8. Sustainable Management Criteria

This section describes the criteria and the approach by which the NASb GSAs established what are collectively referred to as the Sustainable Management Criteria (SMC). As required by SGMA GSP regulations, this section describes the groundwater conditions that constitute SMC and the process by which the NASb GSAs characterize each element of the SMC.

The SMC include a sustainability goal for the entire NASb and for each sustainability indicator, as wells as locally defined undesirable results, minimum thresholds (MTs), and measurable objectives (MOs) with interim milestones. The sustainability goal and measurable objectives define conditions within the NASb that the GSAs plan to achieve while the minimum thresholds define what constitutes NASb wide undesirable results that GSAs hope to avoid. Defining SMC requires sound data, significant analysis, meticulous planning, and effective coordination and communication.

Provided within this section are the qualitative and quantitative defined conditions that make up each element of the SMC, an explanation of how each element of the SMC were developed, and how each element influences all beneficial uses and users of groundwater.

8.1 Sustainability Goal

As required by the SGMA regulations, the NASb GSAs developed a sustainability goal for the North American Subbasin which is to:

Manage groundwater resources sustainably for beneficial uses and users to support the lasting health of the Subbasin's community, economy, and environment. This will be achieved through:

- The monitoring and management of established SMC;
- Continued expansion of conjunctive management of groundwater and surface water;
- Proactively working with local well permitting and land use planning agencies on effective groundwater policies and practices;
- Continued GSA coordination and stakeholder engagement; and
- Continued improvement of our understanding of the Subbasin.

8.1.1 Supporting Sustainability Goal Information

The sustainability goal was developed by the NASb GSAs based on knowledge gained from actively managing groundwater in the NASb for decades.

Measures implemented to manage the NASb within the Sustainable Yield. To support the sustainability goal, the GSAs will continue to implement measures that will result in sustainable groundwater elevations over time. This includes continued and expanded conjunctive use practices.

Measures to be implemented in the Subbasin to ensure its sustainability include:

- Continued integrated management and adaptive management of water resources.
- Routine monitoring and analysis of groundwater levels and quality along with a comparison to established minimum thresholds and measurable objectives.
- Regular meetings with GSAs to discuss monitoring findings and, as necessary, adaptively adjust management activities to address and resolve adverse trends effecting groundwater conditions.
- Ongoing communication and engagement with stakeholders to build on understanding of how groundwater management activities potentially effect beneficial uses and users (*see* **Section 11 – Notice and Communication**).
- Implementation of projects and management actions (*see* **Section 9 - Projects and Management Actions**), as necessary, based on physical measurements of groundwater conditions at representative monitoring wells.

Information from Basin Setting and Groundwater Conditions used to establish Sustainability Goal. The GSAs established the sustainability goal through a comprehensive understanding of groundwater conditions based on technical information as previously documented in **Section 4 – Hydrogeologic Setting and Section 5 – Groundwater Conditions**. This understanding of the Subbasin setting and groundwater conditions provides a strong foundation for evaluating the sustainability indicators[2] through the SMC and by tracking progress through a detailed monitoring network. The process is defined below.

The process of defining the SMC, specifically minimum thresholds and undesirable results, is heavily dependent on evaluating the applicable sustainability indicators through the specific regulatory sections in three separate parts of the GSP regulations. These three sections include the specific sustainability indicator in the Groundwater Conditions section of the Basin Setting

[2] Sustainability indicators are defined and described in greater detail in sections 8.2 and 8.3.

sub article (§354.16), the minimum thresholds section of the SMC sub article (§354.28), and the monitoring network section of the Monitoring Network sub article (§354.34).

There are specific and separate instructions for the GSA to follow for each of the six sustainability indicators, which is carried through in three separate sub articles of the GSP regulations (i.e., the Basin Setting, SMC, and Monitoring Network). The specific information and purpose of these requirements for each sustainability indicator is illustrated in **Figure 8-1** and described below.

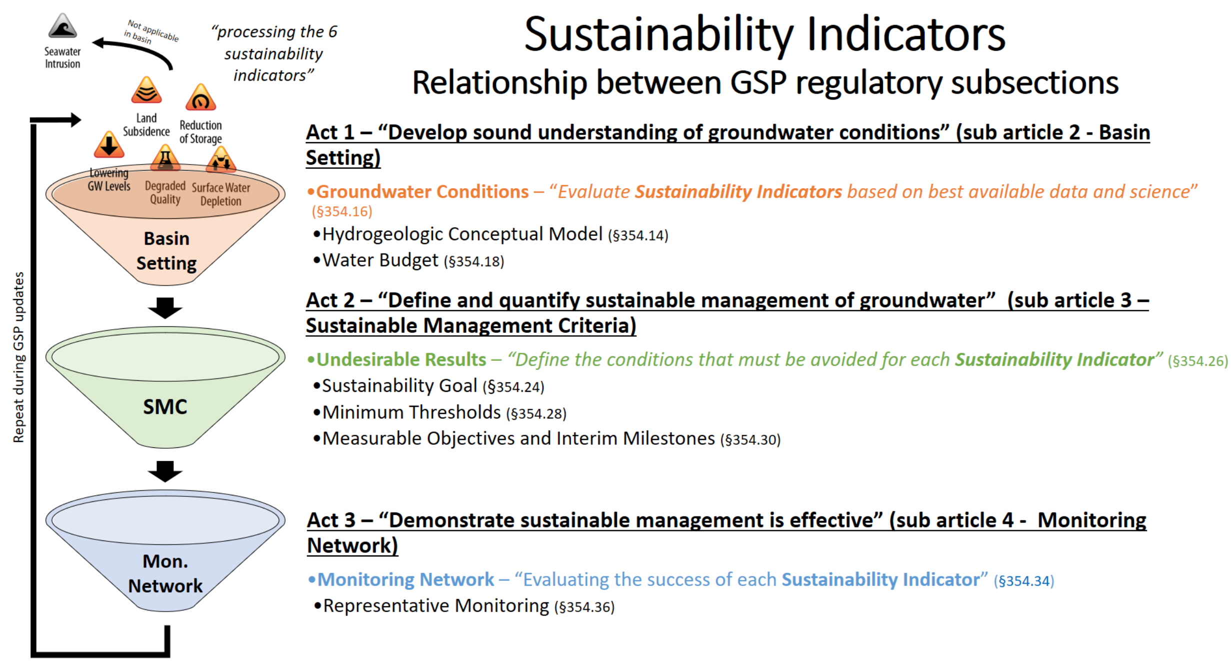

Figure 8-1. Processing of Sustainability Indicators

As illustrated in **Figure 8-1**, the NASb GSAs followed the process of carrying the applicable sustainability indicators for the NASb basin through this process. This process is also referred to as the "three act play" in reference to specific instructions provided for each of the six sustainability indicators that are located in each of three of the GSP regulation sub articles. The general intent of these instructions and how it resulted in NASb GSP development is paraphrased below.

- Basin Setting (GSP regulations - sub article 2) "Act 1" - Within the subsection Groundwater Conditions (§354.16), the current and historical conditions for each sustainability indicator must be evaluated based on best available data and science. This evaluation provides a baseline for each sustainability indicator in the basin and is foundational for the next GSP regulation requirement that applies to each sustainability indicator, the SMC. For the NASb GSP, this foundational baseline information can specifically be found in **Section 5 (Groundwater Conditions)**, but also **Section 4 (Hydrogeologic Setting)** and **Section 6 (Water Budget)**.

- SMC (GSP regulations - sub article 3) "Act 2" – Within the subsection Minimum Thresholds (§354.28), the GSA shall define and quantify the condition that must be avoided for each sustainability indicator. This is done at a site-specific scale through the use of minimum thresholds, and then again defined for each sustainability indictor at a basin scale through the quantifiable definition of undesirable results. These defined conditions provide the State, stakeholders, and GSAs clarity as to what constitutes sustainable groundwater management in the NASb. For the NASb GSP, this information can specifically be found in this section on the SMC.
- Monitoring Network (GSP regulations - sub article 4) "Act 3" - Within the subsection Monitoring Network (§354.34), the GSA shall demonstrate that sustainable groundwater management is effective. Essentially, the GSP defines specific monitoring locations and metrics to adequately evaluate success for each sustainability indicator. For the NASb GSP, this information is in **Section 7 - Monitoring Networks**.

Activities to achieve the sustainability goal for the next 20 years and beyond. The NASb GSAs believe the sustainability goal is currently being met, based on the absence of undesirable results, and plan to continue and expand on activities to maintain the sustainability goal for the next 20 years and beyond. Through the use of empirical data and modeling, the GSAs have evaluated: current groundwater conditions; projected groundwater conditions based on planned land use changes; and projected conditions as a result of planned land use changes with climate change. This evaluation indicates that by managing to the Subbasin's SMC and through implementing planned projects and management actions, the NASb will remain sustainable as defined by the absence of undesirable results.

8.2 Process of Developing SMC

As provided in **Section 8.1**, the sustainability goal defines and summarizes the conditions in this GSP that constitute sustainable groundwater management for the NASb at the highest level. The remaining process of developing the SMCs is focused on the next levels of defined conditions in the NASb, including establishing undesirable results, minimum thresholds and measurable objectives. Remaining SGMA terminology as depicted on **Figure 8-2** such as *Sustainable Yield* is defined in **Section 6 - Water Budgets**.

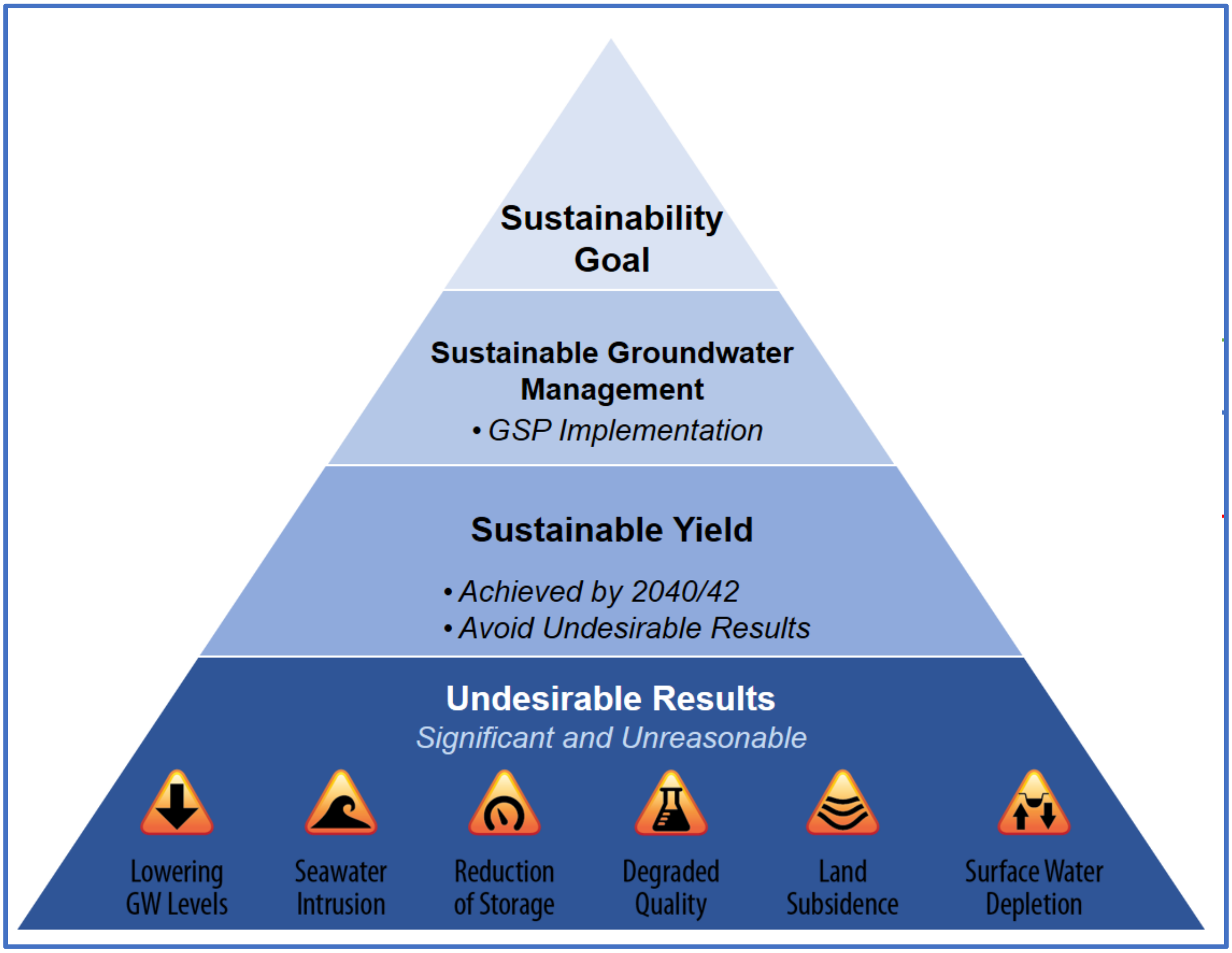

Figure 8-2. Depiction of Key SGMA Compliance Elements

This SMC section of the GSP was developed based on the application of technical information as is documented in:

- Section 4 – Hydrogeologic Setting
- Section 5 – Groundwater Conditions
- Section 6 – Water Budget
- Section 7 – Monitoring Network

The NASb GSAs completed a process during SMC development based on a comprehensive and strong foundational technical understanding of each applicable sustainability indicator. This process then included the development of proposed values that quantified Subbasin conditions that considered beneficial uses and users of groundwater. This process is summarized and illustrated on **Figure 8-3**.

- **Applicability of Sustainability Indicators.** Initially GSAs were required to complete the somewhat simple determination of which sustainability indicators were applicable in the NASb. Sustainability indicators are the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, become undesirable results. As described in **Section 4 – Hydrogeologic Setting** and **Section 5 – Groundwater Conditions** of this GSP, seawater intrusion is not an applicable sustainability indicator in the NASb. A specific description of how undesirable results, minimum thresholds, and measurable objectives were established for the five applicable sustainability indicators is provided in **Section 8.3**.

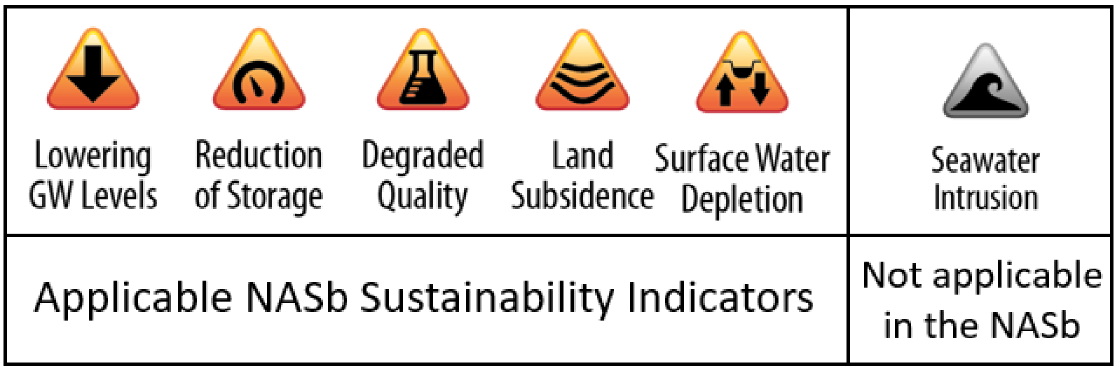

Figure 8-3. NASb Applicable Sustainability Indicators

- **Development of Measurable Objectives (MOs), Minimum Thresholds (MTs) and Undesirable Results.** This process consisted of developing proposed values for the key State regulatory required metrics that define conditions within the NASb that GSAs plan to achieve and also the conditions that GSAs plan to avoid. These include determining the MOs, MTs, and undesirable results for the NASb for each applicable sustainability indicator. **Figure 8-4** illustrates the relationship between the MOs and MTs. The GSAs used consistent methodology in development of the quantitative values for each of these as defined in subsequent sections below. These metrics include:
    - For the MOs, GSAs focused on developing target water levels and water quality that represent optimum water level and quality conditions in the NASb.
    - For the MTs, water levels and water quality values were set that if exceeded, could result in negative effects to beneficial uses and users in the NASb.
    - For the undesirable results, GSAs focused on defining for each sustainability indicator what combination of minimum threshold exceedances may constitute significant and unreasonable groundwater conditions that in turn would mean the NASb groundwater use is unsustainable.

Prior to discussing the proposed values for MOs, MTs, and URs for each sustainability indicator with stakeholders, the GSAs provided stakeholders background information on the status of each indicator in the NASb. This information was provided both in the form of draft GSP technical sections **(Sections 1 through 5)** and summarized in written form and included in presentations at public meetings. Discussion during these public meetings facilitated additional information sharing and clarity for the GSAs. Once GSAs felt that they had an understanding of stakeholder input on the material provided to the public, the GSAs were able to advance the proposed MTs, MOs and undesirable results values for each of the sustainability indicators as provided in the sections below:

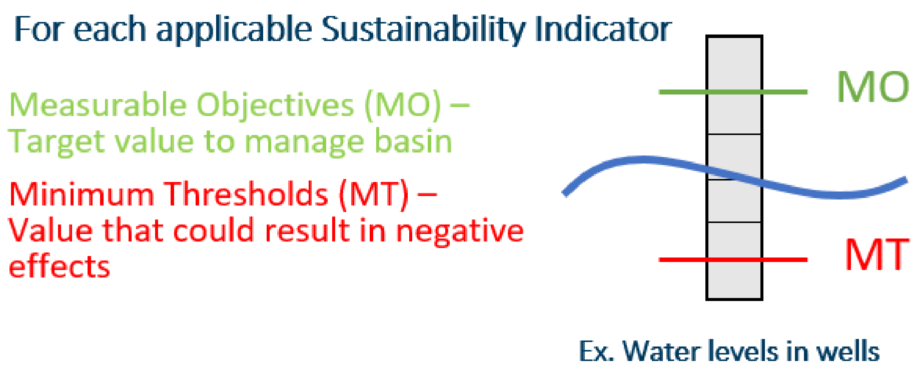

Figure 8-4. MO and MT Relationship

- **Consideration of beneficial uses and users.** This process consisted of identifying all the beneficial uses and users in the NASb and then evaluating the proposed MOs, MTs and undesirable results values based the interests of each beneficial uses and users of groundwater. These beneficial uses and users are listed below:
  - Agricultural
  - Domestic
  - Municipal
  - Public Water Systems
  - Environmental
  - Federal Government
  - Tribes
  - Disadvantaged Communities (DACs)
  - Surface Water Users
  - Parks
  - State Government
  - Local Land Use Planning Agencies
  - Conservancies

Stakeholders provided feedback individually, during public meetings or workshops, or as written comments, which enabled GSAs to fine-tune the quantitative values used for MOs, MTs, and undesirable results as defined below in this section. This approach was taken so that the SMCs would have a strong level of support among stakeholders and the GSAs responsible for implementing this GSP.

8.3 Sustainability Indicators

Sustainability indicators are the effects caused by groundwater conditions occurring throughout the Subbasin that, when significant and unreasonable, become undesirable results. Undesirable results are defined in the SGMA as one or more of the following effects:

1. *Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. 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*

2. *Significant and unreasonable reduction of groundwater storage*

3. *Significant and unreasonable seawater intrusion*

4. *Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies*

5. *Significant and unreasonable land subsidence that substantially interferes with surface land uses*

6. *Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water*

SGMA requires that GSAs demonstrate sustainability through the avoidance of undesirable results. The presence of significant and unreasonable effects for any of these indicators, if left uncorrected, could result in State intervention in the management of groundwater in the Subbasin.

8.3.1 NASb SMC Approach - Sustainability Indicator Grouping

The following sections of the SMC are grouped by sustainability indicator to not only retain an organized approach but to also ensure all of the GSP regulation requirements regarding SMC have been addressed. Each subsection of the NASb GSP follows a consistent format that contains the information required by Section §354.22 et. seq of the SGMA regulations and outlined in the Sustainable Management Criteria BMP (DWR, 2017). Each Sustainable Management Criteria section includes a description of:

- How locally defined significant and unreasonable conditions were developed.

- How undesirable results were developed, including:

- The criteria defining when and where the effects of the groundwater conditions cause undesirable results based on a quantitative description of the combination of minimum threshold exceedances (§354.26 (b)(2)).
- The potential causes of undesirable results (§354.26 (b)(1)).
- The effects of these undesirable results on the beneficial users and uses (§354.26 (b)(3)).

- How minimum thresholds were developed, including:
  - The information and criteria used to develop minimum thresholds (§354.28 (b)(1)).
  - The relationship between minimum thresholds and the relationship of these minimum thresholds to other sustainability indicators (§354.28 (b)(2)).
  - The effect of minimum thresholds on neighboring basins (§354.28 (b)(3)).
  - The effect of minimum thresholds on beneficial uses and users (§354.28 (b)(4))
  - How minimum thresholds relate to relevant Federal, State, or local standards (§354.28 (b)(5)).
  - The method for quantitatively measuring minimum thresholds (§354.28 (b)(6)).
- How measurable objectives were developed, including:
  - The methodology for setting measurable objectives (§354.30).
  - Interim milestones (§354.30 (a), §354.30 (e), §354.34 (g)(3)).

8.4 Sustainability Indicator #1 - Chronic Lowering of Groundwater Levels

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #1 – chronic lowering of groundwater levels.

8.4.1 Undesirable Results – Chronic Lowering of Groundwater Levels

Chronic lowering of groundwater levels is considered significant and unreasonable when:

- *20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41 wells).*

The NASb GSAs believe that this criterion would constitute an undesirable result, because it would indicate that about 20% of the area of the Subbasin would be experiencing an MT exceedance (based on relatively even spacing of the representative monitoring wells). As described further below, MTs were established by detailed modeling of expected future conditions that was then compared to beneficial uses and users to ensure that potential negative impacts would be avoided.

The use of 20% of the wells would help early detection of potential impacts of a regional nature. This is based on past experience in the Subbasin. For example, cones of depression emerged over time in both the agricultural areas in the northern part of the NASb and in urban areas in the southern part of the NASb (*refer to* **Section 5.3 – Historic Groundwater Contours**). These cones of depression represented overdraft conditions in relatively small portions of the subbasin that were significant enough for local agencies to take actions to correct them. For years, these local agency groundwater management activities have led to the stabilization and even some recovery of groundwater levels in the South Sutter Water District area since the mid-1960s and in Sacramento County since the mid-1990s.

Overall, the GSAs intend that groundwater elevations remain sustainable over time, which includes allowing for certain planned and managed areas of declining groundwater levels to support the future needs of the region. However, exceedances of MTs at more than 20% of the representative monitoring sites could be an indication that undesirable results are emerging from conditions that exceed the currently assumed future conditions, which could impact beneficial uses and users.

8.4.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for chronic lowering of groundwater levels is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of:

- Domestic and irrigation wells going dry (i.e., cost to deepen existing or construct new wells).
- Municipal wells decrease in capacity or go dry.
- Increased costs associated with lowering or replacement of pumps.
- Surface water is depleted such that creek flows are significantly reduced over time.
- Groundwater supported vegetation die or cannot repopulate, thereby reducing or eliminating GDEs.
- Significant increase in subsurface inflow from adjacent subbasins could impede adjacent basins from meeting their sustainability goals.
- Delaying contamination cleanup by potentially mobilizing existing plumes at existing remediation sites.

8.4.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for chronic lowering of groundwater level results are:

- A significant increase in NASb pumping distribution and volumes, most likely due to changing land use practices such as an increase or concentration of new agricultural and/or municipal pumping.
- A significant reduction in natural recharge as a result of changing surface water hydrology or land use (conversion to impermeable surfaces such as concrete, asphalt or homes).
- An increase in outside of basin demand for surface water (e.g., exports) that could result decreased surface water available for use in the NASb or decreasing natural recharge.

8.4.1.3 Effects on Beneficial Users and Land Use

If undesirable results occur, the likely effects will be experienced by domestic (i.e., shallow well) users. Shallow domestic wells would tend to be impacted first as groundwater levels decline, and rural residents may be faced with the financial burden of well deepening or replacement. If groundwater levels continued to decline causing a much greater percent of MT exceedances, a significant number of deeper domestic and ultimately agricultural and municipal production wells could be challenged to meet their water demands from groundwater.

The effects of undesirable results could also cause GDEs to be cut off from groundwater. GDEs are “ecological communities or species that depend on groundwater emerging from aquifer or on groundwater occurring near the ground surface” (23 CCR §354.24(m)). Undesirable results could include the disconnection of GDEs from saturated groundwater or reduced base flow to streams that depend on groundwater base flow, thereby impacting riparian ecosystems and aquatic species associated with GDEs.

8.4.2 Minimum Thresholds - Chronic Lowering of Groundwater Levels

The MTs used to support the undesirable results definition of the chronic lowering of groundwater levels are provided within this section.

8.4.2.1 Information and Criteria Used to Establish Minimum Thresholds

The GSP regulations require a description of the information and criteria used for establishing the chronic lowering of groundwater levels MTs (§354.28 (b)(1)). To develop proposed MTs, information was derived from detailed modeling analysis. The GSAs identified what conditions would look like at groundwater elevations at representative monitoring site (RMS) locations throughout the NASb under a scenario that included a 50-year simulation with projected demands, climate change, and an urban conjunctive use program. The scenario is described in

Section 9.2.1 – Project #1 Regional Conjunctive Use Expansion – Phase 1, and the CoSANA model is documented in **Appendix P – Groundwater Model Documentation**. The scenario is intended to provide a reasonable approximation of what groundwater conditions could look like over a 50-year hydrologic sequence if all of the demand, climate, and conjunctive use operations projections were realized.

As described in **Section 6 – Water Budget**, the NASb is currently under its estimated sustainable yield by more than 10 percent. Therefore, the NASb is in position to support additional development and land use changes that will result in increased groundwater use. With these land use changes and projected climate change, some portions of the basin could expect to experience lower groundwater elevations in the future. **Figure 8-5** shows the 50-year simulation projected water level changes from baseline conditions at each groundwater RMS location in the NASb.

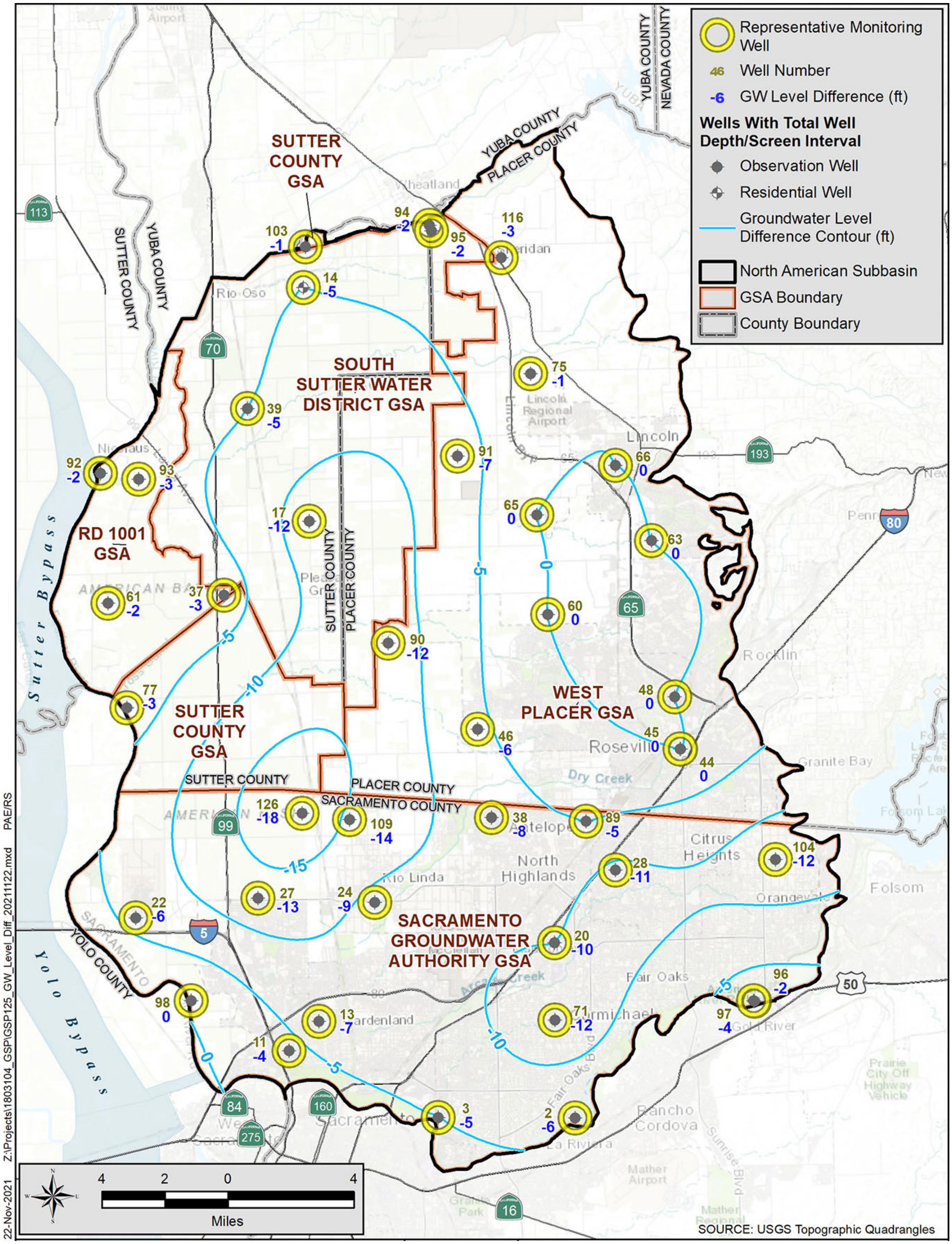

Figure 8-5. Projected Groundwater Elevation Changes at RMS Locations

The elevations in **Figure 8-5** are relative changes to groundwater levels projected at the end of the 50-year groundwater modeling simulation. The methodology used to develop MTs included subtracting the projected groundwater level elevations from baseline elevations. The average of Fall 2014 and Fall 2015 elevations were used for the baseline at each RMS, except in cases where the RMS wells were constructed after that time (data from 2018 through 2020 was used for these recent wells). The NASb GSAs believe this baseline approach is appropriate for the following reasons:

- It is consistent with the conditions present at the time of the passage of SGMA.
- It uses data from the most recent decade, which better reflects current hydrology and regional land use development conditions.
- It represents a period when relatively low levels of groundwater elevations were observed in the basin in which negative effects to beneficial uses and users were not reported or observed.
- As described in **Sections 3.13 and 5.2 through 5.4**, conjunctive use programs in the NASb have been implemented that have resulted in improved groundwater elevations relative to their historical lows in many parts of the subbasin (also see **Figure 5-3**). Using average 2014/2015 levels as the baseline for establishing MTs recognizes the benefit of those conjunctive use programs.

The final MT was then calculated by subtracting the relative change resulting from the 50-year modeled projections at each RMS (as shown in **Figure 8-5**) from the average Fall baseline. Following the calculations of the MTs, the resulting values were evaluated relative to beneficial uses and users and adjacent subbasins (see **Sections 8.4.2.4 and 8.4.2.5** below) to determine whether significant and unreasonable undesirable results would be experienced from those future groundwater elevations.

8.4.2.2 Chronic Lowering of Groundwater Levels Minimum Threshold

Table 8-1 shows the Fall baseline groundwater elevation, the model projected change from baseline, and the final selected MT at each RMS. The final MTs at the RMS locations for chronic lowering of groundwater are shown on **Figure 8-6**. Hydrographs for each RMS showing actual groundwater elevations in comparison to the average Fall condition baseline and model adjusted projected MTs are in **Appendix Q – SMC Hydrographs**.

Table 8-1. Chronic Lowering of Groundwater Level Minimum Thresholds

Representative Monitoring Site		Fall Baseline (ft msl)	Model Projected Water Level Change (ft)	Selected MT (ft msl)
Map No.	Local Name			
2	SGA_MW06	7	-6	1
3	SGA_MW04	0	-5	-5
11	Bannon Creek Park	-1	-4	-5
13	Chuckwagon Park	-8	-7	-15
14	13N04E23A002M	31	-5	26
17	AB-2 shallow	-5	-12	-17
20	SGA_MW05	-27	-10	-37
22	AB-4 shallow	5	-6	-1
24	SGA_MW02	-18	-9	-27
27	AB-3 shallow	9	-13	-4
28	Twin Creeks Park	-17	-11	-28
37	SUT-P1	13	-3	10
38	Lone Oak Park	-19	-8	-27
39	AB-1 shallow	8	-5	3
44	WPMW-10A	133	0	133
45	WPMW-9A	135	0	135
46	SVMW West - 1A	-26	-6	-32
48	WPMW-4A	75	0	75
60	WPMW-2A	22	0	22
61	Sutter County MW-5A	12	-2	10
63	WPMW-3A	145	0	145
65	MW 1-3	49	0	49
66	MW 5-1	108	0	108
71	WCMSS	-28	-12	-40
75	MW 2-3	90	-1	89
77	SREL-1-27-F1	12	-3	9
89	Roseview Park - 315	-17	-5	-22
90	WPMW-12A	-33	-12	-45
91	WPMW-11A	10	-7	3
92	RDMW-101	17	-2	15
93	RDMW-102	15	-3	12
94	RDMW-103	60	-2	58
95	RDMW-104	59	-2	57
96	1516	69	-2	67
97	1518	61	-4	57
98	URS71000-700+00C	7	0	7
103	BR-1B	37	-1	36
104	SGA_MW08	109	-12	97
109	SGA_MW01	-19	-14	-33
116	Old Well #2	71	-3	68
126	DeWit	-7	-18	-25

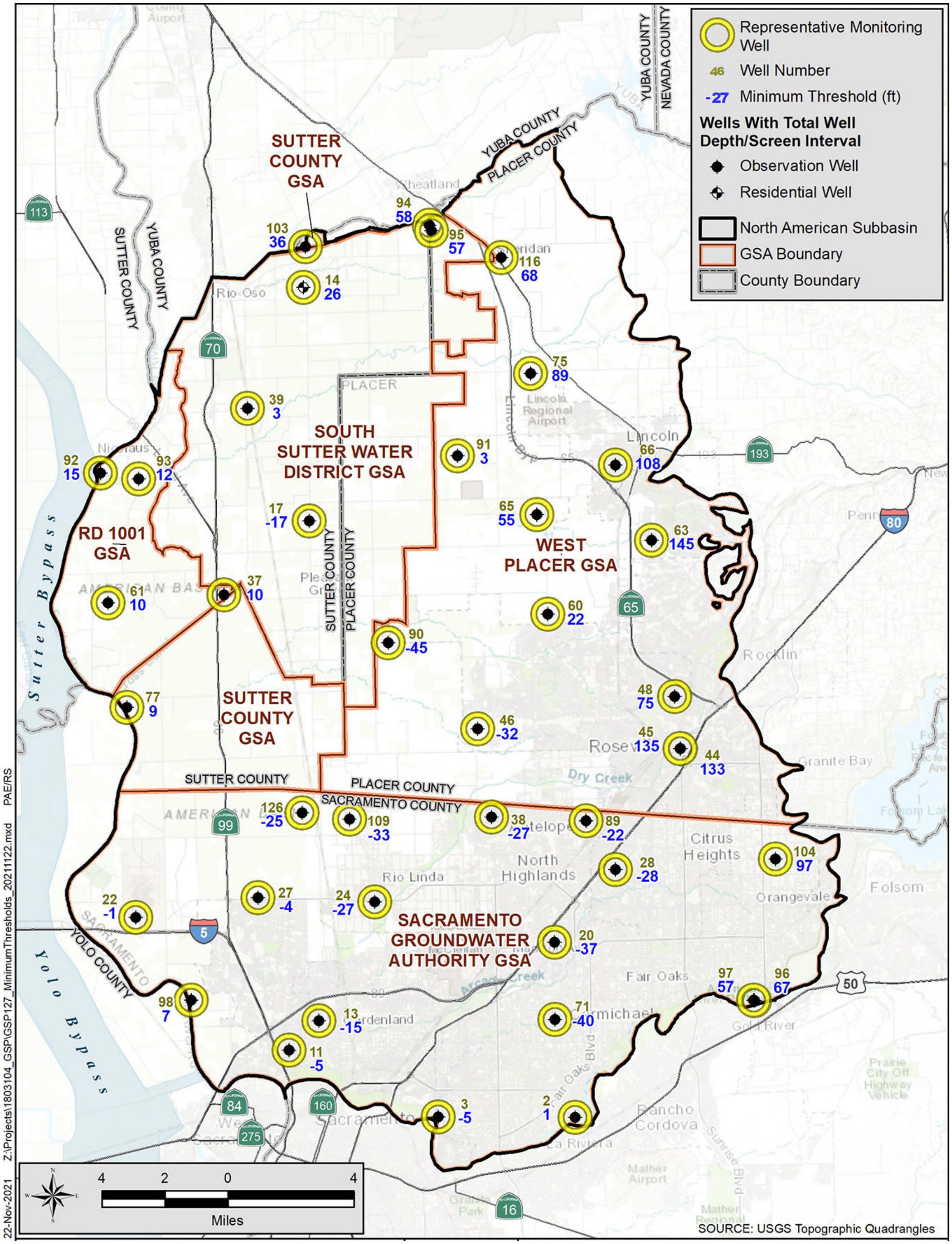

Figure 8-6. Projected Groundwater Elevation MTs at RMS Locations

As described in the groundwater storage, land subsidence, and depletion of interconnected surface water sustainability indicator sections below, groundwater levels were used as a reasonable proxy for defining quantitative thresholds per GSP regulations (§354.28 (d)).

8.4.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

Assessing the relationship between the MTs for each sustainability indicator is a requirement of the GSP regulations (§354.28 (b)(2)). MTs are often established for multiple sustainability indicators at a single RMS. If the same RMS was used for multiple sustainability indicators that use groundwater elevation as a metric, the shallowest (or most protective) groundwater elevation will be used to evaluate potential negative effects at that location.

The relationship between the MT for chronic lowering of groundwater levels and those for other sustainability indicators are discussed below.

Reduction of groundwater in storage. There are different metrics identified in the GSP regulations for reduction of groundwater in storage (volume of groundwater extracted). However, as supported in the GSP regulations (§354.28 (d)), groundwater levels can serve as a reasonable proxy for defining quantitative thresholds for other sustainability indicators. For this reason, since the reduction of groundwater in storage MTs are dependent on avoiding undesirable results pursuant to the NASb's other sustainability indicators, maintaining the MTs for chronic lowering of groundwater levels equates to preventing an undesirable reduction of groundwater in storage.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

Degraded groundwater quality. The MTs are not expected to have a significant impact on groundwater quality. As shown in **Figure 8-5**, the areas of greatest drawdown are in the vicinity of the junction between Sacramento, Sutter, and Placer counties and trending to the north and south. To the north, there are no known areas of contaminants that could be mobilized from these changes in water levels. On the Sacramento County side of the junction, contamination at the former McClellan Air Force Base is actively managed and is expected to be largely remediated in the next two decades; there is very little risk of mobilization of the contaminant plume based on a study by the SGA as discussed in **Section 5.8.3**. Also as shown in **Figure 8-5**, despite some projected declines in groundwater elevations, these are not appreciable in the Subbasin over a 50-year period. This would not be expected to alter conditions in the aquifer to such a degree that significant mobilization or geochemical reactions related to the presence naturally-occurring constituents (e.g., arsenic) would be of concern.

Land subsidence. The MTs are not expected to have a significant impact on land subsidence. **Section 5.10 – Land Subsidence** documents that land subsidence has been negligible in the NASb since the 1990s. The historical rate of subsidence has been approximately 0.01 feet per 1 foot of groundwater level decline. The maximum MT decline is projected at 18 feet, which would equate to approximately 0.18 feet of subsidence over the next 50 years.

Depletion of interconnected surface water. There are different metrics identified in the GSP regulations for depletion of interconnected surface water (rate or volume of surface water depletion caused by groundwater use). As supported by the GSP regulations (354.28 (d)), groundwater levels can serve as a reasonable proxy for defining quantitative thresholds for this sustainability indicator. The NASb GSAs believe that the use of groundwater levels as a proxy is appropriate because:

- The relationship between groundwater elevations and surface water flows has been analyzed and well-established during preparation of this GSP (see **Section 5.11 – Interconnected Surface Water**) and has been analyzed extensively associated with flood control planning efforts in the region (see Luhdorff and Scalmanini 2009).
- An appropriate surface water depletion monitoring network has been established in the NASb (see **Section 7.9 – Surface Water Depletion**).

Similar to the reduction of storage, since depletion of interconnected surface water is dependent on avoiding undesirable results for the NASb's other sustainability indicators, maintaining the MT for chronic lowering of groundwater levels equates to preventing a significant and unreasonable undesirable result with respect to depletion of interconnected surface water. The highest projected future change in gradient associated with the MTs is along the Sacramento River (*see* **Figure 8-5**). As part of the modeling analysis, a review of additional seepage associated with the increased gradient away from the Sacramento River and changes to diversions from the river associated with land use changes reveals that there is an expected net increase in flows in the river. This is described further under **Section 8.9** below. Additional discussion of seepage associated with other interconnected surface waters is also discussed under **Section 8.9** below.

8.4.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The NASb shares boundaries with four groundwater subbasins: the South Yuba Subbasin to the north; the Sutter Subbasin to the northwest; the Yolo Subbasin to the southwest; and the South American Subbasin to the south. The NASb MTs would have negligible effect on adjacent subbasins. This is demonstrated by the modeling conducted to establish the MTs. The first line of evidence is in the limited lowering of average groundwater levels at the boundaries, which range from 0 to 6 feet (see Figure 8-3). These changes in groundwater levels ultimately translate to groundwater gradients, which drive groundwater flow across the boundaries. **Table 8-2** shows the subsurface flows under current and projected conditions used to establish the MTs. The difference in boundary flows associated with implementing the MTs is negligible. Representatives of the NASb met and discussed the boundary conditions with representatives from each subbasin, and the agencies agree that the proposed MTs will not impact their ability to sustainably manage their respective subbasins. This coordination is documented in **Section 11 – Notices and Communications**.

Table 8-2. Groundwater Flow with Neighboring Subbasins

Subsurface Groundwater Flow Across Boundaries with Neighboring Subbasins	Current Conditions (AFY)	Projected with Climate Change and Project Implementation (AFY)	Future Scenario Difference from Current Conditions (AFY)
Inflows			
South American Subbasin	16,600	18,000	1,400
Sutter Subbasin	1,400	2,100	700
Yolo Subbasin	9,000	11,600	2,600
Yuba Subbasin	6,700	7,600	900
Outflows			
South American Subbasin	9,700	11,800	2,100
Sutter Subbasin	2,000	1,400	(600)
Yolo Subbasin	500	400	(100)
Yuba Subbasin	100	100	-
Net Boundary Flows			
South American Subbasin	6,900	6,200	(700)
Sutter Subbasin	(600)	700	1,300
Yolo Subbasin	8,500	11,200	2,700
Yuba Subbasin	6,600	7,500	900

8.4.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The potential effects of MTs to specific applicable beneficial uses and users of groundwater in the NASb are described below.

Rural residential land uses and users. The chronic lowering of groundwater level MTs is protective of domestic well users' ability to access groundwater. As documented in **Appendix B**, domestic well construction was analyzed in the vicinity of each RMS location with a projected decline of 5 feet or more. The evaluation looked at the total depth and first open interval 1,331 potentially existing domestic wells. Note that there are an estimated 2,412 domestic wells NASb-wide. Based on the analysis, no domestic wells of up to 50 years old would go dry (e.g., drop below their total depth). Of wells that are greater than 50 years old, only 2 percent (26 wells) could potentially drop below their total depth; many of these may no longer in use. In terms of maintaining groundwater levels above their first open interval, domestic users are also protected. Of wells that are up to 50 years old, less than 1 percent (9 wells) could potentially drop below the first open interval. Of wells greater than 50 years old, less than 5 percent (65 wells) would potentially drop below their first open interval. Again, many of the wells are over 50 years old and may longer be in use. Confirmation of the status of these domestic wells is a management action in this GSP (see **Section 9.2.6**). MTs could result in slightly higher energy costs associated with greater pumping lifts in limited areas.

Agricultural land uses and users. Similar to rural residential users and users, MTs for chronic lowering of groundwater levels protect agricultural users of groundwater by protecting their ability to meet their typical demands. Most agricultural wells are constructed to deeper depths than domestic wells as shown on **Figure 7-6**. As MTs are set higher to protect other users like rural residences and GDEs, they will also be protective of agricultural beneficial uses of groundwater unless declines continue or are not stabilized. MT exceedances could also increase agricultural land users' energy costs associated with greater pumping lifts.

Urban land uses and users. The MTs for chronic lowering of groundwater levels are set so that all users, including municipal groundwater pumpers can still meet their typical water demands. Similar to the agricultural users, municipal wells are typically deeper, and as MTs are set higher to protect other users such as rural residential and GDEs, if MTs for chronic lowering of groundwater level are exceeded in many areas the exceedance will likely not limit urban beneficial use of groundwater unless declines continue or are not stabilized. MT exceedances could also increase urban land users' energy costs associated with greater pumping lifts.

Ecological land uses and users. The chronic lowering of groundwater level MTs protect Avoid undesirable results with respect to GDEs in the NASb. As described in **Appendix O**, a comparison of existing GDE areas under current conditions compared to conditions at the Subbasin MTs results in only a 2 percent decrease in vegetation and less than a 1 percent decrease in wetland areas. Of those potentially impacted areas, more than 70 percent of the vegetation was classified as low priority (meaning that neither critical species nor diverse vegetation was present) and all of the wetland areas that are potentially impacted were classified as low priority. The MTs are also protective of aquatic ecosystems, which is discussed further under **Section 8.9** below.

8.4.2.6 Relevant State, Federal, and Local Standards

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

8.4.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater levels in RMS wells will be directly measured to determine where groundwater elevations are in relation to MTs and MOs. Groundwater level monitoring will be conducted in accordance with the monitoring protocols outlined in **Section 7.10 – Monitoring Protocols**. Many RMS wells are equipped with continuous data loggers to observe data in between the semi-annual MT and MO monitoring.

After the initial detection of an MT exceedance, the GSAs will:

- Take confirmation measurements.
- If the exceedance is confirmed, initiate an investigation to assess the cause of the exceedance.
- Identify if there are impacts as a result of the MT exceedance and possible mitigation measures, if impacts are noted.

8.4.3 Measurable Objectives – Chronic Lowering of Groundwater Levels

The MOs used to define preferred sustainable groundwater level conditions in the NASb are provided within this section.

8.4.3.1 Measurable Objectives

Groundwater level MOs were set above the MTs to allow for groundwater use for beneficial uses and users in the NASb. The MOs were established based on the approximate average historical Spring groundwater levels from 2010 through 2019 to reflect current conditions and because at these levels there were no reported negative impacts on beneficial uses and users. **Table 8-3** provides a listing of the selected MOs at each RMS.

8.4.3.2 Interim Milestones

Groundwater levels were established as interim milestones at all RMS on a 5-year frequency for the next 20 years as documented in **Table 8-3**. Groundwater levels in the NASb are currently above MTs at all RMS. Minor groundwater level declines in parts of the Subbasin are projected over the next 20 years based on modeling simulations. The 20-year interim milestone groundwater elevation coincides with the MO for each RMS. All of the values provided in **Table 8-3** will be periodically reevaluated as empirical data from monitoring is analyzed. For this reason, the values identified in **Table 8-3** will be evaluated and modified in accordance with the GSP regulatory requirements. The MOs at the RMS locations for chronic lowering of groundwater are shown on **Figure 8-7**.

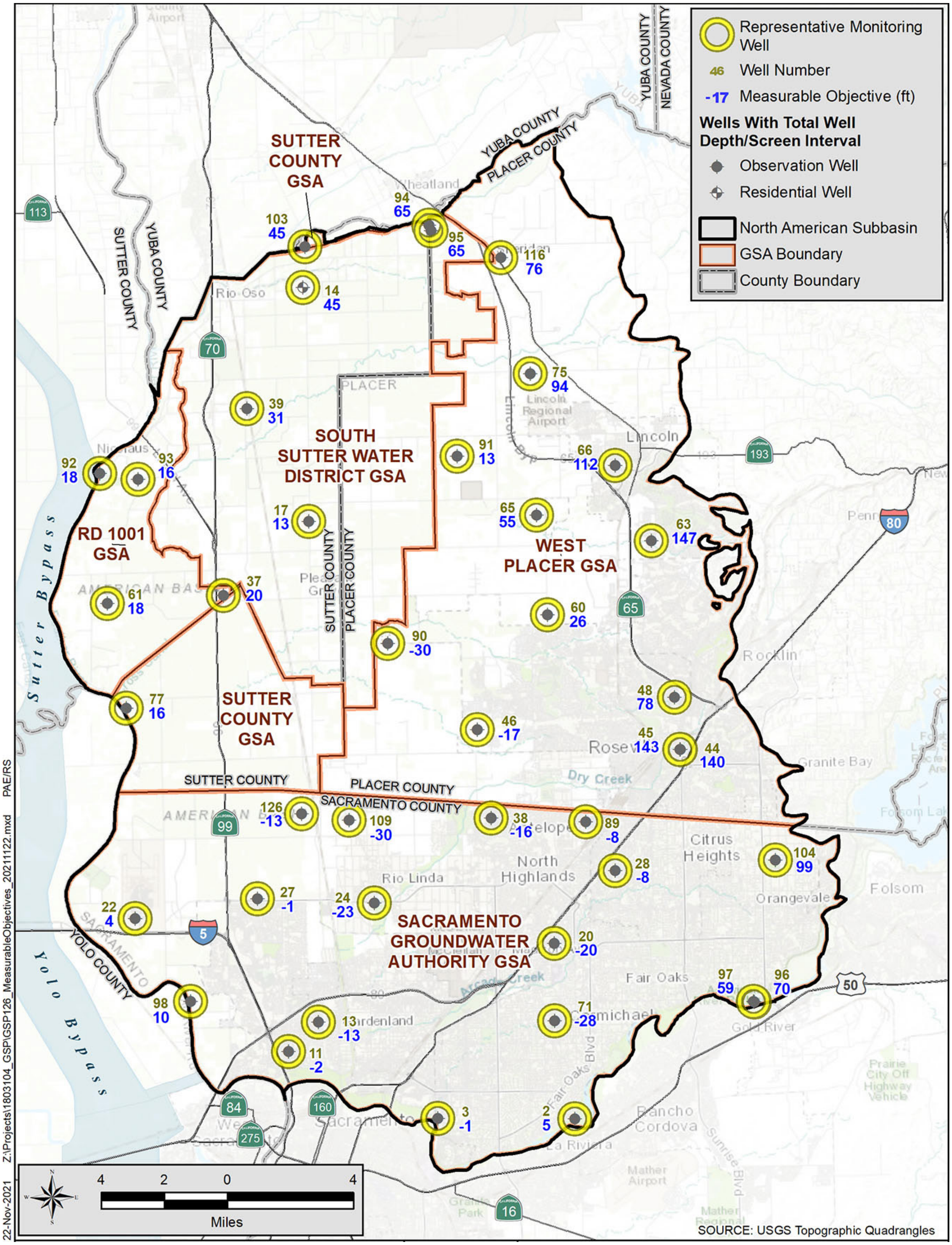

Figure 8-7. Projected Groundwater Elevation MOs at RMS Locations

Table 8-3. Chronic Lowering of Groundwater Level Measurable Objectives and Interim Milestones

Representative Monitoring Site		Selected MO (ft msl)	Interim Milestones (ft msl)			
Map No.	Local Name		Year 5 (ft msl)	Year 10 (ft msl)	Year 15 (ft msl)	Year 20 (ft msl)
2	SGA_MW06	5	9	7	6	5
3	SGA_MW04	-1	3	1	-1	-1
11	Bannon Creek Park	-2	1	0	-2	-2
13	Chuckwagon Park	-13	-8	-10	-12	-13
14	13N04E23A002M	45	49	47	46	45
17	AB-2 shallow	13	21	18	14	13
20	SGA_MW05	-25	-18	-21	-24	-25
22	AB-4 shallow	4	8	6	5	4
24	SGA_MW02	-23	-17	-19	-22	-23
27	AB-3 shallow	-1	8	4	0	-1
28	Twin Creeks Park	-19	-11	-15	-18	-19
37	SUT-P1	20	22	21	20	20
38	Lone Oak Park	-21	-15	-18	-20	-21
39	AB-1 shallow	31	35	33	32	31
44	WPMW-10A	140	140	140	140	140
45	WPMW-9A	143	143	143	143	143
46	SVMW West - 1A	-22	-18	-20	-21	-22
48	WPMW-4A	78	78	78	78	78
60	WPMW-2A	26	26	26	26	26
61	Sutter County MW-5A	18	19	19	18	18
63	WPMW-3A	147	147	147	147	147
65	MW 1-3	55	55	55	55	55
66	MW 5-1	112	112	112	112	112
71	WCMSS	-32	-24	-27	-31	-32
75	MW 2-3	94	95	94	94	94
77	SREL-1-27-F1	16	18	17	16	16
89	Roseview Park - 315	-13	-10	-11	-13	-13
90	WPMW-12A	-30	-22	-25	-29	-30
91	WPMW-11A	13	18	16	14	13
92	RDMW-101	18	19	19	18	18
93	RDMW-102	16	18	17	16	16
94	RDMW-103	65	66	66	65	65
95	RDMW-104	65	66	66	65	65
96	1516	70	71	71	70	70
97	1518	59	62	61	59	59
98	URS71000-700+00C	10	10	10	10	10
103	BR-1B	45	45	45	45	45
104	SGA_MW08	99	107	104	100	99
109	SGA_MW01	-30	-20	-24	-29	-30
116	Old Well #2	76	78	77	76	76
126	DeWit	-13	0	-6	-11	-13

8.5 Sustainability Indicator #2 - Reduction of Storage

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #2 – reduction of storage. Because chronic lowering of groundwater levels can be directly correlated to reduction of storage, groundwater levels will be used as a suitable proxy for reduction of storage.

Using the same modeling scenario for Sustainability Indicator #1 described above, results showed the basin's future projected inflows are balanced with projected outflows (*see* **Table 8-4)**. This would indicate that using the same MTs and MOs as the chronic lowering of groundwater levels MTs and MOs would also result in meeting this sustainability indicator.

Table 8-4. Projected Groundwater Change in Storage

Groundwater Budget Component	Current Conditions (AFY)	Projected with Climate Change and Project Implementation (AFY)
Inflows		
Deep Percolation	183,500	161,000
Stream Seepage	134,500	160,700
GW Injection (from ASR Operations)	200	2,100
Other Recharge	16,700	16,400
Subsurface Inflow	49,900	55,600
Total Inflow	***384,700***	***395,800***
Outflows		
Groundwater Outflow to Streams	53,000	42,400
Groundwater Pumping	303,300	338,500
Subsurface Outflow	13,600	14,900
Other Flows	-	100
Total Outflow	**369,900**	**395,800**
Change in Groundwater Storage	**14,900**	**-**

8.5.1 Undesirable Results – Reduction of Storage

The reduction of storage is considered significant and unreasonable when the following occurs:

- *20% or more of all NASb representative monitoring sites have minimum threshold exceedances for 2 consecutive Fall measurements (8 out of 41).*

8.5.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for reduction of storage are the same as used for chronic lowering of groundwater levels.

8.5.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for reduction of storage are the same as for chronic lowering of groundwater levels.

8.5.1.3 Effects on Beneficial Users and Land Use

The effects on beneficial users and land use are the same as used for chronic lowering of groundwater levels.

8.5.2 Minimum Thresholds – Reduction of Storage

8.5.2.1 Reduction of Storage Minimum Threshold

The GSAs used groundwater levels, which can serve as a reasonable proxy for defining quantitative thresholds for this sustainability indicator as supported in the GSP regulations (§354.28 (d)).

8.5.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

The information and criteria used are the same as used for chronic lowering of groundwater levels.

8.5.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between MTs for each sustainability indicator is the same as used for chronic lowering of groundwater levels.

8.5.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The effects of MTs on adjacent subbasins is the same as used for chronic lowering of groundwater levels.

8.5.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The effects of MTs on beneficial uses and users is the same as used for chronic lowering of groundwater levels.

8.5.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for reduction of storage.

8.5.2.7 Method for Quantitative Measurement of Minimum Threshold

The method for quantitative measurement is the same as used for chronic lowering of groundwater levels.

8.5.3 Measurable Objectives – Reduction of Storage

The measurable objectives used to define reduction of storage conditions in the NASb are provided within this section.

8.5.3.1 Measurable Objectives

MOs for reduction in storage are the same as used for chronic lowering of groundwater levels.

8.5.3.2 Interim Milestones

The interim milestones for MOs for reduction in storage are the same as used for chronic lowering of groundwater levels.

8.6 Sustainability Indicator #3 - Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator because the nearest occurrence of saline water intrusion into waterways, the Sacramento-San Joaquin River Delta, is about 40 miles west of the Subbasin boundary. The location of the saline front in the rivers has been maintained in the Delta in a similar location for nearly 80 years due to construction and operation of dams tributary to the Delta. Seawater intrusion is unlikely to occur during the planning horizon of this GSP.

8.7 Sustainability Indicator #4 - Degraded Water Quality

Although the concentration of constituents varies widely over the NASb and with depth at any given location, the quality of groundwater in the NASb has been suitable for nearly all beneficial uses and users. As described in **Section 5 – Groundwater Conditions**, there are some areas of elevated total dissolved solids (TDS), arsenic (As), hexavalent chromium (CrVI), iron (Fe), and manganese (Mn). Additionally, while not having any concentrations exceeding water quality standards, nitrates are an element of concern in the Subbasin. For the most part, constituent trends have remained stable and concentrations have not significantly changed over many decades, with the exception of nitrate, which has an upward trend in about 20 percent of the wells sampled (*refer to* **Table 5-4**). With scattered to very few possibly increasing trends in As, CrVI, Fe, and Mn observed to date and no significant changes in the planned use or management activities in the Subbasin, the NASb is not setting SMCs for these constituents. Rather, the GSAs will continue to monitor these constituents to observe if consistent increasing trends emerge. Because increases in TDS and nitrate can be associated with human activities, and, therefore, subject to some form of management if needed, the NASb is establishing SMC for these two constituents.

It is also worth noting that in the Sacramento County portion of the NASb, there are well-documented larger areas of contamination as described in **Section 5.8.3**. As also described in that section, the NASb has analyzed expanded groundwater use around the plumes relative to the ongoing remediation operations and found that the plumes have effective capture. Representatives of the NASb have also maintained active coordination with regulators and responsible parties to address effective remediation of these contaminants. For that reason, there are no SMC for the contaminants in groundwater.

Based on the above information, degraded water quality is considered significant and unreasonable in the NASb when either of the following occur:

For public water system wells

- *The basin wide average total dissolved solids (TDS) concentrations of <u>all</u> public water system wells exceeds 400 mg/l.*

OR

- *The basin wide average nitrate (as N) concentration of <u>all</u> public water system wells exceeds 8 mg/l.*

For the shallow aquifer (i.e. domestic and self-supplied) wells

- *25% of the representative monitoring sites (RMS)[3] total dissolved solids (TDS) or nitrate (as N) concentrations exceed state maximum contaminant levels (MCLs).*

[3] Representative monitoring sites (RMSs) are interchangeably referred to as representative monitoring wells (RMWs)

8.7.1.1 Criteria for Defining Undesirable Results

The criteria used to define undesirable results for degraded water quality is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of:

- Groundwater that fails to meet state drinking water standards for domestic and self-supplied wells which are located predominantly in the shallow aquifer.
- Groundwater that fails to meet state drinking water standards for public water systems (i.e., municipal wells).
- Groundwater exceeding agricultural water quality goals for TDS resulting in lesser crop yields.

8.7.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for degraded water quality are:

- Changes in NASb pumping distribution and volumes. This would be most likely due to changing land use practices such as an increase or concentration of new agricultural and/or municipal pumping. This pumping could alter hydraulic gradients and cause movement of poor-quality groundwater towards municipal or domestic wells, causing concentrations to exceed state drinking water standards or agricultural water quality goals.
- Changing land use practices that contaminate the quality of the groundwater basin or cause an increase in recharge of poor-quality water. Groundwater quality could become degraded by increasing the salt content (i.e., lowering of groundwater levels increases and changes in pressure allows saline water from underlying marine sediments to intrude into freshwater aquifers).

8.7.1.3 Effects on Beneficial Users and Land Use

If undesirable results were to occur, the effect may be groundwater quality that does not meet state drinking water standards or agricultural water quality goals. This would result in either potentially expensive treatment or may trigger increased use of an alternative water supply (e.g., surface water) to meet demands. An alternative water supply may be economically or physically infeasible for certain beneficial users.

This undesirable result does not apply to groundwater quality changes that are outside the control of the GSAs. Multiple federal, state, and local regulatory requirements regarding the protection of groundwater quality exist that will be enforced by these agencies.

8.7.2 Minimum Thresholds – Degraded Water Quality

The MTs used to support the undesirable results definition of the degradation of water quality are provide within this section.

8.7.2.1 Degraded Water Quality Minimum Threshold

The MTs are state drinking water standards for constituents of concern monitored in all public water system wells (i.e., municipal wells) and in the RMS locations for domestic/self-supplied wells for degraded groundwater quality. These MTs include:

- *Individual well total dissolved solids (TDS) concentrations that exceed the state secondary recommended maximum contaminant level (MCL).*
- *Individual well nitrate (as N) concentrations that exceed the state primary maximum contaminant level (MCL).*

As defined by the State Water Resources Control Board (SWRCB) the MCL for nitrate (as N) is a primary MCL and for TDS is a secondary aesthetic "taste and odor" MCL. State regulations allow public water systems to serve water that exceeds secondary aesthetic MCL standards under certain conditions and there are no public health goals for secondary MCLs, whereas primary MCL standards are more strictly observed.

8.7.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

Information used to establish the degraded groundwater quality MTs included:

- Historical and current groundwater quality data from municipal and monitoring wells in the NASb.
- Federal and State drinking water standards.
- Agricultural water quality goals.
- Depths, location, and geologic information from well logs throughout the NASb.
- Evaluation and organization of different well type construction data (i.e., domestic, municipal, and irrigation).

The criteria used to establish MTs consisted of analyzing the historical and current groundwater quality data as discussed in **Section 5 – Groundwater Conditions**. Based on a review of the information identified above, the GSAs determined that state drinking water standards are the most appropriate values to define as the MTs.

For public water system, or municipal wells, the SWRCB Division of Drinking Water (DDW) requires all active municipal wells be periodically sampled and analyzed in accordance with California Water Code Title 22 constituent standards. Results from this analysis is provided directly to the Division of Drinking Water through the Electronic Data Transfer site.

For domestic/self-supplied wells, special care was taken to evaluate the density and known well construction details of domestic wells by section in the NASb. As illustrated on **Figure 7-10**, RMSs were strategically located in areas throughout the Subbasin where the greatest density of domestic/self-supplied wells occur, along with additional wells to provide regional coverage in areas with lesser densities.

8.7.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The NASb projects and management actions (*refer to* **Section 9 – Projects and Management Actions**) are focused on ensuring the sustainability of the Subbasin from chronic lowering of groundwater levels, reduction of storage, land subsidence, and depletions of interconnected streams. The NASb groundwater quality generally meets all beneficial uses and users and is currently sustainable. From a GSP project and management action perspective, there are no projects and management actions in the NASb GSP focused on groundwater quality and, therefore, no direct relationship to other sustainability indicators. However, the prevention of migration of poorer quality groundwater, as a result largely of chronic lowering of groundwater levels, is the main relationship between the degraded water quality and other sustainability indicators.

In theory the degraded water quality MT could influence the **chronic lowering of groundwater levels, reduction of groundwater in storage, land subsidence,** and **depletion of interconnected surface water** MTs in a positive way, if groundwater pumping is reduced as a result of domestic and municipal users being unable to pump groundwater to meet demands. However, GSAs will be managing the groundwater to avoid this theoretical situation, so that groundwater can continue to be used for beneficial uses.

The metric of using state standards has been applied to define MTs for the degraded groundwater quality sustainability indicator. The remaining sustainability indicators' minimum thresholds are based on other metrics (i.e. all others use groundwater). For this reason, there is no conflict between the degraded groundwater quality and other MTs.

8.7.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The anticipated negative effects of exceeding the degraded groundwater quality MTs to each of the neighboring basins is very negligible to potentially nonexistent. If NASb degraded groundwater quality MTs were to be exceeded, it would likely be a result of significant groundwater level declines within the NASb that would result in potentially changing the direction or increasing the slope of the hydraulic gradient of groundwater from adjacent basins towards the NASb. This could result in a potential of increased rate and volume of subsurface flow into the NASb. For this reason, any groundwater quality degradation would likely be contained within the NASb. However, the flow dynamics associated with groundwater level declines, which may change the direction or increase the gradient across basin boundaries are also possible in the other subbasins, meaning if adjacent subbasin groundwater quality was significantly degraded it could impact the NASb.

8.7.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

Degraded groundwater quality minimum thresholds (if exceeded) may have effects on beneficial uses and users of groundwater in the NASb.

Rural residential land uses and users. The degraded groundwater quality MTs protect domestic users of groundwater in the basin as the MTs coincide with state drinking water standards. If the MT was exceeded for nitrate (as N) water would not meet primary MCL state standards. If the MT was exceeded for TDS, water would not meet secondary aesthetic MCL state standards. However, for TDS, domestic users would still be able to use groundwater in excess of the taste and odor thresholds.

Agricultural land uses and users. The degraded groundwater quality MTs generally benefit agricultural water users of groundwater in the basin as the MTs for the agricultural water quality goal of 450 mg/L to obtain 90 percent crop production for TDS is close to the drinking water standard of 500 mg/L. For this reason, groundwater quality approaching the MT will likely not negatively affect known agricultural land uses.

Urban land uses and users. The degraded groundwater quality MTs protect urban water users of groundwater in the basin as the MT coincides with state drinking water standards. Preventing groundwater used for drinking water from exceeding the state drinking water standards provides adequate water quality of groundwater for municipal uses.

Ecological land uses and users. The groundwater quality MTs would benefit ecological users by preventing poor quality groundwater from migrating to GDEs.

8.7.2.6 Relevant State, Federal, and Local Standards

The degraded groundwater quality MTs specifically incorporate state drinking water standards.

8.7.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater samples will be taken in accordance with the monitoring network description provided in **Section 7 – Monitoring Networks**. Results from these samples will enable GSAs to make a direct correlation between current groundwater quality concentrations and state water quality standards.

The GSAs also intend to monitor groundwater quality with the use of "Sentry Wells". A Sentry Well is <u>not</u> an RMS as defined by the GSP regulations for degraded water quality. The GSAs have identified Sentry Wells for the specific purpose of providing early warning of groundwater quality changes (spatially or vertically) due to shifting changes in groundwater use in the NASb. The GSAs will sample, analyze, and report on water quality concentrations for TDS and nitrate (as N) at Sentry Wells to determine if water quality changes related to groundwater level changes that could result in MT exceedances could occur.

Many constituents that are routinely sampled and analyzed from groundwater wells (e.g., general minerals and metals) are often observed to have significant fluctuations in concentrations over time. Due to these fluctuations, multiple groundwater samples need to be collected over many years to establish trends and a true and accurate understanding of groundwater quality conditions. It is good practice to sample at the same time of year when collecting and analyzing groundwater quality samples from wells. TDS concentrations from groundwater samples are often more susceptible than many other constituents to fluctuating concentrations over time.

Furthermore, although the GSAs will strive to collect samples in accordance with best management practices, the practice of obtaining water quality samples in the field is done so in an uncontrolled environment and, therefore, can lead to erroneous data. For this reason, if MT exceedances are reported, GSAs may resample to verify measurements to ensure accurate readings are reported. Data determined to be erroneous by the GSA and not representative of actual conditions will not be used for the purposes of defining sustainability.

8.7.3 Measurable Objectives – Degraded Water Quality

The MOs used to define optimal water quality conditions in the NASb are provided within this section.

8.7.3.1 Measurable Objectives

The MO for public water system wells will be 300 mg/l for TDS and 3 mg/l for nitrate (as N). These MO concentrations are slightly higher than average concentrations observed in public supply wells from more than 300 samples of TDS and nitrate (as N) as summarized on **Table 8-5**. Slightly higher average MO concentrations were established based on the understanding that projected groundwater levels might be slightly lower in 2042, possibly increasing concentrations. A list of known public system wells and a summary of water quality detections is provided in **Appendix L – Summary of Water Quality Detections**. The average values for TDS and nitrate (as N) have been calculated based on the most recent sample result from each well as summarized in **Table 8-5**.

Table 8-5. Measurable Objective (Public Supply Well – Average Nitrate and TDS Concentrations)

Public Supply Well Statistic	Nitrate (as N)		TDS	
Units	mg/l		mg/l	
Date Range	4/9/1987	10/1/2019	4/9/1987	9/12/2019
Minimum Concentrations[1]	0		0	
Maximum Concentrations	10		720	
Maximum Contaminant Level (MCL)	10		500	
Number of reported concentrations observed above MCL during date range	0		3	
Number of wells with analytical results during date range	354		313	
Average concentrations reported during date range[2]	**1.8**		**258.4**	
Measurable Objective (Estimated concentration based on projected groundwater levels in year 2042)	**3**		**300**	

[1] For purposes of averaging concentration, less than the reporting limit is calculated as 0.
[2] Concentrations are calculated based on the average of the most recent sample result from each well.

The MOs for the domestic/self-supplied wells is approximately 10 percent higher than recent concentrations for Nitrate (as N) and TDS reported at each RMS as illustrated in **Table 8-6**. Similar to the methodology used to establish MO concentrations for public supply wells, the MOs for domestic/self-supplied wells are slightly higher than average concentrations observed in RMS as summarized on **Table 8-6**. Slightly higher average MO concentrations were established based on the understanding that projected groundwater levels might be slightly lower in 2042 possibly increasing concentrations. If an RMS does not have groundwater quality data during this period, an MO will be established prior to the next 5-year GSP update.

Table 8-6. Measurable Objective (Domestic/Self-supplied – RMS Nitrate and TDS Concentrations)

Map No.	Local Name	TDS (Secondary MCL = 500 mg/L)			Nitrate (Primary MCL = 10 mg/L)			Interim Milestones (mg/l)
		Reported Concentration (mg/L)	Selected MTs (mg/L)	Selected MOs (mg/L)	Reported Concentration (mg/L)	Selected MTs (mg/L)	Selected MOs (mg/L)	Year 5, 10, 15, & 20 (mg/L)
17	AB-2 shallow	200	500	220	ND	10	ND	ND
20	SGA_MW05	274	500	300	1.5	10	1.7	1.7
24	SGA_MW02	270	500	300	4.1	10	4.5	4.5
27	AB-3 shallow	150	500	170	ND	10	ND	ND
37	SUT-P1	110	500	120	ND	10	ND	ND
39	AB-1 shallow	140	500	150	ND	10	ND	ND
46	SVMWWest1A	unknown	500	TBD	unknown	10	TBD	TBD
80	Cemetery (IRLP)	268	500	290	unknown	10	TBD	TBD
89	Roseview Park - 315	190	500	210	unknown	10	TBD	TBD
90	WPMW-12A	210	500	230	0.58	10	0.64	0.64
91	WPMW-11A	220	500	240	1.0	10	1.1	1.1
99	Main Well	unknown	500	TBD	ND	10	ND	ND
109	SGA_MW01	330	500	360	0.9	10	1.0	1.0
133	LW-1	200	500	220	3.6	10	4.0	4.0
177	Well 22 - Northrop	110	500	120	ND	10	ND	ND
298	Tinker Road Well	220	500	240	3.87	10	4.26	4.26

8.7.3.2 Interim Milestones

Groundwater quality in the NASb is currently below the respective MTs for public supply wells and domestic/self-supplied wells, with no change in quality expected from projects and management actions implemented to maintain sustainability. Since the MOs effectively represent current conditions, interim milestones for the RMS wells are set as the same concentrations as MOs shown on **Table 8-6**.

8.8 Sustainability Indicator #5 - Land Subsidence

The following description addresses SGMA GSP regulatory requirements related to the sustainability indicator #5 – land subsidence.

8.8.1 Undesirable Results – Land Subsidence

As described in **Section 5.10 – Land Subsidence**, past land surface subsidence has been very limited and has been gradual through time. As a result, no significant impacts have been documented in the NASb from subsidence. Additionally, the geologic setting (*see* **Section 4.9 - Geologic Sections**) does not indicate the presence of thick, laterally extensive clay deposits that generally create conditions for subsidence to occur. Based on these conditions, significant and unreasonable land surface subsidence could occur when:

The rate of inelastic subsidence exceeds 0.5 feet over a five-year period over an area covering approximately five or more square miles.

8.8.1.1 Criteria for Defining Undesirable Results

Based on past limited subsidence documented in the Subbasin, there have been no undesirable results encountered. Based on the hydrogeologic setting (*see* **Section 4 – Hydrogeologic Setting**) and projected conditions (*see* **Section 6.4.3 – Projected Water Budget**), the Subbasin would not expect to experience undesirable results associated with subsidence. Therefore, the criteria used would indicate exceeding past rates of subsidence. The area of five square miles was selected because it represents one percent of the total area of the Subbasin. An area covering less than that would be a highly localized phenomenon (or potentially based on erroneous data) that would not impact overall basin sustainability.

8.8.1.2 Potential Causes of Undesirable Results

Potential causes that may create these undesirable results could be from groundwater pumping causing groundwater levels to drop below historic lows which may result in inelastic land subsidence.

8.8.1.3 Effects on Beneficial Users and Land Use

As stated above, historically the Subbasin has not experienced undesirable results based on existing land subsidence data. For this reason, the extent and magnitude of how an undesirable result for land subsidence might impact beneficial users of groundwater and land uses can only be theorized. Therefore, should undesirable results for subsidence due to groundwater extractions occur, possible impacts to beneficial users' land use could include:

- Shifting of land gradients causing problems for crops that rely on precise irrigation depths (e.g., rice).
- Damage to pipelines and wells.
- Shifting of grades to sewer and storm drains preventing proper drainage.
- Damage to pavement on local roads and highways or structural damage to buildings.
- Lowering of levee crowns adjacent to rivers increasing flood risk.

8.8.2 Minimum Thresholds – Land Subsidence

8.8.2.1 Land Subsidence Minimum Thresholds

Groundwater levels are being used as a proxy for minimum thresholds. At each groundwater level RMS, either the minimum recorded low water level elevation or the projected low groundwater elevation, whichever is lower, is being used. In the case of historical lows, subsidence would not be expected until the level exceeded the minimum threshold. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (*refer to* **Section 5.10 – Land Subsidence**). As the maximum projected long-term drawdown within the Subbasin is about 18 feet, that would equate to approximately 0.18 feet of subsidence. That would not result in a demonstrable impact in the Subbasin (i.e., no infrastructure damage or loss of surface water conveyance capacity would be expected). **Table 8-7** shows the RMS locations used for land subsidence. The table also shows the MT as determined by the modeled projected conditions, for chronic lowering of groundwater levels and the minimum measured groundwater elevation near each location. Where the minimum elevation is lower than the modeled MT, the lower value is used for the subsidence MT.

Table 8-7. Minimum Thresholds for Land Subsidence RMS

Map No.	Local Name	Model Projected MT (ft msl)	Subsidence Historic Low Groundwater Levels	Selected MT (ft MSL)
2	SGA_MW06	**1**	**7**	**1**
3	SGA_MW04	**-5**	**-2**	**-5**
11	Bannon Creek Park	**-5**	**-2**	**-5**
13	Chuckwagon Park	**-15**	**-10**	**-15**
14	13N04E23A002M	**26**	**15**	**15**
17	AB-2 shallow	**-17**	**-21**	**-21**
20	SGA_MW05	**-37**	**-35**	**-37**
22	AB-4 shallow	**-1**	**4**	**-1**
24	SGA_MW02	**-27**	**-19**	**-27**
27	AB-3 shallow	**-4**	**5**	**-4**
28	Twin Creeks Park	**-28**	**-15**	**-28**
37	SUT-P1	**10**	**8**	**8**
38	Lone Oak Park	**-27**	**-19**	**-27**
39	AB-1 shallow	**3**	**-5**	**-5**
44	WPMW-10A	**133**	**133**	**133**
45	WPMW-9A	**135**	**131**	**131**
46	SVMW West - 1A	**-32**	**-28**	**-32**
48	WPMW-4A	**75**	**72**	**72**
60	WPMW-2A	**22**	**21**	**21**
61	Sutter County MW-5A	**10**	**-1**	**-1**
63	WPMW-3A	**145**	**146**	**145**
65	MW 1-3	**49**	**38**	**38**
66	MW 5-1	**108**	**104**	**104**
71	WCMSS	**-40**	**-26**	**-40**
75	MW 2-3	**89**	**86**	**86**
77	SREL-1-27-F1	**9**	**13**	**9**
89	Roseview Park - 315	**-22**	**-17**	**-22**
90	WPMW-12A	**-45**	**-65**	**-65**
91	WPMW-11A	**3**	**-18**	**-18**
92	RDMW-101	**15**	**14**	**14**
93	RDMW-102	**12**	**8**	**8**
94	RDMW-103	**58**	**36**	**36**
95	RDMW-104	**57**	**36**	**36**
96	1516	**67**	**69**	**67**
97	1518	**57**	**61**	**57**
98	URS71000-700+00C	**7**	**6**	**6**
103	BR-1B	**36**	**36**	**36**
104	SGA_MW08	**97**	**107**	**97**
109	SGA_MW01	**-33**	**-20**	**-33**
116	Old Well #2	**68**	**72**	**68**
126	DeWit	**-25**	**12**	**-25**

The Department of Water Resources (DWR) is advancing statewide understanding of land subsidence through the use of InSAR technology[4]. DWR has recently extended the use of InSAR technology first utilized in the San Joaquin Valley to evaluate the extent of subsidence to the Sacramento Valley. As data from InSAR has only recently become available, the GSAs did not have the time to thoroughly evaluate the use of InSAR collected data at the time of the preparation of this GSP in comparison to the process described above relating to understanding land subsidence in the NASb. For this reason, the NASb GSAs are establishing MTs using the accepted practice of utilizing historic land subsidence data and correlating it to groundwater levels. However, the NASb GSAs may incorporate DWR-provided InSAR data into how the GSAs evaluate compliance with the SMC.

8.8.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

Information used in establishing thresholds and objectives includes multiple lines of directly measured subsidence (*refer to* **Section 5.10 – Land Subsidence**), direct measurements of historic water levels (see **Section 5.2 – Groundwater Levels and Appendices G through I**), and modeled simulation of projected groundwater elevations based on future land use changes and future climate conditions (see **Section 8.4.2.2**).

8.8.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between land subsidence MTs for other sustainability indicators are discussed below.

Chronic lowering of groundwater levels. These are closely related in that the subsidence MTs will be measured at the same locations as for groundwater levels. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater levels are declining below their groundwater level MT, even though subsidence would likely not be occurring.

Reduction of groundwater in storage. These are closely related in that the subsidence MTs will be measured at the same locations as for groundwater levels. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater in storage is being reduced, with some minor projected subsidence.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

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[4] InSAR (Interferometric Synthetic Aperture Radar) is a technique for mapping land subsidence with very precise accuracy using radar images of the Earth's surface that are collected from orbiting satellites.

Degraded groundwater quality. There is no relationship between subsidence and groundwater quality.

Depletion of interconnected surface water. These are closely related in that the subsidence MTs will be measured at the same locations as for interconnected surface water groundwater level locations. There is general agreement between the MT values, although the level established for subsidence could be slightly deeper if historic lows are below the projected future lows. This could create a scenario where groundwater levels are declining that induces additional seepage of surface water, even though subsidence would likely not be occurring.

8.8.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

The MTs are not expected to effect adjacent subbasins because they are established at historical or projected low groundwater levels in the representative groundwater level monitoring network, whichever is lower. In the case of historical lows, subsidence would not be expected until the level exceeded the MT. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (see **Section 5.10 – Land Subsidence**). As the maximum projected long-term drawdown at RMS locations to an adjacent subbasin is about 6 feet, that would equate to approximately 0.06 feet of subsidence. That would not result in a demonstrable impact on an adjacent subbasins.

8.8.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The MTs are not expected to effect beneficial uses and users because they are established at historical or projected low groundwater levels in the representative groundwater level monitoring network, whichever is lower. In the case of historical lows, subsidence would not be expected until the level exceeded the MT. In the case of projected lows, a relationship of approximately 0.01 feet of subsidence per 1 foot of groundwater drawdown has been observed (see Section 5.10). As the maximum projected long-term drawdown within the subbasin is about 18 feet, that would equate to approximately 0.18 feet of subsidence. That would not result in a demonstrable impact on a beneficial user in the subbasin (i.e., no infrastructure damage or loss of surface water conveyance capacity would be expected).

8.8.2.6 Relevant State, Federal, and Local Standards

There are no established state, federal, or local standards for subsidence-related thresholds.

8.8.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater levels are being used as a proxy for MTs. While many of the groundwater elevation monitoring network wells are equipped with pressure transducers to collect at least daily water levels, the minimum standard for quantitative water elevation measurements will be through a manually collected field measurement taken twice annually (Fall and Spring). The Fall water level measurement will be used to compare against the MT.

8.8.3 Measurable Objectives – Land Subsidence

8.8.3.1 Measurable Objectives

Given the well-established relationship between groundwater levels and subsidence, groundwater levels are used as a proxy for MOs for land subsidence. Because the MOs established for chronic lowering of groundwater levels and reduction of groundwater in storage represent the desired state for a sustainable groundwater basin, those same values apply to land subsidence as shown in **Table 8-7**.

8.8.3.2 Interim Milestones

Because the MO interim milestones established for chronic lowering of groundwater levels and reduction of groundwater in storage represent the desired state for a sustainable groundwater basin, those same values apply to land subsidence as shown in **Table 8-7**.

8.9 Sustainability Indicator #6 - Depletion of Surface Water

The following description addresses SGMA GSP regulatory requirements related to sustainability indicator #6 – depletion of surface water. Because the depletion of interconnected surface water is directly related to the gradient between the surface water system at the groundwater interface and the groundwater Subbasin, groundwater levels are a suitable proxy for this sustainability indicator. Because surface water is not interconnected with the groundwater Subbasin over its entire area (*see* **Section 5.11**), only a subset (24 wells) of the RMS for groundwater elevations is used, which is shown in **Figure 7-13** in **Section 7.3 – Representative Monitoring Network**. Of those wells, some are monitoring different depths at the same location. As a result, there are 21 locations that will be used for evaluation purposes.

Using the same modeling scenario for Sustainability Indicator #1 described above, the effects on surface water flows resulting from land use changes and coincident additional use of groundwater can be observed. This would indicate that using the same MTs and MOs as those for the chronic lowering of groundwater levels would also result in meeting this sustainability indicator.

The results of the modeled scenario, which is described further in **Section 9.2.1 – Project #1 – Regional Conjunctive Use Extension – Phase 1**, indicate that NASb-wide groundwater extractions are projected to increase from their Current Conditions Baseline (CCBL) by some 40,000 AFY under the Projected Conditions Baseline with Climate Change (PCBL+CC). As shown in **Figure 8-5** above, the most significant drawdown of groundwater elevations under these conditions is near the Sacramento River. A detailed analysis of seepage along the Sacramento River from the modeling results indicates that the river will lose about 5,800 AFY over the 50-year simulation to the groundwater basin. However, as the municipal development occurs near the river, it will take some agricultural land out of production that currently diverts water from the river. As a result, Sacramento River flows will experience a net increase of about 17,200 AFY. This trend has already been observed by NMWC, which is in the area of proposed land use conversion. NMWC has observed surface water deliveries decline from an average of more than 80,000 AFY in the 1990s down to less than 65,000 AFY in the 2010s.

Figure 8-7 depicts the long-term projected changes along the Sacramento River on a monthly basis. Since the new groundwater demand is for public water supply, there is a baseline demand all year long (rather than a typical 6-month growing season). Additionally, some of the new public water supply will come from surface water, so there is a decrease in streamflow from January through March from diversions to meet that demand. The river will see its greatest increase in streamflow from May through August; this would have otherwise been diverted to meet agricultural demand. There is a net decrease in streamflow for the month of September, because there are still relatively high public supply demands in that month due to high air temperature and lack of precipitation. The net change is partially offset by the fact that many agricultural lands have reduced water applications in September. Overall, the projected land use changes would represent a net improvement to Sacramento River flows on an annual basis.

As described in **Section 5.11**, Central Valley Steelhead and Chinook Salmon are known to rely on the Sacramento, Feather, and American rivers, and Central Valley Steelhead are known to enter western Placer County creeks through the Natomas Cross Canal and the westernmost segment of Steelhead Creek. To evaluate whether there would be potential impacts to these aquatic species, additional seepage from each reach of these systems resulting from the modeled scenario described above was evaluated in comparison to total flow in the interconnected reach on a monthly basis. **Table 8-8** shows the projected average monthly flows in each reach, the projected future seepage from each reach to the groundwater system (value is negative when there is a net contribution from groundwater to surface water), and the percentage of surface water flow that seepage represents for any given month. As can be seen in the table, the seepage at all times represents less than 1 percent, generally substantially less, of flow in the rivers and the Natomas Cross Canal. In Steelhead Creek (aka Natomas East Main Drain), additional projected seepage is greater than 2 percent in a few months. However, that occurs in summer months when the fish species would not be migrating. Finally, it is worth noting that at no time do any of these reaches go dry. The Cross Canal and Steelhead Creek are constantly fed by urban runoff and wastewater treatment plants, and that condition is projected to increase with future development.

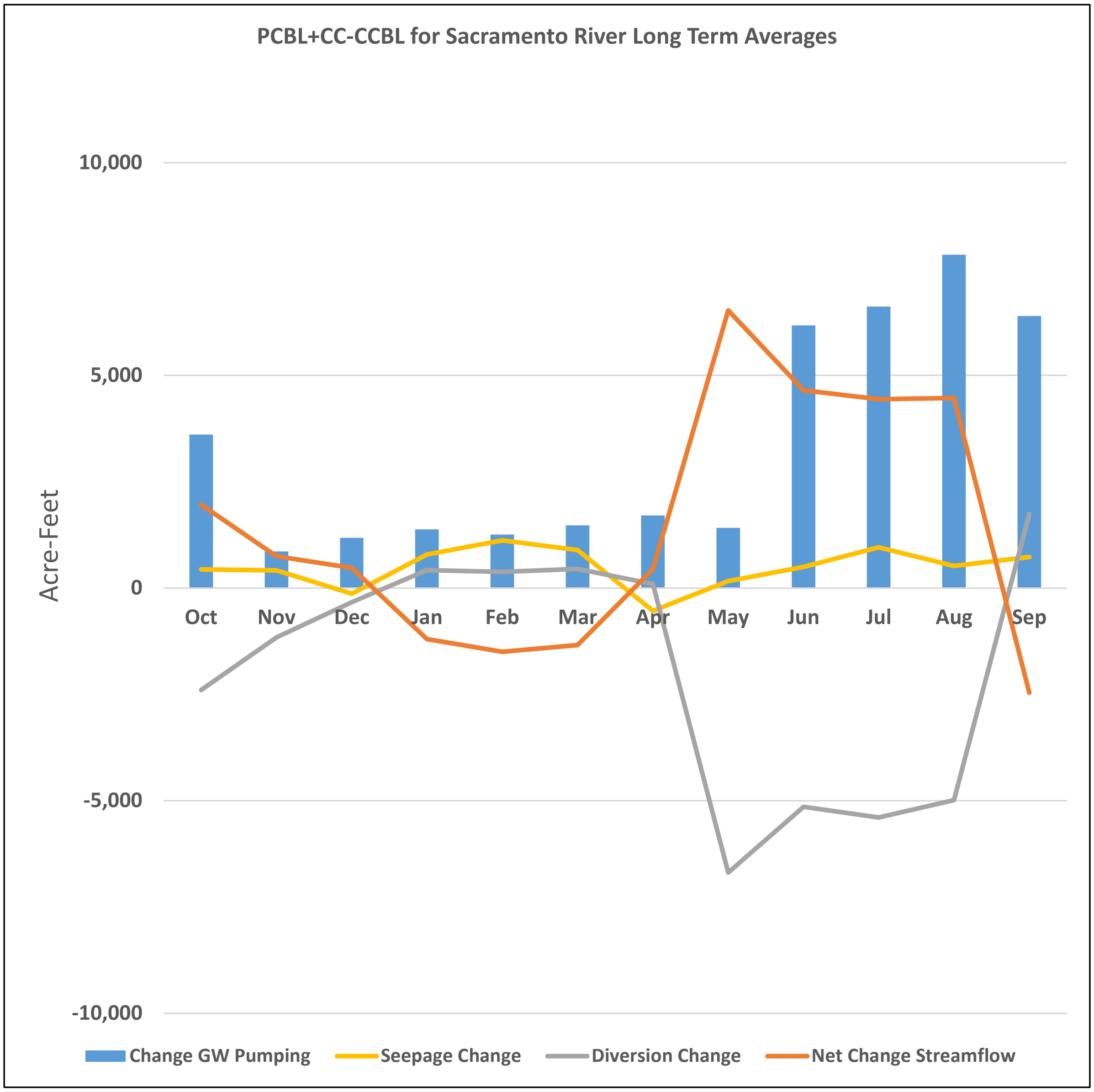

Figure 8-7. Projected Long-Term Average Annual Water Budget Change along the Sacramento River

Table 8-8. Seepage Changes in Interconnected Surface Waters that Support Critical Aquatic Species

Reach	Flow (acre-feet)	Seepage (acre-feet)	Seepage as Percent of Flow
Feather River			
Oct	166,572	156	0.09%
Nov	195,798	56	0.03%
Dec	354,140	369	0.10%
Jan	623,738	234	0.04%
Feb	814,007	422	0.05%
Mar	979,384	583	0.06%
Apr	449,412	-607	0.14%
May	208,164	-631	0.30%
Jun	212,331	87	0.04%
Jul	354,998	604	0.17%
Aug	274,013	-7	0.00%
Sep	288,837	336	0.12%
Annual Total	4,921,394	1,602	0.03%
Sacramento River			
Oct	509,583	485	0.10%
Nov	638,065	463	0.07%
Dec	1,078,974	-70	0.01%
Jan	1,718,596	862	0.05%
Feb	1,932,039	1,163	0.06%
Mar	2,021,789	871	0.04%
Apr	1,027,100	-493	0.05%
May	593,809	240	0.04%
Jun	559,450	568	0.10%
Jul	843,658	1,020	0.12%
Aug	723,319	574	0.08%
Sep	831,110	784	0.09%
Annual Total	12,477,492	6,467	0.05%
American River			
Oct	70,127	410	0.58%
Nov	92,426	517	0.56%
Dec	166,509	524	0.31%
Jan	305,324	784	0.26%
Feb	352,172	710	0.20%
Mar	378,339	918	0.24%
Apr	207,264	293	0.14%
May	104,031	17	0.02%
Jun	209,435	950	0.45%
Jul	221,909	764	0.34%
Aug	107,981	402	0.37%
Sep	117,452	749	0.64%
Annual Total	2,332,969	7,038	0.30%

Reach	Flow (acre-feet)	Seepage (acre-feet)	Seepage as Percent of Flow
Natomas Cross Canal			
Oct	7,156	41	0.57%
Nov	14,695	47	0.32%
Dec	30,120	40	0.13%
Jan	39,131	40	0.10%
Feb	37,100	49	0.13%
Mar	38,076	45	0.12%
Apr	11,913	31	0.26%
May	6,582	29	0.44%
Jun	5,123	21	0.41%
Jul	6,239	32	0.51%
Aug	5,227	30	0.57%
Sep	4,752	31	0.65%
Annual Total	206,114	436	0.21%
Steelhead Creek			
Oct	7,799	109	1.40%
Nov	13,522	75	0.55%
Dec	20,461	95	0.46%
Jan	26,383	92	0.35%
Feb	24,197	113	0.47%
Mar	24,097	133	0.55%
Apr	9,657	69	0.71%
May	6,465	101	1.56%
Jun	5,400	129	2.39%
Jul	6,194	163	2.63%
Aug	5,626	136	2.42%
Sep	5,510	125	2.27%
Annual Total	155,311	1,340	0.86%

8.9.1 Undesirable Results – Depletion of Surface Water

Depletion of surface water is considered significant and unreasonable when the following occurs:

- *20% or more of the NASb interconnected surface water (ISW) representative monitoring sites (RMS) have minimum threshold exceedances for 2 consecutive Fall measurements (5 out of 21).*

8.9.1.1 Criteria for Defining Undesirable Results

The criteria used to define significant and undesirable results for depletion of surface water is inherently focused on the protection of beneficial uses and users. Therefore, these are avoidance of drawing down of groundwater levels such that a gradient is induced that results in significant and unreasonable depletion of surface water that could impact downstream users, riparian and aquatic habitat and species in the river corridor, or adjacent GDEs dependent on shallow groundwater.

8.9.1.2 Potential Causes of Undesirable Results

The possible causes of undesirable results for depletion of surface water are increased groundwater extractions that could induce additional seepage from local rivers and tributaries.

8.9.1.3 Effects on Beneficial Users and Land Use

If undesirable results were to occur, this could reduce the availability of surface water for downstream and in-basin diverters, riparian and aquatic habitat and species in the river corridor, or adjacent GDEs. Reduced surface water availability could limit land use if reliable water supply is determined to not be available.

8.9.2 Minimum Thresholds – Depletion of Surface Water

Groundwater levels were used as a proxy metric for this sustainability indicator.

8.9.2.1 Depletion of Surface Water Minimum Threshold

The MTs for depletion of surface water are the same as for chronic lowering of groundwater levels, with the exception that only a subset of the RMS locations are considered interconnected with the surface water system. These are shown in **Table 8-9**.

Table 8-9. MTs, MOs, and Interim Milestones for Depletion of Surface Water

Representative Monitoring Sites (i.e. Wells)		Final Selection		Interim Milestones (ft msl)			
Map No.	Local Name	(ft msl)	(ft msl)	(ft msl)	(ft msl)	(ft msl)	(ft msl)
2	SGA_MW06	5	1	9	7	6	5
3	SGA_MW04	-1	-5	3	1	-1	-1
11	Bannon Creek Park	-2	-5	1	0	-2	-2
13	Chuckwagon Park	-13	-15	-8	-10	-12	-13
14	13N04E23A002M	45	26	49	47	46	45
22	AB-4 shallow	4	-1	8	6	5	4
27	AB-3 shallow	-1	-4	8	4	0	-1
28	Twin Creeks Park	-8	-17	-8	-8	-8	-8
37	SUT-P1	20	10	22	21	20	20
44	WPMW-10A	140	133	140	140	140	140
45	WPMW-9A	143	135	143	143	143	143
61	Sutter County MW-5A	18	10	19	19	18	18
63	WPMW-3A	147	145	147	147	147	147
66	MW 5-1	112	108	112	112	112	112
75	MW 2-3	94	89	95	94	94	94
77	SREL-1-27-F1	16	9	18	17	16	16
92	RDMW-101	18	15	19	19	18	18
93	RDMW-102	16	12	18	17	16	16
94	RDMW-103	65	58	66	66	65	65
95	RDMW-104	65	57	66	66	65	65
96	1516	70	67	71	71	70	70
97	1518	59	57	62	61	59	59
98	URS71000-700+00C	10	7	10	10	10	10
103	BR-1B	45	36	49	47	46	45

8.9.2.2 Information and Criteria Used to Establish Minimum Thresholds and Measurable Objectives

The criteria used to define significant and undesirable results for depletion of surface water are the same as used for chronic lowering of groundwater levels, with an additional analysis of changes in streamflow as described above.

8.9.2.3 Relationship between Minimum Thresholds for Each Sustainability Indicator

The relationship between depletion of surface water MTs and other sustainability indicators are discussed below:

Chronic lowering of groundwater levels. These are closely related in that the MT values are the same. However, the MTs for depletion of surface water are only applicable at a subset of the overall groundwater level network, because only those locations with likely interconnected surface water are being monitored. Based on modeling results, maintaining groundwater levels above the MTs for surface water depletion will also result in not experiencing chronic lowering of groundwater levels.

Reduction of groundwater in storage. These are closely related in that the MT values are the same. However, the MTs for depletion of surface water are a subset of the overall groundwater level network, because only those locations with likely interconnected surface water are being monitored for that MT. Based on modeling results, maintaining above the MTs for surface water depletion will also result in not experiencing reduction of groundwater in storage.

Seawater Intrusion. This sustainability indicator is not applicable in the NASb.

Degraded groundwater quality. There would not be expected degradation of groundwater quality as surface water is of generally higher quality.

Land Subsidence. The MTs are not expected to have a significant impact on land subsidence. The rate of subsidence been approximately 0.01 feet per 1 foot of groundwater level decline. The maximum MT decline for the depletion of surface water RMS location is projected at 13 feet, which would equate to approximately 0.13 feet of subsidence.

8.9.2.4 Effects of Minimum Thresholds on Adjacent Subbasins

As described under the chronic lowering of groundwater levels, modeling results demonstrate that there are no significant impacts to adjacent basins from those MTs for the NASb.

8.9.2.5 Effects of Minimum Thresholds on Beneficial Uses and Users

The MTs for interconnected surface water use the same elevations as the MTs for chronic lowering of groundwater levels. As described under the chronic lowering of groundwater levels, the MTs protect rural residential, agricultural, and urban users, as well as GDEs. Also as described above, there is no net decrease in surface water outflow from the NASb resulting from the use of groundwater or management actions under this GSP, so downstream uses would not be impacted. The MTs would result in minimal increases in seepage and rivers and their tributaries, and there are projected circumstances in which these systems would go dry; therefore, there are no expected significant and unreasonable undesirable results to aquatic species. As an additional protection to migrating fish species, the RD1001 GSA has a planned project on the Natomas Cross Canal to improve flood protection and improve channel habitat (see **Section 9.2.2**).

8.9.2.6 Relevant State, Federal, and Local Standards

No federal, state, or local standards exist for depletion of surface water.

8.9.2.7 Method for Quantitative Measurement of Minimum Threshold

Groundwater elevations in RMS wells will be directly measured to determine where groundwater levels are in relation to MTs and MOs. Groundwater level monitoring will be conducted in accordance with the monitoring plan outlined in **Section 7 – Monitoring Network**. Many RMS wells are equipped with continuous data loggers to observe data in between the semi-annual MT and MO monitoring.

Because of the sensitivity of the beneficial uses near the interconnected surface water systems, additional data analysis would begin if measurements were nearing an MT exceedance. After the initial detection of an MT exceedance, the GSAs will:

- Take confirmation measurements.
- Assess the groundwater gradients.
- If the exceedance is confirmed, initiate an investigation to assess the cause of the exceedance.
- Identify if there are impacts as a result of the MT exceedance and possible mitigation measures, if impacts are noted.

8.9.3 Measurable Objectives – Depletion of Surface Water

The measurable objectives used to define optimal management of groundwater and surface water conditions in the NASb are provided within this section.

8.9.3.1 Measurable Objectives

The process for establishing depletion of surface water MOs is the same as for chronic lowering of groundwater level MOs. These MOs are shown in **Table 8-9**.

8.9.3.2 Interim Milestones

Interim milestones are shown in **Table 8-9**.

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