Salinas Valley: 180/400-Foot Aquifer Subbasin Groundwater Sustainability Plan

VOLUME 2

Chapter 5. Groundwater Conditions

Chapter 6. Water Budgets

Chapter 7. Monitoring Networks

Chapter 8. Sustainable Management Criteria

Prepared for:

Salinas Valley Basin Groundwater Sustainability Agency

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5 GROUNDWATER CONDITIONS

This chapter describes the historical and current groundwater conditions in the 180/400-Foot Aquifer Subbasin in accordance with the GSP Regulations § 354.16. In this GSP, current conditions are any conditions occurring after January 1, 2015. This GSP Update uses 2020 as the representative current year where possible, thus updating the 2017 data in the original GSP. By implication, historical conditions are any conditions occurring prior to January 1, 2015. The chapter focuses on information required by the GSP regulations, and information that is important for developing an effective plan to achieve sustainability. This chapter provides a description of current and historical groundwater conditions at a scale and level of detail appropriate for meeting the GSP sustainability requirements under SGMA.

This chapter is organized to align the groundwater conditions descriptions with the 6 sustainability indicators relevant to this subbasin, including:

1. Chronic lowering of groundwater levels
2. Changes in groundwater storage
3. Seawater intrusion
4. Subsidence
5. Groundwater quality
6. Depletion of interconnected surface waters

In addition, to meet the GSP Regulations § 356.4 assessment requirements for GSP amendments, this chapter includes a section on water use.

5.1 Groundwater Elevations

5.1.1 Data Sources

The assessment of groundwater elevation conditions is largely based on data collected by MCWRA from 1944 through the present. MCWRA's monitoring programs are described in Chapter 3.

Groundwater elevation data are analyzed and presented with three sets of graphics:

- Maps of groundwater elevation contours show the geographic distribution of groundwater elevations at a specific time. These contours represent the elevation of the groundwater in feet, using the NAVD88 vertical datum. The contour interval is 10 feet, meaning each blue line represents an area where groundwater elevations are either 10 feet higher or 10 feet lower than the next blue line (Figure 5-1 to Figure 5-8).

- Hydrographs of individual wells show the variations in groundwater elevations at individual wells over an extended period of time Figure 5-9).
- Vertical hydraulic gradients in a single location assess the potential for vertical groundwater flow and its direction, as discussed in Section 5.1.4.

5.1.2 Groundwater Elevation Contours and Horizontal Groundwater Gradients

MCWRA annually produces groundwater elevation contour maps for the Salinas Valley Groundwater Basin using data from their annual August trough and fall measurement programs. August groundwater elevations are contoured to assess the driving force of seawater intrusion because this is usually when the aquifers are the most stressed. MCWRA also contours fall groundwater elevations because these measurements are taken from mid-November to December after the end of the irrigation season and before seasonal recharge from winter precipitation increases groundwater levels. The August measurements represent seasonal low conditions in the Subbasin, and the fall measurements represent the seasonal high. In 1995, data collected in March were more representative of seasonal high groundwater elevations.

The following 8 maps present the Current (2019) and Historical (1995) groundwater elevation contours.

Table 5-1. Figures Showing Current and Historical Groundwater Elevation Contours

Figure #	Year	Season	Aquifer
Figure 5-1	Current (2019)	Fall	180-Foot
Figure 5-2	Current (2019)	August Trough	180-Foot
Figure 5-3	Current (2019)	Fall	400-Foot
Figure 5-4	Current (2019)	August Trough	400-Foot
Figure 5-7	Historical (1995)	Fall	180-Foot
Figure 5-8	Historical (1995)	August Trough	180-Foot
Figure 5-7	Historical (1995)	Fall	400-Foot
Figure 5-8	Historical (1995)	August Trough	400-Foot

The groundwater elevation contours only cover the portions of the basin monitored by MCWRA. Contours do not always extend to subbasin margins. Furthermore, MCWRA does not produce groundwater elevation maps of the Deep Aquifers. Insufficient data currently exist to map flow directions and groundwater elevations in the Deep Aquifers. These are data gaps that will be addressed during GSP implementation.

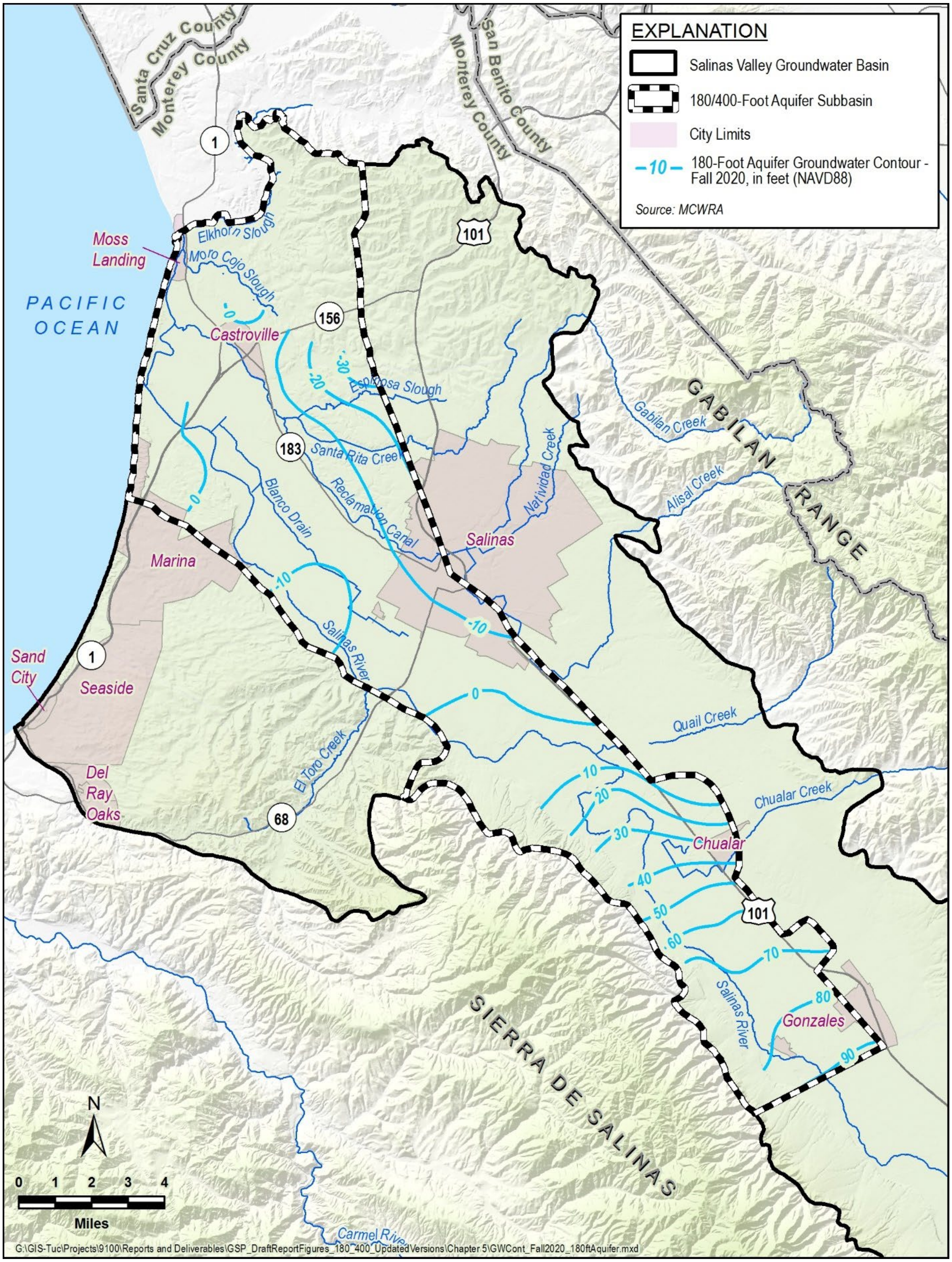


Figure 5-1. Fall 2020 180-Foot Aquifer Groundwater Elevation Contours

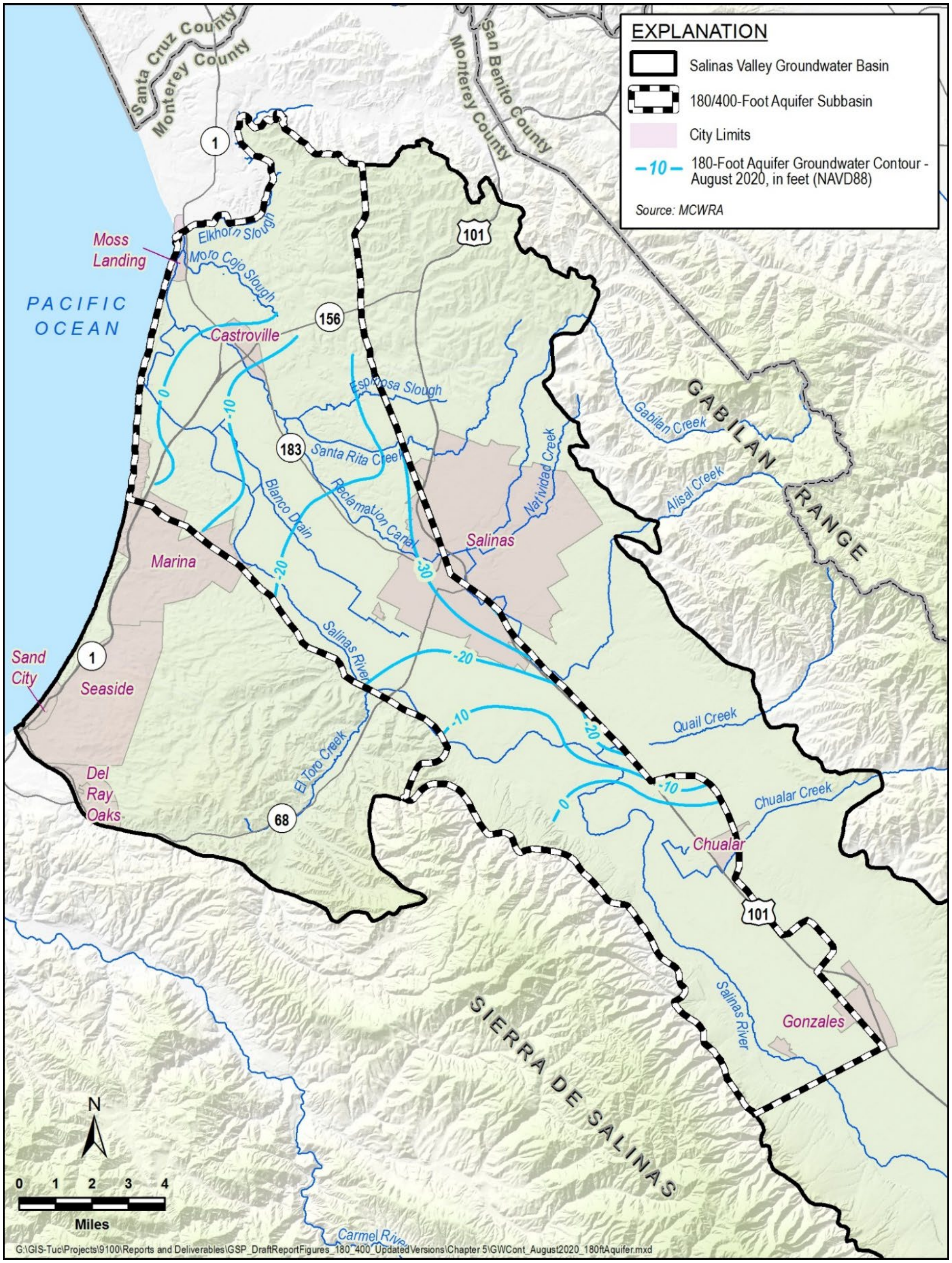


Figure 5-2. August 2020 180-Foot Aquifer Groundwater Elevation Contours

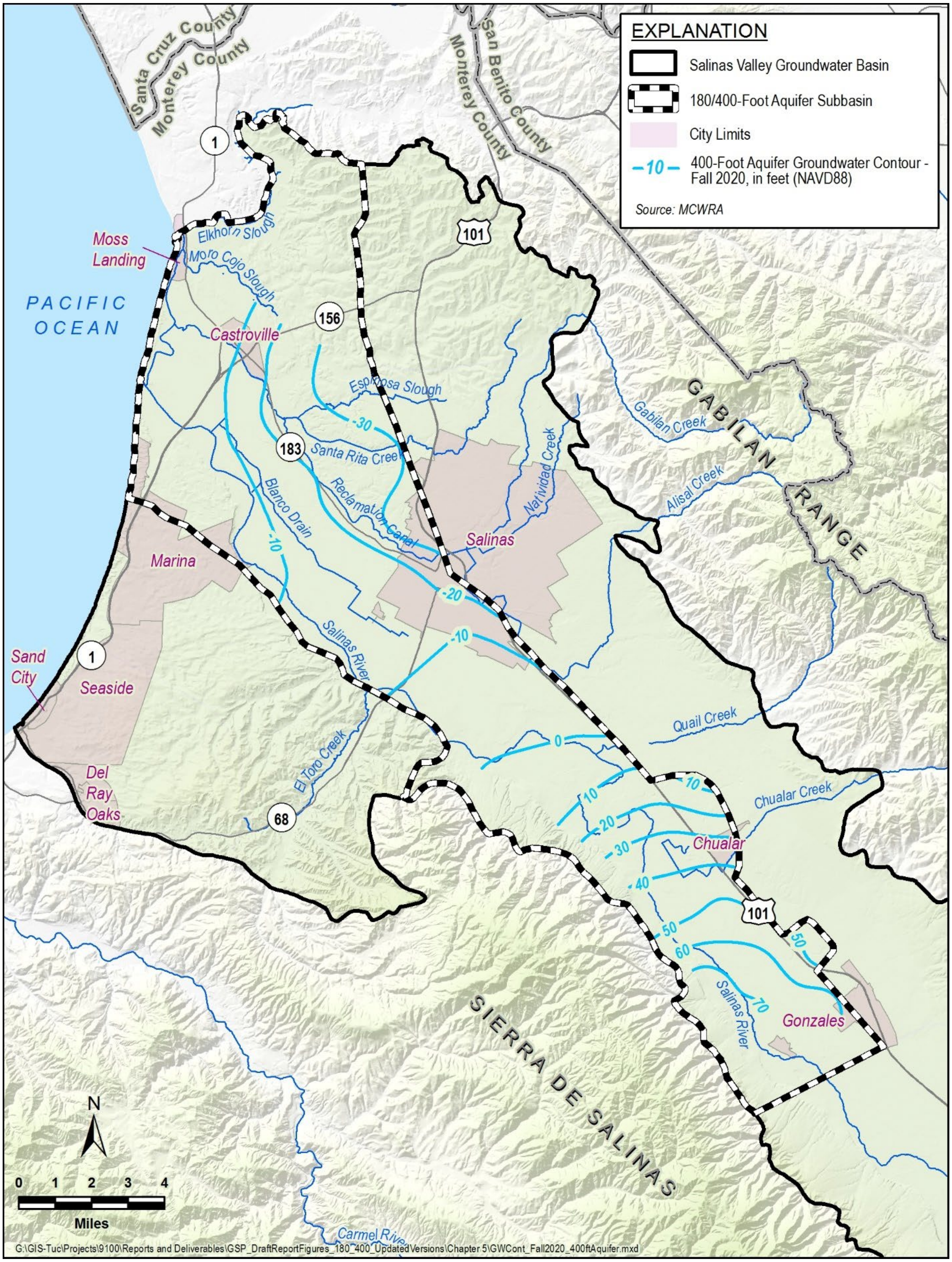


Figure 5-3. Fall 2020 400-Foot Aquifer Groundwater Elevation Contours

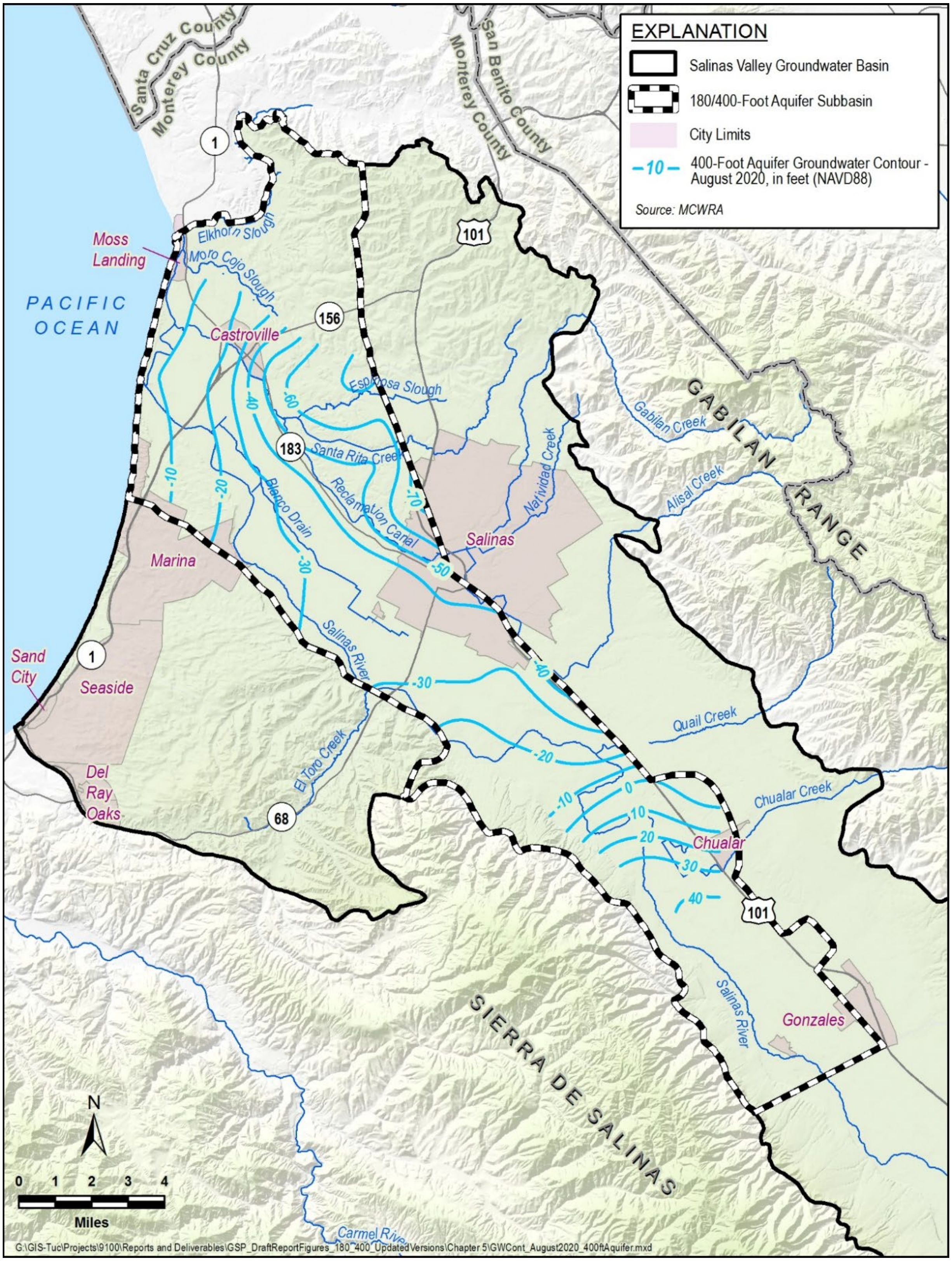


Figure 5-4. August 2020 400-Foot Aquifer Groundwater Elevation Contours

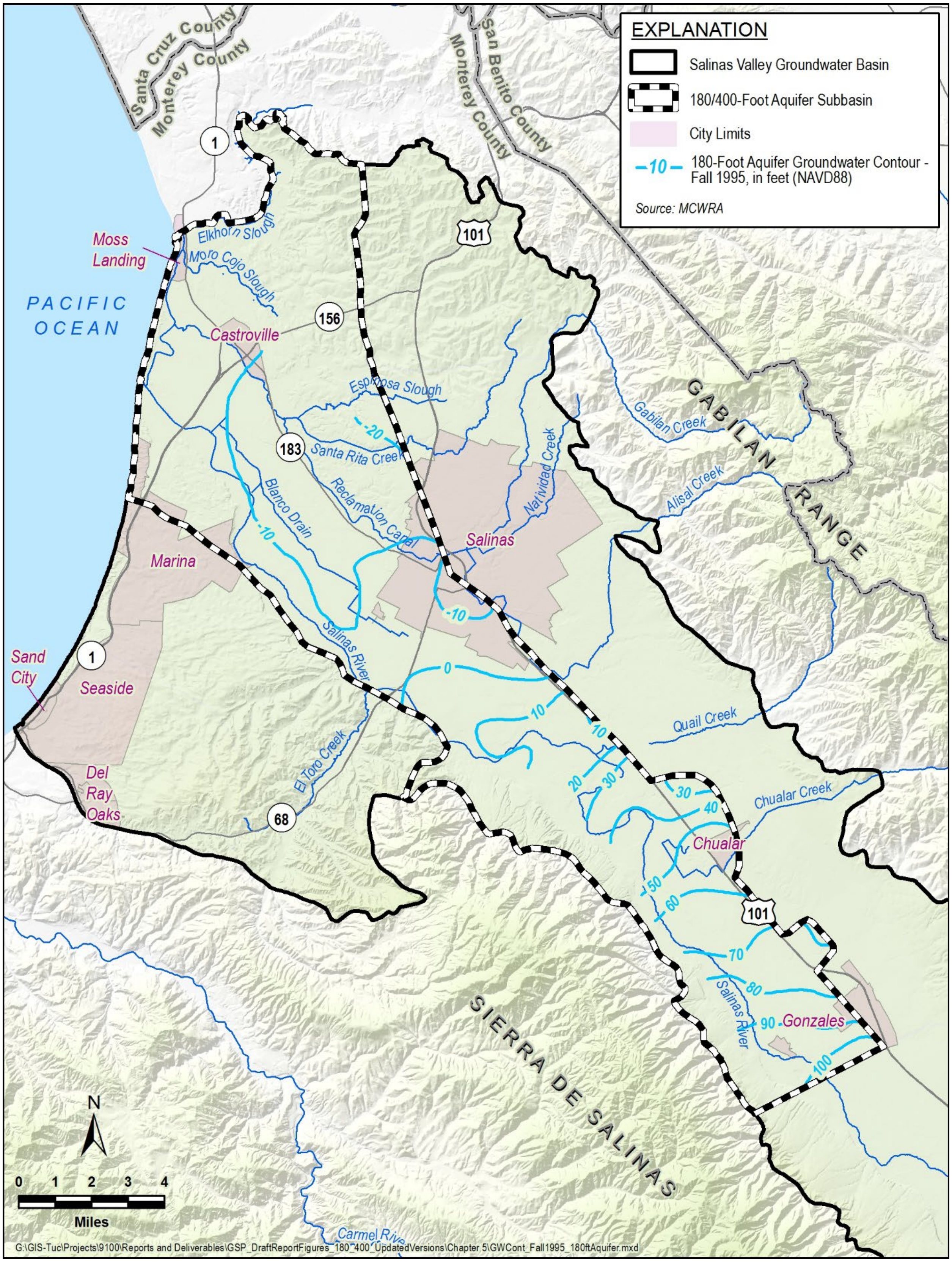


Figure 5-5. Fall 1995 180-Foot Aquifer Groundwater Elevation Contours

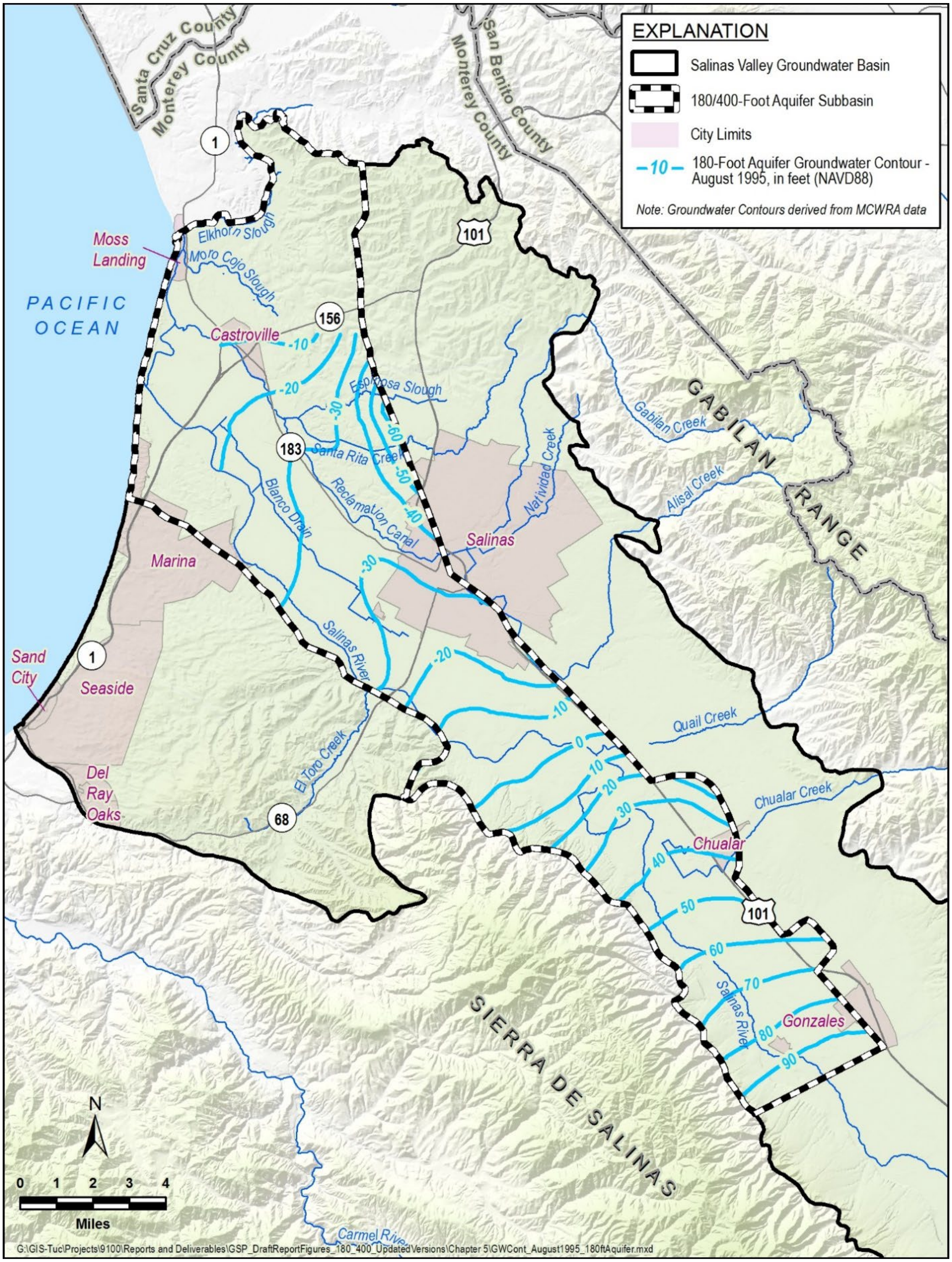


Figure 5-6. August 1995 180-Foot Aquifer Groundwater Elevation Contours

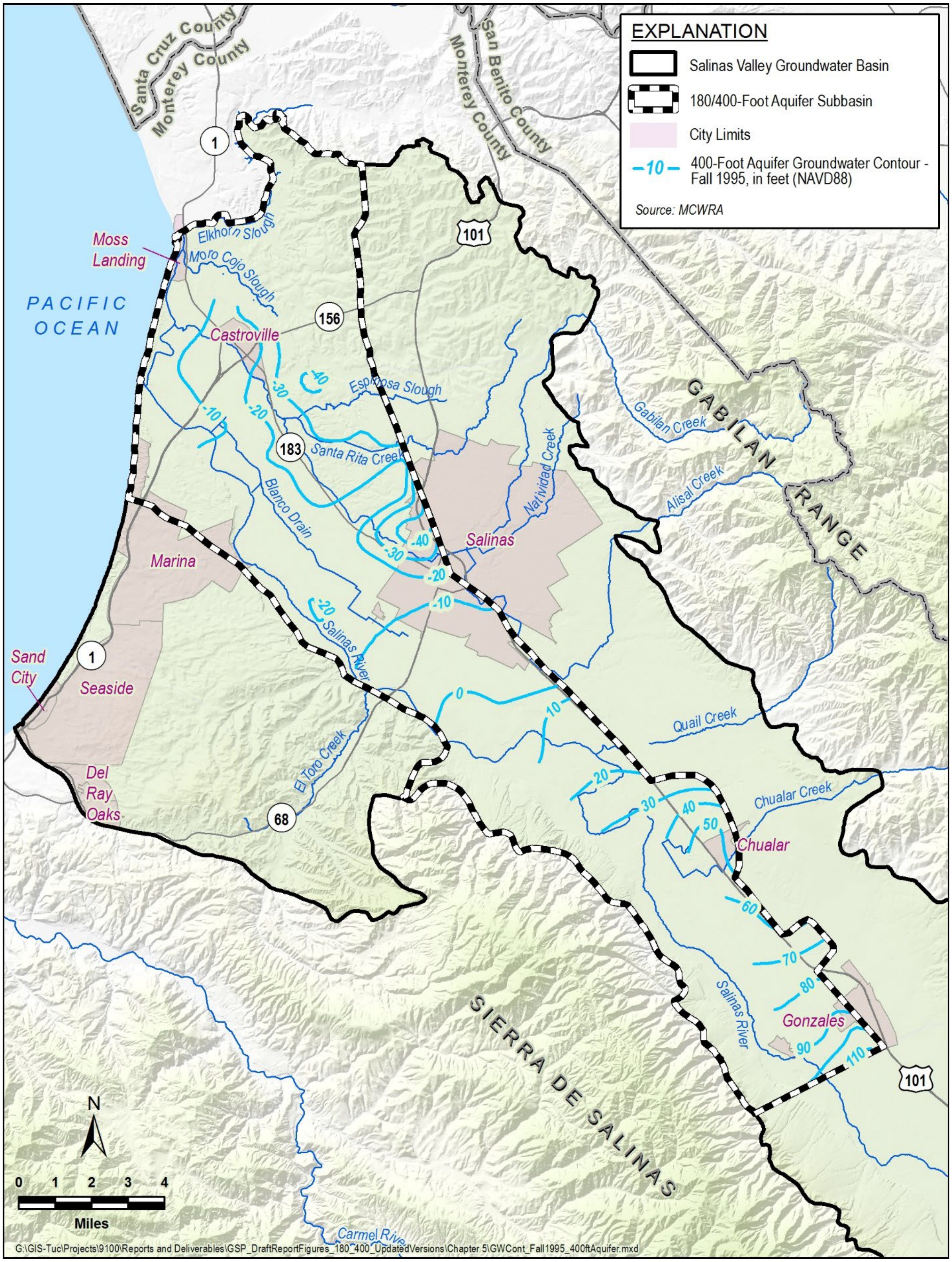


Figure 5-7. Fall 1995 400-Foot Aquifer Groundwater Elevation Contours

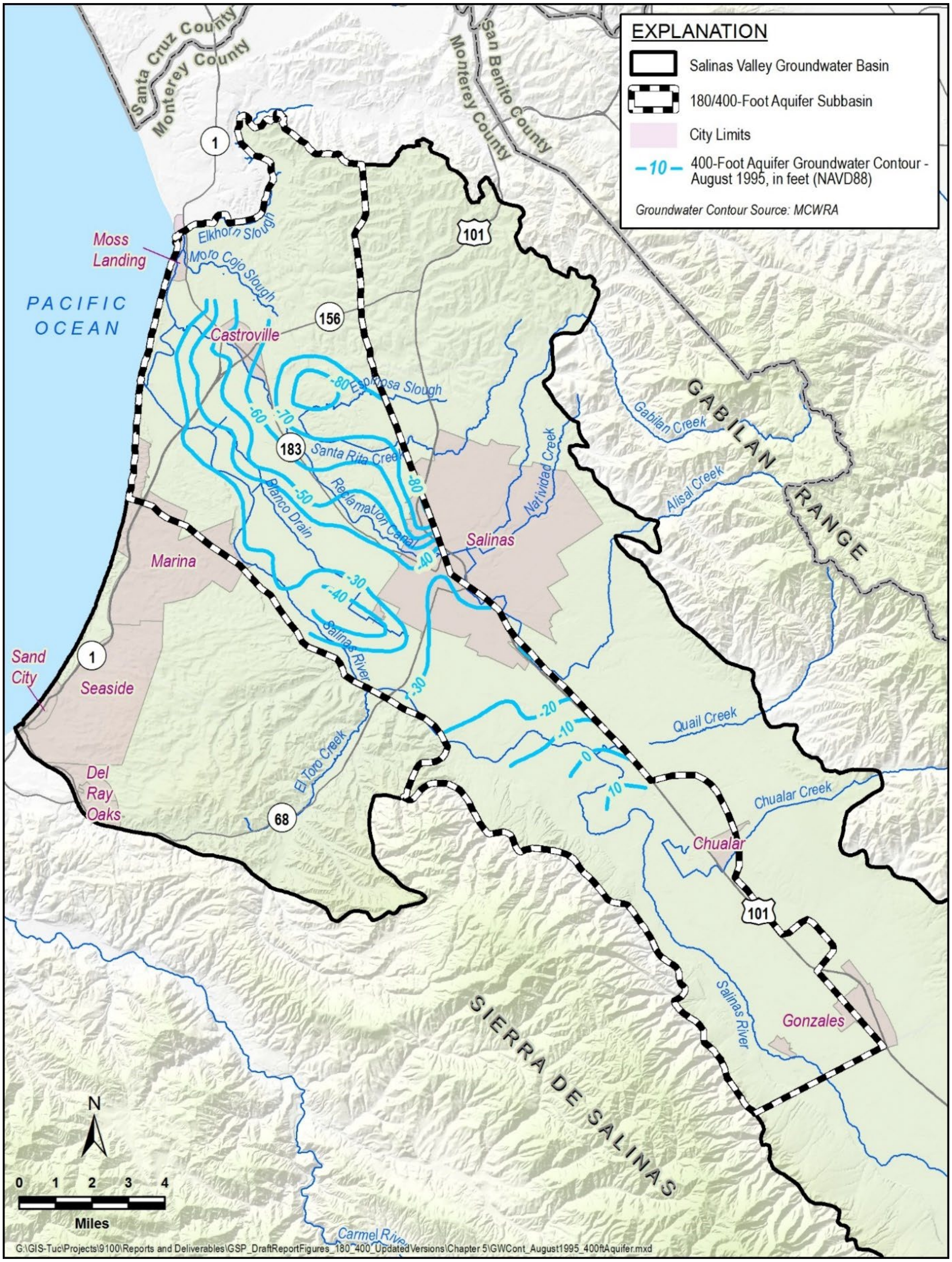


Figure 5-8. August 1995 400-Foot Aquifer Groundwater Elevation Contours

Groundwater generally flows from the south and from adjacent basins toward the north-northwest, with localized depressions around the pumping centers like those along the boundary with the Eastside Aquifer Subbasin northwest of the City of Salinas. The contours indicate that groundwater flow directions are similar in the 180-Foot and 400-Foot Aquifers. However, based on these contours, groundwater elevations in the 400-Foot Aquifer are generally lower than groundwater elevations in the 180-Foot Aquifer during both 1995 and 2019.

Under current conditions (Figure 5-1 to Figure 5-4), groundwater elevations in the northern half of the Subbasin are below sea level, estimated as zero feet NAVD88, as indicated by the negative values on the contour lines. The lowest groundwater elevations for both the 180-Foot and 400-Foot Aquifers occur northwest of the City of Salinas along the boundary with the Eastside Aquifer Subbasin. In the 180-Foot Aquifer, minimum groundwater elevations are approximately -30 ft NAVD88 during the fall measurements (Figure 5-1) and -40ft NAVD88 during the August measurements (Figure 5-2). In the 400-Foot Aquifer, minimum groundwater elevations are approximately -30 ft NAVD88 during the fall measurements (Figure 5-3) and -80 ft NAVD88 during the August measurements (Figure 5-4). The hydraulic gradients differ throughout the subbasin and are difficult to quantify based on variable groundwater elevations.

Groundwater elevations in the 180/400-Foot Aquifer Subbasin increase to the west toward the boundary with the Monterey Bay. They also increase toward the southern boundary with the Forebay Subbasin Aquifer where groundwater elevations are greater than 90 ft NAVD88 in the 180-Foot Aquifer (Figure 5-1 and Figure 5-2) and greater than 40 ft NAVD88 in the 400-Foot Aquifer (Figure 5-3 and Figure 5-4).

Under the historical conditions of 1995, a similar flow pattern to that of current conditions was present in both the 180-Foot and 400-Foot Aquifers; however, the magnitude of the pumping trough has varied over time. A discussion of historical groundwater elevation changes is presented in Section 5.1.3.

5.1.3 Hydrographs

Representative temporal trends in groundwater elevations can be assessed with hydrographs, which plot changes in groundwater elevations over time. Groundwater elevation data from wells within the Subbasin are available from monitoring conducted and reported by MCWRA.

Figure 5-9 depicts the locations and hydrographs of example monitoring wells in the Subbasin. Larger versions of the hydrographs for these wells, as well as all representative monitoring wells, are included in Appendix 5A. The locations of all the representative monitoring wells are shown on Figure 5-10 through Figure 5-12. Chapter 7 provides more information specific to the wells and the monitoring system.

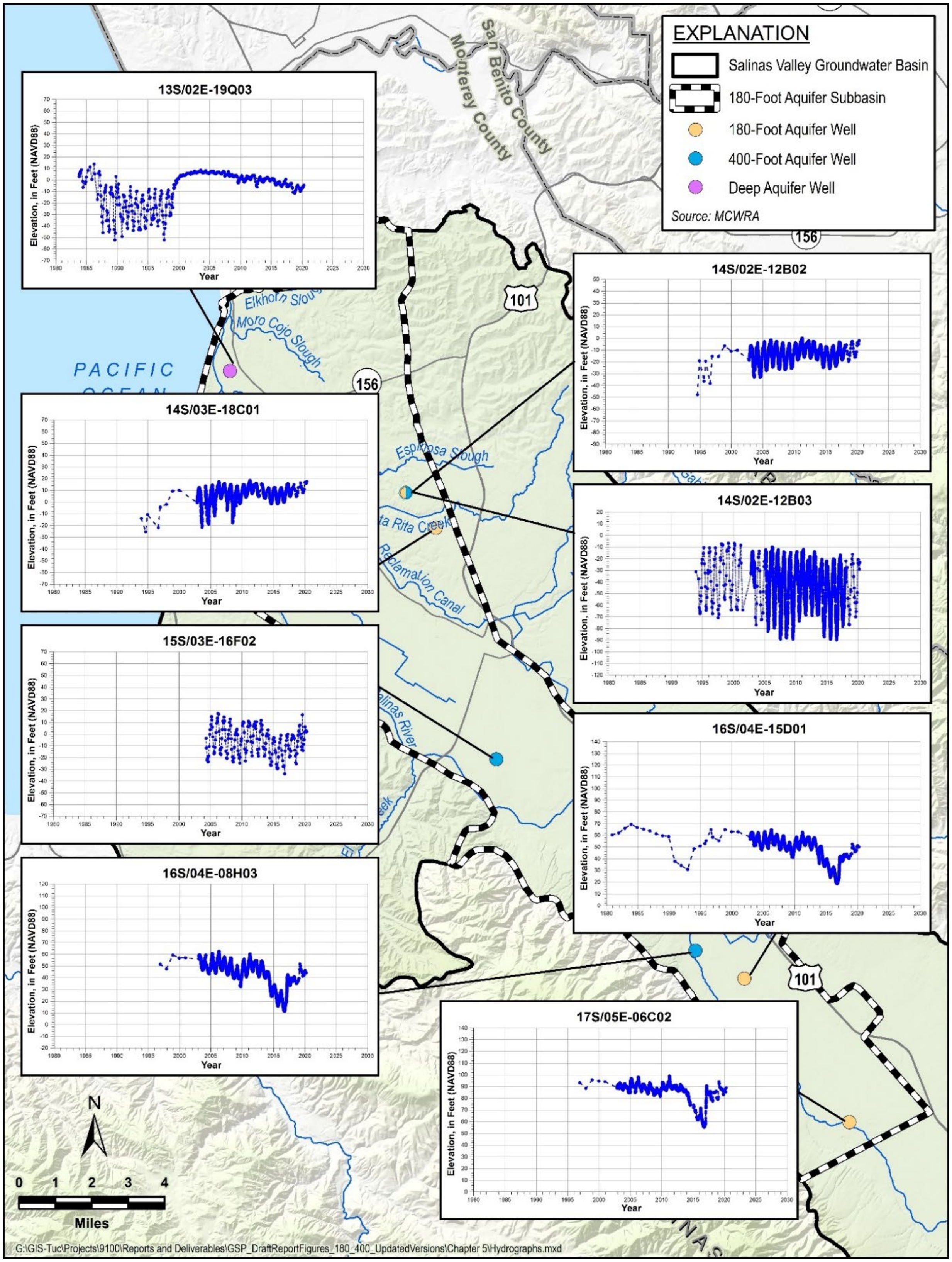


Figure 5-9. Map of Example Hydrographs

Figure 5-10. Locations of 180-Foot Aquifer Wells in the with Hydrographs Included in Appendix 5A

Figure 5-11. Locations of 400-Foot Aquifer Wells in the with Hydrographs Included in Appendix 5A

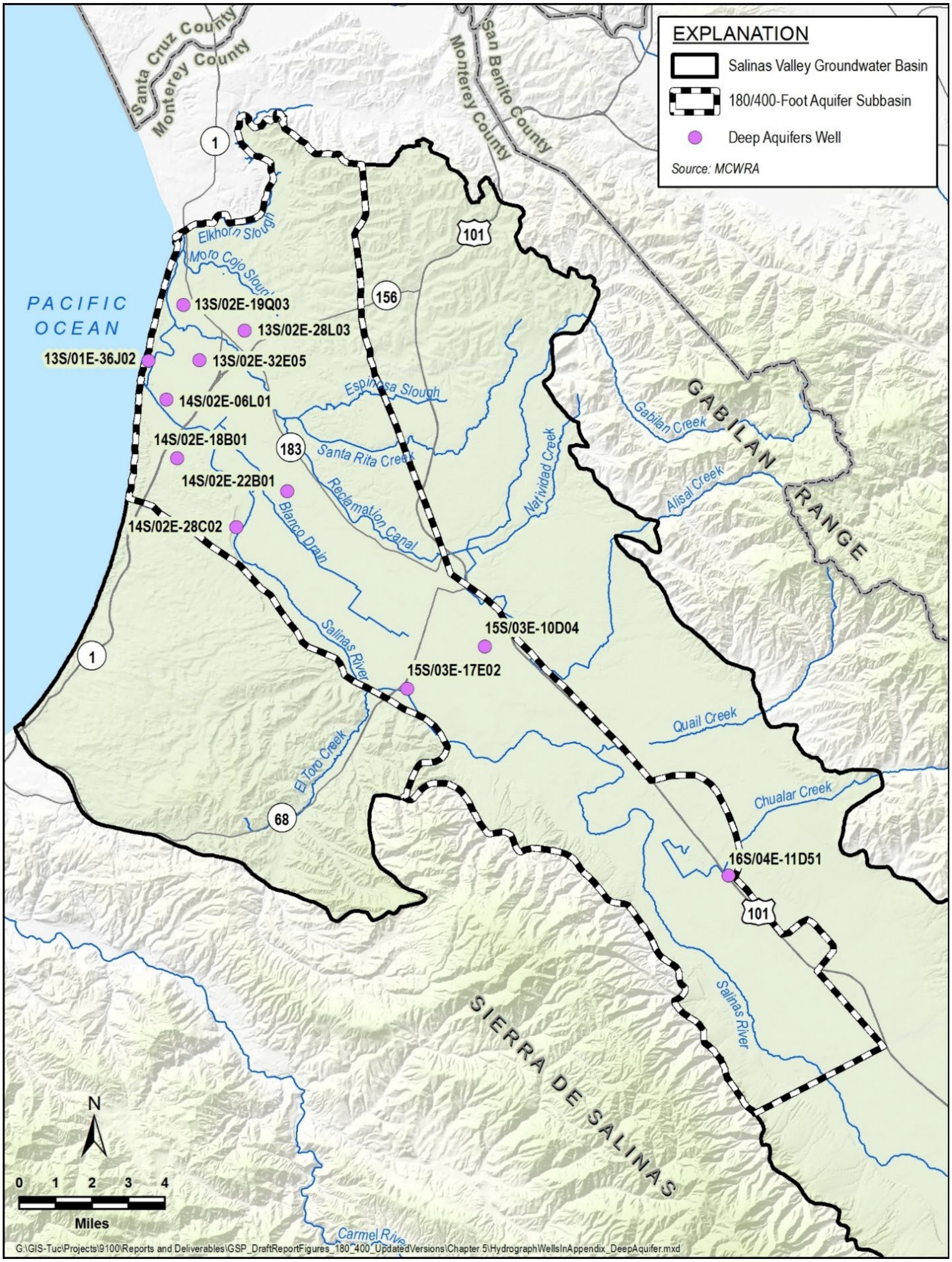


Figure 5-12. Locations of Deep Aquifers Wells in the with Hydrographs Included in Appendix 5A

Figure 5-14 presents a graph of cumulative groundwater elevation change for the 180/400-Foot Aquifer Subbasin. The graph was initially developed by MCWRA and is based on averaged change in fall groundwater elevations for designated wells in the Pressure subarea each year. The Pressure subarea used by MCWRA for its groundwater elevation change analyses overlaps the 180/400-Foot Subbasin, as well as small parts of the Eastside Aquifer Subbasin and most of the Monterey and Seaside Subbasins, as shown on Figure 5-15. The figure was adapted to reflect the cumulative change in groundwater elevations specific to the 180/400-Foot Aquifer Subbasin.

The cumulative change in groundwater elevation graph is developed by MCWRA and is based on averaged change in Fall groundwater elevations for designated wells in the subarea each year. MCWRA uses Fall groundwater elevations because these measurements are taken after the end of the irrigation season and before seasonal recharge from winter precipitation increases in groundwater levels. The cumulative groundwater elevation change plot is therefore an estimated average hydrograph for wells in the subarea. Although this plot does not reflect the groundwater elevation change at any specific location, it provides a general illustration of how the average groundwater elevation in the subarea changes in response to climatic cycles, groundwater extraction, and water-resources management at the subbasin scale.

The cumulative elevation change graph and the specific hydrographs presented in Appendix 5A show that groundwater elevations in the Subbasin show a long-term decline over time.

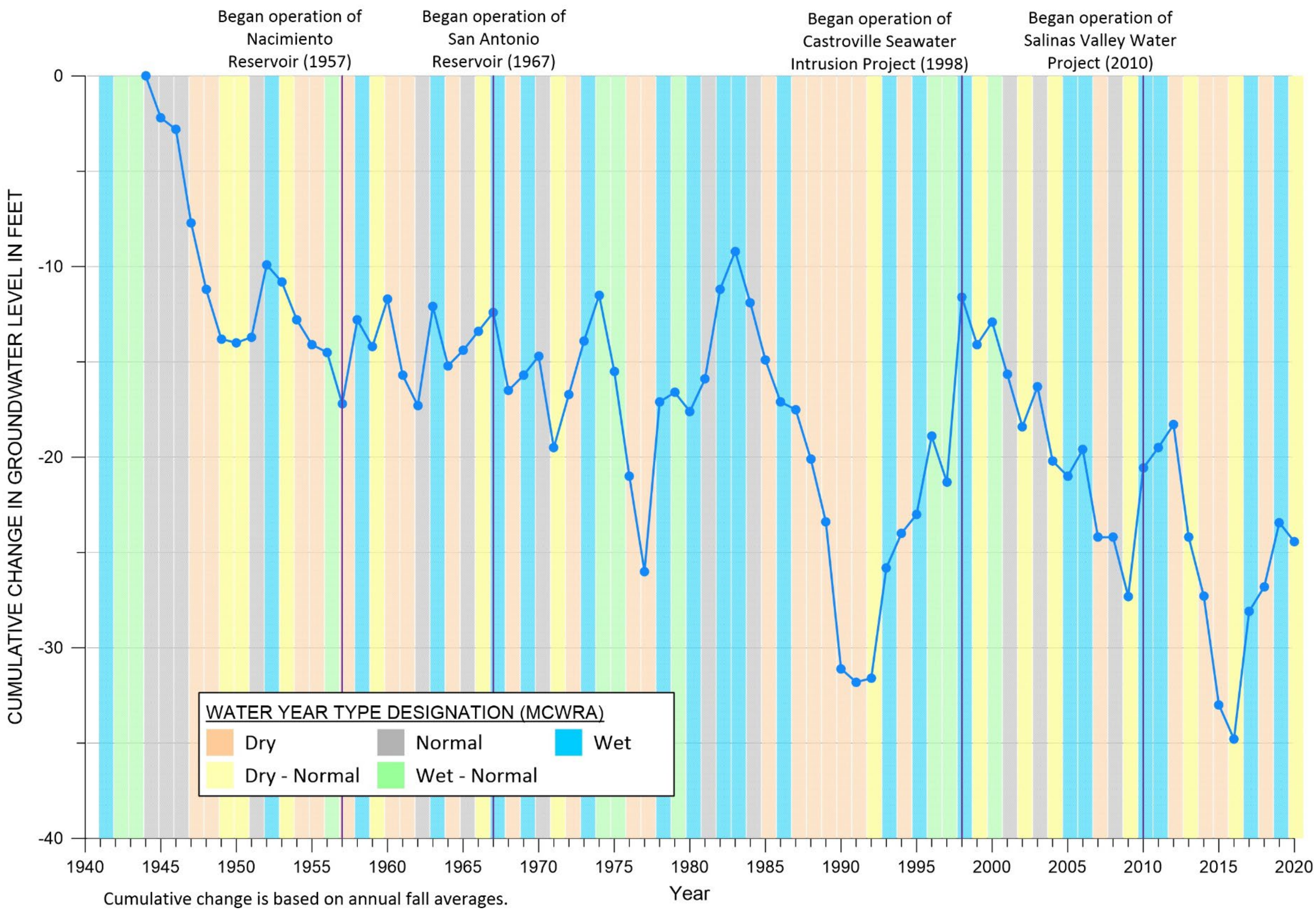


Figure 5-13. Cumulative Groundwater Elevation Change Graph for the 180/400-Foot Aquifer Subbasin
(Adapted from MCWRA, 2018a, personal communication)

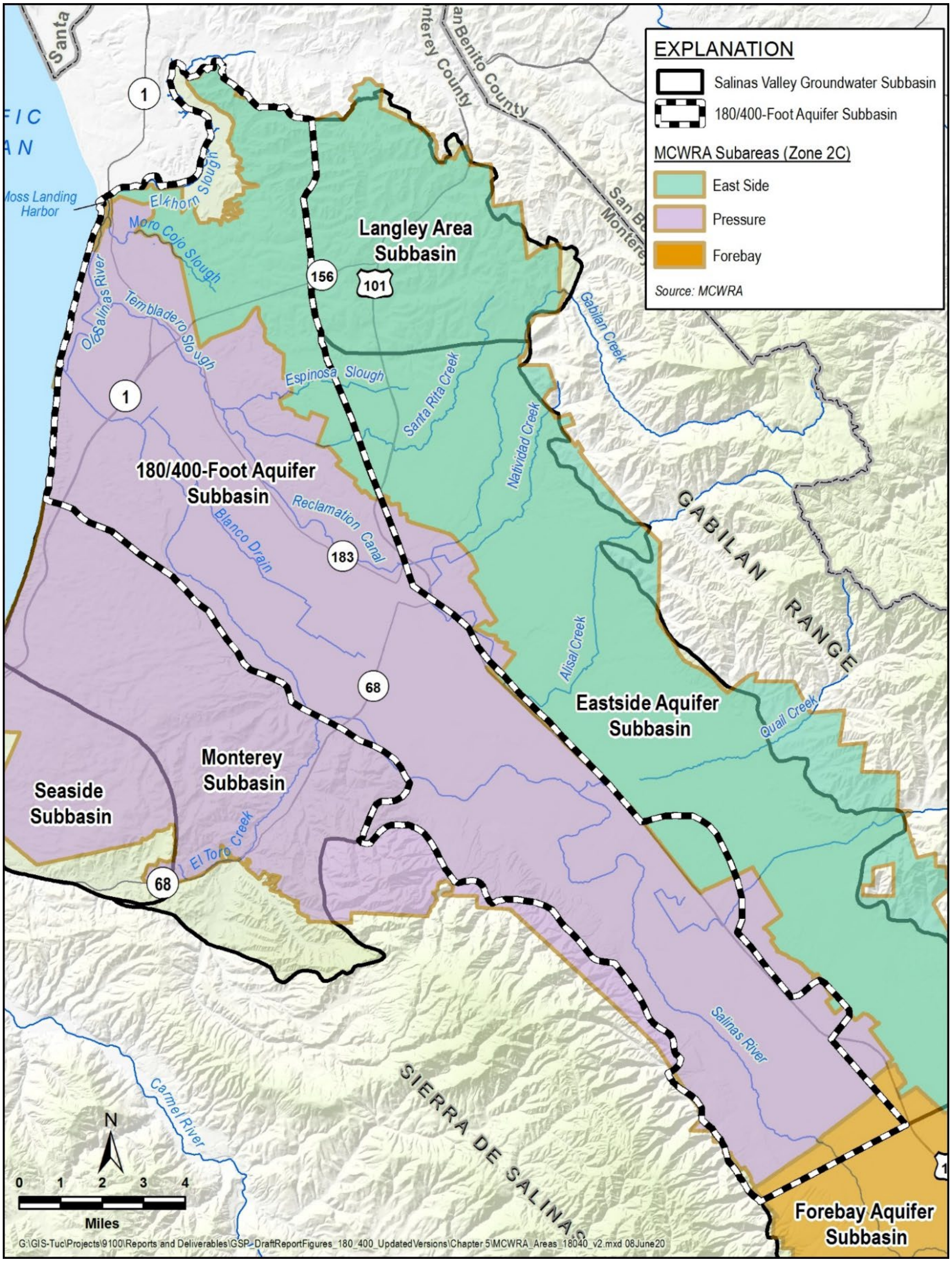


Figure 5-14. MCWRA Management Subareas

5.1.4 Vertical Groundwater Gradients

In the 180/400-Foot Aquifer Subbasin, the laterally extensive aquitards result in notable vertical hydraulic gradients: in some places groundwater elevations are approximately 20 to 50 feet lower in deeper wells than in shallower wells. Because the downward vertical gradients are caused by pumping, the magnitudes of the vertical gradients in many areas are greater during the irrigation season.

Figure 5-15 illustrates how vertical gradients at representative well pairs vary throughout the Subbasin. Each representative well pair consists of two adjacent wells with different well depths. The hydrographs for each well pair illustrate the difference in groundwater potentiometric elevation between wells of different depths at the same location. The two northernmost well pairs for the 180-Foot and 400-Foot Aquifers demonstrate similar fluctuating patterns between each well pair; however, groundwater elevations for the wells in the 180-Foot Aquifer are generally higher than those in the 400-Foot Aquifer. This likely indicates a lack of connection between the 180-Foot and 400-Foot Aquifers. On the contrary, the southern well pair for the 180-Foot and 400-Foot Aquifers does not demonstrate an appreciable difference in groundwater elevations which probably indicates a connection between the aquifers. There are not enough groundwater elevation records for wells in the Deep Aquifer to make a conclusion about the connection among the 180-Foot, 400-Foot, and Deep Aquifers.

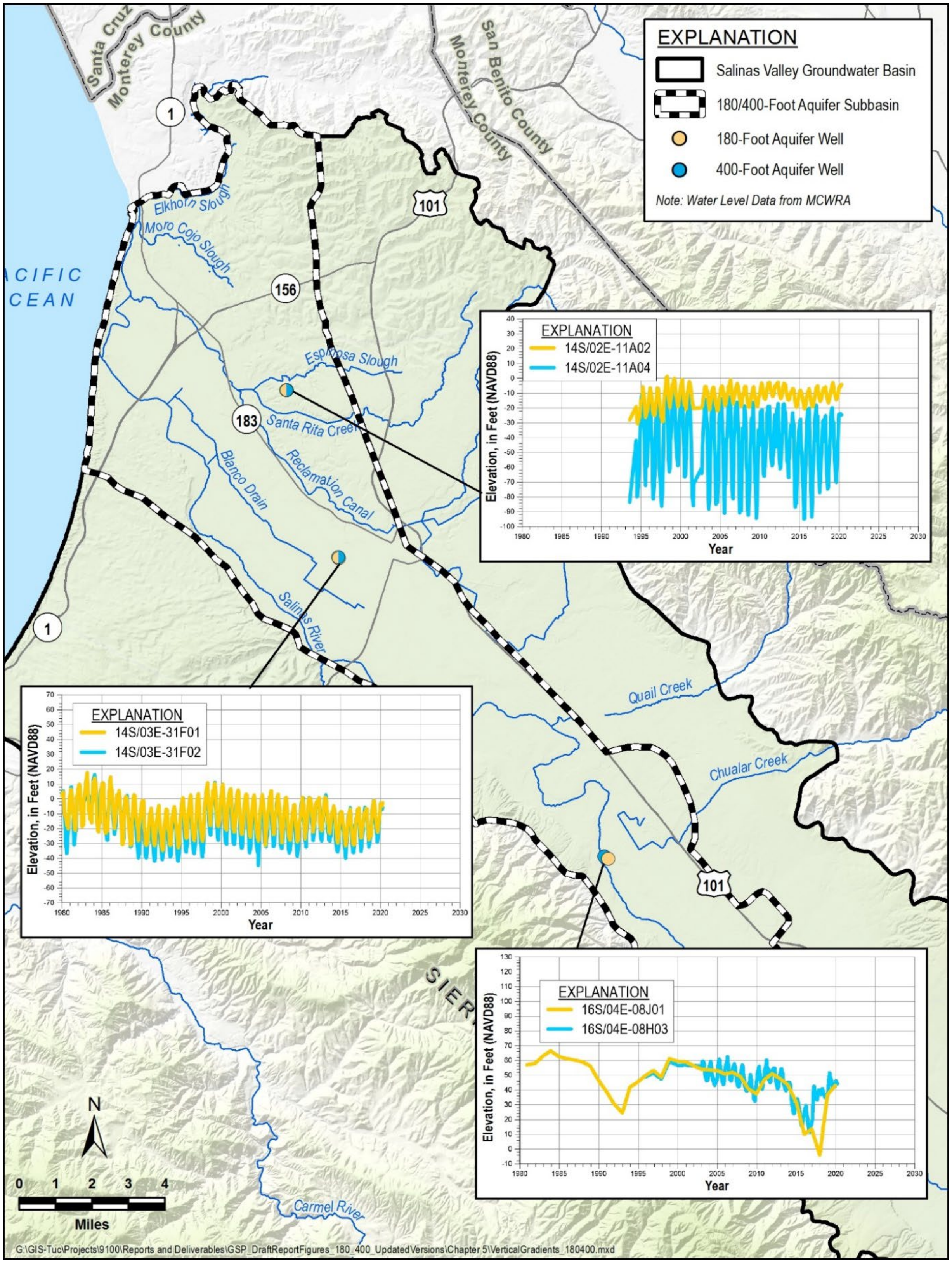


Figure 5-15. Vertical Gradients

5.2 Change in Groundwater Storage

Change in groundwater storage is calculated as the sum of the change in storage due to groundwater elevations outside of the seawater intruded area; and change in storage due to seawater intrusion within the seawater intruded area. This approach calculates the change in usable groundwater in storage rather than a change in total groundwater in storage. This is a common approach that best addresses the intent of SGMA.

Changes in groundwater elevations directly relate to fluctuation of groundwater storage; thus, the change in storage outside of the seawater intruded area is based on the change in groundwater elevations. As seawater intrusion advances inland, freshwater storage is decreased by the intruding seawater. Therefore, inside the seawater intruded area, the change in storage is the change in volume of seawater in the aquifer. To calculate the total change in storage in the Subbasin, the change in storage due to groundwater elevations and seawater intrusion need to be summed together.

5.2.1 Data Sources

Change in storage due to changes in groundwater elevation is developed based on MCWRA's fall groundwater elevation measurements. Fall groundwater elevation contour maps are used because these measurements are taken after the peak irrigation season and before winter precipitation increases groundwater levels; therefore, fall groundwater levels are reflective of annual change in storage caused by recharge and withdrawals of groundwater=. These groundwater elevation measurements are used to create fall groundwater elevation contour maps; and MCWRA's fall 1995 and fall 2019 contour maps are used to determine the spatial distribution of historical storage changes.

The change in storage from 2019 to 2020 is included in this GSP to describe current conditions. However, current conditions reflect the change in storage over the course of only one year; and annual change in storage fluctuates significantly depending on annual groundwater elevation changes. The historical groundwater elevations used to develop the cumulative change in groundwater elevation graph (Figure 5-13) that is used to estimate change in groundwater storage over time are used to validate the storage change due to groundwater elevations.

Change in storage due to seawater intrusion is based on MCWRA's extent of seawater intrusion maps. MCWRA produces these maps annually. The maps identify the inferred extent of the 500 mg/L chloride concentrations in both the 180- and 400-Foot Aquifers. The change in storage calculations assume that all groundwater seaward of the 500 mg/L chloride isocontours is unusable.

5.2.2 Change in Groundwater Storage Due to Groundwater Elevation Changes

The calculation of change in storage using groundwater elevation changes for the non-seawater intruded area is based on the following relationship:

$$\Delta S = \Delta WL \times A \times SC$$

Where: ΔS = Annual change in storage volume in the Subbasin (AF/yr.)

ΔWL= Annual change in average groundwater elevation in the Subbasin (ft/yr.)

SC = Storage coefficient (ft^3/ft^3)

A = Non-seawater intruded land area of Subbasin (acres)

This GSP Update calculates change in storage due to groundwater elevations in two ways:

1) ***Aquifer-specific calculation***: aquifer-specific storage coefficients are used to calculate the storage change in the areas of the 180-Foot and 400-Foot Aquifers that are not seawater intruded.

2) ***Whole subbasin calculation***: a storage coefficient representing all aquifers and aquitards above the 400-Foot/Deep Aquitard is used together with an area that subtracts the seawater intruded area. This is considered more representative because it accounts for the unconfined conditions in part of the Subbasin and shallow sediments. This whole subbasin calculation is also used for the groundwater storage SMC calculation described in Chapter 8.

Both calculations use the same change in groundwater storage due to change in groundwater elevations in the Subbasin (ΔWL), but they differ in how they calculate the storage coefficient (SC) and land area (A).

Annual change in average groundwater elevations (ΔWL): This is calculated by first subtracting the fall 2019 groundwater elevation contours from the fall 1995 groundwater elevation contours. For the 180-Foot Aquifer, Figure 5-5 and Figure 5-16 show the fall 1995 and fall 2019 groundwater elevation contours, respectively. Figure 5-17 shows the estimated change in groundwater storage in the 180-Foot Aquifer calculated by subtracting these two fall groundwater elevation maps. Figure 5-18 shows the estimated change in groundwater storage from fall 2019 to fall 2020 calculated by subtracting the fall 2019 (Figure 5-16) and fall 2020 (Figure 5-1) groundwater elevation contours. Change in storage for the 180-Foot Aquifer was calculated over a non-seawater intruded area of approximately 66,000 acres.

Similarly, for the 400-Foot Aquifer, Figure 5-7 and Figure 5-19 show the fall 1995 and fall 2019 groundwater elevation contour maps, respectively, and Figure 5-20 shows the associated 400-Foot Aquifer change in groundwater storage from fall 1995 to fall 2019. Figure 5-21 shows the estimated change in groundwater storage from fall 2019 to fall 2020 calculated by subtracting the fall 2019 (Figure 5-19) and fall 2020 (Figure 5-3). Change in storage in the 400-Foot Aquifer was calculated over a non-seawater intruded area of approximately 75,000 acres.

Given the limited data available for the Deep Aquifers, the groundwater level data used for calculating change in storage is predominantly from the 180-Foot and 400-Foot Aquifers, not the Deep Aquifers. Change in storage in the Deep Aquifers will be evaluated in the future as more data and information are collected during GSP implementation.

While subbasin calculations of change in storage are averaged over the entire Subbasin, change in storage maps show geographically how change in storage varies across the Subbasin. Between 1995 and 2019, a loss in groundwater storage has occurred in the southern end of the Subbasin in both the 180-Foot and 400-Foot Aquifers near Chualar. The loss in storage in this area ranges from 0.1 to 0.3 AF per acre over an area of approximately 12,000 acres in the 180-Foot Aquifer and 0.1 to 0.3 AF per acre over an area of approximately 900 acres in the 400-Foot Aquifer. Other noticeable areas with loss of groundwater storage are seen around Gonzales. From 2019 to 2020, storage change mostly remained within 0.1 AF per acre in both the 180-Foot and 400-Foot Aquifers throughout the Subbasin, there was only a small area within 1,000 acres that experienced a los in storage within 0.1 to 0.2 AF per acre.

Storage coefficient (SC): The aquifer-specific calculation uses a specific storage estimates from the SVIHM of 8.2×10^{-5} ft^{-1} and 2.7×10^{-5} ft^{-1} for the 180-Foot and 400-Foot Aquifers, respectively. The specific storage estimates from the SVIHM are multiplied by the approximate thickness of 150 feet for the 180-Foot Aquifer and 200 feet for the 400-Foot Aquifer; yielding storage coefficients of 0.012 and 0.005 for the 180-Foot and 400-Foot Aquifers, respectively. When the SVIHM is finalized, its specific storage estimates are likely to change. However, these values are reasonable and are the best available data. The final SVIHM's specific storage estimates will be used when they are available.

For the whole subbasin calculation, the storage coefficient of 0.078 is used for the entire Subbasin. This estimate incorporates the 180-Foot, 400-Foot, and Deep Aquifers. More details and background on how the aquifer-specific and whole Subbasin storage coefficients were calculated are provided in Appendix 5B.

Non-seawater intruded land area of Subbasin (A): For the aquifer-specific calculation, the area used for each individual aquifer calculation differs based on the area covered by annual fall contours and seawater intruded area.

For the whole Subbasin calculation, the area was estimated by subtracting the total volume of seawater intruded groundwater from the total amount of water that can be held in storage above the bottom of the 400-Foot Aquifer. This volume was then divided by the depth to the bottom of the 400-Foot Aquifer to calculate an area. Calculating area in this manner accounts for the aquitards and shallow sediments, which hold some water and are factored into the whole subbasin storage coefficient of 0.078.

Annual Change in Storage Calculation: A summary of components used for estimating change in groundwater storage due to groundwater elevation changes is shown in Table 5-2. Using the aquifer-specific storage coefficients, average annual groundwater storage loss due to changes in groundwater elevation since 1995 was 130 AF/yr. in the 180-Foot Aquifer and 40 AF/yr. in the 400-Foot Aquifer. Using the estimated Subbasin-wide storage coefficient, the total average annual loss in storage due to changes in groundwater elevation was 770 AF/yr. from 1995 to 2019 and 8,390 from 2019 to 2020. The total storage change in the individual aquifers do not add up to the Subbasin-wide storage change. This remaining loss in storage in the Subbasin possibly occurs in the Deep Aquifers and in the shallow sediments above the 180-Foot Aquifer, which are not designated as a principal aquifer. MCWRA does not produce groundwater elevation maps of the Deep Aquifers. Insufficient data currently exist to map groundwater elevations, and thus, groundwater storage changes, in the Deep Aquifers. This is a data gap that will be addressed during GSP implementation.

Table 5-2. Components Used for Estimating Change in Groundwater Storage Due to Groundwater Elevation Changes

Components	*Aquifer Specific Calculation*				*Whole Subbasin Calculation*	
	1995 to 2019		2019 to 2020		1995 to 2019	2019 to 2020
	180-Foot Aquifer	400-Foot Aquifer	180-Foot Aquifer	400-Foot Aquifer	Subbasin Total	Subbasin Total
Area of contoured portion of Subbasin minus Seawater Intrusion Area (acres)	65,600	75,500	65,600	75,300	76,000	76,000
Storage coefficient (ft^3/ft^3)	0.012	0.005	0.012	0.005	0.078	0.078
Average change in groundwater elevation (feet)	-4.00	-2.21	-1.89	-0.94	-3.11	-1.41
Change in groundwater storage (AF)	-3,230	-900	-1,530	-380	-18,410	-8,390
Average annual change in groundwater storage (AF/yr.)	-130	-40	-1,530	-380	-770	-8,390
Total average annual change in groundwater storage (AF/yr.)	**-170**		**-1,910**		**-770**	**-8,390**

Note: Negative values indicate loss, positive values indicate gain. The change from 1995 to 2019 is included to quantify historical change in storage and to be consistent with the other GSPs in the Salinas Valley. The change in storage from 2019 to 2020 is included in this GSP to describe current conditions and because it is based on one year it is largely dependent on annual groundwater elevation changes.

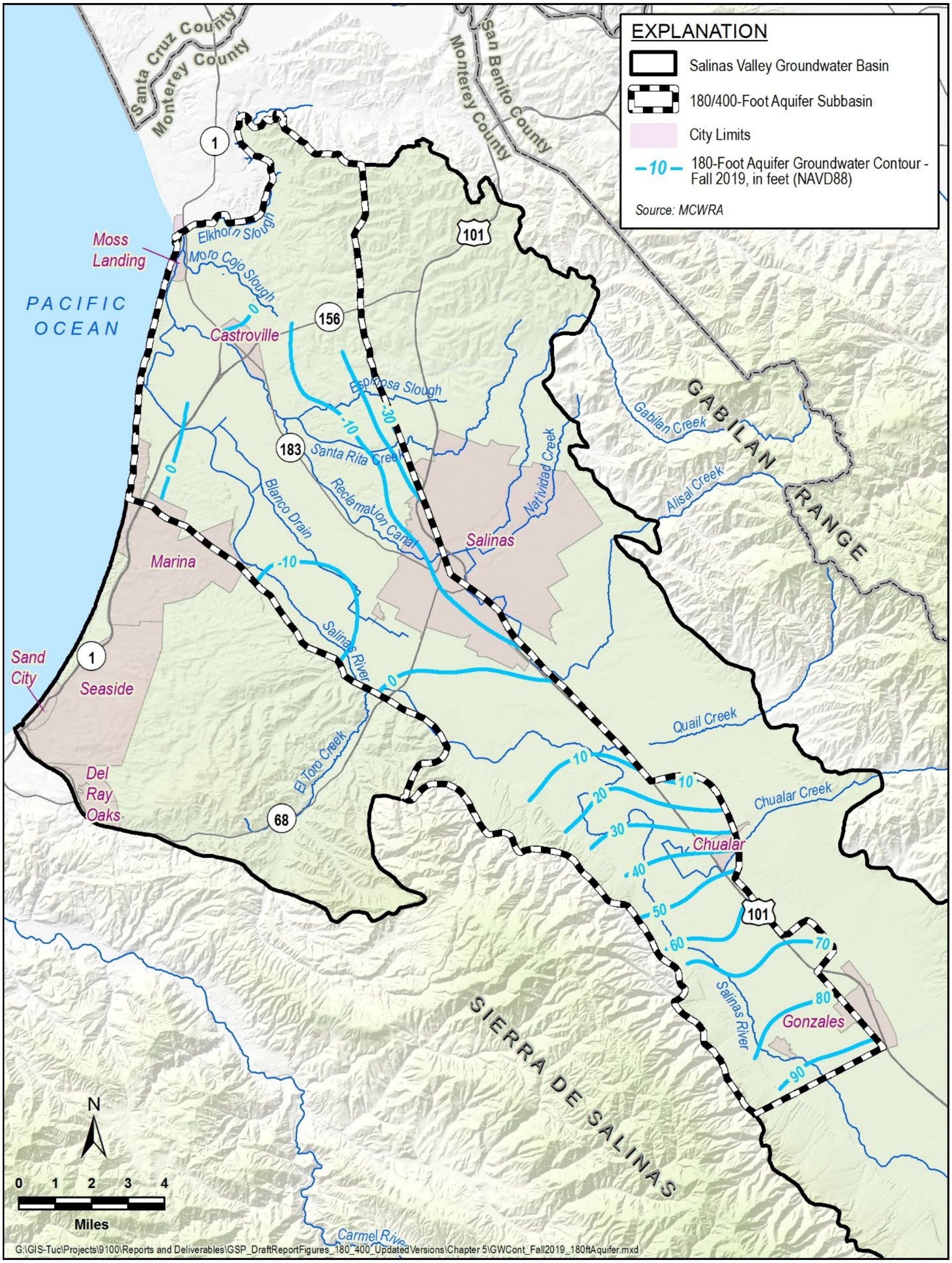


Figure 5-16. Fall 2019 180-Foot Aquifer Groundwater Elevation Contours

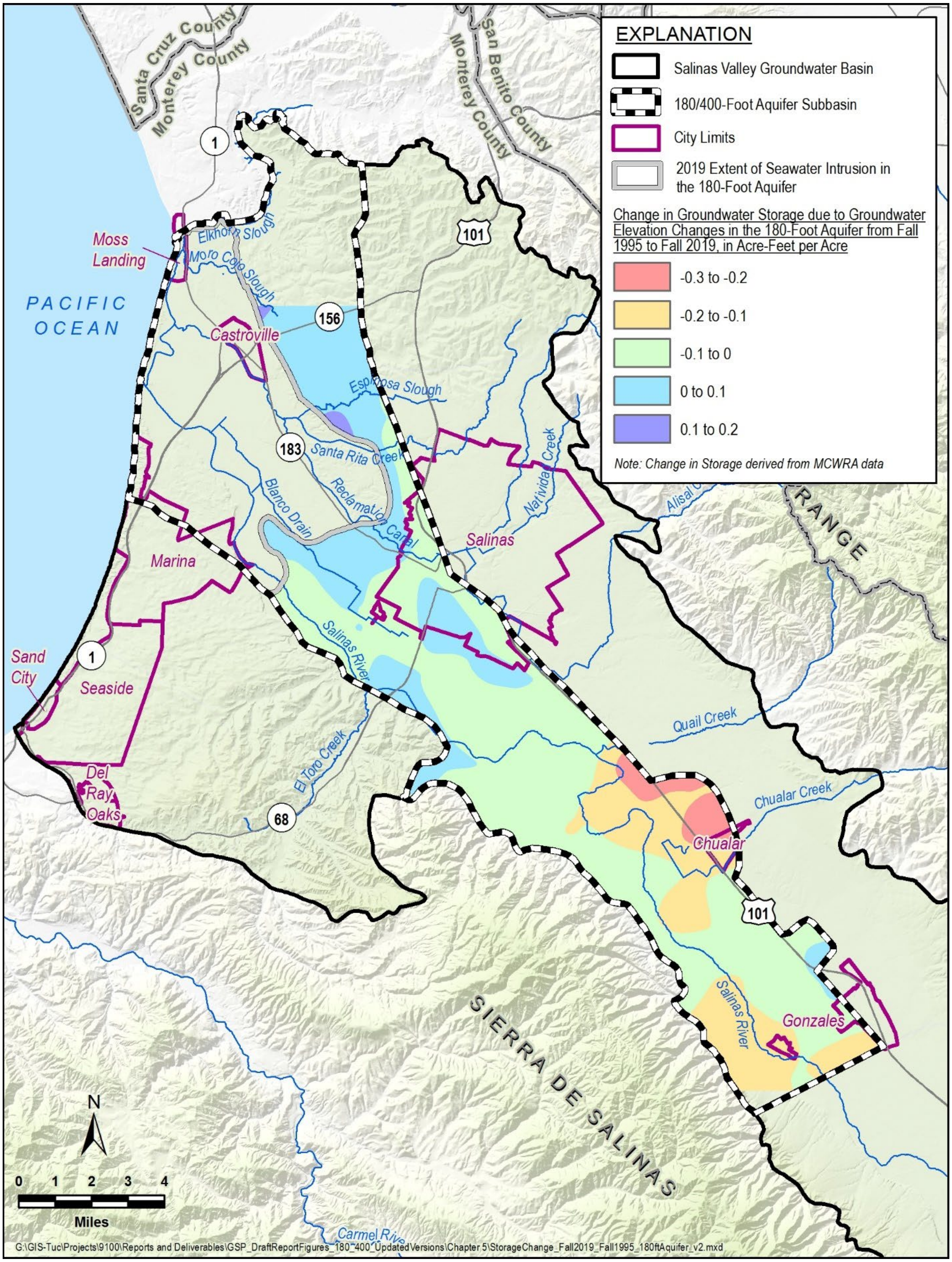


Figure 5-17. Change in Groundwater Storage in the 180-Foot Aquifer from Fall 1995 to Fall 2019

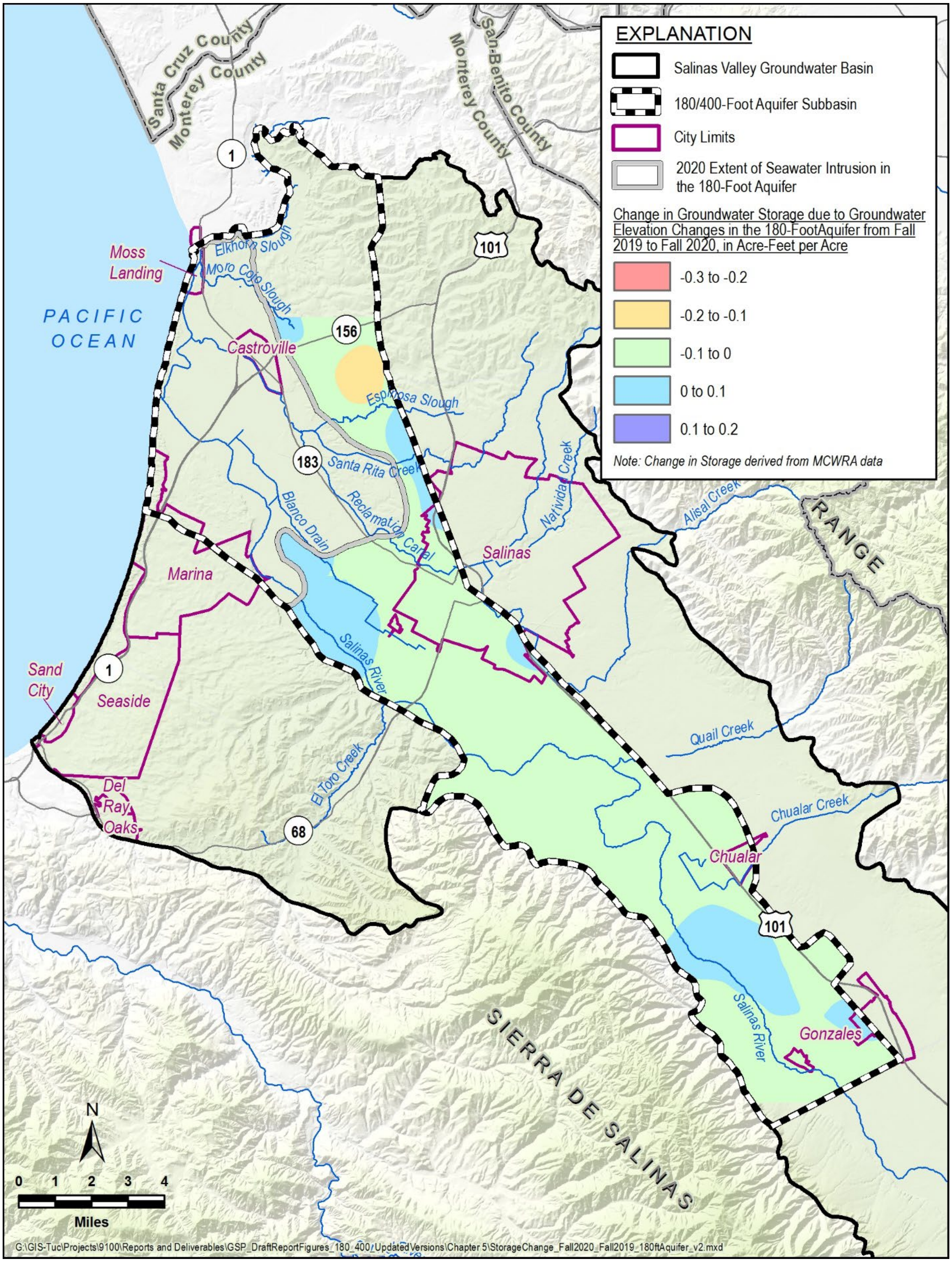


Figure 5-18. Change in Groundwater Storage in the 180-Foot Aquifer from Fall 2019 to Fall 2020

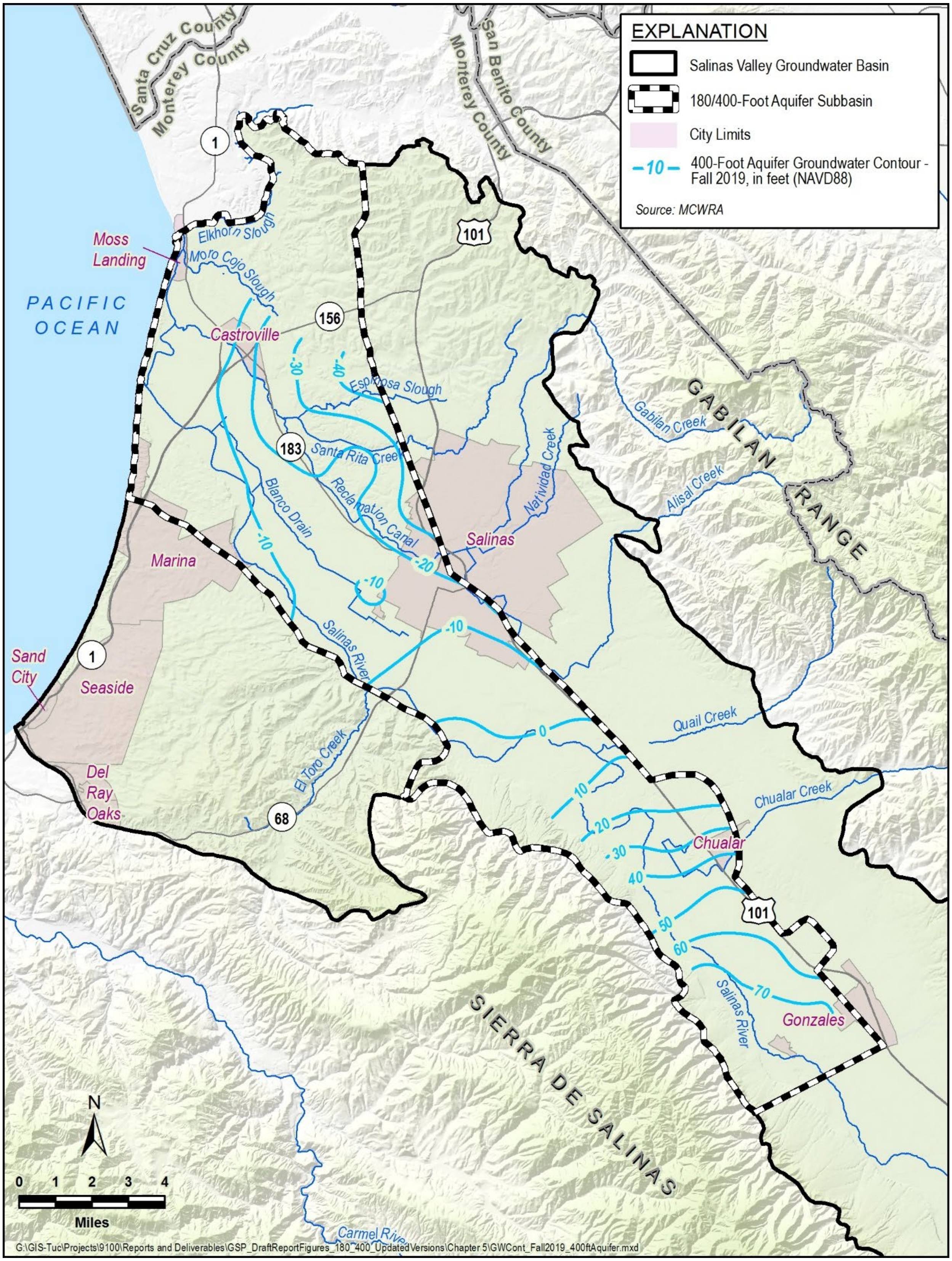


Figure 5-19. Fall 2019 400-Foot Aquifer Groundwater Elevation Contours

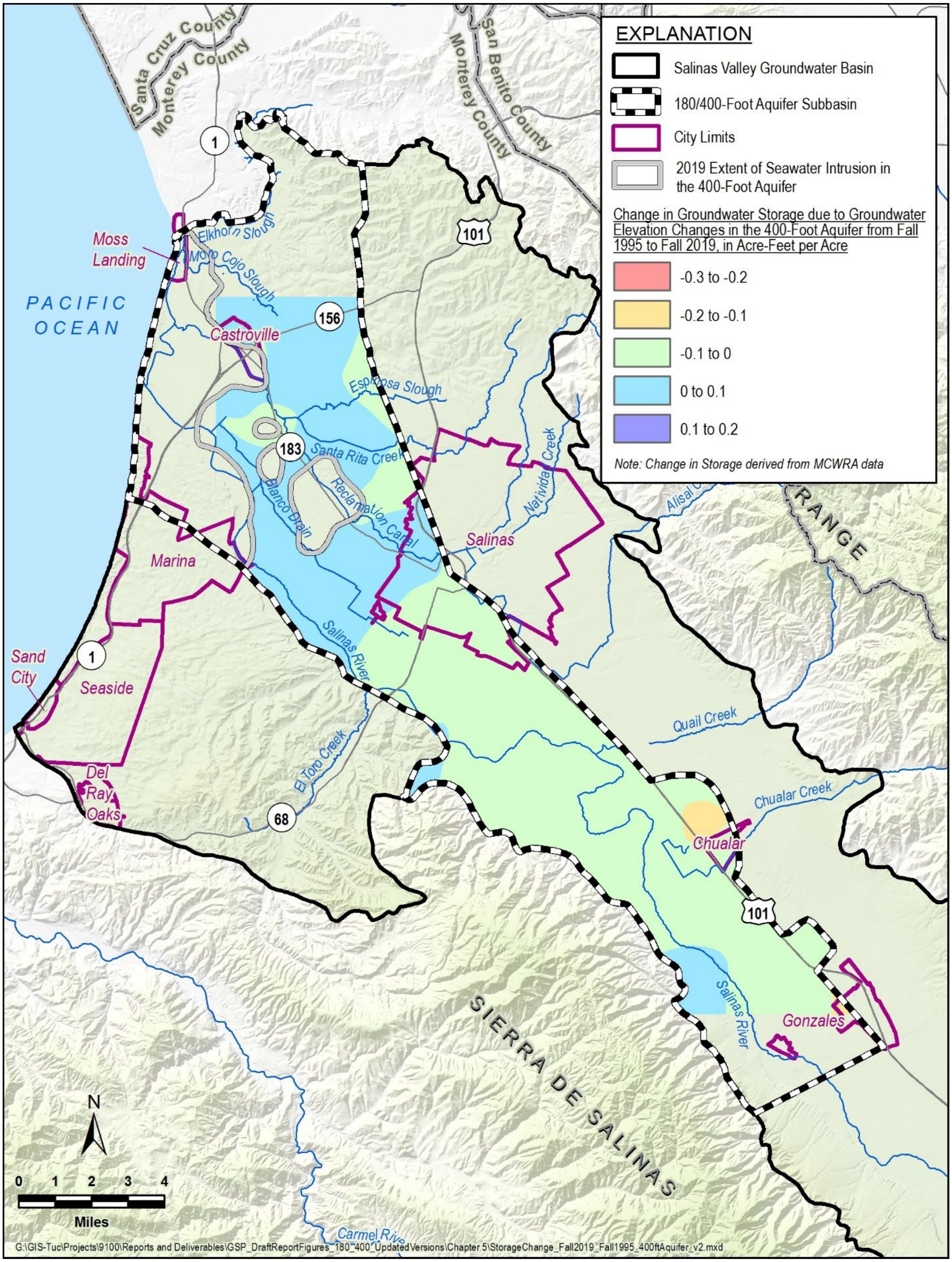


Figure 5-20. Change in Groundwater Storage in the 400-Foot Aquifer from Fall 1995 to Fall 2019

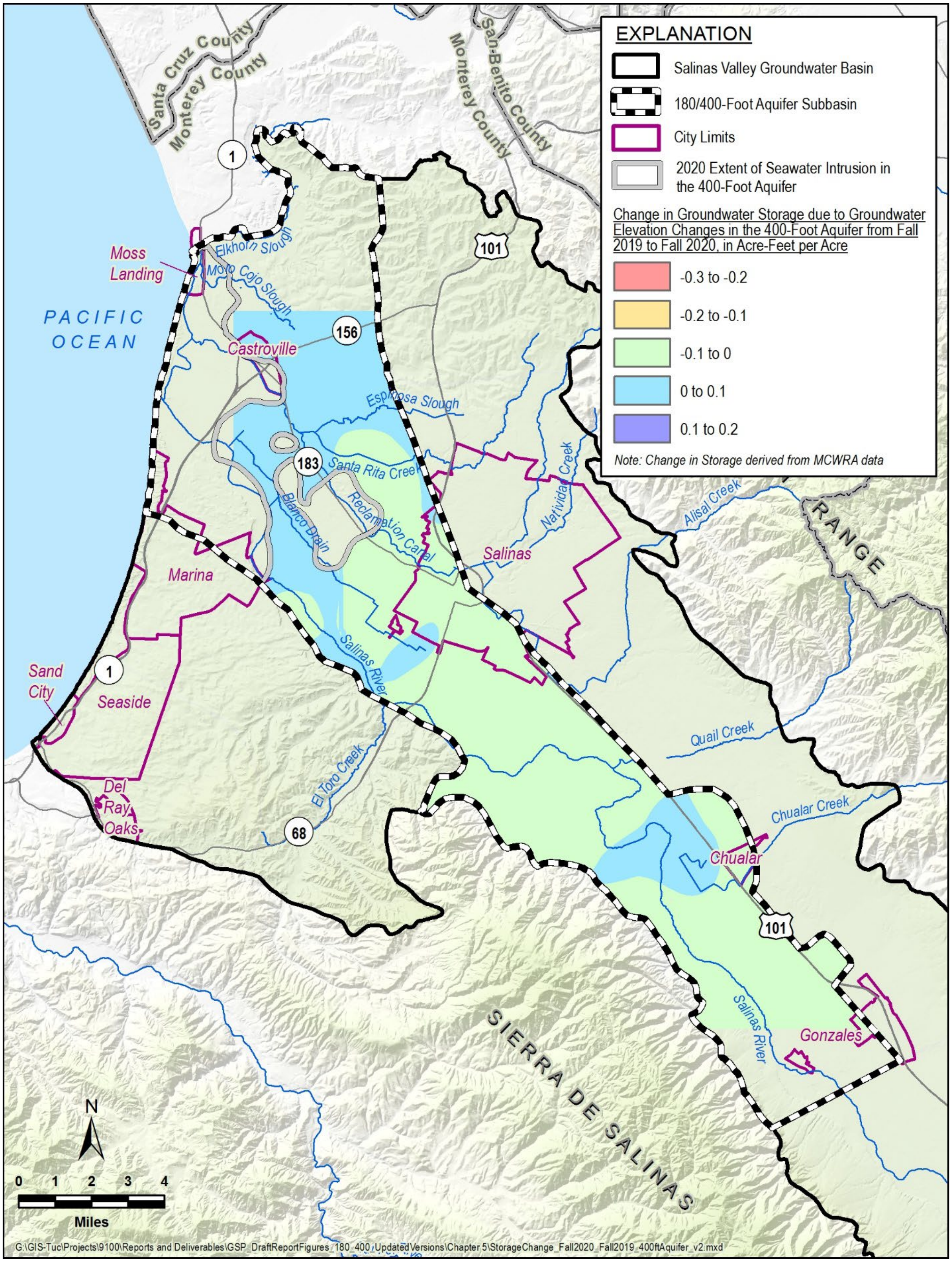


Figure 5-21. Change in Groundwater Storage in the 400-Foot Aquifer from Fall 2019 to Fall 2020

5.2.3 Change in Groundwater Storage Due to Seawater Intrusion

Groundwater storage losses due to seawater intrusion is estimated based on the change in seawater intrusion area, as mapped by MCWRA. The area of change is multiplied by an assumed aquifer thickness and effective porosity of 0.12, which is used in the SVIHM for the 180-Foot and 400-Foot Aquifers, to estimate the average annual loss of groundwater storage due to seawater intrusion. Average aquifer thickness is approximately 150 feet in the 180-Foot Aquifer and 200 feet in the 400-Foot Aquifer, based on descriptions provided in Chapter 4. Average annual groundwater storage loss due to seawater intrusion in the 180/400-Foot Aquifer Subbasin from 1995 to 2019 is -5,180 AF/yr. in the 180-Foot Aquifer and -7,370 AF/yr. in the 400-Foot Aquifer. From 2019 to 2020, storage losses due to seawater intrusion are -540 AF in the 180-Foot Aquifer and -5,280 AF in the 400-Foot Aquifer. This analysis considers the average historic change in storage due to seawater intrusion to be -12,550 AF/yr., which is the total of the 180-Foot and 400-Foot Aquifers storage changes. This storage loss is in addition to the change in groundwater storage due to changes in groundwater elevations. No seawater intrusion has been reported in the Deep Aquifers, thus, there likely is no change in storage due to seawater intrusion.

Table 5-3. Components Used for Estimating Loss in Groundwater Storage Due to Seawater Intrusion

Component	1995 to 2019		2019 to 2020	
	180-Foot Aquifer	400-Foot Aquifer	180-Foot Aquifer	400-Foot Aquifer
Change in seawater intrusion area (acres)	-6,910	-7,370	-30	-220
Effective porosity	0.12	0.12	0.12	0.12
Approximate aquifer thickness (feet)	150	200	150	200
Loss in groundwater storage (AF)	-124,380	-176,880	-540	-5,280
Average annual loss of storage (AF/yr.)	-5,180	-7,370	-540	-5,280
Total average annual change in storage due to seawater intrusion (AF/yr.)	-12,550		-1,740	

Note: Increases in acreage intruded by seawater are indicated by negative values. Negative values indicate loss, positive values indicate gain. The change from 1995 to 2019 is included to quantify historical change in storage and to be consistent with the other GSPs in the Salinas Valley. The change in storage from 2019 to 2020 is included in this GSP to describe current conditions.

5.2.4 Total Annual Average Change in Groundwater Storage

The total annual average change in groundwater storage is the sum of the changes in groundwater storage due to groundwater elevation changes and seawater intrusion. Table 5-4 summarizes the total average annual loss in storage from 1995 to 2019 and from 2019 to 2020. The total change in storage for the Subbasin in Table 5-4 is likely underestimated because the change in storage for the Deep Aquifers is not included. Groundwater elevations contours for the Deep Aquifers could not be drawn at the time of this GSP Update because of a lack of data. This is a data gap that will be filled during GSP implementation.

Table 5-4. Total Average Annual Change in Groundwater Storage

Component	Aquifer Specific Calculation				Whole Subbasin Calculation	
	1995 to 2019		2019 to 2020		1995 to 2019	2019 to 2020
	180-Foot Aquifer	400-Foot Aquifer	180-Foot Aquifer	400-Foot Aquifer	Subbasin Total	Subbasin Total
Annual storage loss due to groundwater elevation decrease (AF/yr.)	-130	-40	-1,530	-380	-770	-8,390
Annual loss due to seawater intrusion (AF/yr.)	-5,180	-7,370	-540	-5,280	-12,550	-5,820
Total annual loss of storage (AF/yr.)	**-5,310**	**-7,410**	**-2,070**	**-5,660**	**-13,320**	**-14,210**

Note: Negative values indicate loss, positive values indicate gain. The change from 1995 to 2019 is included to quantify historical change in storage and to be consistent with the other GSPs in the Salinas Valley. The change in storage from 2019 to 2020 is included in this GSP to describe current conditions and because it is based on one year it is largely dependent on annual groundwater elevation changes.

To verify the change in storage calculation from declining groundwater levels in Section 5.2.2, the change in storage was also calculated using Figure 5-22. The orange line on Figure 5-22 shows estimated cumulative change in groundwater storage in the 180/400-Foot Aquifer Subbasin from 1944 through 2020. This graph is based on MCWRA's cumulative change in groundwater elevation data (Figure 5-13). The groundwater storage changes are calculated by multiplying the annual groundwater elevation change by an assumed storage coefficient of 0.078 and size of the Subbasin. The black line on Figure 5-22 is the best fit linear rate of groundwater storage decline between 1995 and 2019. This black line shows that the average annual loss between 1995 and 2019 was 1,900 AF/yr. in the Subbasin. This estimate does not exactly match what it presented in Table 5-4; however, the two estimates are similar enough for the purposes of verifying the calculation in Section 5.2.2. Figure 5-24 includes limited data for the Deep Aquifers, as more data becomes available for the Deep Aquifers the chart will be refined accordingly.

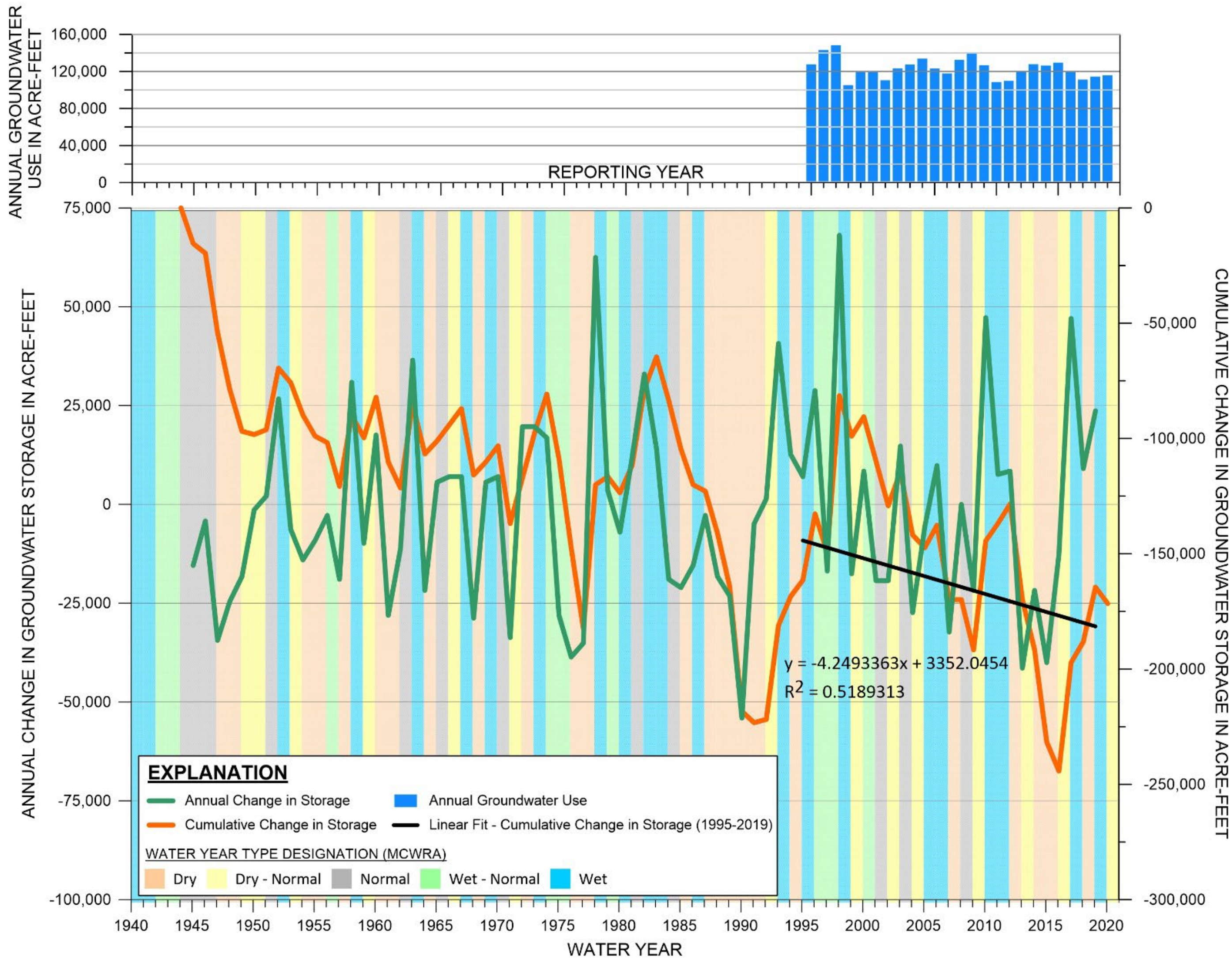


Figure 5-22. Annual and Cumulative Change in Groundwater Storage and Total Annual Groundwater Extraction in the 180/400-Foot Aquifer Subbasin, Based on Groundwater Elevations (adapted from MCWRA, 2018a, personal communication)

5.3 Seawater Intrusion

The 180-Foot and 400-Foot Aquifers have been subject to seawater intrusion for more than 70 years, as demonstrated by increased salt concentrations in wells near the Monterey Bay coastline. The negative impact of seawater intrusion on local water resources and the agricultural economy has been the primary motivation for many studies dating back to 1946 (DWR, 1946). MCWRA and others have implemented a series of engineering and management projects including well construction moratoriums, developing the CSIP system, and implementing the Salinas Valley Water Project (SVWP), among other actions to halt seawater intrusion. Although those actions have managed to slow the advance of intrusion and reduce its impacts, seawater intrusion remains an ongoing threat.

5.3.1 Data Sources

The extent and advance of seawater intrusion are monitored and reported by MCWRA. Monitoring seawater intrusion has been ongoing since the Agency formed in 1947, and currently includes a network of 156 dedicated monitoring and production wells in the Salinas Valley Groundwater Basin that are sampled twice annually in June and August. Most of the wells MCWRA monitors are located in the 180/400-Foot Aquifer Subbasin. The water samples are analyzed for general minerals; and the analytical results are used by MCWRA to analyze and report the following:

- Maps and graphs of historical chloride and specific conductivity trends
- Stiff diagrams and Piper diagrams
- Plots of chloride concentration vs. Na/Cl molar ratio trends

MCWRA publishes estimates of the extent of seawater intrusion every year. SVBGSA uses the MCWRA maps to define the extent of seawater intrusion as the location of the 500 mg/L chloride concentration isocontour. This chloride concentration is significantly lower than the 19,000 mg/L chloride concentration typical of seawater; however, it represents a concentration that may begin to impact beneficial uses. The 500 mg/L threshold is considered the Upper Limit Secondary Maximum Contaminant Level (SMCL) for chloride as defined by the EPA and is approximately ten times the concentration of naturally occurring groundwater in the Subbasin. SVBGSA and MCWDGSA are collaborating closely on the development and implementation of their GSPs for the 180/400 and Monterey Subbasins. MCWDGSA uses an isocontour derived based on a combination of TDS and chloride measurements and geophysical data. There are notable data gaps in the MCWRA seawater intrusion isocontour maps for the Monterey Subbasin, MCWDGSA chose these other data to more accurately map seawater intrusion in the Monterey Subbasin. During implementation, SVBGSA, MCWDGSA, and MCWRA will align the separate data sets with enhanced data-sharing and collaboration.

5.3.2 Seawater Intrusion Maps and Cross Section

Figure 5-23 and Figure 5-24 show the MCWRA mapped extents of current and historical seawater intrusion in the 180/400-Foot Subbasin in the 180-Foot and 400-Foot Aquifers, respectively. In each of the two figures, the maximum extent of the shaded contours represents the extent of groundwater with chloride exceeding 500 mg/L during the 2020 monitoring period. The historical progression of the 500 mg/L extent is also illustrated on these figures through the colored overlays that represent the extent of seawater intrusion observed during selected years.

Figure 5-23 and Figure 5-24 also show the mapped August 2020 groundwater elevations for the 180-Foot and 400-Foot Aquifer and the adjacent Eastside Aquifer Subbasin. These maps show the groundwater elevations that are persistently below sea levels that, when paired with a pathway, enable seawater intrusion. The groundwater elevation contours show that groundwater travels toward the depression at the northern end of the Eastside Aquifer Subbasin in both the Shallow and Deep Zones of the Eastside Aquifer that are generally equivalent to the 180-Foot and 400-foot Aquifers, respectively, in the 180/400-Foot Aquifer Subbasin.

A cross-section showing the vertical distribution of seawater intrusion is shown on Figure 5-25. The hydrostratigraphy shown on this cross section is adapted from the *Final Report, Hydrostratigraphic Analysis of the Northern Salinas Valley* (Kennedy-Jenks, 2004). The location of the cross-section is also shown on Figure 5-25 as line A-A'. The superposition of the seawater intrusion on the existing hydrostratigraphic cross-section was based on the 2020 500mg/L contour from MCWRA and recent groundwater quality data in the GSP database. The entire saturated thickness of the aquifer was assumed to be seawater intruded if any well in the aquifer indicated seawater intrusion.

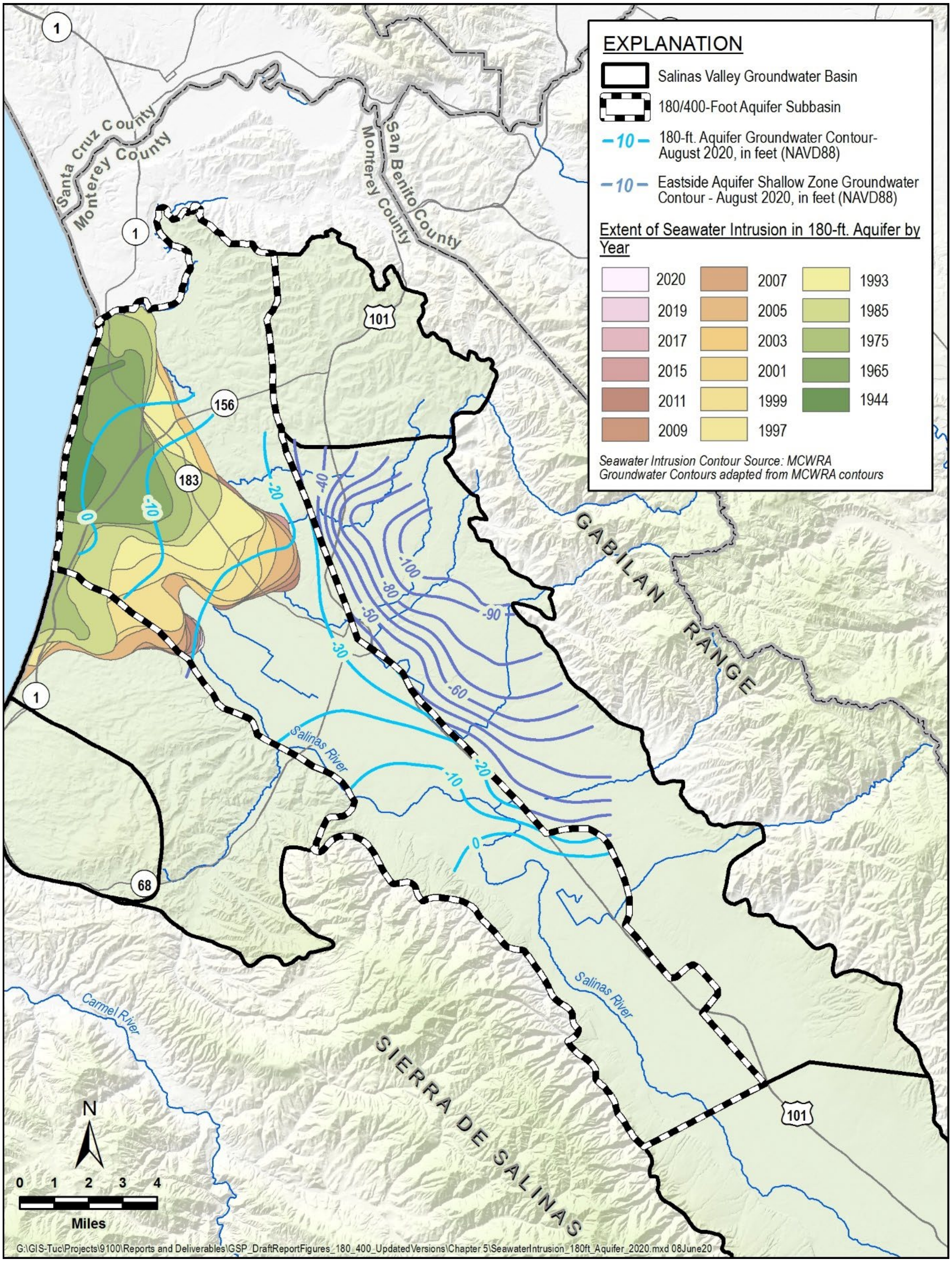


Figure 5-23. Seawater Intrusion in the 180-Foot Aquifer

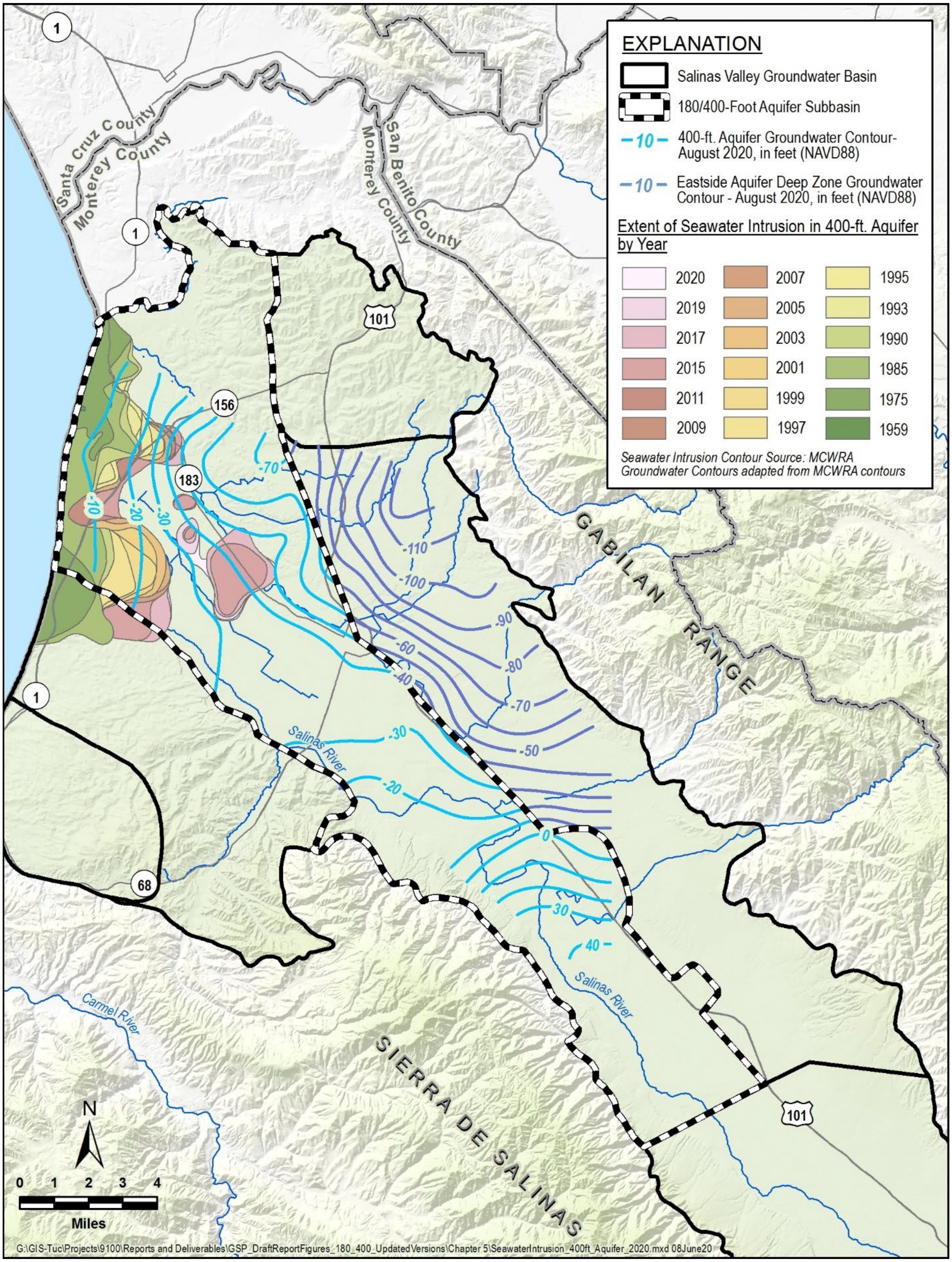


Figure 5-24. Seawater Intrusion in the 400-Foot Aquifer

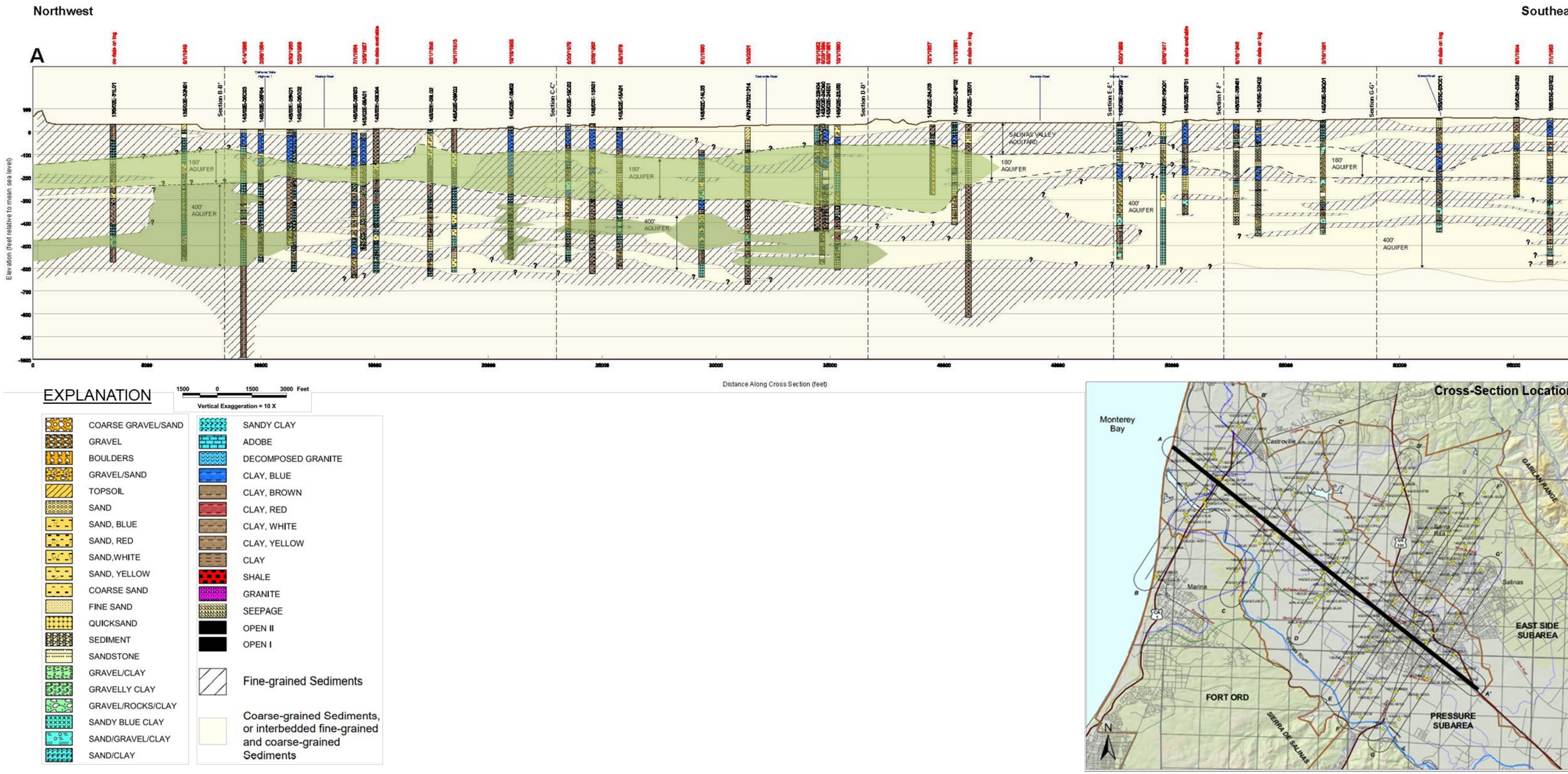


Figure 5-25. Cross-Section of Estimated Depth of Seawater Intrusion Based on Mapped 2020 Intrusion (Adapted from Kennedy-Jenks, 2004)

5.3.3 Seawater Intrusion Rates

Figure 5-26 and Figure 5-27 show time series graphs of the total acreage that overlies groundwater with chloride concentration greater than 500 mg/L. Figure 5-28 shows the time series of acreage overlying seawater intrusion in the 180-Foot Aquifer. In 2020 85% of this seawater intruded area was in the 180/400-Foot Aquifer Subbasin and the remainder was in the adjacent Monterey Subbasin. Figure 5-27 shows the time series of acreage overlying seawater intrusion in the 400-Foot Aquifer. In 2020, 83% of this seawater intruded area was in the 180/400-Foot Aquifer Subbasin and the remainder was in the adjacent Monterey Subbasin.

As shown on Figure 5-26, seawater intrusion into the 180-Foot Aquifer covered approximately 20,000 acres in 1995 and had expanded to approximately 28,000 acres by 2009. Since then, the rate of expansion has decreased, with an overlying area of approximately 28,300 in 2017 and 28,400 acres in 2020. Figure 5-27 shows that the area overlying seawater intrusion into the 400-Foot Aquifer is not as extensive as that in the 180-Foot Aquifer. The 400-Foot Aquifer had an overlying area of approximately 12,000 acres in 2009. However, between 2011 and 2015, the 400-Foot Aquifer experienced a significant increase in the area of seawater intrusion, from approximately 12,600 acres to approximately 15,700 acres. The acreage overlying seawater intrusion increased to about 16,900 acres in 2017 and to about 17,400 in 2020. This apparent rapid increase in this area is likely the result of localized downward migration of high chloride groundwater from the 180-Foot Aquifer to the 400-Foot Aquifer.

The process of downward migration between aquifers may be in part attributed to wells that are screened across both aquifers, discontinuous aquitards, or improperly abandoned wells, which can cause the isolated patches of seawater intrusion in the 400-Foot Aquifer. For example, the middle patch that greatly expanded from 2017 to 2019, is associated with a leaky well that connects the 180-Foot and 400-Foot Aquifers. This well was destroyed in November 2019. Regardless of the specific pathways, the presence of vertical downward hydraulic gradients from the 180-Foot Aquifer to the 400-Foot Aquifer presents a risk that eventually the intruded area of the 400-Foot Aquifer will be as large as that of the 180-Foot Aquifer.

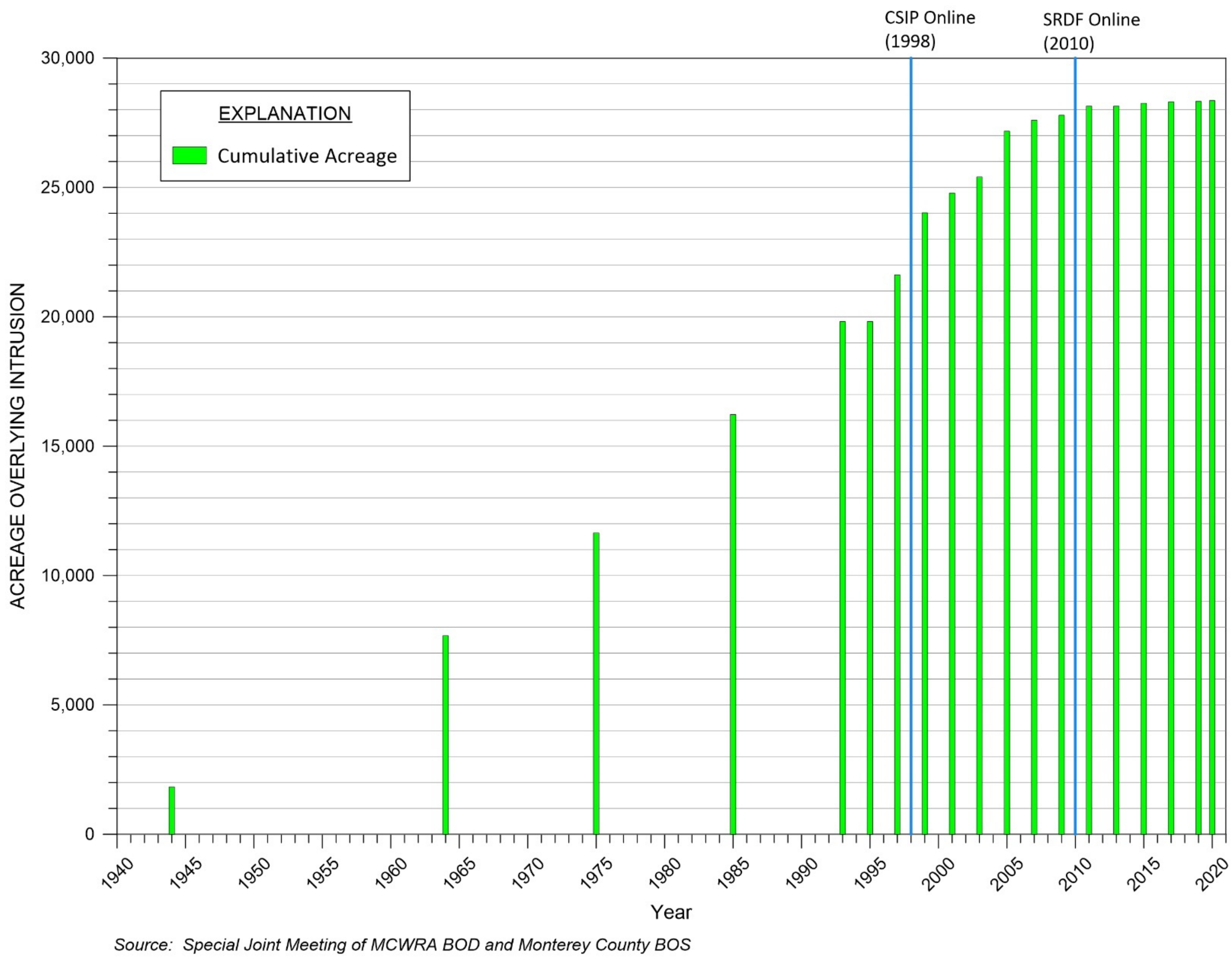
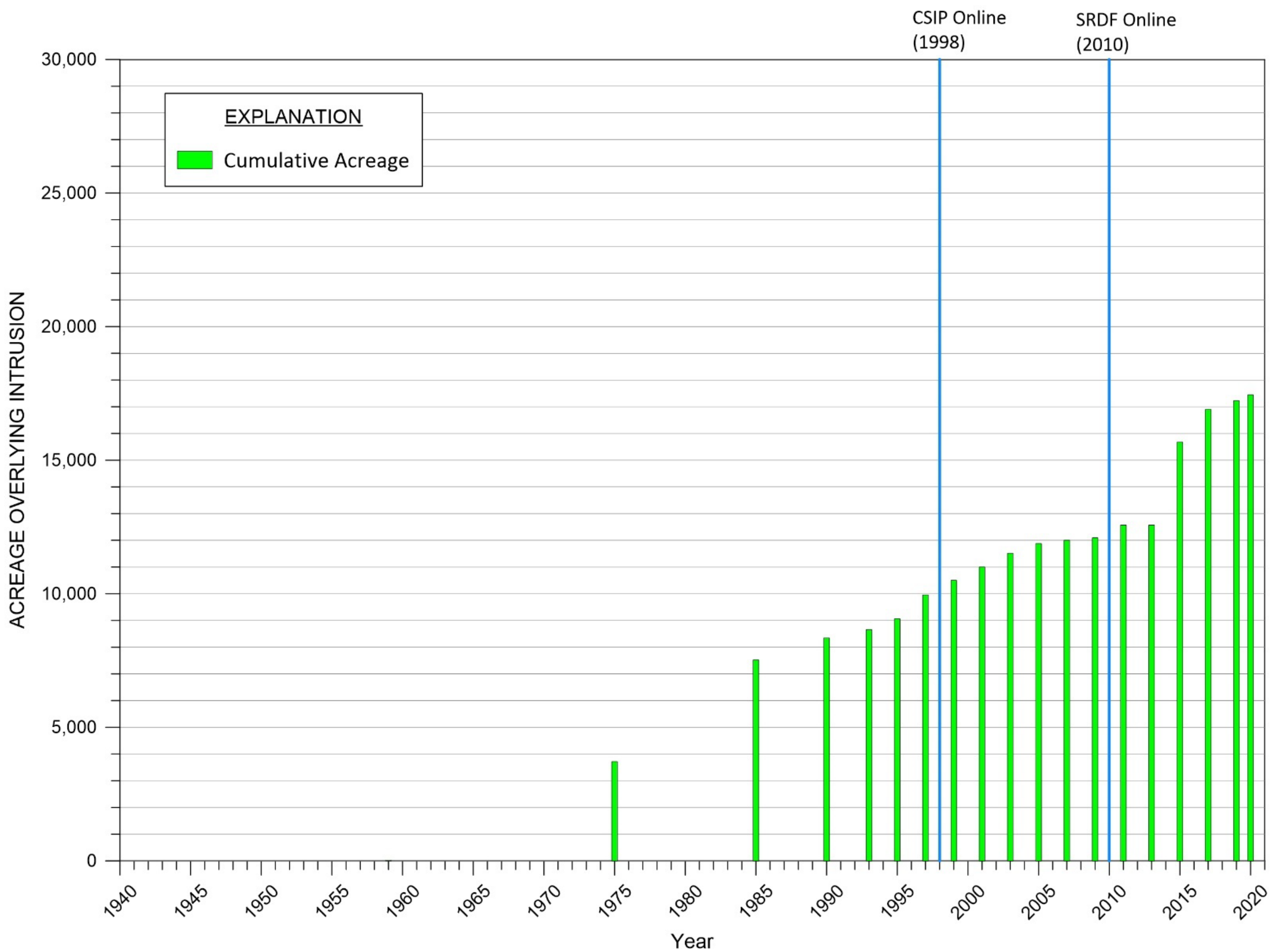


Figure 5-26. Acreage Overlying Seawater Intrusion in the 180-Foot Aquifer
(created with data from MCWRA)



Source: Special Joint Meeting of MCWRA BOD and Monterey County BOS

Figure 5-27. Acreage Overlying Seawater Intrusion in the 400-Foot Aquifer
(created with data from MCWRA)

Seawater intrusion has not been reported in the Deep Aquifers.

The volume of seawater flowing into the Subbasin every year does not strictly correspond to the acreages overlying the seawater-intruded area that are shown on Figure 5-26 and Figure 5-27. As the seawater intrusion front approaches pumping depressions, the front will slow down and stop at the lowest point in the pumping depression. When the seawater intrusion front stops at a pumping depression, no more acreage will be added every year. However, seawater will continue to flow in from the ocean towards the pumping depression.

The State of the Salinas River Groundwater Basin report estimated that approximately 11,000 acre-feet of seawater flows into the Pressure subarea every year. Previous estimates have ranged between 14,000 and 18,000 AF/yr. of seawater intrusion (Brown and Caldwell, 2015). These seawater inflow estimates include portions of the Monterey Subbasin. The length of coastline subject to seawater intrusion is approximately 75% in the 180/400-Foot Aquifer Subbasin and therefore this GSP estimates the flow into the 180/400-Foot Aquifer Subbasin is between 8,250 and 13,500 AF/yr.

5.4 Groundwater Quality Distribution and Trends

The SVBGSA does not have regulatory authority over groundwater quality and is not charged with improving groundwater quality in the Salinas Valley Groundwater Basin. Projects and actions implemented by the SVBGSA are not required to improve groundwater quality; however, they must not further degrade it.

5.4.1 Data Sources

Groundwater quality samples have been collected and analyzed in the Subbasin for various studies and programs. Groundwater quality samples have also been collected on a regular basis for compliance with regulatory programs. Groundwater quality data for this GSP were collected from:

- The Northern Counties Groundwater Characterization report (CCGC, 2015)
- The USGS' Groundwater Ambient Monitoring and Assessment Program (GAMA) reports (Kulongoski and Belitz, 2005; Burton and Wright, 2018)
- State Water Resources Control Board's GeoTracker Data Management System (SWRCB, 2021a)
- State Water Resources Control Board's GAMA Groundwater Information System (SWRCB, 2021b)
- The California Department of Toxic Substances Control's EnviroStor data management system (DTSC, 2021)

5.4.2 Point Sources of Groundwater Contaminants

Clean-up and monitoring of point source pollutants may be under the responsibility of either the Central Coast Regional Water Quality Control Board (CCRWQCB) or the Department of Toxic Substances Control (DTSC). The locations of these clean-up sites are visible in SWRCB's GeoTracker database map, publicly available at: https://geotracker.waterboards.ca.gov/. The GeoTracker database is linked to the DTSC's EnviroStor data management system that is used to track clean-up, permitting, and investigation efforts. Table 5-5 and Figure 5-28 provide a summary of the active clean-up sites within the Subbasin. Table 5-5 does not include sites that have leaking underground storage tanks, which are not overseen by DTSC or the CCRWQCB.

Table 5-5. Active Cleanup Sites

Label	Site Name	Site Type	Status	Constituents of Concern (COCs)	Address	City
1	Dynegy Moss Landing	Corrective Action	Active	metals, petroleum, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs)	Highway 1 & Dolan Road	Moss Landing
2	Moss Landing Power Plant	Cleanup Program Site	Open - Verification Monitoring	metals/heavy metals, petroleum/fuels/oils, polynuclear aromatic hydrocarbons, volatile organic compounds (VOCs)	Highway 1 & Dolan Road	Moss Landing
3	National Refractories (Former)	Cleanup Program Site	Open - Remediation	chromium, trichloroethylene (TCE)	7697 California Highway 1	Moss Landing
4	Union Pacific Railroad - Salinas Yard	Cleanup Program Site	Open - Verification Monitoring	petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), naphthalene, VOCs, metals	Rico and West Lakes Streets	Salinas
5	Toro Petroleum-Agt	Cleanup Program Site	Open - Verification Monitoring	benzene, petroleum hydrocarbons	308 West Market Street	Salinas
6	Pacific Gas & Electric (PG&E), Salinas Manufactured Gas Plant (MPG)	Voluntary Cleanup	Active	cyanide, metals, contaminated soil, hydrocarbon mixtures	2 Bridge Street	Salinas
7	Borina Foundation	Cleanup Program Site	Open - Remediation contaminated soil was excavated in 2013. Soil vapor extraction remedy is operating to treat soil gas	halogenated volatile organic compounds (VOCs) in soil and soil gas	110-124 Abbott Street	Salinas
8	Crop Production Services, Inc. - Salinas	Cleanup Program Site	Open - Remediation Pump and treat system in place	nitrate, pesticides in shallow aquifer	1143 Terven Avenue	Salinas
9	Pure-Etch Co	Corrective Action	Active - dual phase extraction remedy implemented	benzene, ethylbenzene, petroleum hydrocarbon-gas, toluene, xylenes	1031 Industrial Street	Salinas
10	NH3 Service Company	Cleanup Program Site	Open - Verification Monitoring Pump and treat system in place	nitrate	945 Johnson Avenue	Salinas
11	Firestone Tire (Salinas Plant)	National Priorities List	Delisted	1,2-dichloroethylene (DCE), tetrachloroethylene (PCE)	340 El Camino Real South	Salinas

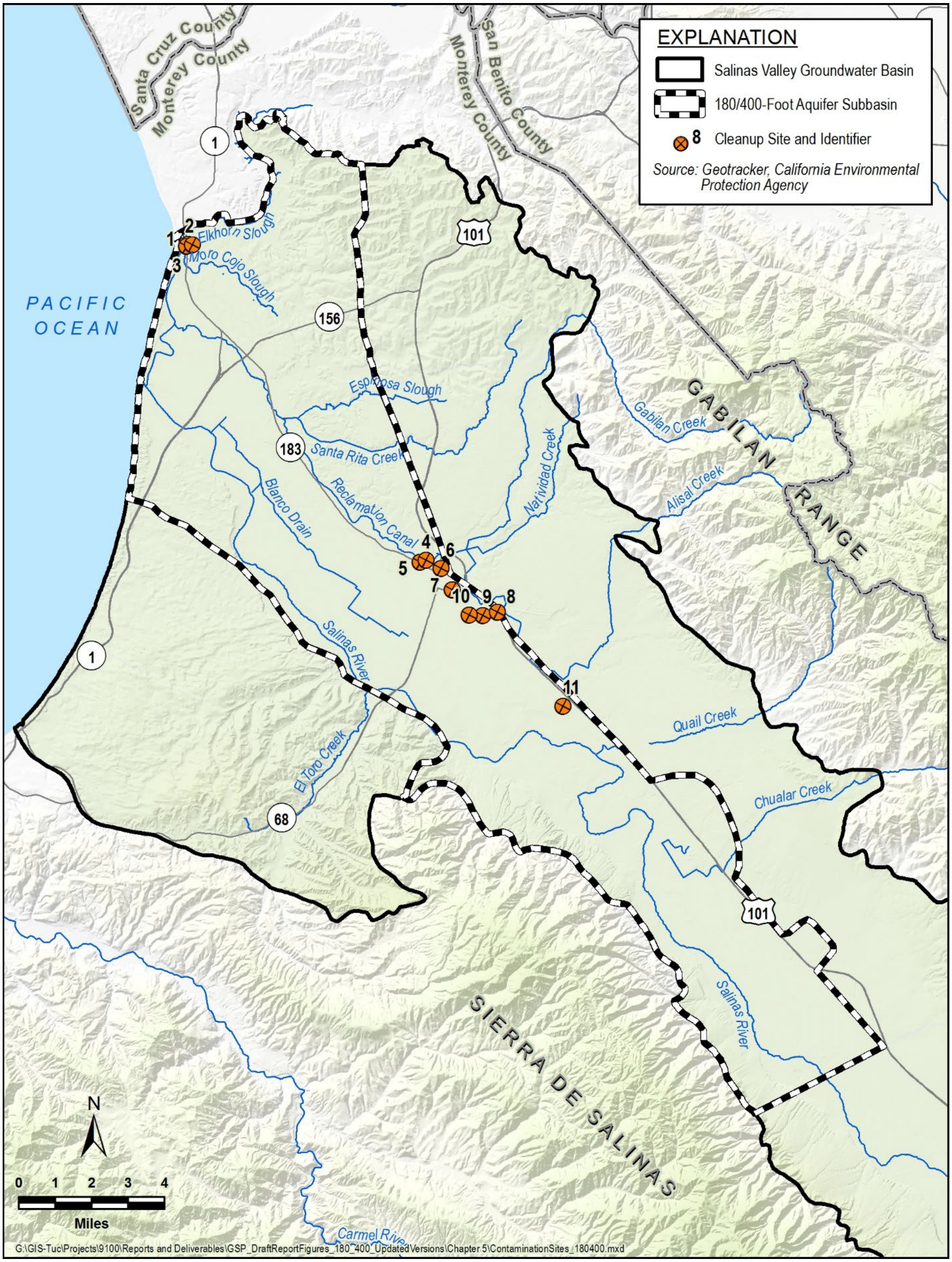


Figure 5-28. Active Cleanup Sites

5.4.3 Distribution and Concentrations of Diffuse or Natural Groundwater Constituents

In addition to the point sources described above, the CCRWQCB monitors and regulates activities and discharges that can contribute to non-point pollutants, which are constituents that are released to groundwater over large areas. In the Subbasin, the most prevalent non-point water quality concern is nitrate. The current distribution of nitrate was extensively monitored and evaluated by the CCGC and documented in a report submitted to the CCRWQCB (CCGC, 2015).

Figure 5-29 shows a map of nitrate distribution in the Subbasin prepared by CCGC. The orange and red areas illustrate the portions of the Subbasin where groundwater has nitrate concentrations above the drinking water MCL of 45 mg/L NO_3.

Figure 5-30 shows maps of measured nitrate concentration from six decades of monitoring for the entire Salinas Valley Groundwater Basin. These maps, prepared by MCWRA, indicate that elevated nitrate concentrations in groundwater were locally present in the 1960s, but significantly increased in 1970s and 1980s. Extensive distribution of nitrate concentrations above the drinking water MCL, as shown on Figure 5-29, has been present in the 180/400-Foot Aquifer Subbasin for 20 to 30 years.

A May 2018 staff report to the CCRWQCB included a summary of nitrate concentrations throughout the Central Coast Region, including the Salinas Valley Groundwater Basin. The staff report includes data from 2008 to 2018, collected at 2,235 wells in the Salinas Valley Groundwater Basin, during Agricultural Orders 2.0 and 3.0 sampling events. The report states that 26% of on-farm domestic wells in the 180/400-Foot Aquifer Subbasin exceeded the drinking water MCL, with a mean concentration of 52.7 mg/L NO_3. In addition, 21% of irrigation supply wells in the Subbasin exceeded this MCL with a mean concentration of 29.7 mg/L NO_3 (CCRWQCB, 2018).

Some constituents of concern can be concentrated at various aquifer depths. Nitrate is a surficial constituent derived from such sources as fertilizer, livestock, and septic systems. Because the sources are all near the surface, nitrate is usually highest near ground surface, and decreases with depth. Raising groundwater levels may mobilize additional nitrate. By contrast, arsenic concentrations usually increase with depth, and lowering groundwater levels may mobilize additional arsenic. The distribution and concentrations of constituents of concern can be further complicated by location and rate of groundwater pumping. The extent to which pumping affects groundwater quality depends on aquifer properties, distance to contamination, constituent characteristics and transport rate, and the time at which contaminants entered the subsurface.

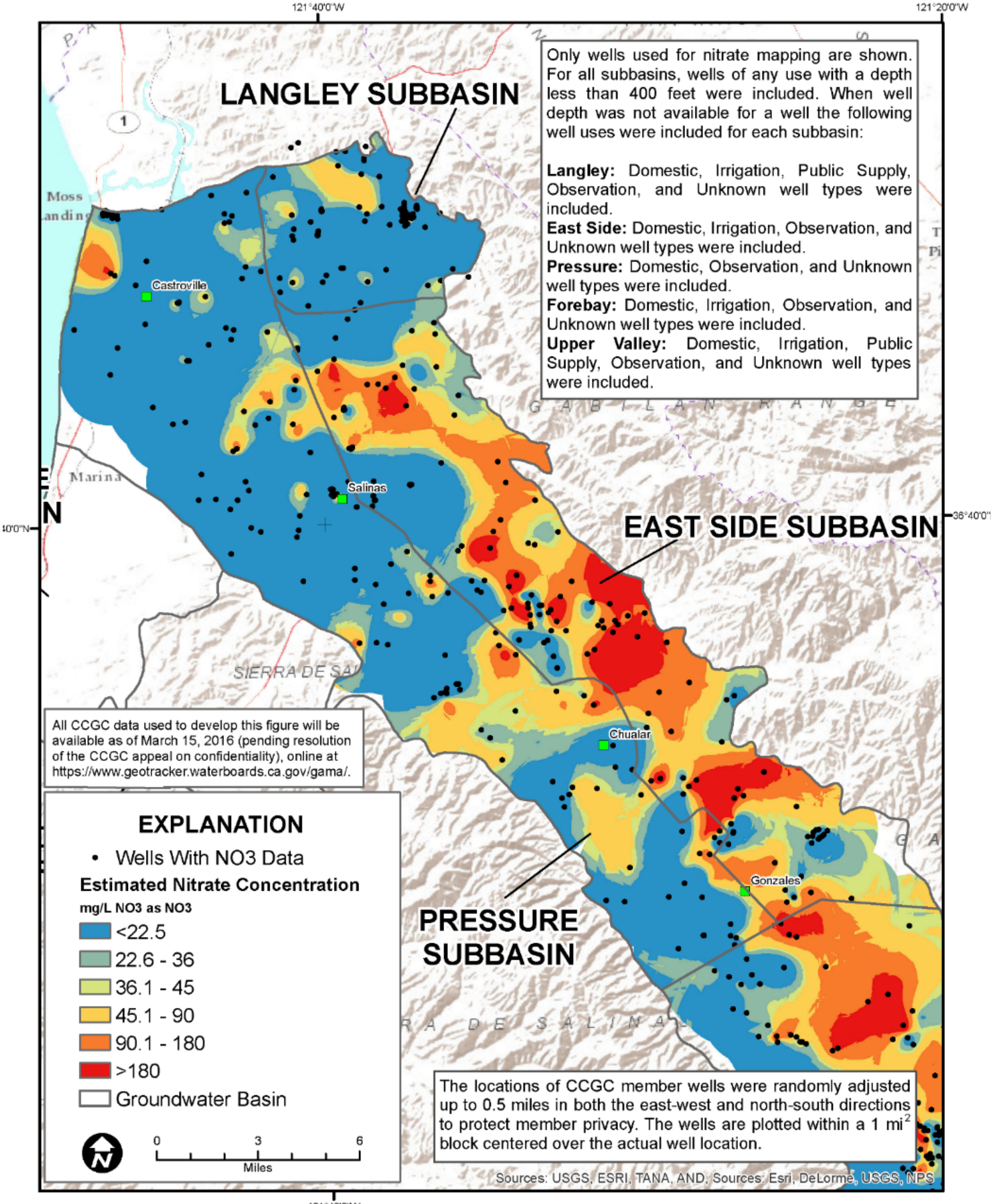


Figure 5-29. Estimated Nitrate Concentrations
(from CCGC, 2015)

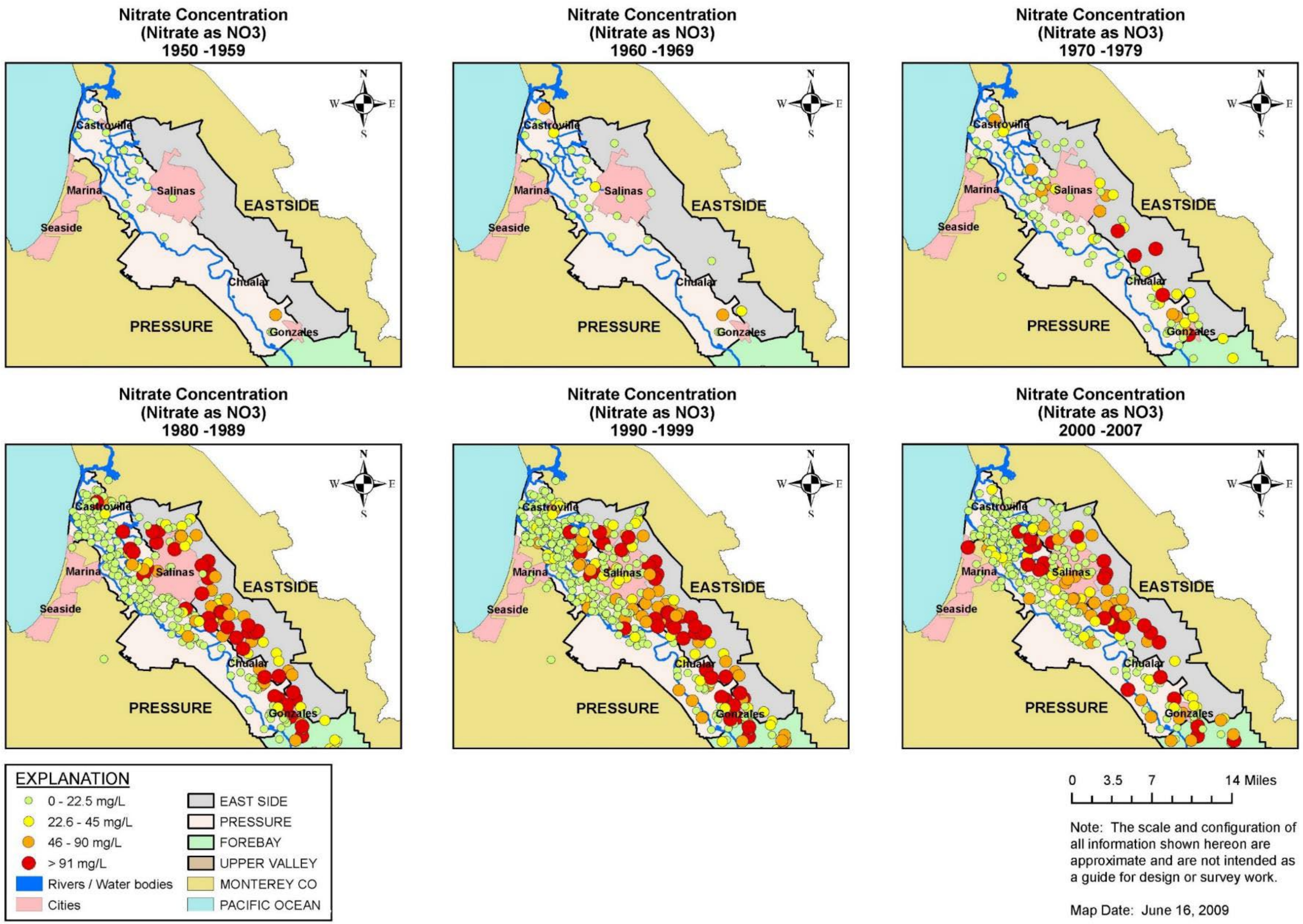


Figure 5-30. Nitrate Concentrations, 1950 to 2007
(modified from MCWRA data)

Additional groundwater quality conditions in the Basin are summarized in two USGS water quality studies in the Salinas Valley. The USGS 2005 GAMA study characterized deeper groundwater resources used for public water supply (Kulongoski and Belitz, 2005). The USGS 2018 GAMA study focused on domestic well water quality (Burton and Wright, 2018). The source data used in these two studies and additional publicly available water quality data can be accessed through the SWRCB GAMA groundwater information system at: https://gamagroundwater.waterboards.ca.gov/gama/datadownload.

The GAMA groundwater information system includes groundwater quality data for public water system supply wells from the SWRCB Division of Drinking Water (DDW), and on-farm domestic wells and irrigation supply wells from CCRWQCB's Irrigated Lands Regulatory Program (ILRP). This GSP relies on established thresholds for constituents of concern (COC): Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) established by the State's Title 22 drinking water standards for public water system supply wells and on-farm domestic wells, and COC levels that may lead to reduced crop production for irrigation supply wells, as outlined in the CCRWQCB's Basin Plan (CCRWQCB, 2019).

Table 5-6 reports the constituents of concern in the 180/400-Foot Aquifer Subbasin based on GAMA groundwater information system data up to 2020. The number of wells that exceed the regulatory standard for any given COC is based on the latest sample for each well in the monitoring network. Not all wells have been sampled for all COC. Therefore, the percentage of wells with exceedances is the number of wells that exceed the regulatory standard divided by the total number of wells that have ever been sampled for that COC. Additionally, Table 5-6 does not report all of the constituents that are monitored under Title 22 or the Basin Plan; it only includes the constituents that exceed a regulatory standard. The total list of constituents sampled in the water quality monitoring network are listed in Table 8-4. Maps with the locations of wells that exceeded the regulatory standard for any of the COC listed in Table 5-6 from 2013 to 2019 are provided in Appendix 5C.

Table 5-6. Water Quality Constituents of Concern and Exccedances

Constituent of Concern	Regulatory Exceedance Standard	Standard Units	Number of Wells Sampled for COC	Number of Wells Exceeding Regulatory Standard from latest sample	Percentage of Wells with Exceedances
DDW Wells (Data from April 1974 to December 2020)					
Aluminum	1000	UG/L	100	1	1%
Arsenic	10	UG/L	102	2	2%
Di(2-ethylhexyl) phthalate	4	UG/L	86	2	2%
Benzo(a)Pyrene	0.2	MG/L	86	2	2%
Chloride	500	MG/L	97	3	3%
1,2 Dibromo-3-chloropropane	0.2	UG/L	81	9	11%
Dinoseb	7	UG/L	100	2	2%

Constituent of Concern	Regulatory Exceedance Standard	Standard Units	Number of Wells Sampled for COC	Number of Wells Exceeding Regulatory Standard from latest sample	Percentage of Wells with Exceedances
Fluoride	2	MG/L	103	1	1%
Iron	300	UG/L	96	6	6%
Hexachlorobenzene	1	UG/L	67	2	3%
Heptachlor	0.01	UG/L	65	2	3%
Manganese	50	UG/L	95	5	5%
Methyl-tert-butyl ether (MTBE)	13	UG/L	101	3	3%
Nitrate (as nitrogen)	10	MG/L	139	12	9%
Tetrachloroethene	5	UG/L	150	1	1%
Specific Conductance	1600	UMHOS/CM	103	4	4%
Selenium	20	UG/L	101	2	2%
1,2,4-Trichlorobenzene	4	UG/L	102	1	1%
1,2,3-Trichloropropane	0.005	UG/L	107	13	12%
Total Dissolved Solids	1000	MG/L	98	7	7%
Vinyl Chloride	0.5	UG/L	150	34	23%
On-Farm Domestic ILRP Wells (Data from August 2012 to December 2020)					
Chloride	500	MG/L	181	9	5%
Iron	300	UG/L	41	11	27%
Manganese	50	UG/L	41	3	7%
Nitrite	1	MG/L	99	1	1%
Nitrate (as nitrogen)	10	MG/L	191	49	26%
Nitrate + Nitrite (sum as nitrogen)	10	MG/L	70	14	20%
Specific Conductance	1600	UMHOS/CM	207	44	21%
Sulfate	500	MG/L	181	3	2%
Total Dissolved Solids	1000	MG/L	154	44	30%
ILRP Irrigation Wells (Data from September 2012 to December 2020)					
Chloride	350	MG/L	324	28	9%
Iron	5000	UG/L	98	2	2%
Manganese	200	UG/L	98	1	1%

5.4.4 Groundwater Quality Summary

Based on the water quality information for the DDW and ILRP wells from GAMA groundwater information system, the following are the COC for drinking water supply wells in the Subbasin and that have exceedances in the Subbasin:

- 1,2 dibromo-3-chloropropane
- 1,2,3-trichloropropane
- 1,2,4-trichlorobenzene

- aluminum
- arsenic
- benzo(a)pyrene
- chloride
- di(2-ethylhexyl) phthalate
- dinoseb
- fluoride
- heptachlor
- hexachlorobenzene
- iron
- manganese
- methyl-tert-butyl ether (MTBE)
- nitrate (as nitrogen)
- nitrate + nitrite (sum as nitrogen)
- nitrite
- selenium
- specific conductance
- sulfate
- tetrachloroethene
- total dissolved solids
- vinyl chloride

The COC for agricultural supply wells that occur in the Subbasin and are known to cause reductions in crop production when irrigation water includes them in concentrations above agricultural water quality objectives include:

- chloride
- iron
- manganese

The COC for active cleanup sites listed in Table 5-5 are not part of the monitoring network described in Chapter 7. However, the status of these constituents at these sites will continue to be monitored by the DTSC or the CCRWQCB. Furthermore, the COC at these sites that have a regulatory standard under Title 22 for drinking water wells, or the Basin Plan for irrigation supply wells will be monitored in the DDW and ILRP wells that are part of the monitoring network.

This GSP relies on data from existing monitoring programs to measure changes in groundwater quality. Therefore, the GSA is dependent on the monitoring density and frequency of the DDW and ILRP. The monitoring system is further defined in Chapter 7.

5.5 Subsidence

Land subsidence is the lowering of the ground surface elevation. This is often caused by pumping below thick clay layers. Land subsidence can be elastic or inelastic. Elastic subsidence is called elastic because the small, lowering and rising of the ground surface is reversible. Inelastic subsidence is generally irreversible and is the focus of this GSP.

5.5.1 Data Sources

To estimate subsidence, DWR has made Interferometric Synthetic Aperture Radar (InSAR) satellite data available on their SGMA Data Viewer web map: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub. These are the only data used for estimating subsidence in this GSP.

5.5.2 Subsidence Mapping

Figure 5-31 presents a map showing the average annual InSAR subsidence data in the 180/400-Foot Aquifer Subbasin between June 2015 and June 2020 (DWR, 2020a). The yellow area on the map is the area with measured average annual changes in ground elevation of between -0.1 and 0.1 foot. As discussed in Section 8.9.2.1, because of measurement error in this methodology, any measured ground level changes between -0.1 and 0.1 foot are considered an area of no subsidence. The white areas on the map are areas with no available data. The map shows that no measurable subsidence has been recorded anywhere in the Subbasin.

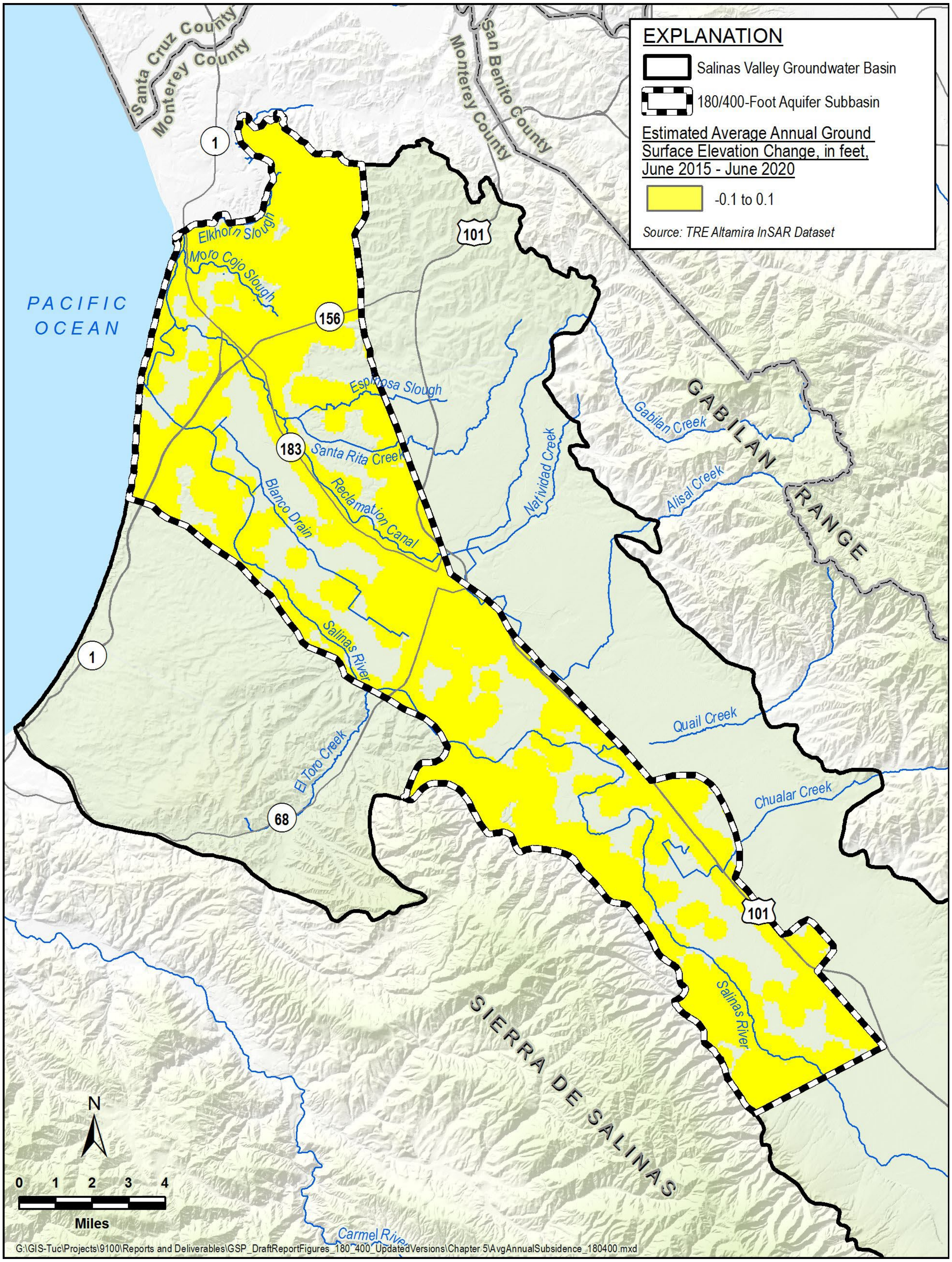


Figure 5-31. Estimated Average Annual InSAR Subsidence in Subbasin

5.6 Interconnected Surface Water

ISW is surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completed. If groundwater elevations are higher than the water level in the stream, the stream is said to be a gaining stream because it gains water from the surrounding groundwater. If the groundwater elevation is lower than the water level in the stream, it is termed a losing stream because it loses water to the surrounding groundwater. If the groundwater elevation is below the streambed elevation, the stream and groundwater are disconnected. SGMA does not require that disconnected stream reaches be analyzed or managed. These concepts are illustrated on Figure 5-32.

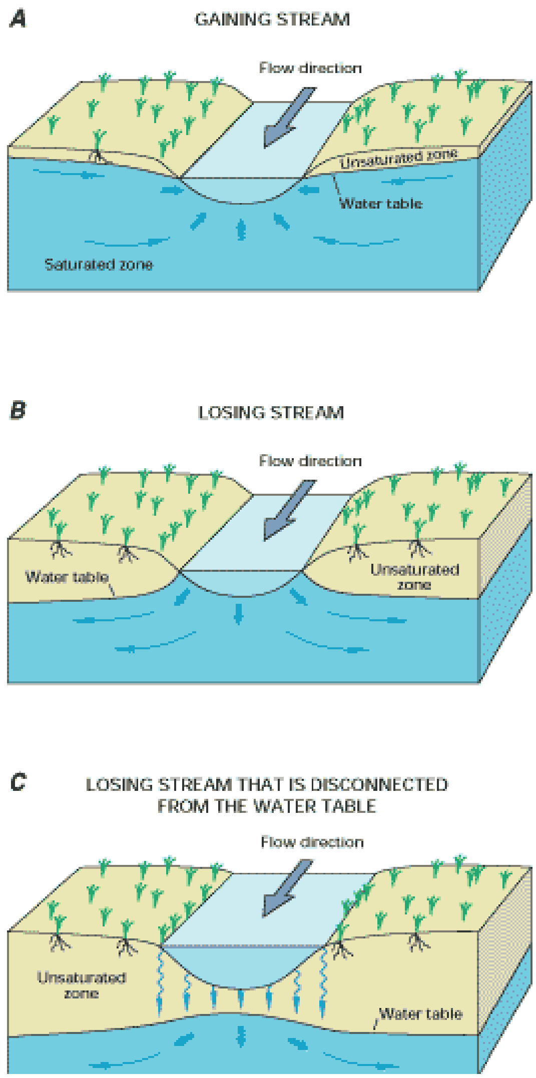


Figure 5-32. Conceptual Representation of Interconnected Surface Water (Winter, et al., 1999)

5.6.1 Data Sources

The preliminary SVIHM is used to map the potential locations of ISW, as described in Chapter 4 and shown on Figure 4-11. There is no data that verifies the location and extent of surface water connection to groundwater, nor the extent to which groundwater extraction depletes surface water. Therefore, this section describes the hydraulic principles that establish the relationship between surface water and groundwater, upon which the current conditions and monitoring network are based.

5.6.2 Evaluation of Surface Water and Groundwater Interconnection

Groundwater extraction can alter flows between surface water and groundwater. Flow changes related to interconnected surface and groundwater could be due to reductions in groundwater discharge to surface water, or increases in surface water recharge to groundwater. These two changes together constitute the change in the amount of surface water depletion.

Depletion of ISW is estimated by evaluating the change in the modeled stream leakage with and without pumping (i.e., water flowing from the stream into the groundwater system). A model simulation without any groundwater pumping in the model (i.e., SVIHM with no pumping) was compared to the model simulation with groundwater pumping (i.e., SVIHM with pumping). The difference in stream depletion between the 2 models is the depletion caused by the groundwater pumping. This comparison was undertaken for the entire area of the Salinas Valley included in the model and also for the Subbasin. The stream depletion differences are only estimated for the interconnected segments identified on Figure 4-11. The Salinas Valley Aquitard extends across much of the Subbasin and inhibits hydraulic connection between the stream and the underlying principal aquifers where groundwater pumping occurs. This analysis assumes that ISW in the Subbasin occurs along stream reaches located outside the mapped extent of the Aquitard shown on Figure 4-12. The methodology for quantifying stream depletion is described in detail by Barlow and Leake (2012).

This analysis uses the "peak" conservation release period from June to September that reflects when most conservation releases are made, not the full April to October MCWRA conservation release period when releases can be made. Depletion of interconnected sections of the surface water bodies is estimated separately for the peak conservation release period of June through September, and the non-peak conservation release period of October through May. Table 5-7 shows the estimated annual average depletion of ISW due to groundwater pumping along the stream segments in the Subbasin shown on Figure 4-11.

Table 5-7. Average SVIHM Simulated Depletion of Interconnected Surface Waters (AF/yr.)

Peak Conservation Release Period	Non-Peak Conservation Release Period
2,600	5,800

Note: provisional data subject to change[1].

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

5.7 Water Use

5.7.1 Data Sources

As mentioned in Chapter 3, water use in the 180/400-Foot Aquifer Subbasin consists of groundwater extraction, surface water, and recycled water. Agricultural and urban groundwater extraction data is collected by MCWRA through GEMS for wells with discharge pipes with an internal diameter greater than 3 inches within Zones 2, 2A, and 2B. Domestic pumping, including water systems small enough to not require reporting to the State, is estimated by multiplying the estimated number of domestic users by a water use factor. The initial water use factor used is 0.39 AF/yr./dwelling unit. Surface water diversions from the Salinas River collected by eWRIMS and SRDF make up the surface water supplies in the Subbasin. SVRP provides most of the recycled water in the Subbasin.

5.7.2 Water Use

5.7.2.1 Groundwater Use

Table 5-8 provides groundwater extraction by water use sector for the 180/400-Foot Aquifer Subbasin from 2017 to 2020. 2017 was considered current conditions in the GSP and this GSP Update uses 2020 to define current conditions. Agricultural pumping is reported by MCWRA for the period November 1 through October 31, whereas urban pumping is reported on a calendar-year basis. These reporting periods and submittal deadlines for the GEMS data is defined by Monterey County Ordinance No. 3717 and 3718. Rural domestic pumping is estimated on a calendar year basis.

Urban use data from MCWRA aggregates municipal wells, small public water systems, and industrial wells. On average, agricultural use accounted for 90% of groundwater extraction from 2017 to 2020; urban and industrial use accounted for 10%. MCWRA's Groundwater Reporting Program allows three different reporting methods: water flowmeter, electrical meter, or hour meter. From 2017 to 2020, 83% of extractions on average were calculated using a flowmeter, 16% electrical meter and <1%-hour meter. MCWRA ordinances 3717 and 3718 require annual flowmeter calibration, and that flowmeters be accurate to within +/- 5%. The same ordinance requires annual pump efficiency tests. SVBGSA assumes an electrical meter accuracy of +/- 5%. No groundwater was extracted for managed wetlands or managed recharge. Groundwater use by natural vegetation is assumed to be small and was not estimated for this report. This is a data gap that will be addressed with the Salinas Valley Integrated Hydrologic Model (SVIHM) in subsequent annual reports. Figure 5-33 illustrates the general location and volume of average groundwater extractions in the Subbasin from 2017 to 2020.

Table 5-8. 2017 to 2020 Groundwater Use (AF/yr.)

	2017	2018	2019	2020
Rural Domestic	200	200	200	200
Urban (includes industrial)	11,000	12,600	12,100	12,300
Agricultural	101,600	103,200	105,100	106,500
Managed Wetlands	0	0	0	0
Managed Recharge	0	0	0	0
Natural Vegetation	0	0	0	0
Total	**112,800**	**116,000**	**117,400**	**119,000**

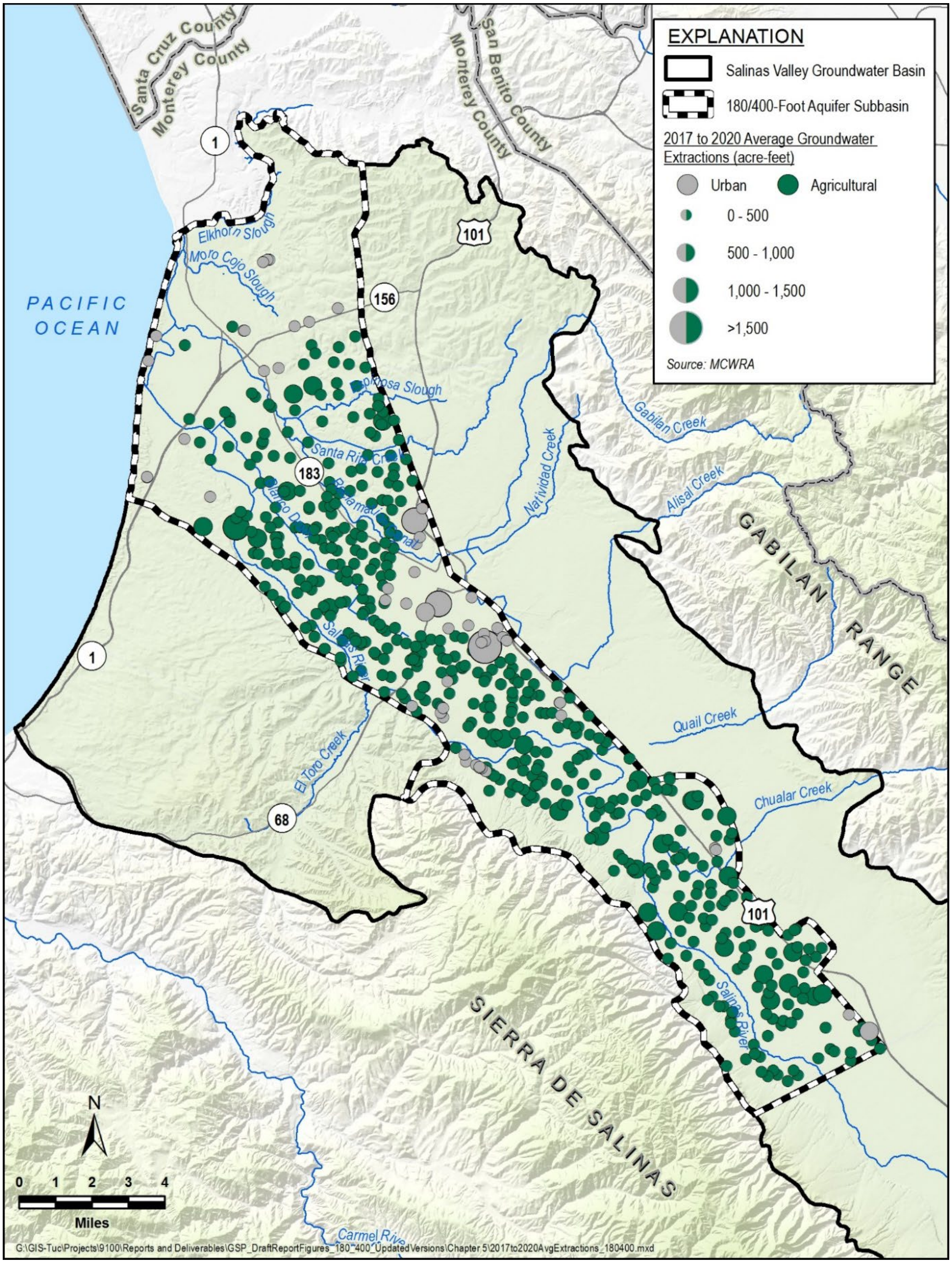


Figure 5-33. General Location and Volume of Groundwater Extractions in the 180/400-Foot Aquifer Subbasin

5.7.2.2 Surface Water Supply

Annual Salinas River diversion data are obtained from the SWRCB's eWRIMS website (SWRCB, 2021c). These data are combined with annual SRDF diversions to calculate the total surface water use in the 180/400-Foot Aquifer Subbasin. This accounting is done for convenience only and is not meant to imply that any or all of the reported diversions are classified as surface water. All surface water is used for irrigation.

Table 5-9. 2017 to 2020 Surface Water Use

Surface Water Diversions	2017	2018	2019	2020
SRDF	4,200	5,300	7,600	6,700
eWRIMS	7,800	7,800	7,100	7,800
Total	**11,900**	**13,100**	**14,700**	**14,500**

5.7.2.3 Recycled Water Supply

In addition to groundwater and surface water, a third water source type in the 180/400-Foot Aquifer Subbasin is recycled water. Monterey One Water treats and delivers this Salinas Valley Reclamation Plant (SVRP) recycled water to the coastal farmland surrounding Castroville through the CSIP system. Recycled water deliveries are summarized in Table 5-10.

Table 5-10. 2017 to 2020 Recycled Water Use

	2017	2018	2019	2020
SVRP-Recycled	10,300	13,600	8,500	12,500

5.7.2.4 Total Water Use

Total water use is the sum of groundwater extractions, surface water use, and recycled water use and is summarized in Table 5-11 and Figure 5-34.

Many growers and residents have noted that some irrigation water use is reported both to the SWRCB's eWRIMS as Salinas River diversions and to the MCWRA as groundwater pumping. Comparing surface water diversion data to groundwater pumping data is complicated by the fact that diversions and pumping are reported on different schedules. An initial analysis was undertaken by matching unique locations and monthly diversion amounts summed by the GEMS reporting year (November 1 to October 31) to reported annual pumping data from 2017 to 2020. The initial analysis suggests an average 2,200 AF/yr. of water was reported to both MCWRA and the SWRCB. Further review indicated that the eWRIMS diversions do not include the Salinas River diversions at the SRDF. To avoid double counting, 2,200 AF of groundwater pumping are deducted from agricultural groundwater use to account for the potential double reporting.

Table 5-11. 2017 to 2020 Total Water Use by Water Source Type and Water Use Sector

Water Use Sector	2017			2018			2019			2020		
	Groundwater Extraction	Surface Water Use	Recycled Water	Groundwater Extraction	Surface Water Use	Recycled Water	Groundwater Extraction	Surface Water Use	Recycled Water	Groundwater Extraction	Surface Water Use	Recycled Water
Rural Domestic	200	0	0	200	0	0	200	0	0	200	0	0
Urban	11,000	0	0	12,600	0	0	12,100	0	0	12,300	0	0
Agricultural	99,400	11,900	10,300	101,000	13,100	13,600	102,900	14,700	8,500	104,300	14500	12500
SUBTOTALS	110,600	11,900	10,300	113,800	13,100	13,600	115,200	14,700	8,500	116,800	14500	12500
TOTAL	**132,800**			**140,500**			**138,400**			**143,800**		

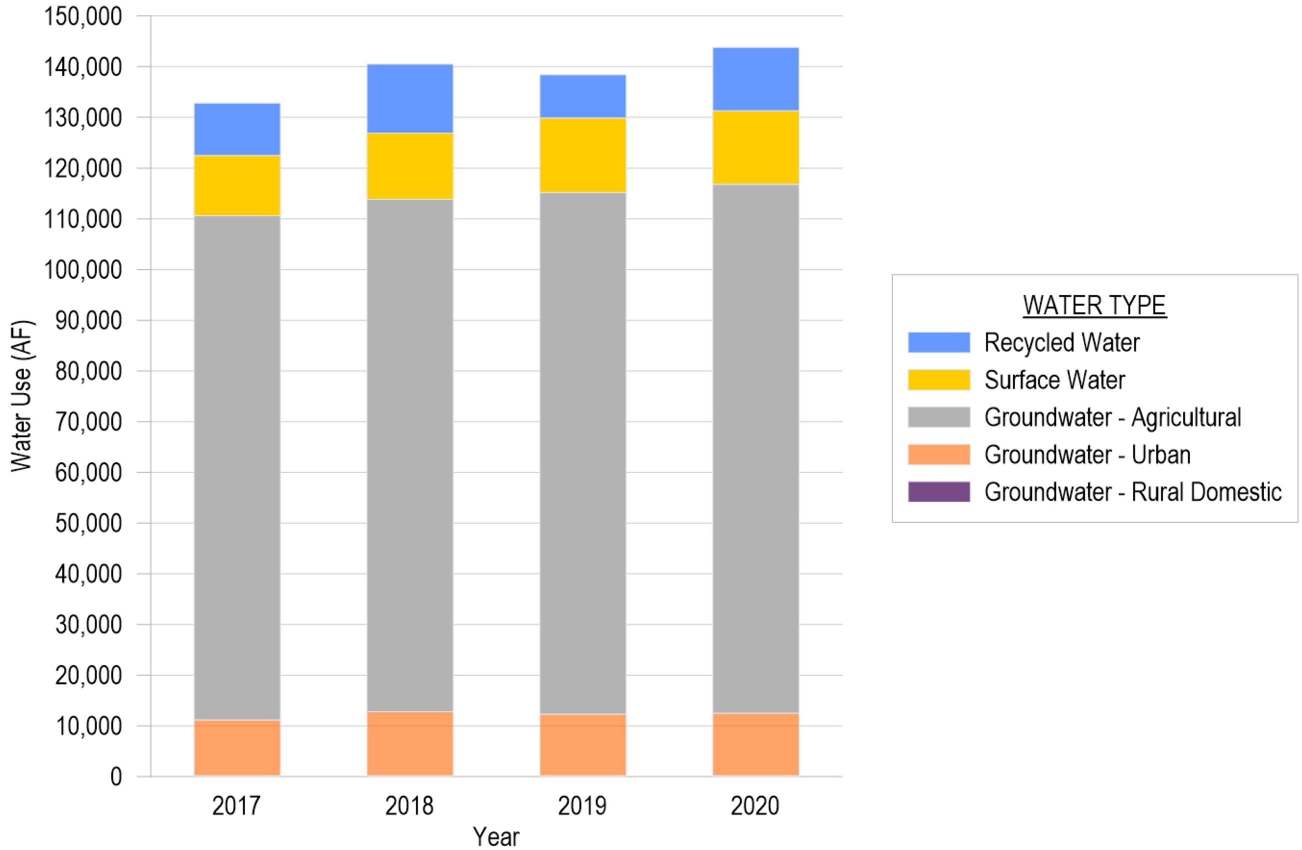


Figure 5-34. 2017 to 2020 Total Water Use by Water Source Type and Water Use Sector

6 WATER BUDGETS

This section summarizes the estimated water budgets for the 180/400-Foot Aquifer Subbasin, including information required by the GSP Regulations and information that is important for developing an effective plan to achieve sustainability. In accordance with the SGMA Regulations § 354.18, this water budget provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the basin, including historical, current, and projected water budget conditions, and the change in the volume of groundwater in storage. Water budgets are reported in graphical and tabular formats, where applicable.

The previous water budgets described in the approved GSP was developed using best tools and methods that were available at the time. Since the release and approval of that GSP, a provisional version of the Salinas Valley Integrated Hydrologic Model and an updated version of the Salinas Valley Operational Model were released by the USGS to the SVBGSA for use in developing GSPs. Updating the water budgets for this Subbasin using these new, best available tools is important for maintaining consistency with adjacent SVBGSA Subbasins managed by the SVBGSA. This section describes the water budgets for this Subbasin in a manner consistent with GSPs for other Subbasins in the Valley.

6.1 Overview of Water Budget Development

The water budgets are presented in two subsections: (1) historical and current water budgets, and (2) future water budgets. Within each subsection a surface water budget and groundwater budget are presented.

Historical and current water budgets are developed using a provisional version of the Salinas Valley Integrated Hydrologic Model (SVIHM)[1], developed by the United States Geological Survey (USGS). The SVIHM is a numerical groundwater-surface water model that is constructed using version 2 of the MODFLOW-OWHM code (Boyce *et al.*, 2020). This code is a version of the USGS groundwater flow code MODFLOW that estimates the agricultural supply and demand, through the Farm Process.

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

The model area covers the Salinas Valley Groundwater Basin from the Monterey-San Luis Obispo County Line in the south to the Pajaro Basin in the north, including the offshore extent of the major aquifers. The model includes operations of the San Antonio and Nacimiento reservoirs. The SVIHM is supported by two sub models: a geologic model known as the Salinas Valley Geologic Model (SVGM) and a watershed model known as the Hydrologic Simulation Program – Fortran (HSPF). The SVIHM is not yet released by the USGS. Details regarding source data, model construction and calibration, and results for historical and current water budgets will be summarized in more detail once the model and associated documentation are available.

Future water budgets are being developed using an evaluation version of the Salinas Valley Operational Model (SVOM), developed by the USGS and Monterey County Water Resources Agency (MCWRA). The SVOM is a numerical groundwater-surface water model constructed with the same framework and processes as the SVIHM. However, the SVOM is designed for simulating future scenarios and includes complex surface water operations in the Surface Water Operations (SWO) module. The SVOM is not yet released by the USGS. Details regarding source data, model construction and calibration, and results for future budgets will be summarized in more detail once the model and associated documentation are available

In accordance with SGMA Regulations § 354.18, an integrated groundwater budget is developed for each principal aquifer for each water budget period. The 180/400-Foot Aquifer Subbasin is pumped from 3 principal aquifers.

6.1.1 Water Budget Components

The water budget is an inventory of the Subbasin's surface water and groundwater inflows and outflows. Some components of the water budget can be measured, such as groundwater pumping from metered wells, precipitation, and surface water diversions. Other components are not easily measured and can be estimated using groundwater models, such as the SVIHM; these include unmetered agricultural pumping, recharge from precipitation and applied irrigation, and change of groundwater in storage. Figure 6-1 presents a general schematic diagram of the hydrogeologic conceptual model that is included in the water budget (DWR, 2020b).Figure 6-2 delineates the zones and boundary conditions of the SVIHM.

The water budgets for the Subbasin are calculated within the following boundaries:

- Lateral boundaries: The perimeter of the 180/400-Foot Aquifer Subbasin within the SVIHM is shown on Figure 6-2.
- Bottom: The base of the groundwater subbasin is described in the Hydrogeologic Conceptual Model and is defined as the base of the usable and productive unconsolidated sediments (Durbin *et al.* 1978). This ranges from less than 800 feet below ground surface in the far north of the Subbasin to almost 2,600 feet deep along the Subbasin's southwestern edge. The water budget is not sensitive to the exact

definition of this base elevation because the base is defined as a depth below where there is not significant inflow, outflow, or change in storage.

- Top: The top of the water budget area is above the ground surface, so that surface water is included in the water budget.

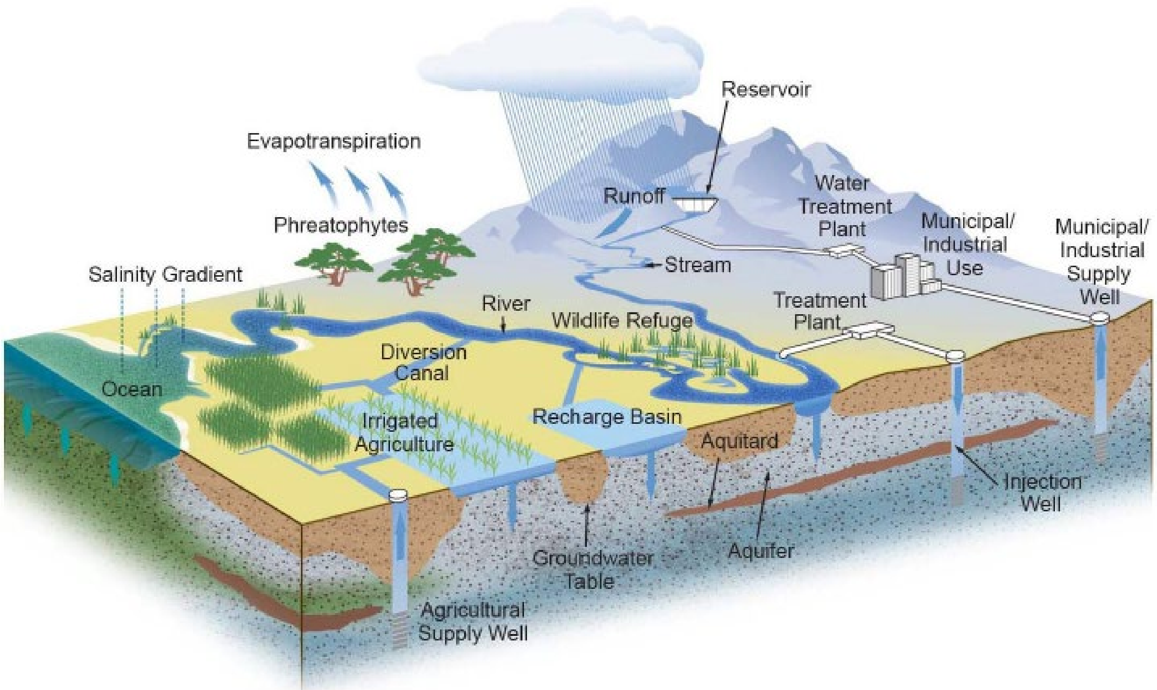


Figure 6-1. Schematic Hydrogeologic Conceptual Model (from DWR, 2020b)

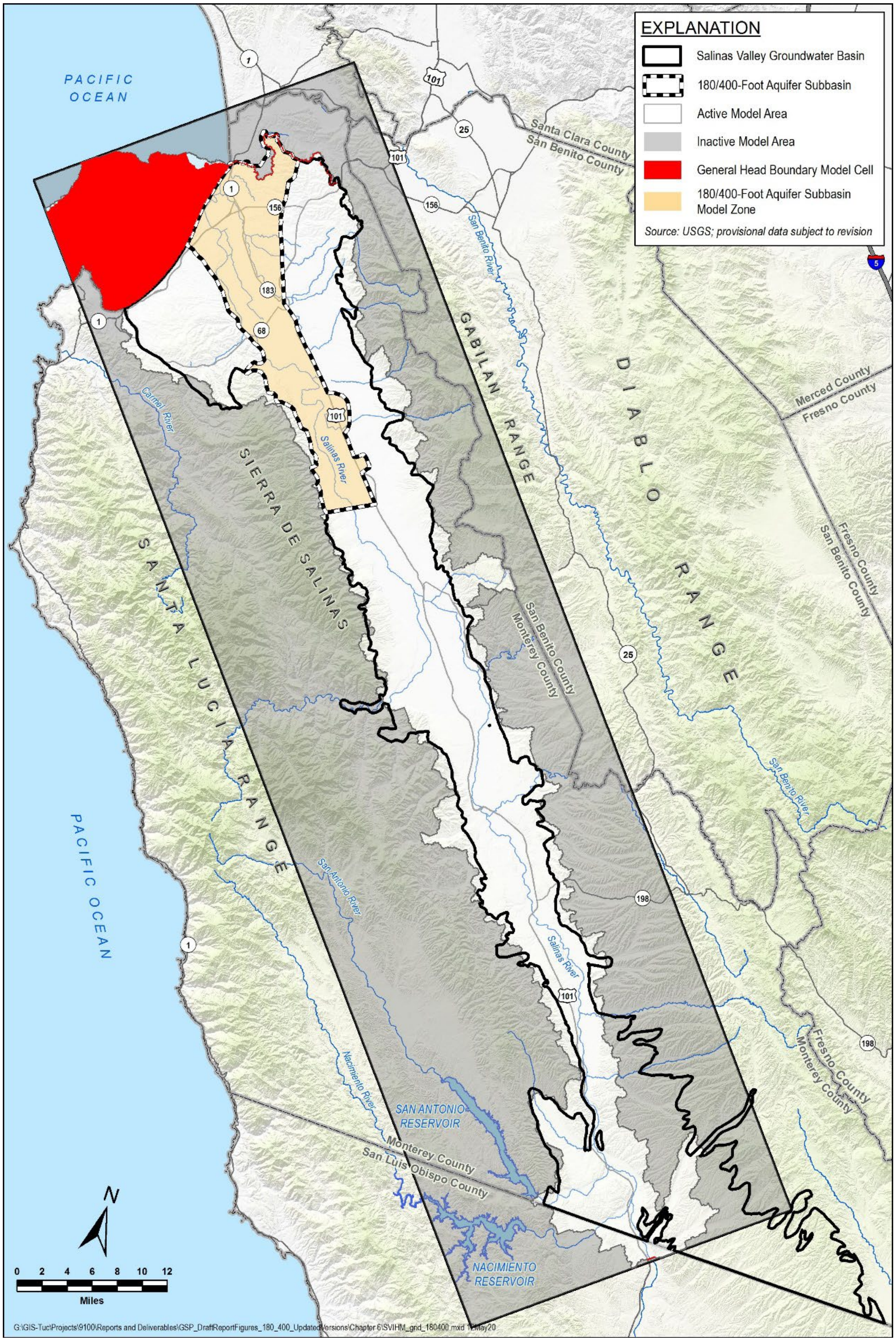


Figure 6-2. Zones and Boundary Conditions for the Salinas Valley Integrated Hydrologic Model

The 180/400-Foot Aquifer Subbasin water budget includes the following components:

<u>Surface Water Budget:</u>

- Inflows
    - Runoff of precipitation
    - Surface water inflows from streams and canals that enter the subbasin, including Salinas River, Chualar Creek, Quail Creek, Alisal Creek, Salinas Reclamation Canal, Santa Rita Creek, and several other smaller creeks
    - Groundwater discharge to streams
- Outflows
    - Stream discharge to groundwater
    - Outflow to the ocean and neighboring subbasins along Salinas River, and other smaller streams

<u>Groundwater Budget:</u>

- Inflows
    - Deep percolation from precipitation and applied irrigation
    - Stream discharge to groundwater
    - Subsurface inflows, including:
        - Inflow from the Forebay Aquifer Subbasin
        - Inflow from the Langley Aquifer Subbasin
        - Inflow from the Eastside Aquifer Subbasin
        - Inflow from the Pajaro Valley Subbasin
        - Inflow from the Monterey Subbasin
        - Inflow from the Pacific Ocean (seawater intrusion)
        - Inflow from the surrounding watershed that are not in other DWR subbasins
- Outflows
    - Crop and riparian evapotranspiration (ET)
    - Groundwater pumping, including municipal, industrial, and agricultural
    - Groundwater discharge to streams

- Groundwater discharge to drains
- Subsurface outflows, including:
    - Outflow to the Forebay Aquifer Subbasin
    - Outflow to the Langley Area Subbasin
    - Outflow to the Eastside Aquifer Subbasin
    - Outflow to the Pajaro Valley Subbasin
    - Outflow to the Monterey Subbasin
    - Outflows to the Pacific Ocean
    - Outflow to surrounding watershed that are not in other DWR subbasins

The difference between groundwater inflows and outflows is equal to the change of groundwater in storage.

6.1.2 Water Budget Time Frames

Time periods must be specified for each of the 3 required water budgets. The SGMA Regulations require water budgets for historical conditions, current conditions, and projected conditions.

- The historical water budget is intended to evaluate how past land use and water supply availability has affected aquifer conditions and the ability of groundwater users to operate within the sustainable yield. GSP Regulations require that the historical water budget include at least the most recent 10 years of water budget information. DWR's Water Budget Best Management Practices (BMP) document further states that the historical water budget should help develop an understanding of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability to operate the basin within the sustainable yield. Accordingly, historical conditions should include the most reliable historical data that are available for GSP development and water budgets calculations.
- The current water budget is intended to allow the GSA and DWR to understand the existing supply, demand, and change in storage under the most recent population, land use, and hydrologic conditions. Current conditions are generally the most recent conditions for which adequate data are available and that represent recent climatic and hydrologic conditions. Current conditions are not well defined by DWR but can include an average over a few recent years with various climatic and hydrologic conditions.
- The projected water budget is intended to quantify the estimated future baseline conditions. The projected water budget estimates the future baseline conditions

concerning hydrology, water demand, and surface water supply over a 50-year planning and implementation horizon. It is based on historical trends in hydrologic conditions which are used to project forward 50 years while considering projected climate change and sea level rise if applicable.

Although there is a significant variation between wet and dry seasons, the GSP does not consider separate seasonal water budgets for the groundwater budget. All water budgets are developed for complete water years. Selected time periods for the historical and current water budgets are summarized in Table 6-1 and on Figure 6-3. and described in Sections 6.1.2.1 and 6.1.2.2.

Table 6-1. Summary of Historical and Current Water Budget Time Periods

Time Period	Proposed Date Range	Water Year Types Represented in Time Period	Rationale
Historical	Water years 1980 through 2016	Dry: 11 Dry-Normal: 7 Normal: 5 Wet-Normal: 3 Wet: 11	Provides insights on water budget response to a wide range of variations in climate and groundwater use over an extensive period of record. Begins and ends in years with average precipitation.
Current	Water Year 2016	Dry-Normal: 1	Best reflection of current land use and water use conditions based on best available data.

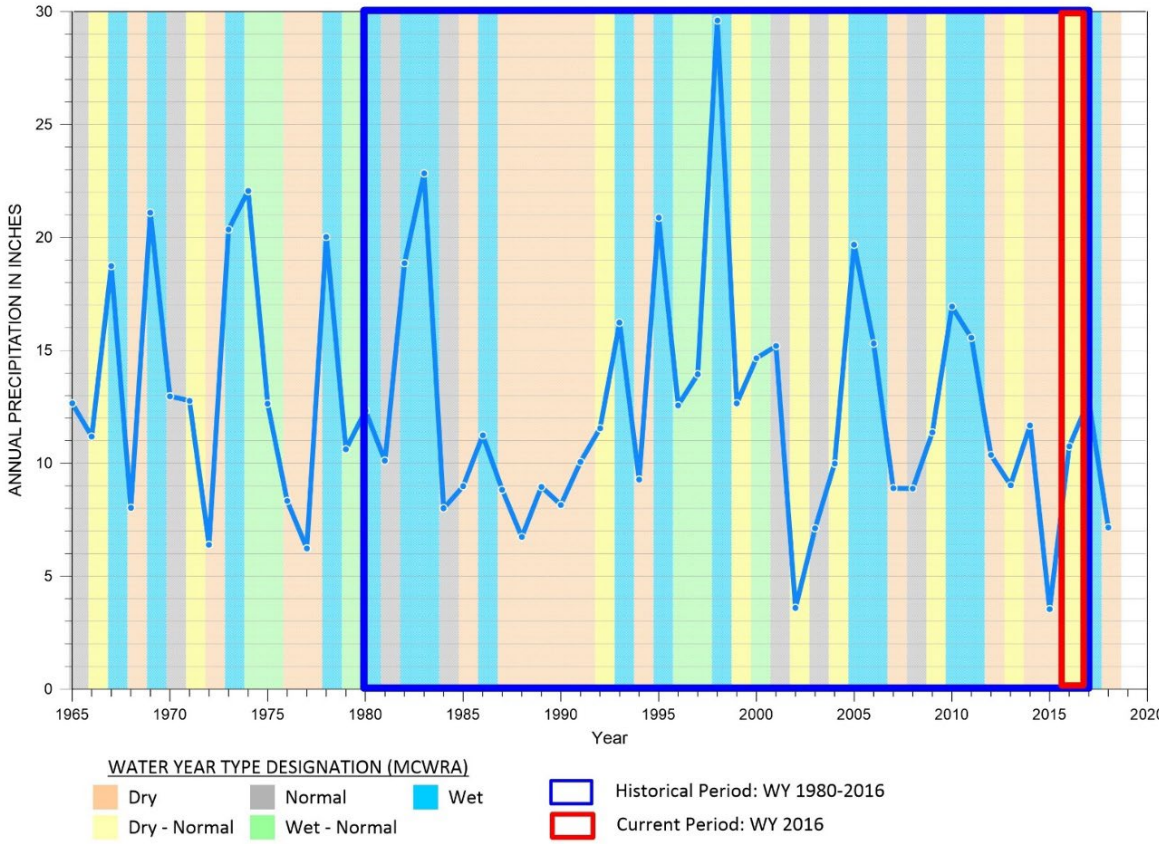


Figure 6-3. Climate and Precipitation for Historical and Current Water Budget Time Periods

6.1.2.1 Historical Water Budgets Time Period

GSP regulations require that the historical water budget be based on at least 10 years of data. The water budget is computed using results from the SVIHM numerical model for the time period from October 1980 through September 2016. The SVIHM simulation covers water years 1967 through 2017; however, model results for years prior to 1980 and the year 2017 were not used for this water budget due to potential limitations and uncertainties in the provisional SVIHM. Water years 1980 through 2016 comprise a representative time period with both wet and dry periods in the Subbasin (Table 6-1, Figure 6-3).

6.1.2.2 Current Water Budget Time Period

The current water budget time period is also computed using the SVIHM numerical model and is based on water year 2016. Water year 2016 is classified as dry-normal and is reflective of current and recent patterns of groundwater use and surface water use. Although Water Year 2016 appropriately meets the regulatory requirement for using the "…most recent hydrology, water supply, water demand, and land use information" (23 California Code of Regulations § 354.18 (c)(1)), it is noted that water year 2016 was preceded by multiple dry or dry-normal years.

6.1.2.3 Future Projected Water Budgets Time Period

Future projected conditions are based on model simulations using the SVOM numerical flow model, using current reservoir operations rules, projected climate-change scenario, and estimated sea level rise. The projected water budget represents 47 years of future conditions. Following DWR guidance on implementing climate change factors, the future water budget simulations do not simulate a 47-year projected future, but rather simulate 47 likely hydrologic events that may occur in 2030, and 47 likely hydrologic events that may occur in 2070.

6.2 Overview of Data Sources for Water Budget Development

Table 6-2 provides the detailed water budget components and known model assumptions and limitations for each. A few water budget components are directly measured, but most water budget components are either estimated as input to the model or simulated by the model. Both estimated and simulated values in the water budgets are underpinned by certain assumptions. These assumptions can lead to uncertainty in the water budget. However, inputs to the preliminary SVIHM were carefully selected by the USGS and cooperating agencies using best available data, reducing the level of uncertainty.

In addition to the model assumptions, additional uncertainty stems from any model's imperfect representation of natural condition and level of calibration. The water budgets for the 180/400-Foot Aquifer Subbasin are based on a preliminary version of the SVIHM, with limited documentation of model construction. The model is in internal review at the USGS, and a final version will likely not be released to the SVBGSA until after the GSP is submitted. Nonetheless, the SVIHM's calibration error is within reasonable bounds. Therefore, the model is the best available tool for estimating water budgets for the GSP.

As GSP implementation proceeds, the SVIHM will be updated and recalibrated with new data to better inform model simulations of historical, current, and projected water budgets. Model assumptions and uncertainty will be described in future updates to this chapter after model documentation is released by the USGS.

Table 6-2. Summary of Water Budget Component Data Source from the Salinas Valley Integrated Hydrologic Model and Other Sources

Water Budget Component	Source of Model Input Data	Limitations
Precipitation	Incorporated in calibrated model as part of land use process	Estimated for missing years
Surface Water Inflows		
Inflow from Streams Entering Basin	Simulated from calibrated model for all creeks	Not all creeks are gauged
Groundwater Discharge to Streams	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks
Overland Runoff	Simulated from calibrated model	Based on land use, precipitation, and soils specified in model
Surface Water Outflows		
Streambed Recharge to Groundwater	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks and groundwater level data from nearby wells
Diversions	Model documentation not available at this time	Based on calibration of streamflow to available data from gauged creeks
Outflow to Streams Leaving Basin	Simulated from calibrated model for all creeks	Not all creeks are gauged
Groundwater Inflows		
Streambed Recharge to Groundwater	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks and groundwater level data from nearby wells
Deep Percolation of Precipitation and Irrigation Water	Simulated from demands based on crop, acreage, temperature, and soil zone processes	No measurements available; based on assumed parameters for crops and soils
Subsurface Inflow from Adjacent Basins and Ocean	Simulated from calibrated model	Limited groundwater calibration data at adjacent subbasin boundaries; seawater intrusion assumed equal to groundwater flow from the ocean across coastline
Subsurface Inflow from Surrounding Watershed Other than Neighboring Basins	Simulated from calibrated model	Limited groundwater calibration data at adjacent subbasin boundaries
Groundwater Outflows		
Groundwater Pumping	Reported data for historical municipal and agricultural pumping, and some small water systems. Model documentation not available at this time.	Water budget pumping reported from the SVIHM contains errors. Domestic pumping not simulated in model. Pumping adjusted according to reported data.
Groundwater Discharge to Streams	Simulated from calibrated model	Based on calibration of streamflow to available data from gauged creeks and groundwater level data from nearby wells

Subsurface Outflow to Adjacent Basins and Ocean	Simulated from calibrated model	Limited calibration data at adjacent subbasin boundaries
Riparian ET	Simulated from calibrated model	Based on representative plant group and uniform extinction depth

6.3 Historical and Current Water Budgets

Water budgets for the historical and current periods are presented below. The surface water budgets are presented first, followed by the groundwater budgets. These water budgets are based on the provisional SVIHM and are subject to change in the future. Water budgets will be updated in future GSP updates after the SVIHM is formally released by the USGS.

6.3.1 Historical and Current Surface Water Budget

The surface water budget accounts for the inflows and outflows for the streams within the Subbasin. This includes streamflows of rivers and tributaries entering and exiting the Subbasin, overland runoff to streams, and stream-aquifer interactions. Evapotranspiration by riparian vegetation along stream channels is estimated by the provisional SVIHM as part of the groundwater system and is accounted for in the groundwater budget.

Figure 6-4 shows the surface water network simulated in the provisional SVIHM. The model accounts for surface water flowing in and out across the subbasin boundary. For this water budget, boundary inflows and outflows are the sum of all locations that cross the Subbasin boundary. In some instances, a simulated stream might enter and exit the Subbasin boundary at multiple locations, such as Salinas River, Chualar Creek, and Natividad Creek/Reclamation Canal. The Salinas Valley Aquitard, which extends over much of the Subbasin, limits connectivity between surface water and principal aquifers where present.

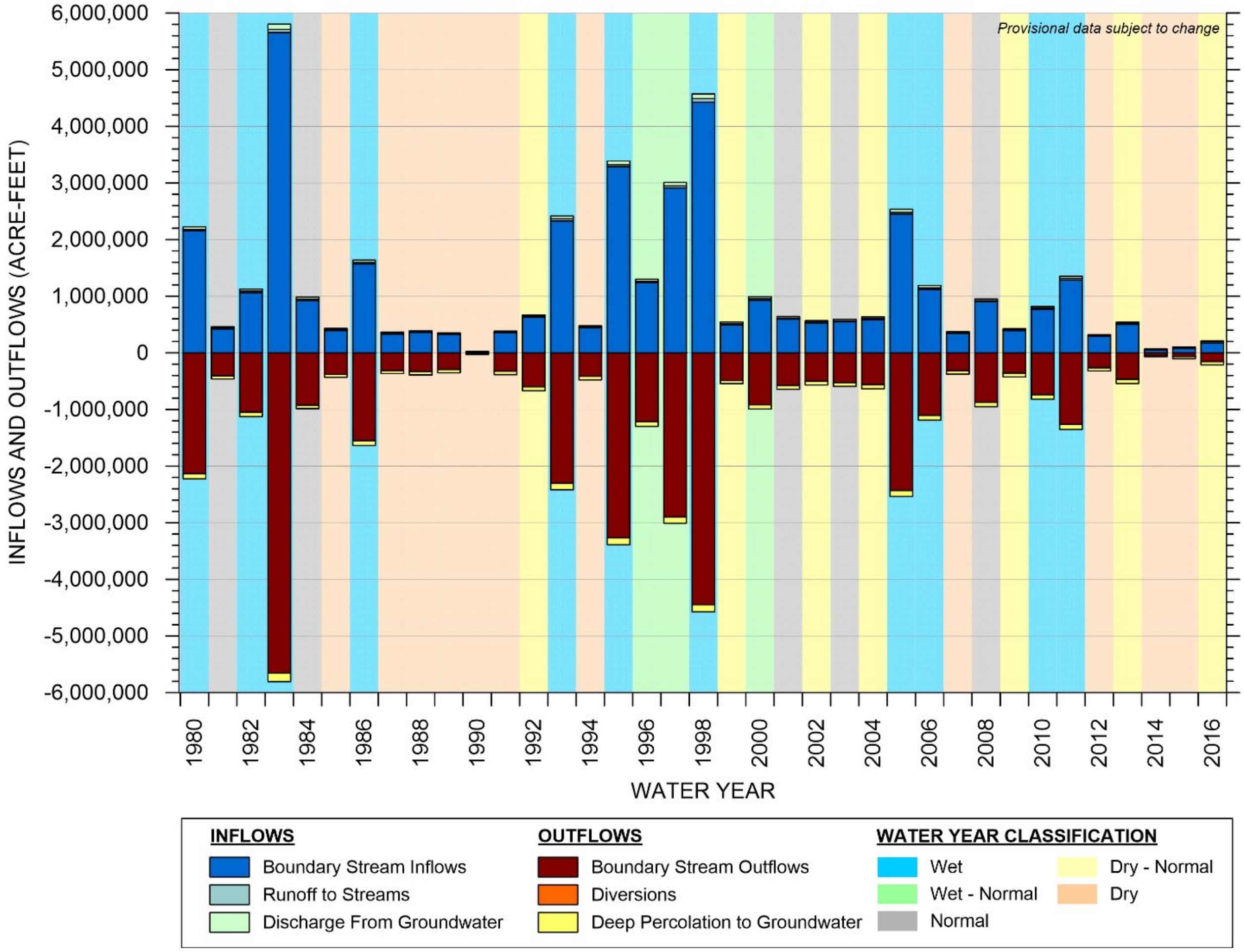


Figure 6-5 shows the surface water budget for the historical period, which also includes the current period. Table 6-3 shows the average values for components of the surface water budget for the historical and current periods. Positive values are inflows into the stream system, and negative values are outflows from the stream system. Boundary stream inflows and boundary stream outflows are an order of magnitude greater than any other component of the surface water budget. The flow between surface water and groundwater in the Subbasin is generally net negative, which indicates more deep percolation of streamflow to groundwater than groundwater discharge to streams.

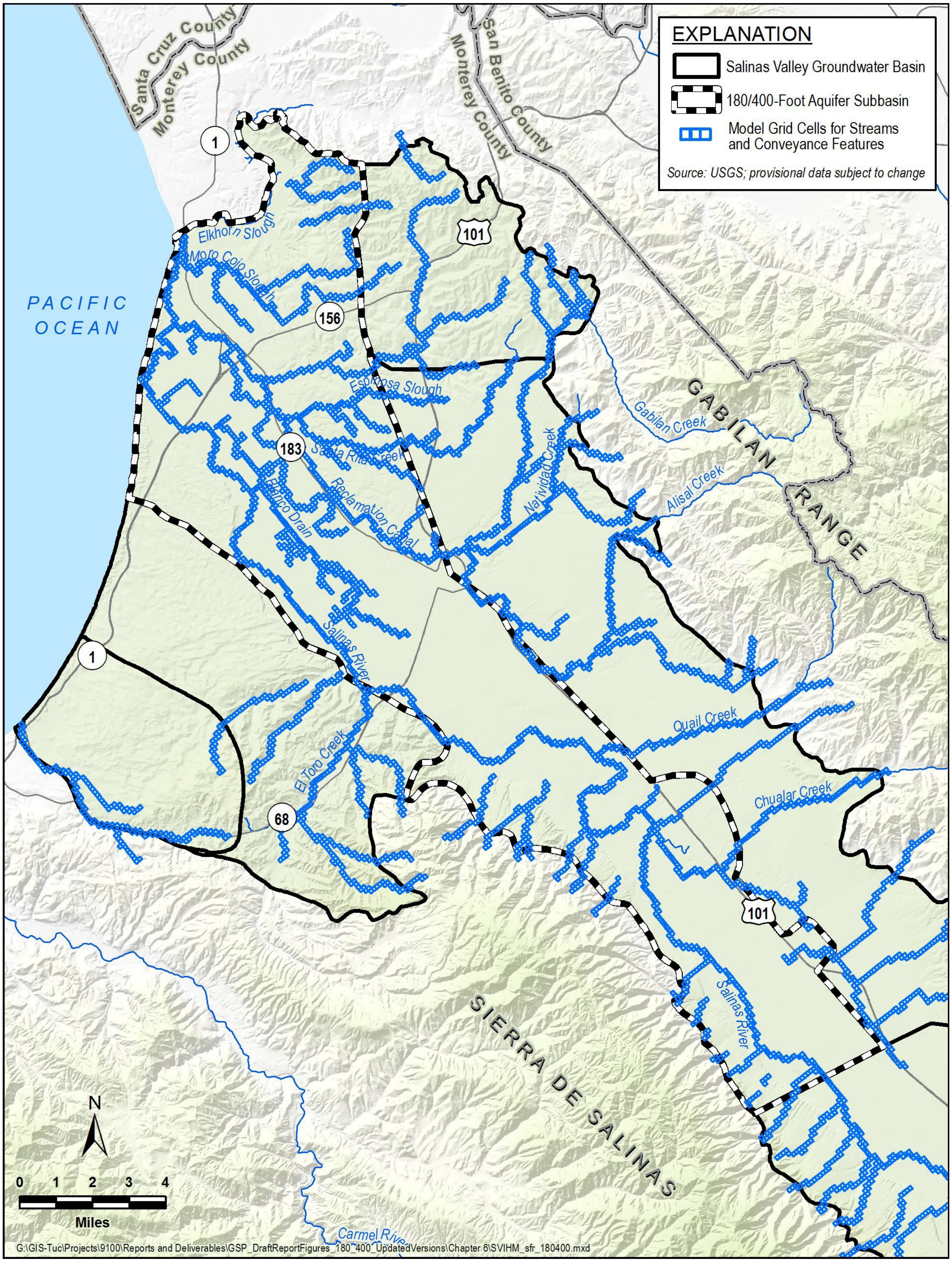


Figure 6-4. Surface Water Network in the 180/400-Foot Aquifer Subbasin from the Salinas Valley Integrated Hydrologic Model

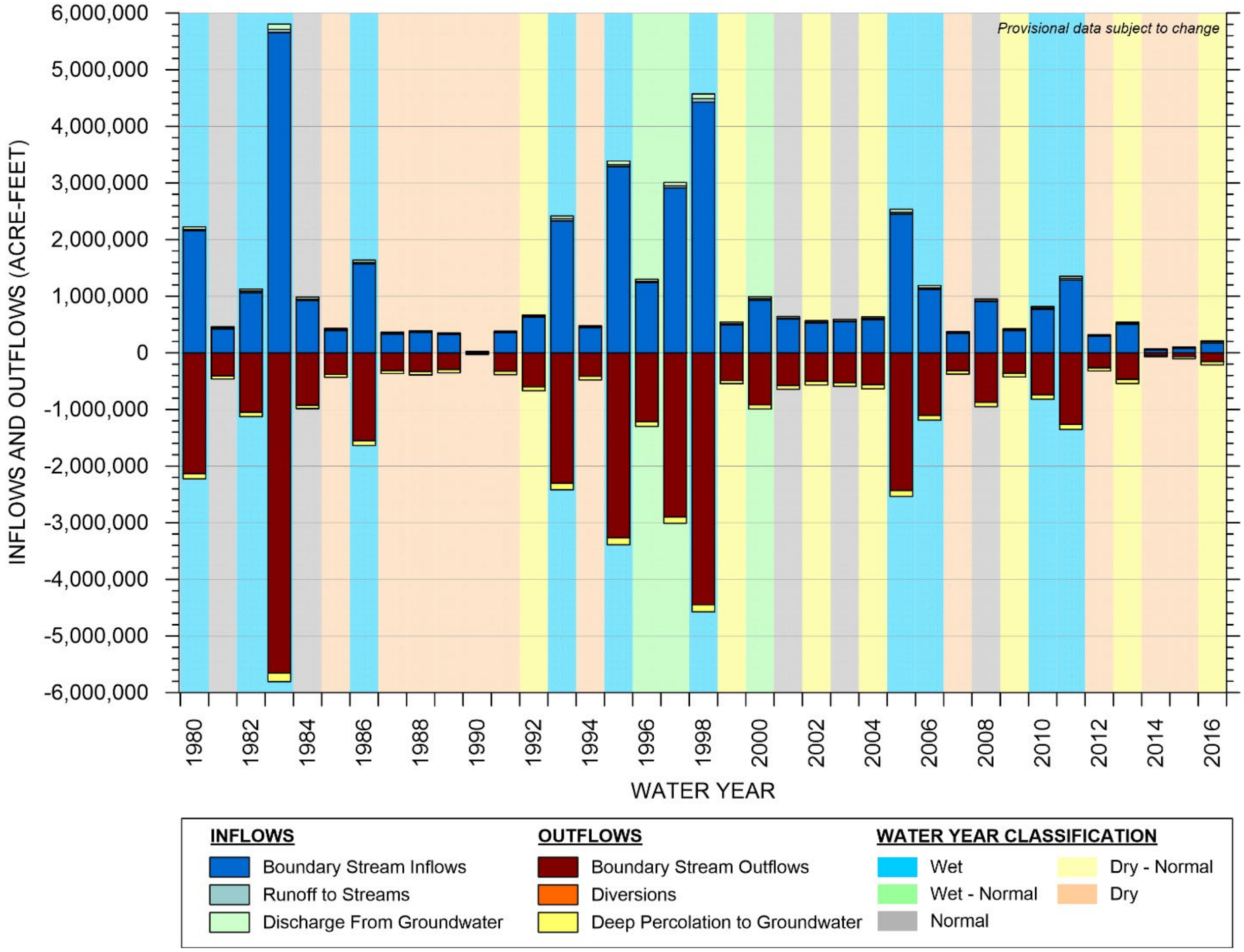


Figure 6-5. Historical and Current Surface Water Budget

Table 6-3. SVIHM Simulated Surface Water Budget Summary (AF/yr.)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Boundary Stream Inflows	1,105,700	174,500
Runoff to Streams	21,400	25,300
Net Flow between Surface Water and Groundwater	-40,700	-43,900
Boundary Stream Outflows	-1,086,100	-156,000
Diversions	-300	0

Note: provisional data subject to change.

6.3.2 Historical and Current Groundwater Budget

The groundwater budget accounts for the inflows and outflows to and from the Subbasin's aquifers, based on results from the SVIHM. This includes subsurface inflows and outflows of groundwater at the Subbasin boundaries, recharge, pumping, evapotranspiration, and net flow between surface water and groundwater.

Figure 6-6 shows SVIHM estimated annual groundwater inflows for the historical and current time periods. Inflows vary substantially from year to year. Table 6-4 provides average groundwater inflows for the historical and current period. The biggest inflow components are deep percolation of streamflow and deep percolation of precipitation and applied irrigation. Deep percolation of streamflow is slightly greater on average but also varies more. Values of 50,000 to 100,000 AF/yr. are typical of each of these components. The most consistent groundwater flows into the Subbasin are from the subsurface, including seawater intrusion. For these water budgets, seawater intrusion is counted as an inflow even though it is not usable. Freshwater subsurface inflows are always between 18,000 and 24,000 AF/yr. Seawater inflows are always between 2,000 and 4,000 AF/yr. These seawater inflows are less than calculated in Chapter 5. This is likely a result of assumptions in the SVIHM that may underestimate seawater intrusion. Developing a variable density groundwater model will address this underestimation. Total annual recharge is similar for the historical period and current period, with each equal to about 158,000 AF/yr.

Figure 6-7 shows the SVIHM estimated groundwater outflows for the historical and current time periods. Outflows vary from year to year; however, the annual variation is dampened compared to the inflows. Table 6-5 provides the SVIHM estimated average groundwater outflows of the historical and current periods. In all but the wettest years, the greatest groundwater outflow is pumping. Averaged over the historical period, groundwater pumping accounts for more than 50% of all groundwater outflows in the Subbasin. In the driest water years, like 1990 and 2014, it accounts for more than 70%. Total average annual groundwater outflow was about 172,000 AF for the historical period and 137,000 AF for the current period. All outflows are shown as negative values.

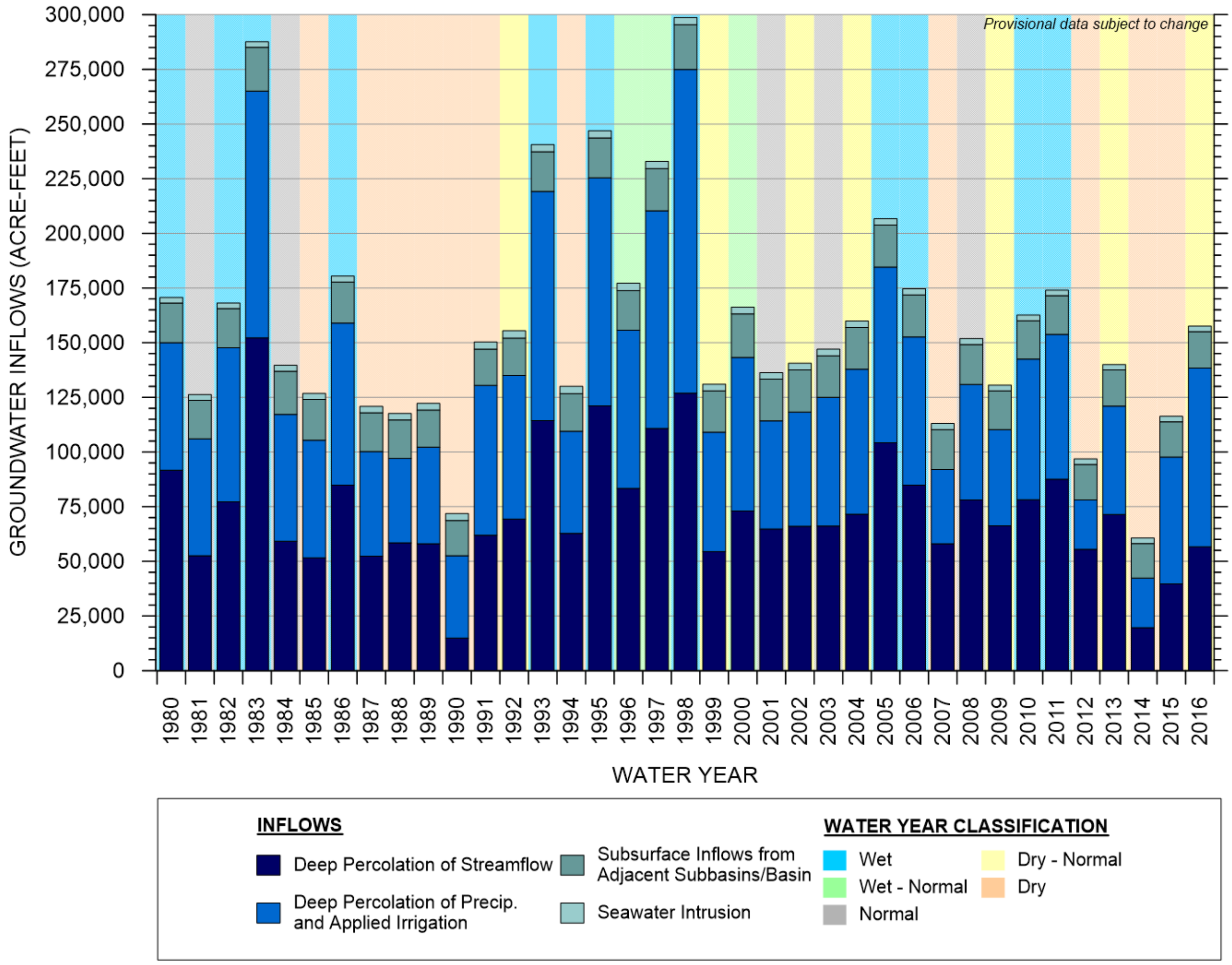


Figure 6-6. SVIHM Simulated Inflows to the Groundwater System

Table 6-4. SVIHM Simulated Groundwater Inflows Summary (AF/yr.)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Deep Percolation of Streamflow	73,000	56,700
Deep Percolation of Precipitation and Applied Irrigation	63,600	81,700
Subsurface Inflow from Adjacent Subbasins	18,100	16,700
Seawater Intrusion	2,900	2,500
Total Inflows	157,600	157,600

Note: provisional data subject to change.

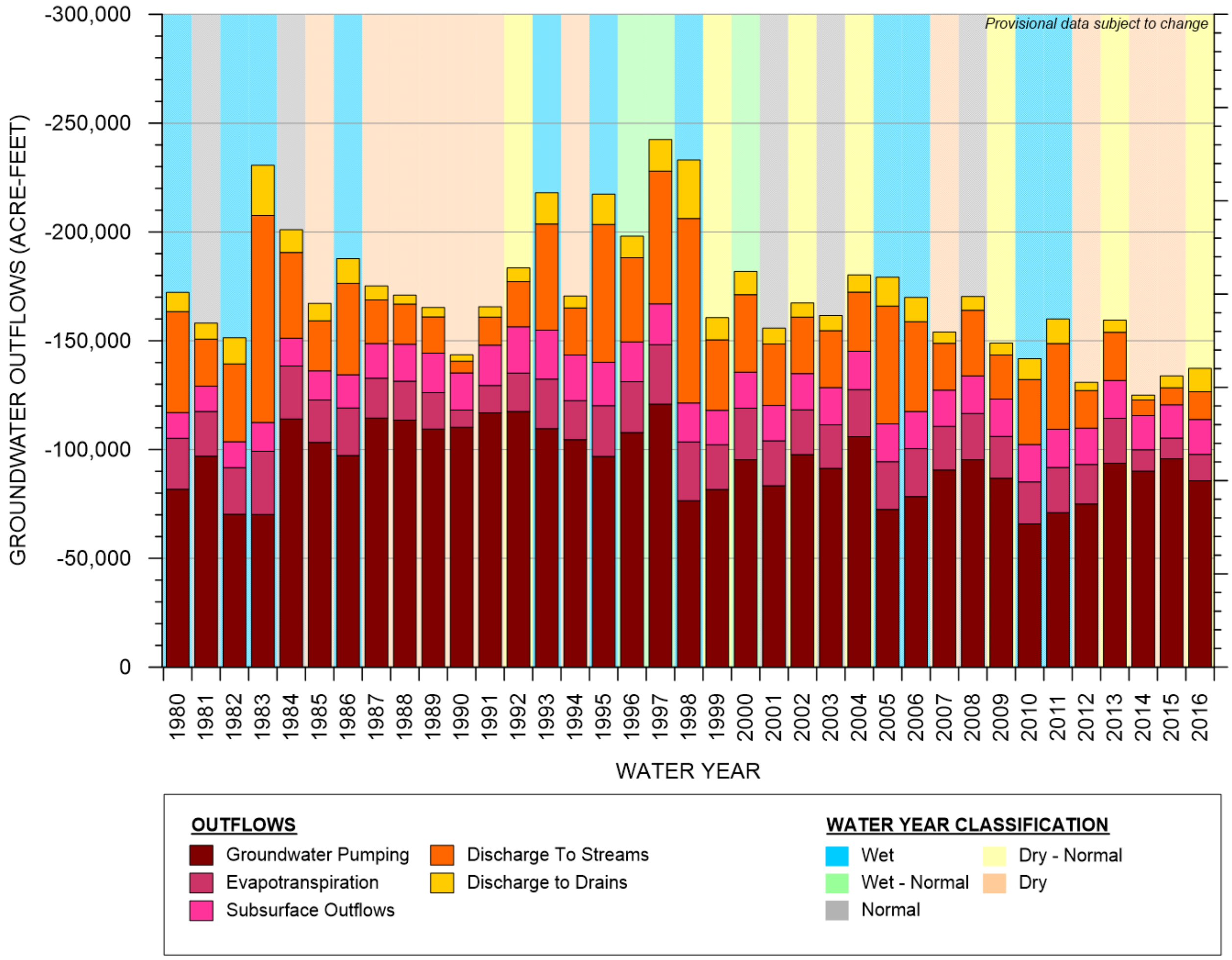


Figure 6-7. SVIHM Simulated Outflows from the Groundwater System

Table 6-5. SVIHM Simulated and Adjusted Groundwater Outflows Summary (AF/yr.)

	Simulated		Adjusted	
	Historical Average (WY 1980-2016)	Current (WY 2016)	Historical Average (WY 1980-2016)	Current (WY 2016)
Groundwater Pumping	-94,300	-85,700	-132,800	-120,700
Groundwater Evapotranspiration	-19,900	-12,100	-19,900	-12,100
Subsurface Outflows	-16,700	-16,000	-16,700	-16,000
Discharge to Streams	-32,300	-12,800	-32,300	-12,800
Discharge to Drains	-9,000	-10,800	-9,000	-10,800
Total Outflows	-172,200	-137,400	-210,700	-172,400

Note: provisional data subject to change.
Adjusted pumping is described below.

Comparing SVIHM output to Groundwater Extraction Management System (GEMS) data reveals that, on average, the preliminary SVIHM estimates only approximately 71% of the pumping reported in the GEMS database for the Subbasin between 1995 and 2016. The historical average groundwater extraction reported to GEMS is 125,500 AF/yr., and the current (2016) extraction is 120,400 AF/yr. These GEMS data are likely more representative of historical conditions than the model generated pumping numbers; however, reliable GEMS data are only available since 1995. To accurately estimate groundwater extraction for the full historical period, this 71% ratio was applied to the SVIHM estimated historical pumping shown in Table 6-5 and Table 6-6, yielding an estimated (adjusted) historical average pumping rate of 132,800 AF/yr.

Figure 6-8 and Table 6-6 show SVIHM simulated groundwater pumping by water use sector. More than 85% of groundwater pumping in the Subbasin is used for agricultural purposes. Groundwater pumping varies from year to year; however, total pumping in the Subbasin has generally decreased since its peak in the 1980s and 1990s. Municipal and agricultural pumping are simulated in the SVIHM; however, domestic pumping, including *de minimis* pumping, is not included in the model, including pumping that occurs from a well with a discharge pipe of less than 3 inches. The SVIHM does not simulate domestic pumping because it is a relatively small portion of overall groundwater pumping in Salinas Valley Basin, and it is not included in the 180/400-Foot Subbasin water budget. The historical average in Table 6-6 is not strictly comparable to the GEMS historical average because the time periods used to calculate the averages are different; however, the ratio between these values is used to adjust simulated pumping to be more consistent with GEMS data.

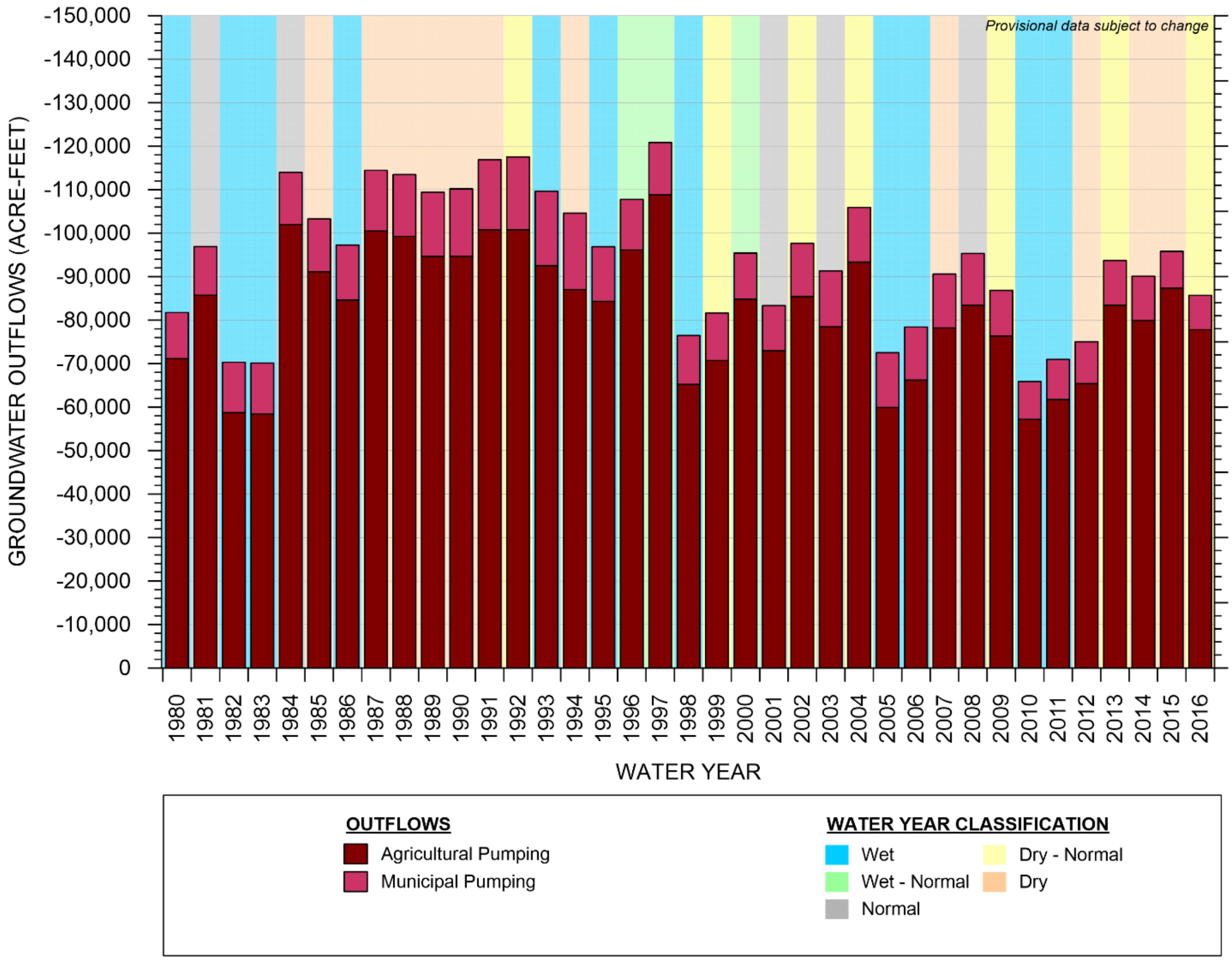


Figure 6-8. SVIHM Simulated Groundwater Pumping by Water Use Sector

Table 6-6. SVIHM Simulated and Adjusted Groundwater Pumping by Water Use Sector (AF/yr.)

	Simulated		GEMS		Adjusted	
	Historical Average (WY 1980-2016)	Current (WY 2016)	Historical Average (WY 1995-2016)	Current (WY 2016)	Historical Average (WY 1980-2016)	Current (WY 2016)
Municipal & Industrial	-12,200	-7,900	-14,100	-11,000	-17,200	-11,100
Agricultural	-82,100	-77,800	-111,500	-109,400	-115,600	-109,600
Total Pumping	-94,300	-85,700	-125,600	-120,400	-132,800	-120,700

Note: provisional data subject to change.

[1] Adjusted agricultural pumping is based on the ratio between SVIHM and GEMS agricultural pumping, as described in text above.

Figure 6-9 shows SVIHM estimated net subsurface flows entering and exiting the Subbasin by watershed and neighboring subbasin. Historically, the Subbasin's subsurface inflows have been about 10% greater than its outflows for a net inflow of about 2,000 AF/yr. Table 6-7 shows SVIHM estimated historical mean and current year subsurface flows.

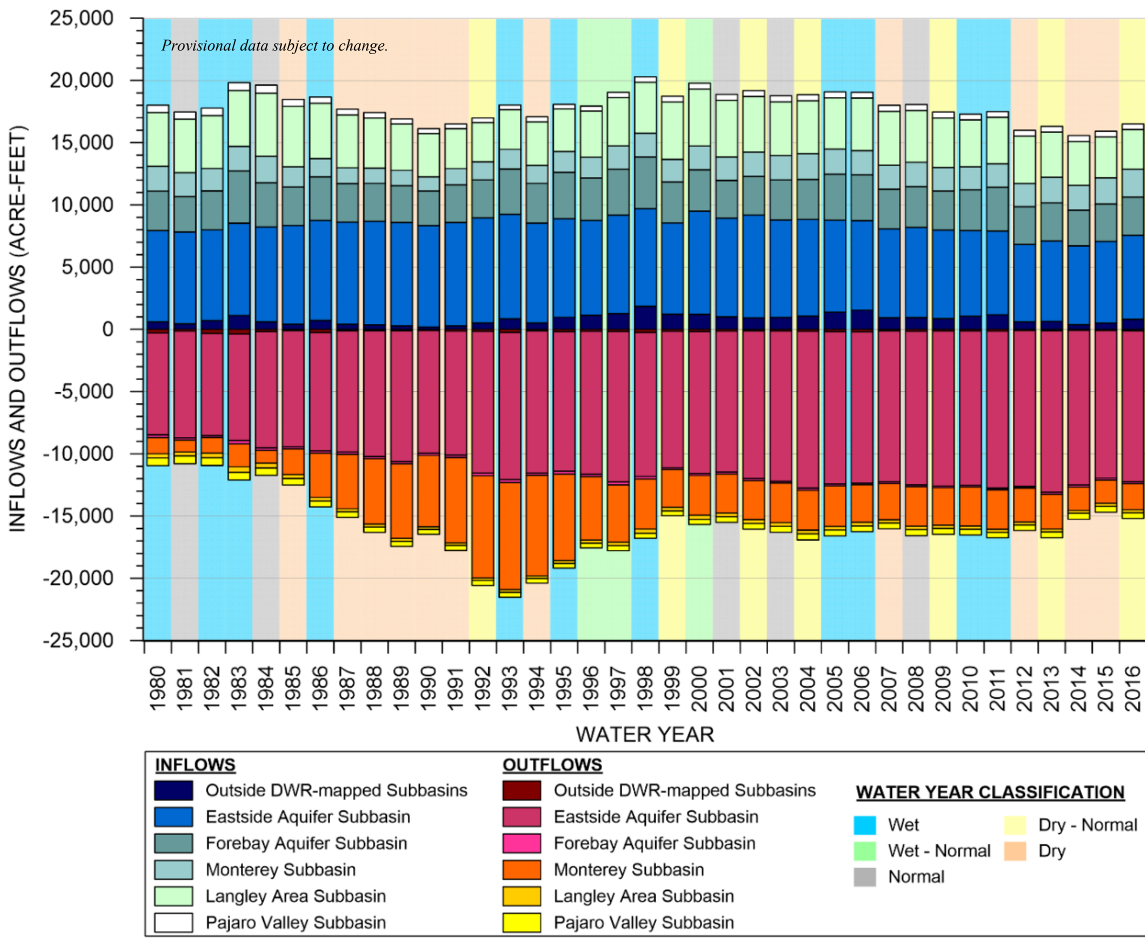


Figure 6-9. SVIHM Simulated Subsurface Inflows and Outflows from Watershed Areas and Neighboring Basins/Subbasins

Table 6-7. SVIHM Simulated Net Subbasin Boundary Flows (AF/yr.)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Eastside Aquifer Subbasin	-3,600	-5,400
Forebay Aquifer Subbasin	3,100	2,900
Monterey Subbasin	-1,900	100
Langley Area Subbasin	3,700	2,900
Pajaro Valley Subbasin	-100	0
Outside Areas	700	700

Note: provisional data subject to change.

Change in groundwater storage is equal to inflow to storage (such as deep percolation) minus outflows from storage (such as pumping). A negative change in groundwater storage value indicates groundwater storage depletion associated with lower groundwater levels; while a positive value indicates groundwater storage accretion associated with higher groundwater levels. Averaged over the historical period, the preliminary SVIHM estimates that the 180/400-Foot Aquifer Subbasin is in overdraft by 14,800 AF/yr. Model results represent storage loss from all aquifer layers, including the Deep Aquifers. However, this simulated overdraft contains significant variability and uncertainty. Figure 6-10 shows considerable variability in change in storage from one year to the next. In water year 1998, inflows exceeded outflows by more than 65,000 AF, while in 1988 outflows exceeded inflows by roughly 60,000 AF. The current period represents a snapshot in time showing variability within the model simulation and are not necessarily representative of actual current conditions.

Estimating storage loss from groundwater levels in the 180/400-Foot Subbasin is difficult because groundwater is pumped from a combination of confined and unconfined aquifers. Groundwater levels react differently to pumping depending on the type of aquifer. The decline in groundwater storage based on measured groundwater elevations from 1995 through 2019 is estimated to be about 800 AF/yr. in the Subbasin, as described in Section 5.2.2. Based on measured groundwater levels from 1944 through 2013, a report by Brown and Caldwell (2015) estimates that groundwater storage decreased at an average rate of 200 AF/yr. (assuming confined conditions) to 1,600 AF/yr. (assuming unconfined conditions). During the drought years of 1984 through 1991, Brown and Caldwell estimates that groundwater storage in the 180/400-Foot Subbasin declined by 1,000 to 2,000 AF/yr. (confined) and 10,000 to 20,000 AF/yr. (unconfined) (Brown and Caldwell, 2015). The long-term average accounts for the short-term increase in storage loss during the drought period. The long-term historical average value reported in Section 5.2.2 is in the middle of the range of average values reported for confined and unconfined conditions by Brown and Caldwell, suggesting that the groundwater measurement dataset represents both confined and unconfined conditions. However, the storage loss estimate from Section 5.2.2 is likely underestimated because it does not account for conditions in the Deep Aquifers, due to lack of data. That estimate will be improved in the future after investigations of the Deep Aquifers.

Uncertainties exist in groundwater storage estimates from both the SVIHM and the analyses using groundwater level measurements. Therefore, based on the average of groundwater level measurements reported in Section 5.2.2, this GSP considers 800 AF as the historical average annual decline in storage due to change in groundwater elevations. This value is used for water budget adjustments described below.

Additional groundwater storage loss occurs due to seawater intrusion. Averaged over the historical period, the preliminary SVIHM estimates groundwater storage loss due to seawater intrusion occurs at a rate of 2,900 AF/yr. in the Subbasin, accounting for all three aquifers. The decline in groundwater storage due to seawater intrusion based on the change in mapped intruded area is estimated to be 12,600 AF/yr. in the Subbasin, as described in Section 5.2.3. This GSP considers 12,600 AF/yr. to be the annual rate of storage loss due to seawater intrusion. Furthermore, the change in groundwater storage calculated by the SVIHM is not comparable to, and should not be equated with, the change in groundwater storage calculated in Section 5.2.2. The SVIHM water budget is an accounting of all flows across the subbasin boundaries. The change in groundwater storage calculated in Section 5.2.2 is an estimate of usable groundwater, and excludes all areas with seawater intrusion.

6.3.3 Historical and Current Groundwater Budget Summary

The main groundwater inflows into the subbasin are: (1) deep percolation of precipitation and irrigation water, (2) subsurface inflow from adjacent DWR groundwater basins and subbasins, and (3) stream recharge. Groundwater pumping is the predominant groundwater outflow. The smaller outflow terms are subsurface outflows to adjacent subbasins, evapotranspiration, discharge to streams, and flows to drains.

Figure 6-10 shows the entire groundwater water budget from the SVIHM and includes annual change in groundwater storage. Changes in groundwater storage are strongly correlated with changes in deep percolation of precipitation and stream flows. For example, 1983 and 1998 were comparatively very wet years and represent the greatest increases in deep percolation and, correspondingly, the greatest increases in groundwater storage over the historical period. Estimated cumulative change in groundwater storage has steadily declined over time with slight increases in response to wet periods.

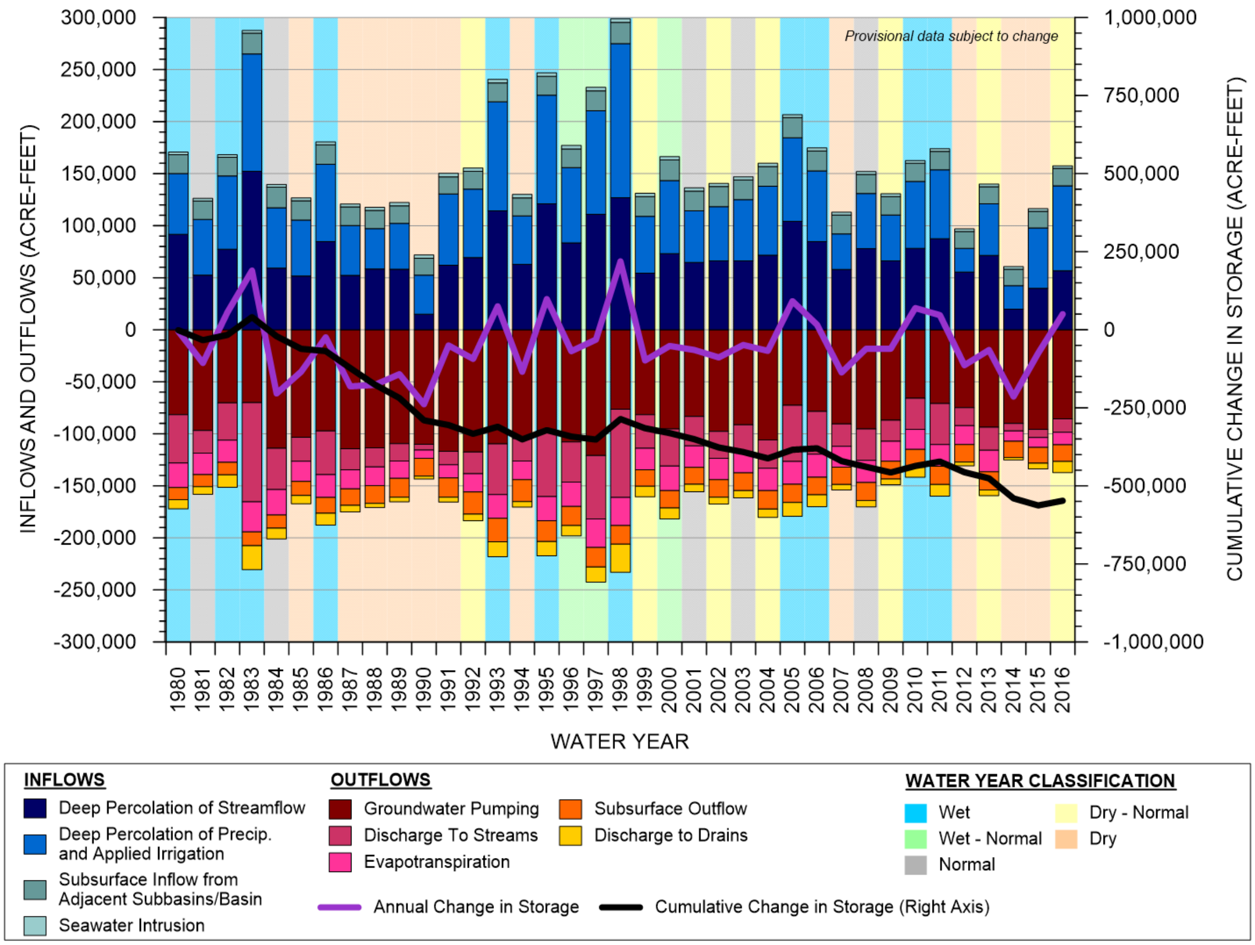


Figure 6-10. SVIHM Simulated Historical and Current Groundwater Budget

The SVIHM estimated the historical annual decline in storage to be 14,800 AF/yr. However, this decline is greater than estimated using groundwater level data, and this GSP considers the average annual historical decline in storage to be 800 AF/yr., as explained above.

A comparison of the historical and current groundwater budgets is shown in Table 6-8. The values in the table are based on the inflows and outflows presented in previous tables. Negative values indicate outflows or depletions. This table is informative in showing the relative magnitude of various water budget components; however, these results are based on a provisional model and will be updated in future updates to this chapter after the SVIHM is completed and released by the USGS.

Table 6-8. Summary of Groundwater Budget (AF/yr)

	Historical Average (WY 1980-2016)	Current (WY 2016)
Groundwater Pumping	-132,800	-120,700
Flow to Drains	-9,000	-10,800
Net Stream Exchange	40,700	43,900
Deep Percolation of Precipitation and Applied Irrigation	63,600	81,700
Net Flow from Adjacent Subbasins/Basin	1,900	1,300
Seawater Intrusion	2,900	2,500
Flow to Ocean	-500	-600
Groundwater Evapotranspiration	-19,900	-12,100
Net Storage Gain (+) or Loss (-)	-800	-15,000

Note: provisional data subject to change.
The net storage value is the estimated historical overdraft based on observed groundwater levels, as described in Sections 5.2.2 and 6.3.2. Water budget error, as reflected in change in storage, for the historical average period is 33%, which is considered unreasonably large and will be addressed and improved in future updates to the GSP.

6.3.4 Historical and Current Sustainable Yield

The historical and current sustainable yields reflect the amount of Subbasin-wide pumping reduction needed to balance the water budget, resulting in no net decrease in storage of useable groundwater. The sustainable yield can be estimated as:

$$\text{Sustainable yield} = \text{pumping} + \text{change in storage} + \text{seawater intrusion}$$

Table 6-9 provides a likely range of sustainable yields based on the GEMS derived historical pumping. This range represents the average GEMS reported pumping from 1995 to 2016, as shown in Table 6-6, plus and minus one standard deviation. The adjusted change in groundwater storage (loss) of 800 AF/yr., described in Sections 5.2.2 and 6.3.3, is used for this calculation, as well as the seawater intrusion estimate described in Section 5.3.2, which is related to the change in volume of useable water rather than flows across the subbasin boundaries. These values are the likely range of the sustainable yield of the Subbasin. This does not include overdraft in the Deep Aquifers due to insufficient data, which is a data gap that will be filled during GSP implementation. This GSP adopts this range of likely sustainable yields as the best estimate for the Subbasin.

Table 6-9. Historical Sustainable Yield for the 180/400 Subbasin Derived from GEMS, Observed Groundwater Levels, and Mapped Seawater Intrusion Areas (AF/yr.)

	Low Historical Average	High Historical Average
Total Subbasin Pumping	114,800	136,600
Change in Storage	-800	-800
Seawater Intrusion	-12,600	-12,600
Estimated Sustainable Yield	101,400	123,200

Note: Pumping is shown as positive value for this computation. Change in storage value is based on observed groundwater measurements and seawater intrusion is based on mapped areas of intrusion, as previously described in the text.

6.4 Projected Water Budgets

Projected water budgets are extracted from the SVOM, which simulates future hydrologic conditions with assumed climate change. Two projected water budgets are presented, one incorporating estimated 2030 climate change projections and one incorporating estimated 2070 climate change projections.

The climate change projections are based on data provided by DWR (2018). Projected water budgets are useful for showing that sustainability will be achieved in the 20-year implementation period and maintained over the 50-year planning and implementation horizon. However, the projected water budgets are based on a provisional version of the SVOM and are subject to change. Model information and assumptions summarized in this section of the report are based on provisional documentation on the model. Additional information will be provided in future GSP updates after the model is released by the USGS.

6.4.1 Assumptions Used in Projected Water Budget Development

The assumptions incorporated into the SVOM for the projected water budget simulations include:

- Land Use: The land use is assumed to be static, aside from a semi-annual change to represent crop seasonality. The annual pattern is repeated every year in the model. Land use specified in the model by USGS reflects the 2014 land use.

- No urban growth is included in this simulation to remain consistent with USGS assumptions. If urban growth is infill, this assumption may result in an underestimate of net pumping increases and an underestimate of the Subbasin's future overdraft. If urban growth replaces agricultural irrigation, the impact may be minimal because the urban growth will replace existing agricultural water use.
- Reservoir Operations: The reservoir operations reflect MCWRA's current approach to reservoir management.
- Stream Diversions: The SVOM explicitly simulates only two stream diversions in the Salinas Valley Basin: Clark Colony and the Salinas River Diversion Facility (SRDF). The Clark Colony diversion is located along Arroyo Seco and diverts stream water to an agricultural area nearby. The SRDF came online in 2010 and diverts water from the Salinas River to the Castroville Seawater Intrusion Project (CSIP) area. Clark Colony diversions are repeated from the historical record to match the water year. SRDF diversions are made throughout the duration of the SVOM whenever reservoir storage and streamflow conditions allow during the period from April through October. For purposes of the projected water budgets, SRDF diversions are specified at a rate of 18 cubic feet per second.
- Recycled Water Deliveries: Recycled water has been delivered to the CSIP area since 1998 as irrigation supply. The SVOM includes recycled water deliveries throughout the duration of the model.

6.4.1.1 Future Projected Climate Assumptions

Several modifications were made to the SVOM in accordance with recommendations made by DWR in their *Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development* (DWR, 2018). Three types of datasets were modified to account for 2030 and 2070 projected climate change: climate data including precipitation and potential evapotranspiration, streamflow, and sea level.

Climate Data

This GSP uses the climate change datasets provided by DWR for use by GSAs. The climate scenarios were derived by taking the historical interannual variability from 1915 through 2011 and increasing or decreasing the magnitude of events based on projected changes in precipitation and temperature from general circulation models. These datasets of climate projections for 2030 and 2070 conditions were derived from a selection of 20 global climate projections recommended by the Climate Change Technical Advisory Group as the most appropriate projections for California water resources evaluation and planning. Because the DWR climate datasets are only available through December 2011 and the SVOM uses a climate time series through December 2014, monthly change factors for January 2012 to December 2014 are assumed. DWR provided climate datasets for central tendency scenarios, as well as extreme wet and dry scenarios; the future water budgets described herein are based on the DWR central tendency scenarios for 2030 and 2070. Historical data were analyzed from the Salinas Airport precipitation gauge record to identify years from 1968 to 2011 that were most similar to conditions in 2012, 2013 and 2014. Based on this analysis, climate data from 1981, 2002, and 2004 are applied as the climate inputs for 2012, 2013, and 2014, respectively.

The modified monthly climate data for the entire model period are applied as inputs to the model, which reads precipitation and potential evapotranspiration data on a monthly basis.

Streamflow

DWR provided monthly change factors for unimpaired streamflow throughout California. For the Salinas Valley and other areas outside of the Central Valley, these change factors are provided as a single time series for each major watershed. Streamflows along the margins of the Basin are modified by the monthly change factors. As with the climate data, an assumption is required to extend the streamflow change factor time series through December 2014. It is assumed that the similarity in rainfall years at the Salinas Airport rainfall gauge could reasonably be expected to produce similar amounts of streamflow; therefore, the same years of 1981, 2002, and 2004 are repeated to represent the 2012, 2013, and 2014 streamflows.

Sea Level

DWR guidance recommends using a single static value of sea level rise for each of the climate change scenarios (DWR, 2018). For the 2030 climate change scenario, the DWR-recommended sea level rise value of 15 centimeters is used. For the 2070 climate change scenario, the DWR-recommended sea level rise value of 45 centimeters is used. The amount of sea level rise is assumed to be static throughout the duration of each of the climate change scenarios.

6.4.2 Projected Surface Water Budget

Average projected surface water budget inflows and outflows for the 47-year future simulation period with 2030 and 2070 climate change assumptions are quantified in Table 6-10. As with the current water budget, the boundary stream inflows and outflows are much greater than the other components.

Table 6-10: SVOM Simulated Average Surface Water Inflow and Outflow Components for Projected Climate Change Conditions (AF/yr.)

Projected Climate Change Timeframe	2030	2070
Overland Runoff to Streams	20,500	21,800
Boundary Stream Inflows	1,184,000	1,327,200
Net Flow Between Surface Water and Groundwater	-53,600	-54,400
Boundary Stream Outflows	-1,144,300	-1,288,100
Diversions	-6,500	-6,600

Note: provisional data subject to change.

6.4.3 Projected Groundwater Budget

Average projected groundwater budget inflows for the 47-year future simulation period with 2030 and 2070 climate change assumptions are quantified in Table 6-11. In both the 2030 and 2070 simulations, the biggest contributors to groundwater inflows are deep percolation of stream flow and deep percolation of precipitation and irrigation.

Table 6-11: SVOM Simulated Average Groundwater Inflow Components for Projected Climate Change Conditions (AF/yr.)

Projected Climate Change Timeframe	2030	2070
Deep Percolation of Stream Flow	56,500	57,800
Deep Percolation of Precipitation. and Irrigation	61,700	65,700
Underflow from Eastside Aquifer Subbasin	8,400	8,800
Underflow from Forebay Aquifer Subbasin	2,600	2,600
Underflow from Monterey Subbasin	1,900	2,000
Underflow from Langley Area Subbasin	4,400	4,600
Underflow from Pajaro Valley Subbasin	800	800
Underflow from Surrounding Watersheds	1,300	1,400
Underflow from Ocean (Seawater Intrusion)	2,900	3,100
Total Inflows	140,500	146,800

Note: provisional data subject to change.

Average SVOM projected groundwater budget outflows for the 47-year future simulation period with 2030 and 2070 climate change assumptions are quantified in Table 6-12. As in the historical and current water budgets, the greatest outflow is groundwater pumping. Negative values are shown in Table 6-12 to represent outflows.

Table 6-12: SVOM Simulated Average Groundwater Outflow Components for Projected Climate Change Conditions (AF/yr.)

	Simulated		Adjusted	
Projected Climate Change Timeframe	**2030**	**2070**	**2030**	**2070**
Groundwater Pumping	-88,500	-92,500	-124,600	-130,300
Flows to Drains	-8,200	-8,800	-8,200	-8,800
Flow to Streams	-3,000	-3,400	-3,000	-3,400
Groundwater Evapotranspiration	-35,200	-37,000	-35,200	-37,000
Underflow to Eastside Aquifer Subbasin	-11,100	-11,300	-11,100	-11,300
Underflow to Forebay Aquifer Subbasin	-200	-200	-200	-200
Underflow to Monterey Subbasin	-2,600	-2,500	-2,600	-2,500
Underflow to Langley Area Subbasin	-300	-400	-300	-400
Underflow to Pajaro Valley Subbasin	-1,000	-1,000	-1,000	-1,000
Underflow to Surrounding Watersheds	-300	-300	-300	-300
Underflow to Ocean	-300	-300	-300	-300
Total Outflows	-150,700	-157,700	-186,800	-205,500

Note: provisional data subject to change.

[1] Adjusted pumping is based on the ratio between historical average SVIHM and GEMS agricultural pumping, as described in Section 6.3.2.

As described in Section 5.2.2 for the historical water budget, data indicate that the Subbasin has historically been in overdraft (on the order of 800 AF/yr. decline). Even though the SVOM projects -10,500 and -11,300 AF/yr. change in storage for 2030 and 2070, respectively, the adjusted historical decline in storage is used with the adjusted future pumping estimates to provide a likely more reasonable estimate for projected sustainable yield. The loss of in groundwater storage is slightly less in the projected simulations than in the historical simulations, even though there is no change in land use. This smaller decrease in groundwater storage is likely due to climate change, which is expected to be warmer and wetter according to DWR climate change factors. The model includes increased precipitation from climate change; however, it does not account for the frequency and magnitude of storm events. If storm events concentrate precipitation within short periods, more water may run off than infiltrate. More analysis needs to be done with regards to future recharge. This projected water budget adopts the historical average annual change in storage as the most reasonable estimate for the future, assuming extraction continues. Since land use is assumed at 2014 conditions and does not change over time in the SVOM, groundwater storage declines are assumed to continue into the future at the historical average rate. This is reflected in the adjusted average change in storage in Table 6-13, which is set to a decline of 800 AF/yr. However, as described above, this storage loss estimate is likely underestimated because it does not account for conditions in the Deep Aquifers, due to lack of data. The estimate will be improved in the future after additional hydrogeologic investigations of the Deep Aquifers.

Combining Table 6-11 and Table 6-12 yields the SVOM simulated net groundwater inflow and outflow data for the 47-year future simulation with 2030 and 2070 climate change assumptions. These flows are shown in Table 6-13. Negative values indicate outflows or depletions. The net storage changes in the last row closely match the sums of the other rows. It is not an exact match due to rounding error and model error.

Table 6-13: Average SVOM Simulated and Adjusted Annual Groundwater Budget for Projected Climate Change Conditions (AF/yr.)

	Simulated		Adjusted	
Projected Climate Change Timeframe	2030	2070	2030	2070
Groundwater Pumping	-88,500	-92,500	-124,600	-130,300
Flow to Drains	-8,200	-8,800	-8,200	-8,800
Net Stream Exchange	53,600	54,400	53,600	54,400
Deep Percolation of Precipitation and Applied Irrigation	61,700	65,700	61,700	65,700
Net Flow from Adjacent Subbasins/Basin	3,800	4,400	3,800	4,400
Seawater Intrusion	2,900	3,100	2,900	3,100
Flow to Ocean	-300	-300	-300	-300
Net Groundwater Evapotranspiration	-35,200	-37,000	-35,200	-37,000
Net Storage Gain (+) or Loss (-)	-10,500	-11,300	-800	-800

Note: provisional data subject to change.

Based on the adjusted change in storage, which is the historical average decline as described in the text, model error is 32% for 2030 and 39% for 2070; these error values are unreasonably large and will be addressed and improved in future updates to the GSP.

[1] Adjusted pumping is based on the ratio between historical average SVIHM and GEMS agricultural pumping, as described in Section 6.3.2.

SVOM projected groundwater pumping by water use sector is summarized in Table 6-14. Because the model assumes no urban growth, future municipal pumping was assumed to be equal to current municipal pumping. Future agricultural pumping is then calculated as the total projected pumping minus the current municipal pumping. The 2030 and 2070 model simulations predict that agriculture will account for about 90% of pumping. Similar to the SVIHM, domestic pumping is not included in the SVOM future projections simulation.

Table 6-14: SVOM Simulated Projected Annual Groundwater Pumping by Water Use Sector (AF/yr.)

	Simulated		Adjusted	
Water Use Sector	2030	2070	2030	2070
Urban Pumping	-7,900	-7,900	-11,000	-11,000
Agricultural Pumping	-80,600	-84,600	-113,600	-129,300
Total Pumping	-88,500	-92,500	-124,600	-130,300

Note: provisional data subject to change.

[1] Adjusted pumping is based on the ratio between historical average SVIHM and GEMS agricultural pumping, as described in Section 6.3.2.

6.4.4 Projected Sustainable Yield

Projected sustainable yield is the long-term pumping that can be sustained once all undesirable results have been addressed. However, it is not the amount of pumping needed to stop undesirable results before sustainability is reached. The SVBGSA recognizes that depending on the success of various proposed projects and management actions there may be some years when pumping must be held at a lower level to achieve necessary rises in groundwater elevation. The actual amount of allowable pumping from the Subbasin will be adjusted in the future based on the success of projects and management actions.

To retain consistency with the historical sustainable yield, projected sustainable yield can be estimated by summing all the average groundwater extractions, subtracting the average loss in storage, and subtracting the average seawater intrusion. This represents the change in pumping that results in no change in storage of useable groundwater, assuming no other projects or management actions are implemented. For this sustainable yield discussion and associated computations, groundwater pumping outflows are reported as positive values, which is opposite of how the values are reported in the water budget tables. As discussed earlier, the current, preliminary version of the SVIHM, and by inference the SVOM, appears to overestimate the historical overdraft in the Subbasin and therefore underestimate the historical sustainable yield. The sustainable yield value will be updated in future GSP updates as more data are collected and additional analyses are conducted.

Although the sustainable yield values provide guidance for achieving sustainability, simply reducing pumping to within the sustainable yield is not proof of sustainability. Sustainability must be demonstrated through the Sustainable Management Criteria (SMC). Table 6-15 provides estimates of the future sustainable yield using estimated future pumping calculated in Table 6-14. As described for the historical sustainable yield, data indicate that the Subbasin has historically been in overdraft (on the order of 800 AF/yr. decline, not including the Deep Aquifers). This historical decline in storage is used with the adjusted SVOM pumping estimates to provide a likely more reasonable estimate for projected sustainable yield. Therefore, although change in storage projected by the preliminary SVOM is on the order of -11,000 AF/yr., the historical average change in storage in Table 6-15 is set to a decline of 800 AF/yr. This does not include the Deep Aquifers, which is a data gap that will be filled during GSP implementation. Similarly, the historical average seawater intrusion rate of 12,600 AF/yr. is also used for this calculation.

Table 6-15. Adjusted Projected Sustainable Yields for the 180/400 Subbasin Derived from GEMS, Observed Groundwater Levels, and Mapped Seawater Intrusion Areas (AF/yr.)

	2030 Projected Sustainable Yield	2070 Projected Sustainable Yield	Historical Sustainable Yield Range
Groundwater Pumping	124,600	130,300	114,800 to 136,600
Seawater Intrusion	-12,600	-12,600	-12,600
Change in Storage	-800	-800	-600
Projected Sustainable Yield	111,200	116,900	101,400 to 123,200

Note: Pumping is shown as positive value for this computation. Change in storage value is based on observed groundwater measurements and seawater intrusion is based on mapped areas of intrusion, as previously described in the text for historical water budgets.

Table 6-15 includes the adjusted estimate of historical sustainable yield for comparison purposes. Although the sustainable yield values provide guidance for achieving sustainability, simply reducing pumping to within the sustainable yield is not proof of sustainability. Sustainability must be demonstrated through the SMC. The sustainable yield value will be modified and updated as more data are collected, and more analyses are performed.

6.4.5 Uncertainties in Projected Water Budget Simulations

Models are mathematical representations of physical systems. They have limitations in their ability to represent physical systems exactly and due to limitations in the data inputs used. There is also inherent uncertainty in groundwater flow modeling itself, since mathematical (or numerical) models can only approximate physical systems and have limitations in how they compute data. However, DWR (2018) recognizes that although models are not exact representations of physical systems because mathematical depictions are imperfect, they are powerful tools that can provide useful insights.

There is additional inherent uncertainty involved in projecting water budgets with projected climate change based on the available scenarios and methods. The recommended 2030 and 2070 central tendency scenarios that are used to develop the projected water budgets with the SVIHM provide a dataset that can be interpreted as what might be considered the most likely future conditions; there is an approximately equal likelihood that actual future conditions will be more stressful or less stressful than those described by the recommended scenarios (DWR, 2018).

As stated in DWR (2018):

> *"Although it is not possible to predict future hydrology and water use with certainty, the models, data, and tools provided [by DWR] are considered current best available science and, when used appropriately should provide GSAs with a reasonable point of reference for future planning."*

6.5 Subbasin Water Supply Availability and Reliability

Water is not imported into the 180/400-Foot Aquifer Subbasin. However, a significant portion of the Subbasin's recharge is derived from reservoir releases that regulate Salinas River streamflow. The historical water budget incorporates years when there was little availability of surface water flow and groundwater elevations declined as a result. Figure 6-5 shows that when Salinas River flows were low, deep percolation to groundwater was also low. Declines in groundwater levels during these years contributed to chronic groundwater storage loss and seawater intrusion during the historical period. The projected water budgets are developed with the SVOM, which is based on historical surface water flows and groundwater conditions, and therefore projected water budgets incorporate reasonable fluctuations in water supply availability. MCWRA plans to revise the Habitat Conservation Plan (HCP) for the Salinas River, which may change the current reservoir release schedule. A revised reservoir release schedule could influence the reliability of groundwater recharge.

6.6 Uncertainties in Water Budget Calculations

The level of accuracy and certainty is highly variable between water budget components. A few water budget components are directly measured, but most water budget components are either estimated inputs to the model or simulated by the model. Additional model uncertainty stems from an imperfect representation of natural condition and is reflected in model calibration error. However, inputs to the models are carefully selected using best available data, the model's calculations represent established science for groundwater flow, and the model calibration error is within acceptable bounds. Therefore, the models are the best available tools for estimating water budgets. The model results are provisional and subject to change in future GSP updates after the models are released by the USGS.

The following list groups water budget components in increasing order of uncertainty.

- Measured: metered municipal, agricultural, and some small water system pumping
- Estimated: domestic pumping, including depth, rate, and location
- Simulated primarily based on climate data: precipitation, evapotranspiration, irrigation pumping
- Simulated based on calibrated model: all other water budget components

Simulated components based on calibrated model have the most uncertainty because those simulated results encompass uncertainty of other water budget components used in the model in addition to model calibration error.

7 MONITORING NETWORKS

This chapter describes the networks that will monitor the SMC discussed in Chapter 8. This description of the monitoring network has been prepared in accordance with the GSP Regulations § 354.32 *et seq.* to include monitoring objectives, monitoring protocols, and data reporting requirements.

7.1 Introduction

7.1.1 Monitoring Objectives

SGMA requires monitoring networks to collect data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the Subbasin, and to evaluate changing conditions that occur as the Plan is implemented. The monitoring networks are intended to:

- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.
- Demonstrate progress toward achieving measurable objectives.
- Monitor impacts to the beneficial uses or users of groundwater.
- Quantify annual changes in water budget components.

7.1.2 Approach to Monitoring Networks

Monitoring networks are developed for each of the 6 sustainability indicators that are relevant to the Subbasin:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Seawater intrusion
- Degraded water quality
- Land subsidence
- Depletion of ISW

Other monitoring networks, such as groundwater extraction, that are necessary to comply with GSP Regulations are also included in this chapter. Representative Monitoring Sites (RMS) are a subset of the monitoring network and are limited to sites with data that are publicly available and not confidential.

The SVBGSA estimated the density of monitoring sites and the frequency of measurements required to demonstrate short-term, seasonal, and long-term trends. If the required monitoring site density does not currently exist, the SVBGSA will expand monitoring networks for some sustainability indicators during GSP implementation. Filling data gaps and developing more extensive and complete monitoring networks will improve the SVBGSA's ability to demonstrate sustainability and refine the existing conceptual and numerical hydrogeologic models. Chapter 10 provides a plan and schedule for resolving data gaps. The SVBGSA will review the monitoring network in each 5-year assessment, including a determination of uncertainty and whether there are remaining data gaps that could affect the ability of the Plan to achieve the sustainability goal for the Subbasin.

7.1.3 Management Areas

No management areas have been defined for the 180/400-Foot Aquifer Subbasin.

7.2 Groundwater Level Monitoring Network

The sustainability indicator for chronic lowering of groundwater levels is evaluated by groundwater elevations monitored by MCWRA in designated monitoring wells. The Regulations require a network of monitoring wells sufficient to demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features.

Figure 7-1 shows the 157 wells in the Subbasin monitored for groundwater elevations that are used to develop groundwater elevation contours. The groundwater elevation data for these wells are publicly available data and shown on the SVBGSA Web Map. The wells are shown by principal aquifer on Figure 7-1.

Of the wells shown on Figure 7-1, 91 are selected for inclusion in the groundwater level monitoring network as RMS wells. Out of the 91 RMS wells, 35 are in the 180-Foot Aquifer, 45 in the 400-Foot Aquifer, and 11 in the Deep Aquifers, as shown on Figure 7-2, Figure 7-3, Figure 7-4, respectively. Criteria for selecting wells as part of the RMS network include:

- RMS wells must have known depths and well completion data
- RMS wells should have a relatively long period of historical data
- Hydrographs of RMS wells should be visually representative of the hydrographs from surrounding wells. Appendix 5A includes the hydrograph comparisons used to establish that RMS wells are representative of surrounding wells
- RMS locations must cover the basin and provide data near basin boundaries
- RMS should be selected for each aquifer. There are 3 aquifers in the 180/400-Foot Aquifer Subbasin

- Data from RMS wells are public data and will be used for groundwater elevation maps and analysis. SVBGSA notified well owners of intent to include well in monitoring network.

The RMS wells in the groundwater level monitoring network are listed in Table 7-1. . The need for any additional wells is discussed in Section 7.2.2. Appendix 5A presents well construction information and historical hydrographs for each RMS well.

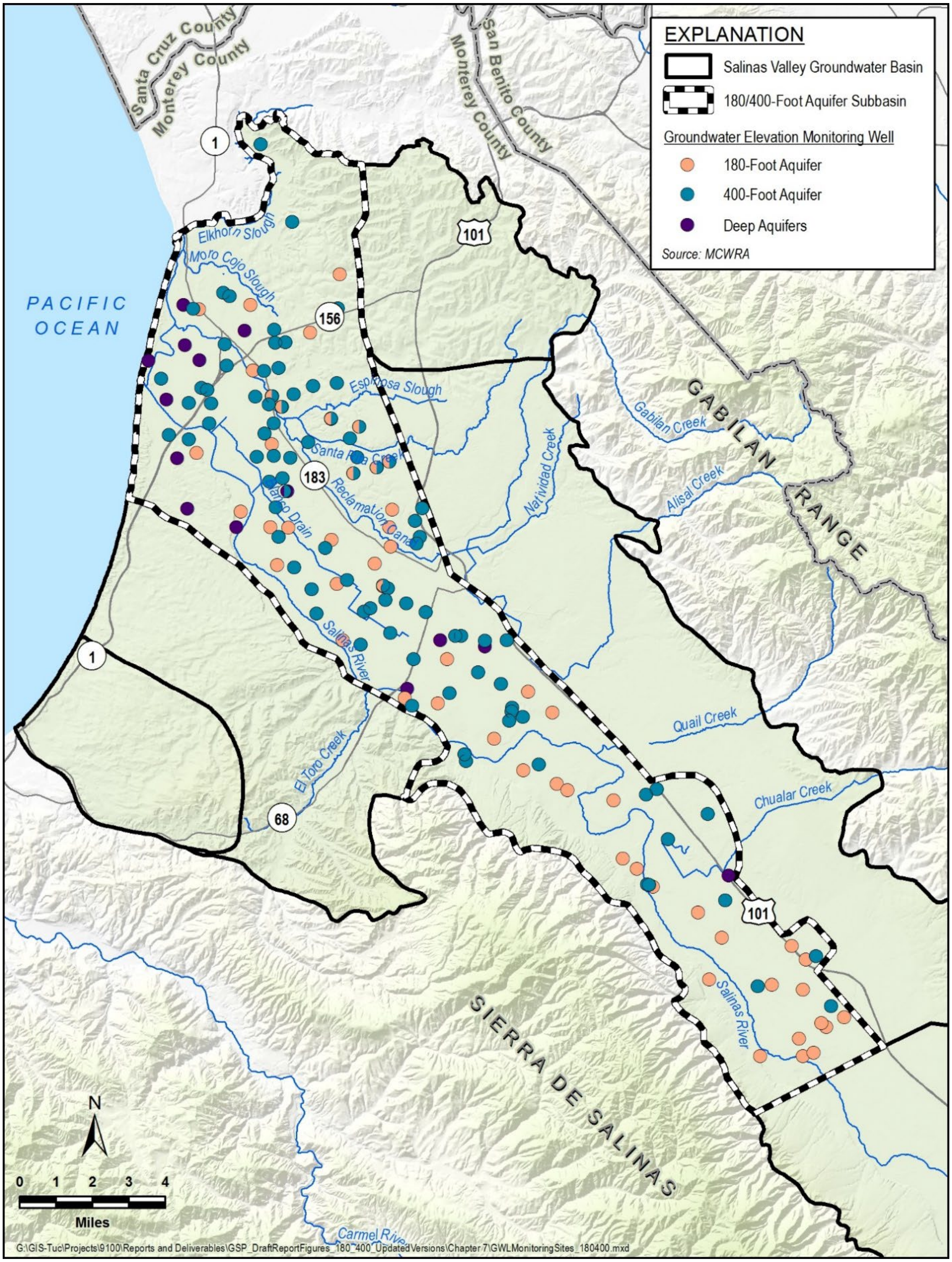


Figure 7-1. 180/400-Foot Aquifer Subbasin Monitoring Network for Groundwater Levels

Figure 7-2. 180-Foot Aquifer Representative Monitoring Network for Groundwater Levels

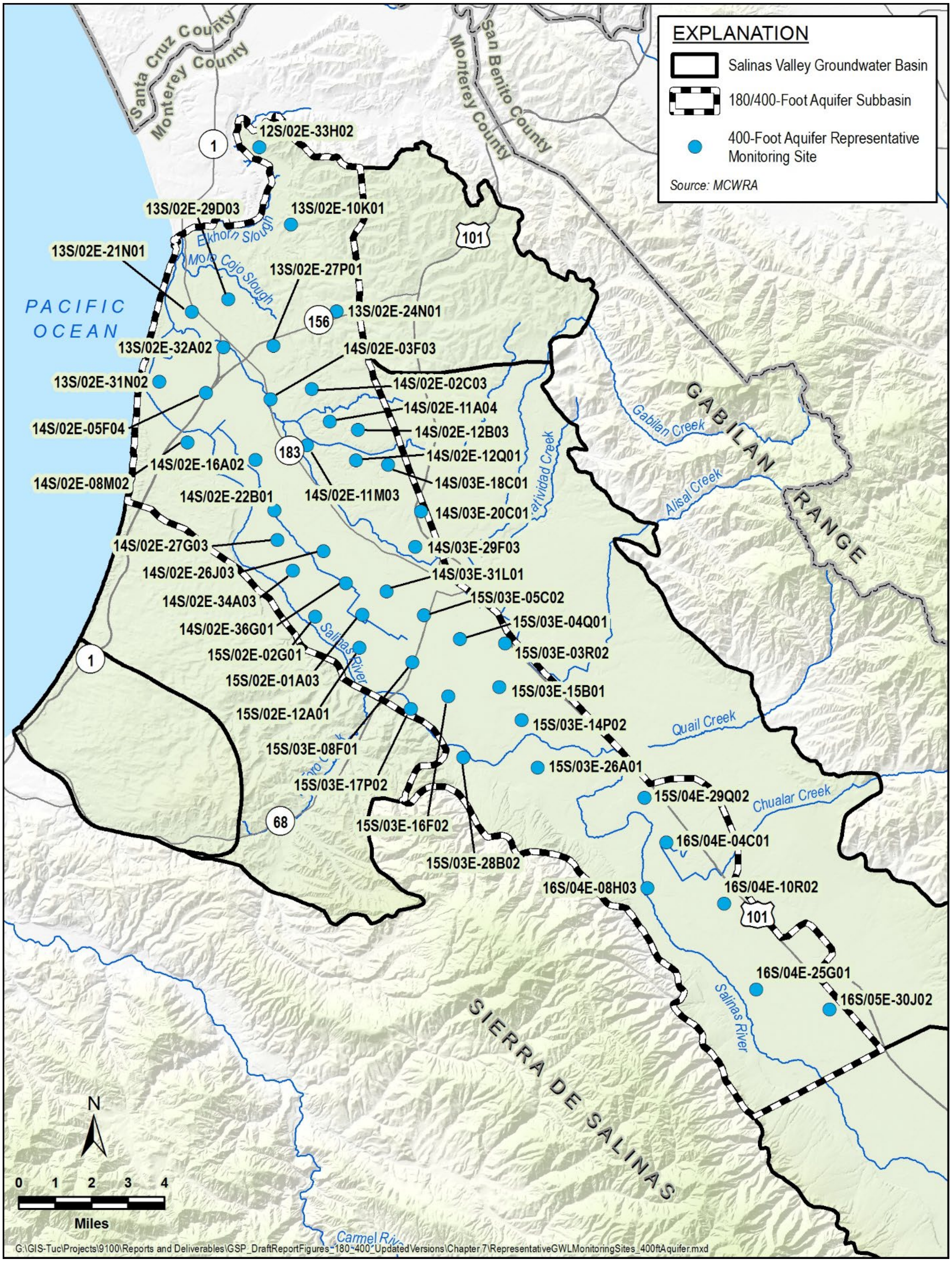


Figure 7-3. 400-Foot Aquifer Representative Monitoring Network for Groundater Levels

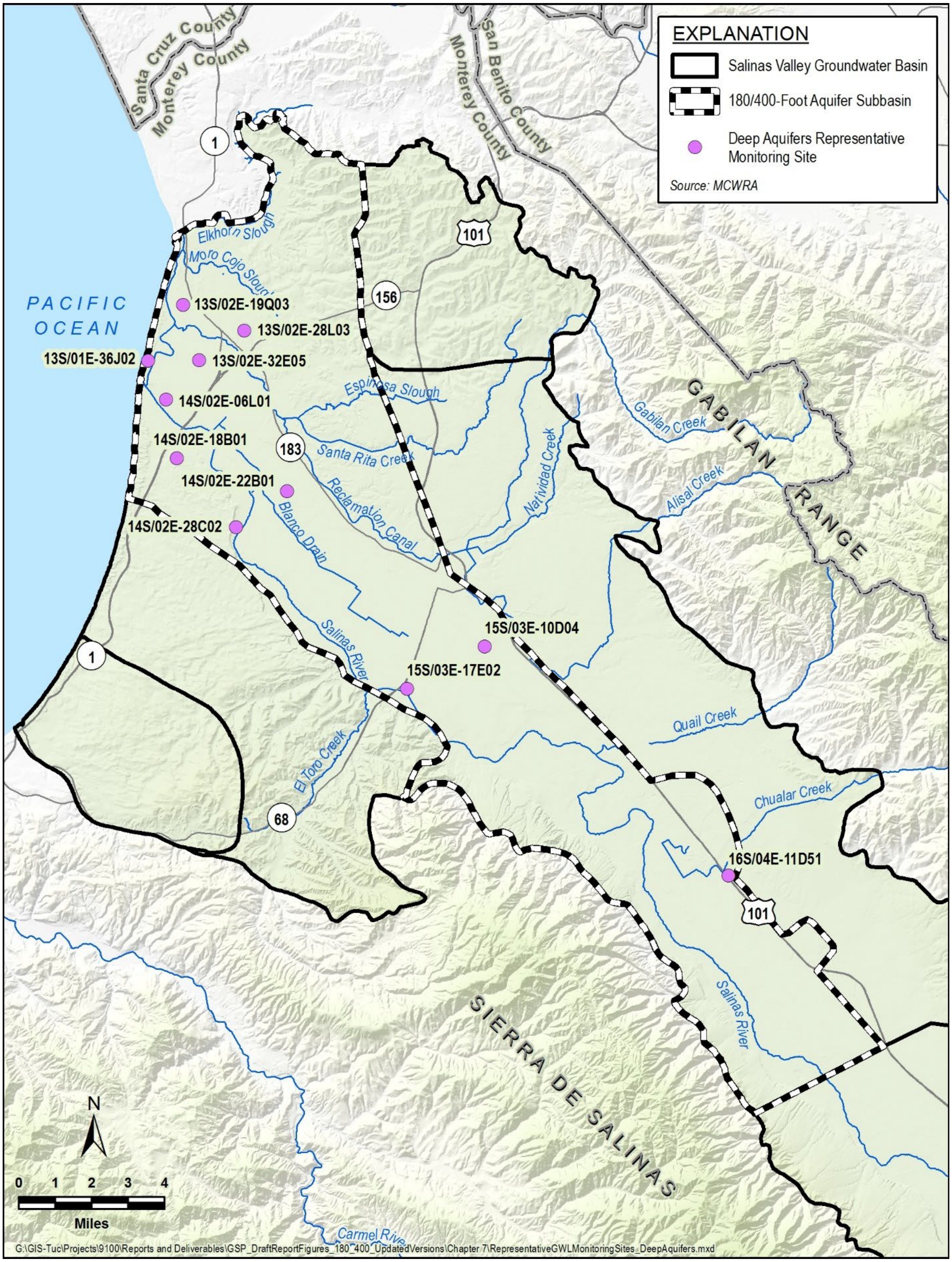


Figure 7-4. Deep Aquifers Representative Monitoring Network for Groundwater Levels

Table 7-1. 180/400-Foot Aquifer Subbasin Groundwater Level Representative Monitoring Site Network

State Well Number	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Reference Point (ft, NAVD88)	Latitude (NAD 83)	Longitude (NAD 83)	Period of Record (years)
180-Foot Aquifer								
13S/02E-13N01	N/A	12672	Irrigation	200	78.0	36.7947	-121.7076	58
13S/02E-21Q01	367816N1217514W001	SELA22633	Observation	157	9.7	36.7816	-121.7514	16
13S/02E-26L01	N/A	11028	Unknown	250	109.1	36.7712	-121.7215	58
13S/02E-29D04	N/A	13020	Domestic	2190	11.0	36.7793	-121.7768	14
14S/02E-03F04	367454N1217393W001	ESPA22636	Observation	205	21.5	36.7454	-121.7393	16
14S/02E-10P01	N/A	2657	Irrigation	186	19.2	36.7263	-121.7390	37
14S/02E-11A02	N/A	14478	Observation	250	59.0	36.7371	-121.7098	26
14S/02E-12B02	367343N1216958W001	RODA14455	Observation	265	52.8	36.7343	-121.6958	26
14S/02E-13F03	N/A	14469	Observation	280	44.8	36.7156	-121.6980	26
14S/02E-17C02	N/A	21667	Domestic	140	55.5	36.7219	-121.7760	5
14S/02E-21L01	N/A	862	Irrigation	250	28.1	36.6991	-121.7533	58
14S/02E-26H01	366889N1217079W001	AMST22651	Observation	339	35.0	36.6889	-121.7079	16
14S/02E-27A01	366933N1217294W001	MCFD22632	Observation	293	22.0	36.6933	-121.7294	16
14S/02E-34B03	N/A	1212	Irrigation	346	30.7	36.6782	-121.7345	47
14S/02E-36E01	N/A	331	Irrigation	198	32.5	36.6714	-121.7046	74
14S/03E-18C01	367207N1216806W001	BORA15009	Observation	225	52.1	36.7207	-121.6806	26
14S/03E-30G08	366869N1216785W001	MKTC22650	Observation	293	41.6	36.6869	-121.6785	16
14S/03E-31F01	N/A	10280	Domestic	201	37.8	36.6709	-121.6818	88
15S/02E-12C01	N/A	1070	Irrigation	182	38.2	36.6490	-121.7010	74
15S/03E-09E03	N/A	183	Irrigation	249	54.0	36.6426	-121.6492	66
15S/03E-13N01	N/A	147	Irrigation	275	67.0	36.6226	-121.5964	65
15S/03E-16M01	366250N1216532W001	1359	Irrigation	N/A	59.5	36.6250	-121.6531	89
15S/03E-17M01	366265N1216692W001	1480	Irrigation	271	49.2	36.6268	-121.6695	23
15S/03E-25L01	N/A	656	Irrigation	392	71.6	36.5942	-121.5934	25
15S/03E-26F01	N/A	648	Irrigation	316	62.0	36.5993	-121.6100	63
15S/04E-31A02	N/A	1020	Irrigation	335	77.0	36.5882	-121.5651	57

State Well Number	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Reference Point (ft, NAVD88)	Latitude (NAD 83)	Longitude (NAD 83)	Period of Record (years)
16S/04E-05M02	N/A	38	Irrigation	261	83.0	36.5652	-121.5597	75
16S/04E-13R02	N/A	447	Irrigation	286	126.3	36.5320	-121.4752	64
16S/04E-15D01	365444N1215220W001	BRME10389	Irrigation	384	99.0	36.5444	-121.5220	67
16S/04E-15R02	N/A	576	Irrigation	300	100.0	36.5346	-121.5100	69
16S/04E-27B02	N/A	204	Irrigation	300	109.0	36.5180	-121.5155	63
16S/05E-30E01	N/A	394	Irrigation	263	118.0	36.5148	-121.4692	103
16S/05E-31M01	N/A	1788	Irrigation	172	121.0	36.4951	-121.4705	88
17S/04E-01D01	N/A	254	Irrigation	310	135.3	36.4878	-121.4894	67
17S/05E-06C02	364883N1214684W001	GZWA21202	Observation	115	116.7	36.4883	-121.4684	24
400-Foot Aquifer								
12S/02E-33H02	N/A	25861	Irrigation	580	55.5	36.8456	-121.7485	3
13S/02E-10K01	N/A	22934	Observation	660	100.0	36.8152	-121.7319	11
13S/02E-21N01	367847N1217618W001	2432	Irrigation	550	17.3	36.7848	-121.7618	67
13S/02E-24N01	N/A	1824	Domestic	600	162.0	36.7812	-121.7080	14
13S/02E-27P01	N/A	1720	Irrigation	606	50.5	36.7667	-121.7387	41
13S/02E-29D03	N/A	2683	Irrigation	632	8.9	36.7793	-121.7797	49
13S/02E-31N02	N/A	1682	Irrigation	576	10.9	36.7512	-121.7946	68
13S/02E-32A02	367653N1217636W001	10161	Irrigation	600	10.6	36.7655	-121.7636	61
14S/02E-02C03	N/A	1716	Irrigation	835	60.4	36.7500	-121.7193	26
14S/02E-03F03	367455N1217395W001	ESPB22635	Observation	455	25.5	36.7455	-121.7395	16
14S/02E-05F04	N/A	1169	Irrigation	582	13.6	36.7472	-121.7715	63
14S/02E-08M02	367275N1217803W001	239	Irrigation	500	14.6	36.7273	-121.7799	88
14S/02E-11A04	N/A	14480	Observation	490	58.9	36.7372	-121.7099	26
14S/02E-11M03	N/A	1705	Irrigation	660	41.5	36.7275	-121.7207	26
14S/02E-12B03	367343N1216959W001	RODB14456	Observation	390	53.2	36.7343	-121.6959	26
14S/02E-12Q01	367221N1216965W001	1707	Domestic/Irrigation	619	64.0	36.7221	-121.6964	88
14S/02E-16A02	N/A	353	Irrigation	669	21.2	36.7211	-121.7461	34
14S/02E-22L01	N/A	1965	Irrigation	700	21.9	36.7013	-121.7359	26
14S/02E-26J03	N/A	113	Irrigation	561	30.5	36.6855	-121.7111	40

State Well Number	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Reference Point (ft, NAVD88)	Latitude (NAD 83)	Longitude (NAD 83)	Period of Record (years)
14S/02E-27G03	N/A	1861	Irrigation	495	26.0	36.6895	-121.7342	34
14S/02E-34A03	N/A	1060	Irrigation	670	32.5	36.6775	-121.7260	25
14S/02E-36G01	N/A	370	Irrigation	416	35.0	36.6731	-121.6998	58
14S/03E-18C02	367207N1216805W001	BORB15010	Observation	395	52.2	36.7207	-121.6805	26
14S/03E-20C01	N/A	1814	Municipal	701	62.0	36.7026	-121.6635	29
14S/03E-29F03	N/A	1147	Municipal	650	52.0	36.6884	-121.6659	28
14S/03E-31L01	N/A	374	Municipal	640	44.0	36.6702	-121.6794	29
15S/02E-01A03	N/A	1357	Irrigation	480	36.0	36.6608	-121.6910	59
15S/02E-02G01	N/A	888	Irrigation	404	30.0	36.6594	-121.7144	64
15S/02E-12A01	N/A	197	Irrigation	549	43.0	36.6474	-121.6920	59
15S/03E-03R02	N/A	1808	Municipal	635	62.0	36.6508	-121.6201	29
15S/03E-04Q01	N/A	375	Municipal	540	62.0	36.6520	-121.6426	29
15S/03E-05C02	N/A	536	Municipal	614	45.0	36.6612	-121.6605	29
15S/03E-08F01	N/A	1821	Domestic/Irrigation	449	49.0	36.6422	-121.6657	74
15S/03E-14P02	N/A	388	Irrigation	606	62.6	36.6205	-121.6109	27
15S/03E-15B01	N/A	1007	Irrigation	452	63.0	36.6334	-121.6224	54
15S/03E-16F02	366292N1216474W001	1862	Irrigation	592	59.5	36.6291	-121.6474	16
15S/03E-17P02	N/A	1838	Domestic	760	52.0	36.6238	-121.6658	29
15S/03E-26A01	N/A	924	Irrigation	570	56.6	36.6017	-121.6025	28
15S/03E-28B02	N/A	1841	Domestic	490	70.0	36.6050	-121.6393	29
15S/04E-29Q02	N/A	1877	Irrigation	555	82.0	36.5910	-121.5492	26
16S/04E-04C01	N/A	441	Irrigation	466	87.0	36.5733	-121.5378	75
16S/04E-08H03	365550N1215465W001	CHEB21205	Observation	295	88.5	36.5550	-121.5465	24
16S/04E-10R02	N/A	546	Irrigation	484	109.4	36.5496	-121.5086	63
16S/04E-25G01	N/A	1882	Irrigation	560	108.3	36.5157	-121.4916	62
16S/05E-30J02	N/A	1790	Irrigation	443	127.0	36.5086	-121.4552	62
Deep Aquifer								
13S/01E-36J02	N/A	22681	Domestic	1364	23	36.7582	-121.8010	11
13S/02E-19Q03	367808N1217847W001	75	Irrigation	1562	18	36.7808	-121.7846	36

State Well Number	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Reference Point (ft, NAVD88)	Latitude (NAD 83)	Longitude (NAD 83)	Period of Record (years)
13S/02E-28L03	N/A	22928	Irrigation	1460	12.2	36.7713	-121.7540	2
13S/02E-32E05	N/A	10164	Observation	1650	18.8	36.7589	-121.7757	35
14S/02E-06L01	N/A	1672	Irrigation	1560	8	36.7429	-121.7917	36
14S/02E-18B01	N/A	26393	Irrigation	1700	86.6	36.7196	-121.7854	1
14S/02E-22A03	N/A	24033	Irrigation	1640	29	36.7077	-121.7304	3
14S/02E-28C02	N/A	23135	Irrigation	1160	45	36.6929	-121.7552	11
15S/03E-10D04	N/A	25553	Public	980	63.3	36.6481	-121.6307	1
15S/03E-17E02	N/A	26373	Domestic	700	48	36.6305	-121.6684	1
16S/04E-11D51	N/A	2776	Irrigation	1000	115	36.5594	-121.5074	3

7.2.1 Groundwater Level Monitoring Protocols

Chapter 4 of the MCWRA CASGEM monitoring plan includes a description of existing groundwater elevation monitoring procedures (MCWRA, 2015). The CASGEM groundwater elevation monitoring protocols established by MCWRA are adopted by this GSP and are included in Appendix 7A. Groundwater elevation measurements will be collected at least 2 times per year to represent seasonal low and seasonal high groundwater conditions. The monitoring protocols described in Appendix 7A cover multiple monitoring methods for collecting data by hand and by automated pressure transducers. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.2.2 Groundwater Level Monitoring Network Data Gaps

Based on GSP Regulations and BMPs published by DWR on monitoring networks (DWR, 2016b), a visual analysis of the existing monitoring network was performed using professional judgment to evaluate whether there are data gaps in the groundwater level monitoring network.

While there is no definitive requirement on monitoring well density, the BMP cites several studies (Heath, 1976; Sophocleous, 1983; Hopkins and Anderson, 2016) that recommend 0.2 to 10 wells per 100 square miles. The BMP notes that professional judgment should be used to design the monitoring network to account for high-pumping areas, proposed projects, and other subbasin-specific factors.

The 180/400-Foot Aquifer Subbasin encompasses 132 square miles. If the BMP guidance recommendations are applied to the Subbasin, the well network should include between 1 and 13 wells in each of the 180-Foot, 400-Foot, and Deep Aquifers. The current network includes 35 wells in the 180-Foot Aquifer, 45 wells in the 400-Foot Aquifer, 11 wells in the Deep Aquifers. The number of groundwater level monitoring wells in each principal aquifer in the Subbasin either exceeds or is within the range of the BMP guidance. Visual inspection of Figure 7-2 and Figure 7-3 shows that wells in the RMS network are adequately distributed across the Subbasin, and there is no significant spatial data gap in the network for the 180-Foot and 400-Foot Aquifers.

However, visual inspection of the geographic distribution of the well network in the Deep Aquifers indicates that additional wells are necessary to adequately characterize the Subbasin. A higher density of monitoring wells is considered in areas of groundwater withdrawal to assess potential variation in groundwater elevations. Figure 7-5 shows the locations of existing groundwater elevation monitoring wells and the generalized locations where monitoring wells are needed in the Deep Aquifers. Although, the 180-Foot and 400-Foot Aquifers do not have any significant spatial data gaps, the data gaps in the northern part of the Subbasin and along the border with the Eastside Subbasin are locations of potential nested wells to help fill vertical data gaps on the connectivity between aquifers.

The generalized locations for new monitoring wells were based on addressing the criteria listed in the monitoring BMP including:

- Providing adequate data to produce seasonal potentiometric maps
- Providing adequate data to map groundwater depressions and recharge areas
- Providing adequate data to estimate change in groundwater storage
- Demonstrating conditions at Subbasin boundaries

Additionally, groundwater elevation measurements for most of the monitoring wells in the Subbasin occur only once a year. SVBGSA will work with MCWRA to ensure that wells within the groundwater level monitoring network are visited at least twice a year as outlined in Section 7.2.1. Furthermore, some of the wells in the monitoring network have unknown well construction information and that is a data gap that will be addressed during GSP implementation.

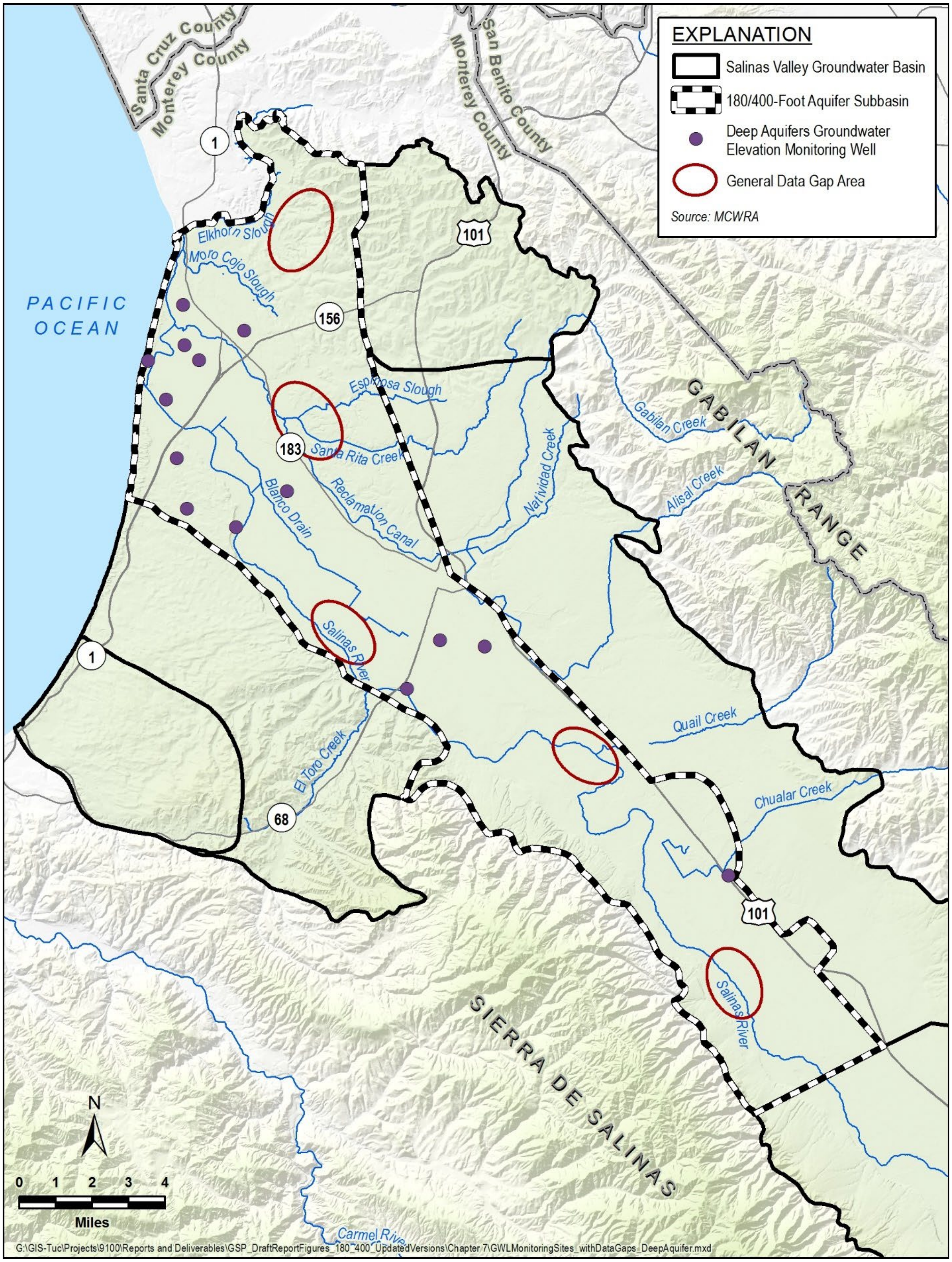


Figure 7-5. Data Gaps in the Groundwater Level Monitoring Network for the Deep Aquifers

7.3 Groundwater Storage Monitoring Network

As discussed in Chapter 8, the sustainability indicator for reduction of groundwater storage is measured using groundwater elevations and the advancement of the seawater intrusion front to calculate change in storage. Thus, the groundwater storage monitoring network is the same as the groundwater levels monitoring network and seawater intrusion monitoring network. Separate calculations of change in storage will be done for the area where seawater has intruded and the area where seawater has not intruded.

7.4 Seawater Intrusion Monitoring Network

The sustainability indicator for seawater intrusion is evaluated using the location of a chloride isocontour, based on chloride concentration measured at a network of monitoring wells. MCWRA currently develops annual maps of the 500 mg/L chloride isocontour (Figure 5-25 and Figure 5-26). The seawater intrusion monitoring network includes only wells where the data can be made publicly available. Should seawater intrusion advance beyond the current monitoring network, MCWRA will expand the existing seawater intrusion monitoring network.

Table 7-2 lists the wells currently used by MCWRA to monitor seawater intrusion in the 180/400-Foot Aquifer Subbasin. These wells are shown on Figure 7-6. Although there is seawater intrusion monitoring in the Deep Aquifers, there is currently no seawater intrusion mapping in the Deep Aquifers. This is a data gap that is addressed below. This table and figure also include wells that are not drilled in one of the 3 principal aquifers but are located in the Subbasin.

Table 7-2. 180/400-Foot Aquifer Seawater Intrusion Well Network

State Well Number	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
180-Foot Aquifer			
13S/02E-15R03	205	36.79763	-121.72885
13S/02E-21Q01	157	36.78164	-121.75139
14S/02E-03F04	205	36.74539	-121.73931
14S/02E-11A02	250	36.73713	-121.70981
14S/02E-12B02	265	36.73431	-121.69585
14S/02E-13F03	280	36.71562	-121.69801
14S/02E-15L02	200	36.71176	-121.74017
14S/02E-20B01	350	36.70568	-121.76872
14S/02E-21L01	250	36.69907	-121.75333
14S/02E-22P02	304	36.69326	-121.73829
14S/02E-24Q01	N/A	36.69382	-121.69398
14S/02E-26H01	339	36.68887	-121.70793
14S/02E-26N03	162	36.68155	-121.72537

State Well Number	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
14S/02E-26N50	336	36.67955	-121.72581
14S/02E-26P01	N/A	36.67908	-121.71880
14S/02E-27A01	293	36.69330	-121.72944
14S/02E-27F02	354	36.68704	-121.73509
14S/02E-34B03	346	36.67822	-121.73449
14S/02E-36E01	198	36.67135	-121.70460
14S/03E-07P02	296	36.72467	-121.68178
14S/03E-18C01	225	36.72072	-121.68056
14S/03E-18E03	260	36.71834	-121.68658
14S/03E-18P51	N/A	36.70528	-121.68057
14S/03E-30F01	1023	36.68833	-121.68128
14S/03E-30G08	293	36.68688	-121.67852
14S/03E-31B01	175	36.67564	-121.67844
15S/02E-02A01	242	36.66245	-121.71090
15S/02E-12C01	182	36.64898	-121.70095
16S/04E-08H01	130	36.55516	-121.54740
16S/04E-08H04	140	36.55502	-121.54656
16S/05E-31P02	115	36.48916	-121.46766
17S/05E-06C02	115	36.48832	-121.46840
400-Foot Aquifer			
13S/02E-15M01	1014	36.79880	-121.74569
13S/02E-15R02	585	36.79763	-121.72880
13S/02E-20J01	600	36.78619	-121.76501
13S/02E-28M02	767	36.77262	-121.75991
13S/02E-34G01	765	36.75682	-121.73652
13S/02E-34G02	N/A	N/A	N/A
13S/02E-34J50	N/A	36.75660	-121.72901
13S/02E-34M01	645	36.75547	-121.74375
13S/02E-35H01	440	36.75967	-121.70933
13S/02E-36F50	660	36.75920	-121.70179
14S/02E-01C01	591	36.75057	-121.69755
14S/02E-02A02	810	36.75136	-121.70754
14S/02E-02C03	835	36.74997	-121.71928
14S/02E-03F03	455	36.74548	-121.73949
14S/02E-03H01	800	36.74656	-121.72881
14S/02E-03M02	587	36.74212	-121.74085
14S/02E-03P01	614	36.74125	-121.73971
14S/02E-03R02	638	36.74009	-121.72778
14S/02E-04H01	512	36.74511	-121.74777
14S/02E-05C03	580	36.74792	-121.77457
14S/02E-05R03	653	36.73862	-121.76228
14S/02E-08C03	556	36.73402	-121.77011

State Well Number	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
14S/02E-09D04	785	36.73640	-121.76008
14S/02E-09N02	622	36.72483	-121.76008
14S/02E-10H01	640	36.73142	-121.73097
14S/02E-10M02	585	36.72736	-121.74325
14S/02E-10N51	580	36.72645	-121.74361
14S/02E-11A04	490	36.73717	-121.70989
14S/02E-11B01	822	36.73609	-121.71422
14S/02E-11M03	660	36.72754	-121.72074
14S/02E-12B03	390	36.73428	-121.69586
14S/02E-13E50	596	36.71645	-121.69917
14S/02E-13F02	480	36.71560	-121.69802
14S/02E-14R50	690	36.71195	-121.70974
14S/02E-15A01	623	36.72115	-121.72964
14S/02E-15N01	552	36.71076	-121.74379
14S/02E-15P01	595	36.71150	-121.73957
14S/02E-22L01	680	36.70133	-121.73594
14S/02E-22R01	672	36.69352	-121.72600
14S/02E-24E01	467	36.70348	-121.70666
14S/02E-24P02	454	36.69388	-121.70174
14S/02E-25D51	700	36.69234	-121.70484
14S/02E-26C50	594	36.69292	-121.72025
14S/02E-26J03	561	36.68549	-121.71108
14S/02E-34A03	670	36.67750	-121.72599
14S/02E-34A04	352	36.67886	-121.72921
14S/02E-36F03	602	36.67450	-121.70291
14S/02E-36G01	416	36.67315	-121.69976
14S/03E-07D50	600	36.73549	-121.68474
14S/03E-07K51	600	36.72946	-121.67609
14S/03E-07P50	1140	36.72324	-121.67989
14S/03E-18C02	395	36.72074	-121.68053
14S/03E-18E04	495	36.71833	-121.68655
14S/03E-30E03	430	36.68630	-121.68643
14S/03E-31F02	518	36.67133	-121.68199
15S/02E-01Q50	524	36.65195	-121.69825
15S/02E-03B05	N/A	36.66367	-121.73295
15S/03E-07K01	570	36.64222	-121.68044
15S/03E-08L01	656	36.63956	-121.66396
16S/04E-08H02	295	36.55514	-121.54741
16S/04E-08H03	295	36.55503	-121.54655
16S/04E-11D51	1000	36.55944	-121.50737
16S/05E-31P01	300	36.48916	-121.46768
17S/05E-06C01	N/A	36.48832	-121.46840

State Well Number	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
Deep Aquifers			
13S/01E-25R01	1393	36.76814	-121.79767
13S/01E-36J02	1364	36.75821	-121.80101
13S/02E-19Q03	1562	36.78080	-121.78457
13S/02E-28L03	1460	36.77132	-121.75396
13S/02E-31A02	1600	36.76468	-121.78329
14S/02E-07J03	1573	36.72741	-121.78209
14S/02E-14R02	1690	36.71190	-121.70989
14S/02E-18B01	1700	36.71959	-121.78541
14S/02E-19G01	1910	36.70157	-121.78617
14S/02E-20E01	2020	36.69959	-121.77964
14S/02E-21K04	1800	36.69771	-121.74999
14S/02E-21L02	1780	36.69665	-121.75524
14S/02E-22A03	1640	36.70771	-121.73043
14S/02E-22J02	1620	36.69352	-121.72966
14S/02E-23G02	1560	36.70217	-121.71199
14S/02E-23J02	N/A	36.69978	-121.70821
14S/02E-23P02	1620	36.69346	-121.71863
14S/02E-25A03	N/A	36.69004	-121.69111
14S/02E-26A10	N/A	36.69231	-121.70810
14S/02E-26D01	1645	36.69360	-121.72371
14S/02E-26G01	N/A	36.68950	-121.71647
14S/02E-26J04	N/A	36.68585	-121.70770
14S/02E-27J02	N/A	36.68761	-121.72609
14S/02E-27K02	1700	36.68466	-121.73528
14S/02E-28C02	1160	36.69290	-121.75521
14S/02E-28H04	1180	36.68865	-121.74453
14S/02E-29C01	1780	36.69275	-121.77143
14S/02E-34M01	1645	36.66970	-121.74113
14S/02E-35B01	1690	36.67893	-121.71497
14S/03E-19C01	1723	36.70575	-121.68395
15S/03E-03N58	682	36.65329	-121.63142
15S/03E-05R52	840	36.65007	-121.65285
15S/03E-10D04	980	36.64805	-121.63066
16S/04E-03K01	1060	36.56520	-121.51296
Not in a principal aquifer			
13S/02E-28L02	529	36.77122	-121.75436
14S/01E-13J01	N/A	36.71182	-121.80015
14S/02E-11A03	100	36.73712	-121.70972
14S/02E-13G01	676	36.71771	-121.69442
14S/02E-17C02	140	36.72192	-121.77596
14S/02E-27C02	488	36.68954	-121.73565

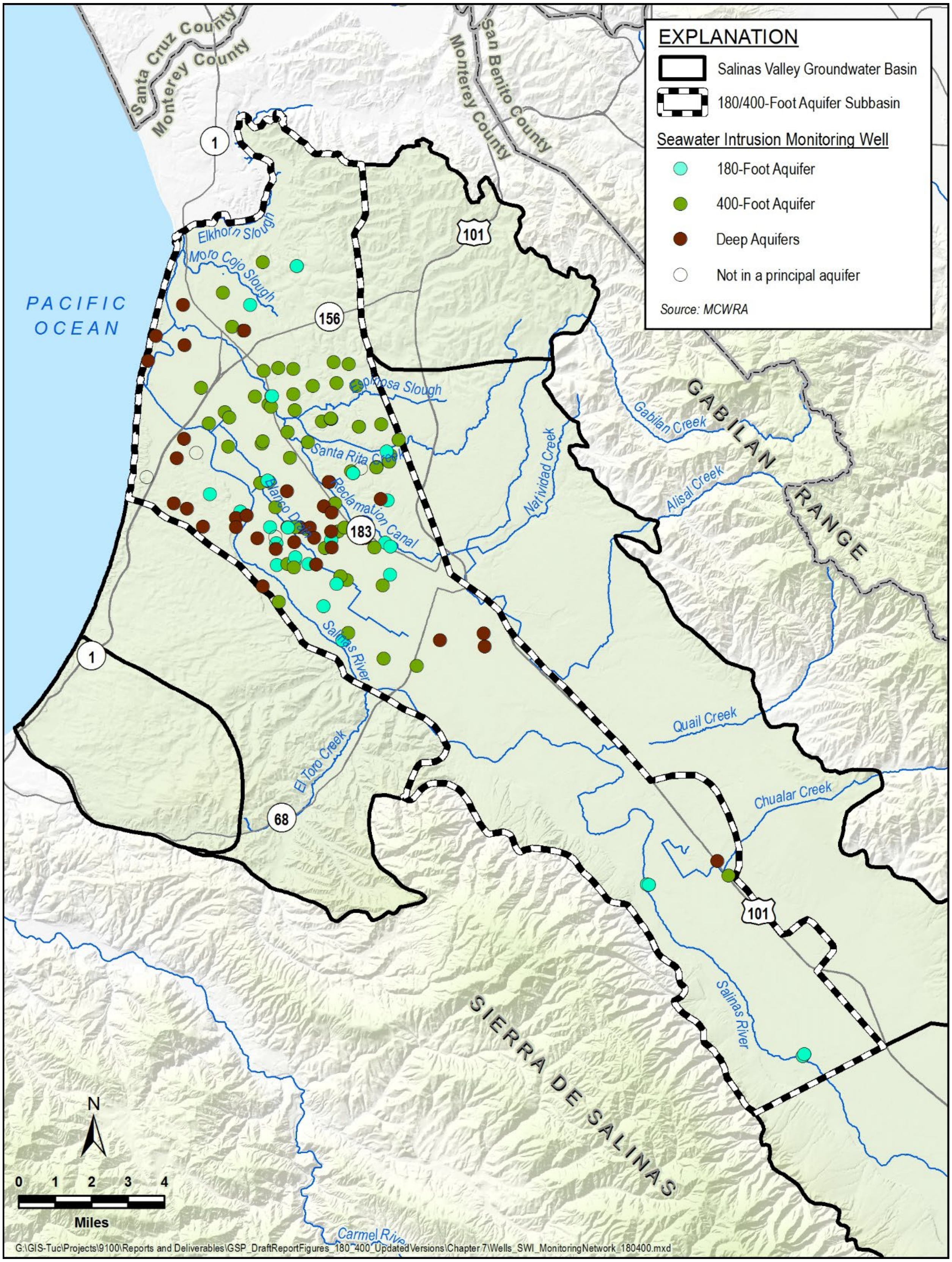


Figure 7-6. 180/400-Foot Aquifer Subbasin Seawater Intrusion Monitoring Network

7.4.1 Seawater Intrusion Monitoring Protocols

The protocols established by MCWRA for collecting groundwater quality data from monitoring wells and analyzing those data for seawater intrusion are adopted by this GSP. The groundwater quality data and seawater intrusion monitoring protocols are available in the Monterey County Quality Assurance Project Plan (QAPP) and included in Appendix 7B. MCWRA also established chloride data contouring protocols to establish the isocontour map, provided in Appendix 7C. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.4.2 Seawater Intrusion Monitoring Data Gaps

The network of wells with publicly available data for monitoring chloride concentrations includes an adequate number and distribution of wells in the 180-Foot and the 400-Foot Aquifers (Figure 7-6). However, the distribution of wells in the Deep Aquifer is inadequate and considered a data gap. As described in Section 7.2, additional wells will be identified in the Deep Aquifer for groundwater level monitoring. The data gap for seawater intrusion monitoring in the Deep Aquifer will be addressed by using the same set of new monitoring wells identified in the groundwater level monitoring network.

7.5 Groundwater Quality Monitoring Network

The sustainability indicator for degraded water quality is evaluated by adopting the SWRCB DDW and CCRWQCB ILRP groundwater quality networks. The water quality monitoring network for the Subbasin is composed of public water system supply wells monitored under DDW, and on-farm domestic wells and irrigation supply wells monitored under ILRP.

As described in Chapter 8, separate minimum thresholds are set for the COC for public water system supply wells, on-farm domestic wells, and irrigation supply wells. Therefore, although there is a single groundwater quality monitoring network, different wells in the network are reviewed for different constituents. COC for drinking water are assessed at public water supply wells and on-farm domestic wells, and COC for crop health are assessed at agricultural supply wells. The COC for the 3 sets of wells are listed in Chapter 5.

The public water system supply wells included in the monitoring network were identified by reviewing data from the SWRCB DDW. The SWRCB collects data for municipal systems; community water systems; non-transient, non-community water systems; and non-community water systems that provide drinking water to at least 15 service connections or serve an average of at least 25 people for at least 60 days a year. The RMS network consists of 98 wells monitored by DDW, as shown on Figure 7-7 and listed in Appendix 7D. The SWRCB is undertaking the SAFER Program to collect their groundwater quality data from small state water systems and make it readily available. Once that data is readily available, SVBGSA may add small system wells to its groundwater quality monitoring network.

All on-farm domestic wells and irrigation supply wells that have been sampled through the CCRWQCB's IRLP are included in the RMS network. Under the existing, Ag Order, the are 573 ILRP wells, consisting of 335 irrigation supply wells and 238 on-farm domestic wells that are all part of the RMS network. The locations of these wells are shown on Figure 7-8 and listed in Appendix 7D. The SVBGSA assumes that Ag Order 4.0 will have a similar representative geographic distribution of wells within the Subbasin. The agricultural groundwater quality monitoring network will be revisited and revised when the Ag Order 4.0 monitoring network is finalized.

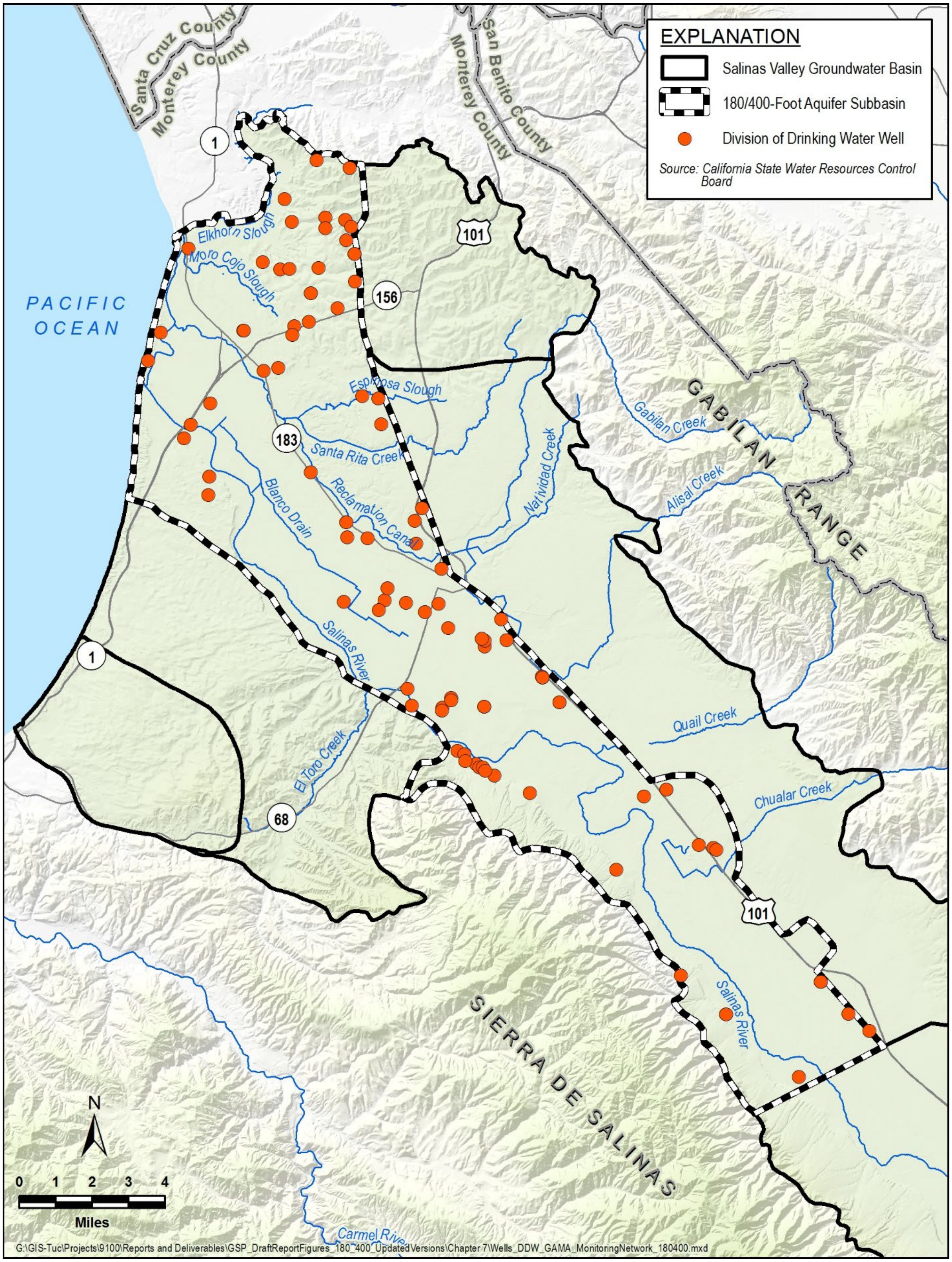


Figure 7-7. DDW Public Water System Supply Wells in the Groundwater Quality Monitoring Network

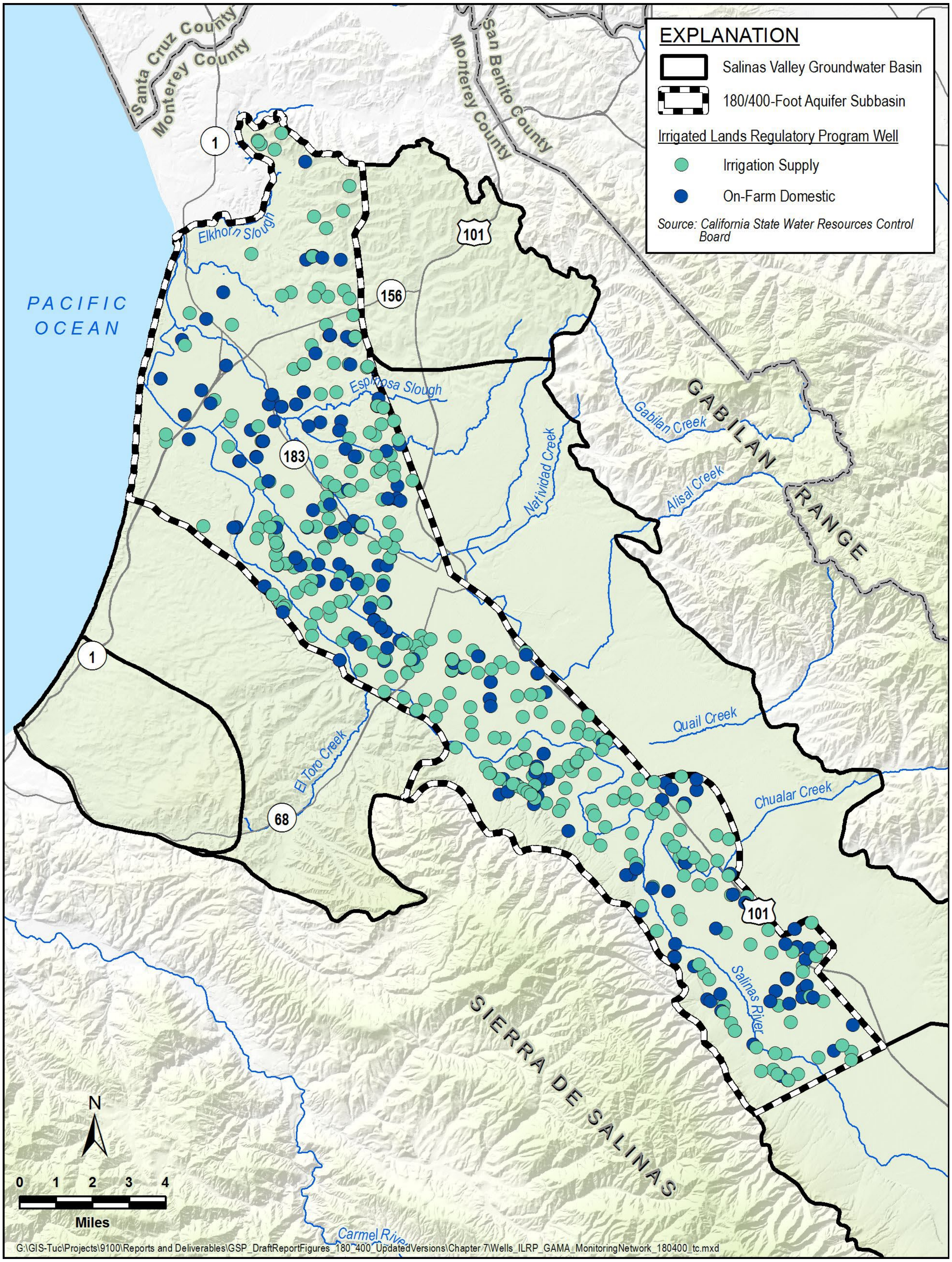


Figure 7-8. ILRP Wells Monitored under Ag Order 3.0 in the Groundwater Quality Monitoring Network

7.5.1 Groundwater Quality Monitoring Protocols

The SVBGSA does not independently sample wells for any COC. Instead, the GSA analyzes water quality data that are collected through the DDW and ILRP. Therefore, the GSA is dependent on the monitoring density and frequency of DDW and ILRP.

Water quality data from public water systems are collected, analyzed, and reported in accordance with protocols that are reviewed and approved by the SWRCB DDW, in accordance with the state and federal Safe Drinking Water Acts. Monitoring protocols may vary by agency.

ILRP data are currently collected under CCRWQCB Ag Order 3.0. ILRP samples are collected under the Tier 1, Tier 2, or Tier 3 monitoring and reporting programs. Under Ag Order 4.0, ILRP data will be collected in 3 phases and each groundwater basin within the Central Coast Region has been assigned to one or more of these phases. The designated phase for each ILRP well is provided in SWRCB's GeoTracker database and is publicly accessible at: https://geotracker.waterboards.ca.gov/. Ag Order 4.0 will take effect in the Subbasin beginning in 2025. Copies of the Ag Orders 3.0 and 4.0 monitoring and reporting programs are included in Appendix 7E and are incorporated into this GSP. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.5.2 Groundwater Quality Monitoring Data Gaps

The DDW and ILRP monitoring network provide sufficient spatial and temporal data to determine groundwater quality trends for water quality indicators to address known water quality issues. Additionally, there is adequate spatial coverage in the water quality monitoring network to assess impacts to beneficial uses and users.

7.6 Land Subsidence Monitoring Network

As described in Section 5.5, DWR collects land subsidence data using InSAR satellite data and makes these data available to GSAs. This subsidence dataset represents the best available science for the 180/400-Foot Subbasin and is therefore used as the subsidence monitoring network.

7.6.1 Land Subsidence Monitoring Protocols

Land Subsidence monitoring protocols are the ones used by DWR for InSAR measurements and interpretation. DWR adapted their methods to measure subsidence on hard surfaces only and interpolate between them to minimize the change in land surface elevation captures in soft surfaces that are likely not true subsidence. The cell size of this interpolated surface is 302 feet by 302 feet. If the annual monitoring indicates subsidence is occurring at a rate greater than the minimum thresholds, then additional investigation and monitoring may be warranted. In particular, the GSAs will implement a study to assess if the observed subsidence can be correlated to groundwater elevations, and whether a reasonable causality can be established. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.6.2 Land Subsidence Data Gaps

There are no data gaps associated with the subsidence monitoring network.

7.7 Interconnected Surface Water Monitoring Network

The primary tool for assessing depletion of ISW due to pumping will be shallow monitoring wells adjacent to the Salinas River in the Subbasin. Table 7-3 lists and Figure 7-9 shows the existing wells from MCWRA's groundwater monitoring programs that will be added to the ISW monitoring network. Figure 7-9 also shows the proposed locations of 2 new monitoring wells. Existing wells are chosen based on the locations of ISW determined by the preliminary SVIHM, well depth, and proximity to the Salinas River. Furthermore, the wells are also located in vicinity of a USGS stream gauge or MCWRA River Series measurement site shown on Figure 7-9. This allows for monitoring of groundwater elevations near the rivers in the Subbasin and may provide insight on the relationship between streamflow and groundwater elevations. Additionally, the combined use of groundwater elevation and streamflow data will allow SVBGSA to assess temporal changes in conditions due to variations in stream discharge and regional groundwater extraction, as well as other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water as discussed in Chapter 8. All ISW monitoring wells are RMS. More information on the development of the ISW monitoring network is provided in Appendix 7F.

Table 7-3. Shallow Wells in the Interconnected Surface Water Monitoring Network

State Well Number	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
16S/04E-08H02	295	36.55514	-121.54741
16S/05E-31P02	115	36.48916	-121.46768

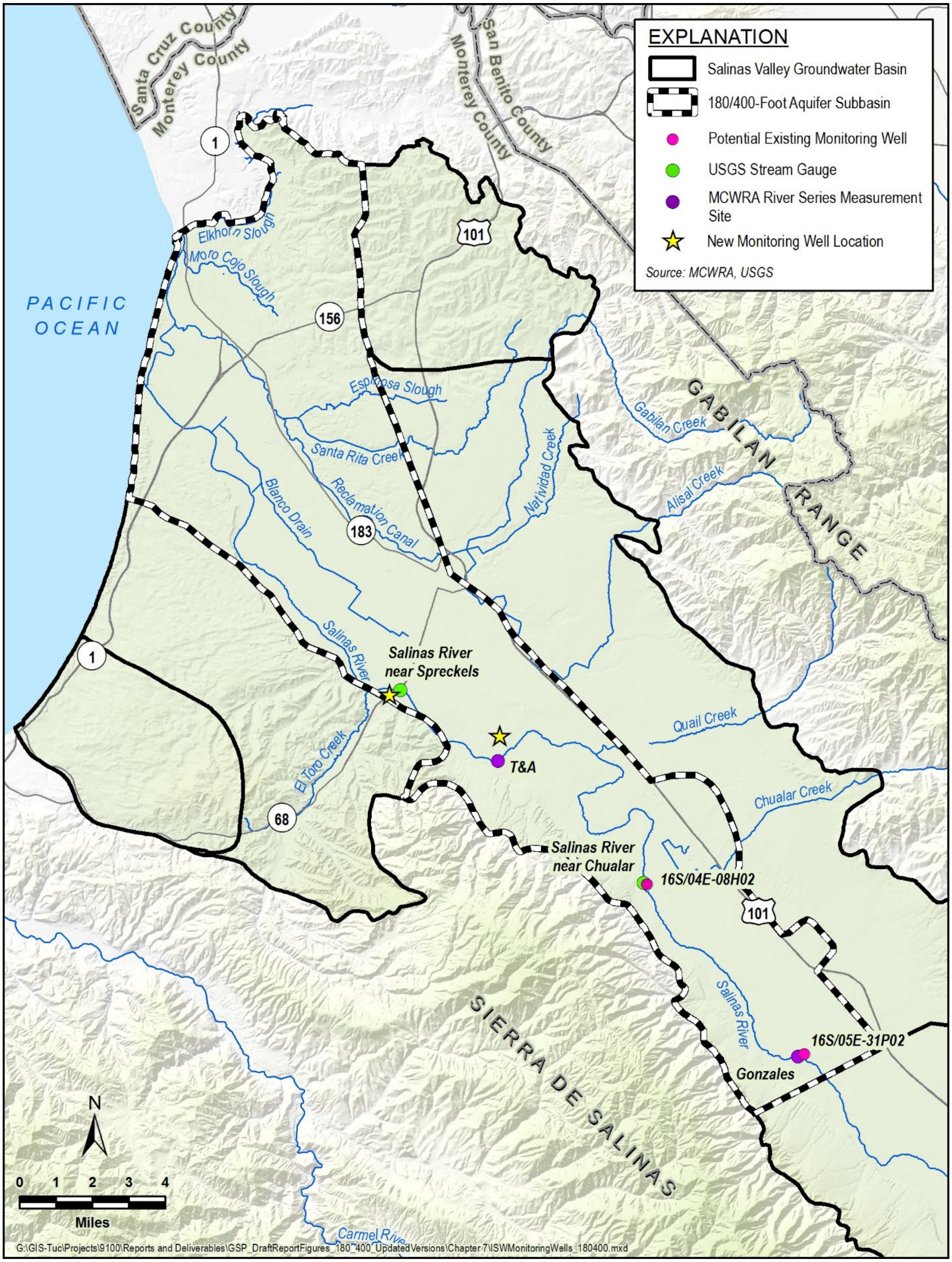


Figure 7-9. Interconnected Surface Water Monitoring Network

7.7.1 Interconnected Surface Water Monitoring Protocols

Monitoring protocols for shallow wells monitoring interconnected surface water will be identical to MCWRA's current groundwater elevation monitoring protocols, included in Appendix 7A. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4. Additionally, if possible, each well that is added to the monitoring network will be equipped with a data logger that will allow SVBGSA to assess if seasonal pumping is resulting in streamflow depletions.

7.7.2 Interconnected Surface Water Data Gaps

As shown in Figure 7-9, the data gaps in the ISW monitoring network will be filled with 2 new wells added along the Salinas River, as discussed in Chapter 10. The new shallow wells will be added to MCWRA's groundwater elevation monitoring program.

7.8 Other Monitoring Networks

7.8.1 Groundwater Extraction Monitoring Network

SGMA requires that annual reports include annual groundwater extraction for the Subbasin. MCWRA's Groundwater Extraction Monitoring System (GEMS) will be used to monitor urban and agricultural extraction in the Subbasin. Under Monterey County Ordinance No. 3717, public water systems and agricultural pumpers using wells with an internal discharge pipe greater than 3 inches within Zones 2, 2A, and 2B report extractions annually to GEMS. Extraction is self-reported by well owners or operators. Agricultural wells report their data based on MCWRA's reporting year that runs from November 1 through October 31. Urban and industrial wells report extraction on a calendar year basis. When extraction data is summarized annually, MCWRA combines industrial and urban extractions into a single urban water use. As depicted on Figure 3-3, these zones provide sufficient coverage of the 180/400-Foot Aquifer Subbasin.

SVBGSA will work with MCWRA to obtain the GEMS data through a coordinated reporting program such that wells owners can provide a single annual reporting to fulfill the requirements of both the GSP and the existing County Ordinance No. 3717.

7.8.1.1 Groundwater Extraction Monitoring Protocols

Groundwater extraction monitoring will be accomplished using the GEMS data provided by MCWRA. Existing GEMS protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.8.1.2 Groundwater Storage Monitoring Data Gaps

Accurate assessment of the amount of pumping requires an accurate count of the number of municipal, agricultural, and domestic wells in the GSP area. As proposed in Chapter 9, SVBGSA will undertake well registration during implementation to develop a database of existing and active groundwater wells. This database will draw from the existing MCWRA database, DWR's OSWCR database, and the Monterey County Health Department database of state small and local small water systems. As part of the assessment, the SVBGSA will verify well completion information and location, and whether the well is active, abandoned, or destroyed as is discussed further in Chapter 9.

A potential data gap is the accuracy and reliability of groundwater pumping reported through GEMS. SVBGSA will work with MCWRA to evaluate methods currently in place to assure data reliability. Based on the results of that evaluation, the protocols for monitoring may be revised and a protocol for well meter calibration may be developed. SVBGSA will work with MCWRA to consider the value of developing protocols for flowmeter calibration and other potential enhancements to the GEMS programs that are discussed in Chapter 9.

7.8.2 Salinas River Watershed Diversions

Salinas River watershed monthly diversion data are collected annually in the SWRCB's Electronic Water Rights Information Management System (eWRIMS). eWRIMS is used track information of water rights in the state and is publicly accessible at: https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/reportingDiversionDownloadPublicSetup.do. These data include diversions from tributaries of the Salinas River.

7.8.2.1 Salinas River Watershed Diversions Monitoring Protocols

Salinas River watershed diversion monitoring protocols are those that the SWRCB has established for the collection of water right information. These protocols are consistent with data and reporting standards described in GSP Regulations § 352.4.

7.8.2.2 Salinas River Watershed Diversions Monitoring Data Gaps

These data are lagged by a year because the reporting period does not begin until February of the following year.

7.9 Data Management System and Data Reporting

The SVBGSA has developed a DMS in adherence to GSP Regulations § 352.6 and § 354.40 that is used to store, review, and upload data collected as part of the GSP development and implementation.

The SVBGSA DMS consists of 2 SQL databases. The HydroSQL database stores information about each well and water level and extraction time-series data. Fields in the HydroSQL database include:

- Subbasin
- Cadastral coordinates
- Planar coordinates
- Well owner
- Well name
- Well status
- Well depth
- Screened interval top and bottom
- Well type
- Water level elevation
- Annual pumping volume

Well owner and annual well-specific pumping information will be stored in HydroSQL; however, neither will be publicly accessible due to confidentiality requirements. Streamflow gauge data from the USGS will be stored in the HydroSQL similarly to the well water level information.

Water quality data are stored in the EnviroData SQL database, which is linked to the HydroSQL for data management purposes. EnviroData SQL contains fields such as:

- Station
- Parameter
- Sample Date
- Detection (detect or non-detect)
- Value
- Unit

The data used to populate the SVBGSA DMS are listed in Table 7-4. Categories marked with an X indicate datasets that were used in populating the DMS, including data that are publicly accessible or that are available to SVBGSA from MCWRA. Some data, such as groundwater extraction are confidential, and cannot be made publicly accessible by SVBGSA unless aggregated. Additional datasets will be added in the future as appropriate, such as recharge or diversion data.

Table 7-4. Datasets Available for Use in Populating the DMS

Data Sets	Data Category					
	Well and Site Information	Well Construction	Water Level	Groundwater Extraction[1]	Streamflow	Water Quality
DWR (CASGEM)	X	X				
MCWRA	X	X	X	X		
GAMA Groundwater Information System	X					X
USGS Gauge Station					X	

[1] Pumping data not publicly accessible

Data are compiled and reviewed to comply with quality objectives. The review included the following checks:

- Removing or flagging questionable data being uploaded in the DMS. This includes identifying outliers that may have been introduced during the original data entry process and plotting each well hydrograph to identify and remove anomalous data points.
- Loading into the database and checking for errors and missing data.

In the future, well log information will be entered for selected wells and other information will be added as needed to satisfy the requirements of the SGMA regulations.

The DMS also includes a publicly accessible web-map hosted on the SVBGSA website; accessible at https://svbgsa.org/gsp-web-map-and-data/. This web-map gives interested parties access to non-confidential technical information used in the development of the GSP and annual reports, and includes public well data and analysis such as water level contour maps and seawater intrusion, as well as various local administrative boundaries. In addition, the web-map has functionalities to graph time series of water levels and search for specific wells in the database. This web-map will be regularly updated as new information is made available to the SVBGSA.

8 SUSTAINABLE MANAGEMENT CRITERIA

This chapter defines the conditions that constitute sustainable groundwater management; and establishes minimum thresholds, measurable objectives, and undesirable results for each sustainability indicator. The minimum thresholds, measurable objectives, and undesirable results detailed in this chapter define the Subbasin's future conditions and commit the GSA to actions that will meet these criteria. This chapter includes adequate data to explain how SMC were developed and how they influence all beneficial uses and users.

The chapter is structured to address all the GSP Regulations § 354.22 *et. seq* regarding SMC. To retain an organized approach, the SMC are grouped by sustainability indicator. The discussion of each sustainability indicator follows a consistent format that contains all the information required by the GSP Regulations, and as further clarified in the SMC BMP (23 California Code of Regulations § 352.22 *et seq.*; DWR, 2017).

8.1 Definitions

The SGMA legislation and GSP Regulations contain terms relevant to the SMC. The definitions included in the GSP Regulations are repeated below. Where appropriate, additional explanatory text is added in italics. This explanatory text is not part of the official definitions of these terms.

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

  The 6 sustainability indicators relevant to this subbasin include chronic lowering of groundwater levels; reduction of groundwater storage; degraded water quality; land subsidence; seawater intrusion; and depletion of ISW.

- Significant and unreasonable

  Significant and unreasonable is not defined in the Regulations. However, the definition of undesirable results states, "Undesirable results occur when significant and unreasonable effects … are caused by groundwater conditions…." This GSP adopts the phrase significant and unreasonable to be the qualitative description of undesirable conditions due to inadequate groundwater management. Minimum thresholds are the quantitative measurement of the significant and unreasonable conditions.

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

  Minimum thresholds are indicators of an unreasonable condition.

- **Measurable objective** refers to a 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.

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

- **Interim milestone** refers to a target value representing measurable groundwater conditions, in increments of 5 years, set by an Agency as part of a Plan.

  Interim milestones are targets such as groundwater elevations that will be achieved every 5 years to demonstrate progress towards sustainability.

- Undesirable result

  Undesirable result is not defined in the Regulations. However, the description of undesirable result states that it should be a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the subbasin. An example undesirable result is more than 10% of the measured groundwater elevations being lower than the minimum thresholds. Undesirable results should not be confused with significant and unreasonable conditions. Significant and unreasonable conditions are qualitative descriptions of conditions to be avoided; an undesirable result is a quantitative assessment based on minimum thresholds.

8.2 Sustainability Goal

The sustainability goal of the 180/400-Foot Aquifer Subbasin is to manage groundwater resources for long-term community, financial, and environmental benefits to the Subbasin's residents and businesses. The goal of this GSP is to 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.

Several projects and management actions are included in this GSP and detailed in Chapter 9. It is not necessary to implement all projects and actions listed in this GSP to achieve sustainability. However, some combination of these will be implemented to ensure the Subbasin is operated within its sustainable yield and achieves sustainability. These management actions include demand management, promoting conservation and agricultural BMPs, land retirement, reservoir reoperation, and operationalization of management guidance from Deep Aquifers Study. Chapter 9 also includes direct and indirect recharge projects, water supply projects to replace groundwater use, and a seawater extraction barrier. Finally, Chapter 9 includes implementation actions that do not directly help meet the SMC, but contribute to GSP implementation through data collection, assistance to groundwater users, and collaboration with partner agencies. This suite of projects and management actions provide sufficient options to achieve sustainability in the 180/400-Foot Aquifer Subbasin throughout GSP implementation.

The management actions and projects are designed to achieve sustainability within 20 years by one or more of the following means:

- Educating stakeholders and prompting changes in behavior to improve chances of achieving sustainability.
- Increasing awareness of groundwater pumping impacts to promote voluntary reductions in groundwater use through improved water use practices or fallowing crop land.
- Increasing basin recharge.
- Developing new alternative water supplies for use in the Subbasin to offset groundwater pumping.

8.3 Achieving Long-Term Sustainability

The GSP addresses long-term groundwater sustainability. Correspondingly, the SVBGSA intends to develop SMC to avoid undesirable results under future hydrologic conditions. The understanding of future conditions is based on historical precipitation, evapotranspiration, streamflow, and reasonable anticipated climate change, which have been estimated on the basis of the best available climate science (DWR, 2018). These parameters underpin the estimated future water budget over the planning horizon (see Section 6.4). The average hydrologic conditions include reasonably anticipated wet and dry periods. Groundwater conditions that are the result of extreme climatic conditions and are worse than those anticipated do not constitute an undesirable result. However, SMC may be modified in the future to reflect observed future climate conditions.

The GSA will track hydrologic conditions during GSP implementation. These observed hydrologic conditions will be used to develop a value for average hydrologic conditions, which will be compared to predicted future hydrologic conditions. This information will be used to interpret the Subbasin's performance against SMC. Year-by-year micro-management is not the intent of this GSP; this GSP is developed to avoid undesirable results with long-term, deliberate groundwater management. For example, groundwater extractions may experience variations caused by reasonably anticipated hydrologic fluctuations. However, under average hydrologic conditions, there will be no chronic depletion of groundwater storage.

Further, since the GSP addresses long-term groundwater sustainability, exceedance of some SMC during an individual year does not constitute an undesirable result. Pursuant to SGMA regulations (California Water Code § 10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater levels may temporarily exceed minimum thresholds during prolonged droughts, which could be more extreme than those that have been anticipated based on historical data and anticipated climate change conditions. Such temporary exceedances do not constitute an undesirable result.

The SMC presented in this chapter are developed on the basis of historically observed hydrologic conditions and, in most cases, reasonably anticipated climate change. These SMC may be updated in future drafts to reflect changes in anticipated climate conditions and climate change based upon groundwater modeling results.

8.4 General Process for Establishing Sustainable Management Criteria

The SMC presented in this chapter were developed using publicly available information, feedback gathered during public meetings including subbasin committee meetings, hydrogeologic analysis, and meetings with SVBGSA staff and 180/400-Foot Aquifer Subbasin Committee members. The general process to develop the initial SMC included:

- Presentations to the Board of Directors on the SMC requirements and implications.
- Presentations to the Advisory Committee and Subbasin Specific working groups outlining the approach to developing SMC and discussing initial SMC ideas. The Advisory Committee and working groups provided feedback and suggestions for the development of initial SMC.
- Discussions with GSA staff and various Board Members.
- Modifying minimum thresholds and measurable objectives based on input from GSA staff and Board Members.

For the GSP Update, the process included:

- Presenting to the Subbasin Committee on the general SMC requirements and implications. These presentations outlined the original approach to developing SMC.
- Presenting to the Subbasin Committee on lessons learned on SMC since the original GSP, including DWR's review and assessment of the 180/400-Foot Aquifer Subbasin GSP, DWR's reviews of other GSPs, and legal consultation and Board direction during the development of 2022 Salinas Valley GSPs. This updated GSP incorporates DWR's suggested corrective actions into the SMC where appropriate.
- Presenting recommendations on whether to update the approach to SMC in the GSP Update, and receiving feedback from the Subbasin Committees and public.

- Modifying SMC approach for the storage and ISW SMC based on direction from the Subbasin Committee.

- Receiving public comment on the GSP Update SMC Chapter, and discussing public comment with the Subbasin Committee.

8.5 Sustainable Management Criteria Summary

Table 8-1 provides a summary of the SMC for each of the 6 sustainability indicators. Measurable objectives are the goals that reflect the Subbasin's desired groundwater conditions for each sustainability indicator. These provide operational flexibility above the minimum thresholds. The minimum thresholds are quantitative indicators of the Subbasin's locally defined significant and unreasonable conditions. The undesirable result is a combination of minimum threshold exceedances that show a significant and unreasonable condition across the Subbasin as a whole. This GSP is designed to not only avoid undesirable results, but to achieve the sustainability goals within 20 years, along with interim milestones every 5 years that show progress. The management actions and projects provide sufficient options for reaching the measurable objectives within 20 years and maintaining those conditions for 30 years for all 6 sustainability indicators. The rationale and background for developing these criteria are described in detail in the following sections.

The SMC are individual criteria that will each be met simultaneously, rather than in an integrated manner. For example, the groundwater elevation and seawater intrusion SMC are 2 independent SMC that will be achieved simultaneously. The groundwater elevation SMC do not hinder the seawater intrusion SMC, but also, they do not ensure the halting of seawater intrusion by themselves. The SMC presented in Table 8-1 are part of the GSA's 50-year management plan: SGMA allows for 20 years to reach sustainability, and requires the Subbasin have no undesirable results for the subsequent 30 years.

Table 8-1. Sustainable Management Criteria Summary

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result
Chronic lowering of groundwater levels	Measured through groundwater level representative monitoring well network.	Minimum thresholds are set to 1 foot above 2015 groundwater elevations. See Table 8-2.	Measurable objectives are set to 2003 groundwater elevations. See Table 8-2	More than 15% of groundwater elevation minimum thresholds are exceeded. Allows for 5 exceedances per year in the 180-Foot Aquifer; 7 in the 400-Foot Aquifer; and 2 in the Deep Aquifers.
Reduction in groundwater storage	Measured by proxy through groundwater level representative monitoring well network.	Minimum threshold is set to 626,000 AF below the measurable objective. This reduction is based on the groundwater level minimum thresholds. This number does not include the Deep Aquifers and will be refined as additional data are collected and other projects are implemented.	Measurable objective is set to zero when the groundwater elevations are held at the groundwater level measurable objectives. Since the goal is to manage to the measurable objective, additional water in storage is needed until groundwater elevations are at their measurable objectives.	There is an exceedance of the minimum threshold.
Seawater intrusion	Seawater intrusion maps developed by MCWRA.	Minimum threshold is the 2017 extent of the 500 mg/L chloride isocontour as developed by MCWRA for the 180-Foot and 400-Foot Aquifers. The minimum threshold is the line defined by Highway 1 for the Deep Aquifers.	Measurable objective is the line defined by Highway 1 for the 180-Foot, 400-Foot, and Deep Aquifers.	Any exceedance of the minimum threshold, resulting in mapped seawater intrusion beyond the 2017 extent of the 500 mg/L chloride isocontour.
Degraded groundwater quality	Groundwater quality data downloaded annually from GAMA groundwater information system.	Minimum threshold is zero additional exceedances of either the regulatory drinking water standards (potable supply wells) or the Basin Plan objectives (irrigation supply wells) for groundwater quality COC. Exceedances are only measured in public water system supply wells and ILRP on-farm domestic and	Measurable objective is identical to the minimum threshold.	Future or new minimum thresholds exceedances are caused by a direct result of GSA groundwater management action(s), including projects or management actions and regulation of groundwater extraction.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result
		irrigation supply wells. See Table 8-5. See Table 8-5		
Land subsidence	Measured using DWR provided InSAR data.	Minimum threshold is zero net long-term subsidence, with no more than 0.1 foot per year of estimated land movement to account for InSAR errors.	Measurable objective is identical to the minimum threshold, resulting in zero net long-term subsidence.	There is an exceedance of the minimum threshold for subsidence due to lowered groundwater elevations.
Depletion of interconnected surface water	Groundwater elevations in shallow wells adjacent to locations of ISW identified using the SVIHM.	Minimum thresholds are established by proxy using shallow groundwater elevations observed in 2015 near locations of ISW.	Measurable objectives are established by proxy using shallow groundwater elevations observed in 2003 near locations of ISW.	There is an exceedance of the minimum threshold in a shallow groundwater monitoring well used to monitor ISW.

8.6 Chronic Lowering of Groundwater Elevations SMC

8.6.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable groundwater elevations in the Subbasin are those that:

- Are at or below the observed groundwater elevations in 2015. Public and stakeholder input identified these historical groundwater elevations as significant and unreasonable.
- Cause significant financial burden to local agricultural interests.
- Interfere with other sustainability indicators

These significant and unreasonable conditions were determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

8.6.2 Minimum Thresholds

> *The minimum thresholds for chronic lowering groundwater levels are set to 1 foot above 2015 groundwater elevations in this Subbasin.*

The minimum threshold values for each well within the groundwater elevation representative monitoring network are provided in Table 8-2. The minimum threshold contour maps, along with the RMS well locations for the 180/400-Foot Aquifer Subbasin are shown on Figure 8-1 and Figure 8-2 for the 180-Foot and 400-Foot Aquifers, respectively. There were not enough 2015 groundwater elevation measurements of the Deep Aquifers to produce contours.

Table 8-2. Chronic Lowering of Groundwater Levels Minimum Thresholds and Measurable Objectives

Monitoring Site	Minimum Threshold (ft)	Measurable Objective (ft)
180-Foot Aquifer		
13S/02E-13N01	6.2	11.2*
13S/02E-21Q01	6.4*	8.5*
13S/02E-26L01	-6.2*	-3.0*
13S/02E-29D04	-4.5*	-2.5*
14S/02E-03F04	-7.9	-4.5
14S/02E-10P01	-17.8	-6.4
14S/02E-11A02	-10.6	-6.0*
14S/02E-12B02	-10.8	-2.0*
14S/02E-13F03	-11.2	-5.7
14S/02E-17C02	5.5	11.5*
14S/02E-21L01	-6.0	-1.8
14S/02E-26H01	-12.3	-6.2
14S/02E-27A01	-9.9	-3.1*
14S/02E-34B03	-21.8	-4.8
14S/02E-36E01	-15.7	-3.3
14S/03E-18C01	7.6	12.4*
14S/03E-30G08	-17.4	-8.5
14S/03E-31F01	-11.4	-2.2
15S/02E-12C01	-13.0*	-3.0*
15S/03E-09E03	-15.1	2.9
15S/03E-13N01	-10.0	12.8
15S/03E-16M01	-6.0	11.5
15S/03E-17M01	-4.6	11.9
15S/03E-25L01	-2.7	24.6
15S/03E-26F01	-8.1	12.5
15S/04E-31A02	16.6	41.5
16S/04E-05M02	18.7	47.9
16S/04E-13R02	63.9	85.3
16S/04E-15D01	30.6	58.6
16S/04E-15R02	35.0	64.3
16S/04E-27B02	69.5*	84.5*
16S/05E-30E01	60.7	85.0
16S/05E-31M01	70.0	94.8
17S/04E-01D01	75.9	100.9
17S/05E-06C02	65.1	91.5
400-Foot Aquifer		
12S/02E-33H02	-3.0*	3.0*
13S/02E-10K01	-19.3	-16.0*
13S/02E-21N01	-6.3	-3.0*
13S/02E-24N01	-7.0	0.0*

Monitoring Site	Minimum Threshold (ft)	Measurable Objective (ft)
13S/02E-27P01	-44.5	-20.8
13S/02E-29D03	-6.4	-2.4
13S/02E-31N02	-5.0*	-0.4
13S/02E-32A02	-4.6*	-1.0*
14S/02E-02C03	-29.9	-20.0*
14S/02E-03F03	-13.5	-5.2
14S/02E-05F04	-15.2	-6.9
14S/02E-08M02	-5.0*	-1.0*
14S/02E-11A04	-25.1	-17.5
14S/02E-11M03	-30.0*	-20.0*
14S/02E-12B03	-27.8	-18.5
14S/02E-12Q01	-13.6	-9.3
14S/02E-16A02	-19.6	-7.9
14S/02E-22L01	-22.9	-3.1
14S/02E-26J03	-20.6*	-5.0
14S/02E-27G03	-17.1	-8.3
14S/02E-34A03	-12.4	-7.5
14S/02E-36G01	-13.7	-0.1
14S/03E-18C02	-19.7	-12.5
14S/03E-20C01	-41.0	-35.0*
14S/03E-29F03	-26.0	-15.0*
14S/03E-31L01	-9.0	-3.0*
15S/02E-01A03	-15.3	-0.7
15S/02E-02G01	-28.0	-11.2
15S/02E-12A01	-17.1	-4.7
15S/03E-03R02	-17.0	-1.0*
15S/03E-04Q01	-11.0	0.0*
15S/03E-05C02	-16.0	-5.0*
15S/03E-08F01	-17.8	-5.2
15S/03E-14P02	-11.7	8.4
15S/03E-15B01	-14.1	5.8
15S/03E-16F02	-6.5	5.0*
15S/03E-17P02	-17.0	-2.0*
15S/03E-26A01	-4.5	15.0
15S/03E-28B02	-0.5	15.0*
15S/04E-29Q02	5.8	33.9
16S/04E-04C01	11.7	47.2
16S/04E-08H03	24.6	54.7
16S/04E-10R02	40.7	67.2
16S/04E-25G01	51.3	76.4
16S/05E-30J02	67.2	90.7
Deep Aquifers		

Monitoring Site	Minimum Threshold (ft)	Measurable Objective (ft)
13S/01E-36J02	-4.2	2.0*
13S/02E-19Q03	-2.4	6.3
13S/02E-28L03	-40.0*	-29.0*
13S/02E-32E05	-9.2	1.6
14S/02E-06L01	-7.2	3.0
14S/02E-18B01	-35.0*	-25.0*
14S/02E-22A03	-80.0*	-60.0*
14S/02E-28C02	-41.2	-15.0*
15S/03E-10D04	-20.0*	-10.0*
15S/03E-17E02	-15.0*	-10.0*
16S/04E-11D51	43.0*	50.0*

*Groundwater elevation was estimated.

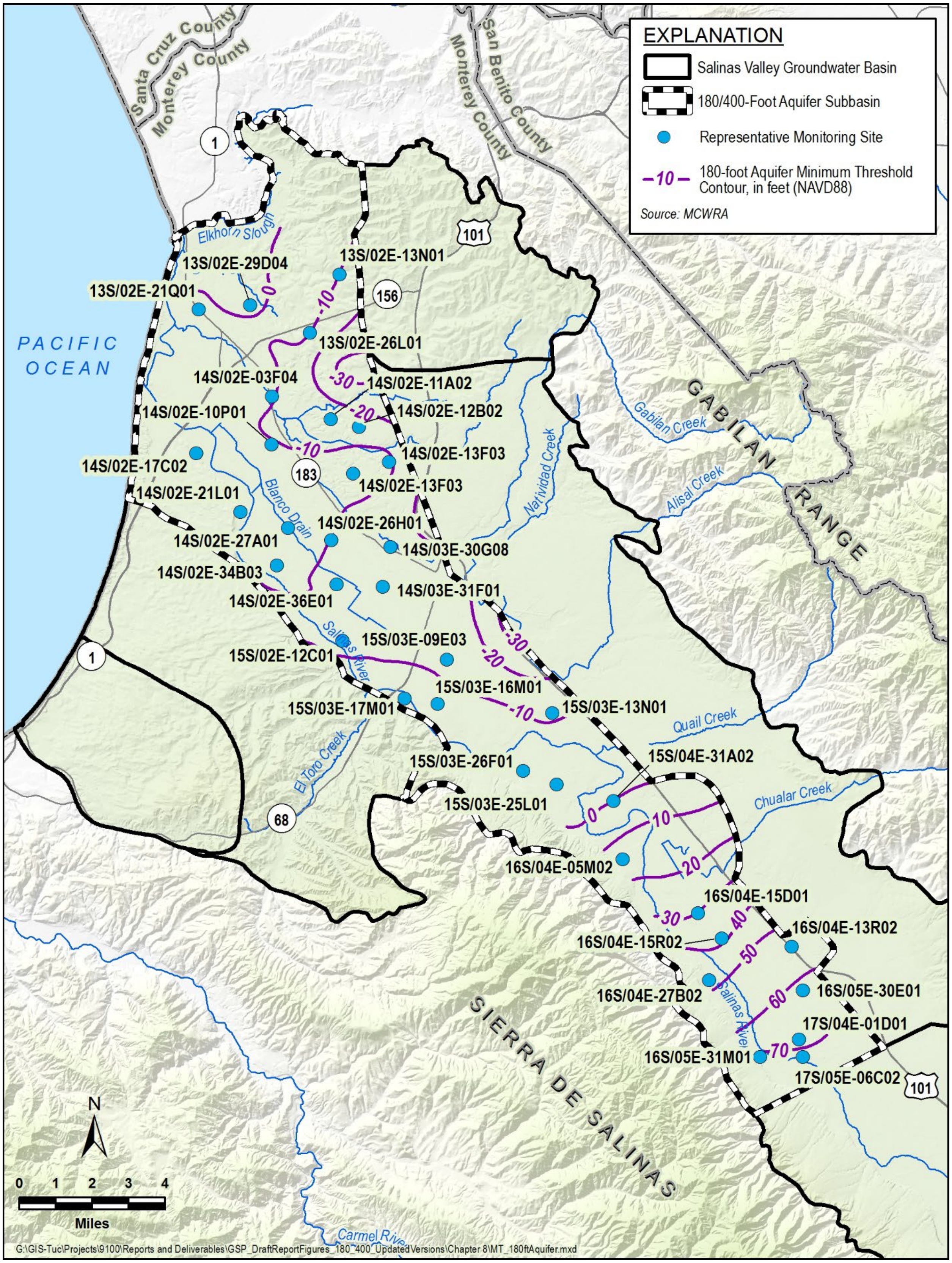


Figure 8-1. Groundwater Elevation Minimum Threshold Contour Map for the 180-Foot Aquifer

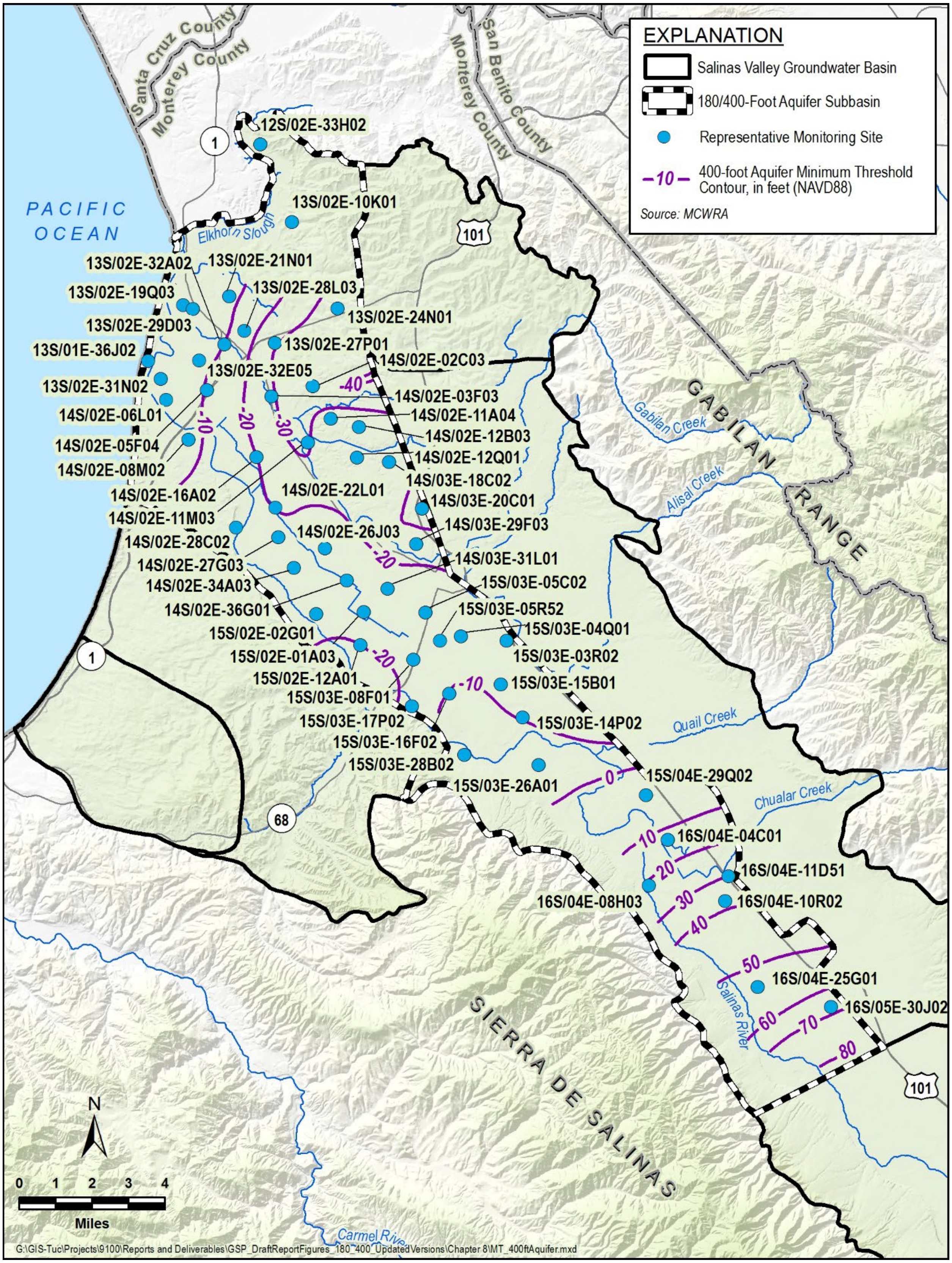


Figure 8-2. Groundwater Elevation Minimum Threshold Contour Map for the 400-Foot Aquifer

8.6.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The development of both minimum thresholds and measurable objectives followed similar processes and are described in this section. The information used includes:

- Feedback from discussions with the Subbasin Committee on challenges and goals
- Historical groundwater elevation data and hydrographs from wells monitored by the MCWRA
- Maps of current and historical groundwater elevation data
- Analysis of the impact of groundwater elevations on domestic wells

The general steps for developing minimum thresholds and measurable objectives were:

1. The Subbasin Committee selected an approach and criteria for to setting the groundwater level minimum thresholds and measurable objectives.
2. SVBGSA used MCWRA's average groundwater elevation change hydrographs to select representative years that could define minimum thresholds and measurable objectives for the Subbasin. Groundwater elevations like those experienced during the representative climatic cycle between 1967 and 1998 were used to identify minimum thresholds and measurable objectives to ensure that they were achievable under reasonably expected climatic conditions. This representative period corresponds to important water management milestones for the Salinas Valley Groundwater Basin; water year 1967 marks the beginning of operations at San Antonio Reservoir, with first water releases in November 1966. The Castroville Seawater Intrusion Project (CSIP) began operating in 1998.

   The average groundwater elevation change hydrograph with preliminary minimum threshold and measurable objectives lines for the 180/400-Foot Aquifer Subbasin are shown on Figure 8-3. The average 2015 groundwater elevations in the 180/400-Foot Aquifer Subbasin are considered significant and unreasonable. When looking at the groundwater elevation changes within the representative climatic cycle, the historical lowest elevations occurred in 1991, at approximately 1 foot higher than 2015 elevations. The minimum thresholds were therefore set one foot above the 2015 groundwater elevations. The measurable objective is set to 2003 groundwater elevations, which is an achievable goal for the Subbasin under reasonably expected climatic conditions.
3. SVBGSA identified the appropriate minimum thresholds and measurable objectives on the respective monitoring well hydrographs. Each hydrograph was visually inspected to

check if the minimum threshold and measurable objective was reasonable. If an RMS did not have measurements from the minimum threshold or measurable objective years, the SMC were estimated using the hydrographs. Moreover, if the SMC seemed unreasonable for an RMS, they were adjusted based on historic water levels. The interpolated or adjusted minimum thresholds and measurable objectives are indicated by an asterisk in Table 8-2.

Hydrographs with well completion information showing minimum thresholds for each RMS are included in Appendix 8A.

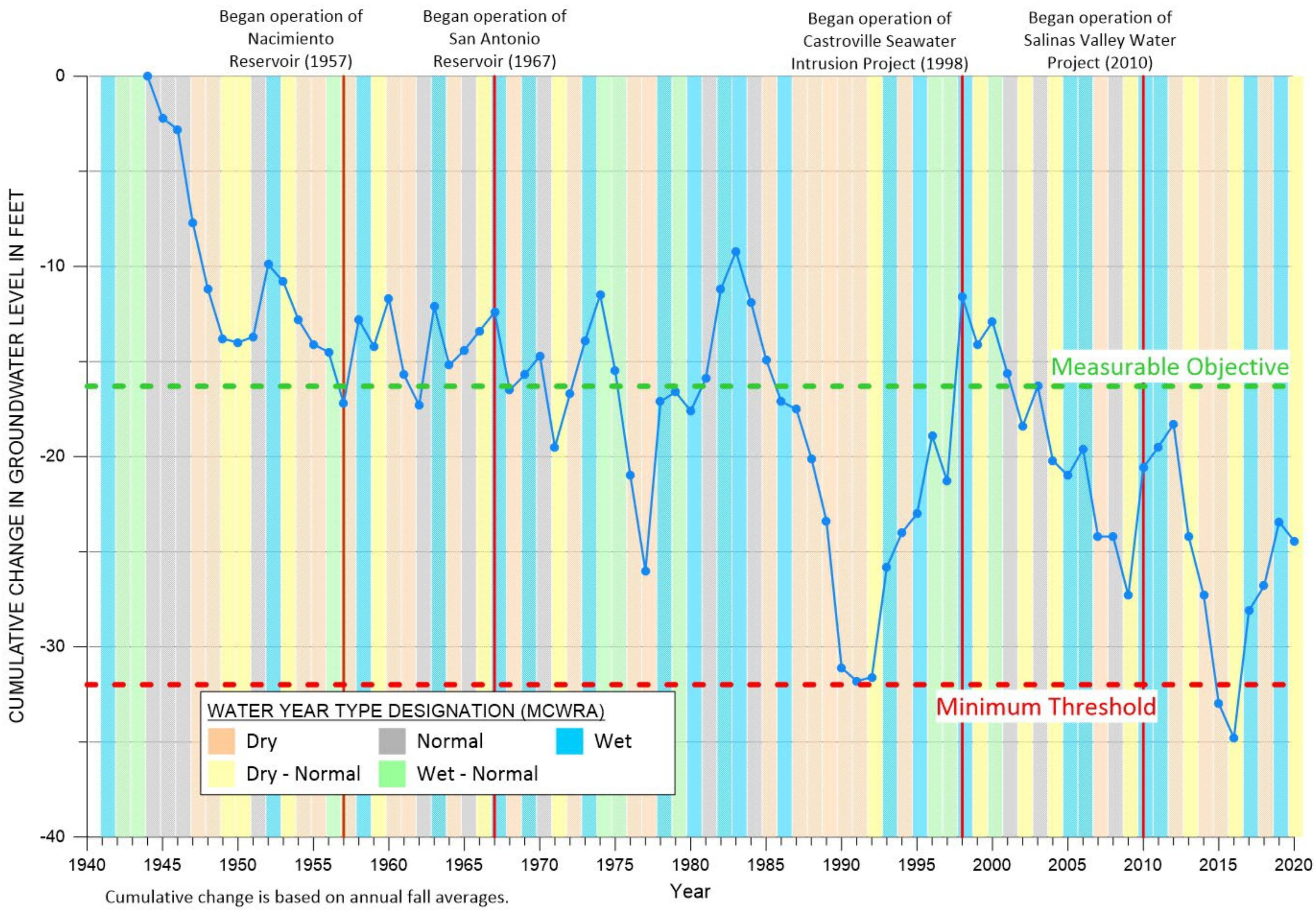


Figure 8-3. Cumulative Groundwater Elevation Change Hydrograph with Selected Measurable Objective and Minimum Threshold for the 180/400-Foot Aquifer Subbasin

8.6.2.2 Minimum Thresholds Impact on Domestic Wells

To address the human right to water, minimum thresholds for groundwater elevations are compared to the range of domestic well depths in the Subbasin using DWR's Online System for Well Completion Reports (OSWCR) database. This check was done to assure that the minimum thresholds maintain operability in a reasonable percentage of domestic wells. The proposed minimum thresholds for groundwater elevation do not necessarily protect all domestic wells because it is impractical to manage a groundwater basin in a manner that fully protects the shallowest wells. The average computed depth of domestic wells in the Subbasin is 362 feet using the Public Land Survey System sections data in the OSWCR database.

While this approach is reasonable, there are some adjustments that had to be made to improve the accuracy of the analysis. These include:

- The OSWCR database may include wells that have been abandoned, destroyed, or replaced, such as if the user switched to a water system, and abandoned or destroyed wells would have no detrimental impacts from lowered groundwater levels.
- Only wells likely to be in the principal aquifers were considered, since some domestic wells may draw water from shallow, perched groundwater that is not managed under this GSP.
- Wells in the Deep Aquifers were not included because there was not enough 2015 or 2003 groundwater elevation data to contour the minimum thresholds or measurable objectives.
- Only wells that had accurate locations were included, since some wells in the OSWCR database are not accurately located, it could lead to inaccurate estimations of depth to water in the wells.
- The depth to water is derived from a smoothly interpolated groundwater elevation contour map. Errors in the map may result in errors in groundwater elevation at the selected domestic wells.

Given the limitations listed above, the analysis only included 14 wells with accurate locations out of the total 294 OSWCR domestic wells in the 180-Foot and 400-Foot Aquifers. The analysis showed that 83% of domestic wells in the 180-Foot Aquifer will have at least 25 feet of water in them as long as groundwater elevations remain above minimum thresholds; and all domestic wells in the 180-Foot Aquifer will have at least 25 feet of water in them when measurable objectives are achieved. In the 400-Foot Aquifer, 88% of domestic wells will have at least 25 feet of water in them if groundwater elevations remain above minimum thresholds and when measurable objectives are achieved. These percentages were considered reasonable given the limitations listed above.

8.6.2.3 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The SVBGSA compared minimum thresholds between RMSs to understand the relationship between RMSs (i.e., describe why or how a water level minimum threshold set at a particular RMS is similar to or different from water level thresholds in nearby RMS). The groundwater elevation minimum thresholds are derived from historical and/or smoothly interpolated groundwater elevations in the Subbasin. Therefore, the minimum thresholds are unique at every well, but when combined represent a reasonable and potentially realistic groundwater elevation map. Because the underlying groundwater elevation map is a reasonably achievable condition, the individual minimum thresholds at RMSs do not conflict with each other.

Groundwater elevation minimum thresholds can influence other sustainability indicators. SVBGSA reviewed the groundwater level minimum thresholds' relationship with each of the other sustainability indicators' minimum thresholds to ensure a groundwater level minimum threshold would not trigger an undesirable result for any of the other sustainability indicators. The groundwater elevation minimum thresholds are selected to avoid undesirable results for other sustainability indicators.

- **Reduction in groundwater storage.** The chronic lowering of groundwater levels minimum thresholds are identical to the groundwater storage minimum thresholds. Thus, the groundwater level minimum thresholds will not result in an undesirable loss of groundwater storage.

- **Seawater intrusion.** The chronic lowering of groundwater level minimum thresholds are set above historical lows. Therefore, the groundwater elevation minimum thresholds are intended to not exacerbate, and may help control, the rate of seawater intrusion. Seawater intrusion may be managed by either lowering groundwater elevations to capture seawater intrusion or raising groundwater elevations to drive seawater intrusion towards the coast. Because it has not been determined if lower or higher groundwater elevations will be used to manage seawater intrusion; the groundwater elevation minimum threshold was not set solve seawater intrusion, but rather to not exacerbate seawater intrusion.

- **Degraded water quality.** The chronic lowering of groundwater levels minimum could affect groundwater quality through 2 processes:

    1. Changes in groundwater elevation could change groundwater gradients, which could cause poor quality groundwater to flow toward production and domestic wells that would not have otherwise been impacted. These groundwater gradients, however, are

only dependent on differences between groundwater elevations, not on the groundwater elevations themselves. Therefore, the minimum threshold groundwater elevations do not directly lead to a significant and unreasonable degradation of groundwater quality in production and domestic wells.

2. Decreasing groundwater elevations can mobilize COC that are concentrated at depth, such as arsenic. The groundwater level minimum thresholds are near or above historical lows. Therefore, any depth dependent constituents have previously been mobilized by historical groundwater levels. Maintaining groundwater elevations above the minimum thresholds assures that no new depth dependent COC are mobilized, and are therefore protective of beneficial uses and users.

- **Land subsidence.** The chronic lowering of groundwater levels minimum thresholds are set at or above recent low groundwater elevations. Thus, they are set at levels that will not induce the dewatering and compaction of clay-rich sediments that causes subsidence in response to lowering groundwater elevations.

- **Depletion of ISW.** The chronic lowering of groundwater levels minimum thresholds are identical to the ISW minimum thresholds. Therefore, the groundwater level minimum thresholds will not result in a significant or unreasonable depletion of ISW, including groundwater-dependent ecosystems.

8.6.2.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The 180/400-Foot Aquifer Subbasin has 4 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Eastside Subbasin to the east
- The Forebay Subbasin to the south
- The Monterey Subbasin to the southwest

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The Langley, Eastside, Forebay, and Monterey Subbasins have submitted GSPs in January 2022. Minimum thresholds for the 180/400-Foot Aquifer Subbasin have been reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability. SVBGSA and MCWDGSA are close collaborators in developing and implementing their GSPs for the 180/400 and Monterey Subbasins. While SVBGSA and MCWDGSA have chosen slightly different groundwater level minimum thresholds for the same aquifers, the groundwater levels across the Subbasin boundary will continue to be closely monitored to ensure both subbasin minimum thresholds are met. Data development and management will be a part of a collaborative relationship during implementation to ensure both subbasins reach sustainability.

The Pajaro Valley Basin lies directly to the north of the Subbasin. Because the minimum thresholds in the 180/400-Foot Aquifer Subbasin are above historical low groundwater elevations, it is likely that the minimum thresholds will not prevent the Pajaro Basin from achieving and maintaining sustainability. The SVBGSA will coordinate closely with the Pajaro Valley Water Agency to ensure that the basins do not prevent each other from achieving sustainability.

8.6.2.5 Effects on Beneficial Users and Land Uses

The groundwater level minimum thresholds may have several effects on beneficial users and land uses in the Subbasin.

Agricultural land uses and users. The groundwater elevation minimum thresholds prevent continued lowering of groundwater elevations in the Subbasin. Unless sufficient projects and management actions are undertaken, this may have the effect of limiting the amount of groundwater pumping in the Subbasin. Limiting the amount of groundwater pumping may limit the amount and type of crops that can be grown in the Subbasin. The groundwater elevation minimum thresholds could therefore limit expansion of the Subbasin's agricultural economy. This could have various effects on beneficial users and land uses:

- Agricultural land currently under irrigation may become more valuable as bringing new lands into irrigation becomes more difficult and expensive.

- Agricultural land not currently under irrigation may become less valuable because it may be too difficult and expensive to irrigate.

Urban land uses and users. The groundwater level minimum thresholds may reduce the amount of groundwater pumping in the Subbasin. This may limit urban growth, or result in urban areas obtaining alternative sources of water. This may result in higher water costs for public drinking water systems.

Domestic land uses and users. The groundwater level minimum thresholds are intended to protect most domestic wells, including small state and small local system wells. Therefore, the minimum thresholds will likely have an overall beneficial effect on existing domestic land uses by protecting the ability to pump from domestic wells. However, extremely shallow domestic wells may become dry, requiring owners to drill deeper wells. Additionally, the groundwater elevation minimum thresholds may limit the number of new domestic wells or small state and small local system wells that can be drilled to limit future declines in groundwater elevations.

Ecological land uses and users. The groundwater level minimum thresholds may limit the amount of groundwater pumping in the Subbasin and may limit both urban and agricultural growth. This outcome may benefit ecological land uses and users by curtailing the conversion of native vegetation to agricultural or domestic uses, and by reducing pressure on existing ecological land caused by declining groundwater elevations.

8.6.2.6 Relevant Federal, State, or Local Standards

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

8.6.2.7 Method for Quantitative Measurement of Minimum Thresholds

Groundwater level minimum thresholds will be directly measured from the representative monitoring well network. The groundwater elevation monitoring will be conducted in accordance with the monitoring plan outlined in Chapter 7. Furthermore, the groundwater elevation monitoring will meet the requirements of the technical and reporting standards included in the GSP Regulations.

As noted in Chapter 7, the current groundwater elevation representative monitoring network in the Subbasin includes 91 wells. Data gaps were identified in Chapter 7 and will be resolved during implementation of this GSP.

8.6.3 Measurable Objectives

The measurable objectives for chronic lowering of groundwater levels represent target groundwater elevations that are higher than the minimum thresholds. These measurable objectives provide operational flexibility to ensure that the Subbasin can be managed sustainably over a reasonable range of hydrologic variability.

> *The measurable objectives for the chronic lowering of groundwater levels are set to 2003 groundwater elevations.*

The measurable objectives are summarized in Table 8-2 and are also shown on the hydrographs for each RMS in Appendix 8A.

8.6.3.1 Methodology for Setting Measurable Objectives

The methodology for establishing measurable objectives is described in detail in Section 8.6.2.1. A year from the relatively recent past was selected for setting measurable objectives to ensure that objectives are achievable. Figure 8-3 shows that there was a slow downward trend in average groundwater elevations through 2003. Since 2003, water elevations have consistently decreased at a more rapid rate. Groundwater elevations from 2003 were selected as representative of the measurable objectives for the 180/400-Foot Aquifer Subbasin. The measurable objective contour maps for the 180/400-Foot Aquifer Subbasin along with the representative monitoring network wells are shown on Figure 8-4 and Figure 8-5 for the 180-Foot and 400-Foot Aquifers, respectively.

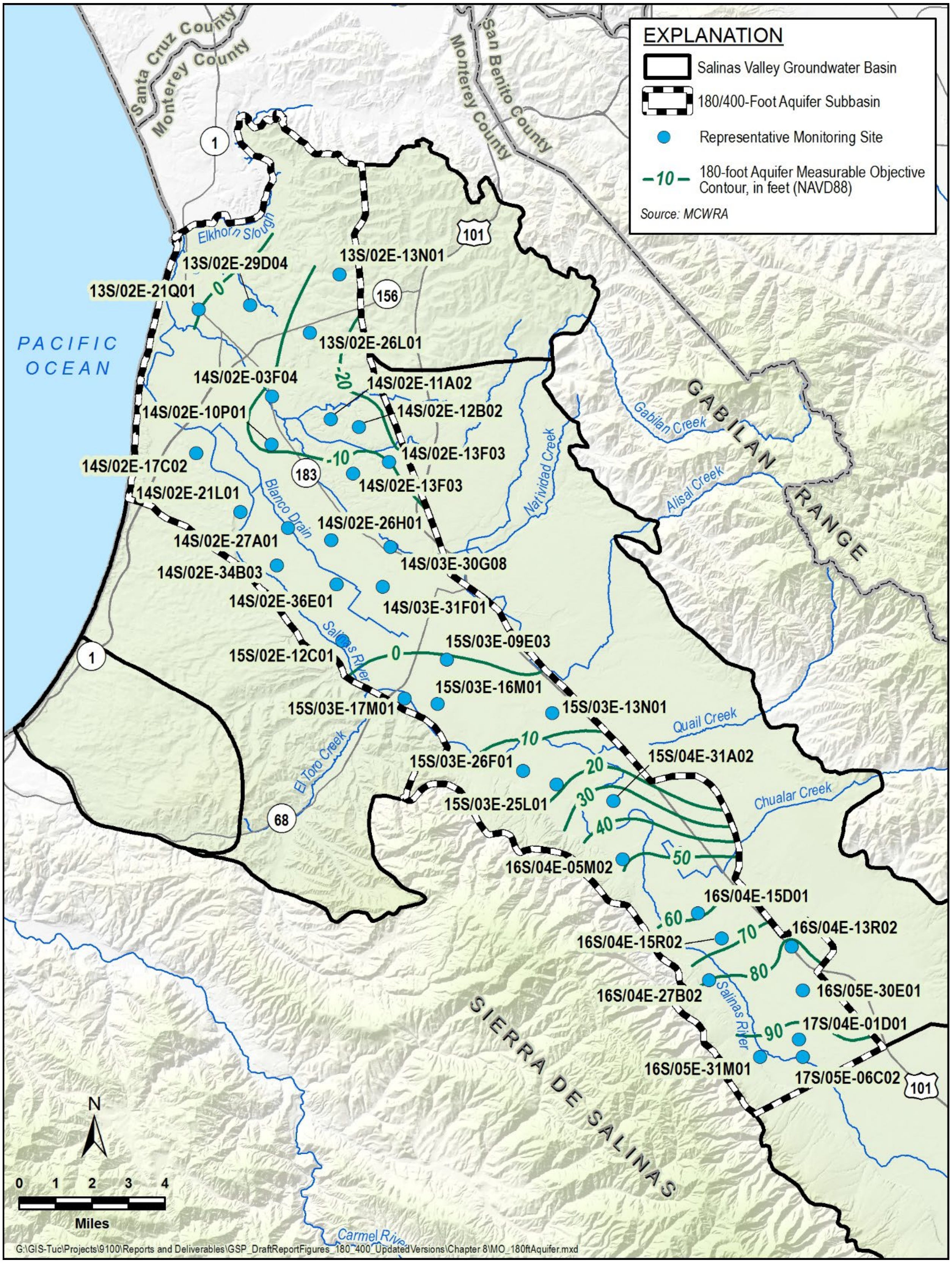


Figure 8-4. Groundwater Elevation Measurable Objective Contour Map for the 180-Foot Aquifer

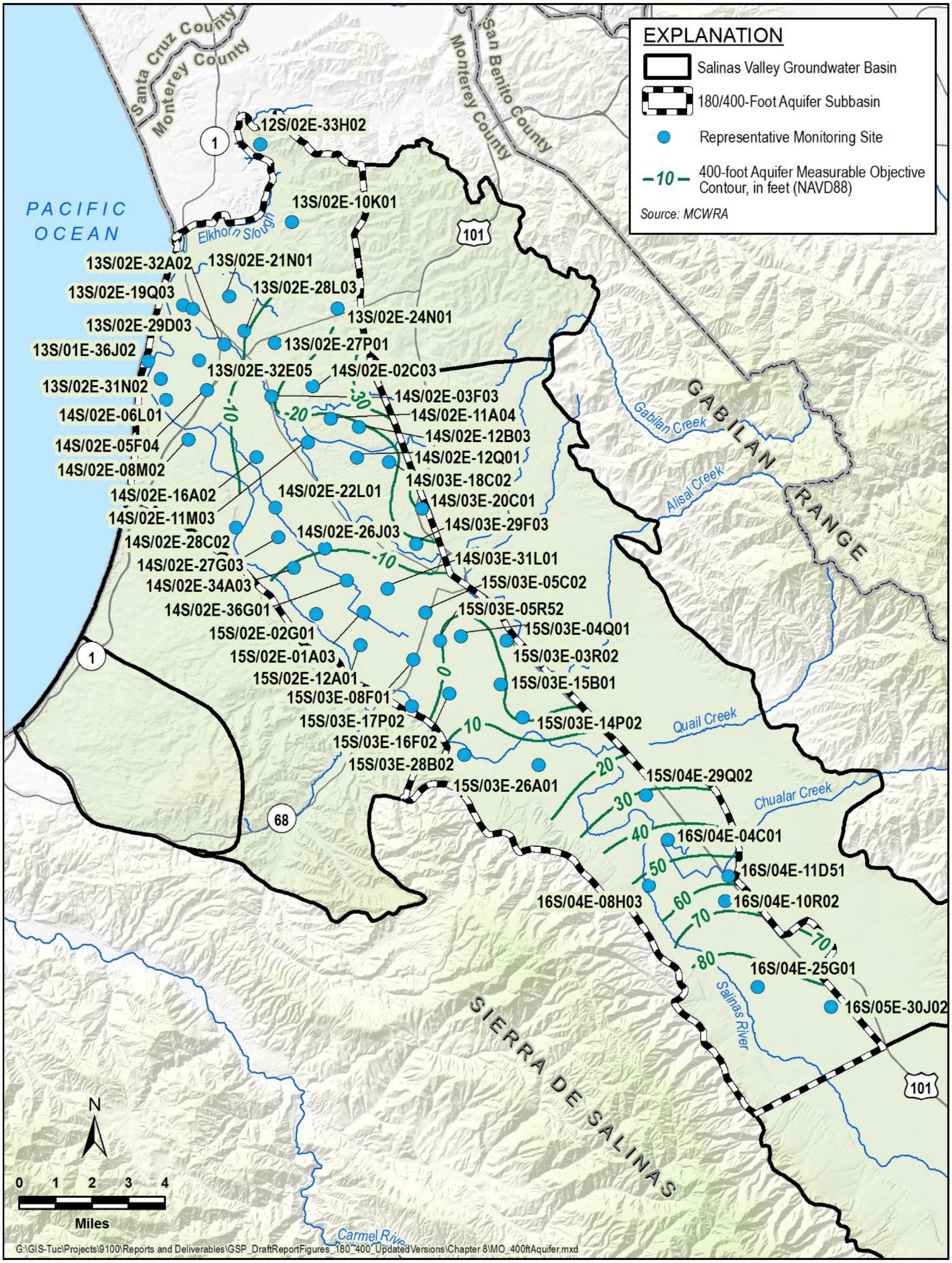


Figure 8-5. Groundwater Elevation Measurable Objective Contour Map for the 400-Foot Aquifer

8.6.3.2 Interim Milestones

Interim milestones for groundwater elevations are shown in Table 8-3. These are only initial estimates of interim milestones. Interim milestones for groundwater levels will be modified as better data, analyses, and project designs become available.

Table 8-3. Chronic Lowering of Groundwater Levels Interim Milestones

Monitoring Site	Current Groundwater Elevation (ft)	Interim Milestone at Year 2025 (ft)	Interim Milestone at Year 2030 (ft)	Interim Milestone at Year 2035 (ft)	Measurable Objective (ft) (goal to reach at 2040)
180-Foot Aquifer					
13S/02E-13N01	6.6*	7.8	8.9	10.1	11.2*
13S/02E-21Q01	8.6	8.6	8.6	8.5	8.5*
13S/02E-26L01	-4.2*	-3.9	-3.6	-3.3	-3.0*
13S/02E-29D04	-3.3	-3.1	-2.9	-2.7	-2.5*
14S/02E-03F04	-5.2	-5.0	-4.9	-4.7	-4.5
14S/02E-10P01	-19.4	-16.2	-12.9	-9.7	-6.4
14S/02E-11A02	-8.2	-7.7	-7.1	-6.6	-6.0*
14S/02E-12B02	-7.6	-6.2	-4.8	-3.4	-2.0*
14S/02E-13F03	-8.0	-7.4	-6.9	-6.3	-5.7
14S/02E-17C02	9.3	9.9	10.4	11.0	11.5*
14S/02E-21L01	-5.0	-4.2	-3.4	-2.6	-1.8
14S/02E-26H01	-9.5	-8.7	-7.9	-7.0	-6.2
14S/02E-27A01	-7.3	-6.3	-5.2	-4.2	-3.1*
14S/02E-34B03	-12.8	-10.8	-8.8	-6.8	-4.8
14S/02E-36E01	-12.5	-10.2	-7.9	-5.6	-3.3
14S/03E-18C01	11.8	12.0	12.1	12.3	12.4*
14S/03E-30G08	-13.1	-12.0	-10.8	-9.7	-8.5
14S/03E-31F01	-7.2	-6.0	-4.7	-3.5	-2.2
15S/02E-12C01	-13.7	-11.0	-8.4	-5.7	-3.0*
15S/03E-09E03	-4.4	-2.6	-0.8	1.1	2.9
15S/03E-13N01	-11.4	-5.4	0.7	6.8	12.8
15S/03E-16M01	3.6*	5.6	7.6	9.5	11.5
15S/03E-17M01	4.7*	6.5	8.3	10.1	11.9
15S/03E-25L01	13.6*	16.4	19.1	21.9	24.6
15S/03E-26F01	0.3	3.4	6.4	9.5	12.5
15S/04E-31A02	30.7	33.4	36.1	38.8	41.5
16S/04E-05M02	35.8	38.8	41.9	44.9	47.9
16S/04E-13R02	74.2	77.0	79.8	82.5	85.3
16S/04E-15D01	48.3	50.9	53.4	56.0	58.6
16S/04E-15R02	55.1	57.4	59.7	62.0	64.3
16S/04E-27B02	69.5*	73.3	77.0	80.8	84.5*
16S/05E-30E01	77.1*	79.1	81.1	83.0	85.0

Monitoring Site	Current Groundwater Elevation (ft)	Interim Milestone at Year 2025 (ft)	Interim Milestone at Year 2030 (ft)	Interim Milestone at Year 2035 (ft)	Measurable Objective (ft) (goal to reach at 2040)
16S/05E-31M01	87.6	89.4	91.2	93.0	94.8
17S/04E-01D01	74.5	81.1	87.7	94.3	100.9
17S/05E-06C02	71.9	76.8	81.7	86.6	91.5
400-Foot Aquifer					
12S/02E-33H02	2.3	2.5	2.7	2.8	3.0*
13S/02E-10K01	-20.4	-19.3	-18.2	-17.1	-16.0*
13S/02E-21N01	-6.1	-5.3	-4.6	-3.8	-3.0*
13S/02E-24N01	-2.0	-1.5	-1.0	-0.5	0.0*
13S/02E-27P01	-28.5	-26.6	-24.7	-22.7	-20.8
13S/02E-29D03	-4.3	-3.8	-3.4	-2.9	-2.4
13S/02E-31N02	-1.8	-1.5	-1.1	-0.8	-0.4
13S/02E-32A02	-2.5	-2.1	-1.8	-1.4	-1.0*
14S/02E-02C03	-29.0	-26.8	-24.5	-22.3	-20.0*
14S/02E-03F03	-11.8	-10.2	-8.5	-6.9	-5.2
14S/02E-05F04	-8.5	-8.1	-7.7	-7.3	-6.9
14S/02E-08M02	-3.2	-2.7	-2.1	-1.6	-1.0*
14S/02E-11A04	-26.7	-24.4	-22.1	-19.8	-17.5
14S/02E-11M03	-24.0	-23.0	-22.0	-21.0	-20.0*
14S/02E-12B03	-28.2	-25.8	-23.4	-20.9	-18.5
14S/02E-12Q01	-10.9	-10.5	-10.1	-9.7	-9.3
14S/02E-16A02	-14.5	-12.9	-11.2	-9.6	-7.9
14S/02E-22L01	-12.7	-10.3	-7.9	-5.5	-3.1
14S/02E-26J03	-18.7	-15.3	-11.9	-8.4	-5.0
14S/02E-27G03	-13.9	-12.5	-11.1	-9.7	-8.3
14S/02E-34A03	-13.4	-11.9	-10.5	-9.0	-7.5
14S/02E-36G01	-9.8	-7.4	-5.0	-2.5	-0.1
14S/03E-18C02	-18.3	-16.9	-15.4	-14.0	-12.5
14S/03E-20C01	-41.0	-39.5	-38.0	-36.5	-35.0*
14S/03E-29F03	-23.0	-21.0	-19.0	-17.0	-15.0*
14S/03E-31L01	-9.0	-7.5	-6.0	-4.5	-3.0*
15S/02E-01A03	-12.7	-9.7	-6.7	-3.7	-0.7
15S/02E-02G01	-23.0	-20.1	-17.1	-14.2	-11.2
15S/02E-12A01	-13.8	-11.5	-9.3	-7.0	-4.7
15S/03E-03R02	-8.0	-6.3	-4.5	-2.8	-1.0*
15S/03E-04Q01	-6.0	-4.5	-3.0	-1.5	0.0*
15S/03E-05C02	-16.0	-13.3	-10.5	-7.8	-5.0*
15S/03E-08F01	-15.4	-12.9	-10.3	-7.8	-5.2
15S/03E-14P02	-7.6	-3.6	0.4	4.4	8.4
15S/03E-15B01	-5.5	-2.7	0.2	3.0	5.8
15S/03E-16F02	0.4	1.6	2.7	3.9	5.0*

Monitoring Site	Current Groundwater Elevation (ft)	Interim Milestone at Year 2025 (ft)	Interim Milestone at Year 2030 (ft)	Interim Milestone at Year 2035 (ft)	Measurable Objective (ft) (goal to reach at 2040)
15S/03E-17P02	-8.0	-6.5	-5.0	-3.5	-2.0*
15S/03E-26A01	5.1	7.6	10.1	12.5	15.0
15S/03E-28B02	4.0	6.8	9.5	12.3	15.0*
15S/04E-29Q02	17.4	21.5	25.7	29.8	33.9
16S/04E-04C01	34.4	37.6	40.8	44.0	47.2
16S/04E-08H03	42.8	45.8	48.7	51.7	54.7
16S/04E-10R02	55.0	58.1	61.1	64.2	67.2
16S/04E-25G01	70.3	71.8	73.4	74.9	76.4
16S/05E-30J02	83.0	84.9	86.9	88.8	90.7
Deep Aquifers					
13S/01E-36J02	-9.6	-6.7	-3.8	-0.9	2.0*
13S/02E-19Q03	-8.9	-5.1	-1.3	2.5	6.3
13S/02E-28L03	-27.4	-27.8	-28.2	-28.6	-29.0*
13S/02E-32E05	-14.7	-10.6	-6.6	-2.5	1.6
14S/02E-06L01	-14.7	-10.3	-5.9	-1.4	3.0
14S/02E-18B01	-27.6*	-27.0	-26.3	-25.7	-25.0*
14S/02E-22A03	-103.2	-92.4	-81.6	-70.8	-60.0*
14S/02E-28C02	-40.0	-33.8	-27.5	-21.3	-15.0*
15S/03E-10D04	-21.7	-18.8	-15.9	-12.9	-10.0*
15S/03E-17E02	-14.0	-13.0	-12.0	-11.0	-10.0*
16S/04E-11D51					

*Groundwater elevation estimated.

8.6.4 Undesirable Results

8.6.4.1 Criteria for Defining Chronic Lowering of Groundwater Levels Undesirable Results

The chronic lowering of groundwater levels undesirable result is a quantitative combination of groundwater level minimum threshold exceedances. The undesirable result is:

> *More than 15% of the groundwater elevation minimum thresholds are exceeded in any single aquifer.*

Since the GSP addresses long-term groundwater sustainability, exceedances of groundwater levels minimum thresholds during a drought do not constitute an undesirable result. Pursuant to SGMA Regulations (California Water Code § 10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater levels may temporarily exceed minimum thresholds during droughts, and do not constitute an undesirable result, as long as groundwater levels rebound.

Undesirable results provide flexibility in defining sustainability. Increasing the percentage of allowed minimum threshold exceedances provides more flexibility but may lead to significant and unreasonable conditions for some beneficial users. Reducing the percentage of allowed minimum threshold exceedances ensures strict adherence to minimum thresholds but reduces flexibility due to unanticipated hydrogeologic conditions. The undesirable result was set at 15% to balance the interests of beneficial users with the practical aspects of groundwater management under uncertainty.

The 15% limit on minimum threshold exceedances in the undesirable result allows for 5 exceedances in the 180-Foot Aquifer, 7 exceedances in the 400-Foot Aquifer, and 2 in the Deep Aquifers. This was considered a reasonable number of exceedances given the hydrogeologic uncertainty of the Subbasin. As the monitoring system grows, additional exceedances will be allowed. One additional exceedance will be allowed for approximately every 7 new monitoring wells.

8.6.4.2 Potential Causes of Undesirable Results

As of 2020, an undesirable result for chronic lowering of groundwater levels does currently exist in all principal aquifers in the 180/400-Foot Aquifer Subbasin. In the 180-Foot Aquifer, groundwater elevations in 5 of the 35 RMS wells (14%) were at or below the minimum threshold in the most recent Fall 2020 groundwater elevation measurements. In the 400-Foot Aquifer, groundwater elevations for 7 out of 45 RMS wells (16%) were at or below the minimum threshold, and in the Deep Aquifers 6 out of 11 RMS (55%) wells were below the minimum threshold in fall 2020. Conditions that may lead to an undesirable result include the following:

- **Localized pumping clusters.** Even if regional pumping is maintained within the sustainable yield, clusters of high-capacity wells may cause excessive localized drawdowns that lead to undesirable results.

- **Expansion of *de minimis* pumping.** Individual *de minimis* pumpers do not have a significant impact on groundwater elevations. However, many *de minimis* pumpers are often clustered in specific residential areas. Pumping by these *de minimis* users is not regulated under this GSP. Adding additional domestic *de minimis* pumpers in these areas may result in excessive localized drawdowns and undesirable results.

- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought.** Minimum thresholds were established based on historical groundwater elevations and reasonable estimates of future climatic conditions and groundwater elevations. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater elevations and undesirable results.

8.6.4.3 Effects on Beneficial Users and Land Uses

The primary detrimental effect on beneficial users from allowing multiple exceedances occurs if more than 1 exceedance take place in a small geographic area. Allowing 15% exceedances is reasonable if the exceedances are spread out across the Subbasin, and as long as any 1 well does not regularly exceed its minimum threshold. If the exceedances are clustered in a small area, it will indicate that significant and unreasonable effects are being born by a localized group of landowners.

8.7 Reduction in Groundwater Storage SMC

8.7.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable conditions in groundwater storage in the Subbasin are those that:

- Lead to chronic, long-term reduction in groundwater storage, or
- Interfere with other sustainability indicators

These significant and unreasonable conditions were determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

8.7.2 Minimum Thresholds

The minimum threshold for reduction in groundwater storage is 626,000 acre-feet below the measurable objective in the 180/400-Foot Aquifer Subbasin. This reduction is based on the groundwater level and seawater intrusion minimum thresholds. This number does not include any storage changes in the Deep Aquifers and will be refined as additional data are collected and other projects are implemented.

Although not the metric for establishing change in groundwater storage, the GSAs are committed to pumping at or less than the Subbasin's long-term sustainable yield. SGMA allows 20 years to reach sustainability.

8.7.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The groundwater storage minimum threshold and measurable objective rely on the groundwater elevation and seawater intrusion minimum thresholds. The methodologies used to the establish those two minimum thresholds are detailed in Section 8.6.2.1 and Section 8.8.2.1. The GSP Regulations § 354.36 (b) states that: "Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following: (1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy." The general relationship between groundwater storage and groundwater elevations is discussed in greater detail in Chapter 4, Section 4.4.2.

Figure 8-6 compares the Subbasin's cumulative change in storage, plotted on the black line, with the average annual change in groundwater elevation, plotted on the blue line. The groundwater elevation change data are derived from the groundwater level monitoring network; the cumulative change in groundwater storage is derived from the SVIHM. Although the data come from 2 sources, the data generally show similar patterns between 1980 and 2016. The decrease in storage modeled by the SVIHM from 1983 to 1998 is not exactly reflected in the change in groundwater elevations, because the modeled storage is dependent on the simulated groundwater elevations in the SVIHM. However, from 1998 to 2016, the cumulative change in storage and annual change in groundwater elevations seem to be more closely related as verified on Figure 8-7.

Figure 8-7 shows a scatter plot of cumulative change in storage and annual average change in groundwater elevation. The blue data points show data for the entire model period from 1980 to 2016 and the orange data points show data from 1998 to 2016. Although, the data for the entire model period demonstrate a weak correlation (R^2=0.3748), a more significant positive correlation exists between groundwater elevations and the amount of groundwater in storage between 1998 and 2016 (R^2=0.8334). The correlation for the 1998 to 2016 period is sufficient to show that groundwater elevations are an adequate proxy for groundwater storage. The data presented on Figure 8-6 and Figure 8-7 are used to establish groundwater elevation as proxies for groundwater in storage for the portion of the Subbasin that is not seawater intruded.

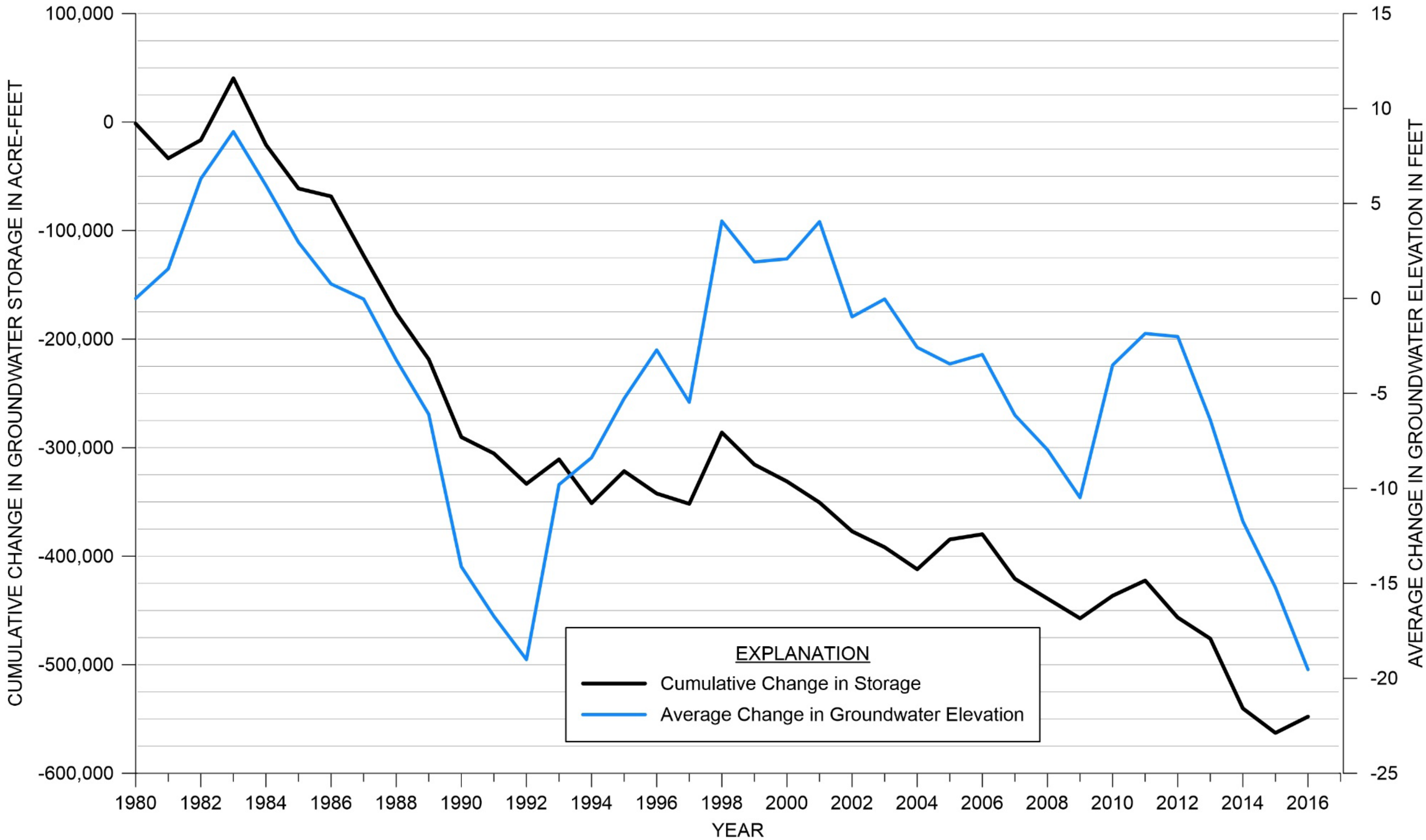


Figure 8-6. Cumulative Change in Storage and Average Change in Groundwater Elevation in the 180/400-Foot Aquifer Subbasin

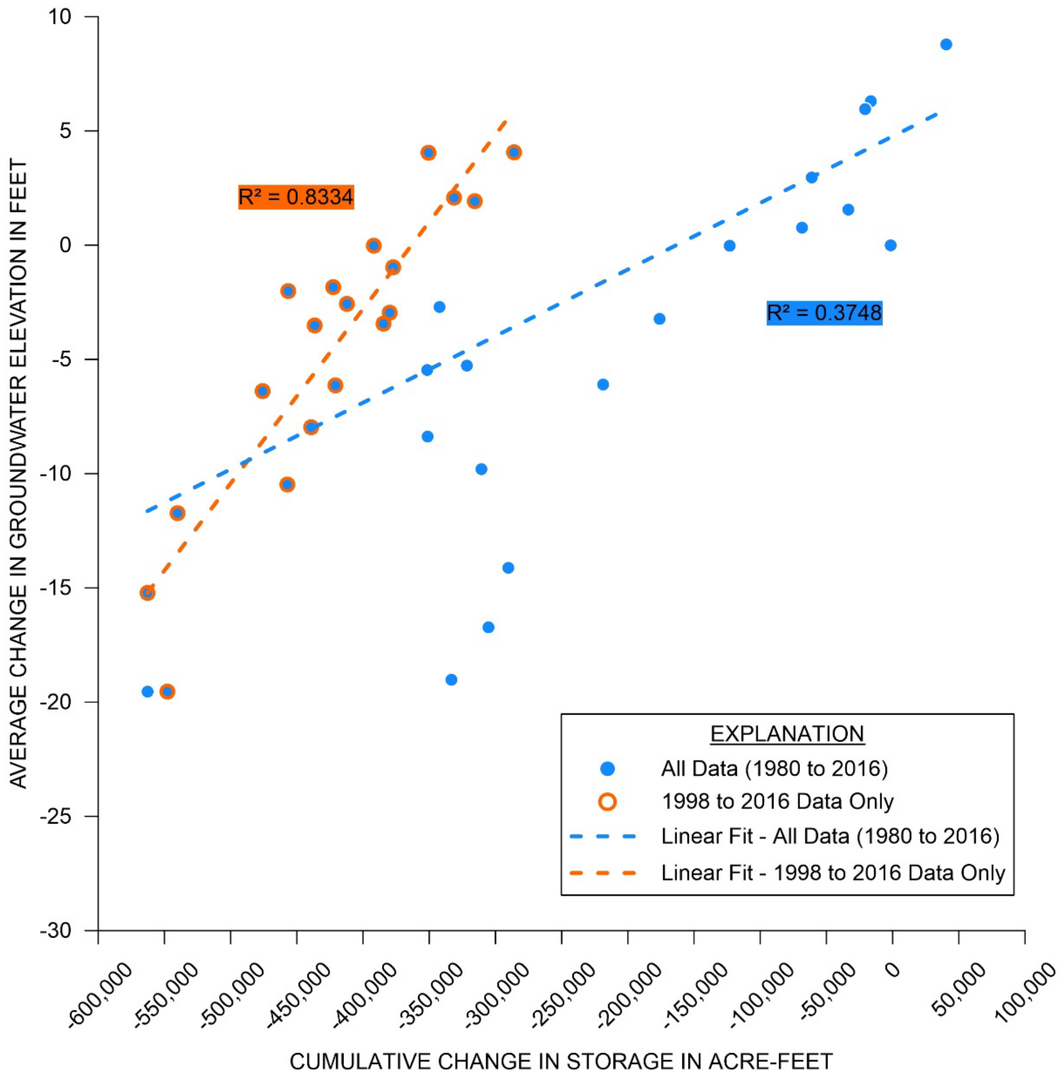


Figure 8-7. Correlation Between Cumulative Change in Storage and Average Change in Groundwater Elevation

The groundwater storage change due to changes in groundwater elevations is calculated based on the average groundwater elevation difference between the minimum threshold and measurable objectives multiplied by the area of the Subbasin that is not seawater intruded and a storage coefficient. The non-seawater intruded area in the Subbasin at the measurable objective is 84,200 acres. As described in Appendix 5B, the storage coefficient of 0.078 is used, based on an average of previous estimates of storage coefficients. Calculations based on the previous storage coefficient estimates result in a range from 41,000 AF to 138,000 AF. An average of the estimates is used here, resulting in a difference between the storage minimum threshold and measurable objective of 90,000 AF for the non-seawater intruded area.

The storage change due to seawater intrusion was estimated by calculating the volume of water in the 180-Foot and 400-Foot Aquifers that would transition from saline to fresh based on the location of the minimum threshold and measurable objective 500-mg/L chloride isocontour locations. Approximately 334,000 acre-feet of usable water would be added to storage in the 180-Foot Aquifer if the 500-mg/L isocontour is moved to the measurable objective location. Approximately 202,000 acre-feet of usable water would be added to storage in the 400-Foot Aquifer if the 500-mg/L isocontour is moved to the measurable objective location. The total increase in usable stored water due to reduced seawater intrusion is therefore 536,000 AF.

Total change in groundwater storage between minimum threshold conditions and measurable objective conditions is the sum of the storage change due to groundwater elevations and the storage change due to seawater intrusion. The previous storage coefficient estimates result in a range from 577,000 to 674,000 AF for the amount of water in storage between minimum threshold and measurable objective groundwater conditions . The average of this range, 626,000 AF, is used to set the minimum threshold for reduction of groundwater storage. A storage coefficient of 0.078 will be used to adequately compare current conditions to the minimum threshold. The groundwater storage change due to a reduction in seawater intrusion accounts for about 86% of the total average storage change between minimum thresholds and measurable objective conditions; change in water levels account for only 14% of the change in storage. Therefore, the choice of storage coefficient only has a small influence on the SMC.

The Deep Aquifers were not included in this calculation, which is a data gap that will continued to be addressed during GSP implementation. This estimate will be refined as more data are gathered and other projects are implemented.

8.7.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The minimum threshold for reduction in groundwater storage is a single value for the entire Subbasin. Therefore, the concept of potential conflict between minimum thresholds at different locations is not applicable.

The reduction in groundwater storage minimum threshold could influence other sustainability indicators. The reduction in groundwater storage minimum threshold is selected to avoid undesirable results for other sustainability indicators, as outlined below.

- **Chronic lowering of groundwater levels.** The reduction in storage minimum threshold is calculated from the groundwater level minimum thresholds. Therefore, the minimum threshold for reduction in groundwater storage is consistent with, and will not result in, a significant or unreasonable impact on groundwater elevations.
- **Seawater intrusion.** The reduction in storage minimum threshold is based on the groundwater level minimum thresholds, which is meant to keep groundwater elevation above historical lows and does not promote additional pumping. Therefore, the minimum threshold for reduction in groundwater storage will not result in a significant increase in seawater intrusion. However, keeping reduction of groundwater storage at the minimum threshold may not, by itself, stop all seawater intrusion.
- **Degraded water quality.** The reduction in storage minimum threshold is established to maintain groundwater elevations above historical lows. The change in storage minimum threshold will not directly lead to any additional degradation of groundwater quality.
- **Land subsidence.** The reduction in storage minimum threshold is established to maintain groundwater elevations above historical lows. Therefore, the change in storage minimum threshold will not induce any additional dewatering of clay-rich sediments; and will not induce additional subsidence.
- **Depletion of ISW.** The reduction in storage minimum threshold is established to maintain groundwater elevations above historical lows. Therefore, the change in storage minimum threshold will not induce additional depletion of ISW.

8.7.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The 180/400-Foot Aquifer Subbasin has 4 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Eastside Subbasin to the east

- The Forebay Subbasin to the south
- The Monterey Subbasin to the southwest

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The Langley, Eastside, Forebay, and Monterey Subbasins have submitted GSPs in January 2022. Minimum thresholds for the 180/400-Foot Aquifer Subbasin have been reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

The Pajaro Valley Basin occurs directly to the north. Because the minimum thresholds in the 180/400-Foot Aquifer Subbasin are set at the long-term future sustainable yield, it is likely that the minimum thresholds will not prevent the Pajaro Basin from achieving and maintaining sustainability. The SVBGSA will coordinate closely with the Pajaro Valley Water Agency as it sets minimum thresholds to ensure that the basins do not prevent each other from achieving sustainability.

8.7.2.4 Effect on Beneficial Uses and Users

The reduction in groundwater storage minimum threshold might limit the amount of groundwater pumping in the Subbasin. Limiting pumping may impact the beneficial uses and users of the Subbasin.

Agricultural land uses and users. Limiting the amount of groundwater pumping may limit agricultural production or restrict options for crops that can be grown in the Subbasin by reducing the amount of available water. Agricultural lands that are currently not irrigated may be particularly impacted because the additional groundwater pumping needed to irrigate these lands could remove groundwater from storage until it is below the minimum threshold.

Urban land uses and users. Limiting the amount of groundwater pumping may increase the cost of water for municipal users in the Subbasin because municipalities may need to find other, more expensive water sources.

Domestic land uses and users. The change in storage minimum threshold is based on groundwater level minimum thresholds that protect most domestic wells. Therefore, the minimum threshold will likely have an overall beneficial effect on existing domestic land uses by protecting the ability to pump from domestic wells.

Ecological land uses and users. Limiting the amount of pumping may generally benefit the environmental groundwater uses. Maintaining historical amounts of groundwater in the Subbasin maintains groundwater supplies for environmental purposes at levels similar to historical levels.

8.7.2.5 Relation to State, Federal, or Local Standards

No federal, state, or local standards exist for reductions in groundwater storage.

8.7.2.6 Method for Quantitative Measurement of Minimum Threshold

The amount of groundwater in storage will be calculated by calculating the change between groundwater elevation contour maps. The change in storage estimates will also be checked every 5 years when the SVIHM model is updated.

8.7.3 Measurable Objectives

> *The measurable objective for reduction in groundwater storage measurable objective is 0 when groundwater levels and seawater intrusion are at their measurable objectives.*

Since the goal is to manage to the measurable objective, additional water in storage is needed until groundwater elevations are at their measurable objectives.

8.7.3.1 Methodology for Setting Measurable Objectives

The measurable objective for reduction in groundwater storage was calculated as described in Section 8.6.2.1.

8.7.3.2 Interim Milestones

The reduction in storage interim milestones are shown in Table 8-4 for each of the 5-year intervals, consistent with the minimum thresholds and the measurable objectives. At 2017 groundwater elevations, the groundwater in storage is about -20,000 AF below the minimum threshold, to reach the measurable objective a gain of 161,400 AF in groundwater storage needs to occur every 5 years until 2040. At current, 2020, groundwater elevations the groundwater in storage is approximately 43,500 AF below the minimum threshold.

Table 8-4. Reduction in Groundwater Storage Interim Milestones

Gain in Storage needed to Reach Measurable Objective (AF)	At Current Conditions (2020)	At Interim Milestone Year 2025	At Interim Milestone Year 2030	At Interim Milestone Year 2035	At Measurable Objective Year 2040
5-year incremental change	-669,100	161,400	161,400	161,400	0
Cumulative change	-669,100	-484,200	-322,800	-161,400	0

8.7.4 Undesirable Results

8.7.4.1 Criteria for Defining Reduction in Groundwater Storage Undesirable Results

The reduction in groundwater storage undesirable result is:

There is an exceedance of the minimum threshold.

Since the GSP addresses long-term groundwater sustainability, exceedances of groundwater storage minimum thresholds during a drought do not constitute an undesirable result. Pursuant to SGMA Regulations (California Water Code § 10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater storage may temporarily exceed minimum thresholds during droughts, and do not constitute an undesirable result, as long as groundwater levels rebound.

Under current conditions, there is an undesirable result for reduction in groundwater storage because the minimum threshold is exceeded by 8,500 AF.

8.7.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result for the reduction in groundwater storage sustainability indicator include the following:

- **Expansion of agricultural or municipal pumping.** Additional agricultural or municipal pumping may result in lowered groundwater elevations that reduce groundwater storage to an undesirable result.
- **Expansion of *de minimis* pumping.** Pumping by *de minimis* users is not regulated under this GSP. Adding domestic *de minimis* pumpers in the Subbasin may result in low groundwater levels that reduce the groundwater storage below to an undesirable result.
- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought.** The undesirable result is established based on reasonable anticipated future climatic conditions and groundwater elevations. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater recharge and unanticipated high pumping rates that could reduce groundwater in storage to an undesirable result.

8.7.4.3 Effects on Beneficial Users and Land Use

The practical effect of the reduction in groundwater storage undesirable result is no chronic, long-term net change in groundwater storage. Therefore, beneficial uses and users will have access to a similar amount of water in storage that currently exists, and the undesirable result will not have an additional negative effect on the beneficial users and uses of groundwater.

8.8 Seawater Intrusion SMC

8.8.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable seawater intrusion in the Subbasin is defined as follows:

- Any seawater intrusion in the Subbasin is significant and unreasonable.

This significant and unreasonable condition was determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

8.8.2 Minimum Thresholds

> *The minimum threshold for seawater intrusion is defined as the 2017 extent of the 500 mg/L chloride concentration isocontour for the 180-Foot and 400-Foot Aquifers, and as the line defined by Highway 1 for the Deep Aquifers.*

Figure 8-8 and Figure 8-9 present the minimum threshold, shown in red, for seawater intrusion in the 180-Foot and 400-Foot Aquifers, respectively, as represented by the 2017 extent of the 500 mg/L chloride concentration isocontour. The purple lines on the two figures show the current 2020 extent of seawater intrusion in the 180-Foot and 400-Foot Aquifers.

Figure 8-10 shows the minimum threshold for the Deep Aquifers in red that is defined by Highway 1. There is no reported seawater intrusion in the Deep Aquifers.

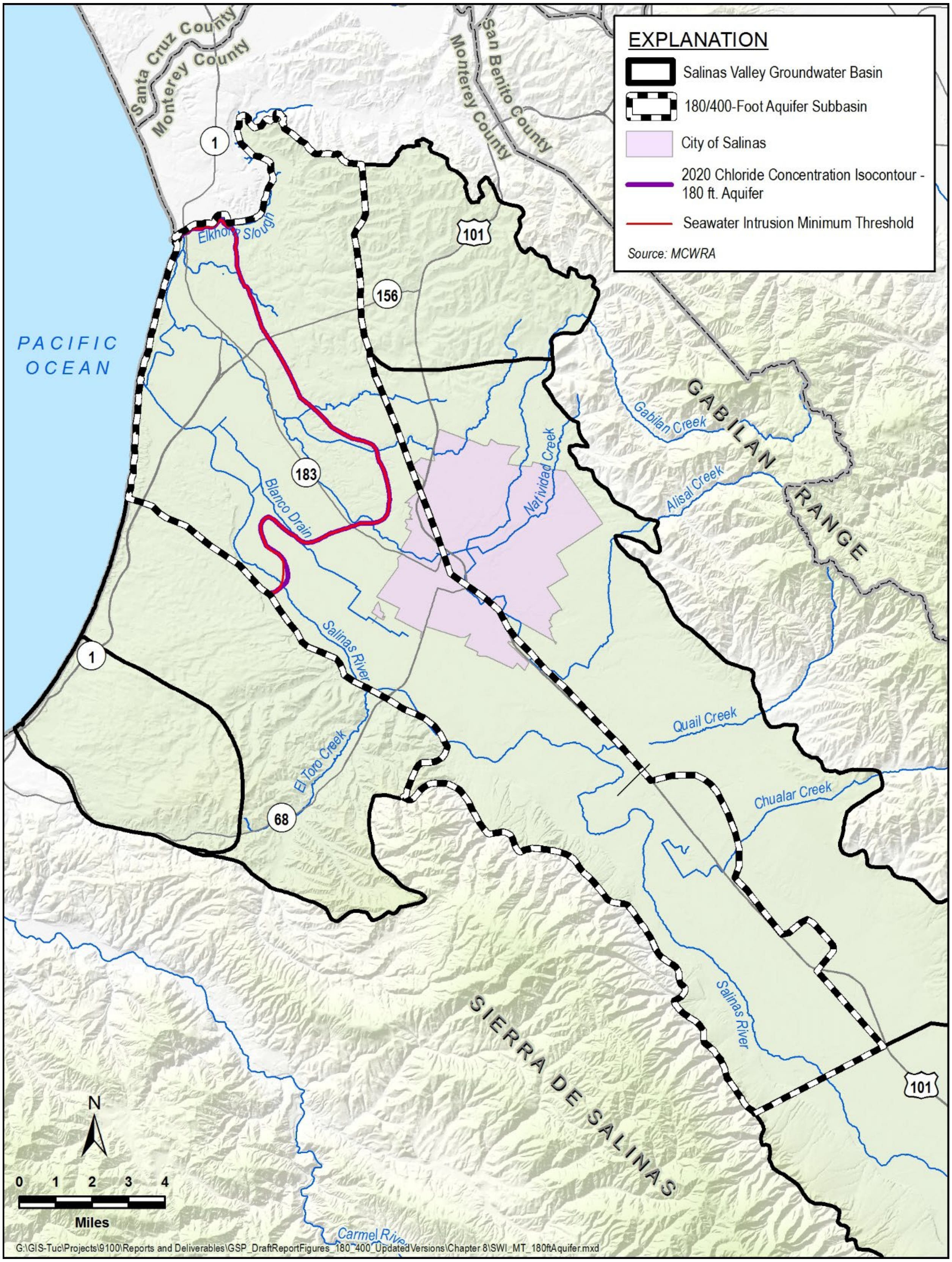


Figure 8-8. Minimum Threshold for Seawater Intrusion in the 180-Foot Aquifer

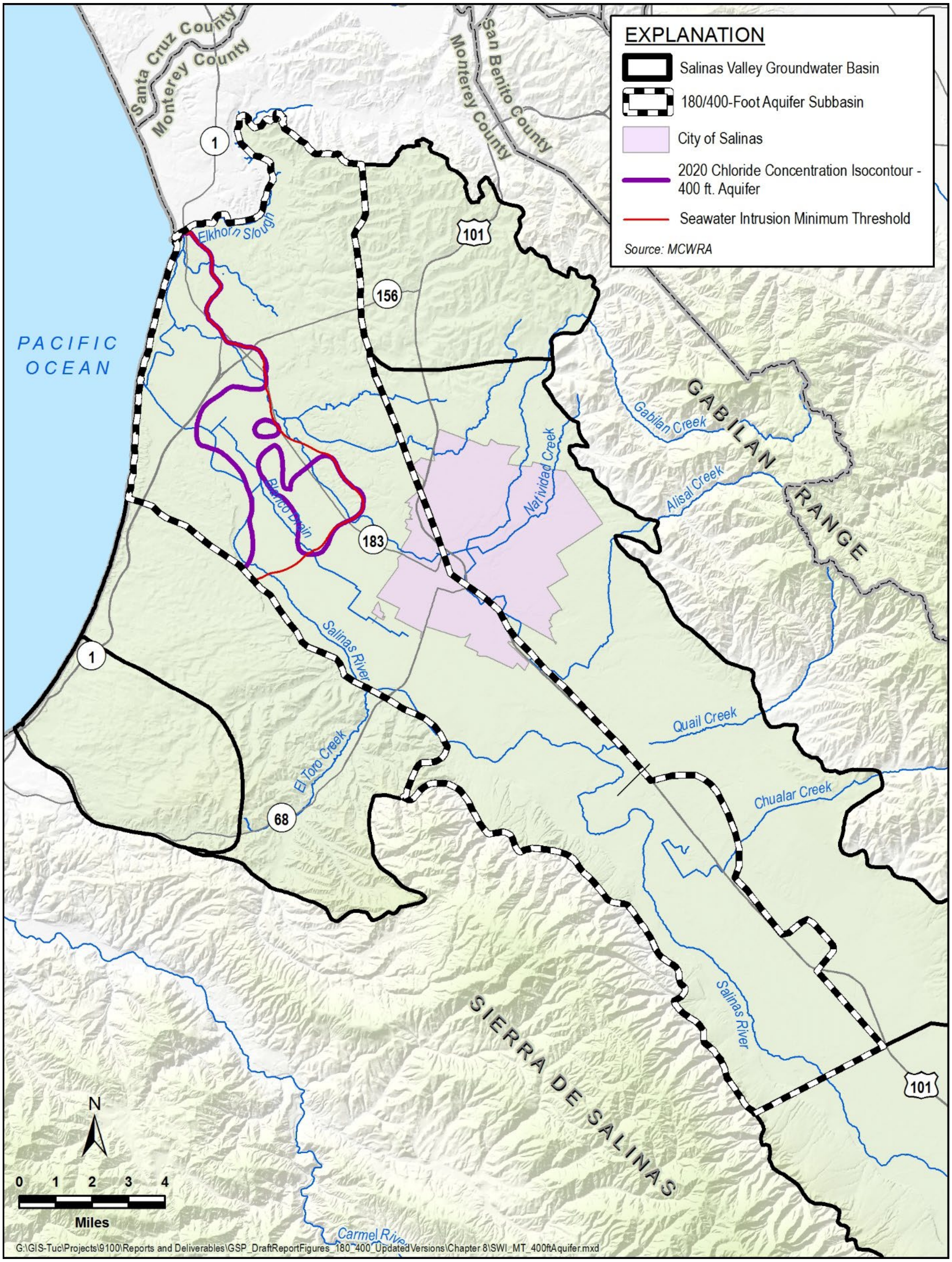


Figure 8-9. Minimum Threshold for Seawater Intrusion in the 400-Foot Aquifer

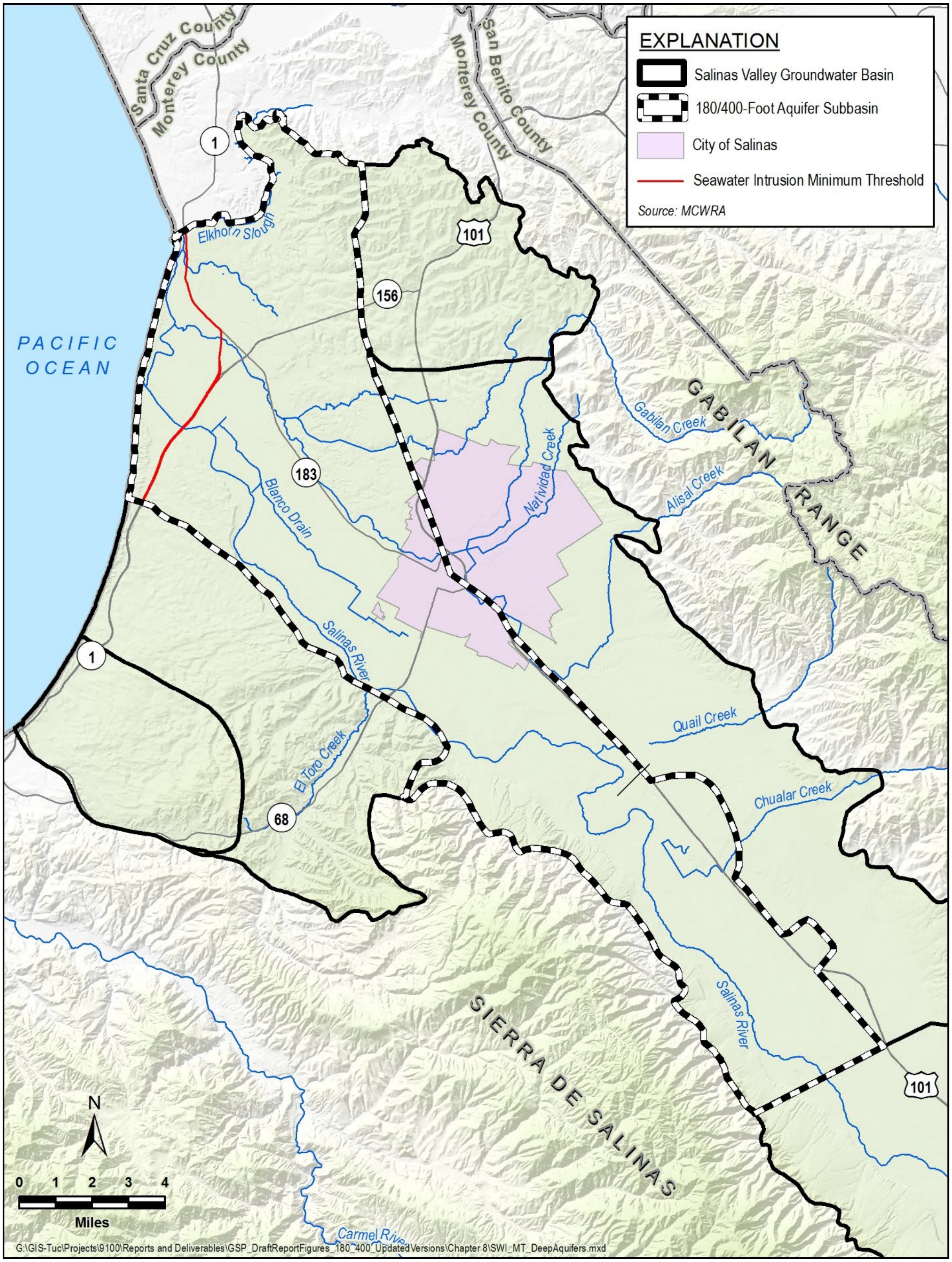


Figure 8-10. Minimum Threshold for Seawater Intrusion in the Deep Aquifers

8.8.2.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The seawater intrusion minimum threshold is based on seawater intrusion maps developed by MCWRA. MCWRA publishes estimates of the extent of seawater intrusion every year. The MCWRA maps define the extent of seawater intrusion as the inferred location of the 500 mg/L chloride isocontour. These maps are developed through analysis and contouring of groundwater quality measured at privately-owned wells and dedicated monitoring wells near the coast. The maps of current and historical seawater intrusion is included in Chapter 5.

The groundwater model that will be used to assess the effectiveness of projects and management actions on seawater intrusion specifically incorporates assumptions for future sea level rise. Therefore, the actions to avoid undesirable results will address sea level rise.

8.8.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The relationship between the seawater intrusion minimum threshold and other sustainability indicators are as follows:

- **Chronic lowering of groundwater levels.** The seawater intrusion minimum threshold does not promote additional pumping that could cause groundwater elevations to decrease in the Subbasin. Therefore, the seawater intrusion minimum threshold will not result in significant or undesirable groundwater elevations.

- **Reduction in groundwater storage.** The seawater intrusion minimum threshold does not promote additional pumping or lowering of groundwater elevations that will lead to a reduction in storage. Therefore, the seawater intrusion minimum threshold will not result in an exceedance of the groundwater storage minimum threshold.

- **Degraded water quality.** The seawater intrusion minimum threshold does not promote decreasing groundwater elevations that could lead to exceedances of groundwater quality minimum thresholds. In fact, the seawater intrusion minimum threshold may have a beneficial impact on groundwater quality by preventing increases in chloride concentrations in supply wells.

- **Land subsidence.** The seawater intrusion minimum threshold does not promote additional pumping that could cause subsidence. Therefore, the seawater intrusion minimum threshold will not result in an exceedance of the subsidence minimum threshold.

- **Depletion of ISW.** The seawater intrusion minimum threshold does not promote additional pumping or lower groundwater elevations adjacent to ISW. Therefore, the seawater intrusion minimum threshold will not result in a significant or unreasonable depletion of ISW.

8.8.2.3 Effect of Minimum Threshold on Neighboring Basins and Subbasin

The 180/400-Foot Aquifer Subbasin has 4 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Eastside Subbasin to the east
- The Forebay Subbasin to the south
- The Monterey Subbasin to the southwest

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The Langley, Eastside, Forebay, and Monterey Subbasins have submitted GSPs in January 2022. Minimum thresholds for the 180/400-Foot Aquifer Subbasin have been reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability. SVBGSA and MCWDGSA are close collaborators in developing and implementing their GSPs for the 180/400 and Monterey Subbasins. Although SVBGSA uses the seawater intrusion isocontour developed by MCWRA, and MCWDGSA uses an isocontour derived based on a combination of TDS and chloride measurements and geophysical data, the seawater across the Subbasin boundary will continue to be closely monitored to ensure both subbasin minimum thresholds are met. The MCWRA seawater intrusion isocontour for the Monterey Subbasin has notable data gaps, which is why MCWDGSA chose other data for more accuracy in the Monterey Subbasin. These data will be aligned during implementation with enhanced data-sharing and collaboration per conversations among SVBGSA, MCWDGSA, and MCWRA staff.

The Pajaro Valley Basin has submitted an alternative submittal. Because the minimum thresholds in the 180/400-Foot Aquifer Subbasin is no further intrusion, it is likely that the minimum threshold will not prevent the Pajaro Basin from achieving and maintaining sustainability. The SVBGSA will coordinate closely with the Pajaro Valley Water Agency as it sets minimum thresholds to ensure that the basins do not prevent each other from achieving sustainability.

8.8.2.4 Effects on Beneficial Users and Land Uses

Agricultural land uses and users. The seawater intrusion minimum threshold generally provides positive benefits to the Subbasin's agricultural water users. Preventing seawater intrusion into the Subbasin ensures that a supply of usable groundwater will exist for agricultural use.

Urban land uses and users. The seawater intrusion minimum threshold generally provides positive benefits to the Subbasin's urban water users. Preventing seawater intrusion into the Subbasin will help ensure an adequate supply of groundwater for municipal supplies.

Domestic land uses and users. The seawater intrusion minimum threshold generally provides positive benefits to the Subbasin's domestic water users. Preventing seawater intrusion into the Subbasin will help ensure an adequate supply of groundwater for domestic supplies.

Ecological land uses and users. Although the seawater intrusion minimum threshold does not directly benefit ecological uses, it can be inferred that the seawater intrusion minimum thresholds provide generally positive benefits to the Subbasin's ecological water uses. Preventing seawater intrusion into the Subbasin will help prevent unwanted high salinity levels from impacting ecological groundwater uses.

8.8.2.5 Relevant Federal, State, or Local Standards

No federal, state, or local standards exist for seawater intrusion.

8.8.2.6 Method for Quantitative Measurement of Minimum Threshold

Chloride concentrations are measured in groundwater samples collected from the MCWRA's seawater intrusion monitoring network. These samples are used to develop the inferred location of the 500 mg/L chloride isocontour. The methodology and protocols for collecting samples and developing the 500 mg/L chloride isocontour are detailed in Appendix 7B and Appendix 7C.

8.8.3 Measurable Objectives

> *The measurable objective for seawater intrusion is defined as the 500 mg/L chloride concentration isocontour as the line defined by Highway 1.*

8.8.3.1 Methodology for Setting Measurable Objectives

In the 180/400-Foot Subbasin, the measurable objective for the seawater intrusion SMC is the same as the line that defines Highway 1. This will improve the Subbasin's groundwater quality and provide access to usable groundwater to additional beneficial users. This measurable objective may be modified as the projects and actions to address seawater intrusion are refined. The methodology used to set measurable objectives is discussed in Section 8.8.2.1.

8.8.3.2 Interim Milestones

The interim milestones for seawater intrusion are:

1. 2025: identical to current conditions
2. 2030: one-third of the way to the measurable objective
3. 2035: two-thirds of the way to the measurable objective

These are only our initial estimates of interim milestones for seawater intrusion. The interim milestones will be refined using the Seawater Intrusion Model, in conjunction with the SVOM based on specific projects and management actions as project scoping progresses.

8.8.4 Undesirable Results

8.8.4.1 Criteria for Defining Seawater Intrusion Undesirable Results

The seawater intrusion undesirable result is a quantitative combination of chloride concentrations minimum threshold exceedances. There is only one minimum threshold for each of the three aquifers. Because even localized seawater intrusion is not acceptable, the basin-wide undesirable result is zero exceedances of minimum thresholds. For the Subbasin, the seawater intrusion undesirable result is:

> *Any exceedance of the minimum threshold, resulting in mapped seawater intrusion beyond the 2017 extent of the 500 mg/L chloride.*

8.8.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result include the following:

- Increased coastal pumping that could draw seawater more inland
- Unanticipated high sea level rise

8.8.4.3 Effects on Beneficial Users and Land Use

The primary detrimental effect on beneficial users and land uses from allowing seawater intrusion to increase in the Subbasin is that the pumped groundwater may become saltier. Thus, preventing further seawater intrusion into the Subbasin prevents greater impacts to domestic, municipal, and agricultural wells and associated land uses.

8.9 Degraded Water Quality SMC

8.9.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable changes in groundwater quality in the Subbasin are increases in a COC caused by a direct result of a GSA groundwater management action that either:

- Results in groundwater concentrations in a potable water supply well above an established MCL or SMCL, or
- Lead to significantly reduced crop production.

These significant and unreasonable conditions were determined based on input from the Subbasin Committee and discussions with GSA staff. These conditions were determined to be significant and unreasonable because groundwater quality in exceedance of these will cause a financial burden on groundwater users. Public water systems with COC concentrations above the MCL or SMCL are required to add treatment to the drinking water supplies or drill new wells. Agricultural wells with COCs that significantly reduce crop production will reduce grower's yields and profits.

8.9.2 Minimum Thresholds

> *The minimum thresholds for degraded water quality are zero additional exceedances of the regulatory drinking water standards (potable supply wells) or Basin Plan objectives (irrigation supply wells) beyond those observed in 2017 for groundwater quality constituents of concern.*

The minimum thresholds for DDW public water system supply wells and ILRP on-farm domestic wells reflect California's Title 22 drinking water standards. The minimum thresholds for irrigation supply wells are based on the water quality objectives listed in the Basin Plan (CCRWQCB, 2019). The minimum threshold values for the COC for all 3 sets of wells are provided in Table 8-5and are based on data up to 2017. Full discussion of these current conditions is included in Chapter 5. Because the minimum thresholds reflect no additional exceedances, the minimum thresholds are set to the number of existing exceedances. Surpassing the number of existing exceedances for any of the listed constituents will lead to an undesirable result. Not all wells in the monitoring network are sampled for every COC.

Minimum thresholds are established based on existing groundwater quality in 2017. Since 2017, there has only been one new additional COC in the Subbasin. Manganese has been added to the list of COC for ILRP irrigation supply wells, because there was no exceedance of manganese in

2017 the minimum threshold for this new COC is set to 0. DDW wells and ILRP on-farm domestic wells do not have any new COC.

Table 8-5. Degradation of Groundwater Quality Minimum Thresholds

Constituent of Concern (COC)	Minimum Threshold/Measurable Objective – Number of Wells Exceeding Regulatory Standard from latest sample (April 1974 to December 2017)
DDW Wells	
1,2 Dibromo-3-chloropropane	9
1,2,3-Trichloropropane	11
1,2,4-Trichlorobenzene	1
Aluminum	1
Arsenic	1
Benzo(a)Pyrene	2
Chloride	2
Di(2-ethylhexyl)phthalate	2
Dinoseb	2
Fluoride	1
Heptachlor	2
Hexachlorobenzene	2
Iron	2
Manganese	1
Methyl-tert-butyl ether (MTBE)	3
Nitrate (as nitrogen)	4
Selenium	2
Specific Conductance	2
Tetrachloroethene	1
Total Dissolved Solids	4
Vinyl Chloride	34
ILRP On-Farm Domestic Wells	
Chloride	9
Iron	7
Manganese	1
Nitrite	1
Nitrate (as nitrogen)	36
Nitrate + Nitrite (sum as nitrogen)	4
Specific Conductance	35
Sulfate	2
Total Dissolved Solids	33
ILRP Irrigation Supply Wells	
Chloride	19
Iron	2
Manganese	0

8.9.2.1 Information and Methodology Used to Establish Water Quality Minimum Thresholds and Measurable Objectives

As noted in the GSP Regulations, minimum thresholds are based on a degradation of groundwater quality, not an improvement of groundwater quality (23 California Code of Regulations § 354.28 (c)(4)). Therefore, this GSP is designed to avoid taking any action that may inadvertently move groundwater constituents already in the Subbasin in such a way that the constituents have a significant and unreasonable impact that would not otherwise occur. COC must meet 2 criteria:

1. They must have an established level of concern such as an MCL or SMCL for drinking water, or a level known to affect crop production.
2. They must have been found in the Subbasin at levels above the level of concern.

Based on the review of groundwater quality in Chapter 5, the COC that may affect drinking water supply wells include those for DDW and ILRP on-farm domestic wells listed in

Table 8-5. The COC that are known to cause reductions in crop production are those for ILRP irrigation supply wells listed in

Table 8-5.

As discussed in Chapter 7, wells for 3 separate water quality monitoring networks were reviewed and used for developing SMC:

- Public water system supply wells regulated by the SWRCB DDW.
- On-farm domestic wells monitored as part of CCRWQCB ILRP. This dataset was obtained from the SWRCB through the GAMA groundwater information system. The ILRP data were separated into 2 data sets, 1 for on-farm domestic wells and the other for irrigation supply wells (discussed below) for purposes of developing initial draft minimum thresholds and measurable objectives for each type of well. The monitoring well network for the ILRP will change when the monitoring network for Ag Order 4.0 is finalized. At that time, the new ILRP domestic monitoring network will be incorporated into this GSP, replacing the current network, for water quality monitoring.
- Irrigation supply wells monitored as part of ILRP. As mentioned above, this dataset was obtained from the SWRCB through the GAMA groundwater information system. Like the on-farm domestic well dataset, the IRLP irrigation supply monitoring network will change when Ag Order 4.0 is finalized.

Each of these well networks are monitored for a different set of water quality parameters. Furthermore, some groundwater quality impacts are detrimental to only certain networks. For example, high nitrates are detrimental to public water system supply wells and on-farm domestic wells but are not detrimental to irrigation supply wells. The constituents monitored in each well network are indicated by an X in Table 8-6. An X does not necessarily indicate that the constituents have been found above the regulatory standard in that monitoring network.

Table 8-6. Summary of Constituents Monitored in Each Well Network

Constituent	Public Water System Supply	On-Farm Domestic[1]	Irrigation Supply
Silver	X		
Aluminum	X		
Alachlor	X		
Arsenic	X		
Atrazine	X		
Boron	X	X	X
Barium	X		
Beryllium	X		
Lindane	X		
Di(2-ethylhexyl) phthalate	X		
Bentazon	X		
Benzene	X		
Benzo(a)Pyrene	X		
Toluene	X		
Cadmium	X		
Chlordane	X		
Chloride	X	X	X
Chlorobenzene	X		
Cyanide	X		
Chromium	X		
Carbofuran	X		
Carbon Tetrachloride	X		
Copper	X		
Dalapon	X		
1,2 Dibromo-3-chloropropane	X		
1,1-Dichloroethane	X		
1,2-Dichloroethane	X		
1,2-Dichlorobenzene	X		
1,4-Dichlorobenzene	X		
1,1-Dichloroethylene	X		
cis-1,2-Dichloroethylene	X		
trans-1,2-Dichloroethylene	X		
Dichloromethane (a.k.a. methylene chloride)	X		
1,2-Dichloropropane	X		
Dinoseb	X		
Diquat	X		
Di(2-ethylhexyl)adipate	X		
Ethylbenzene	X		
Endrin	X		
Fluoride	X		
Trichlorofluoromethane	X		
1,1,2-Trichloro-1,2,2-Trifluoroethane	X		
Iron	X	X	X
Foaming Agents (MBAS)	X		

Constituent	Public Water System Supply	On-Farm Domestic[1]	Irrigation Supply
Glyphosate	X		
Hexachlorocyclopentadiene	X		
Hexachlorobenzene	X		
Heptachlor	X		
Mercury	X		
Manganese	X	X	X
Molinate	X		
Methyl-tert-butyl ether (MTBE)	X		
Methoxychlor	X		
Nickel	X		
Nitrite	X	X	
Nitrate (as nitrogen)	X	X	
Nitrate + Nitrite (sum as nitrogen)		X	
Oxamyl	X		
1,1,2,2-Tetrachloroethane	X		
Perchlorate	X		
Polychlorinated Biphenyls	X		
Tetrachloroethene	X		
Pentachlorophenol	X		
Picloram	X		
Antimony	X		
Specific Conductance	X	X	
Selenium	X		
2,4,5-TP (Silvex)	X		
Simazine	X		
Sulfate	X	X	
Styrene	X		
1,1,1-Trichloroethane	X		
1,1,2-Trichloroethane	X		
1,2,4-Trichlorobenzene	X		
Trichloroethene	X		
1,2,3-Trichloropropane	X		
Total Dissolved Solids	X	X	
Thiobencarb	X		
Thallium	X		
Toxaphene	X		
Vinyl Chloride	X		
Xylenes	X		
Zinc	X		

[1]Basin plan states domestic wells are monitored for Title 22 constituents; however, GAMA groundwater information system only provides data for the constituents listed above.

8.9.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

Preventing degradation of groundwater quality may affect other sustainability indicators or may limit activities needed to achieve minimum thresholds for other sustainability indicators as described below:

- **Chronic lowering of groundwater levels.** The degradation of groundwater quality minimum thresholds could influence groundwater level minimum thresholds by limiting the types of water that can be used for recharge to maintain or raise groundwater elevations. Water used for recharge cannot exceed any groundwater quality standards. In addition, a change in groundwater elevations may cause a change in groundwater flow direction which in turn could cause poor water quality to migrate into areas of good water quality.

- **Reduction in groundwater storage.** The degradation of groundwater quality minimum thresholds do not promote lower groundwater elevations. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the groundwater storage minimum threshold.

- **Seawater intrusion.** The degradation of groundwater quality minimum thresholds do not promote additional pumping that could exacerbate seawater intrusion. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the seawater intrusion minimum threshold.

- **Land subsidence.** The degradation of groundwater quality minimum thresholds do not promote additional pumping that could cause subsidence. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the subsidence minimum threshold.

- **Depletion of ISW.** The degradation of groundwater quality minimum thresholds do not promote additional pumping or lower groundwater elevations adjacent to ISW. Therefore, the groundwater quality minimum thresholds will not result in a significant or unreasonable depletion of ISW.

8.9.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The 180/400-Foot Aquifer Subbasin has 4 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north

- The Eastside Subbasin to the east

- The Forebay Subbasin to the south

- The Monterey Subbasin to the southwest

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The Langley, Eastside, Forebay, and Monterey Subbasins have submitted GSPs in January 2022. Minimum thresholds for the 180/400-Foot Aquifer Subbasin have been reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

The Pajaro Valley Basin lies directly to the north of the Subbasin. Because the minimum thresholds in the 180/400-Foot Aquifer Subbasin are to prevent degradation of water quality, it is likely that the minimum thresholds will not prevent the Pajaro Basin from achieving and maintaining sustainability. The SVBGSA will coordinate closely with the Pajaro Valley Water Agency as it sets minimum thresholds to ensure that the basins do not prevent each other from achieving sustainability.

8.9.2.4 Effect on Beneficial Uses and Users

Agricultural land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's agricultural water users. Preventing any GSA actions that would result in additional agricultural supply wells exceeding levels that could reduce crop production ensures that a supply of usable groundwater will exist for beneficial agricultural use.

Urban land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's urban water users. Preventing any GSA actions that would result in COC in additional drinking water supply wells exceeding MCLs or SMCLs ensures adequate groundwater quality for public water system supplies.

Domestic land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's domestic water users. Preventing any GSA actions that would result in COC in additional drinking water supply wells exceeding MCLs or SMCLs ensures adequate groundwater quality for domestic supplies.

Ecological land uses and users. Although the groundwater quality minimum thresholds do not directly benefit ecological uses, it can be inferred that the degradation of groundwater quality minimum thresholds provide generally positive benefits to the Subbasin's ecological water uses. Preventing any GSA actions that would result in COC migrating will prevent unwanted contaminants from impacting ecological groundwater uses.

8.9.2.5 Relation to State, Federal, or Local Standards

The groundwater quality minimum thresholds specifically incorporate state and federal standards for drinking water and basin plan objectives.

8.9.2.6 Method for Quantitative Measurement of Minimum Thresholds

Degradation of groundwater quality minimum thresholds will be directly measured from existing public water system supply wells, on-farm domestic wells, and irrigation supply wells. Groundwater quality will be measured with SWRCB GAMA groundwater information system data submitted through existing monitoring programs—DDW and ILRP—as discussed in Chapter 7.

- Exceedances of MCLs and SMCLs in public water system supply wells will be monitored with annual water quality data submitted to the DDW.
- Exceedances of MCLs and SMCLs in on-farm domestic wells will be monitored with ILRP data.
- Exceedances of water quality objectives for crop production will be monitored with ILRP data.

Initially, the review of drinking water MCLs, SMCLs, and water quality objectives that maintain adequate crop production will be centered around the COC identified above. If during review of the water quality data additional constituents appear to exceed any of the regulatory standards, these additional constituents will be added to the list of COC for the Subbasin.

8.9.3 Measurable Objectives

The measurable objectives for degradation of groundwater quality represent target groundwater quality distributions in the Subbasin. SGMA does not mandate the improvement of groundwater quality. Therefore, the measurable objectives are based on no groundwater quality degradation and are identical to the minimum thresholds, as defined in 8.9.2.1.

> *The measurable objectives for degraded water quality are zero additional exceedances of the regulatory drinking water standards (potable supply wells) or Basin Plan objectives (irrigation supply wells) beyond those observed in 2017 for groundwater quality constituents of concern.*

8.9.3.1 Methodology for Setting Measurable Objectives

As described above, measurable objectives are set to be identical to the minimum thresholds and therefore follow the same method as detailed in Section 8.9.2.1.

8.9.3.2 Interim Milestones

There is no anticipated degradation of groundwater quality during GSP implementation that results from the implementation of projects and actions as described in Chapter 9. Therefore, the expected interim milestones are identical to current conditions.

8.9.4 Undesirable Results

8.9.4.1 Criteria for Defining Undesirable Results

The degradation of groundwater quality becomes an undesirable result when a quantitative combination of groundwater quality minimum thresholds is exceeded. For the Subbasin, the exceedance of minimum thresholds is unacceptable as a direct result of GSP implementation. Some groundwater quality changes are expected to occur independent of SGMA activities; because these changes are not related to SGMA activities, nor GSA management, they do not constitute an undesirable result. Additionally, SGMA states that GSAs are not responsible for addressing water quality degradation that was present before January 1, 2015 (California Water Code § 10727.2(b)(4)). Therefore, the degradation of groundwater quality reaches an undesirable result when:

> *Future or new minimum thresholds exceedances are caused by a direct result of GSA groundwater management action(s), including projects or management actions and regulation of groundwater extraction.*

The groundwater level SMC is designed and intended to help protect groundwater quality. Setting the groundwater level minimum thresholds at or above historical lows assures that no new depth dependent constituents of water quality concern are mobilized. The GSA may pursue projects or management actions to ensure that groundwater levels do not fall below groundwater level minimum thresholds.

This undesirable result recognizes there is an existing regulatory framework in the form of the California Porter Cologne Act and the federal Clean Water Act that addresses water quality management; and considers existing federal, state, and local groundwater quality standards, which were used in the development of minimum thresholds in the GSP. SVBGSA is not responsible for enforcing drinking water requirements or for remediating violations of those requirements that were caused by others (Moran and Belin, 2019). The existing regulatory regime does not require nor obligate the SVBGSA to take any affirmative actions to manage or control existing groundwater quality. However, SVBGSA is committed to monitoring and disclosing changes in groundwater quality and ensuring its groundwater management actions do not cause drinking water or irrigation water to be unusable.

SVBGSA will work closely with the Central Coast Regional Water Quality Control Board and other entities that have regulatory authority over water quality. SVBGSA will lead the Water Quality Coordination Group, as described in Chapter 9, which includes meeting annually with these partner agencies to review the status of water quality data and discuss any action needed to address water quality degradation.

If the GSA has not implemented any groundwater management actions in the Subbasin, including projects, management actions, or pumping management, no such management actions constitute an undesirable result. If minimum thresholds are exceeded after the GSA has implemented actions in the Subbasin, the GSA will review groundwater quality and groundwater gradients in and around the project areas to assess if the exceedance resulted from GSA actions to address sustainability indicators, or was independent of GSA activities. Both the implementation of actions and assessment of exceedances will occur throughout the GSP timeframe of 50 years as required by SGMA. The general approach to assess if a minimum threshold exceedance is due to GSA action will include:

- If no projects, management actions, or other GSP implementation actions have been initiated in a subbasin, or near the groundwater quality impact, then the impact was not caused by any GSA action.
- Many projects will likely include a new monitoring network. If data from the project-specific monitoring network do not show groundwater quality impacts, this will suggest that the impact was not caused by any GSA actions.
- If a GSA undertakes a project that changes groundwater gradients, moves existing constituents, or results in the exceedance of minimum thresholds, SVBGSA will undertake a more rigorous technical study to assess local, historical groundwater quality distributions, and the impact of the GSA activity on that distribution.
- For SGMA compliance, undesirable results for groundwater quality are not caused by (1) lack of action; (2) GSA required reductions in pumping; (3) exceedances in groundwater quality minimum thresholds that occur, if there are fewer exceedances than if there had been a lack of management; (4) exceedances in groundwater quality minimum thresholds that would have occurred independent of projects or management actions implemented by the GSA; (5) past harm.

8.9.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result include the following:

- **Required Changes to Subbasin Pumping**. If the location and rates of groundwater pumping change as a result of projects implemented under the GSP, these changes could alter hydraulic gradients and associated flow directions, and cause movement of one of the COC towards a supply well at concentrations that exceed relevant standards.

- **Groundwater Recharge**. Active recharge of imported water or captured runoff could modify groundwater gradients and move one of the COC towards a supply well in concentrations that exceed relevant limits.

- **Recharge of Poor-Quality Water**. Recharging the Subbasin with water that exceeds an MCL, SMCL, or level that reduces crop production could lead to an undesirable result.

8.9.4.3 Effects on Beneficial Users and Land Use

The undesirable result for degradation of groundwater quality is avoiding groundwater degradation caused by a direct result of a GSA groundwater management action. Therefore, the undesirable result will not impact the use of groundwater and will not have a negative effect on the beneficial users and uses of groundwater. This undesirable result does not apply to groundwater quality changes that occur due to other causes.

8.10 Land Subsidence SMC

8.10.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable subsidence in the Subbasin is defined as follows:

- Any inelastic land subsidence that is caused by lowering of groundwater elevations in the Subbasin or

- Any inelastic subsidence that causes an increase of flood risk.

These significant and unreasonable conditions were determined based on input collected during Subbasin Committee meetings and discussions with GSA staff.

Subsidence can be elastic or inelastic. Elastic subsidence is the small, reversible lowering and rising of the ground surface. Inelastic subsidence is generally irreversible. This SMC only concerns inelastic subsidence.

8.10.2 Minimum Thresholds

> *The minimum threshold for subsidence is zero net long-term subsidence, with no more than 0.1 foot per year of estimated land movement measured subsidence between June of one year and June of the subsequent year to account for InSAR measurement errors.*

The most current 2020 subsidence data, described in Chapter 5, does not exceed the subsidence minimum threshold.

8.10.2.1 Information Used and Methodology for Establishing Subsidence Minimum Thresholds

The minimum threshold was established using InSAR data available from DWR. The general minimum threshold is for no long-term irreversible subsidence in the Subbasin. The InSAR data provided by DWR, however, is subject to measurement error. DWR stated that, on a statewide level, for the total vertical displacement measurements between June 2015 and June 2019, the errors are as follows (DWR, 2019, personal communication):

1. The error between InSAR data and continuous GPS data is 16 mm (0.052 feet) with a 95% confidence level.
2. The measurement accuracy when converting from the raw InSAR data to the maps provided by DWR is 0.048 feet with 95% confidence level.

By adding errors 1 and 2, the combined error is 0.1 foot. While this is not a robust statistical analysis, it does provide an estimate of the potential error in the InSAR maps provided by DWR.

Additionally, the InSAR data provided by DWR reflects both elastic and inelastic subsidence. While it is difficult to compensate for elastic subsidence, visual inspection of monthly changes in ground elevations suggest that elastic subsidence is largely seasonal. To minimize the influence of elastic subsidence on the assessment of long-term, permanent subsidence, changes in ground level will only be measured annually from June of one year to June of the following year.

8.10.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The subsidence minimum threshold has little or no impact on other minimum thresholds, as described below:

- **Chronic lowering of groundwater levels.** The land subsidence minimum threshold will not decrease groundwater elevations and therefore will not result in significant or unreasonable groundwater elevations.

- **Reduction in groundwater storage.** The land subsidence minimum threshold will not change the amount of pumping and therefore will not result in a significant or unreasonable change in groundwater storage.

- **Seawater intrusion.** The land subsidence minimum threshold does not promote additional pumping that could exacerbate seawater intrusion. Therefore, the subsidence minimum threshold will not induce additional advancement of seawater intrusion along the coast.

- **Degraded water quality.** The land subsidence minimum threshold does not promote decreasing groundwater elevations that lead to exceedance of water quality minimum thresholds and therefore will not result in significant of unreasonable degradation of water quality.

- **Depletion of ISW.** The land subsidence minimum threshold does not promote additional pumping or lower groundwater elevations adjacent to ISW. Therefore, the subsidence minimum threshold will not result in a significant or unreasonable depletion of ISW.

8.10.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The 180/400-Foot Aquifer Subbasin has 4 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Eastside Subbasin to the east
- The Forebay Subbasin to the south
- The Monterey Subbasin to the southwest

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The Langley, Eastside, Forebay, and Monterey Subbasins have submitted GSPs in January 2022. Minimum thresholds for the 180/400-Foot Aquifer Subbasin have been reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

The Pajaro Valley Basin lies directly to the north of the Subbasin. Because the minimum thresholds in the 180/400-Foot Aquifer Subbasin is zero subsidence, it is likely that the minimum thresholds will not prevent the Pajaro Basin from achieving and maintaining sustainability. The SVBGSA will coordinate closely with the Pajaro Valley Water Agency as it sets minimum thresholds to ensure that the basins do not prevent each other from achieving sustainability.

8.10.2.4 Effects on Beneficial Uses and Users

The subsidence minimum threshold is set to prevent any long-term inelastic subsidence. Available data indicate that there is currently no long-term subsidence occurring in the Subbasin, and pumping limits are already required by minimum thresholds for other sustainability indicators. The subsidence minimum threshold does not impact infrastructure and does not require any additional reductions in pumping, and there is no negative impact on any beneficial user.

8.10.2.5 Relation to State, Federal, or Local Standards

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

8.10.2.6 Method for Quantitative Measurement of Minimum Threshold

The minimum thresholds will be assessed using DWR-supplied InSAR data.

8.10.3 Measurable Objectives

The measurable objective for subsidence represents a target subsidence rates in the Subbasin. Because the minimum threshold of zero net long-term subsidence is the best achievable outcome, the measurable objective is identical to the minimum threshold.

> *The measurable objective for land subsidence is zero net long-term subsidence, with no more than 0.1 foot per year of estimated land movement measured subsidence to account for InSAR measurement errors.*

8.10.3.1 Methodology for Setting Measurable Objectives

The measurable objective will be assessed using DWR-supplied InSAR data.

8.10.3.2 Interim Milestones

The subsidence measurable objective is set at current conditions of no long-term subsidence. There is no change between current conditions and sustainable conditions. Therefore, the interim milestones are identical to current conditions of zero long-term subsidence, and annual measurements of no more than 0.1 foot of subsidence per year.

8.10.4 Undesirable Results

8.10.4.1 Criteria for Defining Undesirable Results

By regulation, the land subsidence undesirable result is a quantitative combination of subsidence minimum threshold exceedances. For the Subbasin, no long-term subsidence is acceptable. Therefore, the land subsidence undesirable result is:

> *There is an exceedance of the minimum threshold for land subsidence due to lowered groundwater elevations.*

Should potential subsidence be observed, the SVBGSA will first assess whether the subsidence may be due to elastic subsidence. If the subsidence is not elastic, the SVBGSA will undertake a program to assess whether the subsidence is caused by lowered groundwater elevations. The first step in the assessment will be to check if groundwater elevations have dropped below historical lows. If groundwater elevations remain above historical lows, the GSA shall assume that any observed subsidence was not caused by lowered groundwater levels. If groundwater levels have dropped below historical lows, the GSA will attempt to correlate the observed subsidence with measured groundwater elevations. Additionally, if the Subbasin experiences subsidence in multiple consecutive years that are due to InSAR measurement error, the GSAs will confirm if the error is not actually net long-term subsidence.

8.10.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result include a shift in pumping locations. Shifting a significant amount of pumping to an area that is susceptible to subsidence could trigger subsidence that has not been observed before.

8.10.4.3 Effects on Beneficial Users and Land Use

The undesirable result for subsidence does not allow any subsidence to occur in the Subbasin. Therefore, there is no negative effect on any beneficial uses and users.

8.11 Depletion of Interconnected Surface Water SMC

Areas with ISW occur where shallow groundwater may be connected to the surface water system. This SMC applies only to locations of ISW, as shown on Figure 4-11.

The SVIHM is used to identify the locations of ISW and to develop an estimate of the quantity and timing of stream depletions due to pumping during current and historical groundwater conditions. Shallow groundwater and surface water levels simulated by the SVIHM are used to identify the location of interconnection and evaluate the frequency with which different stream reaches are connected with groundwater in the underlying aquifer. The magnitude of stream depletions in relation to shallow groundwater elevations in interconnected reaches are evaluated in Chapter 5.

8.11.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable depletion of ISW in the Subbasin is defined as:

- Depletion from groundwater extraction that would result in a significant and unreasonable impact on other beneficial uses and users such as riparian water rights holders, appropriative surface water rights holders, ecological surface water users, and recreational surface water uses.

- Depletion from groundwater extraction more than observed in 2015, as measured by shallow groundwater elevations near locations of ISW. While a documented determination of whether past depletions was significant is not available, staying above 2016 depletions was determined to be a reasonable balance for all the beneficial uses and users.

These significant and unreasonable conditions were determined based on input collected during the development of 2022 GSPs, the 180/400 Subbasin Committee, and discussions with GSA staff. There is currently no data that determines what level of depletion from groundwater extraction has a significant adverse effect on steelhead trout or other beneficial use or user of. Should there be a determination regarding what level of depletion from groundwater extraction is significant, SVBGSA will take that into consideration as it reviews how it locally defines significant and unreasonable conditions for the SMC in the 5-Year Update.

8.11.2 Minimum Thresholds

> *The minimum threshold for depletion of interconnected surface water are established by proxy using shallow groundwater elevations 1 foot higher than those observed in 2015 near locations of interconnected surface water.*

No minimum thresholds are established for times when flow in a river is due to conservation releases from a reservoir. One purpose for these conservation releases is to recharge the Salinas Valley Groundwater Basin. Therefore, depletion of conservation releases is a desired outcome, and the minimum thresholds and measurable objectives do not apply to these flows.

The locations of ISW identified with the SVIHM are based on best available data but contain uncertainty, which is discussed in Chapters 4, 5, and 6. Additional stream and groundwater level data are needed to reduce uncertainty, verify with observed conditions, and track changes over time. The shallow groundwater monitoring wells, USGS stream gauges, and MCWRA River Series measurement sites will be used to supplement the analysis of locations of connectivity provided by the SVIHM. These monitoring points will also become part of the ISW monitoring network that is discussed in Chapter 7. Data from the ISW monitoring network will be used to monitor and evaluate the interconnection through time. Current conditions will be assessed according to the SMC when the ISW monitoring network is established.

As discussed in Chapter 7, a monitoring network for ISW composed of shallow groundwater monitoring wells is in the process of development. Two existing shallow wells are part of the monitoring network and they will be supplemented with 2 new shallow wells if needed. The monitoring network is dependent on the location and magnitude of stream reaches determined by the SVIHM. Table 8-7 includes the minimum thresholds and measurable objectives for the existing wells in the network. Neither well had an exceedance of the minimum threshold in 2020. Once the new monitoring wells are drilled, SMC will be determined using the wells' groundwater elevations during the minimum threshold and measurable objective years, or interpolated values from the groundwater elevation contour maps for wells that do not have shallow groundwater elevation measurements for those years.

Table 8-7. Depletion of Interconnected Surface Water Minimum Thresholds and Measurable Objectives

Monitoring Site	Minimum Threshold (ft)	Measurable Objective (ft)
16S/04E-08H02	30.0*	47.2
16S/05E-31P02	80.0*	94.7

*Groundwater elevation estimated.

8.11.2.1 Information Used and Methodology for Establishing Depletion of Interconnected Surface Water Minimum Thresholds

8.11.2.1.1 Establishing Groundwater Elevations as Proxies

The GSP Regulations § 354.28(d) 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."

The evaluation of ISW in the Salinas Valley Groundwater Basin is based on an approach recommended by the Environmental Defense Fund (EDF, 2018) that uses groundwater elevations as surrogates for streamflow depletion rates caused by groundwater use. Basic hydraulic principles state that groundwater flow is proportional to the difference between groundwater elevations at different locations along a flow path. Using this basic principle, groundwater flow to a stream, or conversely seepage from a stream to the underlying aquifer, is proportional to the difference between water elevation in the stream and groundwater elevations at locations away from the stream. Assuming the elevation in the stream is relatively stable, changes in interconnectivity between the stream and the underlying aquifer is determined by changes in groundwater levels in the aquifer. Thus, the change in hydraulic gradient between stream elevation and surrounding groundwater elevations is representative of change in interconnection between surface water and groundwater. Monitoring the hydraulic gradient in the aquifer adjacent to the stream monitors the interconnectivity between stream and aquifer. Therefore, the gradient can be monitored by measuring and evaluating groundwater elevations at selected shallow monitoring wells near streams. No existing estimations of the quantity and timing of depletions of ISW exist, nor data available to make estimations, so the hydraulic principles provide the best available information.

8.11.2.1.2 Review of Beneficial Uses and Users of Surface Water

The various beneficial uses and users of surface waters were addressed when setting the ISW depletion minimum thresholds. The classes of beneficial uses and users that were reviewed include riparian rights holders, appropriative rights holders, ecological surface water users, and recreational surface water users. This is not a formal analysis of public trust doctrine, but it is a reasonable review all uses and users in an attempt to balance all interests. This was not an assessment about what constitutes a reasonable beneficial use under Article X, Section 2 of the California Constitution. The minimum thresholds for depletion of ISW are developed using the definition of significant and unreasonable conditions described above, public information about critical habitat, locations of ISW derived from the SVIHM, and public information about water rights described below.

Riparian water rights holders. Table 8-8 provides a summary of water diversions reported to the SWRCB by water rights holders on the Salinas River and its tributaries within the 180/400-Foot Aquifer Subbasin. The diversion data were obtained from queries of the SWRCB eWRIMS water rights management system. The diversion data are self-reported by water-rights holders with points of diversion located within the Subbasin. Some of the diversions shown in Table 8-8 are also reported to MCWRA as groundwater pumping.

The SVBGSA is not aware of any current water rights litigation or water rights enforcement complaints by any riparian water rights holders in the Subbasin. Therefore, SVBGSA assumes that the current level of depletion has not injured any riparian water rights holders in the Subbasin.

Table 8-8. Reported Annual Surface Water Diversions in the 180/400-Foot Aquifer Subbasin

Diversions (Acre-Feet)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Statement of Diversion and Reported Riparian Diversions	6,524	7,205	9,172	8,912	8,251	7,628	7,786	7,842	7,118	7,756

Appropriative water rights holders. There are no appropriative water right holders in the 180/400-Foot Aquifer Subbasin. The SVBGSA is not aware of any current water rights litigation or water rights enforcement complaints by any appropriative rights holders in the Subbasin. Therefore, SVBGSA assumes that the current level of depletion has not injured any appropriative water rights holders in the Subbasin.

Ecological surface water users. Review of MCWRA's Nacimiento Dam Operation Policy (MCWRA, 2018b) and MCWRA's water rights indicates MCWRA operates the Dam in a manner that meets downstream demands and considers ecological surface water users. Since the reservoir operations consider ecological surface water users and reflect reasonable existing surface water depletion rates, this GSP infers that stream depletion from existing groundwater pumping is not unreasonable. If further river management guidelines are developed to protect ecological surface water users, the SMC in this GSP will be revisited.

Recreational surface water users. No recreational activities such as boating regularly occur on surface water bodies in the Subbasin.

As shown by the analysis above, the current rate of surface water depletion is not having an unreasonable impact on the various surface water uses and users in the Subbasin. Therefore, the minimum thresholds are based on 2015 groundwater elevations, when surface water depletions were not unreasonable.

8.11.2.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The minimum thresholds for depletion of ISW are set to 1 foot above 2015 groundwater elevations in the shallow monitoring wells within the Subbasin. The minimum thresholds all reference the same historical year and have existed simultaneously in the past. Therefore, no conflict exists between minimum thresholds measured at various locations within the Subbasin.

The depletion of ISW minimum threshold could influence other sustainability indicators as follows:

- **Chronic lowering of groundwater levels.** The depletion of ISW minimum thresholds are set at the groundwater level minimum thresholds. Therefore, the ISW minimum thresholds will not result in chronic lowering of groundwater elevations.

- **Reduction in groundwater storage.** The depletion of ISW minimum thresholds are set at the change in storage minimum thresholds, which are the same as the groundwater level minimum thresholds. Therefore, the ISW minimum thresholds will not result in an undesirable loss of groundwater storage.

- **Seawater intrusion.** The depletion of ISW minimum thresholds do not promote additional pumping that could exacerbate seawater intrusion. Therefore, seawater intrusion will not be affected by the depletion of ISW minimum thresholds.

- **Degraded water quality.** The depletion of ISW minimum thresholds do not promote decreasing groundwater elevations that lead to exceedance of groundwater quality minimum thresholds. Therefore, groundwater quality will not be affected by the ISW minimum thresholds.

- **Land subsidence**. The depletion of ISW minimum thresholds do not promote additional pumping that could cause subsidence. Therefore, subsidence will not be affected by the ISW minimum thresholds.

8.11.2.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The 180/400-Foot Aquifer Subbasin has 4 neighboring subbasins within the Salinas Valley Groundwater Basin:

- The Langley Subbasin to the north
- The Eastside Subbasin to the east
- The Forebay Subbasin to the south
- The Monterey Subbasin to the southwest

The SVBGSA is either the exclusive GSA or is one of the coordinating GSAs for the adjacent Subbasins. Because the SVBGSA covers all these subbasins, the SVBGSA is coordinating the development of the minimum thresholds and measurable objectives for all these subbasins. The Langley, Eastside, Forebay, and Monterey Subbasins have submitted GSPs in January 2022. Minimum thresholds for the 180/400-Foot Aquifer Subbasin have been reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

The Pajaro Valley Basin lies directly to the north of the Subbasin. Although a small portion of the 180/400-Foot Aquifer Subbasin does drain into Elkhorn Slough to the north, there is no interconnected surface water and groundwater between the Pajaro Valley and the 180/400-Foot Aquifer Subbasin due to the clay in the Elkhorn Slough. Therefore, the minimum thresholds for depletion of interconnected surface waters does not influence the ability of Pajaro Valley to achieve sustainability.

8.11.2.4 Effect on Beneficial Uses and Users

Table 3-9 of the *Salinas River Long-Term Management Plan* (MCWRA, 2019a) includes a list of 18 different designated beneficial uses on certain reaches of the river. In general, the major beneficial uses on the Salinas River are:

- Surface water diversions for agricultural, urban/industrial, and domestic supply
- Groundwater pumping from recharged surface water
- Freshwater habitat

- Rare, threatened, or endangered species, such as the Steelhead Trout
- CSIP diversions

The depletion of ISW minimum thresholds may have varied effects on beneficial users and land uses in the Subbasin.

Agricultural land uses and users. The depletion of ISW minimum thresholds prevent lowering of groundwater elevations adjacent to certain parts of streams and rivers beyond historical lows. The measurable objectives are higher than the minimum thresholds, providing flexibility for needed groundwater extraction during droughts or periods of low reservoir releases. Minimum thresholds higher than historical levels might affect the quantity and type of crops that can be grown in land adjacent to streams, and the ability of crops to withstand droughts. Therefore, these minimum thresholds are considered the least restrictive for agricultural land users. However, because the Subbasin is in overdraft, pumping limitations may needed to reach sustainability if there are insufficient projects and management actions available.

Urban land uses and users. The depletion of ISW minimum thresholds prevent lowering of groundwater elevations adjacent to certain parts of streams and rivers beyond historical lows. The measurable objective is higher than the minimum thresholds, providing flexibility for needed groundwater extraction during droughts or periods of low reservoir releases. Minimum thresholds higher than historical levels may limit the amount of urban pumping near rivers and streams, which could limit urban growth. Therefore, these minimum thresholds are considered the least restrictive for urban land uses and users. However, because the Subbasin is in overdraft, pumping limitations may needed to reach sustainability if there are insufficient projects and management actions available. If pumping is limited beyond historical levels, municipalities may have to obtain alternative sources of water to achieve urban growth goals. If this occurs, this may result in higher water costs for municipal water users.

Domestic land uses and users. The depletion of ISW minimum thresholds protect existing domestic land users and uses near locations of ISW from groundwater elevation declines below historical lows by maintaining shallow groundwater elevations near streams and protecting the operability of relatively shallow domestic wells.

Ecological land uses and users. The depletion of ISW minimum thresholds address ecological uses and users by preventing depletion of ISW from groundwater pumping beyond what was historically experienced. Additionally, by setting future groundwater levels at or above recent lows, there should be less impact to ecological users than has been seen to date.

8.11.2.5 Relation to State, Federal, or Local Standards

There are no explicit federal, state, or local standards for depletion of ISW. However, both state and federal provisions call for the protection and restoration of conditions necessary for endangered and threatened species.

8.11.2.6 Method for Quantitative Measurement of Minimum Threshold

The SVIHM is used to preliminarily identify areas of ISW and will help determine when any flow in a river is primarily due to conservation releases from Nacimiento and San Antonio reservoirs. Groundwater elevations measured in shallow wells adjacent to these areas of ISW will serve as the primary approach for monitoring depletion of ISW. As discussed in Chapter 7, existing shallow wells will be added, or new shallow wells will be installed to monitor groundwater elevations adjacent to surface water bodies during GSP implementation. There may be areas in the 180/400-Foot Aquifer Subbasin that this approach may not be applicable and additional analysis may need to be conducted from these areas.

New shallow monitoring wells installed pursuant to the GSP will not have data from 2015. Minimum thresholds for those wells will be estimated by either correlation with nearby deeper wells with water-level records that include 2015, or from groundwater model results.

8.11.3 Measurable Objectives

The measurable objectives for depletion of ISW target groundwater elevations that are higher than the minimum thresholds. The measurable objectives are consistent with the chronic lowering of groundwater elevation and reduction in groundwater storage measurable objectives.

> *The measurable objectives for depletion of interconnected surface water are established by proxy using shallow groundwater elevations observed in 2003 near locations of interconnected surface water.*

8.11.3.1 Methodology for Setting Measurable Objectives

The depletion of ISW measurable objectives are set to be identical to the groundwater level measurable objectives. The methodology for establishing measurable objectives is outlined in Section 8.6.2.1. Groundwater elevations from 2003 were selected as representative of the measurable objectives for the 180/400-Foot Aquifer Subbasin.

8.11.3.2 Interim Milestones

The interim milestones leading to the depletion of ISW measurable objectives are included in Table 8-9 for the existing wells in the ISW monitoring network.

Table 8-9. Depletion of Interconnected Surface Water Interim Milestones

Monitoring Site	Current Groundwater Elevation (ft)	Interim Milestone at Year 2025 (ft)	Interim Milestone at Year 2030 (ft)	Interim Milestone at Year 2035 (ft)	Measurable Objective (ft) (goal to reach at 2040)
16S/04E-08H02	39.3	41.3	43.3	45.2	47.2
16S/05E-31P02	89.3	90.6	92.0	93.3	94.7

8.11.4 Undesirable Results

8.11.4.1 Criteria for Defining Undesirable Results

By regulation, the depletion of ISW undesirable result is a quantitative combination of minimum threshold exceedances. The undesirable result for depletion of ISW is:

> *There is an exceedance of the minimum threshold in a shallow groundwater monitoring well used to monitor interconnected surface water.*

Streamflow depletion in the Subbasin is complicated by many factors, such as reservoir releases, recharge of the aquifer from streamflow, losses to vegetation, and ET. The ISW SMC applies to depletion of ISW from groundwater use. For SGMA compliance purposes, the default assumption is that any depletions of surface water beyond the level of depletion that occurred prior to 2015, as evidenced by reduction in groundwater levels, represent depletions that are not significant and unreasonable. Any additional depletions of surface water flows caused by groundwater conditions in excess of conditions as they were in 2015 would likely be an undesirable result that must be addressed under SGMA. There is currently no biological opinion or habitat conservation plan that indicates additional protection is needed for species protected under the Endangered Species Act; however, if it is determined that additional protection is needed and streamflow loss is due to groundwater extraction, not surface water flows, SVBGSA will adapt as necessary to adhere to environmental laws.

8.11.4.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result for the depletion of ISW include the following:

- **Localized pumping increases.** Even if the Subbasin is adequately managed at the Subbasin scale, increases in localized pumping near interconnected surface water bodies could reduce shallow groundwater elevations.
- **Expansion of riparian water rights.** Riparian water rights holders often pump from wells adjacent to streams. Pumping by these riparian water rights holder users is not

regulated under this GSP. Additional riparian pumpers near interconnected reaches of rivers and streams may result in excessive localized surface water depletion.

- **Changes in Nacimiento and San Antonio Reservoir Releases.** Since the Salinas River is dependent on reservoir releases for sustained flows, releases at low levels could cause undesirable results. The ability to avoid undesirable results for ISW is partially dependent on reservoir releases.

- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought.** Minimum thresholds were established based on anticipated future climatic conditions. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater elevations that increase surface water depletion rates.

8.11.4.3 Effects on Beneficial Users and Land Use

The depletion of ISW undesirable result is to have no net increase in surface water depletion due to groundwater use beyond 2015 levels, as determined by shallow groundwater elevations. The effects of undesirable results on beneficial users and land use are the same as the effects of minimum thresholds on beneficial uses and users, as described in Section 8.11.2.4.

SVBGSA will work with National Marine Fisheries Service (NMFS) and MCWRA to further evaluate the effects of the ISW measurable objectives, minimum thresholds, and undesirable results on surface water flows and beneficial users.

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