CHAPTER 4 – SUSTAINABLE MANAGEMENT CRITERIA
Groundwater Sustainability Plan
for the Marina GSA Area
of the 180/400 Foot Aquifer Subbasin

City of Marina
Groundwater Sustainability Agency
Marina, California

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4.1 INTRODUCTION AND BACKGROUND

Regulation Requirements:

§354.22 This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.

California Department of Water Resources (DWR) has identified the 180/400 Foot Aquifer Subbasin (Subbasin) as subject to significant and unreasonable seawater intrusion due largely to long-term groundwater extraction in the inland portions of the Subbasin in excess of the sustainable yield, and DWR has also identified the Subbasin as one of 21 California basins that are in a condition of "critical overdraft" (DWR 2016a). Seawater intrusion was first identified in the jurisdictional area of the Marina Groundwater Sustainability Agency (the MGSA Area) in the 1940s, and over the following decades progressed inland for a distance of over 7 miles in some areas. The purpose of this GSP is to consider local efforts and support regional efforts to address this undesirable result and return to Subbasin to sustainable groundwater management within 20 years, as required by the Sustainable Groundwater Management Act (SGMA). MGSA will achieve this by evaluating local projects and supporting the projects and management actions that will be implemented by Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) under its regional Groundwater Sustainability Plan (GSP), and by assuring that local groundwater resources are managed sustainably to protect local and regional beneficial uses and users.

This chapter of the GSP presents the criteria that constitute sustainable groundwater management in the MGSA Area and describes significant regulatory requirements. These "Sustainable Management Criteria" define the desired future groundwater resources condition of the MGSA Area in the Subbasin and commit MGSA to actions that will meet these objectives. The sustainable management criteria defined in this chapter include the following components (definitions for the terms in quotes are presented further below):

- The "Sustainability Goal" for the MGSA Area of the Subbasin is presented;
- "Undesirable Results" applicable to each "Sustainability Indicator" are identified;
- The "Minimum Thresholds" by which these Undesirable Results may be recognized are selected; and
- "Measurable Objectives" by which the groundwater resources in the MGSA Area may be managed are established.

The following definitions are used to guide the development of sustainable management criteria for the MGSA Area:

- A **Sustainability Goal** is a succinct statement of the GSA's objectives and desired conditions of the groundwater basin, how the basin will get to that desired condition, and why the measures planned will lead to success. Unlike the other sustainable management criteria, the

sustainability goal is not quantitative, but supported by locally-defined minimum thresholds and undesirable results. Demonstration of the absence of undesirable results supports a determination that the basin is operating within its sustainable yield and, thus, that the sustainability goal has been achieved (DWR 2017).

- **Sustainability Indicators** are any of the following six effects potentially caused by groundwater conditions that, when significant and unreasonable, cause undesirable results (California Water Code (CWC) § 10721(x)):
  - Chronic Lowering of Groundwater Levels;
  - Reduction of Groundwater Storage;
  - Degraded Groundwater 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 defined by SGMA are caused by groundwater conditions occurring in the basin. Undesirable results are included as sustainable management criteria as a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin. A description of undesirable results should include the potential effects on the beneficial uses and users of groundwater, land uses and property interests, and other potential effects that may occur or are occurring from the undesirable result. (23 California Code of Regulations (CCR) § 354.26)

  Undesirable results may be defined by minimum threshold exceedances at a single monitoring site, multiple monitoring sites, a portion of a basin, a management area, or an entire basin.
- **Minimum Thresholds** refers to a numeric value or values for each sustainability indicator used to define undesirable results. (23 CCR § 354.28)

  Minimum thresholds are quantitative values that represent groundwater conditions at representative monitoring points and that indicate an unreasonable condition. For example, a discrete groundwater or salinity level in a well may be a minimum threshold because groundwater levels dropping below or salinity levels rising beyond the specified level would be an unreasonable condition.
- **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 basin. Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon. (23 CCR § 354.30)

  Measurable objectives are goals that the GSP is designed to achieve. Measurable objectives are set so there is a reasonable margin of operational flexibility between the minimum threshold and measurable objective that will accommodate droughts, climate change, conjunctive use operations, or other groundwater management activities. For some

sustainability indicators, projects and management actions are needed to achieve measurable objectives. Although measurable objectives are not enforceable during implementation of the GSP, the GSP needs to demonstrate that there is a planned path toward achieving measurable objectives.

This chapter includes or references the data used to develop the sustainable management criteria and to evaluate how they influence the beneficial uses and users of groundwater within and surrounding the MGSA Area. The sustainable management criteria discussed in this chapter were developed based on information about the basin from the hydrogeologic conceptual model (Section 3.1), information about current and historical groundwater conditions (Section 3.2), the water budget (Section 3.3), other publicly available information, information and public feedback about groundwater conditions near the MGSA Area obtained during City Council meetings held over the last three years and during recent public MGSA meetings about the GSP development process, and meetings with MGSA staff.

To retain an organized approach, this chapter follows the same section/subsection structure for each sustainability indicator. The result is somewhat repetitive, but is complete and systematic when addressing the SGMA requirements. Each section follows a consistent format that contains the information required by 23 CCR §§ 354.22 et. seq and outlined in the Sustainable Management Criteria Best Management Practices guidance document developed by DWR (DWR 2017).

4.2 SUSTAINABILITY GOAL

Regulation Requirements:

§ 354.24. Sustainability Goal

Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.

CWC § 10721 defines sustainable groundwater management as "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." A sustainability goal is the desired culmination of sustainable groundwater management, resulting in the maintenance of sustainable groundwater conditions (the absence of undesirable results), or their achievement within 20 years, when compared to a 2015 baseline condition. The sustainability goal reflects these requirements and succinctly states the GSAs' objectives and the desired conditions of the GSP area.

The sustainable yield is defined as the amount of groundwater that can be withdrawn annually over a period of time without causing undesirable results. Regionally, the primary undesirable result in the 180/400 Foot Aquifer Subbasin has been seawater intrusion in the 180-Foot and 400-Foot Aquifers caused by long-term overdraft and declining groundwater levels in the inland portions of the Subbasin (SBVGSA 2019, MCWRA 2017a). Chronic declines in inland groundwater levels have led to a reversal in the groundwater gradients in the 180-Foot and 400-Foot Aquifers from shoreward to landward, causing water affected by seawater intrusion to flow inland for a distance of up to approximately 7 miles. As a

result of these conditions, DWR designated the 180/400 Foot Subbasin as being subject to "Critical Conditions of Overdraft" (DWR 2016a), which means that preparation of GSPs in the Subbasin must be expedited to meet a January 31, 2020 submittal deadline.

Based on a water budget analysis, SVBGSA has estimated the historical sustainable yield of the Subbasin as 96,950 acre-feet per year (AFY), and the long-term average sustainable yield as 112,000 AFY (SVBGSA 2019).[1] In addition, as discussed in Chapter 6, SVBGSA plans to implement a number of projects and management actions to raise groundwater levels in the inland portions of the Subbasin through *in lieu* and applied recharge, with a goal of arresting and even reversing seawater intrusion. This GSP adopts, and MGSA will support, the regional sustainable yield as estimated for the 180/400 Foot Aquifer Subbasin in SVBGSA's GSP. In addition, MGSA will support SVBGSA's projects and management actions that are expected to benefit groundwater elevations at and in the vicinity of the MGSA Area.

Locally, the contribution to the sustainable yield from groundwater extraction in the MGSA Area is defined as the amount of groundwater that can be withdrawn annually over a period of time from the MGSA Area without causing undesirable results within or near the MGSA Area. Current and historical groundwater extraction in the MGSA Area has been limited to process water pumping for the CEMEX sand plant (approximately 300 AFY), which represents the only long-term groundwater extraction within the MGSA Area. Data are not available to assess if groundwater extraction from the CEMEX well historically contributed to seawater intrusion in this area since the 1960s when pumping started. Due to concern about limiting extractions to avoid seawater intrusion, the City of Marina and several other agencies entered into the 1996 Annexation Agreement limiting extractions at the CEMEX property to 500 AFY. Based on available water quality data for the CEMEX well, long-term pumping has likely reached a state of equilibrium as of the SGMA baseline date of 2015. As such, CEMEX well pumping has not resulted in significant and unreasonable seawater intrusion or groundwater quality degradation as defined by SGMA. Pumping of the CEMEX well will cease when the plant closes at the end of 2020, or at the latest in December 2024 when CEMEX removes the well (Section 3.1.8).

In the future, groundwater extraction rates in the MGSA Area are proposed to be increased significantly for the proposed MPWSP. If the proposed MPWSP is implemented, the proposed slant wells for the project would pump up to 17,400 AFY (HWG 2017). As discussed in Section 3.3.13, without additional data and modeling tools, it is not possible to assess the rate of the slant well pumping that would be sustainable in the long term. MGSA will update the estimate for the local sustainable yield and coordinate with SVBGSA to update the basin-wide sustainable yield as needed and as information becomes available during GSP implementation. The sustainable management criteria defined in this chapter, combined with the monitoring program specified in Chapter 5 and the management actions outlined in Chapter 6, are intended to assure that any groundwater extraction in the MGSA Area is managed sustainably, and that undesirable results do not occur in the MGSA Area or the surrounding Subbasin area.

[1] SVBGSA states this is an estimate only, and that the sustainable yield estimate for the Subbasin will be modified and updated as more data are collected and more analyses are performed, including evaluation of the United States Geological Survey (USGS) Salinas Valley Integrated Hydrologic Model (SVIHM), which is expected to be released in late 2020.

Undesirable results potentially associated with future groundwater extraction in the MGSA Area include the following significant and unreasonable impacts, which are further evaluated and discussed in the subsequent sections of this chapter:

- Groundwater level decline which adversely impacts beneficial groundwater uses and/or users, especially near the MGSA Area where several existing groundwater supply wells and groundwater dependent ecosystems (GDEs) are present;
- Reduction in groundwater storage which adversely impacts beneficial groundwater uses and/or users;
- Further seawater intrusion into the Dune Sand, 180-Foot and 400-Foot Aquifers, and/or seawater intrusion into the Deep Aquifer;
- Degradation of groundwater quality within the Dune Sand, 180-Foot and/or 400-Foot Aquifers that adversely affects beneficial uses or users, especially in the low-TDS groundwater zone;
- Land subsidence that adversely affects surface land uses; and
- Surface water depletion that adversely affects beneficial surface water uses or users, including GDEs.

This GSP adopts SVBGSA's sustainability goal, which is stated as follows (SVBGSA 2019):

> *The goal of this GSP is to manage the groundwater resources of the 180/400-Foot Aquifer Subbasin for long-term community, financial, and environmental benefits to the Subbasin's residents and businesses. This GSP will ensure long-term viable water supplies while maintaining the unique cultural, community, and business aspects of the Subbasin. It is the express goal of this GSP to balance the needs of all water users in the Subbasin.*

Local implementation objectives in support of this goal include the following:

> *MGSA will manage groundwater resources in the MGSA Area in a way that ensures all beneficial uses and users in, or affected by, groundwater management in the MGSA Area are protected from undesirable results, and have access to a safe and reliable groundwater supply that meets current and future demand. This goal will support SVBGSA's sustainability goal by addressing undesirable results at a local level and protecting local resources from further degradation, while coordinating with MCWRA, SVBGSA and MCWD GSA to support regional groundwater management, including groundwater level and seawater intrusion monitoring, and mitigation projects and management actions that will contain and reverse the conditions resulting from regional overdraft. MGSA will:*
>
> - *Support the protection of reliable groundwater supply and quality to promote the public health and welfare now and into the future;*

- *Ensure that groundwater is available for beneficial and potential beneficial uses, including all of the diverse municipal, domestic, agricultural, industrial, and environmental uses potentially affected by management actions within the MGSA Area;*
- *Protect the aquifers underlying the MGSA Area against further seawater intrusion;*
- *Comply with State Water Resources Control Board (SWRCB) Resolution No. 88-63, which designates all groundwaters of the State containing less than 3,000 milligrams per liter (mg/L) of total dissolved solids (TDS) as having a potential beneficial use as a domestic or municipal drinking water supply, and SWRCB Resolution No. 68-16, which requires the high quality of these waters to be maintained unless the state finds that certain specific conditions are met;*
- *Maintain or enhance groundwater levels and groundwater discharge where GDEs exist near the MGSA Area;*
- *Maintain operational flexibility within the Subbasin, assuring that groundwater resources are available during times of drought without causing undesirable results;*
- *Account for changing groundwater conditions related to implementation of future groundwater supply projects, projected climate change, and sea level rise, in sustainability planning and management; and*
- *Coordinate with, support, and avoid undesirable results to neighboring GSA areas and groundwater basins in regional efforts to achieve groundwater sustainability.*

To achieve the sustainability goal, MGSA will undertake the following measures:

- Establish sustainable management criteria, including definition of minimum thresholds, measurable objectives, interim milestones and undesirable results as discussed in this chapter;
- Implement a monitoring program as discussed in Chapter 5 for each sustainability indicator at and in the vicinity of the MGSA Area to assess compliance with, and progress toward the identified measurable objectives and interim milestones;
- Implement the management actions identified in Chapter 6 to assure compliance with the measurable objectives and interim milestones identified in this chapter, and to prevent the occurrence of undesirable results; and
- Complete the actions identified in Chapter 7 to implement the GSP, address data gaps, support the plan review and updates, and fulfill reporting obligations.

4.3 APPROACH

Locally-defined significant and unreasonable conditions were identified based on assessment of hydrogeologic conditions, beneficial uses and users of groundwater, existing and historical undesirable

results, potential future groundwater level, storage and quality trends, existing applicable standards and potential future groundwater demands. The consistency of the locally-defined criteria with criteria developed by SVBGSA in their GSP was evaluated, so that the sustainable management criteria in this GSP would address local conditions while remaining regionally compatible. The assessment was conducted based upon the hydrogeologic conceptual model and water budget information summarized in Chapter 3, and was discussed with MGSA staff and local consultants, and coordination discussions were held with SVBGSA, Marina Coast Water District (MCWD) GSA, and Monterey County Water Resources Agency (MCWRA).

As discussed in Chapters 6 and 7, the United States Geological Survey (USGS) is developing the Salinas Valley Integrated Hydrologic Model (SVIHM) as a tool to improve groundwater and surface water management strategies in the Salinas Valley Basin. SVBGSA intends to use this model to refine its assessment of groundwater budgets and flow, and to update its GSP. MGSA intends to cooperate and coordinate with SVBGSA in this effort, assess the need for additional studies and modeling refinement, and update this GSP, including the sustainable management criteria described in this chapter. In addition, MCWD GSA intends to construct a locally-refined groundwater flow model that can incorporate solute transport and density driven flow, to support development and implementation of its GSP in the Monterey Subbasin. MGSA intends to cooperate and coordinate with MCWD GSA and SVBGSA in this effort and will assess using the resulting model to update and refine this GSP.

Similar to SVBGSA's GSP, this chapter follows the same structure for each Sustainability Indicator. A separate subsection is included for each sustainability indicator, with subsections that address each of the regulatory requirements of 23 CCR §§ 354.22, *et. seq* and outlined in the DWR guidance (DWR 2017). Each Sustainability Indicator subsection includes a description of:

- The local factors potentially contributing to significant and unreasonable conditions;
- How minimum thresholds were developed, including:
    - The information and methodology used to develop the minimum thresholds (23 CCR § 354.28 (b)(1));
    - The relationship between minimum thresholds and the sustainability indicators, and how they will avoid undesirable results (23 CCR § 354.28 (b)(2));
    - The effect of minimum thresholds on neighboring basins' and GSPs' ability to meet sustainability goals (23 CCR § 354.28 (b)(3));
    - The effect of minimum thresholds on beneficial uses and users of groundwater (23 CCR § 354.28 (b)(4));
    - Relevant federal, state, or local standards (23 CCR § 354.28 (b)(5)); and
    - The method for quantitatively measuring minimum thresholds (23 CCR § 354.28 (b)(6));

- How measurable objectives were developed, including:
    - The methodology for setting measurable objectives (23 CCR § 354.30); and
    - Interim milestones, as applicable (23 CCR § 354.30 (a), §354.30 (e), §354.34 (g)(3)).
- How locally- significant and unreasonable conditions (undesirable results) were defined, including:
    - The criteria for defining undesirable results (23 CCR § 354.26 (b)(2));
    - The potential causes of undesirable results (23 CCR § 354.26 (b)(1)); and
    - The effects of these undesirable results on the beneficial users and uses (23 CCR § 354.26 (b)(3))

4.4 . CHRONIC DECLINE OF GROUNDWATER LEVELS

4.4.1 LOCAL FACTORS POTENTIALLY CONTRIBUTING TO SIGNIFICANT AND UNREASONABLE CONDITIONS

Regionally, chronic lowering of groundwater levels in the Subbasin's aquifers has historically occurred and is ongoing due to groundwater production for agricultural, municipal, and domestic use that exceeds the long-term sustainable yield of the Subbasin and the absence of viable alternative sources of water supply (SVBGSA 2019). A groundwater depression has developed north of Salinas and is visible on both the 180-Foot/Shallow East Side Aquifer and 400-Foot/Deep East Side Aquifer maps, where elevations are generally -80 to -120 feet mean sea level (msl). Groundwater elevation contour maps for the 180-Foot and 400-Foot Aquifers indicate an inland flow direction over a broad region surrounding the MGSA Area (see for example the groundwater elevation contour maps included in MCWRA [2017a]). East of the MGSA Area, groundwater levels were generally historically interpreted to be -10 to -20 feet msl in the 180-Foot Aquifer and -20 to -30 feet msl in the 400-Foot Aquifer during August measurements (when groundwater elevations are generally lowest), with the depth to groundwater increasing toward the Salinas River. These groundwater gradient data are based on widely spaced wells, and should be considered generalizations for the vicinity of the MGSA Area.

SVBGSA's GSP defines significant and unreasonable groundwater elevation declines in the Subbasin as those that:

- Are at or below the lowest groundwater elevations observed between 1994 and 2015 (based on public and stakeholder input that identified historically low groundwater elevations as significant and unreasonable);
- Cause significant financial burdens to local municipalities, landowners, and farmers; and/or
- Interfere with other sustainability indicators (i.e., seawater intrusion, subsidence, etc.).

With respect to potential future groundwater extraction in the MGSA Area, potential adverse impacts to beneficial users and uses from groundwater level decline include adverse impacts to GDEs, development or worsening of gradients that promote seawater intrusion, well interference drawdown, and lowering of groundwater elevations to uneconomical levels. In the vicinity of the MGSA Area, groundwater extraction from the seawater-intruded portions of the 180-Foot Aquifer and 400-Foot Aquifer is currently relatively limited, and SVBGSA proposes to adopt an ordinance that would prohibit the construction and operation of supply wells within the Castroville Seawater Intrusion Project (CSIP) service area east and northeast of the MGSA Area (Section 6.6.3). Based on this information, this GSP considers significant and unreasonable groundwater elevation declines in and near the MGSA Area as those that:

- Are at or below the lowest groundwater elevations observed between 1994 and 2015 identified regionally by SVBGSA (based on regional public and stakeholder input to SVBGSA that identified these historically low groundwater elevations as significant and unreasonable);
- Cause significant financial burdens to local municipalities, landowners, and farmers through interference drawdown or groundwater pumping level reduction to less economical levels; and/or
- Result in significant adverse impacts to GDEs.

Insufficient data currently exist to map flow directions and groundwater elevations in the Deep Aquifer, and MCWRA does not produce groundwater level maps of the Deep Aquifer. The construction of new wells in the Deep Aquifer is currently prohibited and there are no plans to construct any Deep Aquifer wells within the MGSA Area. As discussed in Chapter 6, MGSA will support management actions by SVBGSA to strengthen these prohibitions. As such, under current and foreseeable future conditions, there will be no groundwater extraction from the Deep Aquifer that could affect the groundwater level decline sustainability indicator that can be managed under this GSP. For these reasons, this sustainability indicator is considered currently inapplicable to this GSP, and undesirable results, minimum thresholds, and measurable objectives for chronic groundwater level decline are not adopted for the Deep Aquifer. This determination will be reassessed during future GSP updates, and additional sustainable management criteria for the Deep Aquifer will be added if appropriate.

4.4.2 MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting. (d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:

(A) The rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin.

SVBGSA determined that average groundwater elevations in 2015 and 2016, at the end of a significant drought, represented a significant and unreasonable condition relative to groundwater elevation decline. Using a composite hydrograph analysis approach for the Subbasin, SVBGSA determined that the lowest average groundwater elevations during the representative climatic cycle (from 1967 to 1998) occurred in 1991 and 1992, and were on average 1 foot above the 2015 and 2016 elevations. The minimum thresholds for significant and unreasonable groundwater level decline were therefore established as 1 foot above 2015 groundwater elevations. A groundwater level map was prepared defining this "compliance surface," and minimum thresholds were determined for designated representative monitoring sites (RMS) by determining the elevation of this surface at each site.

Locally, groundwater extraction within the MGSA Area has the potential to draw down groundwater levels below minimum threshold elevations established by SVBGSA. However, SVBGSA has not designated any RMS near the MGSA Area, so there is limited possibility that groundwater extraction in this area would create an undesirable result detected under their Regional GSP. A single 400-Foot Aquifer well is located approximately 1 mile from the MGSA Area and a single 180-Foot Aquifer well is located approximately 4 miles from the MGSA Area. There are no RMS designated in the Dune Sand Aquifer in SVBGSA's GSP. Groundwater elevation data for existing wells near the MGSA Area do not have sufficient long-term groundwater elevation data to establish historical low groundwater levels prior to 2015. Several wells monitored by MCWRA with data beginning in approximately 2005 are located about 4 miles from the MGSA Area to the east and northeast (Zidar and Feeney 2019). Examination of the hydrographs for these wells indicates groundwater elevations in these wells were either at their lowest point, or near their lowest point, in 2015 and 2016.

Groundwater extraction for the test slant well pumping test performed for the MPWSP resulted in approximately 1 to 5 feet of drawdown (decreasing with distance from the MGSA Area), which recovered rapidly after the end of the test (Sections 3.2.1.2 and 3.2.1.3) and does not represent "chronic" or long-term groundwater elevation decline. As summarized in the following section, an

analysis of evapotranspiration (ET) from a GDE located near the MGSA Area indicates that from 2014 to 2016, a combination of drought conditions and drawdown in the Dune Sand Aquifer resulted in a substantial decrease in summertime ET, indicating vegetative stress. ET from the GDE has since recovered; however, it is not known whether the habitat suffered long term changes and degradation in the process, or if the habitat was able to recover. For these reasons, it is not known whether pumping of the test slant well during this time caused undesirable results. Future groundwater extraction is proposed to be increased significantly above the test slant well extraction rates, which potentially place additional stress on sustainability indicators. The sustainable management criteria in this chapter, and the monitoring and management action programs described in Chapters 5 and 6 are intended to assure sustainable groundwater management.

The following sections describe the process used to establish minimum thresholds for RMS designated under this GSP to address chronic decline in groundwater levels in the MGSA Area. The minimum thresholds and measurable objectives established for RMS near the MGSA are presented in Table 4-1.

TABLE 4-1. MINIMUM THRESHOLDS AND MEASURABLE OBJECTIVES FOR CHRONIC DECLINE IN GROUNDWATER LEVELS

Monitoring Site	Aquifer	Approximate date of Lowest Groundwater Level	2015 Summer/Fall Lowest Groundwater Level (ft NAVD88)	Minimum Threshold (ft NAVD88)	Measurable Objective (ft NAVD88)
MW-4S	Dune Sand	Mid Sept 2015	3.0	4.0	4.0
MW-4M	180-Foot	Mid Aug 2015	-3.0	-2.0	-0.1
MW-4D	400-Foot	Late Aug 2015	-15.9	-14.9	-8.8
MW-5M	180-Foot	Mid Aug 2015	-4.8	-3.8	-2.8
MW-5D	400-Foot	Late Aug 2015	-22.0	-16.0	-10.0
MW-6M	180-Foot	Mid Aug 2015	-26.0	-25.0	-18.0
MW-7S	Dune Sand	Mid Oct 2015	3.8	4.8	4.8
MW-7M	180-Foot	Late Aug 2015	-7.1	-6.1	-2.5
MW-7D	400-Foot	Late Aug 2015	-14.9	-13.9	-7.8
MW-8S	Dune Sand	Mid Sept 2015	1.6	2.6	2.6
MW-8M	180-Foot	Late Aug 2015	-5.9	-4.8	-2.1
MW-8D	400-Foot	Late Aug 2015	-21.0	-14.0	-8.0
MW-9M	180-Foot	Late Aug 2015	-11.4	-10.4	-7.0
MW-9D	400-Foot	Late Aug 2015	-25.1	-24.1	-18.0

Notes:
ft NAVD88 = feet above the North American Vertical Datum of 1988

4.4.2.1 DUNE SAND AQUIFER

As discussed in Sections 2.3.1.2 and 3.2.6.1, several areas of “vernal ponds” are located near the MGSA Area and have been identified as GDEs. Vernal ponds include palustrine and emergent wetlands which are considered locally unique and are protected as Environmentally Sensitive Habitat Areas (ESHA) under the California Coastal Act and managed under a plan prepared by the City of Marina and local environmental stakeholders.

The ecological water requirements and thresholds of responses to changes in groundwater levels differ among GDEs. Deep-rooted obligate phreatophytes such as oak trees are not expected to be significantly affected by drawdown which is within the range of natural groundwater level fluctuations or occurs over a period of years. The gradual change would allow the root systems to adapt. Similarly, the effect of drawdown on riparian woodlands and wetlands that have significant surface water inflows from streams, canals, and agricultural drains is expected to be less significant. However, wetlands such as the vernal ponds present east of the MGSA Area are likely to be more highly groundwater dependent and contain sensitive communities that could be adversely affected by drawdown. The ability of such GDEs to adapt or recover from groundwater declines depends largely on the overall water budget and the degree to which the GDE is dependent on groundwater. The degree of interaction between wetlands and groundwater can vary greatly and depends on many factors including their position in the landscape, the permeability of the substrate, depth to the water table, and seasonal fluctuations in water inputs. GDEs develop in response to unique timing, duration, frequency, and chemistry of water inputs. Major changes in wetland hydrology would be expected to significantly affect ecological function. However, minor changes in hydrology may result in little to no change in the ecological function of wetlands, depending on baseline conditions and whether those changes are short- or long-term and offset by seasonal recharge of the aquifer or surface inputs (JJ&A 2018).

The condition and species composition of wetland vegetation can serve as an early warning indicator of water stress. A compilation of studies conducted by The Nature Conservancy in the western United States that examined plant response of 17 herbaceous wetland indicator species (11 common and six rare) to groundwater drawdown, indicated gradual loss of indicator species starting with as little as 0.66 feet (0.2 meter) of drawdown, with a median of 2.99 feet (0.91 meter), and complete loss at 6.23 feet (1.9 meter) (Gerla *et al.* 2015). Rhode *et al.* (2017) reviewed policies adopted for management of GDEs in the United States and globally, and assessed that thresholds for GDE responses to groundwater level decline are often assumed to follow linear, curvilinear, or step-wise functions, but that in reality they are likely habitat specific. A study of the effects of regulatory drawdown thresholds on inundation area and plant community composition in southeast Australia suggested that drawdowns from 0.82 feet (0.25 meter) to 0.98 feet (0.3 meter) represent a threshold where community composition is likely to change (Deane *et al.* 2017). The study setting was a regional unconfined aquifer with shallow groundwater levels and wetlands dependent on groundwater discharge, and included wetlands considered sensitive to even small declines in groundwater level. Thresholds were assigned based on ecological value, with higher functioning wetlands sensitive to changes assigned a threshold of up to 0.82 feet (0.25 meter) of acceptable drawdown over the course of five years; regional triggers were set at 1.64 feet (0.50 meter) over five years. Drawdown in shallow groundwater systems may alter community composition by increasing cover of exotic and terrestrial species, and increasing soil salinity from evapotranspiration; drawdown in deeper water systems may result in community change with conditions supporting greater cover of sedge species.

The Armstrong Ranch Ponds (Vernal Pond #6) are located approximately 300 to 1,000 feet east of the MGSA Area and include a series of seasonal wetlands with ponded water in the winter and wet herbaceous meadows likely subsisting on shallow groundwater during the dry season (The Habitat

Restoration Group 1994). An analysis of ET from these ponds and the surrounding area is presented in Figure 4-1. Summer (June, July, and August) ET was calculated using the surface energy balance method (Paul *et al.* 2011, 2018) from remote sensing data generated by the Landsat Satellite mission by Formation Environmental under contract to DWR. The results indicate summer ET ranged from approximately 5 to 10 inches from 2010 to 2013, then decreased to approximately 1 to 5 inches in 2014 and 2015, and 1 to 3 inches in 2016. In 2017, ET increased to approximately 3 to 10 inches, and in 2018, ET was approximately 5 to 12 inches. The decline in ET from 2014 to 2016 occurred during a period of severe drought; however, the test slant well pumping test was also conducted from April 2015 to February 2018 (GeoScience Support Services 2019). Hydrographs for well MW-4S indicate that the seasonal fluctuation in groundwater elevations in this well was approximately 2 feet, and suggest that pumping-induced drawdown was approximately 1 foot. The lowest groundwater elevations were observed in the summer of 2016; groundwater elevations averaged about 2 feet higher in summer 2017 and summer 2018.

The above ET analysis demonstrates the correlation between groundwater levels and ET from this GDE, and illustrates its sensitivity to groundwater level declines. ET, and by correlation biomass productivity, rebounded with groundwater levels; however, it is not known whether the stress induced in the GDE resulted in a change in the vegetation community, habitat degradation, or habitat succession that is not readily reversible. Based on this data, it is not possible to determine the extent to which the drawdown induced during the test slant well pumping period resulted in significant and unreasonable impacts to the GDE, or whether the results were temporary and reversable.

For these reasons, the minimum thresholds for chronic groundwater level decline in the Dune Sand Aquifer are established as an elevation of 1 foot above the 2015 low groundwater levels recorded in Dune Sand Aquifer monitoring wells near identified GDEs in the vicinity of the MGSA Area (MW-4S, 7S and 8S). This threshold is based on potential significant and unreasonable impacts to identified GDEs. It is adopted on an interim basis based on the rationale above. The threshold will be updated based on biological assessment of GDEs in the vicinity of the MGSA Area to determine their sensitivity to groundwater elevation declines and confirmation by SVBGSA as to the degree to which potential GDEs along Salinas River are groundwater vs. surface water reliant. The minimum thresholds are established based on the following approach:

- At each RMS for the Dune Sand Aquifer, a groundwater elevation minimum threshold is calculated as a groundwater elevation that is 1 foot above 2015 summertime or fall low groundwater elevation documented in well hydrographs for the shallow MPWSP monitoring wells (Appendix 3.D).

The correlation between groundwater elevations and GDE responses for the identified GDEs is identified as a data gap. In addition, the degree of groundwater dependence of potential GDEs located near Salinas River is a data gap. As discussed in Chapter 7, a baseline biological assessment of the GDEs in the vicinity of the MGSA Area will be performed, and the minimum thresholds and measurable objectives will be adjusted, as appropriate. In addition, the GDE monitoring approach will be refined as discussed in Chapter 5, and the management actions will be updated as discussed in Chapter 6.

4.4.2.2 180-FOOT AND 400-FOOT AQUIFER

Minimum thresholds for the 180-Foot and 400-Foot Aquifers are driven by the potential for well interference drawdown and consistency with minimum thresholds adopted by SVBGSA which are intended, in part, to decrease the inland gradients that have led to regional seawater intrusion. As discussed in Section 4.4.2, SVBGSA determined that average groundwater elevations in 2015 and 2016, at the end of a significant drought, represented a significant and unreasonable condition relative to groundwater elevation decline, and established initial minimum thresholds 1 foot above this elevation. These thresholds were then locally adjusted based on hydrograph analysis at some individual RMS.

Thresholds of significance for well interference drawdown vary, but are commonly lower for domestic wells, which tend to be shallower and have less available drawdown, and greater for irrigation, industrial or municipal supply wells, which are generally deeper and have more available drawdown. A study of well interference drawdown thresholds adopted for projects in California conducted in Stanislaus County concluded that a well interference threshold of 5 feet for domestic wells and 20 feet for higher capacity production wells is unlikely to lead to significant and unreasonable impacts (JJ&A 2018). The range of documented seasonal fluctuation in groundwater elevations in the 180-Foot and 400-Foot Aquifers varies from approximately 5 feet within about 2 miles of the MGSA Area to between approximately 10 to 30 feet further inland about 4 miles from the MGSA Area (Section 3.2.1.2).

The minimum threshold for groundwater elevation decline in the 180-Foot and 400-Foot Aquifers is therefore established consistent with the SVBGSA regional thresholds of groundwater elevations at RMS in the 180-Foot or 400-Foot Aquifers that are 1 foot above historical low groundwater elevations measured in 2015 as determined from analysis of the hydrographs included in Appendix 3.D. For RMS located near well 14S/02E-08M02, which is approximately 1 mile northeast of the MGSA Area, minimum thresholds were adjusted to better match the minimum threshold adopted by SVBGSA for the 400-Foot Aquifer at this location, and in the overlying 180-Foot Aquifer in accordance with existing vertical gradients.. These elevations are generally relatively consistent with SVBGSA's minimum thresholds and are appropriate given seasonal groundwater level fluctuation as well as thresholds commonly used to assess interference drawdown to prevent nearby groundwater users from experiencing significant and unreasonable impacts.

4.4.2.3 RELATIONSHIP BETWEEN MINIMUM THRESHOLDS AND OTHER SUSTAINABILITY INDICATORS

Regulation Requirements

§ 354.28 (b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indictor, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:

(B) Potential effects on other sustainability indicators.

The groundwater elevation minimum thresholds are derived from historical groundwater elevation measurements. Therefore, the minimum thresholds are unique at every RMS, but when combined

represent a "compliance surface." The distribution of groundwater elevations in this compliance surface is a historically accurate, and reasonably achievable condition; that is, individual minimum threshold values at each well will not conflict with each other.

Groundwater elevation minimum thresholds can influence other sustainability indicators. The groundwater elevation minimum thresholds are selected to avoid undesirable results for other sustainability indicators.

- **Reduction in groundwater storage**. As discussed in Section 4.5, a significant and unreasonable condition for change in groundwater storage is defined as an annual extraction of groundwater in the MGSA Area that falls above the total long-term sustainable yield of the Subbasin established by SVBGSA or that results in depletion of the amount of low-TDS groundwater in storage in the Dune Sand, 180-Foot and 400-Foot Aquifers east of the MGSA Area. The minimum thresholds for groundwater elevation decline were selected to protect the beneficial uses of groundwater in the Dune Sand Aquifer by GDEs and to provide continuity with regional minimum thresholds for the 180-Foot and 400-Foot Aquifer. Decline of groundwater elevations would be associated with changes in storage, and will be used in combination with water quality monitoring to assess changes in low-TDS groundwater storage. These sustainable management criteria will be used in combination to manage both chronic decline in groundwater levels and reduction in groundwater storage. Although the minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. These thresholds may be refined during GSP implementation as more information and better tools become available. Therefore, the groundwater elevation decline minimum threshold is unlikely to result in a significant and unreasonable reduction in groundwater storage.

- **Seawater intrusion.** As discussed in Section 4.6, significant and unreasonable seawater intrusion is defined as the migration of chloride isocontours that define the extent of seawater intrusion as of 2017 (for the 180-Foot, 400-Foot and Deep Aquifers) or 2018 (for the Dune Sand Aquifer). Groundwater elevation minimum thresholds were established to be consistent with thresholds established by SVBGSA to prevent inland gradients that may result in the advance of seawater intrusion in the 180- and 400-Foot Aquifers. As discussed in Section 3.2.3.2, a decline in groundwater levels would lead to a change in the interface dynamics between the saline water intrusion wedge and the overlying low-TDS zone. Compliance with the groundwater elevation decline minimum threshold will help to assure a reasonable balance is maintained. As such, the minimum thresholds for groundwater elevation decline and seawater intrusion are compatible and related, and will be used in combination to assure sustainable groundwater management. Furthermore, the thresholds may be adjusted during GSP implementation as more information becomes available in order to refine their alignment. Therefore, the groundwater level decline minimum threshold is unlikely to result in significant and unreasonable seawater intrusion, but rather, will help to prevent seawater intrusion.

- **Degraded water quality**. As discussed in Section 4.7, significant and unreasonable degradation of groundwater quality is defined as the lateral or vertical migration of a TDS isocontour, or the induced migration of a contaminant contour exceeding water quality objectives in a nearby contamination plume. This sustainability indicator is closely related to changes in the dynamic equilibrium between the saline water intrusion wedge near the shore and the overlying low-TDS groundwater zone that could be caused by groundwater level decline. As such, although the

minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. Furthermore, the thresholds for degraded water quality and groundwater elevation decline may be adjusted during GSP implementation as more information becomes available in order to refine their alignment. Therefore, the groundwater elevation decline minimum threshold is unlikely to result in significant and unreasonable degraded water quality, but rather, will help to protect water quality.

- **Subsidence**. A significant and unreasonable condition for subsidence is any measurable long-term inelastic subsidence that damages existing infrastructure. Subsidence is caused by depressurization and compaction of fine-grained sediments in response to lowering groundwater levels, especially in confined systems when groundwater elevations fall below historical lows. The groundwater elevation minimum thresholds are set within 1 foot of historical low groundwater elevations, making measurable subsidence unlikely.
- **Depletion of interconnected surface waters.** A significant and unreasonable condition for the depletion of interconnected surface waters is depletion that induces significant and unreasonable degradation of GDEs, seawater intrusion in the tidal reaches of the river, or groundwater pumping-induced depletion of flow in the Salinas River that results in significant and unreasonable impacts to surface water uses. Lowering average groundwater elevations in areas adjacent to GDEs or other interconnected surface water bodies will incrementally increase depletion rates; however, the thresholds for groundwater level decline are set within the range of historical groundwater elevations in the Dune Sand Aquifer, which is unlikely to increase depletion to the point where it adversely affects GDEs or beneficial uses of surface water in the Salinas River. Furthermore, the threshold for groundwater level decline in the Dune Sand Aquifer was set specifically to be protective of the beneficial uses of surface water by wetland communities. For these reasons, the minimum threshold for chronic decline of groundwater levels is unlikely to result in significant and unreasonable impacts to the beneficial uses of surface water.

4.4.2.4 Minimum Thresholds in Relation to Adjacent Subbasins and GSPs

Regulation Requirements
§ 354.28 (b) The description of minimum thresholds shall include the following:
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The MGSA Area is located adjacent to the Monterey Subbasin and shares boundaries with MCWD GSA and SVBGSA. The minimum threshold was selected to prevent potential locally-caused undesirable results from unsustainable groundwater extraction in the MGSA Area, while retaining compatibility with regional sustainable management criteria. Sustainable management criteria were established in coordination with MCWD GSA to support its sustainable management strategy. In addition, the minimum threshold for the 180-Foot and 400-Foot Aquifers was selected to be compatible with SVBGSA's minimum thresholds, which apply to the remainder of the Subbasin and to the portion of the Monterey Subbasin that is not managed by MCWD GSA. The thresholds represent a smooth groundwater elevation surface and would be continuous across inter-agency and inter-basin boundaries. As such, these thresholds will promote cohesive management to achieve the sustainability goals of MGSA, SVBGSA, and MCWD GSA.

MGSA's local sustainable management criteria for the Dune Sand Aquifer are compatible with SVBGSA's management strategy for the underlying regional aquifers. The minimum thresholds for the Dune Sand Aquifer to address local resource conditions will not impede or conflict with SVBGSA's ability to reach their sustainability goals. To the contrary, they will protect sensitive local resources in the portion of the Subbasin managed by SVBGSA from potential harm caused by unsustainable groundwater extraction in the MGSA Area.

4.4.2.5 Impact of Minimum Thresholds on Beneficial Uses and Users

Regulation Requirements:
§ 354.28 (b) The description of minimum thresholds shall include the following:
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The groundwater elevation minimum thresholds may have the following effects on beneficial users and land uses in the Subbasin:

- The threshold for the Dune Sand Aquifer is designed to prevent significant impacts to GDEs by assuring the groundwater supply on which they rely is not unreasonably affected by groundwater extraction in the MGSA Area. This will help to preserve protected habitats and species.
- The threshold for the 180-Foot and 400-Foot Aquifers is set within the range of historical groundwater level fluctuation, with the intent that beneficial users of groundwater for domestic, irrigation and small non-transient supply systems near the MGSA Area would not experience significant interference drawdown as a result of groundwater pumping in the MGSA Area. In addition, gradients that could induce the advancement of seawater intrusion would be controlled consistent with SVBGSA's regional strategy, so that the effect of seawater intrusion on downgradient groundwater users and property owners would not increase, and potentially could decrease as planned recharge and *in lieu* recharge projects are implemented.
- By setting the threshold within the historical range of groundwater level fluctuation, the likelihood of significant depletion of groundwater resources is decreased, protecting the water rights of potential beneficial users.
- If the MPWSP is constructed and groundwater elevations decline to trigger levels established in Chapter 6, management actions will be implemented to address groundwater level decline before undesirable results occur.

4.4.2.6 Current Standards Relevant to Sustainability Indicator

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

No federal, state, or local standards exist for chronic lowering of groundwater elevations.

4.4.2.7 MEASUREMENT OF MINIMUM THRESHOLDS

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater elevation minimum thresholds will be directly measured at RMS in the monitoring well network. The groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 5. Furthermore, the groundwater level monitoring will meet the requirements of the technical and reporting standards included in DWR's Regulations. A biological resource investigation will be conducted as described in Chapter 7 to assess GDE susceptibility to drawdown, establish current baseline conditions, and develop a GDE response monitoring program.

4.4.3 MEASURABLE OBJECTIVES AND INTERIM MILESTONES

Regulation Requirements:
§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.
(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.
(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.
(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

The measurable objectives for chronic lowering of groundwater levels represent target groundwater elevations that are higher than the minimum thresholds in order to provide early warning so potentially adverse trends can be addressed in a timely fashion. Measurable objectives are also established to leave adequate operating flexibility to deal with anticipated variability in conditions such as seasonal and inter-annual climatic variations and droughts, uncertainties in aquifer conditions or unanticipated events. As stated in Section 4.2,

> *"MGSA will manage groundwater resources in the MGSA Area in a way that ensures all beneficial uses and users in, or affected by, groundwater management in the MGSA Area are protected from undesirable results, and have access to a safe and reliable groundwater supply that meets current and future demand."*

The measurable objectives established for groundwater level decline are summarized in Table 4-2, and were developed based on the following approach:

- **Dune Sand Aquifer.** An elevation 1 foot above 2015 low groundwater levels in RMS near GDEs located east of the MGSA Area was adopted to establish the interim minimum thresholds. These minimum thresholds will be updated as warranted based on future planned investigations to address existing data gaps in the relationship between groundwater level declines and GDE response, as discussed in Chapter 7. MGSA adopts these minimum thresholds as measurable

objectives on an interim basis as the data gaps are addressed and sustainable management criteria are updated early during the GSP implementation process. Based on the limited amplitude of seasonal and inter-annual fluctuation in groundwater levels in the Dune Sand Aquifer and the planned schedule for data gap analysis, this approach allows for protection of GDEs while allowing near-term flexibility in groundwater management.

TABLE 4-2. MEASURABLE OBJECTIVES AND INTERIM MILESTONES FOR CHRONIC DECLINE IN GROUNDWATER LEVELS

Monitoring Site	Aquifer	Minimum Threshold (ft NAVD88)	Current Groundwater Level* (ft NAVD88)	Interim Milestone at Year 2025 (ft NAVD88)	Interim Milestone at Year 2030 (ft NAVD88)	Interim Milestone at Year 2035 (ft NAVD88)	Measurable Objective (goal at Year 2040) (ft NAVD88)
MW-4S	Dune Sand	4.0	6.2	5.6	5.1	4.5	4.0
MW-4M	180-Foot	-2.0	0.8	0.4	-0.1	-0.5	-1.0
MW-4D	400-Foot	-14.9	-9.4	-9.3	-9.1	-9.0	-8.8
MW-5M	180-Foot	-6.3	-3.2	-3.1	-3.0	-2.9	-2.8
MW-5D	400-Foot	-16.0	-14.4	-13.3	-12.2	-11.1	-10.0
MW-6M	180-Foot	-25.0	-17.6	-17.7	-17.8	-17.9	-18.0
MW-7S	Dune Sand	4.8	8.8	7.8	6.8	5.8	4.8
MW-7M	180-Foot	-6.1	-2.9	-2.8	-2.7	-2.6	-2.5
MW-7D	400-Foot	-13.9	-10.6	-9.9	-9.2	-8.5	-7.8
MW-8S	Dune Sand	2.6	4.6	4.1	3.6	3.1	2.6
MW-8M	180-Foot	-4.8	-2.2	-2.2	-2.2	-2.1	-2.1
MW-8D	400-Foot	-14.0	-10.6	-10.0	-9.3	-8.7	-8.0
MW-9M	180-Foot	-10.4	-7.6	-7.4	-7.3	-7.1	-7.0
MW-9D	400-Foot	-24.1	-13.5	-14.6	-15.8	-16.9	-18.0

Notes:
NAVD88 = North American Vertical Datum of 1988

- **180-Foot and 400-Foot Aquifers.** Measurable objectives were established to be consistent with those established by SVBGSA to provide a uniform and compatible and implementable strategy that addresses undesirable results regionally and allows for appropriate operating flexibility. SVBGSA identifies few RMS near the MGSA Area, but in order to establish measurable objectives, the groundwater elevation of SVBGSA's measurable objectives above its minimum thresholds for the nearest RMS in the 180- and 400-Foot Aquifers was utilized to establish compatible measurable objectives for this GSP, as follows:
    - The nearest SVBGSA RMS identified for the 180-Foot Aquifer are well 4S/02E-03F04, located about 4 miles northeast of the MGSA Area, and well 14S/02E-27A01, located about 4 miles to the east. The measurable objectives for these wells are set at 6.1 and 8 feet above the minimum thresholds, for an average of 7.0 feet. Therefore, for each 180-Foot Aquifer RMS in this GSP, the measurable objective was initially established at an elevation that is 7.0 feet above the minimum threshold. Hydrographs for the nested wells at each RMS location were then reviewed, and the measurable objective 180-Foot

Aquifer Wells was adjusted by scaling between the measurable objectives for the shallow and deep wells in accordance with observed vertical gradients to help assure that measurable objectives are set at realistically achievable elevations. Finally, for RMS at which minimum thresholds were adjusted to better match minimum thresholds adopted by SVBGSA, the measurable objectives were adjusted accordingly.

- The nearest SVBGSA RMS identified for the 400-Foot Aquifer is well 14S/02E-08M02, located about 1 mile northeast of the MGSA Area. The measurable objectives for this well is set at 6.1 feet above the minimum threshold. Therefore, for each 400-Foot Aquifer RMS in this GSP, the measurable objective was initially established at an elevation that is 6.1 feet above the minimum threshold. A similar approach to the above was used for final adjustments for RMS near well 14S/02E-08M02.

The above-derived measurable objectives will be further updated as appropriate as additional modeling data from the SVIHM and other tools and studies become available, and in coordination with SVBGSA's update of its GSP.

4.4.4 UNDESIRABLE RESULTS

Regulation Requirements:

§354.26 (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

§354.26 (b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

§354.26 (c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Under SVBGSA's GSP, the groundwater elevation undesirable result for the Subbasin, on a regional scale, is reached when over the course of any one year, more than 15% of the groundwater elevation minimum thresholds are exceeded in any single aquifer (*i.e.*, either in the 180-Foot or the 400-Foot Aquifer). The 15% limit on minimum threshold exceedances for chronic lowering of groundwater levels allows for four exceedances in the 23 existing monitoring wells in SVBGSA's current monitoring network: two in the 180-Foot Aquifer and two in the 400-Foot Aquifer. This was considered by SVBGSA a reasonable number of exceedances given the hydrogeologic uncertainty of the Subbasin. Although the monitoring well network currently employed by SVBGSA does not include any wells located southwest of the Salinas River near the MGSA Area, the sustainable management criteria adopted by SVBGSA, combined with their projects and management actions, are expected by SVBGSA to lead to stabilization and likely improvement of the landward gradients in the 180-Foot and 400-Foot Aquifers that have led to seawater intrusion regionally.

Based on the information in the previous sections, the local definition for significant and unreasonable groundwater level decline considers the following additional criteria:

- Groundwater drawdown in the 180-Foot or 400-Foot Aquifers below historical low groundwater elevations during SVBGSA's representative hydrologic period, assumed to be 1 foot above low groundwater levels measured in 2015 has been determined to be an appropriate definition of minimum thresholds by both SVBGSA and MGSA;

- This minimum threshold addresses potential undesirable results related to interference drawdown that adversely affects the capacity or economic viability of existing wells;

- This minimum threshold also limits landward gradients that drive inland seawater intrusion; and

- A similar approach has been determined by MGSA to be an appropriate definition for minimum thresholds in the Dune Sand Aquifer and would prevent drawdown in the Dune Sand Aquifer that is sufficient to cause vegetative stress in GDEs that leads to habitat degradation or harm to protected species.

The causes of potential undesirable results are discussed in Section 4.4.1 and the potential effects of undesirable results on the beneficial users of groundwater, land uses and property owners are discussed in Sections 4.4.1 and 4.4.2.

An undesirable result for chronic decline in groundwater levels is defined using the following combinations of minimum thresholds identified in Section 4.4.2:

- For the Dune Sand Aquifer, an undesirable result is defined to occur when minimum thresholds are exceeded at two or more RMS. There are currently three RMS located near GDEs proximal to the MGSA Area (MW 4S, 7S and 8S). Review of hydrographs for the Dune Sand Aquifer included in Appendix 3.D indicates that groundwater levels can be affected by a variety of influences, including groundwater extraction, recharge from precipitation, recharge from the Salinas River and climatic factors. In order to account for uncertainty in aquifer conditions, an exceedance at two locations (66% of the RMS) is considered to provide an adequate level of confidence that an undesirable result is occurring given uncertainty about the aquifer system.

- The definition for undesirable results in the 180-Foot and 400-Foot Aquifers is an exceedance of the minimum thresholds in 15% or more of the RMS (i.e., two or more wells) in the MGSA groundwater elevation monitoring well network that are located proximal to potential drawdown receptors (MW 4M, 4D, 5M, 5D, 6M, 6M(L), 7M, 7L, 8M, 8L, 9M, and 9L).

The above definitions are effectively a westward and upward extension of the undesirable result definition adopted by SVBGSA for the Subbasin, so as to avoid the formation of regional groundwater gradients that were determined to be significant and unreasonable and that could result in the advancement of seawater intrusion. Based on the available data, these thresholds will also be adequate to prevent significant and unreasonable well interference drawdown. There are at least three small water supply systems reliant on groundwater in the area, and additional irrigation and domestic wells may exist. Therefore, interference drawdown of existing wells is a potential impact to be monitored as

part of the Mitigation Monitoring and Reporting Plan (MMRP) (Zidar and Feeney 2019) for the proposed MPWSP and is a potential impact prevented under this GSP.

Additional beneficial users of shallow groundwater within the Dune Sand Aquifer include GDEs which could also be adversely affected by groundwater elevation declines induced by pumping in the MGSA Area. As discussed in Section 3.2.6.1, several GDEs that support protected habitat and species are located in the vicinity of the MGSA Area. The identified GDEs include palustrine and emergent wetlands (vernal ponds) with protected habitat and species, and are located to the east, northeast and southeast of the MGSA Area. In addition, riparian vegetation and riverine wetlands were identified along the Salinas River that may be at least partly dependent on groundwater. Shallow groundwater drawdown induced by pumping in the MGSA Area could adversely affect these GDEs, harming or degrading protected habitat, and harming protected species. Drawdown of the shallow groundwater table below the normal range of seasonal variation has the potential to induce stress in vegetation that is dependent upon groundwater for all or a portion of the year, and unable to adapt to the greater groundwater depths. As a result, GDEs can be destroyed, undergo succession to a different state, or be otherwise degraded. The above definition of undesirable results recognizes this possibility and is the basis for sustainable management of this resource that would prevent significant and unreasonable impacts.

4.5 REDUCTION IN GROUNDWATER STORAGE

4.5.1 LOCAL FACTORS POTENTIALLY CONTRIBUTING TO SIGNIFICANT AND UNREASONABLE CONDITIONS

Regionally, reduction in storage in the Subbasin's aquifers has historically occurred and is ongoing due to groundwater production for agricultural, municipal, and domestic use that exceeds the long-term sustainable yield of the Subbasin (SVBGSA 2019). As previously described, a large groundwater depression has developed north of Salinas and is apparent on both the 180-Foot/Shallow East Side Aquifers and 400-Foot/Deep East Side Aquifer maps, where elevations are generally -80 to -120 feet msl, and has led to other undesirable results. As a result, less groundwater in storage is available as a buffer against surface water supply shortfalls without causing undesirable results, most notably seawater intrusion. In keeping with this condition, SVBGSA's GSP defines significant and unreasonable reductions in groundwater storage in the Subbasin as those that:

- Lead to long-term reduction in groundwater storage;
- Lead to seawater intrusion and a reduction of water quality;
- Interfere with other sustainability indicators; and
- Affect GDEs and interconnected surface water.

Locally, the MGSA Area is located at the western edge of a substantial zone of low-TDS groundwater (TDS < 3,000 mg/L) extending vertically from the DSA into the180-Foot Aquifer and the 400-Foot Aquifer Sections 3.1.12 and 3.2.2. The volume of low-TDS groundwater in storage within the DSA alone has been estimated to be 188,000 acre-feet (Gottschalk *et al.* 2018). The State Water Resources Control Board (SWRCB) has designated groundwater with TDS concentrations of less than 3,000 mg/L as having an actual or potential beneficial use as municipal and domestic supply (SWRCB Resolution No. 88-63).

The proposed MPWSP slant supply wells would draw source water from the Dune Sand and 180-Foot Aquifers, including water from this low-TDS zone. California law and the California Public Utilities Commission decision regarding the proposed MPWSP require that groundwater extraction for that proposed project may not adversely affect existing beneficial groundwater users or groundwater right holders (CPUC 2018). Thus, this low-TDS groundwater zone is the primary Subbasin groundwater storage that could be depleted by groundwater extraction in the MGSA Area.

As described Section 3.3.13, the local contribution to the sustainable yield from groundwater extraction in the MGSA Area is the amount of groundwater that can be withdrawn annually over a period of time without causing undesirable results within or near the MGSA Area. Undesirable results include, but may not be limited to, the following significant and unreasonable impacts beyond a 2015 baseline condition:

- Chronic groundwater level decline in the Dune Sand Aquifer that adversely effects GDEs or other beneficial groundwater users, including holders of overlying groundwater rights;
- Further seawater intrusion into the Dune Sand, 180-Foot, 400-Foot, and/or Deep Aquifers; or
- Degradation of the low-TDS groundwater zone within the Dune Sand and/or 180-Foot Aquifer.

Groundwater extraction for the CEMEX plant has been ongoing since the 1960s without reports of undesirable results, and represents the only long-term groundwater extraction within the MGSA Area. It is possible that this well is withdrawing a combination of saline and low-TDS groundwater. Data are not available to assess if groundwater extraction from the CEMEX well historically contributed to seawater intrusion in this area since the 1960s when pumping started, but based on the available data the groundwater level and quality conditions associated with this extraction were likely stable by 2015 and therefore considered sustainable under SGMA. However, due to concern about limiting extractions to avoid seawater intrusion, the City of Marina, MCWD, and Monterey County entered into the 1996 Annexation Agreement (provided as Appendix 8.B) limiting extractions at the CEMEX property to 500 AFY.

Water quality trends and groundwater elevations during test slant well pumping at a rate of 2,860 AFY from April 2015 to February 2018 indicate that low TDS groundwater (< 3,000 mg/L TDS) from the inland portion of the Dune Sand and 180-Foot Aquifers was likely being captured during the test, and that the equilibrium between the saline groundwater wedge and low TDS groundwater zone within and east of the MGSA Area may have been at least temporarily affected. As previously described, ET from nearby GDEs decreased significantly during this test, due to a combination of drawdown and drought conditions. The ET from this GDE has since recovered, but it is not known whether vegetative stress resulted in longer-term changes to the habitat community composition or quality. For these reasons, without additional data and modeling tools, it is not possible to assess whether continued pumping at the rate of the test slant well would be sustainable in the long term or whether it would cause undesirable results that indicate a significant and unreasonable reduction in groundwater storage. If the MPWSP is fully approved and implemented, the proposed increased source water pumping rate of 17,400 AFY would have a greater effect on the local groundwater budget, potentially further stressing

sustainability indicators including groundwater level decline (and impacts to GDEs), water quality degradation, and seawater intrusion.

The construction of new wells in the Deep Aquifer is currently prohibited and there are no plans to construct any Deep Aquifer wells within the MGSA Area. As discussed in Chapter 6, MGSA will support management actions by SVBGSA to strengthen these prohibitions. For these reasons, undesirable results, minimum thresholds, and measurable objectives for reduction in groundwater storage are not adopted for the Deep Aquifer in this GSP.

4.5.2 MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(2) Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Section 354.28(c)(2) of the Regulations state that "*The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results*." SVBGSA has adopted a basin-wide minimum threshold equal to the total volume of groundwater that can be annually withdrawn from the Subbasin without leading to a long-term reduction in groundwater storage or interfering with other sustainability indicators, which is a calculated long-term average sustainable yield of 112,000 AFY. The minimum threshold applies to pumping of natural recharge only. Pumping of intentionally recharged water that is not part of the natural recharge is not considered when compared against the minimum threshold. SVBGSA's calculations account for current land use, future urban growth, and anticipated reasonable climate change. Seawater intrusion (i.e., seawater inflow volume) is not considered part of the sustainable yield. SVBGSA's GSP states that during average hydrogeologic conditions, and as a long-term average over all hydrogeologic conditions, total groundwater pumping shall not exceed the minimum threshold, which is equivalent to the long-term sustainable yield of the aquifers in the Subbasin. SVBGSA states the sustainable yield is an estimate only and will be updated as additional studies are undertaken and data are compiled (e.g., to address identified data gaps). Release of the SVIHM by the USGS, which is currently expected in late 2020, will represent a significant improvement in the tools available for assessment of Subbasin sustainable yield, and SVBGSA, MCWD GSA and MGSA all plan to use this tool to refine their understanding of the local and regional water budgets.

Because the local tools to further assess the MGSA Area component of the Subbasin-wide sustainable yield are not yet available, this GSP adopts SVBGSA's basin-wide sustainable yield estimate as a minimum threshold, supplemented locally by the following interim minimum threshold related to the low-TDS groundwater zone near the MGSA Area in order to prevent undesirable results from groundwater extraction in the MGSA Area:

- A decrease in the amount of low-TDS groundwater in storage in the Dune Sand, 180-Foot and 400-Foot Aquifers as measured by groundwater elevations, extraction reporting and induction logging.

This interim minimum threshold is adopted to prevent significant and unreasonable impacts to GDEs, seawater intrusion, groundwater quality degradation, and potential harm to overlying groundwater right holders, while the data gaps regarding the sustainable yield are addressed as discussed in Chapters 6 and 7, and until a local sustainable yield volume minimum threshold can be determined.

The relationship between groundwater elevations (combined with induction logging and extraction volume logging to assess changes in the volume of low-TDS groundwater storage) and undesirable results related to chronic groundwater level decline (through significant and unreasonable impacts to GDEs), seawater intrusion and groundwater quality degradation is discussed in Section 4.5.1.

4.5.2.1 Relationships Between Minimum Thresholds and Other Sustainability Indicators

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

The minimum threshold for reduction in groundwater storage is based on a basin-wide estimate of sustainable yield shared by the GSAs with jurisdiction in the Subbasin, supplemented by a local storage threshold that prevents undesirable results while data gaps in the local and regional sustainable yield are addressed. Therefore, there is no conflict between the minimum threshold application at different locations in the Subbasin.

Groundwater storage reduction thresholds are related to other sustainability indicators in the MGSA Area and its vicinity. The groundwater storage reduction threshold was selected to avoid undesirable results for other sustainability indicators and to promote compatible management strategies. By definition, the sustainable yield must avoid undesirable results related to any of the other sustainability indicators. If measurable objectives and interim milestones are not met, MGSA will act to curtail local pumping to sustainable levels and refine the local sustainable yield estimate. MGSA will also coordinate with SVBGSA to update the regional sustainable yield estimate as appropriate.

- **Chronic decline in groundwater levels**. As discussed in Section 4.4, a significant and unreasonable condition for change in groundwater elevations is a decline below levels that cause GDE stress, result in significant and unreasonable interference drawdown, or decline below levels regionally determined by SVBGSA to result in undesirable conditions related to

seawater intrusion. Decline of groundwater elevations would be associated with changes in storage and will be used in combination with water quality monitoring to assess changes in low-TDS groundwater storage. These sustainable management criteria will be used in combination to manage both chronic decline in groundwater levels and reduction in groundwater storage. Although the minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. Indeed, the interim minimum threshold for reduction in storage has been developed to prevent potential undesirable results related to decline in groundwater levels. These thresholds may be refined during GSP implementation as more information and better tools become available. Therefore, the groundwater storage reduction minimum threshold is unlikely to result in significant and unreasonable groundwater level decline.

- **Seawater intrusion.** As discussed in Section 4.6, significant and unreasonable seawater intrusion is defined as the migration of chloride isocontours that define the extent of seawater intrusion as of 2017 (for the 180-Foot, 400-Foot and Deep Aquifers) or 2018 (for the Dune Sand Aquifer). This sustainability indicator is closely related to changes in the dynamic equilibrium between the saline water intrusion wedge near the shore and the overlying low-TDS groundwater zone. By definition, sustainable yield is predicated in the avoidance of undesirable results, including seawater intrusion, and the sustainable management of seawater intrusion and reduction in storage will be coordinated. Indeed, the interim minimum threshold for reduction in storage has been developed to prevent potential undesirable results related to seawater intrusion. The thresholds for seawater intrusion and reduction in storage may be adjusted during GSP implementation as more information becomes available in order to refine their alignment and assure the avoidance of undesirable results. Therefore, the groundwater storage reduction minimum threshold is unlikely to result in significant and unreasonable seawater intrusion, but rather, may help to prevent seawater intrusion.

- **Degraded water quality**. As discussed in Section 4.7, significant and unreasonable degradation of groundwater quality is defined as the lateral or vertical migration of a TDS isocontour, or the induced migration of a contaminant contour exceeding water quality objectives in a nearby contamination plume. This sustainability indicator is closely related to seawater intrusion. By definition, sustainable yield is predicated in the avoidance of undesirable results, including degradation in groundwater quality, and the sustainable management of groundwater quality degradation and reduction in storage will be coordinated. Indeed, the interim minimum threshold for reduction in storage has been developed to prevent potential undesirable results related to groundwater quality degradation. The thresholds for degraded water quality and reduction in storage may be adjusted during GSP implementation as more information becomes available in order to refine their alignment and assure the avoidance of undesirable results. Therefore, the groundwater storage reduction minimum threshold is unlikely to result in significant and unreasonable degraded water quality, but rather, may help to protect water quality.

- **Subsidence**. A significant and unreasonable condition for subsidence is any measurable long-term inelastic subsidence that damages existing infrastructure. Subsidence is caused by depressurization and compaction of fine-grained sediments in response to lowering groundwater levels, especially in confined systems when groundwater elevations fall below historical lows. Since the threshold for reduction in groundwater storage is unlikely to be associated with significant and unreasonable declines in groundwater elevations, measurable subsidence is unlikely.

- **Depletion of interconnected surface waters.** A significant and unreasonable condition for the depletion of interconnected surface waters is depletion that induces significant and unreasonable degradation of GDEs, seawater intrusion in the tidal reaches of the river, or groundwater pumping-induced depletion of flow in the Salinas River that results in significant and unreasonable impacts to beneficial surface water uses. As discussed above, the minimum threshold for reduction in groundwater storage is unlikely to result in a significant and unreasonable decline in groundwater levels. Without a significant decline in groundwater levels, significant changes in surface water depletion are not anticipated. Therefore, the groundwater storage reduction minimum threshold is unlikely to result in significant and unreasonable depletion of interconnected surface water.

4.5.2.2 Minimum Thresholds in Relation to Adjacent Subbasins and GSPs

Regulation Requirements
§ 354.28 (b) The description of minimum thresholds shall include the following:
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The MGSA Area is located adjacent to the Monterey Subbasin and shares boundaries with MCWD GSA and SVBGSA. The aquifers for which the minimum thresholds were developed extend from the 180/400 Foot Aquifer Subbasin into the Monterey Subbasin south and southeast of the MGSA Area. The minimum threshold was selected to prevent potential locally-caused undesirable results caused by unsustainable groundwater extraction in the MGSA Area, while retaining compatibility with regional sustainable management criteria that will be coordinated across Subbasin boundaries. Sustainable management criteria were coordinated with MCWD to support their sustainable management strategy in the adjacent Monterey Subbasin. MCWD also participated in the development of SVBGSA's GSP, including establishment of the regional sustainable management criteria for groundwater storage depletion adopted in this GSP, and therefore, the sustainable management criteria are regionally compatible across the jurisdictions of all the GSAs in the 180/400 Foot Aquifer Subbasin and the adjacent Monterey Subbasin, and will promote cohesive management to achieve the sustainability goals of MGSA, SVBGSA, and MCWD GSA.

SVBGSA's GSP does not present sustainable management criteria for the Dune Sand Aquifer; however, the SVBGSA GSP water budget and sustainable yield estimates include recharge through the Dune Sand Aquifer, so in effect, it is included in these estimates. In addition, we understand that MCWD GSA intends to manage the Dune Sand Aquifer as a principal aquifer in the GSP for the Monterey Subbasin. As such, the fact that the minimum threshold for groundwater storage depletion in this GSP applies to the Dune Sand as well as the 180-Foot and 400-Foot Aquifers will not conflict with the ability of MCWD GSA or SVBGSA to meet their respective sustainability goals.

4.5.2.3 Impact of Minimum Thresholds on Beneficial Uses and Users

Regulation Requirements:
§ 354.28 (b) The description of minimum thresholds shall include the following:
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The groundwater storage reduction minimum threshold may have the following effects on beneficial users and land uses in the Subbasin:

- The threshold will help to maintain the amount of low-TDS water in storage with a designated potential beneficial use for domestic and municipal supply.
- The threshold will serve to assure that the low-TDS/saline water balance in the seaward side of the Subbasin is retained, helping to control seawater intrusion and benefiting municipal and irrigation groundwater uses and users.
- The threshold will help assure the future availability of groundwater with potential beneficial uses to groundwater right holders.

4.5.2.4 CURRENT STANDARDS RELEVANT TO SUSTAINABILITY INDICATOR

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

No federal, state, or local standards exist for reduction of groundwater storage. California water law requires that if the MPWSP is fully approved and implemented, the project will not obtain appropriative water rights if the extraction of groundwater causes injury to existing beneficial users or water rights in the Subbasin.

4.5.2.5 MEASUREMENT OF MINIMUM THRESHOLDS

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater storage reduction will be measured using the MGSA monitoring well network using a combination of groundwater level monitoring together with extraction reporting and induction logging to calculate changes in low-TDS groundwater storage as an interim proxy for extraction volume estimates alone. The groundwater level and quality monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 5, and will meet the requirements of the technical and reporting standards included in the Regulations.

4.5.3 MEASURABLE OBJECTIVES AND INTERIM MILESTONES

Regulation Requirements:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

SVBGSA has set a measurable objective for reduction in groundwater storage that is the same as its minimum threshold, which is the estimated sustainable yield of the Subbasin of 112,000 AFY. Recognizing the practical limitations imposed by the current data gaps, the MGSA adopts the same approach in this GSP. This GSP therefore adopts a regional measurable objective equal to the estimated Subbasin sustainable yield of 112,000 AFY, supplemented locally by an interim measurable objective of a decrease in the amount of low-TDS groundwater in storage in the Dune Sand, 180-Foot and 400-Foot Aquifers as measured by groundwater elevations, extraction reporting and induction logging. Interim milestones shall be equal to the measurable objectives. The interim local measurable objective will be updated as local and regional data gaps regarding Subbasin sustainable yield are addressed in accordance with Chapters 6 and 7.

4.5.4 UNDESIRABLE RESULTS

Regulation Requirements:

§354.26 (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

§354.26 (b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

§354.26 (c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Based on the information in the previous sections, the local definition for significant and unreasonable reduction in groundwater storage considers the following:

- The GSP regulations define the minimum threshold for reduction in groundwater storage as a groundwater volume that can be withdrawn without causing conditions that may lead to

undesirable results (23 CCR § 354.28(c)(2)). By definition, this requires consideration of and close coordination with management of other sustainable management criteria.

- Depletion of groundwater storage has the potential to cause, or lead to conditions that in the future may cause, significant and unreasonable:
    - Impacts to GDEs;
    - Seawater intrusion or groundwater quality degradation that affects agricultural, municipal and other beneficial uses and potential beneficial uses; and/or
    - Reduction in the availability of groundwater and surface water by water right holders, or increased pumping or treatment costs.

The causes of potential undesirable results are further discussed in Section 4.5.1 and the potential effects of undesirable results on the beneficial users of groundwater, land uses, and property owners are discussed in Sections 4.5.1 and 4.5.2.

An undesirable result for reduction in groundwater storage is defined based on the minimum threshold discussed in Section 4.5.2 as an annual depletion, in any given year, exceeding the Subbasin-wide minimum threshold of 112,000 AFY or resulting in a depletion of low-TDS groundwater storage east of the MGSA Area as determined as measured by groundwater elevations, extraction reporting and induction logging. Because additional local tools to further assess the MGSA Area component of the basin-wide sustainable yield are expected to be available in the near future, MGSA has adopted this definition of undesirable results to prevent undesirable results as data gaps are addressed.

4.6 SEAWATER INTRUSION

4.6.1 LOCAL FACTORS POTENTIALLY CONTRIBUTING TO SIGNIFICANT AND UNREASONABLE CONDITIONS

As discussed in Section 3.2.3.2, MCWRA has been designated as the agency responsible for monitoring seawater intrusion in the Subbasin and publishes estimates of the extent of seawater intrusion every two years based on the inferred location of the 500 mg/L chloride concentration isocontour. Maps showing the progression of the seawater intrusion front over time up to 2015 in the 180-Foot and 400-Foot Aquifers are presented as Figure 4-1 and Figure 4-2, respectively. These figures also show the advance of seawater intrusion into the Dune Sand Aquifer using a standard of 3,000 mg/L TDS (or 1,660 mg/L chloride using a conversion factor of 0.554 for the chloride content of seawater) identified during the airborne electromagnetic (AEM) survey (Gottschalk *et al*. 2018). Continued seawater intrusion is driven by a large trough north and northeast of Salinas where groundwater elevations have fallen below sea level. SVBGSA estimates of groundwater storage losses due to continued seawater intrusion in the Subbasin range from 8,000 to 14,000 AFY (SVBGSA 2019).

As part of its Best Management Practices (BMPs) for Monitoring Networks[2] for seawater intrusion, DWR emphasizes the importance of capturing "*changes in water quality conditions associated with the dynamic seawater-freshwater interface along coastal aquifers. This system is largely controlled by differences in water density and hydraulic head to maintain the advancement of the seawater front. A robust understanding is necessary to identify the preferential flow pathways where seawater can intrude inland and associate with freshwater groundwater extractions or declines in head*." In compliance with these requirements, the MGSA GSP uses all the available data, including AEM geophysical data, to describe the extent of seawater intrusion, and considers both the nearshore dynamics as well as the inland intrusion front described in SVBGSA's GSP.

Locally, the MGSA Area is located on the seaward side of the interface between a dense saline water intrusion wedge and an over-riding zone of low-TDS groundwater that is locally recharged through the Dune Sand Aquifer. The interface extends from the Dune Sand Aquifer in the eastern portion of the MGSA Area and dips eastward down through the 180-Foot Aquifer and into the 400-Foot Aquifer and is subject to density-driven flow in general conformance with Ghyben-Herzberg dynamics (Sections 3.1.12 and 3.2.2). Groundwater extraction in the MGSA Area has the potential to affect the dynamic equilibrium of this nearshore groundwater system and cause seawater intrusion through the migration of the saline water wedge, which could in turn lead to deeper seawater intrusion into the currently unintruded Deep Aquifer, or promote the lateral migration or persistence of seawater intrusion (as defined by the 500 mg/L chloride concentration isocontour) further inland.

As discussed in Section 3.2.3.1, the gravity-driven interface dynamics which occur near the MGSA Area differ from the advective solute transport that characterizes seawater intrusion in more inland areas, where the intruding water has a much lower TDS concentration and density. In these inland areas, dissolved solids essentially behave as a tracer that follows groundwater flow landward in the 180- and 400-Foot Aquifers and seaward in the Dune Sand Aquifer. Portions of the seawater intruded areas of these aquifers contain groundwater designated as suitable or potentially suitable for municipal and domestic supply under SWRCB Resolution No. 88-63, that are required to be protected from further degradation by seawater intrusion under SWRCB Resolution No. 68-16. The sustainable management criteria for seawater intrusion must therefore address local conditions and anticipated groundwater demand changes so as to supplement and support the regional definition, thus maintaining and achieving sustainable management both locally and regionally.

The Deep Aquifer is not currently seawater intruded. As discussed in Chapter 3, however, the Deep Aquifer is believed to receive recharge via leakance from the overlying 400-Foot Aquifer. The competence and lateral continuity of the aquitards that separate the Deep Aquifer system from the overlying aquifers has not been well characterized; therefore, Monterey County has adopted an ordinance prohibiting further development of this aquifer until the required characterization is complete. As discussed in Chapters 6 and 7, plans are being discussed by MCWRA, SVBGSA and MCWD

[2] California Department of Water Resources (DWR), *Best Management Practices for the Sustainable Management of Groundwater, Monitoring Networks and Identification of Data Gaps BMP*, California Department of Water Resources Sustainable Groundwater Management Practices (December 2016).

GSA to address this data gap. Based on this information, the possibility exists that seawater intrusion could migrate vertically from the 400-Foot Aquifer into the Deep Aquifer. There are currently no Deep Aquifer wells in the MGSA Area, and this GSP includes support for prohibition of installation of Deep Aquifer production wells in the MGSA Area. Nevertheless, groundwater extraction from the upper aquifer system could cause further seawater intrusion by expansion or migration of the saline water wedge that underlies this area. Such an expansion or migration would put the Deep Aquifer at greater risk of seawater intrusion.

4.6.2 MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(3) Seawater Intrusion. The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results. Minimum thresholds for seawater intrusion shall be supported by the following:

(A) Maps and cross-sections of the chloride concentration isocontour that defines the minimum threshold and measurable objective for each principal aquifer.

(B) A description of how the seawater intrusion minimum threshold considers the effects of current and projected sea levels.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence

Section 354.28(c)(3) of the Regulations states that "*The minimum threshold for seawater intrusion shall be defined by a chloride concentration isocontour for each principal aquifer where seawater intrusion may lead to undesirable results*." Regionally, SVBGSA's GSP defines significant and unreasonable seawater intrusion in the Subbasin as seawater intrusion beyond the position of the 500 mg/L chloride isoconcentration contour interpolated by MCWRA in 2017 for the 180-Foot and 400-Foot Aquifers (SVBGSA 2019). The minimum threshold adopted by the SVBGSA for seawater intrusion into the Deep Aquifer is the location of the 500 mg/L chloride isocontour at Highway 1. SVBGSA does not present a minimum threshold for the Dune Sand Aquifer.

Locally, the minimum thresholds for seawater intrusion were developed based on assessment of the following additional criteria:

- The extent of the saline water intrusion wedge (TDS > 10,000 mg/L) interpreted from airborne electromagnetic surveys performed in 2017 (Gottschalk *et al.* 2018) plays an important role in seawater intrusion dynamics recognized in the DWR guidance and could affect both lateral and vertical seawater intrusion;
- Seawater intrusion into the Deep Aquifer has not yet been observed; and

- The Dune Sand Aquifer stores significant volumes of low-TDS groundwater with TDS concentrations less than 3,000 mg/L (chloride < 1,660 mg/L) with a designated beneficial use for domestic and municipal supply.

Based on this information, MGSA established the following minimum thresholds for significant and unreasonable seawater intrusion in this GSP:

- **Dune Sand Aquifer**. In compliance with SWRCB Resolution Nos. 88-63 and 68-16, this GSP defines the minimum threshold for significant and unreasonable seawater intrusion into the Dune Sand Aquifer as migration of the 1,700 mg/L chloride isocontour (equivalent to 3,000 mg/L TDS) beyond the location determined by Gottschalk *et al.* (2018) (Figure 4-2).
- **180-Foot and 400-Foot Aquifers**. This GSP adopts the SVBGSA minimum threshold of significant unreasonable seawater intrusion beyond the position of the 500 mg/L chloride concentration isocontour interpolated by MCWRA in 2017 (Figure 4-2).
- **Deep Aquifer.** In compliance with SWRCB Resolution No. 68-16, this GSP defines significant and unreasonable seawater intrusion into the Deep Aquifer as migration of a 500 mg/L chloride isocontour into the Deep Aquifer landward of the western Subbasin boundary (Figure 4-2).

As discussed in Chapter 6, MCWD GSA plans to develop a groundwater model that incorporates solute and transport and density driven flow, and that can be used to evaluate the effectiveness of local management actions and projects to address seawater intrusion, as well as the potential impacts of increased groundwater extraction. This model will include the MGSA Area and will incorporate the effects of sea level rise. The minimum thresholds adopted herein may be refined or revised based upon the results of this model, when available. Therefore, the minimum thresholds and actions to avoid undesirable results will address sea level rise.

4.6.2.1 Relationships Between Minimum Thresholds and Other Sustainability Indicators

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

The minimum thresholds for seawater intrusion chloride and TDS isocontours are interpolated from water quality, conductance sensor and inductance logging data. Seawater intrusion minimum thresholds are related to several other sustainability indicators. The seawater intrusion thresholds were selected to avoid undesirable results for other sustainability indicators and to promote compatible management strategies.

- **Chronic decline in groundwater levels**. As discussed in Section 4.4, a significant and unreasonable condition for change in groundwater elevations is a decline below levels that cause GDE stress, result in significant and unreasonable interference drawdown, or decline below levels regionally determined by SVBGSA to result in undesirable conditions related to seawater intrusion. A decline of groundwater elevations would likely be associated with any measured migration of the TDS isocontour in the Dune Sand Aquifer, and will be considered in combination with water quality data to assess the relationship of seawater intrusion to pumping

in the MGSA Area. These sustainable management criteria will be used in combination to manage both chronic decline in groundwater levels and seawater intrusion. Although the minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. These thresholds may be refined during GSP implementation as more information and better tools become available. Therefore, the seawater intrusion minimum threshold is unlikely to result in significant and unreasonable groundwater level decline.

- **Reduction in groundwater storage**. As discussed in Section 4.5, a significant and unreasonable condition for change in groundwater storage is defined as an annual extraction of groundwater in the MGSA Area that falls above the total long-term sustainable yield of the Subbasin established by SVBGSA or that results in depletion of the amount of low-TDS groundwater in storage in the Dune Sand, 180-Foot and 400-Foot Aquifers east of the MGSA Area. By definition, sustainable yield is predicated on the avoidance of undesirable results, including seawater intrusion, and the sustainable management of seawater intrusion and reduction in storage will be coordinated. In addition, reduction in the amount of low-TDS groundwater in storage may be associated with seawater intrusion; therefore, storage reduction will be assessed using both groundwater level and quality data. The minimum threshold for seawater intrusion is intended to protective of groundwater quality and will not interfere with the assessment of storage depletion. Although these minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. These thresholds may be refined during GSP implementation as more information and better tools become available. Therefore, the seawater intrusion minimum threshold is unlikely to result in significant and unreasonable reduction in groundwater storage.

- **Degraded water quality**. As discussed in Section 4.7, significant and unreasonable degradation of groundwater quality is defined as the lateral or vertical migration of a TDS isocontour, or the induced migration of a contaminant contour exceeding water quality objectives in a nearby contamination plume. This sustainability indicator is closely related to seawater intrusion. Although the minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. Furthermore, the thresholds for degraded water quality and seawater intrusion may be adjusted during GSP implementation as more information becomes available in order to refine their alignment. Therefore, the seawater intrusion minimum threshold is unlikely to result in significant and unreasonable degraded water quality, but rather, will protect water quality.

- **Subsidence**. A significant and unreasonable condition for subsidence is any measurable long-term inelastic subsidence that damages existing infrastructure. Subsidence is caused by depressurization and compaction of fine-grained sediments in response to lowering groundwater levels, especially in confined systems when groundwater elevations fall below historical lows. Seawater intrusion thresholds are unrelated to the cause of land subsidence.

- **Depletion of interconnected surface waters.** A significant and unreasonable condition for the depletion of interconnected surface waters is depletion that induces, significant and unreasonable degradation of GDEs, seawater intrusion in the tidal reaches of the river, or groundwater pumping-induced depletion of flow in the Salinas River that results in significant and unreasonable impacts to surface water uses. The seawater intrusion thresholds will not affect the mechanics of surface-groundwater interaction, but could theoretically affect the quality of groundwater that is discharged to surface water discharge zones, such as wetlands.

However, the seawater intrusion thresholds include water quality thresholds intended to prevent the significant degradation of groundwater quality that would adversely affect wetlands. In addition, as discussed in Section 4.9, declining groundwater levels near the tidally-influenced lower reach of the Salinas River could cause seawater intrusion through the river bed. The minimum thresholds for groundwater level decline are intended to prevent significant additional seawater intrusion from the lower reaches of the Salinas River. The minimum thresholds established for seawater intrusion are not expected to affect these dynamics.

4.6.2.2 Minimum Thresholds in Relation to Adjacent Subbasins and GSPs

Regulation Requirements
§ 354.28 (b) The description of minimum thresholds shall include the following:
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The MGSA Area is located adjacent to the Monterey Subbasin and shares boundaries with MCWD GSA and SVBGSA. The seawater intruded areas for which the minimum thresholds were developed and the associated saline water intrusion wedge and low-TDS groundwater zone occur, extend from the 180/400 Foot Aquifer Subbasin into the Monterey Subbasin south and southeast of the MGSA Area. The minimum thresholds were selected to align with and support regional efforts to contain seawater intrusion in the 180- and 400-Foot Aquifers and also address local seawater intrusion into the Dune Sand and Deep Aquifers. Sustainable management criteria were established in collaboration with MCWD to support their sustainable management strategy for the Dune Sand and Deep Aquifers in the adjacent Monterey Subbasin. In addition, minimum thresholds for the 180-Foot and 400-Foot Aquifers align with SVBGSA's minimum thresholds for regional groundwater management, which apply to the remainder of the Subbasin and to the portion of the Monterey Subbasin that is not managed by MCWD GSA.

Differences between this GSP and the SVBGSA GSP include that this GSP (1) establishes a minimum threshold for seawater intrusion into the Dune Sand Aquifer to protect significant local resources, and (2) establishes the location of the chloride isocontour that defines the minimum threshold for seawater intrusion into the Deep Aquifer at the coastal margin of the Subbasin rather than at Highway 1 in order to fully protect this important groundwater resource and comply with applicable water quality protection standards. These measures are considered necessary to address gaps in the SVBGSA's regional GSP and support locally-defined sustainable groundwater management and will be coordinated with SVBGSA and MCWD GSA. As such, these thresholds will promote cohesive management to achieve the sustainability goals of MGSA, SVBGSA, and MCWD GSA, which will be refined as needed during GSP implementation.

4.6.2.3 Impact of Minimum Thresholds on Beneficial Uses and Users

Regulation Requirements:
§ 354.28 (b) The description of minimum thresholds shall include the following:
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The seawater intrusion minimum thresholds may have the following effects on beneficial users and land uses in the Subbasin:

- The threshold will help to prevent the regional advance of seawater intrusion in the 180- and 400-Foot Aquifers in the inland areas east of the Subbasin. Local monitoring in support of this minimum threshold will help to fill existing data gaps regarding nearshore processes related to density-driven flow.
- The threshold for the Dune Sand Aquifer will help to protect the quality of low-TDS water in storage with a designated potential beneficial use for domestic and municipal supply from further degradation by seawater intrusion.
- The threshold will help to protect the Deep Aquifer, which is an important municipal and agricultural water supply and currently the only source of municipal water for the City of Marina, from seawater intrusion.
- If the MPWSP is constructed and the seawater intrusion measurable objectives described in Section 4.6.3 are reached, the management actions described in Section 6.2.1 will be implemented.

4.6.2.4 CURRENT STANDARDS RELEVANT TO SUSTAINABILITY INDICATOR

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

The seawater intrusion minimum thresholds incorporate the locally defined 500 mg/L chloride standard for definition of seawater intrusion into the 180-Foot, 400-Foot, and Deep Aquifers. In addition, the seawater intrusion minimum threshold addresses applicable Water Quality Standards incorporated into the Regional Water Quality Control Board's Water Quality Control Plan, including SWRCB Resolution Nos. 88-63 and 68-16.

4.6.2.5 MEASUREMENT OF MINIMUM THRESHOLDS

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Seawater intrusion will be measured from the MGSA monitoring well network using groundwater quality monitoring, including groundwater sampling and analysis, specific conductance sensors, and semi-annual induction logging to assess the lateral and vertical distribution of salinity. The groundwater quality monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 5. Groundwater quality data to evaluate compliance with minimum thresholds and measurable objectives for seawater intrusion will be gathered from the wells listed in Tables 5-1, 5-2, and 5-3 for the Dune Sand, 180-Foot and 400-Foot Aquifers, respectively. Groundwater quality data to evaluate compliance with minimum thresholds and measurable objectives in the Deep Aquifer will be gathered from the supply wells listed in Table 5-4 (MCWD #'s 10, 11 and 12; and MCWRA #'s 25973, 21655 and 22755).

4.6.3 MEASURABLE OBJECTIVES AND INTERIM MILESTONES

Regulation Requirements:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

The measurable objectives for seawater intrusion represent positions of chloride concentration isocontours that define the desired future state of the Subbasin. Measurable objectives are also established to leave adequate operating flexibility to deal with anticipated variability in conditions such as seasonal and inter-annual climatic variations and droughts, uncertainties in aquifer conditions or unanticipated events. As stated in Section 4.2,

> "*MGSA will manage groundwater resources in the MGSA Area in a way that ensures all beneficial uses and users in, or affected by, groundwater management in the MGSA Area are protected from undesirable results, and have access to a safe and reliable groundwater supply that meets current and future demand*."

The following measurable objectives are established in this GSP:

- **Dune Sand Aquifer**. The measurable objectives are established to equal the minimum threshold of maintaining the 1,700 mg/L chloride isocontour at its current location. The interim milestones are identical to the measurable objective.
- **180-Foot and 400-Foot Aquifers**. MGSA will coordinate with SVBGSA, as appropriate, and support the measurable objective and interim milestones in the SVBGSA's GSP of moving the 500 mg/L chloride isocontour westward to Highway 1 by 2020.
- **Deep Aquifer.** The measurable objective for the Deep Aquifer will be to prevent significant and unreasonable seawater intrusion and maintain the location of the 500 mg/L chloride isocontour outside the seaward Subbasin Boundary. The interim milestones are identical to the measurable objective.

4.6.4 UNDESIRABLE RESULTS

Regulation Requirements:

§354.26 (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Based on the information in the previous sections, the local definition for significant and unreasonable seawater intrusion considers the following:

- Ongoing seawater intrusion in the 180- and 400-Foot Aquifers has been regionally identified based on the migration of seawater intrusion beyond the documented position of the 500 mg/L chloride isocontour, and has resulted in the designation by DWR of the aquifer being in a condition of critical overdraft. SVBGSA's GSP does not consider nearshore seawater intrusion dynamics and preferential pathways that are important to understanding this process. The monitoring program discussed in Chapter 5 will provide additional data to promote understanding of the process. Nevertheless the 500 mg/L chloride isocontour is an adequate and appropriate measure of undesirable results.

- The SVBGSA's GSP does not establish a definition for significant and unreasonable seawater intrusion into the Dune Sand Aquifer; however, this GSP considers that this aquifer contains a significant quantity of low-TDS groundwater that requires protection from degradation by seawater intrusion under SWRCB Resolution Nos. 88-63 and 68-16. In order to comply with these resolutions, this GSP defines undesirable results for seawater intrusion into the Dune Sand Aquifer.

- The Deep Aquifer is not currently seawater intruded and is an important local and regional source of municipal and agricultural groundwater supply. Any seawater intrusion into this aquifer would violate existing water quality standards and put this important water supply at risk; therefore, any seawater intrusion into the Deep Aquifer is considered an undesirable result.

The causes of potential undesirable results related to seawater intrusion are further discussed in Section 4.6.1 and the potential effects of undesirable results on the beneficial users of groundwater, land uses and property owners are discussed in Sections 4.6.1 and 4.6.2.

An undesirable result for seawater intrusion is defined as follows based on the minimum thresholds discussed in Section 4.6.2:

- **Dune Sand Aquifer.** Migration of the 1,700 mg/L chloride isocontour beyond its location in 2018, indicating seawater intrusion into the low-TDS zone identified in Gottschalk *et al.* (2018), as interpreted from water quality sampling and induction logging data collected by MCWRA.
- **180-Foot and 400-Foot Aquifer.** Seawater intrusion beyond the position of the 500 mg/L chloride isocontour interpolated by MCWRA in 2017, as determined by seawater intrusion maps prepared by MCWRA.
- **Deep Aquifer.** Seawater intrusion beyond a theoretical 500 mg/L chloride isocontour established as the western (seaward) edge of the Subbasin, as interpreted from groundwater quality monitoring data collected by MCWRA.

4.7 DEGRADED GROUNDWATER QUALITY

4.7.1 LOCAL FACTORS POTENTIALLY CONTRIBUTING TO SIGNIFICANT AND UNREASONABLE CONDITIONS

Regionally, SVBGSA's GSP defines significant and unreasonable changes in water quality in the Subbasin as increases in the concentrations of chemical constituents that either:

- Result in groundwater concentrations in a public supply well above an established Maximum Contaminant Level (MCL) or Secondary Maximum Contaminant Level (SMCL); or
- Lead to reduced crop production.

SVBGSA defines undesirable results based on the exceedance of MCLs or SMCLs in public supply wells, or the exceedance of agricultural standards in irrigation wells. Noting that minimum thresholds are based on a degradation of groundwater quality, not an improvement of groundwater quality, SVBGSA's approach is designed to avoid any action by SVBGSA that may inadvertently move groundwater constituents that have already been identified in the Subbasin in such a way that the constituents have a significant and unreasonable impact to public supply or irrigation wells that would not otherwise occur. A list of constituents of concern was developed based on reported detections of constituents in the Subbasin above levels of concern.

Locally, the MGSA Area is located at the western edge of a substantial zone of low-TDS groundwater (TDS < 3,000 mg/L) extending from the Dune Sand Aquifer into the 180-Foot Aquifer and the 400-Foot Aquifer (Sections 3.1.12 and 3.2.2). Groundwater with TDS concentrations less than 3,000 mg/L is designated as having a potential beneficial use as municipal and domestic supply (SWRCB Resolution No. 88-63) and is required to be protected from degradation under SWRCB Resolution No. 68-16. The California Public Utility Commission's decision regarding the proposed MPWSP requires that groundwater extraction for that proposed project may not cause injury to existing beneficial groundwater users or groundwater water right holders. Groundwater extraction in the MGSA Area could disturb the equilibrium that exists between the saline water intrusion wedge and overlying low-TDS groundwater zone, cause mixing of low-TDS and saline groundwater or otherwise lead to the capture and migration of saline groundwater, potentially impacting the low-TDS groundwater zone or existing supply wells in the area.

Contaminant plumes that are known to impair water quality locally and could be captured by or induced to migrate by groundwater extraction in the MGSA Area include the Fort Ord Superfund Site Operable Unit Carbon Tetrachloride (OUCTP) plume, located in the shallow "A-Aquifer" and 180-Foot Aquifer approximately 2 to 3 miles southeast of the MGSA Area in the Monterey Subbasin. As a required mitigation measure for the proposed MPWSP, MCWRA is tasked with reviewing the monitoring data for this plume to assess whether groundwater extraction for the proposed MPWSP in the MGSA Area is capturing this plume and causing it to migrate. The results of this assessment will be reported annually and will be reviewed by MCWRA.

Other than potential seawater intrusion, no sources of potential point- or non-point source water quality degradation have been identified in the Deep Aquifer. The sustainable management criteria and monitoring programs developed for the Deep Aquifer to address seawater intrusion are sufficient to address potential water quality degradation, and no sustainable management criteria are developed in this GSP for the deep aquifer for the degradation of water quality sustainability indicator.

4.7.2 MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(4) Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be used on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Section 354.28(c)(4) of the Regulations states that "*the minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be used on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin*." SVBGSA has adopted the potential exceedance of MCLs or SMCLs in public supply wells, or the exceedance of agricultural standards in irrigation wells, as a basis for assignment of Subbasin-wide minimum thresholds to wells.

Locally, the minimum thresholds for degradation of groundwater quality were developed considering the following additional criteria:

- Violation of water quality objectives for the low-TDS groundwater zone, including SWRCB Resolution No. 88-63 and SWRCB Resolution No. 68-16;
- Degradation of groundwater quality in nearby public supply wells, including the exceedance of MCLs or SMCLs; and
- Interference with or obstruction of ongoing requirements to investigate or clean up a contamination plume.

Based on this assessment, the following minimum thresholds were established:

- Significant and unreasonable degradation of water quality in the low-TDS groundwater zone in the Dune Sand, 180-Foot and 400-Foot Aquifers is defined as lateral or vertical migration of the 3,000 mg/L TDS isocontour beyond the location established by the 2018 AEM study (Gottschalk *et al.* 2018).
- Significant and unreasonable degradation of water quality in the Deep Aquifer is defined as exceedance of the TDS or chloride SMCL in one or more public supply wells completed in the Deep Aquifer near the MGSA.
- Significant and unreasonable migration of a contamination plume is defined by the following minimum thresholds:
    - Migration or spread of the portion of a contamination plume that exceeds applicable water quality objectives by more than 100 feet toward the center of groundwater extraction in the MGSA Area, as documented by plume maps for the cleanup site.

4.7.2.1 Relationships Between Minimum Thresholds and Other Sustainability Indicators

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

The minimum thresholds for reduction in groundwater storage are thickness measurements of the low-TDS groundwater zone made by induction logging at monitoring well locations, combined with groundwater level measurements to verify influence by pumping in the MGSA Area. These minimum thresholds will complement each other.

Degradation of groundwater quality minimum thresholds are related to several other sustainability indicators. The groundwater quality degradation thresholds were selected to avoid undesirable results for other sustainability indicators and to promote compatible management strategies.

- **Chronic decline in groundwater levels**. As discussed in Section 4.4, a significant and unreasonable condition for change in groundwater elevations is a decline below levels that cause GDE stress, result in significant and unreasonable interference drawdown, or decline below levels regionally determined by SVBGSA to result in undesirable conditions related to

seawater intrusion. Decline of groundwater elevations would be associated with changes in groundwater quality and will be used in combination with water quality monitoring to assess the relationship of water quality changes to pumping in the MGSA Area. These sustainable management criteria will be used in combination to manage both chronic decline in groundwater levels and groundwater quality degradation. Although the minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. These thresholds may be refined during GSP implementation as more information and better tools become available. Therefore, the groundwater quality degradation minimum threshold is unlikely to result in significant and unreasonable groundwater level decline.

- **Reduction in groundwater storage**. As discussed in Section 4.5, a significant and unreasonable condition for change in groundwater storage is defined as an annual extraction of groundwater in the MGSA Area that falls above the total long-term sustainable yield of the Subbasin established by SVBGSA or that results in depletion of the amount of low-TDS groundwater in storage in the Dune Sand, 180-Foot and 400-Foot Aquifers east of the MGSA Area. . By definition, sustainable yield is predicated in the avoidance of undesirable results, including seawater intrusion, and the sustainable management of seawater intrusion and reduction in storage will be coordinated. In addition, reduction in the amount of low-TDS groundwater in storage may be associated with seawater intrusion; therefore, storage reduction will be considered when assessing the potential for seawater intrusion. Reduction in the amount of low-TDS groundwater in storage may be associated with changes in groundwater quality and their distribution; therefore, storage reduction will be assessed using both groundwater level and quality data. The minimum threshold for degradation of groundwater quality is intended to protective of groundwater quality and will not interfere with the assessment of storage depletion. Although these minimum thresholds may not be precisely aligned, they are compatible and related, and will be used in combination to assure sustainable groundwater management. These thresholds may be refined during GSP implementation as more information and better tools become available. Therefore, the groundwater quality degradation minimum threshold is unlikely to result in significant and unreasonable reduction in groundwater storage.

- **Seawater intrusion.** As discussed in Section 4.6, significant and unreasonable seawater intrusion is defined as the migration of chloride isocontours that define the extent of seawater intrusion as of 2017 (for the 180-Foot, 400-Foot and Deep Aquifers) or 2018 (for the Dune Sand Aquifer). Migration of the saline water wedge that underlies the coastal area could be associated with degradation of groundwater quality; as such, the two sustainability indicators and their minimum thresholds are potentially related. Both are intended to prevent related undesirable results. Thus, the minimum threshold for degradation of groundwater quality may help to prevent seawater intrusion.

- **Subsidence**. A significant and unreasonable condition for subsidence is any measurable long-term inelastic subsidence that damages existing infrastructure. Subsidence is caused by depressurization and compaction of fine-grained sediments in response to lowering groundwater levels, especially in confined systems when groundwater elevations fall below historical lows. Water quality thresholds are unrelated to the cause of land subsidence.

- **Depletion of interconnected surface waters.** A significant and unreasonable condition for the depletion of interconnected surface waters is depletion that induces significant and

unreasonable degradation of GDEs, seawater intrusion in the tidal reaches of the river, or groundwater pumping-induced depletion of flow in the Salinas River that results in significant and unreasonable impacts to beneficial surface water uses. The water quality thresholds will not affect the mechanics of surface groundwater interaction; however, they could affect the quality of groundwater that is discharged to surface water discharge zones, such as wetlands. The minimum thresholds for the low-TDS zone will prevent the significant degradation of groundwater quality that would adversely affect wetlands.

4.7.2.2 Minimum Thresholds in Relation to Adjacent Subbasins and GSPs

Regulation Requirements
§ 354.28 (b) The description of minimum thresholds shall include the following:
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The MGSA Area is located adjacent to the Monterey Subbasin and shares boundaries with MCWD GSA and SVBGSA. The low-TDS groundwater zone for which the minimum thresholds were developed extends from the 180/400 Foot Aquifer Subbasin into the Monterey Subbasin south and southeast of the MGSA Area. The OUCTP plume is located in the Monterey Subbasin southeast of the MGSA Area. The Deep Aquifer underlies both the 180/400 Foot Aquifer Subbasin and the Monterey Subbasin. The minimum threshold was selected to prevent potential locally-caused undesirable results from unsustainable groundwater extraction in the MGSA Area, while retaining compatibility with regional sustainable management criteria. Sustainable management criteria were established in collaboration with MCWD to support their sustainable management strategy in the adjacent Monterey Subbasin. In addition, minimum thresholds for the 180-Foot and 400-Foot Aquifers were selected to be compatible with SVBGSA's minimum thresholds for regional groundwater management, which apply to the remainder of the Subbasin and to the portion of the Monterey Subbasin that is not managed by MCWD GSA. As such, these thresholds will promote cohesive management to achieve the sustainability goals of MGSA, SVBGSA and MCWD GSA.

SVBGSA's GSP does not present sustainable management criteria for the Dune Sand Aquifer because its GSP is more regionally focused. MGSA's locally-developed minimum thresholds for degradation of groundwater quality are compatible with SVBGSA's regional sustainable management criteria for the underlying regional aquifers and will protect resources of local value, while also preventing the degradation of water quality in the underlying aquifers caused by groundwater extraction in the MGSA Area.

4.7.2.3 Impact of Minimum Thresholds on Beneficial Uses and Users

Regulation Requirements:
§ 354.28 (b) The description of minimum thresholds shall include the following:
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The groundwater quality degradation minimum thresholds may have the following effects on beneficial users and land uses in the Subbasin:

- The threshold will help to maintain the quality of low-TDS water in storage with a designated potential beneficial use for domestic and municipal supply.
- The threshold will help assure the future availability of low-TDS groundwater with potential beneficial uses to groundwater beneficial users, including GDEs and water right holders.

4.7.2.4 CURRENT STANDARDS RELEVANT TO SUSTAINABILITY INDICATOR

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

The groundwater quality minimum thresholds specifically incorporate state and federal standards for drinking water and applicable Water Quality Standards incorporated into the Regional Water Quality Control Board's Water Quality Control Plan, including SWRCB Resolution Nos. 88-63 and 68-16.

4.7.2.5 MEASUREMENT OF MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater quality degradation will be measured from the monitoring network using groundwater quality monitoring, including groundwater sampling and analysis, the use of specific conductance sensors, and annual induction logging to assess the lateral and vertical distribution of TDS. The groundwater quality monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 5. Groundwater quality data to evaluate compliance with minimum thresholds and measurable objectives for groundwater quality degradation will be gathered from the wells listed in Tables 5-1, 5-2, and 5-3 for the Dune Sand, 180-Foot and 400-Foot Aquifers, respectively. Groundwater quality data to evaluate compliance with minimum thresholds and measurable objectives in the Deep Aquifer will be gathered from the supply wells listed in Table 5-4 (MCWD #'s 10, 11 and 12; and MCWRA #'s 25973, 21655 and 22755).

4.7.3 MEASURABLE OBJECTIVES AND INTERIM MILESTONES

Regulation Requirements:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

The measurable objectives for degradation of groundwater quality in the low-TDS groundwater zone positions of concentration isocontours that define the desired future state of the Subbasin, which is to protect and preserve this resource in compliance with SWRCB Resolution Nos. 88-63 and 68-16. The measurable objectives for water quality degradation in the Deep Aquifer, for which no historical degradation has been reported to date, are intended as indicators that provide early warning so potentially adverse trends can be addressed in a timely fashion. Measurable objectives are also established to leave adequate operating flexibility to deal with anticipated variability in conditions such as seasonal and inter-annual climatic variations and droughts, uncertainties in aquifer conditions or unanticipated events. As stated in Section 4.2,

> "*MGSA will manage groundwater resources in the MGSA Area in a way that ensures all beneficial uses and users in, or affected by, groundwater management in the MGSA Area are protected from undesirable results, and have access to a safe and reliable groundwater supply that meets current and future demand*."

The following measurable objectives have been established for groundwater quality degradation:

- The measurable objective for degradation of water quality in the low-TDS groundwater zone are defined to be the same as the minimum threshold, which is the 2018 vertical and lateral position of the 3,000 mg/L TDS isocontour in the Dune Sand, 180-Foot, and 400-Foot Aquifers, as determined by the 2018 AEM survey (Gottschalk *et al.* 2018).
- The measurable objective for degradation of water quality in the Deep Aquifer is no supply wells with MCL or SMCL exceedances for TDS or chloride.
- The measurable objective for migration of a contamination plume is defined by the following:
    - An observable spread of the portion of a contamination plume that exceeds applicable water quality objectives over two or more consecutive monitoring events toward the center of groundwater extraction in the MGSA Area, as documented by plume maps for the cleanup site.

If significant and unreasonable migration of a contamination plume is identified, it may be assumed that the agencies responsible for oversight of the cleanup will work with groundwater extractors to implement appropriate corrective actions and establish interim milestones as needed.

4.7.4 UNDESIRABLE RESULTS

Regulation Requirements:

§354.26 (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

§354.28 (c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(4) Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be used on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.

Based on the information in the previous sections, the local definition for significant and unreasonable groundwater quality degradation considers the following:

- The SVBGSA's GSP does not establish a definition for significant and unreasonable groundwater quality degradation in the Dune Sand Aquifer; however, this GSP considers that this aquifer and the underlying portions of the 180-Foot and 400-Foot Aquifers contain a significant quantity of low-TDS groundwater that requires protection from degradation under SWRCB Resolution Nos. 88-63 and 68-16. In order to comply with these resolutions, this GSP defines undesirable results for groundwater quality degradation of the low-TDS zone in the Dune Sand, 180-Foot, and 400-Foot Aquifers.

- The Deep Aquifer is not currently seawater intruded and is an important local and regional source of municipal and agricultural groundwater supply. Any water quality degradation of this aquifer would violate existing water quality standards and put this important water supply at risk; therefore, any degradation of water quality in municipal supply wells in the Deep Aquifer beyond applicable water quality objectives is considered an undesirable result.

The causes of potential undesirable results related to groundwater quality degradation are further discussed in Section 4.7.1 and the potential effects of undesirable results on the beneficial users of groundwater, land uses, and property owners are discussed in Sections 4.7.1 and 4.7.2.

An undesirable result for groundwater quality degradation is defined as follows based on the minimum thresholds discussed in Section 4.7.2:

- **Dune Sand Aquifer.** Migration of the 1,660 mg/L chloride isocontour beyond its location in 2018, indicating seawater intrusion into the low-TDS zone identified in Gottschalk *et al.* (2018), as interpreted from water quality sampling and induction logging data gathered by MCWRA.
- **180-Foot and 400-Foot Aquifer.** Seawater intrusion beyond the position of the 500 mg/L chloride isocontour interpolated by MCWRA in 2017, as determined by seawater intrusion maps prepared by MCWRA.
- **Deep Aquifer.** Seawater intrusion beyond a theoretical 500 mg/L chloride isocontour established as the western (seaward) edge of the Subbasin, as interpreted from groundwater quality monitoring data gathered by MCWRA.
- **Migration of Contamination Plumes.** Migration or spread of the portion of a contamination plume that exceeds applicable water quality objectives by more than 100 feet toward the center of groundwater extraction in the MGSA Area, as documented by plume maps for the cleanup site.

4.8 LAND SUBSIDENCE

4.8.1 LOCAL FACTORS POTENTIALLY CONTRIBUTING TO SIGNIFICANT AND UNREASONABLE CONDITIONS

Regionally, land subsidence is not closely monitored in the Monterey Bay region and has not been reported in Salinas Valley. In 2014, DWR reported that continuous monitoring stations located near the coast in the Pajaro Valley and Santa Cruz areas displayed a declining trend, but recorded total cumulative subsidence of less than 1 inch (DWR 2014). Vertical displacement estimates between June 2015 and June 2018 derived from Interferometric Synthetic Aperture Radar (InSAR) data collected by the European Space Agency (ESA) Sentinel-1A satellite and processed by TRE ALTAMIRA Inc. (TRE) under contract with DWR ranged from approximately 0.01 to 0.025 foot near the MGSA Area. This data is subject to a measurement error of 0.1 feet (SVBGSA 2019), so reported subsidence magnitudes are not significant. During the first two years of this time period, the test slant well-constructed for the MPWSP project in the MGSA Area was pumped at a rate exceeding 2,000 gallons per minute.

The risk of land subsidence results from lowered groundwater elevations, specifically when groundwater elevations decrease to levels significantly below the lowest historical groundwater elevations, leading to the depressurization and consolidation of fine-grained sediments. When groundwater elevations fluctuate only within the range of historical conditions, the alluvial layers are not subject to effective stress greater than historical conditions and therefore are generally not at significant risk of subsidence. In addition, sediments in unconfined and predominantly coarse-grained aquifers are at lower risk of significant subsidence. The subsidence risk in and near the MGSA Area is relatively low.

Because seasonal fluctuation and inter-annual variability in groundwater elevations in the unconfined Dune Sand Aquifer are in the range of 1 to 4 feet, subsidence resulting for groundwater level changes in this aquifer are not reasonably anticipated and no sustainable management criteria are established for the Dune Sand Aquifer for the subsidence sustainability indicator. Similarly, there are no Deep Aquifer extraction wells in the MGSA Area, and none are reasonably foreseen. As such, because no Deep

Aquifer groundwater extraction from the MGSA Area requires sustainable management, no sustainable management criteria are established for the Deep Aquifer for the subsidence sustainability indicator.

4.8.2 MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(5) Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:

(A) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including and explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those effects.

(B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Section 354.28(c)(5) of the Regulations states that "*The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results*." Section 354.28(d) of the Regulations states that "*an Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence*."

This GSP uses groundwater elevation data as a proxy for land subsidence measurements. According to the "Draft Sustainable Management Criteria BMP" (DWR 2017), an example land subsidence minimum threshold while using a groundwater elevation proxy can be determined as follows:

> *"Groundwater level minimum thresholds are above historical low groundwater levels. The GSA determines and documents that avoidance of the minimum thresholds for groundwater levels will also ensure that subsidence will be avoided. In this approach, the GSA would be applying the same numeric definition to two undesirable results – chronic lowering of groundwater and subsidence."*

As noted in Section 4.8.1, pumping of the test slant well from 2015 to early 2018 did not result in significant measurable subsidence. Vertical displacement estimates between June 2015 and June 2018 ranged from approximately 0.01 to 0.025 foot near the MGSA Area, which is negligible. The slant well pumping represents the highest historical rate of groundwater extraction in the MGSA, and likely also the lowest drawdown. It did not result in significant subsidence; therefore, application of the groundwater level decline minimum thresholds, which are above historical low groundwater levels, is

very unlikely to result in significant subsidence. Drawdown within the MGSA Area will be greater; however, the aquifers that would be pumped by the MPWSP are the unconfined to semi-confined Dune Sand and 180-Foot Aquifers. These aquifers are relatively granular and are not overlain by infrastructure in the MGSA Area that is vulnerable to damage from subsidence. For these reasons, the minimum thresholds established for the groundwater level decline RMS are an adequate proxy for the management of subsidence. Therefore, this GSP adopts the minimum thresholds presented in Table 4-1 as a proxy for subsidence.

4.8.2.1 Relationships Between Minimum Thresholds and Other Sustainability Indicators

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

Subsidence minimum thresholds have little or no impact on other minimum thresholds, as described below.

- **Chronic lowering of groundwater elevations.** As discussed in Section 4.4, a significant and unreasonable condition for change in groundwater elevations is a decline below levels that cause GDE stress, result in significant and unreasonable interference drawdown, or decline below levels regionally determined by SVBGSA to result in undesirable conditions related to seawater intrusion. Subsidence minimum thresholds are set to be the chronic lowering of groundwater elevation minimum thresholds. Managing subsidence to groundwater elevation minimum thresholds could not cause unacceptably low groundwater levels. Therefore, the subsidence proxy minimum thresholds will not compel a significant or unreasonable lowering of groundwater levels.

- **Change in groundwater storage**. As discussed in Section 4.5, a significant and unreasonable condition for change in groundwater storage is defined as an annual extraction of groundwater in the MGSA Area that falls above the total long-term sustainable yield of the Subbasin established by SVBGSA or that results in depletion of the amount of low-TDS groundwater in storage in the Dune Sand, 180-Foot and 400-Foot Aquifers east of the MGSA Area. The subsidence proxy minimum thresholds will not increase the amount of pumping and will not result in a significant or unreasonable change in groundwater storage.

- **Seawater intrusion**. As discussed in Section 4.6, significant and unreasonable seawater intrusion is defined as the migration of chloride isocontours that define the extent of seawater intrusion as of 2017 (for the 180-Foot, 400-Foot, and Deep Aquifers) or 2018 (for the Dune Sand Aquifer). The subsidence proxy minimum thresholds will maintain groundwater levels above historic lows and therefore will not induce additional advancement of seawater intrusion.

- **Degraded water quality**. As discussed in Section 4.7, significant and unreasonable degradation of groundwater quality is defined as the lateral or vertical migration of a TDS isocontour, or the induced migration of a contaminant contour exceeding water quality objectives in a nearby contamination plume. The subsidence sustainability indicator is closely related to the decline of groundwater elevations and is limited by the proxy minimum thresholds presented in Section 4.4.2. As discussed in Section 4.4.2.3, the minimum thresholds for groundwater level decline

will not lead to degradation of groundwater quality; therefore use of these proxy thresholds for subsidence will not result in a significant or unreasonable change in groundwater quality.

- **Depletion of interconnected surface waters.** A significant and unreasonable condition for the depletion of interconnected surface waters is depletion that causes significant and unreasonable degradation of GDEs, induces seawater intrusion in the tidal reaches of the river, or groundwater pumping-induced depletion of flow in the Salinas River that results in significant and unreasonable impacts to surface water uses. The ground level subsidence minimum thresholds will not change the amount or location of pumping (and therefore, surface water depletion) and will not result in a significant or unreasonable depletion of interconnected surface waters.

4.8.2.2 MINIMUM THRESHOLDS IN RELATION TO ADJACENT SUBBASINS AND GSPS

Regulation Requirements
§ 354.28 (b) The description of minimum thresholds shall include the following:
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The MGSA Area is located adjacent to the Monterey Subbasin and shares boundaries with MCWD GSA and SVBGSA. The MGSA uses groundwater elevation data as a proxy for the land subsidence minimum threshold. The minimum threshold was selected to address potential locally-caused undesirable results associated with groundwater extraction, while retaining compatibility with regional sustainable management criteria. Sustainable management criteria were established in collaboration with MCWD to support their sustainable management strategy. In addition, the proxy minimum threshold for the 180-Foot and 400-Foot Aquifers were selected to be compatible with SVBGSA's minimum thresholds, which apply to the remainder of the Subbasin and to the portion of the Monterey Subbasin that is not managed by MCWD GSA. These thresholds will promote cohesive management to achieve the sustainability goals of MGSA, SVBGSA and MCWD GSA.

4.8.2.3 IMPACT OF MINIMUM THRESHOLDS ON BENEFICIAL USES AND USERS

Regulation Requirements:
§ 354.28 (b) The description of minimum thresholds shall include the following:
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The subsidence proxy minimum thresholds are set to prevent long-term inelastic subsidence that could harm infrastructure. Available data indicate that there is currently no long-term subsidence occurring in the Subbasin that affects infrastructure, and reductions in pumping, to the extent required, are already required by minimum thresholds for other sustainability indicators. Therefore, the subsidence proxy minimum thresholds do not require any additional reductions in pumping and there is no negative impact on beneficial users.

4.8.2.4 CURRENT STANDARDS RELEVANT TO SUSTAINABILITY INDICATOR

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

There are no federal, state, or local regulations related to subsidence.

4.8.2.5 MEASUREMENT OF MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater elevation proxy minimum thresholds will be directly measured from the RMS in the monitoring well network. Groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in Section 5. Furthermore, the groundwater level monitoring will meet the requirements of the technical and reporting standards included in the Regulations.

4.8.3 MEASURABLE OBJECTIVES AND INTERIM MILESTONES

Regulation Requirements:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

The measurable objectives for subsidence are proxy groundwater levels which represent target groundwater elevations that are higher than the proxy minimum thresholds in order to provide early warning so potentially adverse trends can be addressed in a timely fashion. Measurable objectives are also established to leave adequate operating flexibility to deal with anticipated variability in conditions such as seasonal and inter-annual climatic variations and droughts, uncertainties in aquifer conditions or unanticipated events. As stated in Section 4.2,

> "*MGSA will manage groundwater resources in the MGSA Area in a way that ensures all beneficial uses and users in, or affected by, groundwater management in the MGSA Area are protected from undesirable results, and have access to a safe and reliable groundwater supply that meets current and future demand*."

This GSP adopts the measurable objectives and interim milestones summarized in Table 4-2 as a proxy for the subsidence sustainability indicator.

4.9 DEPLETION OF INTERCONNECTED SURFACE WATER

4.9.1 LOCAL FACTORS POTENTIALLY CONTRIBUTING TO SIGNIFICANT AND UNREASONABLE CONDITIONS

The MGSA Area is located approximately 4,000 feet from the Salinas River, and projected groundwater elevations are within less than 20 feet of the river thalweg elevation, suggesting an interconnection may exist between the Dune Sand Aquifer and the river at this location (Section 3.2.6.1.1). Geophysical data collected in 2017 indicate that groundwater elevations in the Dune Sand Aquifer are close to the river stage elevation, and decline away from the river, suggesting a losing condition. Within approximately ½ mile of the river mouth, the geophysical data suggest that seawater intrusion may be occurring through the riverbed and into the Dune Sand Aquifer and underlying 180-Foot Aquifer (Figure 3-22). Under these conditions, a decline in groundwater elevations near the river would affect river flows and could increase the infiltration of saline water from the river into the aquifer. In addition, although they are likely to be primarily dependent on surface water flows, riverine wetlands and riparian habitat located further upstream along the river could be affected by groundwater elevation declines (Figure 3-38).

As discussed in Section 3.2.6.1.1, projected groundwater elevations in the spring of 2018 were within less than 2 to 5 feet of several mapped vernal ponds (palustrine and emergent wetlands) located east of the MGSA Area that are designated as environmentally sensitive habitat areas that are protected by the California Coastal Act, other laws and mitigation agreements (Section 2.1.2). Groundwater elevation declines beneath these GDEs could adversely affect protected habitats and species.

Groundwater modeling for the proposed MPWSP predicted that the amount of river flow depletion would result from makeup groundwater pumping to supply the project would be 400 AFY (ESA 2018). These modeling results have not been verified for preparation of this GSP; however, for perspective, the predicted depletion is less than 1 cubic foot/second and would be unlikely to have a significant and unreasonable effect on the beneficial uses of water in the Salinas River. The USGS is developing the SVIHM as a regional modeling and hydrogeologic assessment tool, and this model is expected to be more robust and refined than the model used for the MPWSP impact analysis. As discussed in Chapters 6 and 7, SVBGSA intends to use the USGS SVIHM to evaluate surface-groundwater interaction. Additionally, the MCWD GSA intends to build a refined local model that may incorporate the Salinas River. MGSA intends to engage with these efforts and review the modeling investigations, and to refine, among other things, the assessment of surface-groundwater interaction along the lower reach of the Salinas River.

The geophysical investigation data illustrated in Figure 3-22 suggest that seawater intrusion through the riverbed in the lower ½ mile reach of the river has historically occurred; however, the data are insufficient to assess whether current intrusion rates differ from historical baseline rates. Review of historical evapotranspiration data suggest a decline in groundwater availability to GDEs east of the MGSA Area occurred during the test slant well pumping test conducted from April 2015 to February

2018; however, this period also coincided with a drought, and measured groundwater elevation declines resulted from both drought and pumping conditions. ET rates in 2017 and 2018 appeared to recover to their pre-test levels. It is not known whether the GDEs were adversely affected during this period of stress. As such, it is not known if there were recent significant and unreasonable impacts to GDEs.

4.9.2 MINIMUM THRESHOLDS

Regulation Requirements:

§354.28 (a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(6) Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:

(A) The location, quantity, and timing of depletions of interconnected surface water.

(B) A description of the groundwater and surface model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph. (B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Section 354.28(d) of the Regulations states that "*an Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence*." According to the "Draft Sustainable Management Criteria BMP" (DWR 2017), one possible approach to using minimum thresholds for chronic groundwater level decline as a proxy for another minimum threshold is to:

> *"[d]emonstrate that the minimum thresholds and measurable objectives for chronic declines of groundwater levels are sufficiently protective to ensure significant and unreasonable occurrences of other sustainability indicators will be prevented. In other words, demonstrate that setting a groundwater level minimum threshold satisfies the minimum threshold requirements for not only chronic lowering of groundwater levels but other sustainability indicators at a given site."*

Depletion of interconnected surface water is directly related to groundwater level decline in the uppermost aquifer system which is in contact with the stream or wetland being affected, in this case, the Dune Sand Aquifer. As discussed in Section 4.9.2, groundwater modeling for the proposed MPWSP predicted that, if implemented, the project would result in a river flow depletion less than 1 cubic foot/second, which would be unlikely to have a significant and unreasonable effect on the beneficial uses of water in the Salinas River(ESA 2018). As such, the primary potential effect of concern associated

with the decline of groundwater levels in the Dune Sand Aquifer is potential stress to GDEs. The rationale for establishment of a minimum threshold for the Dune Sand Aquifer to prevent potential significant and unreasonable impacts to GDEs is described in Section 4.4.2, and also applies to establishment of a minimum threshold for depletion of interconnected surface water. For these reasons, the minimum thresholds established for the groundwater level decline RMS are an adequate proxy for the depletion of interconnected surface water. Therefore, this GSP adopts the minimum thresholds for RMS in the Dune Sand Aquifer presented in Table 4-1 as a proxy for depletion of interconnected surface water based on the potential for adverse impacts to GDEs. Because 180-Foot, 400-Foot and Deep Aquifers are not directly interconnected to surface water, no minimum thresholds or measurable objectives are established for these aquifers.

4.9.2.1 Relationships Between Minimum Thresholds and Other Sustainability Indicators

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indictor, including and explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

The interconnected surface water minimum thresholds use the groundwater elevation decline minimum thresholds for the Dune Sand Aquifer as a proxy. They are derived from historical groundwater elevation measurements. Therefore, the minimum thresholds are unique at every well, but when combined represent a "compliance surface" that represents a cohesive dataset. There is no conflict between the thresholds at adjacent locations.

Interconnected surface water minimum thresholds can influence other sustainability indicators. The groundwater elevation minimum thresholds are selected to avoid undesirable results for other sustainability indicators.

- **Chronic lowering of groundwater elevations.** As discussed in Section 4.4, a significant and unreasonable condition for change in groundwater elevations is a decline below levels that cause GDE stress, result in significant and unreasonable interference drawdown, or decline below levels regionally determined by SVBGSA to result in undesirable conditions related to seawater intrusion. The thresholds for depletion of interconnected surface water and chronic groundwater level decline are identical and will prevent undesirable results for both sustainability indicators.
- **Reduction in groundwater storage**. As discussed in Section 4.5, a significant and unreasonable condition for change in groundwater storage is defined as an annual extraction of groundwater in the MGSA Area that falls above the total long-term sustainable yield of the Subbasin established by SVBGSA or that results in depletion of the amount of low-TDS groundwater in storage in the Dune Sand, 180-Foot and 400-Foot Aquifers east of the MGSA Area. Decline of groundwater elevations would be associated with changes in storage, therefore, limiting changes in storage would also limit groundwater level declines and changes in surface-groundwater interaction. The minimum thresholds for both sustainability indicators will have the same effect – these thresholds will complement each other.

- **Seawater intrusion.** As discussed in Section 4.6, significant and unreasonable seawater intrusion is defined as the migration of chloride isocontours that define the extent of seawater intrusion as of 2017 (for the 180-Foot, 400-Foot and Deep Aquifers) or 2018 (for the Dune Sand Aquifer). As discussed in Section 3.2.3.2, a decline in groundwater levels would lead to a change in the interface dynamics between the saline water intrusion wedge and the overlying low-TDS zone, and could potentially result in seawater intrusion; however, the minimum threshold for groundwater level decline in the Dune Sand Aquifer is set at a much lower level based on protection of GDEs. Thus, these minimum thresholds are adequate to address both seawater intrusion and depletion of interconnected surface water. Groundwater elevation declines could induce additional saline water intrusion the bed of the lowermost reaches of the Salinas River; however, the minimum threshold for interconnected surface waters is set above recent groundwater elevations, so the compliance with the minimum threshold should prevent a worsening of seawater intrusion beyond historical levels. For these reasons, the interconnected surface water minimum threshold is unlikely to result in significant and unreasonable seawater intrusion, but rather, will help to protect water quality.
- **Degraded water quality**. As discussed in Section 4.7, significant and unreasonable degradation of groundwater quality is defined as the lateral or vertical migration of a TDS isocontour, or the induced migration of a contaminant contour exceeding water quality objectives in a nearby contamination plume. This sustainability indicator is closely related to the decline of groundwater elevations; however, the minimum threshold for groundwater level decline in the Dune Sand Aquifer is set at a much lower level based on protection of GDEs. . For these reasons, the interconnected surface water minimum threshold is unlikely to result in significant and unreasonable degraded water quality, but rather, will help to protect water quality.
- **Subsidence**. A significant and unreasonable condition for subsidence is any measurable long-term inelastic subsidence that damages existing infrastructure. Subsidence is caused by depressurization and compaction of fine-grained sediments in response to lowering groundwater levels, especially in confined systems when groundwater elevations fall below historical lows. The groundwater elevation minimum thresholds are set 1 foot above recent low groundwater elevations, making measurable subsidence unlikely.

4.9.2.2 Minimum Thresholds in Relation to Adjacent Subbasins and GSPs

Regulation Requirements
§ 354.28 (b) The description of minimum thresholds shall include the following:
(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The proxy minimum thresholds for the Depletion of Interconnected Surface Water are the same as the minimum thresholds for the Chronic Decline of Groundwater Levels in the Dune Sand Aquifer, and are compatible across Subbasin and GSP boundaries.

The MGSA Area is located adjacent to the Monterey Subbasin and shares boundaries with MCWD GSA and SVBGSA. The minimum threshold was selected to address potential locally-caused undesirable results associated with groundwater extraction, while retaining compatibility with regional sustainable management criteria. Sustainable management criteria were established in collaboration with MCWD to support their sustainable management strategy. The thresholds represent a smooth groundwater elevation surface and would be continuous across inter-agency and inter-basin boundaries. As such,

these thresholds will promote cohesive management to achieve the sustainability goals of MGSA, SVBGSA, and MCWD GSA. SVBGSA's GSP does not present sustainable management criteria for the Dune Sand Aquifer; however, the minimum thresholds established in MGSA's GSP for the Dune Sand Aquifer are compatible with SVBGSA's management strategy for the underlying regional aquifers. The minimum thresholds for the Dune Sand Aquifer to address local resource conditions will not impede or conflict with SVBGSA's ability to reach their sustainability goals. To the contrary, they will protect sensitive local resources in the portion of the Subbasin managed by SVBGSA from potential harm caused by groundwater extraction in the MGSA Area.

SVBGSA has identified aquifer interaction with interconnected surface water and GDEs as a data gap it plans to investigate further through the installation of additional monitoring wells and the use of the United States Geological Survey (USGS) soon to be released Salinas Valley integrated Hydrologic Model (SVIHM). As discussed in Chapters 6 and 7, MGSA plans to support SVBGSA's evaluation and to review the results and other available hydrologic and biological data to determine whether modification of the sustainable management criteria for interconnected surface water in this GSP require updating. The application of the minimum threshold for interconnected surface water in this GSP will not interfere with SVBGSA's management or data gap investigation, and any data gleaned during implementation of the GSP will be shared with SVBGSA.

4.9.2.3 Impact of Minimum Thresholds on Beneficial Uses and Users

Regulation Requirements:
§ 354.28 (b) The description of minimum thresholds shall include the following:
(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The interconnected surface water groundwater proxy minimum thresholds for beneficial uses are the same as groundwater elevation minimum thresholds. Specifically, relative to interconnected surface water, they may have the following effects on beneficial users and land uses in the Subbasin:

- The groundwater elevation threshold for the Dune Sand Aquifer will assure that GDEs are not adversely affected by groundwater extraction in the MGSA Area. This will help to preserve protected habitats and species.
- The threshold will prevent an increase in the rate of seawater intrusion through the riverbed in the lower, tidally-influenced reach of the Salinas River.

4.9.2.4 Current Standards Relevant to Sustainability Indicator

Regulation Requirements:
§354.28 (b) The description of minimum thresholds shall include the following:
(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

Streamflow requirements as described in the National Marine and Fisheries Service (NMFS) *Salinas Valley Water Project Flow Prescription for Steelhead Trout in the Salinas River* (MCWRA 2005). MCWRA currently manages flows in the Salinas River to meet the requirements of the National Marine Fisheries

biological opinion (National Marine Fisheries Service 2007). The NMFS biological opinion was developed using measured streamflows between 1995 and 2005. The measured streamflow reflects current surface water depletion rates, and therefore current depletion rates are already incorporated into the river management plan. Releases from Nacimiento Reservoir and San Antonio Reservoir have successfully maintained required environmental flows under current groundwater pumping and surface water depletion conditions. The Steelhead Trout flow prescriptions are described in MCWRA, 2005. This document guides the operating rules for the San Antonio and Nacimiento reservoir releases.

4.9.2.5 Measurement of Minimum Thresholds

Regulation Requirements:

§354.28 (b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater elevation minimum thresholds will be directly measured from the monitoring well network. The groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 5. Furthermore, the groundwater level monitoring will meet the requirements of the technical and reporting standards included in the Regulations.

4.9.3 Measurable Objectives and Interim Milestones

Regulation Requirements:

§354.30 (a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin within 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

As discussed in Section 4.4 and Chapter 7, groundwater elevation minimum thresholds and measurable objectives are established for the Dune Sand Aquifer on an interim basis until investigations to address data gaps in the degree of groundwater connection of riverine wetlands and GDEs, and the response of other GDEs to groundwater level decline, can be assessed. Because the documented historical range in groundwater elevations in the Dune Sand Aquifer is relatively limited, the interim measurable objectives are established equal to the minimum thresholds, and interim milestones are established at the same elevations.

4.9.4 UNDESIRABLE RESULTS

Regulation Requirements:

§354.26 (a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.

(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

Regionally, the SVBGSA describes significant and unreasonable depletion of interconnected surface water in the Subbasin as depletion of interconnected surface water flows that may prevent the MCWRA from meeting biological flow requirements in the Salinas River, or would cause an unreasonable impact on other water rights holders. The following criteria were considered by SVBGSA (2019):

- MCWRA currently manages flows in the Salinas River to meet the requirements of the National Marine Fisheries Service (NMFS) biological opinion (NMFS 2007). The NMFS biological opinion was developed using measured streamflows between 1995 and 2005. The measured streamflow reflects current surface water depletion rates, and therefore current depletion rates are already incorporated into the river management plan. Furthermore, releases from Nacimiento Reservoir and San Antonio Reservoir have successfully maintained required environmental flows under current groundwater pumping and surface water depletion conditions. The Steelhead Trout flow prescriptions are described in *Salinas Valley Water Project Flow Prescription for Steelhead Trout in the Salinas River* (MCWRA 2005). This document guides the operating rules for the San Antonio and Nacimiento reservoir releases. Therefore, steelhead flow requirements are being met and current surface water depletion rates are not unreasonable with regards to maintaining flow required in the biological opinion.

- In addition to managing the river for environmental needs, the MCWRA manages the Salinas River to maintain adequate water supply for other beneficial uses. The Nacimiento and San Antonio reservoirs provide flood control benefits as well as groundwater recharge benefits through its sandy channels, where water rights holders along the river can pump out water according to their water rights. Therefore, among other things, the Salinas River is managed to satisfy the water supply needs of riparian pumpers and the existing depletions are neither significant nor unreasonable.

- Regionally, there is significant leakance from the Salinas River to the underlying groundwater, but it is not considered unreasonable with regards to riparian rights holders. To the extent that groundwater pumping depletes surface water flows, these depletions and the potential surface

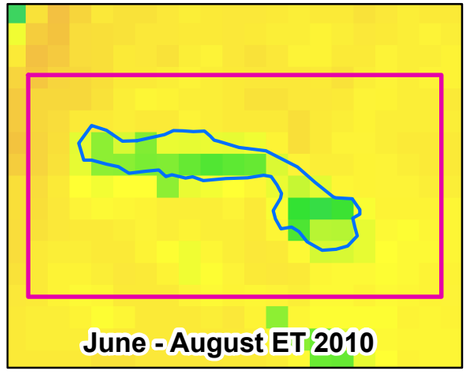
water limitations would be injurious only if the surface water right holders held rights senior to the groundwater pumpers.

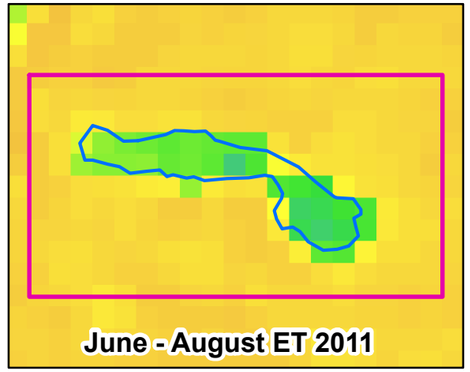
Locally, the following additional criteria were considered in defining undesirable results for this GSP:

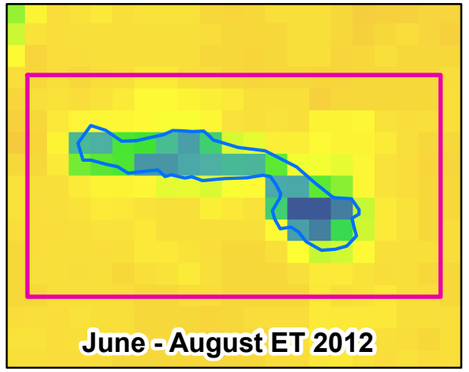
- Potential seawater intrusion through the bed of the tidally-influenced reach of the Salinas River resulting from groundwater drawdown in the Dune Sand Aquifer near the river; and
- Groundwater drawdown in the Dune Sand Aquifer near GDEs that is sufficient to cause vegetative stress that leads to habitat degradation or harm to protected species.

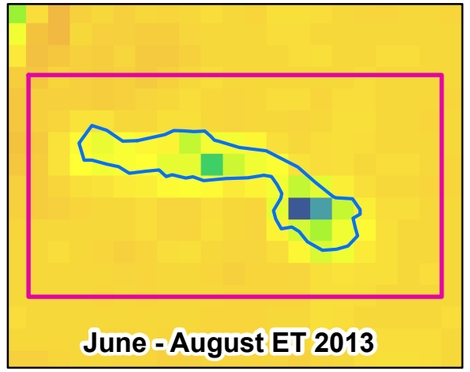
The causes of potential undesirable results are further discussed in Section 4.9.1 and the potential effects of undesirable results on the beneficial users of groundwater, land uses, and property owners are discussed in Sections 4.9.1 and 4.9.2.

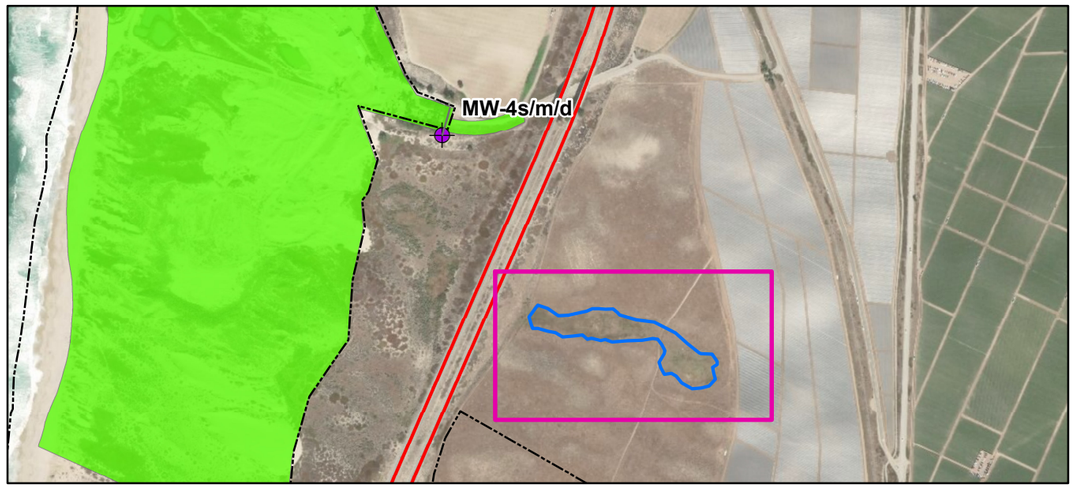
Based on this information, undesirable results for the depletion of interconnected surface water sustainability indicator are defined as an exceedance of the groundwater elevation proxy minimum thresholds at two or more locations in the Dune Sand Aquifer in any given year.

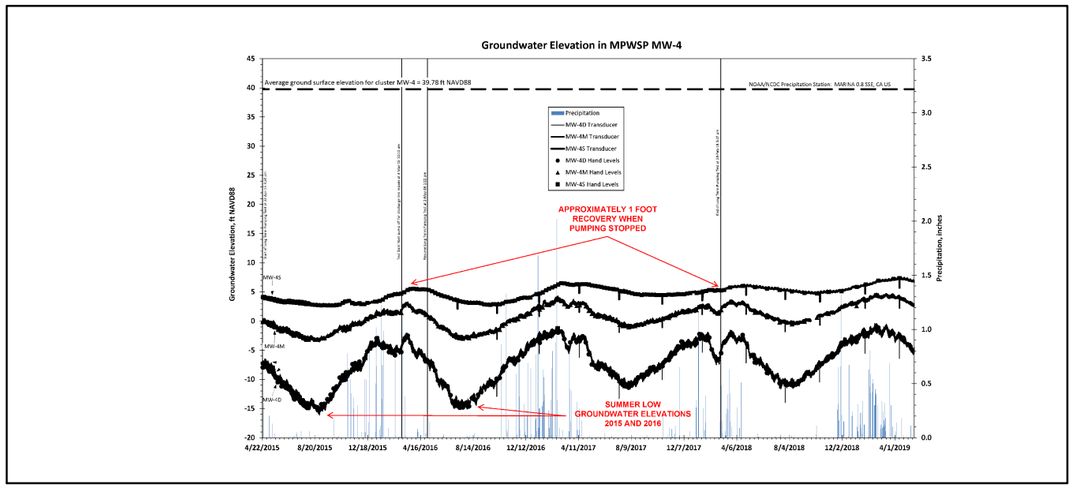


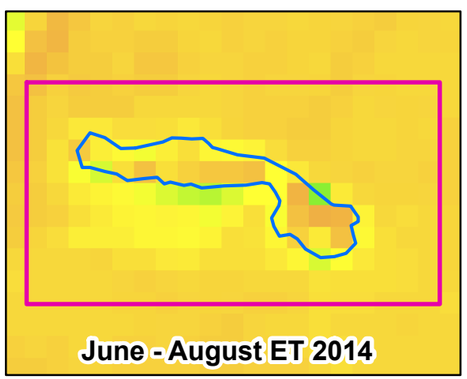


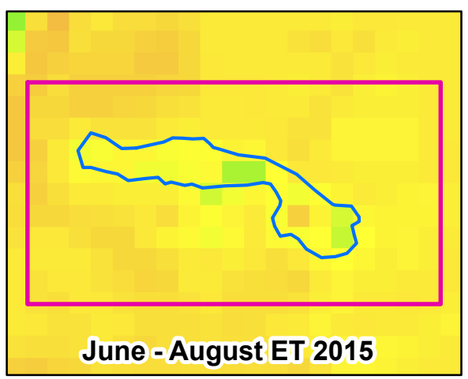


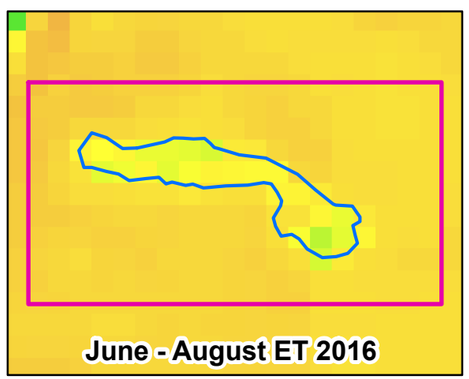


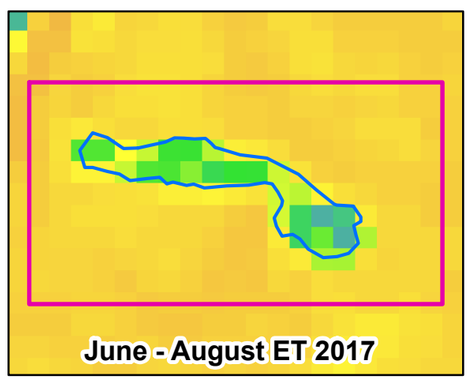












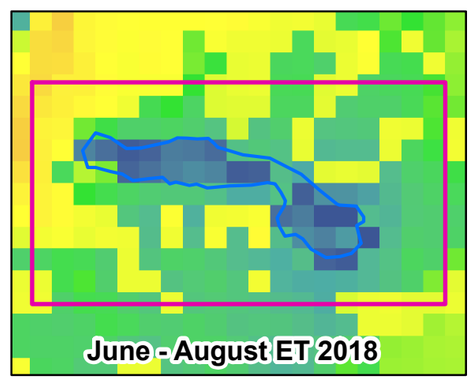


FIGURE 4-1

Analysis of Evapotranspiration from a GDE at the Armstrong Ranch Vernal Pond Complex

Groundwater Sustainability Plan for the City of Marina GSA Area of the 180/400 Foot Aquifer Subbasin

Legend

ET (Inches)

High : >10

Low : 0

MW-4s/m/d

Area of Interest

Wetland

Highway 1

City of Marina

City of Marina GSA (MGSA) Area

Sources: ESRI Map Service Imagery, Geoscience Support Services 2019, Paul et al. 2018, and the NC Dataset https://gis.water.ca.gov/app/NCDatasetViewer/

DATE: DEC. 30, 2019

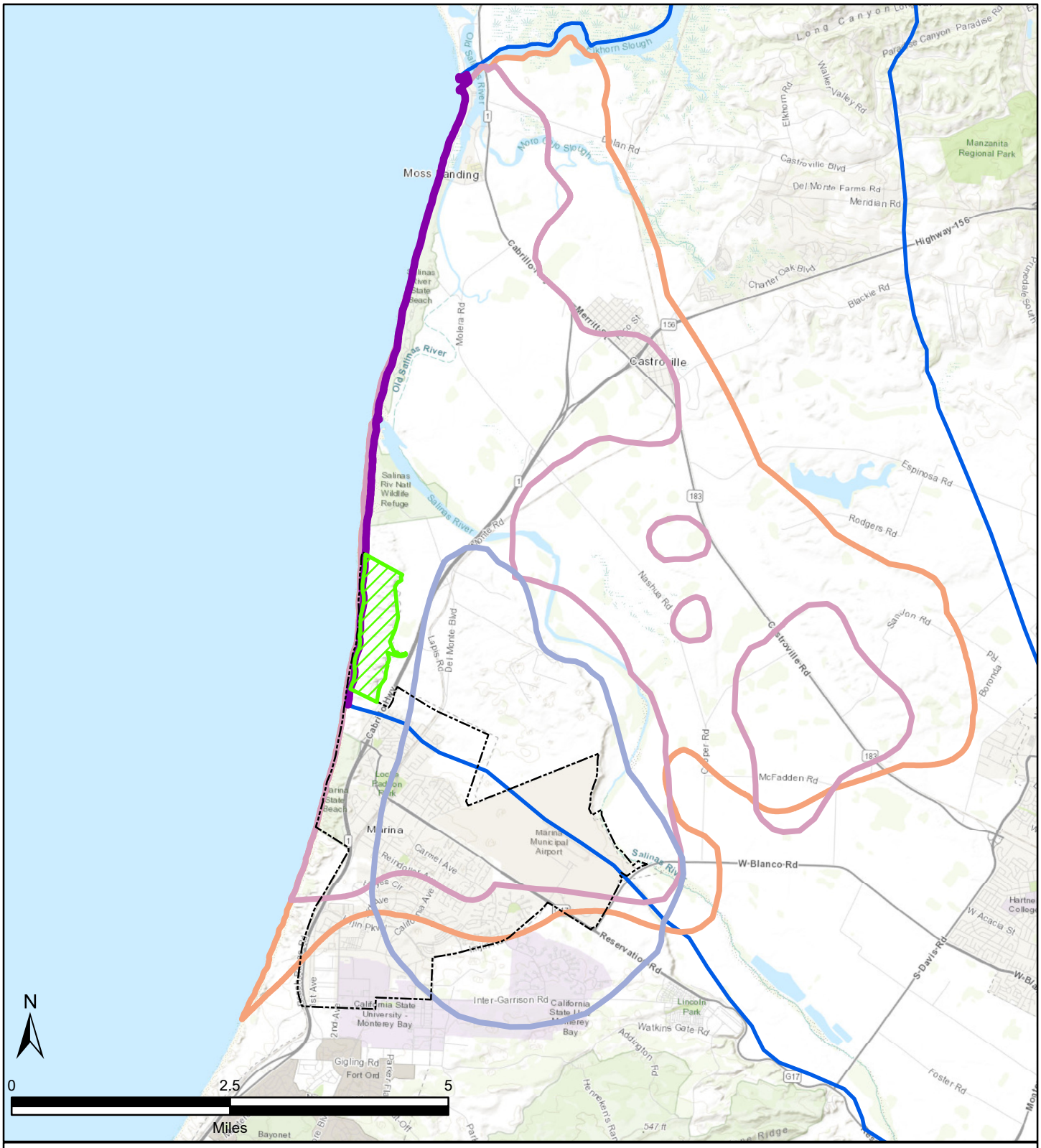


FIGURE 4-2

Minimum Thresholds for Seawater Intrusion

Groundwater Sustainability Plan for the City of Marina GSA Area of the 180/400 Foot Aquifer Subbasin

Legend

- City of Marina GSA (MGSA) Area
- City of Marina
- 180/400 Foot Aquifer Subbasin
- Deep Aquifer Minimum Threshold: Theoretical 500 mg/L chloride isocontour
- Dune Sand Aquifer Minimum Threshold: 1,660 mg/L chloride isocontour in 2018
- 400-Foot Aquifer Minimum Threshold: 500 mg/L chloride isocontour in 2017
- 180-Foot Aquifer Minimum Threshold: 500 mg/L chloride isocontour in 2017

DATE: JAN. 07, 2020

Sources: ESRI Map Service Imagery, https://sgma.water.ca.gov/portal/gsa, reference attached MCWRA 2018 map, reference attached MCWRA 2018 map, reference Gottschalk et al 2018.

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