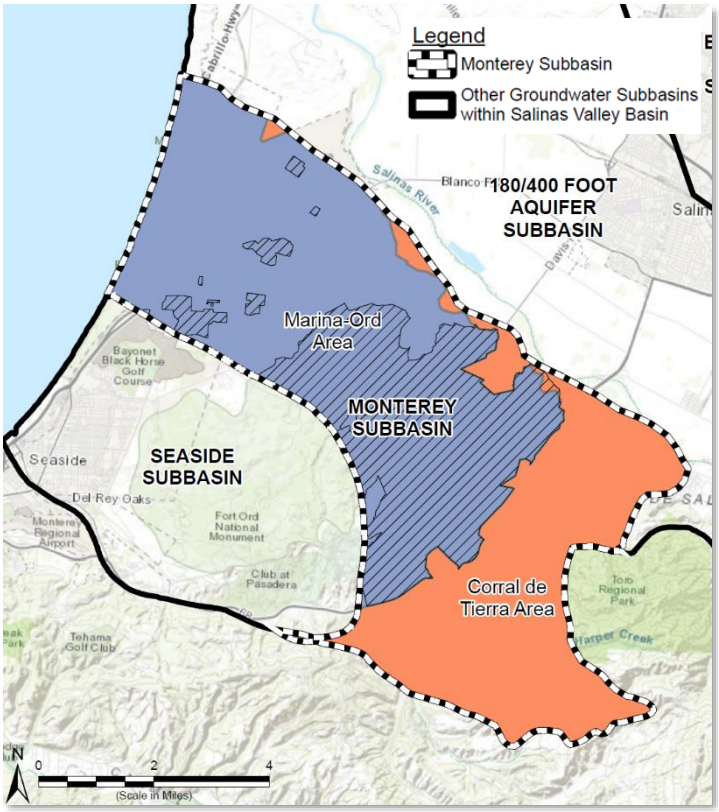


**Figure ES-1. Monterey Subbasin**

## ES.2 Communications and Stakeholder Engagement

The Subbasin GSAs (MCWD GSA and SVBGSA) developed a Framework Agreement regarding GSP development. Pursuant to this agreement, the GSAs have established two Management Areas within the Subbasin. These Management Areas include the Marina-Ord Management Area (Marina-Ord Area) and the Corral de Tierra Management Area (Corral de Tierra Area) (Figure ES-2). The Marina-Ord Area consists of the lands within the City of Marina, City of Seaside, and the former Fort Ord. The Corral de Tierra Area consists of the remainder of the Subbasin, which includes lands generally located south of State Route 68 and a few parcels along the northern subbasin boundary with the 180/400-Foot Aquifer Subbasin.

MCWD GSA has prepared GSP components for the Marina-Ord Area and the SVBGSA has prepared GSP components for the Corral de Tierra Area. Both GSAs have worked collaboratively to develop and implement stakeholder engagement plans for the GSP. Each GSA has also guided stakeholder engagements efforts within their respective Management Areas.

As part of intra-basin coordination, regular Technical Subcommittee meetings have been held by the GSAs and Steering Committee meetings were scheduled and held on an as needed basis. In addition, stakeholders and beneficial users within each management area have been provided a variety of opportunities for public engagement including: GSA Board meetings, Stakeholder

Workshops, One-on-one meetings with selected stakeholders, and Website communications. SVBGSA also established a SVBGSA Monterey Subbasin Planning Committee that met 13 times to develop and provide feedback on draft GSP chapters. The Monterey Subbasin GSA websites (https://www.mcwd.org/governance_meetings.html and https://svbgsa.org) also contain materials presented at meetings as well as a schedule for upcoming meetings and other workshops open to the public.

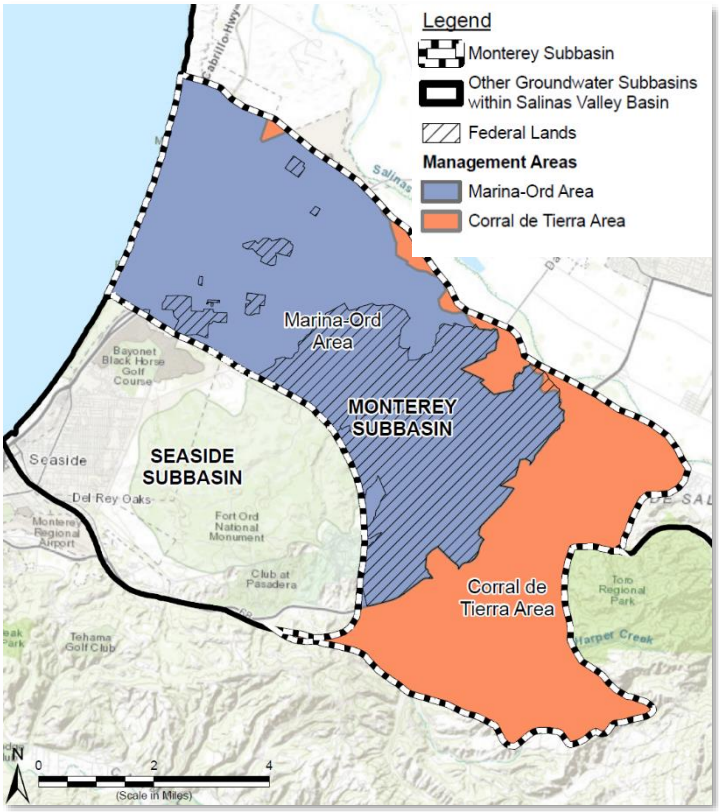


**Figure ES-2. Management Areas**

## ES.3 Plan Area

The Monterey Subbasin is a medium-priority groundwater subbasin in the northwestern Salinas Valley Groundwater Basin in the Central Coast region of California. The Subbasin is covered by the MCWD GSA and SVBGSA and lies entirely within Monterey County. The Subbasin is bounded on the northeast by the 180/400-Foot Aquifer Subbasin (DWR Basin 3-004.01) and on the southwest by the Seaside Subbasin (DWR Basin 3-004.08). The GSAs have established two management areas within the Subbasin, which are the Marina-Ord Area and the Corral de Tierra Area.

The majority of the Subbasin is undeveloped land. Urban uses, including the municipalities of Marina and Seaside, make up primary water users in the Subbasin. Small areas of agriculture, approximately 500 acres of truck nursery and berry crops, are located along the northern subbasin boundary adjoining the 180/400-Foot Aquifer Subbasin. Urban and agricultural water users in the Subbasin rely entirely on groundwater.

A significant number of groundwater monitoring programs exist in the Subbasin and data from these programs have been used to develop the GSP and will continue to be utilized as a part of GSP implementation. The programs and entities that conduct them include:

- California Statewide Groundwater Elevation Monitoring (CASGEM) Program;
- United States Geological Survey (USGS);
- Groundwater Ambient Monitoring and Assessment (GAMA) Program;
- State Water Resource Control Board's (SWRCB's) Division of Drinking Water;
- MCWD, Monterey County Water Resources Agency (MCWRA), and Monterey Peninsula Water Management District (MPWMD);
- Central Coast Regional Water Quality Control Board (CCRWQCB); and
- United States Army Corps of Engineers.

## ES.4 Hydrogeologic Conceptual Model

The Monterey Subbasin is located at the northwestern end of the Salinas Valley Groundwater Basin, an approximately 90-mile-long alluvial basin underlying the elongated, intermountain valley of the Salinas River. The Subbasin includes the portions of the Monterey Bay coastal plain, south of the approximate location of the Reliz Fault, as well as upland areas to the southeast of the coastal plain. Topography generally slopes down to the northwest towards Monterey Bay, ranging from sea level at the shoreline to 1,900 ft msl in the southeastern corner of the Subbasin. Soils within the Subbasin are predominantly of Hydrologic Soil Group A in the coastal plain area, indicating high infiltration rates and low runoff potential. In the Fort Ord hills area, soils predominately belong to Hydrologic Soil Groups C and D, with below average and low infiltration rates, respectively, and moderately high and high runoff potential, respectively. A mix of Hydrologic Soil Groups A through D exists in the Corral de Tierra Area east of El Toro Creek.

The Monterey Subbasin is hydrostratigraphically complex and represents a transition zone between the more defined, laterally continuous aquifer system along the central axis of the Salinas Valley and the less continuous aquifer systems towards the Sierra de Salinas. The water-bearing strata within the Subbasin include river and sand dune deposits of Holocene and Pleistocene age, the Aromas Sand and Paso Robles Formation of Plio-Pleistocene age, the Purisima Formation of Pliocene age, and the Santa Margarita Formation of Miocene age (Greene, 1970; Harding ESE, 2001; Geosyntec, 2007). The Monterey Formation of Miocene age, or the

bottom of the Subbasin, represents the relatively non-water-bearing bedrock that underlies the Subbasin.

Hydrostratigraphy in the Marina-Ord Area consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley. The principal aquifers within the Marina-Ord Area include the unconfined Dune Sand Aquifer and the confined aquifers known as the 180-Foot Aquifer, the 400-Foot Aquifer, and the Deep Aquifers. Hydraulic conductivity of the aquifers underlying the Marina-Ord Area varies by aquifer and location. Groundwater production generally occurs from the 180/ 400-Foot Aquifers and the Deep Aquifers.

Natural groundwater recharge occurs through infiltration of surface water, deep percolation of excess applied irrigation water, and deep percolation of infiltrating precipitation. Most of the Marina-Ord Area has good recharge potential due to the high permeability of the Dune Sand Aquifer which subsequently recharges the underlying 180-Foot and 400-Foot Aquifers.

Within the southern Corral de Tierra Area, the aquifers have historically been described by their geologic names, such as the Aromas Sand, Paso Robles Formation, and Santa Margarita Sandstone (Geosyntec, 2007; Yates 2005). Based on best available information as well as many wells that span multiple formations, these geologic formations are grouped together to form the El Toro Primary Aquifer System for the Corral de Tierra Area. Natural groundwater recharge occurs through infiltration of surface water if and where it occurs, and deep percolation of infiltrating precipitation. Most of the Corral de Tierra Area has good recharge potential due to the high permeability of soils which subsequently recharges the underlying sandy, gravelly layers of the Aromas Sand and Paso Robles Formation.

The primary surface water bodies in the Subbasin are the Salinas River, and Toro Creek, which is generally perennial below the confluence with Watson Creek (Feikert, 2001). Recorded streamflows at USGS gage 11152540 from 1961 to 2001 indicate a mean annual streamflow of 1,590 AFY for Toro Creek, however not all years registered flow (GeoSyntec, 2007). The Salinas River crosses into the Subbasin in two locations in the Corral de Tierra Area and may provide some recharge in areas that do not have the Salinas Valley Aquitard that generally defines the 180/400-Foot Aquifer Subbasin.

## ES.5 Current and Historical Groundwater Conditions

Groundwater conditions in the Subbasin are described for each of DWR's six sustainability indicators identified below.

- Chronic Lowering of Groundwater Levels – Groundwater elevations have generally been stable for over three decades in the Dune Sand Aquifer, the upper and lower 180-Foot Aquifer, and the 400-Foot Aquifer within the northern Marina-Ord Area. Since the mid-2000s, groundwater levels have been declining in 400-Foot Aquifer wells located in the southwestern portion of the Marina-Ord Area and in Deep Aquifer wells. Decreases in groundwater elevations in the Deep Aquifers are the result of increased production from

the Deep Aquifers in the Salinas Valley Groundwater Basin. Groundwater level declines observed in the Deep Aquifers range from about 20 ft to 50 ft over the last two decades. Groundwater level declines have also been observed historically within the El Toro Primary Aquifer System in the Corral de Tierra Area. Groundwater level declines in the El Toro Primary Aquifer System range from about 20 ft to 80 ft over the last two decades.

- Changes in Groundwater Storage – Modeling results indicate an average annual loss of storage of 4,434 acre-feet per year (AFY) over the historical period (Water Year [WY] 2004-2018) in the Monterey Subbasin. This loss in storage is due to declining groundwater levels. There has been a minimal loss in storage due to seawater intrusion during the historical period as there has been negligible expansion of the seawater intrusion front. Seawater that enters the Monterey Subbasin from the ocean flows toward the 180/400-Foot Aquifer Subbasin boundary, where groundwater levels are lower in the seawater intruded aquifers.
- Seawater Intrusion – Seawater intrusion has been documented in the northern portion of the Monterey Subbasin in the lower 180-Foot and 400-Foot Aquifers. MCWRA and others have implemented a series of engineering projects and management actions to address seawater intrusion within the Salinas Valley Groundwater Basin. These projects and actions include the development of the Castroville Seawater Intrusion Project (CSIP), the Salinas Valley Water Project (SVWP), and well construction moratoriums, among other actions. Although these actions have managed to slow the advancement of the seawater intrusion front and reduce its impacts, seawater intrusion remains an ongoing threat. To date, seawater intrusion has not been reported in the Deep Aquifers.
- Groundwater Quality – Known groundwater quality concerns in the Marina-Ord Area include elevated chloride and TDS concentrations and legacy point-source contamination from former Fort Ord. Such point source contamination is being addressed by the United States Army Corps of Engineers (Army) and includes contaminants such as Volatile Organic Compounds (VOCs) and per- and poly-fluoroalkyl substances (PFAS). The primary source of high TDS and chloride concentrations in groundwater within the Marina-Ord Area is seawater intrusion. In the Corral de Tierra Area, the most prevalent water quality concern is naturally occurring arsenic.
- Subsidence – No measurable subsidence has been recorded anywhere in the Monterey Subbasin.
- Depletion of Interconnected Surface Waters – Surface water streams within the Subbasin are generally small intermittent streams that flow only after storm events, and are unlikely to be connected to groundwater, except for the lower reaches of El Toro Creek and two potential locations along the Salinas River near the Monterey-180/400-Foot Aquifer Subbasin boundary where the Salinas River intercepts the Subbasin in a small portion of the Corral de Tierra Area.

## ES.6 Water Budget Information

Water budgets provide an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the Subbasin. This GSP presents three water budgets – historical (Water Year [WY] 2004-2018), current (WY 2015-2018), and a 50-year projected (WY 2019-2068) water budget period. Water budgets for each timeframe are presented for the Subbasin as a whole. In addition, zone budgets are presented for each management area.

The water budget information is based on the numerical Monterey Subbasin Groundwater Flow Model (i.e., "Monterey Subbasin Model" or "MBGWFM"), which was developed for the Subbasin. The MBGWFM uses the USGS Newton formulation of the Modular Three-Dimensional Groundwater Modeling platform (MODFLOW-NWT) to solve the governing groundwater flow equations. Table ES-1 summarizes inflows to and outflows from the basin-wide groundwater system by water source type during the historical water budget period and current water budget period. Water budget components include recharge, well pumping, net inter-basin flow, and net river exchange.

### ES.6.1 Historical Water Budget Period

Although estimated groundwater recharge (10,055 AFY) exceeded pumping in the Monterey Subbasin (5,651 AFY) during the historical period, the net estimated annual change in groundwater storage in the Monterey Subbasin was -4,434 AFY. This value is negative indicating a loss of storage during the historical period. Inter-basin outflows accounted for the majority of the Subbasin's groundwater outflow over the historical period. Net inter-basin outflows (8,999 AFY) well exceeded groundwater pumping and were close to the total estimated recharge in the Subbasin. These estimated outflows are reflective of the large inland gradients that exist between the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin. Groundwater levels in the 180/400-Foot Aquifer Subbasin are more than 40 feet below sea level in the 180- and 400-Foot Aquifers and have recently declined to over 100 feet below sea level in the Deep Aquifers. These results demonstrate the relationship and interdependence between inter-basin inflows, outflows, and the Subbasin water budget and the need for coordinated sustainable groundwater management in all of these subbasins.

The loss in storage is reflected in the groundwater level declines that have been observed in the 400-Foot Aquifer and Deep Aquifers within the Marina-Ord Area and within the El Toro Primary Aquifer in the Corral de Tierra Area. The negative net annual change in storage indicates that the Monterey Subbasin was in overdraft during the historical period.

### ES.6.2 Current Water Budget Period

The current basin-wide water budget is based upon water years 2015 through 2018 and is also presented in Table ES-1. The current water budget includes the same water budget components as the historical water budget but characterizes basin conditions over a much shorter period of time during which recharge was much higher than during the historical period. As such, the net

annual change in groundwater storage (-1,609 AFY) was much smaller during the current period. However, this value is likely not representative of long-term conditions as it is not reflective of the long-term hydrologic cycle.

**Table ES-1. Historical and Current Groundwater Water Budget Results, Monterey Subbasin**

| Net Annual Groundwater Flows (AFY) (a) | Historical Annual Inflows/Outflows WY 2004 - 2018 | Current Annual Inflows/Outflows WY 2015 - 2018 |
|---|---|---|
| **Recharge** | | |
| ● Rainfall, leakage, irrigation | **10,055** | **12,060** |
| **Well Pumping** | | |
| ● Well Pumping | **-5,641** | **-5,274** |
| **Net Inter-Basin Flow (Presumed Freshwater) (b)** | | |
| ● Seaside Subbasin | 918 | 1,334 |
| ● 180/400-Foot Aquifer Subbasin | -9,393 | -9,307 |
| ● Ocean | -524 | -574 |
| | **-8,999** | **-8,547** |
| **Net Inter-Basin Flow (Presumed Seawater) (b)** | | |
| ● 180/400-Foot Aquifer Subbasin | -2,872 | -3,258 |
| ● Ocean | 2,872 | 3,258 |
| | **0** | **0** |
| **Net Surface Water Exchange** | | |
| ● Salinas River Exchange | **151** | **153** |
| **NET ANNUAL CHANGE IN GROUNDWATER STORAGE** | **-4,434** | **-1,609** |

**Notes:**

(a) Positive values indicate a net inflow and negative values indicate a net outflow.
(b) All seawater inflows from the ocean are presumed to leave the Monterey Subbasin across the 180/400-Foot Aquifer Subbasin boundary, as evidenced by negligible expansion of the seawater intrusion front in the Monterey Subbasin over the historical time period.

## ES.6.3 Projected Water Budget Period

Projected water budgets provide estimates of future conditions of water supply and demand within a basin, as well as the aquifer response to implementation of the Plan over the planning and implementation horizon. The projected water budget uses the same tools and methodologies that were used for the historical and current water budget, with updated inputs for climate variables (i.e., precipitation and ET), land use (water demand), and future subbasin boundary conditions. Given that historical water budget results indicate that conditions in the Monterey Subbasin are highly sensitive to conditions in adjacent subbasins, projected water budget results are presented for three alternative sets of boundary conditions in the 180/400-Foot Aquifer Subbasin. These boundary conditions include:

- Minimum Threshold (MT) Boundary Conditions: where groundwater levels along the Monterey Subbasin and 180/400-Foot Aquifer Subbasin boundary are raised to water level MTs established in the 180/400-Foot Aquifer Subbasin GSP.
- Measurable Objective (MO) Boundary Conditions: where groundwater levels along the Monterey and 180/400-Foot Aquifer Subbasin boundary are raised to water level MOs established in the 180/400-Foot Aquifer Subbasin GSP.

- Seawater Intrusion (SWI) Protective Boundary Conditions: Where groundwater levels along the Monterey Subbasin and 180/400-Foot Aquifer Subbasin boundary are set to levels protective against further seawater intrusion within the 180- and 400- Foot aquifers. In the absence of the installation of a hydraulic injection and/or extraction barrier, these SWI protective elevations represent the minimum groundwater elevations that would be needed in the coastal portions of the 180/400-Foot Aquifer Subbasin to stop further seawater intrusion consistent with the MTs for seawater intrusion established in the 180/400-Foot Aquifer Subbasin GSP.

Each of these boundary condition scenarios is predicated on the assumption that the 180/400-Foot Aquifer Subbasin will be managed to its SMCs over the 50-year projected model period. In addition, boundary conditions for the Seaside Subbasin, which is an adjudicated subbasin, are assumed to remain stable at Fall 2017 levels[1].

The chief purpose of this projected water budget analysis is to assess the magnitude of the net water supply deficit that would need to be addressed through Projects and Management Actions to prevent Undesirable Results and achieve the Sustainability Goal.

Projected water budget results are also presented for three alternative sets of hydrology and climate conditions including:

- Baseline (Historical Analog) Conditions: a 50-year analog period developed using a sequence of historical hydrologic input information that reflects the Subbasin's long-term average hydrologic conditions
- 2030 ("Near future") Climate Conditions: A water budget scenario based on 2030 climate change factors published by DWR.
- 2070 ("Late future") Climate Conditions: A water budget scenario based on 2070 "central tendency" climate change factors published by DWR.

Table ES-2 shows the water budget results under a "no project" scenario, which assumes all future projected water demands in the Monterey Subbasin will be met with groundwater. This table provides water budget results under the identified variable boundary conditions and 2030 climate conditions. As shown in Table ES-2, the net annual change in groundwater storage is expected to be minimum.

[1] Or at the established MTs (i.e., based on 2015 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period. See discussion in Section 6.5.2.

**Table ES-2. Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Boundary Conditions and 2030 Climate Condition, Monterey Subbasin**

| Net Annual Groundwater Flows (a) (AFY) | Historical Annual Inflows/Outflows (WY 2004-2018) | Projected Annual Inflows/Outflows 2030 Climate Conditions | | |
|---|---|---|---|---|
| | | Minimum Threshold Boundary Conditions | Measurable Objective Boundary Conditions | Seawater Intrusion Protective Boundary Conditions |
| **Recharge** | | | | |
| ● Rainfall, leakage, irrigation | **10,055** | **10,928** | **10,928** | **10,928** |
| **Well Pumping** | | | | |
| ● Well Pumping | **-5,641** | **-10,955** | **-10,955** | **-10,955** |
| **Net Inter-Basin Flow** | | | | |
| ● Seaside Subbasin | 918 | 2,414 | 1,258 | -453 |
| ● 180/400-Foot Aquifer Subbasin | -12,265 | -5,583 | -3,412 | -295 |
| ● Ocean (Presumed Freshwater) | -524 | -725 | -752 | -794 |
| ● Ocean (Presumed Seawater) | 2,872 | 2,939 | 2,369 | 1,308 |
| | **-8,999** | **-955** | **-537** | **-234** |
| **Net Surface Water Exchange** | | | | |
| ● Salinas River Exchange | **151** | **261** | **254** | **279** |
| **NET ANNUAL CHANGE IN GROUNDWATER STORAGE** | **-4,434** | **-721** | **-310** | **18** |

**Notes:**

(a) Positive values indicate a net inflow and negative values indicate a net outflow.

As shown in this table, the projected net annual change in groundwater storage ranges between -721 and 18 AFY for the "No Project" scenario. The net annual change in groundwater storage is significantly lower than that calculated for the historical period (-4,434 AFY) and indicates that Monterey Subbasin inflows and outflows would be close to balanced under any of these boundary condition scenarios. A review of climate scenario results indicates that this conclusion is true under all identified climate change scenarios, as rainfall and recharge are projected to increase under future climate scenarios within the Subbasin. As such, these projected water budget results indicate that overdraft conditions within the Monterey Subbasin will be substantially mitigated if adjacent basins are managed sustainably and SMCs are achieved.

Projected water level elevations for the "No Project" scenario were also compared to water level MTs and MOs established in the Marina-Ord Area WBZ and Corral de Tierra Area WBZ, to determine if projects and management actions need to be implemented to meet SMCs in these Management Areas. Figure ES and Figure ES depict average projected changes in groundwater elevations at RMS wells in the Marina-Ord Area and Corral De Tierra WBZ under the "No Project"

scenario with variable boundary conditions. These figures also identify the average change in water levels required to reach MTs and MOs at RMS wells in each management area.[2]

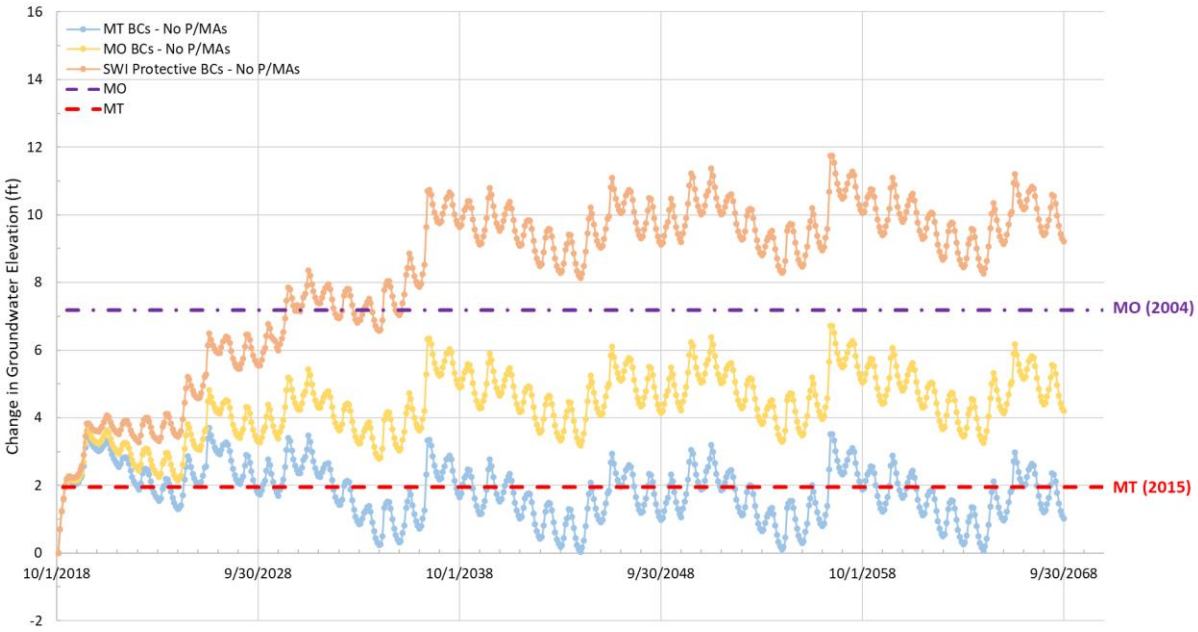


**Figure ES-3. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Boundary Conditions and 2030 Climate Condition, Marina-Ord Area WBZ**

[2] This figure shows average projected groundwater elevation changes in the 35 RMS wells in the Marina-Ord Area with respect to those modeled at the end of the historical period (i.e., 2018). The MT and MO elevations shown on this graph reflects their average elevations with respect to 2018 water levels at the RMS wells. For example, MTs, which are set based on 2015 water levels, are on average 2 feet higher than 2018 water levels in these RMS wells.

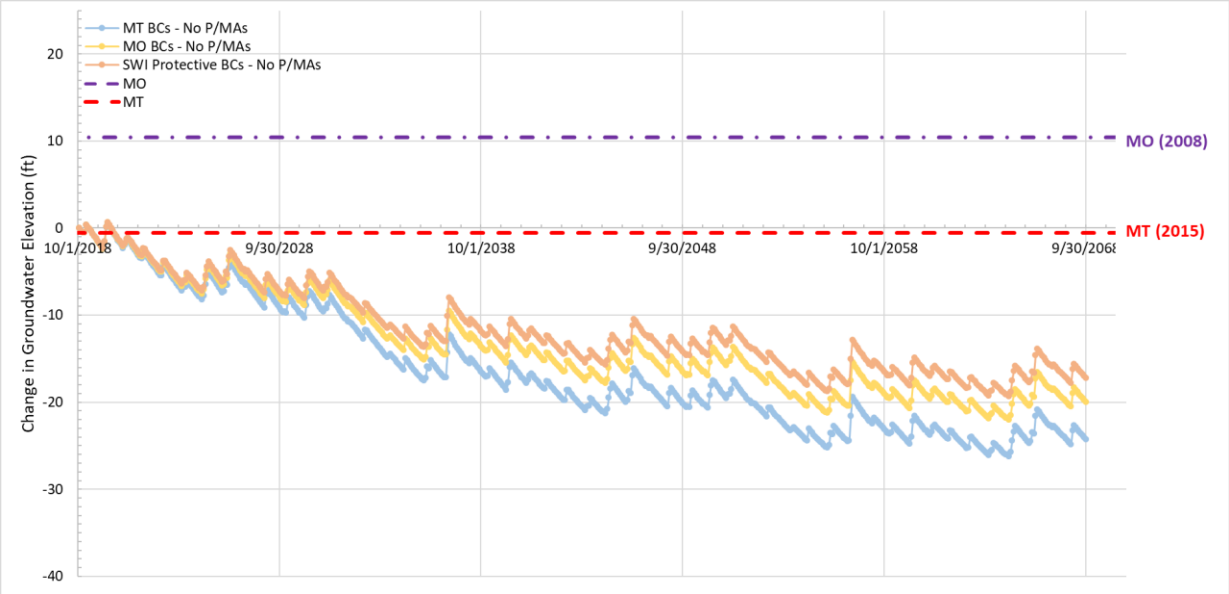


**Figure ES-4. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Boundary Conditions and 2030 Climate Condition, Corral de Tierra Area WBZ**

As shown on Figure ES, groundwater elevations in the Marina-Ord Area WBZ are projected to stabilize under all boundary conditions scenarios within the first ten years of GSP implementation. However, the resulting average groundwater elevation varies significantly between the various boundary scenarios. These results indicate that projects and/or management actions may be required to consistently maintain water levels above MTs and to achieve MOs within the Marina-Ord Area unless SWI protective boundary conditions are achieved in the adjacent subbasins.

As shown on Figure ES, groundwater elevations in the Corral de Tierra Area WBZ are projected to stabilize in the last ten years of the 50-year analog period. However, they stabilize at levels that are on average 17 to 25 feet lower than groundwater elevation MTs and 28 to 36 feet lower than groundwater elevations MOs even if SMCs are achieved in adjacent subbasins under these boundary condition scenarios. These results suggest that projects and/or management actions will be required to raise water levels above MTs and to achieve MOs within the Corral de Tierra Area WBZ.

### ES.6.4 Sustainble Yield

SGMA defines sustainable yield as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the Subbasin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result" (CWC §10721(w)). Determination of the sustainable yield for the Subbasin is supported by water budget information and, more importantly, depends upon whether undesirable results are

avoided within the timeframes required by SGMA. As discussed above, the attainment of MTs and MOs, which are established to avoid undesirable results and achieve basin sustainability, should be considered in the estimation of sustainable yield under SGMA.

The sustainable yield of the Monterey Subbasin is significantly affected by recharge, pumping, and conditions in adjacent subbasins. As such, the sustainable yield established based on historical overdraft has significant uncertainty, does not address all undesirable results. It also does not consider future conditions in adjacent subbasins which are projected to change as these subbasins move toward sustainability. A first-order estimate of the historic sustainable yield based on overdraft is provided Section 6.5. The historical and current sustainable yield estimates are for information only and do not guide groundwater management activities in this GSP.

Projected water budget results have been used to estimate the projected sustainable yield. The sustainable yield has been evaluated by Management Area (i.e., water budget zone) as conditions vary and independent SMCs have been established for each area.

Projected water budget results under the "no project" scenario support the conclusion that 9,870 AFY can be pumped from the Marina-Ord Area WBZ without long-term loss in storage. These calculations provide only first-order estimates of the magnitude of the Marina-Ord Area WBZ sustainable yield. Comparison of projected groundwater levels within the Marina-Ord Area WBZ under the "no project" and "project" scenarios presented in Section 9.6 with established groundwater level MTs and MOs provides significant insight regarding the projected sustainable yield as defined under SGMA. As discussed above, the attainment of MTs and MOs for all sustainability indicators, which are established to avoid undesirable results and achieve basin sustainability, should be considered in the estimation of sustainable yield under SGMA. As discussed in Sections 6.5.4, 9.6, and 9.6.1, projected groundwater level data indicate that:

- Under the "no project" scenario, groundwater levels in RMS wells stabilize and are generally higher than MTs during non-drought periods under all identified boundary conditions and climate scenarios, and reach MOs if SWI Protective Boundary Conditions are achieved in adjacent subbasins.

- Under the "Project" scenario, groundwater levels stabilize and are higher than MTs and reach MOs in RMS wells within the Marina-Ord Area WBZ, if MT and MO boundary conditions are achieved in adjacent subbasins, respectively.

These results indicate that the projected sustainable yield of the Marina-Ord Area WBZ ranges from approximately 4,400 AFY if adjacent subbasins are managed to their groundwater level MTs and adjudication goals as defined in their respective groundwater planning documents, to approximately 9,900 AFY if adjacent subbasins are managed to SWI protective groundwater levels[3]. As such, the actual sustainable yield of the Marina-Ord area will be impacted by the

[3] In the absence of the installation of a seawater intrusion extraction or injection barrier, SWI Protective Boundary Conditions will be required to achieve seawater intrusion MTs in the 180/400-Foot Aquifer Subbasin.

groundwater levels achieved and methods used to address seawater intrusion and reach SWI MTs within adjacent subbasins, e.g., groundwater recharge, seawater intrusion extraction or injection barrier, or a combination of methods. Therefore, a coordinated approach will be required to reach sustainability within the Monterey subbasin and adjacent subbasins. Further, although these projected budget results provide potential insight into the sustainable yield of the Marina-Ord Area, confirmation that these quantities could be extracted without inducing seawater intrusion has to be verified.

A first-order estimate of the projected sustainable yield of the Corral de Tierra Area WBZ is 2,100 AFY. This estimate of sustainable yield is the sustainable yield to hold groundwater levels where they are after the first 20 years of GSP implementation if there are no projects undertaken. Since groundwater levels are declining, this groundwater level would be significantly below current groundwater levels in the Corral de Tierra Area and below the groundwater level MTs. Therefore, this sustainable yield estimate of 2,100 AFY is likely an overestimate of the true sustainable yield where all undesirable results are avoided.

## ES.7 Monitoring Networks

The MCWD GSA and SVBGSA developed the Monterey Subbasin's SGMA Monitoring Network to: (1) collect sufficient data to assess sustainability indicators relevant to the Subbasin, (2) evaluate potential impacts to the beneficial uses and users of groundwater, and (3) assess the effectiveness of the P/MAs implemented by the GSAs. The proposed SGMA Monitoring Network was developed to ensure sufficient spatial distribution and spatial density. The monitoring networks for the six sustainability indicators are described below.

- Chronic Lowering of Groundwater Levels – The sustainability indicator for chronic lowering of groundwater levels is evaluated by monitoring groundwater elevations in designated monitoring wells. The groundwater elevation monitoring network in the Marina-Ord Area consists of over 390 wells, in which water levels are measured by U.S. Army, MCWRA, MPMWD, and/or the Seaside Groundwater Basin Watermaster. The groundwater elevation monitoring network in the Corral de Tierra Area consists of 13 wells, in which water levels are measured by MCWRA. Of these actively monitored wells, 35 have been selected as groundwater elevation representative monitoring site (RMS) wells in the Marina-Ord Area (2 to 6 wells per principal aquifer) and 13 have been selected as groundwater elevation RMS wells in the Corral de Tierra Area. In addition, the GSAs will incorporate groundwater level data from wells in adjacent subbasins and will continue to collaborate with agencies in adjacent subbasins. Areas where data gaps have been identified and additional monitoring is needed will be addressed by identifying an existing well or wells that meet valid monitoring well criteria, or drilling a new well or wells in these areas.
- Changes in Groundwater Storage – Data and minimum thresholds used to define undesirable results for chronic lowering of groundwater levels and seawater intrusion will also be used to assess reduction of groundwater storage. As such, the reduction of

groundwater storage monitoring network will consist of the same RMS wells as those used for groundwater elevation and seawater intrusion monitoring.

- Seawater Intrusion – The sustainability indicator for seawater intrusion is evaluated using the location of the 500 milligrams per liter (mg/L) chloride isoconcentration contour that is based on chloride concentrations, equivalent total dissolved solids (TDS) concentrations, and/or specific conductivity measurements. The seawater intrusion monitoring network consists of 42 RMS wells in the Marina-Ord area that are monitored by MCWD, U.S. Army, MCWRA, MPMWD, and/or the Seaside Groundwater Basin Watermaster. Areas where data gaps in this network have been identified overlap with areas where groundwater elevation monitoring data gaps exist and will be addressed concurrently.
- Groundwater Quality – The sustainability indicator for degraded water quality is evaluated by monitoring groundwater quality at a network of existing water supply wells. Separate minimum thresholds are set for the constituents of concern for public water system supply wells, on-farm domestic wells, and agricultural supply wells. Therefore, although there is a single groundwater quality monitoring network, different wells in the network are reviewed for different constituents. Constituents of concern for drinking water are assessed at public water supply wells and on-farm domestic wells, and constituents of concern for crop health are assessed at agricultural supply wells. There is adequate spatial coverage to access the groundwater quality in the Subbasin, and as new domestic and agricultural supply wells are added to Ag Order 4.0, they will be added to the monitoring program.
- Subsidence – DWR has, and will be, collecting land subsidence data using InSAR satellite data, and will make these data available to GSAs. This subsidence dataset represents the best available data for the Monterey Subbasin and will therefore be used as the subsidence monitoring network.
- Depletion of Interconnected Surface Waters – Shallow groundwater elevations near potential locations of interconnected surface water will be used as a proxy metric for this indicator. As such, the interconnected surface water monitoring network will be comprised of RMS sites adjacent to potential interconnected surface waters where minimum thresholds and measurable objectives based on shallow groundwater levels are developed for depletion of interconnected surface water. Given the stable groundwater patterns in the Dune Sand Aquifer, there is no significant and unreasonable depletion of interconnected surface water under current conditions in the Marina-Ord Area. One RMS well is included in the interconnected surface water monitoring network in this area. In the event that future groundwater activities in the Subbasin or the adjacent 180/400-Foot Aquifer Subbasin may influence the condition of the Marina vernal ponds and/or the Dune Sand Aquifer, the GSAs will work with project proponents to install additional shallow groundwater monitoring wells. In the Corral de Tierra Area, the level of surface water interconnection with the principal aquifer is unclear. An analysis of shallow groundwater levels is used to identify areas of potential interconnection between surface

water and groundwater. There are currently no known existing wells that could be included in the interconnected surface water monitoring network near the El Toro Creek or Salinas River. To fill this data gap, SVBGSA will work to install one shallow well near El Toro Creek into the interconnected surface water monitoring network and may work with the United States Geological Survey (USGS) to reactivate the stream gauge along Toro Creek. The conjunctive data collection will help correlate the potential seasonal flows with shallow groundwater and assess both the interconnectivity as well as the relationship with deeper wells in the area.

Data collected from the SGMA Monitoring Network will be uploaded to a Data Management System to be established and managed for the Monterey Subbasin and reported to the DWR in accordance with the Monitoring Protocols developed for the Subbasin.

## ES.8 Sustainable Management Criteria

Sustainable Management Criteria (SMCs) are the metrics by which groundwater sustainability is judged under SGMA. Key terms related to SMCs under SGMA include the following:

- **Sustainability indicator** refers to any of the effects caused by groundwater conditions occurring throughout the Subbasin that, when significant and unreasonable, cause undesirable results, as described in California Water Code §10721(x).

  *The six sustainability indicators relevant to this subbasin include chronic lowering of groundwater levels; reduction of groundwater storage; degraded water quality; land subsidence; seawater intrusion; and depletion of interconnected surface waters.*

- **Undesirable Results** occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the Subbasin.

  *The GSP Emergency Regulations requires that the description of undesirable results include (1) the cause of groundwater conditions that would lead to or has led to undesirable results; (2) a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the Subbasin (i.e., the undesirable result criteria); and (3) potential effects that may occur or are occurring from undesirable results. An example undesirable result criteria could be defined as: more than 10% of the measured groundwater elevations being lower than the minimum thresholds.*

- **Significant and Unreasonable Conditions**

  *Significant and unreasonable is not defined in the Regulations. However, the definition of undesirable results states, "Undesirable results occur when significant and unreasonable effects … are caused by groundwater conditions…". The SGMA BMP states that "the GSAs must consider and document the conditions at which each of the six sustainability indicators become significant and unreasonable, including reasons for justifying each*

*particular threshold selected." Therefore, this GSP adopts the phrase significant and unreasonable conditions to be the qualitative description of conditions used to justify selected minimum thresholds and undesirable results criteria.*

- **Measurable objectives** refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the Subbasin.

  *Measurable objectives are goals that the GSP is designed to achieve.*

- **Minimum threshold** refers to a numeric value for each sustainability indicator used to define undesirable results.

  *Minimum thresholds are quantitative indicators of an unreasonable condition.*

- **Interim milestone** refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

  *Interim milestones are targets such as groundwater elevations that will be achieved every five years to demonstrate progress towards sustainability.*

The SMCs detailed in Table ES-3 define the Subbasin's future conditions and commit the GSA to actions that will meet these objectives.

**Table ES-3. Sustainable Management Criteria Summary**

| Sustainability Indicator | Measurement | Minimum Threshold | Measurable Objective | Undesirable Result | Interim Milestones |
|---|---|---|---|---|---|
| **Chronic lowering of groundwater levels** | Measured through the groundwater elevation representative monitoring well network within each management area | **Marina-Ord Area:**<br>Minimum groundwater elevations historically observed between 1995 and 2015 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers. | **Marina-Ord Area:**<br>Groundwater elevations observed in 2004 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers. | Over the course of any one year, exceedance of more than 20% of groundwater level minimum thresholds in **either**<br>(a) both the Dune Sand and upper 180-Foot Aquifers, or<br>(b) both the lower 180-Foot and 400-Foot Aquifers, or<br>(c) the Deep Aquifers, or<br>(d) the El Toro Primary Aquifer System. | **Whole Subbasin:**<br>Interim milestones are described in Table 8-3 for each RMS well that is defined in Chapter 7. |
| | | **Corral de Tierra Area:**<br>Groundwater elevations observed in 2015 in the El Toro Primary Aquifer System. | **Corral de Tierra Area:**<br>Groundwater elevations observed in 2008 in the El Toro Primary Aquifer System. | | |

| Sustainability Indicator | Measurement | Minimum Threshold | Measurable Objective | Undesirable Result | Interim Milestones |
|---|---|---|---|---|---|
| **Reduction in groundwater storage** | Measured through the groundwater elevation and seawater intrusion representative monitoring well networks. | **Whole Subbasin:**<br>Minimum thresholds for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy for reduction of groundwater storage minimum threshold. | **Whole Subbasin:**<br>Measurable objectives for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy for reduction of groundwater storage measurable objective. | Over the course of any one year,<br>(1) exceedance of more than 20% of groundwater level minimum thresholds in **either**<br>(a) both the Dune Sand and upper 180-Foot Aquifers, or<br>(b) both the lower 180-Foot and 400-Foot Aquifers, or<br>(c) the Deep Aquifers, or<br>(d) the El Toro Primary Aquifer System;<br>OR<br>(2) Exceedance of seawater intrusion minimum thresholds. | **Whole Subbasin:**<br>Groundwater elevation and seawater intrusion interim milestones described respectively in Table 8-3 and Section 8.9.4.2 will serve as a proxy for reduction of groundwater storage interim milestones. |

| Sustainability Indicator | Measurement | Minimum Threshold | Measurable Objective | Undesirable Result | Interim Milestones |
|---|---|---|---|---|---|
| **Seawater intrusion** | Measured through seawater intrusion representative monitoring well network. | **Whole Subbasin:**<br>The approximate location in 2015 of the 500 mg/L chloride concentration isocontour in the lower 180-Foot and 400-Foot Aquifers;<br>Approximately 3,500 feet from the coast in the Dune Sand Aquifer, upper 180-Foot Aquifer and Deep Aquifers. This distance is generally consistent with the location of Highway 1 in the Monterey Subbasin and seaward of groundwater extraction wells in the Subbasin.<br>No seawater intrusion in the El Toro Primary Aquifer System. | **Whole Subbasin:**<br>Measurable objective is identical to the minimum threshold. | Any exceedance of the minimum threshold is considered as an undesirable result. | **Whole Subbasin:**<br>Identical to minimum thresholds and measurable objectives. No seawater intrusion above 500 mg/L chloride in RMS wells. |

| Sustainability Indicator | Measurement | Minimum Threshold | Measurable Objective | Undesirable Result | Interim Milestones |
|---|---|---|---|---|---|
| **Degraded groundwater quality** | Groundwater quality data downloaded annually from state sources. | **Whole Subbasin:**<br>No additional exceedances of drinking water standards in potable supply wells or Basin Plan water quality objectives for agricultural supply wells as a result of GSP implementation. Exceedances are only measured in public water system supply wells and domestic and agricultural (ILRP) wells. See Table 8-5 for the list of constituents. | **Whole Subbasin:**<br>Measurable objective is identical to the minimum threshold. | Any exceedances of minimum thresholds during any one year as a direct result of projects or management actions conducted pursuant to GSP implementation is considered as an undesirable result. | **Whole Subbasin:**<br>Identical to minimum thresholds and measurable objectives, which represent current conditions |
| **Subsidence** | Measured using DWR-provided InSAR data. | **Whole Subbasin:**<br>Zero net long-term subsidence, with no more than 0.1 foot per year of measured vertical displacement between June of one year and June of the subsequent year to account for InSAR measurement errors. | **Whole Subbasin:**<br>Measurable objective is identical to the minimum threshold. | Any exceedances of minimum thresholds during any one year due to lowered groundwater elevations is considered as an undesirable result. | **Whole Subbasin:**<br>Identical to minimum thresholds and measurable objectives, which represent current conditions. |

| Sustainability Indicator | Measurement | Minimum Threshold | Measurable Objective | Undesirable Result | Interim Milestones |
|---|---|---|---|---|---|
| **Depletion of interconnected surface water (ISW)** | Measured through shallow groundwater elevations as a proxy near potential locations of ISW in the ISW representative monitoring well network. | **Whole Subbasin:**<br>Minimum shallow groundwater elevations historically observed between 1995 and 2015 near locations of interconnected surface water. | **Whole Subbasin:**<br>Identical to minimum threshold shallow groundwater elevations. | Any minimum threshold exceeded in a shallow groundwater well near any location of ISW for more than two consecutive years. | **Whole Subbasin:**<br>Identical to minimum thresholds and measurable objectives, which represent current conditions. |

## ES.9 Projects and Management Actions

This GSP identifies projects and management actions that will allow the Monterey Subbasin to attain sustainability in accordance with §354.42 and §354.44 of the GSP Emergency Regulations. The goal of the projects and management actions is to address significant and unreasonable results related to the chronic lowering of groundwater levels and seawater intrusion in each management area.

The GSP highlights the hydraulic connection between the Monterey Subbasin and both the adjacent critically overdrafted 180/400-Foot Aquifer Subbasin and Seaside Subbasin. Reaching sustainability and achieving measurable objectives within the Monterey Subbasin will be affected by groundwater conditions and management within these adjacent subbasins and the greater Salinas Valley Basin. Therefore, projects, management actions, and implementation actions will need to be coordinated between subbasins to achieve sustainability. Regional coordination projects and multi-subbasin projects are included when they have the potential to directly benefit this Subbasin. Therefore, the Subbasin Groundwater Sustainability Agencies (GSAs) have developed a SGMA implementation approach that includes regional coordination actions, participating in regional, multi-basin projects, in addition to implementing local projects and management actions.

The projects and management actions for this GSP are summarized in Table 9-1 and include these major categories:

- **Multi-subbasin Projects** – Projects that provide supply augmentation to the Monterey Subbasin that require infrastructure or rely on a supply source outside the Monterey Subbasin. These projects are generally identified in multiple Salinas Valley Subbasin GSPs and expand upon how the project would be applied in the Monterey Subbasin. These multi-subbasin projects include:
    - Seasonal Release from Reservoirs with ASR and Direct Delivery
    - Regional Municipal Supply through brackish water desalination extracted from seawater intrusion barrier
    - Multi-benefit Stream Channel Improvements
- **Marina-Ord Area Local Projects and Management Actions** – Projects and management actions to be led by MCWD (or Marina-Ord Area agencies) that will primarily benefit the Marina-Ord Area. These projects and management actions include:
    - MCWD Demand Management Measures – Continued Conservation
    - Stormwater Recharge Management
    - Recycled Water Reuse through Landscape Irrigation and Indirect Potable Reuse
    - Monitoring Wells

- **Corral de Tierra Area Local Projects and Management Actions** – Projects and management actions to be led by SVBGSA that will primarily benefit the Corral de Tierra Area. These projects and management actions include:
    - Pumping Allocation and Control
    - Check Dams
    - Recharge from Surface Water Diversions
    - Wastewater Recycling for Reuse
    - Decentralized Residential In-lieu Recharge Projects
    - Decentralized Stormwater Recharge Projects
    - Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to Lower Corral de Tierra Valley (Artesian Well)

The potential projects presented in the GSP, if implemented in aggregate, are adequate to supply the entirety of projected groundwater demands in the Marina-Ord Area and significantly impact the projected demand in the Corral de Tierra Area.

The MCWD GSA and SVBGSA are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin and will be directly leading joint efforts to achieve sustainability and mitigate any residual overdraft. As described herein, regional, or multi-subbasin projects and management actions will need to be coordinated. For example, in the event that a seawater intrusion extraction barrier is constructed in the 180/400-Foot Aquifer Subbasin, impacts to groundwater levels, seawater intrusion, and cross-boundary flows will need to be assessed.

To demonstrate this future coordination, Implementation Action 1 (Support Implementation of the 180/400-Foot Aquifer Subbasin GSP and Seaside Watermaster Actions) describes the GSAs' plan to support projects and actions in adjacent subbasins, particularly those that will improve groundwater conditions near Monterey Subbasin boundaries and reduce the potential for seawater intrusion and decrease cross-boundary outflows from the Monterey Subbasin.

## ES.10 Plan Implementation

Key GSP implementation activities to be undertaken by the MCWD GSA and SVBGSA over the next five years include:

- Data collection, monitoring, and reporting;
    - Annual monitoring and reporting
    - Updating the Data Management System
    - Improving monitoring networks
    - Addressing identified data gaps in the Hydrogeologic Conceptual Model (HCM)

- Conducting intra-basin and inter-basin coordination;
- Continuing communication and stakeholder engagement;
- Conducting periodic evaluations of the GSP;
- Implementing projects and management actions and preparing grant applications; and
- Developing a funding strategy.